

# electronics



A McGRAW  
PUBLICATION

May • 1951

<b>TESTING AIRBORNE MAGNETOMETERS</b> .....	CG
Experimental setup at Airborne Instruments Laboratory for determining best location in aircraft for magnetometers. Stabilizer is swung back and forth in pendulum fashion to see how much movement of this control surface affects the magnetic field (see p 138)	
<b>ELECTRONIC RESEARCH IN THE EMERGENCY PROGRAM</b> , by W. C. White.....	82
Today's needs are quite different from those just before World War II	
<b>CONSTRUCTING THE TRICOLOR PICTURE TUBE</b> .....	86
Photoengraving and gelatin-stencil printing are employed to align 600,000 phosphor dots	
<b>PHOTO RADIATION PATTERNS</b> , by G. W. Goebel.....	39
Rapid and economical visualization of effects of phase and space separation of antennas	
<b>WASHINGTON ADOPTS AUTOMATIC C-D WARNING SYSTEM</b> , by H. A. Friede.....	90
Centrally-located transmitters broadcast alarm signals to individual alarm positions	
<b>NEW PHOTOELECTRIC REGISTER CONTROLS</b> , by G. M. Chute.....	92
Three automatic side-register and web-register circuits for winding and packaging machines	
<b>ARMY WALKIE-TALKIE IN MASS PRODUCTION</b> .....	98
F-M set is half the size and weight of former model and has twice the range	
<b>EXTENDED CLASS-A AUDIO</b> , by Howard T. Sterling.....	101
Combining triodes with tetrodes in push-pull output stage gives improved efficiency	
<b>IMPROVING INDUSTRIAL CONTROL DESIGN</b> , by E. H. Vedder.....	104
How to make electronic control more universally accepted in industry	
<b>CONTROLLABLE GAS DIODE</b> , by E. O. Johnson.....	107
Characteristics of plasmatron diode for controlling large currents at low voltage	
<b>FIELD-SEQUENTIAL COLOR COMPANION</b> , by Elias Cohen and Allan Easton.....	110
Complete video, sweep and color-disk synchronizing circuits of slave converter	
<b>ECONOMICAL 5-KW A-M TRANSMITTER</b> , by Norman D. Webster.....	115
Phase-to-amplitude modulation provides high-quality signals with stable operation	
<b>SERVO GUIDER FOR SOLAR TELESCOPES</b> , by Fred E. Fowler and Donald S. Johnson.....	118
Photoelectric guiders keep telescopes free from aiming errors in hour angle and declination	
<b>PICTURE-TUBE PERFORMANCE</b> , by K. A. Hoagland.....	123
How to determine resolution capabilities and focusing strength required	
<b>AUTOMATIC CALIBRATION OF RADIOSONDE BAROSWITCHES</b> , by Stephen S. Haynes.....	126
Production-line calibrator prints individual charts for 16 pressure switches in 8 minutes	
<b>SIMPLIFIED Q MULTIPLIER</b> , by H. E. Harris.....	130
Single-stage circuit gives extremely high values of Q with absolute stability	
<b>BUSINESS BRIEFS</b> .....	76
<b>CROSSTALK</b> .....	81
<b>TUBES AT WORK</b> .....	136
<b>ELECTRON ART</b> .....	140
<b>NEW PRODUCTS</b> .....	142
<b>NEWS OF THE INDUSTRY</b> .....	146
<b>NEW BOOKS</b> .....	150
<b>BACKTALK</b> .....	152
<b>INDEX TO ADVERTISERS</b> .....	(Last Page)

**DONALD G. FINK**, Editor; **W. W. MacDONALD**, Managing Editor; John Markus, Vin Zeluff, A. A. McKenzie, Associate Editors; William P. O'Brien, James D. Fahnestock, Ronald K. Jurgen, Assistant Editors; John M. Carroll (on Military Leave), Ann Mastropolo, Marilyn Wood, Editorial Assistants; Gladys T. Montgomery, Washington Editor; Harry Phillips, Art Director; Eleanor Luke, Art Assistant

**KEITH HENNEY**, Consulting Editor

**H. W. MATEER**, Publisher; **WALLACE B. BLOOD**, Manager; R. S. Quint, Buyers' Guide Manager; D. H. Miller, James Girdwood, New York; Wm. S. Hodgkinson, New England; Warren W. Shew, Philadelphia; C. D. Wardner, Chicago; J. L. Phillips, Cleveland; J. W. Otterson, San Francisco; Carl W. Dysinger, Los Angeles; Ralph C. Maultsby, Atlanta; Bernard H. Butler, London, England



May, 1951

ELECTRONICS

Vol. 24, No. 5



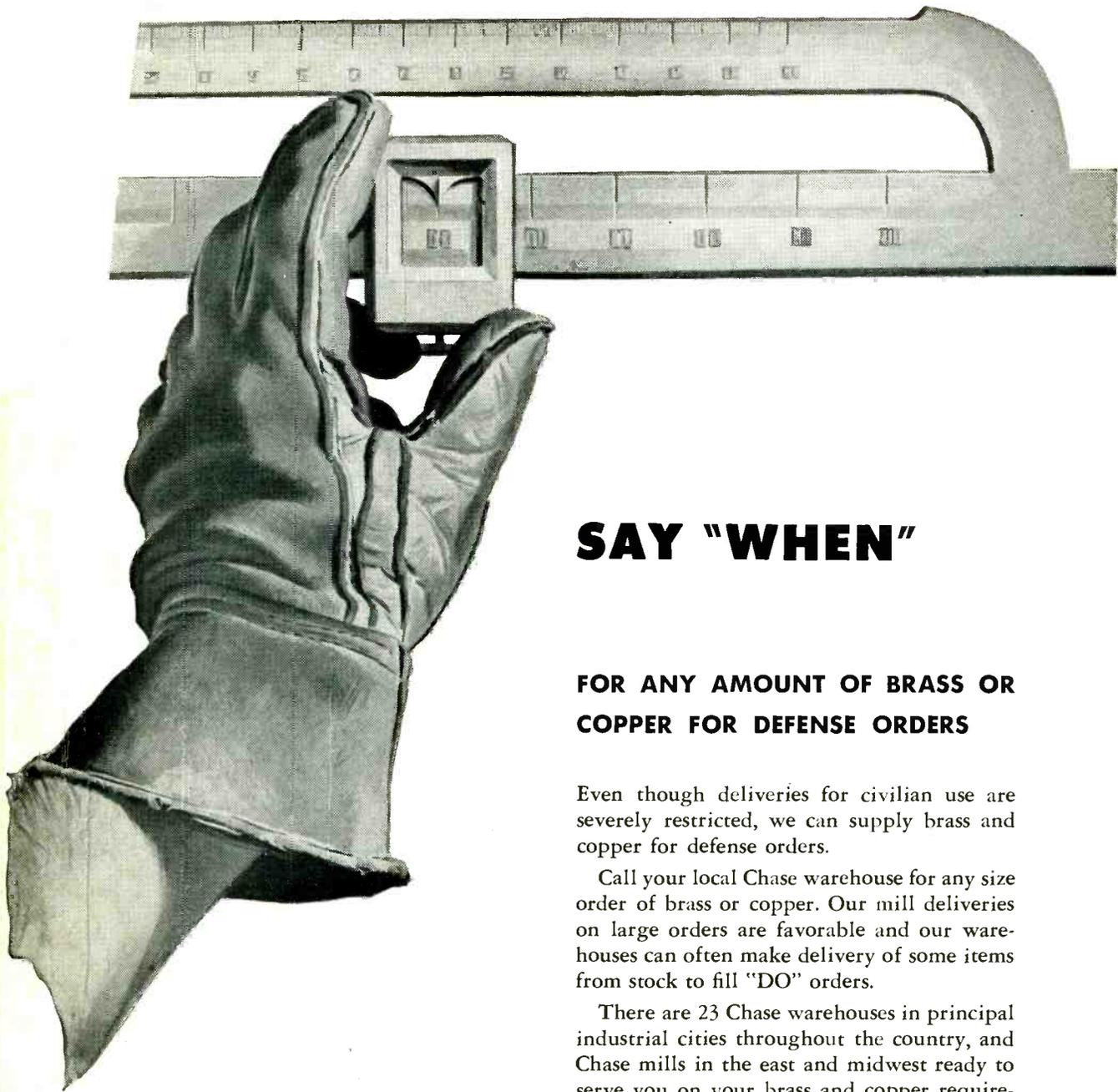
Member ABC and ARP

Published monthly with an additional issue in June by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. Publication Office, 99-129 North Broadway, Albany 1, N. Y.

Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 W. 42nd St., New York 18, N. Y. Curtis W. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Senior Vice-President, Publications Division; Ralph B. Smith, Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation.

Subscriptions: Address correspondence to Electronics—Subscription service, 99-129 N. Broadway, Albany 1, N. Y., or 330 W. 42nd St., New York 18, N. Y. Allow ten days for change of address. Please indicate position and company connection on all subscription orders.

Single copies 75¢ for United States and possessions, and Canada; \$1.50 for Latin America; \$2.00 for all other foreign countries. Buyer's Guide \$2.00. Subscription rates—United States and possessions, \$6.00 a year; \$9.00 for two years; \$12.00 for three years. Canada, \$10.00 a year; \$16.00 for two years; \$20.00 for three years. Pan American countries, \$15.00 a year; \$25.00 for two years; \$30.00 for three years. All other countries \$20.00 a year; \$30.00 for two years; \$40.00 for three years. Entered as second class matter August 29, 1936, at the Post Office at Albany, N. Y., under act of Mar. 3, 1879. Printed in U. S. A. Copyright 1951 by McGraw-Hill Publishing Co., Inc.—All Rights Reserved. BRANCH OFFICES: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, W.C. 2; Washington, D. C. 4; Philadelphia 3; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; Atlanta 3, Ga.; 1111 Wilshire Blvd., Los Angeles 17; 738-9 Oliver Building, Pittsburgh 22. ELECTRONICS is indexed regularly in The Engineering Index.



## SAY "WHEN"

### FOR ANY AMOUNT OF BRASS OR COPPER FOR DEFENSE ORDERS

Even though deliveries for civilian use are severely restricted, we can supply brass and copper for defense orders.

Call your local Chase warehouse for any size order of brass or copper. Our mill deliveries on large orders are favorable and our warehouses can often make delivery of some items from stock to fill "DO" orders.

There are 23 Chase warehouses in principal industrial cities throughout the country, and Chase mills in the east and midwest ready to serve you on your brass and copper requirements for defense. Call on these great Chase warehouse and mill facilities for service.

#### ● CHASE TECHNICAL SERVICE

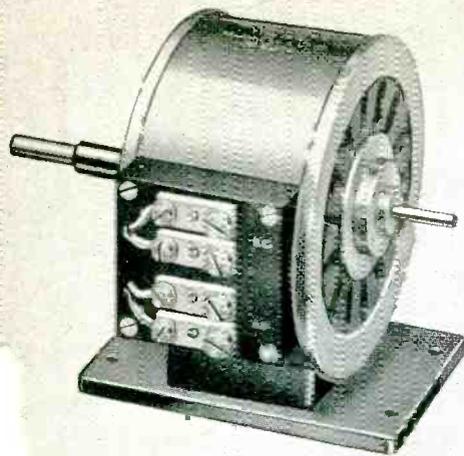
*Our technical engineers are familiar with military specifications for Brass & Copper for ordnance components, and will be glad to consult with you on the selection of these metals for defense orders.*

# Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

#### • The Nation's Headquarters for Brass & Copper

Albany†	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver†	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston†	Newark	Rochester†	(†sales office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	



## Phonic Motors and Timing Devices

IN many branches of scientific work the need arises for a motor capable of a very high standard of constancy of speed. The frequency of the mains electricity supply is not normally controlled to better than one or two per cent., so that a mains-operated synchronous motor may be inadequate, and centrifugal governors, as used on gramophone motors, may not provide a sufficiently precise control. In such cases a phonic motor driven by an alternating current supply of high frequency stability may be employed. It is not perhaps generally realized that in their modern form such motors may be used to give quite a large torque, and are able to maintain synchronism despite the sudden imposition of relatively large inertia loads. Under steady-state conditions, "hunting" is almost entirely eliminated, and the constancy of rotational speed is almost entirely dependent on the frequency stability of the alternating current supply.

A precision quartz crystal controlled frequency of 100 kc/s may attain a frequency stability of the order of one part in  $10^8$ . This frequency is then divided electronically to 1,000 c/s by means of regenerative dividers or locked multivibrators. In order to facilitate comparisons with time signals, or to use the frequency standard as a clock, it is necessary to derive a still lower frequency—preferably one cycle per second. Electronic division in the range 1,000 to 1 cycle per second, with high phase stability, is difficult, and the simplest and most reliable method is to drive a phonic motor from the 1,000 c/s source, and to fit mechanical contacts to suitably geared driven shafts. An added advantage is that by employing further gearing, more widely spaced signals may be obtained. Thus signals spaced at intervals of one sidereal second, or any other specified interval, may be obtained from an oscillator with a fundamental frequency of 100 kilocycles per mean time second. By means of a simple mechanical device, controlled changes in phase of the timing of the contacts are also possible.

### MOTOR TORQUE

The following forms feature...

Are You  
ON OUR  
MAILING LIST  
for

**TECHNIQUE**

A JOURNAL OF INSTRUMENT ENGINEERING

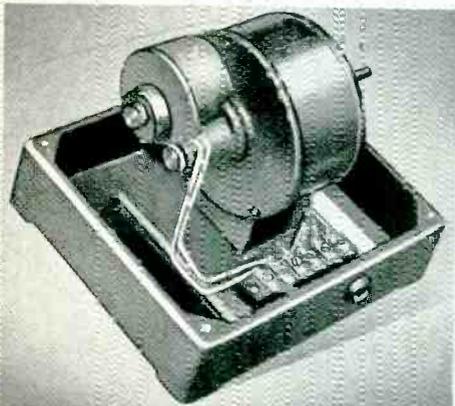


IF NOT  
MAIL COUPON

**NOW**

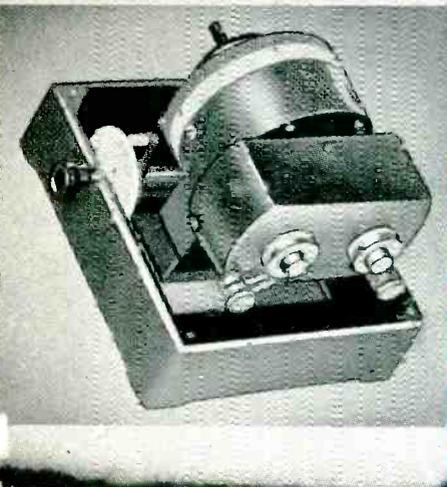


Designed for use at frequencies from 50 c/s - 2000 c/s. Phonic Motors of this type form the nucleus around which are built the timing devices illustrated on this page.



The Timing Device Type D-199-A provides an impulse of  $\frac{1}{10}$  second duration once every second, when the motor is supplied with power at a frequency of 1000 c/s.

The Timing Device Type D-193-A provides an impulse of  $\frac{1}{10}$  second duration 61 times per minute and, in addition, an impulse of  $\frac{1}{2}$  second duration once per minute. A worm and wheel adjustment allows phasing correction.



MUIRHEAD & CO. LTD · BECKENHAM · KENT · ENGLAND

Please mail me, free of charge, your quarterly journal "TECHNIQUE"

NAME

POSITION

COMPANY

ADDRESS

**MUIRHEAD & Co. LTD.**  
PRECISION ELECTRICAL INSTRUMENT MAKERS  
BECKENHAM · KENT · ENGLAND

Telegrams and Cables: MUIRHEADS ELMERS-END

PRECISION

**MUIRHEAD**

ELECTRICAL INSTRUMENTS

MU.26

# Compactness

for  
resistors

More and more components in less and less space! That's the manufacturer's dilemma as necessity shrinks the size of electrical and electronic instruments and equipment.

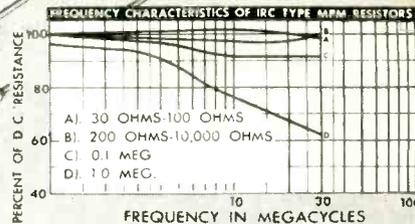
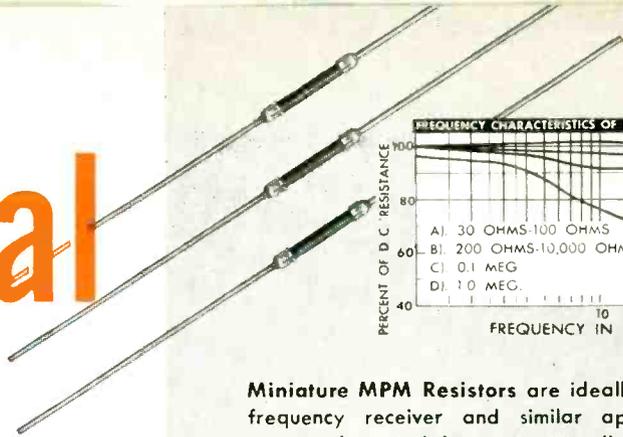
But compactness need not create bottlenecks —if you specify IRC *miniature resistors*. Years ago, we foresaw the trend to compactness and got ready for it. Now, with the widest line of resistor types in the industry, IRC can supply miniature components for almost any application.



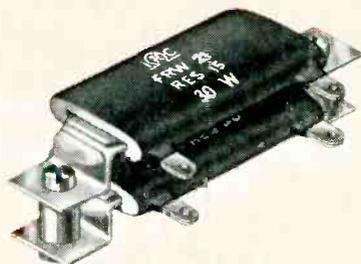
Only  $1\frac{5}{16}$ " in diameter, compact new IRC Type Q Controls adapt to a wide variety of small-space applications. Rugged construction features one-piece dual collector of thin, high-stress alloy—simplified single-unit collector ring—molded voltage baffles—special brass element terminals that will not loosen or become noisy when bent or soldered. Salt-spray materials, when specified, protect against humidity; change in resistance is negligible even after long exposure. Noise level is low and Type Q Controls have unusual durability and efficiency. Coupon brings you full details in Catalog A-4.

# is essential

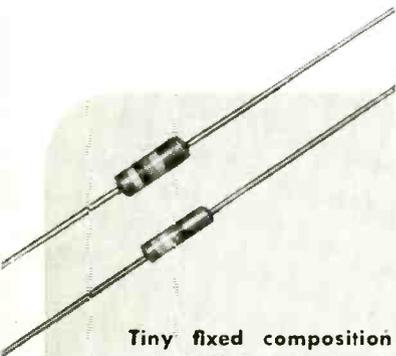
*too!*



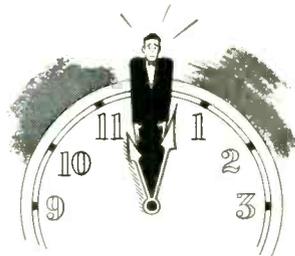
Miniature MPM Resistors are ideally suited to high frequency receiver and similar applications. Frequency characteristics are outstanding, but absolute balance has been maintained with all other significant electrical characteristics. These are the same as in larger IRC Type MP Resistors. MPM's are constructed of solid steatite ceramic rods, to which a thin resistance film is permanently bonded. Changes due to humidity and aging are held to a minimum. Resistor body is  $\frac{1}{16}$ " long, and active resistance section only  $\frac{3}{16}$ " long. Send for complete information in Catalog F-1.



Higher space-power ratio than tubular wire winds suits small, flat Type FRW fixed and adjustable wire winds to voltage dropping applications in limited space. FRW's may be mounted vertically or horizontally, singly or in stacks. Non-magnetic mounting brackets extend through resistors—allow easy and economical mounting—aid in heat distribution along entire length—and transfer internal heat to chassis. Light-weight construction combines with exceptional mechanical strength and ability to withstand severe vibration. Bulletin C-1 gives full performance data.



Tiny fixed composition resistors—Types BTR and BTS—are only  $\frac{1}{32}$ " in body length. At  $\frac{1}{8}$  and  $\frac{1}{4}$  watts, respectively, these miniature units set new performance standards for fixed composition resistors. Advanced BT's easily meet the rigorous requirements of television—actually exceed JAN-R-11 Specifications! Balanced in every characteristic, BT's are especially well suited to high ambient temperatures. Power dissipation is excellent. Other Advanced Type BT's meet and surpass JAN-R-11 Specifications at 1 and 2 watts. Write for full particulars in Catalog B-1.



When you're squeezed for "small-orders" of standard resistors in a hurry, simply call your IRC Distributor. IRC's Industrial Service Plan enables him to give you fast, 'round-the-corner delivery of standard resistors for experimental work, pilot runs, maintenance. We'll be glad to send you his name and address.



**INTERNATIONAL  
RESISTANCE COMPANY**  
PHILADELPHIA 8, PENNSYLVANIA  
In Canada: International Resistance Company,  
Ltd., Toronto, Licensee

*Wherever the Circuit Says* ~~~

Power Resistors • Voltmeter Multipliers  
Insulated Composition Resistors • Low  
Wattage Wire Wounds • Volume  
Controls • Voltage Dividers • Precision  
Wire Wounds • Deposited Carbon  
Precistors • Ultra-HF and High  
Voltage Resistors • Insulated Chokes

**INTERNATIONAL RESISTANCE COMPANY**

403 N. Broad St., Phila. 8, Pa.

Send me additional data on the items checked below:—

- Q Controls
- Flat FRW Resistors
- Advanced BT Resistors
- MPM Resistors
- Name and Address of local IRC Distributor

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....

IN BUSINESS



SINCE 1904

# Wire for Defense Projects!

## HOOK-UP WIRES and CABLES for COMMUNICATIONS EQUIPMENT and ELECTRONIC INSTRUMENTS

**F**OR almost a half century Lenz has been producing insulated Wires and Cables for the Communications Industries, wires that are engineered and designed under high quality standards.

Now, Lenz is prepared to furnish hook-up wire and cables for defense projects, conforming to Government specification JAN-C-76 TYPES WL, SRIR and SRHV. These Thermo-Plastic Insulated Wires, with or without Lacquered Braids, and the cables constructed of same, are available for use in Communications Equipment and Electronic Instruments.

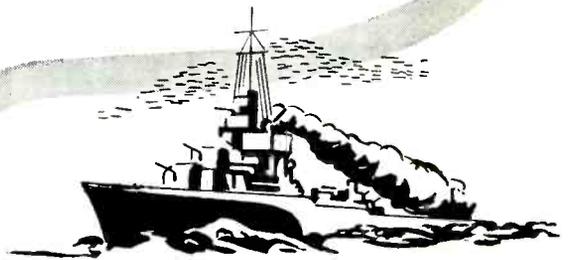
For a dependable source for your wire and cable requirements, consult Lenz.

CONFORMING TO  
**JAN-C-76**  
TYPES WL, SRIR and SRHV

IN THE AIR



ON THE SEA



ON LAND



**LENZ ELECTRIC MANUFACTURING CO.**

1751 No. Western Ave. • Chicago 47, Illinois



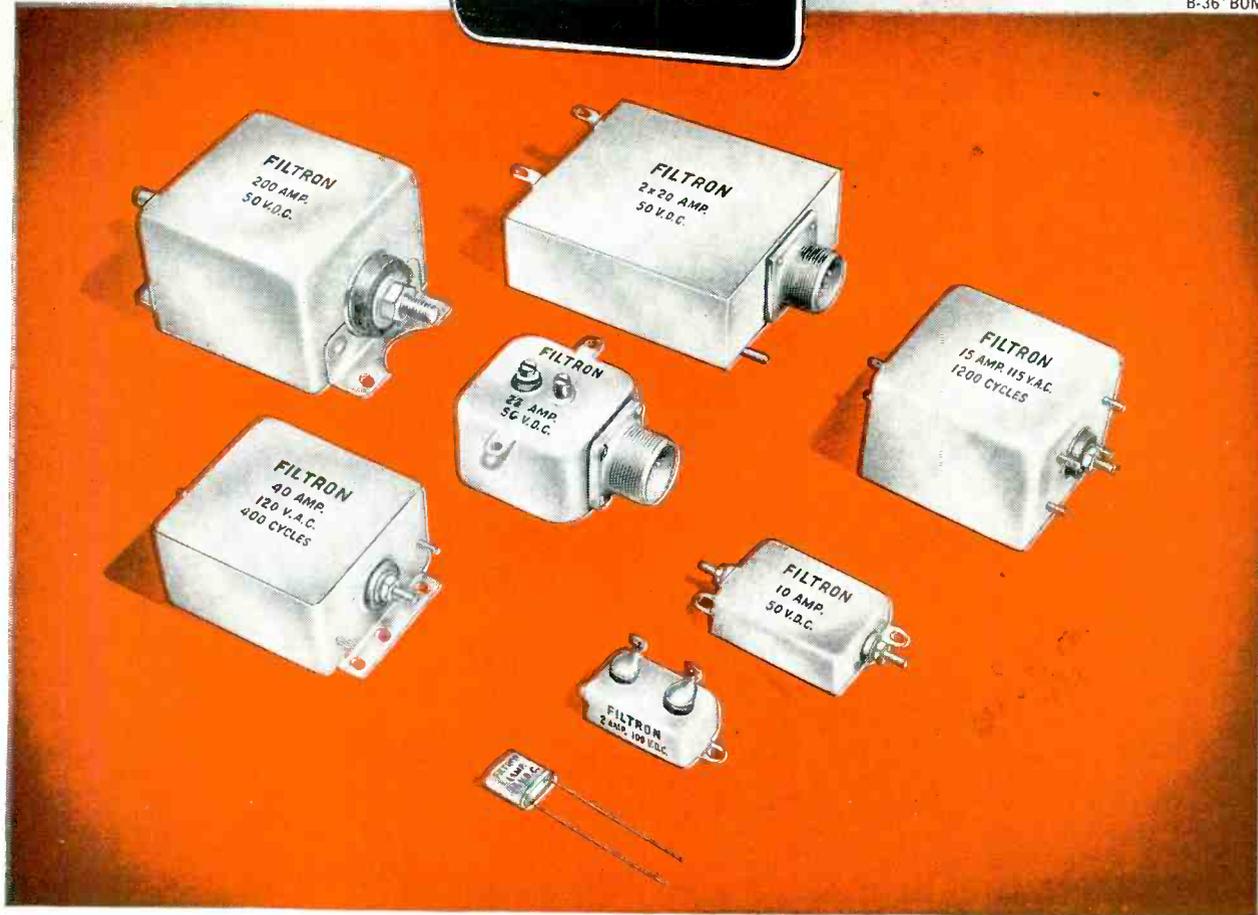
# MORE ENGINEERS THAN EVER BEFORE DEPEND UPON **FILTRON** FOR RF INTERFERENCE SUPPRESSION FILTERS



BELL HTL-3  
HELICOPTER



CONSOLIDATED VULTEE  
B-36 BOMBER



## FILTRON IS SPECIFIED ON THE MAJORITY OF MODERN AIRCRAFT, GUIDED MISSILES, SIGNAL CORPS, ORDNANCE AND NAVAL EQUIPMENT

**FILTRON'S** engineering staff and production facilities are providing better — more compact — efficient filters, to meet today's urgent demand.

**FILTRON'S** engineering division, staffed by experienced RF Interference Suppression engineers, is available for the measuring, testing and filter design for your equipment. With more than 500 standard filter types available, **FILTRON'S** engineers can choose the right filter for your application, or design a special filter to meet your size, weight, mounting, voltage and current requirements.

**FILTRON'S** modern shielded laboratories are equipped to measure RF Interference from 14 KC to 1000 MC, in accordance with military specifications.

**FILTRON'S** production facilities are meeting all schedules and delivering on time...

### BECAUSE:

**FILTRON'S** capacitor manufacturing division, coil winding division, metal fabrication shop and metal stamping departments are exclusively producing the highest quality components for **FILTRON'S** RF Interference filters.

### RF INTERFERENCE SUPPRESSION FILTERS FOR:

- |   |                  |
|---|------------------|
| Motors  | Dynamotors       |
| Generators                                    | Power Plants     |
| Inverters                                     | Actuators        |
| Electronic Controls                           | Gasoline Engines |
| And other RF Interference producing equipment |                  |

An inquiry on your Company letterhead will receive prompt attention

THE **FILTRON** CO., INC.

131-05 FOWLER AVENUE, FLUSHING, LONG ISLAND, N. Y.

LARGEST EXCLUSIVE MANUFACTURERS OF RF INTERFERENCE FILTERS

# VOLTAGE REGULATED POWER SUPPLIES

*For Industrial and Research Use*



## MODEL 510

Model 510 features TWO COMPLETELY INDEPENDENT REGULATED POWER SUPPLIES.  
**OUTPUT DC FOR EACH SUPPLY:** 200-500 volts, 200 Ma.  
**REGULATION:** 1/2% for both line and load variations.  
**RIPPLE:** 5 millivolts.  
**OUTPUT IMPEDANCE:** 2 ohms.  
**OUTPUT AC FOR EACH SUPPLY:** 6.3 volts, 6 Amp., CT.  
 The supplies may be connected for series, parallel, or bucking operation.



## MODEL 245

**OUTPUT DC:** 200-500 volts, 200 Ma.  
**REGULATION:** 1/2% for both line and load variations.  
**RIPPLE VOLTAGE:** 5 millivolts.  
**OUTPUT IMPEDANCE:** 2 ohms.  
**OUTPUT AC:** 6.3 volts, 6 Amp., CT, unregulated.



## MODEL 103, MULTIPLE POWER SUPPLY

**TWO B SUPPLIES:** 0-300 volts, 75 Ma. each, 150 Ma. when paralleled. Ripple 10 millivolts. Unregulated.  
**ONE C SUPPLY:** Minus 50 volts to plus 50 volts, 5 Ma. Ripple 5 millivolts. Unregulated.  
**ONE FILAMENT SUPPLY:** 6.3 volts AC, 5 Amp.



## MODEL 515

**B SUPPLY:** 0-500 volts, 200 Ma.  
**REGULATION:** 1/2% for both line and load variations.  
**RIPPLE:** 5 millivolts.  
**OUTPUT IMPEDANCE:** 2 ohms.  
**C SUPPLY:** 0-150 volts, 5 Ma.  
**REGULATION:** 10 millivolts for line 105-125 volts. 1/2% for load at 150 volts.  
**RIPPLE:** 5 millivolts.  
**FILAMENT SUPPLY:** 6.3 volts AC, 10 Amp., CT.  
 This unit is available with a 300 Ma. B Supply; with or without C Supply.



## MODEL 315

**B SUPPLY:** 0-300 volts, 150 Ma.  
**REGULATION:** 1/2% for both line and load variations.  
**RIPPLE:** 5 millivolts.  
**OUTPUT IMPEDANCE:** 2 ohms.  
**C SUPPLY:** 0-150 volts, 5 Ma.  
**REGULATION:** 10 millivolts for line 105-125 volts. 1/2% for load at 150 volts.  
**RIPPLE:** 5 millivolts.  
**FILAMENT SUPPLY:** 6.3 volts AC, 5 Amp., CT.



## MODEL 600

Model 600 features TWO INDEPENDENT REGULATED POWER SUPPLIES.  
**OUTPUT DC FOR EACH SUPPLY:** 0-500 volts, 200 Ma.  
**REGULATION:** 1/2% for both line and load variations.  
**RIPPLE:** 5 millivolts.  
**OUTPUT IMPEDANCE:** 2 ohms.  
**OUTPUT AC FOR EACH SUPPLY:** 6.3 volts, 10 Amp., CT, unregulated.



Write for specifications on our complete line of power supplies

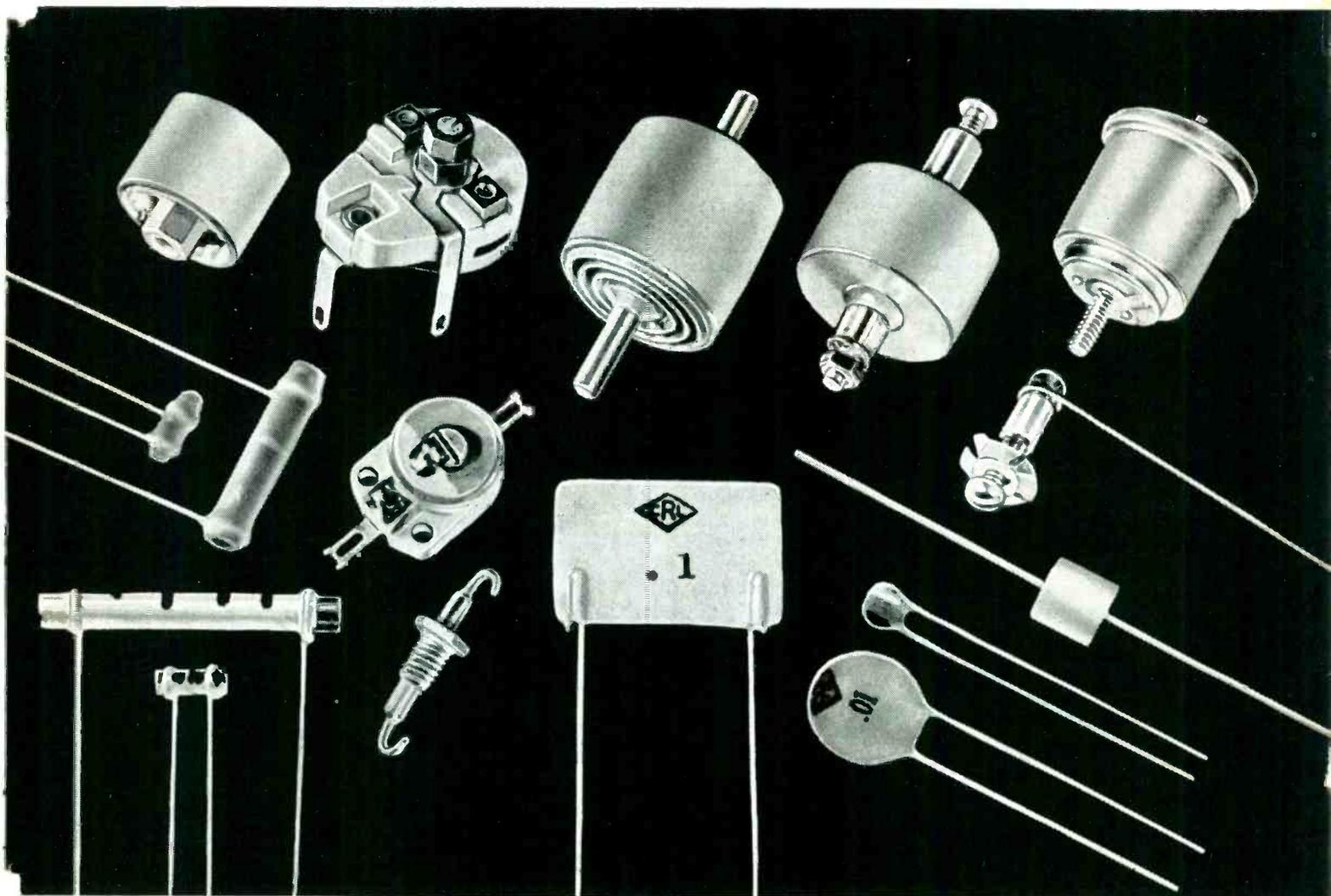
# KEPCO LABORATORIES, inc.

149-14-41st AVENUE

(Dept. M)

FLUSHING, NEW YORK

# CENTRALAB CERAMIC CAPACITORS GIVE YOU THE WIDEST CHOICE PLUS FINEST QUALITY AT ANY PRICE!



## HERE'S WHAT YOU GET FROM CENTRALAB CERAMICS

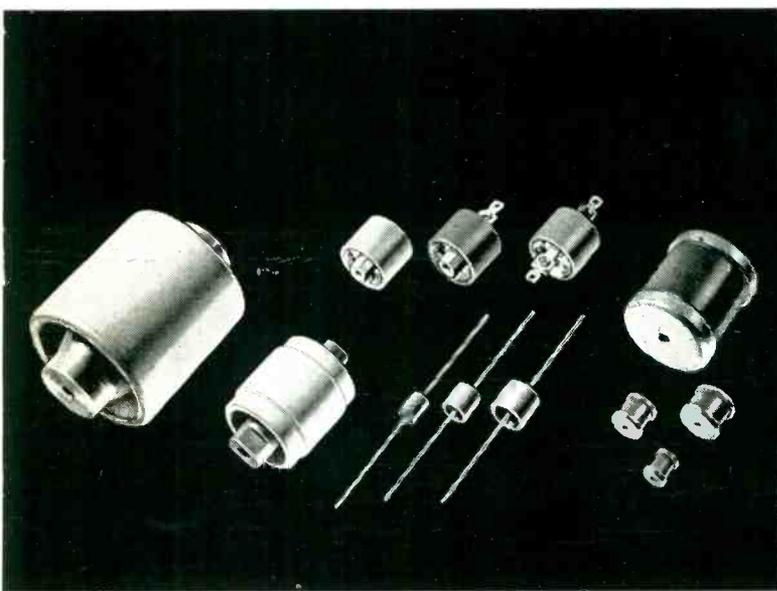
Centralab ceramic capacitors provide a permanence never before achieved with old-fashioned paper or mica condensers. The ceramic body provides imperviousness to moisture, plus unmatched ability to withstand any temperatures normally encountered in electrical apparatus. What's more, ceramics make possible tremendous savings in space; many Centralab ceramic capacitors are  $\frac{1}{4}$ th the size of ordinary capacitors. This is particularly important

where new design requirements call for less bulk. You can rely on Centralab ceramic capacitors for close tolerance, high accuracy, low power factors, and excellent temperature compensating qualities. Compare Centralab Ceramic capacitors for small size, wide range of ratings, variety of types and top quality characteristics. Compare their price. The results will show you why you'll standardize on Centralab—first in the field of electronic ceramics.

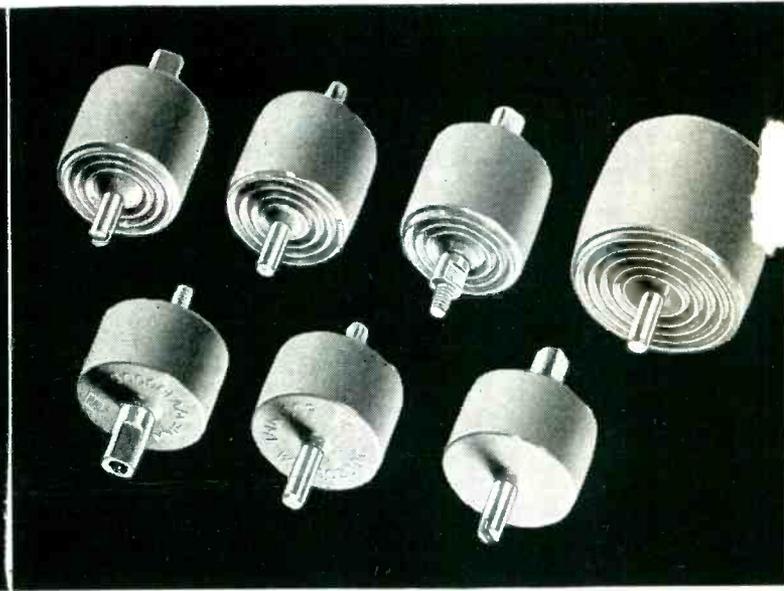
WANT MORE INFORMATION? SEE NEXT TWO PAGES 

# CENTRALAB Offers America's Most

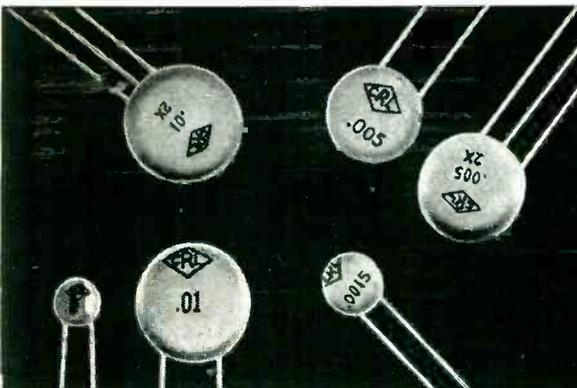
## FOR COMMERCIAL AND



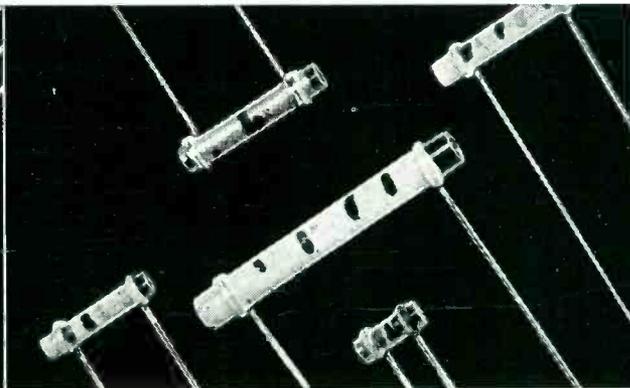
High voltage ceramic capacitors. Capacitance: 5 to 500 mmf., 5 KV to 40 KV D.C. working. Ideal for portable or mobile equipment. Primarily designed for high voltage, high frequency gear. For complete information, check Bulletin No. 42-102 in coupon below.



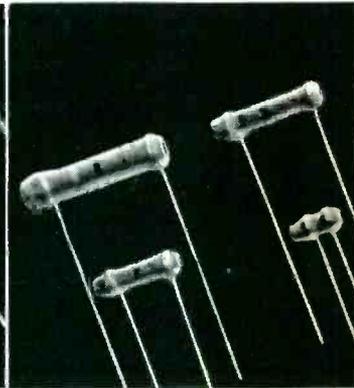
Centralab's famous TV Hi-Vo-Kaps are the standard for the TV industry. Capacitance: 500 mmf., 10 KV, 20 KV and 30 KV D. C. working. Best suited for high voltage, low power applications. For complete information, check Bulletin No. 42-10R in coupon below.



Ceramic Disc Hi-Kap Capacitors hold thickness to a minimum. Make possible very high capacity in extremely small size. Use in HF bypass and coupling. Bulletin No. 42-4R.



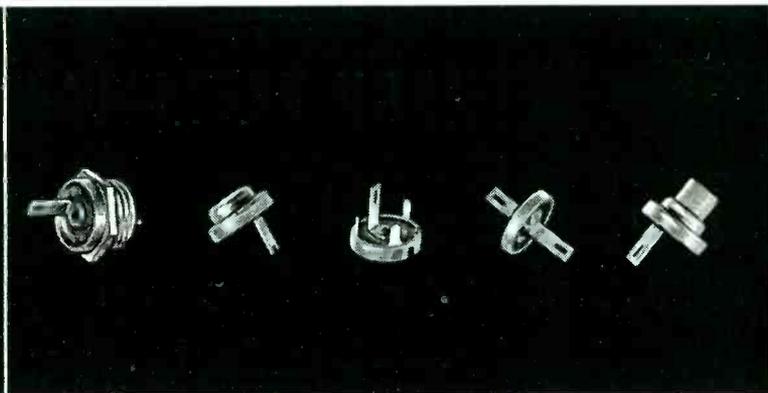
TC (Temperature Compensating) Tubulars—Type TCZ show no capacitance change over wide range of temperature. Type TCN have special ceramic body to vary capacitance according to temperature. Bulletin No. 42-18.



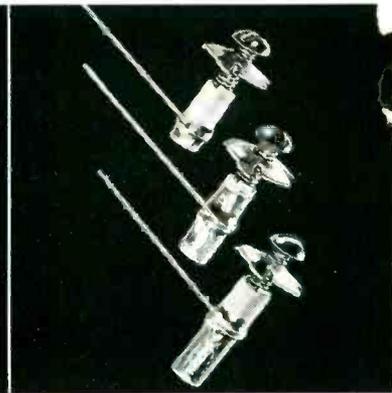
BC (Bypass Coupling) Tubulars — Recommended for bypass coupling. Well suited to general circuit use. Bulletin No. 42-3.



FT (Feed Through) Hi-Kaps — Designed for single hole mounting with ground to chassis or shield. Bulletin No. 975.



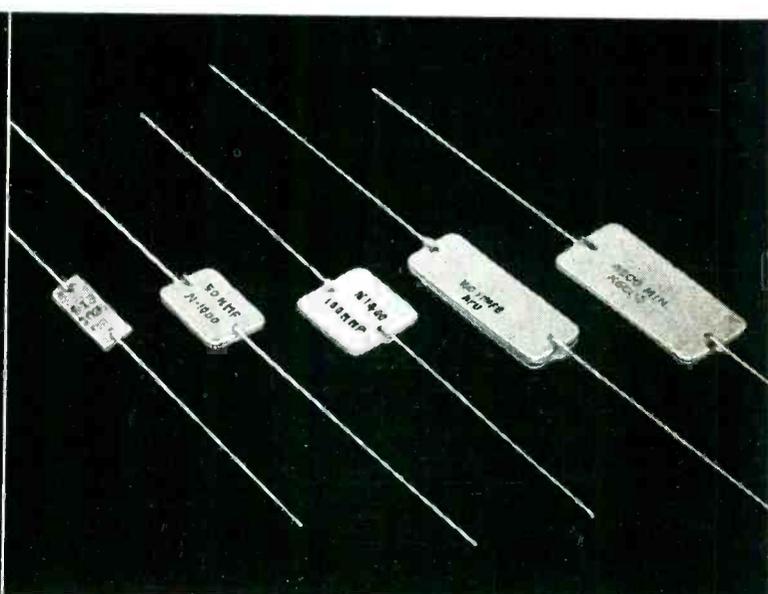
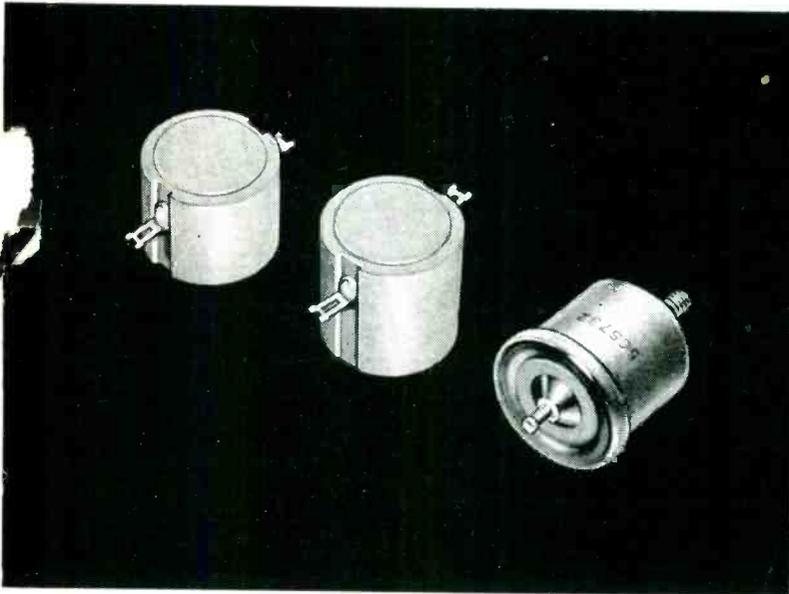
Something new in miniature ceramic capacitors! These "button types" are available in 5 different styles. Used for bypassing in low-power, high frequency applications where small size, low inductance and light weight are essential. Check Bulletin No. 42-122 in coupon for more information.



TV Trimmer Capacitors — ceramic tubulars—threaded. Complete with lock-nut and screw. Use in TV, FM. Bulletin No. 42-59.

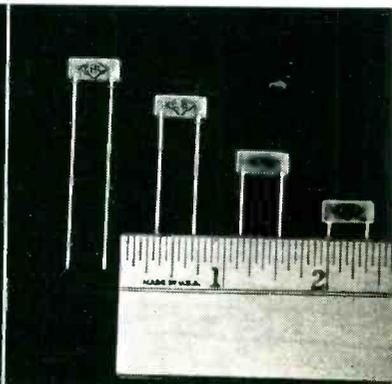
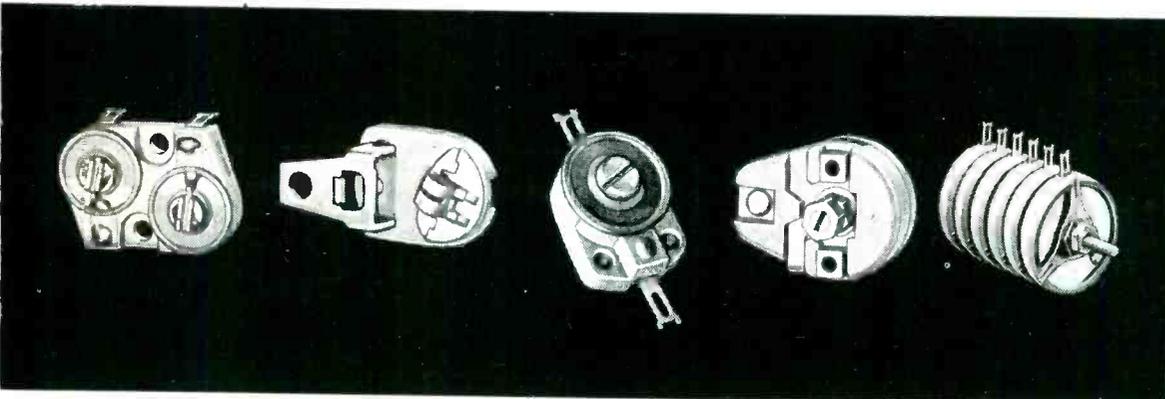
# Complete Line of Ceramic Capacitors

(JAN) MILITARY APPLICATION



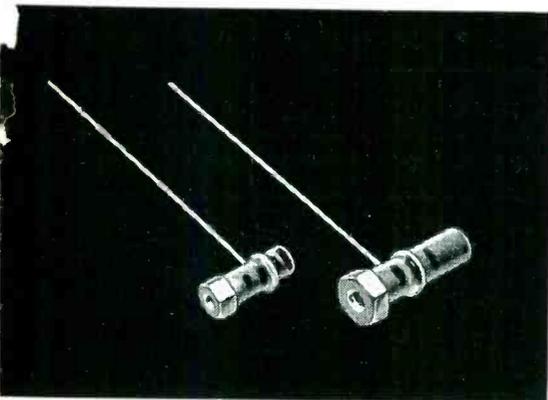
High Accuracy capacitors. Precision units to meet exacting requirements involving extremely rigid frequency control. Extensively used for holding oscillator frequencies to close limits. For complete information, check Bulletin No. 42-123 in coupon below.

Flat Plate, end-lead capacitors. Temperature compensating. Capacitances: 5, 10, 20, 50 and 100 mmf., 500 volts D. C. working. Temperature Compensating Tolerance: 15% or 30 PPM whichever is larger. For complete information Check Bulletin No. 42-124 in coupon below.



Centralab Ceramic and Steatite Trimmers provide high quality stable capacitors, with small size, light weight, easy mounting. Readily adjustable with screw driver and give full capacity range with 180° rotation. Equal stability maintained in any position — minimum to maximum. Have excellent stability under vibration. Rotor and stator contact under spring pressure on optically ground flat surface. Check Bulletin No. 42-101 for more data.

Min-Kaps are very tiny capacitors used where space is at extreme premium. Ask for Bulletin No. 42-24.



Stand-off ceramic capacitors — both Bypass Coupling and Temperature Compensating types. One end threaded. For complete information check No. 42-121 in coupon below.

## Centralab

Division of GLOBE-UNION INC. • Milwaukee

CENTRALAB  
Division of Globe-Union Inc.  
914 East Keefe Avenue, Milwaukee, Wisconsin

Yes — I would like to have the CRL bulletins, checked below, for my technical library!

- |                                 |                                 |                                 |                                 |                                 |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| <input type="checkbox"/> 42-102 | <input type="checkbox"/> 42-124 | <input type="checkbox"/> 42-3   | <input type="checkbox"/> 975    | <input type="checkbox"/> 42-122 |
| <input type="checkbox"/> 42-10R | <input type="checkbox"/> 42-4R  | <input type="checkbox"/> 42-101 | <input type="checkbox"/> 42-121 |                                 |
| <input type="checkbox"/> 42-123 | <input type="checkbox"/> 42-18  | <input type="checkbox"/> 42-24  | <input type="checkbox"/> 42-59  |                                 |

Name.....

Address.....

City..... State.....

# Specify

# SORENSEN

Nobatron Model E-6-15



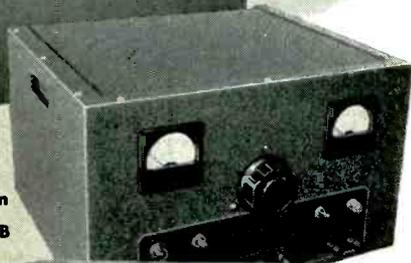
AC Regulator  
Model 500S



3a Regulator  
Model  
3P15000S



B-Nobatron  
Model 500B



Variable Auto  
Transformer



Ranger  
Model SR-10



Saturable Core Reactor

## FUNCTIONAL GROUP

## SPECIFICATIONS

### AC REGULATORS

Models available  
(numbers denote  
VA capacities)

- 150S
- 250S
- 500S
- 1000S
- 2000S
- 3000S
- 5000S
- 10000S
- 15000S

### NOBATRONS\* (DC Supplies — low voltage)

Models available  
(numbers indicate  
voltage & current)

- E-6-5
- E-6-15
- E-6-40
- E-6-100
- E-12-5
- E-12-15
- E-12-30
- E-12-50
- E-28-5
- E-28-10
- E-28-30
- E-28-70
- E-28-150
- E-28-350
- E-48-15
- E-125-5
- E-125-10

### B-NOBATRONS\* (DC Supplies — high voltage)

Input	95-130 VAC, 1 $\phi$ , 50-60~; 190-260 VAC in "-2" models
Output	115 VAC $\pm$ 5%; 230 VAC with "-2" models
Reg. accuracy	$\pm$ 0.1% against line or load
Distortion	2% — 3% max.
P. F. range	Down to 0.7
Load range	0 to full load
Miscellaneous	Fully protected against overload or overvoltage. Models 150S, 250S, 500S, 1000S are self-contained. Cabinets available for others. Normal finish — gray wrinkle.

Input	95 — 130 VAC, 1 $\phi$ , 50-60~. In heavy current 28-volt series — 115/208, 3 $\phi$ , 4-wire, wye.
Reg. accuracy	$\pm$ 0.2% against line or load changes
Ripple	1% RMS max.
Load range	1/10 to full load
Output range	Adjustable $\pm$ 10%
Recovery time	0.2 seconds — this value includes charging time of filter circuit for most severe change in load or input conditions.

Miscellaneous	Fully protected against overload and overvoltage. Normally for rack mounting — cabinets available. Normal finish — gray wrinkle. Meters standard in some models; available in all.
---------------	--

Input	105-125 VAC, 1 $\phi$ , 50 — 60~.
Load range	0 — full load
Ripple	10 mv

output	Model	325B*	360B**	500B*	520B*	560B*	1000B*
VDC		0-325	175-360	0-500	200-500	0-500	200-1000
Ma		0-125	0-120	0-300	0-200	0-200	0-500
* meters furnished as standard equipment. regulation accuracy $\pm$ 0.5% bias supply 0-150 VDC @ 0-5Ma (except model 1000B)							
** no meters, no bias supply regulation accuracy $\pm$ 1.0%							
All have 6.3 VAC, 6-10 amperes, unregulated, C.T.							

SORENSEN and COMPANY INC., Stamford, Conn.

\*Reg. U.S. Pat. Off. by Sorensen & Co., Inc.

# The FIRST Line of Electronic Voltage Regulators

*Coast to Coast*

Authorized Sorensen representatives and their field engineers are listed below. Find the one located nearest you — don't hesitate to call on him for consultation and advice.

FUNCTIONAL GROUP	SPECIFICATIONS				
RANGERS  (Full-range-variable DC Supplies)	Input range	95 — 130 VAC, 1ø, 50 — 60~.			
	Reg. accuracy	±0.25% at any voltage setting.			
	Ripple	1% RMS max.			
	Output	Model	SR-10	SR-30	SR-50
	VDC	3-135	3-30	3-13	
	Amps	1-10	3-30	5-50	
400~ EQUIPMENT: LINE REGULATORS	Similar to 60~ regulators except: Accuracy ±0.5%; distortion 5% max.; frequency 400~ ±10%.				
NOBATRONS*	Same general specifications as 60~ Nobatrons.				
3ø REGULATORS  60~  400~	Capacity 450VA to 45KVA. Wye to wye 115/230, 4-wire preferred. Delta to delta no neutral possible with phase transformation and reasonably balanced loads.  Capacity 100, 250, and 750 VA. Delta to delta normal.				
VARIABLE AUTO-TRANSFORMERS	Output	0-130 VAC, 350-2400~.			
	Current range	5 and 15 amperes. Cased or open construction.			
REACTORS	Built to customer specifications.				
WOUND COMPONENTS: POWER TRANSFORMERS	Limit capacity to 5KVA and 5000 volts.				
PLATE TRANSFORMERS	Limit capacity to 5KVA and 3000 volts C.T.				
FILAMENT TRANSFORMERS	Usual specifications.				
AUTOTRANSFORMERS	Up to 10KVA capacity				
DC REACTORS, CHOKES	Up to 5000 insulation voltage limit. Limit to 20 henries @ 1 ampere.				
AC REACTORS	Up to 5KVA limit				
400-800~ TRANSFORMERS	Using hypersil or thin gauge lamination construction.				
RECTIFIER TRANSFORMERS	Capacity and voltage limitations above. Wound components can be hermetically sealed to pass JAN-T-27, Grade 1 specifications. Conventional "potting" — fosterited — varnish impregnated to specifications.				
FOSTERITE PROCESS	Up to 500 cubic inches. Under Westinghouse license.				

Standard design AC regulators can be converted to meet appropriate AN-E-19, MIL, and JAN specifications.

*Specify*

**SORENSEN**

## CALIFORNIA — HOLLYWOOD

Neely Enterprises  
7422 Melrose Ave.; Phone Whitney 1147

## CALIFORNIA — SACRAMENTO

Neely Enterprises  
2334 42nd St.; Phone Hillcrest 6-5521

## CALIFORNIA — SAN FRANCISCO

Neely Enterprises  
2830 Geary Blvd.; Phone Walnut 1-3960

## D.C. — WASHINGTON

Burlingame Associates — F. L. Horman  
2017 S St., N.W.; Phone Decatur 8000

## FLORIDA — FORT MYERS

Arthur H. Lynch & Associates  
P. O. Box 466; Phone 5-6762

## GEORGIA — ATLANTA

Floyd Fawcett & Son  
1347 Beecher St., S.W.; Phone Raymond 3104

## ILLINOIS — CHICAGO

Loren F. Green & Associates  
4949 W. Diversey Ave.; Ph. National 2-2370

## KANSAS — WICHITA

Standard Products, Inc.  
650 E. Gilbert Ave.; Phone Wichita 2-1431

## MASSACHUSETTS — BOSTON

Burlingame Associates — P. G. Yewell  
270 Commonwealth Av.; Ph. Kenmore 6-8100

## MICHIGAN — DETROIT

S. Sterling Company  
13331 Linwood Av.; Phone Townsend 8-3130

## MINNESOTA — MINNEAPOLIS

Graybar Electric Co. — W. G. Pree  
824 S. Fourth St.; Phone Geneva 1621

## NEW MEXICO — ALBUQUERQUE

Neely Enterprises  
107 S. Washington St.; Phone 5-8731

## NEW YORK — FAYETTEVILLE

Burlingame Associates — J. D. Ryerson  
113 Edgemere St.; Phone 485-R

## NEW YORK — NEW YORK

Burlingame Associates  
103 Lafayette St.; Phone Digby 9-1240

## NORTH CAROLINA — CHARLOTTE

James L. Highsmith  
P. O. Box 1011; Phone 5-6436

## OHIO — DAYTON

Charles D. Boehme  
Talbott Bldg.; Phone Fulton 8188

## OHIO — CLEVELAND

H. A. Watson, Jr.  
817 Citizens Bldg.

## OREGON — PORTLAND

Electronic Specialty Representatives  
331 S.E. 62nd Ave.; Phone East 4331

## PENNSYLVANIA — PHILADELPHIA

Burlingame Associates — Ivan Robinson  
422 W. Coulter St.; Phone Tennessee 9-2006

## PENNSYLVANIA — PITTSBURGH

H. E. Ransford & Co.  
Grant Bldg.; Phone Grant 1-1880

## TENNESSEE — KNOXVILLE

A. R. Hough  
P. O. Box 1452; Phone 8-4312

## TEXAS — HOUSTON

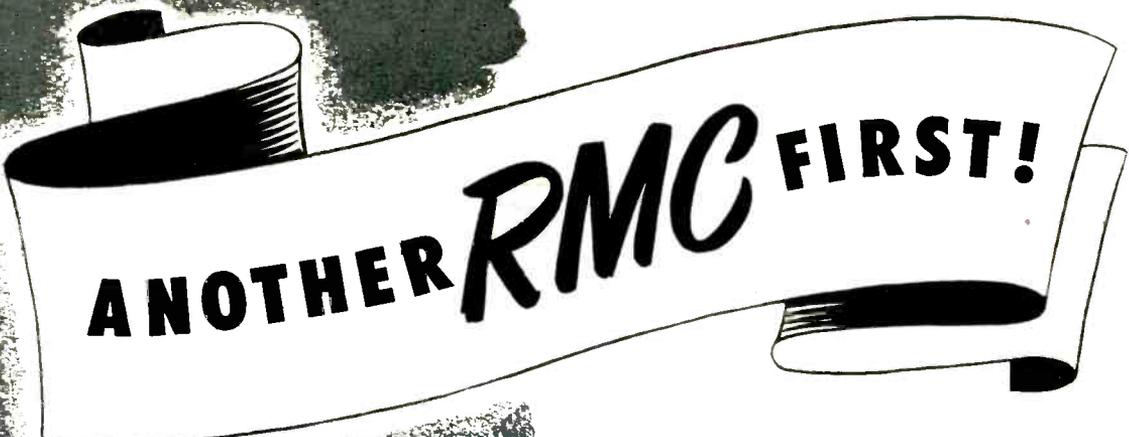
Earl W. Lipscomb & Associates  
2420-B Rice Blvd.; Phone Linden 9303

## TEXAS — DALLAS

Earl W. Lipscomb & Associates  
3561 Marquette St.; Phone Emerson 6-7989

## CANADA — TORONTO, ONT.

Charles W. Pointon  
1926 Gerrard St., East.; Phone Oxford 7435



ANOTHER **RMC** FIRST!

## A MONEY-SAVING DISCAP TO REPLACE MICA AND TUBULAR CERAMIC CONDENSERS

With the expanding defense program requiring a larger share of available mica and tubular ceramic condensers, several of the larger TV manufacturers are replacing many of these items with RMC DISCAPS.

Now, at a substantial saving in cost, RMC offers TV producers a DISCAP rated at 600 V, D. C. which is readily available in quantity and in a capacity range between 5 MMF and 2000 MMF. And, in addition, DISCAPS provide greater mechanical strength with small size for speedy production line assembly.

This is the time to check on the advantages of using RMC DISCAPS. If you will advise us of the capacities required we will quote prices and supply samples for your consideration.

**SEND FOR SAMPLES AND TECHNICAL DATA**



**ACTUAL SIZE**

You can rely on RMC because we produce the complete condenser including the dielectric element. RMC control of all production phases is your guarantee of quality and trouble-free operation. Every DISCAP is 100% tested for capacity, leakage resistance and breakdown.

DISCAP  
CERAMIC  
CONDENSERS

# RMC

**RADIO MATERIALS CORPORATION**

GENERAL OFFICE: 1708 Belmont Ave., Chicago 13, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

*Two RMC Plants Devoted Exclusively to Ceramic Condensers*

# BIG-PICTURE PROBLEM

"Our new deluxe TV set must show a king-size picture. So . . . what tube over 20 inches is now in production?"



**G. E.**'s 24-inch metal tube—24AP4—is coming off the line as you read this, Mr. TV-set Designer! No blue sky about this pace-setter—the promise stage was over long ago, performance of the tube has been amply demonstrated, production is here . . . now!

335 square inches of full-width picture area . . . you have real set appeal, sales appeal in the 24AP4's newspaper-size GIANT picture! And quality of image is tops, with a neutral-density faceplate giving maximum contrast—accenting lights, enriching shadows.

Compact TV cabinet? The 24-inch length of the 70-degree-deflection-angle 24AP4 helps you keep down receiver bulk. . . . Tube weight? Only 27½ pounds, substantially less than with a glass type of equal size.

Act fast—*today!* Telegraph or write for technical bulletin ETD-101, giving ratings and performance information on the 24AP4. Or, at your request, a G-E tube engineer will be glad to call on you. *Electronics Department, General Electric Company, Schenectady 5, New York.*



## 24AP4

*Recommended operating conditions*

Anode voltage	15,000 v
Grid-No.-2 voltage	300 v
Grid-No.-1 voltage	-33 to -77 v
Focusing-coil current (RMA Coil No. 109 at 3½ inches)	114 ma
Ion-trap field intensity	36 gauss

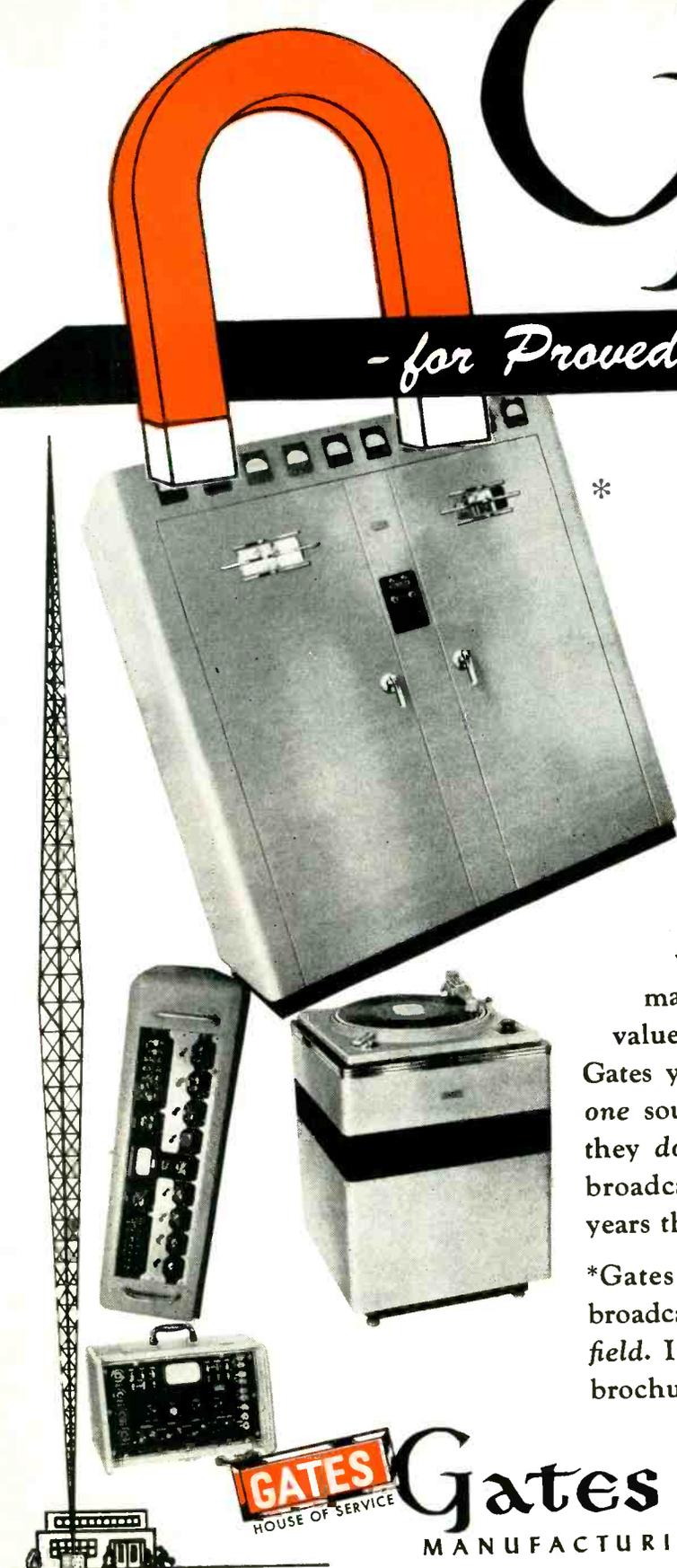
# GENERAL ELECTRIC

181-K2

# Gates

PACKAGED  
BROADCASTING  
EQUIPMENT

*- for Proved Performance*



\*

There is no split responsibility when installing Gates — all items of consequence are manufactured in the spacious Gates factory. These include such vital accessories as frequency and modulation monitors, turntables, antenna coupling equipment, phasors and many other similar equipments often purchased and not manufactured.

Performance and appearance-wise — quality and construction-wise — there is great value in the Gates matched package system. The greatest value of all is in “no buck to pass” — with Gates your one source supply, Gates is the one source that must produce results, and they do! This is evidenced by more Gates broadcasting installations in the past five years than any other make.

\*Gates BC1F air-conditioned 1000 watt broadcast transmitter. *Leader in the quality field.* In use all over the world. Descriptive brochure on request.

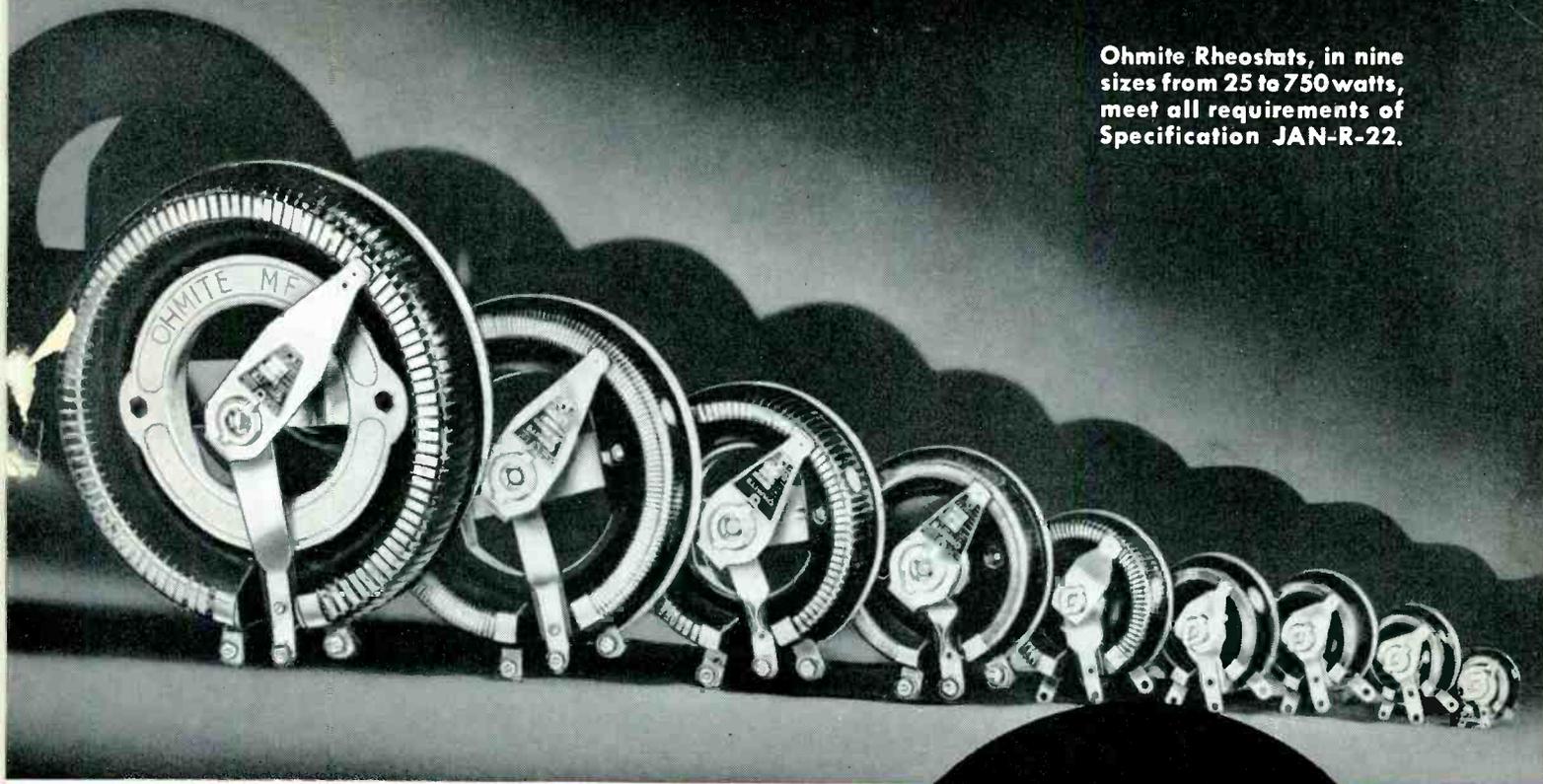
**GATES**  
HOUSE OF SERVICE

## Gates RADIO COMPANY

MANUFACTURING ENGINEERS SINCE 1922  
QUINCY, ILLINOIS, U. S. A.

2700 POLK AVE., HOUSTON, TEXAS — WARNER BLDG., WASHINGTON, D. C.  
INTERNATIONAL DIV., 13 E. 40th ST., NEW YORK CITY — CANADIAN MARCONI COMPANY, MONTREAL, QUEBEC

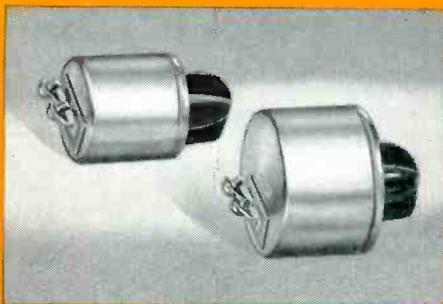
Ohmite Rheostats, in nine sizes from 25 to 750 watts, meet all requirements of Specification JAN-R-22.



# OHMITE RHEOSTATS

MEET REQUIREMENTS OF  
JOINT ARMY-NAVY SPECIFICATION

# JAN-R-22



Models H (enclosed) and J (enclosed)  
Also AN 3155 (AN-R-14a)

### OHMITE RHEOSTATS MEET THESE RIGID TESTS:

- ★ 5-Hour Vibration Test (Required for RP 10-11-15-16-20-25)
- ★ 50-Hour Salt-Spray Corrosion Test
- ★ 150-Hour 95% Humidity Electrolysis Test

and other tests as prescribed in Specification JAN-R-22

By meeting these severe Joint Army-Navy requirements, Ohmite Rheostats have proved what industry has long accepted as true—that they can be depended upon for unfailing performance under the toughest operating conditions. All-ceramic construction . . . a smoothly gliding metal-graphite brush . . . uniform windings locked in place by vitreous enamel . . . insure close control throughout years of trouble-free service. It will pay you to standardize on Ohmite Rheostats for your product.

TYPE	OHMITE MODEL	WATT RATING
RP10	H	25
RP11	H enclosed	12.5
RP15	J	50
RP16	J enclosed	25
RP20	G	75
RP25	K	100
RP30	L	150
RP35	P	225
RP40	N	300
RP45	R	500
RP50	T	750

*Be Right with*

# OHMITE®

RHEOSTATS • RESISTORS • TAP SWITCHES

OHMITE MFG. CO., 4818 Flournoy St., Chicago 44, Ill.

# OHMITE JAN-TYPE WIRE-WOUND RESISTORS

## STYLES AND SIZES TAB-TERMINAL TYPE † Characteristics G and J

Style	Overall length	Diameter	*Watts	Style	Overall length	Diameter	*Watts
RW-29	1-3/4"	1/2"	8	RW-35	4"	29/32"	38
RW-30	1"	19/32"	8	RW-36	4"	1-5/16"	60
RW-31	1-1/2"	19/32"	10	RW-37	6"	1-5/16"	78
RW-32	2"	19/32"	12	RW-38	8"	1-5/16"	110
RW-33	3"	19/32"	18	RW-39	12"	1-5/16"	166
RW-34	3"	29/32"	30				

## TAB-TERMINAL TYPE with terminal hole to clear No. 8 screw † Characteristics G and J

Style	Overall length	Diameter	*Watts
RW-40	3"	29/32"	24
RW-41	4"	29/32"	32
RW-42	4"	1-5/16"	49
RW-43	6"	1-5/16"	74
RW-44	8"	1-5/16"	100
RW-45	12"	1-5/16"	160
RW-46	10-1/2"	1-5/16"	135
RW-47	10-1/2"	1-9/16"	145

## FERRULE-TERMINAL TYPE † Characteristics G and J

Style	Overall length	Diameter	*Watts
RW-10	11-7/16"	1-5/16"	140
RW-11	9-5/8"	1-5/16"	116
RW-12	7-7/16"	1-5/16"	86
RW-13	5-1/8"	1-1/16"	50
RW-14	4-7/16"	1-1/16"	40
RW-15	2-15/16"	3/4"	20
RW-16	2-3/8"	3/4"	14

## FLAT (Stack Mounting) TAB-TERMINAL TYPE Characteristics G and J

Style	Overall length	Width of Core	Thickness of Core	*Watts
RW-20	2-1/2"	1-3/16"	1/4"	15
RW-21	3-1/4"	1-3/16"	1/4"	22
RW-22	4-3/4"	1-3/16"	1/4"	37
RW-23	6"	1-3/16"	1/4"	47
RW-24	7-1/4"	1-3/16"	1/4"	63

\*Watts free air JAN Characteristic "G"

† Also available to meet requirements of Characteristics F, H, E, and D which were recently removed from Spec. JAN-R-26A. (Amend. 2)

## AXIAL-TERMINAL TYPE Characteristics G and J

Style	Length of Core**	Diameter	*Watts
RW-55	1-3/8"	5/8"	5
RW-56	2"	5/8"	10

\*\*2-1/2" wire leads

## MEET REQUIREMENTS OF JOINT ARMY-NAVY SPECIFICATION JAN-R-26A

Ohmite offers an unusually complete line of resistors that meet the most rigid requirements (Characteristics "G" and "J") of Joint Army-Navy Specification JAN-R-26A. To meet these requirements, resistors must pass severe moisture resistance and thermal shock tests. They are required to withstand strenuous vibration applied for five continuous hours. And, they must satisfy the requirements of many other tests, including momentary overload, mechanical strength, and terminal strength.

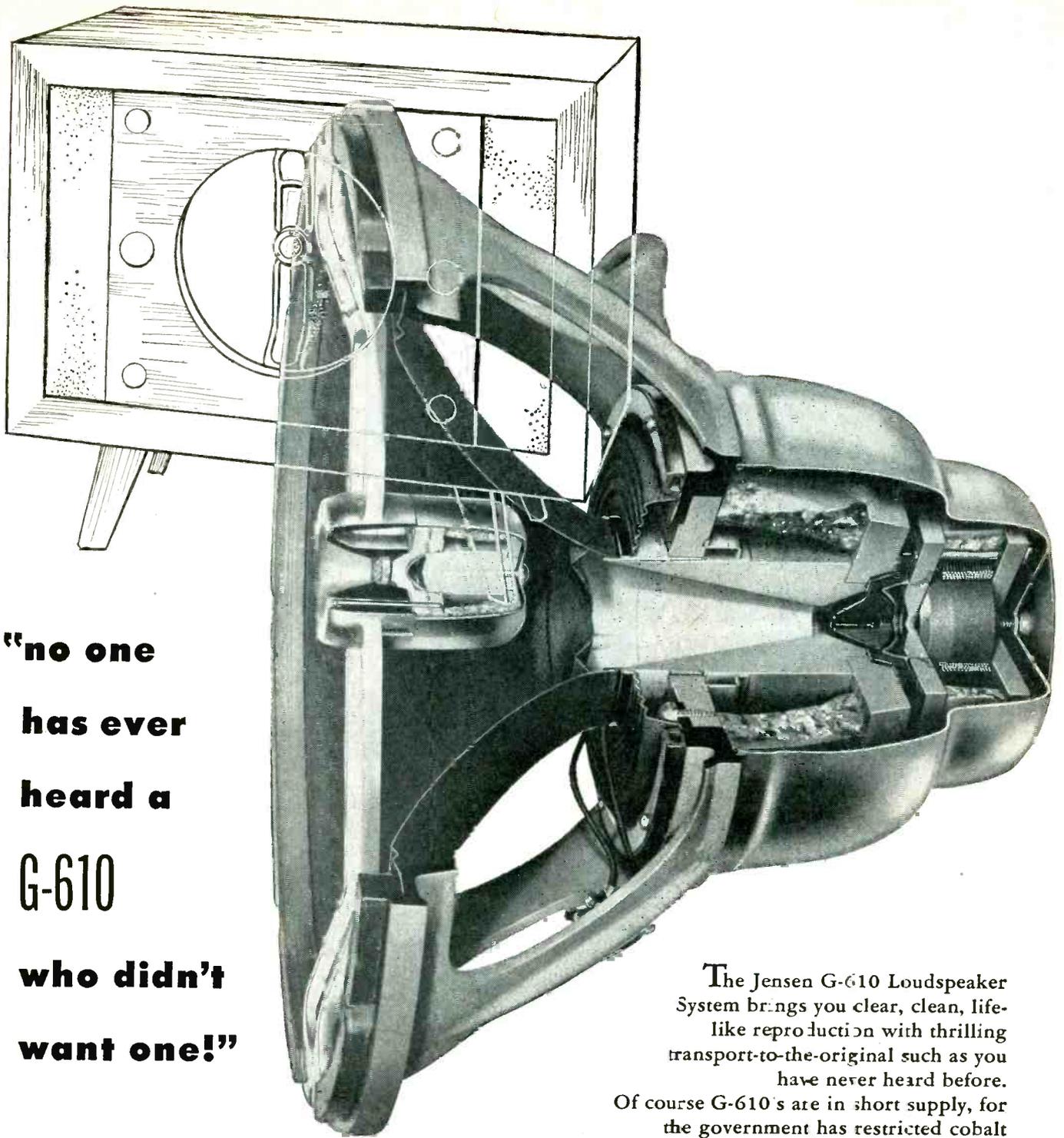
Of the 38 different resistor styles listed in JAN-R-26A, Ohmite offers 33 styles that meet these specifications. These styles represent the most popular resistors, and are available in a complete range of resistance values, in the types and sizes listed.

OHMITE MANUFACTURING COMPANY  
4818 Flournoy St., Chicago 44, Ill.

*Be Right with...*

# OHMITE®

RHEOSTATS • RESISTORS • TAP SWITCHES



**"no one  
has ever  
heard a  
G-610  
who didn't  
want one!"**

*We believe this statement is literally true . . .*

The Jensen G-610 Loudspeaker System brings you clear, clean, life-like reproduction with thrilling transport-to-the-original such as you have never heard before. Of course G-610's are in short supply, for the government has restricted cobalt for Alnico V magnets—and the G-610 has more magnetic energy than any speaker ever built. But when restrictions are relaxed and G-610's are again plentiful, then be sure you get a G-610 . . . NO ONE has ever heard one who didn't want one!

Illustrated with Blonde model M-253 cabinet showing accessory legs.



**Jensen**

**MANUFACTURING COMPANY**

DIVISION OF THE MUTER COMPANY

**6601 SOUTH LARAMIE AVENUE**

**CHICAGO 38, ILLINOIS**

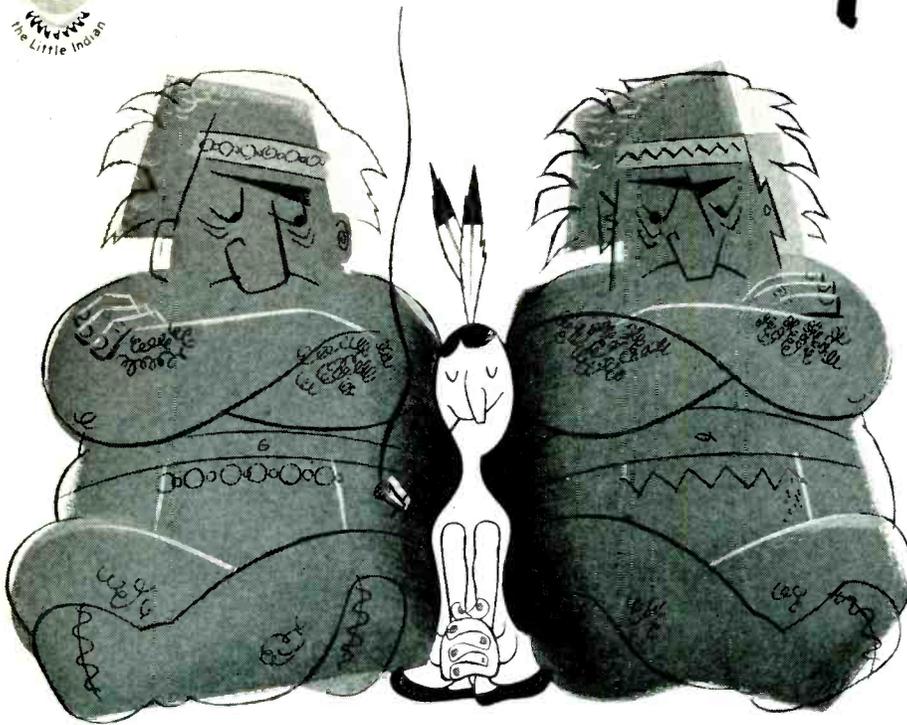
BURTON BROWN ADVERTISING

**ELECTRONICS — May, 1951**



THE LITTLE INDIAN SAYS.

# "Fit in tight Spots!"



## SANGAMO PAPER CAPACITORS

### Sangamo Type 60 Capacitors

You're *right* when you specify Sangamo Type 62 and 64 Paper Capacitors for use where exceptionally small filter capacitors are required for aircraft, guided missile work, or similar applications.

These capacitors are mineral oil impregnated for E characteristic and assure excellent long life performance at temperatures from  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . Types 62 and 64 capacitors are *smaller* than the size requirements of joint Army and Navy Specification JAN-C-25, CP 60 Series. They are hermetically sealed in seamless drawn steel cases. Non-magnetic copper or brass cases can be supplied if desired.

Full information on these, and many other types of Sangamo Paper Capacitors, is given in Catalog No. 832. Write for your copy.



Type 64A



Type 62B



Type 62A

Your Assurance of

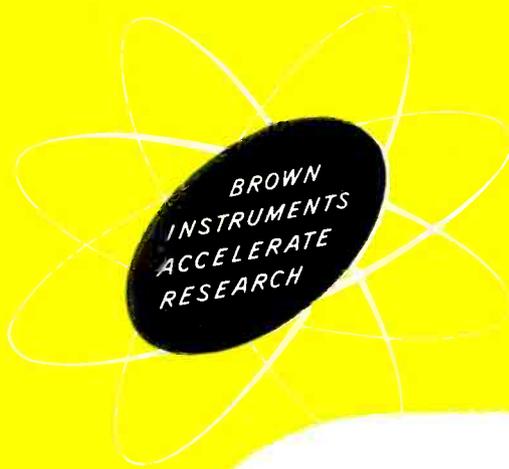


Dependable Performance

## SANGAMO ELECTRIC COMPANY SPRINGFIELD, ILLINOIS

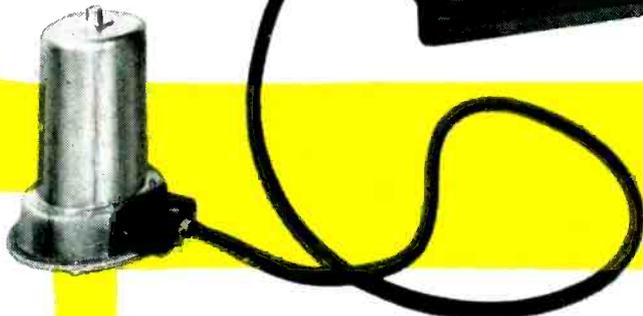
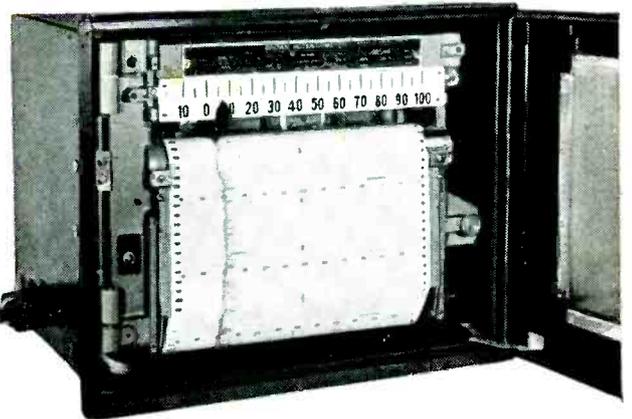
IN CANADA: SANGAMO COMPANY LIMITED, LEASIDE, ONTARIO

82314



for measuring and recording currents as low as  $10^{-15}$  amperes

...THE BROWN ELECTROMETER



*Brown Electrometer showing recorder with door ajar and preamplifier at left.*

**ELECTRICAL CHARACTERISTICS**

- FULL SCALE CURRENT RANGES AVAILABLE:  $10^{-13}$  amperes with  $10^{11}$  ohm resistor, and selector switch adjustment for full scale of  $10^{-12}$  or  $10^{-11}$  amperes. Using other resistors, full scale current ranges up to  $10^{-7}$  amperes can be supplied with selector switch adjustment up to  $10^{-5}$  amperes.
- INPUT RESISTOR:  $10^{11}$  ohms for most sensitive current measurement. (Also supplied in values down to  $10^5$  ohms.)
- SYSTEM ACCURACY: Approximately 1 per cent of scale.
- ZERO DRIFT: Should not exceed 0.3 millivolt per day.
- SYSTEM NOISE: Approximately 5 microvolts.
- INSTRUMENT SPEED OF RESPONSE: Available for either 24, 12 seconds or  $4\frac{1}{2}$  seconds full scale.
- MAXIMUM SPEED OF RESPONSE USING  $4\frac{1}{2}$  SECOND INSTRUMENT SPEED: 5 seconds for 90 per cent of change, with preamplifier located at source.
- POWER SUPPLY: 115 volts, 60 cycles. Also dry cell supplied in instrument.
- POWER REQUIREMENTS: 65 watts.

ACCURATE measurement of extremely small currents is accomplished in this instrument through the use of a null balance servo system and a-c amplifiers that prevent drift and consequent instability. It is the only such system that incorporates a recorder as an integral part of the circuit. Designed to measure and record minute currents in ionization chambers, the Brown Electrometer may be used in any application where currents as low as a billionth of a microampere are encountered.

Features of the instrument include a special power supply to prevent false measurements from stray signals which might originate in an a-c power source . . . vibration frequency carefully selected to prevent phase shift . . . and automatic standardization of voltage across the slide-wire. For detailed information, write for a copy of Data Sheet 10.0-4.

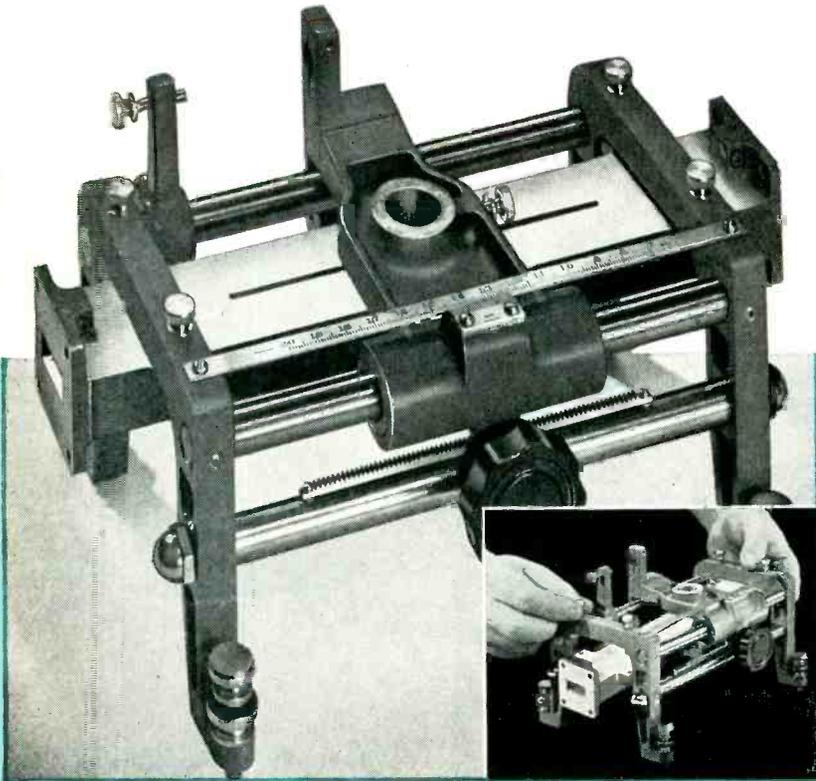
MINNEAPOLIS-HONEYWELL REGULATOR Co., *Industrial Division*, 4428 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

MINNEAPOLIS  
**Honeywell**

BROWN INSTRUMENTS

# IMPEDANCE

## COMPLETE COVERAGE!



**-hp- 809B UNIVERSAL PROBE CARRIAGE  
with -hp- 810A WAVEGUIDE SLOTTED SECTIONS**

Now—a single probe carriage operates with up to 5 different slotted sections—waveguide or coaxial! This means important savings in time; lower investment in instrumentation. The new -hp- 809B Universal Probe Carriage mounts slotted sections covering frequencies from 3,000 to 12,400 mc (see table on opposite page)—and you can interchange sections in 30 seconds or less!

-hp- 809B Carriage is accurately calibrated

in mm. for readings as low as 0.1 mm. Dial gauge may be readily mounted if more accurate readings are needed. Carriage travels on a new 3-point ball-bearing suspension system, and operates in conjunction with -hp- 442A Broad-Band Probe and -hp- 440A Coaxial Detector combination; or with -hp- 444A Untuned Probe. The extremely broad usefulness of this new Universal Carriage means far greater flexibility and lower cost for complete microwave instrumentation.

CONTINUOUS microwave coverage, 10 mc to 12,400 mc. High mechanical stability. Simple operation. Broad applicability. Precision accuracy. Compact size!

New -hp- microwave equipment gives you *complete coverage* for VHF, UHF and SHF impedance measurements. Instrumentation includes VHF Bridges as well as the slotted coaxial and waveguide sections which are fundamental tools in impedance measurements. These instruments can be used to measure load or antenna impedance, system flatness, connector reflection, percentage of reflected power, standing wave magnitude or phase, characteristics of coaxial transmission lines or rf waveguide systems, characteristics of rf chokes, resistors, condensers.

For complete details see your -hp- sales representative or write direct.

### HEWLETT-PACKARD COMPANY

2160A Page Mill Road • Palo Alto, California

Sales representatives in principal areas.

Export: Frazar & Hansen, Ltd.

San Francisco, New York, Los Angeles



**-hp- 417A VHF DETECTOR**

For use with -hp- 803A VHF Bridge. A super-regenerative (AM) receiver covering all frequencies 10 to 500 mc in 5 bands. Offers approx. 5  $\mu$ v sensitivity over entire band; quick, easy operation, direct-reading frequency control. Thoroughly shielded, suitable for general laboratory use including approximate frequency checks, measurements of noise, interference, etc. \$200.00 f.o.b. factory.

**-hp- 415A STANDING WAVE INDICATOR**

Designed for use with all waveguide or coaxial slotted sections, to give direct reading of standing wave ratio in VSWR or db. Consists of high gain amplifier with low noise level, operating at fixed frequencies between 300 and 2,000 cps. (Normal frequency 1,000 cps., plug-ins for other frequencies available). Input circuits for use with crystal detector or bolometer. \$200.00 f.o.b. factory.



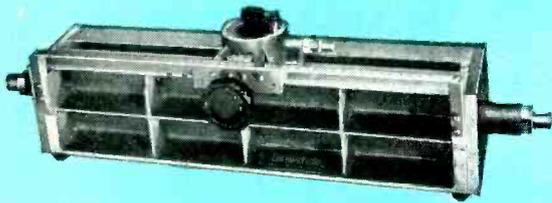
HEWLETT-PACKARD



INSTRUMENTS

# READINGS

## 10 to 12,400 mc.



### -hp- 805A/B COAXIAL SLOTTED SECTIONS

Continuous coverage 500 to 4,000 mc. High accuracy and mechanical stability; negligible slope, minimum leakage. Incorporates radically different structural design employing rigid parallel planes and a non-bowing central conductor. Probe setting readable in mm. to 0.1 mm. Maximum VSWR of basic section and connectors less than 1.04. -hp- 805A, 50 ohms impedance, for Type N connector and flexible cables. Model 805B, 46.3 ohms impedance, for 7/8" rigid transmission lines.

### -hp- 806B COAXIAL SLOTTED SECTION

Continuous coverage 3,000 to 12,000 mc. Employs same time-tested parallel plane principle as -hp- 805A/B. Designed for use with -hp- 809B Universal Probe Carriage. Maximum VSWR of slotted section and connectors is 1.06 to 10,000 mc. Negligible slope, 50 ohm impedance. Uses Type N connectors for flexible coaxial cable. Sets new standard for mechanical stability in coaxial slotted sections.

### -hp- 440A COAXIAL DETECTOR

Tunable crystal and bolometer mount. May be used as an rf detector for coaxial systems between 2,400 and 12,400 mc. Fits Type N connectors; operates with bolometer or silicon crystal. \$85.00 f.o.b. factory.

### -hp- 442A BROAD-BAND PROBE

May be used in combination with -hp- 440A to provide highly sensitive, easily tuned detector for slotted sections. Micrometer depth adjustment provides quick control of rf coupling. \$75.00 f.o.b. factory.

### -hp- 444A UNTUNED PROBE

Frequency range 2,400 to 12,400 mc. Includes 1N26 silicon crystal. Highly sensitive, compact, easy to use. Requires no tuning. \$50.00 f.o.b. factory.

### -hp- 803A VHF BRIDGE

Gives direct readings in impedance magnitude and phase, 10 to 500 mc. Rapid operation for new speed, convenience in reading impedance, or resistance and reactance. Operates on new principle of sampling magnetic and electric field of transmission line. Useful for comparative measurements, 5 to 1,000 mc. Impedance range 2 to 2,000 ohms. Phase angle  $-90^\circ$  to  $+90^\circ$ , at 52 mc and above. Offers utmost convenience in determining characteristics of antennas, transmission lines, rf chokes, resistors and condensers; in measuring connector impedances, standing wave ratios, percentage of reflected power, VHF system flatness.



### -hp- IMPEDANCE MEASURING EQUIPMENT

INSTRUMENT	FREQUENCIES— COAXIAL	FREQUENCIES— WAVEGUIDE	PRICE (F.O.B. FACTORY)
803A VHF BRIDGE	10 to 500 mc		\$495.00
805A/B SLOTTED SECTION	500 to 4,000 mc		\$475.00
806B SLOTTED SECTION	3,000 to 12,000 mc		\$200.00
S810A SLOTTED SECTION		2,600 to 3,950 mc	\$450.00
G810B SLOTTED SECTION		3,950 to 5,850 mc	\$ 90.00
J810B SLOTTED SECTION		5,850 to 8,200 mc	\$ 90.00
H810B SLOTTED SECTION		7,050 to 10,000 mc	\$ 90.00
X810B SLOTTED SECTION		8,200 to 12,400 mc	\$ 90.00
809B UNIVERSAL PROBE CARRIAGE	For slotted sections, 3,000 to 12,400 mc		\$160.00

\* Model 809B Universal Probe Carriage

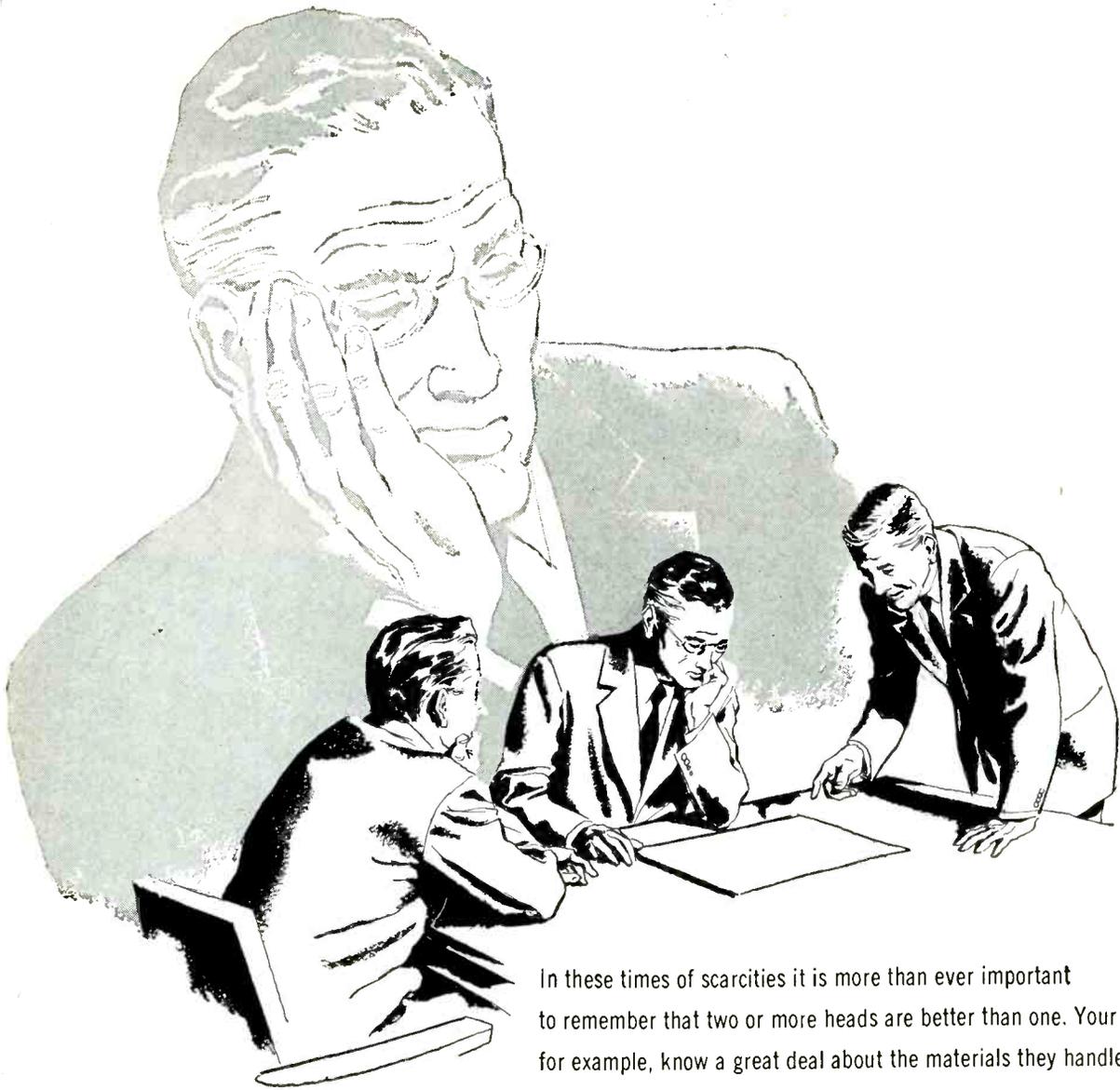
† Complete VHF Bridge, Slotted Section, and Waveguide Adapter Kits Available

Data Subject to Change Without Notice

HEWLETT-PACKARD



INSTRUMENTS



In these times of scarcities it is more than ever important to remember that two or more heads are better than one. Your suppliers, for example, know a great deal about the materials they handle, how to select, specify and install them.

No matter what you buy it will pay you to draw upon this knowledge. It may help you make scarce materials go further, reduce costs of installation, perhaps even suggest a substitute.

AND of course for close collaboration regarding permitted uses of such Revere Building Products as Revere Copper Water Tube, Revere Copper Pipe, Revere Red Brass Pipe, get in touch with the Revere Technical Advisory Service through the Revere Distributor nearest you.

**REVERE** *150<sup>th</sup> YEAR OF SERVICE TO AMERICA*  
**COPPER AND BRASS INCORPORATED**

*Founded by Paul Revere in 1801*  
230 Park Avenue, New York 17, N. Y.

*Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. — Sales Offices in Principal Cities, Distributors Everywhere*

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY



**Master Pieces of Hermetic Sealing  
—Proven to Reduce Rejects!**

**PLUG IN TYPE HEADERS**

OC-8: 1 CHARACTER, .093 D. PIN, .050 I.D., FLASH OVER VOLTAGE 6000 V. PIN TO RIM

OC-12: 1 CHARACTER, .093 D. PIN, .050 I.D., FLASH OVER VOLTAGE 6500 V. PIN TO RIM

**MULTIPLE TYPE HEADERS**

1000 SERIES AVAILABLE WITH 2 TO 10 TERMINALS

2000 SERIES AVAILABLE WITH 2 TO 6 TERMINALS

1 CHARACTER, .15 D. PIN SINGLE, .040, FLASH OVER VOLTAGE 6500 V. PIN TO RIM

1 CHARACTER, .15 D. PIN CIRCLE, .040, 6500 V. PIN TO RIM

**NEO-SIL HERMETIC SEALS**

INDIVIDUAL TYPE TERMINALS

E-1: FLASH OVER VOLTAGE 2500V

E-3: FLASH OVER VOLTAGE 5500V

E-4: FLASH OVER VOLTAGE 5500V

**TEST DATA**

The result of the Electrical Testing Laboratories Inc., Report #330655, dated March 18, 1949, on this material shows the following:

Volume Resistivity at 800 Volts d-c  
 Room Temperature 25°C R.H. 30 percent  
 Megohm-inches  $1.4 \times 10^6$  ohm-centimeters  $3.5 \times 10^{12}$

**Dielectric Constant and Dissipation Factor**

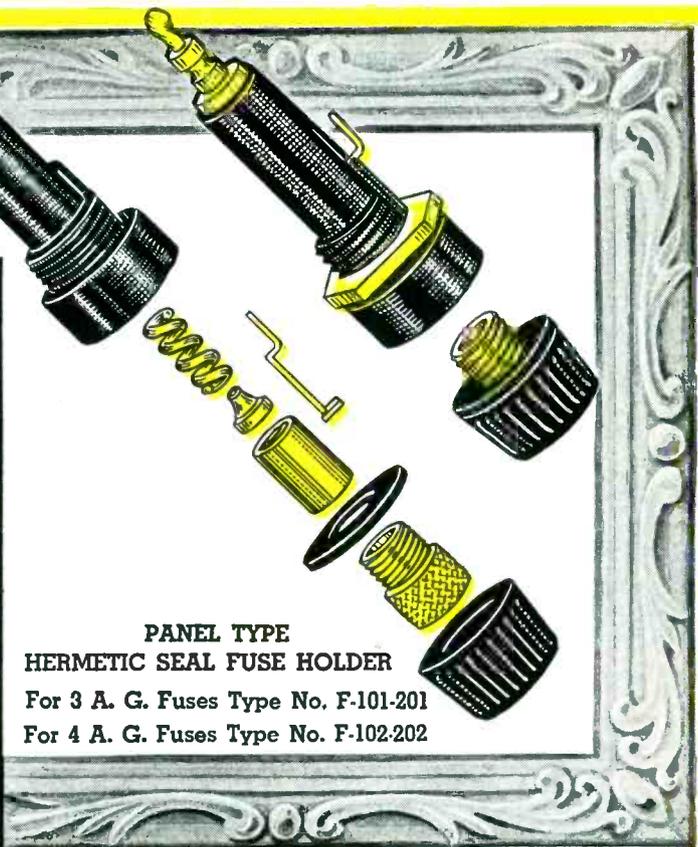
Dielectric Constant	Dissipation Factor	Loss Factor
9.22	@ 60 cycles per second .058	5.32
6.17	@ 1 megacycle per second .0455	.28
5.35	@ 50 megacycles per second 0.20	1.1

Dielectric Strength at 60 cycles Volts per mil — 370

Durometer Average —  $80 \pm 5$

Temperature — Rated as a Class A material conservatively + 105° to -70° centigrade.

The Flashover Voltages indicated were taken at a temperature of 68° Fahrenheit, and 47% Relative Humidity.



**PANEL TYPE  
HERMETIC SEAL FUSE HOLDER**  
 For 3 A. G. Fuses Type No. F-101-201  
 For 4 A. G. Fuses Type No. F-102-202

NEO-SIL proven dependable Hermetic sealing components will reduce your rejects resulting from breakage, strain, cracks, physical shocks, etc. Each NEO-SIL component is pressure checked at 25 lbs. P.S.I. —to meet military requirements. As a unit, NEO-SIL synthetic compound is suitable insulation when bonded to various metals to resist abusive temperature cycling, salt water, high pressure, high vacuum and most acids and alkalis.

In addition to the Panel Type Hermetic Seal Fuse Holder illustrated, NEO-SIL offers many other specialty components: Molded Cable with plugs attached—4 Pin Female Panel Connector—Meter Hermetic Seal Gasket—5 Pin Female Panel Connector—Rotary Hermetically Sealing Panel Bushing.

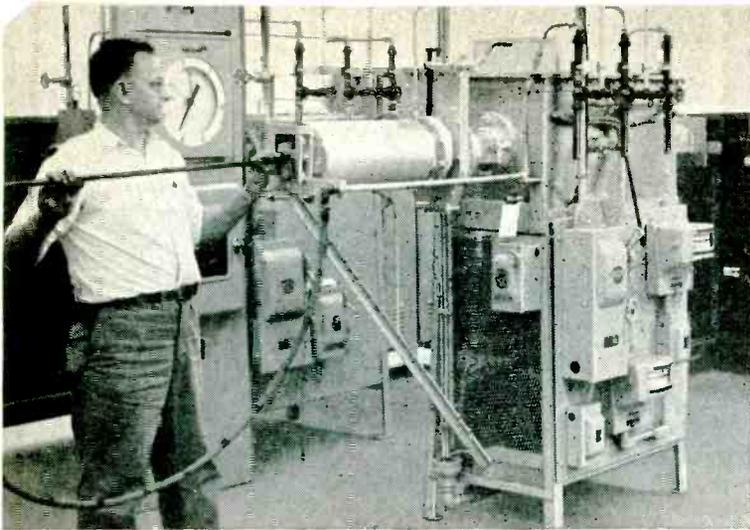
Your special problems are solicited.



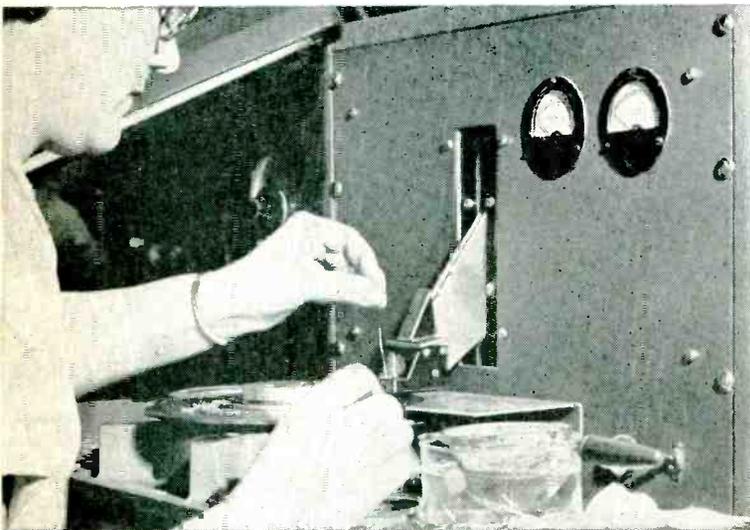
26 CORNELISON AVE., JERSEY CITY 4, N. J.

# NEW GENERAL ELECTRIC PLANT CAN PRODUCE TODAY'S TOTAL INDUSTRY NEEDS OF

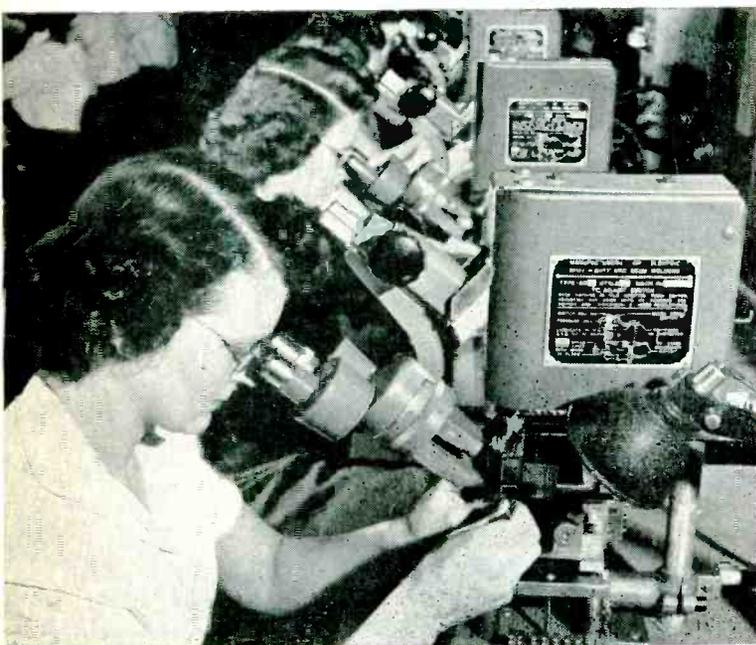
# WELDED GERMANIUM DIODES



1. **MAXIMUM METAL PURITY** is essential in the manufacture of diodes. In photograph above dioxide powder is being reduced to pure germanium metal.



2. **GERMANIUM PELLETS** are mounted to pin assemblies prior to assembly in cases. Precision centering as well as speed are essential to produce these quality units at low cost.

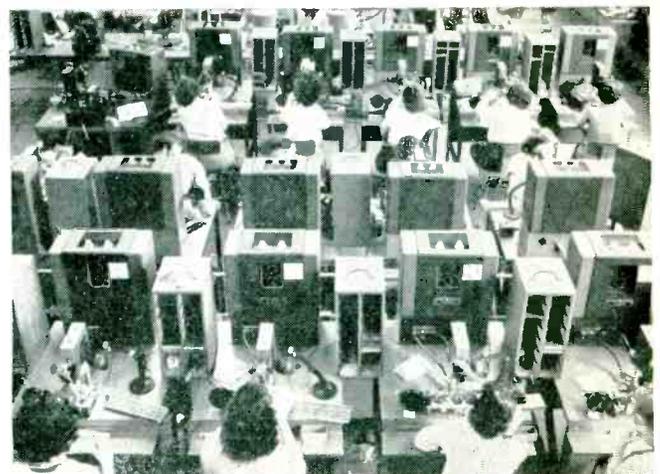


3. **FORMING, SHEARING, AND WELDING WHISKERS** on diode pin assembly calls for careful manipulation under microscope for accurately formed .003 inch diam. whisker.

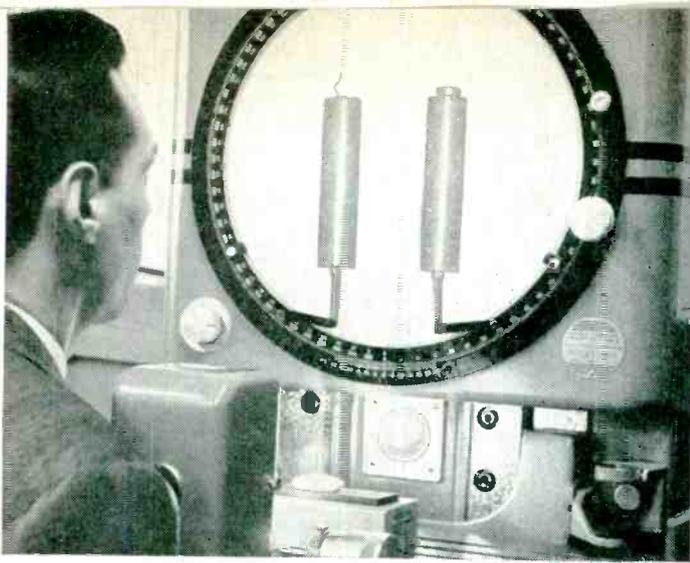
 Capacity unlimited in the production of germanium diodes is the aim of General Electric's new plant\* at Clyde, New York. An offspring of the mother plant at Electronics Park, this factory is equipped to assemble and test as many as 12 million diodes a year. New technological advances in research and manufacture — already proved feasible — can raise this ceiling tremendously. As diodes for commercial and military applications are produced in ever increasing quantities, costs are driven down. To fill your diode requirements — *with speed, accuracy, and at low cost* — compare G. E. with all other manufacturers.

Would you like more information on this? Ask us to call. *General Electric Company, Electronics Park, Syracuse, New York.*

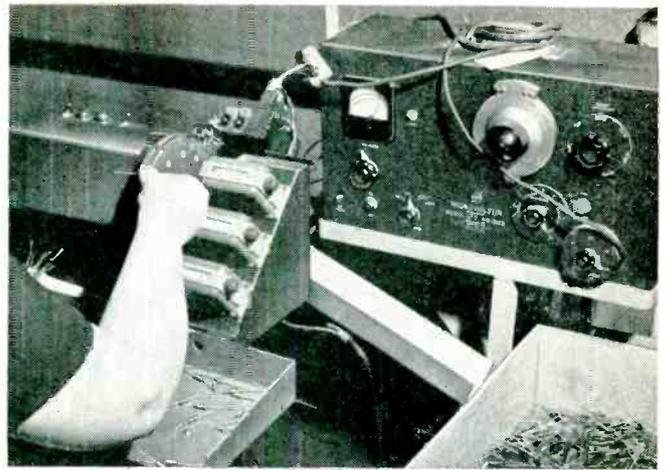
\*Which you are invited to inspect when in the Syracuse area. Meanwhile, let us send you additional information and specifications on G-E diode products. Write for bulletin #X57-01A.



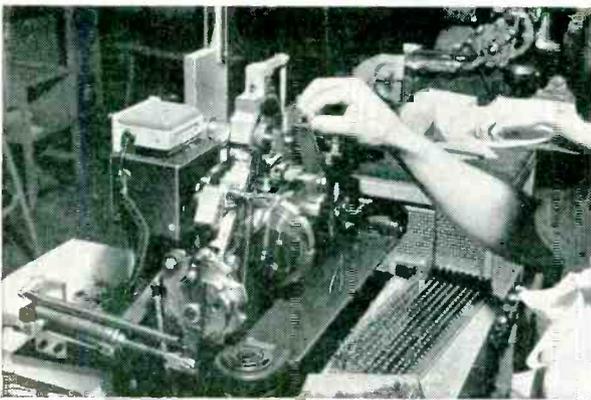
4. **ORDERLY BANK OF WHISKER MACHINES** is typical of modern production facilities in the new G-E plant. Quantities up to 12 million units a year can be produced here.



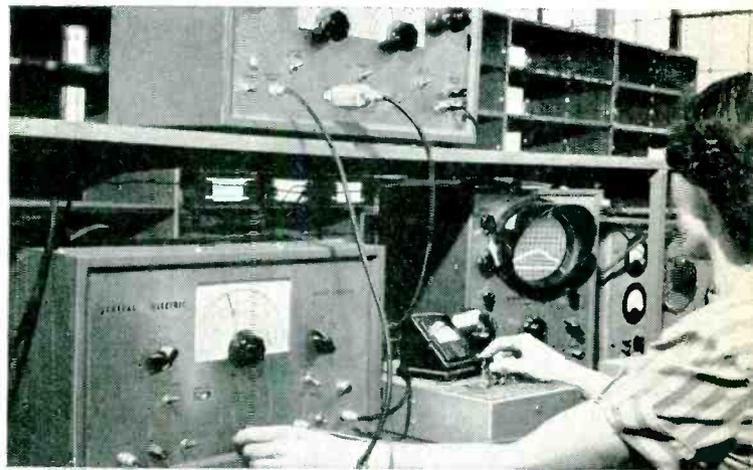
5. **CONTOUR PROJECTION** of diode parts for microscopic inspection. Pellet and whisker (on screen) must follow rigid specifications. This is typical of quality control processes.



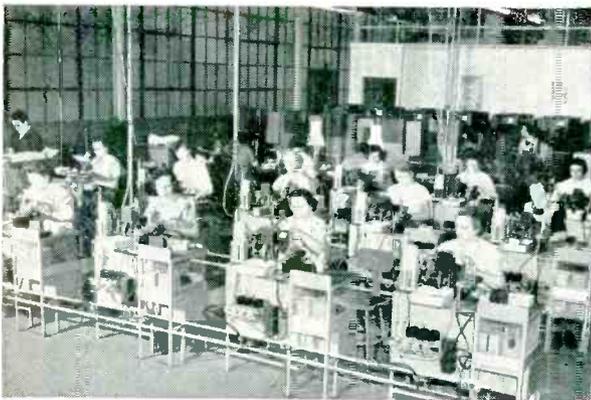
8. **AUTOMATIC TEST SEPARATION** of diodes by types eliminates costly hand sorting of thousands of units per hour. Every G-E diode is tested many times.



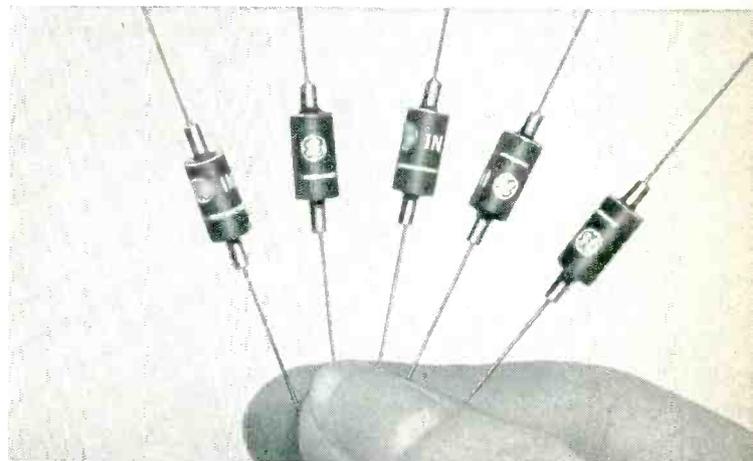
6. **FINAL ASSEMBLY** of whisker and pellet pins in plastic cases requires special machines designed by G-E engineers for speed and accuracy.



9. **HIGH-FREQUENCY TESTING** of diodes for television applications has proved successful in supplying over 2 million G-E units to television manufacturers for high efficiency needs.



7. **ASSEMBLY MACHINES** turn out diodes of 12 different varieties. This process represents unusual advancement over former "hand-made" methods.



10. **FINISHED G-E DIODES** of various types are small, rugged, efficient, and low in cost. These components can replace some categories of vacuum tubes.

*You can put your confidence in—*

**GENERAL**  **ELECTRIC**

# HIGHER EFFICIENCY

*WITH*

# BENDIX SCINFLEX ELECTRICAL CONNECTORS

# MINIMUM VOLTAGE DROP

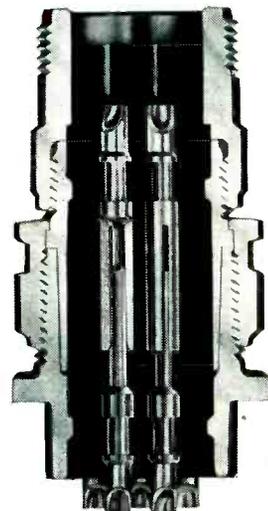
**PLUS**

- Moisture proof
- Pressure Tight
- Radio Quiet
- Single-piece Inserts
- Vibration proof
- Light Weight
- High Insulation Resistance
- Easy Assembly and Disassembly
- Fewer Parts than any other Connector
- No additional solder required

The ability to carry maximum currents with only a minimum voltage drop is an outstanding characteristic of Bendix Scinflex Electrical Connectors. This important feature is only a part of the story of Bendix success in the electrical connector field. The use of Scinflex dielectric material, an exclusive Bendix development of outstanding stability, increases resistance to flash over and creepage. In temperature extremes, from  $-67^{\circ}\text{F.}$  to  $+275^{\circ}\text{F.}$  performance is remarkable. Dielectric strength is never less than 300 volts per mil. All in all, no other electrical connector combines as many important exclusive features as you will find in Bendix Scinflex connectors. For higher efficiency in your electrical connectors be sure to specify Bendix Scinflex. Our sales department will gladly furnish additional information on request.



**PLUS**



**SHELL**  
High strength aluminum alloy  
... High resistance to corrosion ... with surface finish.

**CONTACTS**  
High current capacity ... Low voltage drop.

**SCINFLEX ONE-PIECE INSERT**  
High dielectric strength ... High insulation resistance.

*Bendix*

**SCINTILLA MAGNETO DIVISION of  
SIDNEY, NEW YORK**

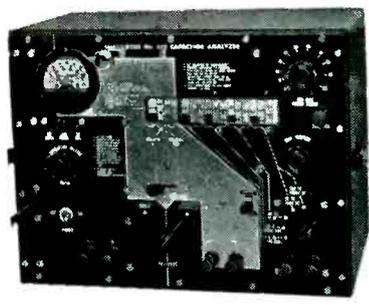
Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

**FACTORY BRANCH OFFICES:**

117 E. Providencia Ave., Burbank, California • 23235 Woodward Ave., Ferndale, Michigan • 7829 W. Greenfield Ave., West Allis 14, Wisconsin • 582 Market Street, San Francisco 4, California

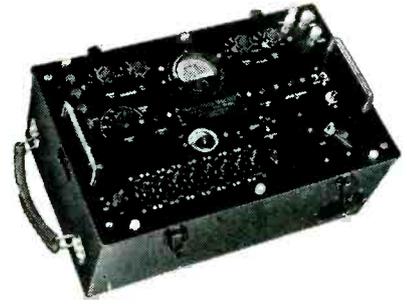


*Something New*



**WIDE-RANGE, DIRECT-READING CAPACITOR ANALYZER**

A laboratory-type Capacitor Analyzer meeting the need for a highly accurate, wide-range, direct-reading measuring instrument capable of determining the essential characteristics of capacitors has been announced by the Shallcross Manufacturing Co. This versatile instrument will determine capacitance values between 5mmf. and 12,000 mfd.; insulation resistance from 1.1 to 12,000 megohms; also leakage current, dielectric strength, and percentage power factor. A divided panel carrying an outline of the operating instructions makes it readily possible to use the instrument without reference to an instruction book. The Shallcross analyzer operates on 110 volt, 60-cycle alternating current. Literature giving full details will gladly be sent on request to the Shallcross Manufacturing Company, Collingdale, Pa.



**MULTI-PURPOSE TRANSMISSION TEST SET**

In addition to measuring the electrical characteristics of telephone lines and equipment the new Shallcross multi-purpose transmission test set may be used for efficiency tests on local and common battery telephone lines and sets, carbon microphones, receivers, and magnetic microphones. It also provides a fast, efficient means of testing capacitors, generators, ringers, insulation resistance, dials, and continuity. Key switches and dials are used to select and control the test circuits. The 693 Transmission Test Set is powered by external batteries. It features compact, substantial construction and is fully portable, thus making it ideal for either field or laboratory use. Details may be obtained from the Shallcross Manufacturing Company, Collingdale, Pennsylvania.

ADV.



**SHALLCROSS**

**DECADE *Resistance* BOXES**

**36 STANDARD TYPES FROM WHICH TO CHOOSE!**

TYPE	DIALS	OHM STEPS	TOTAL RESISTANCE—OHMS
542	1	0.01	0.1
543	1	0.1	1
544	1	1	10
545	1	10	100
546	1	100	1,000
547	1	1,000	10,000
548	1	10,000	100,000
549	1	100,000	1,000,000
550	1	1,000,000	10,000,000
840	2	0.1	11
841	2	1	110
842	2	10	1,100
843	2	100	11,000
844	2	1,000	110,000
817	3	0.01	11.1
818	3	0.1	111
820	3	1	1,110
821	3	10	11,100
822	3	100	111,000
823	3	1,000	1,110,000
824	3	10,000	11,100,000
817-A	4	0.01	111.1
819	4	0.1	1,111
825	4	1	11,110
826	4	10	111,100
827	4	100	1,111,000
828	4	1,000	11,110,000
817-B	5	0.01	1,111.1
8285	5	0.1	11,111
829	5	1	111,110
830	5	10	1,111,100
831	5	100	11,111,000
817-C	6	0.01	11,111.1
8315	6	0.1	111,111
832	6	1	1,111,110
833	6	10	11,111,100

**Accuracy**  
Adjustment of individual resistors is as follows:  
0.01 ohm 5%  
0.1 ohm 1%  
1.0 ohm 0.25%  
All others 0.1%  
  
Closer tolerances available on request

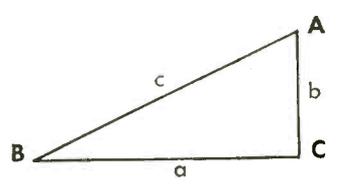
Write for Shallcross Engineering Data Bulletin L-17

**SHALLCROSS MANUFACTURING COMPANY**  
Collingdale, Pa.

Precision Resistors • D-C Bridges • Low Resistance Test Sets • High-voltage measuring equipment • Galvanometers • Rotary Selector Switches • Attenuators • Capacitor Analyzers • Transmission Test Sets . . . and custom-built electronic specialties

**LITTLE THINGS ARE IMPORTANT!**

Arma Electrical Resolver



A Making important things little is a militarily vital objective of the accelerated engineering activity which characterizes Arma. Making them little and interchangeable and more accurate...all at the same time.

C An example of advancing miniaturizing accomplishment is the new lighter, more accurate and interchangeable Arma electrical resolver. This is one of the computing components that replaced a formidable aggregation of gears, bearings and slides previously used in fire-control equipment to solve the trigonometric functions. It is the "thinking" mechanism in modern military instrumentation which solves such gun-laying equations as  $a = c \sin A = c \cos B$  instantaneously.

The mechanical resolvers of World War II have since given way to the electrical. Application of the new miniature Arma electrical resolvers to the needs of all the Services is widening as rapidly as accelerated engineering can push it. This is another way Arma engineers work to help make America safe against those who wish to destroy it.



**ARMA CORPORATION**  
 254 36th STREET, BROOKLYN 32, N. Y.  
 SUBSIDIARY OF AMERICAN BOSCH CORPORATION

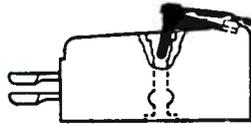
**PRINCIPAL PRODUCTS** Gyroscopic Compasses • Gunfire Control Systems • Stabilizing Devices • Automatic Control Switchboards • Electrical & Electronic Equip. • Electrical Computers • Airborne Instrumentation • Navigational & Plotting Instruments • Mechanical Computers • Servo Mechanisms



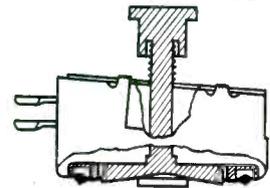
# TONE ARMS— STYLI



Type UPX-006



Type RPX-041



Type RPX-050 (Triple Play)

...still available  
...still tops

### HERE'S PLUS BUSINESS!

Use G-E phono Preamplifiers to sell *modernization* to your customers. Self-contained for easy installation, these units are ready to operate when connected to a power source. They provide sufficient amplification to enable the Variable Reluctance Cartridge to be used with any standard phonograph.

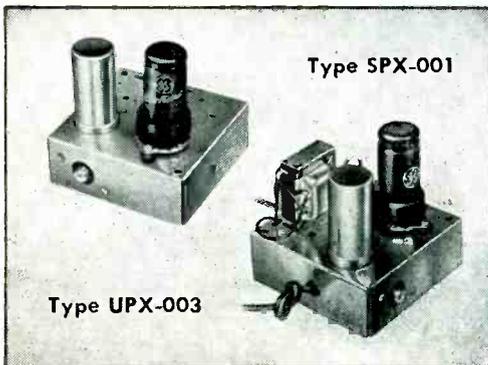
PRODUCT shortages? Sure. But there's *never* a letdown in the *quality* of G-E phono-accessories . . . and the items shown above are still available to manufacturers, jobbers, dealers and servicemen.

The G-E tone arm is built to accommodate the famous G-E Triple Play Cartridge (also in stock). It's equipped with ball bearings for smooth lateral movement . . . special light weight alloy keeps the arm mass to a minimum . . . stylus pressure is *constant at 6-8 grams for all three speeds* to reduce record wear. Plainly marked selector knob projects through the top of the arm—a single twist

places either stylus in playing position.

General Electric's high compliance Baton Stylus with diamond or sapphire tip is unsurpassed in its field. Stock it in quantity—give your customers listening quality that lasts.

**MANUFACTURERS:** Your production requirements of General Electric phono-accessories can still be filled. General Electric application engineers have suggestions that will help you design a better product. Call or wire us today for details. *General Electric Company, Parts Section, Electronics Park, Syracuse, New York.*



Type SPX-001

Type UPX-003

General Electric Company, Section 451  
Electronics Park—Syracuse, N. Y.

Please forward information on the G-E phono accessories checked:

Variable Reluctance Cartridges     Replacement Styli     Phono Preamplifiers     Tone Arms

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_

STATE \_\_\_\_\_

— GENERAL  ELECTRIC —

# UNIFORMITY!



The Radio City Music Hall Rockettes  
World-famous precision dancers.

**T**HE building of the finest precision dancers in the world was not by chance. Neither was the creating, engineering and building of the ARCTURUS television tube, an act of chance. **UNIFORM PERFORMANCE AND DEPENDABILITY** in each Arcturus tube was the goal we set in the early days of television . . . that plus the finest tube man could build. The most informed engineering, the most precise mechanization and the best materials **PLUS** the unrivaled **ARCTURUS QUALITY CONTROL** have placed **ARCTURUS TUBES** at the top of the list of the world's most dependable tubes, and kept it there year after year. You can depend on every Arcturus tube to be as fine as they come in sharpness of picture . . . brilliance . . . long life . . . and stability.

**COMPLETE LINE  
IN SIZES  
10" to 24"**

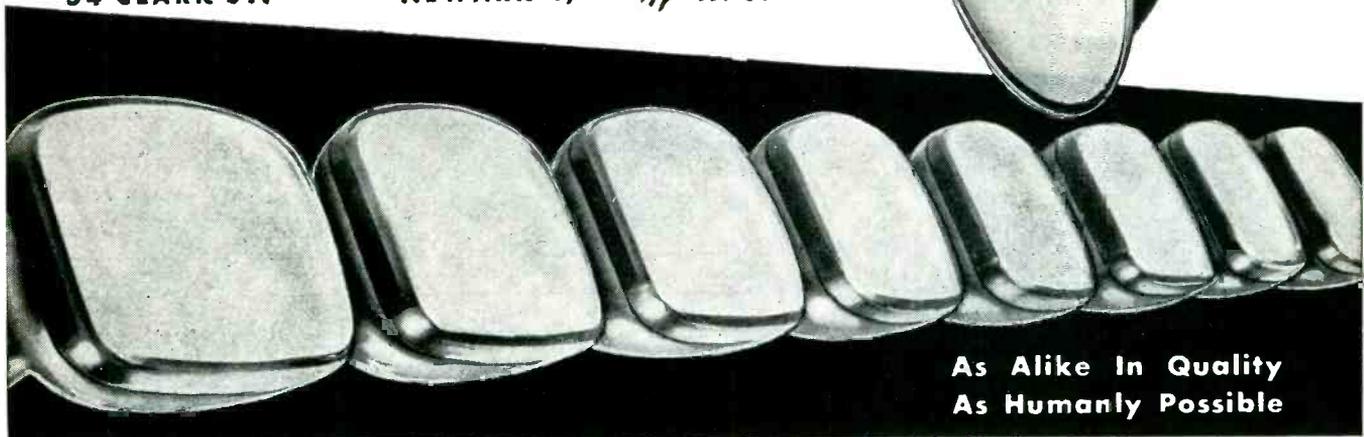
**THE OLDEST NAME  
IN ELECTRONICS**

**ARCTURUS  
ELECTRONICS, INC.**

**54 CLARK ST.**

**NEWARK 4,**

**N. J.**



**As Alike In Quality  
As Humanly Possible**

they

may

look

alike,

but:

there

is

only

one

**C-D**

# RELIABILITY

Businessmen call it *reputation* . . . accountants refer to it as *goodwill* . . . production men think of it as *reliability*. Reliability has a dollar-and-cents value entirely apart from the quality and price of the capacitors you buy.

That is why so many leading radio equipment manufacturers insist on C-D capacitors. They know that C-D's extensive manufacturing facilities, reliable service, dependable quality are features that cannot be measured in dollars and cents. Typical of this C-D reliability is the:



## "Blue Beaver"™\* Electrolytic

- Special formation process—developed by C-D engineers after years of research — insures low leakage; good performance at high temperatures; long life at high voltages.
- Low contact resistance between anode and lead wires and negative lead to can, by unique assembly procedure. Contact resistance checked on kelvin bridges and maintained at low value.
- Special separator material prevents breakdowns under most adverse conditions.
- A positive acting diaphragm vent — developed in C-D labs — insures proper venting when needed.
- Special insulator around positive lead eliminates shorts to can.
- Extreme care in assembly to eliminate all contamination plus the finest raw materials obtainable insure a unit free from corrosion.

For details on these and other C-D electrolytics write for catalog. CORNELL-DUBILIER ELECTRIC CORPORATION, Dept. K51, South Plainfield, New Jersey. Other plants in New Bedford, Brookline and Worcester, Mass.; Providence, R. I.; Indianapolis, Ind., and subsidiary, The Radiart Corp., Cleveland, Ohio.

*C-D Best by Field Test!*



CONSISTENTLY DEPENDABLE

# CORNELL-DUBILIER

CAPACITORS • VIBRATORS • ANTENNAS • CONVERTERS





## “...and the laundry isn't started”

That laundry should be drying. But, Mrs. Burns' new washer stopped dead just as she was putting in the first load of clothes. Her opinion of the machine is definitely not complimentary.

The Westville Electric Company will be over soon and then the explanations will start — perhaps the manufacturer cut corners on electrical insulation . . . perhaps he used an insulation that can't stand vibration and wear.

Mrs. Burns isn't interested in explanations. She wants service. And she isn't much different from you when *you* buy electrical insulation.

**J**oin the ranks of foremost electrical equipment manufacturers who use BH “649” Fiberglas Tubing and Sleeving (Patent Pending) for its superior electrical insulation qualities.

BH “649” will take all kinds of hard punishment. Knot it, then loosen it—twist it 'round and 'round—rub it back and forth on the edge of your desk. Then examine BH “649”—the tough

coating will be undamaged, because no hardening varnish or lacquer is used. There is no flaking, peeling or cracking.

Resistance to chemicals, oil and water is unusually high. Age has little effect on its physical and dielectric properties. Physical and electrical properties unimpaired after exposure to sub-zero temperatures. Retains its remarkable flexibility in these heat endurance tests — 15 minutes at 425-450° F., 24 hours at 302° F., 1500 hours at 220-230° F. Special processing prevents fraying when it is cut and handled — a big help for speedy installation.

BH “649” is one of a family of BH insulations, each designed to meet particular conditions in service. Give us a few facts about your requirements, product, operating temperatures, voltages. We will furnish production samples for testing. Address Dept. E-5 Bentley, Harris Manufacturing Co. Conshohocken, Pa.

# BH *Fiberglas*<sup>\*</sup> SLEEVINGS

\*BH Non-Fraying Fiberglas Sleevings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2393530). “Fiberglas” is Reg. TM of Owens-Corning Fiberglas Corp.

# TUNG-SOL



*damper diode*

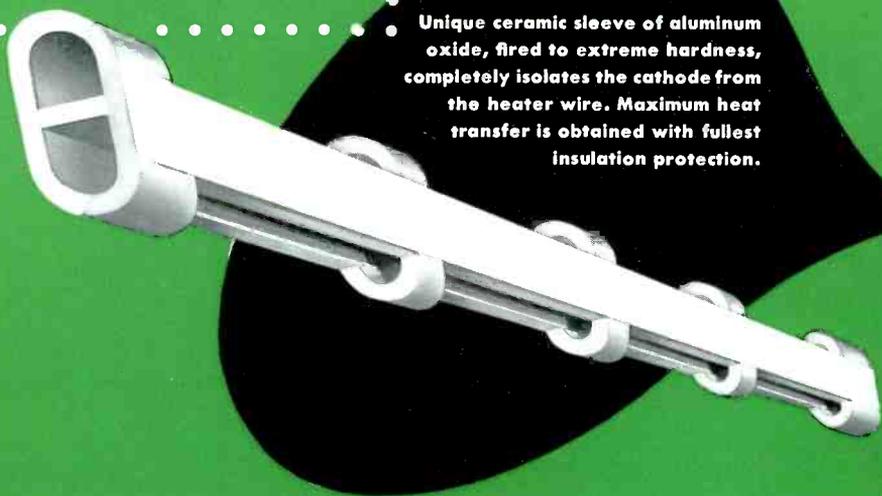
**for transformerless receivers**

**for "direct drive" deflection circuits**

see other side for additional information

# TUNG-SOL

## DAMPER DIODE



Unique ceramic sleeve of aluminum oxide, fired to extreme hardness, completely isolates the cathode from the heater wire. Maximum heat transfer is obtained with fullest insulation protection.



- ★
- ★ **doubles heater-to-cathode insulation rating**
- ★ **eliminates external damper tube transformer**
- ★ **no top cap—simplified wiring**
- ★ **conserves critical materials**
- ★ **lowers manufacturing costs**

Here is a new TUNG-SOL tube designed for use in television horizontal frequency damper service, which is one of the most important and timely engineering developments ever to come out of any electronic laboratory.

It is a single, indirectly heated diode, with the high voltage insulation requirement removed from an external transformer and built into the tube itself.

A specially-designed ceramic sleeve completely isolates the heater from the cathode and other circuits. The receiver designer can handle the damper tube heater just as he does any other heater in the receiver. Normal "warm-up" time is achieved since most of the ceramic insulator body is cut away and yet no sacrifice is made in the insulating properties.

Heater-to-cathode insulation rating has been sharply boosted from 2000 to 4000 volts (pulse rating) and 450 to 900 volts (D.C. rating), thus giving circuit designers new and greater latitude.

Use of the TUNG-SOL 6AX4GT affords manufacturers the opportunity to conserve scarce materials and to effect production economies with the promise of improved set efficiency.

### Mechanical Data

Coated unipotential cathode		
Outline drawing	RMA #9-11	Bulb.....T-9
Base	RMA #B6-48	Short intermediate shell octal 6-pin
Maximum diameter		1-9/32"
Maximum overall length		3-5/16"
Maximum seated height		2-3/4"
Pin connections		RMA basing.....#4CG
Pin 1—no connection		Pin 5—plate
Pin 2—no connection		Pin 7—heater
Pin 3—cathode		Pin 8—heater
Mounting position		Any

### Electrical Data

(Interpreted according to RMA Standard M8-210)\*

#### Ratings

Heater voltage (ac or dc).....	6.3 VOLTS
Heater current.....	1.2 AMPS.
Maximum heater-cathode voltage (heater negative).....	900 VOLTS
Maximum peak heater-cathode voltage (heater negative).....	4000 VOLTS * *
Maximum heater-cathode voltage (heater positive).....	100 VOLTS
Maximum peak inverse plate voltage.....	4000 VOLTS * *
Maximum steady state peak plate current.....	600 MA.
Maximum transient peak plate current.....	3.0 AMPS. * * *
Tube voltage drop (measured with tube conducting 250 ma.)	32 VOLTS
Maximum dc plate current.....	125 MA.

#### Inter-electrode Capacitance

Heater to cathode.....	7.5 $\mu$ f.
------------------------	--------------

\* These are design center ratings. Because of the nature of the service for which this tube is intended, it is important that these values not be exceeded by more than 10% under the most unfavorable operating conditions.

\* \* This rating is applicable where the duty cycle of the voltage pulse does not exceed 15% of one scanning cycle, and its duration is limited to 10 micro-seconds.

\* \* \* This rating applies to hot switching where transient duration does not exceed 0.2 seconds.

This type is also available with 12.6 Volts, 600 MA. heater and is designated 12AX4GT.

# TUNG-SOL

## ELECTRON TUBES

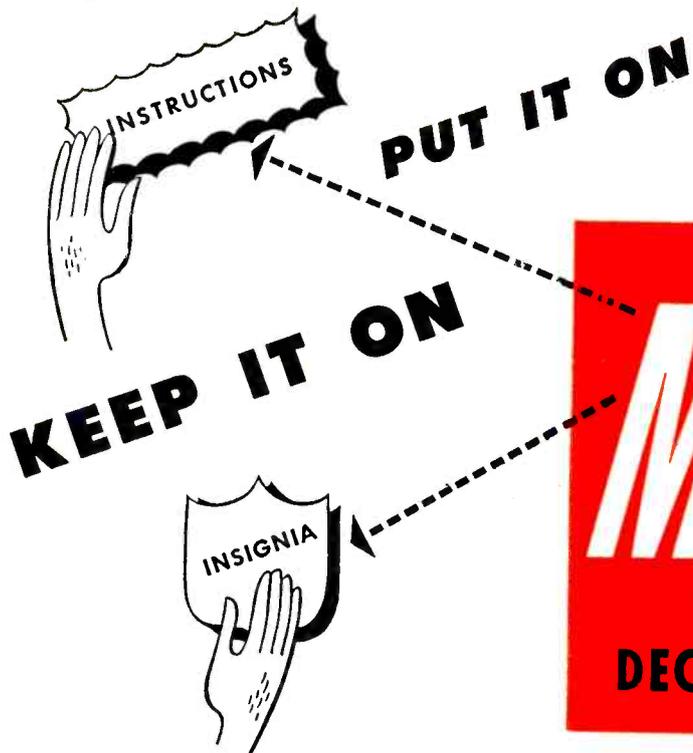
The TUNG-SOL engineering which has produced the 6AX4GT and the 12AX4GT is constantly at work on a multitude of special electron tube developments for industry. Many exceptionally efficient general and special purpose tubes have resulted. Information about these and other types is available on request to TUNG-SOL Commercial Engineering Department.



**TUNG-SOL LAMP WORKS INC., NEWARK 4, NEW JERSEY**

SALES OFFICES: ATLANTA • CHICAGO • DALLAS • DENVER • DETROIT • LOS ANGELES • NEWARK

TELEVISION TUBES • RADIO TUBES • DIAL LAMPS • ALSO ALL-GLASS SEALED BEAM LAMPS AND SIGNAL FLASHERS



**SELF-ADHESIVE • PERMANENT**

**METAL-CALS** consist of a .003" thickness of aluminum foil anodized and dyed, backed with high-tensile bonding material. A METAL-CAL, with your name or message etched into its surface, can be swiftly applied to any smooth, cohesive surface of metals, porcelain, bakelite, polysterene, glass, woods, paints or enamels. Once on—it stays on, telling your story again and again!

**Only METAL-CALS offer all these advantages:**

**ECONOMY**—No holes to drill, no screws, rivets, escutcheon pins or other fastening devices required. Labor, material costs slashed. Long life eliminates replacement cost of decals and litho-plates.

**LONG LIFE**—Won't chip, peel or crack. Letters, characters and colors are part of the aluminum foil itself . . . stay clear, sharp, easy-to-read.

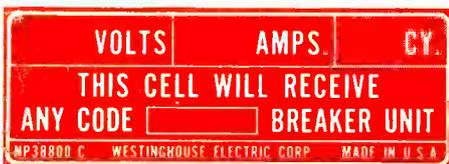
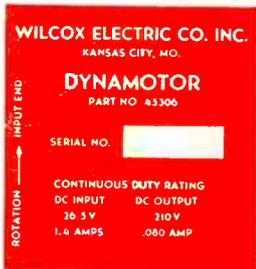
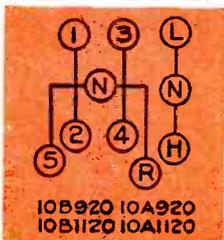
**DURABILITY**—METAL-CALS far surpass in performance the best of decals. They have passed the most rigid weathering, salt spray, humidity, abrasion, low and high temperature tests.

**COLOR VARIETY**—Choose any one of 5 permanent, attractive colors—yellow, red, blue, black, green—plus aluminum. Available with either dull (matte) or lustrous metallic finish.

**SIMPLICITY OF APPLICATION**—After removing by water immersion the cellophane film protecting a METAL-CAL's pressure-sensitive adhesive, anyone can apply quickly to smooth, cohesive surfaces.

**METAL-CALS** have found acceptance and wide use in industries everywhere—wherever there is need for an inexpensive, permanent method of applying trade names, trade marks, insignia, numbers, specifications, diagrams, instructions, dial and gauge markings, operating or maintenance instructions, dealer service nameplates.

**You've tried the rest — Now USE the Best!**



For complete data, samples, technical information, write

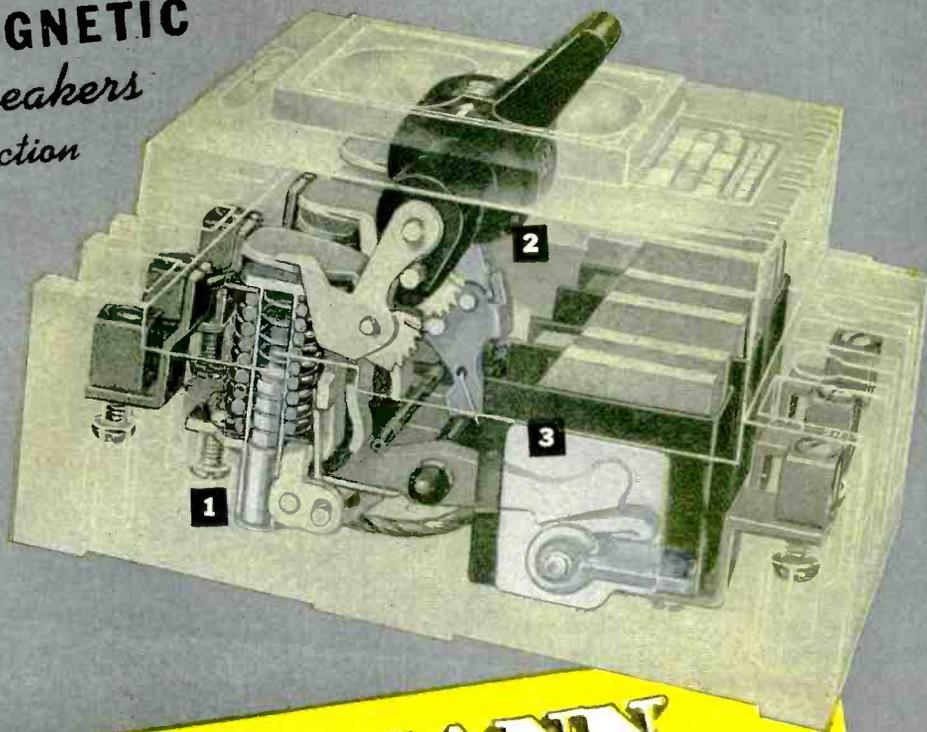
**METAL-CAL DIVISION  
C & H Supply Co.**

Dept. A-2 Boeing Field • Seattle 8, Wash.  
Sales Representatives in All Principal Cities

\* Trade Mark Registered — U. S. and Foreign Patents Pending

# Let's Look Into This!

Three Reasons Why  
**FULLY MAGNETIC**  
Circuit Breakers  
are best protection  
for Electronic  
Equipment



## **HEINEMANN** MAGNETIC CIRCUIT BREAKERS

(1) A magnetic-hydraulic Time Delay Device permits minor overloads to pass for a limited and predetermined length of time, but on short circuit or dangerous over-load the breaker trips INSTANTLY, opening even before an ammeter can indicate the amount of current.

(2) A High Speed Latch, one of the fastest known functions with minimum friction and maximum speed. If a "short" exists, the breaker remains open, even though the handle is held at "ON."

(3) A High Speed Magnetic Blowout assures instant arc interruption. The blowout extinguishes the arc in direct ratio to the strength of the current, due to the intensification of the magnetic field.

Since the breaker operates without thermal elements, NO HEAT is produced. Current-carrying capacity and minimum trip point never vary.

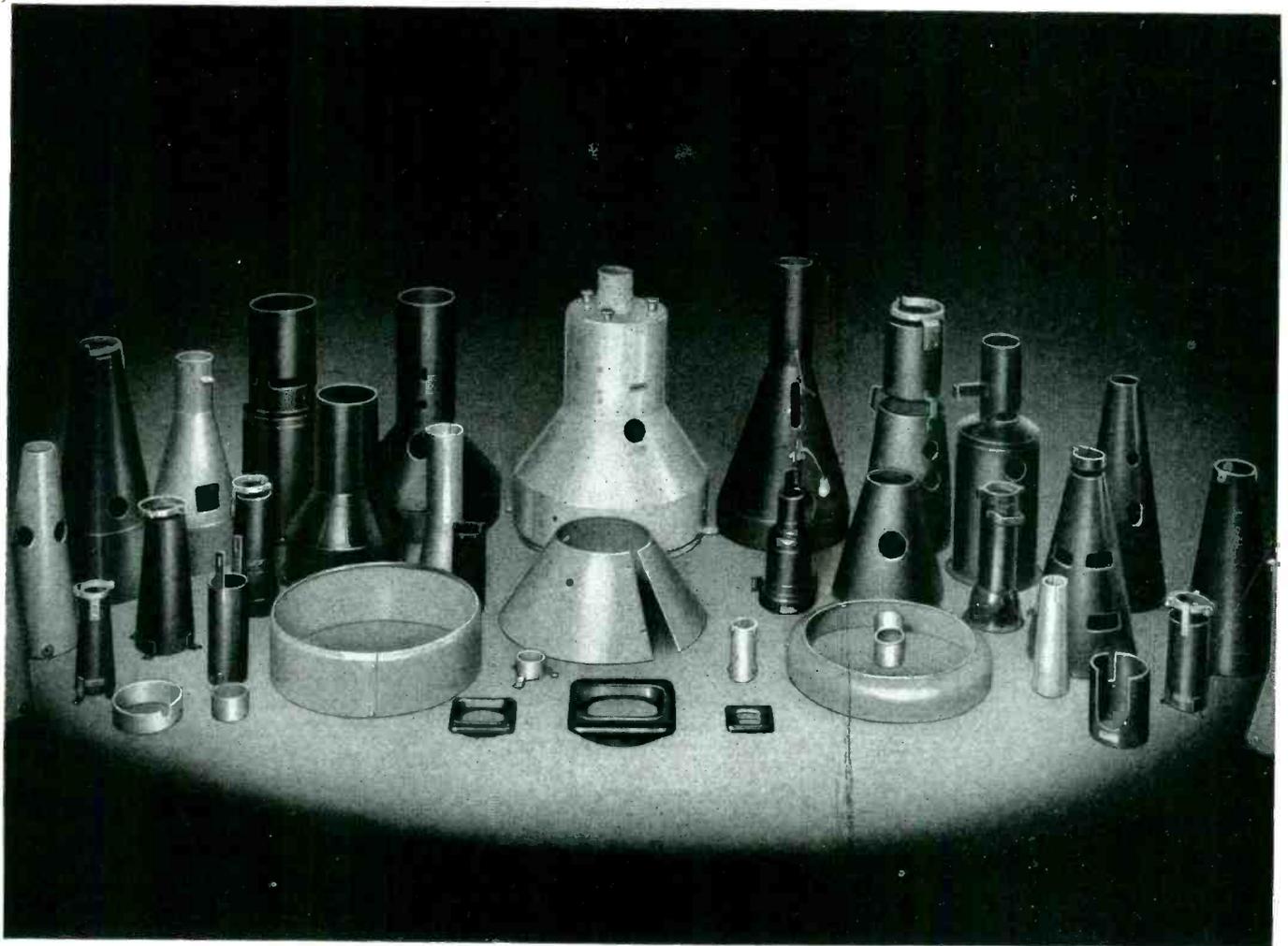
**HEINEMANN ELECTRIC CO.**

TRENTON, N. J.

97 PLUM ST.



*Fully Magnetic - Non Thermal*



## *Designed for Application*

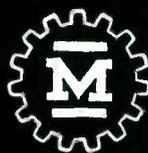
### **Mu Metal Shields**

The James Millen Mfg. Co. Inc. has for many years specialized in the production of magnetic metal cathode ray tube shields for the entire electronics industry, supplying magnetic metal shields to manufacturing companies, laboratories and research organizations. Stock shields are immediately available for all of the more popular sizes and types of cathode ray tubes as well as bezels for 2", 3" and 5" size tubes.

Many production problems, however, make desirable special shields designed in conjunction with the specialized requirement of the basic apparatus. Herewith, are illustrated a number of such custom built shields. Our custom design and fabrication department is at the service of our customers for the development and manufacture of magnetic metal shields of either nicoloi or mumetal for such specialized applications.

**JAMES MILLEN**

MAIN OFFICE



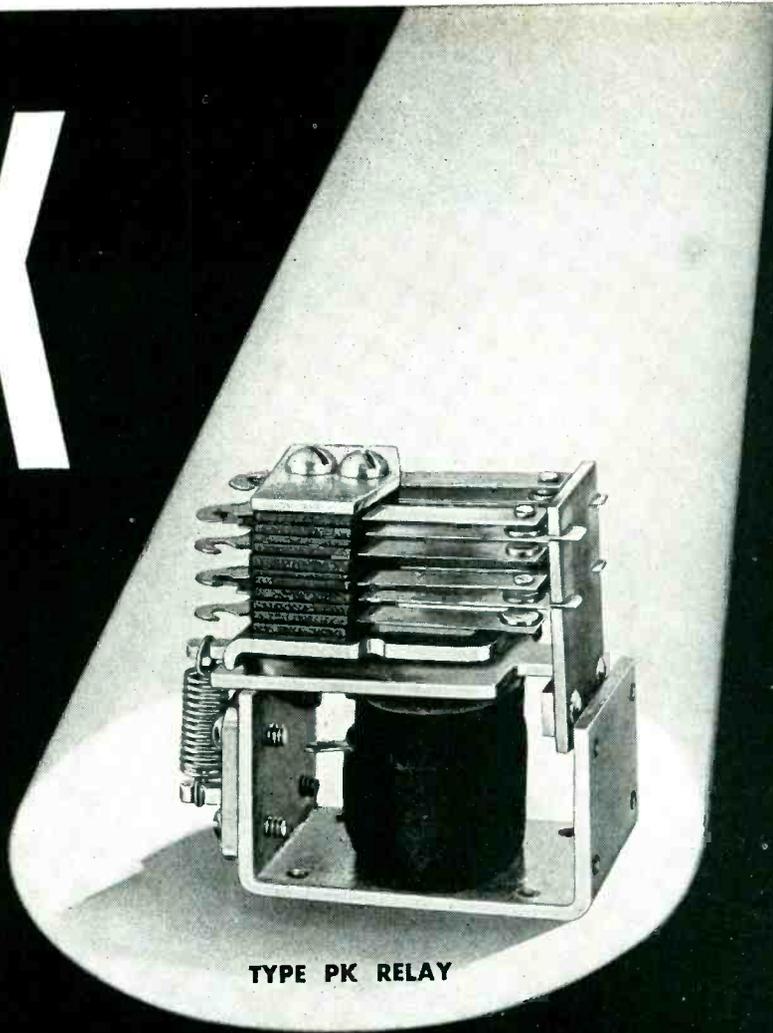
**MFG. CO., INC.**

AND FACTORY

**MALDEN, MASSACHUSETTS, U.S.A.**

# PEAK

IN  
POWER  
VERSATILITY  
QUALITY  
PERFORMANCE



TYPE PK RELAY

## HERE ARE THE FACTS AND FIGURES:

**CONTACTS:** 10 amp. standard. 24 volts D.C., 115 volts A.C.  
15 amp. contacts available.

**SENSITIVITY:** D.C.: 4 pole 1.5 watts  
2 pole .7 watts  
A.C.: 4 pole 5 volt amperes  
2 pole 2.5 volt amperes  
Can also be furnished in 6 pole AC and DC up to 4000 Ohms.

**COIL:** To 115 volts D.C., 230 volts A.C.

**NOMINAL HEAT RISE:** D.C. 30°C above room ambient  
A.C. 45°C above room ambient

**MAX. INPUT FOR 85° RISE:** D.C. 5 watts  
A.C. 11 volt amperes

**MOUNTING:** Base or end mounting

**WEIGHT:** 4.5 oz. 4 P.D.T.

**WEIGHT HERMETICALLY SEALED:** 7.7 oz.

**DIMENSIONS:** Open Relay— $2\frac{1}{16}$ ",  $1\frac{1}{8}$ ",  $2\frac{1}{16}$ "  
Sealed Relay— $3\frac{1}{8}$ ",  $1\frac{1}{2}$ ",  $2\frac{5}{16}$ "  
Overall Mounting Flange— $3\frac{1}{8}$ "  
Center to Center Mounting Holes— $2\frac{11}{16}$ "

## A Quality Relay

The new Allied PK Relay is designed to offer versatility in a power relay where quality and low cost are factors. Besides stability in operation its reliability allows a range in applications from high quality instruments to vending machines. The PKU relay will comply with Underwriters' Laboratories requirements and can also be supplied hermetically sealed.

**Bulletin PK gives complete details. Send for your copy today.**

Be sure to send for your copy of Allied's Relay Guide. It gives the engineering data for 27 Allied relays in a concise tabular form for easy reference.



AL-143

**ALLIED CONTROL COMPANY, INC.** 2 EAST END AVENUE, NEW YORK 21, N.Y.

Complete Coverage!

# 2 to 700,000,000 cps



precision voltmeters for every ac voltage measuring need!



From 2 cps to 700 mc, there's an accurate, easy-to-use *-hp-* voltmeter for any voltage measuring job. You can choose from 5 precision instruments (including a battery-operated portable unit) the dependable *-hp-* voltmeter that exactly fills your need. Each gives you familiar *-hp-* operating characteristics of high sensitivity, wide range, broad applicability, time-saving ease of operation. *-hp-* also provides a complete line of voltmeter accessories—voltage dividers, connectors, shunts and multipliers—to extend the useful range of your equipment. For complete details, see your *-hp-* sales representative or write direct.

### New *-hp-* 410B Vacuum Tube Voltmeter

Gives same wide range and flat response performance as *-hp-* 410A voltmeter, but sets new standard of mechanical convenience, ease of operation, minimum bench space. Readily detachable probe leads fit in handy compartment in new, compact, streamlined case. Special diode probe design places capacity of approximately 1.3  $\mu\text{fd}$  across circuits under test. Shunt impedance is extremely high—10 megohms at low frequencies—thus circuits under test are not disturbed and true voltage readings are assured. New *-hp-* 410B provides 1 db accuracy from 20 cps to 700 mc; and may be used as a voltage indicator up to 3,000 mc. Also serves as audio or dc voltmeter or ohmmeter.



Response, *-hp-* 410B Voltmeter

## HEWLETT-PACKARD CO.

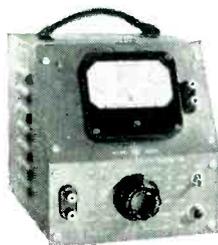
2251A Page Mill Road • Palo Alto, Calif., U.S.A.

Sales representatives in principal areas

Export: Frazar & Hansen, Ltd.

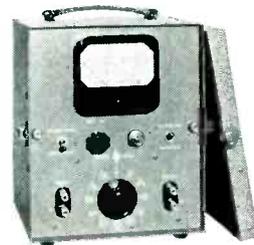
San Francisco • New York • Los Angeles

INSTRUMENT	PRIMARY USES	FREQUENCY RANGE	VOLTAGE RANGE	INPUT IMPEDANCE	PRICE
<i>-hp-</i> 400A	General purpose ac measurement	10 cps to 1 mc	.005 to 300v 9 ranges	1 megohm 24 $\mu\text{fd}$ shunt	\$185.00
<i>-hp-</i> 400B	Low frequency ac measurements	2 cps to 100 kc	.005 to 300v 9 ranges	10 megohms 24 $\mu\text{fd}$ shunt	\$195.00
<i>-hp-</i> 400C	Wide range ac measurements High sensitivity	20 cps to 2 mc	.0001 to 300v 12 ranges	10 megohms 15 $\mu\text{fd}$ shunt	\$200.00
<i>-hp-</i> 404A	Portable, battery operated	2 cps to 50 kc	.0005 to 300v 11 ranges	10 megohms 20 $\mu\text{fd}$ shunt	\$185.00
<i>-hp-</i> 410B	Audio, rf, VHF measurements; dc voltages; resistances	20 cps to 700 mc	0.1 to 300v 7 ranges	10 megohms 1.3 $\mu\text{fd}$ shunt	\$245.00



*-hp-* 400C Vacuum Tube Voltmeter

General purpose precision voltmeter offering wide range, high sensitivity, high stability. Quick-reading linear meter scale shows RMS volts or dbm direct from  $-72$  dbm to  $+52$  dbm. Broad usefulness includes direct noise or hum measurements, transmitter and receiver voltages, audio, carrier or supersonic voltages, or power gain. Also may be used as 54 db amplifier to increase signal level to oscilloscopes, recorders, power amplifiers, etc.



*-hp-* 404A Battery-Operated Voltmeter

Precision vacuum tube instrument for general voltage measurement where ac power is not available. Compact, portable, splash-proof—ruggedly constructed for field operations. Wide voltage range permits all types of measurements including remote broadcast line and carrier checks, strain gauge system tests, telemetering and geophysical circuit measurements, etc. In the laboratory, offers completely hum-free measurements of very low noise level.

HEWLETT-PACKARD INSTRUMENTS



# 99.22% RELIABILITY

**in first year's operation of world's first  
PTM MICROWAVE for a PIPE LINE**

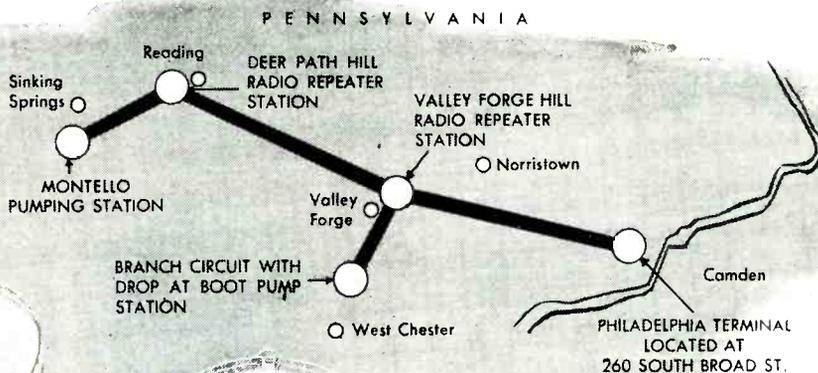
That's the outstanding record of reliability, continuity and quality service achieved by Keystone Pipe Line Company with Federal's Pulse-Time-Modulation Multiplex Microwave System... on the job 99.22% of the time... despite ice, snow, windstorms and other communication problems.

Keystone's pioneer microwave system, comprising 2 repeaters and 3 terminals, extends from Philadelphia to Montello, Pa., a

distance of 60 miles. Operated *without* the necessity of standby RF equipment and requiring only routine maintenance, the first year's total outage time was a mere 0.78% — of which approximately *one-half* represents time consumed by the maintenance man in traveling to outages.

Here is conclusive evidence of the ruggedness, dependability, efficiency and economy of Federal PTM Microwave!

**RAILROADS, UTILITIES, TELEPHONE COMPANIES, RADIO-TV BROADCAST, AVIATION and other fields, as well as pipe lines, can use Federal PTM Microwave to gain outstanding savings and communication facilities.**



For further information on the application of Federal PTM Microwave to your requirements, address: Wire and Radio Transmission Systems Division.

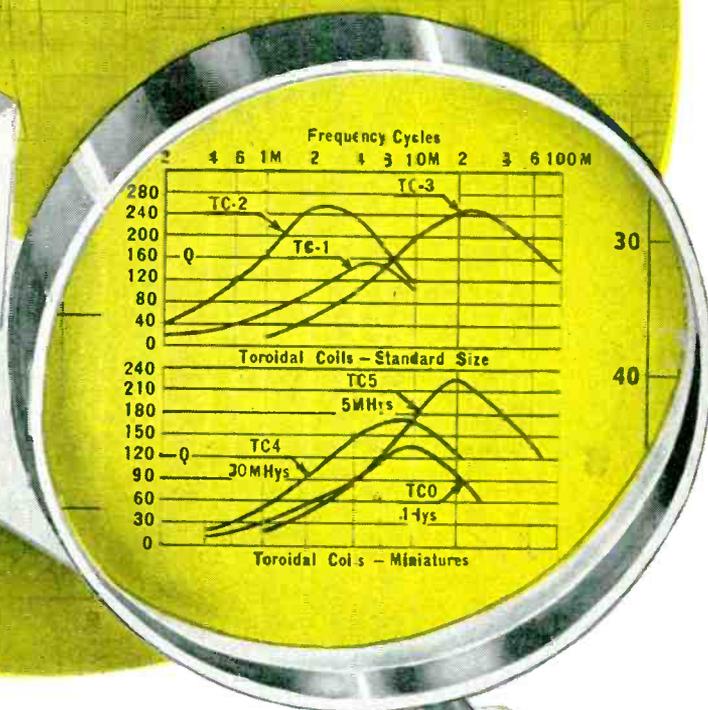
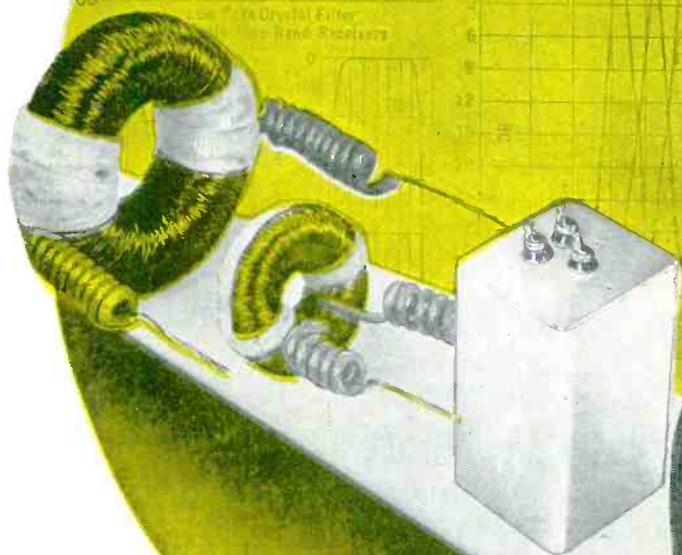
**Federal**  
**Telephone and Radio Corporation**



100 KINGSLAND RD., CLIFTON, N. J.

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P.Q. Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

# Burnell **NOW** BIGGER THAN EVER IN THE PRODUCTION OF TOROIDS AND FILTERS



## TYPICAL "Q" CHARACTERISTICS OF BURNELL TOROIDS WOUND ON MOLYBDENUM PERMALLOY CORES

Several years ago we began to specialize in the design and manufacture of toroidal coils and audio filter networks. At that time too few electronic engineers were aware of the full value of toroids (particularly those wound on molybdenum permalloy dust cores) as very little publicity had ever been devoted to a product that was fast becoming one of the most vital in the development of modern communications and control equipment.

We believe that since then through our technical service and advertising methods we have helped thousands of engineers to understand and appreciate the toroid as an essential in network applications.

The resulting popularity and industry acceptance of our toroidal coils and filters have necessitated an expansion of our production facilities to ten times what they were five years ago and we are proud to point to this growth as an expression from our customers of their satisfaction in the quality of our product and our service.

### STANDARD SIZES

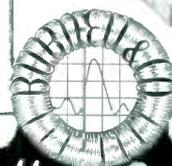
- TC-1 = 1 1/8" O.D. x 3/8"
- TC-2 = 2 1/4" O.D. x 7/8"
- TC-3 = 1 1/2" O.D. x 3/16"

### MINIATURE SIZES

- TC-C = 7/8" O.D. x 3/8"
- TC-4 = 1-3/16" O.D. x 9/16"
- TC-5 = 1-3/16" O.D. x 9/16"

### MAXIMUM INDUCTANCE

- TC-1 - Ind. Up to 10 Hys.
- TC-2 - Ind. Up to 100 Hys.
- TC-3 - Ind. MHY-Up to 750
- TC-C - Ind.-Up to 2 Hys.
- TC-4 - Ind.-Up to 10 Hys.
- TC-5 - Ind. MHY-Up to 750



**Burnell & Company**  
YONKERS 2, NEW YORK

CABLE ADDRESS "BURNELL"

**HAVE YOU  
CHECKED YOUR  
PLANT PULSE  
LATELY ?**



ELECTRO  
MECHANICAL  
TYPE EM4115  
SHOWN



**AUTOMATIC VOLTAGE REGULATION WILL  
HELP CURE OPERATING DEFICIENCIES**

## STABILINE

# EM

*Automatic*

## VOLTAGE REGULATORS

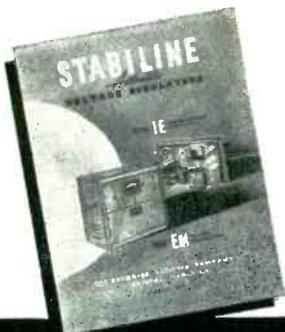
**feature LOW COST and EFFICIENT OPERATION  
IMPROVE PERFORMANCE and REDUCE COSTS**

Increased demands on today's electrical manufacturing equipment call for maximum performance, extended parts life and reduced maintenance. When incoming line voltages fluctuate, manufacturing inefficiencies and rising costs are bound to occur. To maintain constant voltage to equipment regardless of variations in line voltage or load current, install a STABILINE Automatic Voltage Regulator type EM (ELECTRO MECHANICAL).

Simple and easy to install, a STABILINE type EM features high efficiency — zero waveform distortion — complete insensitivity to magnitude and power factor of load — adjustable output voltage and no critical adjustments.

**STABILINE type IE (INSTANTANEOUS ELECTRONIC),** a completely electronic unit with no moving parts, is available in ratings from 0.25 to 5.0 KVA.

Learn more about STABILINES type IE and EM. Write today for Bulletin S351 complete with application data, ratings, dimensions and circuit diagrams.



	Nom. Output Voltage	Input Voltage Range	Output Voltage Range	Output Current (Amperes)	Output KVA	Type
Single Phase	115	95-135	110-120	17.5	2.0	EM4102
				52.0	6.0	EM4106
				130.0	15.0	EM4115
Single Phase	230	195-255	220-240	32.5	7.5	EM4207
				120.0	27.5	EM4228
Single Phase	460	400-520	420-460	15.0	6.6	EM4407
				40.0	17.6	EM4418
Three Phase	230	195-255	220-240	25.0	10.0	EM6210Y
				38.0	15.0	EM6215Y
				50.0	20.0	EM6220Y
				113.0	45.0	EM6245Y
				175.0	70.0	EM6270D
Three Phase	460	400-520	420-460	16.0	12.5	EM6412Y
				22.0	17.5	EM6417Y
				33.0	25.0	EM6425Y
				66.0	50.0	EM6450Y
				100.0	75.0	EM6475Y
				131.0	100.0	EM64100Y
		420-500	420-460			

There's a STABILINE type EM to meet your need. Standard types are listed in the rating chart. For special requirements consult The Superior Electric Company, 405 Church St., Bristol, Conn.

**THE SUPERIOR ELECTRIC CO.**  
BRISTOL, CONNECTICUT



POWERSTAT VARIABLE TRANSFORMERS • VOLTBOX A-C POWER SUPPLIES • STABILINE VOLTAGE REGULATORS

**THE FINEST IN  
ELECTROSTATIC FOCUSING**

*Teletrons\**

**17FP4**

**20GP4**

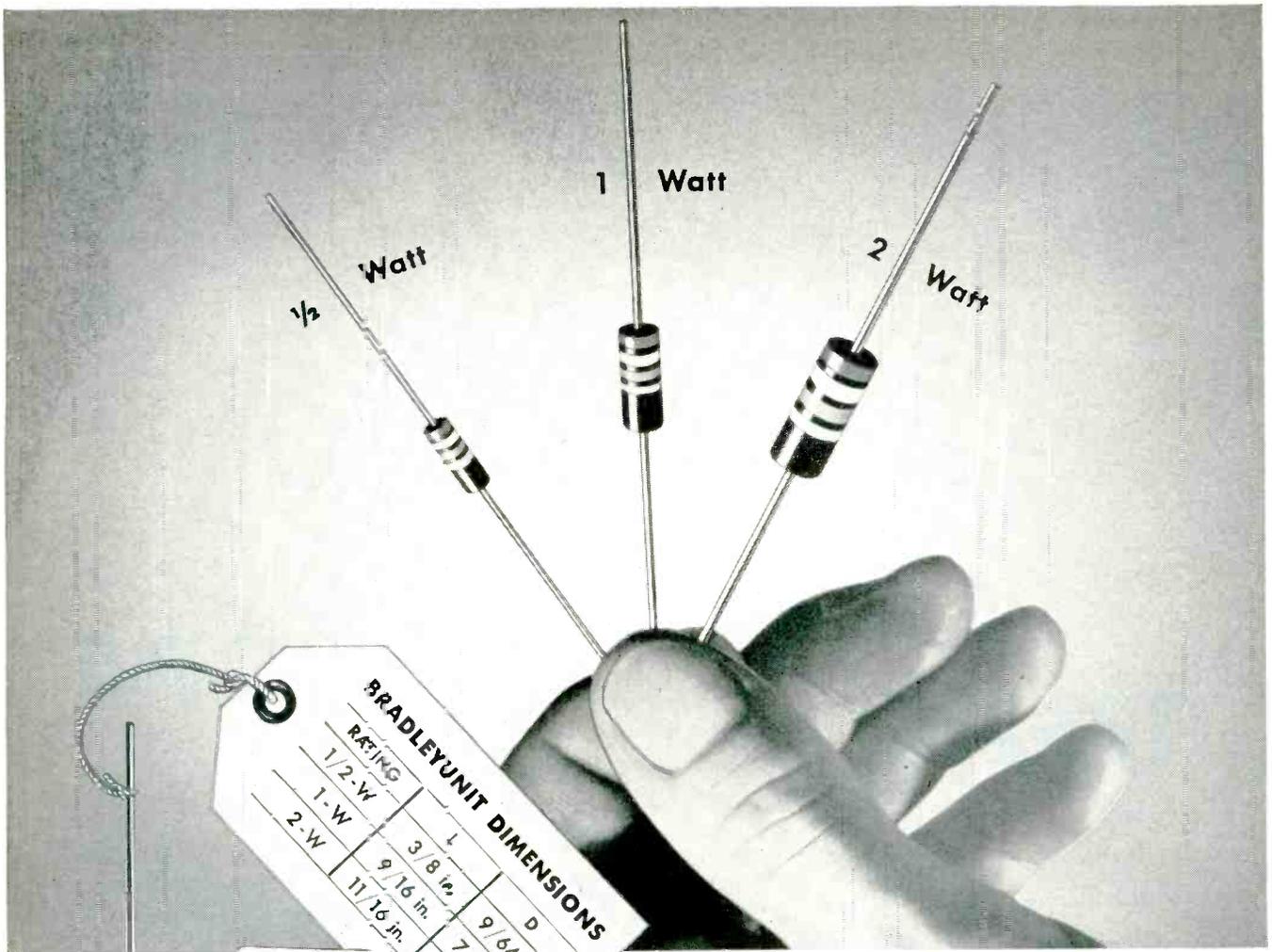


**complete  
engineering data  
on request**

**DU MONT**

TUBE DIVISION, ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J.

\*Trade-mark.



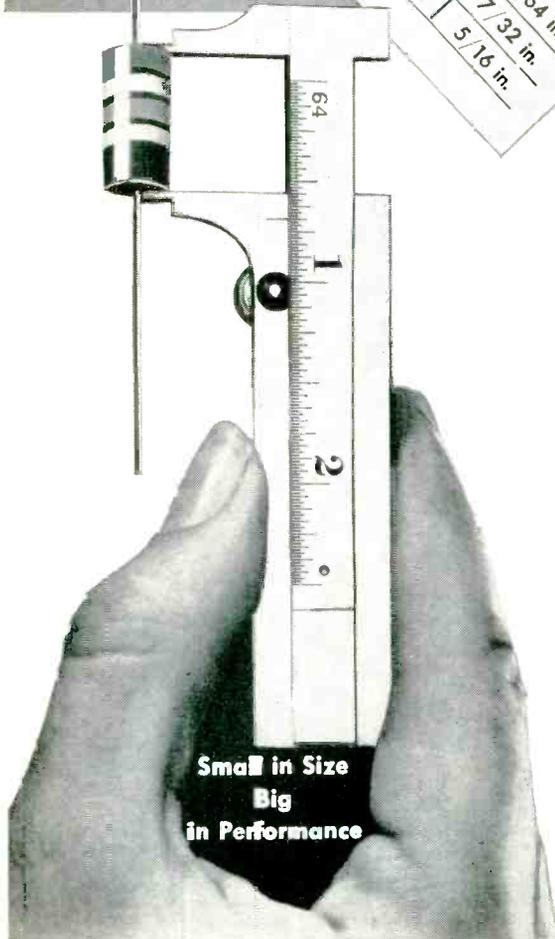
BRADLEYUNIT DIMENSIONS			
RATING			
1/2-W	L	D	
1-W	3/8 in.	9/64 in.	
2-W	9/16 in.	7/32 in.	
	11/16 in.	5/16 in.	

**EXTREMES of TEMPERATURE and HUMIDITY**  
*have no effect*  
**on BRADLEYUNIT RESISTORS**

Bradleyunit resistors are solid molded. This construction assures stability and long life. Moreover, they are rated to operate continuously at 70C ambient temperature . . . not 40C. And, they need no wax impregnation to pass salt water immersion tests. Hence, they can withstand extremes of temperature and humidity without deterioration.

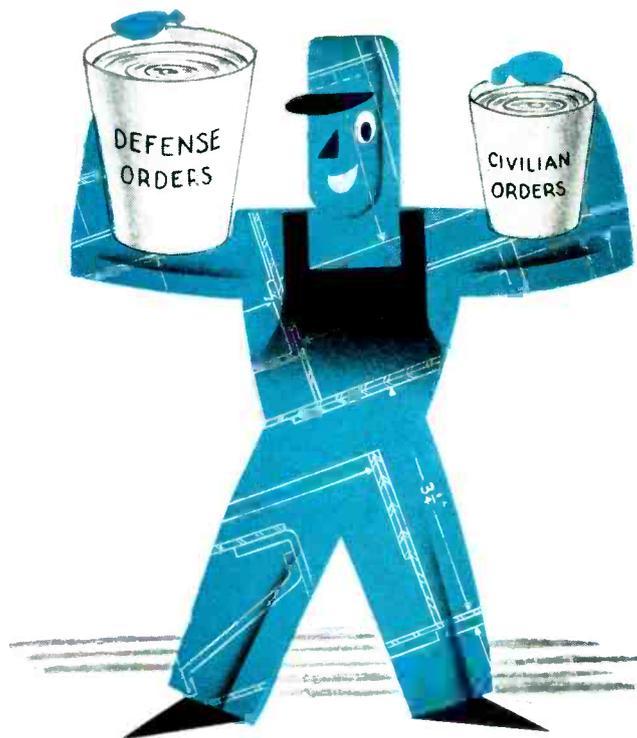
Made in standard R.T.M.A. values in 1/2 and 2 watt ratings from 10 ohms and 22 megohms; 1 watt from 2.7 ohms to 22 megohms. Let us send you a complete A-B resistor chart.

Allen-Bradley Co., 110 W. Greenfield Ave., Milwaukee 4, Wis.



**Small in Size  
 Big  
 in Performance**

  
**ALLEN-BRADLEY**  
**FIXED & ADJUSTABLE RADIO RESISTORS**  
 Sold exclusively to manufacturers  **QUALITY**  of radio and electronic equipment



## WE'RE PRETTY GOOD AT THIS!

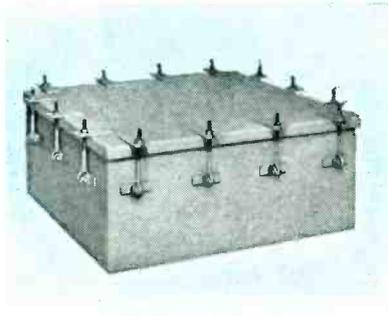
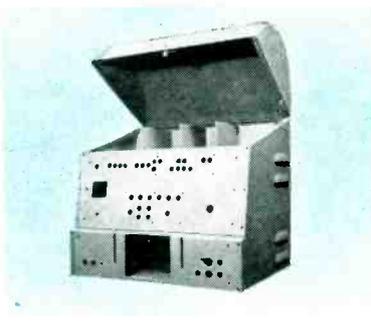
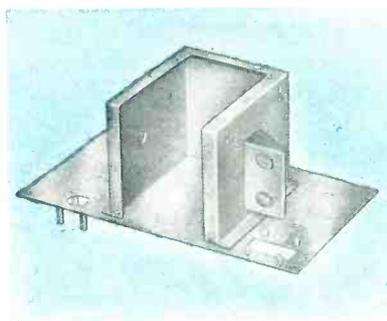
Carrying water on both shoulders is proverbially difficult, but not impossible.

While handling an increasing volume of defense equipment orders, we are still serving our customers who manufacture civilian products, provided such work does not interfere with defense production.

Fortunately most of our customers make products which at this time have definite

military uses. These manufacturers are getting more service from us rather than less. Fortunately, also, we can handle defense orders without the delay of plant conversion. Ours is a custom service easily applied to military equipment needs. Our craftsmen and facilities are certified by the Armed Forces.

Tell us your needs in quality sheet metal fabrication.



## KARP METAL PRODUCTS CO., INC.

215 63rd STREET, BROOKLYN 20, NEW YORK

*Specialists in Fabricating Sheet Metal for Industry*

# for VARIABLE RESISTORS to MILITARY SPECIFICATIONS . . .



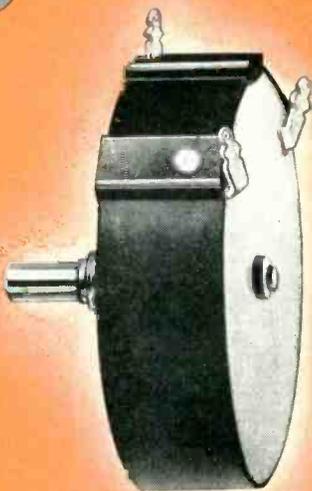
## SPECIALISTS IN PRECISION MASS PRODUCTION FOR 55 YEARS

EXCEPTIONALLY GOOD DELIVERY CYCLE ON MILITARY ORDERS due  
to tremendous precision mass production facilities.

Electronic engineers all over the world depend upon CTS for:

- A variable resistor engineered to the application.
- Uniform high quality on a mass production basis.
- Each variable resistor thoroughly tested electrically and mechanically to assure top performance.
- Delivery when promised.

If you need variable resistors to exacting military specifications, let  
CTS specialists solve your problem.



Type G-C-35-45  
Concentric Shaft Tandem



VARIABLE RESISTORS (COMPOSITION AND WIRE WOUND)

Type 83 NEW High Voltage,  
Electro-Static Focusing.

Type JJ-033 Microphone Jack



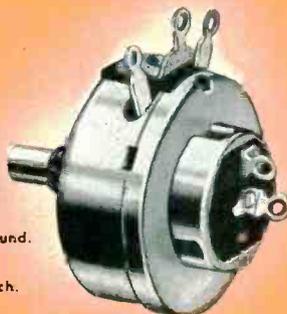
Type JJ-034 Phone Jack

*Specialists in Precision Mass Production Since 1896*



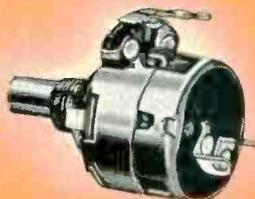
Type 25  
4 Watt, Wire Wound.

GC 25 with Switch.



Type 45  
1 5/16" Diameter,  
Composition.

GC 45 with Switch.



Type 35  
1 1/2" Diameter,  
Composition.

GC 35 with Switch.



Type 252  
2 Watt, Wire Wound.

GC 252 with Switch.



WITH OR WITHOUT ASSOCIATED SWITCH COMBINATIONS.



## CHICAGO TELEPHONE SUPPLY *Corporation*

ELKHART - INDIANA

### REPRESENTATIVES

S. J. Hutchinson, Jr.  
401 North Broad Street  
Philadelphia 8, Pennsylvania  
Phone: Walnut 2-5269

W. S. Harmon Company  
4057 McClurg Drive  
Los Angeles 8, California  
Phone: Administration 3-6219

### In CANADA

C. E. Meredith & Co.  
Streetville, Ontario

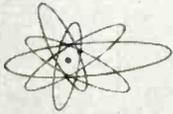
### SOUTH AMERICA

Jose Luis Pantet  
Buenos Aires, Argentina  
Montevideo, Uruguay  
Rio de Janeiro, Brazil  
Sao Paulo, Brazil

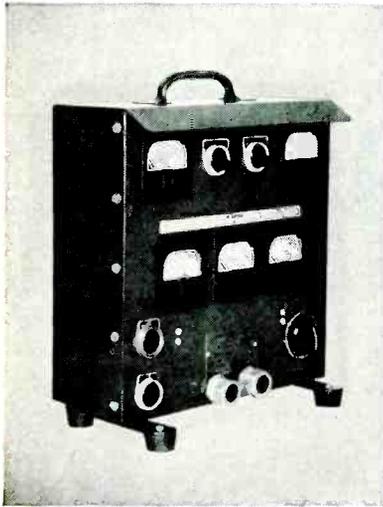
### OTHER EXPORT

Sylvan Ginsbury  
8 West 40th Street  
New York 18, N. Y.

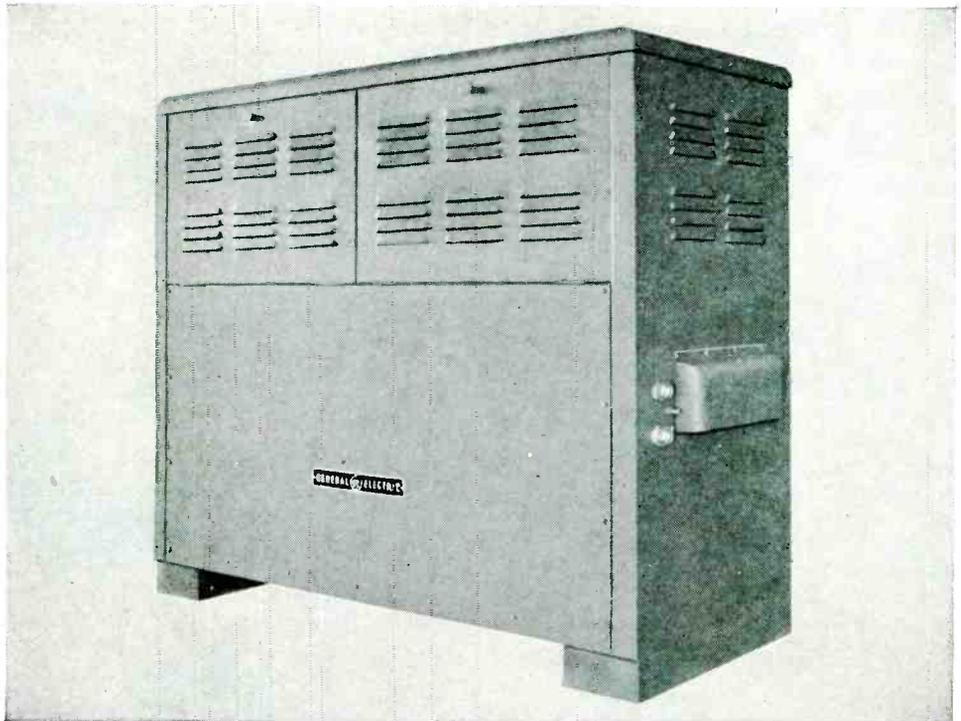
BURTON BROWNE ADVERTISING



# Designers



Operator's Control Unit



Motor-Generator-Type  
Frequency  
Changer



## PACKAGED FREQUENCY CHANGERS

### 400-Cycle Ground Power Supply for Aircraft Radar Units

Here's a low-cost, high-performance, 400-cycle ground power supply with a regulated output voltage adjustable from 187 to 229 volts. It's rugged enough for permanent installation, yet compact enough to be moved on a fork truck. A 30-kva output rating is more than sufficient for virtually all radar, radio, or general load applications.

**Voltage regulation:**  $\pm 2$  per cent variation under all conditions of balanced load, power factor, and heating, within normal operating range.

**Voltage recovery:** To within 5 per cent of steady-state value in 0.1 second.

**Voltage adjustment:** 187-229 volts in increments of 0.5 volts or less.

**Wave shape:** Low harmonic content.

**Radio interference:** Adequate suppression for most rigid applications.

**Enclosure:** Dripproof cabinet houses motor, generator, and controls. A separate operator's panel contains "start-stop" push buttons, adjusting potentiometer, selector switches and meters.

For further data on these G-E frequency changers see Bulletin GEA-5589.

# GENERAL ELECTRIC

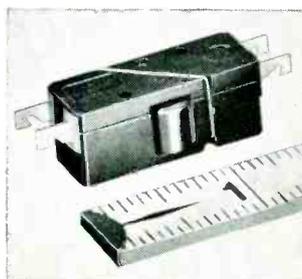
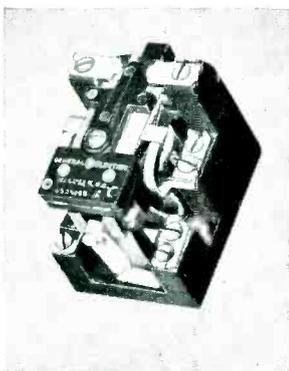
# Digest

## TIMELY HIGHLIGHTS ON G-E COMPONENTS

### Husky Relays Mount 3 Ways Make or Break up to 45 Amps

For those heavy control-circuit applications, here's a versatile relay that can be front-connected, back-connected, or plug-in-connected, and is supplied in open or enclosed models. Circuits: spst, dpst, or dpdt.

Heavy, long-lasting silver contacts carry 10 amps continuous. Normally open forms make or break 45 amps; normally closed forms make or break 20 amps. Coils are supplied for 12-, 24-, 115-, or 230-volt, 60-cycle a-c; for 6, 12, 24, 32, 125 or 250 volts d-c. Dimensions for enclosed model: 6 x 6 x 5 inches. Complete details are available in Bulletin GEC-257.



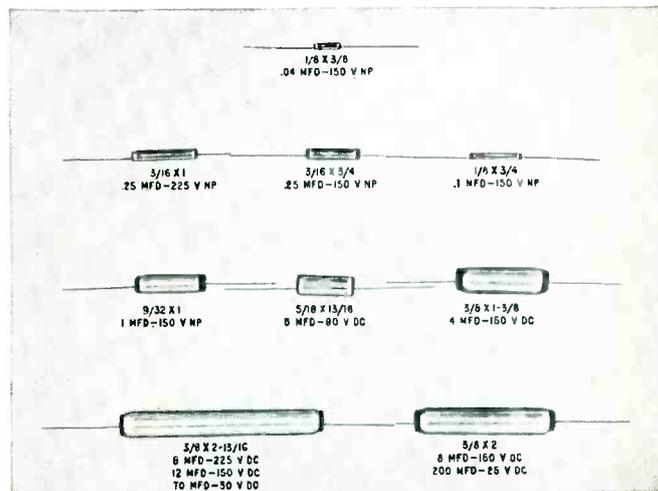
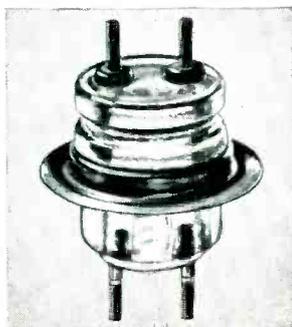
### G-E Switchette Handles High Current in Crowded Quarters

Though small and lightweight, the G-E switchette does the same work as many bulkier switches. Available in a wide variety of forms and circuits, this snap-action unit is approximately  $1\frac{1}{4}$  x  $\frac{1}{2}$  x  $\frac{1}{2}$  inches, weighs only 9 grams, and operates dependably from sea level to 50,000 feet altitude.

Contact arrangements available are single-circuit, normally open; single-circuit, normally closed; and two-circuit, one normally open and one normally closed. Rated  $\frac{1}{2}$  hp at 115 and 230 volts a-c, the switch is designed for ambient temperatures from -70F to +200F and meets the 50-hr salt-spray test for Specification AN-QQ-S-91. For full details, ask for Bulletin GEA-4888.

### Cast-Glass Bushings Permit Hermetically Sealed Apparatus

Embedded nickel-steel hardware eliminates the need for gaskets and makes possible the soldering, brazing, or welding of G-E cast-glass bushings directly to apparatus. This assures gas-tight, oil-tight, or vacuum-tight construction. Extraordinary resistance to vibration and weather means the small, compact bushings are especially suited to aircraft applications or where high humidity occurs. They will not puncture or shatter under excess potentials. For full details ask for Bulletin GEA-5093A.



## Tantalum + New Electrolyte = More Performance, Less Space

### New G-E Tantalitic D-C Capacitors Feature

- Size and weight about the same as conventional electrolytics
- Over-all life as good as paper dielectrics
- Low-temperature properties and shock resistance better than either

By combining tantalum in foil form and a newly developed non-corrosive electrolyte, General Electric has designed a capacitor that packs superior performance into amazingly small space. Good stability, unusually low leakage currents, and hermetic sealing are additional advantages. Operating range is from -55C to +85C. Ratings presently available range from 0.02 muf to 12 muf at 150 volts d-c. Capacitors shown in illustration are representative. For additional information, furnish requirements such as temperature range, leakage resistance values, and operating voltage in writing to *Capacitor Sales Division, 42-304, General Electric Company, Pittsfield, Mass.*

General Electric Company, Section A667-15  
Schenectady 5, N. Y.

Please send me the following bulletins:

- |                                       |                                   |                            |
|---------------------------------------|-----------------------------------|----------------------------|
| (V) Indicate for reference only       | <input type="checkbox"/> GEC-257A | General-Purpose Relay      |
|                                       | <input type="checkbox"/> GEA-4888 | Size 1 Switchette          |
| (X) For planning an immediate project | <input type="checkbox"/> GEA-5093 | Cast-Glass Bushings        |
|                                       | <input type="checkbox"/> GEA-5589 | Packaged Frequency Changer |

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

# TURNER COMPETITOR WINS PRAISE

W. J. Nezerka, Turner Sales Manager, Makes Formal Announcement

New Beauty, New Sales Appeal, New Low Cost Features

"It's Terrific" Say Dealers Coast To Coast

Hand-Held Crystal Microphone Solid Sales Success



Visit TURNER at the Parts Show STEVENS HOTEL May 21, 22, 23 Rooms 519A-520A, Booth 577

The Competitor—a great new Turner microphone. Meets all competition where good quality speech reproduction is required and low cost is important. A natural for hams, economical public address systems, sound systems . . . an ideal replacement unit for home recorders. Designed for hand, desk or stand use (stand adaptor included). Beautifully finished in baked-on beige wrinkle enamel. Rugged, moisture sealed crystal has high output level of 52 db below 1 volt/dyne/sq. cm. Response: 70 to 7000 c.p.s. 6 ft. cable securely anchored to case, cannot pull out. Turner quality all the way through and priced at only . . . \$10.85 List. Model 60X also available with on-off slide switch.

## THE "COMPETITOR" Model 60X Crystal

THE TURNER COMPANY

905 17th Street N. E., Cedar Rapids, Iowa

In Canada:

Canadian Marconi Company, Toronto, Ontario

Export:

Ad. Auriema, Inc., 89 Broad Street, New York 4, N. Y.

Microphones BY

# TURNER

Crystals licensed under patents of the Brush Development Company

# We Must Pay As We Go

*We must do our utmost to pay as we go for our present defense program.*

On that proposition those who speak with authority are remarkably well agreed. This editorial — the second in a series on our mobilization for freedom — sets forth in simple terms why there is this agreement.

Next year — the fiscal year beginning next July 1 — the federal government's budget calls for the expenditure of \$10 billion more than is scheduled to be collected in taxes. The deficit is due to the increase in defense expenditures.

A part of this deficit can be eliminated by cutting non-essential expenditures and increasing efficiency in the defense program. There is wide agreement on this. It is the duty of the President and Congress to see that it is saved.

*How the remaining deficit anticipated in the federal budget—\$5 billion to \$10 billion—is handled is crucial.* The government can meet it by raising taxes—by paying as we go. Or it can borrow, issuing more government bonds.

## **Borrow Again?**

We relied heavily on borrowing in both World War I and World War II. In World War I only about one-third of the expenditures of the federal government were met by taxation. In World War II about 45 percent were met in this way. The rest we borrowed. Some people ask, why can't we rely heavily on borrowing again? Why is it crucially important to avoid adding \$5 billion to \$10 billion to a federal debt that is already \$257 billion?

Part of the answer is found in the contrast be-

tween this defense program and our all-out effort of World War II. Another part—and one that is all-important in combatting inflation—results from the rapid decline in the purchasing power of the American dollar in recent years.

We went "all out" in World War II. We put almost half of everything we produced into our military effort. Taxes high enough to pay the financial costs as incurred would have meant huge tax increases. It was feared that such increases would kill financial incentives to get "all out" production. Since we expected the war to be short, borrowing seemed a safe expedient. Price control and rationing, with wartime patriotism to give them effective support, were relied upon to keep in check the inflationary pressure created by borrowing rather than taxing.

Our present defense program is scheduled to take a much smaller share of our production, but to take it over a much longer period. At its peak, the program as now planned will take only about 20 percent of our total national production. But, to use General Bradley's phrase, "the conditions under which we labor may persist for ten, fifteen and twenty years."

## **What About Controls?**

For a period of any such duration it would be foolhardy to expect that the sort of controls we had for the few years of World War II could hold in check the inflationary pressure created by not paying as we go. It would be as foolhardy as it would be for a family to plan on borrowing to pay the expenses of a member discovered to be afflicted by a chronic ailment which might last a long lifetime.

Obviously, the only safe thing to do in such a case would be to adjust the family budget so that the expenses of the illness would be paid currently.

*Our heavy reliance on borrowing in World War II had consequences which block a successful repeat performance.*

If the borrowing had been done by persuading individuals to transfer their savings into government bonds, relatively little inflationary pressure would have been created. What the government would have spent with the proceeds of such bond sales would have been subtracted from the money individual consumers could spend.

But most of the borrowing was done from banks. That course expanded the amount of money available to the government without any offsetting subtraction of money from the hands of individuals. Thus, when direct price controls were removed after the war, this bottled-up purchasing power contributed to a price inflation which has cut purchasing power of the American dollar about in half — and decidedly changed the attitudes of the American people toward that dollar.

During World War II, Americans in general believed that:

The war would not last long.

The dollar would hold its value, and even gain value after the war.

Many wonderful new products would be available in the postwar period.

Today the American people have:

Seen the value of their dollars melt away fast.

Been assured that, at best, we may have a 10-15-20-year pull ahead.

Been warned not to expect a postwar paradise anytime soon.

One result of these changed attitudes is a notable lack of enthusiasm for government bonds on the part of individual investors. This is indicated by the fact that since Korea redemptions of E bonds have exceeded sales by about \$600 million. Another result is a continuing rush to convert dollars into physical goods and equipment or claims on them. This trend weighs against financing the prospective federal deficit by borrowing from individuals.

*Borrowing from banks to meet the deficit would again add fuel to inflation.*

The prospective deficit is due to federal expen-

ditures for military goods. Even if they are not blown up or shipped abroad, these goods will not be available to civilians. But the money paid to those who produce military goods will still be available to bid up the prices of civilian goods. Thus, at a time when people show relatively little disposition to save dollars, a menacing inflationary pressure — an inflationary gap, the economists call it — will be created.

If our fight against inflation is to be successful this gap must be closed by taxes. We need to do other things, too, for inflation has many different causes. Credit expansion must be effectively controlled. Production of civilian goods must be increased as much as possible by eliminating waste and inefficiency. But a pay-as-we-go tax program is basic to a successful attack on inflation. And inflation — unless it is checked — could wreck our defense effort.

*We cannot pay as we go merely by soaking harder the corporations and those in the upper income brackets.*

As the President's Council of Economic Advisers has reported, "by far the largest part of the additional revenue must come from the middle and lower tax brackets. These are the brackets in which the great bulk of the income is located."

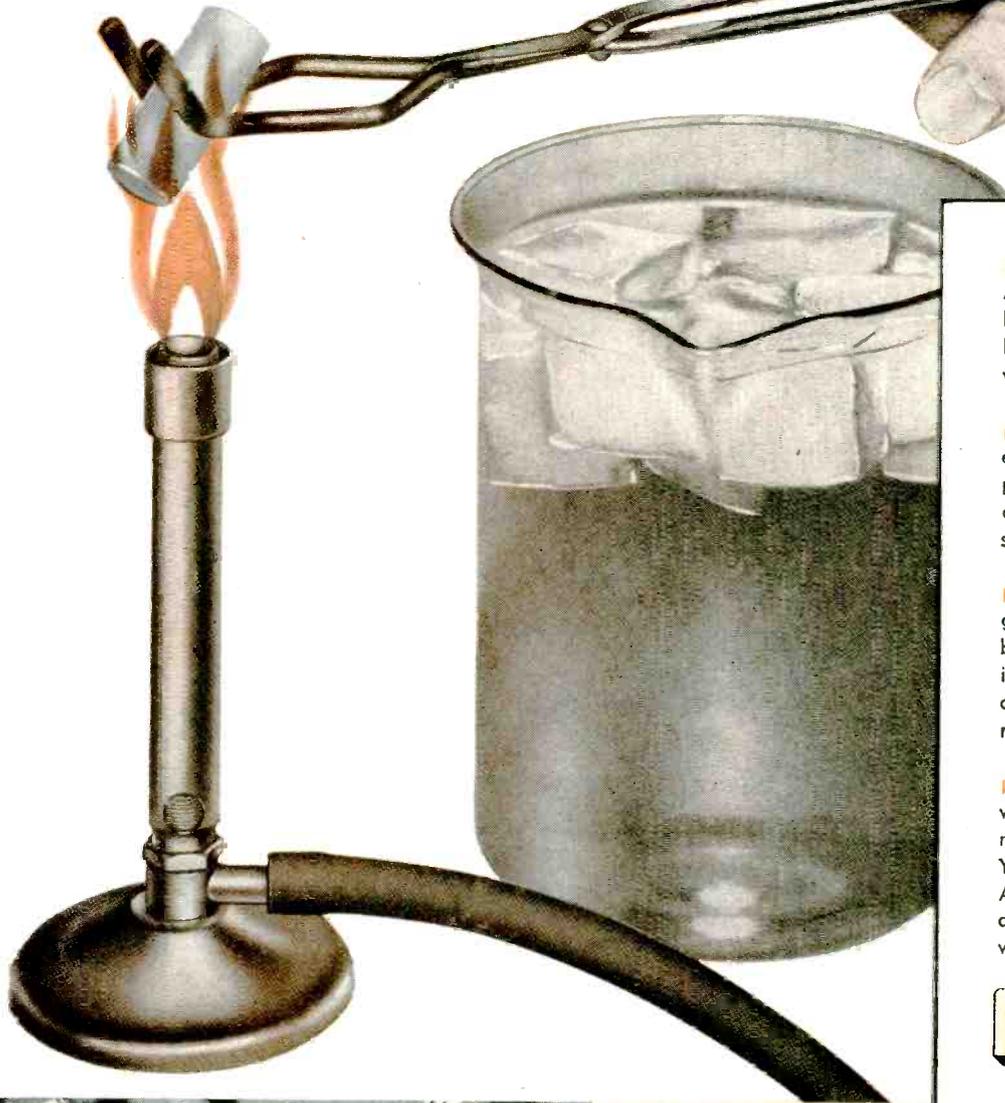
### **Taxes Can Attack Inflation**

By spreading tax increases broadly, taking small amounts from many people, inflationary pressure would be effectively reduced. It is the expenditures of the great mass of people, rather than the small numbers in the upper income tax brackets, that create most of the pressure. Moreover, it is possible to increase taxes broadly without killing the economic incentives to produce. Maintaining these incentives is essential to the success of the defense effort.

Our elected representatives cannot be expected to be enthusiastic about a pay-as-we-go tax program. It involves increasing the taxes of the great body of their constituents, an operation completely lacking in political glamour. However, such a program also involves the integrity of the American dollar. And that is absolutely essential to the success of the defense program. We shall be very foolish if we do not let our leaders know that we want them to do everything possible to pay as we go.

*McGraw-Hill Publishing Company, Inc.*

# It's a fact that



✓ Some of the very low expansion AlSiMag Ceramics have excellent heat shock qualities and can be heated red hot and suddenly cooled without damage.

✓ AlSiMag Ceramics are ideal elastic bodies. They do not show any plastic deformation and retain their original shape after release from strain.

✓ AlSiMag Ceramic plates can be ground to a flatness of 1 or 2 light bands, and retain this flatness even if subjected to severe temperature changes. What could be better as a reference subject?

✓ AlSiMag Ceramics can be made with varying thermal expansions to match those of many other materials. You can match the expansion of AlSiMag Ceramics with many glasses and metals and obtain a fit which will be retained indefinitely.

## ALSiMAG

TRADE MARK REG. U.S. PAT. OFF.



• Submit your difficult material requirements to American Lava Corporation and you will obtain free consultation for the best material for your application and helpful recommendations for solving your designing problems.

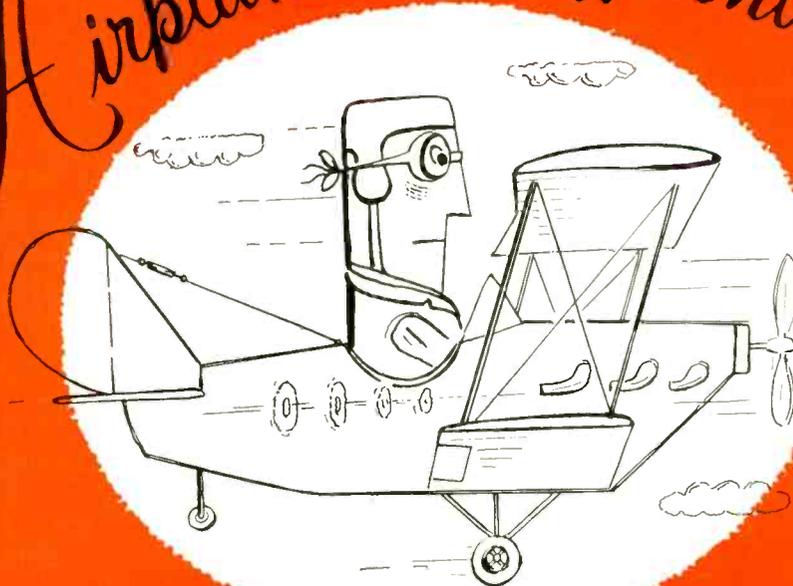
• It is this service which has given American Lava Corporation the reputation as THE consulting firm among ceramic manufacturers.

### AMERICAN LAVA CORPORATION

50TH YEAR OF CERAMIC LEADERSHIP  
CHATTANOOGA 5, TENNESSEE

OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N. J., Mitchell 2-8159 • CHICAGO, 228 North LaSalle St., Central 6-1721  
PHILADELPHIA, 1649 North Broad St., Stevenson 4-2823 • LOS ANGELES, 232 South Hill St., Mutual 9076  
NEW ENGLAND, 38-B Brattle St., Cambridge, Mass., Kirkland 7-4498 • ST. LOUIS, 1123 Washington Ave., Garfield 4959

*Airplanes are different now...*



and in producing new navigation and safety devices  
**MODERN ELECTRONICS LOOK TO HI-Q\***  
 Capacitors • Trimmers • Choke Coils • Wire Wound Resistors

In the air, where space and weight are at a premium, the value of the minute compactness of **Hi-Q** Components is vividly dramatized. Of equal importance is their never failing dependability under any and all conditions. For let a single small unit fail, and life itself may hang in the balance.

The same high engineering standards and unvarying quality which have made **Hi-Q** a leader with producers of aircraft equipment, have found equal favor with other electronic manufacturers. Individual tests of every single component at each stage of production, and as a part of final inspection, insure the precise adherence to specifications, ratings and tolerances. That is one reason why **Hi-Q** is now serving virtually every leading producer of television, communications and other electronic equipment. Another is the ready availability of **Hi-Q** engineers to cooperate in the development of new components to meet specialized needs.

JOBBERS—ADDRESS: 740 Belleville Ave., New Bedford, Mass.



**HI-Q TEMPERATURE  
 COMPENSATING CAPACITORS**

These high voltage tubular capacitors are available in capacities from 25 mmf. to 250 mmf. Units with working voltage of 3000 V. D. C., are 1.840" long with .375" diameter. Those between 500 V. D. C. and 3000 V. D. C. are slightly smaller. All are Durez coated and made of temperature compensating materials.

**BETTER 4 WAYS**

- ✓ PRECISION
- ✓ UNIFORMITY
- ✓ DEPENDABILITY
- ✓ MINIATURIZATION

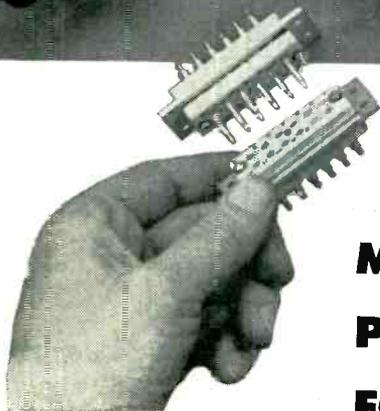
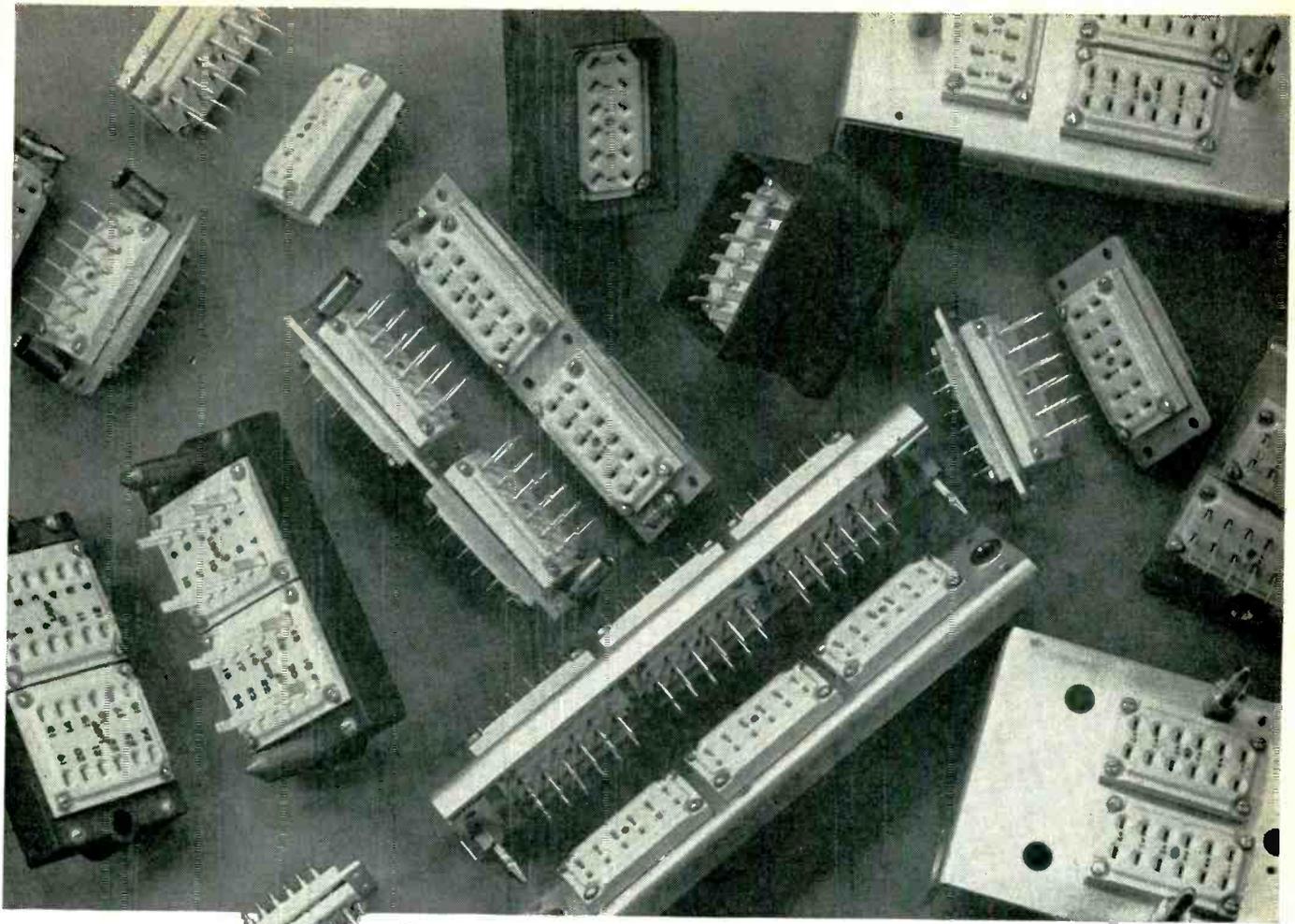
\*Trade Mark Registered, U. S. Patent Office



*Electrical Reactance Corp.*  
 OLEAN, N. Y.

SALES OFFICES: New York, Philadelphia, Detroit, Chicago, Los Angeles

PLANTS: Olean, N. Y., Franklinville, N. Y. Jessup, Pa., Myrtle Beach, S. C.



## **MULTIPLE-CONTACT PLUG-RECEPTACLE UNITS FOR SECTIONALIZING CIRCUITS**

**F**OR panel-rack or other sectionalized circuits, Lapp offers a variety of plug-and-receptacle units, some of which are shown above. Any number of contacts can be provided (in multiples of twelve). Male and female contacts are full-floating for easy alignment and positive contact. Contacts are silver-plated, terminals tinned for soldering. Polarizing guide pins are provided where desired. Insulation is Steatite, the low-loss ceramic which is non-carbonizing even under leakage flashover resulting from contamination, moisture or humidity. Write for complete electrical and mechanical specifications of available units or engineering recommendations for an efficient component for your product. Radio Specialties Division, Lapp Insulator Co., Inc., LeRoy, N. Y.

# Lapp



*Hummingbirds*  
 that boss  
 Eagles . . .



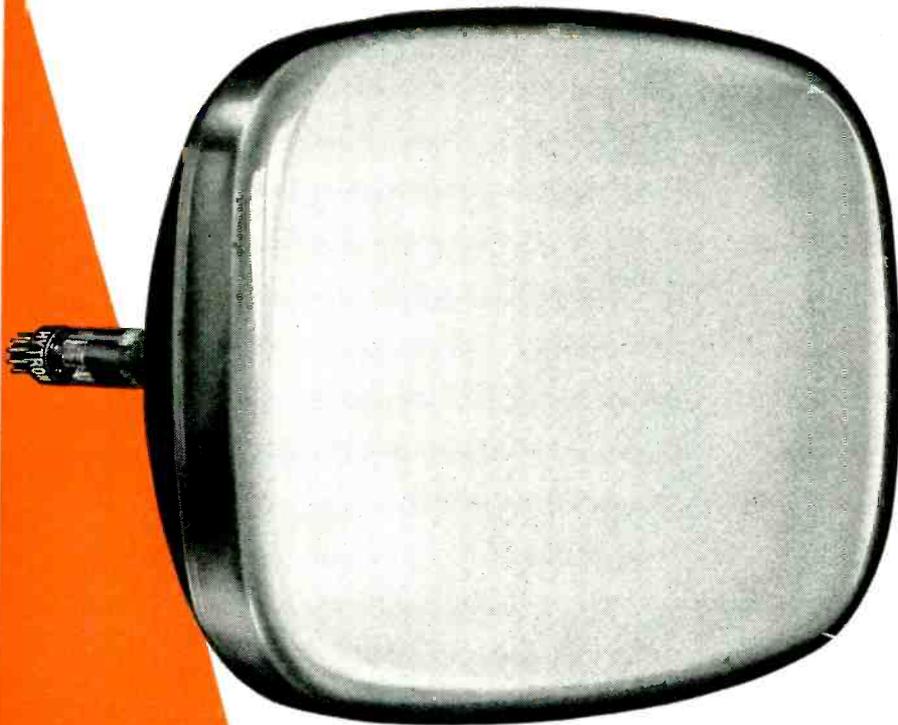
In the realm of the airman, where tiny high-precision motors regulate intricate systems of instrumentation and control, Kollsman miniature motors have no peer.

In fact, these accurate and dependable units have been a Kollsman specialty for years.

Yes, throughout aviation history—where hummingbirds have had to boss eagles—Kollsman has won renown for doing the job inimitably well.

*for precision and dependability*  
 look to **KOLLSMAN**  
**INSTRUMENT CORPORATION**  
 Elmhurst, New York • Glendale, California

# NEW ELECTROSTATIC RECTANGULAR 20FP4



ANOTHER  
**HYTRON FIRST**  
FOR YOU

To its logically designed original *studio-matched* rectangular, Hytron now adds new advantages: the cobalt-and-copper savings of electrostatic focus.

The original Hytron electrostatic type 20FP4 eliminates the magnetic focus unit. Uses a single-field ion-trap magnet. Yet the 20FP4 gives you unsurpassed, clear, sharp pictures . . . despite economies in associated components enforced by defense needs.

Seeing is believing. Watch for this newest Hytron first from the world's most modern picture-tube plant. You'll be seeing it, buying it soon. You'll marvel at its sharp pictures, even at lower line voltages.

Again you'll say it pays to stay out front in picture tubes. It pays to insist on Hytron's original *studio-matched* rectangulars . . . choice of 9 out of 10 leading TV set makers.



MAIN OFFICE, SALEM, MASSACHUSETTS

HAVE YOU  
GOT YOUR COPY?

The new 5th edition of the Hytron Reference Guide for Miniature Electron Tubes is out. See your Hytron jobber. Get your free copy of this old friend brought up to date today.



# improve your product with - MYCALEX

THE OUTSTANDING  
**LOW LOSS**  
**HIGH FREQUENCY**  
**INSULATION**  
FOR OVER  
A QUARTER OF  
A CENTURY

MYCALEX is a highly developed glass-bonded mica insulation backed by a quarter-century of continued research and successful performance. Both pioneer and leader in low-loss, high frequency insulation, MYCALEX offers designers and manufacturers an economical means of attain-

ing new efficiencies, improved performance. The unique combination of characteristics that have made MYCALEX the choice of leading electronic manufacturers are typified in the table for MYCALEX grade 410 shown below. Complete data on all grades will be sent promptly on request.

MYCALEX is efficient, adaptable, mechanically and electrically superior to more costly insulating materials

- PRECISION MOLDS TO EXTREMELY CLOSE TOLERANCE
- READILY MACHINEABLE TO CLOSE TOLERANCE
- CAN BE TAPPED THREADED, GROUND, SLOTTED
- ELECTRODES, METAL INSERTS CAN BE MOLDED-IN
- ADAPTABLE TO PRACTICALLY ANY SIZE OR SHAPE

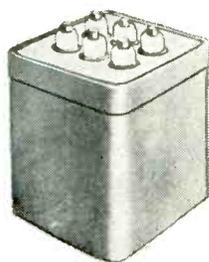
MYCALEX is available in many grades to exactly meet specific requirements

#### CHARACTERISTICS OF MYCALEX GRADE 410

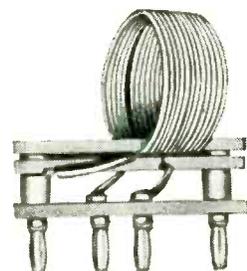
Meets all the requirements for Grade L-4A, and is fully approved as Grade L-4B under Joint Army-Navy Specification JAN-1-10

Power factor, 1 megacycle	0.0015
Dielectric constant, 1 megacycle	9.2
Loss factor, 1 megacycle	0.014
Dielectric strength, volts/mil	400
Volume resistivity, ohm-cm	$1 \times 10^{15}$
Arc resistance, seconds	250
Impact strength, Izod, ft.-lb/in. of notch	0.7
Maximum safe operating temperature, °C	350
Maximum safe operating temperature, °F	650
Water absorption % in 24 hours	nil
Coefficient of linear expansion, °C	$11 \times 10^{-6}$
Tensile strength, psi	6000

MYCALEX is specified by the leading manufacturers in almost every electronic category



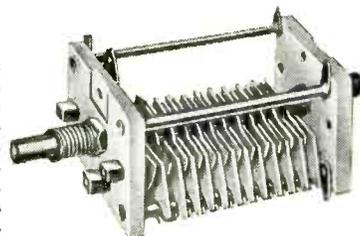
TRANSFORMER WITH MYCALEX-METAL ASSEMBLIES TO GIVE TIGHT SEAL



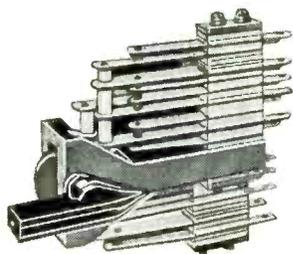
MYCALEX COIL HOLDER AND BASE



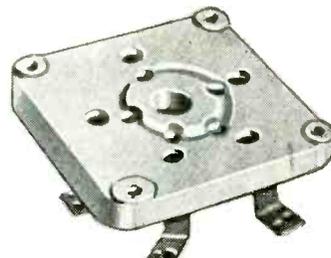
TERMINAL BASE ASSEMBLY FOR FIRE DETECTION EQUIPMENT



CONDENSER WITH MYCALEX LOW-LOSS END PLATES



MULTI-POSITION LEVER SWITCH WITH MYCALEX SPACERS



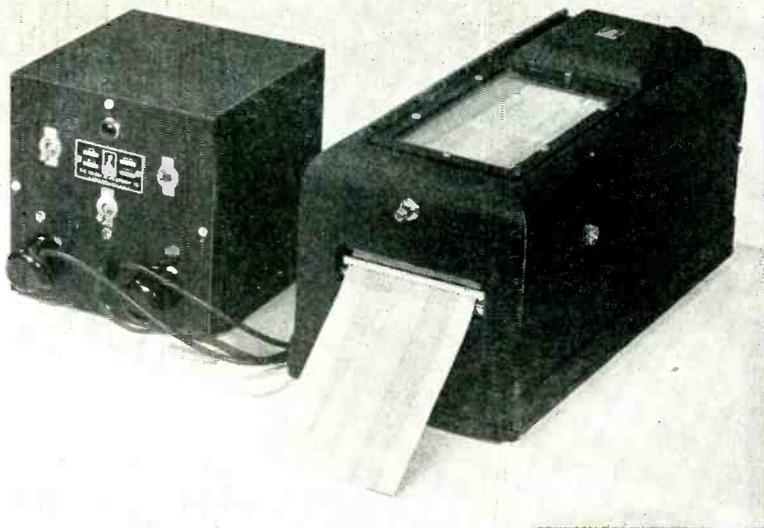
TUBE SOCKET OF MOLDED MYCALEX FOR HIGH FREQ. USE



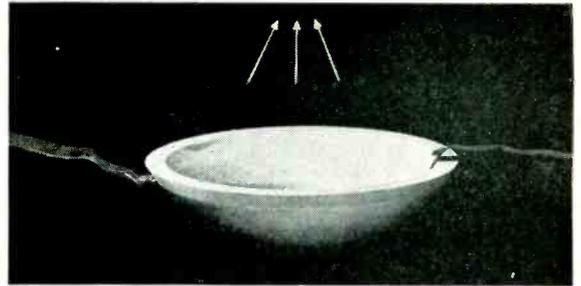
## CORPORATION OF AMERICA

Owners of 'MYCALEX' Patents and Trade-Marks

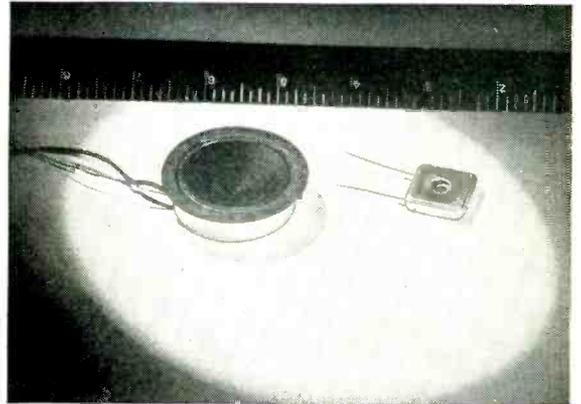
Executive Offices: 30 Rockefeller Plaza, New York 20 • Plant and General Offices: Clifton, New Jersey



INSTRUMENTS



ULTRASONIC TOOLS



ACOUSTIC PRODUCTS



ULTRASONIC GENERATORS  
(Laboratory Size)

# "THIS IS *Brush* OUR BUSINESS IS THE FUTURE

• The new and useful in the fields of Ultrasonics, Piezoelectric Crystals, Recording Devices, Acoustic Products, and Instruments are specialties for which we are equipped with comprehensive engineering and physical facility. Our research has been continuous, fruitful and helpful to many other companies besides our own.

We make finished products valued in industry for their precision and modernity . . . we make component parts for many of the nation's most respected companies and for the Armed Forces. We also do product development work. For our comprehensive booklet, "This is Brush", telling about Brush products and methods, write our Commercial Engineering Department.

— *Manufacturers of* —

**ACOUSTICAL EQUIPMENT**

Microphones—General Purpose and Specialized  
Hearing Aid Microphones  
Earphones—Of Many Types

**MAGNETIC RECORDING DEVICES**

Tape  
Plated Wire, Disc and Drum  
Multichannel Recorders

Recording and Erase Heads  
Memory Storage Units  
Computer Components

**RESEARCH AND INDUSTRIAL INSTRUMENTS**

Universal Strain Analyzers  
Surface Analyzers  
Multichannel Direct Writing  
Oscillographs

AC, DC and Carrier-type  
Amplifiers  
Uniformity Analyzers  
Transient Recorders

**PIEZOELECTRIC CRYSTALS**

**ULTRASONIC EQUIPMENT**  
Generators and Analyzers  
Laboratory Equipment



**THE BRUSH DEVELOPMENT COMPANY**

3405 Perkins Avenue • Cleveland 14, Ohio

Excerpts from  
ENGINEERING REPORTS  
R. R. to H. W. C. to 8/30/50

Company "A"

pointed out considerable savings possible by shifting to Nylclad. Purchasing Department estimated this totals almost \$50,000 for the year.

Company "B"

large motor manufacturer has made extensive tests with Nylclad. Savings resulting from use estimated \$20,000. Engineer stated that none of competitive wires checked were nearly as good as Nylclad from heat and pressure resistance standpoint.

Company "C"

This manufacturer of special equipment has approved Nylclad on the basis of chief engineer's recommendation. Most enthusiastic about its resistance to the solvent action of hot varnish.

Company "D"

Winding foreman, previously highly critical, said, "Nylclad is great stuff — it got me out of a hole." He liked the high abrasion resistance against winding abuse.

Company "E"

Chief Engineer says Nylclad is the answer to many of his company's winding problems. Results of tests exceptionally good, particularly the resistance to softening under heat.

Company "F"

Engineer, after testing Nylclad, told buyer he was convinced it was excellent wire and recommended its use. He noted its uniform solderability.



NYLCLAD MAGNET WIRE combines the desirable properties of Formvar and Nylon types. Its tough, durable coating eliminates the need for paper- or textile-covered wires (in many applications) and reduces winding space requirements. It solders uniformly at 1050 F. Nylclad\* provides increased toughness to resist winding abuses, increased solvent resistance, and resistance to softening under heat and hot varnish; it is not subject to solvent crazing. Nylclad's "slipperiness" means improved windability — more compact coils — many over-all plus values at no increase in price.

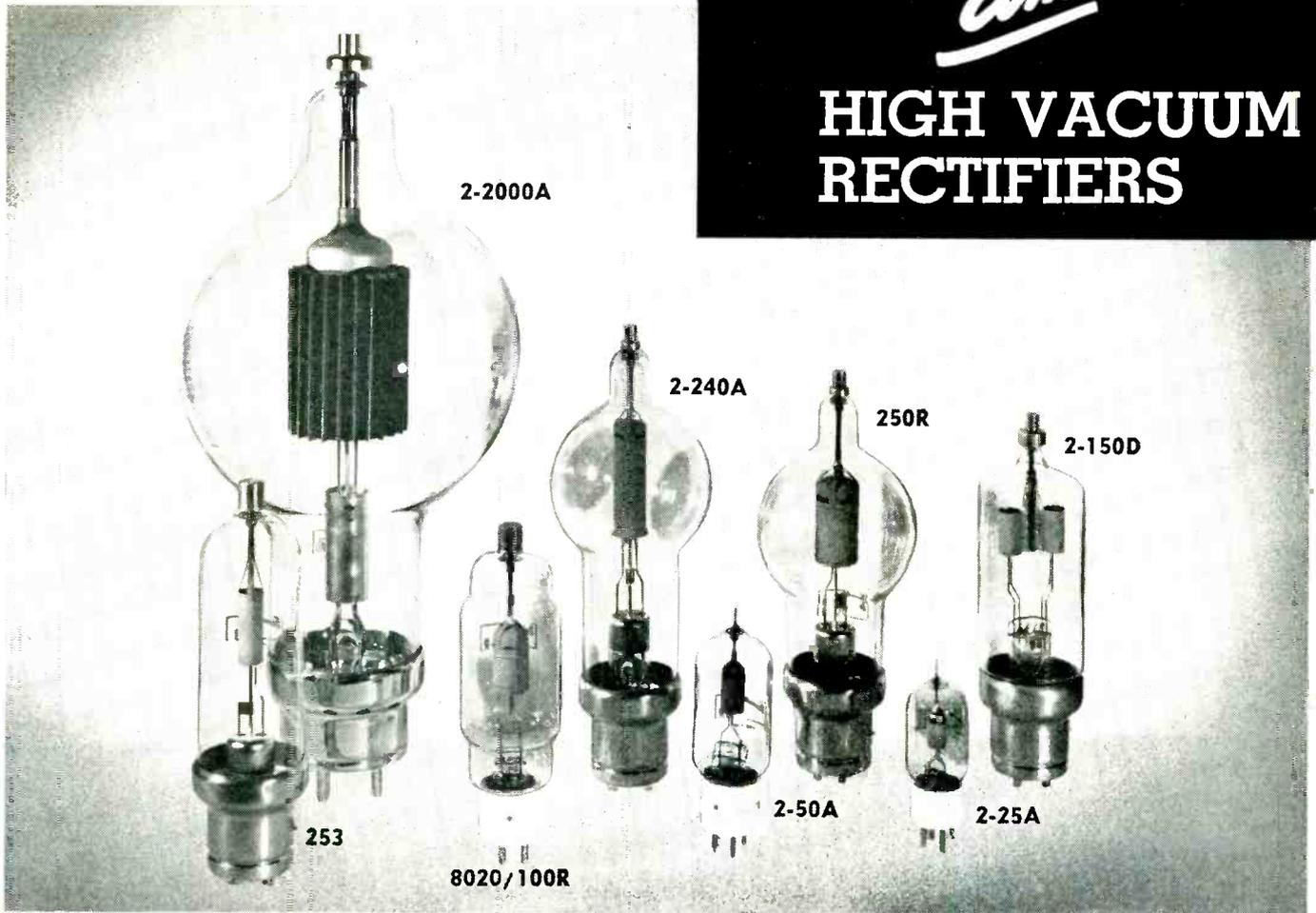
Belden Manufacturing Co.  
4625 W. Van Buren St., Chicago 44, Illinois

**Nylclad**  
\* TRADE MARK  
by **Belden**

THE MAGNET WIRE WITH THE PERFECTED INSULATION

*Eimac*

# HIGH VACUUM RECTIFIERS



Eimac's comprehensive series of vacuum rectifiers permits a choice of "per-tube" ratings of d-c plate current from 50 ma. to 750 ma. and a choice of inverse voltage ratings from 15,000 to 75,000 volts.

These are ruggedly constructed tubes built to withstand more than normal abuse in rectifying and voltage multiplying circuits or as diode clippers. Their design incorporates many of the features long associated with the famous Eimac transmitting tubes . . . Pyrovac plates . . . thoriated tungsten filaments . . . no troublesome internal insulating materials . . . and, of course, a "hard" vacuum.

Put Eimac high vacuum rectifiers to work for you. Write today for detailed data sheets giving complete operating information and application notes.

**EITEL-McCULLOUGH, INC.**  
**San Bruno, California**

Export Agents: Frazur & Hansen, 301 Clay St., San Francisco, California

TYPE	DESCRIPTION	MAXIMUM DIMENSIONS		AVERAGE PLATE CUR. Ma.	PLATE DISSIPATION Watts	PEAK INVERSE VOLTAGE Volts	FILAMENT	
		Length Inches	Diameter Inches				Volts	Amps.
2-25A	High vacuum rectifier. High voltage, medium current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	4.5	1.5	50	15	25,000	6.3	3.0
2-50A	High vacuum rectifier. High voltage, medium current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	5.75	2	75	30	30,000	5.0	4.0
2-150D	High vacuum rectifier. High voltage, medium current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	8.88	2.75	150	90	30,000	5.0	13.0
2-240A	High vacuum rectifier. High voltage, high current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	11.25	4	500	150	40,000	7.5	12.0
2-2000A	High vacuum rectifier. High voltage, high current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	18	8.25	750	1,200	75,000	10.0	25.0
250R	High vacuum rectifier. High voltage, medium current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	10.25	4	250	150	60,000	5.0	10.5
253	High vacuum rectifier. High current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	9	2.75	350	100	15,000	5.0	10.0
8020/100R	High vacuum rectifier. High voltage, medium current. Instant heating, thoriated tungsten filament. Radiation cooled pyrovac plate.	8	2.38	100	60	40,000	5.0	6.5

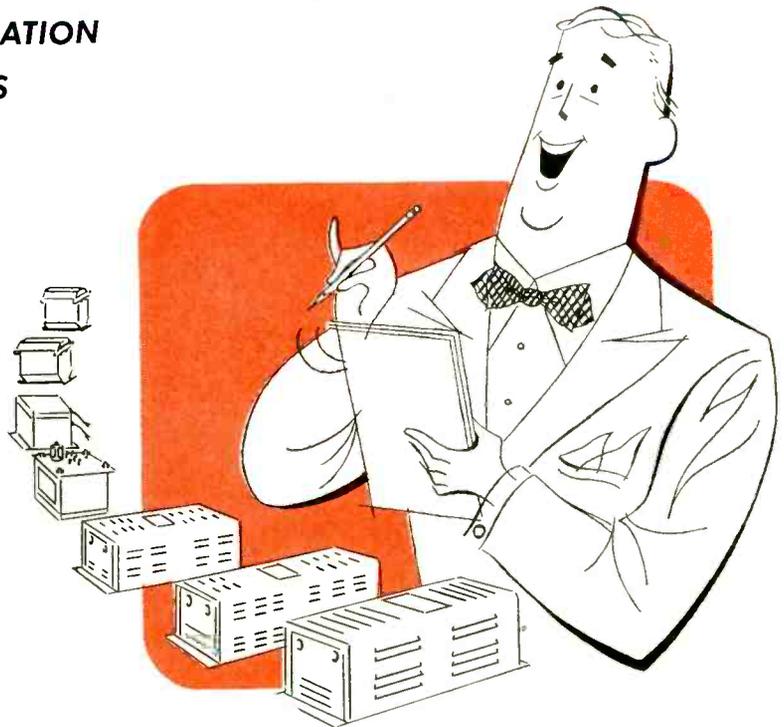
# CHECK THE COMPLETE LINE OF

# ✓ G-E Automatic Voltage Stabilizers

- FOR IMPROVED REGULATION
- FOR DECREASED COSTS

## Need Dependable Voltage Control for One of These Applications?

Radio transmitters and radar equipment  
Laboratory and factory testing equipment  
Motion picture projectors  
Precision photographic equipment  
Electron microscopes  
Calibration of electric instruments  
Color comparators  
Wheel balancing equipment  
Radio testing devices  
Telephone apparatus  
Motion picture sound equipment  
Photometers  
X-ray filament circuits  
Electronic apparatus  
Electrochemical analysis  
Full wave rectifiers  
Electric furnaces  
Heater units  
Frequency oscillators  
Communication systems  
Temperature controls  
Television equipment  
Signal and alarm systems  
Sound recording equipment  
Life testing of bulbs  
Small motors of instrument recording apparatus  
Photographic lighting systems  
(especially color-photography lighting)  
Automatic developing and printing machinery  
Photo-engraving equipment  
Photocell fire control apparatus  
Dielectric heaters  
UHF beam relays  
Aircraft landing systems  
Simulated flight trainers  
Electronically operated weight machines  
Electrostatic paint spraying outfits  
Magnetic measuring gauges  
Oscillographs  
Electrophoresis equipment  
Moisture detection equipment  
Gas analyzers and detectors  
Instruments used to measure a difference  
(such as in bridge circuits)



To provide closely controlled voltage for critical equipment, experienced designers select General Electric automatic voltage stabilizers. They get assurance that their equipment will operate better, longer, and more efficiently with the input voltage held close to nominal. You can't make a better investment!

Investigate G-E automatic voltage stabilizers for the answer to your voltage problems. They decrease field calls, increase customer satisfaction, and save money.

For complete details on how this equipment can help you, contact your local G-E representative. For additional information write for bulletin GEA-3634. General Electric Co., Schenectady 5, N. Y.

# GENERAL ELECTRIC

411-88

**NEW!** 24 Pages of Engineering Data  
on **ARNOLD TAPE-WOUND CORES**

**PROPERTIES OF...**

**DELTAMAX  
4-79 MO-PERMALLOY  
SUPERMALLOY\***

**BULLETIN TC-100**  
March 15, 1951

*Manufactured Under Licensing Arrangement with Western Electric Co.*

**THE ARNOLD ENGINEERING COMPANY**  
SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION  
General Office & Plant: Marengo, Illinois



**WRITE FOR YOUR COPY**



# Fountain of youth\*

A Zetka picture tube stays young . . . stays brilliant always . . . is sharply focused . . . safe . . . long lived. There's no old, dull, tired look on the face of a Zetka tube. It will always reflect the brightness of your reputation, because only Zetka utilizes the power-tube method of producing pace-setter picture tubes.

In addition, each and every Zetka tube (no spot checking permitted) is set-tested in the factory before being shipped. Here indeed is proof positive that Zetka is by far your best buy in picture tubes. Rectangulars and rounds in 16", 17", 19" and 20".

THE SAFEST PICTURE TUBE  
IN THE WORLD . . .



# zetka\*

THE ARISTOCRAT OF TELEVISION TUBES

*\* Most Trusted Name in Picture Tubes*

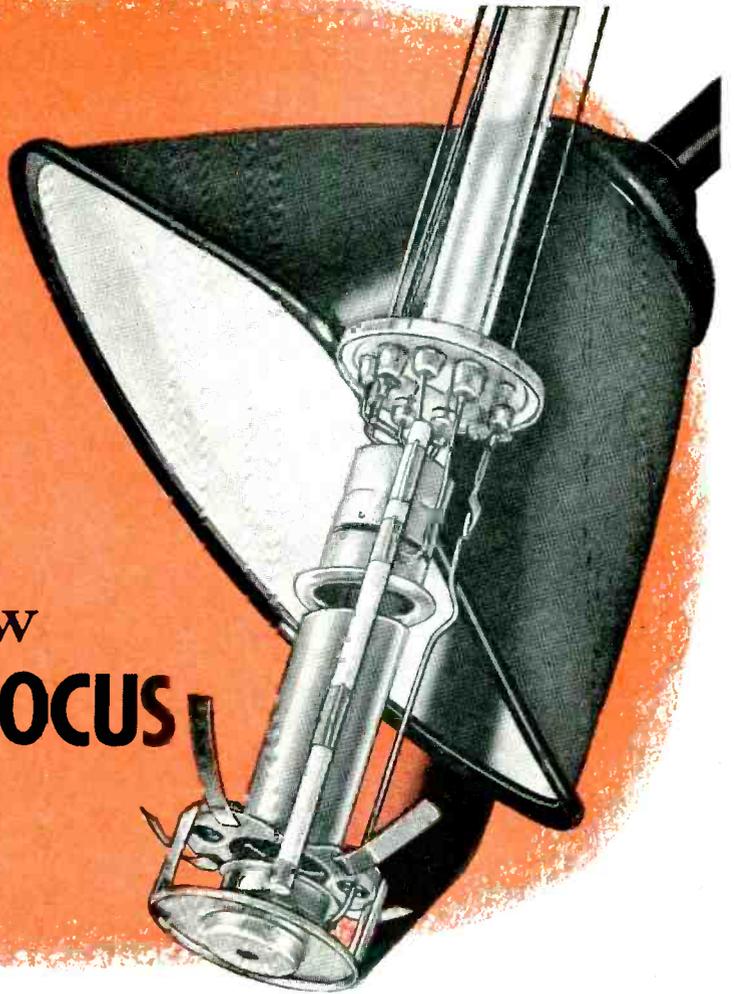
# zetka

**TELEVISION TUBES, INC.** 131-137 GETTY AVE. • CLIFTON, N. J.  
For 37 years, Zetka has been a respected name in the radio and television industry.

Again a  
**D-H ALLOY**  
 contributes as

**RCA**

introduces new  
**ELECTROSTATIC-FOCUS**  
**TV TUBES**



Once more, RCA leads the field! This time, with new rectangular picture tubes which require no focusing coil or focusing magnet . . . thus effecting important savings in critical materials.

The currently used magnetic focus in TV sets requires coils and magnets containing the metals cobalt and copper . . . both on the Government's restricted list.

To meet the shortages, RCA engineers have developed improved electrostatic focusing for wide-deflection-angle TV tubes—eliminating need for a focusing magnet or coil. Result: The new RCA kinescopes—which not only make possible savings in critical materials, but introduce advantages that destine them to become industry's most widely used picture tubes.

Such advantages, for example, as: (a) An improved electron gun which provides excellent uniformity of focus over the entire picture area, and is so designed that the focusing electrode takes negligible current—permitting voltage for the electrode to be supplied easily and

economically; (b) Focus automatically maintained with variation in line voltage and adjustment of picture brightness; (c) Simplification of tube installation and adjustment for optimum performance.

When RCA produced its outstanding Image Orthicon, "eye" of the television camera, it called upon the superlative Driver-Harris radio alloy Nichrome\* V to provide 95% of the metal components of the tube. Now, in the case of the kinescopes, a Driver-Harris produced alloy fills a need.

Here are typical examples of how Driver-Harris stands ready to serve all industry with alloys necessary for new or standard applications.

During the present emergency, of course, strategic materials and the alloys made from them are on strict allocation. However, we shall be glad to make recommendations based upon your specific needs, and serve you to the best of our ability.

*Makers of world-famous Nichrome\* and over 80 other alloys  
 for the electronic, electrical and heat-treating fields*

**Driver-Harris Company**  
 HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco

In Canada: The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada



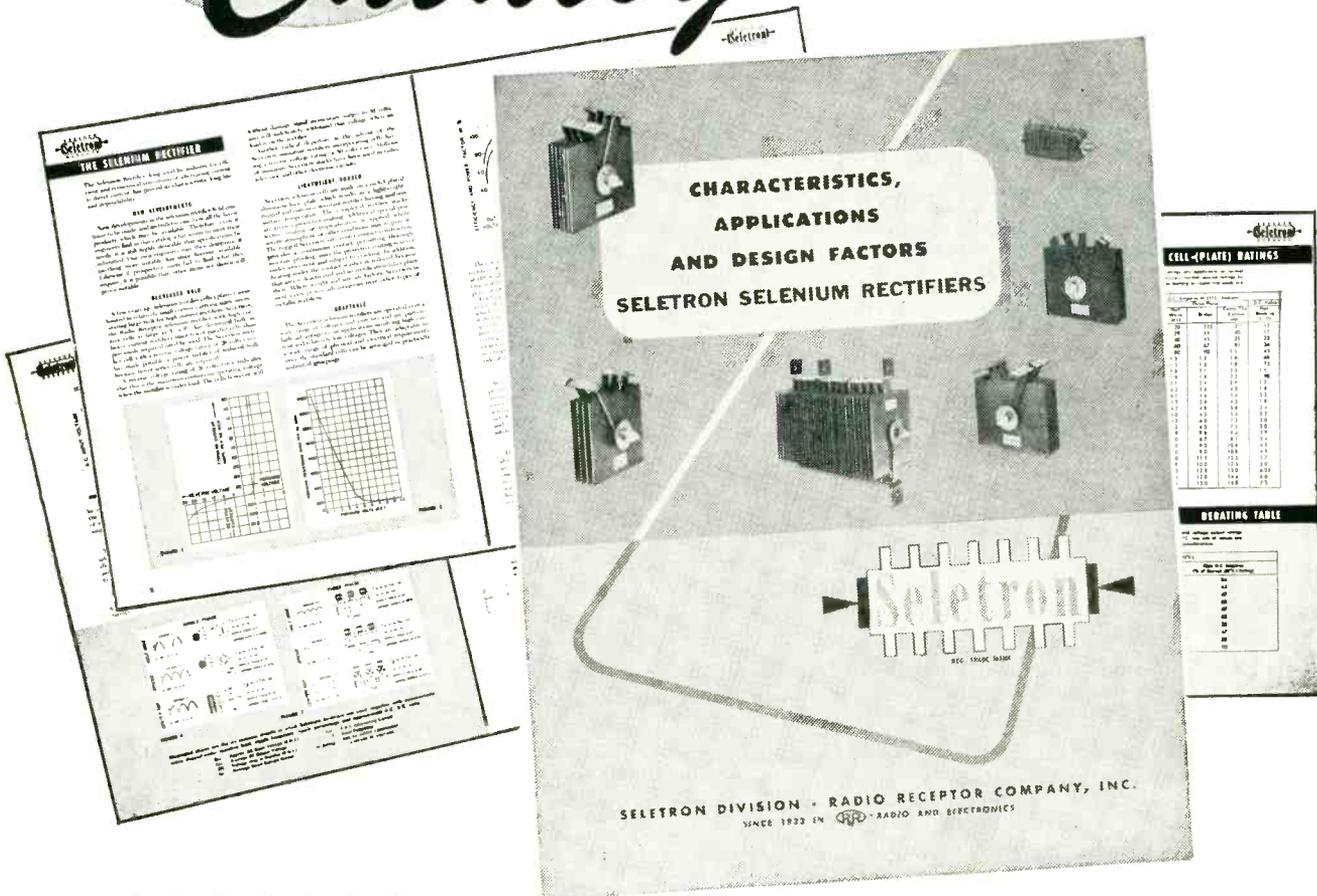
\*T. M. Reg. U. S. Pat. Off.

# New

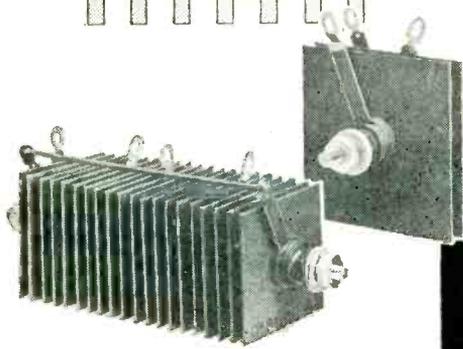
## 16 PAGES OF VALUABLE RECTIFIER DATA...AND YOURS FOR THE ASKING!

### INFORMATION-PACKED SELETRON SELENIUM RECTIFIER

# Catalog



# Seletron



THIS NEW two-color, fully illustrated catalog just off the press belongs on your desk for handy reference. Includes comprehensive listings of dimensions and ratings for miniature SELETRON selenium rectifiers, as well as a large selected group of power stacks. Also contains complete background material on these versatile rectifiers and illustrates many of their uses.

Request your copy today — It's FREE, of course. When ordering, ask for new catalog No. ES-39.

**SELETRON DIVISION**  
**RADIO RECEPTOR COMPANY, Inc.**  
*Since 1922 in Radio and Electronics*

Sales Department: 251 West 19th St., New York 11, N. Y.  
 Factory: 84 North 9th St., Brooklyn 11, N. Y.

# ANOTHER UNIQUE HOLTZER-CABOT PRODUCT

This adjustable motor satisfies a long-felt need. It converts AC electrical energy directly to mechanical energy, without use of tubes or other converting equipment. And its advanced design combines many other features. For example —

- standard controller provides 12 speeds with approximate 7 to 1 range, for instance, 3500 RPM to 500 RPM
- dial control gives smooth, instant change-over from one speed to another
- each speed setting remains constant regardless of variations in load
- instant starting at desired speed — no warm-up period, no lag
- maximum torque for starting under load and for rapid acceleration
- compact — no auxiliary equipment required — ideal for use as a built-in unit
- can be mounted for either local or remote control
- economical — the lowest-price motor unit of its kind, and easy to maintain

This new multi-speed motor is made for AC, single phase, 115 or 230 volts. It is suitable for any application where an adjustable-speed DC motor is used, and has an additional advantage — the starting and maximum torques increase rapidly at high speeds. This motor can be built to operate at speeds as high as 8000 RPM. (A *single-speed* model with the same characteristics is also available.) The fact that the RBA or RWA motor has a service life comparable to that of a DC motor opens up many new and important application possibilities.



**an adjustable, constant-speed, single phase AC motor!**

Holtzer-Cabot builds precision motors in a variety of types, ranging from the small instrument sizes up to heavy duty 1½ horsepower units. They meet demanding specifications for such varied applications as office and recording machinery, machine tools, fans, pumps, hoists, blower units, farm equipment, etc.

Into each Holtzer-Cabot motor goes the same engineering skill and manufacturing excellence that through the years have made Holtzer-Cabot the standard of high quality in motors. Write today for expert assistance in solving your motor problems.

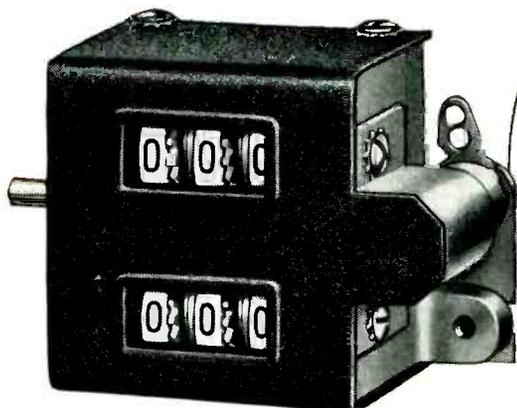


## HOLTZER-CABOT

DIVISION OF NATIONAL PNEUMATIC CO., INC.

BOSTON 19, MASSACHUSETTS

*"Manufacturers of fine electrical apparatus since 1875"*



*"Round and 'round  
and 'round they go—  
and what they count,  
only radarmen  
know!"*

# Everyone Can Count on **VEEDER-ROOT**



Yes, this time as before, every arm of the service counts on Veeder-Root in some way or other. The counters shown, for instance, supply figures that radarmen readily translate into vital information.

And there are scores of other Veeder-Root Counters, standard and special, electrical and mechanical, that "talk the language" of more military and civilian jobs than you can shake a slide-rule at!

**VEEDER-ROOT INC.**  
HARTFORD 2, CONN. • GREENVILLE, S. C.  
Montreal, Canada      Dundee, Scotland  
*Offices and agents in principal cities*

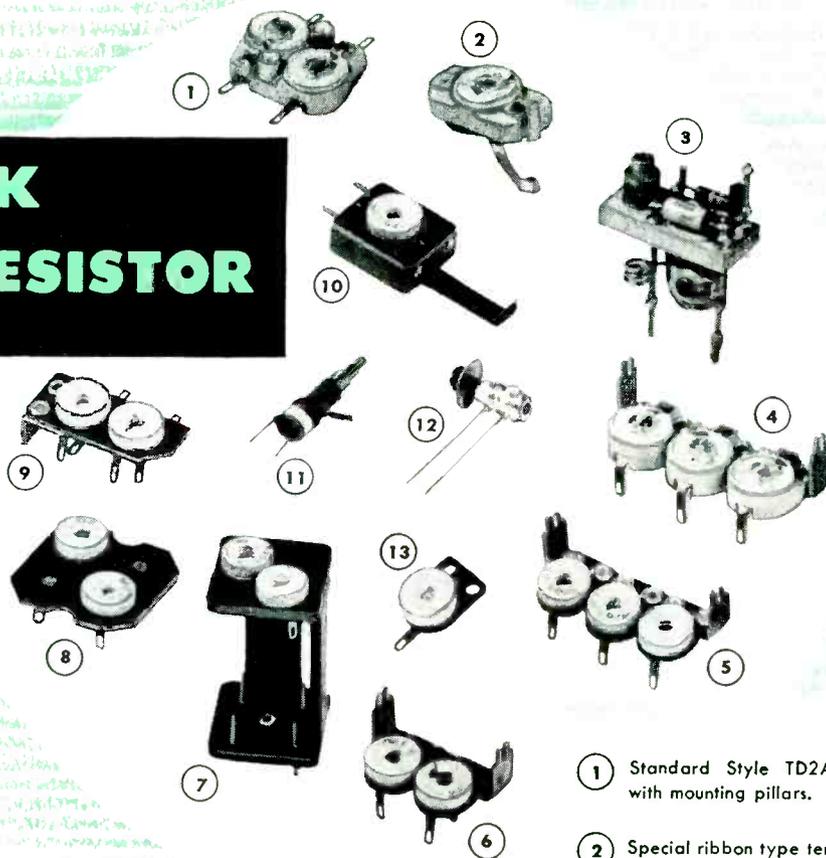


## **VEEDER-ROOT**

## **COUNTERS**

*"Count Everything on Earth"*

# ASK *Erie* RESISTOR



## ... about custom designed trimmers

Pictured above are several custom designed trimmers that incorporate the elements of standard Erie Disc and Tubular Ceramicon Trimmers. Each has been developed for a specific purpose, and each does its job efficiently and economically. Proper design and precision manufacturing, plus our years of experience, are the keynote to Erie quality.

Look at these units carefully. They should suggest the possibility of using Erie Resistor know-how and facilities to make your equipment more compact and more efficient.

Erie has the most complete trimmer line in the industry. We would like to work with you on combining trimmers, fixed capacitors, and other circuit elements into integrated sub-assemblies. Inquiries should specify complete mechanical and electrical requirements.

- 1 Standard Style TD2A Dual Trimmer with mounting pillars.
- 2 Special ribbon type terminals on standard Style TS2B Trimmer for direct connection to other components.
- 3 Compact Trimmer—Capacitor—Resistor—Coil Design. A complete oscillator unit.
- 4 Where special mounting is desired, standard Erie Style TS2A and Style 557 Trimmers can be supplied mounted on brackets.
- 5
- 6
- 7 Two trimmer elements become an integral part of this coil form and I. F. top section.
- 8
- 9 Special bracket and terminal arrangements on dual trimmer unit.
- 10 A compact pluggable assembly for mounting a trimmer in parallel with a plug-in crystal.
- 11 Special tubular ceramic trimmer and variable inductance having one common terminal.
- 12 Special steatite tubular dual trimmer.
- 13 Standard Erie Style 557 Trimmer with special bent rotor terminal.

*Electronics Division*

**ERIE RESISTOR CORP., ERIE, PA.**

LONDON, ENGLAND . . . TORONTO, CANADA



Safe  
Arrival  
Anywhere  
Packaged  
in  
**TEXLITE**<sup>®</sup>

**RUBBERIZED  
CURLED HAIR**



Texlite is the lining material for cases, cartons and containers that cushions away ruinous "G's"—assures safe shipment of delicate and costly equipment to any corner of the globe. Yet Texlite simplifies and speeds packaging—makes every packer a skilled packer.

**TEXLITE** *rubberized curled hair*

- combines high deflection with low density—weight ranges from 3 to 5 lbs. cu. ft.
- is unaffected by changing moisture and temperature conditions.
- is dust free—fungus resistant.
- may be used again and again.
- is available in sheets, or die-cut to specified shape.

Other of our materials available for protective packaging are **SPONGEX**<sup>®</sup> cellular rubber, **SPONGEX CELL-TITE**<sup>®</sup> with almost zero water absorption and 0.28-0.30 K factor, and **TEXFOAM**<sup>®</sup> latex foam rubber. Perhaps one of these materials better meet your product's needs.

If you have a protective packaging problem, consult our packaging division. Let our laboratory analyze, and prescribe, the protective requirements for your products for safe shipment anywhere—by land, sea or air.

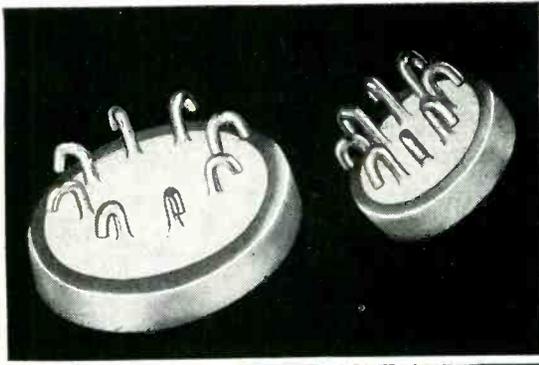
*The World's Largest Specialists in Cellular Rubber*

**THE SPONGE RUBBER PRODUCTS COMPANY**

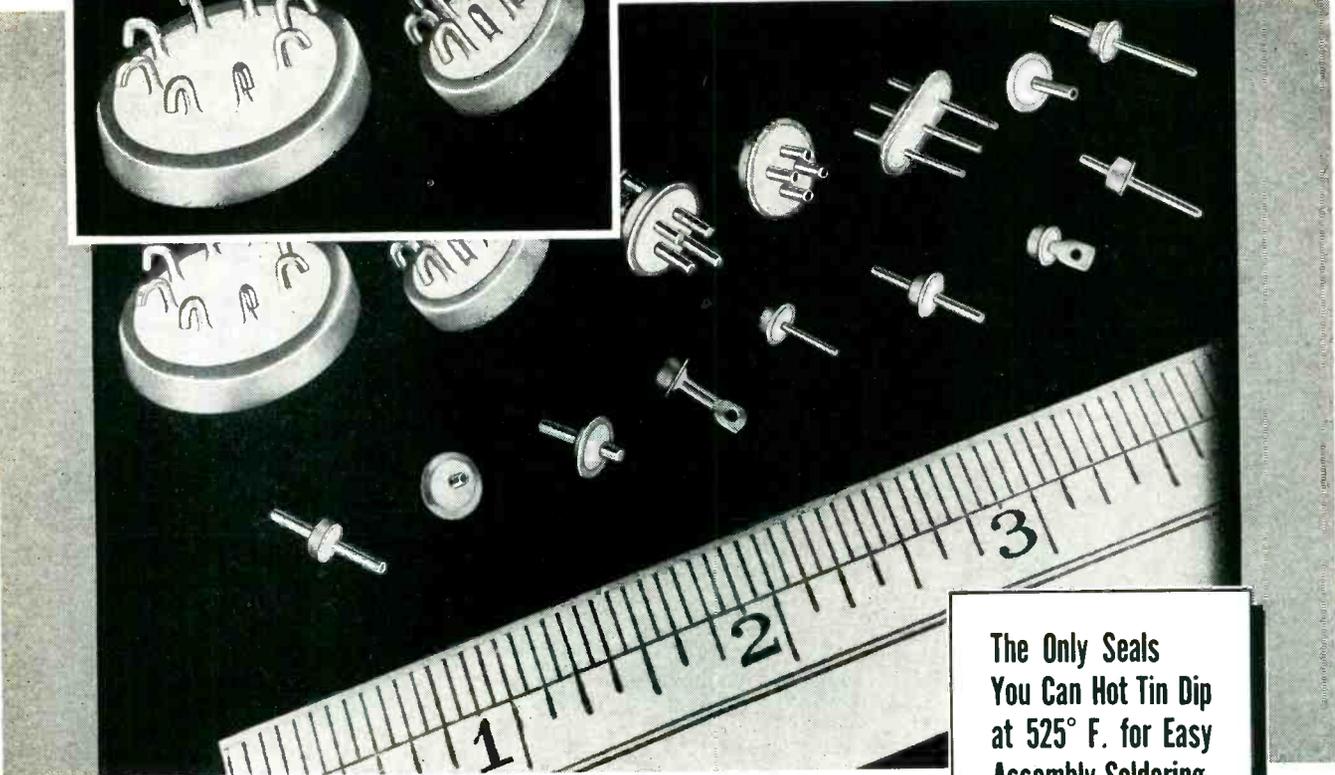
469 DERBY PLACE

SHELTON, CONNECTICUT





Shown in inset are two 8-terminal hermetic seals. The latest seal, at the right, fully 30% smaller than its old-style counterpart, will perform exactly the same function in a much smaller area.



**NO**  
*Swellled Headers*  
**HERE**

The Only Seals You Can Hot Tin Dip at 525° F. for Easy Assembly Soldering, for a Strain and Fissure-Free Sealed Part with Resistance of over 10,000 Megohms!

**Just a Few of Hermetic's Amazing NEW Line of MINIATURE Glass-Metal Headers**

Today's industrial and military production calls for myriad components and controls. The size of each part must, therefore, be kept to a minimum. As a result Hermetic, with its unequalled specialized experience in hermetic seals, has developed and engineered a superb, thoroughly practical line of glass-metal headers in the smallest sizes ever made.

These components have already passed stringent tests, are being used successfully and are ready to go to work for you, too. Available in unlimited shapes, they are unaffected by extremely high or low temperatures, high humidities, vacuums, high

operating pressures, swamp test, salt water immersion and spray, etc. They can be produced surprisingly economically in large or small quantities, thus giving you every opportunity to determine how well these headers can perform with your own products.

**IMPORTANT: Terminals and Headers are Available in RMA Color Code.**

*Free!*

Write for your copy of the most complete catalog ever produced on hermetic seals.



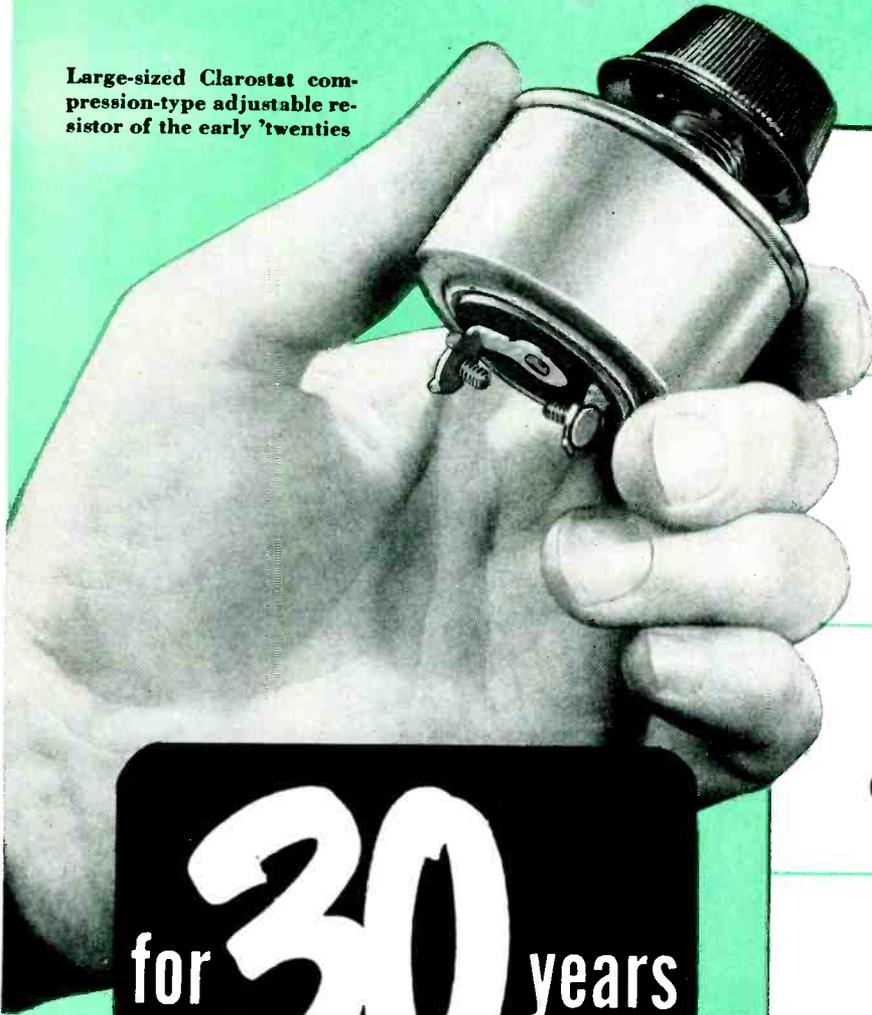
**Hermetic Seal Products Co.**

31-33 South Sixth St., Newark 7, N. J.



1921  1951

Large-sized Clarostat compression-type adjustable resistor of the early 'twenties



for **30** years

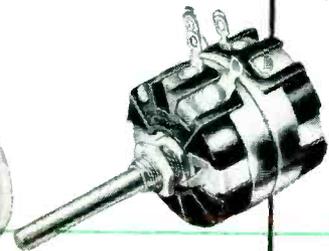
## "the house of Resistors!"

It was the early 'twenties. Socket-power radios needed voltage control to be practical. And Clarostat came up with the *right* answer—the original Clarostat compression-type adjustable resistor. Since then, over three decades, Clarostat has come up time and again with the *right* resistor, control or resistance device. That's *specialization*—and it's yours when you specify CLAROSTAT. Literature on request.

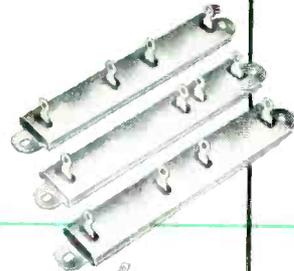


## Controls and Resistors

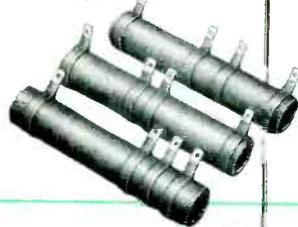
CLAROSTAT MFG. CO., INC. • DOVER, NEW HAMPSHIRE  
IN CANADA: CAÑADIAN MARCONI CO. LTD., MONTREAL, P. Q., AND BRANCHES



Wire-wound potentiometers and rheostats.



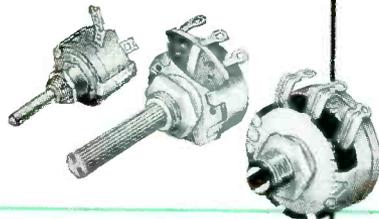
Metal-clad wire-wound molded resistors.



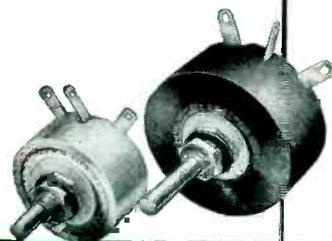
Greenohms — inorganic-cement-coated power resistors.



Voltage-dropping and voltage-regulating ballasts.



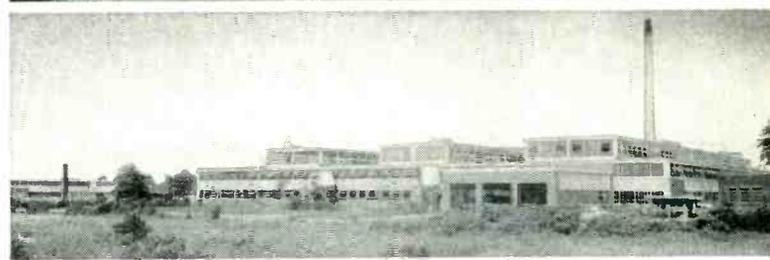
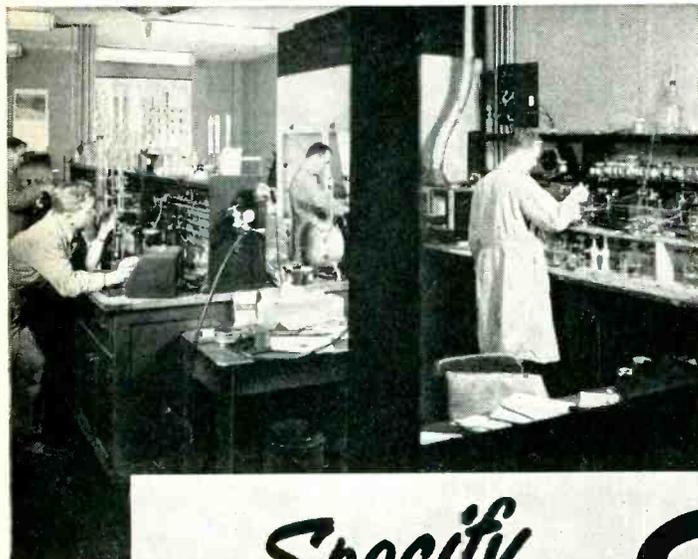
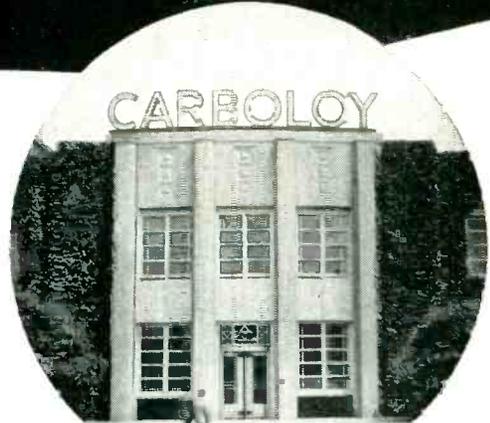
Choice of controls — no bigger than a dime! —  $\frac{1}{16}$ " —  $1\frac{1}{8}$ " dia.



25- and 50-watt power rheostats for roughest going.

# Carboloy Company has led in quality and uniformity of versatile metals for over 22 years

Typical views of our Detroit facilities for  
the manufacture of cemented carbides.

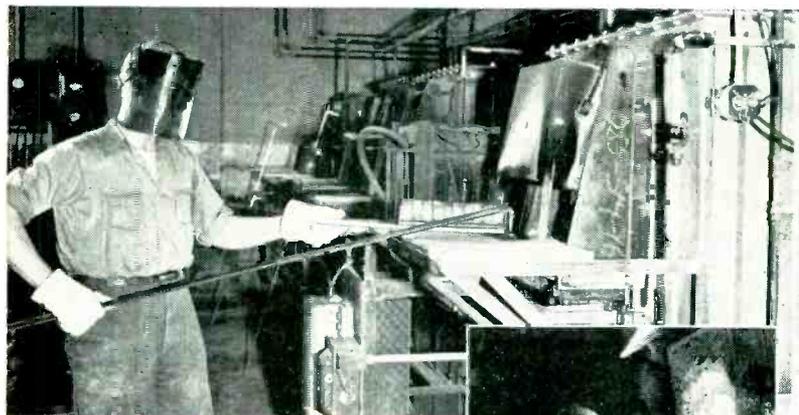


*Specify*

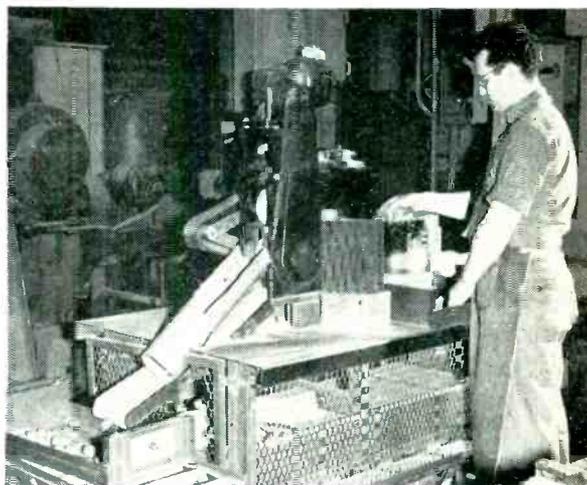
**CARBOLOY**

THE QUALITY BRAND

# **NOW** the same rigid standards of quality control are being applied to the production of **ALNICO** Permanent Magnets



Typical views of our facilities at the Schenectady plant for the manufacture of permanent magnets.



The same rigid quality controls and skilled personnel that made "Carboloy" the leading name in cemented carbides are your assurance of uniform high quality Alnico permanent magnets, too!

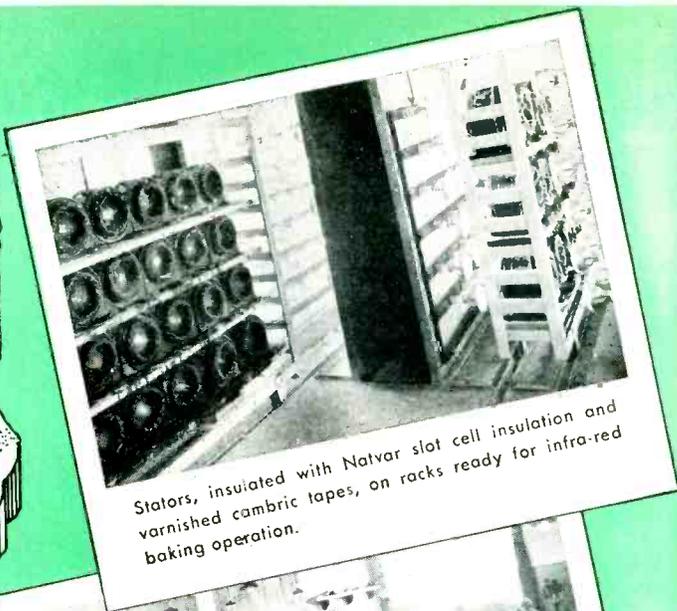
## **CARBOLOY COMPANY, INC.**

A General Electric Affiliate

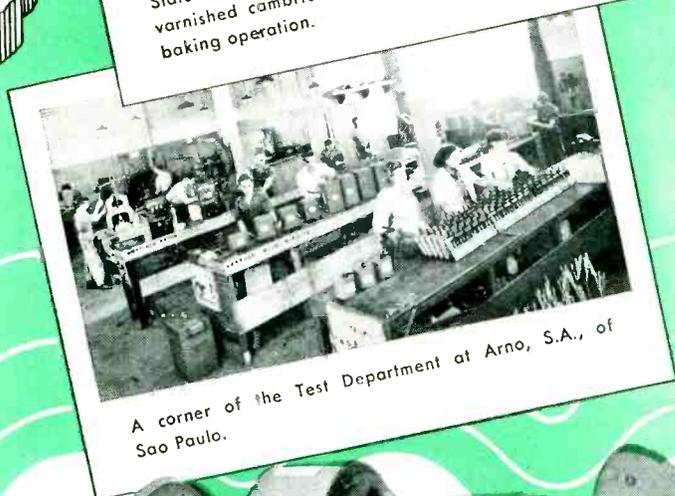
11139 E. 8 Mile Blvd., Detroit 32, Michigan



# **ALNICO** PERMANENT MAGNETS



Stators, insulated with Natvar slot cell insulation and varnished cambric tapes, on racks ready for infra-red baking operation.



A corner of the Test Department at Arno, S.A., of Sao Paulo.



This exploded view shows the simple yet rugged construction typical of Arno motors. The motor shown is 1½ hp., three-phase, drip-proof.

Arno, S.A. of Sao Paulo, Brazil, the leading manufacturer of electrical equipment in Brazil, produces most of the motors, and associated power equipment used in South America's largest country.

Like the manufacturers of similar products in North America, Arno realizes the importance of quality electrical insulating materials for unflinching service in the field. It is for this reason they have selected Natvar products for their insulation requirements. Arno motors depend upon Natvar slot cell insulation, varnished cambric tapes.

All Natvar electrical insulating materials are recognized for their high standards of quality and uniformity throughout the world.

• Natvar flexible insulating materials are distributed in Brazil by Casa Rand Comercio E Industria S.A.

P. O. Box 350	P. O. Box 3619	P. O. Box 267	P. O. Box 978
Rua Senador Dantas 37	Rua 24 de Maio 207	D. de Pernambuco-119	Rua Uruguay 91
Rio de Janeiro, Brazil	Sao Paulo Brazil	Recife, Brazil	Porto Alegre
			Rio Grande do sul, Brazil

**THE NATIONAL VARNISHED PRODUCTS CORPORATION**

Telephone  
Rahway 7-8800

Cable Address  
NATVAR: Rahway, N. J.

201 RANDOLPH AVENUE ★ WOODBRIDGE, NEW JERSEY

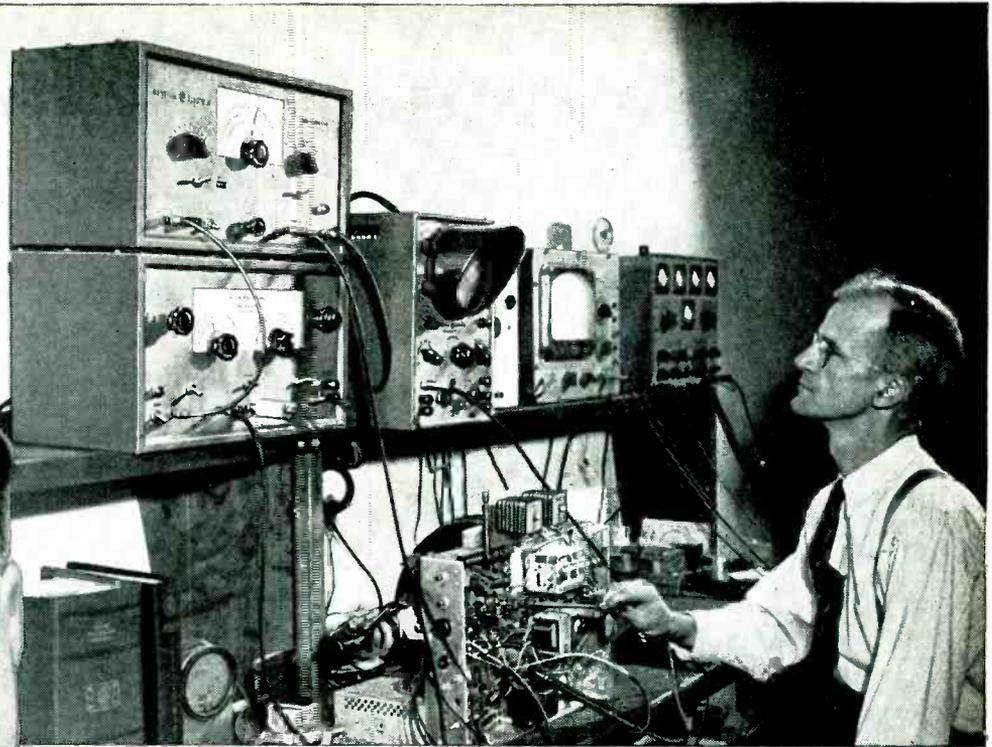
*Natvar*

### Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Silicone coated Fiberglas
- Varnished papers
- Slot insulation
- Varnished tubings and sleeveings
- Varnished identification markers
- Lacquered tubings and sleeveings
- Extruded vinyl tubing and tape
- Extruded vinyl identification markers

Ask for Catalog No. 21

**TOM JACOBS, Owner  
Apex Radio Shop  
Detroit, Michigan**



***“200% MORE TV BUSINESS  
--NO INCREASE IN OVERHEAD!”***



“With no increase in trained personnel, we tripled our TV service business in 6 months. The answer lies in our G-E Test Equipment.

“The *Scope* is the best trouble-shooter on the market . . . it holds a steady trace—it’s stable—you can overload it and it recovers instantly. The *Variable Permeability Sweep* is extremely simple to operate, and with the crystal-controlled

*Marker Generator* we always get accurate and reliable results. While keeping profits up, the G-E Test Package has cut our service time in half!”

Hundreds of TV dealers and servicemen use G-E Test Equipment to turn out clean, accurate jobs that keep customers satisfied and put money in the till. Call your G-E distributor or mail coupon today for full information.



General Electric Company, Section 451  
Electronics Park, Syracuse, New York  
Rush me latest bulletins plus price information on  
General Electric test equipment.

NAME.....

ADDRESS.....

CITY.....STATE.....

*You can put your confidence in—*

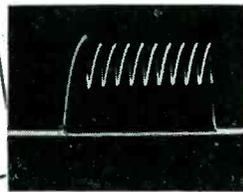
**GENERAL  ELECTRIC**

# establish the signal's D-C LEVEL

...and measure its a-c and d-c  
components directly  
from the oscillograph

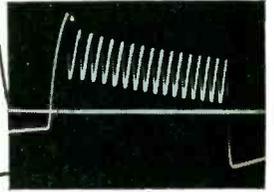
you should see...

this!

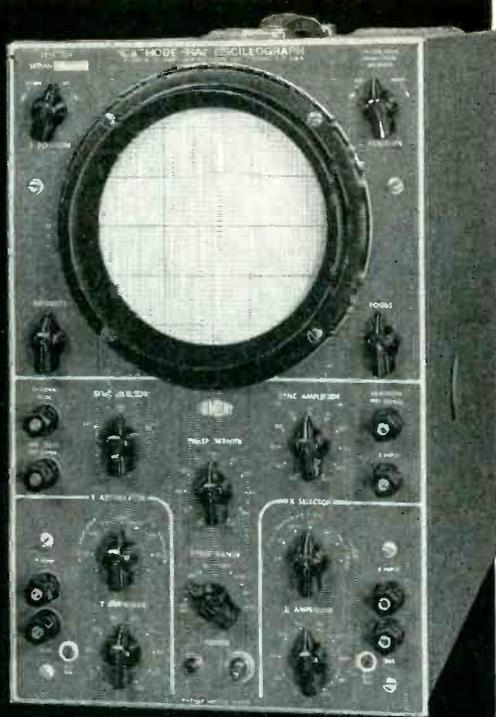


Both a-c and d-c components are displayed through the d-c amplifiers of the Type 304-H. Base line represents zero volts.

not  
this!



The same signal, applied through a-c amplifiers exhibits a shifted reference line and tilt of the signal which make the oscillogram difficult to interpret.



# DU MONT type 304-H

...to make direct measurements



## THE TYPE 264-B VOLTAGE CALIBRATOR

Simply by applying its square-wave output to the oscillograph and producing a deflection equal to that of the signal, the amplitude of the signal may be read, in volts, directly from the calibrated dial of the Type 264-B. The Type 264-B will calibrate your oscillograph to read directly in volts per inch.

...to obtain permanent records



## THE TYPE 296 OSCILLOGRAPH-RECORD CAMERA

To complete the study of the signal, permanent records, such as those above, are obtained most efficiently with this inexpensive, single-frame 35-mm. camera. Operation of the camera is simple and fool proof; construction is compact and rugged. A high-quality f/2.8 coated lens is used, and focus is fixed for best oscillographic results.

The "Standard of Performance" for general-purpose cathode-ray oscillographs.

To study signals containing both a-c and d-c components, direct-coupled amplifiers such as those of the Type 304-H must be used. D-C amplifiers will maintain the true d-c level of the signal and display the actual relationship between the d-c and a-c components of the signal. Then by calibration of the Type 304-H with the Du Mont Type 264-B Voltage Calibrator, these components may be measured directly from the screen of the instrument.

Features such as driven sweeps, sweep expansion, extremely slow sweep speeds, and stabilized synchronization have made the Type 304-H the outstanding general-purpose cathode-ray oscillograph. Its sensitivity of 10 rms millivolts per inch and its versatility often eliminate the need for a second instrument to perform functions not within the range of the ordinary general-purpose oscillograph.

Portability contributes highly to the usefulness of the Type 304-H, especially in field work requiring good performance and in the laboratory where it serves many benches. The Type 304-H measures 13½" high, 8⅝" wide, 19" deep, and weighs only 50 pounds.

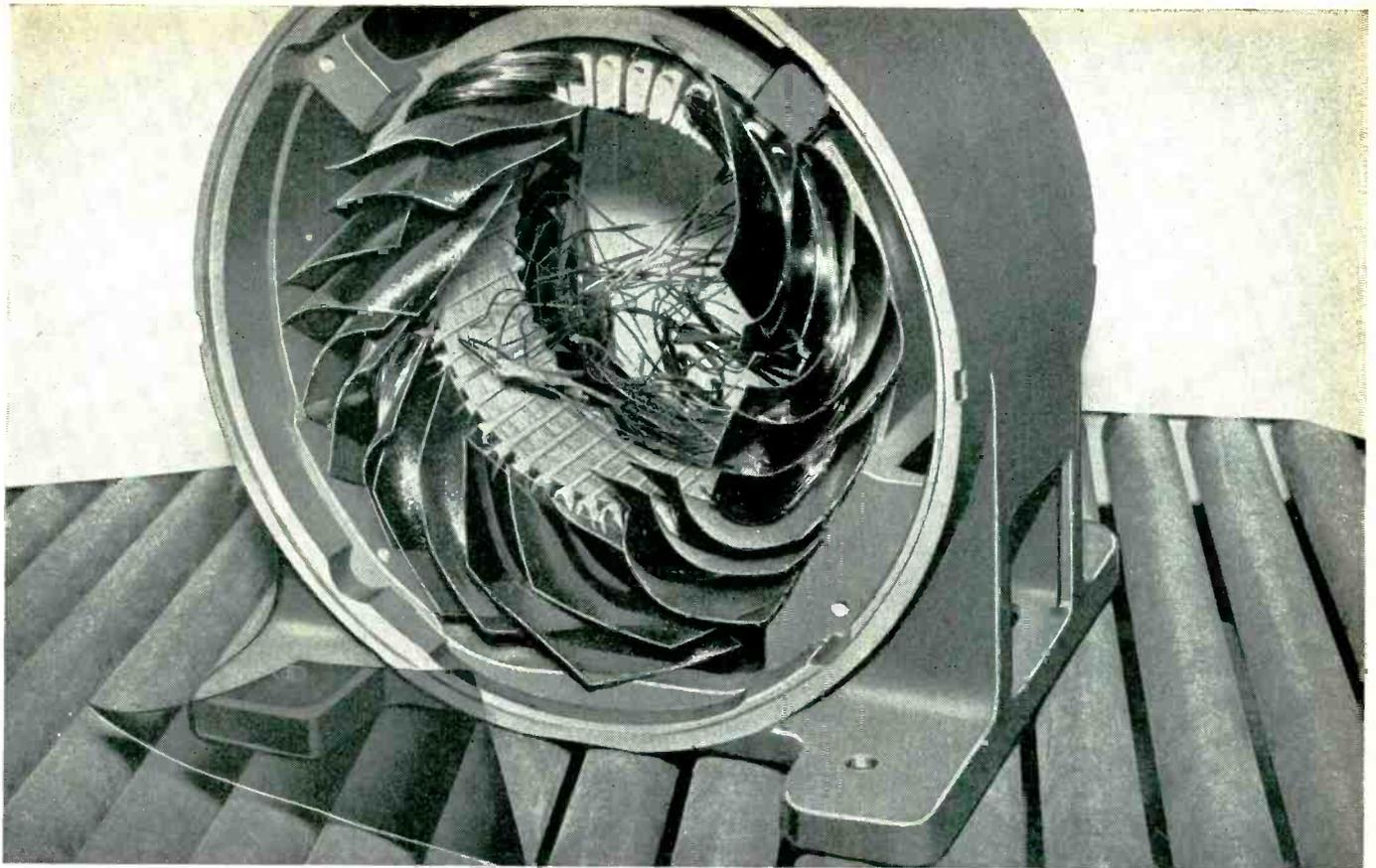
Write today for catalog...

Instrument Division, Allen B. Du Mont Labs., Inc.  
1000 Main Avenue, Clifton, N. J., U. S. A.

# DU MONT



# in Oscillography



## When insulation must stand 500° Heat ...look to **IRVINGTON'S** Class "H" Line

Whether you are winding for service at high ambient temperatures — for increased *continuous* power ratings — for greater *short-time* overload capacity ...

Or *designing* for space-and-weight savings ...

You will find the Class "H" insulation you want in the complete Irvington line.

Depending on service requirements, *your* high-temperature insulation job may call for Silicone Varnished Fiberglas\*, in yard goods, tape or tubing forms; Silicone Glass Mica; Silicone Saturated or Silicone Coated Asbestos; Silicone Rubber Coated Fiberglas; Silastic\*\*Tape, Teflon Coated Fiberglas.

We make them *all* — we're ready to help you use *each* to best advantage. Write for a free copy of our book — Irvington Class "H" Insulations — it contains samples. Perhaps you'd prefer to talk with one of our engineers. The coupon below is for your convenience. Send it today. No obligation.

\*Owens-Corning Fiberglas Corp. \*\*Dow Corning

Look to  
**IRVINGTON**  
 for insulation leadership  
 INSULATING VARNISHES  
 VARNISHED CAMBRIC  
 VARNISHED PAPER  
 VARNISHED FIBERGLAS  
 INSULATING TUBING  
 CLASS "H" INSULATION



Send this convenient coupon now

# Irvington

VARNISH & INSULATOR COMPANY

6 Argyle Terrace, Irvington 11, New Jersey

Irvington Varnish & Insulator Co.  
 5E Argyle Terrace, Irvington 11, N. J.

EL-5/51

Please send me a free copy of "Irvington Class 'H' Insulations".

I'd like to see one of your engineers. Please have him phone or write for an appointment.

Name..... Title.....

Company.....

Address..... Phone.....

City..... State.....

# new!

ACTUAL SIZE



## PYRAMID TINY TYPE 85LPT TUBULAR PAPER CAPACITORS

**Fit anywhere!  
Suitable for  
85°C. operation!**

**CAPACITANCE RANGE:**  
.0001 TO .5 MFD.

**VOLTAGE RANGE:**  
200 TO 600 V., INCLUSIVE

**Sturdily built in phenolic-impregnated tubes. Ends are plastic-sealed.**

**WRITE FOR COMPLETE LITERATURE**  
Representatives and Distributors  
Throughout the U.S.A. and Canada



## PYRAMID

**PYRAMID ELECTRIC COMPANY**

1445 Hudson Boulevard  
North Bergen, N. J., U. S. A.

TELEGRAMS: WUX North Bergen, N. J.  
CABLE ADDRESS: Pyramidusa

# BUSINESS BRIEFS

By W. W. MacDONALD

**Component-Part Makers** are more vulnerable when emphasis shifts from peace to war than the assemblers of electronic equipment for whom we painted a picture of what probably lies ahead (p 82, April) last month. Assemblers can sometimes design and produce simple electronic equipment in 90 days, while it takes the average parts maker six months or more to tool up for a new item. Thus a reduction of civilian business while preparing for production of military items leaves a nasty time gap.

Washington is well aware of this, as it is also aware of the fact that component parts represent the backbone of any military electronic equipment production program. That is why the Services are being weaned away from the use of special components in equipment prototypes as rapidly as possible by their own procurement officers. It also explains why orders for some replacement parts are being placed as much as 36 months ahead, instead of the usual 6 months.

Planning for the manufacture of assembled electronic equipment is difficult enough short of actual war. Planning for the production of component parts from which the equipment must be assembled is still more difficult and it is our impression that Washington is comparatively mum on the subject because the problems are legion and the answers elusive.

More later, when and if the situation jells.

**Last Month** it seemed as though a shortage of materials might be the television industry's 1951 pain in the bottleneck. Now it looks like sluggish consumer buying may be a companion headache.

The industry got a lot of production under the wire early this year. Sets are backing up in distributors' warehouses and in retail stores. Prices are high. Saturation is now a factor, and markets are prevented from expanding by the continued station freeze.

On the consumer side, war scare, the heavy income-tax take, rising

food and clothing costs and tightened time-payment restrictions are causing a pulling in of the pocket-book. Television may this year experience its first really serious summer slump, considered normal in the radio business.

Television is still in a buyer's market, despite the threat of material shortages.

**MRO Order** issued by NPA to insure availability of Maintenance, Repair and Operating supplies by permitting industry to write its own priority ticket is a wordy document. We're supposed to be adept at interpreting fine print but, so far, have bogged down.

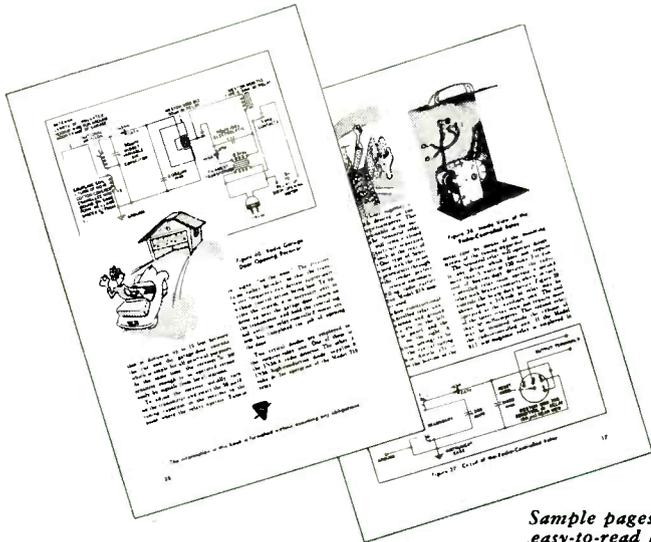
People we've talked to in the field about the order tell us it will take a few test runs to make the meaning clear. When they are made, and when it is, on this subject too, we will report further.

**Speaking Of Materials**, minerals are most important in the field of electronics. Evan Just of the McGraw-Hill magazine *Engineering & Mining Journal* says this is the way the world's supply is distributed, expressed in percentages of the total:

Mineral	West Hem.	Aust. New Z.	West Eur., S. Af.	Mid. Eur., N. Af.	East	Soviet Sphere
Antimony	50	2	13	9	1	25
Asbestos	60	15	4	1	1	20
Bauxite	60	6	8	18		
Beryl	55	2	10	3	3	30
Chromite	5	3	34	24	14	20
Cobalt	10	3	80	4		?
Columbite			99			?
Colum-Tanta			90	5		?
Copper	62	1	20	6	2	9
Diamonds	5	95				?
Fluorspar	50	2	20	13	3	?
Iron Ore	45	10	20	20	5	?
Lead	50	18	10	13	1	8
Manganese	9	21	7	18	45	?
Mercury	16	32	40	5		10
Molybdenum	88		2			?
Nickel	80	3				17
Petroleum	66	1	1	18	14	
Phosphates	40	3	1	25	1	30
Potash	25	5	40	30		?
Steel	47	1	11	20	3	13
Tantalite	15					?
Tin	20	1	15		58	6
Tungsten	21	5	22	3	12	37
Vanadium	78	13	?	?	?	?
Zinc	56	11	6	14	1	12

**A Trans-Lux Theatre** in downtown Washington displays a Geiger counter borrowed from the National Bureau of Standards in its entrance lobby, invites pensive

# Put Electronics to work IN YOUR HOME!



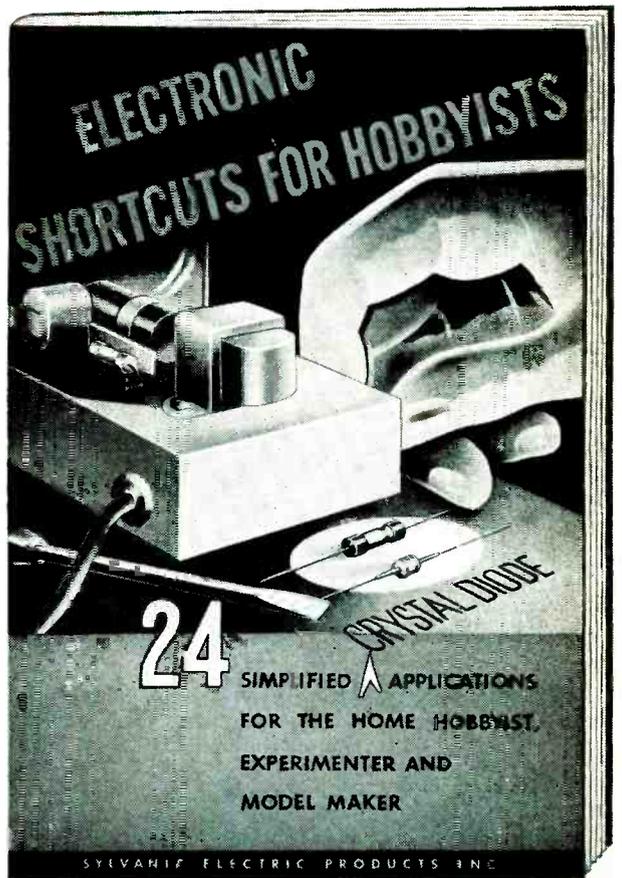
Sample pages showing easy-to-read diagrams.

## HERE'S HOW TO MAKE 24 VALUABLE TIME- AND LABOR-SAVERS

You don't have to be an electronics engineer to build these useful household gadgets. The step-by-step instructions in Sylvania's fascinating new book, "Electronic Shortcuts for Hobbyists," are written expressly for the home hobbyist, model maker and electrical experimenter. With this book you can build:

- A Radio-Controlled Door Opener.
- An Electronic Door Lock.
- A Charger for Small Dry Batteries.
- Radio-Controlled Relays.
- Pocket-Sized Stroboscopes.
- Remote Control for Model Trains.
- A Doorbell Booster.
- Photoelectric Relays.
- Photographic Interval Timers.
- An efficient Crystal Radio . . . and many other valuable gadgets.

All you need is some inexpensive Sylvania Crystal Diodes and a few everyday materials. Book contains full instructions and easy-to-follow diagrams. Send a quarter along with the coupon for your copy.



**ONLY 25¢**

Sylvania Electric Products Inc.  
Dept. E-1005, Emporium, Pa.

Enclosed please find my 25¢ for copy of  
"Electronic Shortcuts for Hobbyists."

Name \_\_\_\_\_  
Street \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



# SYLVANIA ELECTRIC

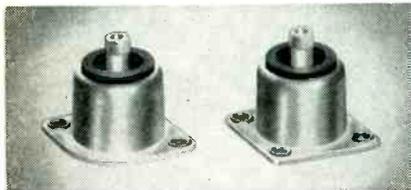
ELECTRONIC DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

# SHOCK and VIBRATION NEWS

BARRYMOUNTS FOR ASSURED CONTROL OF SHOCK AND VIBRATION

## SMALL AIR-DAMPED BARRYMOUNTS for Miniaturized Airborne Equipment

New-series Barrymounts, designed to meet requirements for compact isolators usable with miniaturized equipment, provide effective shock and vibration isolation in small space.



These mountings utilize air damping to minimize shock of aircraft landing and taxiing and to limit excursion so there is no snubber contact, even at resonance.



Upright and inverted types are available for two-hole or four-hole mounting. Unit mountings are one inch in diameter and 1-1/32 inches high under maximum rated load. Load ratings are 0.1 to 3.0 pounds per mount. The mountings weigh only 5/16 ounce each.



Bases using the inverted mountings raise the mounted equipment only 1/2 inch. Either upright or inverted unit mountings can be furnished on bases that conform to your specifications, load-ratings, and dimensions.

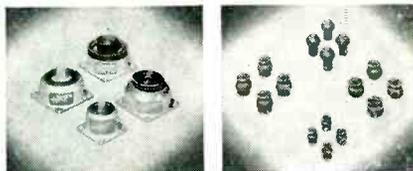
### FREE CATALOGS

- 502 — Air-damped Barrymounts for aircraft service; also mounting bases and instrument mountings.
- 509 — ALL-METL Barrymounts and mounting bases for unusual airborne applications.
- 605-606 — Miniaturized air-damped Barrymounts for use with airborne equipment.

## STANDARD MOUNTINGS ISOLATE VIBRATION Available for Aircraft, Marine, Mobile, Instrument, and Industrial uses.

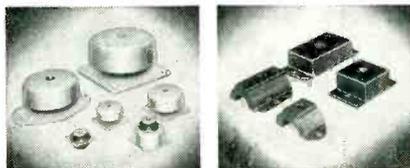


Standard bases built to meet government specifications can be furnished by Barry; special bases can be supplied in sizes and load ratings to fit customers' exact requirements, including miniaturized bases. See catalog 502 and data sheets 605 and 606.



Aircraft vibration isolators designed to meet Army, Navy, and CAA requirements are available in 1/4-pound to 45-pound unit ratings; also miniature mounts to 0.1 lb. See catalogs 502 and 509 and bulletins 605-6.

Instrument mountings are furnished for electronic components, tiny, fractional-HP motors, record changers, dictating machines, and other lightweight apparatus. See catalogs 502 and 504.



Shock mountings for mobile, railroad, and shipboard service also give vibration isolation at frequencies above 2000 c.p.m.; useful for general sound isolation. See catalog 504.

Industrial mountings isolate vibration from fans, motor-generator sets, transformers, punch presses, and other heavy industrial equipment. Bulletin 607 tells how to cut maintenance costs with Barrymounts.

BUSINESS BRIEFS

(continued)

pedestrians to step up and check their radioactivity.

Engineering Manpower continues to be a critical commodity. We mentioned the growing demand for technicians last month (p 76, April) and, since then, have looked into the subject further.

We've contacted 14 of the 22 manufacturers advertising for help in the classified section of the March issue of ELECTRONICS. These 14 alone say they can use 927 electronic engineers before the end of the year. Nearly half the jobs offered are on the West Coast, largely in aircraft-electronic plants.

Practical Experience on radar design and development plus a thorough educational background appear to be the twin requirements of many manufacturers looking for engineering personnel. Now, radar is only about 10 years old. So there are only a thousand or two engineers in the country who can meet both requirements.

The shortage of experienced engineers is severe. The shortage of men having the right background and capable of being trained for specialized equipment design and development is not. It seems to us that a forced-draft training program in radar and allied military equipment is indicated.

Production Help is plentiful in radio and related fields, according to the U. S. Department of Labor. Total employment over the last four years was as follows:

1947	142,400
1948	123,000
1949	112,700
1950	156,300

There were, according to this same source, 250,000 production workers engaged in the field during the peak war year of 1944.

Philco's Bob Long, commenting on an item concerning the preparation of instruction manuals (p 60, Feb.), says his company has a Technical Publications Department whose sole business is the preparation of manuals to go with its own products and for various branches of the armed forces. The department . . . and this may be startling to manufacturers bidding for the

THE **BARRY** CORP.

707 PLEASANT ST., WATERTOWN 72, MASSACHUSETTS

### SALES REPRESENTATIVES IN

New York Rochester Philadelphia Washington Cleveland Dayton Detroit  
Chicago Minneapolis St. Louis Seattle Los Angeles Dallas Toronto

first time on government contracts involving manuals . . . contains over 200 people. This includes writers, editors, artists, draftsmen, photographers, layout men and typists.

The preparation of manuals is a major publishing venture, not to be dismissed lightly with a wave of the hand. Watch our feature pages next month for a discussion of some of the problems involved, and suggestions for their solution.

**Guided Missile Development** is by no means confined to airborne apparatus. A great deal of work is currently going into the design of guided torpedoes.

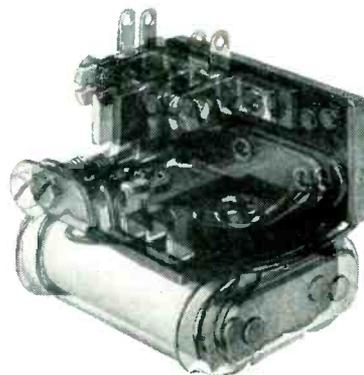
**Receiver Sales** by licensees during 1950 totaled 20,656,486, worth \$1,605,731,113. Here's the way the total broke down:

Electric	Units	Dollars
Table (under \$12.50 billing price) . . . . .	2,472,075	\$26,088,004
Table (over \$12.50 billing price)		
A-M . . . . .	3,028,184	53,145,145
A-M/F-M . . . . .	343,751	10,500,152
F-M (including converters) . . . . .	11,923	286,181
Consoles		
A-M . . . . .	6,550	431,088
A-M/F-M . . . . .	6,050	660,908
Table-Radio-Phonos		
A-M . . . . .	382,630	16,553,385
A-M/F-M . . . . .	15,143	975,929
Console-Radio-Phonos		
A-M . . . . .	76,796	6,700,255
A-M/F-M . . . . .	495,362	59,919,504
Battery		
Portable		
A-C/D-C . . . . .	1,475,738	26,393,887
Table . . . . .	96,113	1,574,476
Consoles . . . . .	60	5,451
Auto . . . . .	4,757,035	123,427,992
Television		
Converters . . . . .	5,705	754,081
Radio Table Models . . . . .	2,781,458	393,511,544
Radio Consoles		
Direct-Viewing . . . . .	2,344,938	645,105,666
Projection . . . . .	11,739	2,723,745
Radio Phonos		
Direct-Viewing . . . . .	789,666	217,501,568
Projection . . . . .	1,258	448,628
Phonographs		
Phono only . . . . .	405,513	7,125,362
With radio attachment . . . . .	29,730	963,714
Without Cabinets		
A-M . . . . .	13,564	343,544
A-M/F-M . . . . .	19,975	925,054
Television . . . . .	85,521	9,665,850

**Gene Anthony** of New York's GE Supply says he has discovered a way to make technicians clean up their habitually littered workbenches. He insists that all benches be shellacked once a month . . . and of course you can't shellac a bench without first removing the last year's birdsnests.



## VIBRATION



### and sensitive relays

In most military and much industrial gear relays must function correctly while subject to vibration in varying degree. In consideration of this fact standards for design, comparison and procurement have been set up. It is customary to speak of resistance to so many "g's" of vibration (one "g" equals the acceleration of gravity), and to specify by stating that units will be shaken at stated amplitude at frequencies up to a certain maximum. On the assumption of *simple harmonic motion*, such a specification correlates directly into "g's" of peak acceleration according to familiar laws for which convenient nomographs are available.

There are two principal ways of designing vibration resistance into a relay,

1. **Statically balance the moving parts (armature-contact assembly)**
2. **Increase the holding-force-to-mass ratio associated with moving parts.**

But this doesn't make it easy. A balanced armature tends to be twice as long as one which is end-pivoted. Increasing the forces tends to reduce sensitivity, while reducing the mass tends to limit switch capacity.

Here's a relay (Sigma 5F) the design of which is eight years old. It is a good sensitive relay,

although we won't claim, as a competitor once did of his pride and joy, that no one has been able to improve on it. We know that isn't so — we have improved on it ourselves. Still there are some jobs it will do better than anything else.

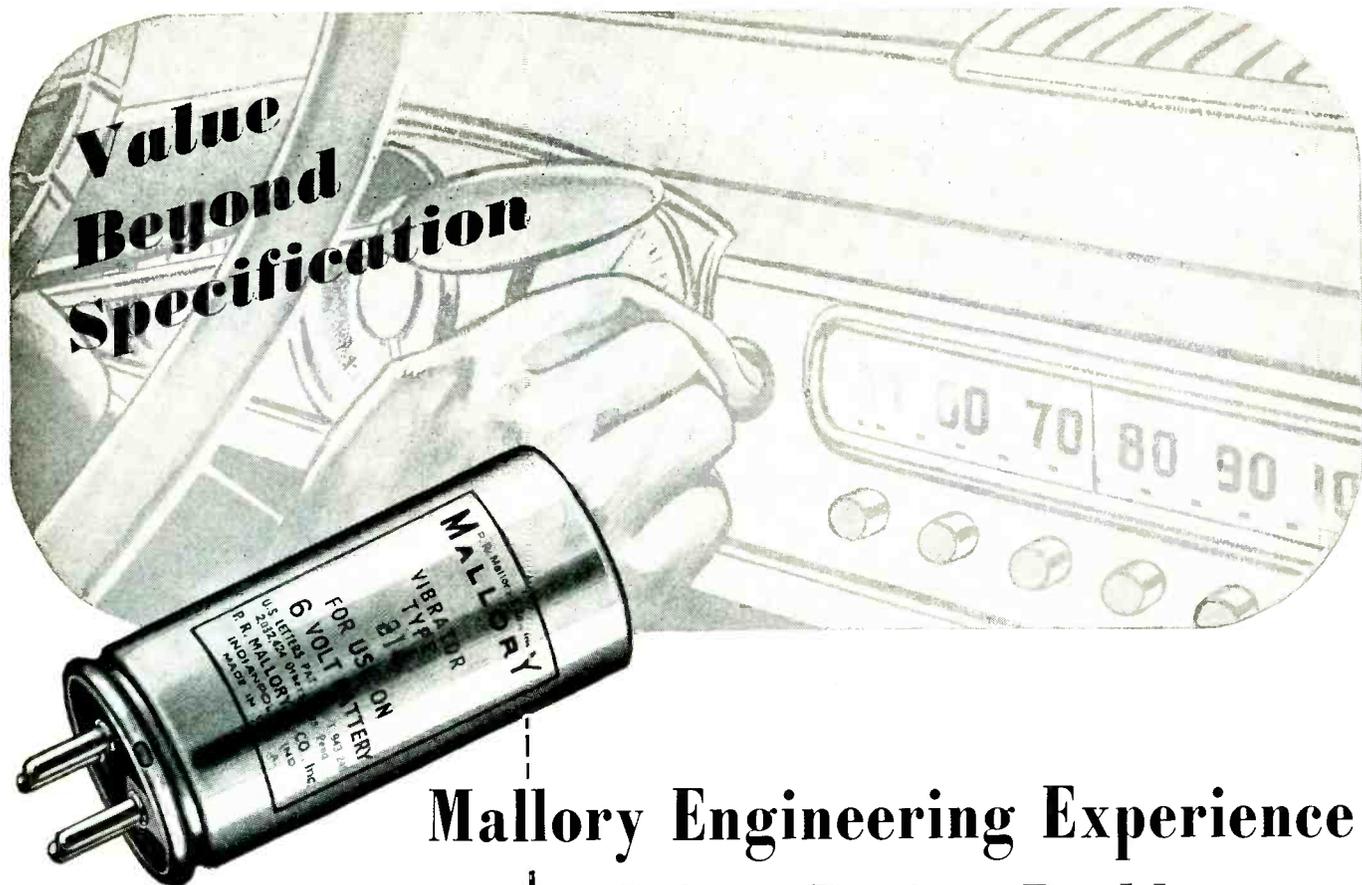
This relay resists vibration by means of a balanced armature and attains high sensitivity by precise control of small air gaps — which necessitates a non-resilient armature and switch mechanism. But as always, you pay for what you get! Although when adjusted for 5 milliwatt sensitivity it will positively withstand 10 g's of vibration at frequencies up to 60 cps — much difficulty attaches to demonstrating this on common "shake tables". Its non-resilient armature "feels" high-frequency noise components present in most testing machines which, although small in amplitude, are high in acceleration value, and which are absorbed by contact resilience on many other relays. The result — on cam or crank-driven testing machines — a given adjustment, in reality good for 15 g's (demonstrable with voice coil or tuning fork type equipment) may appear to withstand less than 5 g's.

If the "output" of a shake table is analyzed by means of vibration pickup and oscillograph permitting calculation of "g's" resulting from noise frequencies present — the results are often surprising!

P. S. Many Sigma Relays have both balanced armatures and resilient contact structures. Even so, it is well to be aware of the characteristics of the shake table when running tests.

# SIGMA

SIGMA INSTRUMENTS, INC., 62 CEYLON STREET, BOSTON, MASS.



## Mallory Engineering Experience Solves Design Problem... Saves Customer Money

### MALLORY VIBRATORS

Mallory Vibrators are based on exclusive design and manufacturing methods that assure long, trouble-free service. Send the details of your application. Get Mallory's recommendation on the Vibrator or Vibrapack\* power supply best suited to your needs.

Mallory contributes more than a fine product to the solution of a customer's problem. With the product comes the intelligent application of experienced engineering knowledge that cuts costs and eliminates delays.

For example, a large electrical manufacturer, designing a new automobile radio, was unable to match certain elements in the circuit. This company turned to Mallory for advice. The problem was solved quickly... with a redesigned transformer, a timing condenser and a Mallory Vibrator. Tests showed excellent results, and a great saving to the customer in engineering time.

*That's value beyond specification!*

Mallory electronic know-how is at your disposal. What Mallory has done for others can be done for you.

### Vibrators and Vibrapack\* Power Supplies

**P. R. MALLORY & CO., Inc.**  
**MALLORY**

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

#### SERVING INDUSTRY WITH

Electromechanical Products  
*Resistors      Switches*  
*TV Tuners      Vibrators*

Electrochemical Products  
*Capacitors      Rectifiers*  
*Mercury Dry Batteries*

Metallurgical Products  
*Contacts      Special Metals*  
*Welding Materials*

*\*Reg. U.S. Pat. Off.*



## CROSS TALK

► **FCC** . . . Having been sharply critical of the technical judgment recently exhibited by the FCC, it is a pleasure to come out in praise of the high standard of engineering foresight exhibited in the proposed allocation of vhf and uhf television channels. The choice of mileage separation between stations, the adoption of standard intermediate frequencies, the mandatory use of offset carrier operation, the increase in maximum transmitter power, the removal of power limitations due to radiator height—all are calculated to give the public a better grade of service, more uniformly distributed, than it now enjoys even in the most favored localities. At a time when government and industry had seemed lined up on opposite sides of an ideological fence, it is reassuring to note that these features of the allocation plan had wide support from the same engineers who were so largely ignored in the color decision. Since the allocation plan must serve both color and black-and-white transmissions, it is doubly important that there be general agreement on its basic features.

► **SERIES** . . . We are happy to record the completion of the MIT Radiation Laboratory Series, a monumental set of books on the theory and practice of pulses and microwaves, with particular emphasis on radar techniques. The 27th volume of the series, the Waveguide Handbook (Volume 10),

made its appearance last month.

At a celebration honoring the completion of the Series, a soiree arranged by the publishers, we renewed with pleasure the acquaintance of many former associates who served as its editors and authors. The conversation turned inevitably to the question of military security, particularly since a purported sketch of the Nagasaki atom bomb had just been published in connection with the espionage trial of Sobell and the Rosenbergs. One editor observed that the staggeringly detailed and copious content of the Rad Lab books could never have been passed to the enemy by spies. This being the case, the availability of the Series to all and sundry is no doubt a source of considerable comfort on the other side of the Iron Curtain. But, it was agreed, the comfort was vastly greater on this side, in view of the greater number of technicians and facilities available to make use of the published knowledge.

Over 150,000 copies of these books have been distributed, an average of over 5,000 per volume. One eminent consultant told us at the IRE Convention that certain volumes were used so hard by his staff that they wore right out, despite the fact that the bindings are as rugged as the book trade knows how to produce. This consultant, who would have warmed the heart of Frederick W. Taylor, decided to replace the worn-out copies by gifts of personal copies to key technicians!

► **BIG** . . . The final count of registrants at the 1951 IRE Annual Convention and Show was 23,451, an increase of more than 5,000 over the previous record of 1950. This appears to be the largest registration in history at a meeting of a technical society, a record at which all IRE members are justly proud. Although the total attendance at the annual show of the American Chemical Society has reached 65,000, the largest A.C.S. registration was of the order of 10,000 people.

The convention copped the prize for unadulterated amplitude, also, in the technical sessions: 210 papers in six simultaneous sessions held sequentially seven times in three locations. As we have observed in a small voice before, this is too many papers in too many places to suit anyone but the most specialized of specialists, namely the guy who is interested in not more than one paper. If he goes early, he has a chance. Anyone with a more catholic taste is very likely out of luck.

The last time we brought this up, confreres at IRE headquarters asked what constructive steps we had to suggest. The proposal for a number of smaller conventions on narrower bases is obvious and has been adopted by many other societies. If things go on at the present pace, this may be the only out. A more immediate step, with less disastrous fiscal implications, is to apply a sharp and heavy axe to the technical program.

# Electronic Research in the

Today's needs are quite different from those just before World War II. There may be little parallel even in the event of a new all-out conflict. Future safety suggests careful use of available laboratory facilities

**C**ONSIDER the several ways in which today's research program differs from the 1938-1939 period, when preparedness was also an all-important activity.

In the first place, nearly a quarter of a century elapsed between World War I and 1938. Not only had there been an almost complete change in all personnel involved, but during that interval applied science had become a vastly more important element in warfare. As a second factor, we entered both World War I and World War II after they had been under way for some time in Europe. The general nature of each conflict, as well as many of the accompanying techni-

cal and scientific problems which involved electronics, was fairly apparent.

Today, in contrast, only five years have elapsed since the end of World War II and the broad technical aspects of warfare are much the same. Many of the men who did research and development work in electronics during World War II are not only still active but are in closely related fields. Military action during the past year, however, has been in a primitive country, against a foe that uses few of the highly technical devices developed or greatly improved during the last war. Examples of such devices are radar, proximity fuses, improved sub-

marines, long-distance missiles and atomic explosives. Experience in Korea does not make clear just what would be our basic technical problems in case of a new war.

The most important research needed in a full-scale war against any enemy with highly developed technical skills is not yet fully apparent. Much effort, of course, is being put into such obvious things as improvements in radar, guided missiles and the use of and defense against atomic weapons. It is nevertheless conceivable that in the case of war we would be faced with unexpected opportunities as well as serious new threats.

Offensive military action might require some wholly new technical devices. If this occurs, research would be an all-important activity. Imaginary projects of this nature might be antisabotage devices and complete broadcasting systems involving anti-jamming features to reach large masses of people behind enemy lines. The latter might include receivers dropped in very large numbers by parachutes far inside an enemy country.

The point to be remembered is that at present we simply cannot predict the nature of much of the required research work in any actual future world war.

## **Today's Research Facilities**

As regards research in electronics, probably the most important

### **BOTTLENECK**

- Most military projects involve refinements of existing gear, rather than basically new things.
- Today's crop of men from the universities seems to have a better theoretical background than that of 15 years ago, but less interest in converting ideas into finished items.
- There are probably a dozen men who can devise a new circuit for every one who can translate it into a piece of equipment that will do a good military job in all respects.
- If the emergency continues or becomes more serious, some drastic measures may be necessary to shift men interested in basic research into design and development

# EMERGENCY PROGRAM

By **W. C. WHITE**

*Electronics Engineer  
General Electric Research Laboratory  
The Knolls  
Schenectady, N. Y.*



Industry's facilities have been tremendously expanded since the last war. Here is just part of the key research personnel in a new GE laboratory

change since 1939 is the tremendous increase in laboratory facilities and personnel, particularly in government-operated laboratories. Not only have the then existing laboratories been greatly expanded, but new and larger ones have been organized and are in active operation.

In addition, many millions of dollars in research contracts involving electronics have been awarded by the government to a large number of university and industrial laboratories. These contracts cover projects which the various branches of the services believe offer opportunities for new devices and worthwhile improvements in existing military equipment.

An example of what just one government agency was doing in 1949 in this direction is given in an interesting article in *ELECTRONICS* for that year.<sup>1</sup> A publication<sup>2</sup> of the Engineering College Research Council also indicates the nature of research being carried on by the group of some 80 universities listed.

Such contracts have greatly changed university research. Fifteen years ago, in the case of most universities, an expenditure of \$100 for equipment for a research project, or the expense for the attendance of some member of the staff at an out-of-town scientific society meeting, was a serious problem. It might even have required action by the trustees. To-

day, in contrast, it might almost be said that no expense is spared in matters such as these.

The present shortage of available engineers is caused to a considerable extent by the great increase in university and government research. As a result of this change, as well as some other factors, it is doubtful whether a new organization along the lines of the National Defense Research Committee, with its several large and highly specialized laboratories such as the Radiation Laboratory, MIT, will again be organized. Of course, some wholly new problem or scientific discovery not now foreseen could change this picture.

In one important aspect, industrial research differs greatly from that carried on in university and government laboratories. In industry the development, design and manufacturing methods based on results of research laboratory findings have by necessity become highly developed and closely coordinated procedures. In government and university laboratories, there is not a similar situation because they

seldom manufacture and sell equipment. This fact makes industrial laboratories relatively efficient in a practical sense.

## **Current Military Requirements**

The increase in manpower that has gone into research in electronics in the past ten years is far greater than that devoted to practical design of electronic equipment. This contributes to one of the most serious problems facing the science of electronics, the matter of more reliable operation of complicated electronic gear. There are probably a dozen capable research and development engineers who can devise a new circuit to accomplish a certain result, for each engineer who can translate a perfectly practical idea into a piece of equipment that will stand up under the severity of military use and give a long life of trouble-free service. The disparity is least severe in industry.

The growth of the science of electronics has widened the gap between the basic research man and the manufacturing man. When the ideas and equipment involved were

relatively simple, these two groups saw more of each other. Now refinements and complications have entered the picture and often necessitate middlemen in the form of advanced development groups, engineering laboratories or pilot-plants. There is in some places a tendency to expect of a research laboratory only the job of making investigations and reporting on the results, which involves uncovering new

phenomena but does not include seeing a project through to a new product. This is not necessarily a fault, but it must be taken into consideration when research findings must quickly be translated into practical equipment.

Whether it is a cause or a result of the various trends mentioned, today's crop of research men from the universities seems to have a better theoretical background (in-

cluding skill in mathematics) but less interest in the practical application of research than their predecessors of 15 or more years ago.

### **The Manpower Problem**

So much for some of the factors that may influence the nature of research in electronics in the near future. What are some of the probable effects?

In an adequately financed research laboratory, there are two ever-present, all-important problems. The first is getting individuals who as a group have all the necessary abilities for getting the desired result. The second is the choice of projects to be undertaken or continued. The available manpower question is undoubtedly the one that will be the controlling factor on both counts, and there are two relatively new aspects to the manpower problem.

In most universities the staffs had been greatly enlarged at the close of World War II to take care of the increased influx of students resulting from so-called GI Educational Rights. Now not only has GI registration dropped, but draft rules and policies may drastically cut down the flow of other students. Under these conditions, the natural tendency for the universities is to seek government research contracts in order to retain as many of their staff as possible.

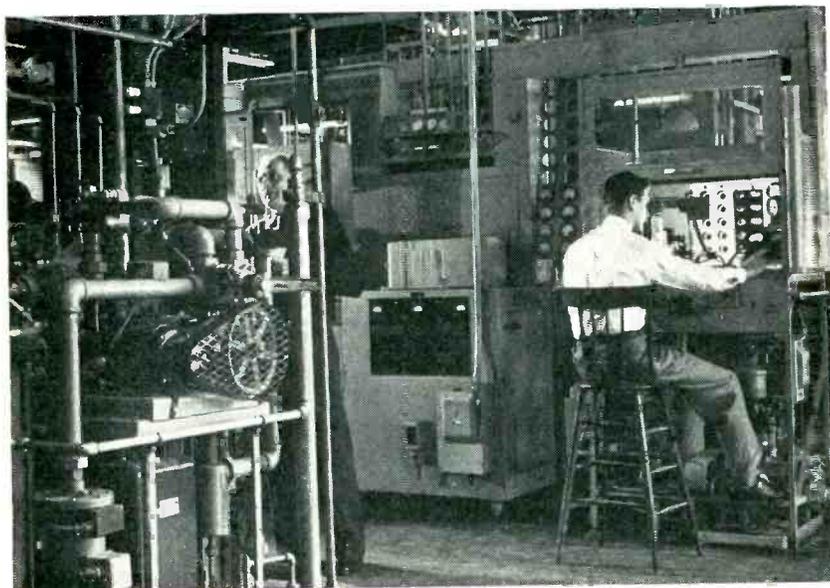
It is a common error to underestimate the amount of manpower required for a given research project and, as a result, take on more work than can be handled with existing staffs. Thus we will probably find in some cases that a university is in the market for additional engineers for research work rather than being a source of supply to outside laboratories. As a corollary, some university placement men may become recruiters.

### **Project Screening Needed**

As regards the problem of choice of research projects, there is no question but that a military economy will greatly curtail the freedom of choice. This is to be expected, because many projects for civilian products should not be started or continued. Also, in such



Military contracts in force since the last war and now being placed in increased number have enabled many laboratories, both in universities and in industry, to buy needed instruments



Equipment involved in the development of new tubes, the heart of electronic apparatus, can be quite elaborate

an economy, not only does the threat of drafting of men for military service preclude some civilian-product research and development but a great many engineers, regardless of age or eligibility for active military duty, feel very strongly that they should be doing work to aid the mobilization effort.

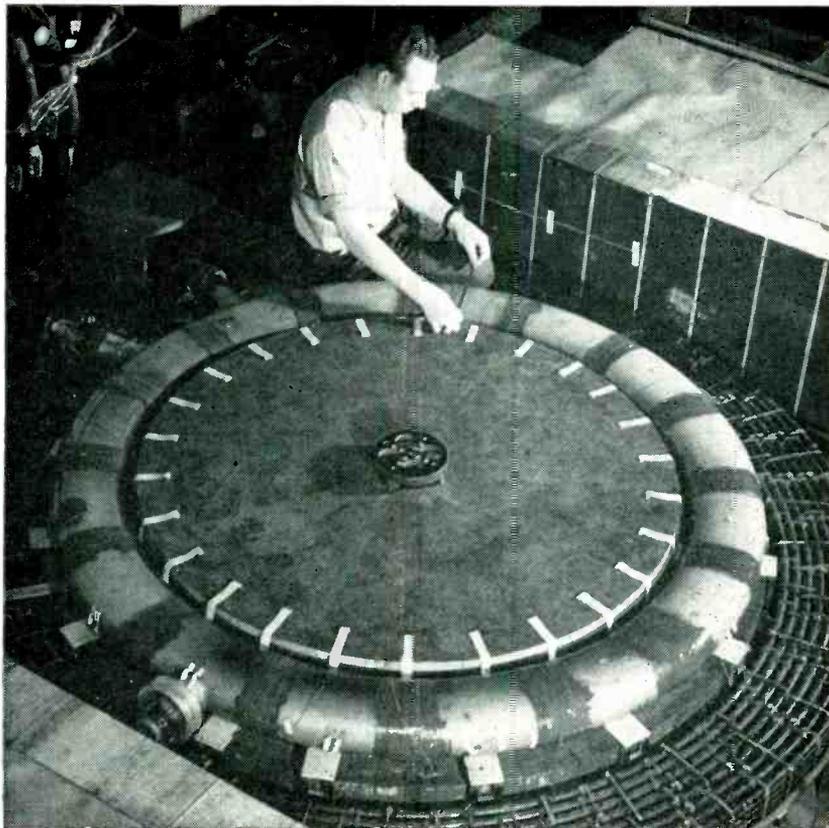
The choice of new projects, therefore, pretty much narrows down to military ones and thus consists of those offered or contracts which can be obtained on the basis of previous results, present activities or special equipment and skills.

There is one great danger. Key men in all groups inside government, as well as outside, often have pet projects held in abeyance for lack of funds or opportunity. Sometimes a military situation provides both the funds and the opportunity and some laboratory group is persuaded to go into a project that is not really needed and which later will be forced out of the picture when more vital problems are well defined. This means a waste of manpower and a chance that the work will be reclassified as non-essential. The men engaged on it might be subject to military service. It is well to be coldly analytical of some of the projects suggested or offered by early eager beavers.

There is also bound to be a natural tendency for research groups to hang on to an active current contract at least until new ones are available. Undoubtedly as the manpower problem becomes more acute and new needs develop, many of the now active contracts will be discontinued. Certainly some should be.

### **Design and Development Bottleneck**

If some new and now unforeseen highly technical and large-scale military project arises requiring very large amounts of research manpower, it is probable that the real bottleneck will be in its engineering rather than research phases. There is a great reservoir of facilities and manpower in government and university laboratories available for new investigations and basic research projects. The real problem in obtaining procurement of new designs of satisfactory



Electronic research today involves many problems associated with nuclear physics

military electronic equipment will be in the design and development of components and complete units or systems. Particularly, there will be a problem in producing equipment that will satisfactorily meet all the varied requirements in a practical way as well as electronically and at the same time be suitable for efficient quantity manufacture.

It would thus appear that the role of the industrial research laboratory to an increasing extent will be one of aiding its engineering and manufacturing groups to meet promises of delivery and reliability of performance. It is believed that this trend will be accentuated by the fact that much of the activity in military electronics will consist of refinements and improvements rather than basic developments faced ten years ago such as radar, loran and proximity fuzes. Refinements and improvements may have a much higher engineering content than new projects.

The requirement that industrial research laboratories come to the aid of their engineering and manufacturing departments, rather than devoting all their time to what

might be termed basic research will probably not be to the liking of many men involved, but it seems more or less inevitable when a real emergency arises. Therefore, because research is now a sort of magic word, appeals to so many engineers, and is so relatively easy to organize and carry on, there is danger that the supply of engineers capable of really getting things done from the procurement viewpoint will be further depleted. Research men will struggle to stay in research.

If the emergency continues or becomes more serious, some drastic measures may be necessary to supply added development and design engineering manpower to manufacturers. Much of it will probably have to come from qualified men who are at present doing research work in universities as well as in industry.

### REFERENCES

- (1) E. R. Spangenberg and W. E. Green, Basic Research Projects Under ONR Contracts, *ELECTRONICS*, p 66, June 1949.
- (2) Review of Current Research, E.C.R.C. of the American Society for Engineering Education at the College of Engineering, State University of Iowa, Iowa City, Iowa, 1949.

# CONSTRUCTING the

Recent release of manufacturing information to tube licensees gives industry first detailed description of internal structure and processing of color-tv kinescope. Photoengraving and gelatin-stencil printing processes are employed to insure precise alignment of phosphor dots and apertures

**E**ARLY IN MARCH the Radio Corporation of America released to its tube-manufacturing licensees a bulletin giving manufacturing information on the RCA three-gun tricolor picture tube. This tube, the only direct-view color television tube yet demonstrated, was shown to the press on December 5, 1950, as reported in the February issue, page 80. Although the bulletin was not released to the press, the interest in its contents was so high that the word was quickly passed throughout the technical fraternity. This report has been collected from several such informed sources.

Figure 1 shows the assembly of the tricolor tube. At the right, three electron guns are mounted with their axes parallel to the center line of the tube. Since the guns operate at high voltage (typically 15 to 25 kv), the edges of the cylin-

drical electrodes are rolled. The outermost cylinder in each gun is welded to a convergence electrode. This is a large cup, with its open side toward the phosphor screen, which exerts a focusing force on all three electron beams, bringing them to a common focus at all points of the scanned surface.

At the opposite end of the tube is the screen assembly, which consists of a pierced metal plate ("aperture mask") and the glass viewing screen ("phosphor-dot screen"). The mask and screen are mounted parallel to each other and about one-half inch apart, on a metal frame ("spacer frame"); see Fig. 2. The assembly of mask and screen must be very precise, to insure that the apertures in the mask line up exactly with the clusters of phosphor dots on the screen. The screen assembly is bolted to four

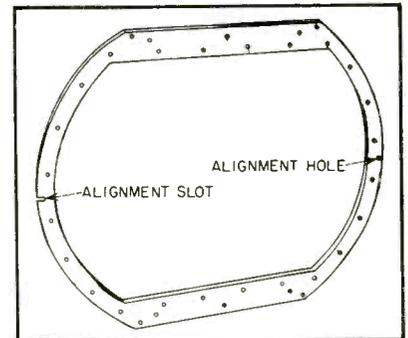


FIG. 2—Spacer frame. Aperture mask is bolted to one side of this frame, glass plate, carrying phosphor dots, to other side. Screen assembly is then bolted inside metal shell

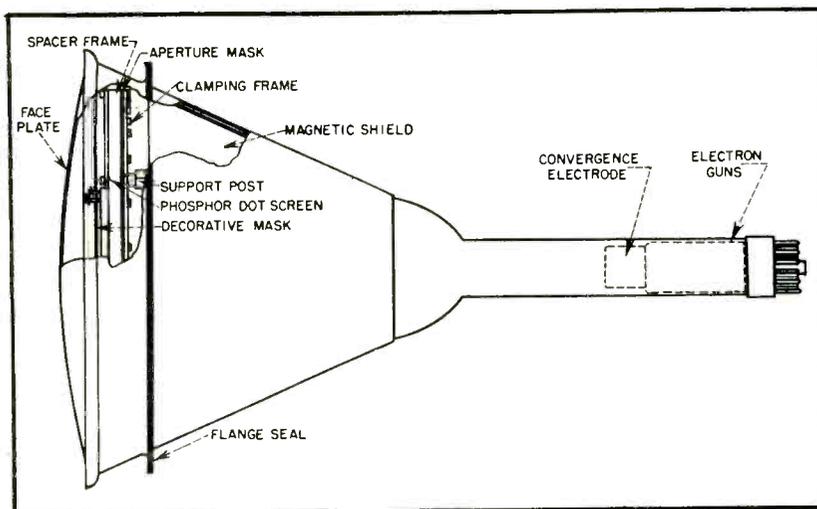


FIG. 1—Internal elements of the tricolor tube. The metal shell has approximately the same dimensions as the 16AP4 black-and-white kinescope

posts, mounted on the inner surface of the metal shell of the tube.

Within the shell, also supported on these posts, is a high-permeability magnetic shield which extends from the aperture mask to the neck of the tube. A black mask, which frames the phosphor screen and hides the frame bolts, is mounted directly in front of the screen, as shown.

After the screen assembly and magnetic shield are mounted within the metal shell, the front portion ("cap assembly") of the tube is welded to the shell on the flanged seal shown. The cap assembly consists of a conical metal shell, blackened on the inner surface to reduce reflected light, and a curved clear-glass face plate.

## Fabrication of the Aperture Mask

The aperture mask is a sheet of copper-nickel alloy, 4 mils thick.

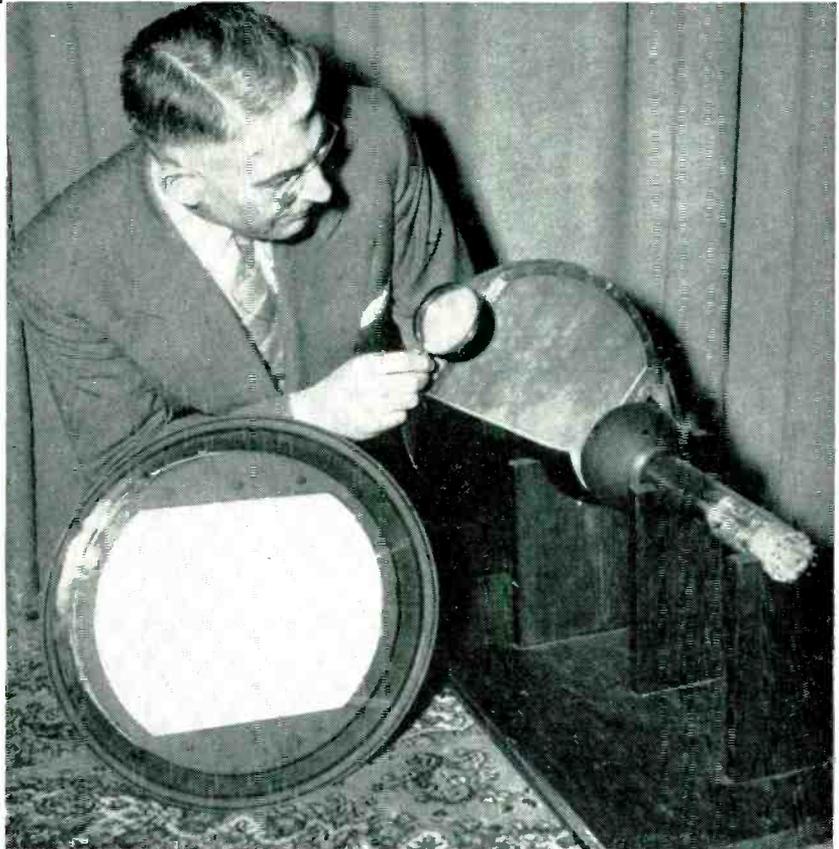
# TRICOLOR PICTURE TUBE

By means of a photoengraving process, 200,000 holes are etched in this sheet according to the dimensions shown in Fig. 3. Although the details of the photoengraving process are not given, the following description of commercial photoengraving is illustrative of the general principles involved.

The metal sheet is coated with a solution of fish glue and ammonium bichromate which renders it photosensitive. The sheet is then exposed to light through a dotscreen negative. The negative in turn is made by exposure through a screen plate, consisting of two glass plates, each engraved with fine parallel lines filled with an opaque substance. The glass plates are bound together so that the two sets of opaque lines cross at 60 degrees, forming transparent dots between the sets of lines. The light, passing through the screen plate to the negative, exposes the negative material in a series of closely spaced dots. The negative consists, then, of an array of black dots having the spacing and arrangement shown in detail in Fig. 3.

The metal sheet is placed in contact with this dot negative and exposed. The sheet is then developed in water, which removes the coating where it was unexposed to light (in the dots). The rear (untreated) surface of the metal sheet is coated with asphalt, and the sheet is placed in a bath of iron perchloride, which etches the metal in the unexposed (dot) regions. The etch is allowed to proceed until the metal is eaten through, the holes thereby formed being exact replicas of the dots in the negative. The metal sheet is then cleaned to remove all traces of bichromate, asphalt and iron perchloride.

The aperture mask is mounted on the spacer frame so that it fits snugly over two guide pins. To assure that the mask is perfectly flat when mounted, it is heated to about



Cutaway view of tricolor tube from rear, showing aperture mask. Holes in mask, 200,000 of them each 9 mils in diameter, are formed by photoengraving process



External view of tricolor kinescope. Phosphor screen and aperture mask are assembled as a unit before mounting within metal shell

85 degrees centigrade and the mounting screws are driven home while the mask is hot. When it cools, the mask becomes stretched taut over the spacer frame. The guide pins are then removed from the spacer frame, to allow light to pass through the guide-pin holes, as outlined below.

### Photographic Gelatin Stencil

When the aperture mask and spacer frame are assembled, they are used to produce a gelatin printing stencil, by which the phosphor dots are laid down on the viewing screen. The method is as follows: The mask and spacer frame are covered with a glass photographic Kodalith plate. The plate takes the position later to be occupied by the phosphor-dot screen. A very brilliant point source of light (the Western Union zirconium concentrated-arc lamp is suitable) is then placed, as shown in Fig. 4, so that its light passes through the holes in the mask to the Kodalith plate. The lamp is placed precisely where the blue electron gun will be located, relative to the screen assembly, in the completed tube. Consequently, the Kodalith plate is exposed, through the holes in the mask, at precisely the places where the blue phosphor dots are to appear. Two separate light sources expose the plate through the guide-pin holes.

The photographic plate is then developed and opaque spots appear on it, one for each hole in the mask, as well as two larger stencil marks which mark precisely the location

of the guide pins. The gelatin is then made from the Kodalith plate as follows: A paper-backed gelatin sheet, photosensitized with ammonium bichromate, is covered with a 5-mil sheet of clear Vinylite plastic and exposed in contact with the Kodalith plate.

The paper backing of the gelatin is removed, and the gelatin developed by washing in warm water. This removes the gelatin where it was unexposed. Consequently the gelatin takes the form of a stencil, that is, a sheet with 200,000 holes in it, corresponding to the holes in the aperture mask.

The gelatin stencil, still in contact with the vinylite sheet, is then placed face down on a metal wire mesh, which acts as a carrier and preserves the shape and dimensions of the sheet. The vinylite sheet is peeled off, leaving the gelatin stencil on the wire mesh.

### Printing the Phosphor-Dot Screen

The phosphor-dot screen is printed on a flat glass plate which has been accurately drilled to accept the guide pins previously mentioned. This plate is placed on a printing table and the gelatin stencil placed on top of it, with the gelatin in contact with the glass. The guide-pin holes in the glass are very precisely lined up with the corresponding holes in the gelatin stencil. A paste, made up of the blue phosphor in a binder of ethylcellulose in amyl alcohol, is then pressed through the wire-mesh backing and thence through the holes in the stencil and

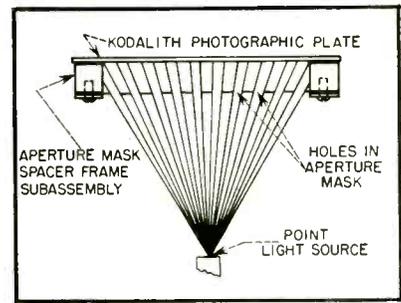


FIG. 4—Method of exposing photosensitive plate (Kodalith) through mask apertures to secure exact register

onto the plate. The viscosity of the paste must be carefully controlled to insure that the phosphor dots are of the proper size.

The stencil is then removed, cleaned and replaced over the glass plate. This time, however, the glass plate is moved by a calibrated cross-fed screw arrangement under the table, with respect to the stencil, until the holes in the stencil take up the proper position for the red dots. The red phosphor paste is then applied in the same manner. Finally, the stencil is cleaned, replaced, and the glass plate moved to the proper position for the green dots. The green phosphor paste is then applied. The process may then be repeated, printing each set of dots two or three times to build up the proper thickness of phosphor.

The phosphor screen is then baked in air to remove the binder, and the plate is sprayed with potassium silicate to bind the phosphor to the glass. The screen is then aluminized and rebaked. Finally, the completed screen is assembled to the spacer frame, using the guide pins to insure accurate alignment. The screen assembly is then mounted as a unit within the metal shell, as previously described, and the cap assembly welded in place.

The glass neck of the tube, containing the electron guns, is fastened to the metal cone with the aid of a mandrel which maintains the bore of the tubing in exact alignment with the screen assembly. The tube is evacuated through an exhaust tubulation at the base-end of the tube. The base itself is a 14-pin (diheptal) structure which provides separate connections to the cathodes, control electrodes, and focusing electrodes.—D.G.F.

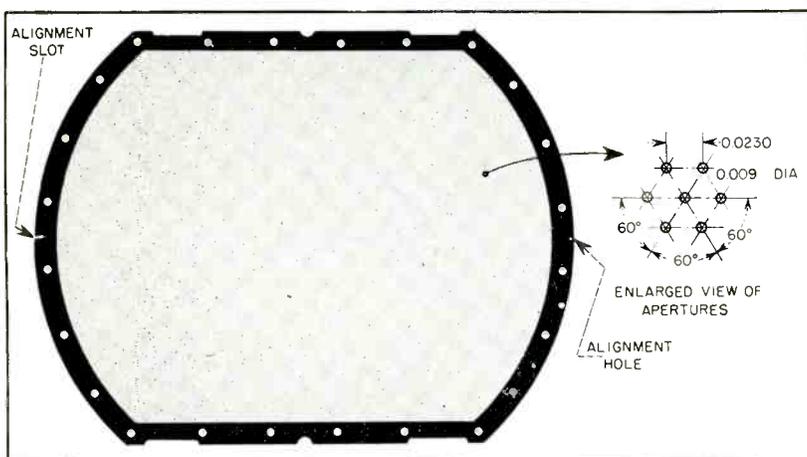
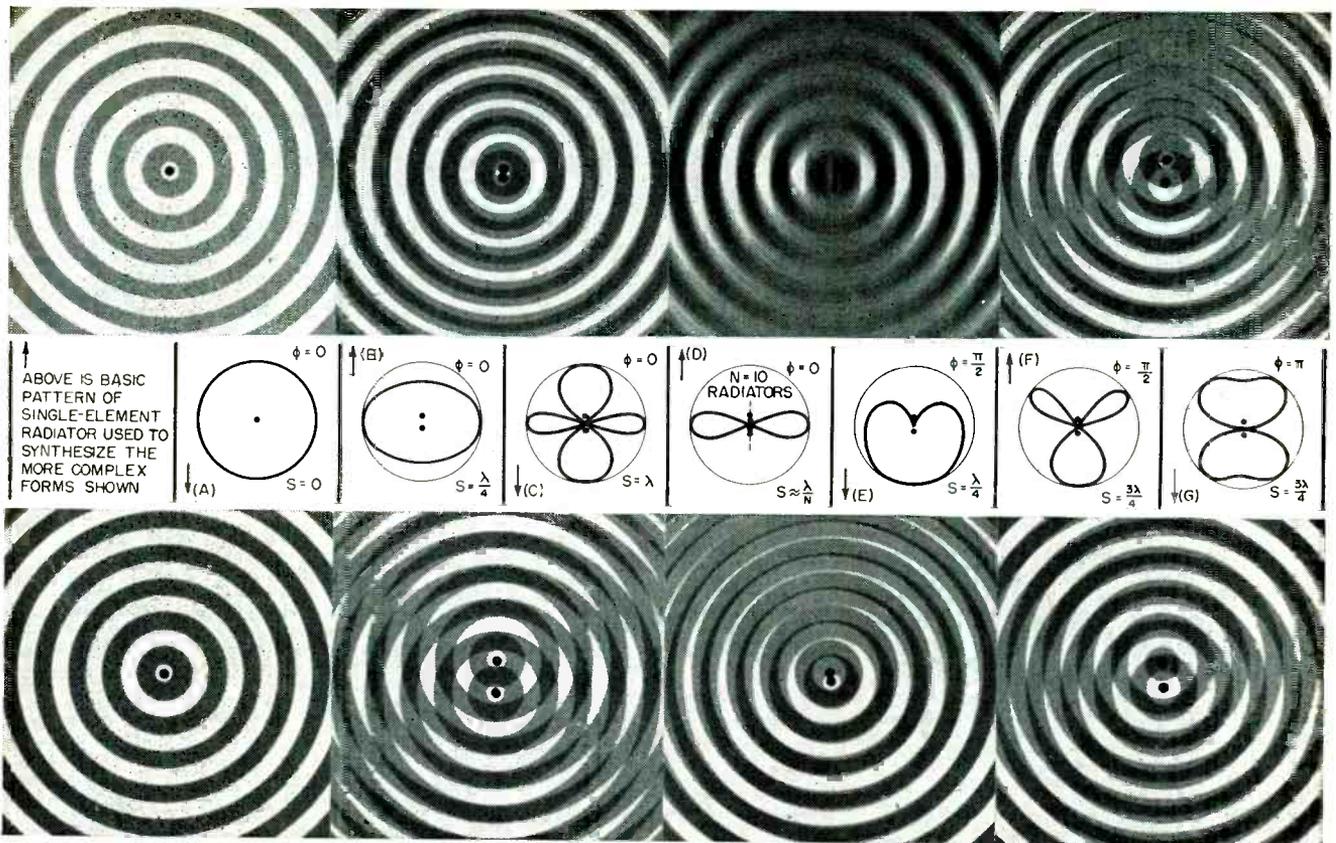


FIG. 3—Dimensions and arrangement of holes in aperture mask



# Photo Radiation Patterns

Two-dimensional wave interference patterns of two or more radiators of same frequency and polarization can be synthesized quickly and economically by superimposing bullseye patterns photographically. Examples are shown above

**P**HENOMENA of wave propagation, reflection and refraction are best demonstrated by the ripple tank. In cases where the extreme versatility of the ripple tank and its high cost and complexity are not justified, the simple and economical photographic process described may be used. The system provides two-dimension patterns of two or more radiators of the same frequency and polarization.

The image of a wave in a plane normal to the radiator is first drawn in the form of concentric circles centered on the radiating source which appears as a point. The lines represent either a minimum or a maximum; thus they are made equal in thickness to the

By **GERHART W. GOEBEL**

*Telecoms Central Office  
German Post Department  
Darmstadt, Germany*

spaces between them, which represent the opposite wave condition. A photographic negative prepared from the target-shaped drawing is then printed on soft photographic paper with an exposure value of one-half normal. This produces the basic pattern of grey and white.

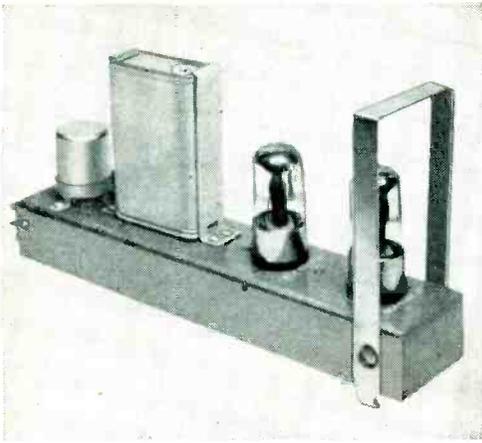
### Pattern Synthesis

In the radiation pattern of two radiators spaced  $S$  degrees and having phase difference  $\phi$  (where  $S = 0$  and  $\phi = 0$ ), the negative is printed twice with the same expos-

ure. The result is an image of two grey-and-white patterns superimposed to form a black-and-white pattern as illustrated in (A). The double density of the dark portion indicates reinforcement.

For various phase differences, separate sets of basic patterns are required, with phase angles shown as increased distances from the center to the first grey circle.

The method described is especially useful in helping students visualize the effects of spacing and phase changes on radiation patterns. Extremely vivid illustrative material can be prepared by taking cartoon-type movie exposures of patterns with gradually changing conditions of phase and/or spacing.



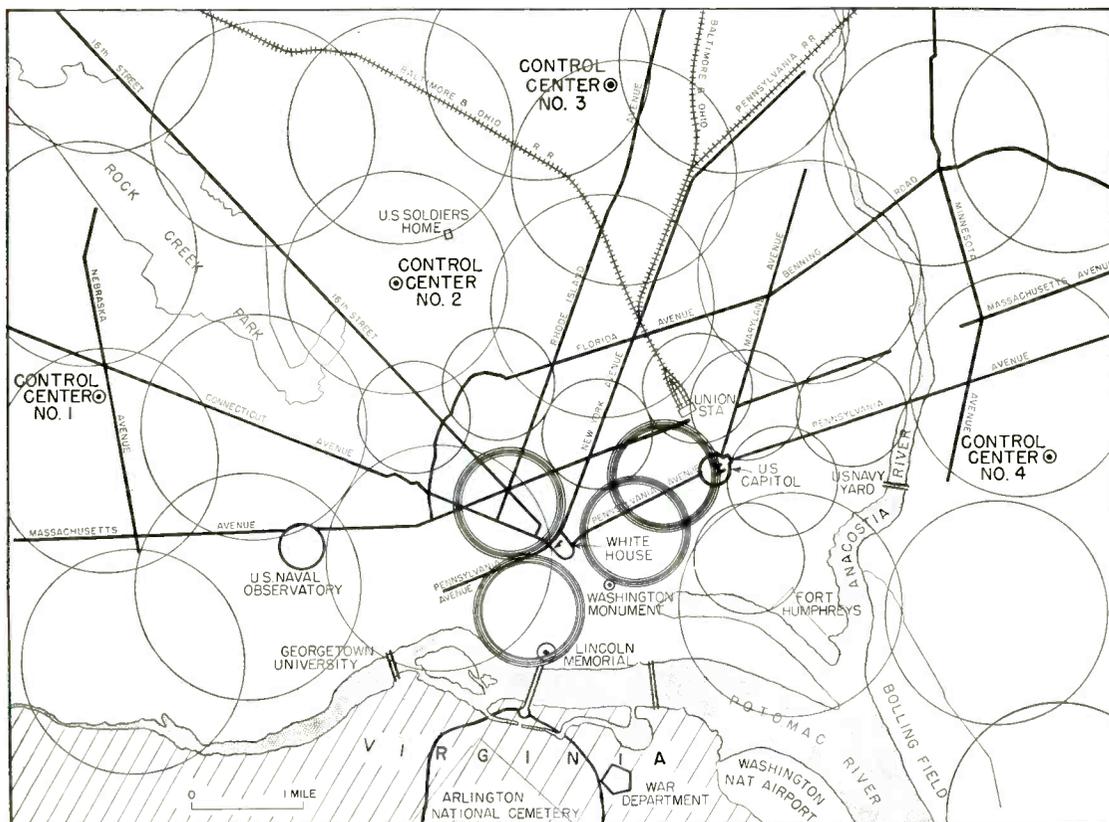
Electronic siren at control-transmitter location generates alarm signals for all receiver locations



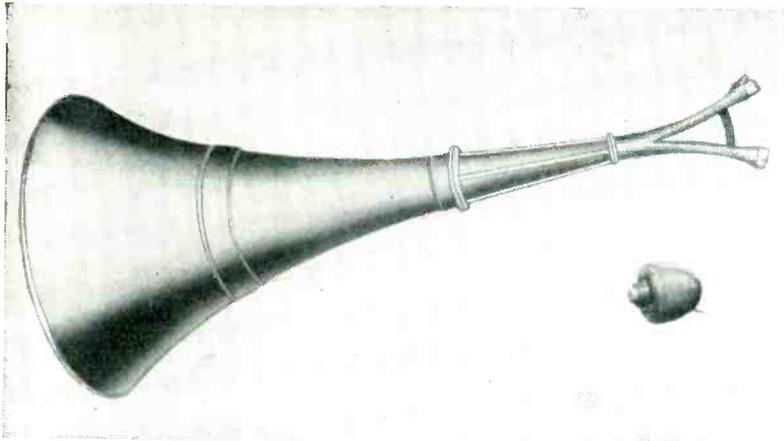
Entire populace can be warned from central control station which can broadcast both alert signals and verbal instructions during and after an attack

# WASHINGTON ADOPTS Automatic

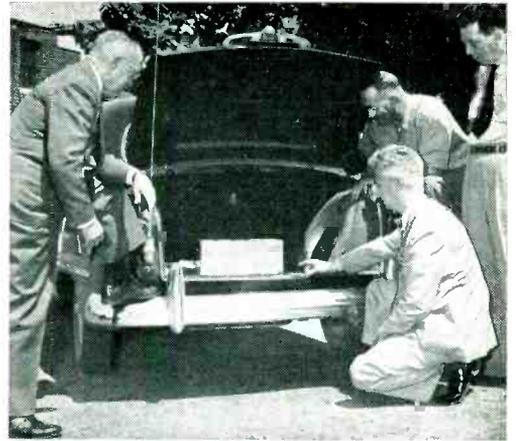
F-M transmitters at control locations send coded messages to strategically-located alarm positions. Decoding receivers and high-powered amplifiers broadcast transmitted alarms instantaneously. System can also disseminate verbal instructions



Each alarm position (center of each circle on District of Columbia map at left) receives coded signals from control center antenna (shown at right). Heavy circles in vicinity of White House and U. S. Capitol indicate alarm positions that have already been installed



Warnings are broadcast by six-foot horn loudspeakers, each of which is fitted with two driving units, and capable of providing 75-db signals at one mile



Mobile units are also tied in with District of Columbia emergency-communications system

# C-D Warning System

**S**UCCESSFUL operation of a city's civil-defense organization depends on the existence of a dependable communications system.

Warning centers are faced with two communications problems: (1) air-raid-warning signalling, and (2) civil-defense communications for operational purposes. For various reasons, land lines cannot be relied upon as the sole means of signalling and communicating. Radio lends itself to the problem in many ways and can, in fact, be used as the basic mutual-aid communications system after a warning has been activated by the Air Force.

The system described here has been approved for use in the District of Columbia for the protection of Washington and much of the area surrounding it. Every known safety precaution has been incorporated. In the event of an alarm, the pushing of a single button will immediately alert the entire populace, and the same equipment can be used subsequently for issuing verbal instructions to the public.

## Coding System

The warning system makes use of f-m transmitter control stations

By **HERBERT A. FRIEDE**

*Deputy Director of Civil Defense  
Government of the District of Columbia  
Washington, D. C.*

so designed that special coded signals are transmitted which automatically turn on loudspeaker horns located throughout the city. Each horn is equipped with an automatic decoding device that can be operated only by the controlling transmitter, and then only when the properly coded signals are transmitted, thus preventing any horn from issuing a false alarm. As an additional safety factor, and to facilitate maintenance and possible future signal changes, the actual 400 to 1,000-cps alarm tones are generated by an electronic siren at the control headquarters. The siren has a distinctive tone that distinguishes it from fire and police alarms. Provisions are made for transmitting alerts, the all clear and such verbal instructions as may be desired. All main equipment at a command center, including auxiliary power supplies, is in duplicate.

The accompanying map shows the general locations of the various alarm units. Each circle designates one alarm unit, the multiple circles

indicating installations that have already been made. Alarm units are capable of providing a minimum of 125 db at 100 feet, or 75 db at a distance of one mile.

Each alarm unit contains a receiver, a decoder, and four 70-watt amplifiers that are capable of continuous operation. Each of these amplifiers is connected to a 6-foot horn speaker equipped with two driving units, as illustrated in the photographs. These horns broadcast information transmitted by the main station transmitter, whether actual alarm signal or voice.

The power amplifiers have less than 5-percent distortion. In full operation, they consume over 220 watts. Push-pull 807's in class AB<sub>1</sub> provide the desired amplification, when used with 10-db inverse feedback. Standard output impedances are provided. Self-contained power supplies operate on standard line power. The response curve of the amplifiers is essentially flat from 20 to 20,000 cps, gradually tapering off at both ends. The receivers used are conventional.

Alarm-position equipment is designed to perform under all conditions of weather, and all components are electrically and mechanically interchangeable.

## By GEORGE M. CHUTE

Application Engineer, Apparatus Dept.  
General Electric Co., Detroit, Mich.

**A**UTOMATIC PACKAGING at eye-blurring speed is today an essential complement to mechanized production of consumer goods. Only by eliminating manual handling, filling and sealing operations can an attractively packaged product be turned out at prices low enough to meet competition and achieve the required sales volume.

In order for a machine to convert a web of printed paper and a stream of finished products into a production of wrapped or boxed consumer goods, with each printed design accurately centered on the face of the package, some type of photoelectric web-register control is needed. In the early days of electronics a single phototube fed a few conventional amplifier tubes that actuated the solenoid of the cutter bar. This sufficed for slow-speed equipment and simple package designs, but today much more elaborate control equipment is required. Thyratrons, saturable reactors and selsyns now appear in the circuits, and some even use as many as three phototubes to obtain the required accuracy of register control.

With minor modifications, the same electronic control equipment can be used also for side-register control. This insures that paper, rubber, metal or other sheet material is wound evenly onto a roll at high speed. Here the electronic equipment must actuate a motor that shifts the winding arbor in either direction as required to make the wound edges of the rolled product smooth.

### Simple Two-Point Side-Register Control

In this article, a number of new control circuits developed for side-register control and web-register control will be presented and analyzed in detail.

In the photoelectric side-register control circuit of Fig. 1, the photo-

This article is based on material contained in a forthcoming book by the author, "Electronic Motor and Welder Controls," to be published by McGraw-Hill Book Co.

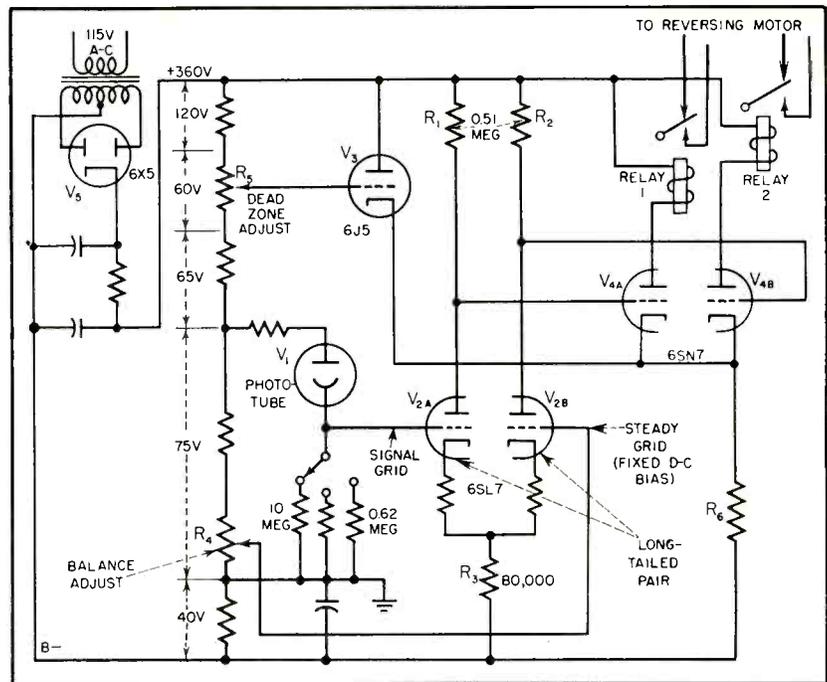


FIG. 1—Simplified circuit of two-point side-register control for lining up ends of roll of sheet material while it is being wound at high speed. Relays in the output stage control reversing motor directly or through contactors

# New Photoelectric

tube is aimed at the edge of a continuous web or strip of paper or metal that is being wound onto a roll. Any small sidewise movement of the strip is detected by the phototube, which in turn actuates the electronic control circuit that makes a motor move the whole roll axially so its wound edge will be smooth. This control unit is used when the rate at which the edge of the strip changes position is not more than 10 inches per minute.

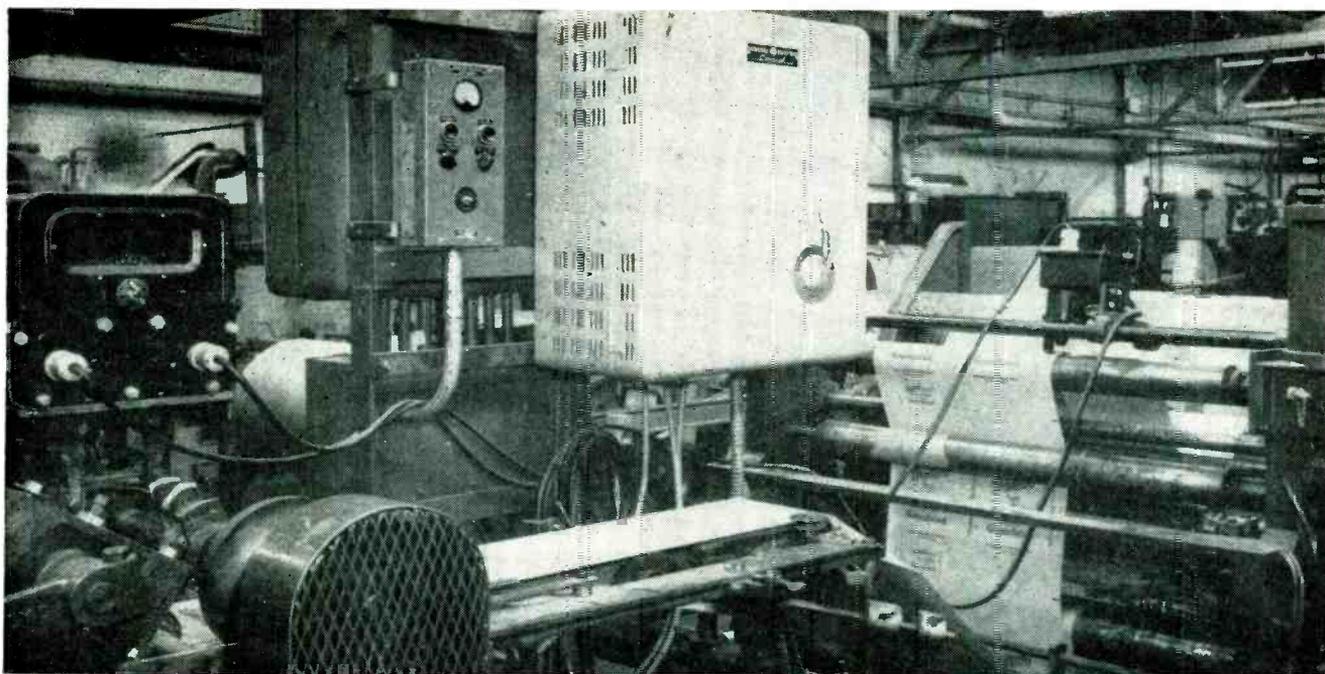
At the desired strip position, the beam of light from the light source is half cut off by the edge of the strip, and neither  $V_{4A}$  nor  $V_{4B}$  pass enough plate current to pick up their relays. If this edge moves in the direction wherein less light reaches the phototube, the increased phototube resistance drives the grid of  $V_{2A}$  more negative. The resulting lower plate current in this tube means reduced voltage drop across  $R_1$ , making the grid of  $V_{4A}$  more positive so that this tube's increased plate current picks up relay 1. The relay contacts then make the roll-shifting motor move the roll axially

in the proper direction so half of the light beam again reaches the phototube. If the roll moves too far in this correcting direction, or if the initial error was such that more than half the light beam reached the phototube,  $V_{2A}$  and  $V_{2B}$  act as a long-tailed pair to operate relay 2 and make web correction in the opposite direction.

### Long-Tailed Pair

As a long-tailed pair,  $V_{2A}$  and  $V_{2B}$  (usually exactly alike and in the same enclosure) have equal plate resistors  $R_1$  and  $R_2$  and have their cathodes connected to a single resistor  $R_3$ . Any current through either triode must pass through  $R_3$ , which is the long tail for this pair of tubes. The grid potential of  $V_{2B}$  does not change once it has been set by balance adjustment  $R_4$ .

The long-tailed pair of tubes receives just one signal, at the grid of  $V_{2A}$ , and changes this into two equal and opposite output signals. When the circuit is in balance, so that the signal grid is at exactly the same potential as the steady



Photoelectric cutoff web-register control installed on bag-making machine. Scanning head that views register marks is just over printed paper on machine at right. Unit with two cables (left center) is photoelectric selector switch that checks position of cutter knife and compares with register marks

# REGISTER CONTROLS

Three recently developed automatic side-register and web-register circuits boost output and improve quality of high-speed winding and packaging machines using sheet material. Unique circuit features are long-tailed pairs, thyratrons feeding correction motor directly, and three-phototube arrangement for precise cutting of moving patterns

grid, the plate currents are equal and the voltage drops across equal-value plate resistors  $R_1$  and  $R_2$  are equal. If the combined plate current flow of the two tubes is 0.6 ma, it produces a 48-volt drop across the 80,000-ohm cathode resistor  $R_3$ . The balance control might be set typically to make the grids 46 volts above B-, giving grid-to-cathode voltages of -2 volts at balance.

If now the signal grid becomes more positive, as when the phototube receives more light, the increased plate current in  $V_{2A}$  and  $R_1$  makes the grid of  $V_{1A}$  more negative. The increased  $V_{2A}$  plate current also increases the voltage drop across  $R_3$  so that the cathode of  $V_{2B}$  rises slightly, perhaps to 48½ volts above ground. Since the grid po-

tential of  $V_{2B}$  is fixed at 46 volts, the grid voltage of  $V_{2B}$  becomes -2½ volts instead of -2 volts, thus decreasing the current in  $V_{2B}$  and  $R_2$ . The resulting decreased voltage drop across  $R_2$  makes the grid of  $V_{4B}$  more negative, giving the desired opposite output signal here. The large plate current increase in  $V_{2A}$  is nearly offset by the large plate current decrease in  $V_{2B}$ , so the total current in  $R_3$  has increased very little; this long-tailed pair draws nearly constant current from the d-c supply.

### Dead Zone Adjustment

When a motor moves a heavy roll to the right or left to seek a central position, the roll may coast beyond the center; before it stops moving

to the left, the control circuit may give a signal to move it back to the right. To decrease this hunting action or back-and-forth movement of the roll, a dead-zone adjustment of the roll, a dead-zone adjustment  $R_5$  is included. This acts with  $V_3$  to let the roll overshoot the central position without causing an opposite correction.

If the  $R_5$  slider is moved away from B+ until the grid of  $V_3$  is say 200 volts above ground, enough current will flow through cathode resistor  $R_6$  to make the cathodes of  $V_3$ ,  $V_{4A}$  and  $V_{4B}$  about 205 volts above B-. The latter two tubes may be passing a small amount of current, but not quite enough to pick up the relays inasmuch as their grids are also about 200 volts above B-. With this setting of  $R_5$ , a very small

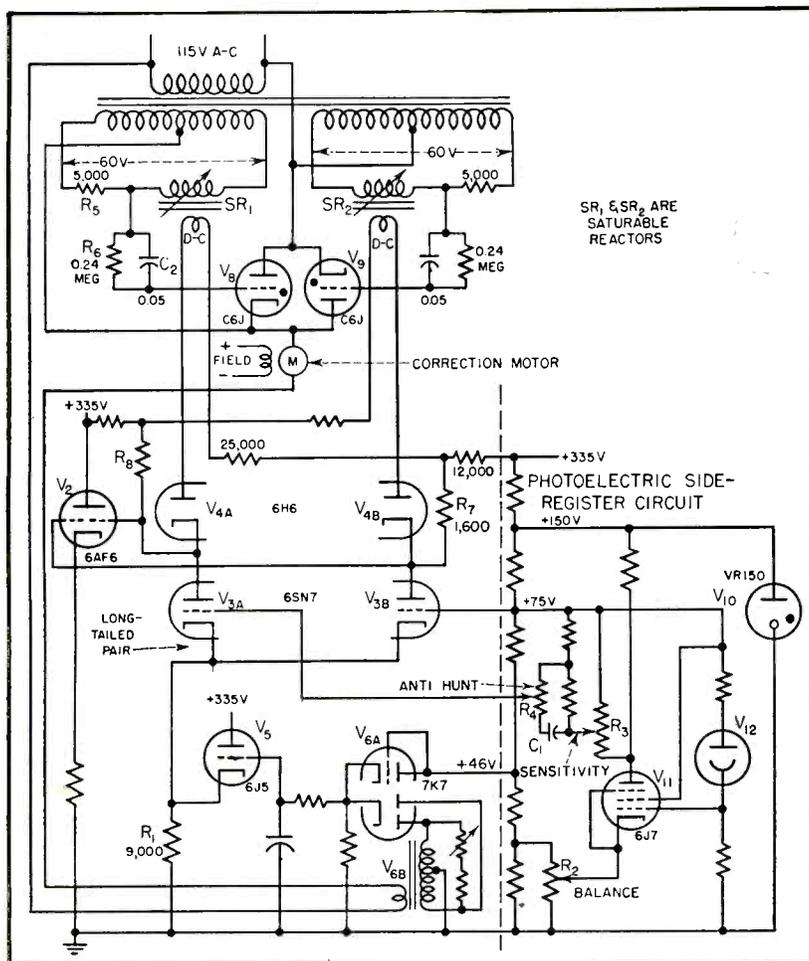


FIG. 2—Side-register control with thyatron output tubes that supply armature current directly to correction motor. Each thyatron furnishes current for one direction of rotation of correction motor

result as a rise in the grid potential of  $V_{3B}$ ; greater current flows in  $V_{3B}$ ,  $V_{4B}$  and the d-c winding of saturable reactor  $SR_2$ , and no current flows in  $SR_1$ . The greater current in  $SR_2$  fires  $V_8$  earlier in its half-cycle of a-c plate voltage, while  $V_8$  fires later or not at all. The current pulses from  $V_8$  (flowing always in the same direction) pass through the armature of a d-c correction motor, turning this motor so as to give the desired movement to keep the roll or web in register. No tubes in the circuit are capacitor-coupled.

Before studying the thyatron circuits in detail, let us see how the photoelectric side-register circuit produces a signal that lowers the grid potential of  $V_{3A}$  as outlined above.

### Phototube Action

When the web roll is in the correct position, no motion of the correction motor is desired. At this position, the phototube receives a certain amount of light that determines the value of the steady control grid voltage on  $V_{11}$ . The amount of  $V_{11}$  plate current can be adjusted with  $R_2$ , which determines the cathode potential of the tube. There will be one correct setting of  $R_2$  at which both  $V_{3A}$  and  $V_{3B}$  pass very little current, so that both thyatrons are held off equally and the correction motor does not turn.

When the web shifts sidewise and increases the light on the phototube,  $V_{11}$  passes more current; as a result, the potential at the plate of  $V_{11}$  is lowered. This potential change acts on the grid of  $V_{3A}$  through sensitivity control  $R_3$ . Advancing  $R_3$  to pass on a larger portion of the  $V_{11}$  plate signal makes the circuit more sensitive, for the correction motor responds to a very small shift of the web. With such quick action the equipment may hunt. To decrease such hunting, part of the output voltage of the sensitivity control is applied to an antihunt circuit consisting of  $R_4$  and  $C_1$ . When light increases at the phototube, lowering the signal voltage applied to the antihunt circuit, the voltage across  $C_1$  does not change at once; the grid of  $V_{3A}$  is forced negative as though connected directly to the plate of  $V_{11}$ ,

movement of the strip edge or small change of light will cause the plate current of either  $V_{4A}$  or  $V_{4B}$  to increase slightly and pick up a relay. Such close adjustment may be expected to cause hunting or continued back-and-forth motion of the roll.

If the slider of  $R_2$  is moved about 10 volts closer to B+, the increased  $V_8$  plate current raises the voltage drop across  $R_8$  by nearly 10 volts so that the cathodes of  $V_{4A}$  and  $V_{4B}$  are about 215 volts above B-. This makes the tube grids about 15 volts negative with respect to their cathodes. A greater change of light is therefore needed at the phototube in order to drive the grids the extra 10 to 12 volts positive before a relay can cause a correction. In this way a dead zone is formed; when the wound roll approaches the central position and both relays are dropped out, the roll, while coming to rest, may overshoot by the

amount of this dead zone without causing another correction. Of course the wider dead zone is obtained at a sacrifice in smoothness of wound roll.

### Side-Register Control with Thyatron Drive

In the all-electronic side-register control of Fig. 2, thyatrons  $V_8$  and  $V_9$  supply current directly to the correction motor, hence no relays are used. Thyatron  $V_8$  fires to make the motor move the roll sidewise in one direction, while  $V_9$  causes roll movement in the opposite direction.

Triodes  $V_{3A}$  and  $V_{3B}$  respond to signals received from the phototube amplifier tube  $V_{11}$ . When the grid of  $V_{3A}$  is made more negative, less current flows through the tube and its cathode resistor  $R_1$ . Since these two triodes and  $R_1$  operate as a long-tailed pair, reducing the voltage drop across  $R_1$  has the same

but it then returns more positive as  $C_1$  discharges. In this way, the d-c correction motor is forced to turn quickly at first, then it slows down or stops until the effect of its correction can be seen at the phototube.

Now let us see in detail how the circuits in Fig. 2 use this signal at the grid of  $V_{3A}$  to control the speed and direction in which the motor turns.

### Steady-State Condition

When no correction signal is received at  $V_{3A}$  or  $V_{3B}$ , the grids of both these triodes are at the same potential (about 75 volts positive to ground), as finally adjusted by balance potentiometer  $R_2$ . Under this steady-state condition the triodes are passing about 5 ma each, and their cathodes are perhaps 80 volts above ground, as also is the cathode of  $V_6$ . The grid of  $V_5$  is 30 or 40 volts more negative than its cathode now, hence  $V_5$  passes no current.

Part of the plate current of  $V_{3B}$  flows through  $V_{4B}$  and the d-c winding of saturable reactor  $SR_2$  on its way to B+. Similarly, a part of the plate current of  $V_{3A}$  flows through  $V_{4A}$  and the d-c winding of  $SR_1$ . These small direct currents, flowing equally through the two

saturable reactors under balanced steady-state conditions, make both thyratrons fire late in their half-cycles. Since the thyratrons are connected back to back across the a-c supply, only a small a-c voltage appears across the motor armature when they pass the same amount of current. There is no d-c voltage to make the motor turn either way, even though the motor receives full field current (from a 5U4 full-wave unfiltered rectifier circuit, not shown).

To make the motor turn one way, the current through  $V_5$  must be made greater than that through  $V_6$ . The thyatron current is gradually increased or decreased by the phase-shifting bridge circuit that includes a fixed resistor  $R_6$  and a variable inductance provided by saturable reactor  $SR_1$ . The 60-cycle impedance of this reactor ranges from 30,000 ohms (for zero current through the d-c winding of  $SR_1$ ) down to 1,000 ohms for 2 ma direct current.

If less than 1 ma of direct current flows in  $SR_1$ , so that it has 5,000 ohms impedance, the result is as shown in Fig. 3A. Since  $SR_1$  and  $R_6$  each have 5,000 ohms, the grid voltage of  $V_5$  lags 90 deg behind this thyatron's plate voltage (or behind the power transformer secondary voltage which is in phase with the plate voltage). Firing of  $V_5$  is then delayed by the angle A, so that this thyatron applies voltage to the motor armature for about half of its positive half-cycle.

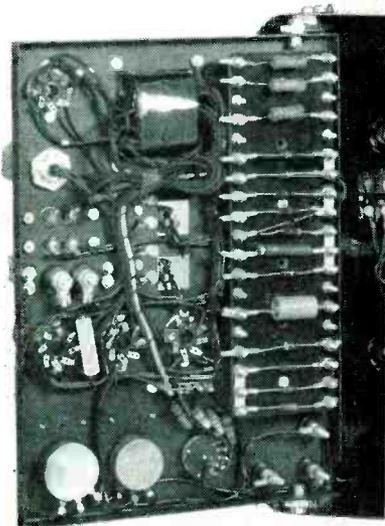
To prevent accidental firing of  $V_5$  at the start of its half-cycle,  $R_6$  and  $C_2$  are inserted in the grid circuit. By grid rectification, the power transformer secondary forces current through  $R_6$ , charging  $C_2$  so that it is more negative at the grid connection. The effect is most important when the a-c hold-off wave is nearly 180 deg out of phase with the plate voltage.

In the balanced condition where only small equal direct currents flow through the d-c windings of the saturable reactors, the impedance of the a-c winding of  $SR_1$  is perhaps 15,000 ohms, as shown in Fig. 3B. The grid voltage of  $V_5$  then lags the plate voltage by the angle B, so  $V_5$  fires very late, and

applies voltage to the motor armature for a small part of the half cycle. While the circuit is in balance,  $SR_2$  also receives this same small amount of direct current, so  $V_6$  also fires after an equal delay E behind its own plate voltage; the thyratrons pass the same amount of current, but in opposite directions, so the d-c motor does not turn.

### Correction Signal Action

Now see what happens when a correction signal swings the grid of



Two-point side-register control, showing type of chassis assembly used on industrial electronic equipment. Trend is toward use of screw and nut terminals so that repairs in factory can be made without need for soldering

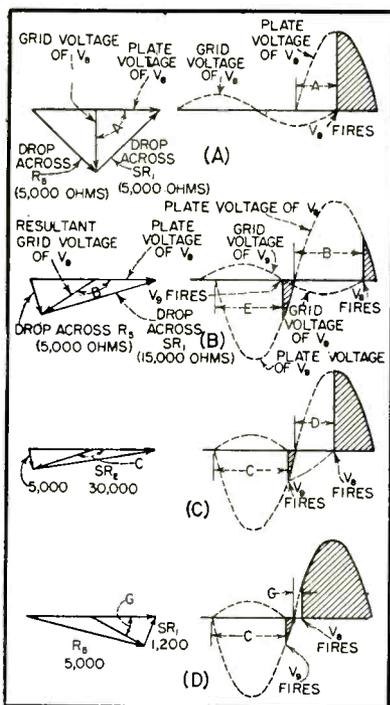


FIG. 3—Thyatron firing actions for various voltage conditions in circuit of Fig. 2

two points and no current flows through  $SR_1$ . This gives the condition shown in Fig. 3C, where firing of  $V_6$  is delayed by the large angle  $C$  (almost 180 deg) so that the plate current flowing in this thyatron is negligible. Meanwhile the increased direct current in  $SR_1$  has caused earlier firing of  $V_8$ , delayed only by the angle  $D$ . Since the positive voltage applied to the armature by  $V_8$  is greater than the negative voltage (below the line in Fig. 3C) applied by  $V_6$ , the motor armature turns at medium speed (to retard the web or to move the roll, say, to the left).

If a stronger correction signal further decreases the plate current of  $V_{3A}$ , it cannot shut off  $V_6$  further but can increase the plate current of  $V_{3B}$  and thereby increase the direct current through  $SR_1$ . Under this new condition, shown in Fig. 3D,  $V_8$  fires after a small delay angle  $G$ ; much greater voltage is applied to the motor armature, which turns at high speed to cause faster correction.

To produce an opposite correction, the grid of  $V_{3A}$  is driven more positive by the correction signal so that the direct current decreases in  $SR_2$  and increases in  $SR_1$ . Then  $V_8$  fires very late but  $V_6$  fires early, applying a large voltage of opposite polarity (below the line) to the armature so that the motor advances the web or moves the roll, say, to the right. Electron-ray indicator tube  $V_2$  shows what web correction is being made.

### Two-Way Cutoff Web-Register Control

Replacing the phototube circuit of Fig. 2 (at the right of the dashed line) with the three-phototube arrangement of Fig. 4 gives a high-speed web-register control for cutting off material precisely at printed register marks as the material is drawn off a roll at high speed.

The general arrangement of the photoelectric sensing system is shown at the lower right in Fig. 4. The draw rolls pull the sheet or web off of a roll of material, previously printed with a design and accurately spaced register marks. This web is fed between cutter rolls that try to cut the web in line with a register mark. The cutters are

driven at constant speed, but the speed of the draw rolls is changed or controlled by the correction motor in Fig. 2 so as to feed the web forward just fast enough to bring a register mark at each cutoff point. A beam of light  $X$  is so located that a preceding register mark decreases the light reaching phototube  $V_{15}$  at the exact instant when a register mark reaches the cutoff point. If the register mark is early, so that this decrease in light occurs before the cutoff knives have turned to the cutting position, the phototube circuit of Fig. 4 makes  $V_8$  of Fig. 2 pass current; the correction motor turns and through a differential gear slows the draw rolls to retard the web.

Just as phototube  $V_{15}$  sees when the register mark reaches the cutoff point, phototubes  $V_{15}$  and  $V_{16}$  see when the knife makes its cut. In the selector-switch assembly that includes these phototubes there is a turning disk, driven by chain or

gear from the cutoff roll; through pairs of holes in this disk, beams of light may reach the phototubes. For an instant before the cut is made, light beam  $Y$  reaches phototube  $V_{16}$ , trying to turn on  $V_{11}$  and thyatron  $V_6$ . Just after the cut is made, light beam  $Z$  reaches phototube  $V_{15}$ , trying to turn on  $V_{12}$  and thyatron  $V_6$ . By a mechanical dead-zone adjustment, the holes in the turning disk may be located so that no light reaches these phototubes at the time of cutting. If the register-mark light dip at phototube  $V_{15}$  occurs during this dead zone, then neither  $V_{11}$  nor  $V_{12}$  passes current and the correction motor does not turn; web speed is right.

Briefly, phototube  $V_{15}$  controls pentode  $V_{17}$  and the control grids of mixer tubes  $V_{11}$  and  $V_{12}$ ; phototubes  $V_{15}$  and  $V_{16}$  control  $V_{14A}$  and  $V_{14B}$  and the third grids of mixer tubes  $V_{11}$  and  $V_{12}$ . This mixer type of tube passes current only when both its first and third grids are positive;

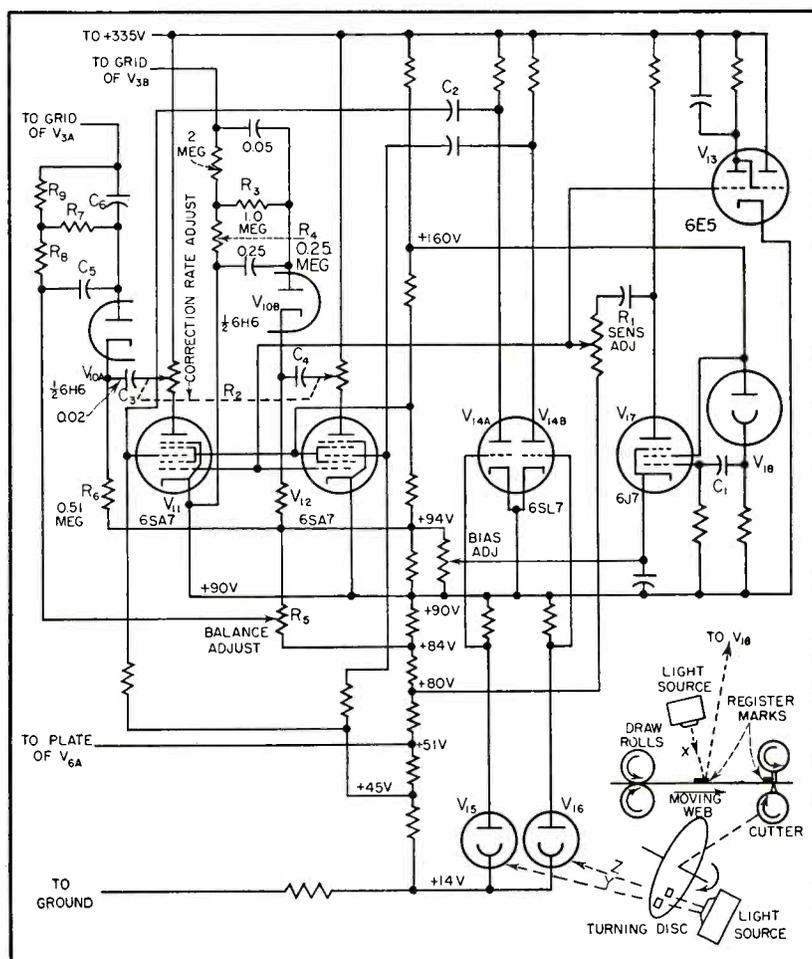


FIG. 4—Two-way cutoff web-register control using three phototubes, replacing single-phototube circuit at right of dashed line in Fig. 2

other grids prevent any interaction between the signals received at the first and third grids. When  $V_{11}$  passes current, the potential fed to the grid of  $V_{3A}$  drops, increasing the current of thyatron  $V_8$  in Fig. 2 to retard the web. When  $V_{12}$  passes current, a similar drop in the potential fed to the grid of  $V_{3B}$  increases the current of thyatron  $V_8$  to advance the web.

### Action While in Register

Phototube  $V_{18}$  and pentode amplifier  $V_{17}$  in Fig. 4 are coupled through capacitor  $C_1$ ; only a sudden light change can thus affect  $V_{17}$ . Each dark register mark on the web dips the grid voltage of  $V_{17}$ , reducing its plate current and correspondingly increasing the potential at all parts of sensitivity adjuster  $R_1$ . This raises the control grid potentials of  $V_{11}$ ,  $V_{12}$  and  $V_{13}$ , and therefore each passing register mark makes electron-ray tube  $V_{13}$  wink and tries to turn on  $V_{11}$  and  $V_{12}$ . This turn-on impulse, at A in Fig. 5A, will not turn on  $V_{11}$  or  $V_{12}$  as long as the impulse occurs during dead zone B. During B, the third grids of  $V_{11}$  and  $V_{12}$  are both so negative that neither tube can fire, even when the first grids are positive.

The holes in the turning disk are adjusted so that no light reaches phototubes  $V_{15}$  or  $V_{16}$  during zone B. With no current through these phototubes, the grids of double-triode  $V_{14}$  are at cathode potential so  $V_{14}$  passes current through both of its plate supply resistors, causing voltage drops that make both plate potentials low. The third grids are about 45 volts more negative.

Earlier than zone B, a disk hole lets light reach phototube  $V_{15}$ ; the resulting phototube current produces a voltage drop across  $R_6$  that lowers the grid potential of  $V_{14A}$  and turns off this triode section. The plate potential of  $V_{14A}$  then rises, and through  $C_2$  raises the third grid of  $V_{11}$  also, as shown during zone G in Fig. 5A. The time constant of  $C_2$  and the third-grid resistor of  $V_{11}$  is about  $\frac{1}{2}$  sec, so the voltage across  $C_2$  changes little during zone G.

Also, later than zone B a different disk hole lets light reach phototube  $V_{16}$ ; current through  $R_{10}$  lowers the control grid potential of  $V_{14B}$  so its

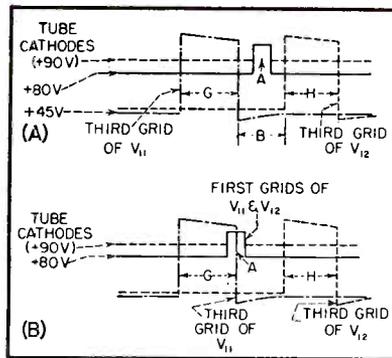


FIG. 5—Voltage relationships in cutoff web-register control under two conditions of operation

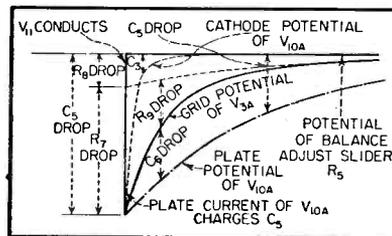


FIG. 6—Action of diodes in providing momentarily a large correction signal

plate potential rises and the third grid of  $V_{12}$  is driven positive, during zone H. Neither of these actions turns on  $V_{11}$  or  $V_{12}$ , for their first grids are too negative to permit electrons to flow. As long as signal A from the register mark stays within zone B, these tubes pass no current and give no correction signal.

So long as  $V_{11}$  and  $V_{12}$  pass no current, the sliders of correction-rate adjuster  $R_2$  are at B + potential (about 335 v). The cathodes of diode sections  $V_{10A}$  and  $V_{10B}$  are at a lower potential (about 94 v), so capacitors  $C_3$  and  $C_4$  are charged to the difference voltage (about 241 v). The plate of diode  $V_{10B}$  is connected through  $R_3$  and  $R_4$  to +90 v; since this is 4 volts negative with respect to the cathode, diode  $V_{10B}$  passes no current. The grid of  $V_{3B}$  in Fig. 2 is therefore held about 90 volts above ground; similarly, the grid of  $V_{3A}$ , adjusted by balance dial  $R_5$ , holds the grid of  $V_{3A}$  also about 90 volts above ground, so that the plate currents of thyatrons  $V_8$  and  $V_9$  are equal and the correction motor does not turn.

### Web Correction

Suppose that the web is moving too fast, so that the register mark produces signal A too early, as

shown in Fig. 5B. At A the control grid of  $V_{11}$  becomes positive while its third grid is still positive; with both grids positive,  $V_{11}$  passes current and its plate potential drops. This sudden lowering of the positive or  $R_2$  side of  $C_3$  drives the cathode of  $V_{10A}$  far more negative than +94 v or the  $R_5$  slider. Tube  $V_{10A}$  then passes current, and its plate also is pulled negative; this negative pulse passes through an R-C network that holds the grid of  $V_{3A}$  negative for a time long enough to let the correction motor reduce the web speed.

Even though the register mark is large or is moving slowly, thereby making  $V_{11}$  pass current for say 1/10 sec, the short time constant (1/100 sec) of  $C_3$  and  $R_5$  lets the cathode of  $V_{10A}$  recover or rise quickly after  $V_{11}$  has lowered its plate potential. Therefore, to provide a correction signal that is not affected by the size or speed of the register mark, diode  $V_{10A}$  passes current for perhaps only 1/1,000 sec, to charge  $C_5$ . Although charged so quickly,  $C_5$  discharges more slowly through  $R_7$  and  $R_8$  ( $\frac{1}{2}$  sec time constant). Moreover, to provide a large correction signal for an instant at the control grid of  $V_{3A}$ , followed by a lesser signal for a longer time,  $C_6$  and  $R_9$  are added (1/10 sec time constant). As is shown in Fig. 6, plate current of  $V_{10A}$  at once pulls the plate of this diode far negative; since  $C_6$  cannot charge at once, the grid of  $V_{3A}$  also is pulled far negative for the first instant. As  $C_6$  charges through  $R_7$  to the voltage across  $R_7$ , the grid of  $V_{3A}$  rises quickly until it remains negative only because of the voltage across  $R_8$ . When  $C_6$  has discharged, this grid returns to the potential at the  $R_8$  slider, ready for the next correction signal.

When the register mark arrives too late, impulse A makes the first grids of  $V_{11}$  and  $V_{12}$  positive while the third grid of  $V_{12}$  is also positive. Current passes through  $V_{12}$  and  $R_2$ ; for an instant the charge on  $C_4$  drives negative the cathode of  $V_{10B}$ . In the same manner as for the too-early condition, the grid potential of  $V_{3B}$  is driven negative, and the current of  $V_9$  increases so that the correction motor raises the draw-roll speed and advances the web.

# Army Walkie-Talkie in Mass Production

Lilliputian f-m set developed by RCA is one of first small military electronic units to roll off assembly lines. Subminiaturization techniques give new vhf unit half the size and weight of former model but twice the range

**M**ASS production of the AN/PRC-10 walkie-talkie, designed by RCA for the U. S. Army Signal Corps, is under way. It is one of the first new military electronic units lending itself to radio-tv-type mass-production methods.

The unit, which contains 290 components furnished by 181 suppliers, went into production under a priority calling for completion of initial sets in 44 weeks, compared to the 55 weeks normally allowed for such a job. Engineers and production men worked closely together to complete the work in less time. They did it in 36 weeks.

Many things were involved in

the production of the needed unit in a hurry. Among them, the following stand out: expediting, sub-assemblies, subminiaturization and dip soldering.

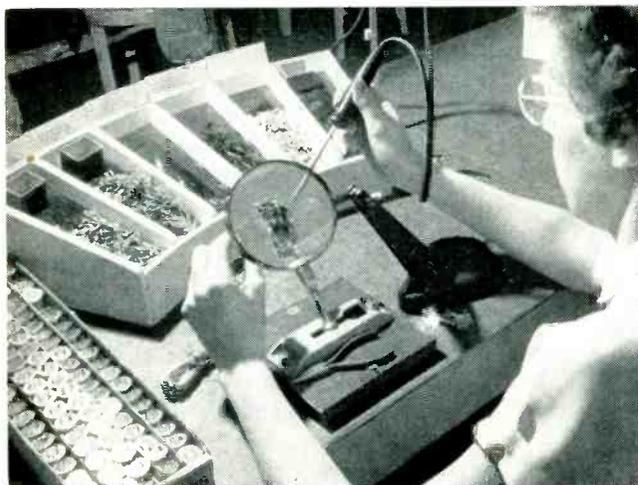
Procurement specialists located sources of supply and placed orders for needed materials by following design growth on the engineers' drafting boards. Each step in the production cycle was given an early boost by having key men all along the line anticipate requirements and start their phase before the preceding one was completed.

Subassemblies consisting of complete i-f and f-m discriminator stages have been reduced in size so

that they can be contained in a metal cylinder about the size of a single miniature tube.

Germanium crystal diodes are used in place of tubes where feasible and subminiature tubes are used elsewhere except for the power output tube, which is of miniature size. Tiny circuit components such as transformer coils less than a quarter-inch deep and half an inch in diameter, yet having a Q near 100, necessitate the use of magnifying lenses by workers in the production line.

One of the most important manufacturing techniques used to turn out the equipment in a minimum of



Magnifying lens being used in assembly-line production of a subassembly of the new walkie-talkie

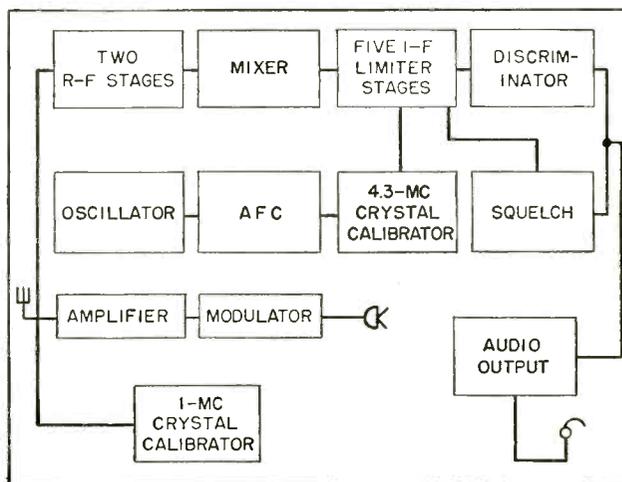
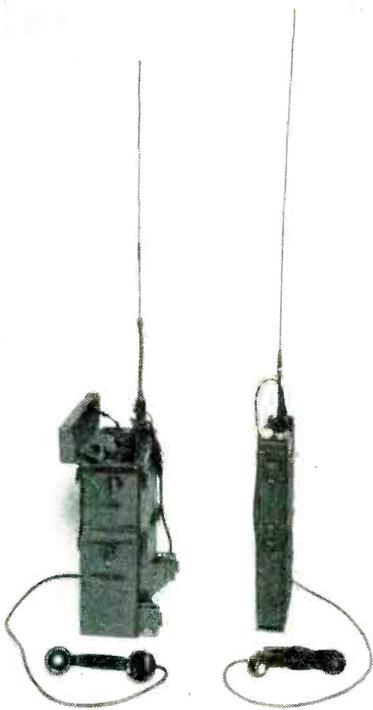
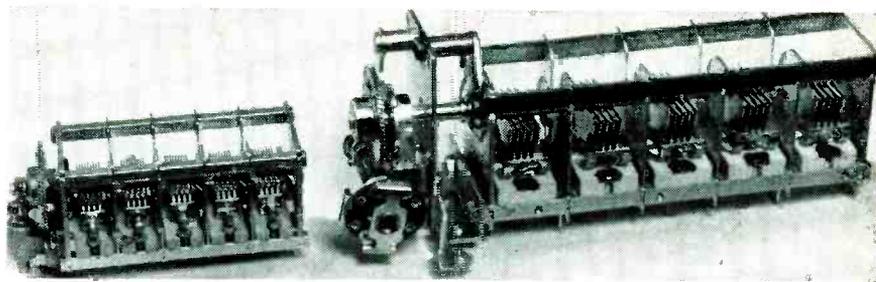


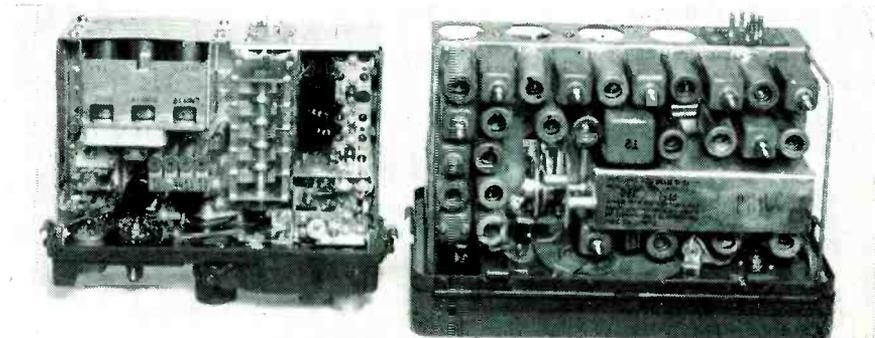
FIG. 1—Block diagram of the AN/PRC-10 walkie-talkie. Effective range is about five miles



Comparison of larger old model with the new at right. Transmitter-receiver unit is in top case, power supply in bottom



Reduced size of ganged tuning capacitor is shown at left as compared with old unit at right



Side-by-side view of new chassis on left and old at right. Miniature components and compact construction permit packing 16 tubes into new model with resulting reduction in size and weight

time is resistance-weld type soldering employed in the i-f stages and other small components.

### Description of Equipment

The AN/PRC-10 is half the size and weight of its predecessor and has twice the range. The transmitter-receiver unit is 9½ inches high, 10½ inches wide, 3 inches deep and weighs 9 pounds. The entire equipment, including power supply and spare parts, weighs only 25 pounds. Reduction in size and weight has not only made the set more portable but has also effected savings in critical materials.

The new unit has increased stability which permits operation of many more walkie-talkies in a given area without interference than could formerly be tolerated.

Provision is made by the 16-tube equipment for two-way voice communication over a range of about five miles on frequencies within the vhf band. It can be used as portable gear strapped to the back of the operator or as a semipermanent installation in a vehicle or on the ground.

Remote operation and unattended relay operation are important fea-

tures made possible by using two units back to back with interconnections enabling them to pick up and retransmit messages in both directions. This type of operation enables communication to be established between two stations separated by high ground by having two relay sets located on the intervening elevation.

The equipment is housed in two waterproof cases, held together by spring clamps. The top case contains the receiver-transmitter unit and the bottom case contains the battery pack. An eight-wire cable connects the transmitter-receiver with the battery.

Transmitting and receiving circuits are both adjusted to operating frequency by the same tuning knob. The dial-drive mechanism is an antibacklash gear train with the antenna tuning components mounted on and operated by it. Other important adjustments are the volume and squelch controls.

The r-f, mixer and oscillator circuits are individual subassemblies consisting of decoupling resistors, a small coil, capacitors and a sub-miniature tube and socket. Each subassembly is located in a small

box. The antenna coil is common to both transmitter and receiver.

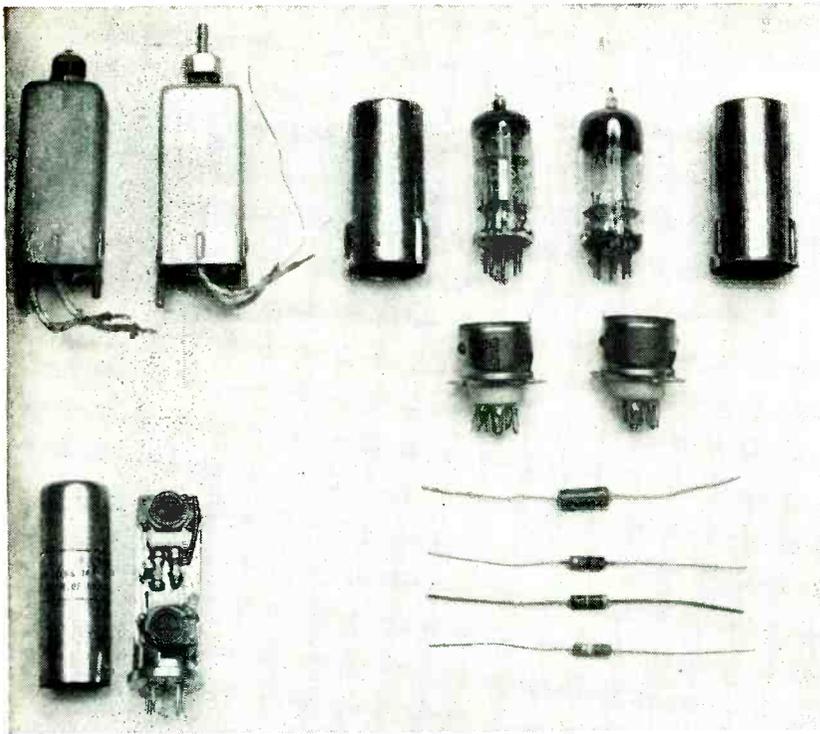
Each i-f amplifier subassembly includes the tube and is hermetically sealed in a can about ¾ of an inch in diameter and 2 inches long. The cans are made with 7-prong plug bases which plug into sockets on the chassis. A similar can contains the discriminator unit which uses two germanium diodes instead of a subminiature tube.

### Location of Parts

The squelch and audio tubes and the crystal calibrator are mounted vertically in the left-center portion of the chassis. The microphone and output transformers are located in front of these tubes and a calibration crystal is located at each end of the row of tubes.

The modulator tube is mounted on the box containing the transmitter oscillator. The grid coil, trimmer and coupling capacitors are all located inside the box. Coils, tuning capacitors, decoupling circuits, coupling capacitors and germanium diodes are located inside the afc box.

Two types of antennas are provided with each equipment. For



New army walkie-talkie discriminator assembly and cover at lower left replace all the other pictured discriminator-stage components, used in old World War II model

maximum range, stationary use and two-way unattended relay operation, a seven-section whip-type antenna is used. Each section of this antenna fits into the ferrule of the previous section. To protect the long antenna from damage by bending if it should strike an object, a spring-section is provided.

For general operation, a short semirigid steel antenna is used, made up of lengths of flexible steel tape riveted together at the base and at various points along the length of the antenna. This tapered antenna is about three feet long and can be folded into a small area without damage.

Location of the equipment naturally affects its range of operation because of the high frequency and low power used. If a semipermanent antenna is mounted on a high elevation point, the effective range of the equipment is greatly extended. The AN/PRC-10 can be used in liaison-type aircraft by making a slight change in the antenna system.

The receiver sensitivity is  $0.5 \mu\text{V}$  with 2.5-mw output, 15-kc deviation and a 10-db signal-to-noise ratio. Selectivity is 80 kc at 6 db down.

A received signal is resonated in both the antenna and the antenna coil and then amplified in the two r-f stages gang-tuned to the operating frequency, as shown in Fig. 1. The amplified r-f signal is fed to a mixer stage together with the local oscillator signal to produce the intermediate frequency in the plate circuit of the mixer.

Five identical cascaded i-f stages follow the mixer and are connected as grid limiters. If the signal from the mixer is strong enough, the i-f stages operate as cascade limiters.

Following the five i-f stages is a discriminator and a single audio stage feeding the handset receiver. The discriminator uses two germanium diodes instead of tubes.

When no signal is being received and the squelch circuit is turned on, the discriminator output is shorted by a relay operated by the squelch tube. This tube is controlled by the grid voltage of the last i-f limiter. The grid voltage cuts off the squelch tube, releases the relay and thereby removes the short on the audio input.

The equipment is calibrated by two crystal-controlled oscillators. The constant-frequency output of one oscillator feeds into the an-

tenna coil. Certain harmonics of this oscillator frequency beat with the intermediate frequency of the second calibration oscillator to produce a calibration signal at every megacycle point on the calibration dial.

The transmitter contains an electron-coupled oscillator whose frequency is controlled by comparing it with the local-oscillator frequency of the receiver. The antenna coil common to both the transmitter and receiver makes up the output circuit for the transmitter.

Frequency modulation is accomplished by varying the magnetic flux through the ferrite core of an inductance coil shunting the grid coil in the tank circuit of the transmitter. The microphone signal and the constant output voltage from the afc circuits are both fed into the modulator stage.

### AFC Operation

Automatic frequency control is provided by an amplifier driver tube followed by a discriminator employing germanium diodes. Zero output is obtained from the discriminator at the intermediate frequency because the discriminator center frequency is tuned exactly to the intermediate frequency. At other frequencies, a positive or negative output voltage is obtained, depending on whether the input frequency is higher or lower than the intermediate frequency. The transmitter center frequency is controlled by the discriminator output voltage which is fed to the modulator stage.

While the transmitter is operating, some of the output signal is by-passed by the first r-f stage, which is inoperative during transmission, and is amplified by the second r-f stage. The amplified transmitter signal is then mixed with the local oscillator signal to produce a given intermediate frequency. The closer this frequency is to the center intermediate frequency the smaller the voltage developed in the afc discriminator. Consequently, the transmitter frequency is controlled to the local oscillator frequency less the given i-f signal frequency. Output from the walkie-talkie is approximately one watt.—R. J.

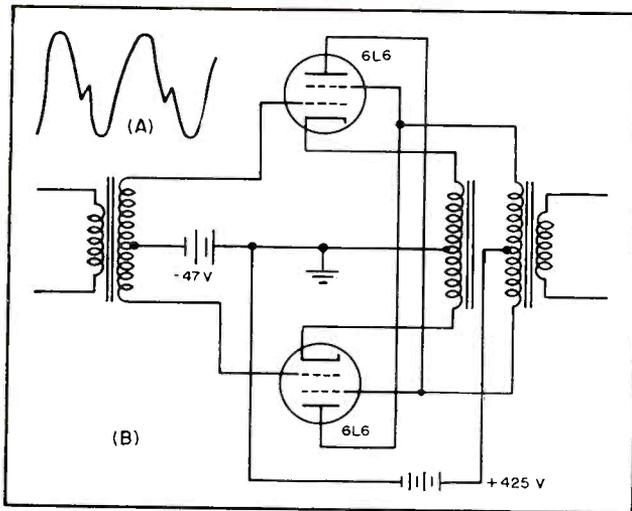


FIG. 1—Typical distortion due to switching transient in class-B amplifier, and McIntosh amplifier circuit

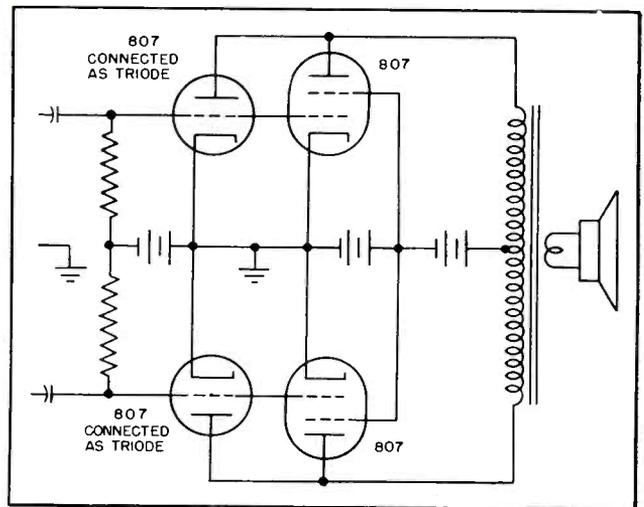


FIG. 2—New extended class-A amplifier circuit, in which the tetrodes are cut off at low operating levels

# Extended Class-A Audio

Combining triode and tetrode operation in each half of a push-pull output stage gives almost 50 watts from four 807's, without special transformers. At low levels only the triode-connected tubes conduct, reducing the house-heating effect

**T**HE PROBLEMS involved in providing power amplification, essentially free of distortion, over the wide range of frequency and amplitude required of a high-fidelity audio system have challenged the ingenuity of engineers for many years. This paper describes a method of combining the familiar advantages of both triodes and tetrodes in such a way as to extend the range of class-A operation to peak power levels heretofore achieved only with class-AB and class-B operation.

The principal disadvantage of class-A operation lies in the relatively high idling or no-signal plate power involved, since for class-A operation the input power will re-

## By HOWARD T. STERLING

Chief Engineer  
The Electronic Workshop  
New York, N. Y.

main nearly constant, regardless of signal level. The power supply accordingly must be designed to provide the power normally required for maximum-signal operation at all times. Many an engineer has designed and built that "amplifier to end all amplifiers" along these lines, only to discover that he has achieved what is primarily a new method for heating the house.

Regardless of the efficiency of a system at maximum level, its no-signal efficiency is still zero. Efficiency figures for full output tell us nothing about idling power. And unfortunately (for the efficiency-minded), the nature of music is

such that full power capability is rarely required. Even the noisiest kind of music (like *Rite of Spring*) hits maximum level only occasionally; most of the peaks will be down about 10 db from maximum, and the average level of the full orchestra will be down about 20 db. This assumes that one is listening at full volume levels. Most of the time one is forced, by wives or neighbors, to turn down the level, and then the excessive power consumption required to accommodate those occasional peaks at full volume is wasted.

### Class-B Distortion

For many years, the answer to this problem of efficiency has been the use of class-AB or class-B operation. For relatively uncritical applications this has been satisfactory. However, with increasing interest in extremely high-quality

This article is based on a paper presented by the author at the 1950 convention of the Audio Engineering Society in New York City.

amplifier design, minor sources of distortion have become more significant. For example, attention has recently been drawn to an inherent distortion due to the switching transients that occur as the plate current in either side of a class-AB or class-B amplifier is driven to cutoff. The nature of this distortion can be seen in Fig. 1A. Work by Sah<sup>1</sup> shows this notch in the curve to be a function of the leakage inductance in the output transformer. Since this distortion is due to the transformer and not the tubes, it does not appear in the distortion figures for this type of operation in the tube manuals. It increases with frequency, and becomes serious above a few thousand cycles.

### McIntosh Circuit

An ingenious method of reducing the inherent distortion of the class-AB or B amplifier was introduced by McIntosh and Gow,<sup>2</sup> using a special transformer in the circuit of Fig. 1B. The close coupling permitted by this configuration minimizes the distortion resulting from the switching transient, by reducing the effective leakage reactance and thereby reducing the magnitude of the transient.

The McIntosh circuit is further distinguished by the presence of a large amount of direct feedback, with  $\beta$  equal to one-half. In this respect there is a similarity to the cathode-follower circuits recently discussed in the literature, and the distortion is correspondingly low.<sup>3</sup> On the other hand, correspondingly high driving voltages are required, calling for special driver design.

As Fig. 1 indicates, both plates and cathodes of the output tetrodes in the McIntosh circuit are connected to appropriate windings on the output transformer. The cathode and plate windings are phased so that the signal currents aid, and the close coupling gives feedback with excellent phase-shift characteristics. By splitting the load between plate and cathode, the impedance of the individual primaries is reduced, so that a smaller turns ratio is required. The screens are so connected that as the cathode voltage of each tube rises with the signal, its screen, being connected

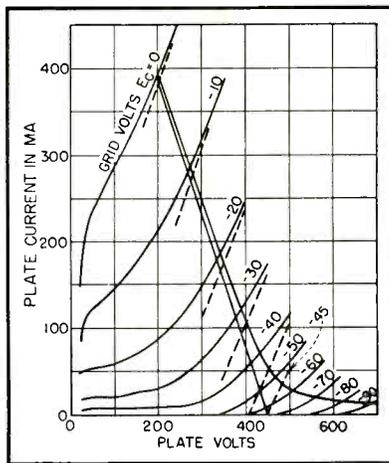


FIG. 3—Composite plate characteristics for 807's operated in extended class A, for 450 volts on the plates and 45-volt bias. Tetrode screen voltage is 300 volts

to the opposite plate, rises in potential with it. The screen-to-cathode potential difference thus remains constant, and high transconductance is maintained throughout the cycle.

What is not generally recognized is that the high power capability of this circuit—50 watts using 6L6's, without grid current—is not a function of the circuit, but is due to operation of the screens at over 400 volts; this is well above normal voltage ratings, though within allowable dissipation limits.

### Extended Class-A Operation

The advantages of class-A operation over class B, however, must be considered. Since plate current flows throughout the cycle, there is no distortion due to switching transients.

In conventional class-A operation of triodes, the output power—and hence the efficiency—is limited by the voltage and current excursions permissible within the restrictions of class A. The peak plate-voltage swing is limited by the fact that the plate current of a triode decreases with plate voltage. Large voltage swings are possible with lead lines of fairly flat slope, but the current swing is then limited.

The triode has the desirable characteristic, though, that as the plate voltage swings positive, greater negative grid voltages are required for cutoff. As a result, the corresponding negative grid swing has further to go to reach cutoff, and class-A operation is

maintained for large values of signal.

Tetrodes and pentodes, on the other hand, are distinguished by relatively high conductance (high plate current at low plate voltage) and by the fact that plate current is essentially independent of plate voltage. High peak currents can therefore be drawn by these tubes, but the cutoff point is fixed. This seriously limits the allowable total grid swing for class-A operation.

Much more satisfactory class-A operation might result if it were possible to combine the large signal-handling capabilities of the triode (where large positive plate-voltage swings effectively extend the cutoff point) with the tetrode's characteristic of high peak current at low plate voltage. For some reason, the characteristics of triodes and tetrodes have always been considered mutually exclusive. The question of how best to combine them posed an interesting problem. A number of solutions were considered, including the development of some sort of hybrid tube. Finally, it appeared that the simplest way to combine these two completely different methods of operation was to make use of both in the circuit shown in Fig. 2.

In this circuit, the triodes are biased for normal class-A operation. This amount of bias will normally cut off the tetrodes. The grid voltage swing becomes positive enough to activate the tetrodes only when it reaches about one-third of its maximum value—about 10 db below maximum power. By operating triodes and tetrodes with the same bias, they reach the grid-current point at the same time. However, at that point the greater current capability of the tetrode results in so large a plate voltage swing that the current from the triode is much less than it would normally be at the grid-current point, since the instantaneous plate voltage is so much lower.

Figure 3 shows the type of combined characteristic obtained. The curves are drawn for 807's, which can be conveniently used as either triodes or tetrodes. The dashed lines in the drawing are the composite grid lines for push-pull operation.

The first and most important

point of interest is the path of operation for one side. Even with maximum grid swing, operation is class A; in fact, the path of operation is nowhere near the zero axis. The load line is drawn for 2,500 ohms plate-to-plate, and its slope is the negative of the slope of the composite plate resistance, thus fulfilling the classic requirements for optimum load. In effect, the triode characteristics are simply elevated by the current drawn by the tetrode, and throughout the region traversed by the load line the performance is typical of the triode. This assures the characteristically low damping impedance which is such a distinctive feature of triodes.

Figure 4 shows half of a typical transfer characteristic for this mode of operation. The slight curvature of the characteristic has been intentionally exaggerated by choice of operating conditions, to show the transition from triode operation to triode-plus-tetrode operation. Careful choice of tubes and operating conditions will serve to minimize this curvature and the resulting distortion.

There is no inherent feedback in this circuit, as there is in the McIntosh-Gow arrangement. Normal use of feedback will have its usual beneficial effects in reducing distortion and improving damping.

Characteristic of this new mode of operation, which we propose to call extended class A, is the broad linearity at low levels typical of normal class-A operation, as distinct from most high-efficiency circuits where low-level operation is close to the cutoff region. In class-B circuits, where feedback is used, at low levels the feedback must attempt to control plate current in a tube which is cut off. This difficult situation is avoided here, and the feedback is fully effective at all levels.

### Economy of Operation

The idling plate current in the extended class-A system is typical of that of a class-A amplifier of about one-third the power capability. The maximum-signal d-c plate current will exceed this idling value by a factor of about three. The power-supply components must be

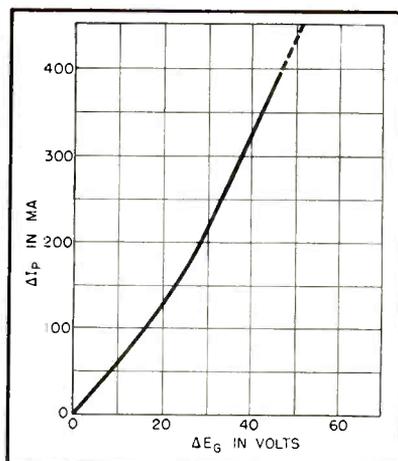


FIG. 4—Transfer characteristic for extended class-A operation. The slight curvature has been intentionally exaggerated by choice of operating conditions

capable of supplying this higher current, but only on an intermittent basis, since actual peak power demands in normal speech or music reproduction occur so rarely. Thus, what is probably the least desirable result of high-power class-A operation, the house-heating effect, has been reduced by a factor of three, with no loss in music-power capability.

One point should be made: the time-honored bogey of operation in the grid-current region is not one that need seriously be considered. While the graphical construction shown is for operation without grid current, the dashed portion of the transfer characteristic (Fig. 4) shows the extension of this operation to a grid swing running positive by 5 volts. This represents a 20-percent increase in power, with a peak grid current of the order of 10 milliamperes. This value of grid current can readily be provided by cathode-follower drive using such tubes as the 6SN7.

Although this system uses four tubes instead of two, it provides about three times the output power that those four tubes would in normal operation. Type 807 tubes, as they are used in most current amplifier designs, will deliver about 8 watts per pair class A, or 16 watts in push-pull-parallel. The same tubes operated in extended class A deliver almost 50 watts at the grid-current point, about three times as much. In addition, of course, there is a substantial saving in idling power.

In addition, the tetrodes are cut off while the amplifier is idling or operating at low level so their life will be significantly prolonged. Furthermore, the tetrodes may be removed from the circuit entirely without affecting low-level operation, the loading being still about optimum; in fact, they can even be considered as spares in case of emergency. This suggests another variation: here is the convenient place for a high-level low-level switch for those passionately interested in numerical efficiency. The tetrode heaters may be switched off except when the maximum power capability is required.

The use of 807's in this discussion does not mean that they are the best tubes for the job. They were chosen for their relative popularity, and because with the operating conditions indicated they demonstrate the knee in the transfer characteristic showing the transition to extended class-A operation.

In a more conventional amplifier design, Electronic Workshop has employed the 6AR6. This tube, currently made by Tung-Sol, is a tetrode somewhat like the 6L6, but designed to handle much higher plate currents at comparable bias voltages. As a triode, the 6AR6 will deliver considerably higher power than the 807 or 2A3, since triode operation at voltages of the order of 400 is within allowable operating conditions. The 6AR6 is very well suited for use in this extended class-A circuit, and will be used in a commercial model.

To summarize briefly: By this kind of parallel operation of triodes and tetrodes, it is possible to realize the significant advantages of both, and to maintain class-A triode operation to a power level and to a degree of efficiency heretofore obtained only in class-AB and class-B operation (usually of tetrodes). As soon as patent arrangements, now in progress, are completed, a commercial version of this circuit will be made available.

### REFERENCES

- (1) A. P. Sah, Quasi-transients in Class B Audio Frequency Push-pull Amplifiers, *Proc. IRE*, Nov. 1936.
- (2) F. H. McIntosh and G. J. Gow, Description and Analysis of a New 50-watt Amplifier Circuit, *Audio Engineering*, Dec. 1949.
- (3) H. T. Sterling, The Cathode Follower as Audio Power Amplifier, *Audio Engineering*, Dec. 1949.

# Improving Industrial Control

To make electronic control more universally acceptable in heavy industries, design engineers must provide more rugged appearance, longer tube life and stable performance.

Equipment should be designed for psychological effect and ease of maintenance

**P**RESENT-DAY electronic design practices are only partially satisfactory in many industrial applications. Acceptance of control units will increase only as they become competitive in cost, performance and reliability with other methods. In only limited fields is electronic control the one practical method.

Long-term reliability and ease of maintenance are the two basic requirements of any electrical apparatus used in continuous-process mills. Many mills operate continuously for many months and shut down for major maintenance only once in several months or a year. Performance of the mill is measured in tonnage and accurate logs of down time chargeable to electrical and mechanical outages go to top management periodically. Outage time is usually measured in minutes per month.

Such a mill may have six motor-driven sections which are electronically regulated. Each section may have six electronic tubes and 30 or more other electrical components. Considering the tubes alone, there are 36 expendable items with a definite life. For no more than one tube failure per month of 720 hours, there must be an average tube life of about 26,000 hours. Such tubes do not exist today.

Ease of maintenance or lack of it results from a combined effort of component and apparatus designers. A mill electrician whose experience has been primarily with heavy devices may not favor flimsy electronic equipment. The problem is not only to make apparatus more in keeping with the average electrician's experience, but also to exert

extra effort toward educating the user on proper care of the strange things with which he considers himself afflicted. The process of education can be made easier by designing apparatus that is mechanically more in keeping with mill practice.

We electronic engineers should remind ourselves frequently that whether we like it or not our products are compared with magnetic control which is almost invariably more sturdily built.

## Construction

Electronic control applications range all the way from full electronic to nearly all magnetic. This poses a dilemma for the designer.

Mixed control is difficult because the two kinds of apparatus are so different physically. To a large extent, this particular problem is psychological. Either method of control may appear plausible by itself but may not when placed side by side in the same cabinet with the other type. Many rather poor dodges are used. One of these is to enclose the lighter electronic equipment in a cabinet within the main control cubicle. This usually leaves a poor impression.

One of the outstanding differences between magnetic and electronic control practices is in panel wiring. The identical wire can seldom be used for both purposes. It has been found that when two kinds of wire are used, the heavier must be used for interconnection between the two panels, otherwise, the whole unit is made to look cheap.

Most electronic apparatus is built on steel panels. Magnetic control, especially for d-c machines, is built on insulating panels. This leads to the necessity of proper arrangement to prevent a patchy ap-

pearance in the finished product.

The light weight of electronic control is very helpful to the designer because it permits convenient plug-in subassemblies. This is advantageous to the purchaser because of quick availability of a great variety of special combinations for quick maintenance. It also permits convenient bench assembly with less-skilled labor than would be required for a more complex complete assembly. One of the outstanding examples of the use of subassemblies is in resistance-welding control where 20 subassemblies can make hundreds of different units.

Many electronic units are packed into a small space by means of hinged panels. In many cases this is desirable but often a large cubicle with stationary panels would be more desirable and less costly.

Because of the small terminal spacings used on standard components, electronic apparatus is more subject to trouble from dirt than magnetic control. This makes it necessary, in many cases, to use nonventilated enclosures. Since some parts of electronic control equipment, such as ignitrons, are more comparable in design to heavy control, it is less necessary to protect them from dirty atmosphere.

Scanners for register regulators and other photoelectric devices have tended to be of sheet-metal construction. The trend now is toward the use of cast enclosures. This is especially important when the device is to be used on a machine having in itself a massive appearance. A cast housing blends well into the over-all machine design.

## Components

The electrical parts that make up electronic control are the building

This article is based on a paper presented at the 1950 National Electronics Conference. The Conference paper will appear in *Proceedings of the NEC*.

# Design

By E. H. VEDDER

*Manager  
Electronic Control Engineering  
Westinghouse Electric Corporation  
Buffalo, N. Y.*

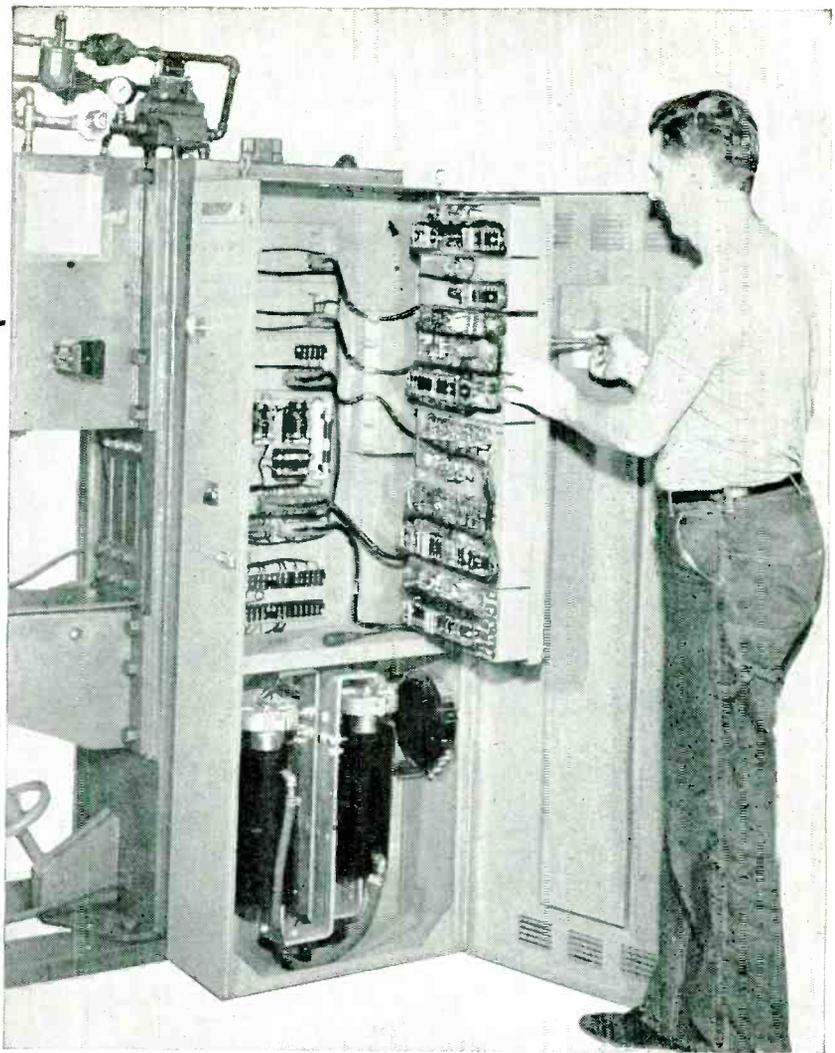
blocks from which the designer must produce a device that will please the user. Most industrial electronic designers will agree that available electronic components are, at best, only partially satisfactory.

The one problem common to all components is one of terminal spacings. Many components are now quite satisfactory in this respect. Among the better ones are capacitors, resistors and transformers. On the other hand, potentiometers and sockets need improvement. Some improvement has been made in sockets by a few manufacturers but little has been done with potentiometers. Only minor changes in design would provide much improvement and should not increase cost or make them less desirable for radio use. For instance, enlarging the terminal clearance hole in the metal case would be a big improvement and mean only a tool change in production.

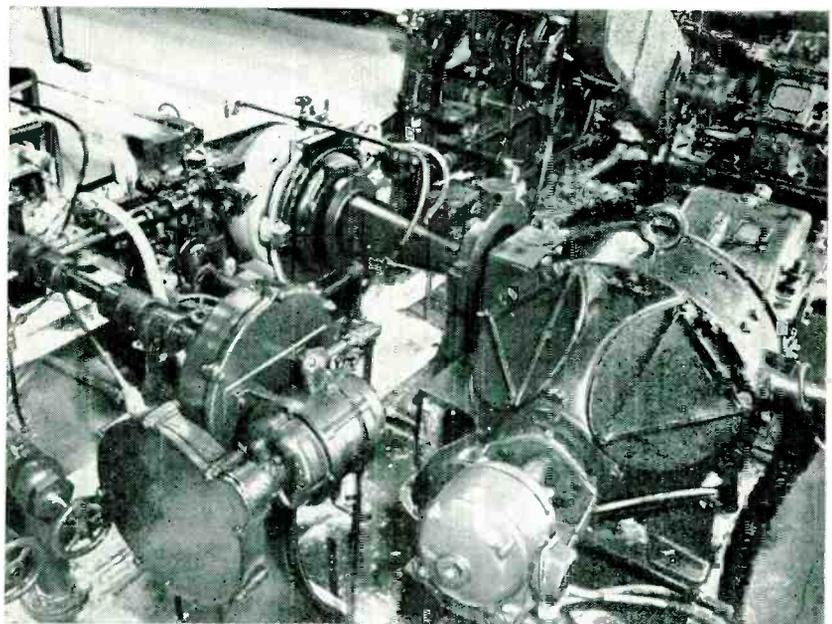
## Tubes

The root of all electronic design and performance is the tube itself, which is not riveted or bolted in place and soldered permanently. Sockets have to be provided for tubes so that they can be replaced easily. This is in itself an admission of expendability. Telephone engineers put tubes in undersea repeaters and expect a five-year life. Is the reliability of a steel mill less important?

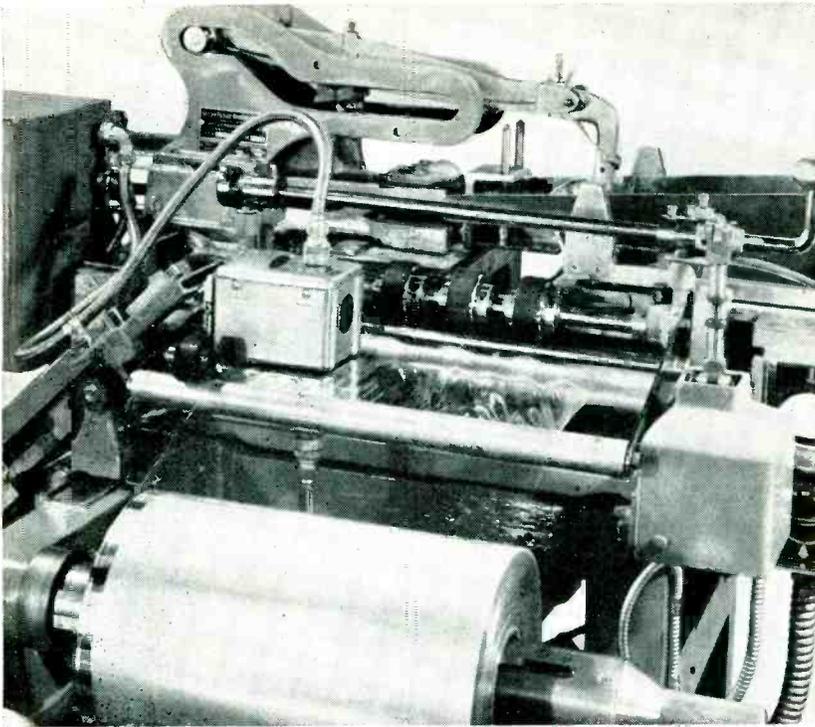
This is the very situation which is encouraging the use of magnetic amplifiers. Many electronic enthusiasts are beginning to wonder whether, for industrial purposes, emphasis should not be shifted to magnetic amplifiers. The two things needed in an electronic system are a tube life of at least 10,000 hours and completely stable, reli-



A typical fully electronic resistance-welding control, showing good hinged panel design, ignitrons in separate compartment and accessible components



Massive machines in a paper mill typify the environment to which the maintenance electrician is accustomed



Cast-aluminum housing on the photoelectric scanner of a packaging machine illustrates how an electron tube assembly can be given a rugged appearance

able performance during that time. Efforts are being made by some manufacturers but the concept needs wide acceptance by all electronic engineers. Management in the tube industry should get behind this movement.

Closely related to tube design is the need for better tube data. There are many ways of applying a tube, each resulting in different performance. Most regulators depend on calibrated characteristics of the first amplifier tube. Many other applications do not need to rely on this at all. The circuit designer certainly needs to know what can be expected of various available tubes if he is to do an intelligent job. Unfortunately, he is now confronted in most cases with a mere statement by the tube manufacturer that tubes shouldn't be used so as to depend on close calibration of characteristics.

Actually, we know that tubes do work remarkably well. Is it not putting too much burden on the circuit designer to find out his limits by cut and try? This dilemma is one that can probably be resolved best by joint committees of those interested in tube design and others in apparatus design.

Progress has been made by

NEMA and the Joint Electron Tube Council in regard to thyratrons and they have worked in this direction on small high-vacuum tubes. This failed largely because of lack of support by enough tube manufacturers. This effort should be revived.

Sockets are a weak link in the reliability chain. Experience has shown that the best socket contact is made with a separate spring backing to apply pressure. Most other available contacts distort because after repeated insertion of tubes with maximum pin diameters, tubes with minimum pin diameters do not make reliable contact. A loose contact buried in a molded socket is difficult for a mill electrician to find and is costly at \$1,000 or more per hour. There are those who prefer solder-type terminals and others who prefer the screw type. However, this difference is minor compared with the matter of contact reliability. The important point is that terminals should be physically spaced so that an average wireman can work on them easily.

Fortunately for the designer, there is a fair selection of resistors, capacitors, plugs, switches and transformers. This permits a design which looks reasonably rugged and is in reality quite reliable ex-

cept for the points previously discussed. The industry has been slowly moving toward better components but not fast enough to silence critics of electronic control.

### Circuits

Control designers could improve their designs greatly, using parts now available. There are several principles which can be applied to nearly all industrial control which will be just as productive of improved apparatus as will improved components.

Perhaps one of the most common faults of circuit designers is not to recognize the reality of published tolerances on tubes. This may result in marginal performance. Three of the most commonly abused tube tolerance values are temperature, phototube sensitivity and high-vacuum tube plate current limits. One contributing reason for this is the difficulty of getting limit tubes for test purposes. However, this does not excuse the circuit designer from making proper allowances for tolerances.

Because of the generally short electrical spacings used on components, the circuit should be designed with as low voltages in the circuit and to ground as possible. Careful design now allows many circuits to operate at less than 200 volts even though the tubes and other components are rated much higher. This is certainly necessary when some available components will not withstand ground tests of over 1,000 volts.

The desire to reduce costs has a strong tendency to force the designer to select less expensive and, in many cases, low-quality components. This is a vicious circle in our competitive system which in many cases prevents our making the proper quality of apparatus for the job. We must have the courage to do the job right, even though more costly. In the long run, the reduced maintenance and improved user acceptance will justify our action.

If control and component manufacturers will work together to move in the direction discussed we can have a wide range of very dependable control accepted by industrialists who will not do so today.



Experimental plasmatron

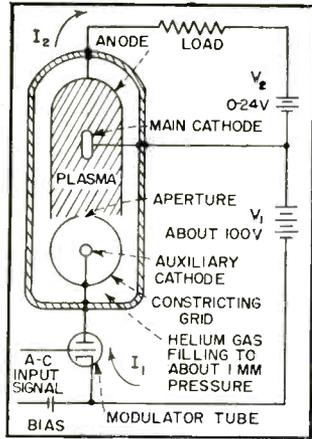


FIG. 1—Tube cross-section and associated external circuit

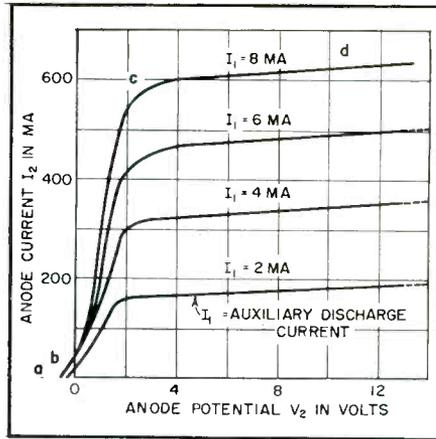


FIG. 2—Current-voltage characteristic with auxiliary discharge current as parameter

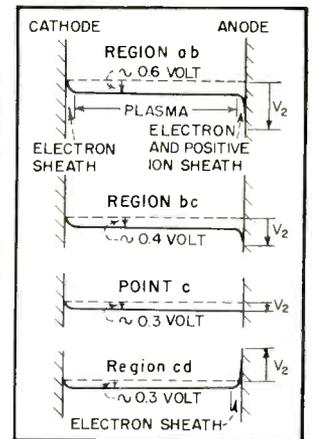


FIG. 3—Potentials between cathode and anode

# Controllable Gas Diode

Construction and characteristics of the plasmatron, a hot-cathode helium-filled diode capable of controlling large currents continuously at low voltages. Small control current acts on auxiliary discharge that provides ionization to neutralize space charge

THE TYPICAL grid-controlled vacuum tube, by virtue of its space-charge-limited anode current, is a relatively high-impedance device which is most effective in high-impedance circuits. Since a grid-controlled gas tube such as the thyatron is a low-impedance device as a consequence of its neutralized space charge, it has limited applicability in low-impedance circuits because of its lack of continuous grid control. Need exists for an electron tube which has both the continuous control feature of the vacuum tube and the low-impedance characteristic of the thyatron.

The "plasmatron", a developmental tube, gives good promise of helping to fulfill this need. It operates at anode potentials as low as several volts and has a continuously controllable output current of hundreds of milliamperes.

The tube's name is derived from the word "plasma", which designates a unique part of a gas discharge's anatomy that is instrumental in

By E. O. JOHNSON

RCA Laboratories Division  
Radio Corporation of America  
Princeton, N. J.

providing the tube with these unusual characteristics. A plasma<sup>1</sup> is a region which contains high but approximately equal densities of free electrons and positive ions, and is usually evidenced by the familiar glow which can be seen in gas discharge tubes. The charge neutrality plus the high electron density and mobility make the plasma a good conductor of electron current; in addition, this conductivity is proportional to the plasma density. Thus, in the plasmatron, an independently produced plasma is used as a conductor between a hot cathode and an anode. By controlling the small discharge current which generates this plasma, we can effect a continuous control of the plasma conductivity and hence of the cathode-anode current.

A cross-section of a plasmatron tube, accompanied by its associated circuit, is shown in Fig. 1. Potential  $V_1$  creates a discharge between the auxiliary cathode and the main electrodes, giving rise to an auxiliary current  $I_1$  whose magnitude is limited by the modulator tube. This tube is an ordinary vacuum tube such as the 6J5. The discharge is responsible for a high degree of ionization, as manifested by the formation of a plasma in the region between the main cathode and the anode.

The plasma density is enhanced, for any given value of  $I_1$ , by forcing the auxiliary discharge to pass through the narrow aperture in the constricting grid. The increase in the plasma density follows from the fact that the constriction in the discharge path raises the voltage drop across the auxiliary discharge. This in turn gives the discharge electrons more energy so that they ionize more effectively.

The free positive ions and elec-

trons in the plasma, generated by the auxiliary current  $I_1$ , diffuse to the end micas and other available surfaces where they are lost by recombination. (The recombination of the charged particles in the interelectrode spaces of these structures, at the 1-mm pressure of helium used, is relatively negligible.) The steady-state density of the charged particles in the plasma is then a function of the generation and loss rates and turns out to be approximately proportional to the magnitude of the auxiliary current  $I_1$ . Thus the input signal, by exercising an essentially linear control over  $I_1$ , can effect an approximately linear control over the plasma density and hence its conductivity.

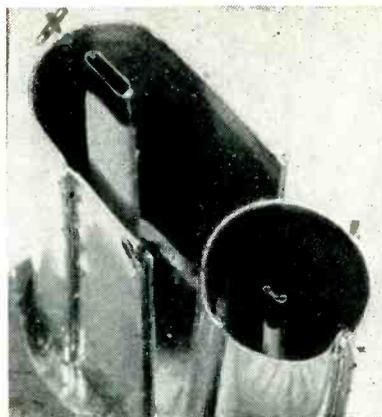
The presence of the plasma in the region of the main electrodes now makes possible the passage of large currents between the main cathode and anode even though the anode voltage may be as low as several volts. Since the effective conductivity of the plasma is directly proportional to its density, the anode current can be controlled by means of the input signal to the grid of the modulator tube.

Anode supply voltage  $V_2$  must never be high enough to cause ionization. This restricts  $V_2$  to a maximum value of about 24 volts when the tube contains helium. Voltages higher than this would result in a discharge between the main cathode and anode in a manner similar to that encountered in an ordinary gas diode. The controlling ability of the auxiliary current is then lost.

The auxiliary cathode is an ordinary oxide-coated cathode with an area of about one square centimeter. However, since it need only supply small currents, it could have been several times smaller in size. The main cathode is also a standard oxide-coated cathode and has an effective area of about three square centimeters. For normal operation the size of this cathode must be sufficient to provide a total emission current which is at least twice the maximum required anode current.

### Plasma Behavior

Since the plasma is a good conductor and as such is essentially



Demounted internal structure of plasmatron. Auxiliary cathode is inside cylinder, and oval-shaped main cathode is inside U-shaped anode. Electrode sizes are not critical, and tube works just as well in miniature sizes as in proportions for handling amperes of plate current. Available main cathode emission limits anode current

a uni-potential entity, we need only take into account its behavior at the boundaries where it contacts the anode and cathode surface. At such boundaries the plasma reacts to the electric field from the electrode by setting up a narrow region, termed a sheath, which absorbs this electric field. As a consequence of this protective action the main body of the plasma is not penetrated by the field and so in almost all cases is never appreciably affected by electrode potentials.

The sheath contains the field and is characterized by the presence of a considerable net space charge that is comprised of particles in transit to the electrode. These particles can be of either sign depending on the electrode potential. Thus, when the electrode is negative with respect to the plasma most of the electrons will be repelled and the sheath will contain mostly positive ions. The converse is also true.

When the sheath contains particles of one sign, its thickness is related to the potential across the sheath and the particle current through it by the familiar  $3/2$  power law. For the plane case this is

$$j = \frac{2.33 \times 10^{-6}}{\sqrt{M/m}} \frac{V^{3/2}}{d^2} \quad (1)$$

Here  $j$  is the particle current density in amperes per square centimeter,  $V$  is the potential across the sheath in volts,  $d$  is the sheath

thickness in centimeters,  $M$  is the particle mass and  $m$  is the mass of an electron.

The magnitude of the current density  $j$  is fixed by the plasma density adjacent to the sheath edge and can be expressed as

$$j = Ne\bar{v} \quad (2)$$

Here  $N$  is the particle density in particles per cubic centimeter,  $e$  is the electronic charge in coulombs, and  $\bar{v}$  is the average particle velocity, due to conditions within the plasma, in a direction normal to the sheath boundary. This velocity can be computed from kinetic theory in terms of temperature and the mass of the particle. For electrons in a typical plasma,  $\bar{v} = 7.7 \times 10^9$  centimeters per second. Thus, in our plasma, where  $N = 10^{11}$ ,  $j = 10^{11} \times (1.6 \times 10^{-19}) (7.7 \times 10^9) = 120$  ma per sq cm. For the same volume density of positive ions the current would turn out to be less than a hundredth of this. This follows primarily from the fact that the larger mass of the ion gives it a much smaller value of  $\bar{v}$ . Consequently, in discussing the plasmatron currents we will deal only with those due to the electrons.

It is important to notice that Eq. 2 implies that the current  $j$  is independent of the electrode potential. Thus, if an electrode is made more positive with respect to the plasma the electron current to it remains unchanged.

### Current-Voltage Characteristic

A typical current-voltage characteristic is shown in Fig. 2. The characteristic is seen to be very similar in form to that of a pentode vacuum tube. This interesting result can be understood by considering the potential distributions which exist in the tube for different applied anode voltages. Shown in Fig. 3 are the different modes of this distribution which correspond to the various regions  $ab$ ,  $bc$  and  $cd$  of the 8-milliamper characteristic.

In region  $ab$ , the electron current to the anode is negligible because of the large retarding field in the anode sheath. At the cathode we can consider two currents as flowing. One is an electron current from the plasma into the cathode

according to Eq. 2. The other is a current from the cathode into the plasma. For equilibrium these must be equal.

Since the total temperature-limited cathode emission current is normally much greater than the first current, a small retarding field, in the direction shown, must appear at the cathode to bring the currents into equality. The resulting potential depression is found to have a magnitude of about one-half volt, the actual value depending primarily upon the total cathode emission and the plasma density.

As the anode potential is raised to put the system in region *bc* of the characteristic, the retarding field at the anode is diminished to the point where a considerable electron current can flow to the anode. This current increases rapidly with voltage, as is shown by the curves. Meanwhile, at the cathode, the retarding field must be less so that more current from the cathode can enter the plasma to supply the drain to the anode. Since the current-voltage relationship at the cathode is of an exponential nature the slight changes in the plasma potential, as indicated in the diagram, are sufficient to account for the large current changes.

When the system is at point *c* the anode has reached plasma potential and collects an electron current whose density is given by Eq. 2. Further increases in anode potential, corresponding to operation in region *cd*, leave the anode current virtually unaffected, as evidenced by the nearly horizontal slopes of the characteristic. These increases in the anode potential will serve only to expand the electron sheath at the anode in accordance with Eq. 1 in which *j* is given by Eq. 2.

When operation is in this saturated current region the device can be treated as a close-spaced vacuum diode with its cathode at the plasma edge of the anode sheath. The emission current density of this virtual cathode is then given by Eq. 2 and the diode spacing by Eq. 1.

The fact that the point of current saturation does not occur at negative anode voltages, as indicated by Fig. 3, can be accounted

for by the contact potential differences acting in the tube along with the potential drop in the plasma.

### Current Gain

The relationship between the auxiliary and main currents is shown in Fig. 4. The average slope corresponds to a current amplification of about 90:1 and is seen to be fairly linear. However, if the currents are pushed beyond the point where the retarding field at the cathode is eliminated, the cathode emission approaches the temperature-limited state and the curve saturates to a value equal to the temperature-limited emission current from the cathode.

The relations which express the rate of ion generation and loss in the plasma, in terms of the auxiliary current, fix the value of *N* in Eq. 2 which determines the anode current. As implied previously, the approximate linearity of the relationship between the cur-

rents arises from the fact that *N* and hence *I<sub>2</sub>* are approximately linearly related to *I<sub>1</sub>*.

The frequency response, normalized to the d-c current amplification, is shown in Fig. 5. The rapid reduction in gain which occurs at frequencies higher than 10 kc can be attributed to the fact that a definite time is required for changes in plasma density to take place. The times involved are determined by the rate of diffusion of the participating charged particles to the available boundary surfaces. This time is comparable to the plasma decay time constant and is readily computable.<sup>2</sup> Its value is such as to account for the observed frequency response. This time constant of plasma decay varies directly as the gas pressure, directly as the square root of the mass of the gas atoms and directly as the square of the geometrical dimensions of the plasma region.

### Applications

Experimental forms of the tube have been used with encouraging results in audio output stages with direct speaker drive, in motor control circuits, in oscillators, and in pulse circuits.

Whereas such factors as life and uniformity have yet to be studied in detail, no difficulties beyond those usually experienced in ordinary hot-cathode gas tubes are anticipated. In fact, since the tube is never subjected to the large voltages often experienced by tubes such as thyratrons, it is expected that the gas cleanup and cathode life problems should be relatively simpler. The main cathode seems to be well protected from ion bombardment by the retarding field which exists around it during normal operation.

Summarizing, it can be said that the plasmatron offers excellent promise for low-frequency, low-impedance applications which require a continuously controllable current.

### REFERENCES

- (1) Rompe and Steenbeck, "The Plasma State of Gases" translated from the German by G. C. Akerlof, Mellon Institute of Industrial Research; J. D. Cobine, "Gaseous Conductors", First Edition, McGraw-Hill Book Co., New York, 1941; C. G. Found, U. S. Patent 2,034,571; H. R. Nelson, U. S. Patent 2,213,551.
- (2) M. A. Biondi and S. C. Brown, *Physical Review*, 75, p 1700, 1949.

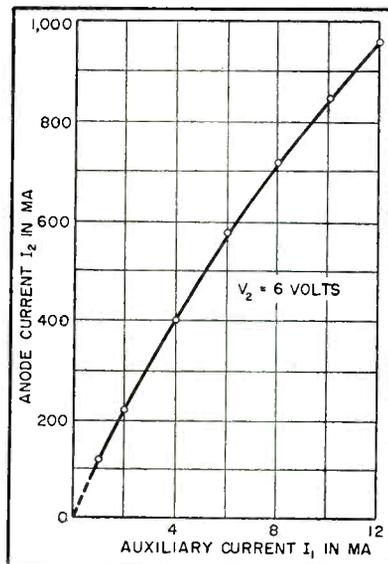


FIG. 4—Current amplification characteristic of new tube

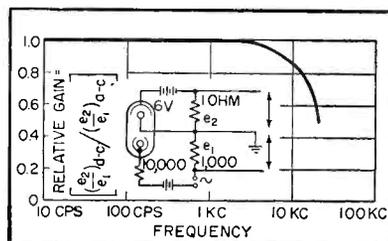


FIG. 5—Frequency response characteristic

# FIELD-SEQUENTIAL

By ELIAS COHEN

and

ALLAN EASTON

*Chief Development Engineer  
Tele-Tone Radio Corp.  
New York, N. Y.*

*Formerly Chief Engineer  
Product Engineering Division  
Tele-Tone Radio Corp.  
New York, N. Y.*



Tele-color converter attached to a black-and-white Tele-tone receiver at the CBS showings in New York City

**T**HE FCC DECISION which approved the CBS field-sequential system of color television presented the problem of how best to meet the inevitable demand for a commercial device which, operating in conjunction with existing black-and-white receivers, would produce good color reception from stations

transmitting programs in color. The companion color unit was to bridge the gap between standard monochrome and the new field-sequential color television until there developed sufficient economic justification for complete color or color and black-and-white receivers. In this manner the consumer was

protected against complete obsolescence of his monochrome equipment and at the same time could purchase the means of securing color television.

The standards set by management and engineering pointed out the necessity for a universal package converter of the slave type. This would be a self-contained cabinet-enclosed unit which would plug into one of the tube sockets in the existing receiver by means of an adapter plug without any chassis reworking. This could be a customer rather than a serviceman operation.

The slave converter receives a composite video signal from the black-and-white receiver through the interconnecting cable. A block diagram of the complete system is shown in Fig. 1.

Connection to the black-and-white receiver is made by a plug, or color accommodator. This is inserted in the input video amplifier socket of the black-and-white receiver. The pins are connected to another tube socket at the top of the plug in which the video amplifier tube fits. A 6J6 cathode-loaded stage inside the plug couples the composite video signal from the grid of the video amplifier through 70-ohm cable to the color converter. The circuit of the cathode follower and the video amplifier of the color converter is shown in Fig. 2.

The input loading of the cathode follower is extremely small. Plate and filament power is fed to the cathode follower from the color converter.

The color accommodator plug is built in four different forms to accommodate seven-pin miniature, nine-pin miniature, octal or loctal

# COLOR COMPANION

Designed for connection to video amplifier of any monochrome television receiver, this slave converter provides color pictures from CBS field-sequential transmissions. Complete circuitry is given, including motor control system for speed and phase correction of color disk, which would be required by this system

video amplifier tubes in the black-and-white receiver.

## Overall Circuit

The signal is amplified in the two-stage video amplifier system and is applied to the picture-tube grid. A polarity switch in the input circuit accounts for the difference in signal polarity that exists in some monochrome receivers. Part of the output of the video amplifier is fed in a conventional manner to the sync separator which in turn feeds a syncroguide type horizontal oscillator at 29,160 cps and an impulse-triggered vertical oscillator at 144 cps, which feeds the vertical output amplifier. A flyback high-voltage doubler system is used.

The color disk is turned by a speed-controlled induction motor. The speed control circuit consists of a balanced phase and frequency comparator that compares the sine-wave output of a six-pole alternator, which is mechanically coupled to the motor, with pulses derived from the vertical output circuit. The control voltage is amplified in a d-c amplifier which varies the inductance of a saturable reactor and which in turn varies the a-c voltage applied to the induction motor for speed control.

## Breakdown of Circuit

The video amplifier requirements are similar to that of a monochrome design but are more exacting. Since the composite signal derived from the black-and-white receiver could be either positive or negative depending on the type of receiver, provision had to be made for switching circuitry so that the polarity of the signal at the color converter kinescope grid was al-

ways sync negative.

The gain and frequency responses were to be independent of switch setting. The high-frequency response was to be 4-mc wide so that the geometric resolution would be as good as the i-f response of the black-and-white receiver would allow. A rising characteristic is also desirable to obtain some video overshoot to add crispness to the picture and to compensate for the slight smear present in the tran-

sient response of many i-f systems.

The low-frequency response has to be approximately 3 db at 48 cps which is the primary color rate. Poor low-frequency response will result in misrepresentation of the background color tones in the different frames, whereas in monochrome reception it would only result in a slight shading from top to bottom of the picture.

It was considered that a gain of approximately 70 with a drive of

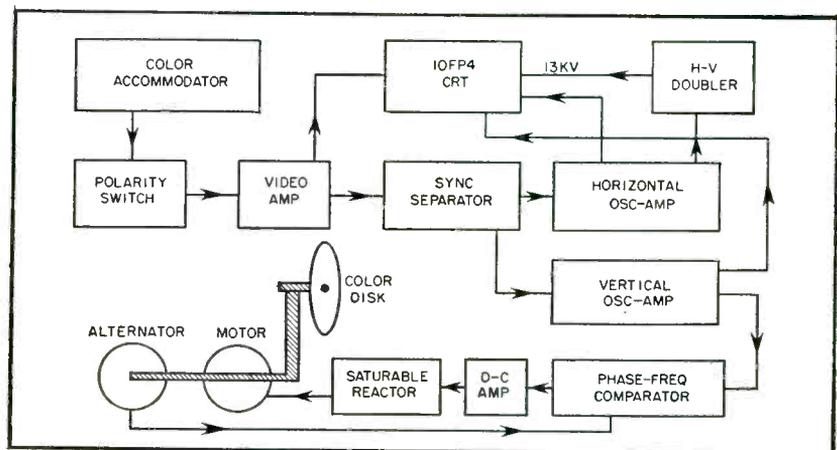


FIG. 1—Arrangement of stages of the slave color viewer

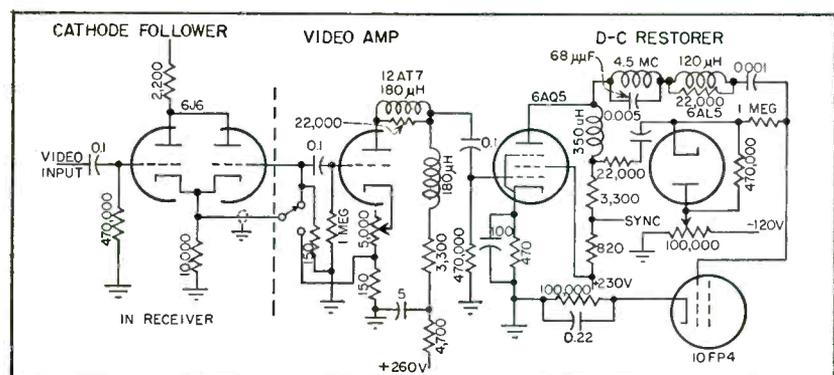


FIG. 2—Composite video signal from the black-and-white receiver is handled by this circuit. Choice of signal polarity is provided by the switch

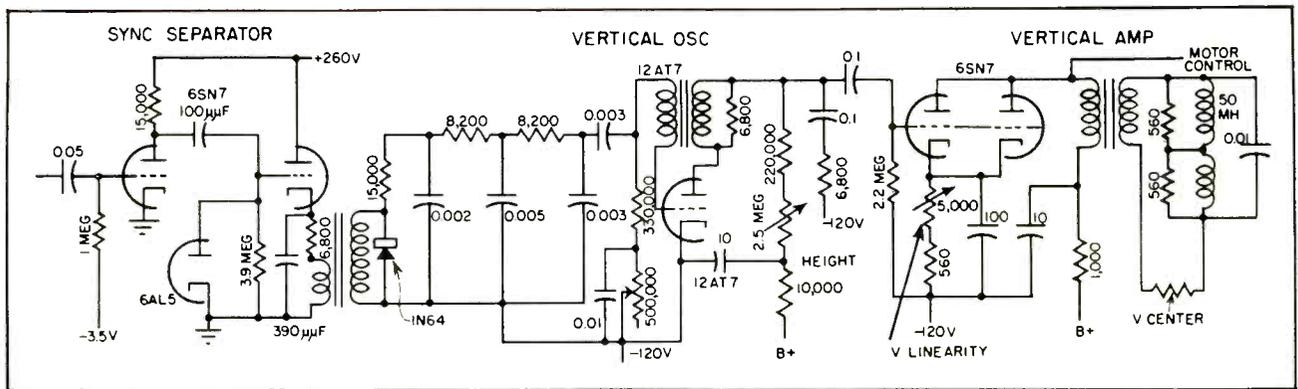


FIG. 3—Sync separator and vertical deflection circuits

approximately 100 volts peak to peak was necessary to have sufficient reserve drive for the 10FP4 picture tube under all conditions of operation. Another aspect to be closely watched in the video system was amplitude distortion which would give rise to color distortion, since different colors are transmitted during different frames and any compression of levels would affect one color more than others.

Thus, the amplifier has to be substantially linear over its entire range of operation, unlike monochrome reception where nonlinearity is often introduced to obtain a more pleasing ratio between average and peak brightness at high contrast settings. Since the majority of present black-and-white receivers have intercarrier sound, good 4.5-mc rejection is needed before the crt grid to avoid the fine beat affect which would be caused by excessive 4.5-mc signal on the kinescope grid.

Figure 2 indicates a simple way in which polarity switching is accomplished. The first video amplifier is either cathode or grid coupled depending on the input polarity. For most installations the tube will be grid coupled because a majority of the black-and-white television sets in use have their video detector arranged to yield a composite video signal with sync tips negative.

Contrast variation is accomplished by means of a degenerative control in the cathode of the first video amplifier. This stage is a high-gain triode and the second stage is a beam power output tube to provide sufficient drive and linear operation. Good frequency response is provided for by the

two-section constant- $k$  filter in the first video stage and a combination of series and shunt peaking in the second video stage. Good low-frequency response is accomplished by means of the low-frequency R-C boost network in the first video, and the use of 0.1  $\mu$ f coupling capacitors as well as the maximum possible grid leak resistors wherever possible.

The background control varies the negative voltage to which the d-c restorer diode plate is returned.

The video amplifier is linear, has a gain of approximately 70, provides 100 volts peak to peak drive at a bandwidth of 48 cycles to 4 mc and has provisions to supply d-c restored signal of negative polarity to the crt grid for either polarity video input to the system.

### Sync Separator

The sync separator requirements are similar to those in monochrome reception, and the type of separator used is a fast-time-constant cathode-follower type, using a separate diode to keep sync tips at ground level. This is a standard type illustrated in Fig. 3, and need not be discussed further. There is a definite need for better noise immunity in the color system than in black-and-white transmission. Loss of horizontal synchronization for a few lines is more noticeable than in monochrome transmission because the tearout will appear in the color of the frame during which it occurs. Loss of vertical synchronization is extremely bad, because unless the recovery time is faster than the inertia of the speed control circuit, the color disc will also go out of synchronization.

The field rate, the frequency at which the kinescope face is scanned vertically, is 144 cps. Vertical retrace must be accomplished in 0.05 of a field which is approximately 350  $\mu$ sec. This is approximately 40 percent of the time allotted in monochrome transmission. The self-resonant frequency of vertical output transformers and yoke circuits now used for monochrome receivers is good enough to permit direct conversion to the new frequencies.

### Vertical Deflection

A 53-degree, 50-mh vertical yoke is used. The yoke impedance being mainly resistive, the same output transformer can be used to match the yoke to the vertical output tube with very little loss in efficiency. As shown in Fig. 3, a single-triode blocking oscillator was chosen to act as a combined vertical oscillator and discharge tube. The transition to 144 cycles permits a decrease in plate-time constant to give the necessary drive for the output tube without any loss in linearity.

The percentage of step to sawtooth is larger in color operation necessitating a larger step resistor in series with the discharge capacitor. The reason for this is apparent when it is realized that the purpose of the additional step to the sawtooth grid drive is to compensate for the voltage drop across the inductive portion of the yoke. The retrace time being much faster than before will cause the voltage drop  $L_{di}/dt$  to be larger.

The problem of interlace is basically a 30-cycle phenomena in monochrome transmission and is therefore relatively unaffected by 60 or

120-cycle power supply and line hum because of its harmonic nature.

In color transmission, interlace is basically a 72-cycle phenomena and is easily deteriorated by 60 and 120-cycle hum. Sixty-cycle hum for example will cause the pattern to go in and out of interlace at a 12-cycle rate. It is extremely important that the integrated vertical sync pulse be free of all hum voltages. As will be noted in Fig. 3, the output of the sync separator is transformer coupled to the integrating pads to remove the hum voltages from the negative supply. Care must be taken so that the power line leads or filament leads do not come too close to the vertical oscillator circuitry.

The usual care must be taken to remove all horizontal pickup from the vertical oscillator circuit. This can be helped considerably in the chassis layout by putting the vertical oscillator as far as possible from the horizontal oscillator and output circuit. The major problem in the vertical circuit seems to be to obtain good interlace rather than that of height and linearity.

### Horizontal Deflection and High Voltage

The horizontal scanning rate is 29,160 cps (405 horizontal lines interlaced every two fields). This is almost twice the rate used in monochrome transmission. The maximum retrace time allowable is  $0.14 H$  where  $H$  is the period of the horizontal scan. This figure is the minimum value that the width of horizontal sync pulse plus back porch may fall to. This calls for a maximum retrace time of  $5 \mu\text{sec}$  as against almost  $10 \mu\text{sec}$  in monochrome transmission. The losses in the yoke and transformer which are a function of frequency such as hysteresis and eddy currents tend to decrease the efficiency at this new frequency. A high voltage of 13 kv is desirable which in conjunction with a 10FP4 53-degree aluminum-backed tube produces sufficient light output in spite of the light losses in the color disc and lens.

The horizontal synchroguide has to be readjusted to operate at the new frequencies and the capacitor

across the stabilizing coil is set so it too can operate at the new frequencies.

To improve the retrace time, the horizontal output transformer has much less than the customary number of turns on the high-voltage winding. To make up for the loss in high voltage, a two-tube voltage doubler is used in the circuit of Fig. 4. The use of an auto-transformer permits more high voltage and subsequently less retrace time because the secondary winding is then in series with the primary and high-voltage winding.

A device borrowed from the CBS engineering department was to a-c couple the secondary winding to the primary with the yoke being returned to the low side and the damper tube being returned to the high side. This provides electrical centering which is normally unfeasible in an auto-transformer type of system. The filament of the damper tube is connected through a resistor to the boost voltage. The cathode-to-heater rating of this tube for pulses as well

as for inverse peak plate to cathode voltages allows safe operation of the circuit.

Horizontal centering is accomplished by a 50-ohm control which varies the amount of B plus current which goes through the yoke. A tapped potentiometer is used so that this control is bidirectional.

The power input to the horizontal output 6BG6 tube (370 volts at 70 ma) is 33 watts and is not proposed as the most efficient method of scanning a 53-degree tube operating at 13 kv. It does however give good linearity, good retrace time, plenty of width and a high voltage of 13 kv with a regulation of 500 volts per 100 microamperes. The yoke is a 53-degree 8.3-mh type with a powdered iron core.

### Power Supplies

The power supply (Fig. 5) design problem is no different generally from that existing in normal monochrome receivers except for the fact that the maximum allowable ripple voltage must be severely restricted. The hum voltages whether 60 or

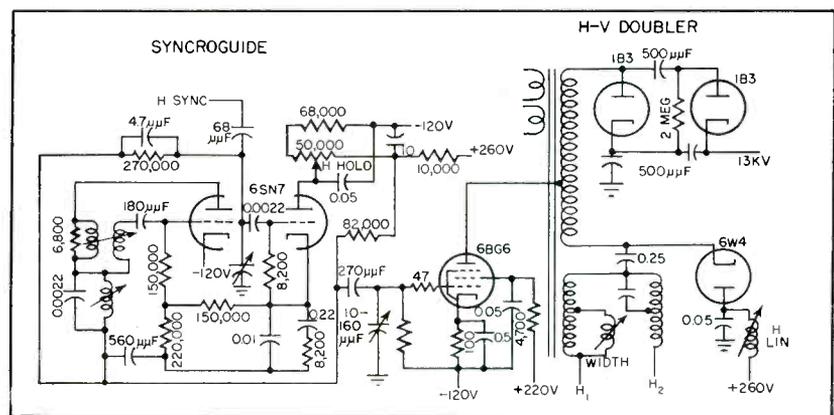


FIG. 4—Horizontal deflection circuits and voltage doubler

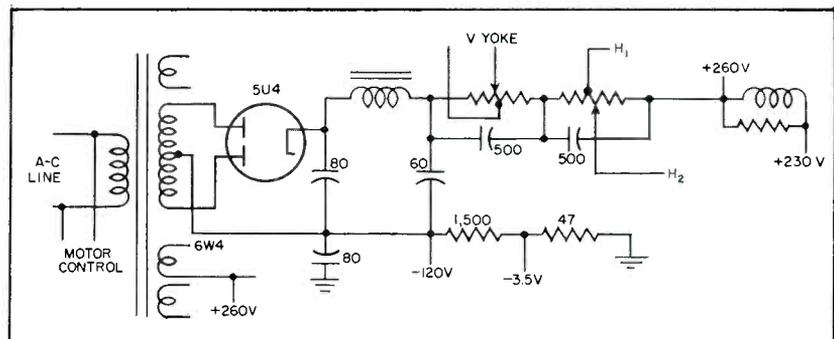


FIG. 5—Sources of positive and negative voltage feed points required by the other circuits

120 cycles, are extremely harmful because of the nonsynchronous relationship between the 60-cycle power line and the 144-cycle field rate of the color transmission.

A full-wave rectifier 5U4 in conjunction with a capacitor-input filter yields a positive B-plus voltage of 280 volts at 175 ma. A negative supply of approximately 120 volts is obtained across a bleeder resistor between secondary center-tap and ground.

Care must be taken in the physical placement of the power transformer and other iron-core components to minimize the effect of any stray magnetic fields on video and vertical circuitry and the kinescope. Although the filter circuit is not unduly elaborate from a filtering standpoint, hum reduction is further accomplished by the utilization of decoupling networks between the power supply and the appropriate circuits.

### Motor Speed Control Circuits

An entirely new problem presented by the color television unit is that of motor speed control. Color presentation is accomplished by means of a rotating filter disk similar to that used in the camera which is positioned before the face of the picture tube. This disk carries six filter segments, two in each of the three primary colors, red, blue and green. The disk rotates at 1,440 rpm and is synchronized with the 144-cycle field scanning rate of the receiver. The image formed on the screen of the picture tube is in white light and this light is passing through the colored filters, takes on successively the three primary colors. The system thus comprises two filter disks rotating in rigid synchronism, so positioned that the filters before the camera and the picture tube always have the same color at any instant. To synchronize the position of the receiver filter disk, the speed must be kept at 1,440 rpm and the phase must be automatically adjusted by means of synchronizing impulses so that the red light is produced by the receiver only when the red filter is positioned before the camera tube at the transmitter and similarly for the other two colors.

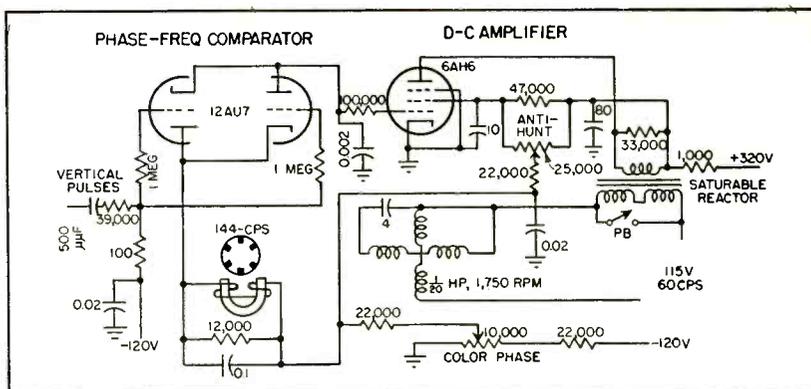


FIG. 6—Automatic phase and frequency comparison circuit used for motor control

Speed control is accomplished by means of an automatic phase and frequency control circuit, Fig. 6. The driving motor is a 1/20 hp split-phase induction motor, belt coupled to the color wheel and direct coupled to a six-pole alternator which, when running at 1,440 rpm, delivers a sine-wave voltage output at a frequency of 144 cps. The frequency is directly proportional to the motor speed. A balanced phase and frequency comparator consisting of a 12AU7 compares the sine-wave output from the alternator to vertical pulses at the 144-cycle field rate. The control voltage generated is applied to the grid of a high- $g_m$  d-c coupled current amplifier which utilizes a 6AH6 tube. The plate current of this amplifier flows through the primary of the saturable reactor which saturates the iron core and so varies the inductance of the secondary winding in a manner which is to a first approximation inversely proportional to the primary current.

As shown in Fig. 6, the secondary inductance of the reactor is in series with the induction motor across the line voltage. A variation of secondary inductance will vary the 60-cycle voltage fed to the motor and thus control its speed. A color-phasing potentiometer controls the d-c bias at the grid of the 6AH6 control amplifier tube. An antihunt potentiometer controls the amount of feedback from the screen of the control tube back to the input circuit.

The gain and accuracy of the control system must be high enough so that the amount of phase deviation or instability caused by normal

line voltage variation or heating effects will not be large enough to permit any trace of the preceding or following color field to be visible.

As mentioned before, proper color phasing is obtained only when the color of the filter at the receiver is identical to the one at the camera at any moment. The speed control circuit does not utilize any information which permits it to recognize the various color fields. It is therefore possible to be initially synchronized on any one of the three color fields when the set is turned on. The ambiguity is corrected by means of a front-control push-button which momentarily shorts out the secondary of the saturable reactor thus permitting the color disk to slip free for a short period and lock itself to a new color frame.

The converter chassis, cabinet, and shafts are insulated to avoid shock hazard when used with a black-and-white receiver of the hot-chassis type in which one side of the power line is connected to the chassis.

### Overall Performance

The slave color converter unit provides good color pictures on transmissions using the CBS field-sequential system. A unit of this type has been demonstrated at the CBS color show at the Tiffany Bldg. in New York and found completely satisfactory.

The authors wish to credit the Engineering Staff of the Columbia Broadcasting System for their assistance and guidance, without which the work described herein would not have been possible.

# Economical 5-KW A-M Transmitter

Phase-to-amplitude modulation provides high-quality signals with 1.5-percent rms distortion at low and medium audio frequencies and 2.8 at 7,500 cps. Total power input to transmitter is 13.5 kw for full output

**N**EEED AROSE at station KOH in Reno, Nevada, for a 5-kw a-m transmitter that would fit into an existing building that was originally designed to house a 1-kw transmitter.

It was decided that a phase-to-amplitude modulated transmitter would be used. The 5-kw design finally adopted resembles, to a certain extent, the 50-kw version used at KFBK in Sacramento, California, with the exception of a few simplifications. These modifications include the elimination of negative feedback circuits, the use of a simple phase modulator and triplers instead of cascaded phase modulators, and the elimination of complex tuning mechanisms. Several years of operating experience with the KFBK transmitter prove the feasibility of screwdriver tuning adjustments. The system used differs from the original one described by Chireix in the 1935 *Proceedings of the IRE* in that more straightforward phase modulators are employed, by the use of quarter-wave final-amplifier plate-tank networks and by use of a simple pre-distorting circuit to overcome the inherent distortion of the system, this inherent distortion being approximately five percent.

### Brief Theory of Operation

The transmitter consists of a crystal oscillator, a buffer amplifier branching into two channels, two phase shifters, two frequency triplers, two sets of cascaded class C r-f power amplifiers and output circuits wherein the currents from the two phase-modulated channels are

By **NORMAN D. WEBSTER**

*McClatchy Broadcasting Company  
Sacramento, California*

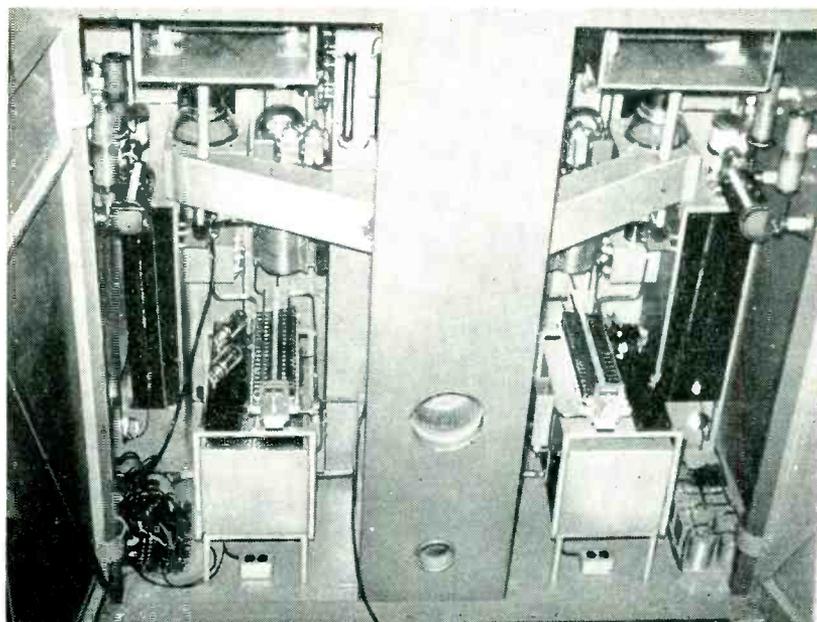
brought together resulting in the production of amplitude-modulated waves.

The output of the buffer amplifier divides into two components of equal amplitude and opposite phase. Each of these two components passes through a manually-operated phase shifter and excites a single constant-amplitude phase-shift modulator. Each modulator drives a separate tripler and a chain of power amplifiers which are common to each other only at the output of the final amplifier and at the grid circuit of the final ampli-

fier where a compensating resistor for linearity adjustment is connected between the two grids.

The system operation is such that for a modulation trough the two r-f channels are fed into the common load in phase opposition so that no output results. Over the remainder of the modulation cycle the two channels are made to be more in phase in such a manner that their power outputs combine in the common load according to the modulation.

The grid or plate voltages of the two r-f channels will normally operate at a phase angle of 135 degrees. For conditions of 100-percent modulation, the phase of one channel is advanced 22½ degrees and the other is retarded 22½ degrees. At this



Five-kilowatt a-m transmitter is housed in 7 x 7 x 3 foot cabinet shown. Power supply is external

instant the phase difference between channels could be 180 or 90 degrees depending on which channel initially leads or lags the other.

When the two channels are 180 degrees out of phase no voltage will appear across  $R_L$  as illustrated in Fig. 1A. This condition constitutes in effect a short circuit of the sink ends of both quarter-wave networks shown in Fig. 1A. Then due to the impedance-inverting qualities of the quarter-wave networks, the source ends of these networks will appear as very high impedances and little energy will be supplied from the power tubes.

When the phasing conditions are reversed, 100-percent positive peak modulation is obtained. Each channel then supplies energy to the load  $R_L$ . Due to the effect of the two sources of r-f power feeding  $R_L$  the resistance seen by each channel at the sink end of the quarter-wave network varies from zero to four times the load resistance required to obtain the correct carrier power. Then again due to the impedance inverting qualities of the quarter-wave networks, the power amplifiers themselves look into a load resistance which varies from an extremely high value to approximately one quarter that encountered at the 135-degree carrier condition.

### Vector Diagrams

Figure 1B is a voltage diagram showing the phase relations of the final plate voltages of the two channels at carrier (solid vectors), at modulation peak (dashed vectors) and at a modulation trough (dotted vectors). Inasmuch as the two channels are connected to  $R_L$  in shunt rather than in series, the power relations at the load itself can best be understood by reference to the current diagram of Fig. 1C.

It is seen that the current  $I_L$ , flowing through the load is the vector sum of the two channel currents  $I_1$  and  $I_2$ . When the relative phase between channels  $\theta$  is 135 degrees the load current is at its carrier value. When  $\theta$  is 180 degrees the load current (and consequently the load voltage) is 0, and with  $\theta = 90$  degrees,  $I_L$  has its maximum value corresponding to a peak of modulation.

Here it also becomes evident that inasmuch as each final tube delivers varying amounts of power at a substantially constant r-f voltage, the phase-to-amplitude system is in reality one of load-impedance modulation. The load presented to the output terminals of the coupling network of channel 1 is

$$Z_{L1} = \frac{E_L}{I_1} = \frac{I_L R_L}{I_1}$$

An examination of Fig. 1C will show that

$$I_L = 2 I_1 \cos \frac{\theta}{2}$$

Thus

$$|Z_L| = \left( 2 \cos \frac{\theta}{2} \right) R_L$$

and varies from a short circuit at  $\theta = 180$  degrees to  $\sqrt{2} R_L$  at  $\theta = 90$  degrees.

This gives the absolute value of the complex impedance. Further study of Fig. 1 will show that the phase angle, of the impedance, or the power factor angle, is  $\theta/2$ . This makes the complete expression for the load impedance as seen by each channel

$$Z_L = \left( 2 \cos \frac{\theta}{2} \right) R_L \angle \theta/2$$

or in rectangular form

$$Z_L = \left( 2 \cos^2 \frac{\theta}{2} \right) R_L + j \left( 2 \sin \frac{\theta}{2} \cos \frac{\theta}{2} \right) R_L$$

$$R_L = 2 R_L \cos^2 \frac{\theta}{2} + j R_L \sin \theta$$

This shows that in addition to the desired resistance variation  $2R_L \cos^2 \theta/2$  there is also introduced

a reactive component, caused by the circulating current common to the two tank circuits. The reactance will be inductive for one channel and capacitive by an equal amount for the other channel.

Unfortunately these reactive components vary with the operating angle  $\theta$  making it impossible to balance them out completely over the entire modulation cycle by introducing fixed reactances. However, it is evident that if enough fixed reactance of the proper sign is added to each channel to make the power factor unity at, or slightly below, the operating angle chosen for the proper carrier power, the power factor over the remainder of the modulation cycle will remain good except near the amplitude-modulation troughs where low efficiency is of little consequence.

### Final Amplifier

If we assume that each final tube operates as a constant voltage generator, the power drawn from either tube varies inversely as the square of  $\cos \theta/2$ . When the operating angle is chosen so that  $\theta/2$  varies over the near-linear portion of the cosine curve, the load impedance and power output vary as the square of the angle of phase separation, which is the desired result.

It is also of interest that in actual practice the loaded Q of the 90-degree final amplifier plate-tank networks may vary from 20 at carrier to 5 for a positive crest of modulation and from 20 to 600 or so depending on the inherent Q of the output networks for a negative trough of modulation. For good fidelity, means must be provided to prevent the loaded Q of the tank, and consequently the r-f plate voltage, from rising above a predetermined value during part of a modulation cycle. This is accomplished at KOH by biasing the final amplifier grids so that plate current flows during a large portion of the positive r-f grid driving half cycles, thus keeping the output tanks loaded by the plate circuits of the output tubes. Such procedure reduces the plate efficiency to approximately 70 percent at carrier level.

A further improvement in r-f voltage regulation is effected by the

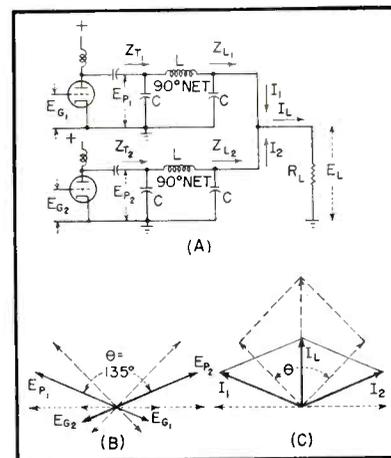


FIG. 1—Basic output schematic and vector diagrams show phase-to-amplitude principle

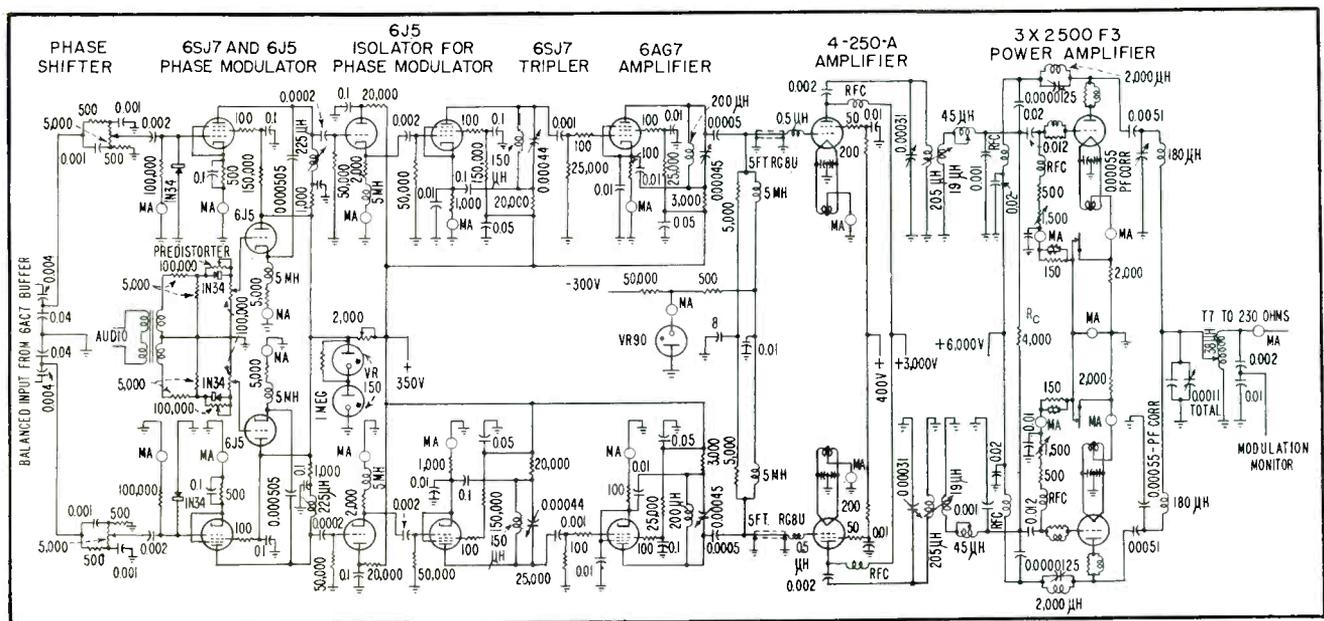


FIG. 2—Schematic of 5-kw phase-to-amplitude modulation transmitter. Two 6AC7's are used as crystal oscillator and buffer

use of a compensating load resistor  $R_c$  connected between the grids of the final amplifier tubes. When conditions of phasing between the two channels of the transmitter are momentarily more in phase less r-f power is dissipated in  $R_c$ . This results in an increase of final amplifier grid driving power at the times it is needed or during positive excursions of modulation.

During negative troughs the resistor serves to reduce the driving power and the final amplifier grid bias voltage. This in turn reduces the tendency for the final amplifier r-f plate voltage to rise during the portion of a modulation cycle when the final amplifier plate circuits are practically unloaded. The current through  $R_c$  varies approximately as  $(2 \sin \theta/2) E_p/R_c$  where  $E_p$  is the rms r-f plate voltage of one driver tube. A rather complex vacuum tube r-f voltage regulator is used on the KFBK 50-kilowatt transmitter for the purpose of maintaining a constant r-f voltage at the plates of the final amplifier tubes.

### Overmodulation

A very attractive feature of this transmitter not obtainable in other transmitters is that it may be heavily overmodulated without attendant side band interference, since the two phase-modulated channels can never in practice be exactly identical in power output. The

carrier, therefore, will not cut off during accidental overmodulation. The positive peaks will continue to rise until the two phase-modulated channels are in phase or until the final amplifier tubes are saturated. Measurements on the KOH transmitter show 10 percent rms distortion at 110 percent positive peak modulation. At double the audio input level required for 100 percent modulation the second harmonic distortion is about 100 percent.

This may be understood from an inspection of Fig. 1C. Here 22.5-degree phase excursions in the two channels will cause a 180-degree out-of-phase condition and a negative trough of amplitude modulation. Any further phase changes in the same direction will cause the carrier to commence increasing in power. This is a condition that would change an over-all negative feedback circuit momentarily to one of positive feedback with resultant oscillation over a portion of the input audio cycle.

This difficulty was minimized on the KFBK 50-kilowatt transmitter by inserting a properly-phased carrier voltage into the negative feedback r-f rectifier. With the amount of carrier insertion used at KFBK, oscillation will not take place until positive peaks of modulation of approximately 130 percent are exceeded. The most straightforward manner of eliminating this

complexity is to eliminate the necessity for the negative feedback as was done in the KOH transmitter.

Designed to operate without negative feedback, this transmitter has a noise level of -59 db below the 100-percent modulation level, an rms distortion at 100-percent modulation of 1.5 percent at low and medium audio frequencies and 2.8 percent at 7,500 cps. The distortion is predominantly of the second-harmonic variety, which is difficult to detect even with a trained ear.

### Conclusion

A year of operation of this transmitter proves it to be stable, reliable and economical of tubes. The total power drain of the transmitter averages 13.5 kilowatts during operation. Although it is more critical of original adjustment than high-level-modulated transmitters, its economy of space, power and tubes and its excellent audio fidelity and its ability for heavy modulation recommend this type of transmitter to those stations having circuit-minded chief engineers and a flair for economy.

The author wishes to thank F. E. Terman and Oswald G. Villard, Jr. of Stanford University and William E. Evans, Jr. for their invaluable assistance in the development of the phase-to-amplitude modulated transmitters discussed in this paper.



Exterior of the Climax Observatory, where a prototype of the system described is in use

# SERVO GUIDER for

Photoelectric devices keep telescope free from aiming errors in both hour angle and declination. Threshold control is incorporated to aid guiding during cloudy periods. Most changes in atmospheric transmission do not introduce false error signals

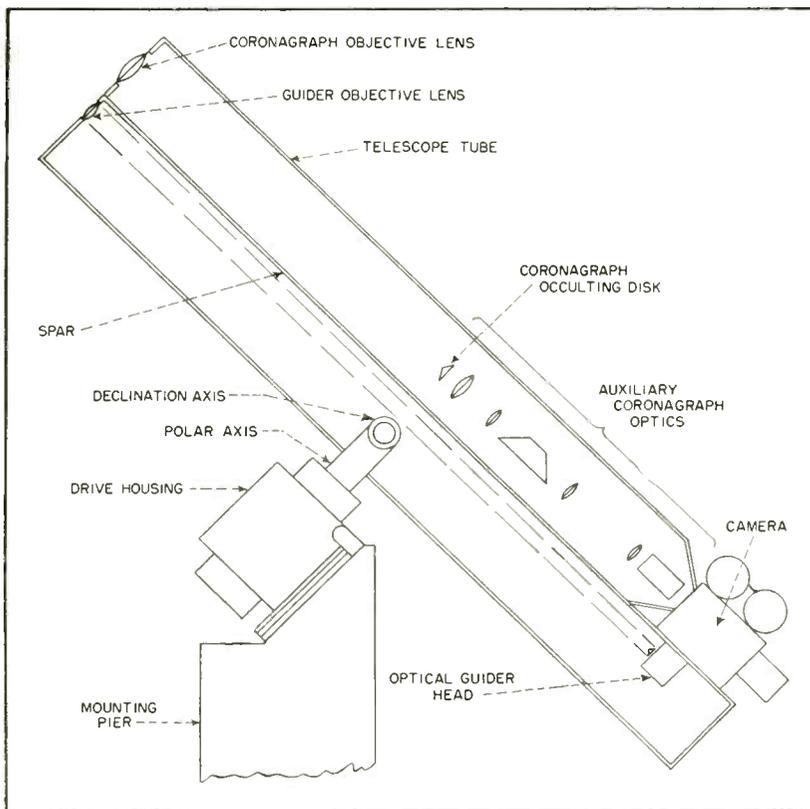
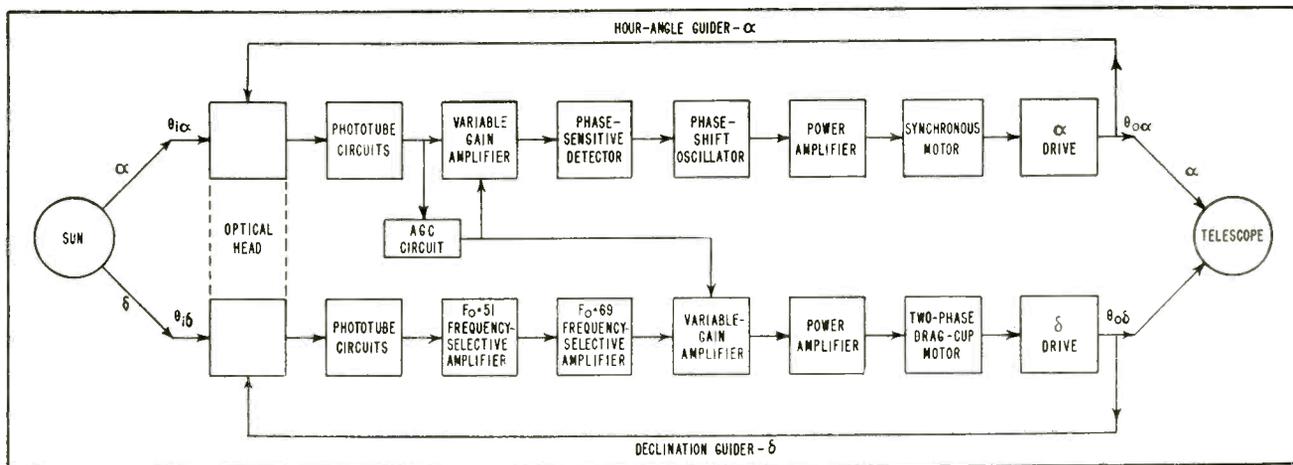


FIG. 1—Arrangement of components in the coronagraph and guider telescope

**T**HE CORONAGRAPH is a special form of refracting telescope that makes it possible for the observer to look at the edge of the sun artificially eclipsed behind a disk within the telescope so that the faint features above the limb of the sun are visible.

To maintain the artificial eclipse and so prevent the intense light from the disk of the sun from obscuring the phenomena to be observed, the telescope must be pointed toward the sun with an accuracy of about one second of arc.

For several years the Harvard College Observatory coronagraph at Climax, Colorado, was pointed satisfactorily by off-on type servo guiders.<sup>1</sup> The continuous-control servo guiders described in this article were designed to control a new improved coronagraph. The first of these new coronagraphs is now in operation at Sacramento Peak, New Mexico, and a similar installation will soon be made at Climax. A prototype of the servo system to be described has been in operation for the past two years on the original



Block diagram of hour-angle and declination guiders

# SOLAR TELESCOPES

By FRED E. FOWLER AND DONALD S. JOHNSON

*High Altitude Observatory  
Harvard University and University of Colorado  
Boulder, Colorado*

Climax coronagraph installation.

Since the apparent movement of the sun is naturally resolved into two components, two guiders or servomechanisms are used to point the telescope. The hour-angle motion is the apparent east-west movement of the sun caused by the rotation of the earth on its polar axis. The declination motion of the sun consists of small, random movements plus systematic movements north or south of the normal east-west movement.

The hour-angle and declination guiders correct the aiming errors which would otherwise arise from such factors as refraction effects in the atmosphere, lack of precision in the telescope drive mechanism, mounting alignment error, and flexure of the telescope tube. Thus, the sun is kept accurately in the telescope sights for long periods of time without manual corrections by the observer.

## Hour-Angle Guider

The hour-angle guider may be considered as a system having a

constant-velocity input with more or less random positive and negative displacements added to it. The telescope must follow the constant-velocity input without lag and also follow the random deviations as well as possible. The problems encountered in the design of such a system were solved largely by departing from conventional servo practice to the extent of employing a synchronous motor to supply the driving power.

In the absence of any error in pointing of the telescope, this motor is driven with a fixed frequency. This solar-rate frequency causes the telescope to follow the constant-velocity component without calling in the servo feedback loop. Zero error signal is required to run the telescope at the mean apparent velocity of the sun.

The servo loop acts to vary the frequency of the drive power and thus the speed of the motor only when the input deviates from this fixed velocity. This enables the use of a simple position servo rather than a velocity servo and also elimi-

nates the need for the differentially geared correction motor used in conjunction with the constant-speed motor in conventional astronomical telescope drives.

Low inherent time lag is made possible by keeping the motor in synchronization during all speed variations. The guiding accuracy is limited by the random "seeing" variations caused by variable differential refractive indices of adjacent atmospheric media, even with the system gain well below the threshold of instability. Therefore, anti-hunt stabilization is unnecessary.

## Declination Guider

The basic difference between this guider and the hour-angle guider results from the absence of a constant-velocity component in the declination movement. The input to this guider is merely a set of partially random displacements or drifts in a north-south direction.

The declination guider is similar to the hour-angle guider in that the servo loop operates in response to displacements between the sun and

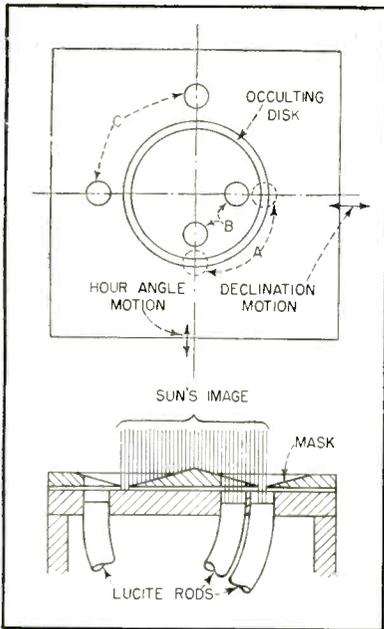


FIG. 2—The occulting disk assembly contains guider apertures A, reference apertures B and apertures used to extend range of return C

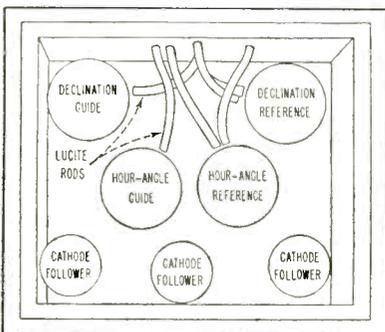
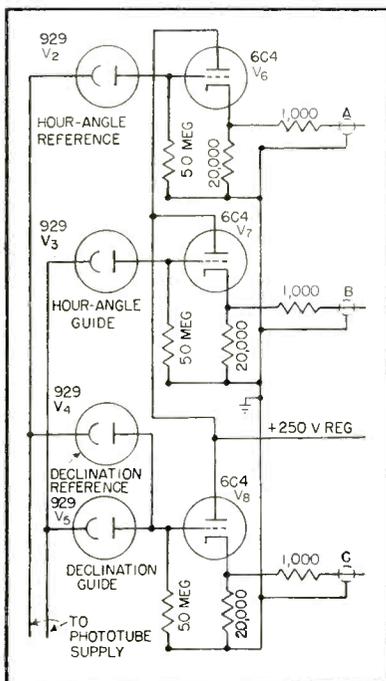


FIG. 3—Placement of lucite rods and phototubes in optical head



telescope. The servomechanism is at once an ordinary position servo and, as is customary with such systems, the driving power is supplied by a small two-phase low-inertia induction motor.

### Guider Optical System

The optical system functions as the error detector for the two servomechanisms. Any differential angular displacement between telescope and sun produces variations in light flux proportional to this displacement. These variations are converted by phototubes into electric currents that vary with the error.

The optical system consists of a simple telescope mounted directly on the equatorial table of the coronagraph. The guider lens produces an image of the sun on an occulting disk of special design. Location of coronagraph and guider telescope components is shown in Fig. 1.

The guider lens produces an image of the sun slightly larger than the special occulting disk. The configuration of the disk is shown in Fig. 2. The apertures located parallel to an east-west line on the image are used to detect hour-angle errors; the apertures located parallel to a north-south line on the image are used to detect declination errors. Two beams of light are required for each coordinate.

The reference beams for each coordinate are taken from the photosphere or disk of the sun and pass through the apertures located between the edge and center of the disk. The guide beams for each coordinate are formed from a portion of the edge of the image that protrudes beyond the occulting disk. Under conditions of zero error, the sun's image is, in general, concentric with the occulting disk and nearly equal amounts of light flux emerge from the apertures near the center and at the edge of the disk.

As the error increases from zero, the reference beam area remains

constant while the guide beam varies in area roughly in proportion to the deviation. The difference in intensity between the reference and guide beams is the measure of the error angle of the telescope. Thus, the magnitude of the difference of the two beams is proportional to the magnitude of the error, within limits, and the sign of the difference is indicative of the direction of the error. It should be noted that the guider cannot correct for the apparent vertical contraction of the sun caused by differential atmospheric refraction as the sun departs from the zenith.

Since small variable inhomogeneities in the photosphere (sunspots, faculae, filaments, flares) might change the reference beam intensity and thus introduce errors in telescope pointing, the area of the reference beam is made large and a light reducing filter is used to equalize the light flux to that of the edge beam at zero error. Lucite rods are used to direct the light from the apertures to the phototubes.

The phototubes and following portions of the system convert the light signal into an error-proportional direction-sensitive electrical signal. Since the error signal is a function of the difference between the two light beams, uniform variations in atmospheric transmission will not introduce false error signals. The sensitivity of the error detector varies with the overall light level but this sensitivity variation is compensated for by simultaneously applying inverse variations in gain to an amplifier stage later in the system.

A third aperture for each coordinate, designated C in Fig. 2, is located a short distance away from the occulting disk on the side opposite the other two apertures. No sunlight passes through this aperture under normal guiding conditions. However, in event of a prolonged cloudy period resulting in an error which would displace the image beyond the normal reference apertures, the C apertures take over the function of reference apertures. In this way the range of return is greatly increased.

The placement of the Lucite rods and phototubes in the optical head

FIG. 4—Optical head circuit. Leads A and B connect to the grid of the controlled amplifier stage, V<sub>6</sub>, of the hour-angle circuit and also to amplifier V<sub>13</sub> of that circuit. Terminal C connects to the input grid of the cascaded parallel-T feedback stages of declination circuit

is shown in Fig. 3. The cathode-followers provide low-impedance outputs for the signals from the telescope to the cabinet housing the remainder of the circuits.

### Electrical Circuits

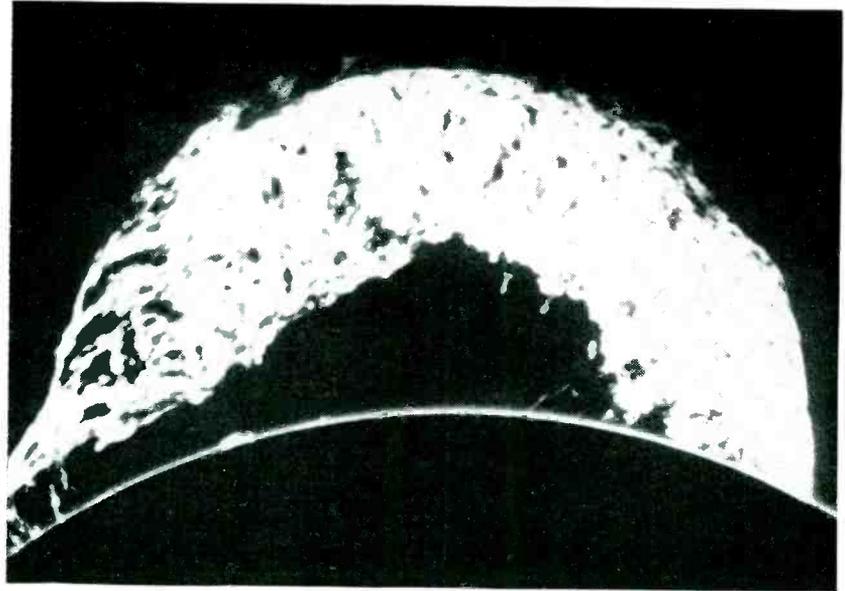
The electrical circuits of the two servomechanisms are shown in Fig. 4, 5 and 6. The reference and guide phototubes are made operative on alternate half cycles of the power line voltage by the action of  $V_1$  in Fig. 6. The output of the phototubes are fed to cathode-followers  $V_6$ ,  $V_7$  and  $V_8$ . The amplitudes of the output pulses from the cathode followers will be dependent upon the illumination of the respective phototube cathodes.

As previously explained, the light flux reaching the reference phototubes is not subject to variation with guiding error, but changes only with variations in the ambient light level. The light flux reaching the guide photocells is a function of the error angle. Therefore, the difference in pulse amplitudes becomes the indication of the magnitude of the error angle. The direction of the error is indicated by the relative amplitude of the guide pulse with respect to the reference pulse.

The hour-angle reference and guide pulses appear at the grid of the controlled amplifier stage  $V_{10}$ . The pulses are amplified and coupled through cathode follower  $V_{10}$  to the input of the phase-sensitive detector  $V_{11}$  and  $V_{12}$ . The cathode follower provides a low-impedance output for the operation of a remotely located oscilloscope used to monitor guiding during photographic operations.

The reference pulse is also applied to amplifier  $V_{13}$ , rectified by  $V_{14}$  and used to make the gain of  $V_6$  of the hour-angle system and  $V_{15}$  of the declination system inversely proportional to the ambient light level. Thus,  $V_6$  and  $V_{15}$  compensate for the variations in sensitivity with ambient light of the error detector.

The amplified output of the hour-angle reference and guide phototubes is converted into a direct voltage by the phase-sensitive detector. This direct voltage is thus an almost exact replica of the error



Solar prominence photograph taken with coronagraph telescope

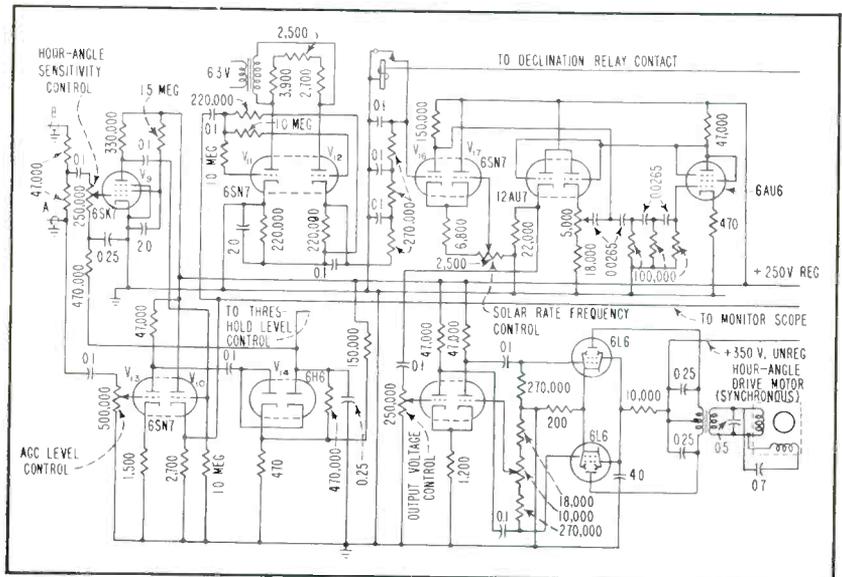


FIG. 5—Hour-angle circuit. Lead A connects to the cathode follower fed by the hour-angle reference phototube and B connects to the hour-angle guide phototube circuit

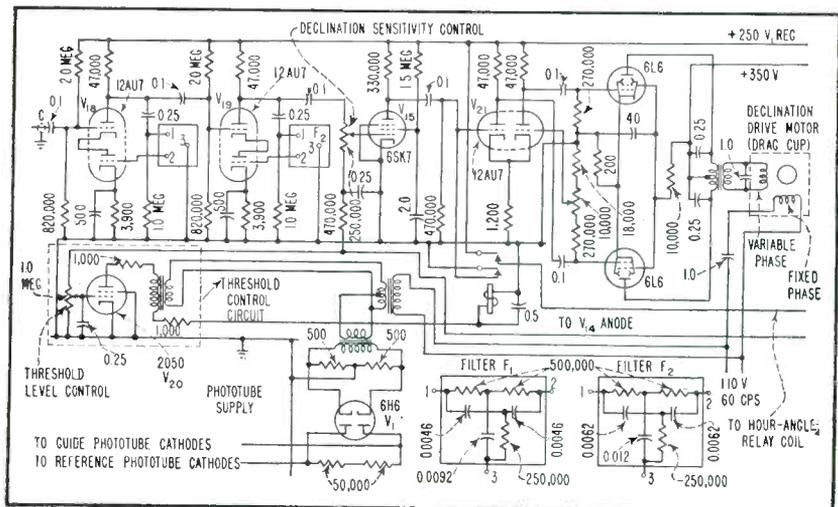


FIG. 6—Declination circuit. C connects to the cathode follower fed by the declination reference and guide phototubes

as a function of time.

Since the telescope is being driven by a synchronous motor, its angular velocity is exactly proportional to the frequency of the alternating voltage applied.

### Speed Control

The required speed control is realized by driving the motor with the amplified output of a frequency-modulated phase-shift oscillator.<sup>2</sup> The frequency of the oscillator is dependent upon the d-c grid-cathode voltage of  $V_{16}$  which functions as one of the resistive elements in the R-C phase-shift network of the oscillator. The grid voltage of  $V_{16}$  is the d-c output of the phase-sensitive detector so that the frequency of the oscillator and therefore the speed of the motor is a function of the magnitude of the error angle between telescope and sun.

The constant-velocity component of motion for zero detector output is obtained by a cathode biasing system. An adjustable voltage of sufficient stability is produced by  $V_{17}$ . This voltage normally produces an oscillator frequency of approximately 60 cycles. The drive mechanism is designed to give the telescope a velocity equal to the apparent velocity of the sun at this frequency so that in event of guider failure the motor may be operated from the 60-cycle power line and the telescope corrected manually.

The simple f-m system used produces an increase in oscillator output voltage with an increase in oscillator frequency.<sup>3</sup> This characteristic tends to keep the power input to the motor constant with respect to frequency variation so that the motor operation is synchronous at all times.

The telescope declination motion is imparted by a two-phase drag-cup motor. The motor is driven by the amplified output of the declination phototubes. If the reference and guide pulses are of equal amplitude, the condition of zero error, the lowest frequency component in the phototube output will be 120 cycles. This signal will be attenuated by the frequency-selective characteristics of the declination amplifier and applied to the motor. The fixed phase excitation is from the 60-cycle power line; therefore,



Rear view of cabinet housing guiders

this null signal will not cause rotation of the motor shaft.

An error in guiding will produce a displacement in pulse amplitudes thereby introducing a directional-sensitive 60-cycle component into the output of the phototubes. This signal, applied to the motor through the amplifier, will cause the motor to drive the telescope in such a direction as to reduce the error to zero. By keeping the time constants small, the maximum sensitivity is again limited by "seeing," rather than system instability. In an earlier model of the guider, anti-hunt provisions were incorporated but operational experience has proved these unnecessary in the present system.

### Frequency-Selective Characteristics

The frequency-selective characteristics of the declination amplifier are obtained by using  $V_{18}$  and  $V_{19}$  in cascaded, parallel-T feedback stages.<sup>4</sup> These amplifiers are tuned to frequencies of 51 and 68 cycles to provide a constant phase shift with frequency around 60 cycles. This is done to maintain the proper phase relation between the fixed and variable phase voltages during expected power line frequency variations at the Sacramento Peak installation. The remainder of the declination circuit is conventional in every respect.

To facilitate guiding during cloudy periods, a threshold control has been incorporated in the guider. When clouds obscure the sun, the hour-angle reference phototube output decreases with a resulting decrease in agc voltage. When the agc voltage drops below a predetermined level, thyatron  $V_{20}$  is allowed to conduct thus closing the relay shown in its plate circuit. The relay grounds the declination signal at the input to  $V_{21}$ , so that no declination corrections are made.

An auxiliary set of contacts on the declination relay cause a relay located on the hour-angle chassis to return the grid of  $V_{16}$ , the frequency control tube, to ground. The hour-angle system then operates at the solar-rate frequency during the cloudy period. When the clouds disappear, the agc voltage rises and the guider resumes automatic operation without any attention from the observer.

In the guider, the power supply is placed on the top rack of the cabinet, the hour-angle chassis is on the middle rack, and the declination chassis is placed on the bottom of the cabinet. The only control on the front panel of the guider is the off-on switch.

The guider is the result of the efforts of Walter O. Roberts, Superintendent of the High Altitude Observatory, John W. Evans, Assistant Superintendent, R. H. Lee, J. C. Palmer, and the writers. Preliminary development was carried on at the firm of W. D. Pratt, consulting engineer. The work was done under a research and development contract administered by the Air Force Cambridge Research Laboratory.

### BIBLIOGRAPHY

- D. H. Menzel, "Elementary Manual of Radio Propagation," Prentice-Hall Inc., New York, 1948.  
C. R. Burrows, Radio Astronomy, *Electronics* 22, p 75, Feb. 1949.  
H. Alfvén, *Cosmical Electro-dynamics*, Oxford-Clarendon Press, p 108, 1950.

### REFERENCES

- (1) W. O. Roberts, Photoelectric Sight for Solar Telescopes, *ELECTRONICS* 19, p 100, June 1946.
- (2) E. L. Ginzton and L. M. Hollingworth, Phase-shift Oscillators, *Proc. IRE*, p 43, Feb. 1941.
- (3) M. Artzt, Frequency Modulation of Resistance-Capacitance Oscillators, *Proc. IRE*, 32, p 409, July 1944.
- (4) G. E. Valley and H. Wallman, "Vacuum Tube Amplifiers," Ch. 10, McGraw-Hill Book Co., New York, 1948.



Dual magnetic-deflection test setup for side-by-side comparison of picture-tube resolution

# Picture-Tube Performance

How to determine focusing strength performance and resolution characteristics for tv picture tubes. Equations are given for both magnetic-focus types and new electrostatic-focus tubes designed to conserve critical materials

**E**XTENSIVE application of television picture tubes utilizing magnetic focus and deflection somewhat complicated the problem of tube design because of the influence of the focus and deflection devices on tube performance.

Since in many instances the tube designer has not been responsible for the design of components, it is desirable to study the magnetic-type cathode-ray tube in a basic manner with emphasis on those performance characteristics which can be modified by external accessories.

The first problem to be considered is the determination and specification of focusing strength. Tube manufacturers' specifications define the focusing strength as current in a standard focus coil at specified conditions of pattern size, anode voltage and brightness. The location of the focus-coil air gap is specified with respect to the yoke or neck reference line. The focusing current value is given as ap-

By **KENNETH A. HOAGLAND**

*Cathode Ray Tube Division  
Allen E. DuMont Laboratories, Inc.  
Passaic, N. J.*

proximate, or with a wide tolerance such as  $\pm 20$  percent. However, focusing devices are in use which cannot achieve the range required by tube specifications.

The simplest approach to the problem of focus-strength determination is to consider the magnetic focus lens as represented by an ideal thin lens of an analogous optical system, assuming that a plane through the center of the air gap represents the Gaussian plane of the lens. Also, it may be assumed that the object of the optical system is a small point in the vicinity of the control-grid aperture and that the image lies at the tube screen. Treating the lens as a path-changing device, it is obvious that to achieve focus at the image, lens strength must change as the angle

through which a given ray from the object is changed.

Figure 1 illustrates the geometry of the ideal case. The height from the axis of the intercept of an object ray and an image ray is taken as a constant and is represented by  $R$ . The object distance is  $d$  and the image distance is  $d'$ . The sum of the angles  $\alpha$  and  $\beta$ , which the object and image rays make with the optical axis, is assumed to be a factor proportional to lens strength and is represented by  $S$ . The following relationships may be derived

$$\begin{aligned}
 S &= \alpha + \beta = \tan^{-1} \frac{R}{d} + \tan^{-1} \frac{R}{d'} \\
 &= \frac{R}{d} + \frac{R}{d'} = \frac{R(d' + d)}{dd'} \\
 &\quad \text{since } R \ll d \text{ or } d' \\
 \frac{S}{R} &= \frac{d' + d}{dd'} = \frac{1}{f}
 \end{aligned}$$

In essence, this derivation is the familiar thin-lens relationship  $1/f = 1/u + 1/v$ , if  $S/R$  is set equal to  $1/f$ . Since an expression is avail-

able for the focal length of a thin magnetic lens in terms of the magnetic field distribution and the accelerating voltage, it is apparent that the focal length for a given case may be taken as inversely proportional to the square of current in the electromagnetic lens. In the idealized case the focus current may be expected to vary as the square root of the sum over the product of the object and image distances.

For electromagnetic lenses<sup>1</sup>

$$\frac{1}{f} = \frac{1}{8} \frac{e}{m} \frac{1}{V} \int_{-\infty}^{+\infty} H^2 dz$$

$$= k I^2$$

$$I = K \sqrt{\frac{d' + d}{dd'}}$$

The resulting relationships which are the most useful in applying the thin-lens law are as follows:

$$I_1 = K \sqrt{\frac{d_1 + d_1'}{d_1 d_1'}}$$

$$I_2 = K \sqrt{\frac{d_2 + d_2'}{d_2 d_2'}}$$

$$\frac{I_1}{I_2} = \sqrt{\frac{(d_1 + d_1') d_2 d_2'}{(d_2 + d_2') d_1 d_1'}} \quad (1)$$

When  $d_1 + d_1' = d_2 + d_2'$

$$\frac{I_1}{I_2} = \sqrt{\frac{d_2 d_2'}{d_1 d_1'}} \quad (2)$$

When  $d_1 = d_2$

$$\frac{I_1}{I_2} = \sqrt{\frac{(d_1 + d_1') d_2'}{(d_2 + d_2') d_1'}} \quad (3)$$

Equation 1 gives the ratio of currents required for focus in the general case of two different sets of object and image distances. Equation 2 considers the special case where the length of the optical system is a constant. This equation is useful in predicting the change in focus current required when the focus coil is located at different positions on the neck of a given tube type. Equation 3 is the case analogous to comparing tubes with

the same gun to focus coil distance but of different screen size or deflecting angle.

### Test Results

To test the validity of the equations, a number of measurements were made on cathode-ray tubes ranging in size from 5 to 19 inches in outside diameter. The tubes tested utilized the same type electron gun.

Figure 2 shows the experimental results on a 19-in. tube as compared to a 5-in. tube. The lower solid line curve represents the measured data for the 19-in. tube, and the circles indicate the theoretical points using Eq. 2 and setting  $I_1 = I_2$  at a distance from  $G_1$  to focus-coil gap of 2.2 inches.

The upper solid line of Fig. 2 represents measured data on the 5-in. tube, while the points indicated by squares were computed using Eq. 3 and the measured 19-in. data.

### Electrostatic Focus

Using essentially the same approach as for the magnetic focus case, it is possible to derive similar equations for electrostatically focused tubes.

In view of material shortages it has been proposed to eliminate the need for external focusing components by the use of an electrostatic lens of the Einzel type. This lens<sup>2</sup> utilizes a focusing electrode in the form of a ring or disk located between electrodes maintained at final anode potential.

Strength of a given lens of this type is a function of the focusing electrode voltage  $V_f$  and the anode voltage  $V_a$ . Setting  $1/f$  equal to  $k(V_a - V_f)/V_f$ , the general equation for variations in focus voltage with variations in tube and gun dimensions becomes

$$\frac{\phi_1}{\phi_2} = \frac{(d_1' + d_1) d_2 d_2'}{(d_2' + d_2) d_1 d_1'}$$

where  $\phi_1$  equals  $V_{a1}/V_{f1} - 1$  and  $\phi_2$  equals  $V_{a2}/V_{f2} - 1$ . The other relationships analogous to the magnetic focus case may be derived from the preceding equations.

On the larger sizes of direct-view tubes, from 12 inches up, focusing strength required for a given anode

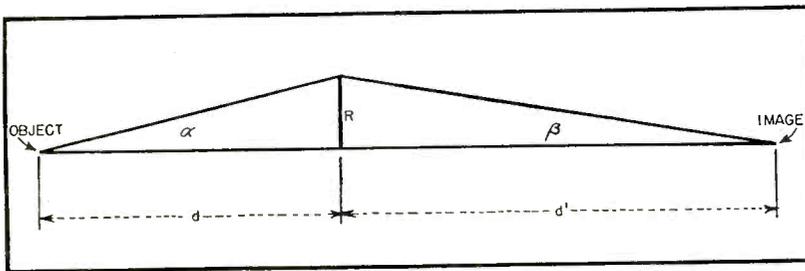


FIG. 1—Geometry of thin-lens setup for evaluating picture-tube focus strength

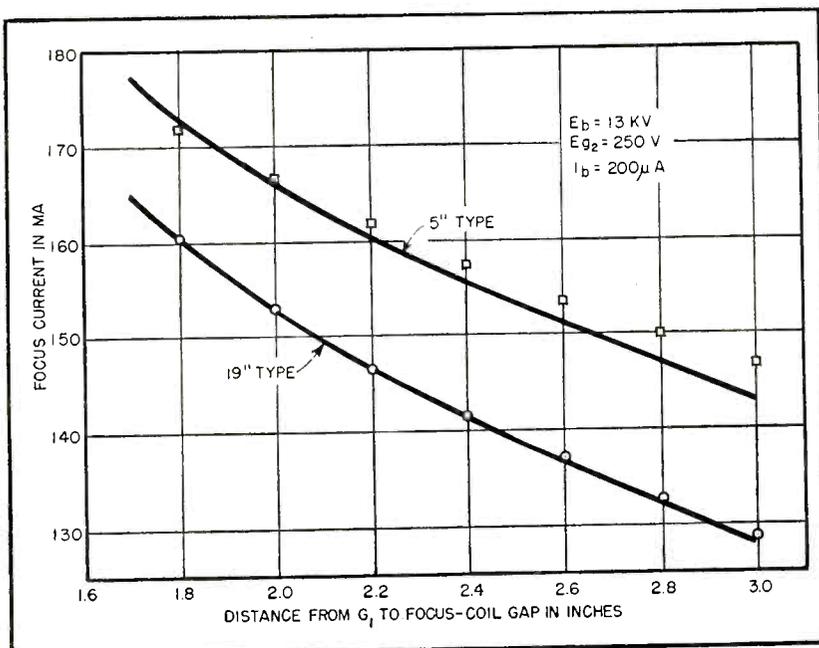


FIG. 2—Focus-current variation with tube size as determined by Eq. 2 and 3

voltage varies only slightly with distance to the screen and in a direction such as to decrease as the tube size becomes larger.

The greatest variation in focus strength on existing types occurs with variations in location of the focusing device with respect to the electron gun. To minimize the range of adjustment required for such devices, it is desirable to locate with respect to the electron gun rather than to a reference point on the tube neck or bulb body.

### Resolution Capability

The second problem of major importance is the resolution capability of a given picture-tube type and the influence of external component designs on this characteristic. A method of vertical resolution determination has been used which is an adaptation of the merging-pattern type of line-width measurement used extensively for industrial and military instrument and indicator tubes.

In applying this method to television picture tubes, 525-line interlaced scanning is used with the horizontal width adjusted to normal picture size. The tube is operated without video modulation, but by means of a grid-gating circuit, a square-wave blanking signal is used to remove the interlaced scan. Elimination of the interlace results in a highly stable pattern which is necessary for determination of the vertical amplitude at which the individual scanning lines appear to merge and are no longer discernible as individual lines.

Figure 3 illustrates the appearance of a test pattern at a near-merged (left side), merged (center) and over-merged condition (right). This result was obtained by slight defocusing of the pattern to show all three conditions at the same time. On all of the types tested, the merged condition was readily discernible and the reproducibility of observed data was good.

Vertical resolution may be determined by the formula  $R = N_s V / 2h$ , where  $R$  is the apparent vertical resolution in number of lines,  $V$  is the maximum vertical dimension of picture scan,  $h$  is the measured height of the merged pattern and



FIG. 3—Test pattern appearance at near-merged (left), merged (center) and over-merged (right) conditions. Result was obtained by slight defocusing of pattern

$N_s$  is the total number of scanning lines.

Figure 4 shows the results of measurements made on a 19-in. type picture tube. In this case, the resolution was measured as a function of location of the focusing component with respect to the control-grid aperture.

A change in distance of 1 inch causes a change in resolution of from 435 to 720 lines and resolution changes approximately inversely with focus current in the electromagnetic coil.

With the size and current distribution of the object fixed, the tube designer can change resolution by changing the location of the electron gun with respect to the focus device or by introducing varying degrees of electrostatic prefocusing between the object and the focus lens. The ultimate result of either method is to produce a larger beam diameter at the focus and deflection region if the center resolution is increased, or a smaller beam diam-

eter if the resolution is decreased.

A low-center resolution cathode-ray tube has less deflection distortion and gives the viewer the impression that the focus is uniform over the entire picture area. The viewer may find this more pleasing than added detail sharpness in the central-picture zone achieved at the expense of focus uniformity.

To resolve this problem, side-by-side comparison tests were made on a number of tubes with known vertical resolution characteristics. It was found, considering the central picture area alone, that a definite preference existed for tubes with resolution figures in excess of 500 lines, because of increased detail contrast.

When the same tests were made considering the entire scanning area, those tubes with very high resolution were found objectionable because of the lack of focus uniformity from the center to the picture edges. On tubes of low resolution, below 400 lines, the lack of detail sharpness was found objectionable despite excellent uniformity of focus.

On the basis of such subjective tests, a vertical resolution range of from 450 to 550 lines was chosen as optimum with a preference for the higher side of the range in view of the increased availability of low-distortion deflection yokes.

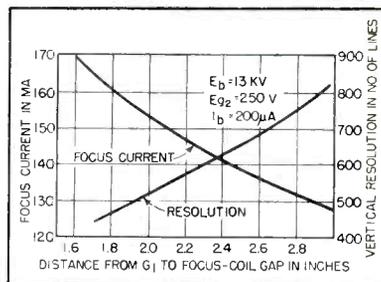


FIG. 4—Focus current and vertical resolution as a function of distance from control grid to focus-coil gap for a 19-in. magnetic-type picture tube

### REFERENCES

- (1) I. G. Maloff and D. W. Epstein, "Electron Optics in Television," McGraw-Hill Book Co., Inc., New York, 1938.
- (2) K. R. Spangenberg, "Vacuum Tubes," McGraw-Hill Book Co., Inc., New York, p 386, 1948.

# Automatic Calibration of Radiosonde Baroswitches

Production-line calibrator turns out individual 150-point calibration charts for 16 pressure switches simultaneously in 8 minutes without human-element errors. Servo motor moves phototube to follow top of mercury column in automatic barometer, and synchro generator transmits column position to chart-printing recorders

**C**ALIBRATION of the precision multipoint pressure switches of meteorological radiosondes involves determining the exact pressure required to make each of 150 successive electrical contacts. Before the development of the automatic calibrator for these baroswitches, an operator working with her individual bell jar, test barometer and audio oscillator would observe the exact pressure value corresponding to each 5th contact.

About 6 years ago a simple automatic calibrator was developed consisting essentially of a mercury J tube, with one end connected to the test chamber and the other end open to the atmosphere. A float switch arrangement followed the top of the mercury in the open end and controlled 10 recorders, each of which recorded the data from a

By **STEPHEN S. HAYNES**

*Friez Instrument Division  
Bendix Aviation Corporation  
Baltimore, Md.*

switch in the test chamber. While relatively crude in the light of modern instrument development, this equipment was effective and has successfully calibrated approximately 750,000 baroswitches.

Recent design modifications in the baroswitch, plus greatly increased accuracy requirements, necessitated modernization of the calibration procedure. A photoelectric follower was developed to replace the float switch, and chart scale length was increased from 11½ inches to about 30 inches for the full 30-inch range of atmospheric pressure. This made each millibar division approximately ½

inch, the millibar being roughly 0.001 atmosphere. The individual test points were printed on this scale by a recording mechanism, with sufficient test points numbered to identify any test point at a glance. To handle such a scale it was decided to use the rather unusual method of feeding the paper through the recorder in proportion to the changes in the test chamber pressure, rather than in proportion to time as is used in many conventional recorders.

The complete calibration equipment as finally designed results in an extremely simple procedure for the operator. He merely loads 16 baroswitches into the test chamber, closes the door, pushes a start button and 8 minutes later, removes the 16 baroswitches from the chamber and 16 corresponding cali-

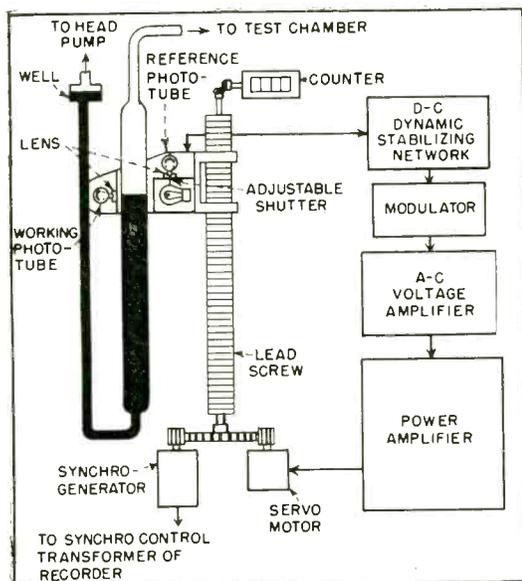


FIG. 1—Arrangement of automatic barometer that measures pressure in test chamber

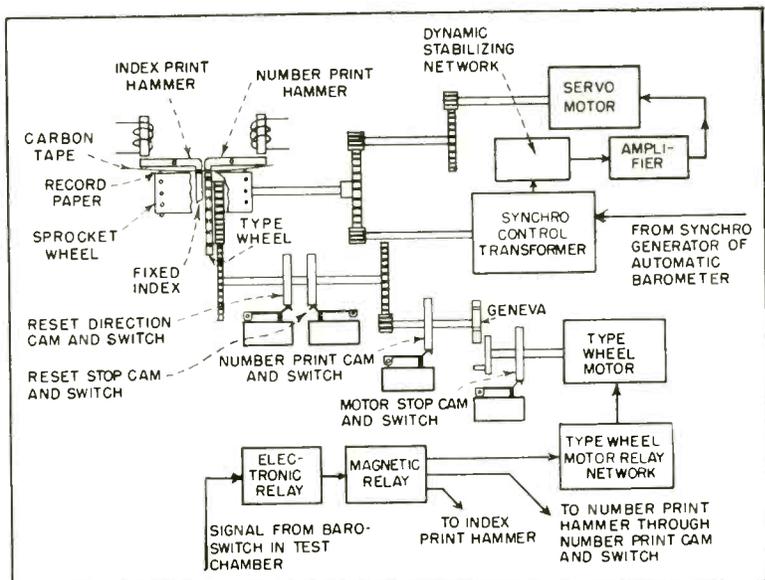
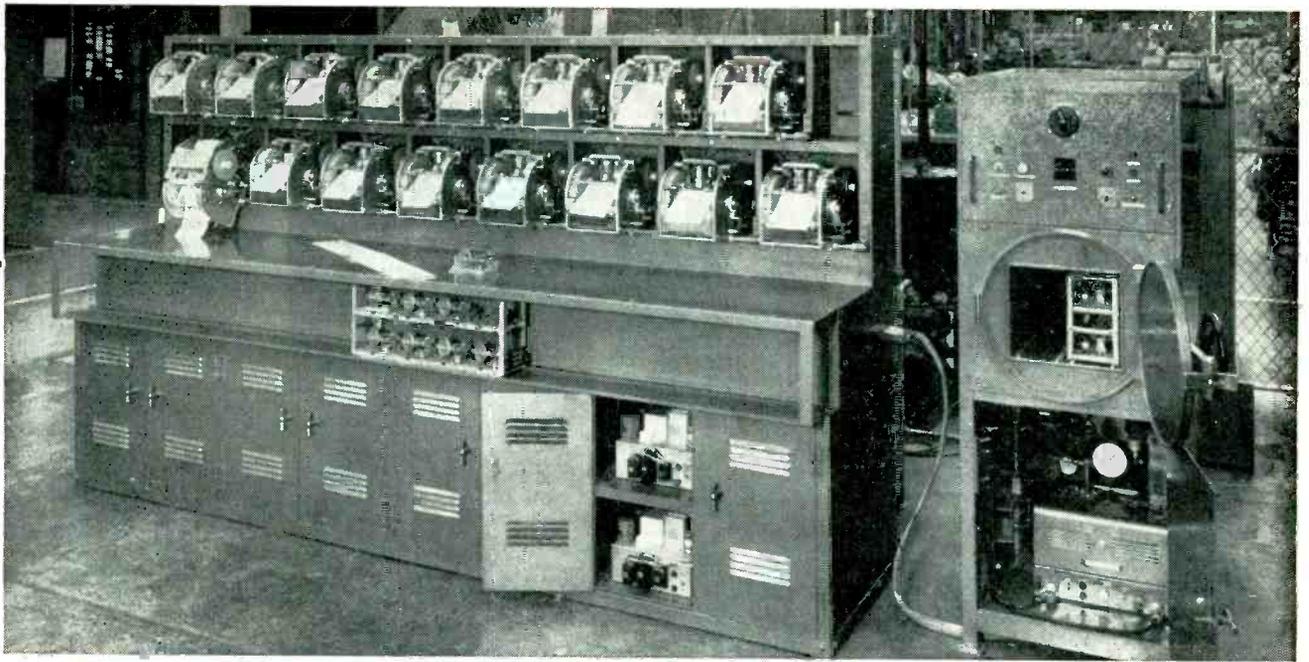


FIG. 2—Method of driving chart paper in recorder as function of changing pressure in test chamber



Test chamber for holding baroswitches is at right, with vacuum pump underneath for varying pressure in chamber from atmospheric to vacuum. Servo amplifier is in front of pump in lower compartment, and chart-printing recorders are on bench

bration charts from the 16 recorders incorporated in the equipment.

### Automatic Barometer

The basic measuring element is a mercury column, chosen because of the high accuracy obtainable together with freedom from drift and hysteresis problems. An accuracy in the order of 0.02 percent of full range is obtainable from the measuring system, and the over-all accuracy including the recorder is 0.05 percent.

The biggest and most variable error encountered in an ordinary mercury column is due to temperature variations, and is corrected by placing the column in a constant-temperature cabinet. Using a continuously operating vacuum pump to maintain a high order of vacuum at the top of the mercury column eliminates the next most troublesome feature of the ordinary barometer, uncertainty as to the order of vacuum above the column. Scale linearity is assured by the use of machined parts and precision bore glass tubing.

A rectangular metal housing surrounding the mercury column near the top contains a light source and phototube system used to detect the location of the top of the mercury column. This housing is moved up and down the tube, to follow the mercury column, by a precision lead

screw located behind the mercury column. In the phototube assembly, the use of an optical condensing system was avoided to simplify adjustment and maintenance. A system of slits collimates the light between the lamp and the phototube. A plastic concave cylindrical lens is used to spread this narrow beam of light evenly over the area of the phototube cathode. A second phototube illuminated by the same lamp through another slit, having an adjustable shutter, compensates for variations in intensity of the light source.

A 2-phase 5-watt a-c motor geared to the lower end of the screw acts as the servo motor in a precision servo system controlled by the phototube. One phase is fed directly from the 115-volt, 60-cycle supply. The other phase is driven from an amplifier fed by the phototube. This motor, working from the amplifier signal, drives the lead screw in a direction to bring the phototube toward the location of the top of the mercury column. A conventional counter driven by the top end of the lead screw shows pressure in millibars directly. A synchro generator, also driven by the lead screw gear, transmits mercury column position information to the recorders in the system.

Figure 1 shows the basic action of the phototube amplifier circuit,

which is essentially a conventional electronic servo system. The amplifier receives a signal from the phototube which is proportional to the error in location of the phototube relative to the location of the mercury column top. This is d-c voltage proportional in value to the amplitude of the error, reversing in polarity when the sign of the error reverses. This signal is fed into an R-C network which modifies it in such a manner as to produce dynamic stability of the entire system, principally counteracting the inertia effects of the servo motor rotor and attached rotating parts.

The synchronous vibrator-type modulator converts this d-c voltage into a 60-cycle a-c voltage with amplitude proportional to error and a phase shift of 180 deg with change in sign of the error. This signal is fed through one stage of voltage amplification and a power amplifier stage to the control phase of the servo motor. The closed loop of the conventional servo system is completed through the mechanical lead screw back to the phototube carriers.

### Chart Printer

The sprocket wheel driving the paper chart of the recorder is located below the hold-down fingers at either edge of the chart. This sprocket is driven by another pre-

cision servo motor system receiving its control signal from the automatic barometer. With this arrangement the paper position becomes a precise function of the mercury column position in the automatic barometer. For this to be true, precision printing and punching of the perforated charts is necessary, as the principal source of error is in maintaining good registration between sprocket holes and chart printing. Such charts have been obtained after some effort and are in the form of a continuous strip several thousand charts long with perforations between each chart for easy separation.

Two printing hammers with their associated electromagnetic drives are at the top of the recorder. The lefthand hammer prints the index marks for successive test points. The right-hand hammer prints the test point numbers, printing every 5th number only. Directly below the hammers and under the paper is located a fixed index point below the left hammer and a number type wheel below the right hammer. This type wheel moves after every index printing but requires five such moves to travel from one type position on its circumference to the next. A carbon paper ribbon is located between hammers and chart.

The recorder mechanism is shown in Fig. 2. The paper drive sprocket wheel is gear-driven by a 2-watt, 2-phase, 60-cycle, low-inertia servo motor. The sprocket wheel gear in turn drives a synchro control transformer which has a gear ratio corresponding to 36 millibars on the chart per revolution of the control transformer. Since synchro control transformers of this type are accurate to well under 1 deg of rotation, this gear ratio produces a basic accuracy of 0.1 millibar or 0.01 percent of full range.

The type wheel motor in Fig. 2 is a geared motor producing 60-rpm shaft speed and driving the motor stop cam and the input member of a Geneva stepping drive. The motor stop cam serves to stop the motor after one revolution of its shaft. The Geneva drive has a reduction of 5 to 1 and drives the number cam, also the type wheel countershaft through a 30-to-1 gear reduction. The countershaft carries

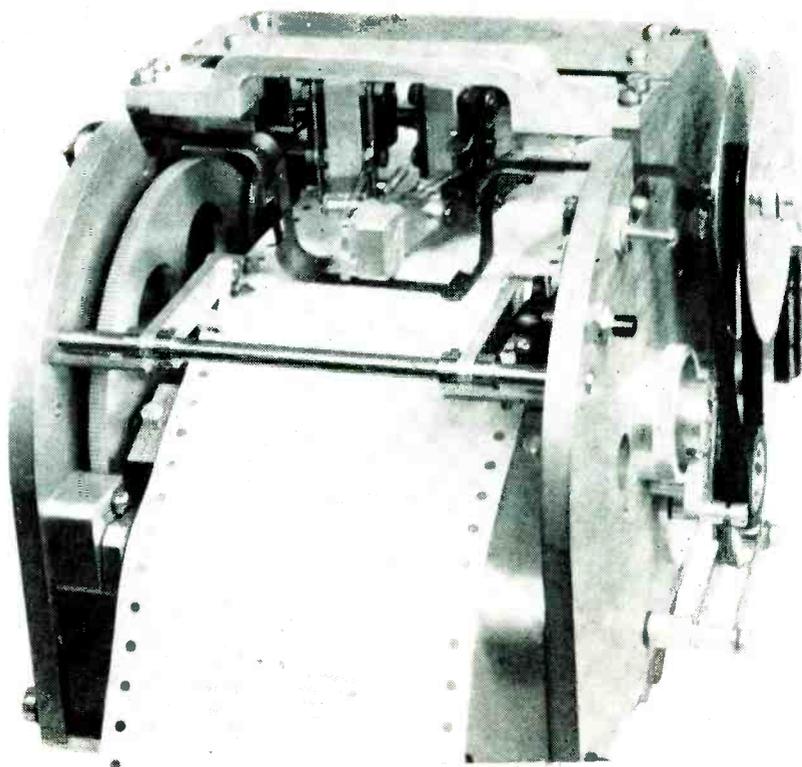


Chart-printing recorder. Lines and numerals at right of printed scale are put on by the recorder automatically by hammer-actuated type wheels, giving over-all chart accuracy of 0.05 percent

the reset direction cam and reset stop cam.

At the end of a recording cycle, the print wheel is reset by continuously driving the type wheel motor in a direction to move the type wheel back to its starting position by the shortest path. The reset direction cam controls the direction of motor rotation to produce this effect, while the stop cam stops the motor when the starting position is reached. This countershaft also drives the type wheel through a 1-to-1 gear ratio. A ribbon drive, not shown in the diagram for simplicity, is driven by the type wheel motor through a ratchet mechanism which prevents backing up of the ribbon when the motor is run backwards during a reset operation.

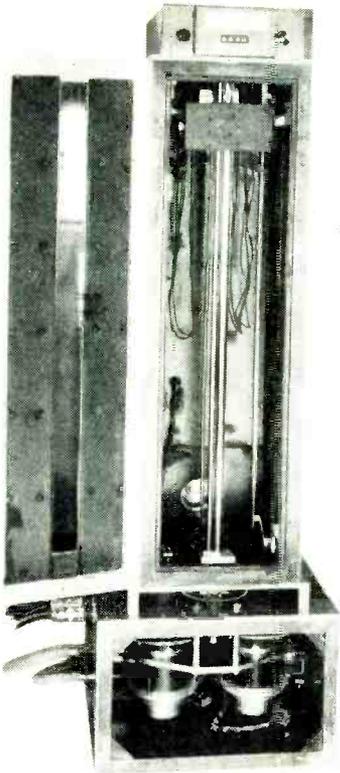
#### Chart Drive

The signal coming from the automatic barometer via a program control, showing the mercury column position, is fed to the synchro control transformer in the recorder. This is a typical 3-phase, 60-cycle synchro secondary signal. The control transformer compares the sprocket wheel position with the

signal from the barometer, and produces a single-phase 60-cycle signal proportional in amplitude to the position error and having a 180-degree phase shift with a change in sign of the error. This signal is fed into a stabilizing network similar in purpose to that in the barometer.

After passing through two stages of amplification, the signal is fed into the servo motor control winding. The servo motor then drives the sprocket wheel in a direction to reduce the error shown by the control transformer. The sprocket wheel gearing acts to close the servo loop back to the control transformer. Since the speed of this servo is considerably faster than that of the barometer, no difficulty is encountered from failure in synchronization between the barometer and recorder so long as operation is uninterrupted.

With each make of the baroswitch contacts in the test chamber, a signal is fed to an electronic relay in the printing system. The electronic relay reduces the load on the delicate baroswitch contacts. The output of the relay is a pulse which closes a magnetic relay momen-



Automatic barometer with cover open, showing mercury column, phototube follower at top, and synchros below

tarily, producing a power pulse to operate the printing hammers. This pulse is fed directly to the index hammer mechanism, but the pulse to the number hammer passes through the cam-actuated number switch that is only closed for one out of five pulses, allowing printing of 5th contacts only.

The magnetic relay pulse is also fed into the type wheel motor relay network, which acts to drive the motor until a signal is received from the motor stop switch after one shaft revolution.

### Operating Sequence

The program control controls the operation of the barometer and recorders in proper sequence. It includes necessary auxiliary functions, consisting of a pressurizing mechanism, an evacuating mechanism, a venting mechanism and a test circuit used in testing operation of the equipment and calibrating the calibrator. The baroswitches to be calibrated snap into two trays, each carrying eight switches. These trays slide into the test chamber and automatically plug into the electrical circuit by means of a plug

system located at the rear of the test chamber. A quick-acting door clamp seals the chamber door.

The vacuum rate-sensing mechanism consists of a metal siphon connected to the test chamber system and balanced by a heavy helical spring. The extension of this spring is controlled by a motor-driven cam on which the desired pressure-time cycle has been cut. In operation, revolution of the cam produces varying tension in the spring which, if not balanced by pressure changes in the siphon, moves the core of a small differential transformer located between the spring and bellows. The a-c signal from this transformer, fed through the amplifier, drives the motor of the control valve in a direction to change the pressure so as to reduce the error thus indicated.

The sequence of operation begins with the closing of the start switch by the operator. This energizes the pressure relay network, which in turn opens the pressure solenoid valve and starts the air compressor. Pressure builds up in the test chamber until the high-pressure contact on the servo pressure switch on the control chassis closes at a pressure of 1,070 millibars. This closure acts on a relay network to close the pressure solenoid and shut off the air compressor. Simultaneously the recorder paper feed servos, the recorder printing circuit and the evacuation rate mechanism motor are activated.

The chamber is evacuated at a rate predetermined by the contour of the pressure rate cam, while the 16 recorders simultaneously record the switch closures of their respective baroswitches. This action continues until evacuation is carried to a pressure of somewhat less than 5 millibars, at which point the low-pressure contact of the servo pressure switch is closed. This, acting on the relay network, shuts off the recorder servos and printing circuits. The recorder reset circuit is simultaneously energized, which activates the evacuation rate control reset, the recorder reset mechanisms and the vent solenoid on the test chamber.

As soon as the test chamber pressure has reached atmospheric pressure, the operator may open the

chamber and remove the 16 baroswitches. The recorder servos and printing circuits are deenergized during the return of the test chamber pressure to atmospheric to prevent feeding the chart back into the recorder and to avoid extraneous printing by baroswitch contact action during the switch closures resulting from the increasing pressure.

Before starting another calibration cycle, the operator feeds the finished chart out of the recorder and sets the next chart at approximately the pressure at which the high-pressure contact of the servo pressure switch closes. When this contact closes during the next calibration cycle, the chart is automatically synchronized with the barometer by the recorder servo system.

At mercury column speeds above 10 millibars per second, up to the maximum of about 15 millibars per second, the servo system tends to lag behind the mercury column excessively. To avoid danger of inaccurate readings due to excessive speed, a neon bulb connected across the control phase of the servo motor lights at about 10 millibars per second as a warning to the operator. Since control phase voltage is a criterion of phototube position error relative to the mercury column, lags due to excessive mechanical friction will also be indicated. The formation of dirt deposits on the glass tube has not proved to be a problem in connection with the use of a phototube pickup, provided a clean system is maintained.

### Other Applications

The equipment described may be used as a general laboratory precision barometer. Elimination of corrections and the ease of reading to high accuracies without optical magnification or parallax is of great value where much pressure observation is required. Other uses include remote indication of barometric pressure by synchro repeaters, automatic pressure recording of other phenomena adaptable to electric switching technique and the development of programming equipment suitable for adapting the barometer-recorder combination to other products.

# Simplified Q Multiplier

Portion of cathode-follower output is stepped up by passive components and fed back to grid of tube to give extremely high selectivity with absolute stability. Extra parts needed are one tube, one capacitor and two resistors

**W**ITH THE RISE of radio navigation, c-w radar, and other systems requiring maximum signal-to-noise ratio, there have grown up in recent years a large number of applications for amplifying systems of very narrow bandwidth. Since the basic limitation on the narrowness of bandwidth which can be obtained in an ordinary tuned amplifier is the resistance associated with the tuned circuit it uses, it seems logical that one solution to the problem would be the use of an active network to supply energy to the system according to exactly the same laws by which the resistance dissipates it, so that some of the effect would be cancelled out.

The use of such active networks, known, for obvious reasons, as negative resistances, turns out to be an entirely practical method of raising the Q of a tuned circuit, Ohm's law holds exactly for a negative resistance element, except for sign change, so it is possible to treat it exactly as any other circuit component, even to the extent of combining it with the positive resistances in the circuit.

Consider, for instance, a tuned circuit having an equivalent parallel resistance  $R$ . The initial value for Q would be

$$Q_0 = \frac{R}{\omega L} \quad (1)$$

and suppose there is put in parallel with this tuned circuit an active network having a negative resistance characteristic. The negative resistance can be combined with the positive resistance of the circuit by the usual laws of combination of parallel resistances to give the

The author is now with Magnetic Device Section, Control Divisions, General Electric Co., Schenectady, New York. Work described was done at MIT Research Laboratory of Electronics under U. S. Navy Bureau of Ordnance contract Nord-9661.

By **H. E. HARRIS**

Research Laboratory of Electronics  
Massachusetts Institute of Technology  
Cambridge, Massachusetts

following relationship for  $R_{eff}$ :

$$R_{eff} = \frac{(-R_n)R}{(-R_n) + R} = \frac{R R_n}{R_n - R} \quad (2)$$

which is obviously greater than the original  $R$ , corresponding to a multiplication of the original Q by a factor equal to the ratio of the two resistances. In other words

$$\frac{Q_{eff}}{Q_0} = \frac{R_n}{R_n - R} \quad (3)$$

This Q multiplication can be made arbitrarily large by simply letting  $R_n$  approach  $R$ .

## Practical Systems

A number of systems have been used to secure this negative resistance characteristic, such as secondary emission in a tetrode (dynatron)<sup>1</sup> or the formation of a virtual cathode between screen and suppressor (transitron)<sup>2</sup>. By far the most satisfactory method to date, however, has been the use of positive feedback around a vacuum-tube amplifier.<sup>3,4</sup> This basic method is

used in the new circuit proposed here.

Consider an amplifier of gain  $A$  and internal resistance  $R_i$ , such as is represented schematically in Fig. 1A, and assume that positive feedback is introduced through the resistor  $R_f$ .

Under the assumption that the input resistance of the amplifier is so high compared to the other circuit resistances that it may be neglected—a condition easily realizable in practice—Kirchhoff's voltage law can be applied to yield the following equation

$$e_1 = i_1 R_f + i_1 R_i + A e_1 \quad (4)$$

which can be rearranged to yield

$$Z_1 = \frac{e_1}{i_1} = -\frac{R_f}{A-1} - \frac{R_i}{A-1} \quad (5)$$

where  $Z_1$  is simply the effective input impedance of the circuit.

This effect is the basis for the increased selectivity of the ordinary regenerative amplifier or detector. Such a regenerative circuit, however, lacks the important characteristic of stability. Referring to Eq. 3 it is seen that appreciable multiplication of the Q is to be had only when  $R_n$  is very nearly equal to  $R$ .

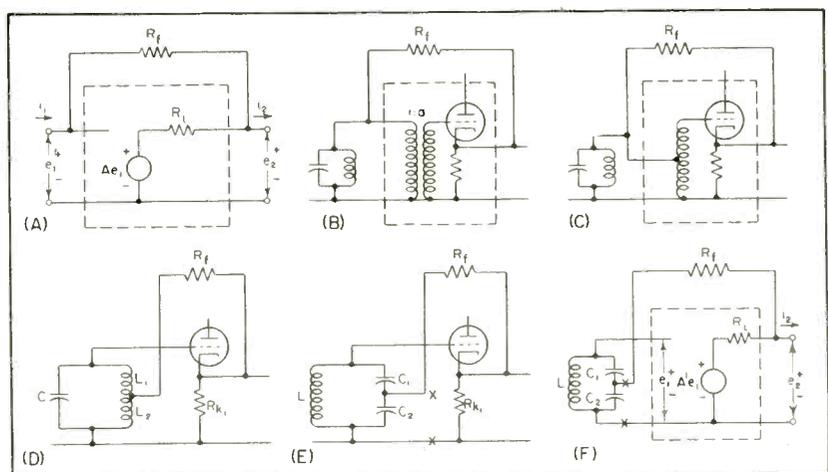


FIG. 1—Simplified circuits showing evolution of single-tube Q multiplier

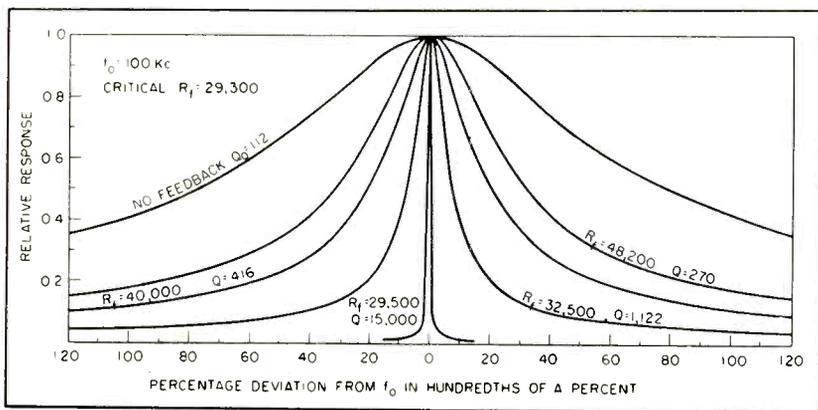


FIG. 2—Curves show selectivity obtainable with Q multiplier. Higher Q values were not tested because of measurement equipment limitations

Therefore it takes only a very slight percentage change in  $R_n$ , such as would be caused by variations in plate supply voltage, to cause the two resistances to become equal, the Q and impedance level to go to infinity, and oscillations to ensue.

One way to resolve this difficulty is to use a highly stabilized amplifier for the active element so that changes in electrode voltages and other random variations will have little effect upon the gain, and hence upon the negative resistance which is produced. Both Terman<sup>3</sup> and later Ginzton<sup>4</sup> have considered in some detail one such circuit utilizing a highly stabilized two-stage amplifier. It is the purpose of the present paper to describe a much simpler circuit which achieves essentially the same results with only a single stage. The basis of this circuit is the cathode follower. It has power gain, correct phase relation, and it has very high stability. But, it has less than unity gain. Fig. 1B shows that this drawback can be eliminated by a passive gain element, a transformer. The evolution from this circuit to the practical ones is shown in Fig. 1.

### Stability Considerations

The most serious factor limiting the applicability of any positive feedback circuit is the stability. Ginzton<sup>4</sup> described a two-tube circuit; a more general derivation follows:

Consider the circuit shown in Fig. 1F in schematic form. Note that in the special case where  $C_1 = \infty$  and  $A' > 1$ , this circuit reduces to the type of system considered by Gizton, while when  $C_1 \neq \infty$ ,  $A' <$

1, it represents the new circuit of Fig. 1E.

The gain of any feedback amplifier can be represented by the equation

$$A' = \frac{K}{1 - \beta K} \quad (6)$$

In the present case, the gain of primary interest is not that of the tube itself, but rather that from points X-X (Fig. 1F) to the tube grid and through to the output at the cathode. This gain is the product of the active gain  $A'$  and what might be called the passive gain  $a$ , or gain contributed by the tapped tuned circuit

$$A = \frac{aK}{1 - \beta K} \quad (7)$$

where

$$a = \frac{C_2 + C_1}{C_1} \quad (8)$$

At this point the assumption is made that the output impedance of the amplifier is negligible with respect to the feedback resistor  $R_f$ . This is reasonable for an amplifier stabilized with a high degree of negative feedback. Equation 5 for the negative resistance developed across terminals X-X then reduces to

$$-R_n = -\frac{R_f}{A - 1} \quad (9)$$

or, substituting from Eq. 7 for the actual gain of the circuit

$$-R_n = -\frac{R_f(1 - \beta K)}{aK - 1 + \beta K} \quad (10)$$

Passing over the details of the derivation, it may be said that this equation is now differentiated partially with respect to the no-feedback gain  $K$ , simplified, and rearranged

to yield an equation relating the fractional change in the negative resistance produced to the fractional change in the no-feedback gain. That is, an equation of the form

$$\frac{\delta R_n}{R_n} = \frac{1}{k} \frac{\delta K}{K} \quad (11)$$

where the factor  $k$  might be called the stability coefficient of the system. In this case the stability coefficient is

$$k = \frac{(1 - \beta K)[(a + \beta)K - 1]}{aK} \quad (12)$$

It is apparent that one would like to make the magnitude of this stability coefficient as large as possible. The maximum possible value is found by differentiating again with respect to a convenient parameter—in this case  $\beta$ —and setting the derivative equal to zero. The optimum value of  $\beta$  turns out to be

$$\beta_{opt} = -\left[\frac{a}{2} - \frac{1}{K}\right] \quad (13)$$

The corresponding value of the stability coefficient is

$$k_{opt} = -\frac{aK}{4} \quad (14)$$

It is now a simple matter to determine the optimum operating conditions for the circuit

$$\beta_{opt} = -1 \quad (15)$$

$$k_{opt} = -K/2 \quad (16)$$

The stability of the negative resistance is merely incidental to the matter of prime concern—the stability of the effective Q. The above results can be related to the Q stability by beginning with Eq. 3 and employing much the same process of differentiating (this time with respect to  $R_n$ ) and simplifying as in Eq. 10. The result is

$$\frac{\delta Q_{eff}}{Q_{eff}} = -\left[\frac{Q_{eff}}{Q_0} - 1\right] \frac{\delta R_n}{R_n} \quad (17)$$

Or, combining the two equations

$$\frac{\delta Q_{eff}}{Q_{eff}} = \left[\frac{Q_{eff}}{Q_0} - 1\right] \frac{2}{K} \frac{\delta K}{K} \quad (18)$$

A number of interesting facts are apparent from this expression: (1) The stability is independent of the absolute value of initial Q. It is then just as easy to multiply Q from 100 to 1,000 as from 10 to 100. Thus it is important to begin with as high a Q as possible to gain maximum stability. (2) The stability

is independent of the frequency, so that the circuit can be used to multiply Q anywhere in the spectrum where the stated assumptions can be met. (3) The higher the Q multiplication, the lower is the stability. For high multiplications this is approximately an inverse relation. (4) The stability increases in direct proportion to the no-feedback gain.

### Another Stability Criterion

It seems logical to set up as an important design criterion of a narrow-band amplifier circuit, the amount of change in the no-feedback gain—that is, the change in the  $g_m$  with electrode voltage changes, aging, and other possible circuit variations—which can be tolerated without causing the system to break into oscillation.

As a starting point, consider again Eq. 3 for the Q multiplication, and solve this equation for  $R_n$ .

$$R_n = R \frac{\frac{Q_{eff}}{Q_0}}{\frac{Q_{eff}}{Q_0} - 1} \quad (19)$$

From Eq. 3 it is apparent that the point at which oscillations begin will be that point where  $R_n$  becomes equal to  $R$ . Therefore if  $R$  is subtracted from the above expression for  $R_n$ , the result will be the absolute value of the change in  $R_n$  which can be tolerated without causing oscillations. This can then be divided by  $R_n$ , to yield the fractional change in  $R_n$  which can be tolerated

$$\left(\frac{\Delta R_n}{R_n}\right)_{\text{tolerable}} = \frac{R}{R_n} \frac{Q_{eff}}{Q_0} - 1 \quad (20)$$

or, making use of Eq. 19 again

$$\left(\frac{\Delta R_n}{R_n}\right)_{\text{tolerable}} = \frac{Q_0}{Q_{eff}} \quad (21)$$

But here again the negative resistance is merely a derived characteristic of the circuit. What is really wanted is the permissible change in the no-feedback gain  $K$ . It is apparent from the optimum operating conditions which were derived, and from Eq. 10 that the negative resistance can be represented as

$$R_n = R_f \left(\frac{K+1}{K-1}\right) \quad (22)$$

Then if  $R_{nl}$  represents the value

of the negative resistance at some particular chosen operating point of the circuit and  $R_{nc}$  the critical value of negative resistance at which oscillations occur, Eq. 21 above can be rewritten

$$\left(\frac{\Delta R_n}{R_n}\right)_{\text{tolerable}} = \frac{R_{nl} - R_{nc}}{R_{nl}} = \frac{Q_0}{Q_{eff}} \quad (23)$$

Substituting from Eq. 22 and simplifying, this becomes

$$\frac{R_{nl} - R_{nc}}{R_{nl}} = \frac{2(K_c - K_1)}{K_1 K_c - K_1 + K_c - 1} \quad (24)$$

where  $K_1$  is the no-feedback gain at the particular operating point chosen above, and  $K_c$  is the no-feedback gain at the critical point.

Now let  $K_c = K_1 + \Delta K$ . Then

$$\frac{R_{nl} - R_{nc}}{R_{nl}} = \frac{2 \Delta K}{K_1^2 + K_1 \Delta K + \Delta K - 1} \quad (25)$$

which, by Eq. 21 is equal to  $\frac{Q_0}{Q_{eff}}$ .

Equating and solving for  $\Delta K$  gives:

$$\Delta K = \frac{K_1^2 - 1}{\frac{2 Q_{eff}}{Q_0} - (K_1 + 1)} \quad (26)$$

If this equation is now divided by  $K_1$  the result is the fractional change in no-feedback gain  $K$  ( $=g_m R_k$ ) which can be tolerated without oscillations

$$\left(\frac{\Delta K}{K}\right)_{\text{tol}} = \frac{1 - \frac{1}{K^2}}{\frac{1}{K} \left(2 \frac{Q_{eff}}{Q_0} - 1\right) - 1} \quad (27)$$

In practice,  $K$  is almost always kept much larger than 1, and the Q multiplication much larger than a half, so that a somewhat simpler working formula may be obtained:

$$\left(\frac{\Delta K}{K}\right)_{\text{tol}} \approx \frac{1}{\frac{Q_{eff}}{Q_0} - 1} \quad (28)$$

This is a most interesting expression. For suppose that at some particular operating point  $a$

$$\frac{Q_{eff}}{Q_0} \Big|_a = \frac{K}{2} \Big|_a \quad (29)$$

The above equation then goes to infinity, signifying an infinite change in  $K$  necessary to cause oscillation. Further, suppose that

$$\frac{Q_{eff}}{Q_0} \Big|_a < \frac{K}{2} \Big|_a \quad (30)$$

Then the fractional change in  $K$

necessary to cause oscillations is a negative number greater than 1. But this would require a negative gain, which, of course, is impossible in a vacuum-tube amplifier. It can be concluded, therefore, that if at any operating point, the condition

$$\frac{Q_{eff}}{Q_0} \Big|_a \leq \frac{K}{2} \Big|_a \quad (31)$$

is met, or, in other words if the circuit constants are adjusted so that the no-feedback gain  $K$  ( $=g_m R_k$ ) is always greater than twice the degree of Q multiplication which is desired, there will be no chance of the circuit breaking into oscillation no matter how much the  $g_m$  of the tube may change with aging, changes in electrode voltages, shock and so on.

Here, then, is the fundamental contribution of this new circuit. Without any substantial increase in the complexity over the ordinary regenerative system, it has made possible attainment of arbitrarily high Q multiplications, while at the same time retaining the absolute stability of the ordinary amplifier.

### Practical Circuit

It is not possible to set down any hard and fast rule as to the magnitude of the  $g_m R_k$  product which may be obtained. Experience has shown, however, that with a 6AK5 and a supply voltage of 200 volts, values of about 100 are easily attainable. With higher supply voltages, correspondingly higher values of the  $g_m R_k$  product may be realized.

Now suppose that a relatively modest degree of Q multiplication—say 10—is all that is wanted. (This still will allow Q's of the order of 2,000 to 3,000 if a good coil is used). The above equations then become

$$\left(\frac{\% \text{ change in } Q_{eff}}{Q_{eff}}\right) = \frac{1}{5.5} \left(\frac{\% \text{ change in } g_m}{g_m}\right) \quad (32)$$

Oscillation impossible

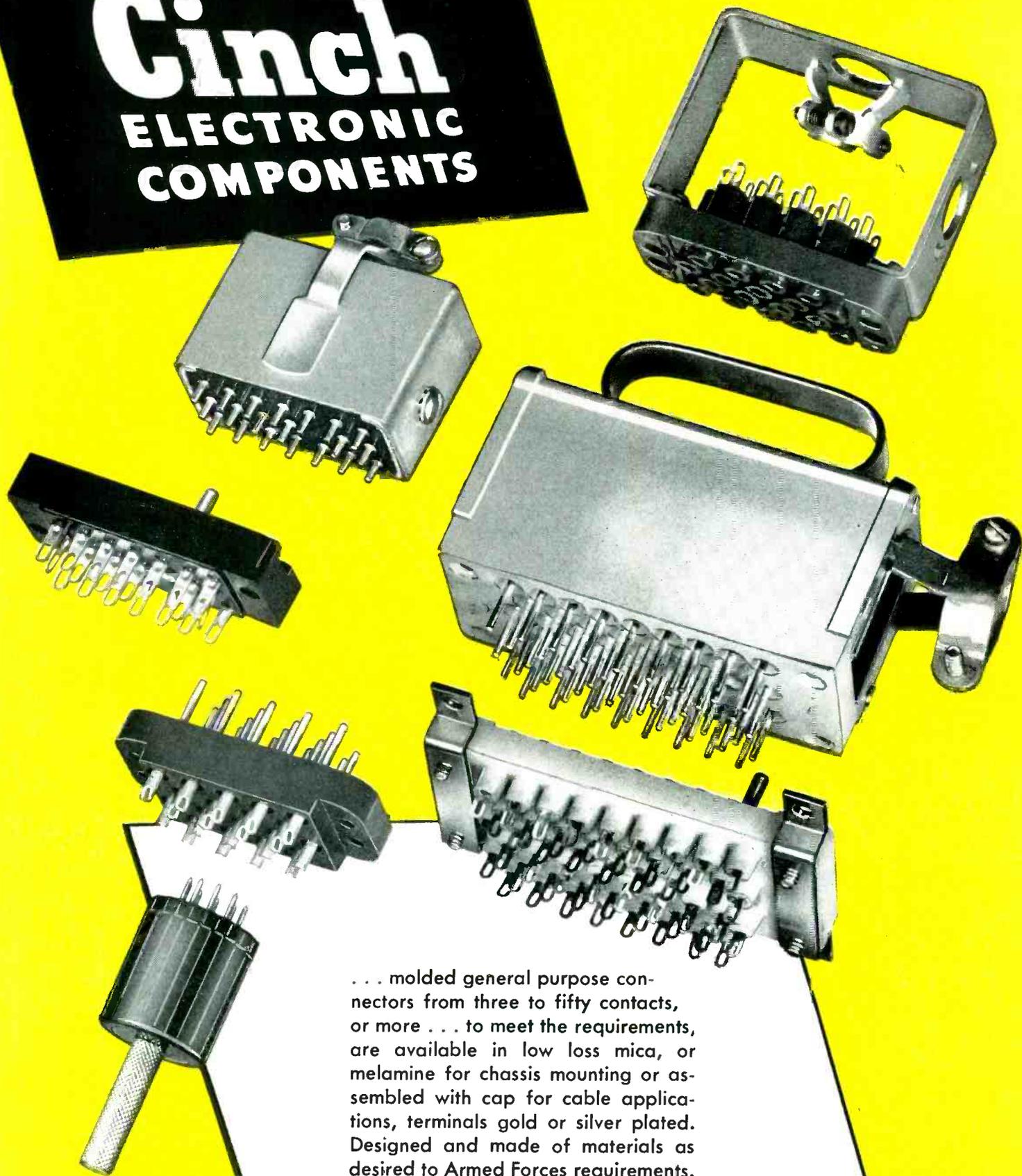
In other words, the percentage change in the Q is only approximately a sixth of the percentage change in the  $g_m$  which caused it, and it will be impossible to cause the circuit to oscillate no matter how much the  $g_m$  may change with shifts in plate voltage and other circuit parameters.

Even for the relatively high Q multiplication of 100, which would

(Continued on p 134)

# Cinch

**ELECTRONIC  
COMPONENTS**



... molded general purpose connectors from three to fifty contacts, or more ... to meet the requirements, are available in low loss mica, or melamine for chassis mounting or assembled with cap for cable applications, terminals gold or silver plated. Designed and made of materials as desired to Armed Forces requirements. Consult Cinch.

Available at leading electronic jobbers—everywhere.



**Cinch**  
**ELECTRONIC  
COMPONENTS**

**CINCH MANUFACTURING CORPORATION**

1026 South Homan Ave., Chicago 24, Illinois

Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

[www.americanradiohistory.com](http://www.americanradiohistory.com)

(Continued from page 132)

correspond to possible Q's of the order of 30,000, stability is excellent.

$$\left(\frac{\% \text{ change in } Q_{eff}}{100\% \text{ change in } g_m}\right) = 2 \left(\frac{\% \text{ change in } g_m}{100\% \text{ change in } g_m}\right) \quad (33)$$

This is still well within the practical range of operation, if a power supply of any reasonable regulation is used.

### Experimental Results

The curves of Fig. 2 show the results obtainable from a typical circuit of this new type. These curves were taken by applying a variable-frequency, constant-voltage signal to the Q multiplier circuit through an isolating stage and measuring the output voltage as a function of the frequency. The no-feedback curve is a plot of output voltage versus frequency when the feedback circuit was opened, or when  $R_f = \infty$  and the circuit was operating as an ordinary cathode follower. The other curves show the effect of reducing the feedback resistor closer and closer to the critical value of 29,300 ohms. The maximum Q value of 15,000 shown was by no means the limit obtainable with the circuit. There was simply no measuring equipment available precise enough to allow a reliable set of data to be taken for higher Q's.

Theory indicates that the shape of the response curve should be unaltered by the Q multiplication. This was checked by plotting data taken for several values of multiplication on the same graph as the universal resonance curve. In every case the results were identical. This means that these circuits may profitably be cascaded or staggered, using the identical means of calculation as for ordinary resonant circuits.

Experiments have verified the two stability relations. In both cases, the stability turned out to be slightly higher than predicted.

### Practical Suggestions

For the convenience of the designer, it might be well here to summarize a few practical hints which have been discovered in the course of working with this circuit. First of all, for reference, the actual cir-

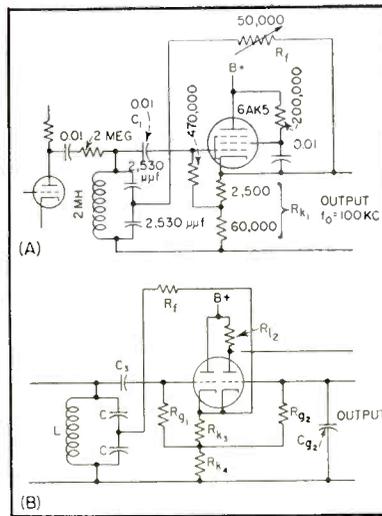


FIG. 3—Practical circuits of single-tube Q multiplier. In B the first triode section serves as the Q multiplier and the second as a grounded-grid amplifier

cuit used for the preceding experimental measurements is reproduced in Fig. 3A.

The exact critical value of the resistance  $R_f$  is easily found from Eq. 3. Remembering that the negative resistance is developed across only half of the tuned circuit in this system, Eq. 3 actually becomes:

$$\frac{Q_{eff}}{Q_0} = \frac{R_n}{R_n - R/4} \quad (34)$$

But  $R_n$  is given by Eq. 22. Substituting and regrouping gives

$$\frac{Q_{eff}}{Q_0} = \frac{1}{1 - \frac{R/4}{R_f} \frac{(K-1)}{(K+1)}} \quad (35)$$

from which it is apparent that the critical resistance is

$$\left[ R_f \right]_{crit} = \frac{R}{4} \frac{(K-1)}{(K+1)} \quad (36)$$

For design purposes this value can be taken simply as one-fourth of the tuned circuit impedance. If the circuit is operating properly, oscillations will ensue for all values of  $R_f$  less than this value. For  $R_f = \infty$  the circuit operates as a cathode follower, and as  $R_f$  decreases toward the critical value, the Q multiplication increases without limit.

The actual  $R_k$  to be used in computing the  $g_m R_k$  product is the cathode resistor  $R_{k1}$  in parallel with the series combination of  $R_f$  and one-fourth of the impedance of the tuned circuit—that is, approximately the cathode resistor in parallel with one-half the tuned circuit

impedance in the multiplier.

The grid biasing connection shown in Fig. 3A is used for the purpose of increasing the  $g_m R_k$  product, and hence the stability. Using this arrangement, a large cathode resistor can be used without increasing the grid bias excessively and thus reducing  $g_m$ .

Somewhat higher stabilities are obtained by using pentode as in Fig. 3A, instead of the triode discussed previously. The screen should be by-passed to the cathode. Otherwise the tube will operate as a triode. If only moderate multiplications are needed, however, the double triode circuit shown in Fig. 3B may be found useful. Here the first section is used as a Q multiplier, and the second as a grounded-grid amplifier.

The source impedance should be kept high, either by the use of a series resistor as in Fig. 3A, or by designing the preceding stage for a high output impedance. If high Q multiplications are sought, the series resistor is preferable, in conjunction with a low output impedance for the previous stage.

The phase shift must be kept to a minimum to avoid frequency shift as the Q multiplication is changed.

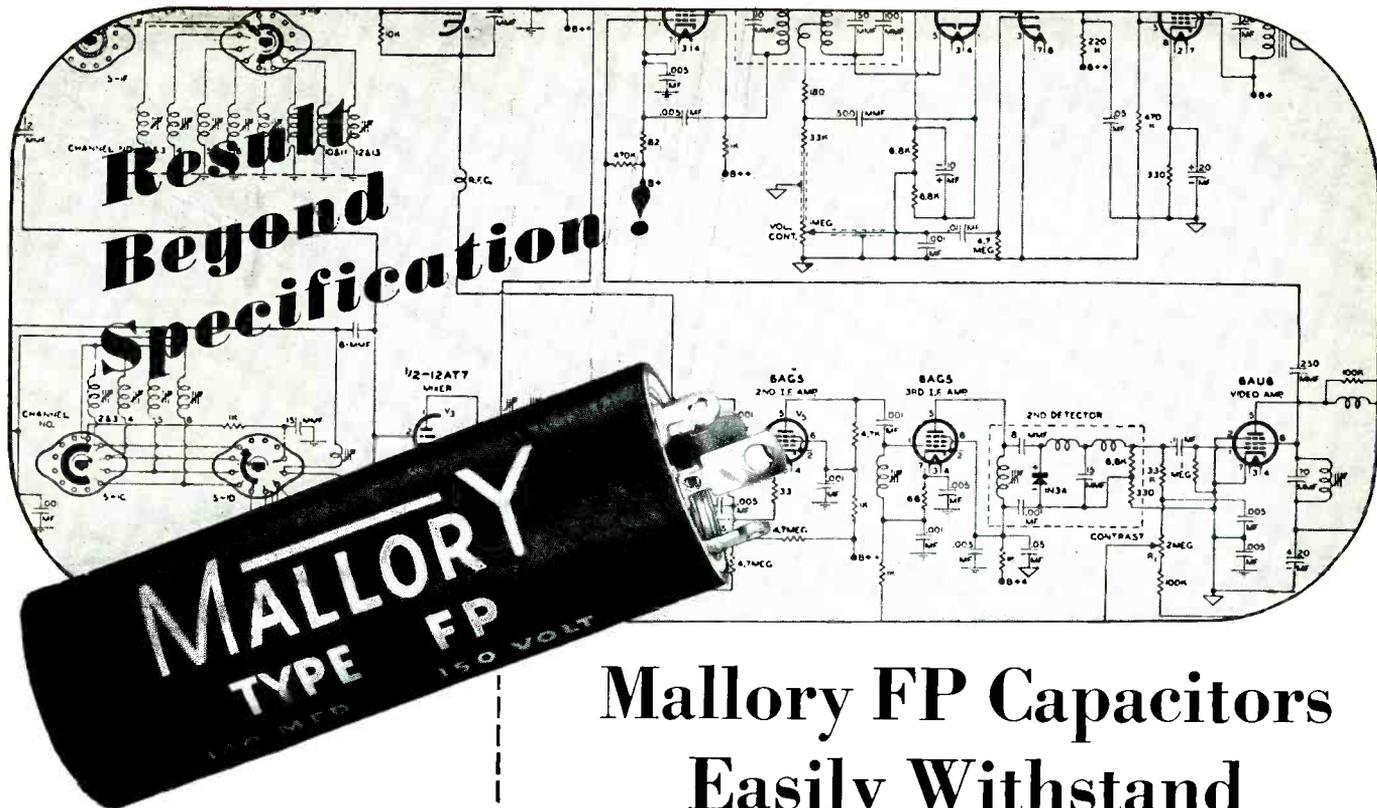
When the split inductor variation of Fig. 1D is used, the cathode resistor  $R_{k1}$  may be omitted. This allows about a 2-to-1 increase in stability.

The signal input should be kept relatively low for best results. Experience with the type 6AK5 has shown that inputs much more than a volt or two result in reduced effective Q multiplication due to curvature of the tube characteristic.

It is possible to raise the Q of a coil alone by use of the circuit in Fig. 1D with the capacitor omitted. Use in such a manner suggests a number of additional applications for the circuit.

### REFERENCES

- (1) F. M. Colebrook, Voltage Amplification with High Selectivity by Means of the Dynatron Circuit, *Wireless Engineer*, 10, p 69, Feb. 1933.
- (2) E. W. Herold, Negative Resistance and Devices for Obtaining It, *Proc. IRE*, 23, p 1,201, Oct. 1935.
- (3) F. E. Terman, R. R. Buss, W. R. Hewlett and F. C. Cahill, Some Applications of Negative Feedback with Particular Reference to Laboratory Equipment, *Proc. IRE*, 27, p 649, Oct. 1939.
- (4) E. R. Ginzton, Stabilized Negative Impedances, *ELECTRONICS*, Part I, 18, p 140, Jul. 1945; Part II, 18, p 138, Aug. 1945; and Part III, 18, p 140, Sept. 1945.



## Mallory FP Capacitors Easily Withstand High Ripple Currents In TV Circuits

When you specify Mallory Capacitors for television receivers or other equipment where heat is a problem, you can be sure they will stand the test. Mallory FP Capacitors are designed to give long, trouble-free performance at 85°C. —naturally they give even longer service at normal temperatures. In addition, Mallory FP Capacitors are famous for their long shelf life. Write for your copy of the FP Capacitor Engineering Data Folder.

The superior heat dissipation characteristic of Mallory FP Capacitors —long inherent in our production method—proved to be an important factor in meeting the problem of high ripple currents in TV receivers.

Thorough testing demonstrated that standard Mallory FP Capacitors would stand up in the rugged service involved in the voltage doubling rectifier circuit. The jump from radio ripple currents of about .15 amperes to five or six times this current in TV service places a tremendous burden on capacitors. But Mallory FP Capacitors are giving long, uninterrupted performance . . . at temperatures approximating the boiling point of water.

*That's result beyond specification!*

Mallory capacitor know-how is at your disposal. What Mallory has done for others can be done for you.

*FP is the type designation of the Mallory developed electrolytic capacitor having the characteristic design pictured and famous throughout the industry for dependable performance.*

**P. R. MALLORY & CO., Inc.**  
**MALLORY**

**P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA**

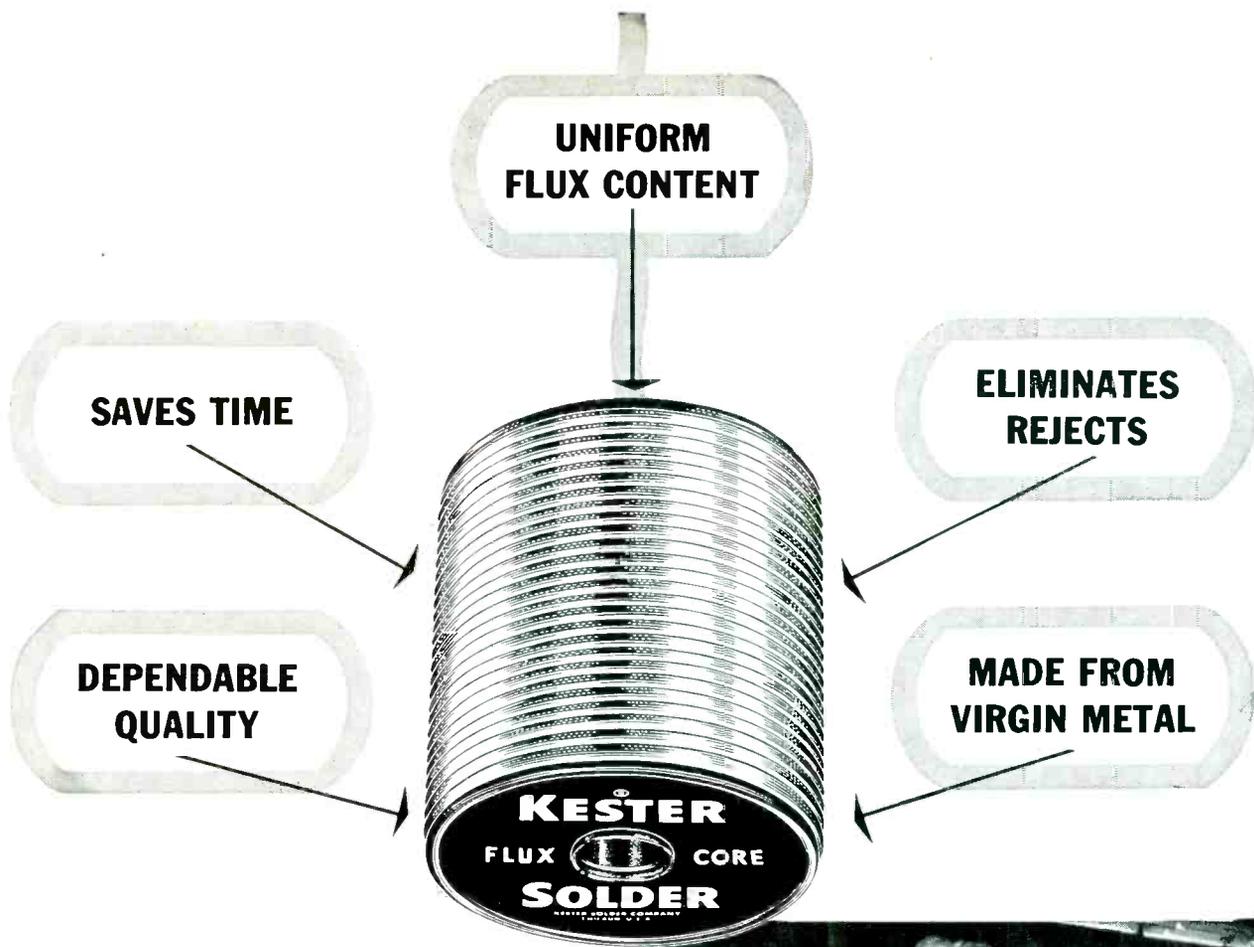
### SERVING INDUSTRY WITH

Electromechanical Products  
Resistors                      Switches  
TV Tuners                      Vibrators

Electrochemical Products  
Capacitors                      Rectifiers  
Mercury Dry Batteries

Metallurgical Products  
Contacts                      Special Metals  
Welding Materials

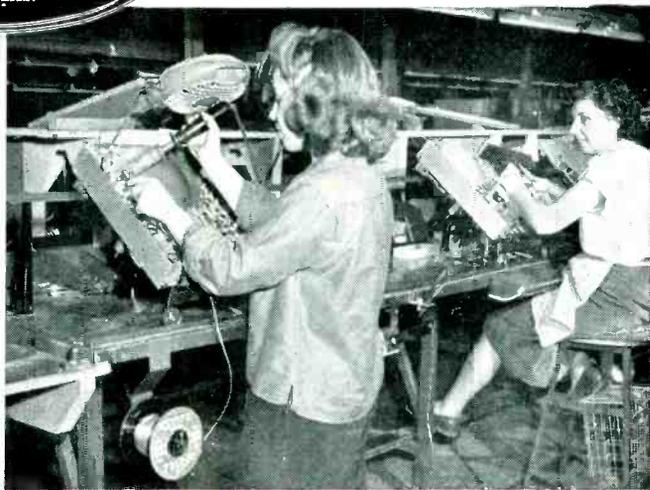




**KESTER**

the Solder

*that gets Speed  
into  
TV Production*



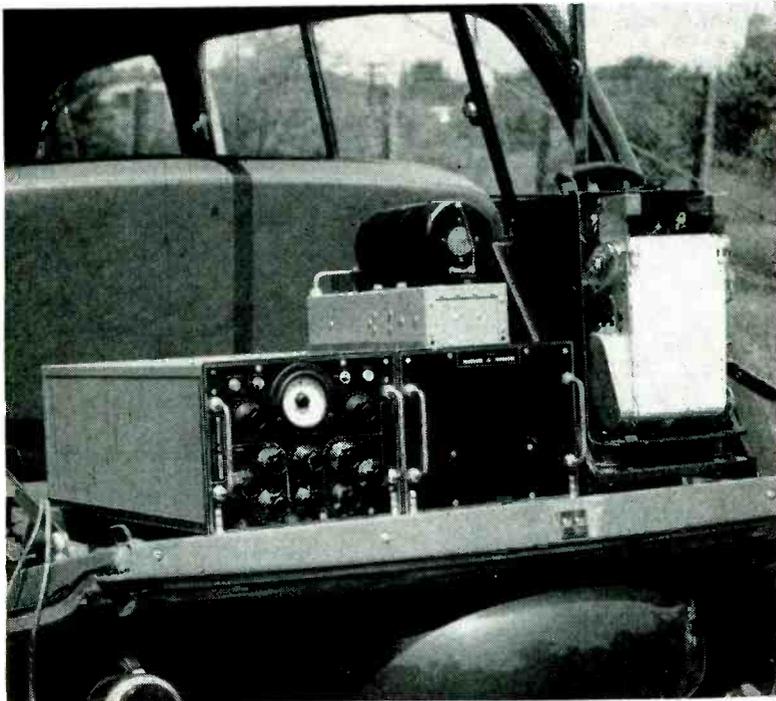
Using Kester Flux-Core Solders, Plastic-Rosin and "Resin-Five" Core Solders, will keep your solderers satisfied. Kester flows better—handles easier—faster to use. Kester Solders are made only from newly mined grade A tin and virgin lead.

**FREE TECHNICAL MANUAL**—Send for your copy of SOLDER and Soldering Technique.

**KESTER SOLDER COMPANY** • 4204 WRIGHTWOOD AVE.  
CHICAGO 39, ILL. • NEWARK, N. J. • BRANTFORD, CANADA



## THE FRONT COVER



**E**DDY-CURRENT DISTURBANCE induced in the vertical stabilizer of a P2V aircraft is being measured at Airborne Instruments Laboratory with the experimental setup shown in the cover picture. The magnetically sensitive element mounted on the crosspiece of the gallows suspending the stabilizer is connected to the recording equipment located in the station wagon, as shown in the accompanying photograph. As the stabilizer is swung back and forth in a pendulum fashion, the resulting disturbances in the magnetic field at the instrument are recorded.

From the magnetic-field disturbance measurements, it is possible to determine the positions in the aircraft best suited for the magnetometer. The same measurements are used in the design of equipment for cancelling the remaining disturbing fields which exist at the chosen locations.

circuit<sup>1</sup> it is possible to obtain sharp trigger pulses of constant amplitude throughout the entire frequency range of the sweep oscillator. This circuit utilizes a pair of triodes direct-coupled in such a manner as to have two definite stable operation states depending upon the voltage on the input control grid. Transition between the two states of operation is extremely rapid, with the result that when an alternating voltage is applied to the control grid the output is a square wave. The square-wave voltage is of the same frequency as the input signal and its amplitude is constant

for all values of input above approximately 8 volts rms.

Transition time of the Schmitt circuit is independent of the frequency of the input voltage so that when the output wave is differentiated by an R-C differentiating circuit the resulting pulses are constant in both sharpness and amplitude.

In the circuit diagram shown, the sawtooth sweep voltage is obtained from one of the horizontal deflection plates of the oscilloscope crt and is fed to the control grid of the 6SN7 Schmitt circuit stage. The square-wave output is differentiated by the

50- $\mu$ f coupling capacitor and 100,000-ohm grid resistor of the 6SL7 triode pulse amplifier.

The 6SL7 is biased beyond cutoff so that the negative grid pulses are most ineffective and only negative plate pulses are supplied to trigger the flip-flop circuit which follows.

The negative trigger pulses are applied simultaneously to both grids of the 6SN7 flip-flop circuit, triggering the circuit back and forth. The resulting output from the flip-flop is the required square wave of one-half the frequency of the sweep oscillator. This voltage is applied to the grids of the 6SN7 cathode-follower stage whose cathodes are tied to the cathodes of the two 6SJ7 switching tubes.

When a positive half cycle is on the grid of one cathode follower, the plate current flowing through the cathode resistor produces enough voltage drop across the resistor to bias the 6SJ7 to cutoff. At the same time the other cathode follower is cut off by the negative grid voltage since the grids are 180 degrees out of phase. One switch tube is cut off while the other is functioning to pass its input signal during one sweep of the beam across the face of the cathode ray tube. During the next sweep the situation is reversed and the other signal input is passed.

The 500,000-ohm potentiometer connected between the cathodes of the switching tubes is used to select the amount of separation desired between the two traces. When the slider is off center, one switch tube will be biased more strongly than the other. The average plate voltages on the switch tubes while they are conducting will be different and this difference will be carried on through the oscilloscope amplifier as a trace separation.

A 25,000-ohm potentiometer in the grid circuit of the flip-flop stage sets the negative bias level for the grids. It may be an internal adjustment since it is set initially for optimum operation and then left unchanged.

The electronic switch has an input impedance of 4.7 megohms at the grids of the 6SN7 cathode-follower input tube. Signal voltages

(Continued on p 156)

**NEW!**



**ACE HIGH**

• • **for miniaturization,  
mounting, and temperature problems**

Here they come, right off the top of the deck, to fill in what's been needed—new ways of mounting subminiature capacitors in military electronic equipment!

You'll find side stud, end stud, threaded neck, and two types of side bracket capacitors in Sprague's new 16 page Engineering Bulletin **213-B**.

These new Sprague-pioneered designs make even broader the world's most complete line of solder-seal terminal metal-

encased subminiature paper capacitors.

And they're now available as standard in a 125°C. temperature rating Vitamin Q® capacitor series. Voltage ratings range from 100 to 1000 volts in both inserted tab and extended foil constructions.

And remember, Sprague Capacitors are the standard of dependability for critical electronic circuits. Write for your copy of Bulletin **213-B** which gives the complete Sprague Subminiature Story.

**SPRAGUE**  
PIONEERS IN

**SPRAGUE ELECTRIC COMPANY**  
NORTH ADAMS, MASSACHUSETTS

**ELECTRIC AND ELECTRONIC DEVELOPMENT**

# THE ELECTRON ART

Edited by JAMES D. FAHNESTOCK

Accurate Instantaneous Frequency Comparison.....	140
Multiple-Channel D-C Amplifier.....	188
Wide-Range Resonators for VHF and UHF.....	200
Boucherot Compensation.....	206
Noise Figure Standards.....	214
Super-Speed Scintillation Counting.....	218

## Accurate Instantaneous Frequency Comparison

BY RAYMOND M. WILMOTTE  
*Raymond M. Wilmotte Inc.*  
*Washington, D. C.*

THE USUAL METHOD of finding when the varying frequency of a signal passes through a predetermined frequency, is by means of an oscillator at this latter frequency, obtaining the beats between the signal and the oscillator and noting when the beat frequency passes through zero. That process is in general simple and satisfactory except in the case when the frequency of the signal varies rapidly. When there is a very rapid change, the beat frequency may not remain long enough at a low value for a circuit to be able to recognize it as a low frequency. The key characteristic in such a case is not that the beat frequency is zero at a particular instant, but that it changes sign. Unfortunately most circuits are unable to detect the difference between a positive and a negative beat frequency.

This problem came up in connection with special work on certain f-m systems and was disclosed some time ago to the Patent Office.

A simple circuit to distinguish between positive and negative beat frequencies makes use of the theory of the operation of limiters. It is known that when two f-m signals of different but nearly equal amplitude are passed through a limiter, the resulting output contains short periods during which the rate of change of phase is very large. These phase changes can be translated

into voltages by means of a discriminator circuit designed to have a sufficiently wide frequency characteristic to be able to respond adequately to these large rates of change of phase.

The expressions for the value of the maximum and minimum output of a discriminator caused by two signals are simple and well known. If the frequencies of the two signals A and B are  $f_A$  and  $f_B$  respectively,

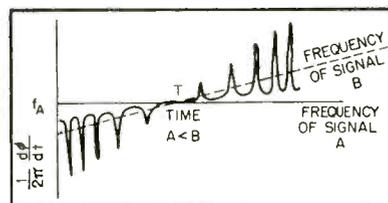


FIG. 1—Curve shows rate of change of phase of resultant as frequency B passes through frequency A

and the amplitude ratio of A to B is  $r$  then the maximum and minimum responses of the discriminator are respectively proportional to

$$f_A + q \left( \frac{r}{1+r} \right) \quad (1)$$

and

$$f_A - q \left( \frac{r}{1-r} \right) \quad (2)$$

where

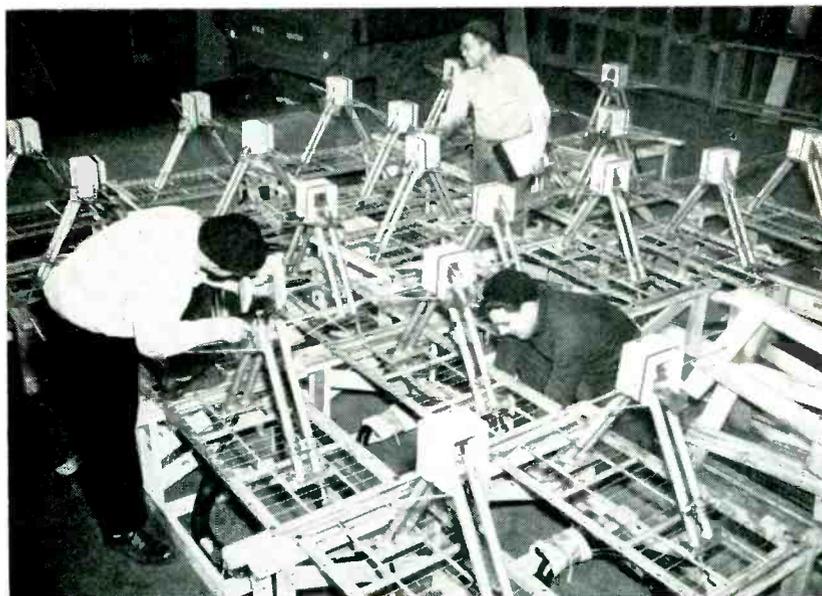
$$q = f_A - f_B \text{ and } r > 1$$

It is to be noted that when  $q$  is positive  $f_A$  is less than expression 1 and greater than expression 2, while when  $q$  is negative the reverse is true. It is also to be noted that in either case when  $r$  is nearly equal to unity, the maximum given by expression 2 differs very much more from the mean value  $f_A$  than the maximum given by expression 1.

The application of these results to the simple case of signal A of steady frequency and another signal B of frequency varying linearly is

(continued on page 186)

## WPIX ANTENNA READY FOR INSTALLATION

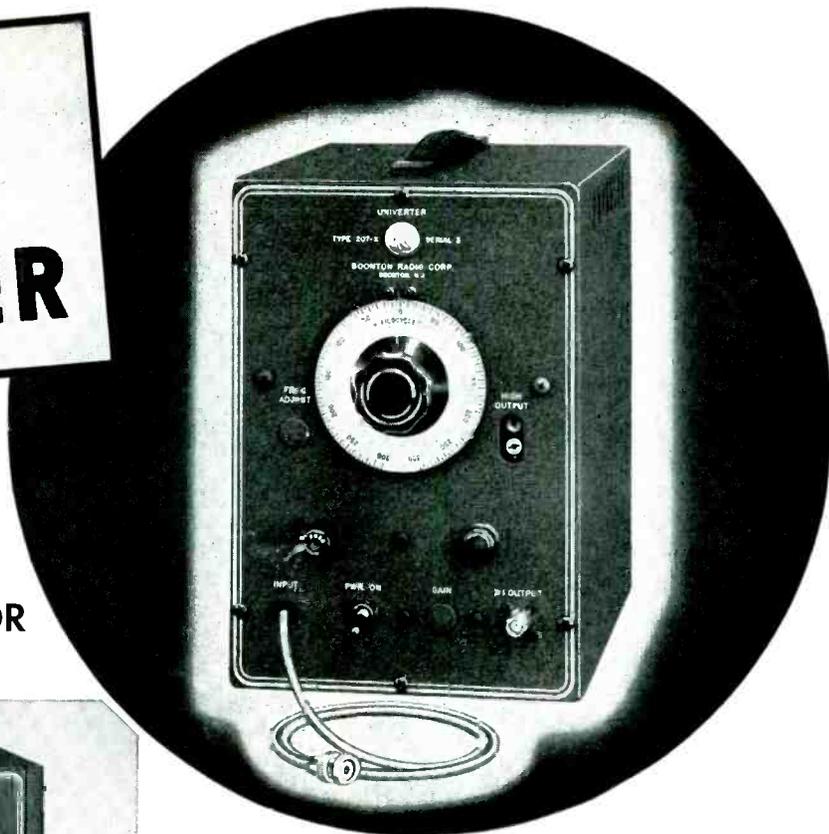


WPIX channel-11 super-gain antenna undergoes final crating for shipment from RCA Camden, N. J., plant for installation on Empire State tv totem pole in New York City. Operation from the new location is expected to begin August 1, 1951

# Announcing a **NEW** **UNIVERTER**

**Continuous Coverage  
0.1 to 216 mc.**

Accessory for the  
**FM-AM SIGNAL GENERATOR**  
TYPE 202-B



**UNIVERTER**  
TYPE 207-A

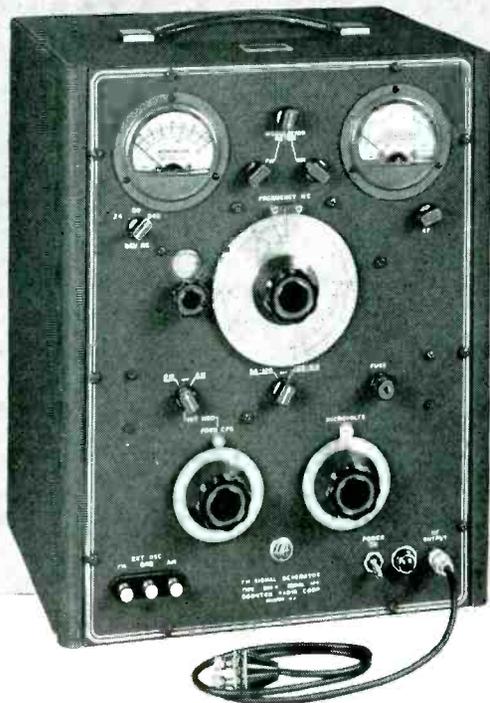
The Type 207-A Univertor fills the widespread need for an FM-AM source in the frequency range of from 0.1 to 55 mc. This instrument is a unity gain frequency converter which subtracts 150 mc. from a signal derived from the Type 202-B FM-AM Signal Generator to produce an output of from 100 kc. to 55 mc. This is accomplished without change of signal level or of modulation and with negligible spurious frequencies. Thus the Type 207-A Univertor when used with the Type 202-B Signal Generator shown at the left will provide complete FM-AM Signal Generator coverage from 100 kc. to 216 mc.

In addition to the unity gain output, the Type 207-A Univertor provides a high level output of about 7.5 times the input thus making about 1.5 volts available for high level tests.

In order to facilitate band-width measurements, the Univertor is provided with an incremental frequency dial which is calibrated in 5 kc. increments over a range of  $\pm 300$  kc. This permits selectivity curves to be taken on even the most selective mobile receivers.

The power supply is well regulated to prevent change of gain or output frequency with line voltage variation from 95 to 130 volts.

Complete specifications, price, and delivery information will be furnished on request.



**FM-AM SIGNAL GENERATOR**  
TYPE 202-B

This instrument has become the standard signal source for the FM and Television Industry.

The Type 207-A Univertor described at the right was developed to extend its useful frequency range down to 100 kc. without changing the signal level or modulation characteristics shown below.

**SPECIFICATIONS:**

RF RANGE: 54-108, 108-216 mc.  
FREQUENCY DEVIATION: 0-24 kc., 0-80 kc., 0-240 kc.  
FM DISTORTION: Less than 2% at 75 kc. deviation  
AMPLITUDE MODULATION: Continuously variable 0-50%.  
RF OUTPUT VOLTAGE: 0.1 microvolt to 0.2 volt.

**BOONTON RADIO**

BOONTON - N. J. - U. S. A.



DESIGNERS AND MANUFACTURERS OF THE Q METER • QX CHECKER  
FREQUENCY MODULATED SIGNAL GENERATOR • BEAT FREQUENCY  
GENERATOR AND OTHER DIRECT READING INSTRUMENTS

# NEW PRODUCTS

Edited by WILLIAM P. O'BRIEN

## Civil Defense Receiver

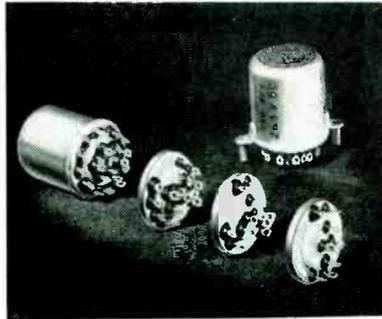
GENERAL ELECTRIC Co., Syracuse, N. Y., has announced a new f-m receiver for civil defense applications wherever two-way radio systems exist—fire, police, taxi, electric service companies, key CD agencies and personnel. Messages can be broadcast to all groups at once or to separate groups individually, each receiver being inactive until turned on by headquarters. Type ER-18-A is for use in the 152 to 174-mc band; type ER-19-A, for the



30 to 50-mc band. Designed to operate on 117-volt a-c power, they are easily adaptable to 6-volt d-c operation by use of a low power inverter and a storage battery. Called the Civil Defender, it can be used to automatically start and stop air raid sirens and other warning devices upon reception of a special tone from headquarters.

## Miniature Relays

STRUTHERS-DUNN, INC., 150 N. 13th St., Philadelphia 7, Pa. A complete line of miniature d-c relays in 2, 3, 4 and 6-pole units with double-throw contacts has been developed for jet-propelled aircraft and guided missile uses. Designed to meet USAF Specification MIL-R-5757, the relays are supplied in type A style for operation at ambient temperatures up to 200 C, and type B for use where ambient temperature is limited to 85 C. They are available in hermetically sealed



metal containers 1 1/4 in. in diameter, 1 1/2 in. long and weighing only 3 ounces. Palladium contacts are nominally rated at 28 v d-c noninductive on permanent installations. For guided missile applications the contact rating may be increased to 12 amperes noninductive if the required number of relay operations does not exceed 50 to 100. Time of operation is less than 0.005 sec.

## Electronic Voltmeter

BALLANTINE LABORATORIES, INC., Boonton, N. J. Model 310A electronic voltmeter measures 100  $\mu$ v to 100 volts on a single logarithmic voltage scale by means of a six-decade range switch. Its accuracy at any point on the scale is 3 percent from 10 cycles up to 1 mc and 5 percent up to 2 mc. Input imped-



ance is 2 megohms shunted by 8  $\mu$ mf on the two most sensitive ranges, and by 15  $\mu$ mf on the other ranges. The amplifier section of the voltmeter may be used separately as amplifier flat within 1/2 db up to 2 mc with a maximum gain of 60 db and an output impedance of 500 ohms.

## Adjustable Sealed Relay

G-V CONTROLS INC., 28 Hollywood Plaza, East Orange, N. J., has produced an hermetically sealed thermal time-delay relay designed to permit the adjustment of the time interval by the user while the relay remains completely sealed. Adjustment is made simply by turning a



screw located outside the sealed space. This screw permits the timing to be changed over a 5 to 1 range. The miniature size, 3/4 in. in diameter and 2 3/8 in. seated height, fits a 7-pin miniature tube socket. Contacts are single pole, rated at 6 amperes. Relays are available for any energizing voltage up to 125 and operate interchangeably on a-c and d-c.

## Gas-Filled Rectifier Tube

ELECTRONS, INC., 127 Sussex Ave., Newark 4, N. J. Type C1K xenon gas-filled grid-controlled rectifier tube has all electrode connections brought out to the metal-base pins. It may be used in such applications as precise motor control, high-speed or synchronous switching, servo amplifiers, temperature controls and regulated d-c power supplies. Average anode current is 1 ampere d-c;

# RAYTHEON

WORLD'S LARGEST MANUFACTURERS OF  
AND

WORLD HEADQUARTERS FOR

## PULSE TYPE MAGNETRONS

Tunable or fixed frequency — 1,000 to 25,000 megacycles — power range from a few watts to several megawatts.

## CW MAGNETRONS

Fixed frequency, tunable and frequency modulated tunable — 1,000 to 10,000 megacycles — power range from a few watts to several kilowatts.

## KLYSTRONS

Integral and external cavity, low power — frequency range, 500 to 50,000 megacycles.

## SPECIAL PURPOSE TUBES\*

Cold-cathode, gas-filled rectifier tubes — ruggedized diodes, triodes and pentodes for aircraft, industrial and military service — voltage regulator, voltage reference and radiation counter (Geiger-Mueller) tubes — germanium crystal diodes.

## SUBMINIATURES\*

Filamentary and cathode type tubes; fit standard sockets or may be soldered or welded into the circuit. Over 40 types—over half a million in stock—available through 310 Raytheon Tube Distributors.

For detailed information, get in touch with

**RAYTHEON MANUFACTURING COMPANY**

Power Tube Division  
WALTHAM 54, MASS.

\*Receiving Tube Division  
NEWTON 58, MASS.

**RAYTHEON**

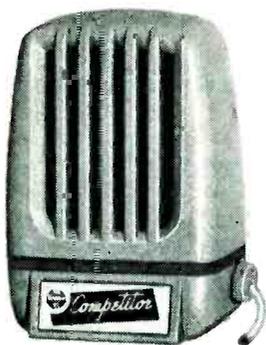
*Excellence in Electronics*



peak anode current, 8 amperes; maximum peak inverse voltage, 1,250 v; maximum peak forward voltage, 1,000 v. Grid shielding results in a grid-anode capacitance of only 1  $\mu\text{pF}$  with a grid-cathode capacitance of 10  $\mu\text{pF}$ . Critical grid current is less than 5  $\mu\text{a}$ .

### Crystal Microphone

TURNER CO., 900 17th St. N.E., Cedar Rapids, Iowa. The Competitor, model 60X crystal microphone for hand, desk or stand use, is designed for amateurs and for economical public address and sound systems. Response is 70 to 7,000 cps. Level is 52 db below 1 volt per dyne per sq cm. It features a



moisture-sealed crystal. List price of the microphone complete with 6-ft cable and stand adaptor is \$10.85.

### Video Amplifier

RIPLEY CO., INC., Middletown, Conn., has announced a video amplifier designed for complex wave form inspection in connection with an oscilloscope. Having a gain of 1,000, the frequency response is flat

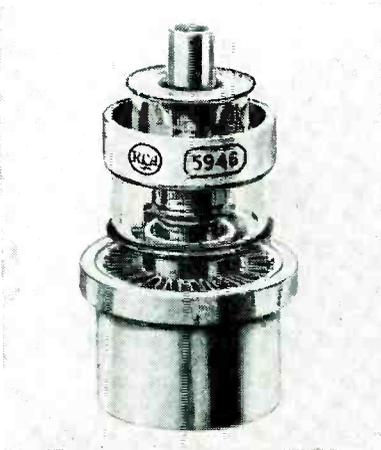
from 15 cps to 4 mc within 1.5 db of the 10-kc response point. A cathode-follower input stage is used for circuit isolation and includes an input attenuator providing 1 to 1, 1 to 10 and 1 to 100 attenuation ratios as indicated by a control knob on the front panel. Input impedance without probe is approximately 2.2 megohms and 40  $\mu\text{pF}$  on all attenuator ranges. A gain control is provided for adjusting the output from 0 to 50 volts rms. Phase shift is minimized to provide



satisfactory reproduction of pulses on the order of one  $\mu\text{sec}$  and square waves at repetition rates as low as 100 per second.

### Power Triode

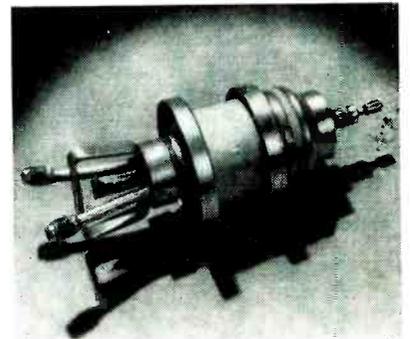
RADIO CORP. OF AMERICA, Harrison, N. J., recently announced a compact, forced-air-cooled power triode designed for uhf plate-pulsed oscillator and amplifier service. In such service the type 5946 triode has a maximum rated plate dissipation of 250 watts, and can be operated with full plate voltage at frequencies up to 1,300 mc. Featured in the design is a coaxial-electrode structure for use with circuits of



the coaxial-cylinder type. The design provides low-inductance, large-area, r-f electrode terminals for insertion into the cylinders and permits effective isolation of the plate from the cathode. The latter feature makes the tube particularly suitable for grounded-grid circuits.

### Ceramic Transmitting Tube

GENERAL ELECTRIC Co., Syracuse, N. Y. Type GL-6019 all-ceramic tube was designed primarily for uhf tv transmitter service. This power tetrode is capable of operating up to and beyond 890 mc at 1-kw output. Maximum ratings at synchronizing level for class-B tv service include: d-c plate voltage,



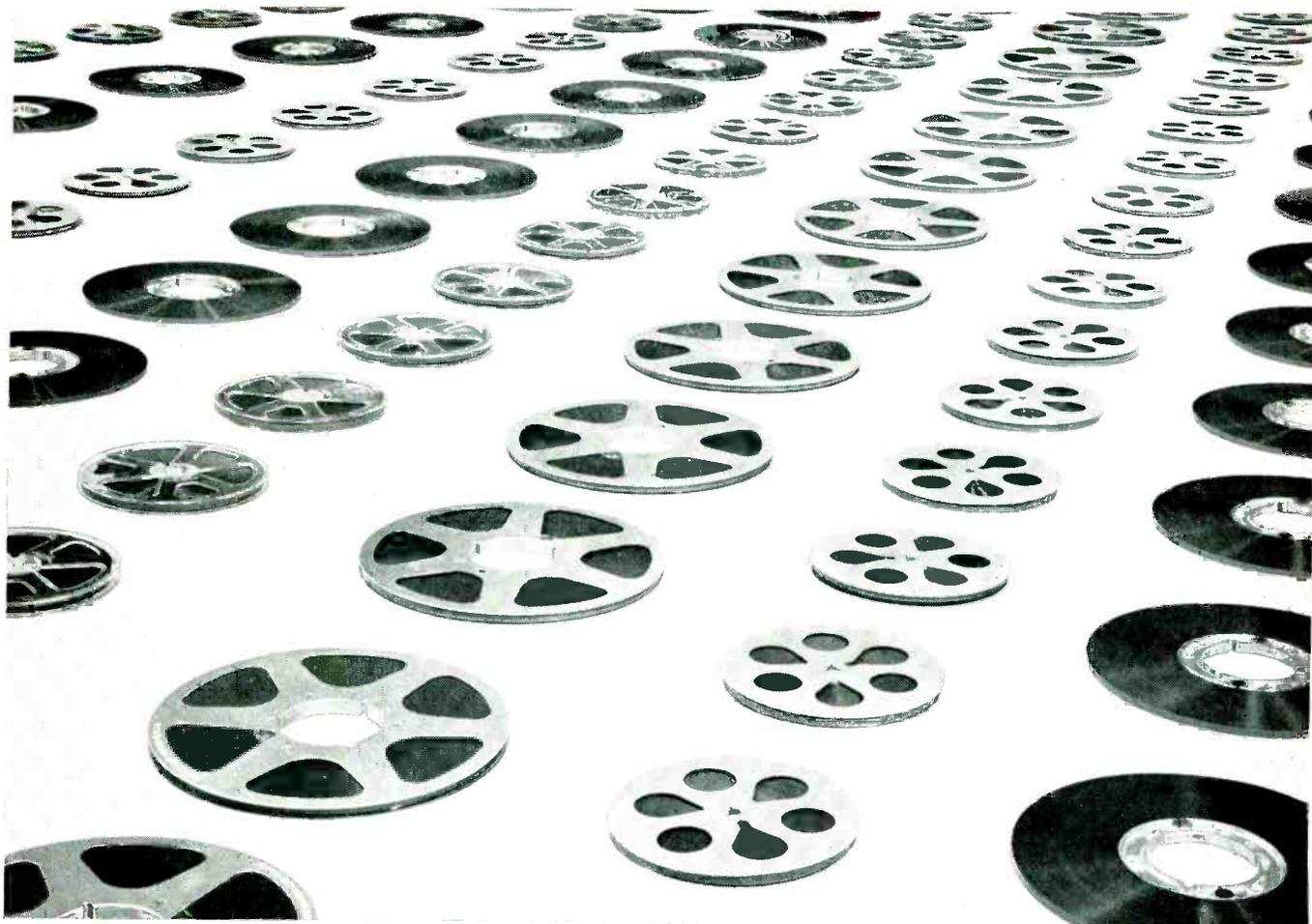
4,000 v; d-c screen voltage, 600 v; d-c plate current, 700 ma; plate input, 2.5 kw; plate dissipation, 2 kw.

### Calibrator

RUTHERFORD ELECTRONICS Co., 3724 1/2 So. Robertson Blvd., Culver City, Calif. Model D1 calibrator is a device for the accurate generation of pulse trains, having 16 different pulse rates available at the output connections. Coincidence circuits are employed to render negligible the phase lags between the various outputs. Particularly valuable for the calibration of synchroscopes, it may also be used as a secondary frequency standard, as a master timing oscillator for pulse equipment, for the generation of timing signals for oscillographic recording, and the detection of jitter in delayed signals. Simultaneous outputs having the following pulse

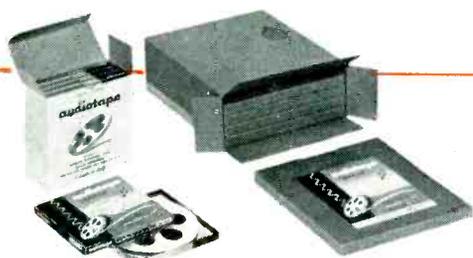
(Continued on page 220)

# CONSISTENT UNIFORM QUALITY



*... reel after reel after reel!*

That's just one of the EXTRA VALUES that you get in **audiotape**® made by audio engineers, for audio engineers



**NOW**—output curves in every package!

Here's output uniformity that you can see for yourself. For every 5-reel package of plastic base Audiotape, in 1250 and 2500 ft sizes, now contains an Esterline-Angus output curve made from one of the reels in that package. And since all five reels are slit from the same roll after coating, it shows you the actual output characteristics of every reel — giving positive visual proof of unequalled uniformity.

● Yes — when you reach for a reel of Audiotape, you can be sure that you will have the finest recording that your equipment can produce. You *know* that the output volume will not vary more than  $\pm \frac{1}{4}$  db within every 1250 ft or 2500 ft reel of plastic base Audiotape. That is *guaranteed*. You *know* that these reels are entirely free from splices. That is guaranteed also. But, still more important, you know that you can depend on Audiotape for unequalled over-all performance — with maximum fidelity of reproduction and minimum surface noise and distortion.

In short, Audiotape *always* gives you the same consistent, uniform quality that has characterized Audiodiscs for more than a decade.

Have you heard about our new disc *recoating service*? We are now prepared to recoat your used discs for you — at a substantial saving over the cost of new discs. Your Audiodisc distributor will be glad to give you complete details.

\*Trade Mark

## AUDIO DEVICES, Inc.

444 MADISON AVE., NEW YORK 22, N. Y.

Export Dept.: 13 East 40th St., New York 16, N. Y., Cables: "ARLAB"

# NEWS OF THE INDUSTRY

Edited by WILLIAM P. O'BRIEN

## Engineering Positions Available

POSITIONS in the electric and electronic engineering fields are available with Headquarters of the Air Transport Service (MATS), Washington, D. C.

Men and women who meet the educational and practical experience requirements may apply for positions in one of these government service jobs with starting salaries from \$5,400 to \$6,400. Employees accepted will have the opportunity to be placed on permanent status.

Interested applicants may write to the Civilian Personnel Officer, Andrews AFB, Washington 25, D. C., for further information.

MATS is the integrated Air Force-Navy command utilizing personnel and equipment of both services in strategic air support of the U. S. Air Force. At present it is

assisting United Nations forces in the Far East with an around-the-clock airlift of critical cargoes and high-priority personnel. On return trips, MATS planes carry ill and wounded from the fighting front.

## Rad Lab Series Completed

THE RADIATION Laboratory Series, a monumental technical series started in 1947 under the sponsorship of the wartime U. S. Office of Scientific Research and Development, was completed recently with the publication of the twenty-seventh and final volume in the series.

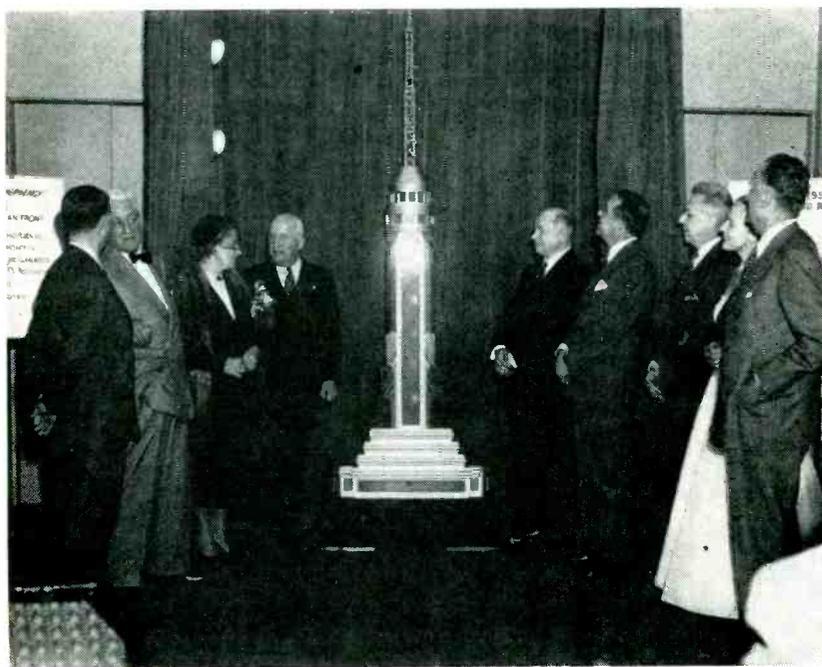
Published by the McGraw-Hill Book Company under contract with the Massachusetts Institute of Technology, this series contains in

report form the vast results of five years of intensive work on radar done at the Radiation Laboratory of the Massachusetts Institute of Technology during World War II. The twenty-seven volumes total more than 16,000 pages. Over 150,000 copies of the published volumes have been sold to date.

This was the first time in history that a commercial firm had been allowed to produce an official technical publication of such large scale. The Government had a net saving of approximately \$260,000 on the production of the volumes as official technical reports. In addition, the publisher has paid over \$80,000 into the U. S. Treasury as royalty on sales here and abroad. Thus, the benefit to taxpayers already totals about \$340,000. Additional royalty in substantial amounts will be paid into the Treasury during the next ten years.

McGraw-Hill officials expressed a hope that the success of the Radiation Laboratory Series would encourage government officials to arrange commercial publication of similar official reports and surveys that have large scientific and technical importance.

## IRE SHOWS GIANT ANTENNA IN MINIATURE



Unveiling of the model of the Empire State Building tv antenna at the Waldorf-Astoria Hotel, N. Y. C., during the recent IRE Convention. Left to right are George Sterling, FCC Commissioner; Mortimer W. Loewi, director of the Du Mont television network; Frieda Hennock, FCC Commissioner; Hugh Drum, president of Empire State Building, Inc.; David Sarnoff, chairman of the board of RCA; Phillip B. Stephens, business manager of the N. Y. Daily News (owner of station WPIX); E. M. Webster, FCC Commissioner; Kay Burke, "Miss Empire State;" and Edward J. Noble, chairman of the board of the American Broadcasting Co.

## MIT Offers Servomechanisms Course

THEORY and applications of feedback control systems (servomechanisms), and the broad concept of system engineering, will be the subject of a special course during Summer Session 1951 at the Massachusetts Institute of Technology, from August 20 to 31.

Plans for the ten-day course were recently announced by Professor Donald P. Campbell, of the MIT department of electrical engineering. It will include a survey of the theory of feedback systems with emphasis on dynamic operations and system synthesis. Industrial applications of feedback control systems, or servomechanisms, in such diverse fields as steel making, printing, petroleum processing, wood working, textile manufacturing, chemical processing, and power distribution will be discussed.

Following morning lectures, demonstrations and laboratory work in



# Instrument NEWS



## Arco Cuts Testing Time 80% With Thickness Gage

Engineers of the Arco Company, Cleveland, Ohio, manufacturers of industrial finishes and coatings, say that they have cut testing time and costs 80 per cent by using a General Electric Type B magnetic thickness gage for quality control.

Every Arco finish is designed to be applied at a specific thickness for the best possible adhesion. Because the thickness gage makes it possible to check and control thickness quickly and accurately, the G-E gage has become a vital part of their manufacturing process.

Arco Company also uses this gage to help determine the hardness of their paint. The standard Type B thickness gage has a range of 0.10 mils to 100 mils. Other instruments of this type with ranges from 0.10 mils to 300 mils can be furnished to measure the thickness of any non-magnetic material on a magnetic base.



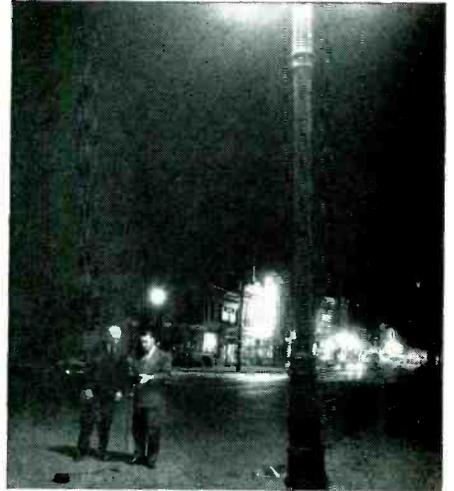
**CAPACITOR PEAK VOLTAGE** in a jet-engine-ignition system is measured by a General Electric electrostatic voltmeter. It can measure peak voltages of critical ignition circuits without disturbing the ignition system itself.

## SENSITIVE LIGHTMETER AIDS STUDY OF STREET LIGHTING FOR NIAGARA MOHAWK

Niagara Mohawk Power Corporation, Albany, N. Y. is currently using a G-E Type PF-13 sensitive lightmeter to aid its streetlighting surveys. "Because of its portability and high sensitivity, the PF-13 lightmeter enables us to check quickly and efficiently critical low-light intensities—both indoors and outdoors," reports Mr. C. E. Waldron, street-lighting advisor for Niagara Mohawk.

The Type PF-13 lightmeter, weighing only 14 pounds with carrying case, has its cell corrected for oblique angles of light by a cosine-corrected lens. With two ultra-sensitive ranges, 0-1 and 0-5 footcandles, streetlighting levels that before couldn't be determined without elaborate equipment are taken with ease.

In addition to use in utility-company surveys of street lighting, the meter is especially adaptable to surveys by law-enforcement, safety-lighting, and civic groups attempting to combat crime and



to prevent motor-vehicle accidents through better lighting of streets and highways.

## New "Radiation Monitor" Just Announced by G. E.

A new radiation detector, known as the "radiation monitor," has been announced by the General Electric Company. It is designed for the use of engineers, scientists, doctors, and technicians engaged in work where x-ray or gamma radiation is present. In addition, it may be a valuable tool for civilian defense radiation programs.

The monitor's high sensitivity detects much smaller amounts of gamma radiation than is permitted by the most stringent safety regulations. This sensitivity, coupled with continuously visible indication, quickly gives warning of a radiation hazard in areas where the monitor is placed.

Light weight (only fourteen ounces) adds to the convenience of the monitor. It's also small—about the size of a quart oil can. Since it has a self-contained power source, it can easily be moved about. Furthermore, it does not require tubes or batteries. Full-scale



reading is from 0 to 20 milliroentgens; accuracy is plus or minus ten per cent. The monitor can be recharged by merely turning it upside down.

SECTION A602-206, GENERAL ELECTRIC  
SCHENECTADY 5, N. Y.

Please send me the following bulletins:

Indicate:

- for reference only
- for planning on immediate project
- PF-13 Sensitive lightmeter (GEC-611)
- Type B Magnetic thickness gage (GEC-319)
- Radiation Monitor (GEC-778)
- Electrostatic Voltmeter (GEC-403)

NAME .....  
 COMPANY .....  
 STREET .....  
 CITY ..... ZONE ..... STATE .....

# GENERAL ELECTRIC

afternoons during the course will make use of the student laboratories in the electrical engineering department. Measurement of system and component performances and methods of testing and evaluating process control equipment are to be included in the laboratory program.

Three members of the MIT faculty will assist Professor Campbell in presenting the course: Professor Gordon S. Brown, director of the MIT Servomechanisms Laboratory; and Paul E. Smith, Jr., and Leonard A. Gould, instructors in the electrical engineering feedback control laboratory.

The course is intended for engineers with a background in the problems of industrial engineering and production management. It will be open to those who have had no previous acquaintance with the servomechanisms field, though a familiarity with the engineering problems to be discussed will be helpful.

The course in feedback control systems is one of a series of special summer activities planned during 1951, under the general direction of Professor Walter H. Gale, director

**MEETINGS**

APR. 30-MAY 4: SMPTE Spring Convention, Hotel Statler, N. Y.

MAY 21-23: 1951 Parts Distributors Show, Hotel Stevens, Chicago, Illinois.

MAY 23-24: Fifth National Convention, American Society for Quality Control, Hotel Cleveland, Cleveland, Ohio.

MAY 23-25: 1951 IRE Technical Conference on Airborne Electronics, Biltmore Hotel, Dayton, Ohio.

JUNE 18-22: ASTM Annual Meeting, Hotel Chalfonte-Haddon Hall, Atlantic City, N. J.

JUNE 20-22: IRE 7th Region Conference, U. of Washington, Seattle, Wash.

JUNE 25-29: AIEE Summer General Meeting, Royal York Hotel, Toronto, Ontario, Canada.

AUG. 15-18: 1951 APCO Conference. Everglades Hotel, Miami, Florida.

AUG. 20-23: AIEE Pacific General Meeting, Multnomah Hotel, Portland, Oregon.

AUG. 22-24: Seventh Annual Pacific Electronic Exhibit and West Coast Annual IRE Convention, San Francisco Civic Auditorium, San Francisco, Calif.

AUG. 28-SEPT. 8: Eighteenth British National Radio Show, Earls Court, London, England.

SEPT. 10-14: Sixth National Instrument Conference and Exhibit, sponsored by Instrument Society of America, Sam Houston Coliseum, Houston, Texas.

OCT. 22-26: AIEE Fall General Meeting, Hotel Cleveland, Cleveland, Ohio.

Nov. 12-15: NEMA Convention, Haddon Hall, Atlantic City, N. J.

of the MIT Summer Session. All are designed to make MIT's technical and educational facilities available to those who cannot par-

ticipate in the regular academic program.

Further information on this and other special summer activities may be obtained from Professor Gale at Room 3-107, Massachusetts Institute of Technology, Cambridge 39.

## INDUSTRIAL COLOR TV AT IRE SHOW



At the IRE annual exhibition at Grand Central Palace, N. Y., in March many visitors saw this demonstration of industrial color television. The color receivers used are a product of the Gray Research & Development Co., a subsidiary of The Gray Mfg. Co., and were designed in cooperation with CBS engineers. The camera chain, consisting of color camera and monitor, was operated from Gray's main floor booth. Additional receivers were in use on the third floor

## Stanford Plans New Labs

TWO NEW electronics laboratories, one for applied research and the other for student electrical engineering activities, will be constructed at Stanford University, California. The new facilities will represent a \$250,000 outlay.

The university has received an Office of Naval Research contract for a research program in applied electronics. The grant supplements existing basic research contracts held by the university with ONR, the Air Force, Signal Corps and the National Bureau of Standards.

Construction of the student engineering laboratory was made possible through a gift from Hewlett-Packard Co. of Palo Alto, electronics equipment manufacturing firm.

The buildings will have 13,500 sq ft of floor space and will be about

(Continued on page 255)

ALCOA  
STEAMSHIP  
COMPANY,  
INC.

AMERICAN  
EXPORT LINES,  
INC.

AMERICAN  
PRESIDENT  
LINES

ARNOLD  
BERNSTEIN  
SHIPPING CO., INC.

BERGEN  
STEAMSHIP  
CO., INC.

BULL  
LINES

DELTA  
LINE

EASTERN  
STEAMSHIP  
LINES

FARRELL  
LINES



GRACE  
LINE

HOLLAND-  
AMERICA  
LINE

HOME  
LINES

ISBRANDTSEN  
CO., INC.

MATSON  
LINES

NORWEGIAN  
AMERICA  
LINE

PANAMA  
LINE

SCANDINAVIAN  
AMERICAN  
LINE

SWEDISH  
AMERICAN  
LINE

## ON THE SHIPS THAT SAIL THE SEVEN SEAS

... it's Sylvania tubes  
for dependability!

You'll find equipment of many leading manufacturers on the ships of these famous world-wide lines.

In radio and communications, especially, where reliability is indispensable, Sylvania tubes are constantly on watch.

For, Sylvania is a pioneer in the development of dependable radio tubes. Improved manufacturing techniques and quality control methods, over a period of 25 years, have resulted in Sylvania's recognized leadership in the radio and TV tube field. Receiving or transmitting, Sylvania tubes offer outstanding performance and long life.

Moreover, the Sylvania tube line is a complete line, including practically every known type . . . from tiny sub-miniatures to large TV picture tubes. For detailed information, ratings, prices, or deliveries write today to: Sylvania Electric Products Inc., Dept. R-1105, Emporium, Pa. *Sylvania representatives are also located in all foreign countries. Names on request.*



# SYLVANIA ELECTRIC

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

**GOT RECORDING PROBLEMS**

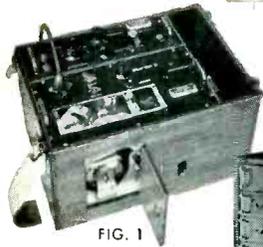


FIG. 1

**SANBORN**

**1, 2, and 4 channel RECORDING SYSTEMS**



FIG. 2

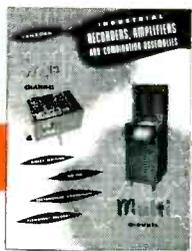


FIG. 3

- NO INK
- DIRECT WRITING
- RECTANGULAR COORDINATES
- PERMANENT RECORDS

Electrical phenomena from a few millivolts to over 200 volts may be readily and continuously recorded. Registration, by heated stylus on plastic-coated paper, is clear, sharp, permanent. **Single-channel Model 128** (Fig. 1) has standard speed of 25 mm./sec. (slower speeds available). **Two-channel Model 60** (Fig. 3) has ten speeds—0.5 to 100 mm./sec. **Four-channel Model 67** (Fig. 2) has eight speeds—0.25 to 50 mm./sec. Built-in timing and code marking, and ready interchangeability of Amplifiers (D.C. and Strain Gage) are features of all models.

For complete descriptions, illustrations, tables of constants, and prices, send for catalog, using coupon below.



**SANBORN COMPANY**

INDUSTRIAL DIVISION  
39 Osborn St.,  
Cambridge 39, Mass.

Please send me complete catalog of Sanborn Industrial Recording Equipment.

Name \_\_\_\_\_  
Position \_\_\_\_\_  
Company \_\_\_\_\_  
Street \_\_\_\_\_  
City & State \_\_\_\_\_

5-5-51

## NEW BOOKS

### Electrons and Holes in Semiconductors

By WILLIAM SHOCKLEY. *Bell Laboratories Series, D. Van Nostrand Company, Inc., New York, 1950, 558 pages, \$9.75.*

*Reviewed and summarized by G. D. O'Neill, Head, Solid State Section, Physics Laboratories, Sylvania Electric Products Inc., Bayside, N. Y.*

WHEN THE TRANSISTOR was announced in the summer of 1948, the imagination of physicists, electronics engineers and a large section of the general public was excited by the amazing news. The more naive, especially among those not in a position to make a reasonable evaluation of this most promising discovery, were led to expect too much too soon. Meanwhile, system-

#### RELEASED THIS MONTH

**Ferromagnetism:** R. M. Bozorth; Van Nostrand; \$17.50.

**Servomechanisms and Regulating System Design:** H. Chestnut and R. W. Mayer; Wiley; \$7.75.

**Short Wave Wireless Communication:** A. W. Ladner and C. R. Stoner; Fifth Edition; Wiley; \$8.00.

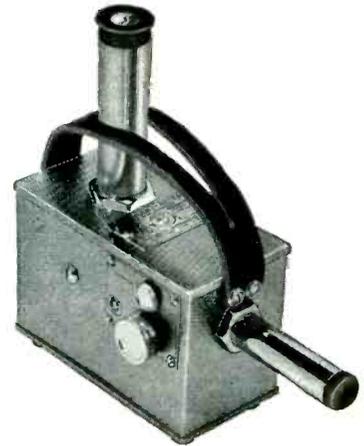
atic investigation of the phenomena associated with transistor action has continued along scientific lines, with the certainty that out of this work will come devices of major importance. The present volume is, to a large extent, based upon a lecture series organized by Dr. Shockley as a part of the program of transistor research and development being carried out at the Bell Telephone Laboratories.

This book might be described as a set of three monographs of increasingly rigorous treatment. Part I, called "Introduction to Transistor Electronics", presents an elementary picture of semiconductor phenomena, the transistor as a circuit element and the physical theory of transistor action. The presentation is such that it will be easily understood by persons whose training in science or engineering does not in-

(Continued on p 263)

## THE CONDENSER r-METER

for the accurate determination of x-radiation intensity



The accepted secondary standard for the laboratory and the hospital

Chamber values for a wide range of applications

- 0.25 r chambers
- 25 r chambers
- 100 r chambers
- 250 r chambers
- 1000 r chambers
- 2500 r chambers

Isotope chambers

Also special chamber values to order.

The condenser r-meter is a portable instrument designed for rapid accurate measurement of x-ray intensity and can be furnished with a number of different ionization chambers to cover the needs of laboratory and clinical requirements.

For 20 years, with modifications and refinements, the condenser r-meter has served as an essential tool to those interested with problem of x-ray measurement.

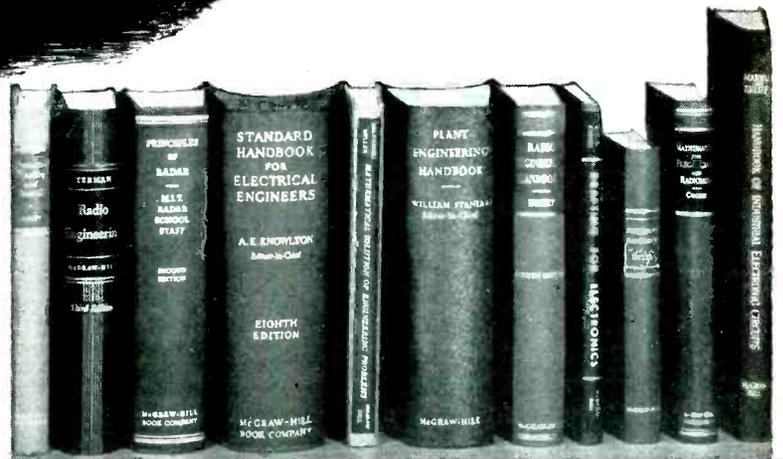


**THE VICTOREEN INSTRUMENT CO.**  
5806 HOUGH AVENUE  
CLEVELAND 3, OHIO

# McGraw-Hill BOOKS are TOOLS

for training  
and upgrading  
personnel

in defense production



The McGraw-Hill imprint on a technical book certifies that it is the work of a competent authority bringing you the best of the recorded experience in your field.

Check your needs against this representative list of books

- 1.—ELECTRONICS IN ENGINEERING, Hill, \$4.00
2. FUNDAMENTALS OF VACUUM TUBES, Eastman, \$6.00
3. RADIO ENGINEERING, Terman, \$7.00
4. PRINCIPLES OF RADAR, M. I. T., \$6.00
5. RADAR ENGINEERING, Fink, \$7.50
6. FREQUENCY MODULATED RADAR, Luck, \$4.50
7. DRAFTING FOR ELECTRONICS, Carini, \$2.75
8. SMALL PLANT MANAGEMENT, A. S. M. E., \$6.00
9. PRODUCTION PLANNING AND CONTROL, Landy, \$5.50
10. QUALITY CONTROL, Feigenbaum, \$7.00
11. INSPECTION ORGANIZATION AND METHODS, Thompson, \$5.00
12. VITALIZING THE FOREMAN'S ROLE IN MANAGEMENT, Gardiner and Gardiner, \$6.00
13. THE FOREMAN'S HANDBOOK, Heyel, \$5.00
14. THE MATHEMATICAL SOLUTION OF ENGINEERING PROBLEMS, Salvadori and Miller, \$3.75
15. HIGHER MATHEMATICS FOR ENGINEERS AND PHYSICISTS, Sokolnikoff and Sokolnikoff, \$5.50
16. APPLIED MATHEMATICS FOR RADIO AND COMMUNICATION ENGINEERS, Smith, \$3.75
17. MATHEMATICS FOR ELECTRICIANS AND RADIO-MEN, Cooke, \$5.00
18. RADIO ENGINEERING HANDBOOK, Henney, \$10.00
19. STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, Knowlton, \$15.00
20. HANDBOOK OF INDUSTRIAL ELECTRONIC CIRCUITS, Markus and Zeluff, \$6.50
21. RADIO ENGINEERS' HANDBOOK, Terman, \$8.00
22. HANDBOOK ON DESIGNING FOR QUANTITY PRODUCTION, Chase, \$7.50
23. AMERICAN ELECTRICIANS' HANDBOOK, Croft, \$7.50
24. PLANT ENGINEERING HANDBOOK, Staniar, \$15.00

DEFENSE production needs have put the spotlight on today's rapid technical developments—in machines, materials, processes, and management. New demands for know-how and skill face your personnel, from top engineering design on down through the many levels of supervisory and mechanical shop work.

Make sure you get maximum efficiency and production from your whole staff—give them the advantages of the technical training and upgrading afforded by McGraw-Hill books.

Today's intensive demand for McGraw-Hill technical books indicates how important it is to have these standard instruction and reference volumes available. If you want to know what a working library of technical books will do for *your personnel*, ask any training director or technical librarian. He can tell you how eager American workers are for the latest technical information that can help them do new jobs better.

Act now to provide your personnel with the best engineering, management, and technical training literature. Fill out the coupon below, describing your firm's needs. We will send you without obligation the lists of books your workers ought to have.

### McGraw-Hill Books Chosen "BEST" By I.R.E. Members

In a recent survey of technical book users, McGraw-Hill books were selected as best by 84% of I.R.E. members who responded; 25% more than any other publisher named. (See I.R.E. Proceedings, December, 1950.)



MAIL THIS CONVENIENT COUPON TODAY

McGraw-Hill Book Co., Special Service Section, 327 W. 41 St., N.Y.C. 18

SEND ME CATALOG of McGraw-Hill books, 1951 Issue, just out, listing more than 2000 technical, scientific, industrial, and business books.

SEND ME BOOKS according to numbers encircled below, for 10 days' examination on approval. In 10 days I will pay for books I keep, plus few cents for delivery, and return others postpaid.

SEND ME INFORMATION on new and standard books you publish on the following subjects:

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24

SEND YOUR REPRESENTATIVE to call on our training Director:

(Print)  
Name

Address ..... City ..... Zone ..... State .....

Company ..... Position ..... IL-5-51

# Backtalk

This department is operated as an open forum where our readers may discuss problems of the electronics industry or comment upon articles which **ELECTRONICS** has published.

## Wobble Organ

DEAR SIRs:

In the article, Electronic Music For Four (Feb. 1951), the "wobble organ" is described as being representative of the present state of the art. Actually, it would be more appropriate to say that the monophonic electronic musical instrument of the crank-operated, continuously-tuned oscillator type built by the author represents the state of the art approximately 20 years ago. Except for the name, there is little if anything new in the "wobble organ".

In this connection, your attention may be directed to Péchadre's U. S. patent No. 1,791,374, corresponding to French patent No. 672,968 (1929). The differences between Meachem's and Péchadre's structures are very minor and Péchadre's device may even be superior with respect to practical operation.

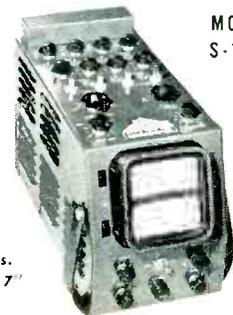
Another good example of electronic musical instruments of the crank-controlled type is described in Mager's German patent No. 536,855 (1928). Bertrand's "Dyna-phon", described in French patent No. 664,305 (1929) likewise employs a crank-type operating mechanism for a continuously-tuned audio oscillator.

Nor is Mr. Meachem the first one who has assigned an individual oscillator to each of four or more performers to produce polyphonic music. As far back as in 1932, the writer organized and directed the five-piece Emicon Electronic Or-

(continued on page 292)

# THE TWIN TUBE POCKETSCOPE

BY WATERMAN



MODEL S-15-A

Wt. 16 1/4 lbs.  
12" x 6" x 7"

A new concept in multiple trace oscilloscopy made possible by Waterman developed RAYONIC rectangular cathode ray tube, providing for the first time, optional screen characteristics in each channel. S-15-A is a portable twin tube, high sensitivity oscilloscope, with two independent vertical as well as horizontal channels. A "must" for investigation of electronic circuits in industry, school, or laboratory.

Vertical channels: 10mv rms/inch, with response within -2DB from DC to 200kc, with pulse rise of 1.8μs. Horizontal channels: 1v rms/inch within -2DB from DC to 150kc, with pulse rise of 3μs. Non-frequency discriminating attenuators and gain controls, with internal calibration of traces. Repetitive or trigger time base, with linearization, from 1/2cps to 50kc, with ± sync. or trigger. Mu metal shield. Filter graph screen. And a host of other features.

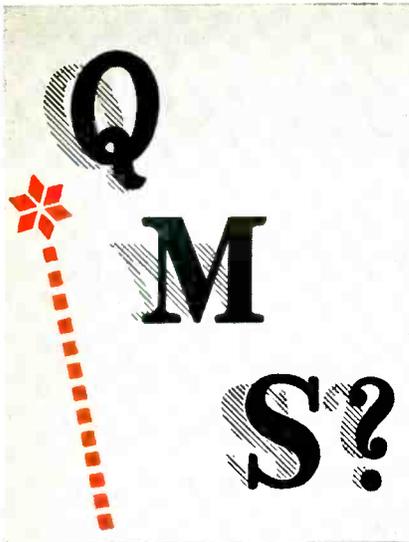
## WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PA.  
CABLE ADDRESS: POKETSCOPE

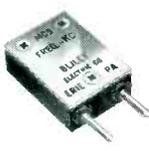
### WATERMAN PRODUCTS INCLUDE:

S-10-B GENERAL	POCKETSCOPE
S-11-A INDUSTRIAL	POCKETSCOPE
S-14-A HI-GAIN	POCKETSCOPE
S-14-B WIDE BAND	POCKETSCOPE
S-21-A LINEAR TIME BASE	

Also RAKSCOPES, LINEAR AMPLIFIERS, RAYONIC® TUBES and other equipment



TYPE SR5A  
FREQ 2.0-15.0 MC



TYPE MC9  
FREQ 1.0-10.0 MC



TYPE AR23W  
FREQ 0.080-0.19999 MC



TYPE BH6A  
FREQ 0.8-75.0 MC



TYPE BH7A  
FREQ 15.0-50.0 MC



TYPE TCO-1  
TEMPERATURE CONTROL OVEN



## Concerning Military Specifications?

Bliley is well acquainted with "MIL" crystal requirements. Solid production experience is an important factor when you need "MIL" quality as well as dependable delivery.

Bulletin 42, describing "MIL" crystals, will be sent to design engineers on request.

# Bliley

CRYSTALS

BLILEY ELECTRIC COMPANY  
UNION STATION BUILDING  
ERIE, PENNSYLVANIA

# Defense needs are claiming a larger share



Production of GLOBAL brand ceramic resistors is being directed to manufacturers of defense equipment in ever-increasing quantities. These manufacturers must, necessarily, receive first priority if they are to produce critically needed equipment during this national emergency.

However, our productive capacity is such that we are able to meet most needs of producers of civilian equipment—and will

continue to do so in every way that does not affect defense production.

The unique characteristics of GLOBAL resistors have resulted in many improvements in circuit designs. Whether you are producing defense or civilian equipment, it will pay you to investigate the many types available. Our complete co-operation is assured. Write Dept. V-51, The Carborundum Company, GLOBAL Division, Niagara Falls, New York.



# GLOBAL Ceramic Resistors

BY **CARBORUNDUM**

TRADE MARK



*"Carborundum" and "Global" are registered trademarks which indicate manufacture by The Carborundum Company, Niagara Falls, N. Y.*

bringing

# YOUR PRODUCTS to market is the year-round job of electronics **BUYERS' GUIDE**

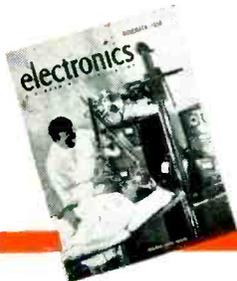
*The following statements by subscriber-users of the Guide give an idea of how it does that job.*

"The Buyers' Guide is used almost 100% in making inquiries and is a constant reference." ... "The one copy of ELECTRONICS that I keep on file for reference purposes in my office." ... "We need another copy of the Buyers' Guide. The one we have in our electronic department is in constant use. Please send another copy and bill us." ... "Your Buyers' Guide issue is in daily use at the laboratory. We have ordered many products as a result of consulting it, some of those which have been most difficult to obtain come to mind right now, small selenium rectifiers, transformers, capacitors and drawn metal cans, ceramic dielectrics, paints and various plugs and sockets. From our point of view we believe that manufacturers would really do themselves more good in the Guide if they could be persuaded to give more information on their products."

And here's the other side of the story — by "Guide" advertisers.

"Results obtained have really amazed me. Quantity of requests for data and catalogs has been tremendous. Initial orders received have paid for advertisement many times over. Repeat orders have already followed. We have many engineering representatives all over the country but it is, of course, impossible for them to contact every designer and engineer in every company. With this advertisement in the Guide, we reached into engineering, research and production departments where previously our products were unknown, also many Government procurement agencies, laboratories and so forth." ... "Our best customer came about as the result of our 1948 ad in the Buyers' Guide. Recently we received an order well up in the four figures from another customer whose first contact with us was his request for our catalog described in the 1949 issue of the Guide. This customer is in a field not even remotely connected with electronics."

*Your ELECTRONICS' representative will be glad to show you the letters from which these quotes were taken and many more—all telling the same story — the unparalleled use and sales value of ELECTRONICS BUYERS' GUIDE.*



# electronics



**12 REGULAR ISSUES**  
supplying latest technical information, design and product news

A McGraw-Hill Publication • 330 West 42nd St., New York 18, N. Y.

**ANNUAL BUYERS' GUIDE**  
supplying all basic product source and technical specifying data



**WHERE  
BUYING  
DECISIONS  
ARE MADE**

When you consider that there are more than 2,000 widely diversified products sold to manufacturers and users of electronic equipment, the engineers' need for, and the sales-making success of the "Guide" witnessed to by the quotes on the opposite page become readily understandable.

The only publication of its kind, the "Guide" is the engineers' standard source of specifying and buying information on allied as well as electronic products . . . bearings, blowers, bobbins, bushings, ceramics, couplings, fasteners, gases, hand tools, heating tanks, ionization chambers, metals, moldings, motors, mountings, paper, plastics, rings, seals, solder, tapes, tubing, washers, wire and cable as well as amplifiers, antennas, capacitors, coils, controls, counters, crystals, deflection yokes, h-f generators and heating equipment, ion traps, isotopes, loudspeakers, oscillators, potentiometers, radar, receivers, resistors, spectrometers, standards, testers, thermistors, timers, transducers, transmitters, tubes and tube parts, varistors, wave guides, wave traps, and X-ray equipment . . . materials, components or packaged electronic equipment—getters or gear trains, coils or cabinets, servos or springs.

Designers and users of electronic equipment look to the "Guide" for product source and specifying information. Results of a just completed survey available from your *ELECTRONICS'* representative prove beyond question that *ELECTRONICS BUYERS' GUIDE* is not only the standard buying guide in the field, it is the only one with real, proven, sales potential for your products. You owe it to yourself to study this independent survey report. Copies available on request.

Advertising closing dates for the Guide are close at hand. Copy-to-set now: Complete plates May 1st. There is no time to lose in planning and preparing your product sales story for presentation to the most important audience as far as your products are concerned—the design engineer subscribers to *ELECTRONICS* who this year more than ever before are making your markets. Do it now. Begin by seeing if your questionnaire for free listings in the Guide has been properly filled-out and returned. That is the first step to sales through the Guide. It is the indexed-to-advertising, product directory listings that send your potential customers to the supporting sales data pages in the Guide that take your products to market and bring you sales.

**THE DIRECT ROUTE TO — — — — — A \$2,000,000,000 MARKET PLACE**

## TUBES AT WORK

(continued from page 138)

of as high as 150 volts rms may be handled by the cathode followers without distortion. The low impedance gain controls in the output of the cathode followers have very little frequency discrimination.

The 10,000-ohm balance potentiometers are adjusted to give zero direct volts across the gain controls. In this way no transients due to charging and discharging of the 0.25- $\mu$ f coupling capacitors will appear during gain control adjustments.

In order to improve stability and prevent line-voltage variations from being amplified and fed to the oscilloscope, the cathode-follower and switch-tube positive and negative power supplies are regulated. Four VR-150 (OD3) regulator tubes are used to give 300 volts positive and negative with respect to ground.

The oscillogram of Fig. 2 shows

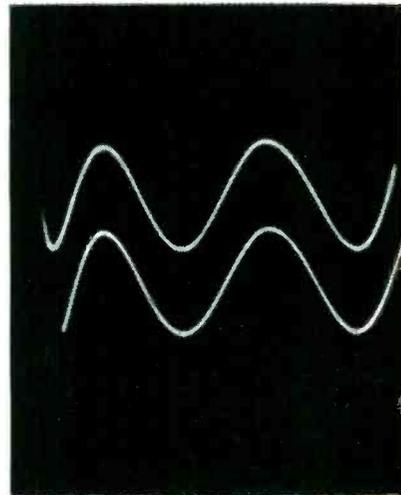


FIG. 2—Oscillogram with 30-kc signal applied simultaneously to both inputs and a sweep frequency of 10 kc

the switch operation with a 30-kc signal applied simultaneously to both inputs with a sweep frequency of 10 kc. With the circuit constants shown in the schematic diagram, satisfactory operation is obtained at sweep frequencies as high as 30 kc. The chief limiting factor is the frequency response of the flip-flop stage. If it is desired to switch at even higher frequencies, the plate load resistances for the flip-flop circuit may be lowered, necessitat-

# RG CABLES

by Amphenol—

AMPHENOL Coax and Twinax Cables are produced to standards surpassing military specifications for electrical performance and mechanical design.

The majority of AMPHENOL'S RG Cables utilize polyethylene which possesses exceptional dielectric properties—low loss, flexibility, mechanical stability. Teflon dielectrics used in others designed to operate efficiently under extremely high temperature conditions.

AMPHENOL RG Cable standards require closer centering of conductors than "AN" specifications—20% closer for Coax and 50% closer for Twinax. Perfection of design, quality of materials and precision of manufacture are basic factors behind the superior performance of AMPHENOL Cables. Specify AMPHENOL, the quality name in electronics.

**AMPHENOL**

**AMPHENOL**

**AMERICAN PHENOLIC CORPORATION**

1830 So. 54th Avenue  
Chicago 50, Illinois

RG-87A/U

RG-5/U

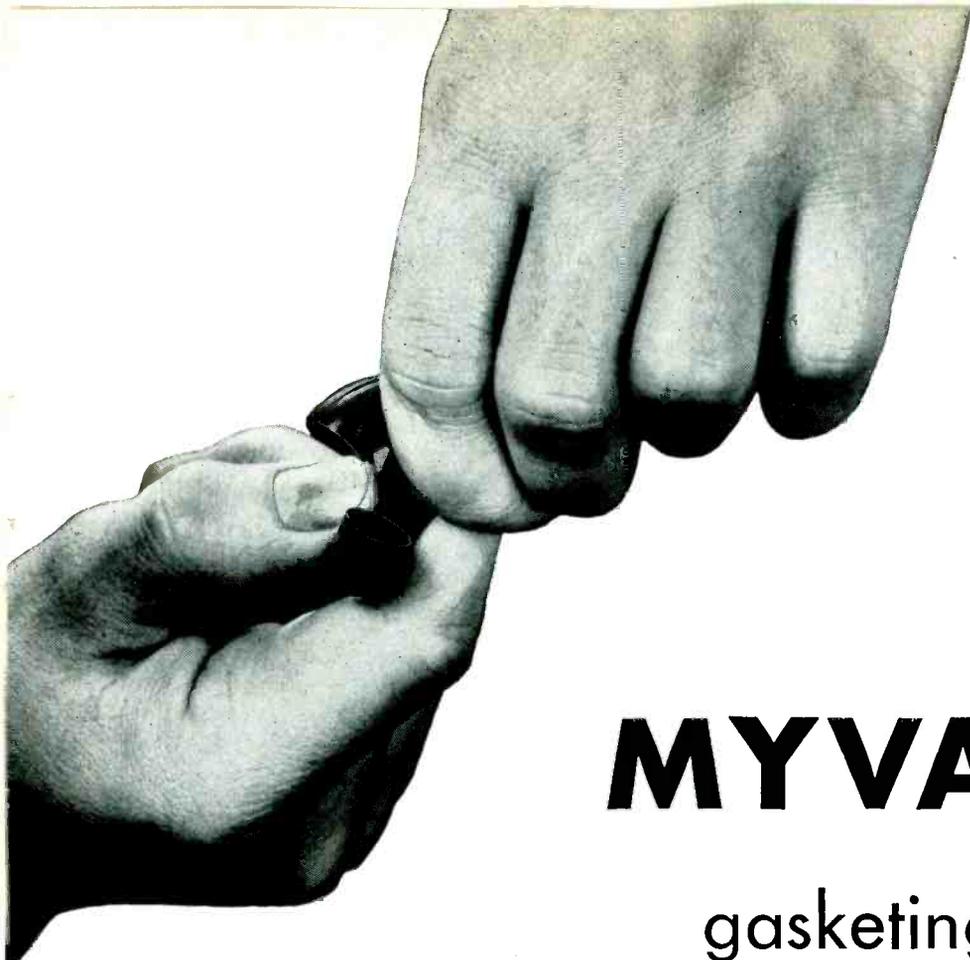
RG-8/U

RG-22A/U

RG-55/U

RG-58/U

RG-11/U



# MYVASEAL\*

gasketing material—  
for **high vacuum**

**H**ERE'S something different—a synthetic elastomer that's tough and has a very low vapor pressure.

In the ports of electron tube exhaust machines, Myvaseal Gasketing Material results in longer-lasting tubes because its remarkably low vapor pressure means higher vacuum with less pumping.

The newest television pic-

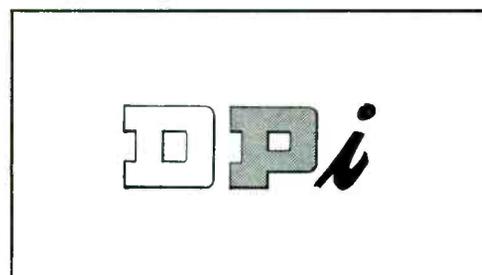
ture-tube pumping systems and rotary exhaust systems are being built with it. Older equipment can benefit from it. And users of other high vacuum systems, small and very large, are turning to Myvaseal Gasketing Material.

This new product is just another example of DPI's research in the interests of those who work with high vacuum.

Whatever your need in that field, let our technical staff serve you. Write to *Distillation Products Industries*, Vacuum Equipment Department, 727 Ridge Road West, Rochester 3, N. Y. (Division of Eastman Kodak Company).

\*Trade-mark

**high vacuum research  
and engineering**





fine wire  
made finer

Specify the electrical properties, flexibility, tensile strength, laying speed, uniformity and other characteristics you must have. Our Hudson and Winsted Divisions will meet and maintain your specifications.

Yes, "Fine Wire Made Finer!" That's why Hudson-Winsted fine wires are the first choice of electrical, radio-TV and electronic manufacturers whose products are noted for reliability and long life.

custom drawn  
custom insulated  
custom spooled...  
to your most exacting requirements

Tell us your wire problems and requirements. Our research, engineering and production facilities are at your disposal. Let us quote!



HUDSON WIRE COMPANY

general offices: ossining, n. y. winsted division, winsted, conn.

**NEW** **ONE-PACKAGE CONTROL SYSTEM**

for  
**DIFFERENTIAL TRANSFORMERS**  
or  
**STRAIN GAGES**  
at the Flip of a Switch



**DYNA-MYKE**

The Dyna-Myke Model 129-B is a precision, high speed, dynamic micrometer using linear differential transformers as the sensing element. It measures and provides for recording such phenomena as force, torque, strain, vibration, acceleration, temperature, pressure, thickness, surface finish, etc., with a linear frequency response of DC to 1000 cps. Direct displacements are measured in five ranges from  $\pm .1$  inch to  $\pm 10$  micro inches. On standard magnetic recorders a sensitivity of 1 micro inch per millimeter is available. A toggle switch converts the Dyna-Myke to a high frequency, high sensitivity strain gage indicator. The output is used to drive any type of magnetic, null balance or galvanometer recorder—or the DC or modulated carrier may be viewed on an Oscilloscope. Selsyn motors may be driven for remote indication or control. Request Technical Bulletin 129-B for full details.

**DYNA-METER**



The Dyna-Meter Model 144, when used with the Dyna-Myke, indicates by neon lights the peak amplitude of transients as fast as 1 millisecond. This indication may be instantaneous or a memory feature may be used to maintain the reading until reset. Built-in power relays provide on-or-off control to any plus or minus limits established by the Dyna-Myke. The combination of the Dyna-Myke and the Dyna-Meter offers many applications to industrial processes resulting in the elimination of scrap at the source. Uses in connection with machine tool operations are particularly impressive. Request Dyna-Meter Technical Bulletin 144.

Custom Builders of Electronic Instruments Since 1943



**INDUSTRIAL ELECTRONICS, INCORPORATED**

8062 Wheeler St., Detroit 10, Mich.

Standard • STANDARDIZE ON Standard • STANDARDIZE ON Standard

**Eliminate CRYSTAL TEMPERATURE CONTROL COSTS . . .**

Now you can forget temperature control. Just specify Standard's Type 20 Crystal Unit for your products.

In addition to lowering power requirements and weight, it increases compactness, durability and dependability. Type 20 meets all Government specifications, too.

Discover how the Standard Type 20 can cut costs and increase sales for you. A letter will bring Engineering data and complete details by return mail.

**Standard Piezo COMPANY**  
CARLISLE, PENNSYLVANIA



## 6 REASONS WHY

### CORNING ALL-GLASS TELEVISION BULBS HELP CUT COSTS FOR TUBE MANUFACTURERS

1. Corning has consistently led the way with price reductions made possible by steady, planned improvement in production efficiency.
2. High glass quality level assures minimum rejections.
3. Strong, uniform bulbs permit very low processing losses.
4. Steadily reduced bulb weights, resulting from lead-free glass and improved manufacturing techniques, save on handling and transportation costs.
5. Highly trained technical service men are immediately available to help solve tube processing problems.
6. Reliability of supply permits operation with minimum inventory.



**CORNING GLASS WORKS, CORNING, N. Y.**

*Corning means research in Glass*

ELECTRONIC SALES DEPARTMENT—ELECTRICAL PRODUCTS DIVISION

1851 • 100 YEARS OF MAKING GLASS BETTER AND MORE USEFUL • 1951

AN approved (3303-1)



# R-B-M

## ELECTRONIC AND COMMUNICATION RELAYS

*Now Hermetically Sealed*

**H**UNDREDS of thousands of R-B-M telephone type relays saw Government service in World War II. Now most of these relays are available in hermetically sealed enclosures designed to meet AN specifications.

R-B-M hermetically sealed telephone type relays are available in contact forms up to and including 4-pole, double throw, 3 ampere, 28 Volts D. C. construction. Also 10 ampere rating up to and including 2-pole double throw at 28 Volts D.C. All relays available with approved AN plug connector, or with solder connections.

**Engineers!** What is YOUR hermetically sealed relay requirement? R-B-M is developing new and smaller relays to meet Armed Services requirements. Perhaps one of these will solve your problems. Write giving complete relay specifications, application, quantity and AN specifications applying. Address Dept. F-5.



AN approved (3304-1)



R-B-M Production and Engineering facilities in two plants, located in different states, (over a quarter million square feet), can assist you in the development and production of special electro-magnetic devices for Armed Services application.

**R-B-M DIVISION  
ESSEX WIRE CORP.**

*Logansport, Indiana*



MANUAL AND MAGNETIC ELECTRIC CONTROLS  
— FOR AUTOMOTIVE, INDUSTRIAL, COMMUNICATION AND ELECTRONIC USE

ing some adjustment in the other circuit components.

### REFERENCE

(1) O. H. Schmitt, A Thermionic Trigger, *Jour. Sci. Inst.*, 15, p 24, Jan. 1938.

## New High-Speed Facsimile System

THE HIGH-SPEED facsimile system recently developed by Western Union requires no processing at any time during transmission or reception. Transmission and recording in final form of 3,000 words of newsprint per minute is possible with the device.

Copy to be transmitted is placed in a horizontal transparent cylinder. When the end gate of the cylinder is closed transmission is automatically started. The copy is held in place in the transmitting cylinder by the centrifugal force of 1,800 cylinder revolutions per minute.

Two transmitting cylinders are used to keep the machine busy. The operator inserts copy in one cylinder while the other is transmitting, as shown in Fig. 1. Transmission shifts from one cylinder to the other automatically to give continuous operation.

A pin point of light is focused on the revolving page and moves along a track parallel to the cylinder. A



FIG. 1—Transmitting cylinders of the new facsimile system. Lower cylinder is loaded and copy is being transmitted while operator prepares upper cylinder for automatic take-over

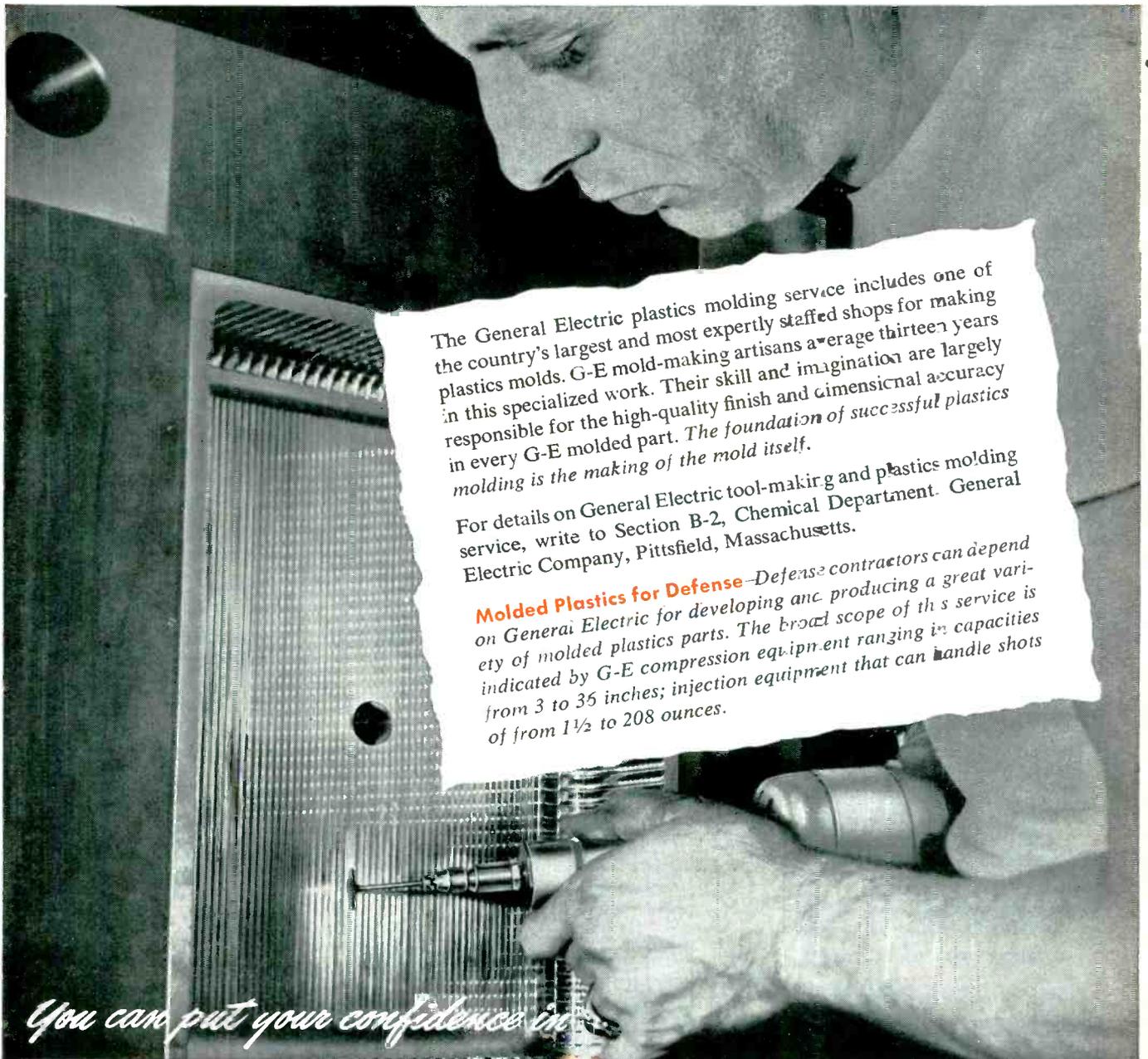
HOW



One of a series of messages to design engineers to show how General Electric's specialized plastics molding service is geared to highly efficient defense and industrial production.

# Specialized MOLDING SERVICE

ASSURES FINER QUALITY PLASTICS PARTS



The General Electric plastics molding service includes one of the country's largest and most expertly staffed shops for making plastics molds. G-E mold-making artisans average thirteen years in this specialized work. Their skill and imagination are largely responsible for the high-quality finish and dimensional accuracy in every G-E molded part. *The foundation of successful plastics molding is the making of the mold itself.*

For details on General Electric tool-making and plastics molding service, write to Section B-2, Chemical Department, General Electric Company, Pittsfield, Massachusetts.

**Molded Plastics for Defense**—Defense contractors can depend on General Electric for developing and producing a great variety of molded plastics parts. The broad scope of this service is indicated by G-E compression equipment ranging in capacities from 3 to 35 inches; injection equipment that can handle shots of from 1½ to 208 ounces.

*You can put your confidence in*

GENERAL  ELECTRIC



ON LAND . . .

. . . SEA . . .



. . . AND IN THE AIR . . .

## . . . NEY PRECIOUS METAL ALLOYS

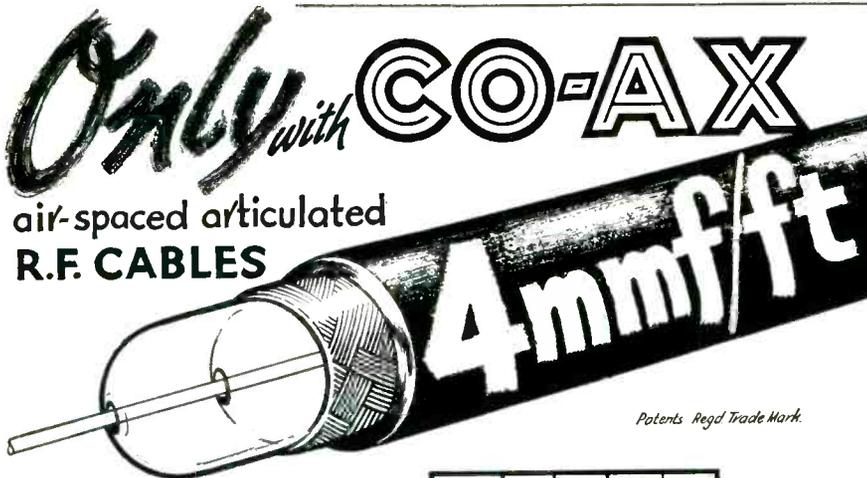
*aid precision control and instrumentation*

If you are being called upon to design and build precision electrical and electronic apparatus for tough field service, be sure to write for a copy of the Ney book, "Precious Metals for Sliding Contacts and Non-Corrosive Wear Resisting Parts." New experience and wealth of successful application data in this specialized field may be the solution to one of your important problems. The book includes comprehensive technical data on Ney precious metal alloys together with photographs and dimension drawings of a wide variety of contacts, brushes and other components now standardized for production.

### THE J. M. NEY COMPANY

179 ELM STREET, HARTFORD, CONN.

SPECIALISTS IN PRECIOUS METAL METALLURGY SINCE 1812



Patents Regd Trade Mark.

### THE LOWEST EVER CAPACITANCE OR ATTENUATION

We are specially organized to handle direct enquiries from overseas and can give

**IMMEDIATE DELIVERIES FOR U.S.A.**  
Billed in Dollars Settlement by your check.  
Transaction as simple as any local buy.

### TRANSRADIO LTD

CONTRACTORS TO H.M. GOVERNMENT  
138A CROMWELL ROAD-LONDON SW7 ENGLAND  
CABLES: TRANSRAD. LONDON.

LOW ATTEN TYPES	IMPED OHMS	ATTEN db/100ft of 100 Mcs.	LOADING $\mu$ w	O.D."
A 1	74	1.7	0.11	0.36
A 2	74	1.3	0.24	0.44
A 34	73	0.6	1.5	0.88
LOW CAPAC TYPES	CAPAC mmf/ft.	IMPED OHMS	ATTEN db/100ft 100Mc.	O.D."
C 1	7.3	150	2.5	0.36
PC 1	10.2	132	3.1	0.36
C 11	6.3	173	3.2	0.36
C 2	6.3	171	2.15	0.44
C 22	5.5	184	2.8	0.44
C 3	5.4	197	1.9	0.64
C 33	4.8	220	2.4	0.64
C 44	4.1	252	2.1	1.03

HIGH POWER FLEXIBLE

PHOTOCELL CABLE

V.L.C. ★

★ Very Low Capacitance cable.



# Kenyon TRANSFORMERS

For all

## ARMY NAVY

## SPECIFICATIONS



There's a Kenyon quality transformer to meet almost any standard or special application.

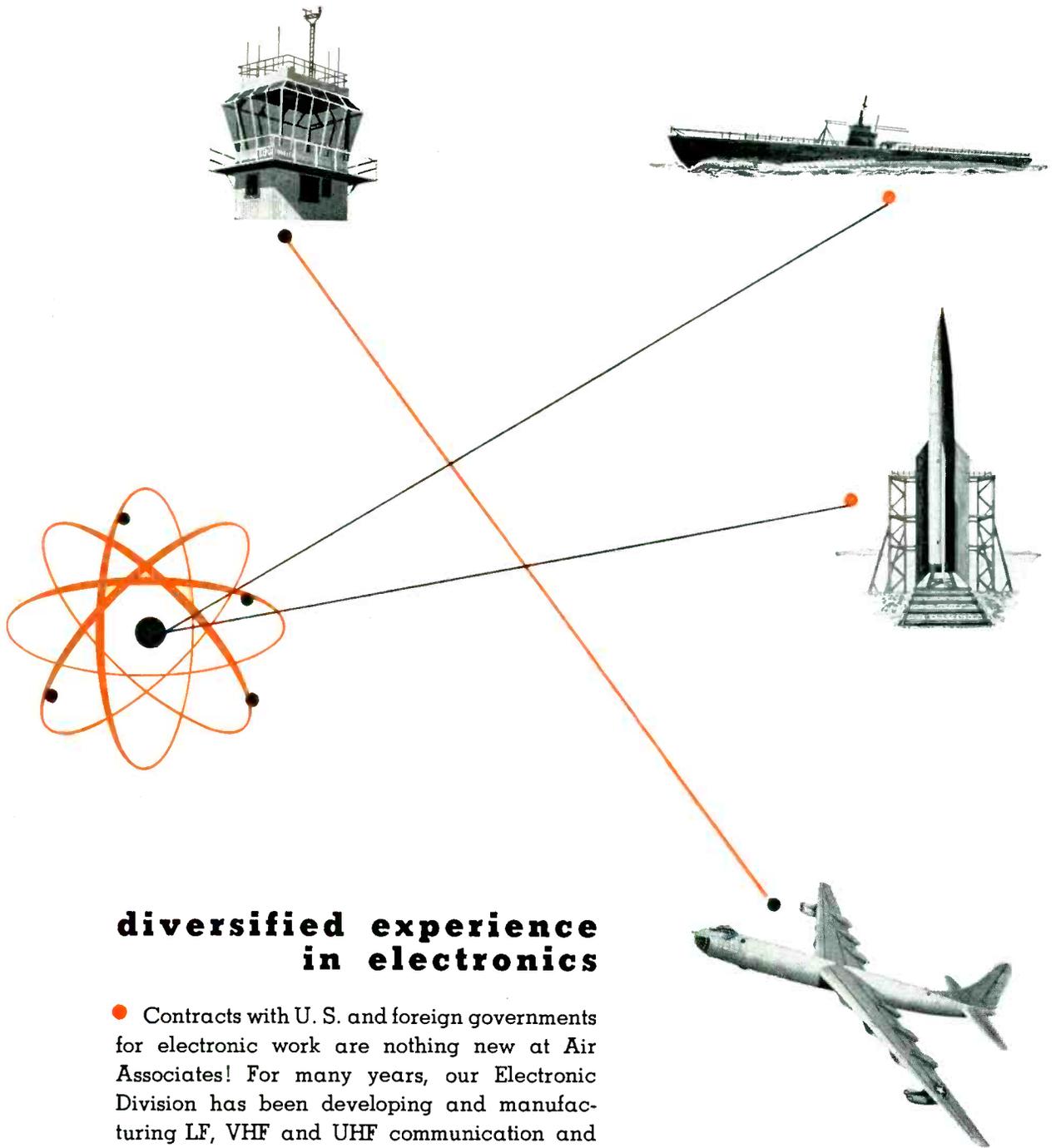
- RADAR
- BROADCAST
- JAN APPLICATIONS
- ATOMIC ENERGY EQUIPMENT
- SPECIAL MACHINERY
- AUTOMATIC CONTROLS
- EXPERIMENTAL LABORATORIES

For full details—  
Contact Kenyon today



# Kenyon Transformer Co., Inc.

840 Barry St. New York 59, N. Y.



## **diversified experience in electronics**

● Contracts with U. S. and foreign governments for electronic work are nothing new at Air Associates! For many years, our Electronic Division has been developing and manufacturing LF, VHF and UHF communication and navigation systems, landing systems, firing error indicator systems, echo ranging systems (including sonar) and special miniaturized electronic devices. Our wide experience and expanded facilities for airborne, marine and ground electronics equipment are available to help solve your design and production problems. Your inquiry to Teterboro will receive prompt attention.

*Air Associates*  
INCORPORATED  
TETERBORO, NEW JERSEY



**SERVING THE NATION IN AVIATION**



## Resists Violent Temperature Changes

because all parts are  
**MATCHED**  
for thermal characteristics

Switch the temperature back and forth from 340 to  $-55^{\circ}\text{C}$ , over and over, and still you won't affect the stability of Ward Leonard Vitrohm Resistors.

Reason is: Ward Leonard, making all components\*, can control thermal characteristics so as to survive the greatest temperature variations.

Write for Vitrohm Resistor Catalog, Ward Leonard Electric Co., 31 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

\*Vitreous enamel coating and ceramic cores formulated and made by Ward Leonard . . . wire drawn to Ward Leonard's specifications.

**WARD LEONARD  
ELECTRIC COMPANY**

**R**esult-**E**ngineered Controls Since 1892

RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES



FIG. 2—Transmitted copy feeding from the recorder at a speed of  $\frac{1}{4}$  inch per second

photocell reacts to the varying light from the page and causes a current to vary rapidly in proportion to the amount of light reflected. The page being transmitted is scanned in parallel lines, 120 to the inch.

Electrical impulses from the transmitter go to the distant recorder via a radio beam or wire circuit. The receiving machine, which operates at the same speed as the transmitter, receives the amplified pulses and reproduces the transmitted copy on an electrosensitive dry recording paper, as shown in Fig. 2.

## High-Voltage Pulse Power Supply

BY H. E. BROWN  
*Naval Research Laboratory  
Washington, D. C.*

IN THE DEVELOPMENT of a special cathode-ray tube a high-voltage power supply was required having an output voltage adjustable between 5 and 15 kv. Because this range of adjustment is not easily obtainable with an r-f high-voltage power supply and because of the convenient availability of television horizontal sweep and high-voltage transformers, it was decided to use such a transformer in the supply.

Figure 1A shows the circuit diagram. A type 6N7 multivibrator is used to generate an approximate sawtooth waveform which drives

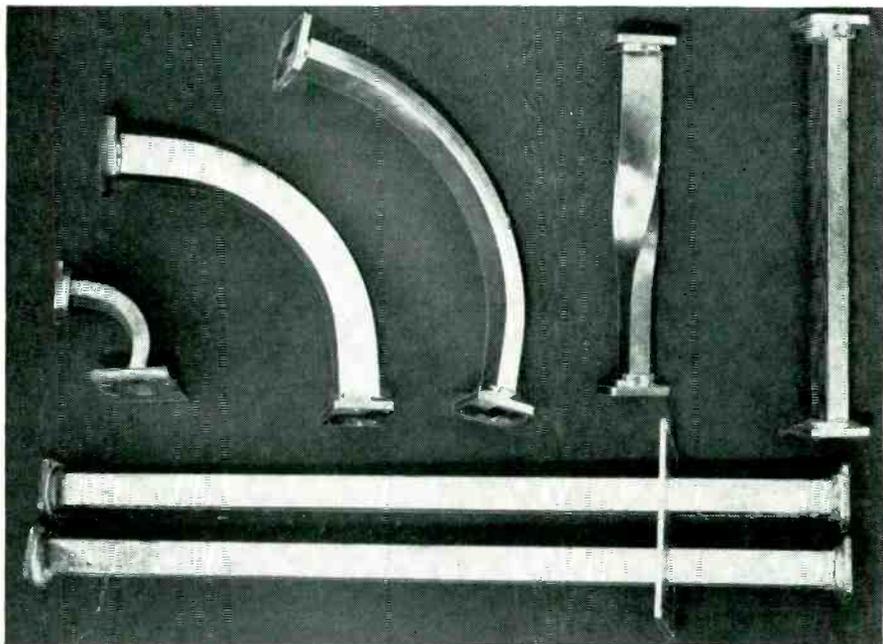


BRIDGEPORT BRASS COMPANY

# COPPER ALLOY BULLETIN



MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



Waveguide tubing which can be accurately bent and twisted due to the ductility of commercial bronze. Flanges are silver soldered to tubing. Courtesy Carl W. Schutter Mfg. Co., Lindenhurst, N. Y.

## Copper-Base Alloys Prove Value In Growing Field of Microwaves

The electrical characteristics of coaxial and waveguide components in microwave transmission lines are as dependent on the precise physical dimensions as on the conductivity of the materials used. The greater the conductivity of the materials the more efficient the lines become.

Copper-base alloys are widely used because of their good workability, machinability, conductivity and the ease with which they may be joined through either brazing, welding or soft or hard soldering.

### Corrosion Resistance Important

Two other characteristics of these alloys are also important to this type of work: Corrosion resistance and the fine manner in which they take a plate and hold it without flaking or peeling.

Since microwaves travel along the surface of a conductor, corrosion of even a minor degree would seriously impair the conductivity of the component.

Silver and copper plates are often used to improve the conductivity. Here

again electrical characteristics would be impaired by a break in the plated surface. Since internal plating is involved, many difficulties experienced in plating of other metals are eliminated.

In wave guide tubing, commercial bronze (90% copper, 10% zinc) is used on the larger sizes. High electrical conductivity is sacrificed for greater strength and rigidity. Oxygen-free copper, with a conductivity of 102, compared to 44 for commercial bronze, is being proposed for the smaller tubing in work of higher frequency.

### Lead Aids Machining

When machining is involved on flanges and many types of cavities, leaded commercial bronze (89.5 copper, 2% lead, 8.5% zinc) is the choice. In this alloy 2 points are lost in the electrical conductivity compared to commercial

bronze but the lead increases the machinability to a point only 20% less than free machining brass rod of 100%.

Not only are accurate dimensions required on these flanges but smooth surfaces are necessary. These would be very hard to obtain unless lead were present to help machinability.

Since coaxial connectors are machined from bar stock and then silver plated to bring up their conductivity and ability to withstand corrosion, free turning brass rod (61% copper, 3.4% lead and 35.6% zinc) is the choice in most cases. This rod has the highest machinability rating of all the copper-base alloys.

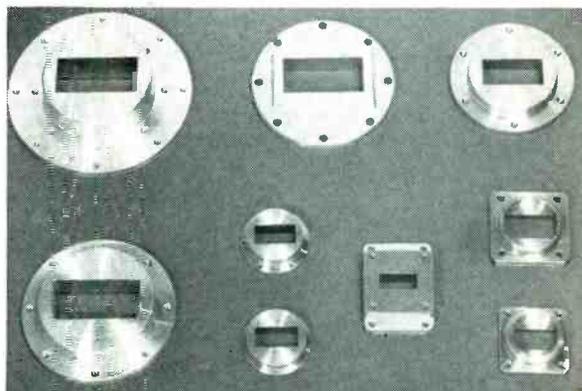
### Phosphor Bronze Used

Phosphor bronze, in both wire and strip form, is used for terminal pins and jacks and for other spring applications due to its fatigue resistance to repeated flexings as well as its high tensile strength.

In the manufacture of rigid coaxial lines both tough pitch and oxygen-free copper tube or strip (formed into a tube) are generally used. Both the high conductivity of these coppers as well as their ability to withstand corrosion under many corrosive conditions make them invaluable to this application.

The copper alloys are also used for sockets, pins, shields, conductors, springs, screws, rivets and many other parts found in electronic devices.

For information on the choice of copper or copper alloys for your product, write either to Bridgeport's nearest district office or to our Laboratory.



Machined flanges made from leaded commercial bronze showing operations calling for turning, drilling, tapping and broaching. Courtesy Carl W. Schutter Mfg. Co., Lindenhurst, N. Y. (6636)

**IMPRINT  
YOUR  
PACKAGES  
YOURSELF**



**faster . . . clearer . . . cheaper**

A Markem machine in your plant lets you imprint vital information such as trade mark, variable facts about size, style, stock number, etc., on cartons, flat boxes, envelopes, and labels. Best of all, you can change imprints or color in only seconds. Consider these advantages the Markem box printers offer anyone packaging electronic products: (1) You have no bulky inventory of preprinted stock because you mark the exact quantities when and as you need them. (2) Marking with Markem equipment gears in with your production line—because you imprint cartons, envelopes, etc., as you assemble and fill them,—the most economical way. (3) Clear, crisp imprints, readable at a glance, are possible with Markem box printers. The printing area can be as large as 11"x3".

Write, enclosing sample or sketch of your imprint. We'll be glad to estimate on the economical Markem box printer best suited to the job.



**Keene 27,  
New Hampshire**

**the right combination** 

**AiResearch Rate  
of Change  
Control**

**FOR THE RIGHT  
CABIN PRESSURE**

The AiResearch Rate of Change Control regulates the rate at which pressure in the airplane's cabin changes. An A. W. Haydon Motor was chosen to drive the instrument because of its proved performance record in scores of important aircraft applications. Other functions for which similar A. W. Haydon Motors are used include controls for wing and propeller de-icing, propeller feathering, camera intervalometer, hydraulic bypass, fuel tank purging as well as recorder chart drives, trim control, telemetering and destructor control, etc.

Send for  
complete catalog.



A. W. Haydon  
Standard D.C. Tim-  
ing Motor No. 5301



**The  
A.W. HAYDON  
COMPANY**  
235 NORTH ELM STREET  
WATERBURY 20, CONNECTICUT  
Design and Manufacture of Electrical Timing Devices

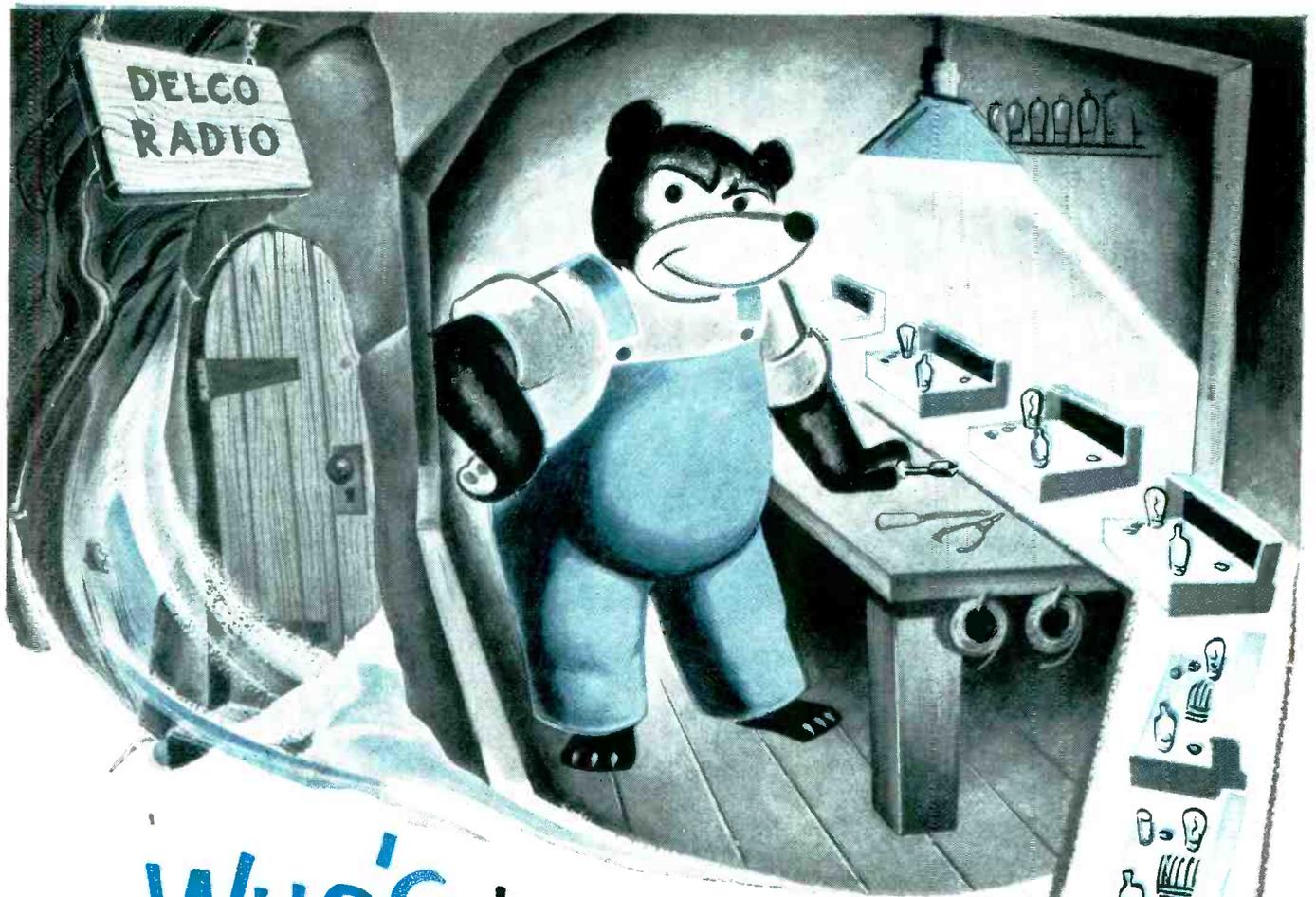
**PHYSICISTS  
And  
SENIOR RESEARCH  
ENGINEERS  
...  
POSITIONS NOW  
OPEN  
...**

Senior Engineers and Physi-  
cists having outstanding  
academic background and  
experience in the fields of:

- Microwave Techniques
- Moving Target Indication
- Servomechanisms
- Applied Physics
- Gyroscopic Equipment
- Optical Equipment
- Computers
- Pulse Techniques
- Radar
- Fire Control
- Circuit Analysis
- Autopilot Design
- Applied Mathematics
- Electronic Subminiaturization
- Instrument Design
- Automatic Production Equipment
- Test Equipment
- Electronic Design
- Flight Test Instrumentation

are offered excellent work-  
ing conditions and opportuni-  
ties for advancement in our  
Aerophysics Laboratory. Salaries are commensurate with ability, experience and background. Send information as to age, education, experience and work preference to:

**NORTH AMERICAN AVIATION, INC.**  
Aerophysics Laboratory  
Box No. K-4, 12214 S. Lakewood Blvd.  
DOWNEY, CALIFORNIA



# WHO'S been hibernatin'?

If you'll pardon the pun, we at Delco Radio don't *bear* the slightest resemblance to brother Bruin.

We haven't been hibernatin' . . . not by a long shot!

The fact is we've been too busy for words . . . and *have been* ever since those critical days of World War II when we produced tons and tons of radio and electronic equipment for the armed forces.

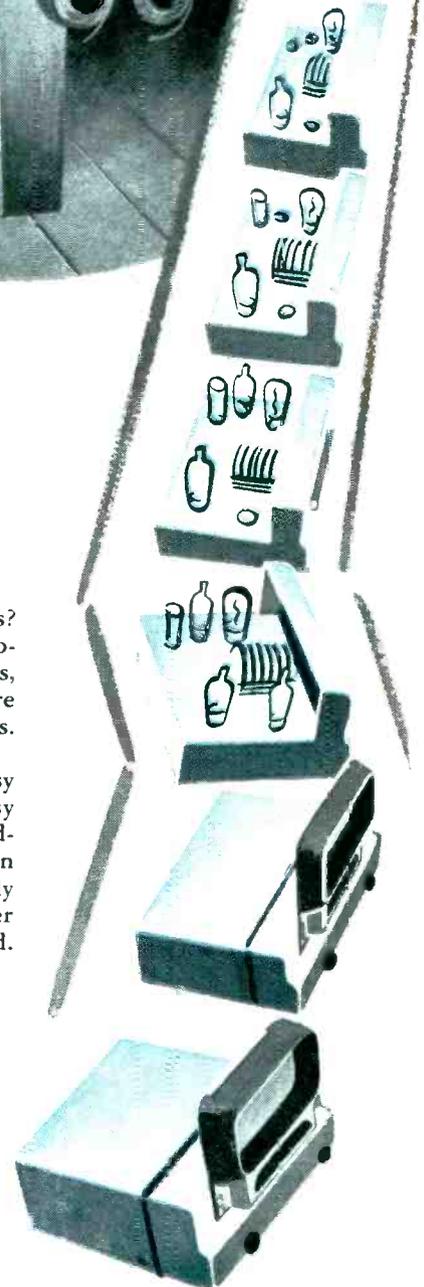
You know those fine resonant radios in

Cadillacs and Buicks and other GM cars? They're our products. Last year we produced nearly 2,000,000 radios for cars, trucks and other vehicles . . . many more than any other builder in the business.

You see, we've really been busy . . . busy getting additional experience . . . busy acquiring greater facilities . . . busy finding new ways to increase production efficiency. And, today, we can truthfully say that we're better prepared than ever to serve our country. Just say the word. We're ready to go!

## Delco Radio

DIVISION, GENERAL MOTORS CORPORATION  
KOKOMO, INDIANA





Typical set-up for measuring characteristics of r-f coil. Types 1330-A Bridge Oscillator, 821-A Twin T Impedance Measuring Circuit and a communications-type receiver. The oscillator is equally suited to use with other bridges such as the Type 716-C Capacitance Bridge and the Types 916-A and 916-AL R-F Bridges.

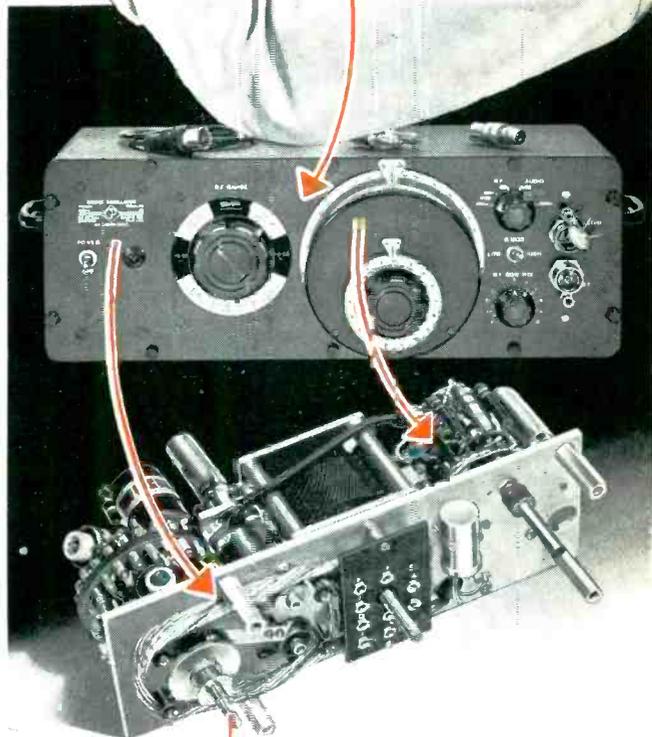


## NEW **GR** Wide-Range BRIDGE OSCILLATOR

5 kc to 50 Mc — 12 Volts Output

The new G-R Type 1330-A Bridge Oscillator is designed especially as a power source for bridge, antenna and general laboratory measurements. It is relatively inexpensive, has high output, excellent shielding and many operating conveniences. Among its features are:

- **WIDE FREQUENCY RANGE:** 5 kc to 50 Mc, carrier
- **THREE MODULATION FREQUENCIES:** *intermediate* a-m at line and at 400 c and 1,000 c, at two levels of approximately 30% and 60%
- **GOOD OUTPUT:** 12 volts, open circuit;  $\frac{1}{2}$  watt into 50-ohm load
- **FREQUENCY ACCURACY:** Carrier —  $\pm 2\%$  above 150 kc,  $\pm 3\%$  below, no load. Audio —  $\pm 5\%$  for 400- and 1,000-cycles
- **LOW LEAKAGE:** about 50  $\mu$ v per meter at 1 Mc, two feet from oscillator
- **COAXIAL OUTPUT jacks, cable and adapters** permit complete shielding from oscillator to measuring instrument
- **LOGARITHMIC DIAL:** calibration logarithmic from 5 kc to 15 Mc
- **INCREMENTAL-FREQUENCY DIAL:** indicates increments of 0.1% per division from 5 kc to 15 Mc
- **VERY COMPACT CONSTRUCTION:** panel relay-rack width, only 7 inches high; cabinet 9 inches deep
- **EASY SERVICING:** oscillator plugs out of shielding box and has servicing cable to test instrument
- **LOW DISTORTION:** between 1% and 6% at 60% modulation level; r-f distortion 3% over most of range



Excellent mechanical construction throughout. Oscillator assembly plugs into deep brass box; double cover completes shielding. Note servicing cable permitting instrument to be tested on bench.

Type 1330-A Bridge Oscillator... \$525.00

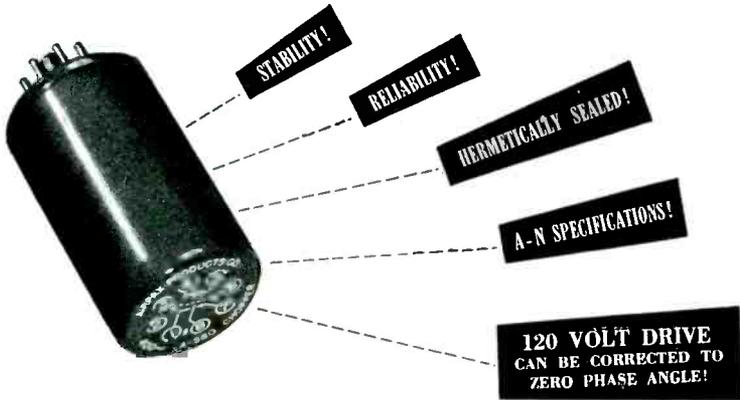
# GENERAL RADIO COMPANY

Cambridge 39,  
Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 1000 N. Seward St., Los Angeles 28



# 5 Big Reasons WHY AIRPAX CHOPPERS ARE AN ESTABLISHED STANDARD FOR THE INDUSTRY!



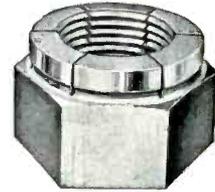
## AIRPAX A580 400 CYCLE CHOPPERS

Modulating minute DC potentials, this chopper combines rugged action with sensitivity and precision for delicate servo applications.



# FLEXLOC

## SELF-LOCKING NUTS



STAY  
**TIGHT**  
AFTER  
**171,360,000**  
VIBRATIONS AT 4000  
CYCLES PER MINUTE...

Plain nuts with lock washers loosened after only ONE HOUR of 4000-cycle-per-minute operation on the vibrator of a concrete block machine at the plant of the Bethayres Concrete Block Co., Bethayres, Pa.

When FLEXLOC Self-Locking Nuts were installed, they were *still tight* when the machine was torn down for rebuilding after 6 weeks operation—at 4000 C.P.M., 17 hours a day, 7 days a week!

If you have an application where nuts loosen or back off, try FLEXLOC, the one-piece, all-metal STOP- and LOCK-NUT "that won't work loose."

Send for Bulletin 619-A today.

# -SPS-

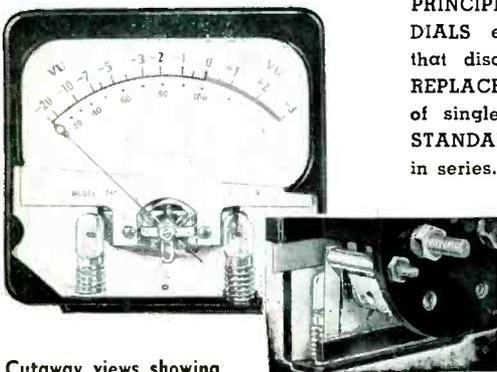
STANDARD PRESSED STEEL CO.

JENKINTOWN 10, PENNSYLVANIA

# New! Burlington

## ILLUMINATED INSTRUMENTS

EXCELLENT LIGHT DISTRIBUTION affords EASE in READING. GLARE REDUCED to a minimum by retaining COMPACT DESIGN of front case extension. REFLECTED LIGHT PRINCIPLE permits use of standard METAL DIALS eliminating translucent materials that discolor with age and use. BULB REPLACEMENT FACILITATED by removal of single lamp assembly. Two 3.8 volt STANDARD BULBS are used and connected in series.



Cutaway views showing positions and connections of lamp assembly.

Available in all ranges 3½" and 4¼" rectangular semi-flush models. Write Dept. F-51 for complete details.

## BURLINGTON INSTRUMENT COMPANY

BURLINGTON, IOWA

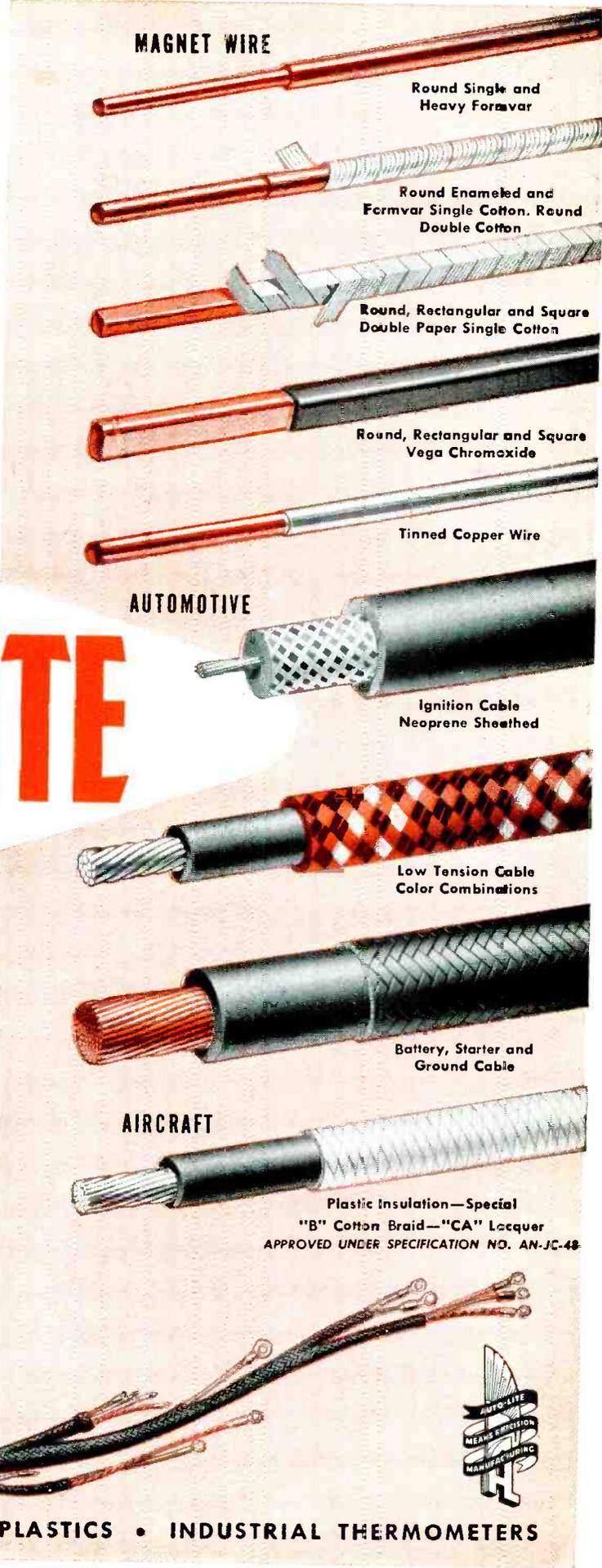
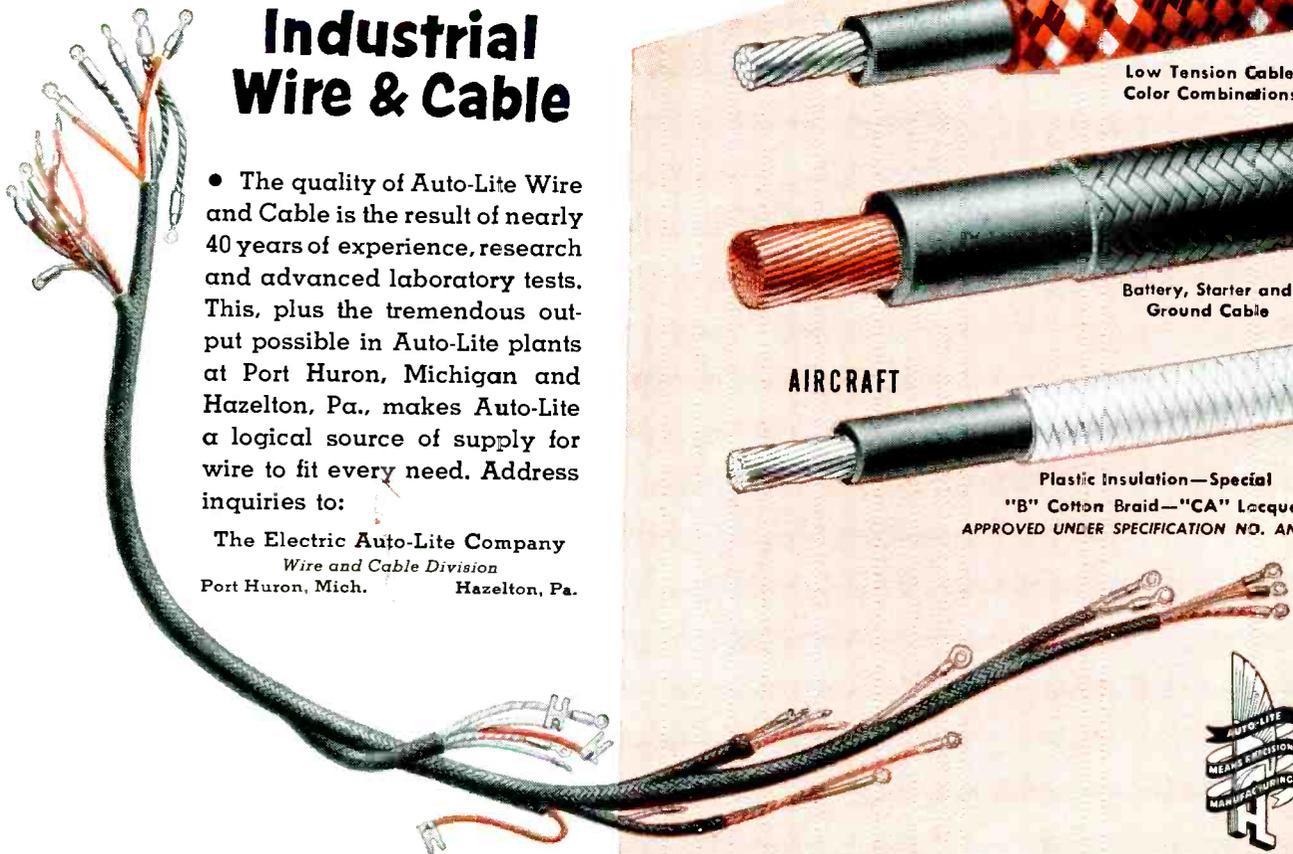
**You're  
always  
right  
with**

**AUTO-LITE**

**Industrial  
Wire & Cable**

• The quality of Auto-Lite Wire and Cable is the result of nearly 40 years of experience, research and advanced laboratory tests. This, plus the tremendous output possible in Auto-Lite plants at Port Huron, Michigan and Hazelton, Pa., makes Auto-Lite a logical source of supply for wire to fit every need. Address inquiries to:

The Electric Auto-Lite Company  
Wire and Cable Division  
Port Huron, Mich. Hazelton, Pa.



**MAGNET WIRE**

Round Single and Heavy Formvar

Round Enameled and Formvar Single Cotton. Round Double Cotton

Round, Rectangular and Square Double Paper Single Cotton

Round, Rectangular and Square Vega Chromoxide

Tinned Copper Wire

**AUTOMOTIVE**

Ignition Cable Neoprene Sheathed

Low Tension Cable Color Combinations

Battery, Starter and Ground Cable

**AIRCRAFT**

Plastic Insulation—Special "B" Cotton Braid—"CA" Lacquer  
APPROVED UNDER SPECIFICATION NO. AN-JC-48



**WIRE & CABLE • DIE CASTINGS • PLASTICS • INDUSTRIAL THERMOMETERS**



- ✓ Lower losses
- ✓ Higher efficiency
- ✓ Lower operating temperatures
- ✓ Lighter weight . . . smaller sizes
- ✓ Less corona effect

# STACKPOLE

- ✓ Higher permeability

*Ceramag*

ELECTRONIC COMPONENTS DIVISION

**STACKPOLE CARBON COMPANY, St. Marys, Pa.**

FIXED RESISTORS • VARIABLE RESISTORS  
 IRON CORES • CERAMAG CORES • LINE  
 and SLIDE SWITCHES • MOLDED COIL  
 FORMS • GA "GIMMICK" CAPACITORS, etc.

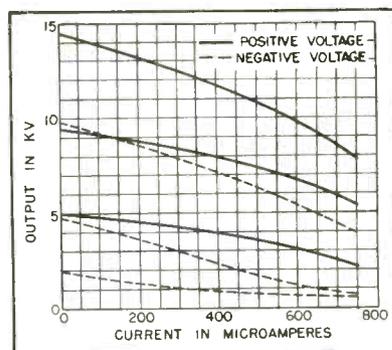


FIG. 2—Regulation curves for the high-voltage pulse power supply

curves, the negative output voltage obtained by reversing the 1B3 connections is somewhat less than the positive output voltage. The output voltage is adjusted by the potentiometer in the grid circuit of the 6CD6 with minor adjustments of the two other potentiometers at the extreme ranges. The maximum load currents of the 6CD6 and 6N7 are 100 ma and 10 ma respectively with a 300-volt power supply. With a higher power supply voltage a higher output voltage may be obtained.

## Simple Phase-Sequence Indicator

BY ALVIN B. KAUFMAN  
 Los Angeles, Calif.

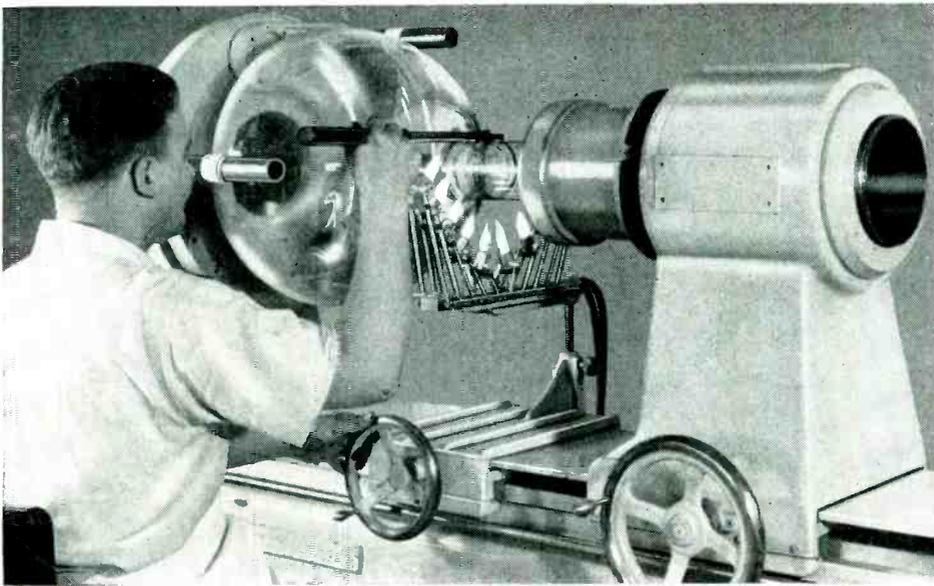
WHEREVER three-phase power sources are used, a question of phase sequence will often arise. The phase sequence or direction of rotation of voltages determines the direction in which a three-phase electric motor revolves and, therefore, indirectly affects gyro instruments, autopilots and other miscellaneous equipment.

In a powerhouse or other commercial power system, adequate instrumentation to determine phase sequence normally exists. In other industries, such as the aircraft industry, the equipment may not be on hand for economic reasons and a portable indicator may be desired.

The simple and inexpensive unit to be described is capable of field use without danger of breakage but is versatile enough so that it may be built into test equipment.

All phase-sequence indicators employ three test leads and these

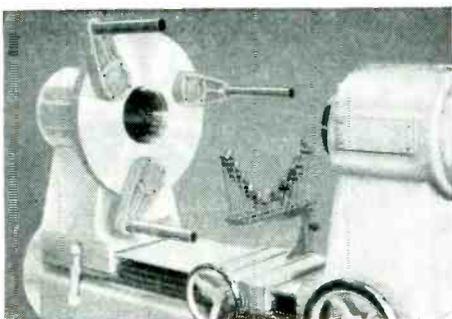
# LITTON INDUSTRIES NEWS



## LITTON GLASSWORKING LATHES SPEED PRECISION ASSEMBLY OF TV KINESCOPE, VACUUM TUBES

Modern vacuum tubes have extremely close alignment tolerances. Often, sub-assemblies must be separately aligned before junction. During sealing, both assemblies must be rotated in perfect phase to maintain this alignment.

Versatile, adaptable Litton Glassworking Lathes meet these requirements. They are built on a normalized cast iron bed, with precision ground ways and axial alignments of highest accuracy and positive phase. The lathes will chuck and hold units such as copper anodes to runouts of .001".



Close-up of spindle head, Litton Model K lathe, showing exceptionally large diameter opening of universal chuck

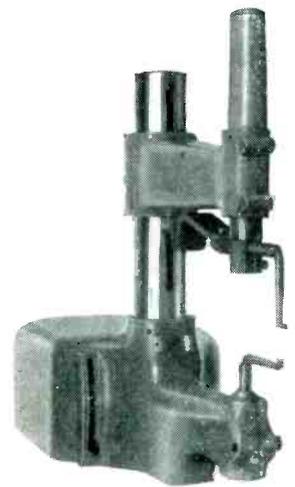
Air passages are arranged to avoid contamination, yet permit use of neutral gasses when sealing glass to metal. Burners provide the narrowest possible heating area commensurate with ample total heat. Continuously variable spindle speed, which makes possible much glassworking without blowing, is optional on all models. Foot pedals control the air or neutral gas supply, and the oxygen and gas volume. Convenient hand controls govern carburetion and air intake to the spindles.

Leading TV tube makers use Litton Glassworking Lathes to speed production of kinescope tubes 10" to 27" in diameter. Manufacturers find that the speed and handling ease of Litton lathes enable glassworkers to seal tube funnels to domes in minimum time—with complete control of glass distribution. Since most manufacturers align sub-assemblies on the lathe, the accurate phasing of Litton spindle heads is also an important factor.

Reliable Litton Glassworking Lathes are adaptable to the widest possible variety of glassworking jobs. Five models offer a choice of radial clearance ranging from 4" to 17½", and axial working lengths from 20¾" to 75½".

## LITTON SPOTWELDERS OFFER HIGH POWER, EXTREME FLEXIBILITY FOR PRECISION JOBS

Litton Model A Precision Spotwelder offers broad applicability of use in the manufacture of vacuum tubes. It makes possible the quick altering of production set-ups. Rated 2 kva continuous duty, it efficiently handles average sized



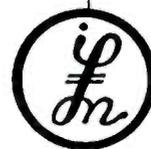
or very precise jobs. Accurate alignment and absence of side play permit butt welding or parallel welding of small wires without rolling. Foot pedals and switches control top mandrel and power supply. Model A spotwelder has 6½" throat depth and extension jaws can be added.

## SPOTWELDER TIMER

A new timer for the Litton Model A Spotwelder has been developed by Litton Industries and will be available for delivery soon. The timer employs two simple controls. One adjusts weld time in steps of 1, 2, 3, 5, 7, 10, 15, 25 and 60 cps. The other adjusts heat control in 6 steps. Proper adjustment of these controls makes possible precision welds up to the 2 kva rating of the welder.

## LITTON INDUSTRIES

SAN CARLOS, CALIFORNIA, U. S. A.



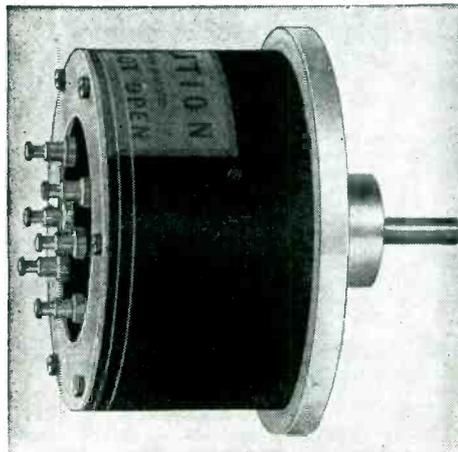
DESIGNERS AND MANUFACTURERS of:  
Glassworking Lathes and Accessories,  
Vertical Sealing Machines, Burner Equipment,  
Precision Spotwelders, Oil Vapor  
Vacuum Pumps, Glass Baking Ovens,  
Vacuum Tubes, and Tube Components,  
Magnetrons, High Vacuum Lubricant Oil,  
Microwave Equipment.

# PRECISION POTENTIOMETERS

Various types of potentiometers custom wound to specifications are available. They feature extremely close limits in electrical characteristics and mechanical construction, low electrical noise, low torque, and long life.

All types will operate within specified limits of performance at temperatures  $-55^{\circ}\text{C.}$  to  $+55^{\circ}\text{C.}$ , 95% relative humidity at altitudes up to 50,000 feet. Corrosion resistant materials are used throughout and all insulating parts are fungicided. Our potentiometers meet AN-E-19 specifications.

We invite your inquiries and specifications.



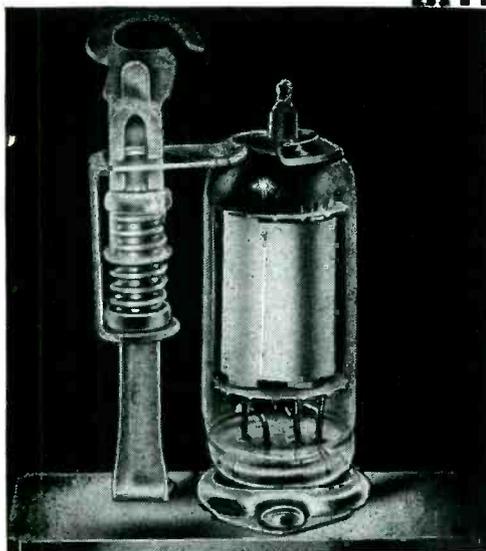
A minor modification of the standard sinusoidal potentiometer type RL-11-C (as illustrated) permits operation up to 1800 RPM. After a test of 28 million cycles at 1800 RPM, one of these units showed negligible wear.

Write for Bulletin F-68.

**THE GAMEWELL COMPANY**  
Newton Upper Falls 64, Massachusetts



## New BIRTCHER TUBE CLAMP FOR MINIATURE TUBES



### POSITIVE PROTECTION AGAINST LATERAL AND VERTICAL SHOCK!

The New Birtcher Type 2 Tube Clamp holds miniature tubes in their sockets under the most demanding conditions of vibration, impact and climate. Made of stainless steel and weighing less than  $\frac{1}{2}$  ounce, this New clamp for miniature tubes is easy to apply, sure in effect. The base is keyed to the chassis by a single machine screw or rivet...saving time in assembly and preventing rotation. There are no separate parts to drop or lose during assembly or during use. Birtcher Tube Clamp Type 2 is

all one piece and requires no welding, brazing or soldering at any point.

If you use miniature tubes, protect them against lateral and vertical shock with the Birtcher Tube Clamp (Type 2). Write for sample and literature.

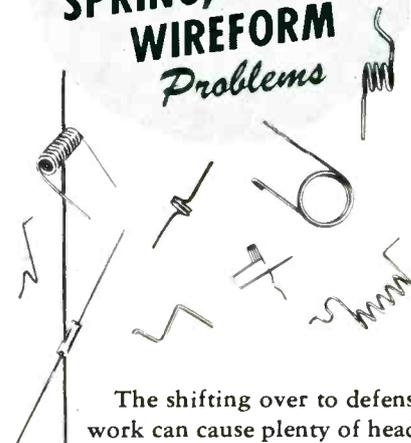
Builder of millions of stainless steel Locking Type Tube Clamps for hundreds of electronic manufacturers.

*The* **BIRTCHER Corporation**

501 HUNTINGTON DRIVE • LOS ANGELES 32

GOING TO MAKE NEW PRODUCTS SOON?

We're Ready to Help  
with your  
**SPRING, COIL and  
WIREFORM**  
Problems



The shifting over to defense work can cause plenty of headaches. The old familiar problems of new specifications, shortages, manpower, equipment, schedules, etc., etc., are approaching us again. We can't help solve all your problems, but we probably can save you several aspirins when it comes to springs, coils and wireforms.

*What can Lewis offer you?...*

Extensive, modern facilities and equipment — experienced design and engineering personnel — skilled production workers — practical, economical manufacturing methods — unusual assistance in selecting the "right" springs for the job.

So, when you're ready, take advantage of the experienced help that Lewis Spring Engineers can offer — if possible, while your products are still in the blueprint stage. Phone, wire or write — no obligation.

**LEWIS SPRING &  
MANUFACTURING CO.**

2656 W. North Ave. • Chicago 47, Ill.

*Lewis*  
PRECISION  
**SPRINGS**

THE FINEST LIGHT SPRINGS AND WIREFORMS  
OF EVERY TYPE AND MATERIAL



# Permafil D-C CAPACITORS

for ambient temperatures

from **-55°C**

to **+125°C**



General Electric Permafil capacitors are designed for use at extremes in temperature—in high ambients—or in high altitudes where extreme cold is encountered. They are suitable for all blocking, by-pass and filtering applications.

These capacitors, while using paper dielectric, are treated with a plastic compound that retains its electrical stability at both high and low operating temperatures. Units are available in case styles CP-53, 61, 63, 65 and 70, as covered by specifications JAN-C-25—in ratings of .05 to 2.0 muf, 400 volts DC. Containers are metallic and are sealed with G-E long-life all-silicone bushings.

For full information on Permafil capacitors see your local G-E representative. Or write *Apparatus Department, General Electric Company, Schenectady 5, New York.*

### Where space or weight are especially important

Permafil capacitors will average about 1/10 the size and weight of liquid-filled capacitors when designed to operate at 125° C.

Where short-life characteristics are permissible additional savings in size and weight are possible. If you have a short-life capacitor application in mind, G-E engineers would like to discuss it with you.

# GENERAL ELECTRIC

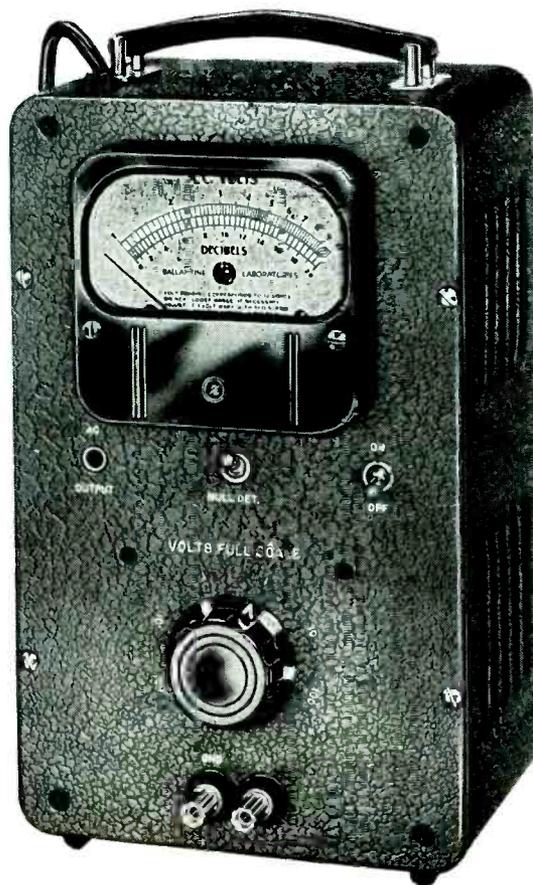
407-302

# Another BALLANTINE

achievement in  
SENSITIVE ELECTRONIC VOLTMETERS

... THE MODEL 310A, a Super-Sensitive Electronic Voltmeter, measuring 100 microvolts to 100 volts from 10 cycles up to 1 MC with 3% accuracy (and up to 2 MC with 5% accuracy) at any point on the single logarithmic voltage scale.

- Input Impedance is 2 megohms shunted by 15 mmfds on the 0.001 and the 0.01 ranges and by 8 mmfds on the other ranges.
- Generous use of negative feedback provides customary Ballantine stability.
- Null Detector Switch enables instrument to be used as a null balance detector in bridge measurement work down to 20 microvolts.
- Six decade range switch permits entire voltage range to be read on a single voltage scale. Linear DB Scale.
- Illuminated and hand-calibrated meter scale.
- Amplifier section may be separately used as a 60, 40 or 20 DB pre-amplifier flat within  $\frac{1}{2}$  DB up to 2 MC.
- Available multipliers increase the voltage range to 1,000 or 10,000 volts.
- Available precision shunt resistors permit the measurement of AC currents from 1 ampere down to one-tenth of a microampere.



MODEL 310A

Price: \$235.

For further information on this Voltmeter and the Ballantine Model 300 Voltmeter, Battery Operated Voltmeters, Wide Band Voltmeters, Peak to Peak Voltmeters, Decade Amplifiers, Multipliers and Precision Shunt Resistors, write for catalog.

## BALLANTINE LABORATORIES, INC.

100 FANNY ROAD, BOONTON, NEW JERSEY



three leads may be rotated, but not interchanged, around the three power wires and still indicate the same phase sequence. Any leg can be taken as the starting point and if it is arbitrarily assigned the symbol A, then B and C can be located.

By referring to the schematic diagram of Fig. 1, it can be seen that two lamps and one capacitor or inductor are required. The lamps may be 110-volt 6-watt types, in which case satisfactory operation may be had on both 26 and 110 volts. Normally, for three-phase 26-volt 400-cycle aircraft systems, two 28-volt aircraft panel bulbs would be used with a 1- $\mu$ f capacitor. The lamps used should be of the same voltage rating as the three-phase line.

The capacitor or inductor value is not critical but should be selected

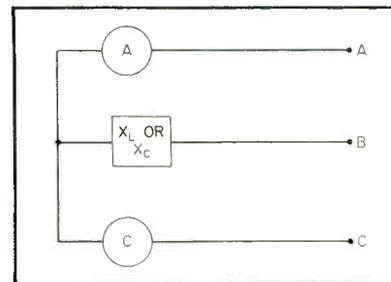


FIG. 1—Circuit for the phase-sequence indicator

for the line frequency utilized. The impedance value of the capacitor or inductor determines the brightness at which the two lamps will operate. Too high an impedance will cause the lamps to light dimly while too low an impedance will cause full brilliance of each lamp. The impedance should be approximately the same as the resistance of one lamp.

Commercially and economically, it is easier to employ a capacitor for the unit than an inductor. The voltage rating of the capacitor should be in proportion to the line voltage, the d-c rating approximately three times the a-c line voltage.

The capacitor value must be calculated for each tester and depends to a large extent upon the voltage and wattage rating of the lamps and the line frequency. The capacitance

# NEW INDICATOR ION TRAP

*A  
Rauland  
"Exclusive"*



## Helps you Cut Production Costs

Rauland's new Indicator Ion Trap can help you in your battle to cut pennies off production costs and thereby to price receivers competitively.

First of all, the Indicator Ion Trap completely eliminates the need for any equipment and any trained judgment in the adjustment of ion trap magnets. Adjustment can be made faster than equipment could be attached. The ion trap magnet is simply moved until the green glow signal is reduced to minimum. It can be done in seconds with absolute accuracy—without even seeing the front of the picture tube.

Second, the Rauland Tilted Offset Gun which incorporates this Indicator Ion Trap requires only one Ion Trap Magnet instead of two, nibbling a little more off production costs. Yet it gives better results—the electron beam is bent only once and is focused to maximum sharpness.

Specify Rauland tubes with these exclusive advantages, and get the benefits that only Rauland offers.

For further information, write to...

### **RAULAND**

**The first to introduce commercially these popular features:**

**Tilted Offset Gun**

**Indicator Ion Trap**

**Luxide (Black) Screen**

**Reflection-Proof Screen**

**Aluminized Tube**

## **THE RAULAND CORPORATION**



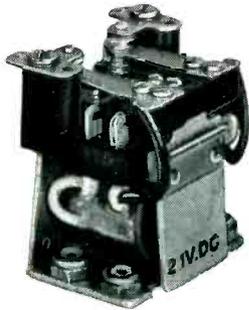
*Perfection Through Research*

4245 N. KNOX AVENUE • CHICAGO 41, ILLINOIS



# HERE'S A QUALITY RELAY

That Meets Exacting Requirements



**THIS LIGHTWEIGHT, COMPACT RELAY CAN HANDLE POWER LOADS USUALLY DEMANDING LARGER, HEAVIER UNITS**

Tiny... but powerful! This general-purpose relay meets rigid aircraft requirements, and also has wide industrial application. Coils are normally rated at 2.5 watts d.c., or 3 watts, 60 cycle a.c., for voltages up to 230 volts d.c. or 440 volts a.c. Maximum standard contact combination, double-pole double-throw — others on request. Contact rating, 15 amps—at 115 volts a.c. non-inductive or 32 volts d.c. Weight, 4 oz. Size, 1-7/8" high, 1-5/8" wide, 1-13/32" deep.

**WRITE FOR FURTHER INFORMATION**



ALSO HERMETICALLY SEALED TYPES



**American Relay & Controls, Inc.**  
4911 W. Flournoy St., Chicago 44, Ill.



## "TEFLON" A PLASTIC HAS OUTSTANDING ELECTRICAL PROPERTIES

• It's power factor is less than 0.05% over the entire spectrum measured to date, 60 cycles to 30,000 megacycles. Its volume resistivity is greater than  $10^{15}$  ohm-cm. even after prolonged soaking in water. The surface resistivity of the plastic is quite high and drops to only  $10^{13}$  ohms at 100% relative humidity. "Teflon" also shows good arc resistance. On exposure to an arc, the material is decomposed to a vapor which leaves no carbonized path regardless of time of exposure to the arc. Short time dielectric strengths are high. These values range from 1000 to 2000 volts per mil., depending on thickness. "Teflon" is almost as good in this respect at 200°C (392°F) as at room temperature.

We have complete manufacturing facilities to mold "Teflon" for your application in the following shapes:

- Tapes
- Special Molded Shapes
- Tubes
- Sheets
- Packing Sets
- Gaskets Plain and Envelope
- Rods

SEND FOR CATALOGUE 711

*John L. Dore Inc.*  
MOLDERS OF "TEFLON" SHAPES

P. O. BOX 6002  
5406 Schuler, St. Houston 6, Texas

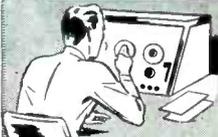


## IN-RES-CO

offers a complete line of standard RESISTORS that meet practically every requirement

Prompt Quotations supplied on both standard and special types

**—more compact, higher accuracy!**



Economical in Cost IN-RES-CO WL series resistors were designed to meet increasing demands for a compact resistor of high accuracy priced for general use. They meet the most critical requirements — close tolerance, ability to withstand overload, long life. Write for catalog.

**IN-RES-CO**  
APPLICATION-DESIGNED  
**RESISTORS**



INSTRUMENT RESISTORS CO., 1036 COMMERCE AVE., UNION, N. J.

TYPES WL 5/8 and WLA 5/8



1/2 WATT  
INDUCTIVE

MAX. RES: .01 to 7,500 ohm (331 Alloy)  
.01 to 4,000 ohm (Nichrome)  
.01 to 1,250 ohm (Manganin)

BODY SIZE: 5/8" lg. by 3/16" diam.  
TOLERANCE: STANDARD 1%

TYPES WL and WLA



1 WATT  
INDUCTIVE

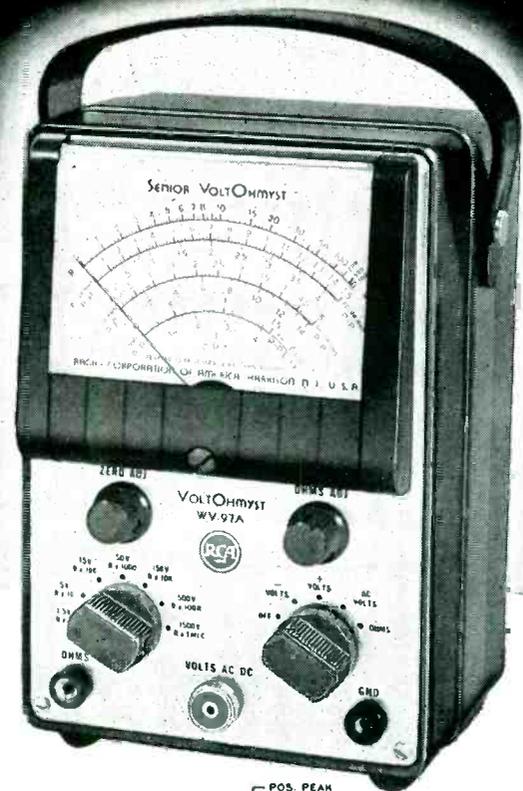
MAX. RES: .01 to 15,000 ohm (331 Alloy)  
.01 to 8,000 ohm (Nichrome)  
.01 to 2,500 ohm (Manganin)

BODY SIZE: 1" lg. by 3/16" diam.  
TOLERANCE: STANDARD 1%

Can be supplied non-inductive with one-half indicated maximum resistance.

# The **NEW** RCA WV-97A Senior VoltOhmyst\* reading peak-to-peak voltages **ONLY \$67<sup>50</sup>** Suggested User Price

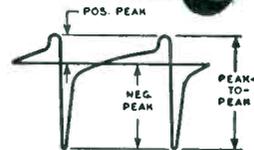
Includes direct probe and cable,  
dc probe, ohms lead, and ground lead



## TEN WAYS BETTER!

1. Directly measures complex waves from 0.2 volt to 2000 volts, peak-to-peak.
2. Has an over-all accuracy for dc measurements of  $\pm 3\%$  of full scale.
3. Measures dc voltages from 0.02 volt to 1500 volts.
4. Measures rms values of sine-wave voltages from 0.1 volt to 1500 volts.
5. Has 7 non-skip ranges for both resistance and voltage.
6. All full-scale voltage points increase in a uniform "3-to-1" ratio.
7. Frequency response flat from 30 cps to approximately 3 Mc.
8. Negative-feedback circuit provides better over-all stability.
9. Fully enclosed metal case shields sensitive electronic-bridge from rf fields.
10. More convenient to use because of smaller size and new slip-on probes.

The WV-97A measures peak-to-peak voltage directly. Hence, it quickly provides information essential for servicing TV receivers with their pulse-type waveforms.



The WV-97A has a range of usefulness extending beyond that of any other instrument in the field. Its quality, dependability, and accuracy make it a true laboratory instrument; it is exactly what is needed for television in the design laboratory, factory, and service shop.

The new Senior VoltOhmyst measures dc voltages in high-impedance circuits, even with ac present. It reads the rms values of sine waves and the peak-to-peak values of complex waves or recurrent pulses, even in the presence of dc. Its electronic ohmmeter has a range of ten billion to one.

Like all RCA VoltOhmysts, it features high input resistance, electronic protection from meter burn-out, zero-center scale for discriminator alignment, molded-plastic meter case, a 1-megohm isolating resistor in the dc probe, and sturdy metal case for good rf shielding.

An outstanding feature is its usefulness as a television signal tracer . . . made possible by its high input resistance, wide frequency range, and direct reading of peak-to-peak voltages.

For complete information on the new RCA WV-97A Senior VoltOhmyst, see your RCA Test Equipment Distributor, or write RCA, Commercial Engineering, Section 42EX, Harrison, New Jersey.

\*Reg. U. S. Pat. Off.

## SPECIFICATIONS

### DC VOLTMETER:

Seven continuous ranges . . . . . 0 to 1.5, 5, 15, 50, 150, 500, 1500 volts

Input resistance (including 1 megohm in dc probe):

AR ranges . . . . . 11 megohms  
Sensitivity for the 1.5 volt range . . . . . 7.3 megohms-per-volt

Over-all Accuracy . . . . .  $\pm 3\%$  of full scale

### AC VOLTMETER—Fourteen continuous ranges:

Peak-to-peak ranges . . . . . 0 to 4, 14, 42, 140, 420, 1400, 4200 volts

Maximum peak-to-peak input voltage for complex waves, 2000 volts

RMS ranges (for sine waves) . . . . . 0 to 1.5, 5, 15, 50, 150, 500, 1500 volts

Input Resistance and Capacitance with WG-218 Direct Probe and Cable:

1.5, 5, 15, 50, 150-volt ranges . . . . . 0.83 megohm shunted by 70  $\mu\text{f}$

500-volt range . . . . . 1.3 megohms shunted by 60  $\mu\text{f}$

1500-volt range . . . . . 1.5 megohms shunted by 60  $\mu\text{f}$

Frequency Response with WG-218 Direct Probe and Cable:

1.5, 5, 15, 50, 150, 500-volt ranges flat from 30 cps to 3 Mc for voltage source having 100-ohm impedance

Overall Accuracy:

1.5, 15, 50, 150, 500, 1500-volt ranges . . . . .  $\pm 3\%$  of full scale

### OHMMETER:

Seven continuous ranges . . . . . 0.2 ohm to 1000 megohms

Center scale values . . . . . 10, 100, 1000, 10,000 ohms; 0.1, 1, 10 megohms

DIMENSIONS: 7 $\frac{1}{8}$ " high; 5 $\frac{1}{4}$ " wide, 4 $\frac{1}{2}$ " deep

### AVAILABLE ACCESSORIES:

WG-254 Crystal Diode Probe. Extends range to 250 Mc

(\$7.75 suggested user price)

WG-289 High-Voltage Probe and WG-206 Resistor to extend range to 50,000 volts. (\$9.95 suggested user price)



Available from your RCA Test Equipment Distributor  
**RADIO CORPORATION of AMERICA**  
TEST EQUIPMENT  
HARRISON, N. J.

# PRECISION FREQUENCIES

**ACCURACY: 1 PART IN 100,000 (OR BETTER) .001%**

**FOR USE IN  
SUCH FIELDS AS**

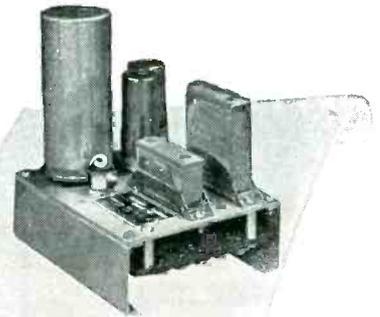
AVIATION  
ASTRONOMY  
BALLISTICS  
HIGH-SPEED PHOTOGRAPHY  
VISCOSITY MEASUREMENT  
NUCLEAR PHYSICS  
TELEMETERING  
RADIATION COUNTING  
FLUID FLOW  
CHEMICAL REACTION  
NAVIGATION  
SCHOOL LABORATORIES  
INDUSTRIAL RESEARCH LABS  
ACCURATE SPEED CONTROL

The controlling unit of these frequency standards is a bi-metallic fork, temperature-compensated and hermetically sealed against humidity and variations in barometric pressure. When combined with related equipment, accurate speed and time controls are afforded by mechanical, electrical, acoustical or optical means.

Instruments of our manufacture are used extensively by industry and government departments on such precision work as bomb sights and fire control.

Whatever your frequency problems may be, our engineers are ready to cooperate.

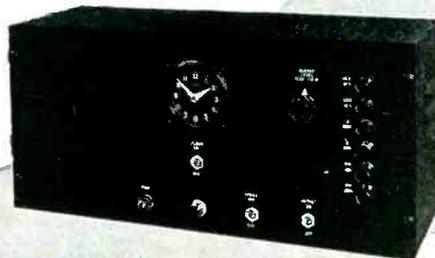
*When requesting further details, please specify the Type Numbers on which information is desired.*



**TYPE 2001-2. BASIC UNIT**  
Frequencies, 200 to 1500 cycles.  
Dividers and Multipliers available for lower and higher frequencies. Miniaturized and JAN construction. Output, 6 volts.



**TYPE 2005. UTILITY UNIT**  
consists of Type 2001-2 and booster to provide 10 watts at 110 V at 60 cyc. Input, 50-100 cyc.



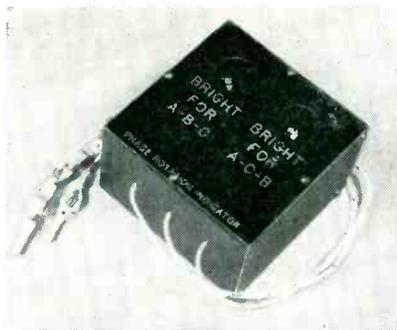
**TYPE 2121A. LAB. STANDARD**  
Outputs, 60 cycle, 0-110 Volts.  
120-240 cycle impulses.  
Input, 50-400 cycles, 45 W.



**TYPE 2111. POWER UNIT**  
50 W output, 0-110 V at 60 cyc.  
Input, 50-100 cyc., 275 W.

**American Time Products, Inc.**  
580 Fifth Avenue  
New York 19, N. Y.

OPERATING UNDER PATENTS OF THE WESTERN ELECTRIC COMPANY



Typical 115-volt 400-cycle tester

required may be found by the formula

$$C = \frac{10^6}{2 \pi f X_c}$$

where  $X_c$  is the hot resistance of one of the two lamps. The hot resistance of the lamp may be found by

$$R = \frac{E^2}{P}$$

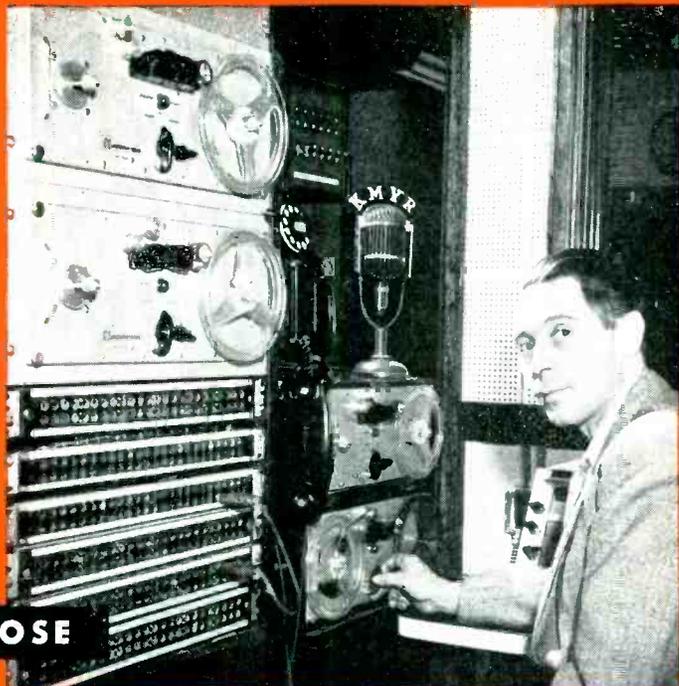
where  $E$  is the line voltage and  $P$  the wattage rating of the lamp.

Single lamp units of different designs are not too satisfactory. The test-lead coding may be selected to have the lamp either on or off for correct sequence but if the off system were used there would always be a question of whether the lamp was burnt out or the tester not completely connected. Using the on system, the unit would be susceptible to error from line-voltage change or frequency variation with any large deviation causing false indication of phase rotation.

All testers using lamps should be constructed so that the bulb is clearly visible. Any jewels should be removed from the light socket assemblies. Jewels cause the light intensity of the two lamps to appear similar because of the faceting of the glass.

Voltage regulation of from 110 to 120 volts is desirable when testing for sequence. The test voltmeter should be connected across each of the three phases in succession in order to determine the voltage of each phase. If this is satisfactory, the two lamps and a reactance may be connected according to Fig. 1.

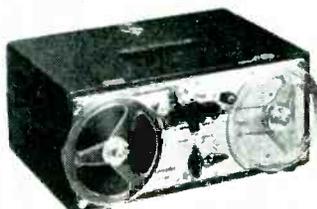
Brightness of the lamps is an indication of the phase sequence of the power leads. When an inductive



HE CHOSE

# Magnecorder

THE FIRST CHOICE OF RADIO ENGINEERS



## FLEXIBILITY

In rack or console, or in its really portable cases, the Magnecorder will suit every purpose. PT6 Series shown is the most widely used professional tape recorder in the world, and is available with 3 speeds (3 3/4, 7 1/2, 15") if preferred.

## FIDELITY

Lifelike tone quality, low distortion meet N.A.B. standards — and at a moderate price! PT63 Series shown in rack mount also offers three heads to erase, record, and play back to monitor from the tape while recording.



## FEATURES

PT7 accommodates 10 1/2" reels and offers 3 heads, positive timing and pushbutton control. PT7 Series shown in complete console model is also available for portable or rack mount. For outstanding recording equipment, see the complete Magnecord line — PT6, PT63 and PT7.

## WRITE FOR NEW CATALOG

Magnecord, Inc., Dept. EB-5  
360 N. Michigan Ave., Chicago 1, Ill.  
Send me latest catalog of Magnecord Equipment.

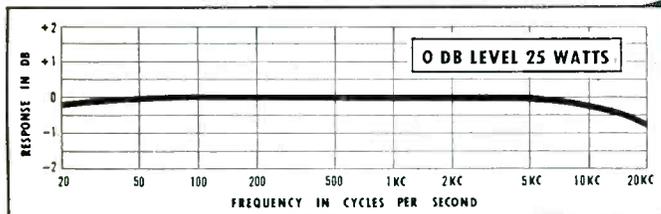
Name.....  
Address.....  
City..... Zone..... State.....

**Magnecord, Inc.**

360 NORTH MICHIGAN AVENUE  
CHICAGO 1, ILLINOIS

# STANCOR

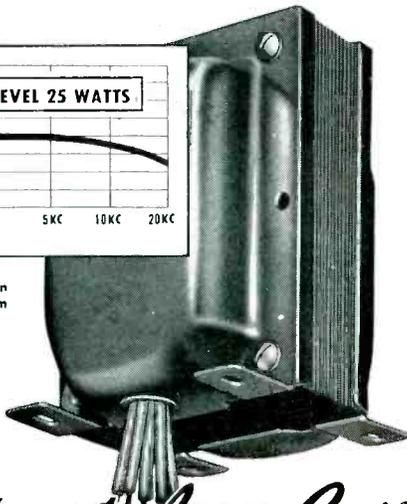
## High-Fidelity Output Transformers



Curve represents an average response of the ten transformers in this series. Units used for this test were drawn at random from current Stancor stock.

**±1db FROM 20 TO  
20,000 cps**

*Premium Quality at Low Cost*



Stancor has taken advantage of the most advanced design and manufacturing practices to bring you a series of output transformers combining outstanding audio response with very moderate cost.

Extensively interleaved "trifilar" windings, extremely tight coupling, and careful electrical balance result in audio fidelity to please the most critical specialist. An inexpensive, but thoroughly practical, type of mounting is used since elaborate shielding is not required at the audio output power level.

Listed part numbers have a maximum power level rating of 50 watts and provide a wide selection of impedances for popular amplifier applications.

PART NO.	PRI. IMP. (P-P) IN OHMS	SEC. IMP. IN OHMS*	MAX. PRI. D. C. PER HALF	NET PRICE
A-8050	1500	8, 16	200 ma	\$10.86
A-8051	2500	8, 16	150 ma	10.86
A-8052	3000	8, 16	175 ma	10.86
A-8053	5000	8, 16	150 ma	10.86
A-8054	9000	8, 16	100 ma	10.86
A-8060	1500	500	200 ma	10.86
A-8061	2500	500	150 ma	10.86
A-8062	3000	500	175 ma	10.86
A-8063	5000	500	150 ma	10.86
A-8064	9000	500	100 ma	10.86

For complete specifications and prices of more than 450 stock part numbers, including other high fidelity transformers, see the current Stancor catalog. Ask your distributor for a copy or write direct.



### STANDARD TRANSFORMER CORPORATION

3578 ELSTON AVENUE, CHICAGO 18, ILLINOIS

reactance is used, the correct sequence A-C-B is indicated if lamp C is brighter than lamp A. When a capacitive reactance is used, the correct sequence is indicated if lamp A is brighter.

In trouble shooting, if both lamps light to the same brightness, lead B is open or the reactance value selected is of too low or high an impedance. With proper selection of the reactance, one lamp will be almost completely out and the other will light to full brilliance.

Where it is desirable to use an inductance, its value may be calculated from the formula

$$L = \frac{X_L}{2\pi f}$$

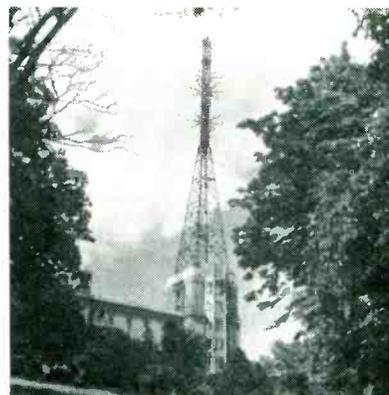
where  $X_L$  is the hot resistance of one lamp.

### Television in Britain

**M**ORE than half a million people in Britain now have television sets and, if the proposed expansion program is carried through, every home in the country will be within range of a transmitting station by 1954.

Television sets may be obtained in Britain for less than about \$135, but the average price is higher. Besides the initial cost, other expenses are for installation charges and for a combined sound and vision receiving license, which costs a little over \$5 a year. More than half of the tv set owners, concentrated at present in the southern half of the country, are in the lower middle and working classes.

The two transmitting stations in



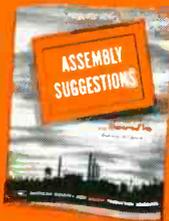
Alexandra Palace station's 300-foot tv antenna at Muswell Hill, London

*Need parts like these?*

**SHAKEPROOF OFFERS COMPLETE  
PRECISION STAMPING SERVICE!**

If you need small precision parts in large volume  
Shakeproof's unique design and development experience plus  
the most advanced die-making, stamping,  
heat treating and plating facilities  
are certain to help solve your  
procurement problems.

WRITE TODAY FOR THIS BOOKLET  
OF ASSEMBLY SUGGESTIONS ...  
see how Shakeproof can help  
you meet urgent production schedules.



**SHAKEPROOF inc.**  
*"Fastening Headquarters"*

Division of Illinois Tool Works  
2501 N. Keeler Avenue, Chicago 39, Illinois  
In Canada: Canada Illinois Tools Ltd., Toronto, Ontario



*other Shakeproof products include:*



LOCK WASHERS



KEYS



THREAD-CUTTING  
SCREWS



"SPEED NUTS"

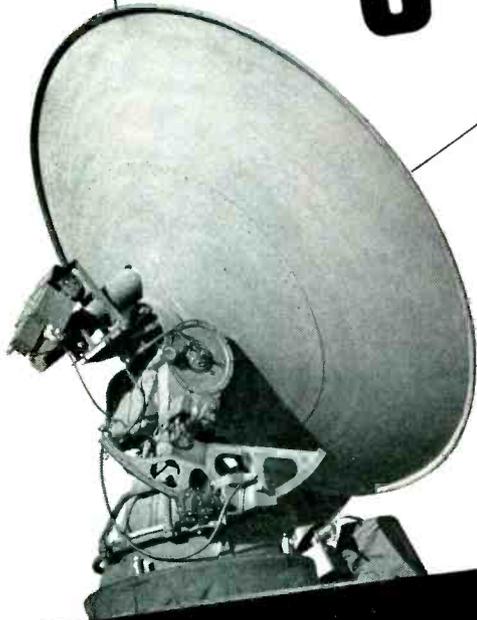


SEMS-BY-  
SHAKEPROOF

FROM 3 INCHES



TO 10 FEET



## "S" Band Radar Antennas for the Armed Forces

Nothing could better demonstrate the versatility of the WORKSHOP staff and facilities than these two radar antennas designed for the Army Signal Corps. The 3-inch gold-plated "beacon," flush-mounted on the belly of a plane, is "fired" by the 10-foot parabolic antenna . . . they operate as a team. This extreme range in size is easily accommodated by the WORKSHOP's elaborate research and test equipment.

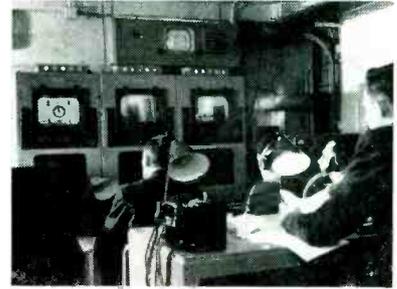
Military antennas of all types — rocket, guided missile, beacon and communications — are being developed regularly in the WORKSHOP laboratories under Government contracts. Our engineering staff is always available for consultation on any antenna problem without obligation. Write, or phone Needham 3-0005.



**THE WORKSHOP ASSOCIATES**  
Incorporated

*Specialists in High-Frequency Antennas*  
135 Crescent Road, Needham Heights 94, Mass.

operation now are Alexandra Palace in London and Sutton Coldfield in the Midlands. Alexandra Palace operates at 17 kw on a video frequency of 45 mc with sound at 3 kw on 41.5 mc. Sutton Coldfield operates at 35 kw on a video frequency of 61.75 mc with sound at



Control room at Lime Grove studio, Shepherd's Bush. Screen at bottom right shows picture being transmitted from Lime Grove. Upper screen shows cricket score being transmitted from Alexandra Palace

12 kw on 58.25 mc. In Britain, 405 lines per picture and 25 frames per second are used.

A third station is due to be opened next summer at Holme Moss, on the moors near Huddersfield, in Yorkshire, and a fourth station at Kirk o'Shotts, midway between Edinburgh and Glasgow is scheduled to open at the end of 1951. Other stations are planned to serve Wales, the South West of England, Aberdeen, Belfast, Newcastle, Southampton and Plymouth.

### *Video Diplexer*

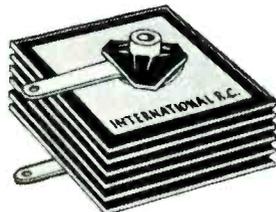
A unique device known as a diplexer which does about the same kind of work as a hybrid transformer in telephone line equipment will be used in the new tv transmitting stations. It combines sound and video signals so that a single antenna array can handle both. The diplexer serves another purpose in preventing video power from being fed back into the sound feeding system. Both the video and sound feeding systems will employ 53-ohm coaxial feeders.

The present \$2,700,000 a year service provides afternoon and evening programs consisting of studio shows, outside broadcasts and films. Films are mainly of the documentary type and comprise the smallest part of the programming.

# SELENIUM RECTIFIERS • PHOTO-ELECTRIC CELLS

## FOR UNSURPASSED PERFORMANCE

### MINIATURE RECTIFIERS



130 Volts  
R.M.S.

Peak Inverse  
Volts: 380

### FOR ELECTRONIC APPLICATIONS UP TO 1,000 MILLIAMPERES

*As easily installed as a Resistor or Condenser*

**ONLY 2 SOLDERING OPERATIONS REQUIRED**

Approximate Voltage Drop: 5 volts

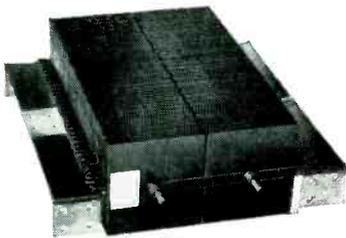
#### RATINGS AVAILABLE

Type No.	RS65	RS75	RS100	RS150	RS200	RS250
Current (ma)	65	75	100	150	200	250

Type No.	RS300	RS350	RS400	RS500	RS1000
Current (ma)	300	350	400	500	1000

SEND FOR TECHNICAL AND DESCRIPTIVE  
BULLETIN NO. 15-1249

### POWER RECTIFIERS



#### RATINGS TO 250 KW

EFFICIENCY TO 87% — POWER FACTOR 95%

*Suitable for Oil Immersion*

FOR ELECTROPLATING, BATTERY CHARGING,  
ELEVATOR AND AIRCRAFT POWER SUPPLY UNITS, ETC.

#### PARTIAL LIST OF POWER RECTIFIERS

TYPE NO.	DC VOLTS	DC AMPS	SIZE PLATE
D507	0-15	0.5	1 1/4" Sq.
D510	0-15	3.0	3" Sq.
D513	0-15	14.0	6 1/4" x 7 1/4"
D517	15-30	3.0	3" Sq.
D520	15-30	14.0	6 1/4" x 7 1/4"
D521	95	5.0	4 3/8" Sq.

WRITE FOR BULLETINS C-349 and C-848.

**INQUIRIES ON YOUR APPLICATIONS INVITED • PROMPT DELIVERY**

Subscription to Bi-monthly Technical Bulletin, "Rectifier News" if requested on company letterhead.

### HIGH VOLTAGE RECTIFIERS

#### CARTRIDGE TYPE

RATINGS TO 25 KV AND 75 MA.

In half-wave, voltage doubler or bridge circuits  
From 1/4" to 1 1/4" O.D. or built to your specifications

#### TYPICAL APPLICATIONS

BIAS SUPPLIES  
CONDENSER TESTING  
CATHODE RAY TUBES  
ELECTRON MULTIPLIERS  
ELECTROSTATIC PROCESSES  
GEIGER COUNTERS  
INVERSE PEAK SUPPRESSORS  
PHOTOFLASH POWER SUPPLIES  
TELEVISION CIRCUITS

#### TYPE V-HF SERIES

1/2 WAVE — 5 MA. DC



DC OUTPUT VOLTAGE	RECTIFIER PART NO.	DC OUTPUT VOLTAGE	RECTIFIER PART NO.
20	V1HF	800	V40HF
40	V2HF	1000	V50HF
60	V3HF	1500	V75HF
80	V4HF	2000	V100HF
100	V5HF	2500	V125HF
200	V10HF	3000	V150HF
400	V20HF	3500	V175HF
600	V30HF	4000	V200HF

#### TYPE Y-HP SERIES

1/2 WAVE — 11 MA. DC



DC OUTPUT VOLTAGE	RECTIFIER PART NO.	DC OUTPUT VOLTAGE	RECTIFIER PART NO.
20	Y1HP	800	Y40HP
40	Y2HP	1000	Y50HP
60	Y3HP	1500	Y75HP
80	Y4HP	2000	Y100HP
100	Y5HP	2500	Y125HP
200	Y10HP	3000	Y150HP
400	Y20HP	3500	Y175HP
600	Y30HP	4000	Y200HP

SEND FOR BULLETIN HVR-850

### PHOTO-ELECTRIC CELLS



Unmounted cells  
available

#### SELF-GENERATING TYPE



DP5—Hermetically  
Sealed (front view)

#### LONG LIFE STABLE CHARACTERISTICS

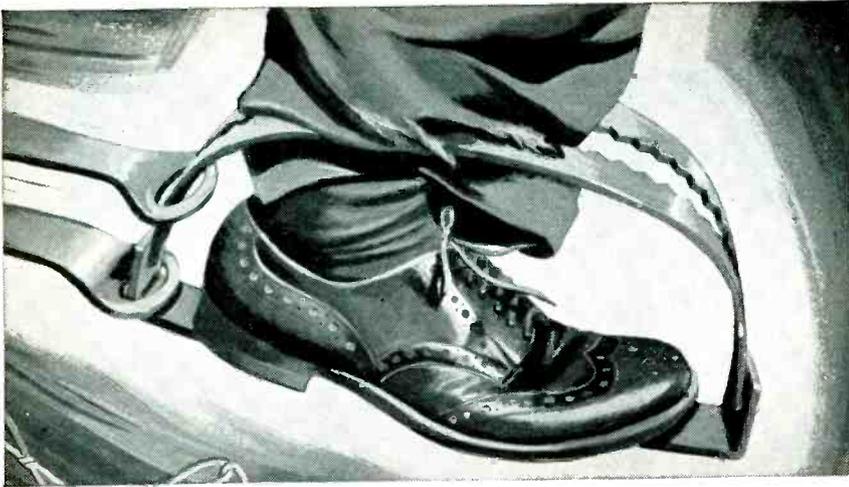
Output up to 600 microamperes at  
100 foot-candles illumination and  
100 ohms external resistance.

WRITE FOR BULLETINS  
PC-649, PPC-250, HPC-450

## INTERNATIONAL RECTIFIER CORPORATION

6809 SOUTH VICTORIA AVENUE • LOS ANGELES 43 • CALIFORNIA

REPRESENTATIVES IN PRINCIPAL CITIES • CONSULT YOUR LOCAL TELEPHONE DIRECTORY



# TRAPPED!

To the \$5,000 Man who wants to make \$10,000 or more a year

A year goes by quickly—so quickly that the average man is not discouraged to find himself at the end just about where he was at the beginning.

But, suddenly, middle-age arrives; he awakes to the startling realization that he has been *trapped* by mediocrity . . . by half-way success.

The big jobs and big salaries which only yesterday seemed possible of accomplishment now appear remote and unobtainable. The future that held great promise no longer exists.

Look back over your own business career. Have you made as much progress as you are capable of making? Are you adding to your knowledge of business fundamentals each day? Or are you, too, lying back contentedly waiting for the success that will never come?

Men who sincerely want to get out of the "trap" can turn to the Alexander Hamilton Institute with great hope. Over a period of thirty-nine years, the Institute has re-kindled the ambitions of thousands of men, and has enabled them to turn their dreams of success into actual achievements.

## ALEXANDER HAMILTON INSTITUTE

Dept. 772, 71 West 23rd Street New York 10, N. Y.  
In Canada: 54 Wellington Street, West, Toronto 1, Ont.

ALEXANDER HAMILTON INSTITUTE  
Dept. 772, 71 West 23rd Street, New York 10, N. Y.  
In Canada: 54 Wellington Street, West, Toronto 1, Ont.

Please mail me, without cost, a copy of the 64-page book—  
"FORGING AHEAD IN BUSINESS."

Name.....  
Firm Name.....  
Business Address.....  
Position.....  
Home Address.....

Send for "Forging Ahead in Business"

It is one of the fascinating delights of business to see what a single year can do in the lives of ambitious men working under systematic guidance. The Institute works no miracles, but it does provide a program so complete and scientific that each day carries subscribers closer to their goal.

That program is outlined in a 64-page booklet aptly titled "Forging Ahead in Business". It was written for mature men only; men who seek—not a magic formula—but a sound, realistic approach to the problems they face in trying to improve their positions and increase their incomes.

There is no charge for "Forging Ahead in Business" for the simple reason that it is worth only what you make it worth. Some men glance through it, and toss it aside. Others have found a fortune in its pages.

If you are willing to devote one short evening to the study of a plan that has meant rapid progress to thousands of executives, send for "Forging Ahead in Business" today. Fill out and return the coupon below; your complimentary copy will be mailed to you promptly



## THE ELECTRON ART

(continued on p 140)

shown in Fig. 1. The horizontal line corresponds to  $f_A$ , the inclined dashed line, to  $f_B$ . At time  $T$  the two frequencies are equal. The line with spikes corresponds to the rate of change of phase of the resultant when the two signals  $A$  and  $B$  have passed through a limiter.

It is seen that as the beat frequency increases in numerical value, the spikes increase in size and occur more frequently. At time  $T$  when the beat frequency is zero the spikes disappear. Before time  $T$  the spikes are negative while after time  $T$  they are positive. That is so if the intensity of  $A$  is less than  $B$ . If  $A$  were greater than  $B$  the reverse would be the case. The important point for the present purpose is that the direction of the spikes changes as the beat frequency passes through zero. The direction of the spikes indicates therefore whether the beats are positive or negative, that is whether the frequency of  $A$  is greater or less than that of  $B$ .

The spiked line is readily turned into a voltage of the same wave form by means of a discriminator or the equivalent. By finding from this wave form whether the positive peaks are greater or smaller than the negative peaks it is therefore possible to ascertain the polarity of the beat frequency provided the ratio  $r$  remains either greater or less than unity.

### Circuit

A circuit for this purpose is shown in block diagram in Fig. 2.

The signal  $B$  is amplified, then limited and passed through a filter. The purpose of this limiter and filter is to obtain a signal of predetermined amplitude. An oscillator set at the desired frequency is added to this signal, its amplitude being either slightly greater or

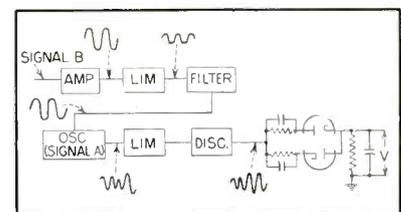
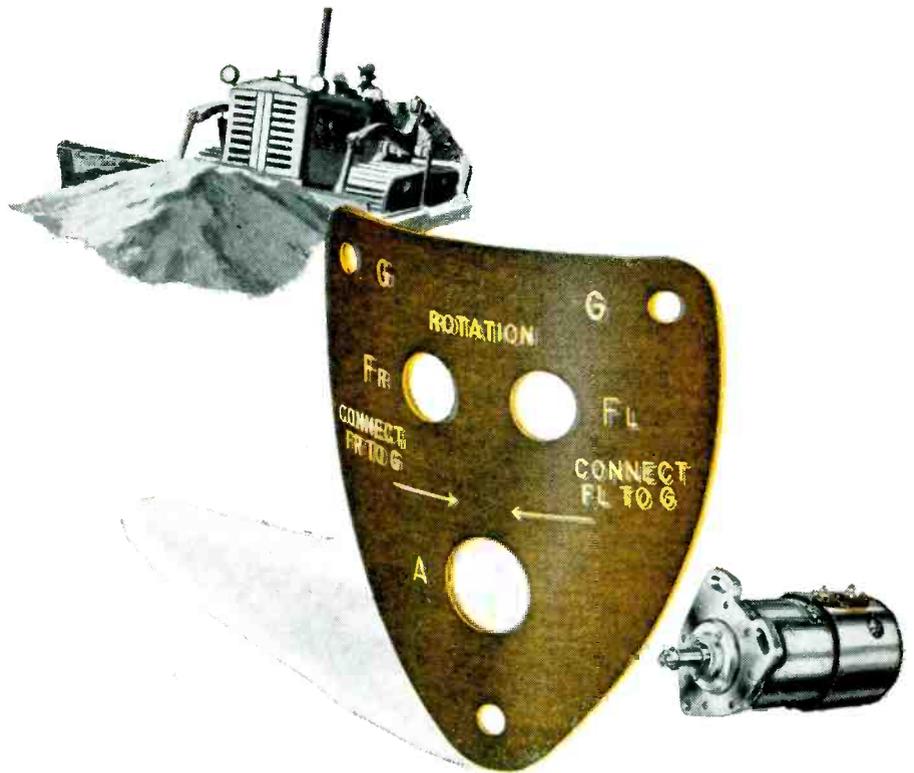


FIG. 2—Block diagram of equipment for determining exact instant when one variable frequency is of same value as another



## How to move mountains—non-stop

When it comes to moving mountains—or spreading the landscape around—you can't beat bulldozers.

You can, however, beat a bulldozer if you put into it a part that can't stand the gaff.

An example is the generator. Vibration, abrasive dust, weather, shifting stresses and stray oils or greases are constantly taking their hardest licks at it. It leads a tough life.

That's why American Bosch Corporation, makers of dust-proof, heavy-duty generators for industrial tractors and bulldozers, selected Synthane laminated plastics for the insulation plate shown above.

Synthane is a material for industry. It possesses an unusual *combination* of physical, mechanical, chemical and electrical properties.

Synthane is light, strong, dense, abrasion resistant. It is easily machined or produced in formed shapes. Dielectrically strong, it is a natural for electrical applications. Synthane is corrosion and fungus resistant, chemically inert, stable over a considerable temperature range.

If this capsule description of Synthane excites your imagination, send for the complete Synthane catalog. Synthane Corporation, 6 River Road, Oaks, Pennsylvania.

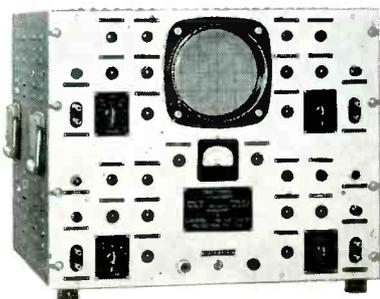
PLASTICS WHERE PLASTICS BELONG

**SYNTHANE**  
S

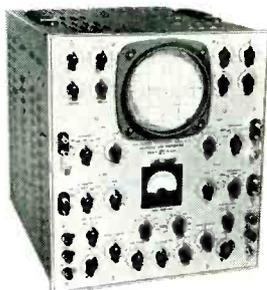


# Why Limit Testing or Research?

ETC multi-gun cathode ray tubes and multi-channel oscilloscopes pave the way to test and research activities far beyond the limitations imposed by single-gun or single-channel models. By registering 2, 4, 5—and even more—related or independent wave forms simultaneously on the same screen they permit far faster and more accurate comparative analyses than are possible by any other method. Whether in industrial, medical, geophysical or other applications, send details of your problem for recommendation by ETC engineers.



H-43 Four-channel oscilloscope for strip film recording.



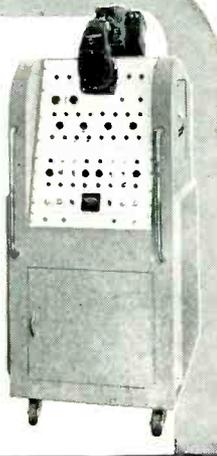
H-21 dual-channel oscilloscope.

## ... for high-frequency STRAIN ANALYSIS

Utilizing ETC 4-channel oscillographic equipment, this H-42A Strainalyzer contains complete equipment for simultaneous measuring, analyzing, and recording of four static or dynamic strains from 0 to 50,000 cycles. Includes four calibration bridge circuits, power supplies, recording camera, ready to connect directly to strain gages—a complete testing laboratory in one instrument. Write for Bulletin H-42A.

*electronic tube corporation*

PHILADELPHIA 18, PENNSYLVANIA



slightly less than the signal  $B$  at that point of the circuit. It is important that the ratio of the signal intensities remains substantially the same and does not pass through unity. The two signals  $A$  and  $B$  are passed through a limiter and discriminator which produces the spiked wave form shown in Fig. 1. This output is then analyzed by means of two diodes to establish whether the positive maximum is greater or less than the negative maximum. The polarity of the voltage  $V$  provides the required indication. When  $V$  is zero the frequencies of  $A$  and  $B$  are equal. Thus the time  $T$  is obtained.

A corollary to this system can be developed into a means for finding accurately when the amplitude of a signal equals that of another. If the frequency of signal  $A$  is greater than that of signal  $B$ , the spikes will be negative when the amplitude of signal  $A$  is greater than that of signal  $B$ , and vice versa. The method consists, therefore, of making the frequency of signal  $A$  always either consistently greater or consistently less than that of  $B$  and finding whether the spikes are positive or negative by a circuit similar to that described. The point at which the spikes change sign is very sharp and indicates the point of equal amplitude of the two signals.

## Multiple-Channel D-C Amplifier

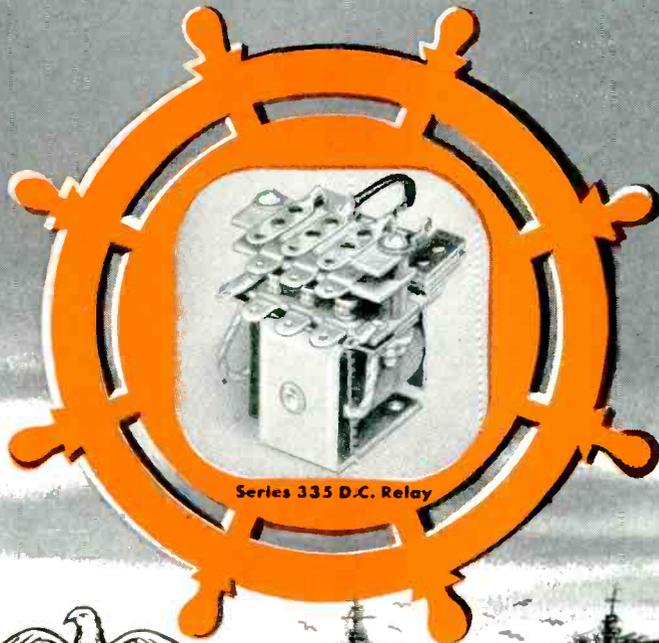
By LEONARD GOLDBERG  
Reeves Instrument Corporation  
New York, N. Y.

D-C AMPLIFIERS employing negative feedback are universally used as operational amplifiers in d-c analog computers, each desired operation requiring one amplifier. This article describes a new type of amplifier which will perform any number of operations simultaneously, thereby substituting one amplifier for several standard ones. Greater economy may be expected through the use of fewer tubes and other components.

*Open Loop*

The new circuit may best be described by comparison to a con-

# ONE OF A LINE



Series 335 D.C. Relay



**CHOICE OF THE NAVY FOR Dependable Controls**

On peacetime boats of commerce and travel—on warcraft—Guardian Relays play major control roles, ranging from Marine radio to navy aircraft. The Series 335 D.C. approved Guardian Relay shown above is typical of Guardian units built to rigorous aviation standards. Meets the 10-G Vibration Test and the Mil-R-6106. Generous coil winding area permits single winding up to 15,000 ohms. Parallel and double windings available.



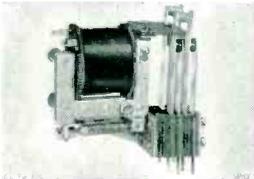
## GUARDIAN RELAYS

A.N. CONNECTOR PLUG  
HERMETIC SEALED  
CONTAINER



The Series 335 D.C. approved Guardian Relay packs loads of power over a wide operating range, withstands moisture, salt air, temperature changes, dust, vibration and impact. Available in standard open model or with A.N. Connector Plug, Octal Plug and Lug Header hermetic seal containers.

NEW CATALOG on Hermetically Sealed Guardian Relays with various containers is yours for the asking, cost-free.



Series 30 A.C.



Series 210 A.C.—215 D.C.



Series 220 A.C.



Series 595 D.C.



Series 610 A.C.—615 D.C.

WRITE OR WIRE... FREE CATALOG, SPECIFIC RECOMMENDATIONS, NO OBLIGATION.

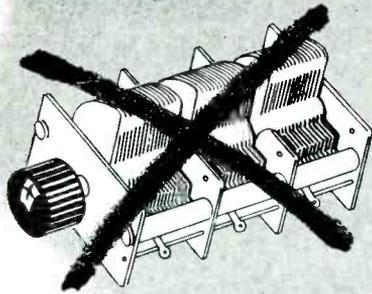
# GUARDIAN ELECTRIC

1625-F W. WALNUT STREET

CHICAGO 12, ILLINOIS

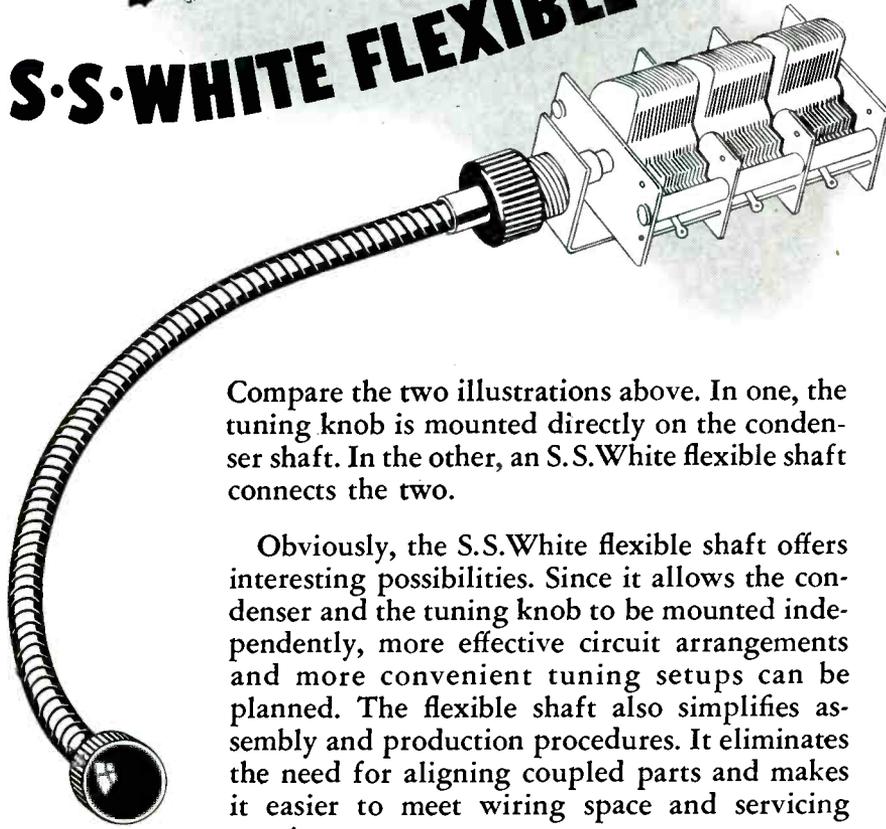
A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

# Why not take advantage



of an—

# S.S. WHITE FLEXIBLE SHAFT?



Compare the two illustrations above. In one, the tuning knob is mounted directly on the condenser shaft. In the other, an S.S. White flexible shaft connects the two.

Obviously, the S.S. White flexible shaft offers interesting possibilities. Since it allows the condenser and the tuning knob to be mounted independently, more effective circuit arrangements and more convenient tuning setups can be planned. The flexible shaft also simplifies assembly and production procedures. It eliminates the need for aligning coupled parts and makes it easier to meet wiring space and servicing requirements.

S.S. White flexible shafting has a place in almost every type of electronic equipment and other regulated devices. It will pay you to have on hand the full facts concerning their possibilities and advantages. For details,



**WRITE FOR NEW BULLETIN 5008**

*It contains the latest information and data on flexible shafts and their application. Write for a copy today.*



**THE S.S. White INDUSTRIAL DIVISION**  
**DENTAL MFG. CO.**



Dept. E, 10 East 40th St.  
NEW YORK 16, N. Y.

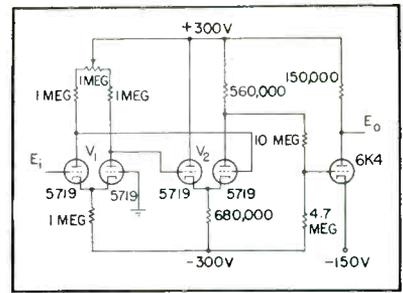


FIG. 1—Conventional single-channel amplifier

ventional single-channel amplifier, such as illustrated in Fig. 1. Other basic designs may just as easily be employed; the only requirement is that the circuit have a differential first stage. This is a three-stage amplifier using five tubes. The grid of  $V_1$  is grounded so as to establish the input grid at a virtual ground, when connected closed loop. Tube  $V_2$  is necessary to maintain a constant cathode current in the second stage. Furthermore,  $V_1$  and  $V_2$  are employed for compensation against variations in filament and supply voltages. The circuit equation is

$$E_o = -A E_i \tag{1}$$

where  $A$  is the gain of the amplifier.

The multiple-channel amplifier, as illustrated in Fig. 2, may be designed by a direct expansion of the single-channel amplifier. The purpose of tubes  $V_1$  and  $V_2$  is the same as before, yet the total number of these compensatory tubes is two, regardless of the number of channels employed. The circuit equations for  $N$  channels are

$$E_{ao} = -A E_{ai} \tag{2}$$

$$+ \frac{A}{N} (E_{bi} + E_{ci} + \dots + E_{ni})$$

(N - 1) terms

$$E_{no} = -A E_{ni} \tag{3}$$

$$+ \frac{A}{N} (E_{ai} + E_{bi} + \dots + E_{(n-1)i})$$

(N - 1) terms

For closed loop operation, each input-output pair may be treated as an independent amplifier.

The degree of independence of one amplifier to another (interaction between channels) is defined as the effective zero shift at the input of any one channel caused by a sig-

# Reduce size up to 50% with **Bogue**

## **TAILORED COORDINATED DESIGN VOLTAGE & SPEED REGULATORS**

Bogue being the only company where both regulators and motor generator sets are manufactured under one roof has taken advantage of its position by instituting a program whereby the design of both the Motor-Generator and Regulator are tailored to take full advantage of their flexibility. The aim of this program is to secure a minimum

number of components and a minimum size and weight of the complete integrated power unit.

By coordinating the design of the two components the reduction in size and weight of the regulators has averaged better than 50% over competitive designs. Bogue will be glad to consult with you on your voltage and speed regulator problems.

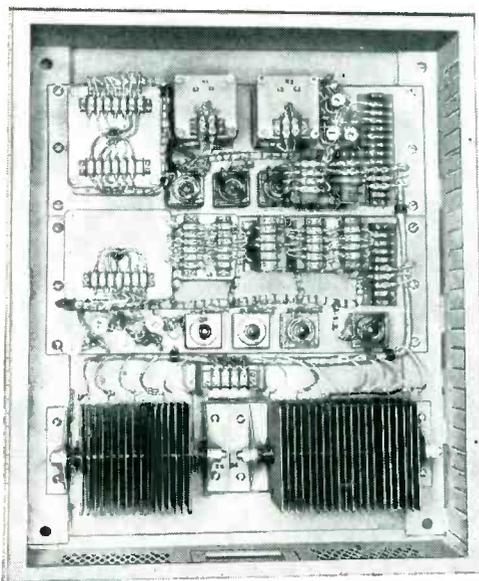


Illustration shows speed and voltage regulator used with a 5 KW, DC, 400 Cycle Motor-Generator Set. The regulators maintain the output frequency to within 1 Cycle of 400 and the output voltage to within 1% of 120 volts over the full range of no load to full load and with the input DC Voltage varying over a 2 to 1 range.

### **BOGUE ELECTRIC MANUFACTURING COMPANY**

*Where Precision Coordinated Design...Counts!*

50 IOWA AVENUE

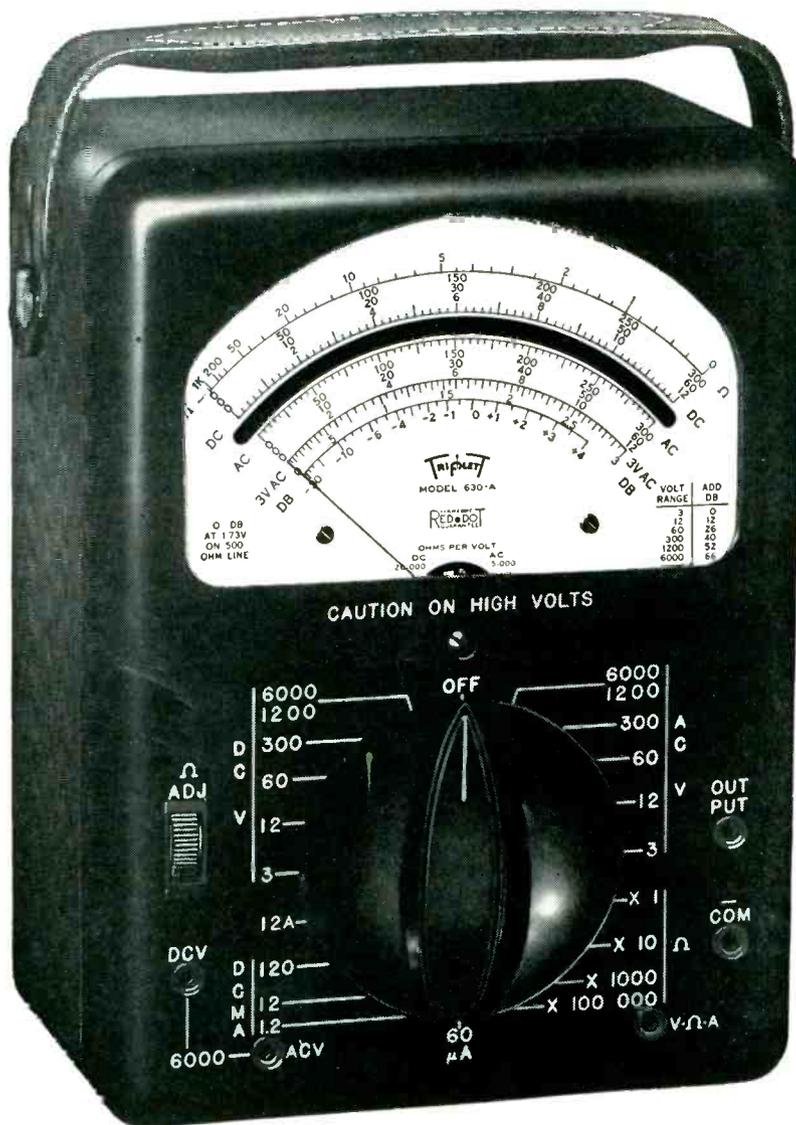
PATERSON 3, NEW JERSEY

MAGNETIC AMPLIFIERS • MAGNETIC CONTROLLERS • AC & DC MOTORS  
AC & DC GENERATORS • VOLTAGE & SPEED REGULATORS • SWITCHBOARDS

ELECTRONICS — May, 1951

SINCE 1892 SPECIALISTS •  
**Bogue** •  
FINE MOTORS & GENERATORS

# NEW



- 1/2%  
RESISTORS**
- COMPENSATED  
OHMMETER  
CIRCUIT**
- LONG  
HAND-DRAWN  
MIRRORED  
SCALES**

# ACCURACY

Designed for the engineer and technician who wants laboratory accuracy. Achieved in Model 630-A by more accurate components and hand-drawn scales that compensate for the average individual characteristic of each instrument. Also includes knife-edge pointer and mirror scale to eliminate parallax.

## Model 630-A

**ONLY \$49.50 AT YOUR DISTRIBUTOR**



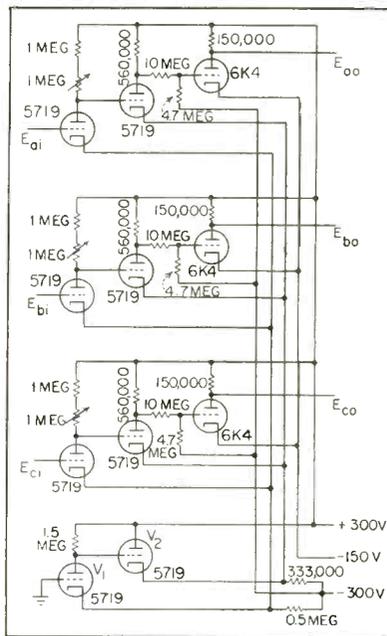


FIG. 2—Multiple-channel amplifier (three channels shown) using basic design of Fig. 1

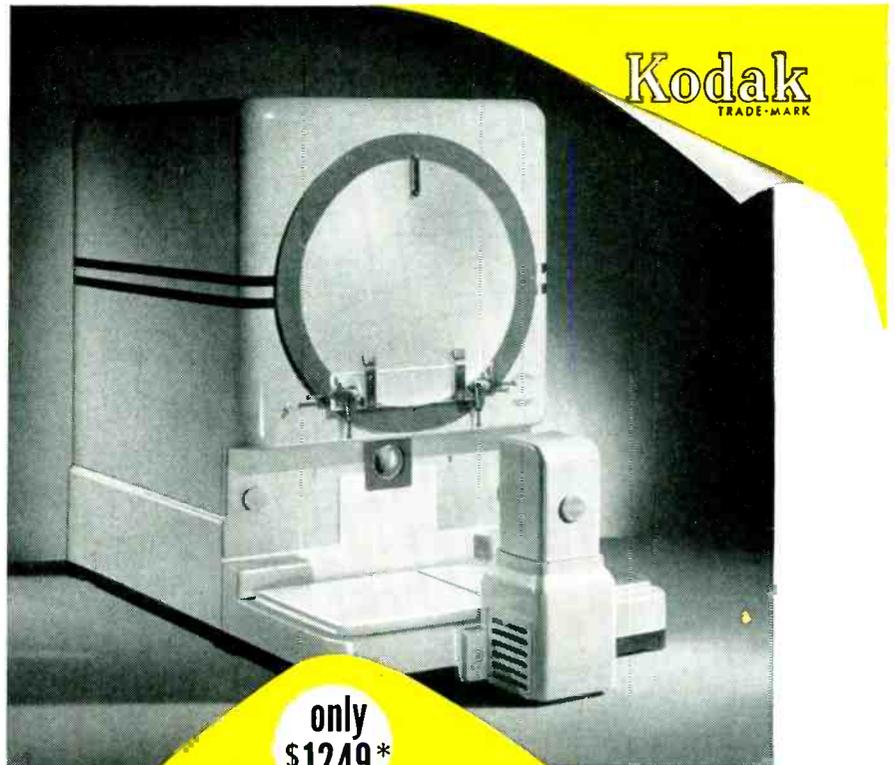
nal being impressed at a different channel. Expressed another way: what new voltage is required at the input to channel  $N$  ( $E_{ni}$ ), such as to maintain its output ( $E_{no}$ ) at zero? This is easily derived from Eq. 3; set  $E_{no} = 0$ , and solve for  $E_{ni}$ .

$$E_{ni} (E_{no} = 0) = \frac{1}{N} \overbrace{(E_{ai} + E_{bi} + \dots + E_{(n-1)i})}^{N-1 \text{ terms}} \quad (4)$$

Equation 4 states that the zero position of any input grid is equal to the algebraic average of all the other grid voltages in the first stage, including the grounded grid of  $V_1$ .

However, since  $E_{ni}$ ,  $E_{bi}$ , and so on, are usually not known and are not of primary interest, this equation is not in usable form. It is neither simple nor useful to solve this equation in the general case (free choice of external circuitry for all channels), although interaction may be easily determined in any particular closed-loop circuit. Two examples, therefore, are given. The effect of one channel upon all the others is derived from the circuit of Fig. 3A; the effect of all but one channel upon the one remaining is derived from the circuit of Fig. 3B.

Consider the circuit of Figure



only \$1249\*

## a new instrument for fast accurate assembly and inspection

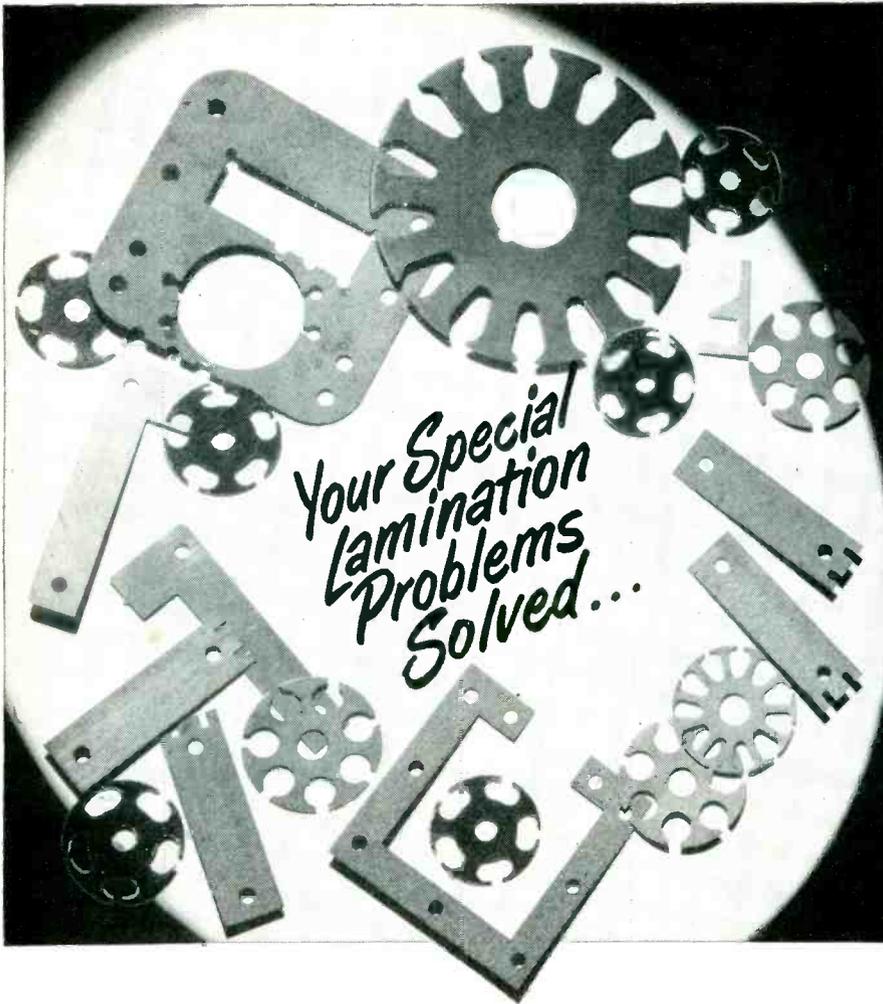
It's a new version of the unique Kodak Contour Projector, stripped of toolroom features for greater flexibility in getting out production on all sorts of precision jobs, small or large.

- 1 At any magnification up to 100X you get the same 8 inches of free space from lens to object. This makes it easy to design fixtures that handle parts fast.
- 2 The projector body (with all optical parts dust-sealed in because they never need adjustment), the work stage, and the front lamp house all come apart. You can attach them in any combination to a big fixture for holding heavy parts.
- 3 There's an accessory for vertical projection if that's better for your work than horizontal.
- 4 There's another accessory for examining surface detail and deep recesses by light coming right out of the lens that picks up the image.
- 5 The 14-inch screen is so uniformly bright that no hoods, curtains, or darkened rooms are required.

We'll be glad to arrange a demonstration on your own special problems. Write Eastman Kodak Company, Industrial Optical Sales Division, Rochester 4, N. Y.

### the KODAK CONTOUR PROJECTOR, model 3

Distributed by ENGINEERS SPECIALTIES, Buffalo 9, N. Y.  
\*List price, F. O. B. Rochester, N. Y., lenses and accessories extra, price subject to change without notice.



# Sure Source for Special Shapes

Special shapes are often the *only* way to meet rigid specifications . . . the *only* way to reduce *weight*, to save *space*.

Whether your problem is a transformer, a rotating device, a choke or a saturable reactor, check with Thomas & Skinner. With their quarter

century of experience, they can offer you a solution that will incorporate all the latest advances in technology and design.

For peak performance to rigid specifications, make Thomas & Skinner your *sure source for special laminations*.

**THOMAS & SKINNER—Specialists in magnetics—permanent magnets and laminated cores.**



**THOMAS & SKINNER Steel Products Company**  
 1120 East 23rd Street • Indianapolis, Indiana

3A. The appropriate equations are

$$E_{bi} = E_{ci} = \dots E_{ni} = E_{bo} = E_{co} = \dots E_{no} \text{ (circuit symmetry)} \quad (5)$$

$$E_{ai} = \frac{N-1}{N} E_{ni} - \frac{E_{ao}}{A} \quad (6)$$

(from Eq. 2 and 5)

$$E_{ni} = \frac{A}{2A + N} E_{ai} \quad (7)$$

(from Eq. 3 and 5)

$$E_{ni} = -\frac{N}{A(N+1) + N^2} E_{ao} \quad (8)$$

(from Eq. 6 and 7)

Since  $A$  may be expected to be considerably larger than  $N$ , Eq. 8 may be rewritten

$$E_{ni} \cong -\frac{N}{A(N+1)} E_{ao} \quad (9)$$

Equation 9 states that the effective zero shift at any input grid caused by a signal being impressed at a different channel is a function of both the open-loop gain of the amplifier  $A$ , and of the number of channels  $N$ . It is evident from this expression that it is desirable to make  $A$  as large as is feasible. Note further that

$$E_{ai} = -\frac{N(2A + N)}{A(A + AN + N^2)} E_{ao} \quad (10)$$

(from Eq. 6 and 7)

which, since  $A$  is large, may be rewritten

$$E_{ai} \cong -\frac{2N}{A(N+1)} E_{ao} \quad (11)$$

This states that the effective open

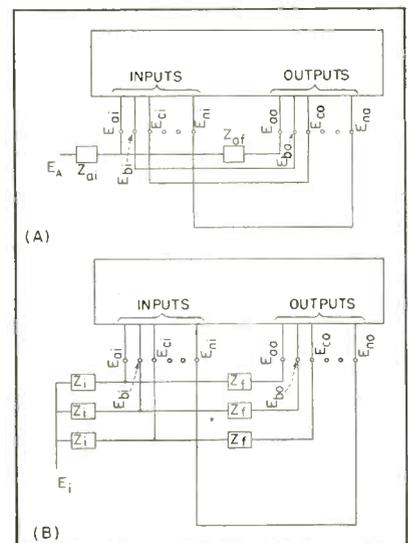


FIG. 3—Multiple-channel amplifiers ( $N$  channels) with only  $A$  channel connected in usual manner (A) and with all but  $N$  channel connected in usual manner (B)

# Here's Fairchild's Newest Potentiometer!

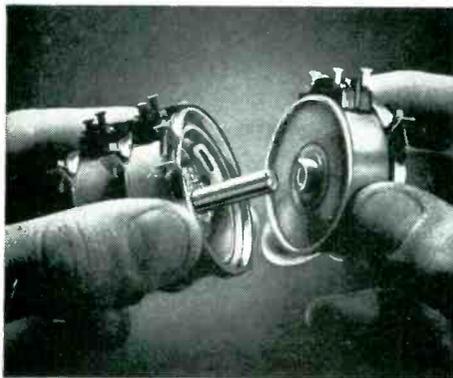
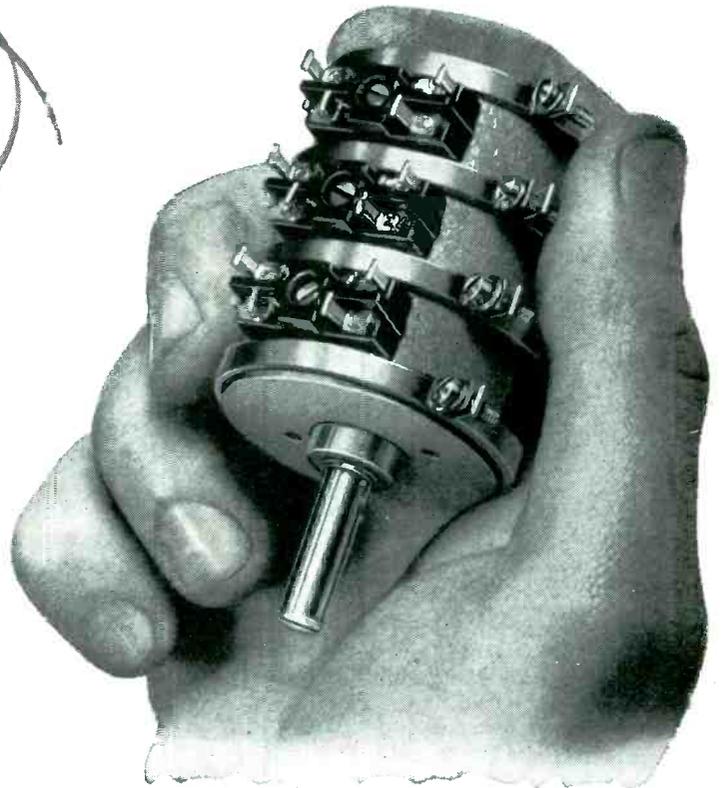
## TYPE-746 PRECISION POTENTIOMETER OFFERS:

- Low Torque
- Accurate Phasing
- Quick Replacement
- Ganging up to 20 on a shaft

The finest we've ever built! That's our idea of the new "746". It's got lower torque, a new more accurate phasing adjustment, and a new method of ganging that makes it easy to put as many as twenty cups on a single shaft. Individual cups in a gang are easily replaced if necessary.

The new potentiometer is available with linear or non-linear windings to meet your specifications. Its attractive case is made of grey anodized aluminum.

The "746" is just one of the complete Fairchild family of precision potentiometers. What are your requirements? Write, giving details, to *Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Boulevard, Jamaica 1, N. Y. Dept. 140-13A1.*



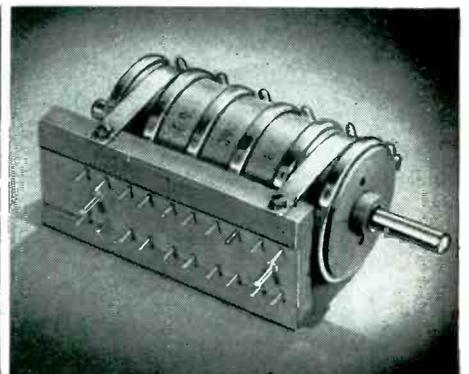
### EASY REPLACEMENT

To replace a unit in a "746" gang, loosen connecting-band screws, remove "cup," slip new "cup" under bands, and tighten screws. This feature pays off in experimental work where circuit elements are changed periodically.



### ACCURATE PHASING

A new type phasing adjustment is simpler and more accurate. A retainer plate clamps shaft to wiper arm. To adjust for phasing, loosen two screws, set the arm to the correct position, then tighten screws.



### FLEXIBLE DESIGN

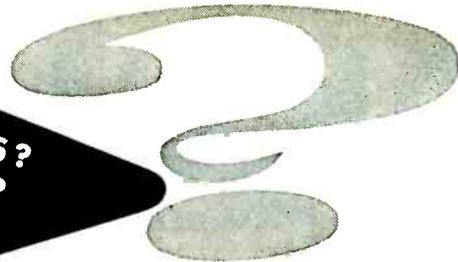
Typical of the special consideration Fairchild gives to its customers' special requirements is this plug-in version of the "746." Where fast servicing is a must, the advantages of this "quick-change" unit are quite apparent.

### SPECIFICATIONS

**Accuracy (overall resistance)**— $\pm 0.5\%$  (linear),  $\pm 1.0\%$  or better (non-linear)  
**Mechanical accuracy**—  
 concentricity (shaft to pilot)—.0015 in. FIR max.;  
 radial play—.0009 in. FIR max.;  
 shaft—centerless ground stainless steel to .2500 diam.  
 (+.0000, —.0005 in.);  
 pilot hub—machined to .5000 (+.0000, —.0005 in.)  
**Torque**—1.5 oz-in.  
**Dimensions**—diameter 1.750 max.; length (1 cup)  
 .800 in.  $\pm 0.009$  in.; added length per unit ganged  
 .580 in.  $\pm 0.002$  in.  
**Case**—grey anodized aluminum

**FAIRCHILD**  
**PRECISION POTENTIOMETERS**

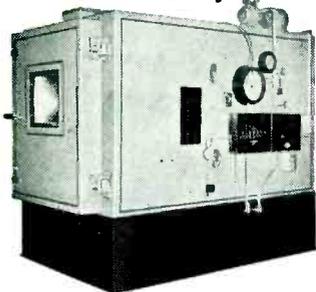
**TEMPERATURES?  
ATMOSPHERES?  
PRESSURES?**



for the finest in Test Chambers

**TEST WITH *Tenney***

Tenney has combined years of specialized experience with the most advanced engineering methods. Results have convinced industry that Tenney testing equipment is the finest available. For complete confidence, specify Tenney.

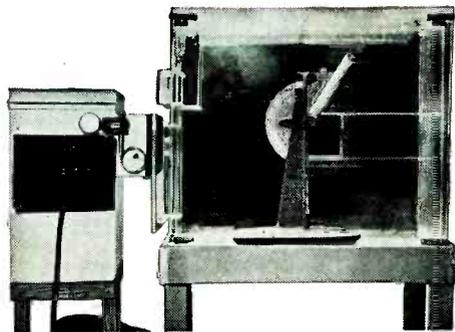


**TENNEYZPHERE ALTITUDE CHAMBERS**

Designed to withstand atmospheric pressure and to simulate global conditions of pressures, temperatures and humidities. Altitudes from sea level to approx. 75,000 ft. Temperature range from plus 200°F to minus 100°F. Also simulates desired relative humidity.

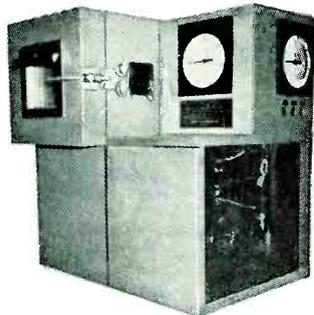
**TENNEY SERVO UNIT**

Portable air conditioning unit which may easily be attached to various types of laboratory enclosures—impact machines; tension machines; torsion testers; cold boxes and similar equipment. Through its use, articles undergoing testing, aging or weathering can be subjected to wide variations of humidity, heat and cold.



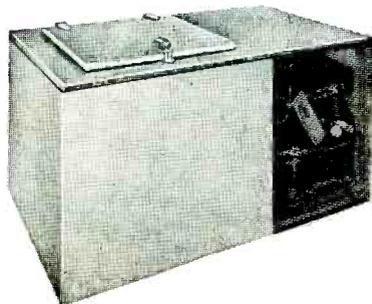
**TENNEY TEMPERATURE AND HUMIDITY CHAMBER**

Designed for positive control of temperature, humidity and air circulation. Permits the accurate checking of physical quality, fragility, tension and other factors.

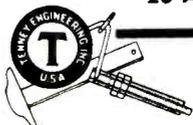


**TENNEY SUB-ARCTIC INDUSTRIAL CABINETS**

Designed for low-temperature testing of metals, radios, instruments, plastics, liquids, chemicals and pharmaceuticals. Temperature ranges of -40°F, -60°F, -95°F and -150°F are standard for each size.



For further information on these and other Tenney test equipment, write to Tenney Engineering, Inc. Dept. A  
26 Avenue B, Newark 5, New Jersey.



**Tenney**

Engineers and Manufacturers of Automatic Temperature, Humidity and Pressure Control Equipment

loop gain of the amplifier is reduced by the factor  $(N + 1)/2N$  from that of the equivalent single channel amplifier. Note, however, that this reduction in gain can never exceed 1/2, as  $(N + 1)/2N$  is always greater than 1/2.

Consider next the circuit of Fig. 3B:

$$E_{ai} = E_{bi} = \dots E_{(n-1)i} \quad \text{(circuit symmetry)} \quad (12)$$

$$E_{ao} = E_{bo} = \dots E_{(n-1)o} \quad \text{(circuit symmetry)} \quad (13)$$

$$E_{ni} = E_{no} \quad (14)$$

$$E_{ai} = \frac{1}{2} E_{ni} - \frac{N}{2A} E_{ao} \quad (15)$$

(from Eq. 2 and 12)

$$E_{ni} = \frac{A(N-1)}{N(A+1)} E_{ai} \quad (16)$$

(from Eq. 3, 12 and 14)

$$E_{ni} = -\frac{N(N-1)}{2N+AN+A} E_{ao} \quad (17)$$

(from Eq. 15 and 16)

Since  $A$  may be expected to be considerably larger than  $N$ , Eq. 17 may be rewritten

$$E_{ni} \cong -\frac{N(N-1)}{A(N+1)} E_{ao} \quad (18)$$

Comparing Eq. 9 and 18 it is seen that the effective zero shift at channel  $n$  is the algebraic sum of the zero shifts caused by each of the other channels, from which the general expression for interaction may be induced:

$$E_{ni} \cong -\frac{N}{A(N+1)} \times \quad (19)$$

$$(E_{ao} + E_{bo} + \dots E_{(n-1)o})$$

It might be wise at this point to cite an example of Eq. 19 so as to illustrate the order of expected interaction between channels. In the worst case, if  $E_{ao}$  thru  $E_{(n-1)o}$  are equal and large, say 100 volts,  $N = 10$ , and  $A = 10,000$ , then  $E_{ni} = -82$  millivolts. Since interaction

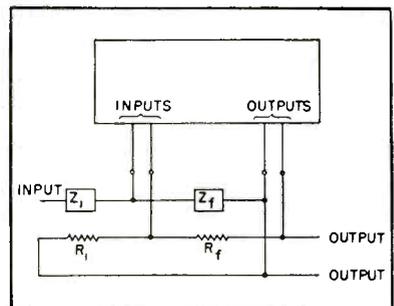
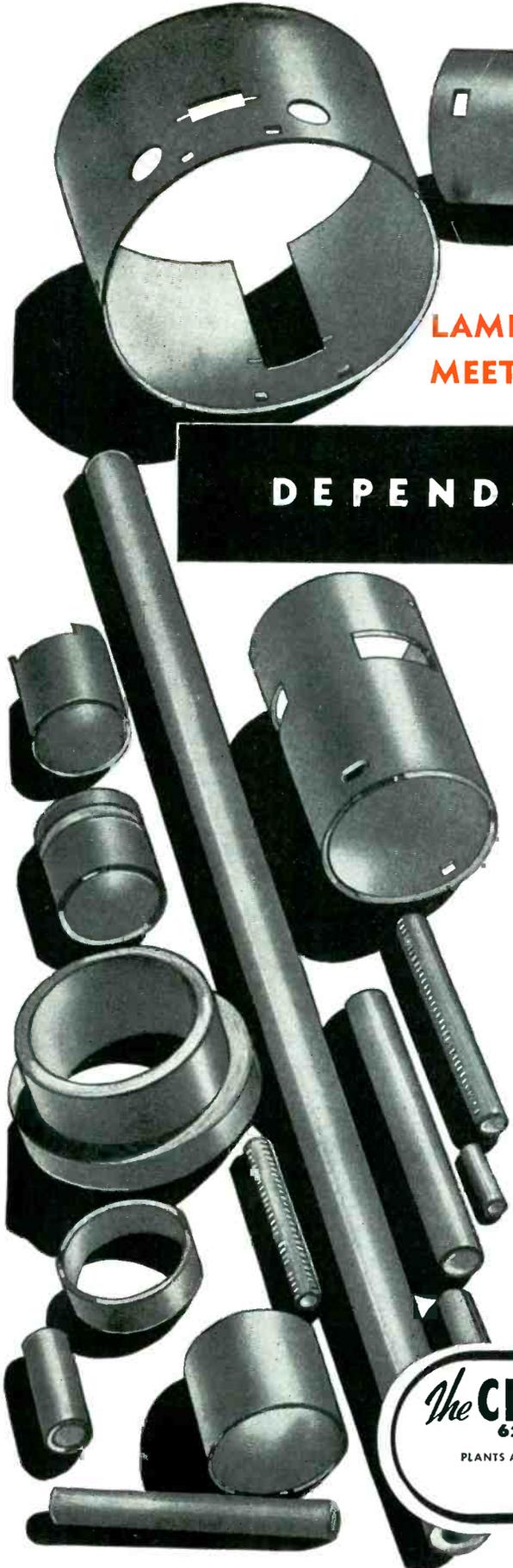


FIG. 4—Two channel amplifier connected with one independent and one slave channel. When  $R_i$  equals  $R_f$  this is typical push-pull operation



# CLEVELITE\* COSMALITE\*

LAMINATED PHENOLIC TUBING THAT  
MEETS THE MOST EXACTING REQUIREMENTS!

DEPENDABLE DELIVERIES

Cleveland Container can relieve your procurement problems on phenolic tubing by assuring prompt deliveries. In fact, orders can be filled immediately on any number of the more popular sizes.

Clevelite and Cosmalite have high dielectric strength . . . low moisture absorption . . . low loss . . . strength and good machineability.

They are available in diameters, wall thicknesses and lengths to meet special or new adaptations, with a grade for every need. Ask for samples.

**Why Pay More?**

**"CALL CLEVELAND"**

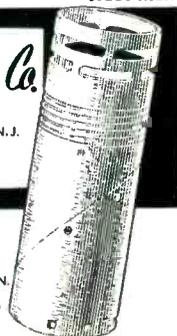
*The* **CLEVELAND CONTAINER Co.**  
6201 BARBERTON AVE. CLEVELAND 2, OHIO

PLANTS AND SALES OFFICES at Plymouth, Wisc., Chicago, Detroit, Ogdensburg, N. Y., Jamesburg, N. J.  
ABRASIVE DIVISION at Cleveland, Ohio  
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario

REPRESENTATIVES

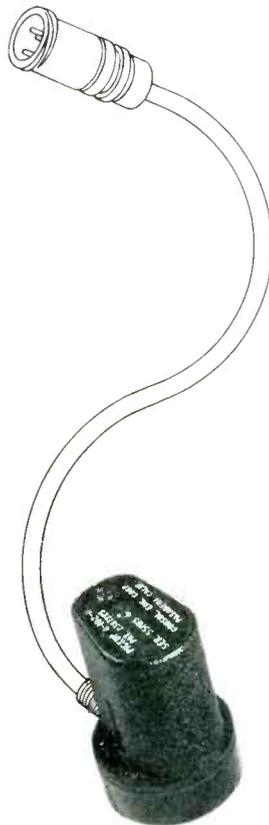
NEW YORK AREA R. T. MURRAY, 604 CENTRAL AVE., EAST ORANGE, N. J.  
NEW ENGLAND R. S. PETTIGREW & CO., 10 N. MAIN ST., WEST HARTFORD, CONN.  
CHICAGO AREA PLASTIC TUBING SALES, 5215 N. RAVENSWOOD AVE., CHICAGO

\*Trade Marks



# ACCURATE MEASUREMENT OF LOW AMPLITUDES AT LOW FREQUENCIES

Isolation and evaluation of vibration in any of its linear directions becomes a simple matter with the Consolidated 4-102A Velocity Pickup and its high-temperature counterpart, the 4-103. These instruments, highly insensitive to transverse accelerations, allow accurate determination of velocity in any linear direction, for their sensitivity does not change with orientation. When fixed to the machine or structure under test, their light weight (12.7 oz.) causes no material change of vibratory characteristics nor spurious damping. Patented spring suspension of the seismic mass completely eliminates friction, thus providing accuracy at extremely low amplitudes and frequencies, where ordinary vibration-measuring equipment often tends to stick.



## Consolidated VELOCITY PICKUPS

For construction detail and operating principle of these CEC Pickups as well as description of indicating or recording equipment used with them, write for Bulletin 1507-X4. TORSIONAL VIBRATION may be measured with Consolidated 9-102 Torsiograph described in the same Bulletin.



designed, manufactured and sold by

**CONSOLIDATED ENGINEERING**

Corporation

Analytical Instruments for Science and Industry  
300 N. Sierra Madre Villa Pasadena 8, California



may be thought of as a new source of drift, 82 millivolts would in most cases be prohibitive.

Therefore, the use of the multiple channel amplifier should be limited, as follows: (a) Open-loop gain as large as is feasible, (b) Not too many independent channels. Slave channels (wherein the input of one channel is fed from the output of another) need not be considered independent in this regard. (c) The maximum output voltage should be kept low.

### Conclusion

In general, the advantages of the multiple-channel amplifier are as follows: (a) Uses fewer tubes and other components. It is therefore of great value wherever size, weight, and power consumption are at a premium—such as airborne and other portable equipment. (b) This amplifier is particularly well adapted for slave channel operation, such as push-pull output from a single signal (see Fig. 4), or in general for any set of channels wherein there is actually but one variable input voltage. When operated in this manner, interaction may be completely eliminated by a slight readjustment of the feedback resistors in the slave channels. (c) It lends itself well to plug-in construction techniques. To the basic circuit of Fig. 1 may be added any number of additional

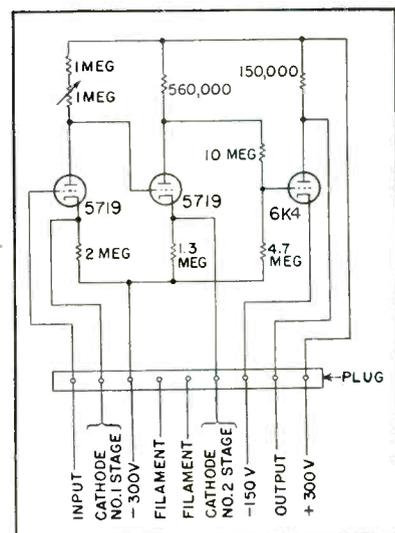


FIG. 5—Circuit for each additional channel illustrates possibility of plug-in technique

Good names to know for -

# finer electronic metals & alloys



FILAMENT BASE METALS:  
**SYLVALOY**  
**MODIFIED HILO**  
**COBANIC**  
**TENSITE**  
**UNIMET**

CARBONIZED NICKEL:  
**RADIOCARB**  
**DUOCARB**  
**POLICARB**  
GRID WIRE:  
**MANGRID**

— BACKED BY YEARS OF SPECIALIZED PRODUCTION

Since the inception of AC radio, Wilbur B. Driver Company has pioneered in the development and production of filament alloys, carbonized nickel and grid wire. Thus it is a logical conclusion that Wilbur B. Driver Company is the dependable source of supply for radio and electronic requirements . . . the choice when materials must be held to exacting and precise specifications.

*It's **WILBUR B. DRIVER** for Critical Tube Alloy Requirements!*

**WILBUR B. DRIVER COMPANY**

150 RIVERSIDE AVENUE, NEWARK 4, NEW JERSEY



# RCA TUBES...

*The complete line  
for industry...*



RCA-857-B★

## For on-the-spot service phone your RCA Tube Distributor

RCA Tube Distributors are veterans in the electronics field . . . geared to give you top service on critically needed industrial tubes. Whether you need "on-the-spot" delivery or are planning future tube requirements, it pays to call on their experience. You will find an RCA Distributor close by—*anxious to serve you.*

### ★RCA Mercury-Vapor Rectifiers

RCA mercury-vapor rectifiers are noted for their freedom from arcing and for their long, trouble-free service in industrial applications. The RCA line includes such well-known types as the 575-A, 673, 816, 857-B, 866-A, 869-B, 872-A, 5558, 5561, and 8008.



**RADIO CORPORATION of AMERICA**

**ELECTRON TUBES**

**HARRISON, N. J.**

amplifiers, such as illustrated in Fig. 5, with no other effect upon remaining channels than to necessitate a slight rezeroing.

The disadvantages include: (a) Output impedance slightly higher (by factor  $2N/(N + 1)$ ). (b) Interaction between channels resulting in a loss of accuracy. (c) While this amplifier may replace any number of inverse gain amplifiers, it cannot perform all the operations of the universal d-c amplifier to be described in a future issue of *ELECTRONICS*. (d) A practical difficulty may be encountered in trying to locate  $N + 1$  nearly matched triodes for the first stage.

### Wide-Range Resonators for VHF and UHF

G. FRANKLIN MONTGOMERY AND  
PETER G. SULZER

*Central Radio Propagation Laboratory  
National Bureau of Standards  
Washington, D. C.*

THE RESONATORS discussed in this note have been used successfully as oscillator tank circuits between 50 and 550 megacycles. Their large tuning range suggests that they may be useful in uhf television receivers or in laboratory oscillators. Work on the resonators was inspired by Aske's description<sup>1</sup> of a single-ended variable capacitance-inductance tuned circuit. Two experimental balanced types, drawings of which are shown in Fig. 1, were machined from brass tubing. Tuning is effected by moving a cylindrical conducting slug axially through the resonator. Terminals of the resonators are located at points  $x$ . There is a superficial resemblance to the coaxial butterfly circuits described by Karplus<sup>2</sup>, but the resonators are essentially lumped-constant devices rather than transmission line sections.

The resonator of Fig. 1A consists of a single-loop inductance connected to capacitors made up of two short half-cylinders and the tuning slug. The minimum frequency is produced when the slug is entirely contained by the half-cylinders, since then both the capacitance and the inductance are at a maximum. Conversely, the maximum frequency is produced when slug is contained by the loop. The

**MITCHELL-RAND** announces....

# 3738

## DIP-COATING and POTTING COMPOUND

ANOTHER SIGNIFICANT DEVELOPMENT OF  
MITCHELL-RAND LABORATORY RESEARCH

3738 is a special hot-melt, black thermoplastic moisture-proofing, insulating compound with unusual low-pouring, high cold-flow characteristics. This relatively low-cost compound also has flexible toughness at room temperature and a low rate of moisture vapor transmission.

### 3738 Applications

- FLASH DIP-COATING coils and small transformers to furnish moisture resistance and electrical insulation.
- POTTING JOBS which require its distinctive properties.
- SEALING SOCKETS AND SCREW HOLES for which a filling composition with good adhesion and high cold-flow temperature are specified.

### 3738 Features

- HIGH COLD-FLOW TEMPERATURE COUPLED WITH LOW-POURING TEMPERATURE facilitates potting high operating temperature units which contain delicate parts that would be damaged by compounds poured at high temperatures. The low pouring viscosity of 3738 recommends its application to potted units in which minimum clearances of small filling holes require a free flowing composition.  
The combination of viscosity and cold-flow, in 3738, permits rapid application of dip-coatings to resist sagging and sweating at temperatures above 105°C.
- GOOD FLEXIBILITY AND ADHESION permit good moisture seals around leads and physical shock-resistance on both dip-coated and potted units.
- RAPID RATE OF SET speeds production when used for dip-coating, potting or sealing.
- NON-TACKY SURFACE reduces the possibility of accumulating surface contamination or sticking on the production line or in storage.

Write for your laboratory test samples  
... free upon request.

### Methods of Application

- POTTING AND SEALING: The viscosities of 3738 differ appreciably between the upper and lower limits of the suggested pouring temperature range. To obtain higher or lower pouring viscosities, temperatures below or above this range can be employed.

Best adhesion, without surface priming, is obtained by pouring at temperatures in the upper portion of the suggested range or by preheating the unit.

Although 3738 has a low-pouring viscosity, preheating is recommended when filling close tolerance areas where a quick chill may be caused by cold parts. Preheating is suggested since 3738 sets at relatively high temperatures.

DIP-COATING: The thickness of 3738 on a single dip can be varied considerably. Generally higher bath temperatures and shorter periods of immersion will control thickness or thinness of coating.

### 3738 Specifications

Cold Flow (M-R).....248/253 F	Softening Point (B&R) .....254/259 F
<b>Penetrations</b>	Pouring Temperature...340/390 F
32/200/60 .....1-2	Specific Gravity .....1.03
77/100/5 .....7-8	Flash Point .....480 F
115/50/5 .....10-12	
Color .....Black	



## MITCHELL-RAND INSULATION CO., INC.

51 MURRAY STREET

COrtlandt 7-9264

NEW YORK 7, N. Y.

A PARTIAL LIST OF M-R PRODUCTS: FIBERGLAS VARNISHED TUBING, TAPE AND CLOTH • INSULATING PAPERS AND TWINES • CABLE FILLING AND POTHEAD COMPOUNDS • FRICTION TAPE AND SPLICE • TRANSFORMER COMPOUNDS • FIBERGLAS SATURATED SLEEVING • ASBESTOS SLEEVING AND TAPE • VARNISHED CAMBRIC CLOTH AND TAPE • MICA PLATE, TAPE, PAPER, CLOTH, TUBING • FIBERGLAS BRAIDED SLEEVING • COTTON TAPES, WEBBINGS AND SLEEVINGS • IMPREGNATED VARNISH TUBING • INSULATED VARNISHES OF ALL TYPES • EXTRUDED PLASTIC TUBING

# Arrow

## FOR MALLORY

### NOW *for immediate delivery*

#### TELEVISION SECTION

Condensers, Switches and Special Components for Television Applications

#### CAPACITORS

Fabricated Plate • Dry Electrolytic • Paper Dielectric • Mica Ceramics • Noise Filters • Associated Tools and Hardware.

#### CONTROLS

Mallory Midgetrols • Volume Control "Deals" • 1 $\frac{1}{8}$ " and 1 $\frac{1}{2}$ " Carbon Controls • Standard Wire-Wound Controls • Dual Carbon and Wire-Wound Controls • Carbon Variable Resistors • Wire-Wound Variable Resistors • T and L Pads • Associated Tools and Hardware.

#### RESISTORS, Vitreous Enamel

Fixed and Adjustable with new and improved insulating qualities

#### SWITCHES, Jacks and Plugs

Circuit Selector Switches • "Hamband" Switches • Pushbutton Switches • Jack Switches • Jacks and Plugs • Lever Action Switches.

#### VIBRATORS and Vibrapacks

All Auto and Special Replacement Types

#### RECTIFIERS and Battery Chargers

Selenium and Industrial Rectifiers • Wet Cell Chargers • Auto Radio Power Packs

#### SPECIAL COMPONENTS

Inductuners • Videocoupler • Grid Bias Cell • Yard Ohm Kit

#### MISCELLANEOUS ITEMS

Soldering Iron Tips • Knobs, Nuts and Washers • Dial Plates

A COMPLETE STOCK

OF ALL P. R. MALLORY PRODUCTS

# ARROW ELECTRONICS INC.

82 CORTLANDT ST., NEW YORK 7, N. Y. • DIGBY 9-4714

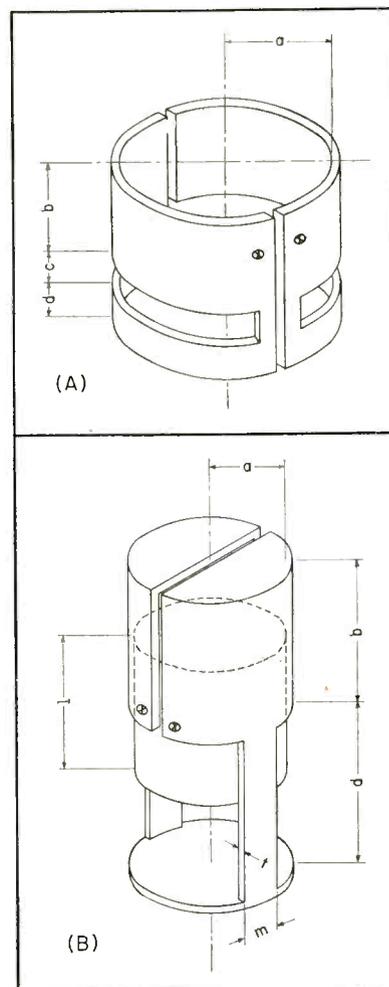


FIG. 1—Experimental vhf-uhf resonators, having frequency ranges from 50 to approximately 550 mc

resonator shown in Fig. 1B is similar in that half-cylinders are employed for capacitors; however, the inductors consist of two parallel strips, as shown. The tuning mechanism is essentially the same as for the first resonator.

Optimum ratios of the resonator dimensions for maximum tuning range are probably best determined by experiment. But if it is assumed that the tuning slug shall always remain inside the resonator, then it appears that maximum variation in the capacitive and inductive parts of the resonator will be obtained for  $b = c + d$  in Fig. 1A and for  $b = d$  in Fig. 1B.

In Fig. 1A, assume that the dimensions are fixed at

$$a = b = 2c = 2d$$

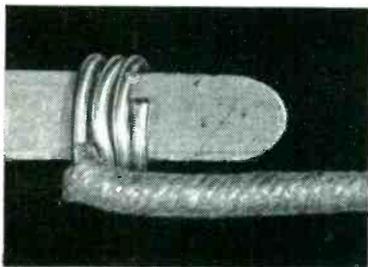
and that the slug length is  $b$ . Then the maximum capacitance with air



This "gun" shoots wire around corners



Bell Telephone Company craftsman wraps a wire to complete a connection. Wire is inserted into the nozzle and a rotating spindle whips it around terminals.



Close-up of connection made with new tool—neat, tight windings.

IT DOESN'T take long to wrap a wire around a terminal and snip off the end. But *hundreds of millions* of such connections are being made each year to keep up with America's growing demand for telephone service.

Now this job is done much more efficiently with a new wire wrapping tool invented at Bell Telephone Laboratories. This "gun" whirls wire tightly around terminals before solder is applied. The connection is better and there is no excess wire to be clipped off — perhaps to drop among a maze of connections and cause trouble later.

The new tool is being developed in different forms for specialized uses. The hand-operated wrapper in the illustration is for the telephone man's tool kit. Power-driven wrappers developed by Western Electric, manufacturing unit of the Bell System, are speeding the production of telephone equipment. The gun's small nozzle reaches where fingers couldn't — a big advantage these days when efforts are being made to produce telephone system parts smaller as well as better.

Bell Telephone Laboratories scientists devise many special tools that help your telephone system to keep pace with service demands economically — keeping your telephone service one of today's best bargains.

# BELL TELEPHONE LABORATORIES

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE BIG IN VALUE AND LOW IN COST



**NOW THERE ARE 3**

**They do everything you want!**

**They make tough jobs easy!**

**E-V Slim-Trim DYNAMICS**

**for TV... Broadcasting... Recording... PA**

*... for wide range high fidelity response ... for fixed position or man-in-motion ... for ruggedness and versatility ... for exclusive Acoustalloy diaphragm ... for pop-proof pick-up indoors and outdoors*

You see ... and hear ... the E-V Slim-Trim on network and local telecasts and broadcasts. You find it in studios and on remote hook-ups. You find it on important PA jobs, too. And you know it's there *because* it has met the most exacting tests... *because* it serves so superbly in every way for voice and music. *First* in dynamic, it has features only *Electro-Voice* can provide. 3 models meet every need!

**Ask your E-V Distributor or Send for Full Facts Now!**

**FOR TELECASTING-BROADCASTING**

"655"—Response 40-15,000 c.p.s., ±2.5 db. Power rating -53. Omnidirectional. Changeable low impedance. Removable swivel. List \$200

"654"—Response 50-14,000 c.p.s., substantially flat. Power rating -55. Omnidirectional. 50-250 ohm impedance selector. Swivel head. List \$90

**FOR PUBLIC ADDRESS**

"636"—Response 60-13,000 c.p.s., substantially flat. Power rating -55. Omnidirectional. High or low impedance. Swivel head. List \$65

**Electro-Voice**

401 CARROLL ST. • BUCHANAN, MICHIGAN  
Export: 13 E. 40th St., N.Y. 16, U.S.A. Cables: Arlab  
MICROPHONES • PHONO-PICKUPS • HI-FI SPEAKERS • SELF-TUNING TV BOOSTERS



dielectric will be, approximately,

$$C = \frac{0.225 \pi a^2}{2r} \mu\mu f,$$

where  $r$  is the radial clearance between slug and resonator, the dimensions being in inches. The corresponding maximum inductance, assuming a thin conductor and neglecting skin effect, will be, approximately,

$$L = 0.071 a \mu h$$

and the minimum resonant frequency will be

$$f \approx 1,000 \sqrt{\frac{r}{a^3}} \text{ mc}$$

If  $r/a$  is a constant  $k$ , then

$$f \approx 1,000 \frac{\sqrt{k}}{a} \text{ mc}$$

where  $a$  is in inches.

In Fig. 1B, assume that

$$b = d = l = 2a = 5m = 24t$$

Then the maximum capacitance will be, approximately,

$$C = 0.112 \left( \frac{\pi ab}{r} + \frac{\pi a^2}{2r} \right) = \frac{0.28 \pi a^2}{r} \mu\mu f$$

where  $r$  is both the radial clearance and the axial clearance between the slug and the inside end of the resonator.

The corresponding maximum inductance will be, approximately,

$$L = 0.04 a \mu h,$$

and the minimum resonant frequency will be

$$f \approx 850 \sqrt{\frac{r}{a^3}} \text{ mc}$$

If  $r/a$  is a constant  $k$ , then

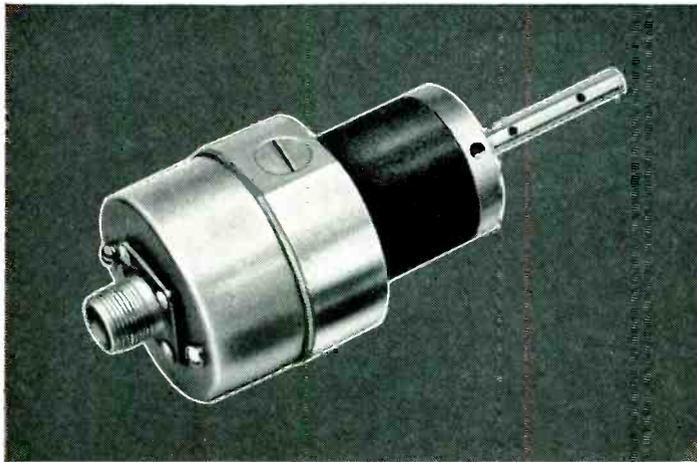
$$f \approx 850 \frac{\sqrt{k}}{a} \text{ mc}$$

where  $a$  is in inches.

Three experimental resonators are pictured in Fig. 2. The one at the left, which is the type drawn in Fig. 1B, has the largest tuning range. With no external connections, the resonant frequency tunes from about 50 to 600 mc. When the resonator is used as an oscillator with a 6K4 tube having one-half-inch external leads, the frequency range is 50 to 500 mc.

The medium-size resonator in the center of Fig. 2 is the type drawn

Let  
**Bendix**  
Solve Your  
Problems



When you are faced with specifications that place impossible requirements on dynamotors or small DC motors, according to World War II standards, take advantage of recently developed improvements in high temperature and high altitude techniques by simply outlining your requirements to Bendix. Model units *exactly* meeting your performance specifications will be developed and tested for pre-production use—production units will then follow in accordance with your manufacturing schedule.

**DYNAMOTORS**

Regular • Multiple output • Special purpose

**DC MOTORS**

1/100 hp—1/2 hp • Continuous and Intermittent Duty  
DC Servos and special motors

WITH  
**SPECIALIZED  
DYNAMOTORS  
AND  
DC MOTORS**

**RED BANK DIVISION OF BENDIX AVIATION CORPORATION**  
RED BANK, NEW JERSEY

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N.Y.

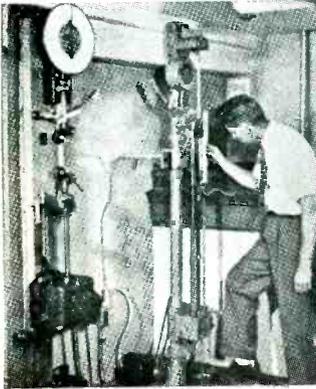


Write for this colorful and informative book  
—it's free. You'll find it loaded with facts  
and figures about all types of dynamotors.



# PHALO

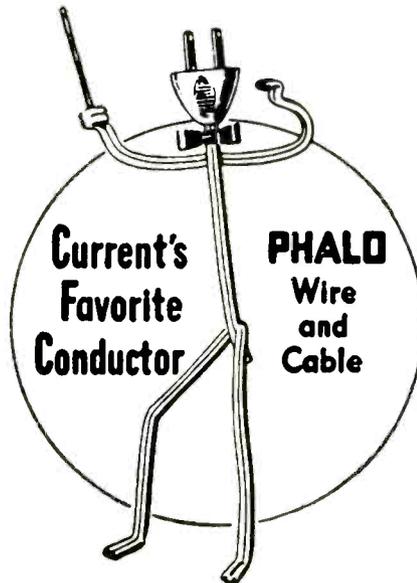
## CONSTANT QUALITY CONTROL



Every foot of PHALO Thermoplastic insulated wire and cable, every plug or cord set is produced under constant quality control.

Rigid inspection, the latest testing methods and equipment, and skilled production craftsmen join to make PHALO wire and cable—CURRENT'S FAVORITE CONDUCTOR!

Your inquiry will have our prompt attention!



Ask for the latest PHALO catalog.

**PHALO**  
Plastics Corporation

Manufacturers of Thermoplastic insulated wire, cables, cord sets and tubing

CORNER OF COMMERCIAL STREET,  
WORCESTER, MASS.

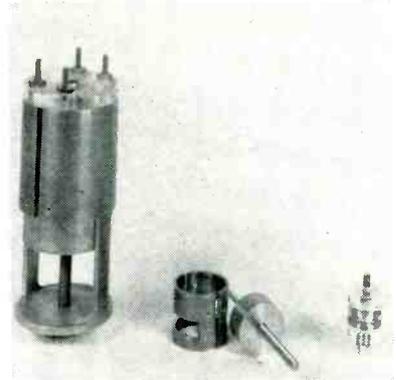
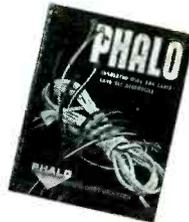


FIG. 2—Photograph of three experimental wide-range resonators that may be applicable to uhf and vhf television

in Fig. 1A. With the same 6K4 tube, the oscillation range is 220 to 520 mc. The small resonator at the right is the same type. With no external connections, the tuning range is 440 to 1,900 mc; with the 6K4 tube, the oscillation range is 340 to 550 mc.

As oscillators, the maximum frequencies of all three resonators appear to be limited by tube capacitances and lead inductances. For applications where there is no appreciable external loading of the resonator, such as an absorption wavemeter, the frequency range is limited by the smallest radial clearance that can be obtained between the tuning slug and the resonator's inner surface.

#### REFERENCES

- (1) Vernon H. Aske, Front End Design for a 400-Mc Receiver, *Tele-Tech* 9, p 46, Sept. 1950.
- (2) Eduard Karplus, Wide-Range Tuned Circuits and Oscillators for High Frequencies, *Proc. IRE* 33, p 426, July 1945.

#### Boucherot Compensation

BY HANS E. HOLLMANN  
Oxnard, California

THE ELECTRONICS QUIZ in the December 1950 and January 1951 issues of *ELECTRONICS* deserves more attention for it reveals the phenomenon of aperiodically compensating any impedance by a conjugate impedance. This compensation, based on a theorem of complex algebra, has important application in the Boucherot circuit named after the French inventor.

We are dealing with the theorem that any complex number  $Z' = a + jb$ , where  $j$  can be made real

To:

**PRIME CONTRACTORS  
and SUBCONTRACTORS  
on GOVERNMENT WORK . .**

*Invitation*  
TO RECEIVE A  
**PRODUCTION  
SAMPLE**  
*Transformer*

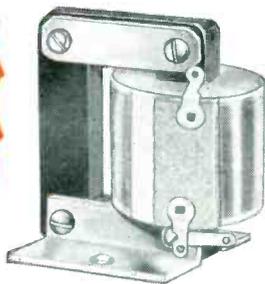
BUILT TO YOUR SPECIFICATIONS

*this is our offer to you . . .*



**WE WILL**, without cost or any obligation whatever, design a PRODUCTION SAMPLE transformer (hermetically sealed to JAN-T-27 or MIL-T-27 Government specifications), or open type construction, if unit is to be used for awarded prime or sub-contract work. Our approach stresses quality of product, efficiency in service and an alertness to techniques that discard the old for more functional methods.

*James M. Blackledge*  
PRESIDENT

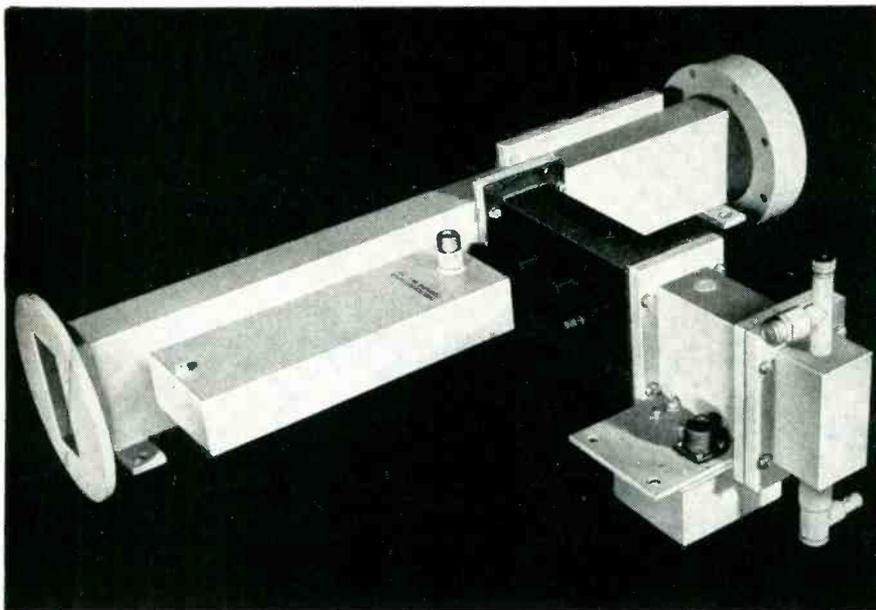


**SEND YOUR  
B/P  
SPECIFICATIONS**

# GRAMER

**TRANSFORMER  
CORPORATION**

2734 N. PULASKI ROAD • CHICAGO 39, ILLINOIS



# Duplexer • Mixer • Coupler • Shutter...

by **Terpening**

This duplexer-mixer, with its directional coupler, protective "shutter," TR and ATR connections, for high-power operation in S-band, was designed in our labs to comply with performance specifications for SWR, attenuation, etc., and produced in quantity in our shops.

This is another example of the type of help Terpening is set up to provide prime contractors on microwave transmission line systems—from design through production. Though all of the components we manufacture currently are made to order, we do have a limited stock of some special components which might just happen to fit your requirements.

In any event, although our engineering staff, laboratories, and fully equipped shop are busy with government contracts, we will be happy to talk with you about your needs on similar work.



**L. H. TERPENING COMPANY**  
 DESIGN • RESEARCH • PRODUCTION  
 Microwave Transmission Lines and Associated Components  
 16 West 61st St. • New York 23, N. Y. • Circle 6-4760

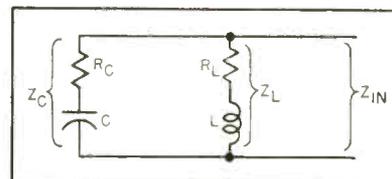


FIG. 1—Basic circuit shown in Electronics Quiz problem

with the aid of another complex number  $Z'' = c - jd$ . A simple addition yields:  $Z_{IN} = Z' + Z'' = a + c + j(b - d)$  which becomes real for  $d = b$ . Another combination is the reciprocal sum of the reciprocals

$$Z_{IN} = \frac{1}{\frac{1}{Z'} + \frac{1}{Z''}} = \frac{Z'Z''}{Z' + Z''}$$

$$= \frac{ac + bd + j(bc - ad)}{a + c + j(b - d)}$$

Now, there exist two conditions for making the expression real. The first is  $c = a$  and  $d = b$  because the imaginary terms disappear separately in numerator and denominator so that  $Z_{IN}' = (a^2 + b^2)/2a$ . The second condition is  $c = a = \sqrt{bd}$ , and yields

$$Z_{IN}'' = \frac{2a^2 + ja(b - a^2/b)}{2a + j(b - a^2/b)} = a$$

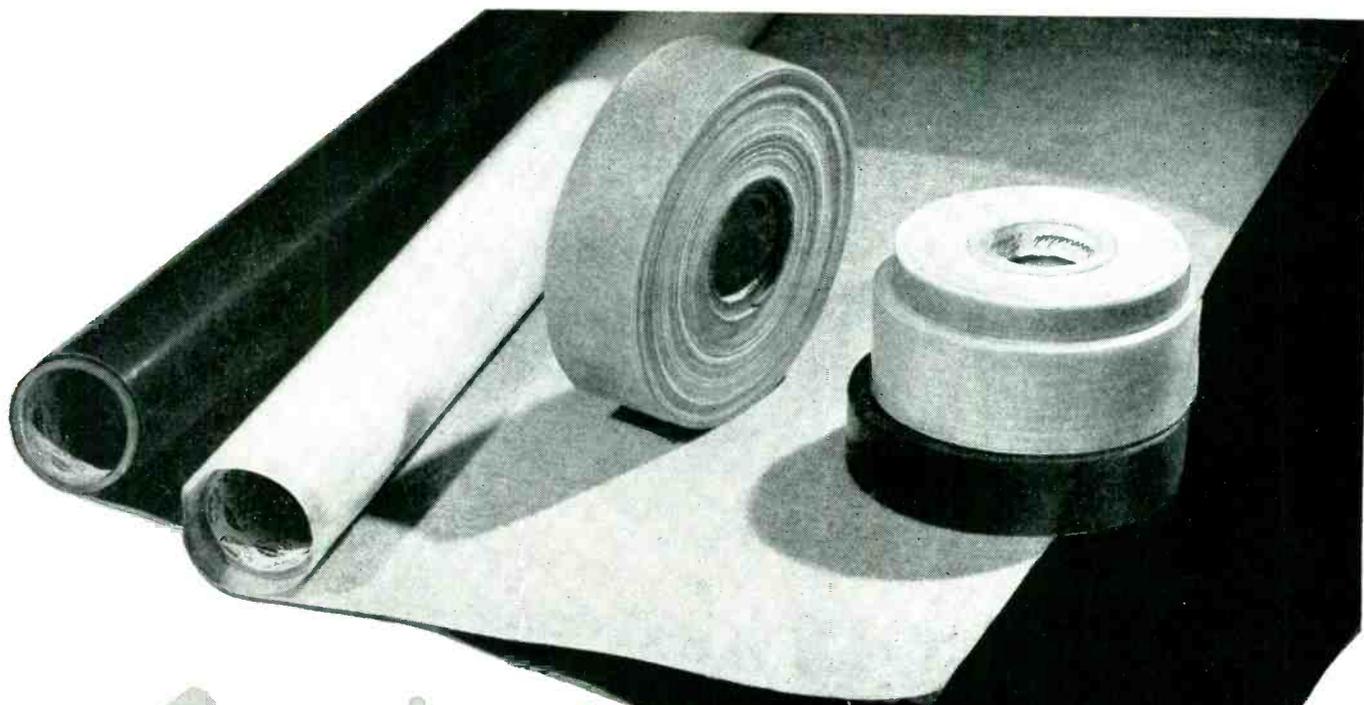
According to Fig. 1 let us examine the impedance  $Z_c = R_c + 1/j\omega C$  of the capacitive branch shunted by the inductive branch having the impedance  $Z_L = R_L + j\omega L$ . If we assume  $R_c = R_L = R$ , the impedance of the network becomes:

$$Z_{IN} = \frac{Z_L Z_C}{Z_L + Z_C} = \frac{(R + j\omega L)(R - j/\omega C)}{R + R + j(\omega L - 1/\omega C)}$$

$$= R \frac{L/RC + R + j(\omega L - 1/\omega C)}{R + R + j(\omega L - 1/\omega C)}$$

Following the outline,  $Z_{IN}$  becomes real if both imaginary terms disappear. That is the condition  $L = C$  of parallel resonance with  $Z_{IN}' = (1 + R^2)/2R \rightarrow R/2$ . On the other hand, numerator and denominator differ only by their first terms. Hence, setting  $L/RC = R$  or (in accordance with  $a = \sqrt{bd}$ )  $R = \sqrt{L/C}$  yields  $Z_{IN}'' = R$ , the aperiodic or antiresonance case of the quiz problem.

The conversion of an originally complex network into a real one, that is, into a resistance, by supplementing a complex conjugate impedance, either in series or in paral-

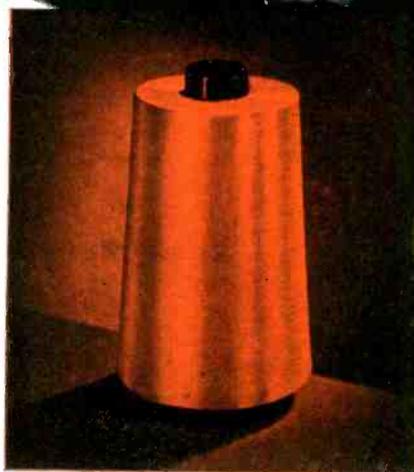


*Specify*

**FIBERGLAS\***

*Yarns* when you order

**VARNISHED CLOTH**



... because *Varnished Cloth* woven of *Fiberglas Yarns*

Along with the entire electrical industry, Owens-Corning Fiberglas Corporation is faced with increasing civilian and military demands. While we cannot now supply all the materials our customers want, we are substantially increasing our production facilities. Therefore, we believe it to your future best interests to consider this new and recommended use of Fiberglas yarns.

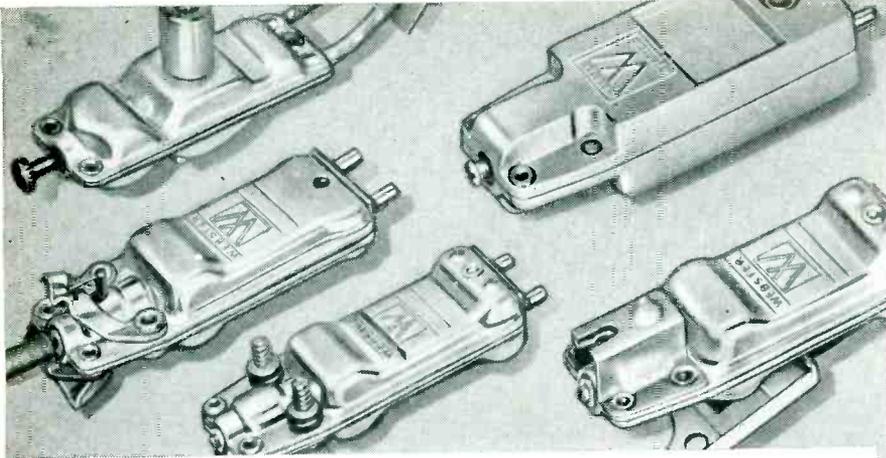
- keeps its excellent dielectric strength even under prolonged adverse operating conditions
- has exceptionally high tensile strength, with minimum bulk
- resists heat, moisture, and corrosion
- costs less today than ever before!

\*Fiberglas is the trade-mark (Reg. U. S. Pat. Office) of Owens-Corning Fiberglas Corporation for a variety of products made of or with glass fibers.

OWENS-CORNING  
**FIBERGLAS**

*Yarns*

OWENS-CORNING FIBERGLAS CORPORATION • Textile Products Division, Dept. 860 • 16 East 56th Street, New York 22, N. Y.



WEBSTER ELECTRIC one of the original  
manufacturers of crystal cartridges

## FOR OVER 20 YEARS a complete line of cartridges

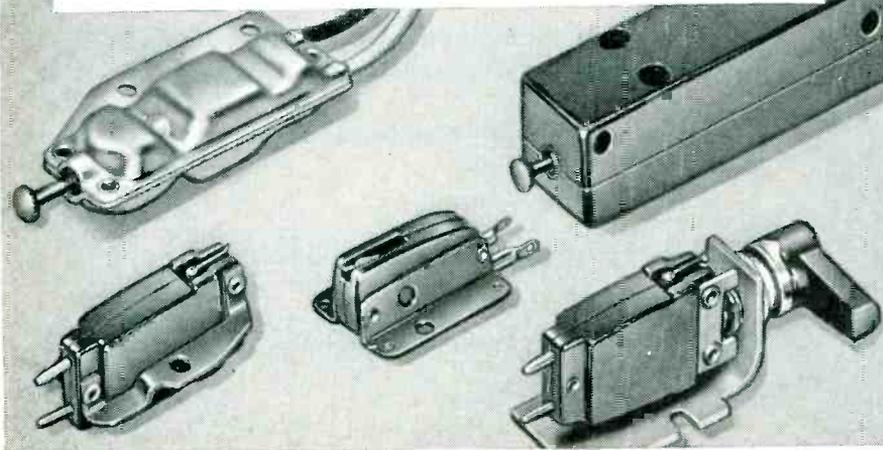
*Engineered to meet your requirements*

Webster Electric has been making cartridges for years and years... starting way back when cartridges were nearly as big as baseballs. The line of cartridges has constantly changed and improved to meet current requirements. Each year has brought improvements until cartridges are now available in thumb-nail size and versatile enough to meet the requirements of 78, 33 $\frac{1}{3}$  and 45 RPM.

Webster Electric has the experienced engineers, manufacturing know-how and long-range experience to make cartridges to meet all of the industry's requirements.

When you need a new cartridge submit your problem to Webster Electric. When your record players or changers are equipped with Webster Electric cartridges, you can be assured of the best in dependable performance.

Webster Electric Company, Racine, Wis., Established 1909



**WEBSTER ELECTRIC**  
RACINE ♦ WISCONSIN

"Where Quality is a Responsibility and Fair Dealing an Obligation"

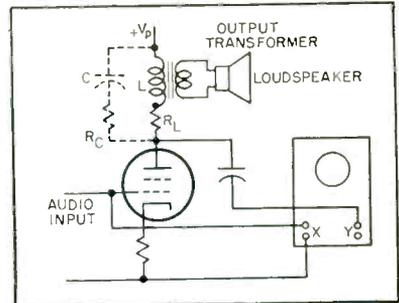


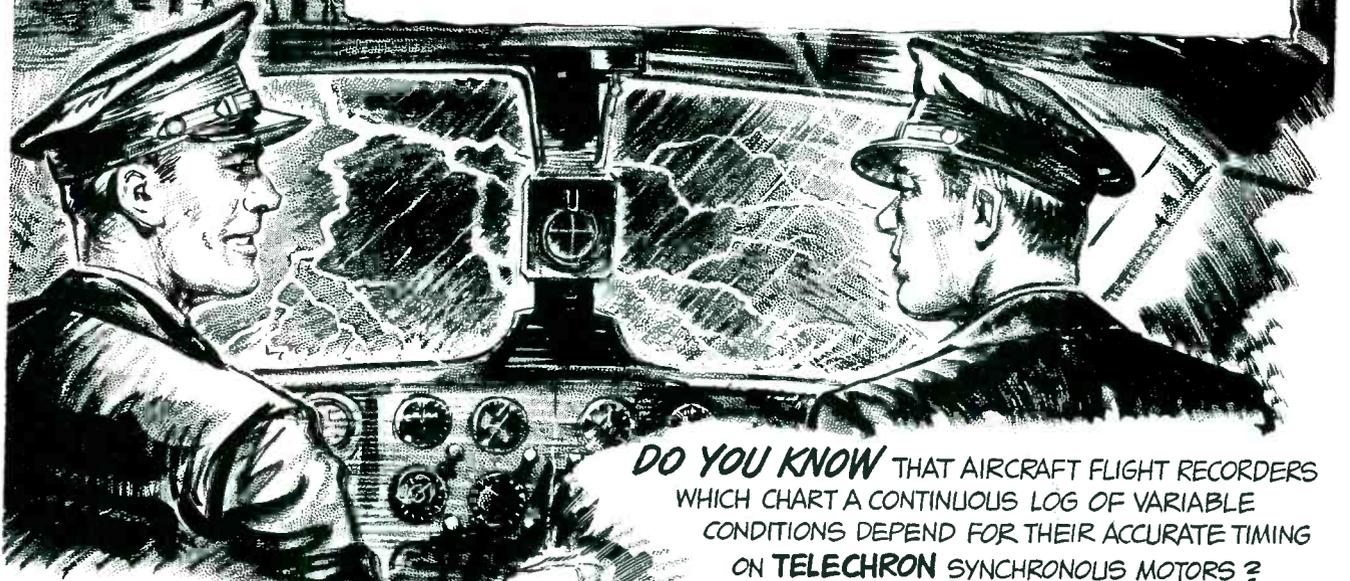
FIG. 2—Loudspeaker analogy studied after Boucherot

lel, is of great importance for many practical purposes. A typical example is the Boucherot compensation in the end stage of an audio amplifier, a triode, pentode, or beam tetrode loaded with a matching transformer as shown in Fig. 2. As is well known, the equivalent network of the transformer seen from the plate, in fairly good approximation, is an inductance  $L$  in series with a resistor  $R_L$ . The reactive component brings the tube out-of-phase so that harmonic as well as intermodulation distortions occur. These distortions limit the value of a multigrid tube as compared to a simple triode and counterbalance the inherent advantage of the higher gain. Today there are two conflicting opinions in rating an end triode exhibiting a lower plate resistance and useful efficiency under low distortions as compared to multigrid tubes requiring less driving power at the expense of distortions even at moderately high frequencies.

In order to shift the balance in favor of multigrid tubes, the Boucherot compensation is of significant importance because it makes the multigrid tubes operate purely in-phase and improves the power output versus distortion figure. The suggestion: "go ahead by going back—back to triodes" seems to be premature as long as the Boucherot compensation is not taken into consideration.

The improvement which is achieved by the Boucherot network is clearly demonstrated by means of the dynamic transfer characteristic. According to Fig. 2, the end stage is driven by an a-f voltage which also controls the X-input of the oscilloscope, the Y-deflection of which is produced by the plate voltage. If the test device is driven

# Do You Know?

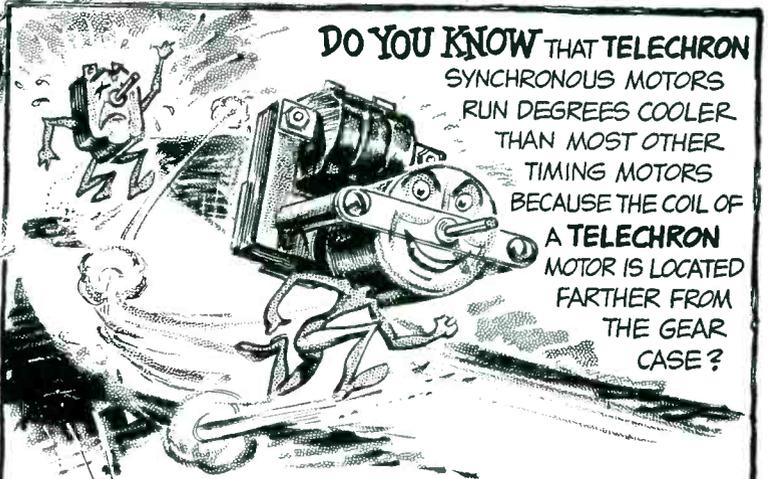


**DO YOU KNOW** THAT AIRCRAFT FLIGHT RECORDERS WHICH CHART A CONTINUOUS LOG OF VARIABLE CONDITIONS DEPEND FOR THEIR ACCURATE TIMING ON **TELECHRON** SYNCHRONOUS MOTORS ?



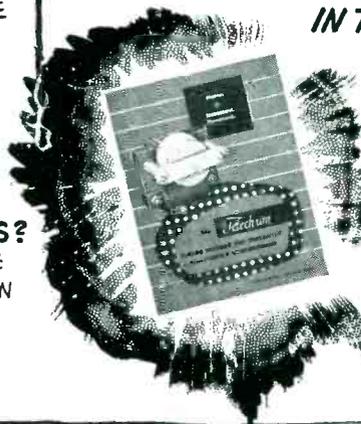
**DO YOU KNOW** THAT THE ROTOR SHAFTS OF MANY **TELECHRON** SYNCHRONOUS TIMING MOTORS HAVE MADE MORE THAN **30 BILLION** CONTINUOUS REVOLUTIONS AND THAT THE MOTORS ARE STILL OPERATING AS ACCURATELY AND DEPENDABLY AS WHEN THEY WERE NEW ?

**NEED SKILLED HELP ON "EMERGENCY" CONTRACTS ?** TELECHRON INC. HAS AVAILABLE CAPACITY FOR DEFENSE ORDERS. NEW BROCHURE, "PRECISION ON THE PRODUCTION LINE," GIVES A QUICK PICTURE OF PERSONNEL CAPABILITIES AND MASS PRODUCTION FACILITIES. **WRITE FOR YOUR COPY TODAY.**



**DO YOU KNOW** THAT **TELECHRON** SYNCHRONOUS MOTORS RUN DEGREES COOLER THAN MOST OTHER TIMING MOTORS BECAUSE THE COIL OF A **TELECHRON** MOTOR IS LOCATED FARTHER FROM THE GEAR CASE ?

**READ ALL ABOUT TELECHRON MOTORS IN THIS BULLETIN**



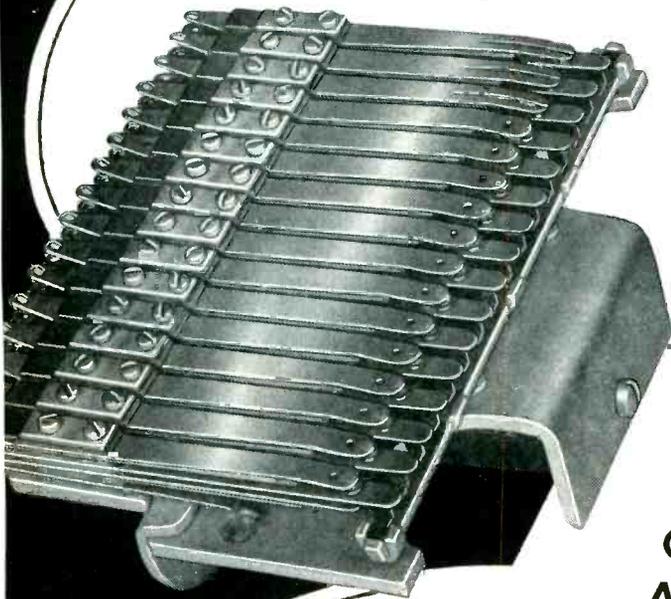
WRITE FOR BULLETIN IS-110 WHICH CONTAINS CHARTS, TORQUE RATINGS AND COMPLETE SPECIFICATIONS ON **TELECHRON** SYNCHRONOUS MOTORS FOR USE IN TIMERS, TIME SWITCHES, RECORDING AND CONTROLLING INSTRUMENTS, COST RECORDERS, CYCLE CONTROLLERS, ETC. **TELECHRON INC., 45 UNION ST., ASHLAND, MASS. A GENERAL ELECTRIC AFFILIATE.**

**Telechron**

ALL TELECHRON TIMING MOTORS ARE

INSTANTLY...CONSTANTLY SYNCHRONOUS

## a Single **NORTH** "Gang" **RELAY**



**MAKES  
and/or  
BREAKS  
as many  
as  
17  
CIRCUITS  
AT ONCE!**

**T**YPICAL of the almost endless variety of special-function relays made by the North Electric Manufacturing Company is this 700-Type multiple contact unit. With it as many as 17 separate circuits may be closed, opened or transferred with a single low-current impulse. There are more than 50 make and break contact combinations available in stock assemblies of this versatile relay. Available with single or double fast-acting coils, depending upon speed required. All are of low current consumption, rapid and positive in performance virtually wear-proof.

The new **NORTH RELAY CATALOG** describes the many types of available North relays, from Multiples to Midgets, and the unmatched facilities of this company for special relay engineering, developed in more than sixty years of experience; write for a copy today . . .

**Special  
Relays ?**

**Let North Engineer them for you!**



**THE NORTH ELECTRIC  
MANUFACTURING COMPANY**

Originators of ALL RELAY  
Systems of Automatic Switching

1438T, South Market Street, Galion, Ohio, U.S.A.

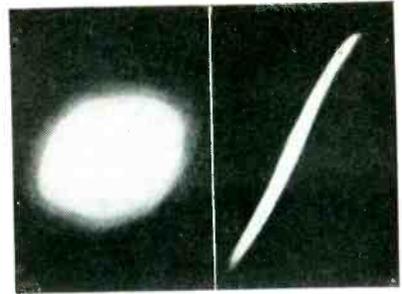


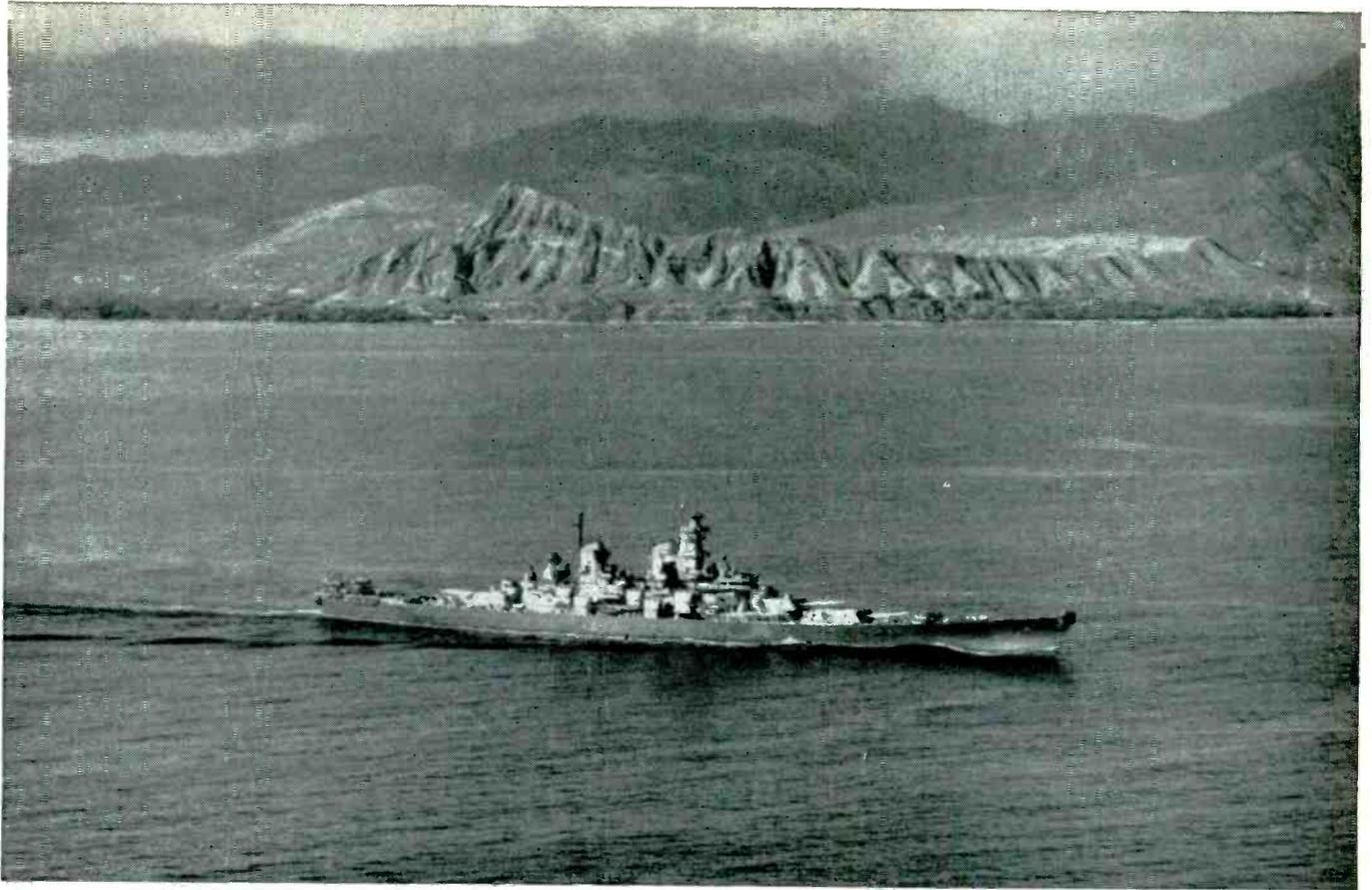
FIG. 3—Oscilloscope figures show improvement in performance

with various frequencies, as delivered by a radio or phonograph pickup in the form of music or speech, the resulting Lissajous figure on the oscilloscope screen fluctuates according to the momentary frequencies and amplitudes. The result, taken during sufficiently long exposure time, is the blurred figure shown at the left in Fig. 3, disclosing innumerable Lissajous ellipses of various forms and sizes superimposed upon each other during exposure.

As soon as the output transformer is compensated by the dotted Boucherot network, the end stage operates in-phase and the Lissajous ellipses contract to the pure-in-phase characteristic shown at the right in Fig. 3. Needless to say, the harmonic and intermodulation distortions diminish to a considerable extent bringing to the listener a faithful reproduction of the original speech or music.

The oscillogram reveals the effect of the Boucherot compensation only in a qualitative manner. A better insight is obtained by measuring the harmonic or the intermodulation distortions with and without Boucherot compensation. Figure 4 illustrates such an experiment<sup>2</sup>, namely the intermodulation factor of an end tetrode in relation to the measuring frequency when the tube is driven by a constant input voltage. While the output phase condition produces increasing modulation, the distortions decrease slightly as soon as the Boucherot compensation is applied.

Certainly the Boucherot circuit is not perfect and cannot produce an ideal condition of operation. In comparison to the evident advantages, however, the following disadvantages must be mentioned. First, the equivalent network of the transformer and its loudspeaker



Official U. S. Navy Photo

## strange waters...

Strange waters off strange lands hold much less mystery to ships of the United States Navy thanks to new developments and improvements in sonar equipment which give the navigator accurate knowledge of how much water there is below.

Much of this progress in development of under-water detection equipment has taken place in the research laboratories of the Edo Corporation. Edo-designed and -manufactured depth-measuring instruments provide the navigator with depth indications of far greater range and accuracy, especially in shallow water.

Because of its far reaching developments in the field of electronics and sonar, Edo has come to be recognized as a leader in the development and manufacture of under-water detection equipment so vital to our Nation's defense.

### LOCATING BED ROCK BY SONAR!

One Edo-developed sonar equipment has been put to unique use in Chicago Harbor where a new filtration plant is being built. Part of the project involved boring a 5-mile tunnel 50 feet below the top level of bed rock under the harbor.

To plot the irregular level of the bed rock under a thick deposit of silt and hard pan normally would have required expensive and time-consuming test borings. Edo sonar equipment was put to use instead, with excellent results both in time saved and accuracy of the recordings.

If you haven't yet received your copy of our book describing Edo's first quarter of a century of progress, write to Department M-5, Edo Corporation, College Point, L. I., N. Y.



EDO CORPORATION · COLLEGE POINT, N. Y.

# Standard RADIO INTERFERENCE and FIELD INTENSITY Measuring Equipment

Complete Frequency Coverage - 14 kc to 1000 mc!



**VLF!**

**NM - 10A**

14kc to 250kc

Commercial Equivalent of AN/URM-6.

Very low frequencies.



**HF!**

**NM - 20A 150kc to 25mc**

Commercial Equivalent of AN/PRM-1. Self-contained batteries. A.C. supply optional. Includes standard broadcast band, radio range, WWV, and communications frequencies.

**VHF!**

**NMA - 5**

15mc to 400mc

Commercial Equivalent of TS-587/U.

Frequency range includes FM and TV Bands.



**UHF!**

375mc to 1000mc **NM - 50A**

Commercial Equivalent of AN/URM-17.

Frequency range includes Citizens Band and UHF color TV Band.



These instruments comply with test equipment requirements of such radio interference specifications as JAN-I-225, ASA C63.2, 16E4(SHIPS), AN-I-24a, AN-I-42, AN-I-27a, AN-I-40 and others.

**STODDART AIRCRAFT RADIO CO.**

6644-A SANTA MONICA BLVD., HOLLYWOOD 38, CALIFORNIA

Hillside 9294

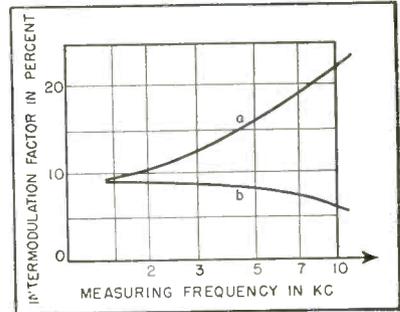


FIG. 4—Curves show actual measurements on equipment using Boucherot compensation

load holds only within certain limitations. Second, there is a power loss in the compensating branch which increases toward higher frequencies thus making the frequency response poorer. This can be compensated for by other means, for example, by filter circuits in the driver stage or in the feedback loop.

After all, the disadvantages do not count too seriously when compared with the pure-in-phase condition and the associated reduction of distortions in the most important output stage.

REFERENCES

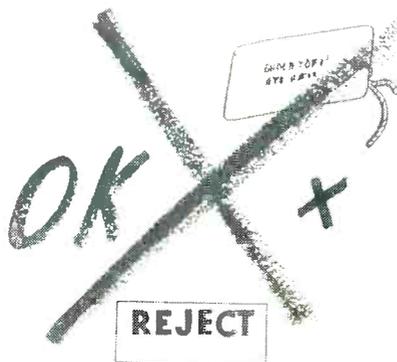
- (1) W. Bowen, Triode versus Pentode, *ELECTRONICS*, p 268, Nov. 1947.
- (2) A. V. Lüpke, Verbesserung der Wiedergabe mit Lautsprechern hinter Mehrgitterröhren durch Verwendung der Boucherot-Schaltung (Improvement of loudspeaker quality when driven by multi-grid tubes with the aid of the Boucherot circuit), *Zeits. für Tech. Physik*, Vol. 23, p 119, 1942.

Noise Figure Standards

THE NOISE FIGURE, a fundamental measure of the quality of linear electrical networks, is of basic importance in radar, telemetering, and all communications. In these systems some of the limitations on reliability, sensitivity, and distance are set by the type and magnitude of noise in the device as well as by the noise produced ahead of the network input terminals. In order to assist laboratories and industry in the evaluation of this important factor, the National Bureau of Standards is offering a calibration service for the noise figure in the frequency range of 500 kc to 30 mc.

The noise figure of a linear network is the ratio of the available noise power at the output (the to-

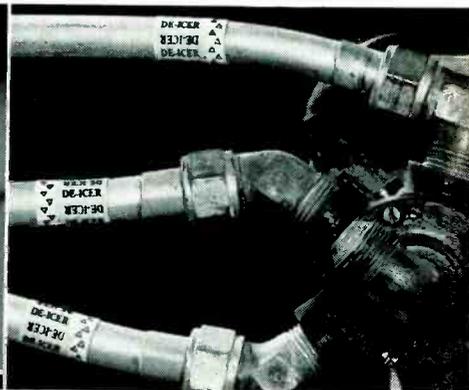
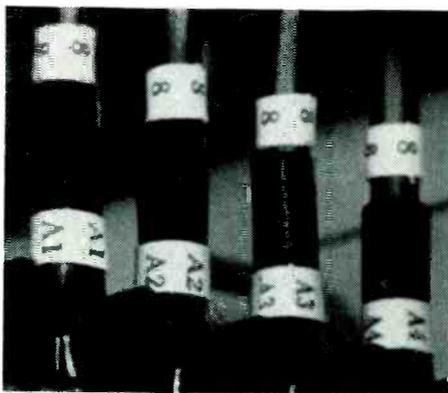
# eliminate obsolete marking methods...



*speed production  
cut costs  
maintain accuracy  
simplify assembly*

Messy, time-consuming, inaccurate marking with loose labels, chalk, string tags and stickers are eliminated by fast, accurate and inexpensive Westline Marking Methods for wires, wiring assemblies, cable, conduit, product identification, inspection, rejection and trademark information. And here is why!

If you mark wire, E-Z Codes are the solution to the colored wire shortage, provide the fastest, most accurate and inexpensive method of wire marking. They make even the most complicated wiring circuit an open book to even "green" employees. E-Z Codes are applied with finger-tip pressure, without moistening. They stick permanently...will not pop or peel even in extremes of heat and humidity...or when pulled through conduit.



If you mark flow lines, cable or conduit, E-Z Code markers provide a fast, accurate method of identifying each line at a fraction of the cost of other methods. Self-adhesive strips in standard wording, or printed to your specifications, applied without moistening by inexperienced help in a few seconds. They last indefinitely.

**FREE SAMPLES**  
Send for Complete  
Information and Samples

For inspection or rejection, instruction or warning labels in production, repair or service work, use these Westline pressure-sensitive labels. They are applied without moistening. They will not pop, peel or curl even under extremes of heat and humidity...yet are easily peeled off without harming surface.

For production installation and service data, Westline Self-Backing, pressure-sensitive tape on either cellophane, acetate film, paper or cloth stock can be furnished plain or printed with your message and in size required. Widths from 1/2" to 3". Lengths from 648" to 2592". Apply without moistening. They stick until time for removal.

## WESTLINE

*Products Division*

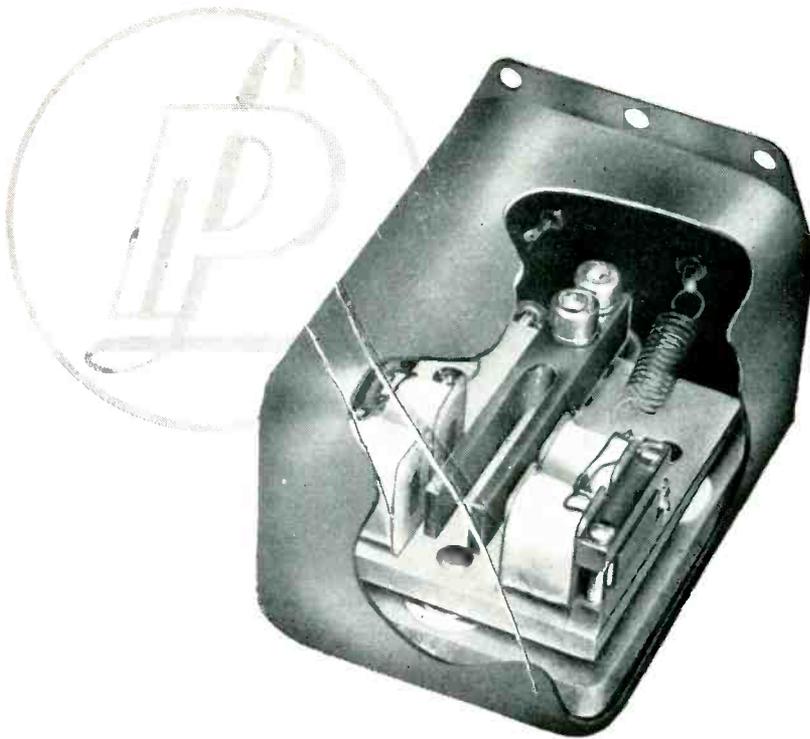
**Western Lithograph Co.**  
Dept. E-5  
600 E. Second St., Los Angeles 54, Calif.  
Box 3804, St. Louis 22, Mo.  
Rocket Distributors, Bozside, L.I., N.Y.



Set-up at National Bureau of Standards for noise figure calibration. At left arm of tee is the noise diode, and the right arm is a two-terminal network simulating the source. At right is a precision attenuator with a voltmeter directly in front of it

tal network and source noise) to the available noise power at the output source alone. Noise power in an electrical network is generated by the network resistance (Johnson noise) and its vacuum tubes (shot noise). The noise figure is a function of frequency and of the network and source impedance; both are measurable to a high degree of accuracy by various independent techniques. With these important parameters of a unit accurately evaluated, calibration can now be made. The Bureau's calibration method breaks down into one involving only five components—a temperature-limited noise diode, a two-terminal source network, a four-terminal network under calibration, an attenuator, and a sensitive voltmeter.

The equivalent noise resistance used in evaluating the technique utilizes the concept that the noise power from the network can be represented by the Johnson noise of this resistance. Experimental verification of this theory was made with eleven different values of test impedance and at frequencies of 0.5, 4.3, 12, and 30 mc. Measurements made with the temperature-limited diode conclusively proved that the equivalent noise resistance was constant for all the values of test network impedance at each frequency. The evaluation has shown that the Bureau's calibration method will yield precise noise figures. It was also proved that this method of calibrating noise figures is valid for a matched or unmatched condition of input impedance. In



# Tuning Forks

## for precision frequency control

**A complete line of tuning fork resonators to meet your reference standard . . . timing . . . or speed control requirements.**

**ACCURATE . . .** Manufactured in accuracies up to 1 part in 10,000 for operation from  $-40$  to  $+75^{\circ}\text{C}$ .—and up to 1 part in 100,000 for operation from  $0$  to  $+75^{\circ}\text{C}$ .

**COMPENSATED . . .** Thermal compensation method employed maintains fork accuracy throughout rated operating temperature range without benefit of oven control or warm-up time.

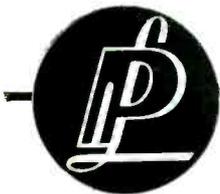
**RUGGED . . .** Internally shock-mounted using relatively permanent, semi-inorganic, silicone rubber—a desirable feature for stringent shock and vibration applications.

**HERMETICALLY SEALED . . .** Solder-sealed evacuated container prevents barometric pressure and relative humidity variations from affecting fork accuracy.

**FREQUENCIES . . .** 400 cycles and from 700 to 3,000 cycles for accuracies up to 1 part in 10,000—from 1,000 to 3,000 cycles for accuracies up to 1 part in 100,000.

*Available individually—as a part of compact sub-assemblies—or in completely engineered equipment constructed to your specifications.*

*Write Dept. B for complete information or telephone HYacinth 2-4800.*



**PHILAMON LABORATORIES**  
5717 Third Avenue Brooklyn 20, N. Y.

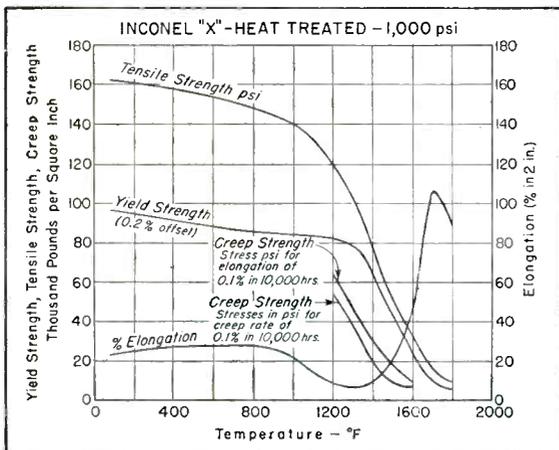
# INCONEL "X"

## An oxidation-resisting alloy with very high strength over 1000°F

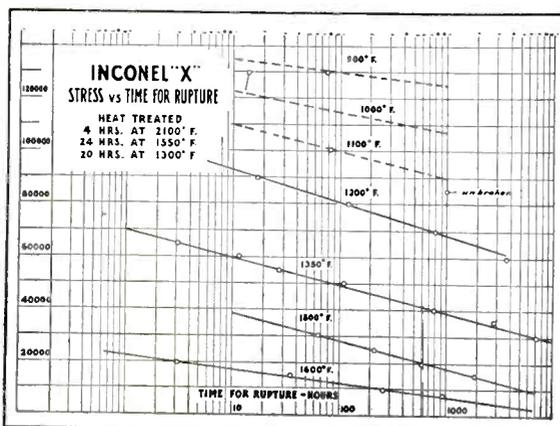
Inconel "X"<sup>®</sup> is an age-hardenable alloy which is unusually strong both at ordinary temperatures and at red heat. Suitably heat-treated, Inconel "X" has low creep rate under high stresses over 1000°F—and exceptionally high spring properties up to 1100°F.

The principal engineering characteristics of Inconel "X" (besides those shown on accompanying charts) are:

- **Oxidation Resistance**—Tests indicate that oxidation resistance of Inconel "X" is of the same order as that of Inconel.
- **Fatigue Strength**—Measurements of fully heat-treated Inconel "X" on rotating beam machines, at 100,000,000 cycles, show fatigue strengths ranging from 55,000 psi at 1200°F to 36,000 psi at 1500°F.



Short-time high-temperature properties of fully heat-treated Inconel "X".



High-temperature stress-to-rupture properties of fully heat-treated Inconel "X".

- **Impact Strength**—For fully heat-treated Inconel "X", typical impact strength values are: 33 ft. lbs. at -320°F, 37 ft. lbs. at room temperature, 67 ft. lbs. at 1500°F, and 113 ft. lbs. at 1600°F.
- **Hardness**—By proper heat treatment, the room temperature hardness of Inconel "X" can be developed as desired from BHN 140 to BHN 400.
- **Spring Properties**—By a combination of heat treatment and cold working, Inconel "X" develops unusually high spring properties. For spring applications from sub-zero temperatures up to about 650°F, it is useful where otherwise unusually strong ferrous springs must be used. Up to 1100°F, Inconel "X" springs will give useful performance where few other metals can be relied on.
- **Machining**—Inconel "X" is machinable in all conditions. Because of its strength and toughness, it cannot be machined as easily as softer metals; it can, however, be machined at satisfactory rates.
- **Forging**—No unusual difficulties are encountered in forging Inconel "X", though heavier equipment than that used on ordinary steels is required.
- **Welding**—Inconel "X" can be welded by nearly all commonly used methods including: metal arc, inert gas metal arc, atomic hydrogen arc, resistance spot and seam, resistance butt welding. Satisfactory joints have been made between two parts of Inconel "X", and also between Inconel "X" and other alloys including standard Inconel, Stainless Steels types 310 and 347, and cast Stellite 21 and 30.
- **Applications**—Inconel "X" is used for springs supporting television tubes in a face coating dryer. Also for highly stressed bolts and for expansion bellows . . . wherever a combination of high stress and extreme heat must be met.
- **Forms Produced**—Inconel "X" is produced in most commonly used mill forms—billets, rod, flats, rounds, hexagons, sheet, strip, bar, wire, seamless tubes, and welding rods. Like all alloys containing nickel, it is in very limited supply except for defense use.

### FURTHER DATA AVAILABLE

A 79-page reference manual "Inconel 'X', Data and Information," contains all the engineering information compiled to date on this alloy. This publication is available, free, for your information.

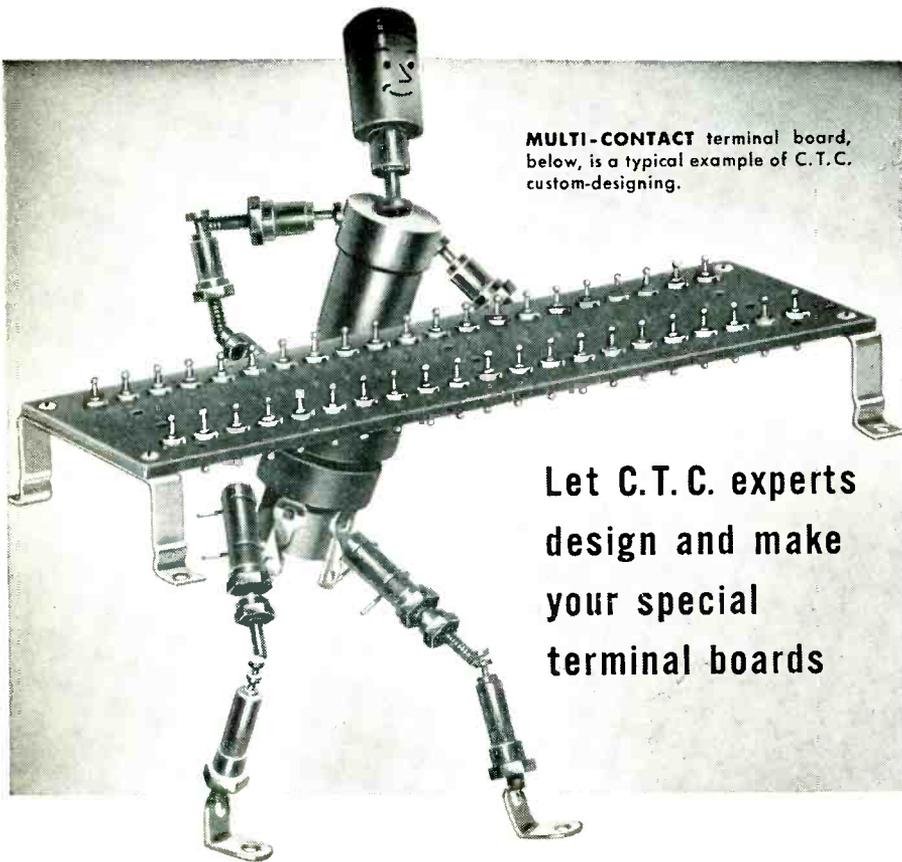
And for technical help on specific problems involving metals at high temperatures, write, outlining your problems, to Inco's Technical Service Section.

### THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE  
**NICKEL INCO ALLOYS**

MONEL<sup>®</sup> • "R"<sup>®</sup> MONEL • "K"<sup>®</sup> MONEL • "KR"<sup>®</sup> MONEL • "S"<sup>®</sup> MONEL  
 NICKEL • LOW CARBON NICKEL • DURANICKEL<sup>®</sup>  
 INCONEL<sup>®</sup> • INCONEL "X"<sup>®</sup>



**MULTI-CONTACT terminal board, below, is a typical example of C.T.C. custom-designing.**

**Let C.T.C. experts design and make your special terminal boards**

Special boards for electronic units are required by many government contracts. Specifications are so severe and standards so rigid, these boards must be fabricated to fit the job.

C.T.C.'s Custom Engineering Service is well-equipped to fill these specifications for you. We are thoroughly familiar with the JAN-approved materials in accepted usage by government agencies and the armed forces. This, combined with assembly know-how developed over many years of supplying electronic components and equipment to the government and to electronic manufacturers, enables us to meet your needs.

C.T.C. can supply any size or shape terminal board with practically any terminal arrangement desired . . . in any production quantity.

**SPECIAL CONSULTING SERVICE**

To aid you in securing exactly the right components to meet the requirements of your designs, prototypes, etc., C.T.C. maintains a staff of thoroughly experienced component engineers. These experts will work closely with you for the most economical and satisfactory results—and where standard parts are not suitable will design special units. *This service is always available to you — without cost!*

**C. T. C. Products Include:**



**NEW! SLUG TUNED COIL FORM — TYPE LS-8** — Here's a brand new slug tuned coil form featuring silver-plated phosphor bronze clip terminals which cannot loosen. Height, 23/32". Maximum diameter, 1/2". Mounts in "D" punched hole or in 1/4" round hole. Coil form is of grade L-5 silicone impregnated ceramic. Slug is provided with a spring lock. All metallic parts except clips are cadmium plated. Supplied complete with slug and all mounting hardware.

**CAMBRIDGE THERMIONIC CORPORATION**  
437 Concord Avenue, Cambridge 38, Mass.

- Please send me more information on special terminal boards.
- More information on C.T.C.'s cooperative engineering service.
- More information on the following C.T.C. products:

Name ..... Position .....

Firm .....

Street .....

City ..... Zone ..... State .....

*custom or standard... the guaranteed components*



addition this method may be successfully applied to measuring the impedance of two-terminal networks.

Thus, with the theory verified by a wide range of experiments, the Bureau is equipped to provide standards for noise figure measurements. Calibrations can be made for high gain, linear, four-terminal networks such as radio receivers and amplifiers (10 to 150 ohms) source impedances) to  $\pm 0.2$  decibel and at frequencies up to 30 mc. Work is in progress to extend noise figure standards to 300 mc.

**Super-Speed Scintillation Counting**

BY PLACING 4,000 volts on a conventional multiplier phototube instead of the prescribed 1,000, Stanford University researchers have succeeded in extending the range of scintillation counters.

The use of such high voltage is made possible by cutting down on duty factor. The counter is being used to study the operation of Stanford's linear accelerator, which operates for approximately one microsecond once every 1/60 second. Certain studies require that the



Operating multiplier phototube at 4,000 volts for short periods of time, instead of 1,000 volts prescribed, extends range of scintillation counter

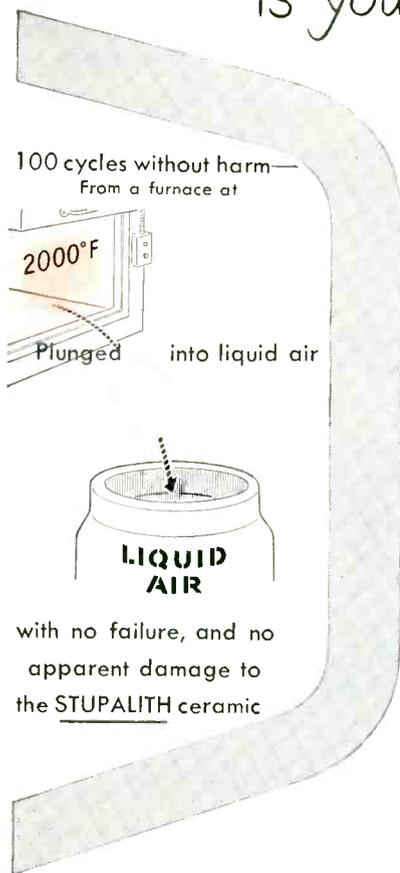
scintillation counters be operative for only a billionth of a second, thus permitting the higher voltage to be applied without inflicting permanent damage to the tube.

It is hoped that the stepped-up counting speed will enable time-in-flight measurements to be made with sufficient accuracy to facilitate direct mass measurements of particles.

Looking for a material  
to withstand  
**EXTREME THERMAL SHOCK?**

**STUPALITH**

is your answer!



with no failure, and no  
apparent damage to  
the STUPALITH ceramic

Remarkably low thermal-expansion characteristics make STUPALITH *ideal* for applications where conditions of extreme thermal shock are present.

Stupalith may be formulated and processed to possess Zero, Low-Positive and Low-Negative expansivities. Formed by conventional methods—pressing, extrusion or casting—STUPALITH may be machined or ground to precision tolerances. Can be safely used at temperatures up to 2200° F.

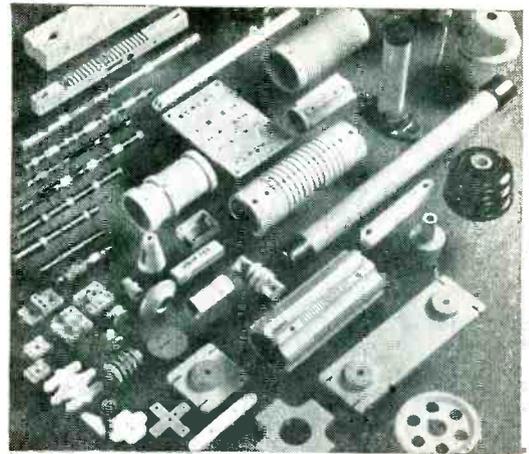
The demonstration described in the illustration at the left shows the amazing ability of STUPALITH to withstand thermal shock.

We will be glad to send you a copy of Bulletin 849, which gives full details of this remarkable group of ceramics.

**STUPAKOFF**

CERAMIC AND MANUFACTURING CO.

*Latrobe, Pa.*



**STUPAKOFF  
PRODUCTS**

*For Electrical and  
Electronics Applications*

**ASSEMBLIES**—Stupakoff assemblies include Induction COILS for radio receivers and transmitters; SHAFTS for air-tuning condensers; METALLIZED PLATES for making fixed rigid assemblies.

**CERAMICS**—Stupakoff has long been a leading supplier of ceramic products for a wide variety of electrical and electronic applications—precision made for all voltages, frequencies and temperatures.

**RESISTOR CERAMICS**—Stupakoff Temperature-Sensitive Resistors are used for temperature indicating or measuring equipment such as Radiosonde, for infra-red light source and for heating elements. Supplied complete with terminals, in the form of rods, tubes, discs, bars, rings, etc.

**SEALS—KOVAR METAL TO GLASS**—Terminals; Lead-ins; Standoffs—for hermetically sealing for mechanical construction in radio, television, electronic and electrical apparatus. Single or multiple terminal units, in a wide variety of sizes and artings.

**KOVAR METAL**—Kovar is the ideal alloy for sealing to hard glass. Used for making hermetic attachments for electrical and electronic products. Available in the form of rod, wire, sheet, foil—or as cups, eyelets or other fabricated shapes.



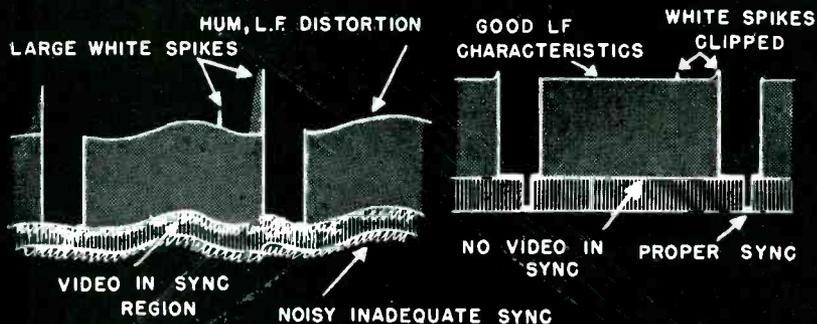
# Facts-

## YOU SHOULD KNOW ABOUT

### GENERAL ELECTRIC STABILIZING AMPLIFIER TYPE TV-16-B



**Input and Output** — No other stabilizing amplifier gives you a choice of matching or bridging input with an input gain for both. This unit provides *two* standard RTMA outputs. One of these can be used for monitoring—with as much as 37 db of isolation between monitor output and picture output.



**Vertical Wave Form** — Output level control can be adjusted while maintaining critical circuits at a constant signal level. This effectively increases the range of input variation over which the amplifier will maintain stability.

**White Clipper**—A unique General Electric feature that guards against overloads due to “whites”. It may also be used as a guard against buzz in inter-carrier type receivers.

**Automatic Correction** of the sync and blanking portion of the television signal, adjustable sync percentage, and improved LF characteristics are the important benefits available with G.E.'s new Stabilizing Amplifier.

**FREE**— Handy leatherette folder containing specification bulletins of all General Electric TV Station equipment will be forwarded on request to television station managers and engineers. Write: General Electric Company, Section 451, Electronics Park, Syracuse, New York.



# GENERAL ELECTRIC

## NEW PRODUCTS

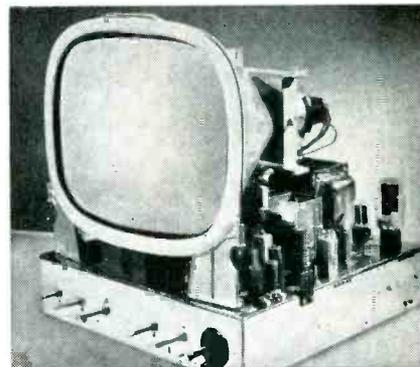
(continued from page 144)



spacings are available: 10, 100, 1,000, 10,000 and 100,000  $\mu$ sec. Additionally a selection of one of the following pulse spacings is available: 20, 50, 200, 500, 2,000, 5,000, 20,000, 50,000 and 200,000  $\mu$ sec. The foregoing pulses are generated by blocking oscillators.

### Mounting-Insulating Ring

ANCHOR INDUSTRIAL Co., 533 Canal St., New York, N. Y., has developed a new type mounting and high-voltage insulating ring and sleeve for the 17-in. rectangular metal tube. The ring and sleeve, which permit mounting the metal picture tube on a metal chassis, are of the

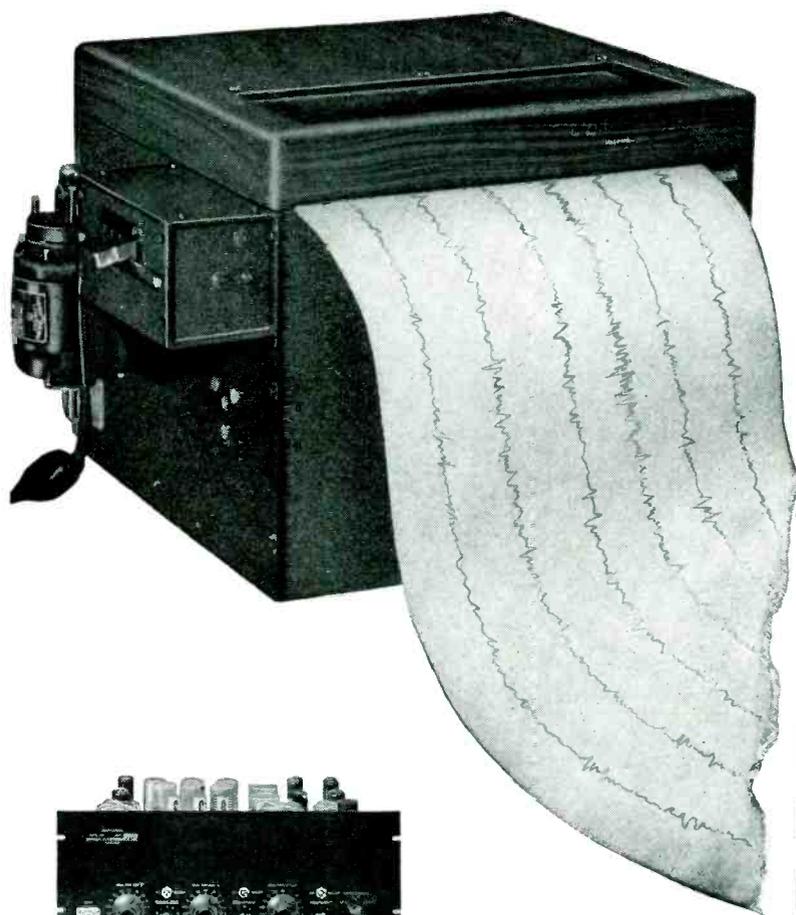


same general type as those at present supplied to almost all major television manufacturers. Specially engineered models are available for all round and rectangular metal picture tubes.

### Tube Cap

ALDEN PRODUCTS Co., 117 North Main St., Brockton 64, Mass., has developed the 90 ISTL one-piece tube cap for miniature tube applications. Designed for use with a 1X2 tube or tubes of similar physical dimensions, it has a long skirt that prevents danger of flashover from grid cap to chassis when operated at high voltages. The wire insulation and grid cap molded as

# THE OFFNER DYNOGRAPH RECORDER



Type 133 Amplifier

**drift-free  
d-c recording**

**SPEED**

**TEMPERATURE**

**PRESSURE**

**VIBRATIONS**

**POSITION**

**OTHER VARIABLES**

## check these exclusive Dynograph features

**Pen Deflection Linearity** of 1% with pen response of 1/120th of a second.

**Sensitivity** of 150 microvolts d-c per centimeter of pen deflection.

**Stability** and drift-free operation through a special chopper type amplifier.

**No extra equipment** needed with reluctance type pick-ups.

**True Differential input** obtained through special transformer coupling.

Offner Electronics Inc., the original manufacturer of precision, direct writing oscillographs, now offers to industry the Dynograph Recorder—a direct writing, high speed oscillograph with microvolt d-c sensitivity.

Operating at approximately 100 times the speed of other industrial recorders with comparative sensitivity, the Dynograph simultaneously records many variables formerly recorded only by photographic means.

Now you can obtain a precise record of transients in the operation of various equipment through a ruggedly built, easy to maintain, versatile d-c recorder—the Dynograph.

Write Today for Bulletin L-311—Complete  
Specifications and Construction Details of the Dynograph

## OFFNER ELECTRONICS INC.

5320 N. KEDZIE AVENUE

CHICAGO, 25

For INDUSTRY • RESEARCH • PRODUCTION • SERVICE

You can get it—  
at **MILO!**



**FAIR DISTRIBUTION FOR ALL**  
is the **MILO** Watchword!

Yes, in these days of war and re-armament there are plenty of shortages in electronic components and equipment. But **Milo comes through for you!** And here's why:

Because Milo believes in **just and equitable distribution to all** its customers, whether old or new. This is the fair-play creed of service

and cooperation that built Milo—and Milo sticks to it, scarcities or no.

Because Milo's great warehouse holds **complete stocks of all the best lines.** Just look at this partial list of the more than 150 first-rate manufacturers whose products are available now from Milo:

ADVANCE ELECTRIC  
AEROVOX  
ALPHA WIRE  
AMERICAN TELEVISION & RADIO  
BELDEN • BLILEY  
DAVID BOGEN  
BUD • BURGESS  
BUSSMANN  
CLAROSTAT  
CONDENSER PRODUCTS  
CORNELL-DUBILIER  
CONTINENTAL CARBON  
DEJUR-AMSCO  
DIALCO • DRAKE  
EITEL-McCULLOUGH

ERIE  
GENERAL CEMENT  
GENERAL ELECTRIC  
GUARDIAN ELECTRIC  
HAMMARLUND  
HICKOK • HYTRON  
INSULINE • IRC  
E. F. JOHNSON  
KESTER  
KINGS ELECTRONICS  
LITTELFUSE  
JAMES MILLEN  
NATIONAL COMPANY  
OHMITE  
PAR-METAL  
POTTER & BROMFIELD

PRECISION APPARATUS  
PREMAX  
SANGAMO  
SHALLCROSS  
SHURE BROS.  
SIMPSON ELECTRIC  
SOLA ELECTRIC  
SPRAGUE  
STANDARD TRANSFORMER  
SUPERIOR ELECTRIC  
SYLVANIA • TUNG-SOL  
TRIPLITT  
UNGAR ELECTRIC  
WARD LEONARD  
WESTON



Write for  
your  
**MILO**  
Catalog

Milo's newest catalog, jam-packed with 1053 pages of descriptions, specifications, illustrations and prices, is the key to the latest electronics products you want. Write for it today—on your company letterhead, please, stating your position, since it is limited to responsible officials only.

**For ultra-fast  
TELETYPE SERVICE—  
Call #NY1-1839**

**MILO**

PHONE

**BEekman 3-2980**

**Radio & Electronics Corp.**

200 Greenwich Street, New York 7, N. Y.

Cable Address: **MILOELECTRO**

The ONE source for ALL your electronic needs

NEW PRODUCTS

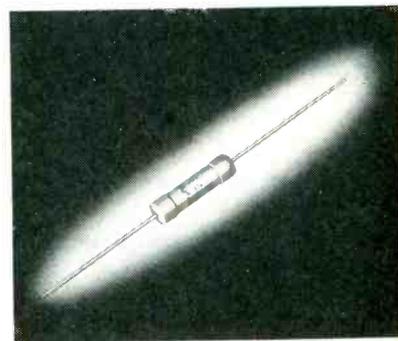
(continued)



one unit in polyethylene give positive strain relief of leads against vibration twisting or strain and gives complete insulation. Elimination of sharp edges and multiple fingers with a smooth metal clip of two curved surfaces reduces possibility of corona.

### Deposited Carbon Resistors

ELECTRA MFG. Co., Resistor Division, 2537 Madison Ave., Kansas City 8, Missouri, is manufacturing deposited carbon resistors in ½-watt size with values to customers' specifications. They are particularly adapted to high-frequency applica-



tions in which high stability and close tolerance of resistance values is a must. The resistors are supplied with 1-percent tolerance and are calibrated within tolerance at 25 C (77 F).

### Beacon Antenna

WORKSHOP ASSOCIATES, INC., 135 Crescent Road, Needham Heights, Mass., has in production the model 6HW high-gain beacon antenna for 450 to 470 mc. It consists of 6 half-wave dipoles with an overall gain of

# For all your potentiometer needs check this complete L&N line

When you're looking for the right potentiometer to do a specific job, it will pay you to check the *complete* L&N line first. Whether you need the extreme precision of an N.B.S.-certified Wenner, the convenience of a Micromax or Speedomax recorder, or an intermediate instrument, you'll find the characteristics you want in a soundly engineered L&N potentiometer.

More than a score of models comprise the line. Just glance at the table below. There's a potentiometer for practically any purpose—measurement of low voltages,

temperature vs. temperature-difference, calorimetry, pH and other emf cell work . . . self-contained portables for temperature and pyrometer checking . . . and the popular, general-purpose Type K's. Models run from highest to moderate precision. They come in convenient single, double, even triple ranges . . . to suit the job at hand.

Naturally, we can't begin to tell you all you want to know in so short a table. So for complete details, let us send you catalog information. Simply write our nearest office, or 4979 Stenton Ave., Phila. 44, Pa.

MODEL	CAT. NO.	PURPOSE	LIMIT OF ERROR†					RANGE
			better than .01%	.01%	.02%	.03% to .1%	.3% of range	
Wenner (N.B.S.-certified)	7559	thermocouple; other low voltages	x					0 to 0.011111 v; 0 to 0.11111 v
	7558	maintain primary standards	x					0 to 0.19111 v; 0 to 1.9111 v
White (Single) (Double)	7620	thermocouple voltages; calorimetry			x			0 to 0.01 v
	7621	thermocouple voltages; calorimetry			x			0 to 0.1 v
	7622	temp; temp-difference;			x			0 to 0.01 v
	7623	temp-current; etc.			x			0 to 0.1 v
Type K-1	7551	general		x				0 to 0.161 v; 0 to 1.61 v
Type K-2	7552	general		x				0 to 0.0161 v; 0 to 0.161 v; 0 to 1.61 v
Students'	7651	general				x		0 to 0.016 v; 0 to 1.6 v
Indicator *	7655	pH, emf's				x		0 to 1.110 v
Millivolt Indicator *	7659	corrosion testing					x	triple; 0 to 4.1 v total
	8667	pyrometer check (lab.); temp.				x		0 to 111 mv
	8656 B,D,X	pyrometer check (plant); temp.					x	0 to 16 mv; 0 to 70 mv; or as spec.
	8657	pyrometer check (plant); temp.					x	0 to 16 mv & 16 to 64 mv; or as spec.
	8662	pyrom. check (lab. & plant); temp.				x		0 to 16.1 mv; 0 to 80.5 mv
Temperature Indicator *	8658	pyrom. check (lab. & plant); temp.					x	single; direct-reading temp.
	8659	pyrom. check (lab. & plant); temp.					x	double; direct-reading temp.
	8663-CD	body temps.					x	25 to 125 F; -3.9 to +51.7 C
	8663-X	temp. check (lab. or plant)					x	single or double, as spec.
Panel Indicator *	8671-76	temp. meas.					x	single or double, as spec.
pH Indicator *	7663-A1	pH; emf cell potentials					x	0 to 13 pH; 0 to 1.100 v
Brooks (Deflection)	7630	ammeter, voltmeter, wattmeter test.				x		0 to 153 mv
	7640	lamp efficiency test.				x		0 to 1.53 v
Micromax *		automatic indicating, recording, controlling: voltage, temp., pH, etc.					x	as spec.
Speedomax *							x	as spec.

\*Self-contained

†Under normal operating conditions, except when using lowest part of ranges.



MEASURING INSTRUMENTS • TELEMETERS • AUTOMATIC CONTROLS • HEAT-TREATING FURNACES

# LEEDS & NORTHRUP CO.

Jrl. Ad EN(12)

## LOW-COST PROTECTION for Airborne Electronic Equipment

### New LORD \*TEMPROOF Mountings

- Exceed AN-E-19 Drop Test Requirements
- Designed for JAN-C-172A Equipment
- Maintain Efficiency from  $-80^{\circ}\text{F}$  to  $+250^{\circ}\text{F}$



\*Temperature-proof

Here is reliable vibration protection for base-mounted airborne electronic equipment . . . and for other apparatus which must function properly above and below usual temperatures. And TEMPROOF Mountings are priced to meet the needs of manufacturers in competitive markets.

TEMPROOF Mountings provide superior protection by maintaining their high vibration-isolating efficiency from  $-80^{\circ}\text{F}$  to  $+250^{\circ}\text{F}$ . Selective-action friction dampers prevent excessive movement at resonant frequencies. Equipment does not sag or droop . . . mounting drift is negligible. The unusually wide load range of TEMPROOF Mountings makes it possible to standardize on one mounting for several types of equipment, and to effect additional economies in purchasing, storage and assembly.

*For complete information on TEMPROOF Mountings, or for specific recommendations concerning their use, write to Product and Sales Engineering Department. A quantity of Vibration Isolation and Natural Frequency Charts in full color is available. Copy of each will be sent free upon request.*

**LORD MANUFACTURING COMPANY • ERIE, PA.**  
Canadian Representative: Railway & Power Engineering Corp., Ltd.



**Vibration-Control Mountings  
. . . Bonded-Rubber Parts**



nearly 8 db. Impedance is 50 ohms with vswr of less than 2 to 1. The new antenna is helping to provide dependable mobile communications at the higher frequencies. The vertical radiation pattern is narrowed to concentrate energy on the horizon, enabling greater distance coverage, and horizontal radiation is nondirectional.

### Mixer-Preamplifier

RAULAND-BORG CORP., 3515 Addison St., Chicago 18, Ill. Model 1904 mixer-preamplifier is designed to mix four a-f inputs and to feed the program over remote line to main amplifying equipment located at any required distance away. It features master gain control, separate bass and treble controls, self-



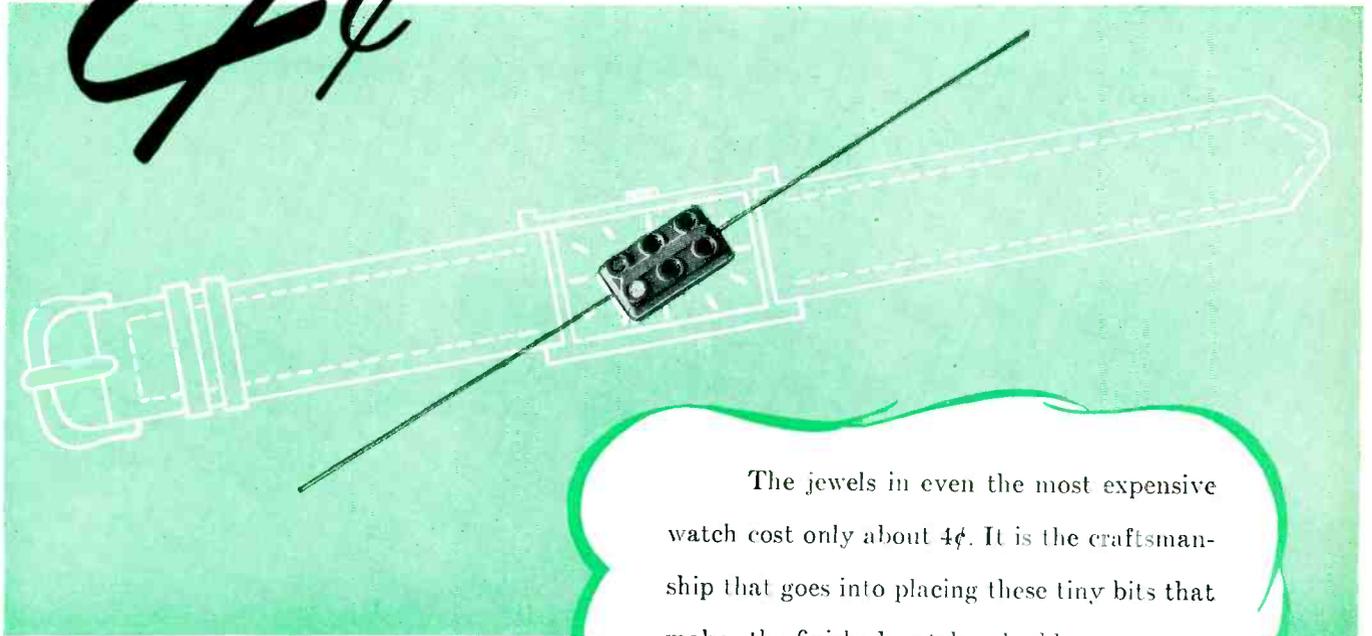
contained 24-volt a-c supply and switch for remote relay control of main amplifying equipment. Output, measured at 100, 400 and 5,000 cps is 300 mw, 2 percent at 600 ohms. Frequency response is  $\pm 1$  db, 40 to 20,000 cps.

### UHF TV Transmitter

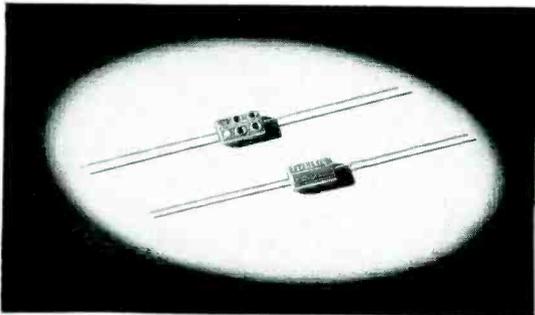
GENERAL ELECTRIC Co., Syracuse, N. Y., has developed a uhf tv trans-

# 4¢

## WORTH OF JEWELS



The jewels in even the most expensive watch cost only about 4¢. It is the craftsmanship that goes into placing these tiny bits that makes the finished watch valuable.



### CM-15 MINIATURE CAPACITOR

Actual Size 9/32" x 1/2" x 3/16"  
For Television, Radio and other Electronic Applications.  
2 mmf. to 420 mmf. cap. at 500v DCw.  
2 mmf. to 525 mmf. cap. at 300v DCw.  
Temp. Co-efficient ± 50 parts per million per degree C for most capacity values.  
6-dot color coded.

The same may be said of the El-Menco CM-15 Capacitor. Tested for dielectric strength at *double* its working voltage, this mighty mite surpasses the strictest requirements of the Army and Navy. It withstands extraordinary strain under the most critical operating conditions—in any climate. Put it in your product—for peak performance.

### A COMPLETE LINE OF CAPACITORS TO MEET EVERY REQUIREMENT

**THE ELECTRO MOTIVE MFG. CO., Inc.**  
WILLIMANTIC CONNECTICUT

Write on your firm letterhead for Catalog and Samples.



**MOLDED MICA**

# El-Menco CAPACITORS

**MICA TRIMMER**

FOREIGN RADIO AND ELECTRONIC MANUFACTURERS COMMUNICATE DIRECT WITH OUR EXPORT DEPT. AT WILLIMANTIC, CONN. FOR INFORMATION.  
**ARCO ELECTRONICS, INC.,** 103 Lafayette St., New York, N.Y.—Sole Agent for Jobbers and Distributors in U.S. and Canada

# ALTEC

## Microphones



21B—stand, lavalier or chestplate

*the world's finest*

### 21B MICROPHONE

The ultimate in advanced microphone design and performance—omnidirectional, new pickup techniques with maximum fidelity for critical broadcast, recording, television, etc. Available in stand, lavalier or chestplate.

### 639 MICROPHONE

Cardioid directional—for critical public address and broadcast use... an excellent all-purpose microphone, the solution to many troublesome and difficult microphone problems in studios and auditoriums.

### 633 MICROPHONE

Dynamic microphone for high quality general utility work... non-directional or semi-directional... for announcing, public address, broadcasting and sound distribution systems.

### 632C MICROPHONE

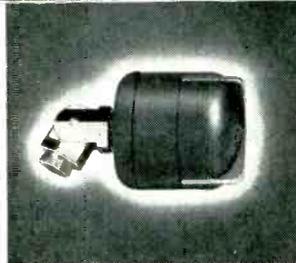
Specifically engineered to give maximum intelligibility for all close talking applications. Rugged and dependable for speech reinforcement, announcing and paging. May be used as stand or hand microphone.



639



633



632C

This select group of high quality microphones is daily meeting every need demanded of microphones... they are products of the same Altec advanced designing, research, development and quality workmanship that have for many years set higher and higher standards of performance throughout the industry. For paging, public address, sound distribution systems or the more critical demands of television, broadcast and motion picture or phonograph recording—choose the finest, choose Altec!

# ALTEC

LANSING CORPORATION

9356 Santa Monica Blvd., Beverly Hills, Calif.

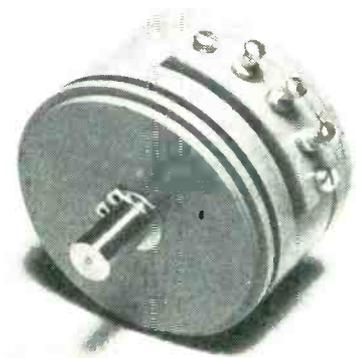
161 Sixth Avenue, New York 13, New York



mitter with an effective radiated power of 100 kw. This is made possible by the development of a new type of uhf velocity-modulation 5-kw tube (illustrated) and a radically new type of antenna which increases the effective radiated power by 20 times. The transmitter will operate in the 500-mc region. The company has applied for FCC authorization to conduct transmission tests.

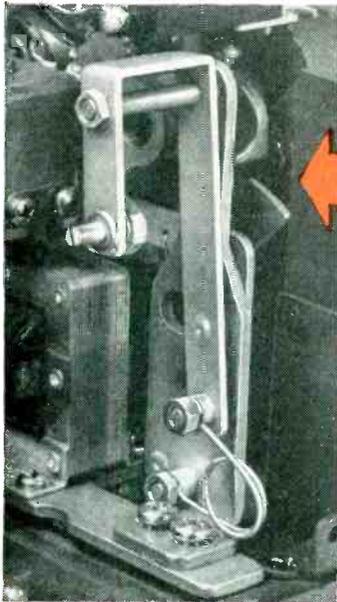
### Precision Potentiometers

GEORGE RATTRAY & Co., INC., 92-32 Union Hall St., Jamaica 5, N. Y., has in production precision wire-wound potentiometers of the single-turn linear and nonlinear types. Size of the type 162 potentiometers (1½ in. in diameter) enables the units to replace larger types in the interest of miniaturization. They



may be ganged on a rotating shaft. Mechanical rotation is continuous and a maximum electrical angle of up to 350 deg is obtainable. Operational life is better than 1 million

# 5 WALDES TRUARC RINGS ELIMINATE 4 TOOLING OPERATIONS... SAVE 22½¢ PER 100 UNITS



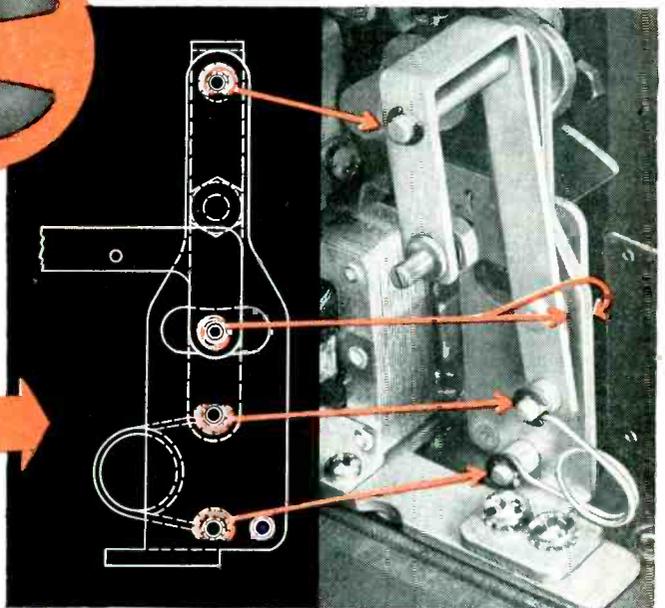
## OLD WAY

Unit requires 4 hex head nuts, 4 washers, 4 shoulders, threading of 4 shafts. Clearance and end-play specifications necessary... constant maintenance.



## NEW WAY

Just 5 Truarc "E" Rings set into pre-determined grooves secure parts permanently. Assembly is simple, economical. No clearance specifications... no maintenance!



5 Waldes Truarc Retaining Rings in one assembly of the Dictaphone Time-Master dictating machine brought great savings to Dictaphone Corp., Bridgeport, Conn. And this is just one of three different applications where Truarc Rings cut material, tooling and assembling costs for this product.

Redesign with Truarc Rings and you too will cut costs. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better job of holding parts together.

Truarc Rings are precision-engineered... quick and easy to assemble and disassemble. Always circular to give a never-failing grip. They can be used over and over again.

Find out what Truarc Rings can do for you. Send your blueprints to Waldes Truarc engineers for individual attention, without obligation.

Waldes Truarc Retaining Rings are available for immediate delivery from stock, from leading ball bearing distributors throughout the country.

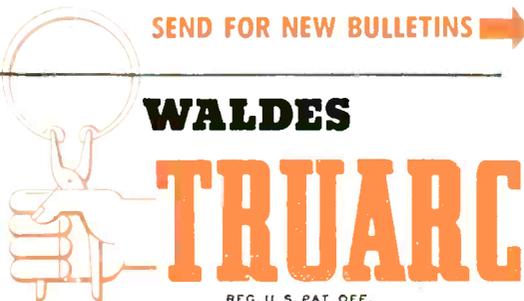
### REDESIGN WITH 5 TRUARC "E" RINGS BRING THESE BIG SAVINGS...

Assembly time per unit using screws and washers . 24 seconds

Assembly time per unit using Truarc Rings . . . . . 15 seconds

- Time saved per unit with Truarc Rings . . . . . 9 seconds
- Eliminates skilled labor milling and threading operations
- Eliminates maintenance
- **TOTAL MATERIAL AND LABOR COST SAVINGS PER 100 UNITS . . 22½¢**

SEND FOR NEW BULLETINS →



**WALDES**  
**TRUARC**  
REG. U. S. PAT. OFF.



Waldes Kohinor, Inc., 47-16 Austel Place E-053  
Long Island City 1, N. Y.

Please send Bulletins 6, 7 and 8—giving engineering specifications for all types of Waldes Truarc Rings.

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Business Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

678

**RETAINING RINGS**  
WALDES KOHINOR, INC., LONG ISLAND CITY 1, NEW YORK  
WALDES TRUARC RETAINING RINGS ARE PROTECTED BY THE FOLLOWING PATENT NUMBERS:  
U. S. PAT. 2,382,948; 2,420,921; 2,411,761; 2,487,803; 2,487,802; 2,491,306 AND OTHER PATS. PENDING.

# QUICK SERVICE FROM STOCK

# CHICAGO

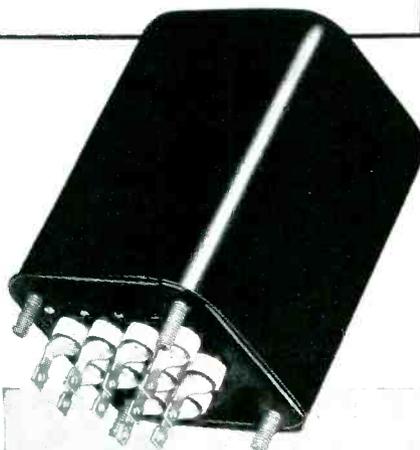
## JAN-T-27 Hermetically Sealed Transformers

### A Complete Range of Hermetically Sealed Units

*for prototype electronic  
equipment and pilot runs*

- **POWER TRANSFORMERS**  
FOR CAPACITOR AND  
REACTOR INPUT SYSTEMS
- **BIAS TRANSFORMERS**
- **FILAMENT TRANSFORMERS**
- **FILTER REACTORS**
- **AUDIO TRANSFORMERS**  
IN 3 RANGES: FULL FREQUENCY  
PUBLIC ADDRESS & COMMUNICATIONS

THEY'RE AVAILABLE FOR TODAY'S IMPORTANT NEED. CHICAGO Hermetically Sealed Transformers meet all requirements of Grade I, JAN-T-27 specifications for Class A operation. Designed expressly to fill transformer requirements for military airborne, marine, and ground communication equipment, as well as for use in tropical and sub-zero climates. Ideal for a wide range of application, particularly in research and development work, prototype equipment and pilot runs. The complete range of CHICAGO JAN-T-27 units is available for quick shipment from stock.



#### Meets JAN-T-27 Specifications

1. Alternately heated and chilled for 20 cycles (20 days) temperature range from +65°C to -10°C, 90% humidity. Also tested for 5 cycles from -55°C to +85°C.
2. Immersed in hot and cold brine at temperatures of 75°C to 0°C.
3. Subjected to severe vibration on shake table for 20 periods of 15 minutes each.
4. Given a pull test on all terminals, from all directions, of 5 lbs. or more for 30-second intervals.
5. Tested on each winding at twice rated a-c voltage and frequency.
6. Tested for insulation resistance in excess of 500 megohms throughout heat-and-cold cycles.
7. Tested for corona discharge at voltages 1¼ times operating voltage of transformers.
8. Capable of operation in 65°C ambient temperature with temperature rise not exceeding 40°C.
9. Operated 48 hours with 12% overload at rated ambient temperature.

**SEND  
FOR IT**

#### NEW EQUIPMENT TRANSFORMER CATALOG

Have the full details at your finger-tips on CHICAGO'S New Equipment Line—covering all JAN-T-27 units as well as famous Sealed-in-Steel transformers engineered for every application and geared to today's circuit requirements. Write for your free copy of this important catalog today, or get it from your distributor.



## CHICAGO TRANSFORMER

DIVISION OF ESSEX WIRE CORPORATION

3501 ADDISON STREET • CHICAGO 18, ILLINOIS



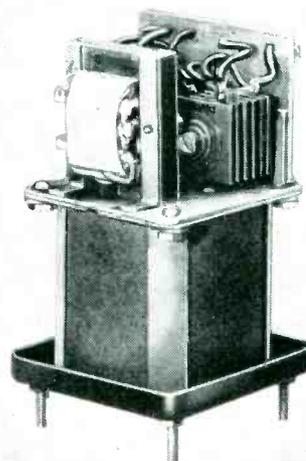
NEW PRODUCTS

(continued)

cycles for speeds up to 100 rpm. Capacitance to ground is approximately 40  $\mu\text{f}$  from winding to case.

### Magnetic Amplifiers

MAGNETIC AMPLIFIERS, INC., 11-54 44th Drive, Long Island City 1, N. Y., has announced a new line of packaged, standard magnetic amplifiers for automatic control and servomechanism application at powerline frequencies of 60 and 400 cps and with power-handling capacities up to approximately 350



watts. Aside from the completely self-contained type of unit illustrated, amplifiers are built to customer specifications. Literature is available.

### Voltmeter

THE DAVEN Co., 191 Central Ave., Newark 4, N. J. Type 170 electronic voltmeter covers a frequency range from 10 cycles to 250 kc with an accuracy of  $\pm 2$  percent. Its high stability circuit, with internal regulated power supply, makes its





*They brought*  
**Paris**  
*to the oil fields*

A wonderful new fashion show was held in Paris . . .

One week later, the same show was staged—in Texas!

The place was Neiman-Marcus of Dallas, one of the most remarkable stores in the world. Though hundreds of miles from the "fashion capitals," they sell more exclusives from more top designers than

any other store in the U. S.

After new Paris creations arrive in New York, it's only a matter of hours before they're displayed in the N-M salons!

Want to know their secret?

When Neiman-Marcus want a fashion scoop, they bring their high-fashions in at high altitudes. They use Air Express!

You don't have to be a Texan to want the *fastest* service in the world. Your business doesn't have to be fashions to profit from regular use of Air Express. Here are its unique advantages:

**IT'S FASTEST** — Air Express gives the fastest, most complete door-to-door pick up and delivery service in all cities and principal towns, *at no extra cost.*

**IT'S MORE CONVENIENT** — One call to Air Express Division of the Railway Express Agency arranges **everything.**

**IT'S DEPENDABLE** — Air Express provides one-carrier responsibility all the way and gets a *receipt upon delivery.*

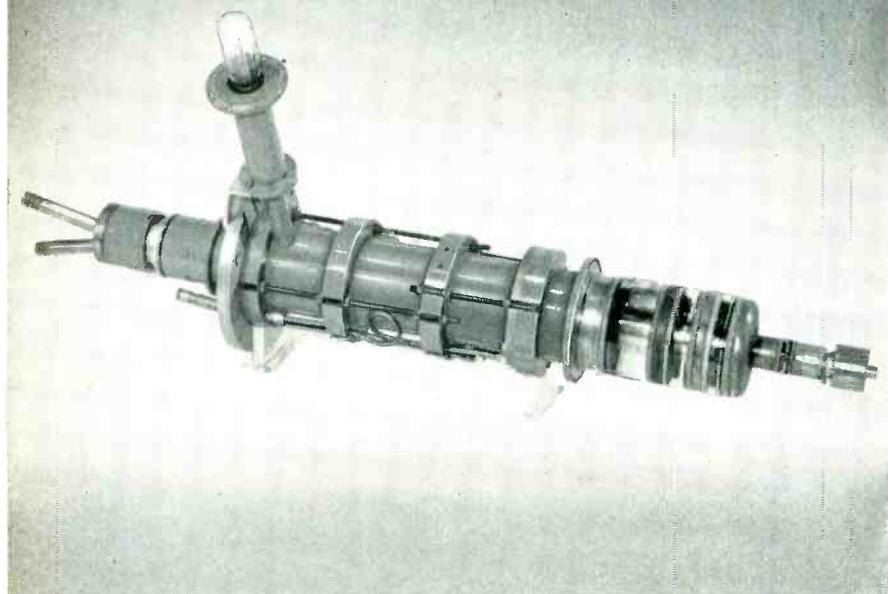
**IT'S PROFITABLE** — Air Express expands profit-making opportunities in distribution and merchandising.

For more facts call Air Express Division of Railway Express Agency.



**AIR EXPRESS**  
**GETS THERE FIRST**

# VARIAN MICROWAVE ENGINEERING



## ... develops a new 5-kw linear-amplifier klystron

Operating in the final stage of a uhf transmitter, the new X-25 Varian Klystron provides continuous output power up to 5 kw with approximately 15-w drive. The tube is tunable from 1016 to 1056 mc and has a half-power bandwidth of about 2 mc. Gain of approximately 27 db is essentially linear to 80 per cent of maximum output.

Particularly suited to applications where crystal control and/or low-level modulation are used, the new X-25 introduces sidebands 60 db or more below the carrier and negligible noise or spurious modulation.

Long service life has been attained by use of a bombarded tantalum cathode, part of an assembly which can be replaced easily in case of accident or failure. A cascade amplifier with three cavities, the new design lends itself to stagger-tuning and other methods of broad-banding. It is typical of amplifiers practicable for other frequencies in this band.

### TENTATIVE SPECIFICATIONS

#### Typical Operating Characteristics

Beam Voltage, kv	12
Beam Current, amp	1.6
Power Output, max kw	5
Linear Output, max kw	4
Gain, db	27
Frequency, mc	1016-1056
Bandwidth, mc	2
Spurious Sidebands, db	-60

#### Mechanical Characteristics

Length, overall, in.	42
Weight, approx lb	60
Input Connection	Type N
Output Connection	Probe to feed 4-in. by 8-in. waveguide
Focussing	Magnetic
Cooling	Water and Air

A 4-foot 200-pound counterpart of the X-25 klystron illustrated above is the heart of the powerful new General Electric uhf television transmitter. These as well as other high-power I-band klystrons being produced by Varian Associates have a wide range of communication and industrial applications.

**VARIAN**  
associates

99 washington st.  
san carlos, calif.

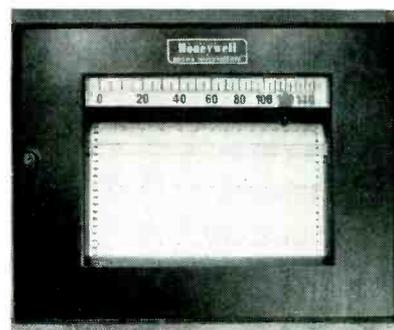
NEW PRODUCTS

(continued)

readings independent of normal power line variations. It has a high input impedance of 500,000 ohms and its cathode follower input provides an effective input capacitance as low as 6  $\mu\text{f}$ . The multiplier control provides four additional ranges of 20 db in addition to the decibel range meter scale, 0 to 20 db. The voltmeter may also be used as a wide-range, high-gain amplifier, due to its output jack and separate volume control.

### Temperature Recorder

MINNEAPOLIS-HONEYWELL REGULATOR Co., Brown Instruments Division, 2753 Fourth Ave. S., Minneapolis, Minn. An electronic recorder for accurately and quickly measuring temperature of the rotor in large electric generators has been developed. The ElectroniK was de-



signed to provide a better and more economical instrument to assist operators in avoiding overloads. In addition it furnishes a 12-inch strip chart record which can be used as a guide for gradually cooling a generator. The recorder has a range of 0 to 150 C, a limit error of 1.5 C, a dead zone of 0.3 C and a pen speed of 1.4 minutes full scale. Its range of rotor winding resistance is 0.1 to 4.0 ohms and it has a dielectric test of 1,500 volts rms for one minute.

### Dynamic Microphone

THE TURNER Co., 909 17th St., N. E., Cedar Rapids, Iowa. The 50D Aristocrat dynamic microphone, designed for use in tv, broadcast, recording and public address, is laboratory calibrated to a response of 50 to 15,000 cps, flat within  $\pm 2.5$  db. Swivel-type mounted for stand



Want to make  
your product  
safer to use?

## Little lamps flash warnings—prevent accidents

**W**HEN you can show a customer that your product is safer to use than your competitor's, you've got a big start toward clinching the sale.

General Electric miniature lamps can add extra safety and utility to your product. As indicator lights, they can be used to tell whether current is on or off, to flash a warning of high temperature or voltage. Used as dial lights, they make it easier for operators to read dials and gauges quickly, help spot trouble before it happens.

Plan now to design greater safety and utility into your product with General Electric miniature lamps. They're available in both filament and neon glow, in many types and sizes. You're always sure of long, dependable service from G-E lamps because General Electric Lamp research is always at work to make G-E lamps *Stay Brighter Longer*. Lamp Department, General Electric Co., Nela Park, Cleveland 12, Ohio.



*You can put your confidence in —*

**GENERAL**  **ELECTRIC**

Thinking of  
Stainless?



Think  
of **ALLMETAL**  
for the finest in  
**STAINLESS  
STEEL  
FASTENERS**

**MADE RIGHT —**

By specialists in stainless steel since 1929.

**PRICED RIGHT —**

Because ALLMETAL uses modern equipment—including cold-heading machines—devoted solely to stainless.

**RIGHT COMBINATION**

For solving fastening problems quickly, economically.

Allmetal has the fasteners you want. Stock items, including Government and "AN" specs, shipped immediately. Prompt delivery on various types of Phillips Recessed Head screws and specials. Switch to Allmetal Stainless Fasteners when you switch to Stainless!

Use our "Rush Order" direct wire service—Send telegrams to "Allmetal Screw Products—WUX—New York."—that's all—

WRITE FOR CATALOG 49C

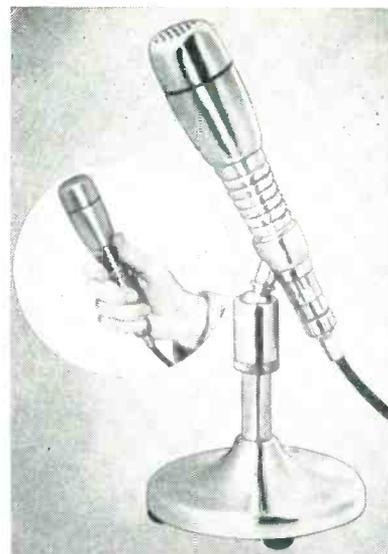


MANUFACTURERS SINCE 1929

**ALLMETAL**

*Screw Products Co., Inc.*

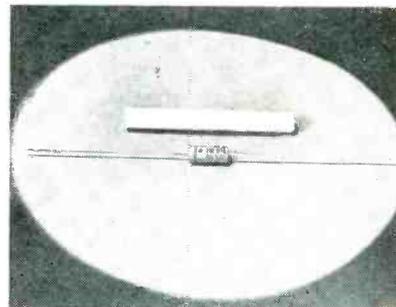
33 GREENE STREET, NEW YORK 13, N. Y.



or boom use, it is quickly detachable for hand use. It is omnidirectional and available in 15,200 ohm or high impedance. Sensitivity is 56 db below 1 volt per dyne per sq cm.

**Miniature Tubulars**

PYRAMID ELECTRIC Co., 1445 Hudson Blvd., North Bergen, N. J. Type 85LPT miniature tubular paper capacitors are designed to withstand a life test of 250 hours at 85 C. Available in rated voltages of 200, 400 or 600 volts d-c working, they will withstand 2½ times rated voltage for 5 seconds. The capaci-



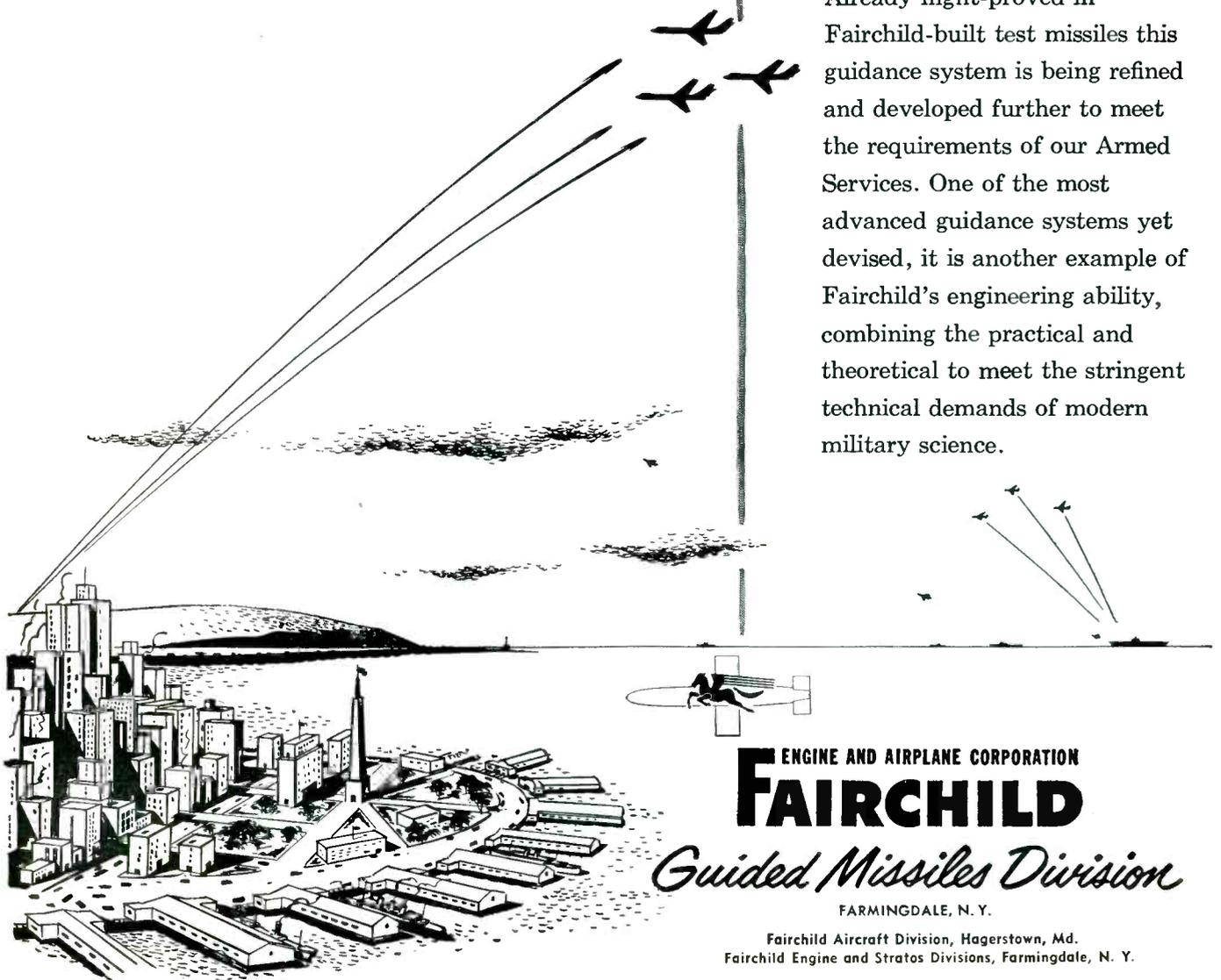
tors are sturdily built in phenolic-impregnated tubes, plastic end-filled. Capacitances, dimensions and prices for the whole line are given in form LPT-1.

**Video Picture Generator**

TELECHROME, INC., 88 Merrick Road, Amityville, L. I., N. Y., has developed the model 300-A flying spot low-cost tv picture generator

# BRAIN WORK

*high in the heavens*



**GUIDED MISSILES** that become more accurate as they close the range on attacking enemy aircraft are being developed by the Fairchild Guided Missiles Division. Missile experience dating back into World War II has enabled Fairchild engineers to design a guidance system which "homes" on radar echoes reflected from attacking planes and cuts down the margin of error the closer the "bird" gets to its target.

Already flight-proved in Fairchild-built test missiles this guidance system is being refined and developed further to meet the requirements of our Armed Services. One of the most advanced guidance systems yet devised, it is another example of Fairchild's engineering ability, combining the practical and theoretical to meet the stringent technical demands of modern military science.

ENGINE AND AIRPLANE CORPORATION

## FAIRCHILD

*Guided Missiles Division*

FARMINGDALE, N. Y.

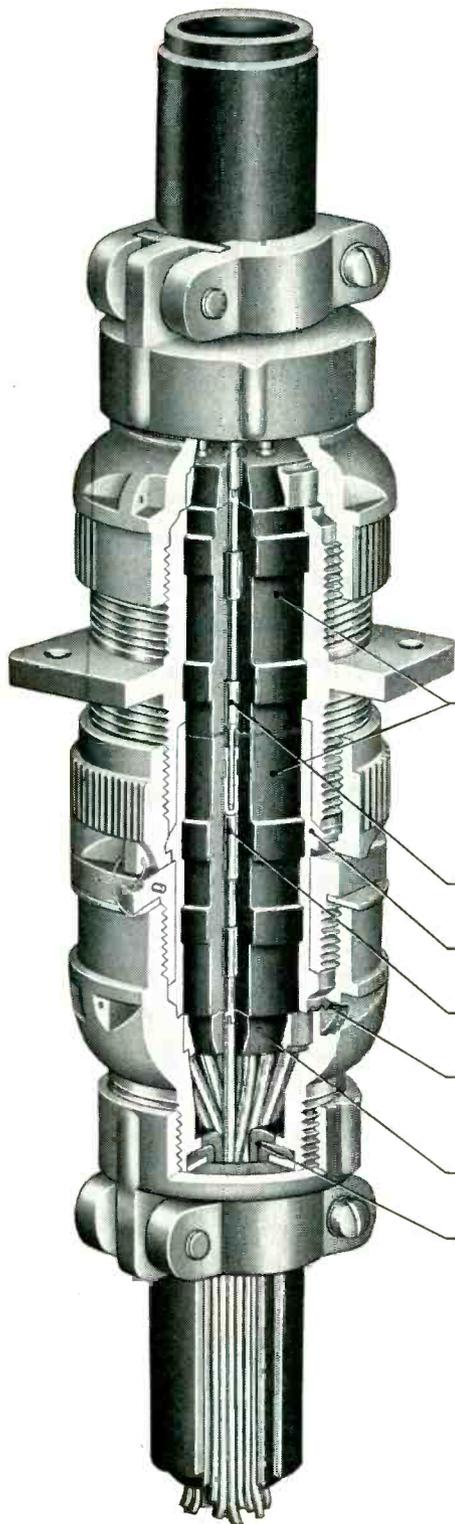
Fairchild Aircraft Division, Hagerstown, Md.

Fairchild Engine and Stratos Divisions, Farmingdale, N. Y.

Here's why those in the know

—demand

## CANNON PLUGS



Here's another example of the meticulous care Cannon Electric uses in building connectors for highly specialized, tough jobs. This AN-"M" type connector is moisture-proof, vibration-proof and pressurized. Radio shielding is provided and every threaded part is drilled for safety wiring.

No corners are cut—nothing is overlooked to assure you outstanding performance. This connector is designed for aircraft use but there are more than 18,000 different Cannon Plugs made with the same care to serve the exacting needs of many industries. If you are looking for real value, regardless of the field you work in, your best bet is Cannon.

Engineering bulletins describing each of the many basic types of connectors are available. We will gladly send you any of these if you will simply describe your connector requirements.

Molded Polychloreprene inserts 75-80 shore hardness provide pressure-proofing of both pin and socket contacts. Have high dielectric strength under wide range of temperatures and at extreme altitudes. Mated fittings will not show more than 10 microamperes dielectric leakage and will not arc when subjected to 7500v dc at room temperature.

Pin Contacts machined from solid brass, silver-plated. Solder cup hand-tinned.

Machined ball-in-cone joints provide radio shielding and improve vibration resistance.

Socket contacts machined from solid copper alloy with new Cannon design, silver-plated.

Marching serrations in end bell and shell make practical wrench-tightening from one side of the installation without putting strain on contacts or wires.

Polychloreprene grommets make moisture-proof seal over soldered connections.

Concentric rubber bushings under pressure of cable clamp provide snug, moisture-proof wire entry. Eliminate usual strain on outer wires. Provision is made for grounding lug.



## CANNON ELECTRIC

Since 1915

Cannon Electric Company  
Los Angeles 31, California

Factories in Los Angeles, Toronto, New Haven. Representation in principal cities.

NEW PRODUCTS

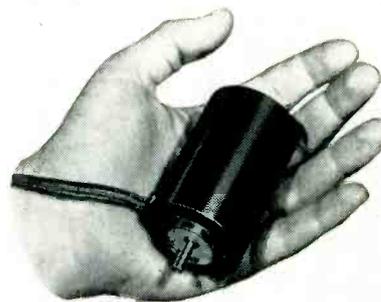
(continued)



using 3 × 4-in. slide transparencies and negatives. It is designed to supplement or replace monoscopes, camera chains in tv stations, laboratories, factories, schools and colleges. It is completely self-contained with regulated power supplies. Resolution greater than 500 lines meets RTMA picture quality specifications. It will run on standard driving pulses, off-the-air sync, or on self-contained sweep generators.

### Fractional H-P-Motor

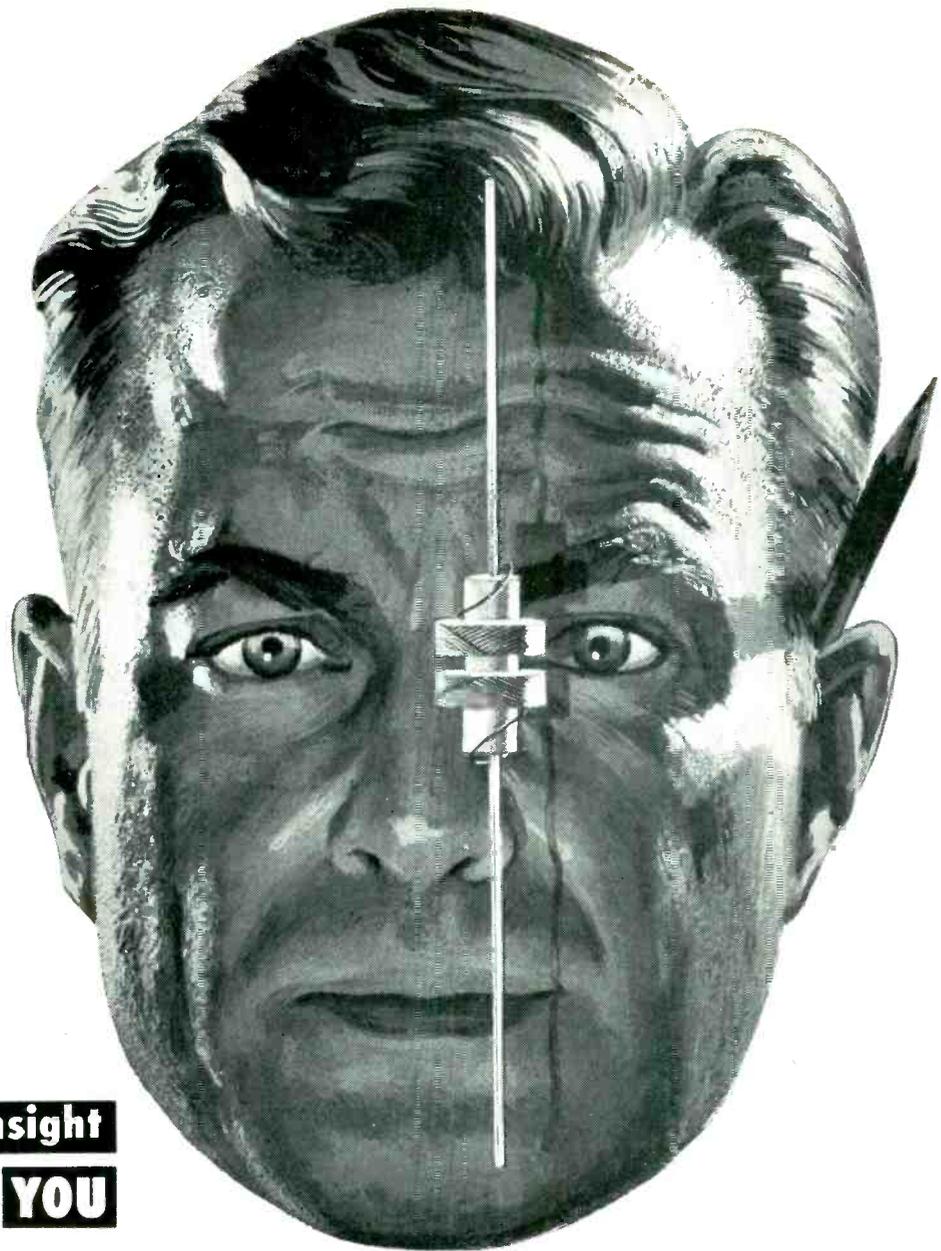
JOHN OSTER MFG. Co., Racine, Wis., has added a new 400-cycle current motor to its fractional h-p electric motor line. It is available as a capacitor-run single-phase or



polyphase induction motor. Typical ratings for continuous duty are 1/100 h-p at 7,000 rpm on 400-cycle current or 1/300 h-p at 3,000 rpm on 60-cycle current. The type is especially suited to needs calling for high speeds and plenty of power.

### Grid-Dip Meter

JAMES MILLEN MFG. Co., INC., 150 Exchange St., Malden 48, Mass., has announced a new industrial version of its grid-dip meter. In addition to having an individually hand-calibrated direct-reading dial the model 90662 meter has an extended fre-



**we'll sight our  
engineering insight  
especially for YOU**

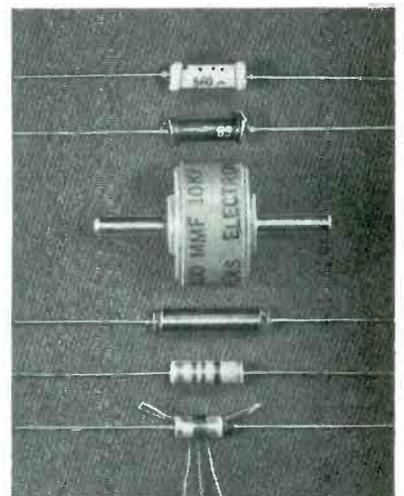
**...if electronic components, such as chokes, are your problem**

*Other electronic components also  
built in quantity  
to your most exacting specifications  
for stability in service*

**JEFFERS**  
*Electronics* **INC.**

A SPEER CARBON COMPANY SUBSIDIARY

DU BOIS, PENNSYLVANIA



Complete your Circuits with Resistors, Coil Forms and Iron Cores by Speer Resistor Corp., St. Marys, Pa. another SPEER CARBON CO. subsidiary

7276

*Telesyn* **THE** name for Synchros  
made **ONLY** by...

**FORD**

*Telesyn* Generators and Motors for  
transmitting angular positions.

*Telesyn* Control Transformers for voltage  
indication and servo control.

*Telesyn* Differential Generators and Motors  
for addition and subtraction.



FIND OUT ABOUT FORD TELESYNS — WRITE FOR CATALOG

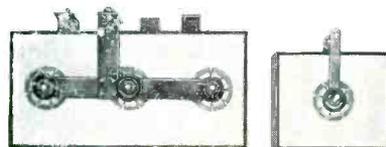
**FORD INSTRUMENT CO.**

Division of The Sperry Corporation

31-10 Thomson Avenue, Long Island City 1, N. Y.

*SYNTRON*

**SELENIUM  
RECTIFIERS**



Made by a new process  
to a uniform, high qual-  
ity for continuous,  
heavy-duty  
service.



1" sq. to 12" x 16"  
cells—in stacks, or sin-  
gle cells for customer  
assembly.



Write for literature

**SYNTRON CO.**

241 Lexington  
Homer City, Pa.



**PREMAX**

## ANTENNAS FOR CIVIL DEFENSE

Base and Center-Loaded Antennas to cover all amateur frequencies allocated for Civil Defense, plus spot channels used by MARS. CAP. National Guard, Etc.

Straight whips for 28 to 50 meg. Plus all types of mobile mountings.

Fixed operations for HQ stations in ranges from 2 to 60 meg. can be had by using Premax Marine and Commercial Vertical Antennas up to 35 feet in height, and also Premax Coil-Loaded 17-foot models.

See your distributor or  
write for Catalog.

**PREMAX PRODUCTS**  
DIVISION CHISHOLM-RYDER CO., INC.

5101 Highland Ave. Niagara Falls, N. Y.



Nickel alloy, filament wire  
and ribbon: flat—grooved  
—crowned.

Grid wire electroplated.

Alloys for special require-  
ments—bare and enameled.  
Pamphlet E sent upon re-  
quest.

**SECON METALS  
CORPORATION**

228 East 45th Street  
New York 17, N. Y.  
Telephone: MUrray Hill 7-1594

**ENGINEERING  
AND TECHNICAL**

**MEN**

*Positions available in*

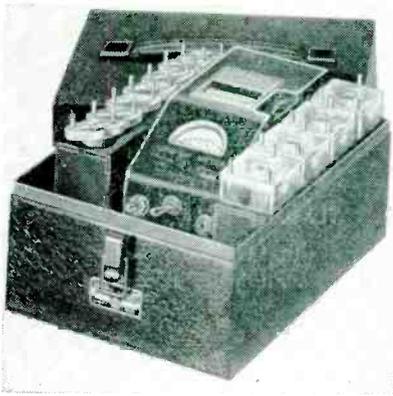
- Mechanical design and development
- Electronic research and development

with

one of California's leading  
DESIGNERS AND MANUFACTURERS  
of  
PHOTOGRAPHIC AND ELECTRONIC  
INSTRUMENTS

Apply or write to

**HYCON MFG. CO.**  
2961 E. Colorado St.  
PASADENA, CALIFORNIA



quency range to cover the entire spectrum from 200 kc to 300 mc. Included with the meter is also a remote probe for coupling into extremely small and normally inaccessible places.

### Gas Ratio Meter

RESEARCH ELECTRONICS LABORATORY, 2459 Susquehanna Road, Roslyn, Pa. The gas ratio meter illustrated permits checking up to 200 (preheated) c-r tubes per hour with accurate, stable gas readings. Particularly adapted to in-line production, it is also portable, a-c operated and as easily used in ware-



house or laboratory. An adaptation of the JAN gas ratio formulas uses standard, stabilized, regulated circuits for utilizing the c-r gun as its own ionization gage. A 3-in. meter reading 0.2 at midscale measures all electromagnetic types.

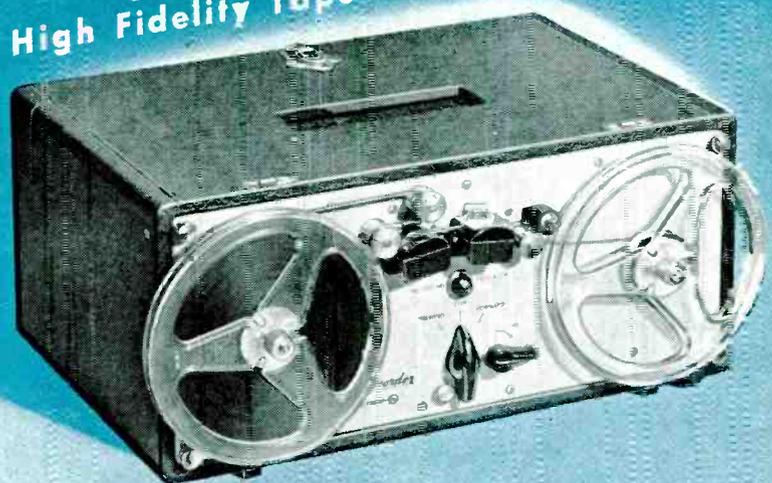
### Limiting Amplifier

RADIO CORP. OF AMERICA, Camden, N. J. Type BA-6A amplifier limits the high peaks that occasionally occur during a-m and f-m broadcast-



Improve your product through **SOUND** research

WITH  
*Magnecorder*  
High Fidelity Tape Recorders for Industry



**NOISE ANALYSIS • PROCESS CONTROL**  
**VIBRATION TESTS • TELEMETERING**

Used by more engineers than all other professional tape recorders combined

#### Write for NEW CATALOG

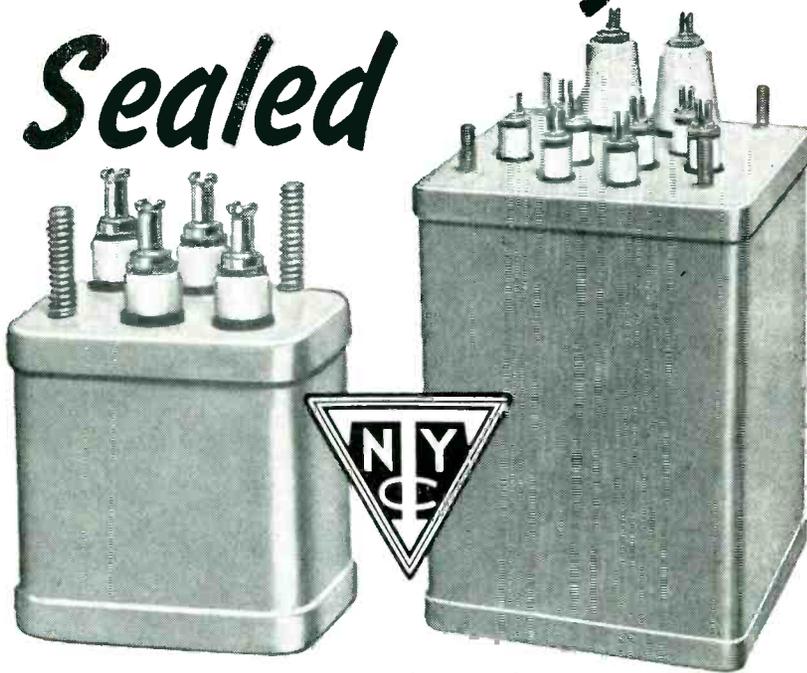
Magnecord, Inc., Dept. EA-5  
360 N. Michigan Ave., Chicago 1, Ill.  
Send me further information on Magnecord tape recordings for industrial Sound Research

Name.....  
Company.....  
Address.....  
City..... Zone..... State.....



360 NORTH MICHIGAN AVENUE  
CHICAGO 1, ILLINOIS

# Hermetically Sealed



Power — Audio — Plate

## TRANSFORMERS

FULL RANGE  
of  
STANDARD

**MIL-T-27**  
CASES

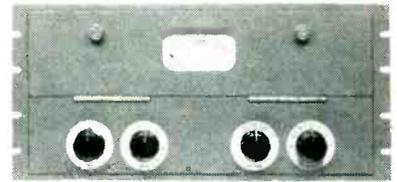
**Prompt  
Delivery**

of  
Pre-production samples  
to your specifications

**NEW YORK  
TRANSFORMER CO., INC.**  
ALPHA, NEW JERSEY

NEW PRODUCTS

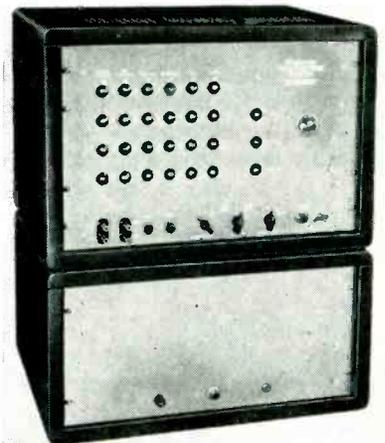
(continued)



ing and prevents overmodulation of the transmitter, thus permitting substantial increase in the average modulation level and a greater transmitting range with the same carrier power. In recording applications it prevents overcutting of the recording disc on heavy passages and allows a marked improvement in signal-to-noise ratio. It features a 54-db gain below the verge of limiting, and a maximum output level of 30 dbm at the verge of limiting. Frequency response is approximately  $\pm 1$  db from 30 to 15,000 cps, while harmonic distortion is less than 1 percent rms from 100 to 15,000 cps at 15-db gain reduction. Signal-to-noise ratio is 83 db at verge of limiting, and compression ratio above verge of limiting is 20 db into 2 db.

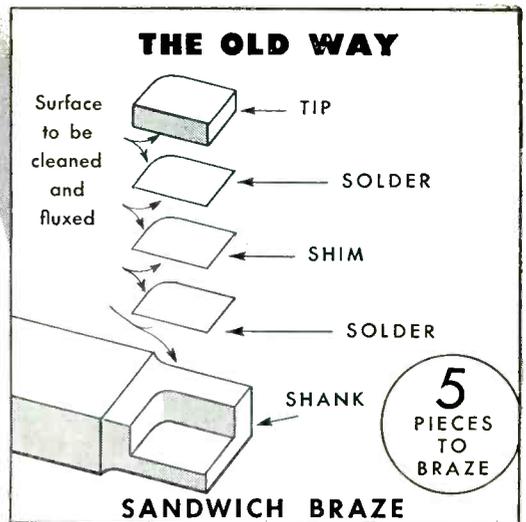
### Frequency-Time Counter

POTTER INSTRUMENT CO., INC., 115 Cutter Mill Road, Great Neck, N. Y. Model 801 megacycle frequency-time counter can be used for frequency measurements, time interval measurements and frequency ratios and, in addition, can be used as a secondary frequency standard, a 1-mc totalizing electronic counter and a direct-reading rpm tachometer. The instrument incorporates two



## Problem:

### How to Speed Up Sandwich Brazing Carbide Tool Tips



## General Plate:

### Provided the Solution with "BONDWICH"... a Composite Metal Combination

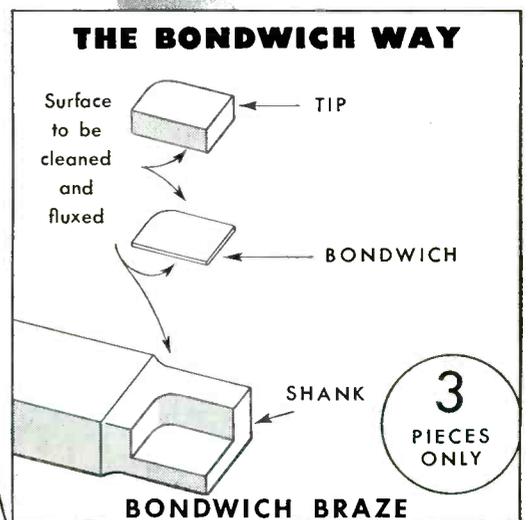
Carbide tipped tools give best results if the tip is brazed to the shank by sandwich brazing. However, the disadvantage of this method is the work involved in cleaning, fluxing, and positioning the three separate pieces of brazing alloy and shim material in addition to the tip and shank.

General Plate engineers solved the problem by bonding *into a single sheet* the three mentioned pieces. The result... a *General Plate composite metal* called "BONDWICH."

The two outer layers of "BONDWICH" are brazing alloy... the center piece a ductile shim. The bond is so perfect that when the brazing temperature is reached, complete wetting takes place. There are minimum voids in the final braze as the evenly wetted shim carries the braze all over. In addition to providing a better braze, "BONDWICH" speeds up carbide tip tool brazing, cuts production costs.

No matter what your metal problem, it will pay you to consult with General Plate. Their vast experience in cladding precious to base metals or base to base metals can overcome your problems... often reduce costs.

General Plate Products include... Precious metals clad to base metals, Base metals clad to base metals, Alcuplate (copper and aluminum), Silver Solders, Composite contacts, buttons and rivets, Platinum fabrication and refining, Age-hardenable #720 Manganese Alloy. Write for information.



Have You a Composite Metal Problem?  
General Plate can solve it for you

**GENERAL PLATE**

Division of Metals & Controls Corporation  
305 FOREST STREET, ATTLEBORO, MASS.



● Our Engineering Department will assist you in the design and application of high quality fine pitch gears, worms, etc., without obligation. We invite you to submit your prints for quotation.

*Gear*

**REFLECTIONS...**

● Gears are the motivating force in such units as highly sensitive instruments, fishing reels, timers, tuning devices, or gear reducers. The smooth operation and often the success of these units depends on the quality of gears used.

● Quality-made gears reflect the ability and experience of their maker. In turn, they also reflect the reliability of the unit in which they are installed.

MEMBER OF

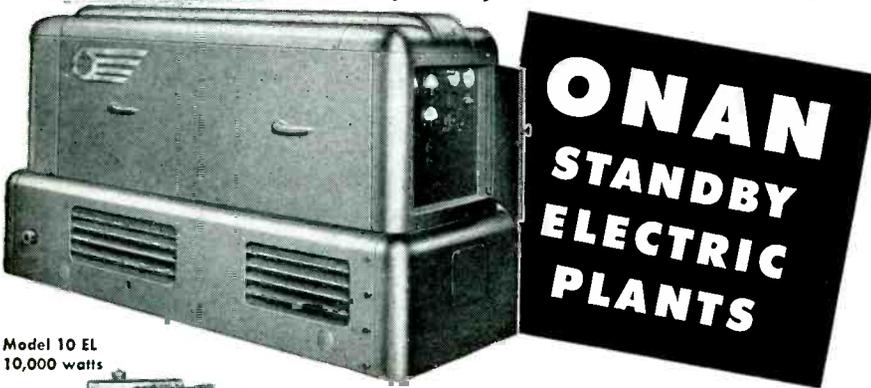


SEND FOR BULLETIN

*Beaver Gear Works Inc.*

1021 PARMELE STREET, ROCKFORD, ILLINOIS

*Emergency*  
**ELECTRIC POWER**  
For A.M., F.M., and Television Stations



Model 10 EL  
10,000 watts



**PORTABLE A.C. ELECTRIC PLANTS  
FOR FIELD AND MOBILE RADIO**

Supply power for transmission at scene of events. Can be carried by hand or in trunk of car. Take up only a few square inches of space in mobile unit. Weigh as little as 80 pounds. Lightweight models: 350 to 3,000 watts. Other models to 35,000 watts.

Stay on the air during power failures. When storms, floods, or breakdowns interrupt electric service to your station and force you off the air, you lose listeners, you lose income. Protect yourself against loss . . . make sure of your ability to give vital service to your community during disaster periods by installing a dependable Onan Emergency Electric Plant.

An Onan plant will take over the job of supplying electricity for studios and transmission automatically when power is interrupted. Plant stops itself when power is restored. Upkeep costs are negligible.

Write for Folder  
or Engineering Service



**D. W. ONAN & SONS INC.**  
7022 Royalston Avenue, Minneapolis 5, Minnesota

complete electronic counting chains, a 100,000-cps crystal oscillator frequency standard and unique electronic switching and gating circuits. Frequency measurements up to 1 million cps may be made in a few seconds with a minimum accuracy of 0.001 percent. Time intervals up to 10 seconds may be measured in increments of 10  $\mu$ sec from common or separate input lines.

**Literature**

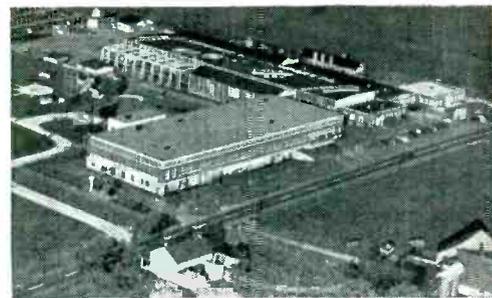
**Injection Molding Powders.** Rohm & Haas Co., Washington Square, Philadelphia 5, Pa. Booklet PL-35 is a 12-page brochure giving reference data for the man who has to design molded acrylic parts and for the men who mold them. Techniques included are design, predrying the powder, and typical molding conditions. Suggested steps to produce high quality Plexiglas molded parts are shown in tabular form under the headings, defects and suggested remedies.

**Control Track Generator.** Fairchild Recording Equipment Corp., 154 St. & 7th Ave., Whitestone, N. Y. A single-page bulletin tells how the control track generator makes possible picture synchronous sound-track recording with any tape recorder with response good to 14 kc. The unit described and illustrated has a minimum number of controls and connections, and is compact and portable.

**Electronic Transformers.** Triad Transformer Mfg. Co., 2254 Sepulveda Blvd., Los Angeles 64, Calif. Catalog TR-51 contains detailed specifications, illustrations and prices on a line of electronic transformers. The publication features 35 new items, including a series of transformers developed especially for regulated power supplies, tv components and complete details on the HF-10 Hi-Fidelity amplifier kit.

**R-F Gear-Hardening Machine.** Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. Detailed operational information about the

# With our hands full today...we've our eye on tomorrow



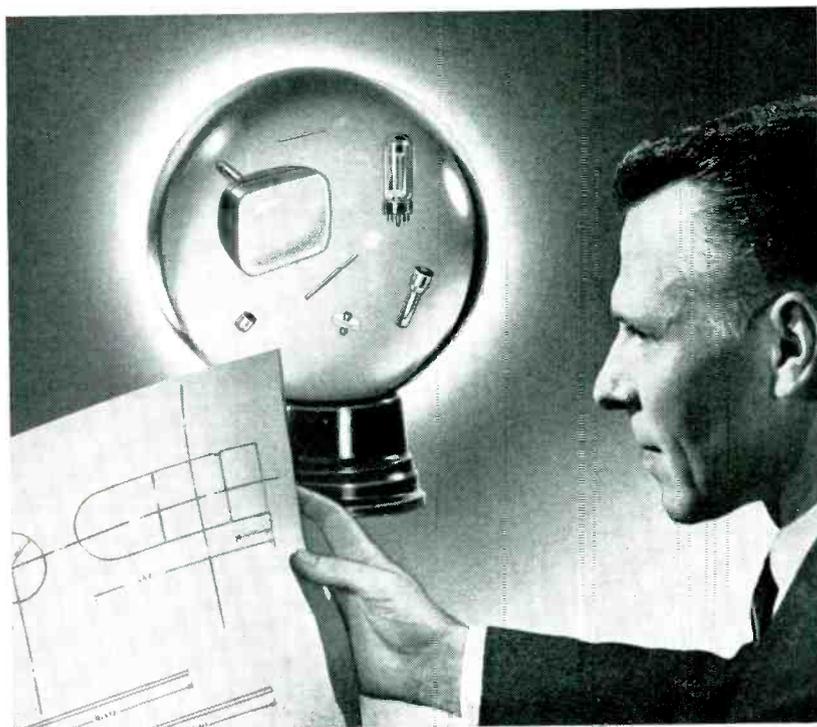
**Buildings** . . . enclosing more than 4 acres —all devoted to the development, production and testing of fine small tubing.



**Men and Machines** . . . fabricating, inspecting and finishing parts to meet the most exacting specifications.



**Engineering** . . . laboratory equipment for all kinds of testing, including emission characteristics of nickel cathode materials.



Here at Superior we produce quantities of quality parts for the Electronics Industry. Our research engineers are constantly at work to improve these products and to develop new parts to do the job better. Production-wise we're working just as constantly to produce more and more of these better products for you.

From 1949 to '50, we doubled our disc cathode capacity, added over 50% to Seamless cathode capacity. Through the same period we almost doubled the number of machines making Lockseam

cathodes . . . more than doubled capacity. 1950 production of Lockseam cathodes increased 280% over 1949. Demand kept pace with the increase.

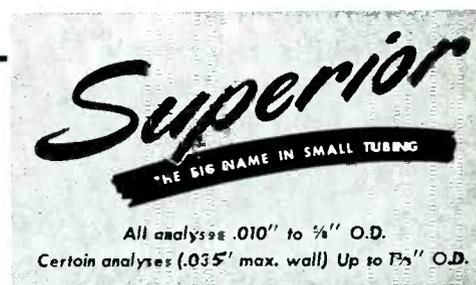
Plans for the future include the installation of new machines and the improvement of already good processes so that the Electronics Industry's coming needs may be as well met as its past demands.

Then as now, we at Superior will deliver truly superior small tubing products to do tough jobs better. Superior Tube Company, 2500 Germantown Ave., Norristown, Pa.

## Which Is The Better For Your Product . . .

**SEAMLESS** . . . ? The finest tubes that can be made. Standard production is .010" to .121" O.D. inclusive, with wall thicknesses of .0015" to .005". Cathodes with larger diameters and heavier walls will be produced to customer specification.

**Or LOCKSEAM\*** . . . ? Produced directly from thin nickel alloy strip stock, .040" to .100" O.D. in standard length range of 11.5 mm to 42 mm. Round, rectangular or oval, cut to specified lengths, beaded or plain.



\*MFD. UNDER U. S. PATS. SUPERIOR TUBE COMPANY • Electronic Products for export through Driver-Harris Company, Harrison, New Jersey • Harrison 6-4800

MANUFACTURERS AND DESIGNERS OF  
**CONTINUOUSLY VARIABLE  
 REGULATED DC SUPPLIES**

**MODEL  
 D6-DUAL,  
 HEAVY DUTY**



- ✓ **DUAL regulated outputs, continuously variable, 0 to 600 volts.**
- ✓ **Maximum current 200 milliamperes each, or 400 combined.**
- ✓ **Regulation better than .5%.**
- ✓ **6.3 volts AC at 10 amperes center-tapped.**
- ✓ **Ripple voltage less than 10 millivolts.**
- ✓ **Stabilized bias supply.**
- ✓ **Request Bulletin 53 for Detailed Information.**

**MODELS  
 A3 AND A3A**



- ✓ **Continuously variable, 0 to 350 volts.**
- ✓ **Ripple voltages less than 10 millivolts.**
- ✓ **Regulation better than .5%.**
- ✓ **Maximum current 200 milliamperes.**
- ✓ **Stabilized variable bias supply.**
- ✓ **6.3 volts AC at 5 amperes.**
- ✓ **Request Bulletin 52 for Detailed Information.**

**Oregon** ELECTRONICS  
MANUFACTURING CO.  
 206 S.W. WASHINGTON ST., PORTLAND 4, ORE., U.S.A.

new radio-frequency gear-hardening machine, the Inductall, is presented in booklet B-5259. Adaptability of the unit described in handling spindle gears, spur gears, cluster gears and shafts for either through or contour hardening is explained with the help of diagrams and photographs. Versatility of operation, the booklet points out, is achieved by use of a single-spindle type of feed that makes setups simple and fast.

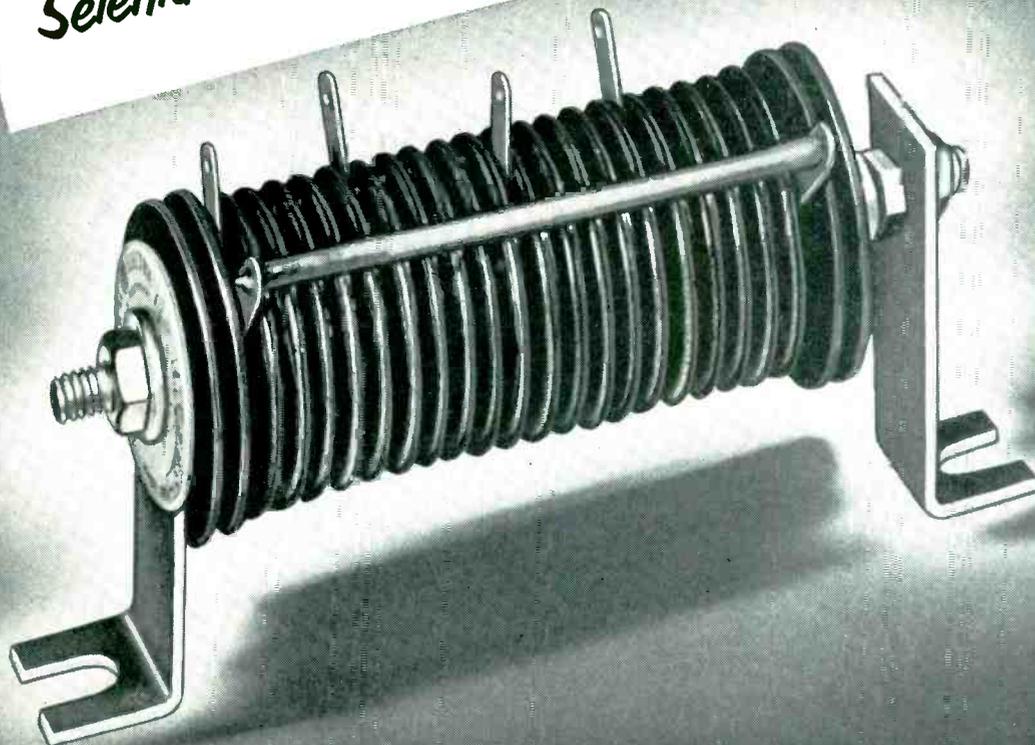
**Laminating Resin.** Houghton Laboratories, Inc., 322 Bush St., Olean, N. Y. Sales bulletins No. 615 and 613 deal with Hysol 6102, and 6101 respectively. The former describes a new type of low-pressure laminating resin, supplied in two components and characterized by excellent electrical properties and outstanding resistance to acids and alkali. The latter treats of a new resin (for use in coating electronic equipment subjected to corrosive conditions) that can be used at 230 to 250 F continuously without embrittlement. Specifications and properties are included.

**Rubber-Sealed Plugs.** Cannon Electric Development Co., Div. of Cannon Mfg. Corp., 3209 Humboldt St., Los Angeles 31, Calif., has issued a four-page bulletin (RS-1) on its new line of RS hermetically-sealed (rubber-sealed) plugs used largely on aircraft relays and other sealed components. Two basic variations comprise the series described: those with coupling nuts and those with barrels only. Inserts discussed are made of polychloroprene rubber with high insulation resistance and dielectric strength, and hold standard AN-type pin contacts only.

**Servicing with VTVM.** Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y., has announced a new 48-page booklet with comprehensive information on the use of vacuum-tube voltmeters in radio and tv servicing. The booklet is divided into five chapters of concise instructive text describing different types of vtvm's, their adjustment and application for: radio receiver tests



## High Voltage Selenium Rectifiers



# HOW TO TEST RECTIFIER QUALITY

Whether you buy selenium rectifiers for your own use or to build into your product, you want to know just what you are getting. We want you to compare G-E rectifiers with other rectifiers of the same rating. That way you can see for yourself the superior qualities of G-E selenium rectifiers before you buy.

*Read these suggestions and then send for the testing bulletin.*

**COMPARE FORWARD RESISTANCE**—Comparison will show the extremely low forward resistance of G-E cells—will show you why they deliver higher output voltage—will

show how you can cut costs in circuit components and design.

**COMPARE BACK LEAKAGE**—Comparison will show the low back leakage of G-E cells—will show you why their lower internal losses mean higher output. Lower leakages mean less heating, longer life, economical operation for G-E high-voltage rectifiers and the equipment they ably service.

**COMPARE TEMPERATURE RISE**—Because of their low forward resistance and low back leakage, they are cooler operating—don't overheat nearby parts—require less ventilation—have longer life.

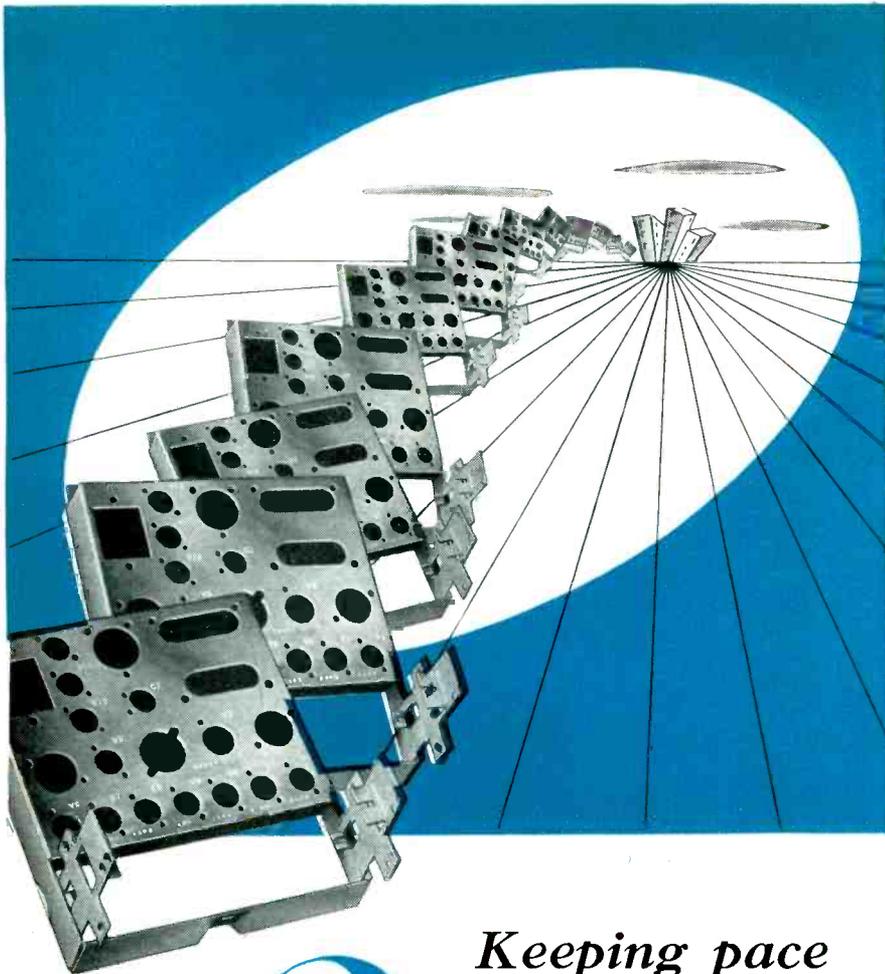
We want you to make these comparison tests. We want you to prove to yourself conclusively that G-E selenium high-voltage rectifiers are superior. Compare, and you'll decide to use them in your next job—to make the long-term high output of G-E stacks help keep your product out front.

\* \* \*

Write Section 461-15, *Apparatus Department, General Electric Company, Schenectady 5, New York* for a copy of GEA-5524 which gives details on comparative testing. Or, arrange for test details and sample units through the General Electric specialist at your local G-E office.

461-15

# GENERAL ELECTRIC



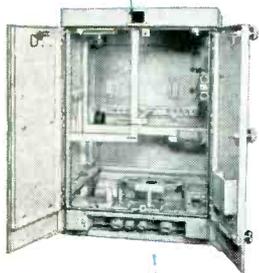
Keeping pace  
with **3** times the space!

With the addition of a new plant in Hingham, Mass., Donnelly now has three times the floor space of a year ago. More and more machinery and skilled workers have also been added to meet the enormously increased demands of defense production. America's top manufacturers of military radar, sonar, bombsight, fire control and jet engine equipment now call on Donnelly for fast, quantity production of Armed Forces Certified sheet metal work.

So why take a chance? For fabrication of aluminum and steel chassis and cabinets —

**Donnelly** MANUFACTURING

A DIVISION OF JOHN DONNELLY & SONS  
3134 WASHINGTON ST., BOSTON, MASS.



and measurements, tv receiver tests and miscellaneous uses. The publication will be sold at one dollar per copy.

**Antenna Catalog.** The LaPointe Plascomold Corp., Windsor Locks, Conn. The 16-page 1951 catalog, including the complete line of Vee-D-X tv antennas and accessories, was recently issued. Along with technical, installation and ordering data on all antennas, the catalog contains general information of interest to the trade. Considerable space has been devoted to such products as the lightning arrester, the 3-way switch box, the Mighty-Match and Vee-D-X towers.

**Self-Recording Accelerometers.** Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul W4, Minn., has published a four-page folder on its self-recording accelerometers that feature a permanent-magnet recorder, exchangeable seismic element, convenient electrical playback and expanded visual display. The well-illustrated bulletin gives complete description and technical specifications.

**Pressure Terminals and Connectors.** The Thomas & Betts Co., Inc., Elizabeth 1, N. J. Sta-Kon bulletin No. 61 lists a wide line of pressure terminals and connectors for every type of application on all wire sizes from No. 26 through 250 mcm. A particularly useful feature is a section giving a complete listing of Armed Forces procurement numbers with corresponding catalog numbers. Complete dimensions of specific types are given in simplified tabular arrangement.

**Soft-Soldering Technique.** Multicore Sales Corp., 164 Duane St., New York 13, N. Y., has available reprints of an article on soft-soldering technique. Ideal for an employee training manual, the text is written in simple language and accompanied by diagrams. The history, content and construction of solders is discussed with the uses and purposes of each. The joinings necessary for various metals, and the occurrence and

# Westinghouse offers

## **OPPORTUNITY and SECURITY** **FOR** **ELECTRICAL and MECHANICAL** **ENGINEERS** **METALLURGISTS, PHYSICISTS, and CHEMISTS** **IN DESIGN, RESEARCH, APPLICATION, DEVELOPMENT**

### **investigate immediately!**

See what Westinghouse offers you in the CAREER OF YOUR CHOICE.

**Unlimited Opportunity**—Good engineers have unlimited opportunity at Westinghouse where more than half of the top executives are engineers. They understand your language. They are proof that you can make your own future at Westinghouse. Right now we are building seven new plants. As new plants and divisions get into production, many supervisory posts will be filled from our engineering staff.

**Security**—Nearly all of the engineers who joined us in World War II are still with us, and in the past 10 years our total employment has almost doubled. These are not temporary jobs.

**Participation in the Defense Effort**—In 1951, a large part of all Westinghouse production will be to satisfy the nation's military needs.

**Minimum Experience Required**—2 years . . . but some of these openings call for top-flight men with more experience.

**Salaries**—Determined individually on the

basis of the experience and ability of the applicant.

**Location**—There are openings for engineers, metallurgists, physicists, and chemists at most of Westinghouse's 36 plants. For example: you'll find opportunities to do jet engine work at Kansas City, Missouri and South Philadelphia, Pa. . . . in Ordnance manufacturing at Sunnyvale, California and Sharon, Pa. . . . on atomic power projects in Pittsburgh, Pa. . . . in radar and electronics at Baltimore, Md. . . . in aircraft equipment and fractional horsepower motors at Lima, Ohio . . . and in commercial and airport lighting at Cleveland, Ohio . . . and in power producing equipment to speed the production lines of America. And all of these activities have a definite and established peacetime application.

### **WESTINGHOUSE OFFERS YOU IN ADDITION TO GOOD PAY**

- Help in finding suitable housing.
- Low cost life, sickness and accident insurance with hospital and surgical benefits.
- Modern pension plan.
- Opportunity to acquire Westinghouse stock at favorable prices.
- Privilege of buying Westinghouse appliances at employe discount.

**Investigate Westinghouse today . . . write Mr. R. P. Meily,  
Westinghouse Electric Corporation, Box 2182  
306 Fourth Ave., Pittsburgh 30, Pa.**



Let us be  
your dependable  
production arm for

CABINETS

CHASSIS

HOUSINGS

COMPLETE ASSEMBLIES

Corry-Jamestown's three large plants can give you *prompt* delivery on cabinets, housings, chassis and complete assemblies for radar and other electronic equipment. We're ready with the latest time-saving metal fabricating equipment . . . skilled craftsmen . . . a staff of highly specialized engineers . . . and the production know-how of 30 years experience fabricating steel, stainless steel and aluminum. Best of all, a high regard for quality has always been second nature with us. We're ready, *right now*, to sit down with you over your blueprints . . . or to send you detailed information on our equipment, our capacity, etc. Your inquiries are invited.

**CALL, WRITE OR WIRE US TODAY!**

**CORRY-JAMESTOWN MFG. CORP.**

CORRY, PENNSYLVANIA

*Makers of famous Steel Age office furniture*

avoidance of dry joints are described. Fluxes and the way they work are explained.

**Recording Equipment.** Cook Research Laboratories, 1457 Diversey Parkway, Chicago 14, Ill. Bulletin R-8 contains a series of project digests describing in detail a line of recording equipment that has been developed which may prove helpful to laboratories and related services in avoiding unnecessary expense and duplication in the development of similar equipment. The well-illustrated booklet gives project titles, statements of problems and summaries of results. Price sheets are included.

**Components Catalog.** Stackpole Carbon Co., St. Marys, Pa. The new 42-page RC-8 catalog lists, besides the standard lines, a number of items that are cataloged for the first time. Included are several single, dual-shaft and special-purpose volume controls, new 3-ampere slide switches, and Ceramag non-metallic cores in "U," "E," width control and segmented deflection yoke types for modern tv uses. Complete mechanical and electrical specifications simplify component selection and the catalog contains a great deal of helpful engineering data.

**Electronics Parts Catalog.** A. W. Franklin Mfg. Corp., 43-20 34th St., Long Island City 1, N. Y. A 20-page catalog gives detailed specifications on a wide variety of acorn, c-r tube, ceramic, laminated, miniature, molded, octal and wafer-type sockets. Terminal strips, connectors, plugs and pen-board assemblies are also described. A revolutionary miniature tube socket suitable for automatic mass production dip soldering of circuit components is illustrated. Four pages of illustrations and descriptions are also provided on a circuit stamping process. Applications of this process are shown for loop antennas, amplifier circuits, cable assemblies and tv tuners.

**Dynamic Microphone.** Electro-Voice, Inc., Buchanan, Michigan. Bulletin 160 illustrates and de-

# TWO NEW OSCILLATORS EVERY LABORATORY NEEDS

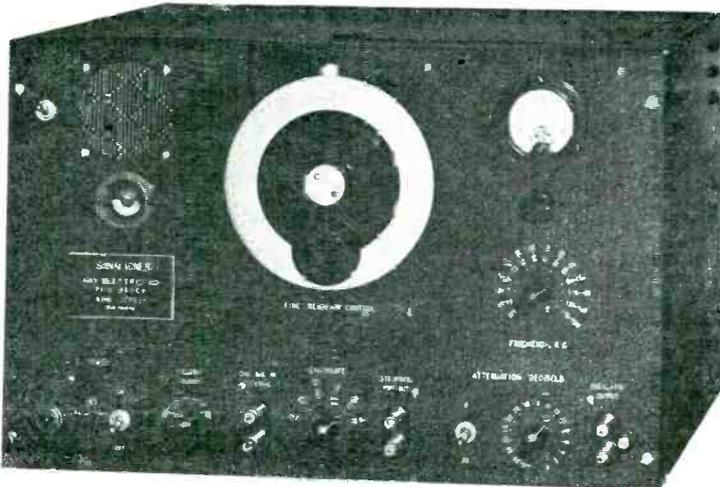
## THE MARKA-SWEEP MODEL VIDEO

The Marka-Sweep Model Video is an electronically swept video sweep oscillator covering frequencies up to 20 mc. Crystal positioned marks of pip type are provided at 1, 2, 5, 10, 15 and 20 mc. By use of external signal generator a variable frequency pip type marker is available. Output maximum is 0.3 volt from a 72 ohm internal impedance.



Sweep Ranges: 50 kc to 10 mc and 50 kc to 20 mc.  
Crystal positioned pip type Marks connected directly to oscilloscope.  
Variable frequency pip Mark directly to oscilloscope by use of external signal generator. Separate attenuators on

pip markets and video output.  
Sawtooth sweep for sweeping video output and deflecting oscilloscope horizontal.  
Produces Zero Level Baseline on oscilloscope.  
Price: \$495.00 F.O.E. Factory



## THE SORALIGNER

The Soraligner is a very stable and accurate oscillator in the supersonic range suitable for use in determining the pass band of narrow band supersonic filters and other accurate work in this range.

Outputs Developed at Fundamental Frequency—No beat oscillators.

Frequency Range: 1 kc to 200 kc in 13 Bands. Output: Maximum of 2 volts from 600 ohms Includes Output Level Meter and Calibrated Attenuator; Crystal Check Point: Accuracy to 0.01% included—may be externally

calibrated—Marks every 2, 10, 50, 200 kcs—Timing "comb" may be used for accurate alignment of Radar range circuits.

Accuracy: 0.1% Closer at Check Points.

Price: \$695.00 F.O.B. Factory

Prices 10% Higher outside of U. S. A. and Canada. Send for 1951 Catalog.



# KAY ELECTRIC COMPANY

25 Maple Avenue

Phone Caldwell 4-4096

Pine Brook, New Jersey



## planting trees with tractors to make fibres for industry



With this MOSINEE Tree Planter, 1500 or more seedlings can be planted per hour! It *completes* the planting operation...even tamps the seedlings into the ground.

This is the beginning of a 30 to 40-year cycle during which seedlings grow to matured trees, ready for harvesting. They then will provide the kind of fibres needed for many products of industry.

From seedlings to technically controlled industrial paper, MOSINEE safeguards every step in the process of making MOSINEE fibres that work for Industry.

MOSINEE PAPER MILLS CO., Mosinee, Wis.



# MOSINEE

**makes fibres work for industry**

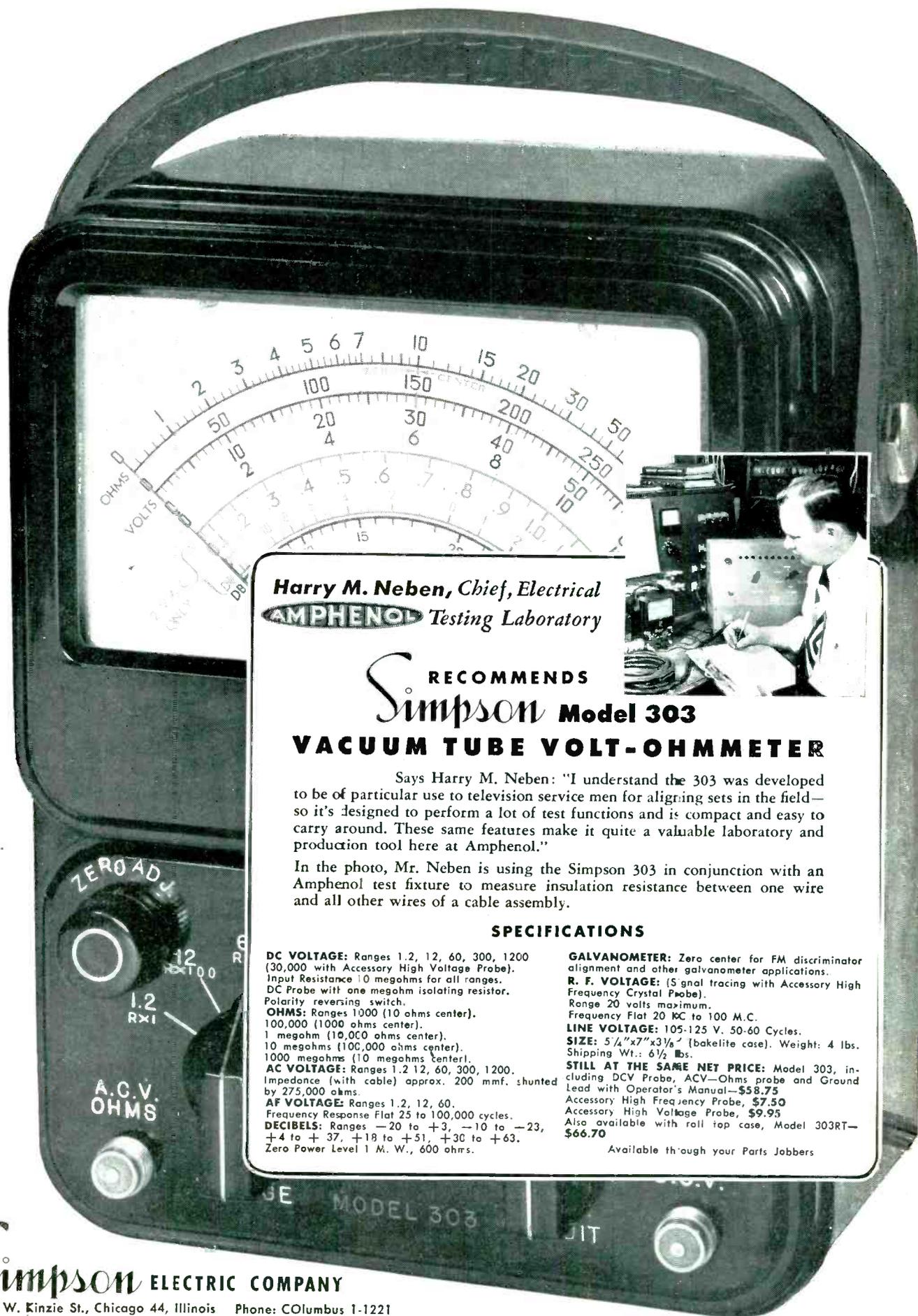
scribes the model 636 Slimair dynamic microphone. Photos show the modern slim-trim design of the unit and how easily it can be used on a stand or boom, vertically or tilted, or in the hand. It also shows how the Acoustalloy diaphragm and the pop-proof head insure smooth response and make the mike extra rugged for indoor and outdoor use, in all climates. Complete specifications and data are given.

**Subminiature Capacitors.** Fansteel Metallurgical Corp., 2200 Sheridan Road, North Chicago, Ill. A series of subminiature tantalum capacitors, notable for stability over wide ranges of time and temperature, is announced in bulletin 6.531. The polarized electrolytics described occupy less than 1/10 cubic inch excluding connection leads, and consist of a porous tantalum anode permanently sealed into a fine silver cathode that also serves as the container. Nine standard capacitors are listed, ranging from 30  $\mu\text{f}$  at 6 volts d-c to 3.5  $\mu\text{f}$  at 75 volts d-c.

**Quartz Crystal Units.** Reeves-Hoffman Corp., Cherry and North Streets, Carlisle, Pa. An 8-page folder illustrates and describes a complete line of quartz crystal units. Frequency ranges, dimensional diagrams, circuits, a typical frequency-temperature characteristic and ordering information are included.

**Low-Power Klystron Supply.** The Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif. Volume 2, No. 4 of the Journal is chiefly devoted to the model 715A bench-type power supply for operating low-power klystrons. The unit described provides a regulated beam supply adjustable from -250 to -400 volts d-c at currents up to 50 ma; a regulated reflector supply adjustable from -10 to -900 volts d-c; square-wave modulation on the reflector supply at a nominal repetition frequency of 1,000 cps; and a 6.3-volt a-c filament supply. Illustration, complete description and specifications are included.

**Ceramic Disc Capacitors.** Cornell-Dubilier Electric Corp., South Plainfield, N. J. Four single-page



**Harry M. Neben, Chief, Electrical**  
**AMPHENOL Testing Laboratory**



RECOMMENDS  
**Simpson Model 303**

**VACUUM TUBE VOLT-OHMMETER**

Says Harry M. Neben: "I understand the 303 was developed to be of particular use to television service men for aligning sets in the field—so it's designed to perform a lot of test functions and is compact and easy to carry around. These same features make it quite a valuable laboratory and production tool here at Amphenol."

In the photo, Mr. Neben is using the Simpson 303 in conjunction with an Amphenol test fixture to measure insulation resistance between one wire and all other wires of a cable assembly.

**SPECIFICATIONS**

**DC VOLTAGE:** Ranges 1.2, 12, 60, 300, 1200 (30,000 with Accessory High Voltage Probe).  
 Input Resistance 10 megohms for all ranges.  
 DC Probe with one megohm isolating resistor.  
 Polarity reversing switch.  
**OHMS:** Ranges 1000 (10 ohms center), 100,000 (1000 ohms center), 1 megohm (10,000 ohms center), 10 megohms (100,000 ohms center), 1000 megohms (10 megohms center).  
**AC VOLTAGE:** Ranges 1.2, 12, 60, 300, 1200. Impedance (with cable) approx. 200 mmf. shunted by 275,000 ohms.  
**AF VOLTAGE:** Ranges 1.2, 12, 60. Frequency Response Flat 25 to 100,000 cycles.  
**DECIBELS:** Ranges -20 to +3, -10 to -23, +4 to +37, +18 to +51, +30 to +63. Zero Power Level 1 M. W., 600 ohms.

**GALVANOMETER:** Zero center for FM discriminator alignment and other galvanometer applications.  
**R. F. VOLTAGE:** (Signal tracing with Accessory High Frequency Crystal Probe). Range 20 volts maximum. Frequency Flat 20 KC to 100 M.C.  
**LINE VOLTAGE:** 105-125 V. 50-60 Cycles.  
**SIZE:** 5 1/4" x 7" x 3 1/8" (bakelite case). Weight: 4 lbs. Shipping Wt.: 6 1/2 lbs.  
**STILL AT THE SAME NET PRICE:** Model 303, including DCV Probe, ACV-Ohms probe and Ground Lead with Operator's Manual—\$58.75  
 Accessory High Frequency Probe, \$7.50  
 Accessory High Voltage Probe, \$9.95  
 Also available with roll top case, Model 303RT—\$66.70

Available through your Parts Jobbers

**Simpson ELECTRIC COMPANY**

5200 W. Kinzie St., Chicago 44, Illinois Phone: COLUMBUS 1-1221  
 In Canada: Bach-Simpson, Ltd., London, Ont.

*World's Largest Makers of Electronic Test Equipment*

# FOR YOUR PANEL

A NOVEL and UNIQUE CIRCUIT INDICATOR

**DIALCO**

DESIGNED FOR NE-51 NEON LAMP

For 110 or 220 volt circuits

The required resistor is an integral part of this assembly — "built-in."

**RUGGED • DEPENDABLE  
LOW IN COST**



PATENTED: No. 2,421,321  
Cat. No. 521308-997

## WILL YOU TRY A SAMPLE?

Write on your company letterhead. We will act at once.  
No charge, of course.

**SEND FOR THE 192 PAGE HANDBOOK OF PILOT LIGHTS**

Among our thousands of Pilot Light Assemblies there is one which will fit your special conditions. Many are especially made and approved for military use. We pride ourselves on prompt deliveries—any quantity.

**ASK FOR OUR APPLICATION ENGINEERING SERVICE**

Foremost Manufacturer of Pilot Lights

**The DIAL LIGHT COMPANY of AMERICA**

900 BROADWAY, NEW YORK 3, N. Y.      SPRING 7-1300



**2 PROBLEMS**

1. How can I strengthen the magnetic field without increasing the size of my coil?
2. How can I reduce resistance, and hold my coil to the same space?

**2 ANSWERS!**

1. More winding of same gauge on same size coil base.
2. Larger gauge wire on same size coil base.

when you use  
**PRECISION BOBBINS**

**NO INSULATION STRIPS NEEDED**

Each winding layer fits snugly into the one below. This permits use of minimum coil size, yet provides adequate windings—enables you to cut costs substantially.

Precision Bobbins are spirally wound and heat-treated for extra strength; tube ends swaged to firmly lock vulcanized flanges. The entire Precision Bobbin is impregnated to meet Underwriters' requirements.

SEND FOR SAMPLES TODAY!

**PRECISION PAPER TUBE CO.**

2041 W. Charleston St.  
Chicago 47, Ill.

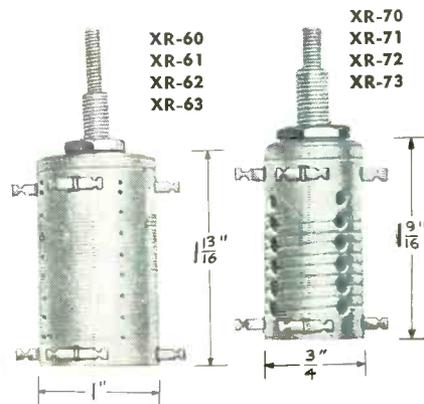
Plant No. Two, 79 Chapel St., Hartford, Conn.

Also Mfrs. of dielectric paper tubes



**NATIONAL**

- Proven
- Dependable
- Quality



**NEW  
CERAMIC  
& BAKELITE  
COIL  
FORMS**



High-grade ceramic coil forms conforming to JAN specifications. May be wound as desired to provide a permeability-tuned coil. Extra lugs provided • XR-60 (grooved for #26 wire, with iron slug) • XR-61 (same, brass slug) • XR-62 (not grooved, winding length 1 1/4", with iron slug) • XR-63 (same, brass slug) • XR-70 (grooved for #19 wire, with iron slug) • XR-71 (same, brass slug) • XR-72 (not grooved, winding length 1", with iron slug) • XR-73 (same, brass slug) • Mica-filled bakelite coil forms may be wound as desired to provide a permeability tuned coil. The form winding length is 1 1/16" and the form winding diameter is 1/2 inch. Slug is 3/8" dia. by 1/2" long • XR-50 (iron slug) • XR-51 (brass slug) • Write for drawings.

EXPORT DIV.—DEPT E551



bulletins describe a series of miniature ceramic disc capacitors for bypass and coupling in tv, f-m, uhf and vhf in compact, miniaturized equipment. The five basic types described are: type 2TM— $\frac{1}{4}$  in. diameter, single capacitor units from 500 to 1,000  $\mu\mu\text{f}$  at 500 volts d-c working; type 6TM— $\frac{19}{32}$  in. diameter, single capacitor units from 50 to 5,000  $\mu\mu\text{f}$  at 500 volts d-c working; type 8TM— $\frac{3}{4}$  in. diameter, with a capacitance rating of 10,000  $\mu\mu\text{f}$  (8TM5S1C) at 500 volts d-c working; type 6TM— $\frac{19}{32}$  in. diameter dual capacitor units (from  $2 \times 100$  to  $2 \times 2,500$   $\mu\mu\text{f}$ ) and type 8TM— $\frac{3}{4}$  in. diameter dual capacitor units, (from  $2 \times 3,000$  to  $2 \times 10,000$   $\mu\mu\text{f}$ ) all rated at 500 volts d-c working.

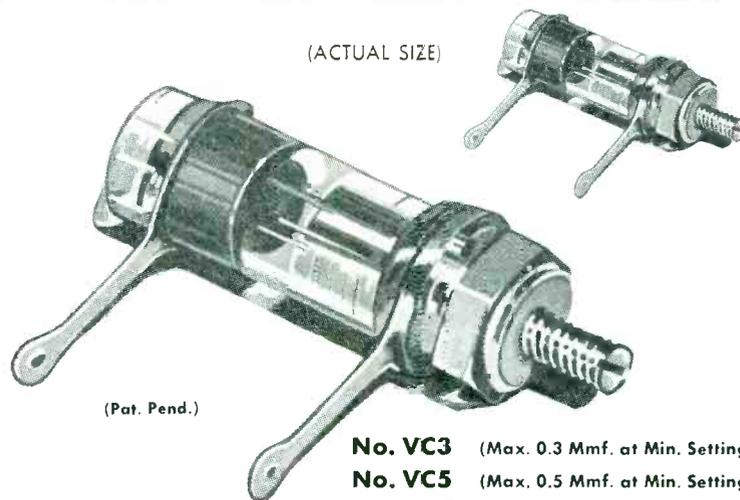
**Supersensitive Galvanometer.** Midwestern Geophysical Laboratory, 2803 W. 40th, Tulsa, Okla. A single-page bulletin gives an illustrated description of the model 1-06-SS galvanometer that has a sensitivity of 0.005 ma per in. at 12-in. focal distance (100-cps elements), a normal balance of 0.003 in. per G, and a special balance of 0.001 in. per G at the same distance. The unit described is available in three frequencies and characteristics of each are listed. The instrument in question was especially developed for use in recording signals direct from source without amplification.

**Miniature Tap Switches.** Tech Laboratories, Inc., Bergen & Edsall Boulevards, Palisades Park, N. J. Bulletin 29 covers the type 2B miniature tap switches that have already found many applications in defense work and can be furnished to JAN specifications. Included are a mechanical diagram, photos of the unit and complete technical specifications.

**Strip Chart Potentiometers.** Minneapolis-Honeywell Regulator Co., Brown Instruments Division, Wayne and Windrim Ave., Philadelphia 44, Pa. Multirecord ElectroniK strip chart control potentiometers furnished in both contact and proportional control types, and equipped with either a single or double set-point index, are de-

- ✦ New Standard of Tuning Accuracy!
- ✦ Maximum Space Economy!
- ✦ New Ease of Mounting!
- ✦ Low Temperature Coefficient!

## JFD PISTON TYPE VARIABLE TRIMMER CAPACITOR



(Pat. Pend.)

No. VC3 (Max. 0.3 Mmf. at Min. Setting)

No. VC5 (Max. 0.5 Mmf. at Min. Setting)

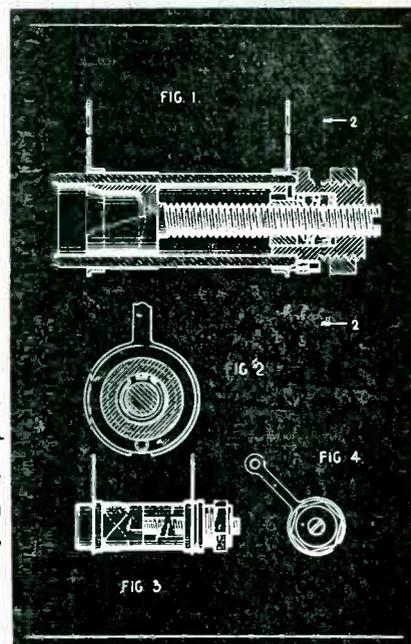
No. VC11 (Max. 1.5 Mmf. at Min. Setting)

The new JFD Piston Capacitor provides the minimum capacities needed for exceptionally accurate and stable electronic adjustments.

Tubular in design, it delivers continually uniform change of capacitance in relation to rotation. You can make and maintain smooth, precise settings without backlash or disturbance from severe vibrations. Thread wear is automatically taken up. Extremely compact, the space-saving JFD Piston Capacitor is only one inch in length—fits practically anywhere. Thus offering designers maximum space economy with ease of mounting.

### FIND OUT WHAT IT CAN DO FOR YOU!

Our engineers are ready and willing to discuss the application of this outstanding capacitor in your circuits. Write for complete data sheet.



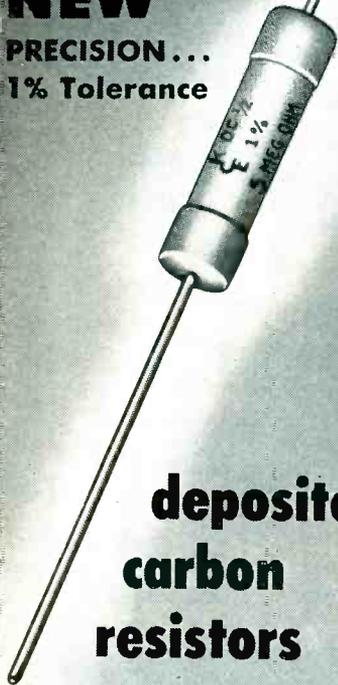
MANUFACTURING CO., Inc.

6145E 16th AVE., BROOKLYN 4, N. Y.

FIRST In Television Antennas and Accessories

*Electra*  
**carbon-coat**  
 PRECISION RESISTORS

**They're  
 NEW**  
 PRECISION...  
 1% Tolerance



**deposited  
 carbon  
 resistors**

The right choice for ACCURACY... ECONOMY... and STABILITY in circuits where wire wound resistors are often times too expensive and the characteristics of carbon composition resistors are not suitable. Deposited carbon resistors are especially adapted to high frequency applications that require high stability and close tolerance of resistance values. Manufactured to customer's specifications. For complete data mail coupon.

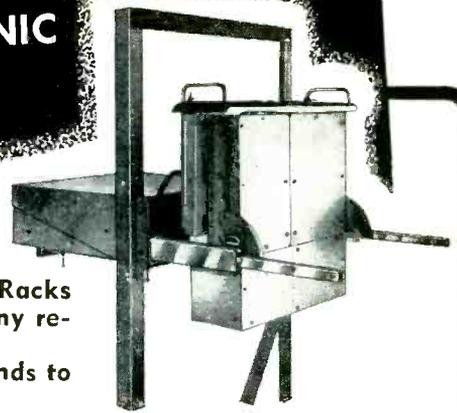
**ELECTRA MFG. COMPANY**  
 RESISTOR DIVISION  
 2537 Madison Ave. • Kansas City 8, Mo.  
 FOR 25 YEARS A MANUFACTURER OF  
 PRECISION ELECTRICAL EQUIPMENT

**ELECTRA MFG. COMPANY**  
 2537 Madison Ave. • Kansas City 8, Mo.

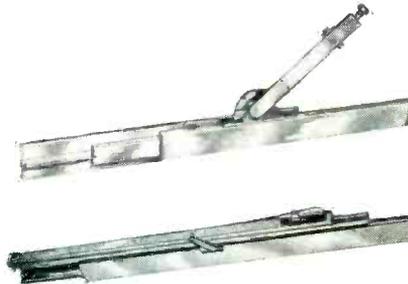
Please send Bulletin E-1—Complete Data on Deposited Carbon Resistors.

NAME \_\_\_\_\_  
 COMPANY \_\_\_\_\_  
 ADDRESS \_\_\_\_\_  
 CITY \_\_\_\_\_  
 STATE \_\_\_\_\_

**GRANT ELECTRONIC  
 EQUIPMENT  
 SLIDES..**



for Chassis, Consoles, and Racks  
 • a standard slide to meet any requirement  
 • slides to carry from 25 pounds to 2,000 pounds



No. 392 Three section slide, progressive action type. Locks in open position. Slide includes mechanism for unlocking from outside of chassis and for tilting to 90 degrees. Mechanisms vary to suit individual problem. Load Capacity: 100 lbs. per pair (depending upon length of slide and travel required)  
 No. 375 Three section slide, progressive action type. Ball bearing motion. Rugged, yet smooth in operation. Locks in extended position. Tripping mechanism controls unlocking. Slide travel distances as required. Load Capacity: 200 lbs. per pair (depending upon length of slide and travel required)

Consult our engineering department on your individual problems.



WRITE DEPT. E-5 FOR COMPLETE ILLUSTRATED INFORMATION  
**GRANT PULLEY & HARDWARE CO.**  
 31-87 WHITESTONE PARKWAY, FLUSHING, N. Y.  
 Representatives in all major cities

*The foremost name in Sliding Devices*

**"Precision first!"**

says famous instrument manufacturer  
 . . . specifies Bird Jewel Bearings



Almost invisible to the naked eye — yet precision depends on these quality controlled Bird Bearings

Microampere Meters from this leading manufacturer\* are world famous for top precision — owe much credit to quality construction that includes Bird Jewel Bearings. Two precision-made jewels — used as bearings for armature — assure smooth response . . . guarantee a lifetime of accurate operation.

Discover how Bird Jewel Bearings can solve your miniature bearing problems with unset or set assemblies to suit your requirements — write for information.

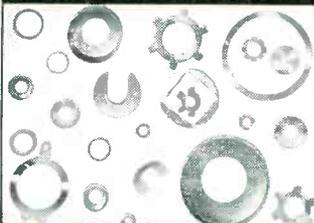
\*Name on request

*Richard H. Bird & Co., Inc.*

1 Spruce Street, Waltham 54, Mass.

Mfrs. of glass and sapphire jewel bearings for instruments, dials and gauges of all types

**WASHERS—ALL KINDS**



WASHER SPECIALISTS for nearly half-a-century. Dies in stock will produce most sizes. Big runs made with automatic presses. An economical, accurate, and highly reliable source for washers, also all kinds of metal stampings. HAVE WHITEHEAD'S CATALOG ON FILE; write for it.

BEVELED CUP  
 D-HOLE RETAINER  
 LOCK SPACERS  
 SPRING TENSION  
 SQUARE HOLE  
 STAR LOCK  
 THRUST TONGUE



EST. 1903

**WHITEHEAD STAMPING COMPANY**

1691 W. LAFAYETTE

• DETROIT 16, MICH.

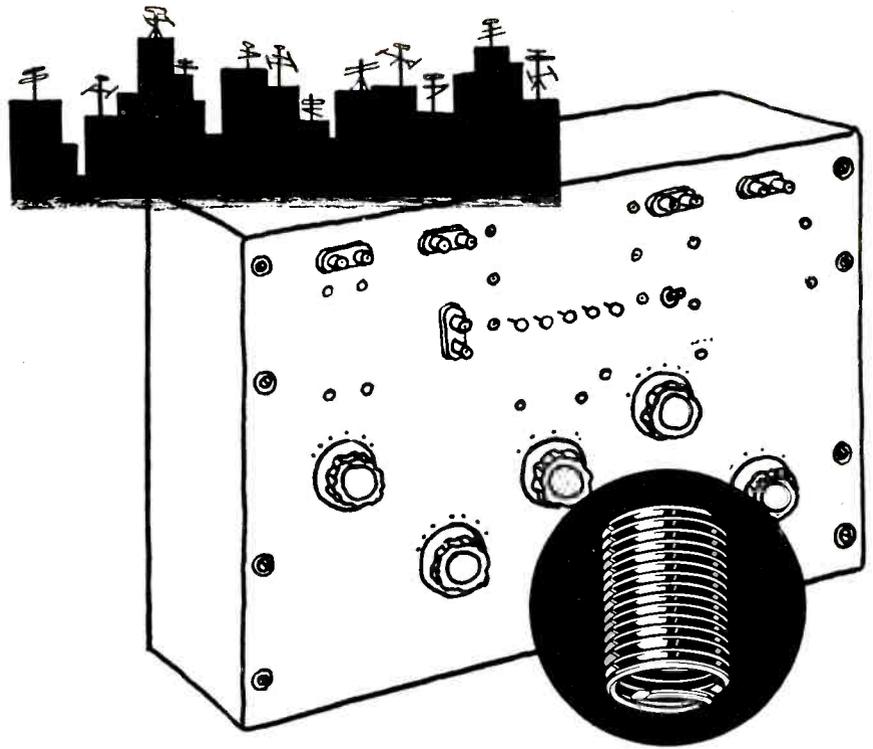
scribed and illustrated in specification sheet No. 189. Method of operation, general specifications, control forms and dimensional diagrams are included.

**Servo Amplifier System.** Minneapolis-Honeywell Regulator Co., Brown Instruments Division, Wayne and Windrim Ave., Philadelphia 44, Pa. A four-page pamphlet illustrates and gives technical details on the operation and application of a servo amplifier system especially adaptable to the detection and correction of error signals and operation of null-balance systems. The system described consists of a converter, amplifier and two-phase fractional horse-power motor.

**Power Supplies Catalog.** Furst Electronics, 12 S. Jefferson St., Chicago 6, Ill. The latest edition of the company's condensed catalog illustrates, in addition to a line of regulated power supplies, the new model 120 wide-band d-c amplifier as well as the model 115-R wow meter. Tables show model numbers, maximum output power for each, output voltages and currents, approximate output impedances, maximum ripple voltages (rms) and sizes.

**Flow-Detector Amplifier.** Rochester Electronics Co., Inc., Box 227, Penfield, N. Y. A single-sheet bulletin tells of the flow-detector amplifier (a low-priced instrument for detecting discrete particles falling onto a probe element) that was originally designed to detect drops of liquid, but can be used with smaller or larger masses of liquids and solids. The instrument's mode of operation and technical specifications are given.

**Rheostat Bulletin.** Rex Rheostat Co., 3 Foxhurst Road, P. O. Box 232, Baldwin, L. I., N. Y., has issued a bulletin on its vitreous enameled round type and tubular slide-contact rheostats. The new round type described features a rigid spring-hinged contact arm that assures unchangeable constant contact pressure; and is available in 7 sizes—50, 75, 100, 150, 225, 300 and 500 watts.



## HELI-COIL SCREW THREAD INSERTS ELIMINATE "ON-AND-OFF" WEAR AND FATIGUE

Strength and useful life of assemblies is increased without using awkward heavy bushings. Assemblies are lighter... design more compact.

Heli-Coil Inserts, precision-formed of stainless steel wire or phosphor bronze wire, outlast the product... never fail... never strip, gall, seize or corrode, and are free from vibration wear and electrolysis. Hence, assembly and disassembly are easy, however frequent, without screw thread wear and fatigue. Production salvage, repair and maintenance are simplified. You don't need any inventory of oversize bolts, studs and nuts.

Heli-Coil guarantees freedom from screw thread troubles for the life of the product. Made in National Coarse and Fine Thread sizes and pipe thread sizes... also in aircraft and automotive spark plug sizes. Meet all industrial, military and aircraft specifications. Class 2, 2B and 3 fit.

**HELI-COIL**

Heli-Coil is a Registered  
U. S. Tradename



Protecting Screw Threads for Industry

**CORPORATION**

HELI-COIL CORPORATION  
47-242 Thirty-Fifth Street,  
Long Island City 1, N. Y.

Please send me

- Bulletin 650 on Design Data  
 Bulletin 349 on Salvage and Service

NAME \_\_\_\_\_

FIRM \_\_\_\_\_

STREET \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

# Coil Insurance

## FOR FAMOUS PRODUCTS

SQUARE, ROUND  
OR RECTANGULAR  
1/2" to 30" LONG  
.450" to 25" I.P.  
TOLERANCES to .002"

PARAMOUNT Spiral Wound PAPER TUBES  
Protect Coil Accuracy and Stability  
in Countless Applications

Years of specialized "know-how" easily enable PARAMOUNT to provide exactly the shape and size tubes you need for coil forms and other uses. *Hi-Dielectric. Hi-Strength.* Kraft, Fish Paper, Red Rope or any combination wound on automatic machines. Wide range of stock arbors. Special tubes made to your specifications or engineered for you.

NEW! Moisture-Resistant *Shellac-Bond* Kraft Paper Tubing. Heated shellac forms a bond which prevents delaminating under moisture conditions.

### Paramount PAPER TUBE CORP.

616 LAFAYETTE ST., FORT WAYNE, IND.

Manufacturers of Paper Tubing for the Electrical Industry

WRITE  
ON COMPANY  
LETTERHEAD FOR  
STOCK ARBOR  
LIST OF OVER  
1000 SIZES

SEND  
FOR IT!

## 1951 ALLIED CATALOG

free!  
212-Page  
Buying  
Guide

World's Largest Stocks  
ELECTRONIC SUPPLIES  
for INDUSTRY and  
BROADCAST STATIONS



### One Complete Dependable Source for Everything in Electronics

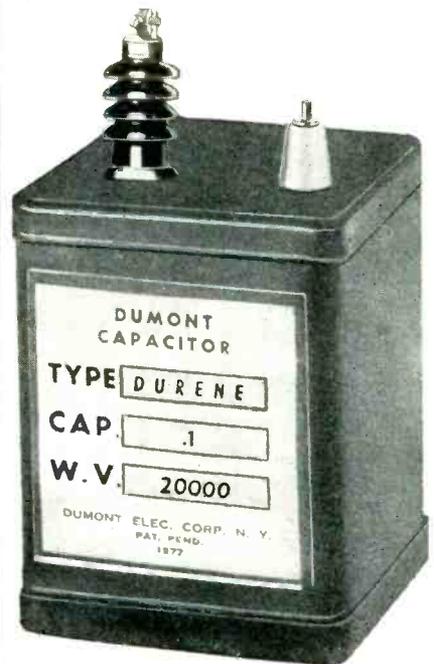
Simplify your purchasing—send your consolidated orders to ALLIED—the single, complete source for all Electronic Supplies. Depend on ALLIED for the world's largest stocks of special tubes, parts, test instruments, audio equipment, accessories—complete quality lines of electronic supplies. Our expert Industrial supply service saves you time, effort and money. Send today for your FREE copy of the 1951 ALLIED Catalog—the only complete, up-to-date guide to Electronic Supplies for Industrial and Broadcast use.

### ALLIED RADIO CORP.

833 W. Jackson Blvd., Dept. 11-E-1, Chicago 7, Illinois

We Specialize in Electronic  
Equipment for Research,  
Development, Maintenance  
and Production Operations

SEND FOR  
FREE 1951  
ALLIED CATALOG



# DUMONT

TYPE S2

*Polyethelene Film*  
(ZERO LOSS)

# CAPACITORS

FOR  
TELEVISION AND SHORT WAVE

Built in  
ALL VOLTAGES TO 50,000 V.

•  
*Extreme High Q*  
*Excellent Power Factor*  
*Moisture Proof*  
*Stable Capacity Range*  
*Long Life Duration*

•  
AVAILABLE IN TUBES  
OR METAL CANS

For Dependability  
Always Specify  
Dumont

Write for literature and samples

# DUMONT

## ELECTRIC CORP.

MFR'S OF  
CAPACITORS FOR EVERY REQUIREMENT  
308 DYCKMAN ST., NEW YORK, N. Y.

## NEWS OF THE INDUSTRY

(continued from page 148)

three-quarters as large as the Microwave Laboratory in which the university is constructing a new-type atom smasher, the electron linear accelerator, under another ONR contract.

### MIT announces Communications Course

A SPECIAL course in modern communications during the 1951 Summer Session from June 18 to July 6 at MIT will consist of lectures and laboratory experiments on selected topics in this new development, in both theory and application. The course is designed for research engineers concerned with the problems of transmission, presentation and assimilation of information. It should be of help to those interested in statistical methods and techniques for signal detection. Those concerned with human organizations will also find it stimulating, since consideration of the reactions and behavior of human beings in communication systems is a part of the communication problem.

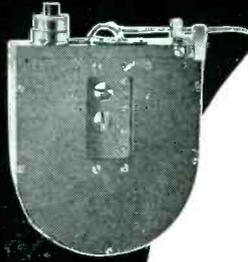
Lectures daily from 9 to 12 will be followed by discussion periods from 2 to 3 and laboratory work from 3 to 5, the latter in the Research Laboratory of Electronics or the Acoustics Laboratory. Tuition for the three-week program is \$175; no academic credit will be offered.

Since enrollment will be limited, early registration is advisable. Preference will be given to electrical and communication engineers and psychologists having a professional interest in the course, and to qualified students who wish to specialize in this subject. Requests for application forms and further information should be sent to Professor Walter H. Gale, Director of the Summer Session, Room 3-107, Massachusetts Institute of Technology, Cambridge 39, Mass.

### Guided Missiles Plant Opened

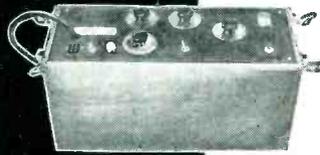
A PRODUCTION plant for guided missiles operating at supersonic speed has been opened in San Diego by

# Edin instruments



### OSCILLOGRAPH GALVANOMETER

No's. 8001, 8002, 8003 and 8004 ink-writing galvanometers have sensitivities from 3.5 to 40 volts per cm., resonant frequencies from 15 to 120 cps., resistances from 1000 to 2000 ohms, frequency response up to 350 cps., and a single-jewel pivot construction. Units are designed for multiple operation up to 10 channels in a total width of 12 inches.



### DIRECT-COUPLED AMPLIFIER

No. 8100 direct coupled amplifier has a voltage amplification of 13,000 with a maximum output of 70 volts. Frequency response from d.c. to 10,000 cps. is flat within 10%. Input impedance is 2 megohms; output impedance is 150 ohms. Input may range from 0.1 mv. to 100 volts. Stability is better than 0.1 mv. per thirty minutes, or 0.5 mv. per day. Attenuator is stepped for factors from 1 to 1000.



### OSCILLOGRAPHS

Recorders can be supplied with 1, 3 or 9 chart speeds ranging from 0.1 mm./sec. to 250 mm./sec. See specifications of OSCILLOGRAPH GALVANOMETER for frequency range.

### OSCILLOGRAPH AMPLIFIER

No. 8121 special amplifier has a time constant of 1 second, an exponential response to a square wave at high gain, input impedance of 1 megohm, and input from 0.1 mv. to 1000 volts. At low gain, No. 8121 becomes a DC amplifier with a voltage gain of 100 and an input of 10 mv./mm.

### HIGH-GAIN AMPLIFIER

No. 8130 amplifier has a voltage gain of 1,000,000 and includes a built-in pre-amplifier. Frequency response is from 1 to 200 cps. Input may range from 10 microvolts to 100 millivolts. This amplifier is particularly suited for Biological studies.

Many other types of recording and amplifier circuits are available and special equipment can be assembled to meet particular specifications.

EDIN COMPANY, INC.  
207 Main Street  
Worcester 8, Mass.

Please send complete information on:

- RECORDERS  No. 8100 AMPLIFIER  
 NO. 8121 AMPLIFIER  No. 8130 AMPLIFIER  
 GALVANOMETERS

SPECIAL (Enclose details)

(NAME)

(NO.)

(STREET)

(CITY)

(STATE)

COMPANY

POSITION

AGASTAT  
 TYPE No.  
 TIMING MIN SEC  
 COIL V. CY.

- SMALL
- COMPACT
- WELL DESIGNED
- DEPENDABLE

**AGASTAT**  
TRADE-MARK

**TIME DELAY RELAY**  
**PROTECTS BIG INDUSTRY PROCESSES**

ACA AIRPORT LIGHTING    ACA AGASTAT RELAYS    ACA STRONGITE ELECTRONICS    ACA ELECTRIC METER CO.

Address inquiries to Special Products Division  
**American Gas Accumulator Company**  
 1027 Newark Avenue, Elizabeth 3, New Jersey

**HOLTITE**  
*Precision*  
**FASTENERS**  
*for*  
**ELECTRONIC ASSEMBLIES**



The uniform precision of HOLTITE fasteners meets the high standards demanded of component parts in the assembly of electronic equipment. Made of the highest grade, laboratory-tested materials, these accurate, rugged units are quality-controlled at every stage of production to insure smooth application and trouble-free performance.

HOLTITE screws are made in all types, sizes, metals (especially stainless steel) and finishes required in electronic equipment. Special fasteners are made, on order, exact to specifications, samples or prints.

**CONTINENTAL**  
**SCREW COMPANY**  
 New Bedford, Mass. U.S.A.

**WRITE FOR THIS!**

A new, comprehensive Crystal Catalog by the JAMES KNIGHTS COMPANY is now off the press. It contains the complete JK line, lists modern up-to-the-minute crystals about which engineers will want information in designing their new equipment.

Advances in crystals and holders have been tremendous during the past few years and this JK Crystal Catalog presents for your consideration new crystal types offering greater stability and precision. These new crystals mean improved performance for your new equipment!

In addition to these newer types, JAMES KNIGHTS still offers a complete line of standard crystals for replacement use. You'll find descriptions of all, with dimension drawings, in the new catalog.

**WRITE FOR YOUR COPY—TODAY!**

**THE JAMES KNIGHTS CO.**  
 SANDWICH, ILLINOIS

**JK**  
 CRYSTALS

Consolidated Vultee Aircraft Corp. under a contract with the Navy's Bureau of Ordnance.

Initial production will be on a supersonic anti-aircraft missile. Hiring of 1,500 persons, who will work in a 200,000-sq-ft plant, started March 1. The company expects to reach its first production goals within a few months.

All details concerning the new San Diego plant, even to its generally known location, are being withheld insofar as a description of the work is concerned. Previously announced activities by Convair in the field of guided missiles, however, include these developments:

The Convair Lark was developed for the Navy between 1947 and 1949. It is a needle-nosed, double-finned experimental anti-aircraft missile intended for shipboard use, powered with liquid rocket fuel and remotely guided.

Last summer Convair had under development a revolutionary long-range surface-to-surface missile for the Navy.

Work in developing a ramjet engine capable of propelling missiles at twice the speed of sound was carried on last year at the company's Daingerfield, Texas, missile research center.

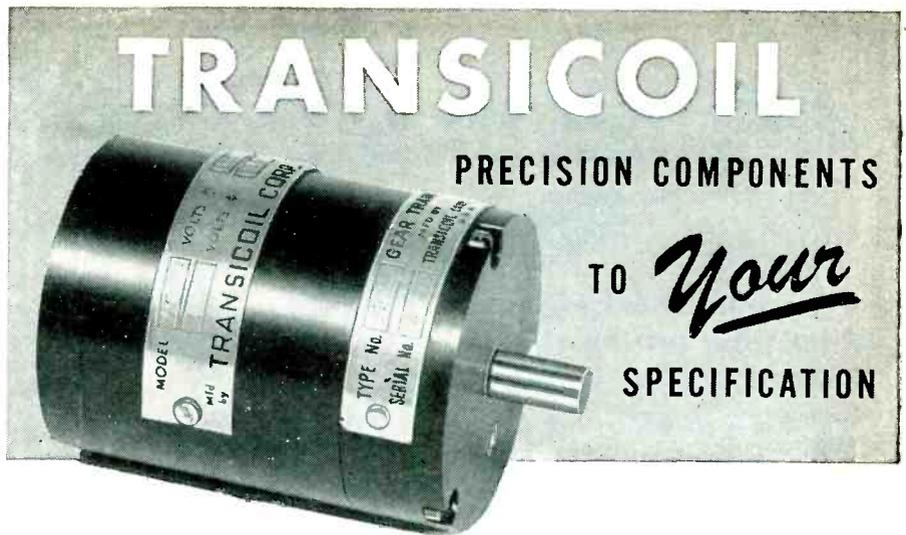
### BUSINESS NEWS

THE INSULINE CORP. of America has taken possession of a new 50,000-sq-ft factory in Long Island City, N. Y., to increase production of radio, tv and general electronic components.

CORNING GLASS WORKS, Corning, N. Y., has begun construction of a new 170,000-sq-ft plant in Danville, Ky., to provide additional facilities for the manufacture of glass bulbs and tubing. When in operation the plant will initially employ approximately 550 people.

NATIONAL ELECTRONIC MFG. CORP., producers of antennas and accessories, recently moved from Astoria, L. I., to new and larger quarters at 4202 Vernon Blvd., Long Island City, N. Y.

SYLVANIA ELECTRIC PRODUCTS INC. recently purchased a new factory



# TRANSICOIL

PRECISION COMPONENTS

TO *Your*  
SPECIFICATION

## CONTROL MOTORS

Transicoil Servo Control Motors are 2-phase units, available for either 60-cycle or 400-cycle operation, in sizes from fractions of a watt to 10 watts mechanical output. They are precision assembled to operate under difficult conditions. Manufactured to

your phase voltage requirements—line operation or plate-to-plate. Plate-to-plate types are a Transicoil development that has reduced weight and size. Moreover, they eliminate the need for output transformers.

## PRECISION GEAR TRAINS

Beautifully miniaturized, designed to mount the motor and data elements and to provide the necessary output shaft, Transicoil Precision

Gear Trains match a fine watch in their precise construction. Types supplied for all Transicoil and other control motors.

## INDUCTION GENERATORS

Designed for operation in electronic equipment in which a variable voltage output must be proportional to a shaft speed having the same frequency as the supply. Output voltage is linear over an extended range. Low re-

sidual voltage, as a function of the design, enhances the performance of associated components. Induction generators also furnished with motor gear trains as a complete assembly when desired.

## SERVO AMPLIFIERS

There are no fixed restrictions when you use Transicoil Servo Amplifiers! You specify such characteristics as: phase voltage, reduction rate, mounting, gain, phase shift, input

impedance, and damping. We confine standardization to physical dimensions! Electromechanical feedback loops can also be built up with Transicoil components.

## NOW! GREATLY EXPANDED FACILITIES

To meet the fast-growing demand for its products, Transicoil has recently tripled its production facilities. As in the past, there will be no "standard" Transicoil components. Each unit is designed, elec-

trically and mechanically, to match your specifications exactly. Engineering representatives in leading cities. They will be happy to give you information on any specific problem.

**TRANSICOIL CORPORATION**  
107 Grand Street New York 13, N. Y.

# S.S. White MOLDED RESISTORS



TYPE 65X  
(Actual Size)

The resistors that give you...

- Inherent low noise level
- Good stability in all climates

**STANDARD RANGE**  
1,000 OHMS TO 4 MEGOHMS

These resistors are used extensively in commercial equipment, including radio, telephone, telegraph, sound pictures, television, etc. They are also used in a variety of U.S. Navy equipment.

**HIGH VALUE RANGE**  
10 TO 10,000,000 MEGOHMS

This unusual range of high value resistors has been developed to meet the needs of scientific and industrial control, measuring and laboratory devices — and of high voltage applications.

SEND FOR BULLETIN 4906

It gives details of Standard and High Value Resistors, including construction, characteristics, dimensions, etc. Also described are S.S. White 80X Resistors, designed for extremely high voltage equipment. Copy with Price List sent on request.



**THE S.S. White INDUSTRIAL DIVISION**  
**DENTAL MFG. CO.**



Dept. R, 10 East 40th St.  
NEW YORK 16, N. Y.

## INSULATION FORMVAR • FORMEX • ENAMEL

### STRIPPED CLEAN IN SECONDS

with **X-VAR**

IN



1. DIP WIRE in X-VAR for 3 seconds.

OUT



2. WITHDRAW and watch coating disintegrate.

WIPE



3. WIPE CLEAN. Operation completed in seconds.

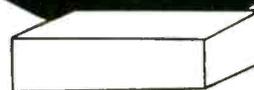
X-VAR is non-corrosive, non-creeping — leaves wire ready for soldering. Now in use by leading manufacturers of electrical products. Write for FREE SAMPLE for testing.

**FIDELITY CHEMICAL PRODUCTS CORP.**  
472 Frelinghuysen Avenue, Newark 5, New Jersey

This represents the actual size of the housing which totally encloses the Ulanet

## MINIATURE THERMOSTAT

MODEL 13



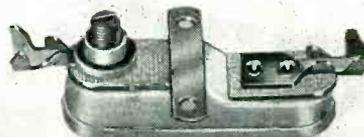
### Measure it!

Only 1" L x 5/16" W x 1/4" H

★ And into this tiny space a complete three-element thermostat is housed. Severe temperature changes can't strain the bimetal (principal cause of calibration changes) because of the special strain relief construction. Precision calibration is effected by extra fine threaded adjustment screw. Electrolytic silver contacts are used, too. Temperature ranges up to 400°F. are available.

Here's the mechanically rugged unit you should investigate for positive control. Ulanet engineers will be glad to help you if you state the application you have in mind.

MODEL 13



## GEORGE ULANET COMPANY

417 MARKET STREET  
NEWARK 5, NEW JERSEY

If your problem is *Heat Control* your solution is *Ulanet* — Precision Thermostats & Thermal Timers Exclusively Since 1931

# ULANET

ELECTRIC HEAT CONTROL ENGINEERS

site at Woburn, Mass., where it will produce electronic tubes and equipment for national defense. The new factory, with 100,000 feet of floor space, will employ about 600 people and cost in the neighborhood of a million dollars.

CENTRAL TRANSFORMER Co., Chicago, Ill., was recently formed by M. R. Whitman, formerly chief engineer of Thordarson Electric, and L. G. Shore, formerly in charge of Geiger counter production at Radiation Counter Laboratories. The new company will specialize in custom transformer design and manufacture.

WESTINGHOUSE ELECTRIC CORP. is building a headquarters plant and engineering laboratories for its new electronic tube division on a 100-acre tract four miles northwest of Elmira, N. Y.

THE KELLEY-KOETT MFG. Co., manufacturer of x-ray equipment, was recently consolidated with Tracerlab, Inc., Boston, Mass., to expand both firms' operations in the fields of radiology and nucleonics.

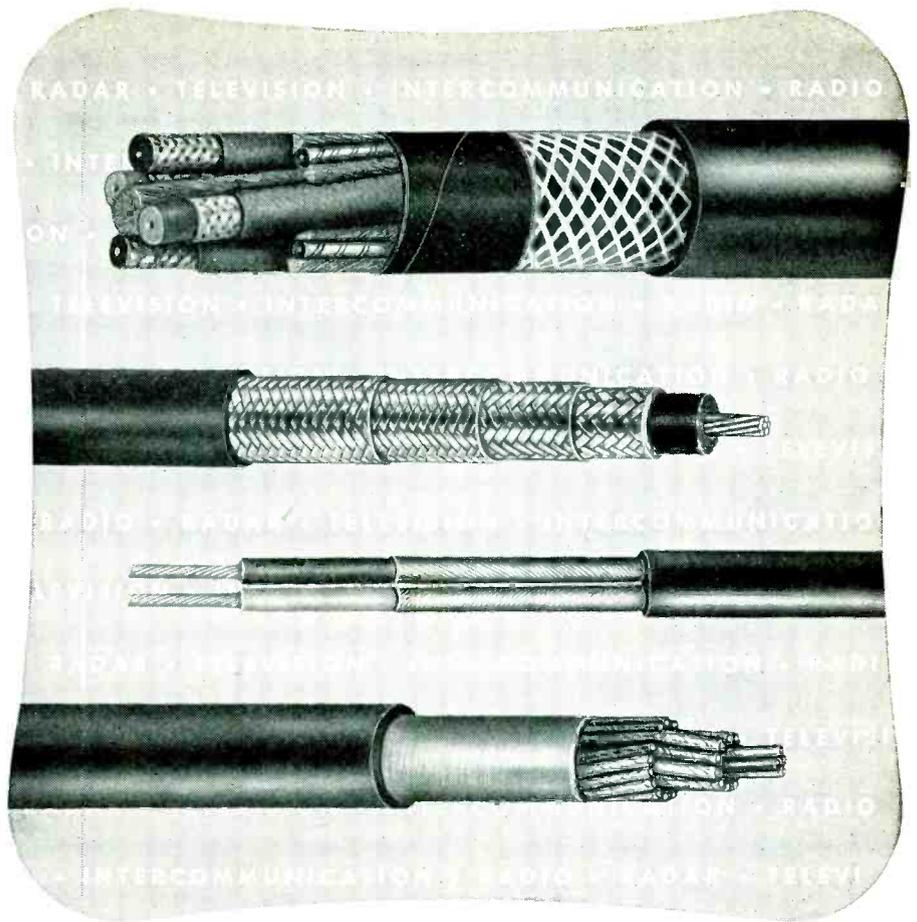
**PERSONNEL**

JOHN K. HILLIARD, chief engineer of Altec-Lansing Corp., is now on a two-month tour of western Europe, coordinating military design and production of Armed Services equipment and investigating commercial aspects of new European developments in microphones and loudspeakers. He is scheduled to return May 15.

JOHN RHOADES, since 1946 on the engineering staff of the Hoffman Radio Corp., Los Angeles, Calif., has been advanced to chief engineer of the company's Special Apparatus Division.

THOMAS A. FARRELL, JR., education director and service engineer, Soudscrubber Corp. of New Haven, Conn., has been appointed general service manager for the company.

F. J. COOKE, formerly chief engineer of the Electronic Tube Laboratory of Remington Rand, has



**For special cables go to specialists**

**... Rome Cable**

Electronic wiring components must conform to exacting specifications for quality performance. This is particularly true in high frequency applications where sensitive and dependable operation is so important. Leading manufacturers turn to Rome Cable for their electronic needs . . . because they know their specification requirements will be met exactly.

Rome Cable has the facilities, experience and engineering "know-how" to produce complicated special cables of the highest quality, utilizing both rubber and thermoplastics, typical examples of which are shown above. This, coupled with a complete line of Underwriters' Approved standard radio and television hook-up wires (including military types), makes Rome your best source of supply. The coupon below will bring you descriptive literature. Mail it today.

**IT COSTS LESS TO BUY THE BEST**

ROME CABLE CORPORATION

Dept. E-5 • Rome, N. Y.

Please send me information on Electronic Wiring.

Name.....

Company.....

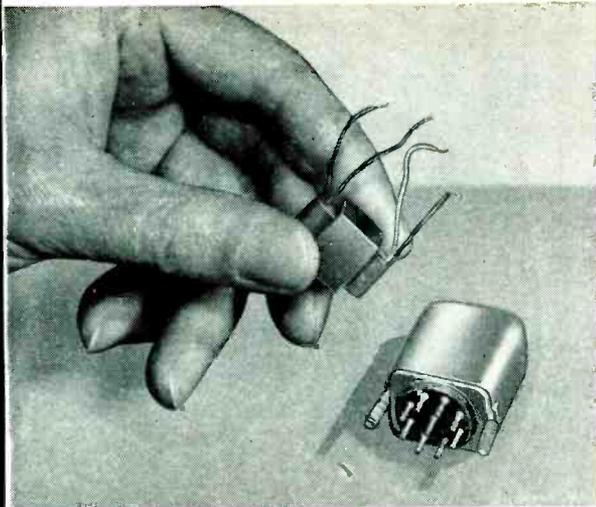
Address.....

City..... State.....

**ROME CABLE CORPORATION  
ROME, NEW YORK**



Miniature  
Transformers  
and  
Coils  
to your



## Specifications!

Here is a line of sub-miniature transformers developed especially to meet the requirements of today's electronic gear, where space and weight is at a premium.

We can produce to your specifications Hermetically Sealed Transformers,

Radar Deflection Yokes and Coil Components, Television Flyback Transformers and Television Focus Coils.

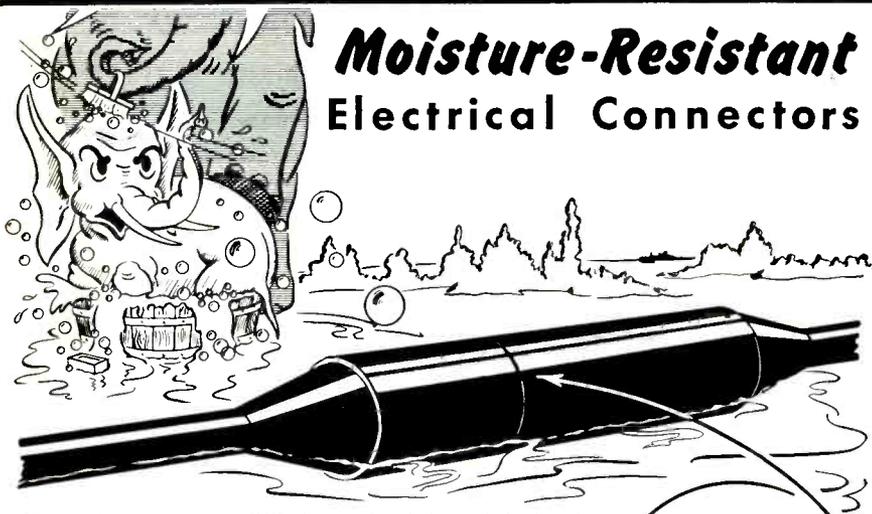
Custom-made parts to JAN and MIL specifications.

Submit blueprints and quantities for estimates.

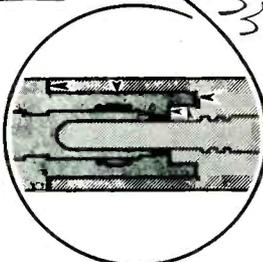
4921 EXPOSITION BLVD.  
LOS ANGELES 16, CALIF.

**TETRAD CO., INC.**

## Moisture-Resistant Electrical Connectors



No question about it . . . JOY plugs and sockets are today's outstanding electrical connector value! Molded as one-piece Neoprene units and factory vulcanized to cords, they won't crack or shatter under hard blows—are surprisingly immune to climatic changes—and are trim, safe and easy to handle. Whenever advantageous, JOY Connectors are equipped with the famous MINES "Water-Sealing" face. Cut-away illustration in circle shows how close fitting segments on mating Male and Female plugs positively "Seal-out" dirt and moisture by enclosing contacts in a resilient rubber housing. Ask for a complete description on this and other advantages that only JOY Connectors provide.



MALE & FEMALE PLUG ENGAGED  
Note 5-way WATER-SEAL (arrows)

ME-150.3

*Consult a Joy Engineer*

100 Years of Engineering Leadership



**JOY MANUFACTURING COMPANY**

HENRY W. OLIVER BUILDING, PITTSBURGH 22, PENNSYLVANIA  
IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LTD., GALT, ONTARIO

## ENGINEERS DESIGNERS PHYSICISTS

**T**HE Aerophysics & Atomic Energy Research Division of North American Aviation, Inc. offers unparalleled opportunities in Research, Development, Design and Test work in the fields of Long Range Guided Missiles, Automatic Flight and Fire Control Equipment and Atomic Energy. Well-qualified engineers, designers and physicists urgently needed for all phases of work in

Supersonic Aerodynamics,  
Preliminary Design & Analysis,  
Electronics,  
Electro-Mechanical Devices,  
Instrumentation,  
Flight Test,  
Navigation Equipment,  
Controls,  
Servos,  
Rocket Motors,  
Propulsion Systems,  
Thermodynamics,  
Airframe Design,  
Stress & Structures.

Salaries Commensurate with training & experience.  
Excellent working conditions.  
Finest facilities and equipment.  
Outstanding opportunities for advancement.

Write now — Give complete resume of education, background and experience

PERSONNEL DEPT.  
AEROPHYSICS & ATOMIC ENERGY  
RESEARCH DIVISION

**NORTH AMERICAN AVIATION  
INC.**

12214 LAKEWOOD BLVD.  
DOWNEY, CALIFORNIA

joined the manufacturing executive staff of Reeves Soundcraft Corp., New York, N. Y.

RUSSELL A. WHITEMAN has resigned his position with Tuttle and Kift, Inc., Chicago, to join the engineering staff of Eugene Mittelmann, consulting engineer, Chicago, Ill. He will be in charge of research and development in the applied electronics field.

LOUIS G. PACENT, president of the Pacent Engineering Corp., was recently awarded the Marconi Memorial Medal of Achievement by the Veteran Wireless Operators Association, for pioneer work in radio and communication.

NORMAN L. WINTER, until 1949 executive director of the Research and Development Board's committee on electronics, was recently named director of special electronic sales for Sperry Gyroscope Co., Great Neck, N. Y.



N. L. Winter



W. B. Bergen

WILLIAM B. BERGEN, with The Glenn L. Martin Co., Baltimore, Md., since 1937, was recently elected vice-president—chief engineer of the company. He had held the title of chief engineer since October 1949.

SHELDON E. YOUNG, formerly assistant chief engineer of The Barry Corp., Watertown, Mass., has been promoted to manager of field engineering service. In this capacity he will cooperate with designers and project engineers in the analysis and solution of shock and vibration problems.

A. V. ASTIN, formerly chief of the Electronics and Ordnance Division of the National Bureau of Standards, has been appointed associate director of the NBS.

# Need Front Surface Aluminum Mirrors ?

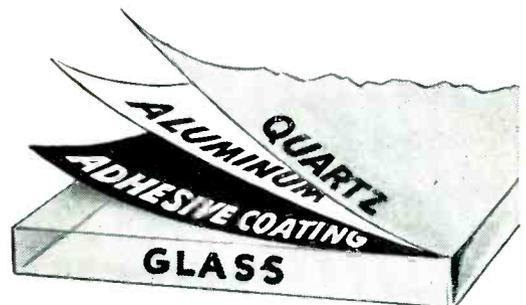
Liberty Front Surface Aluminum Mirrors are available in sizes up to 48" x 66"—and in a range of constructions to meet the most exacting requirements. The glass in these mirrors is coated with aluminum which has a protective layer of quartz. No base metal is used because bimetallic mirrors are subject to galvanic action.

Liberty Aluminum Mirrors retain their reflectivity—and they contain a minimum of pinholes. Moreover, these few pinholes do not increase in size or number in service. Liberty's patented adhesive coatings insure exceptionally strong adhesion.

The basic design superiority and quality of Liberty Front Surface Aluminum Mirrors is evidenced by an ever-increasing list of satisfied customers. We invite your comparison test order. For a quotation, use the coupon below.

**FOR COMMERCIAL AND OPTICAL FIELDS** where normal cleaning is sufficient and where exceptional exposure to salt water or salt atmosphere is not required, we recommend our Specification #1051, Finish #749.

**FOR HIGH RESISTANCE TO ABRASION AND SALT AIR**—and especially for high-grade optical instruments requiring maximum reflectivity and unchanging durability, we recommend our Specification #1054, Finish #752.



LIBERTY MIRROR DIVISION  
LIBBEY-OWENS-FORD GLASS CO.  
L-251 NICHOLAS BUILDING  
TOLEDO 3, OHIO

I am interested in your Liberty Front Surface Aluminum Mirrors for

.....  
(Application)

Please quote me on ..... in size.....  
(Quantity)

( ) Please have salesman call.

Name..... Title.....  
Company.....  
Address.....  
City..... Zone..... State.....

**LIBERTY VACUUM DEPOSITED COATINGS**

*Liberty Mirror Division*  
**LIBBEY-OWENS-FORD GLASS CO.**  
**NICHOLAS BUILDING, TOLEDO 3, OHIO**

**ECONOMY  
ACCURACY  
STABILITY  
COMPACTNESS**

IN PRECISION  
● **RESISTORS**

★ ★ ★

*Have your Cake . . . and Eat it, too, with*  
**JELLIFF ALLOY 1000 RESISTANCE WIRE**

The new high in Resistivity—1000 ohms/cm—plus an impressive array of important electrical and physical characteristics, make our new ALLOY 1000 the most desirable material for windings in compact, precision resistors of all types. And the best thing about it is that you don't gain one characteristic at the cost of serious losses elsewhere. Write today for Bulletin 17, with the full story and technical data on JELLIFF ALLOY 1000 RESISTANCE WIRE



# ZOPHAR

WAXES  
COMPOUNDS

Anti-Corona high heat-resistant compounds for Fly Back Transformers.

Waxes and compounds from 100° F to 285° F Melting Points for electrical, radio, television, and electronic components of all types.

Pioneers in fungus-resistant waxes.

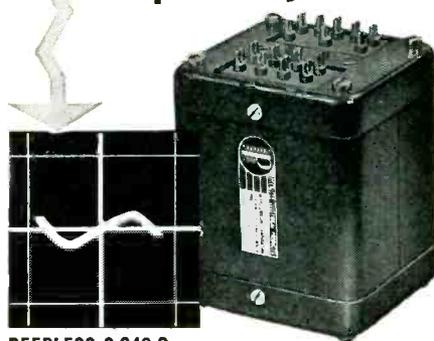
Our efficient and experienced laboratory staff is at your service.



**ZOPHAR MILLS, INC.**  
112-130 26th Street,  
Brooklyn 32, N. Y.

**“exciting  
current  
test”**

Another in a series which  
demonstrates  
**PEERLESS**  
transformer  
superiority!

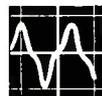


PEERLESS S-240-Q

Since the 1949 Audio Fair, comparative square wave tests on transformers shown all over the country have demonstrated Peerless superiority . . . Now Peerless emphasizes another very important property of transformers as shown by the “exciting current test.”



Competitor No. 1



Competitor No. 2



Competitor No. 3



Competitor No. 4

An output transformer's ability to deliver plenty of clean, low-frequency power (the goal of every music lover) is inversely proportional to the amplitude and distortion of its exciting current.

PEERLESS superior low-frequency power handling capacity is illustrated in these comparative oscillograms.

Write for complete data.

**PEERLESS**  
Electrical Products



Division

161 Sixth Avenue  
New York 13, N. Y.

9356 Santa Monica Blvd.  
Beverly Hills, Calif.



## NEW BOOKS

(Continued from page 150)

clude quantum mechanics or solid-state physics. This review will be largely concerned with Part I for the reason that this portion of the book is likely to be of greatest interest to most readers of *ELECTRONICS*. Parts II and III, entitled "Descriptive Theory of Semiconductors" and "Quantum-Mechanical Foundations", will again be mentioned.

### *Conduction in Metals*

To understand the action of the transistor, it is necessary first to distinguish between electrical conduction in metals and in semiconductors. The distinction is, in a way, arbitrary since the gradation between a pure metal and a perfect insulator is almost continuous. As it happens, semiconductors such as the highly purified germanium used in transistors occupy a rather unique position in this scale, making it instructive to compare their electrical characteristics with those of a pure metal.

In metals the general nature of conduction is visualized by aid of the electron gas concept. Here the valence electrons—those belonging to the outermost shell of the atom—are free to move about. We say that a conduction electron in a piece of metal is not to be identified with any particular atom, and that a field produces a drift in these electrons which is observed as an electric current. It is characteristic of metals that conductivity decreases with increasing temperature because of lattice vibration.

### *Conduction in Semiconductors*

In a semiconductor such as germanium, the valence electrons are not normally free to move about but form electron-pair bonds. A few of these may be broken by heat or light, but at low temperatures most of the few charges available for carrying current come from ionization of chemical impurities or from imperfections in the lattice. As the temperature is increased, the number of free charges increases, with resultant increase in conductivity. At higher temperatures, the effects of lattice vibration become predominant so that, as in metal, conductivity decreases with increasing tempera-

# Measure DC, AF, IF, RF, UHF, POTENTIALS

RESISTANCES TO 1000 MEGOHMS

# ...with Full Scale Sensitivity!



### SCALE RANGES

AC... 0-1, 0-3, 0-10, 0-30, 0-100,  
0-300, 0-1000 volts  
DC... 0-1, 0-3, 0-10, 0-30, 0-100,  
0-300, 0-1000 volts  
-Ohms... 0-1000 megohms (in seven  
overlapping ranges)  
DB... —20 to +11 scale; total  
range to +51 D. B.

### PRICE

**\$89.50**

F. O. B. CINCINNATI  
(Model 406)



## Clippard ELECTRONIC VOLT-OHMMETER

With a new bridge-type circuit, fully balanced through three stages for maximum accuracy and stability, the Clippard Electronic V-O-M gives laboratory accuracy anywhere. You can read AC, +DC, —DC and resistance on seven overlapping ranges... A. F. through V. H. F. (30 cycles to 100 megacycles). The entire instrument is calibrated to 2% accuracy, guaranteed to 5% accuracy.

Arranged for the ultimate in operating ease and accuracy, the Model 406 is a true vacuum tube volt-ohmmeter with extreme range and rugged durability. The new Clippard

circuit automatically compensates for line fluctuations and tube aging within wide limits.

Operates on 110 volt, 50-60 cycle (25 cycle optional); ohmmeter operates on standard flashlight cell. Size: 10" high, 8½" deep and 6¼" wide; weight: approximately 12 lbs. For complete details on this all-in-one V-O-M, write for Catalog Sheet 5-E.

## Clippard

INSTRUMENT LABORATORY INC.  
1125 Bank Street • Cincinnati 14, Ohio

MANUFACTURERS OF R. F. COILS AND ELECTRONIC EQUIPMENT

# HICKOK *new model* 640 OSCILLOGRAPH

STABLE • VERSATILE  
OUTSTANDING RANGE



Model 640

For Industrial and  
Electronic  
*Laboratories*

The new HICKOK Model 640 Oscilloscope with its exceptional design features and characteristics provides an outstanding versatile instrument for the engineer in observing regular recurring or transient phenomena.

**Wide Band Amplifier:** Frequency response DC, 0 to 4.5 mc. (down 3 db.).

**Vertical DC and AC Amplifier:** 10 MV per inch with sensitivity switch in high position. 25 MV per inch in low position.

**Frequency Response:** 0 to 1,000,000 cycles, (3 db point), in high position. 0 to 4,500,000 cycles, (3 db point), in low.

Maximum Input Potential; 1000 volts peak.  
Input Impedance; 2 megohms, 50 mmf.

**Horizontal Amplifier:** Deflection Factor—Direct: 20 volts RMS per inch.

Full Gain Setting; 50 millivolts RMS per inch.  
Frequency Response; 0 to 200,000 cycles, (3 db down).

**Test Signals:** Line Frequency, 3 volts RMS per inch.

Sawtooth available from front panel. Direct connection to both horizontal and vertical deflection plates.

**Linear Time Base:** Recurrent and Driven Sweep; 2 cycles to 30,000 cycles.

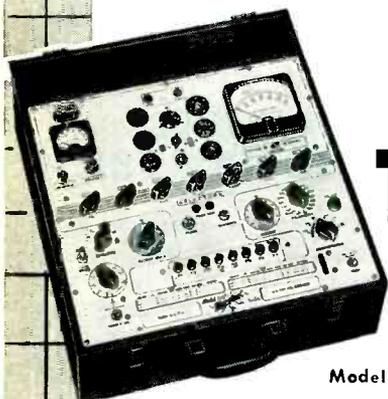
Provision for external capacities for slower frequency sweeps of 10 seconds and slower.  
Sweep Speeds; Faster than 0.75 inch per microsecond.

Television Fixed Frequencies; 30 and 7,875 for observing blanking and sync waveforms in the horizontal and vertical circuits of TV receivers.

Synchronization at line or 2-times line frequency.

**"Z" Axis Modulation:** Capacitively coupled to the grid of the cathode ray tube. 15 volts will blank trace fully at normal intensity.

Shielded, Shock Mounted, Built-in Calibrating Voltages, Excellent Stability and Expandable Sweep (6 times expansion) are several additional features of this highest quality instrument. Write for further information today. Price \$355; Subject to change without notice.



Model 539

## Dynamic Mutual Conductance TUBE TESTER HIGHLY ACCURATE *Laboratory Model*

- Dynamic Mutual Conductance circuits . . . Readings in micromhos.
  - Permits choice of 3 AC signals, .25, .5 and 2.5 volts.
  - Vernier adjustment permits accurate setting of grid voltage.
  - Separate AC meter measures line voltage at all times.
  - Provision for insertion of plate millimeter for measuring plate current.
  - Optional self-bias arrangement.
  - Tube life and tube gas test for accurate matching of tubes.
- Write for additional information today!

**THE HICKOK ELECTRICAL INSTRUMENT CO.**  
10527 DUPONT AVENUE • CLEVELAND 8, OHIO

THE STANDARD OF QUALITY FOR OVER 40 YEARS

ture over a considerable range. At still higher temperatures, conductivity again increases due to the excitation of carriers from the valence band.

As Dr. Shockley points out, it is basic to the theory of semiconductors that current conduction is accomplished by two distinctly different processes. One of these is conduction by electrons, the other by "holes". These processes may be described in terms of energy bands and Brillouin zones. Fortunately, a fairly satisfactory description can be given on the basis of the energy band scheme alone; the idea of Brillouin zones need not be introduced in a qualitative description.

### Quantum Numbers of Electrons

According to modern theory, the energy of the conduction electrons in a metal is described by quantum numbers, and it follows from the exclusion principle that no two electrons may have the same set of quantum numbers. At absolute zero, every quantum number up to a certain maximum will be represented by an electron somewhere in the body; no electron will have energy represented by a higher quantum number. Figure 1A is intended to show this scheme; energy is represented as increasing upward. The line *F* is the Fermi level, which is the upper limit of electron energies at absolute zero;  $\chi$  represents the energy which an electron must possess in

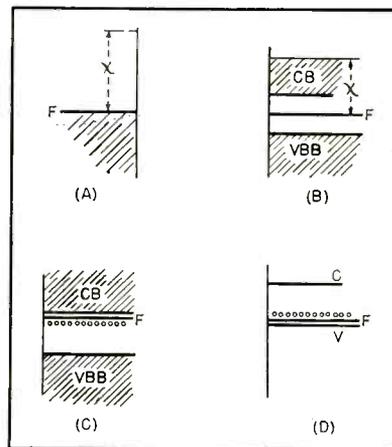
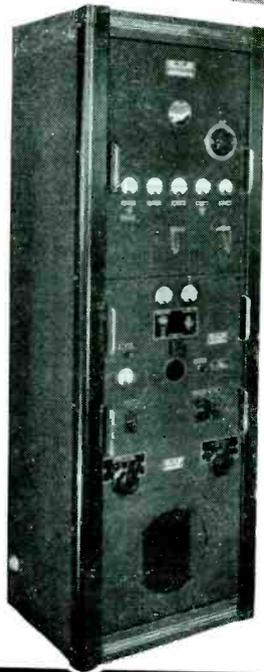


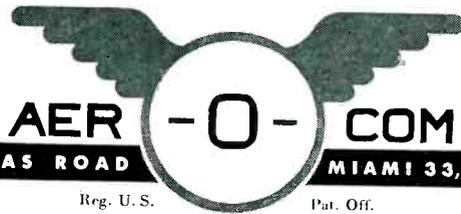
FIG. 1—Energy level diagrams for (A) a metal, (B) an intrinsic semiconductor, (C) an n-type semiconductor and (D), a p-type semiconductor

## AEROCOM MEANS TROUBLE-FREE SERVICE! From Ground To Air or Point to Point



Although demand for AeroCom equipment still exceeds our ability to offer immediate deliveries, you may wish to evaluate its possible future use in solving your communication, navigation, or meteorological problems.

The model 12GLX-M, 1KW Beacon Transmitter illustrated, operates on a single frequency in the range 200-415 Kcs. Oscillator coil can be supplied crystal-controlled or self-excited. Tone oscillator provides 30% high level modulation for identification when keyed with AeroCom's model AK-3B automatic keyer. The unit can also be voice modulated. Power supply... any stable voltage in the range 200-240 volts, 50/60 cycles, single phase. Overall dimensions in CM, 56W x 62D x 177H. Net weight 286 kilos.



3090 DOUGLAS ROAD

MIAMI 33, FLA.

Reg. U.S.

Pat. Off.

### SUB MINIATURE ROTARY SWITCH

#### Features —

- Only  $\frac{5}{8}$  in. Diameter,  $\frac{7}{32}$  in. Thick
- Weight 1.5 Grams
- Maximum of 15 Positions
- One, Two, or Three Poles
- Ganged Operation Facility

LITERATURE ON REQUEST

#### ELECTRO DEVELOPMENT CORPORATION

6014 W. Washington Blvd.  
Culver City, Calif.



## DANO COILS a sweet production note!

Today, with emphasis on uninterrupted production, it's vitally important to be sure of quality materials and parts. Dano is ready, as always, to supply you with top quality coils made to your exact specifications. Keep production running smoothly. Let Dano make your coils.

Send us samples or specifications with quantity requirements for our recommendations. No obligation!

Also, Transformers Made to Order

- Form Wound
- Paper Section
- Acetate Bobbin
- Molded Coils
- Bakelite Bobbin
- Cotton Interweave
- Coils for High Temperature Applications



**THE DANO ELECTRIC CO.**  
MAIN ST., WINSTED, CONN.

## Need VOLUME on Small Parts Like These?



## Investigate MULTI-SWAGE

### Economy Way to Get Volume!

If it's VOLUME you need on small tubular metal parts similar to these, be sure to look into Bead Chain's MULTI-SWAGE Process. Send the part (up to  $\frac{1}{4}$ " dia. and to  $1\frac{1}{2}$ " length) and your specs for a quotation. Chances are you'll find a new way to effect important savings.

### Much Cheaper Than Solid Pins

Many prominent users of solid pins for electronic and mechanical purposes have cut costs by switching to Multi-Swaged tubular pins . . . without sacrificing strength or accuracy. Often this is possible to accomplish.

### Typical Applications —

As terminals, contacts, bearing pins, stop pins, male-female connections, etc., in a wide variety of electronic and mechanical products:—Toys . . . Business Machines . . . Ventilator louvres . . . Radio and Television apparatus . . . Terminal-boards . . . Electric Shavers . . . Phono Pick-ups, etc. For DATA BULLETIN, write to



### The BEAD CHAIN Mfg. Co.

88 Mountain Grove St., Bridgeport 5, Conn.

Manufacturers of BEAD CHAIN—the kinkless chain of a thousand uses, for fishing tackle, novelty, plumbing, electrical, jewelry and industrial products.

# for Uninterrupted Communications across OCEANS and CONTINENTS...



dependable  
**ANDREW Rhombic Antenna Equipment**

Whether your problem is uninterrupted communication half-way around the world . . . or only 100 miles . . . ANDREW offers you (1) a world-wide reputation of reliability and (2) the convenience of obtaining all necessary equipment from one dependable source.

- **Receiver Coupling Unit** efficiently distributes the output of one antenna among as many as 10 receivers. Interaction between receivers is held to negligible levels. Power gain is approximately unity (0 db) over the entire range of operation. A 4-channel unit is also available.
- **Rhombic Receiving Antenna Kit** contains in one "package" everything you need for an antenna except poles.
- **Transmitting antennas** available on special order.
- **Rhombic Antenna Coupling Transformer** is a broad band, low loss unit which matches the balanced impedance of the rhombic to the unbalanced impedance of a coaxial line.
- **Transmitting Rhombic Tuning Units** for single or multiple frequencies are available on special order.

## For Rapid, Frequent Changes in COAXIAL CIRCUITS...

- (a) **Coaxial Patch Panel** has 24 jacks. Fits 19" relay rack. Facilitates switching coaxial circuits.
- (b) **ANDREW Coaxial Jacks and Plugs** are simple to install. No soldering through a window. Just remove one screw, slide the sections apart and solder.



Write for further  
information TODAY—

WORLD'S LARGEST ANTENNA EQUIPMENT SPECIALISTS  
TRANSMISSION LINES FOR AM-FM-TV • ANTENNAS • DIRECTIONAL ANTENNA EQUIPMENT  
ANTENNA TUNING UNITS • TOWER LIGHTING EQUIPMENT

addition to  $F$  to escape from the body, and is commonly called the work function. At temperatures greater than zero, electrons may acquire energies such that their position in the diagram will be above  $F$ ; it follows that a corresponding number of vacancies will occur below  $F$ . These elementary principles are fully discussed in modern texts on physics and on electron tubes. The scheme for metals should be kept in mind when considering the flow of electric charge across a metal-semiconductor boundary.

### *Energy Bands of Semiconductors*

In a semiconductor there are several bands representing energy states. Figure 1B shows the uppermost bands of an intrinsic semiconductor. The lower band, marked  $VBB$ , is the valence bond band; it represents the energies of the valence electrons which bind the atomic nuclei together. In germanium, most commonly used for transistors, and in silicon, each atom has four valence electrons. These electrons form electron-pair bonds in such a way that the diamond lattice shown in Fig. 2 is formed. At low temperature, these bonds are quite stable with only a few disrupted by thermal agitation.

The upper band of Fig. 1B, labeled  $CB$ , is the conduction band. Normally, this band is practically empty; the few electrons present usually come from the ionization of an impurity atom or they may be excited to that level by disruption of the valence bond. The range of energies between the top of the

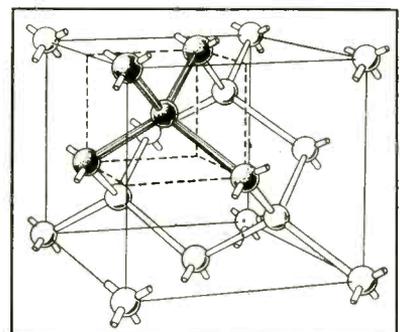


FIG. 2—The diamond structure, showing how each atom forms four bonds with its nearest neighbors. Each bond is represented by a rod which may be considered as a pair of valence electrons (Courtesy D. Van Nostrand Company, Inc.)

**ONLY  
SPECIFIC COILS  
CAN DO  
THIS JOB-**



The Taft-Peirce SUPERPOWER magnetic chuck is demonstrably the most powerful magnetic chuck made, possessing holding power even greater than is demanded by the latest machine tools. Shown below is a coil which helps give this famous chuck its SUPERPOWER. Accurately form wound from cotton-covered enamel wire and carefully taped, the coil is then impregnated with insulating varnish and precisely baked to assure the high dielectric strength necessary to withstand heat generated through constant use.



**Builds Them!**

When you need electrical coils, why not take advantage of 34 years of experience, engineering competence, and modern production facilities. Coto coils are built for you, to your specifications.

**COTO-COIL CO., INC.**

COIL SPECIALISTS SINCE 1917  
65 PAVILION AVE  
PROVIDENCE 5, R.I.



## PRODUCTION LINE TESTING

### SERVOSCOPE®



### OF SERVOMECHANISMS

**SERVO CORPORATION  
OF AMERICA**  
DEPT. E-5  
NEW HYDE PARK  
LONG ISLAND  
NEW YORK

INVALUABLE IN RESEARCH

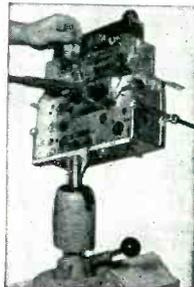
RAPID INSPECTION ON THE PRODUCTION LINE

## A SERVO ANALYZER

- STANDARD RANGE: .1 TO 20 CYCLES PER SECOND
- SINE WAVE
- MODULATED CARRIER
- SQUARE WAVE
- READS DIRECTLY
- 50 TO 800 CYCLES
- SERVO LAG OR LEAD
- IN DEGREES

## Cut Your Costs, Too, With **POWRARM** WORK POSITIONERS

HERE'S HOW  
OTHERS DO IT



POWRARM cuts costs by increasing every worker's productivity. It gives the worker a powerful *third hand* to hold work while two hands produce. That's why POWRARM works on the most efficient assembly lines in America today, and *belongs on yours*. Write us about your production "head-ache" . . . we'll show you how POWRARM can cure it.

Write For Catalog 101E  
32 informative pages, FREE



Holds work at any angle in Horizontal, Vertical or Co-axial Plane.

Three sizes of  
Powrarm—24  
to 150 lbs. ca-  
pacity.



## WILTON TOOL MFG. CO.

Precision Built Bench Vises, "C" Clamps and Work Positioners

925-T Wrightwood Avenue • Chicago 14, Illinois

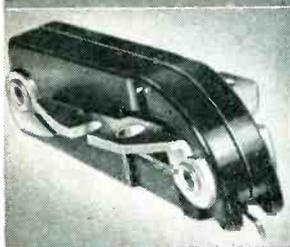


**A new SHURE family of crystal and ceramic fine-groove and standard cartridges**

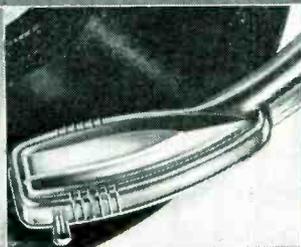
SPECIAL CRYSTAL MODEL W31AR and Ceramic Model WC31AR are unsurpassed for replacement of RCA "45" R.P.M. Changer Cartridges (ideal for 33 1/3 R.P.M. too)!

Unique needle design provides the easy needle replacement everybody has been looking for—and protects cartridge from mechanical shock.

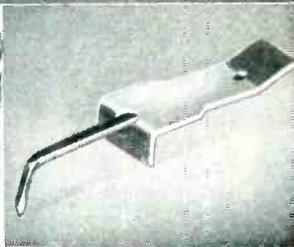
**THESE NEWLY DEVELOPED CARTRIDGES PROVIDE:**  
Easy Cartridge Installation • Maximum Fidelity • Easy Needle Replacement.



Universal, light-weight aluminum mounting ears will fit either 1/2" or 3/4" mounting.



Response-frequency characteristic designed to complement record response for maximum fidelity and minimum noise.



New, specially designed needle with broad shank and finger-nail grip bar. Long-life osmium point.

**THIS NEWLY DEVELOPED SERIES OF CARTRIDGES**

is the last word for first-place reproduction at low cost. So easy to install, the Serviceman will ask for them over and over again. High vertical compliance of the especially designed needle protects the crystal and ceramic elements from "drop-shock" damage.

Model	Type	List Price	Output Voltage	Needle Force	Shure Needle No.	Code
W31AR	Crystal 33 1/3 & 45 R.P.M.	\$6.50	2.1 V	7 grams	A53MG	RUGEB
WC31AR	Ceramic 33 1/3 & 45 R.P.M.	6.50	.65 V	7 grams	A53MG	RUGED
WC33B	Ceramic 78 R.P.M.	6.50	.75 V	9 grams	A52A	RUGEL
W36B	Crystal All-Purpose	6.50	2.5 V	9 grams	A56U	RUGEN
WC36B	Ceramic All-Purpose	6.50	.7 V	9 grams	A56U	RUGER

Shure Patents Pending.  
Licensed Under Patents of Brush Development Co.



**SHURE BROTHERS, Inc. ★**

**Manufacturers of Microphones and Acoustic Devices**

225 W. Huron St., Chicago 10, Illinois • Cable Address: SHUREMICRO

valence bond band and the bottom of the conduction band is called the *forbidden zone* because electrons do not occur in the semiconductor with energies between the extremes mentioned.

*n-type Semiconductors*

The Fermi level may occur midway between the conduction and valence bond bands under certain idealized conditions. More commonly, most of the electrons in the conduction band will come from the ionization of "donor" atoms. As the ionizing energy of these atoms is a rather small fraction of an electron volt, the energy level of the ion is not far below the bottom of the conduction band. In this case the Fermi level will lie somewhere between the energy position of the ion and the bottom of the conduction band. A semiconductor in which electrons are present in the conduction band as the result of the ionization of donor atoms shown in Fig. 1C is called an *n-type* semiconductor, the designation *n* arising from the fact that current is conducted by negative carriers. It is also convenient to remember that in an *n-type* rectifier the current is greater when the semiconductor is negative.

*p-type Semiconductors*

In a *p-type* semiconductor, represented by Fig. 1D, one considers the conduction band to be entirely devoid of electrons under ordinary conditions; current is carried by holes having energies near the upper part of the valence bond band. The word hole is used to designate the absence of an electron from its normal position in the lattice. This absence of an electron behaves as a positive charge, hence the designation *p*. Unlike an ion in a solid, a hole is free to drift in a semiconductor; when a field is applied it moves in the direction of decreasing potential just as an electron moves in the direction of increasing potential. Some holes are furnished when thermal or light energy causes a breaking of the valence bonds, but under ordinary conditions most of the holes in a *p-type* semiconductor occur as the result of the formation of negative ions by impurity atoms. These impurity



## Wizardry in WIRE FORMS

Small diameter wire formed in any shape you need!

### IMMEDIATE CAPACITY FOR DEFENSE SUB-CONTRACTS

#### STRAIGHTENING & CUTTING

Perfect straight lengths to 12 ft.  
.0015 to .125 diameter

#### WIRE FORMS

.0015 to .080 diameter

#### SMALL METAL STAMPINGS

.0025 to .035 thickness  
.062 to 3 inches wide

★

Specializing in Production of Parts for Electronic and Cathode Ray Tubes

Write for Illustrated Folder  
Send Blueprints or Samples for Estimate

**ART WIRE & STAMPING CO.**  
227 High Street Newark 2, N. J.

## WINCHESTER ELECTRONICS, INCORPORATED

# CIRCUIT CONNECTORS of Highest Quality



Our Series "R" Connectors were designed by us for the United States Signal Corps to provide water-tight and pressure-tight plugs and receptacles. They had to be compact and exceptionally strong. The special double lead center lock screw (with bale), which facilitates both engagement and disengagement, eliminates accidental disconnection. Cable entry can be oriented in any desired position.

These and other types can be furnished in a variety of sizes. Contacts are brass or phosphor bronze, precision machined and gold plated over silver. (ILLUSTRATED ONE-HALF ACTUAL SIZE)

CODENo.  
MR3CPR

Let our experienced engineering department help you with your connector design problems.

Patent No. 2,513,080  
Patent No. 2,532,538  
Patent No. DES. 161,900

# Winchester Electronics

INCORPORATED  
GLENBROOK, CONNECTICUT, U.S.A.

## ENGINEERS

### ELECTRONICS RESEARCH AND DEVELOPMENT

In Baltimore, Maryland  
Career Positions for

Top Engineers and Analysts in

Radar Pulse, Timing and Indicator Circuit Design  
Digital and Analogue Computer Design  
Automatic Telephone Switchboard Design

Also

Electro-Mechanical Engineers

Experience in servo-mechanism, special weapons, fire control, and guided missile design.

Recent E.E. graduates and those with at least one year electronics research and development work will also be considered.

Salary commensurate with ability. Housing reasonable and plentiful. Submit resume outlining qualifications in detail. Information will be kept strictly confidential. Personal interviews will be arranged.

**THE GLENN L. MARTIN COMPANY**  
Employment Department  
Baltimore 3, Maryland



## MICRODIMENSIONAL WIRE

Custom-Enameled  
TO YOUR SPECIFICATIONS

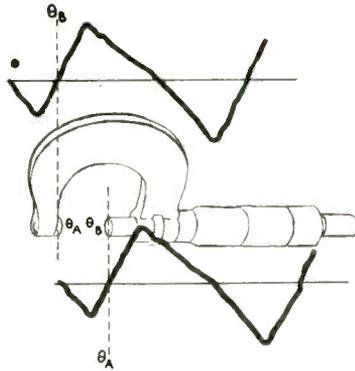
The enamel-insulation of our microdimensional wire meets the high standards of quality set by all our products. The enamel is uniform, tough, flexible and has high dielectric strength... Send us your specifications or inquire for further details.



Since 1901

**SIGMUND COHN CORP.** • 44 GOLD ST., NEW YORK 7

save work . . .  
 increase  
 precision . . .  
 measure  
 phase difference  
**DIRECTLY**



with the new **TIC** Phase Meter



TIC's New 320-A Phase Meter is the first commercially available instrument for the direct measurement of the phase difference between two recurrent mechanical motions or two electrical signals independent of amplitude, frequency, and wave shape.

Phase measurements are made instantly and accurately—no balances, adjustments or corrections are involved. Phase angle readings at audio and ultrasonic frequencies are indicated directly on a large wide-scale meter with ranges of 360°, 180°, 90° and 36°. Useful frequency range 2 cps. to 100 k.c.

In audio facilities, ultrasonics, servomechanisms, geophysics, vibration, acoustics, aerial navigation, electric power transformation or signaling . . . in mechanical applications such as printing register, torque measurement, dynamic balancing, textile and packaging machinery and other uses where an accurate measure of the relative position of moving parts is required . . . the Phase Meter is a long needed measuring instrument never before available—a new tool for a heretofore neglected field of measurement.

Price Relay Rack Mount \$525.00  
 Cabinet for above \$25.00

For low voltage phase measurement  
 Add Type 500-A Wide Band  
 Decade Amplifier



Designed for use with the phase meter at voltage levels below one volt and as a general purpose laboratory amplifier—features high gain negligible phase shift and wide band width. Unique circuitry—which employs three cathode followers—offers wider frequency range, higher input impedance and lower output impedance than other types. Panel switch selects proper feedback compensation when either optimum amplification or phase shift operation is desired. Outstanding specifications: Amplification—10; 100; 1000 selected by rotary switch . . . Accuracy—±2% nominal . . . Frequency response—±0.5db from 5 cycles to 2 mc on gain of 10; ±0.5db on 5 cycles to 1.5mc on gain of 100; ±0.8db from 5 cycles to 1mc on gain of 1000 . . . Phase shift—0 ± 2° from 20 cycles through 100 kc . . . Gain stability—constant with line voltages (105-125v).

Prices: Single Type 500-A in cabinet, \$205.00 (Rack mount, \$200.00)  
 Dual Type 500-AR in cabinet, \$425.00

**TIC TECHNOLOGY INSTRUMENT CORP.**  
 531 Main St., Acton 54, Massachusetts  
 Engineering Representatives

Cleveland, Ohio—FRospect 1-6171    Manhasset, N. Y.—Manhasset 7-3424    Chicago, Ill.—UPtown  
 8-1141    Boonton, N. J.—Boonton 8-3097    Rochester, N. Y.—Monroe 3143    Cambridge, Mass.—  
 ELot 4-1751    Canaan, Conn.—Canaan 649    Hollywood, Cal.—Hollywood 9-6305    Dayton, Ohio—  
 Michigan 5721, Dallas, Texas—Dixon 9918

atoms, which may be lattice defects, are called "acceptors" for the reason that they accept electrons which then become bound, leaving the hole free to move.

*Carrier Injection in Semiconductors*

If a piece of semiconductor such as germanium or silicon is connected by broad-area contacts to a pair of wires which are connected to a battery, current will flow through the semiconductor. As previously mentioned, the current will be carried by electrons in an *n*-type semiconductor or by holes in *p*-type material. With *n*-type material one readily imagines electrons flowing from the metal at the negative terminal into the semiconductor and, at an equal rate, electrons flowing into the wire at the positive terminal. For the *p*-type semiconductor, one may think of the positive terminal accepting electrons from the valence bond band so that holes flow across to the negative terminal, at which point electrons flow out of the metal to fill the holes reaching it. Such a picture is a gross over-simplification of actual conditions, especially when small-area contacts are used and surface effects are considered.

*Proof of Hole Theory*

Figure 3, from Dr. Shockley's book, illustrates an experiment which he and J. R. Haynes performed which confirmed predictions made upon theoretical reasoning and provided certain quantitative data concerning the movement of holes in *n*-type germanium. Figure 3A represents the experimental ar-

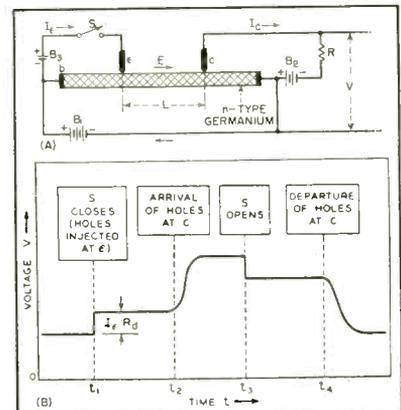
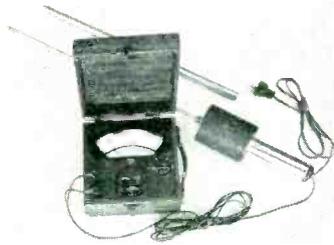


FIG. 3—Experiment to investigate the behavior of holes injected into *n*-type germanium (Courtesy D. Van Nostrand Company, Inc.)

ANNOUNCING the  
**RAWSON-LUSH**  
Rotating-Coil  
**GAUSS METER**



Tiny coil (approx. 3mm diameter) rotates in the magnetic field to be measured. The voltage generated is rectified by a synchronous rectifier and deflects a Rawson high sensitivity voltmeter with scale calibrated in kilogausses.

**FEATURES**

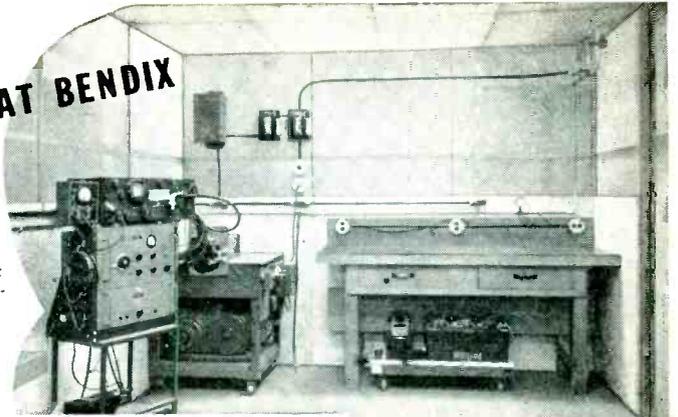
- 1) Simple operating principles, simple to maintain.
- 2) Compact and portable, just one meter and the long probe unit.
- 3) Ranges 0.4/1.2/4/12/40/120 kilogausses, all on one instrument.
- 4) Practically point measurement of field.
- 5) Can be inserted in any gap wider than 1/4", and will reach the center of 3/7" diameter gap. Coil protected by stationary outer tubing.
- 6) Measures direction of field as well as intensity.
- 7) Guaranteed accuracy 1% or better.
- 8) Low price \$325 complete with meter.

**RAWSON ELECTRICAL  
INSTRUMENT COMPANY**

111 Potter St. Cambridge, Mass.

**ON THE JOB AT BENDIX**

This Ace Screen Room in the laboratories of the Scintilla Magneto Division of the Bendix Aviation Corp. at Sidney, N. Y. provides maximum shielding efficiency for the accurate measurement of r-f fields.



**HERE'S MAXIMUM  
Screen Room Efficiency!**

ACE Screen Rooms provide attenuations of 100 db.—and higher—and frequencies as low as 0.15 and as high as 10,000 mc. Rooms are available for attenuations as high as 140 db. Ace shielding characteristics have been determined by reputable electronic laboratories. Write, wire or 'phone for descriptive bulletin.

**ACE ENGINEERING & MACHINE CO., INC.**

3644 N. Lawrence St.

Philadelphia 40, Pa.

REgent 9-1019



**SPECIALTY**

**LAB-BILT DRY BATTERIES**



INDUSTRY



LABORATORY



RADIO  
AND IGNITION

Write for New  
**FREE CATALOG**

Here are complete descriptions of 78 Lab-Bilt Batteries of industrial and hard-to-get types. Specification Sheet enables you to order batteries especially designed to your own requirements. No order is too small. Specialty makes and ships FRESH Lab-Bilt Batteries without delay. Get this new catalog today.

**SPECIALTY BATTERY COMPANY**

Ray-O-Vac

**RAY-O-VAC**

Subsidiary

MAJISON 10, WISCONSIN



**HEAT RESISTANT WIRES FOR EVERY APPLICATION**

**DO**

DO you realize that DO stands for "Defense Order" and that more and more of our production comes under that category?

We are proud that we can help our country prepare for our defense.

We thank our old customers for their continued confidence in our products.

Send your electronic control, communications or appliance wiring specifications for a recommended solution by our engineers.

FOR A TRIAL ORDER OR A CARLOAD consult

- HEATING UNITS
- HEATING ELEMENT
- RESISTANCE LINE CORD
- THERMOCOUPLE WIRE
- ASBESTOS LEAD & FIXTURE WIRE
- INSULATED RESISTANCE WIRE
- FIBERGLAS INSULATED WIRE
- WIRE TO ANY SPECIFICATIONS



**THE LEWIS ENGINEERING CO.**

*Wire Division*

NAUGATUCK

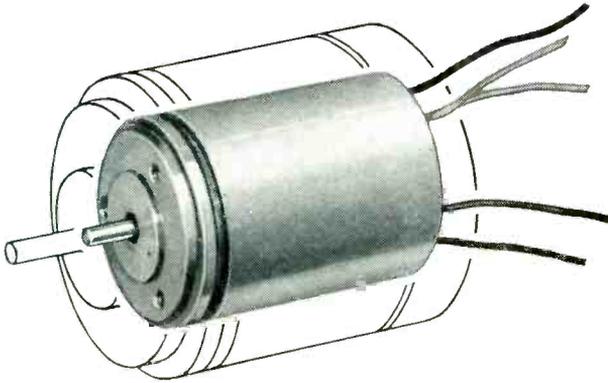
CONNECTICUT

# ECLIPSE-PIONEER

Announces the New Line of

## PYGMY SYNCHROS

Size of pygmy  
as compared  
to AY-200  
series outline



Eclipse-Pioneer has added a tiny new member to its great family of famous Autosyn\* synchros. It's the new AY-500 series, a precision-built pygmy weighing only 1¼ oz. while scaling only 1.278" long and .937" in diameter (the same diameter, incidentally, as a twenty-five cent piece). Its accuracy and dependability are assured, thanks to Eclipse-Pioneer's 17 years of experience and leadership in the development of high precision synchros for aircraft, marine and industrial applications. For more detailed information on the AY-500 and other E-P Autosyns, such as the remarkably accurate AY-200 series (guaranteed accuracy to within 15 minutes on all production units), please write direct to Eclipse-Pioneer, Teterboro, N. J.

\*REG. TRADE MARK BENDIX AVIATION CORPORATION

LOOK FOR THE PIONEER MARK OF QUALITY  
REG. U.S. PAT. OFF.

### Typical Performance Characteristics

	One AY-201-3 Driving		One AY-500-3 Driving
	One AY-500-3 Control Transformer	Two AY-500-3 Control Transformer	One AY-500-3 Control Transformer
<b>INPUT</b>			
Voltage	26-volts, single-phase	26-volts, single-phase	26-volts, single-phase
Frequency	400 cycles	400 cycles	400 cycles
Current	88 milliamperes	110 milliamperes	55 milliamperes
Power	0.8 watts	1.2 watts	0.9 watts
Impedance	105 + j280 ohms	100 + j220 ohms	290 + j370 ohms
<b>OUTPUT</b>			
Voltage Max. (rotor output)	17.9 volts	16.2 volts	14.1 volts
Voltage at null	40 millivolts	40 millivolts	40 millivolts
Sensitivity	310 millivolts/degree	280 millivolts/degree	245 millivolts/degree
Voltage phase shift	23 degrees	26 degrees	44 degrees
System accuracy (max. possible spread)	0.6 degrees	0.6 degrees	0.75 degrees

Other E-P precision components for servo mechanism and computing equipment:

Servo motors and systems • rate generators • gyros • stabilization equipment • turbine power supplies • remote indicating-transmitting systems and special purpose electron tubes.

For detailed information, write to Dept. C

**ECLIPSE-PIONEER DIVISION of**

TETERBORO, NEW JERSEY

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.



rangement, while Fig. 3B shows the voltage  $V$  (measured between the points indicated in the circuit) as related to the time of closing and opening switch  $S$ . The cross-hatched element is a rod of  $n$ -type germanium having broad-area contacts at the ends; holes are injected into the germanium by the point contact  $\epsilon$  (for emitter) and collected at a similar contact  $c$ .

Before the switch is closed,  $V$  is the battery voltage  $B_2$  minus the drop  $RI_e$ , where  $I_e$  is an electron current in the semiconductor. When the switch is closed at time  $t_1$ , a current  $I_e$  flows in the emitter circuit so that, regardless of the type of material from which the rod is made, there is a change in current through the resistor  $R$ . However, when the rod is an  $n$ -type semiconductor the current through  $R$  begins to increase at a later time  $t_2$  and reaches a new value. From this it is clear that, when the switch is closed, holes are emitted into the germanium which drift down the rod to the collector under the influence of the field provided by battery  $B_1$ . When they arrive at the collector they increase the current in the collector circuit. When the switch is opened the process is reversed. The key to the explanation is best given in Dr. Shockley's own words: "In a sample having carriers of one type only, electrons for example, it is impossible to alter the density of carriers by trying to inject or extract carriers of the same type. The reason is . . . that such changes would be accompanied by an unbalanced space charge in the sample and such an unbalance is self-annihilating and does not occur." The fact that carriers of opposite type can be injected into a semiconductor with consequent alteration in the apparent conductivity at another point on the semiconductor constitutes the necessary and sufficient condition for transistor action to be a reality.

### Surface States of Electrons

The term "surface states" frequently crops out in almost any discussion of semiconductor theory. In the few pages devoted to this topic, Dr. Shockley presents an

# The New STAVER MINI-SHIELD

TRADE MARK REG. AND PAT. PEND.

The shield that fits all Miniature Tubes



A flexible shield that snugly fits all miniature tubes because it compensates for all variations in tube dimensions. Mini-Shields are made for both T5½ and T6½ bulb tubes. Send for catalog sheet.

**THE Staver COMPANY**  
INCORPORATED

91 PEARL ST. • BROOKLYN 1, N. Y.  
ULSTER 5-6303

## ELECTRONICALLY REGULATED LABORATORY POWER SUPPLIES



• STABLE  
• DEPENDABLE  
• MODERATELY PRICED

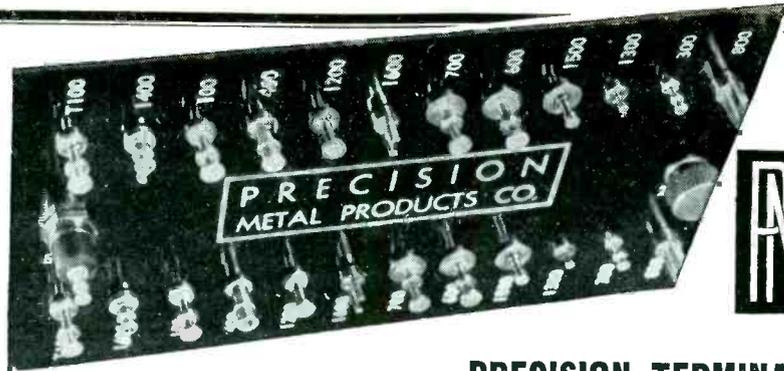
MODEL 28  
STANDARD  
RACK  
MOUNTING

PANEL SIZE  
5¼" x 19"  
WEIGHT 16 LBS.

- **INPUT:** 105 to 125 VAC, 50-60 cy
- **OUTPUT #1:** 200 to 325 Volts DC at 100 ma regulated
- **OUTPUT #2:** 6.3 Volts AC CT at 3A unregulated
- **RIPPLE OUTPUT:** Less than 10 millivolts rms

For complete information write for Bulletin E

**LAMBDA ELECTRONICS CORPORATION**  
CORONA NEW YORK

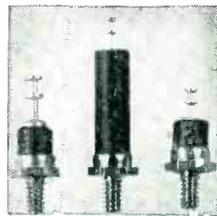


### Tubular Turret Terminals:

Permit mounting of components on both sides of a terminal board. Where compactness is necessary these tubulars have found wide use in electronic circuitry.

### Insulated Stand-off Terminals:

Engineered and manufactured to the highest specifications. The insulating material is



Grade XXX phenolic. Bases are nickel plated brass and are furnished in 2 types: Threaded or riveting. Terminals are silver plated.

### PRECISION TERMINALS

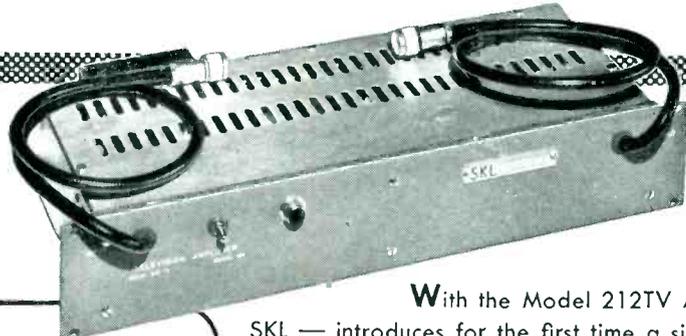
PMP designs and fabricates terminals for every conceivable electronic requirement. Their unusual production methods and engineering skill provides products of far better quality—yet at costs below competition. Base material is brass with an approved silver plated finish. Centrifugal tin dipped finish available at no extra cost. Their standard line is available immediately and specially designed terminals can be produced within any reasonable requirement. Before you buy consult PMP.

### For Complete Data & Prices

on all PMP products send for Catalog No. 20. Requests on company letterhead promptly answered.

**PRECISION METAL PRODUCTS CO. of Malden**  
41 Elm St. Stoneham 80, Massachusetts

## 40 MC TO 220 MC TV AMPLIFIERS



### SPECIFICATIONS

- **BANDWIDTH**  
40 MC—220 MC
- **IMPEDANCE**  
200, 52 and 72 ohm unbalanced, 300 ohm balanced
- **GAIN**.....20 db
- **OUTPUT VOLTAGE**  
4 volts RMS maximum
- **RESPONSE**  
± 2 db over bandwidth
- **LIST PRICE**  
\$366.00 f.o.b. Cambridge, Mass.  
Trade Discounts Available

With the Model 212TV Amplifier—SKL — introduces for the first time a single broad band booster capable of amplifying all 13 television channels simultaneously. Because of its stability and reliability — a tube failure means only a slight loss of gain, not amplifier failure — the Model 212TV Amplifier can be safely left unattended for long periods of time. Its low noise level, high output, and low impedance make the Model 212TV Amplifier ideal for television distribution systems in hotels, apartment houses, sales rooms and television stations and manufacturers' plants.

Write today for further information

**SKL SPENCER-KENNEDY LABORATORIES, INC.**  
186 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.

# RAYTHEON

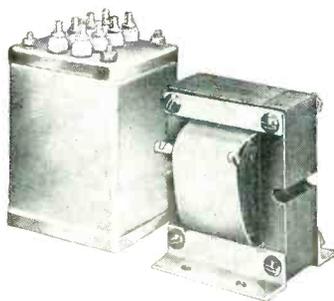
## MAGNETIC COMPONENTS FOR MILITARY APPLICATIONS

Raytheon Voltage Stabilizers, Transformers and other Magnetic Components are noted for reliability in the most exacting military service. As a leading manufacturer for 20 years, Raytheon has developed engineering and production facilities which enable it to produce highest quality components to meet the most rigid MIL requirements. Write for complete information.



### VOLTAGE STABILIZERS

Precision built to provide maximum voltage stabilization with minimum variation in output voltage. An essential component for all electronic or electrical equipment requiring constant voltage for dependable, accurate operation. Available in catalog models from 15 to 2000 watts output capacity . . . or custom-engineered to suit special applications.



### CUSTOM-BUILT TRANSFORMERS

Individually engineered to meet the most exacting military or commercial requirements. Typical units include: single or polyphase power transformers, pulse transformers, servo transformers, chokes, saturable magnetic components, etc. Cased or open types to meet MIL specifications as well as Underwriters' Laboratories and R. M. A. requirements.

#### Write for Complete Information

Raytheon Products include Mariners Pathfinder\* radar; Fathometers\*; radio and television receivers; tubes; microwave communications; electrostatic air cleaners; Weldpower\* welders; voltage stabilizers; Recticharger\* battery chargers; Rectifilter\* battery eliminators; Rectiringers\*; transformers; Microtherm\* diathermy; fractional hp motors, and other electronic equipment.\*®

Magnetic Components Division, Dept. 6460-A

## RAYTHEON MANUFACTURING COMPANY

Waltham 54, Massachusetts

especially satisfactory exposition of the elementary aspects of the theory which has been developed by J. Bardeen. "The conclusion reached by Bardeen is that electrons which move in the body of the semiconductor can become tightly bound in *surface states* on the surface of the semiconductor and thus become immobilized." Investigation of certain aspects of this problem by Drs. Bardeen and Walter H. Brattain led to the invention of the transistor. Surface states in themselves play an important part in rectifier and transistor phenomena, as is further shown by Dr. Shockley in the section "On the Nature of Metal-Semiconductor Contacts". A brief review of this section also shows that the effect of work function differences between the metal and the semiconductor affect the behavior of the contact in more subtle ways than are suggested by Fig. 1B.

#### Type-A Transistors

Transistors may be of more than one general type. That known as the type A is shown schematically in Fig. 4. It may employ either *n*- or *p*-type material; the battery polarities indicated are for the *n*-type material and would be reversed for the *p*-type transistor. The filamentary and *p-n-p* transistors will be mentioned later.

The similarity between the transistor of Fig. 4 and the experimental set-up for observing the effects of hole injection into *n*-type germanium shown in Fig. 3 is at once evident. When the emitter current  $I_e$  is varied the collector current  $I_c$  also varies. That the collector current can vary more than the emitter current is not, however, obvious from what has so far been

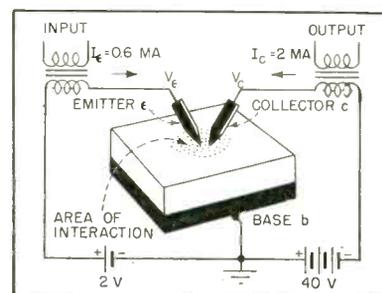


FIG. 4—Type-A transistor with typical operating conditions (Courtesy D. Van Nostrand Company, Inc.)

## AVAILABLE NOW

MANUFACTURING FACILITIES  
FOR

- Components For Radio & Television
- Screw Machine Products
- Stampings
- Tools & Dies
- Production Precision Parts
- Jigs & Fixtures
- Mechanical Assemblies
- Electrical Assemblies
- Electrical Instruments
- Electrical Test Equipment
- Special Coil Winding
- Special Transformers

Production for Nationally known Companies since 1906—20,000 square feet—qualified design, engineering, production personnel. For complete information, write to:

**EASTERN  
SPECIALTY CO.**

3621 North 8th Street,  
Philadelphia 40, Penna.

## SENIOR ELECTRONIC SYSTEMS ENGINEERS

Lockheed in California  
offers you a job—with a future

Lockheed invites you to participate in its long-range production program, developing the aircraft of the future.

Lockheed offers an attractive salary commensurate with your ability and background, a chance to live in Southern California, a future in aeronautical science. In addition, Lockheed provides generous travel allowances.

If you have:

1. An M. S. or Ph. D. in Electrical Engineering or Physics—
2. A minimum of three years' experience in advanced electronic systems development, including radar microwave techniques, servomechanisms, computers and fire control—
3. Familiarity with airborne electronics equipment requirements—

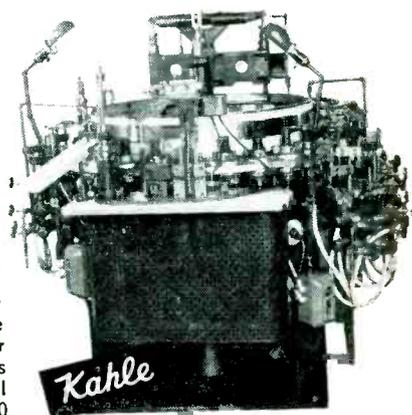
... write today for  
free, illustrated booklet  
describing life and work at  
Lockheed in Southern California.  
Include pertinent data on your  
training and experience.  
Address:

M. V. Mattson, Employment Manager  
**LOCKHEED**  
Aircraft Corporation, Burbank, California

# Kahle

specialists in custom-built, ultra-precision  
**ELECTRON TUBE MACHINERY**

KAHLE CUSTOM-BUILDS machines to make the exact tubes you require—from big 20-inchers to tiny sub-miniature—from laboratory types to those for high-speed production. Kahle puts each unit through exhaustive trial runs in our plant to assure trouble-free operation in yours.



#1197

24-HEAD

### BUTTON STEM MACHINE

For miniature and subminiature tubes. Two upper molds for making non-tabulated stems with short lead wires. Dual motor drive. Capacity 1000 per hour.

Consultations invited  
Send for our new catalog

Kahle

Production-boosting, labor-saving equipment for complete manufacture of cathode ray tubes, standard, miniature and sub-miniature radio tubes, sub-miniature tubes, fluorescent lamps, photocells, x-ray tubes, glass products.

# Kahle ENGINEERING CO.

1309 Seventh Street, North Bergen, New Jersey

## FOR POSITIVE AND INEXPENSIVE SHIELDING

—use Metex "Electronic Weather Strips"

Because they combine exceptional *resiliency* with good *conductivity*, Metex Electronic Products made of knitted wire mesh offer an unusually effective means of sealing and shielding a wide variety of types of electronic equipment.

As closures for sheet metal cabinets, for instance, the resiliency of "Metex" assures positive conductive contact *at every point* between cover and cabinet—eliminating costly machining for close tolerances. Metex Gaskets also assure resilient metal-to-metal contact between flanges, and can be combined with rubber com-

pounds to function both as a shield and as a seal.

Applications in which "Electronic Weather Strips" have already proved their effectiveness include pulse modulator shields, wave-guide choke-flange gaskets, replacement of beryllium-copper fingers and springs on TR and ATR tubes.

We will be glad to put our experience at your disposal. A letter to Mr. R. L. Hartwell, outlining your problem, will receive immediate study.

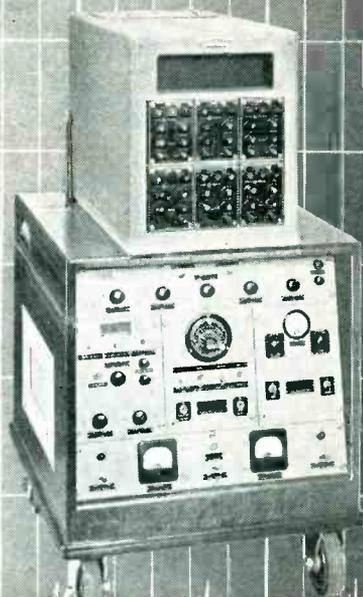
For preliminary information, write for bulletin "Metex 'Electronic Weather Strips.'"



## METAL TEXTILE CORPORATION

641 EAST FIRST AVENUE, ROSELLE, N. J.

## NEW HIGHS IN RESOLUTION



### THE HATHAWAY SC-16A SIX ELEMENT RECORDING CATHODE-RAY OSCILLOGRAPH

NEW HIGHS IN RESOLUTION are obtained by this new oscillograph because of its unusually HIGH FREQUENCY RESPONSE and HIGH CHART SPEED... designed for recording fast transients and continuous phenomena.

FREQUENCY RESPONSE 0 to 200,000 cycles per second  
RECORDS up to 1000 ft. long at speeds up to 600 inches per second  
RECORDS up to 10 ft. long at speeds up to 6000 inches per second  
WRITING SPEED as high as 5,000,000 inches per second

#### Note these additional unusual features.

- SIX ELEMENTS with convenient interchangeable lens stages for 1, 2, 3, or 6 traces on full width of chart.
- INTERCHANGEABLE RECORD MAGAZINES for CONTINUOUS RECORDING on strip chart, either 6 inches or 35mm in width up to 1000 feet in length, DRUM RECORDING for short, high-speed records, and STATIONARY CHART for very short transients.
- PRECISION TIMING EQUIPMENT, tuning fork controlled, for 1-millisecond or 10-millisecond time lines.
- Crystal-controlled Z-AXIS MODULATION for 1/10 millisecond time marks.
- QUICK-CHANGE TRANSMISSION for instantaneous selection of 16 record speeds over a range of 120 to 1.
- AUTOMATIC INTENSITY CONTROL.
- CONTINUOUS SWEEP OSCILLATOR which permits viewing as well as recording.
- Single-pulse LINEAR OSCILLATOR for recording transients on stationary film. The record can initiate the transient to be recorded, or the transient can initiate the record.

Each recording element is a complete unit, fully housed, which can be instantly inserted or removed. Recording element contains high-intensity cathode-ray tube, and both AC and DC amplifiers. Control panel is located on outside end.

FOR FURTHER INFORMATION, WRITE FOR  
BULLETIN 2 G1-G

*Hathaway*  
INSTRUMENT COMPANY.  
1315 SO. CLARKSON STREET • DENVER 10, COLORADO

noted. One defines the current amplification as

$$\alpha = -(\delta I_c / \delta I_e), V_e = \text{constant.}$$

An average value of  $\alpha$  might be 2.5; values several times this amount are sometimes encountered. The reason for such high values is to be found in a number of factors.

#### Factors Affecting Amplification

First, the current in the collector circuit is increased by the magnitude of the hole current reaching the collector point. Second, the potential in the region of the point tends to be altered by the holes which act like positive charges so that a further increase in electron current from the collector results. This increase in electron current is, of course, limited to that which restores the normal space charge. As a rough approximation, if all holes injected by the emitter reach the collector, and if one hole balances the charge of one electron, the current gain as above defined should be two. There are, however, other factors to be considered.

By measurements of the Hall coefficient and resistivity, as well as by interpretation of data obtained from experiments like Fig. 3, it has been shown that the mobility of holes in germanium is only about half that of conduction electrons. If this ratio holds in the strong field existing in the space-charge region near the collector, the holes exert their influence twice as long, so that two electrons are emitted for every hole. Thus if  $b$  is the ratio of electron mobility (or velocity) to hole mobility, the current gain  $\alpha$  is  $1 + b$ . For weak fields, as in the rod of Fig. 3,  $b$  is about 2, so that from these deductions  $\alpha$  could be only about 3. That  $\alpha$  can have much higher values may be taken as indication that some further action must take place such, for example, as the trapping of holes in trapping centers. "If a concentration of centers which has the property of binding holes tightly could be produced directly in front of the collector, then the holes would tend to accumulate there with a resultant increase in space charge."

Dr. Shockley discusses briefly his theory of the "p-n hook" as a prob-

# NEW Subscription Order

Please enter my new subscription for  
THREE YEARS of ELECTRONICS for \$12.

If you prefer 1 year of ELECTRONICS for \$6 check here


Name: ..... Position .....

Street Address: .....

City: ..... Zone ..... State .....

Company: .....

Foreign Rates (1 year) Canada \$10, Latin America \$15, Other \$20

5-51

# NEW Subscription Order

Please enter my new subscription for  
THREE YEARS of ELECTRONICS for \$12.

If you prefer 1 year of ELECTRONICS for \$6 check here


Name: ..... Position .....

Street Address: .....

City: ..... Zone ..... State .....

Company: .....

Foreign Rates (1 year) Canada \$10, Latin America \$15, Other \$20

5-51

Postage  
Will be Paid  
by  
McGraw-Hill  
Pub. Co.

No  
Postage Stamp  
Necessary  
if Mailed in the  
United States

**BUSINESS REPLY CARD**

First Class Permit No. 64 (Sec. 34.9, P. L. & R.) New York, N. Y.

4¢ POSTAGE WILL BE PAID BY —

McGRAW-HILL PUBLISHING CO., Inc.

**ELECTRONICS**

330 WEST 42nd STREET

NEW YORK 18, N. Y.



Postage  
Will be Paid  
by  
McGraw-Hill  
Pub. Co.

No  
Postage Stamp  
Necessary  
if Mailed in the  
United States

**BUSINESS REPLY CARD**

First Class Permit No. 64 (Sec. 34.9, P. L. & R.) New York, N. Y.

4¢ POSTAGE WILL BE PAID BY —

McGRAW-HILL PUBLISHING CO., Inc.

**ELECTRONICS**

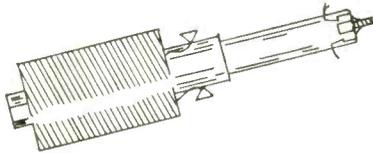
330 WEST 42nd STREET

NEW YORK 18, N. Y.



# COILS

*By Experts*



## TO YOUR SPECIFICATIONS

*For* TV — Radio — FM or any other application you desire.

*For* quick dependable service.

*For* long or short production runs.

Write, wire, phone or send your prints. No obligation of course.

## **CENTRONICS Co.**

*Leader in the field of electronic design and manufacture*

5065 Broadway, New York, N. Y.  
LOrraine 9-4540

# *Runzel*

## WIRE, CORD and CABLE

In almost endless variety of sizes, insulation and colors to your specifications, Runzel products are available to assist you in your wiring problems.

Shielded wire and cords . . . popular hook-up and lead-in wire . . . speaker cords and all types of insulated wire products.

Precision made RUNZEL products are the finest. Write for samples.



**RUNZEL** CORD & WIRE CO.  
4723 Montrose Avenue  
Chicago 41, Illinois

# HI-TEST

INSULATING COMPOUNDS  
**WAXES**  
SEALING COMPOUNDS

For dipping, potting, impregnating and sealing of radio components and all types of electrical units

**HI-TEST** can supply you with materials for highest and lowest temperature applications, with a wide range of melting points, and varying degrees of hardness, flexibility and toughness.

**HI-TEST** is ready to serve you with products developed and made according to YOUR specifications. If you have a problem requiring a product with special or unusual characteristics, we invite your inquiry.

# HI-TEST

**CHEMICAL CORPORATION**  
722 64TH ST., BROOKLYN 20, N. Y.

look to

# ALLIED

for

# CHICAGO

transformers  
for industry

famous  
Sealed-in-Steel Units

- Power Transformers
- Bias Transformers
- Filament Transformers
- Filter Reactors
- Audio Transformers
- JAN-T-27 Transformers
- Stepdown Transformers
- Isolation Transformers



## Quick, Expert Industrial Service

We specialize in the supply of famous CHICAGO Sealed-in-Steel Transformers for prototype electronic equipment, pilot runs, and special applications. Our large stocks include three types of constructions: hermetically sealed JAN-T-27 units, semi-sealed, and compound sealed units. Most types are available for immediate shipment from stock. You can depend on ALLIED to save you time, effort and money on your transformer requirements. Make ALLIED your central supply source for all electronic supplies—special tubes, parts, test instruments, tools, audio amplifiers, accessories—available quickly from the world's largest stocks.



Allied Radio

## See Your ALLIED Catalog

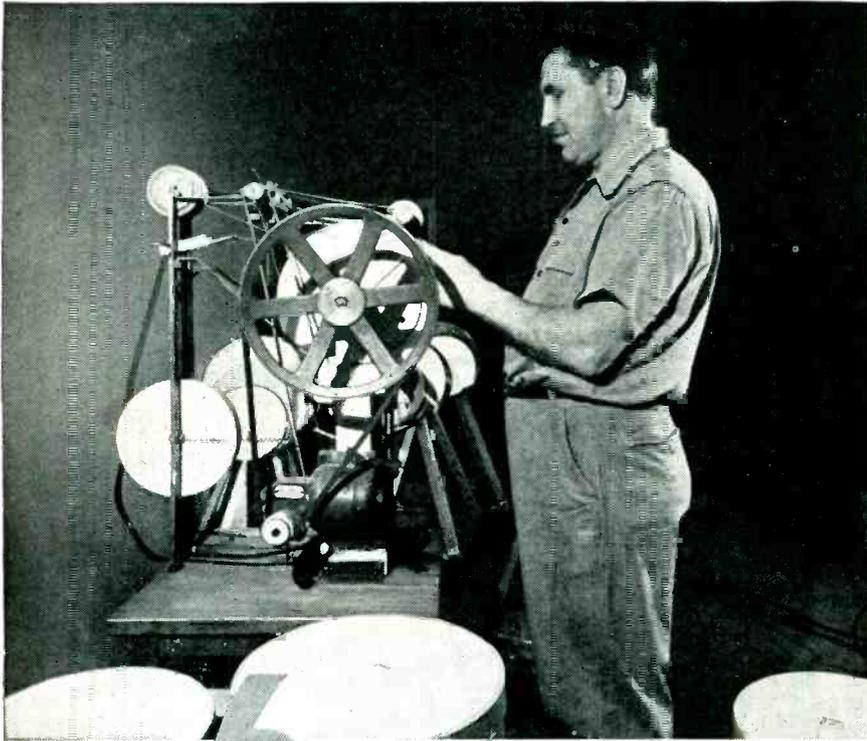
for complete listings of CHICAGO transformers. Keep this 212-page book handy—it's the one complete up-to-date guide to electronic supplies for Industrial and Broadcast use. If you haven't the latest ALLIED Catalog, write for it today.

## ALLIED RADIO

833 W. Jackson Blvd., Dept. 11-EE-1  
Chicago 7, Illinois

Everything in Electronics from ONE Source

# PRESTO.... most carefully made recording discs in the world



## step 6 - sealing and packing

Lacquer recording surfaces are vulnerable to grit and dust and need complete protection from these abrasives. The smallest particle of dirt between adjacent discs can result in permanent damage to their surfaces, showing up in "pops" or "clicks" when reproduced.

At PRESTO, the last, and one of the most important steps in disc production, is airtight sealing and packing. Discs are sandwiched between specially treated fibre end pieces. The entire rim of this circular stack of discs is then sealed with tape and they are carefully packed in triple-reinforced cartons ready for shipment around the world.

This extra protection against surface damage is still another reason why PRESTOS are known and preferred as the finest, most permanent recording discs available.



The name is PRESTO "Green Label" world's finest recording disc.



RECORDING CORPORATION  
Paramus, New Jersey  
Mailing Address:  
Box 500, Hackensack, New Jersey

In Canada:  
Walter P. Downs, Ltd.  
Dominion Sq. Bldg.  
Montreal, Canada

Overseas:  
M. Simons & Son Co., Inc.  
25 Warren Street  
New York, New York

able means of current multiplication, the hook being a thin region of weakly *p*-type material formed between the *n*-type body of the crystal and an *n*-type region adjacent to the collector.

In view of the mechanism of current multiplication, whatever it may be, the factor  $(1 + b)$  is apt to be of minor significance in most cases. The symbol  $\alpha_i$  is used for the intrinsic current gain taking place at the collector and, for the device, the current gain  $\alpha$  will be  $\alpha_i \beta \gamma$ . The factor  $\beta$  is the fraction of holes leaving the emitter which arrive at the collector. Since some holes are lost by recombination with electrons,  $\beta$  is somewhat less than unity and drops to low values for wide separation between emitter and collector points. The factor  $\gamma$  is the fraction of emitter current carried by holes; it will also be somewhat less than unity for the reason that a part of the emitter current may be due to electrons entering the emitter from the conduction band of the semiconductor.

### Equivalent Circuit

In Part I of his book, Dr. Shockley devotes about 13 pages to the equivalent circuit and noise. One naturally wishes that these sections could have been somewhat expanded, but the fact that these topics have already been well covered in the literature by some of his associates is reason enough for brevity.

Figure 5 shows three equivalent circuits for the transistor and the relationships among the parameters. Attention must here be called to the fact that a transistor is a current-operated device and as such may be considered the dual of the triode. We write the functional relationships in the form

$$v_e = f_1(I_e, I_c)$$

$$v_c = f_2(I_e, I_c)$$

The subscripts refer to the emitter and collector. The small a-c voltages  $v_e$  and  $v_c$  produced by small a-c currents  $i_e$  and  $i_c$  are then

$$v_e = \frac{\delta f_1}{\delta I_e} i_e + \frac{\delta f_1}{\delta I_c} i_c = r_{11} i_e + r_{12} i_c$$

$$v_c = \frac{\delta f_2}{\delta I_e} i_e + \frac{\delta f_2}{\delta I_c} i_c = r_{21} i_e + r_{22} i_c$$

The *r*'s are the slopes of the char-



## Ungar's little Angels

### DO A HEAVENLY SOLDERING JOB

Pick any job and you'll find a pip of a tip to use with the trim, slim Ungar Pencil. Any of the 8 Ungar Angels interchange in the No. 776 Handle to make a honey of a tool that does work faster and better than larger, heavier irons. Whatever your problem, you'll bless the day you discovered these saintly soldering cherubs!



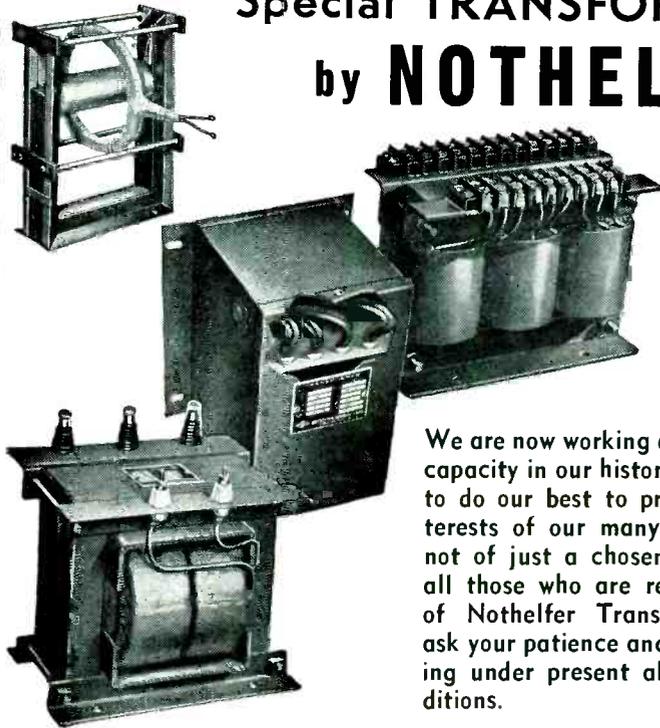
No. 538 1/8" CHISEL TIP, 20 Watts

For Light Duty Work. Especially recommended for Printed Circuits. Very useful for small joints and hard-to-reach points on radio and TV, electronic assemblies, aircraft instruments, bearing and assembly and repair.

Write for Catalog No. 600

**Ungar** ELECTRIC TOOLS, INC., Los Angeles 54, Calif.

## Special TRANSFORMERS by NOTHELPER



Proven by  
Past  
Performance

We are now working at the highest capacity in our history. We intend to do our best to protect the interests of our many customers—not of just a chosen few, but of all those who are regular buyers of Nothelfer Transformers. We ask your patience and understanding under present abnormal conditions.



## NOTHELPER

WINDING LABORATORIES

9 ALBEMARLE AVE., TRENTON 3, N. J.

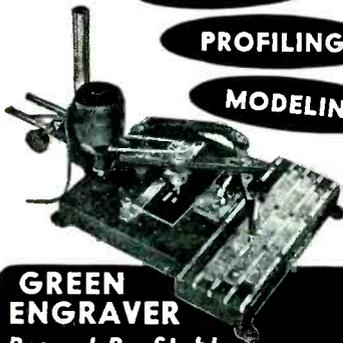


ENGRAVING

ROUTING

PROFILING

MODELING



### GREEN ENGRAVER

Proved Profitable —

Machine Tool, Radio, Electrical  
and Instrument Mfrs., Sales Pro-  
motion and Advertising.

Fast, rugged, convenient—and inexpensive. The Green Engraver is tops for low-cost performance —zips out precision work on metal, plastics or wood . . . cuts four lines of letters from 3/64" to 1" on curved or flat surfaces . . . operates by tracing . . . makes anyone an expert . . . engraves panels, name plates, scales, dials, molds, lenses and instruments. (Also widely used for routing, profiling and three dimensional modeling.) Electric etching attachment available.

Special attachments and engineering service available for production work.

FREE—Fact-packed folder. Send for yours, today

### GREEN INSTRUMENT COMPANY

**GREEN**

363 PUTNAM AVENUE  
CAMBRIDGE, MASS.

## TELEVISION SIGNAL GENERATOR

Model 90

Specifications:

### CARRIER FREQUENCY

RANGE: Continuously variable from 20 to 250 megacycles, in eight ranges.

### MODULATION

PERCENTAGE: Continuously variable from 0 to 100%.

ENVELOPE: Sinusoidal, or composite television.

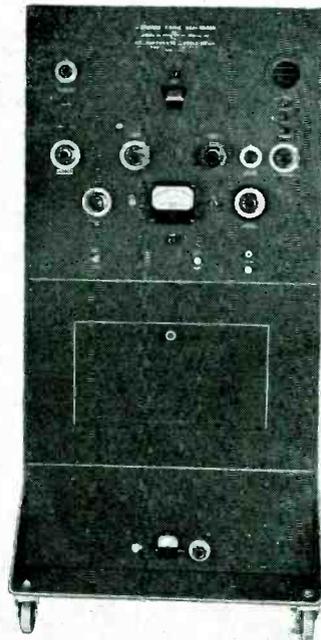
### OUTPUT

LEVEL: Continuously variable from 0.3 microvolt to 0.1 volt balanced to ground (measured at 100% modulation level).

DIMENSIONS: Height—58 3/4"  
Width—28 1/4" Depth—25 1/2"

POWER SUPPLY: 117 volts, 60 cycles, 700 watts.

Complete Data On Request



The first commercial wide-band,  
wide-range Signal Generator  
to be developed to meet the  
exacting standards of high de-  
finition television use.

### MEASUREMENTS CORPORATION

BOONTON



NEW JERSEY

# SYNTHETIC SAPPHIRE *for*



## Resistance to Wear

Outlasting hardened steel and cemented carbides 2 to 5,000 times.



## Resistance to Friction

Affording very low friction surfaces due to hardness and surface continuity.



## Resistance to Heat Distortion

Retention of form at temperatures up to 1,000°C.



## Retention of Insulating Properties

Excellent dielectric properties over a wide range of temperatures.

LINDE Synthetic Sapphire is available in a variety of forms. It can be polished by flame or ordinary diamond polishing; it can be formed and bent by flame. Polished sapphire surfaces keep free of dirt, and in many anti-friction applications, need not be lubricated.

The experience that LINDE engineers have in applying sapphire to industrial processes may be of help to you. Call or write the LINDE office nearest you. Get your copy of the booklet, "LINDE Synthetic Crystals For Industry." Ask for Form 7560.

*Linde*  
Trade-Mark

## LINDE AIR PRODUCTS COMPANY

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

30 E. 42nd St., New York 17, N. Y.  Offices in Other Principal Cities

In Canada: DOMINION OXYGEN COMPANY, LIMITED, Toronto

The term "Linde" is a trade-mark of Union Carbide and Carbon Corporation.

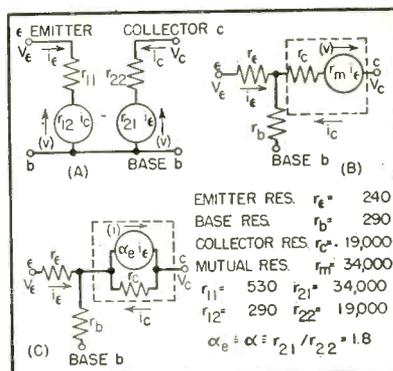


FIG. 5—Equivalent circuits for the transistor and average equivalent circuit parameters in ohms. For computation of performance, the network may be arranged as in (B) or (C), the elements in the boxes being the required constant-voltage or constant-current generators (Courtesy D. Van Nostrand Company, Inc.)

acteristic curves of the transistor units under consideration.

### Transistor Noise Figures

The noise of the transistor has a frequency spectrum associated with contact or current noise. "The noise power per cycle varies inversely with frequency so that the noise per octave is the same for all octaves, at least over the frequency range for which the equivalent circuit parameters are independent of frequency." The equivalent circuit is that of Fig. 5A but with  $v_{n\epsilon}$ , the noise generator voltage at the emitter, substituted for  $v_\epsilon$  and with  $v_{nc}$ , the noise generator voltage at the collector, substituted for  $v_c$ . Typical values are  $v_{n\epsilon} = 1$  microvolt and  $v_{nc} = 100$  microvolts, these being the rms noise voltages in a 1-cps band at 1,000 cps. Since the noise power varies as  $1/f$ , the values of  $v_{n\epsilon}$  and  $v_{nc}$  at another frequency  $f$  are  $(1,000/f)^{1/2}$  times their values at 1,000 cps.

A typical noise figure is 55 db for the 1,000 to 10,000 cps band which is, of course, poorer than that of a triode. Comparison is not so unfavorable at considerably higher frequencies; for example, the typical transistor would have a noise figure of about 30 db at 1 mc. Dr. Shockley indicates that "there appears to be no basic physical principle which will prevent lowering the noise in transistors greatly." While results of recent tests at the Bell Telephone Labora-



## LOW or HIGH PRESSURE

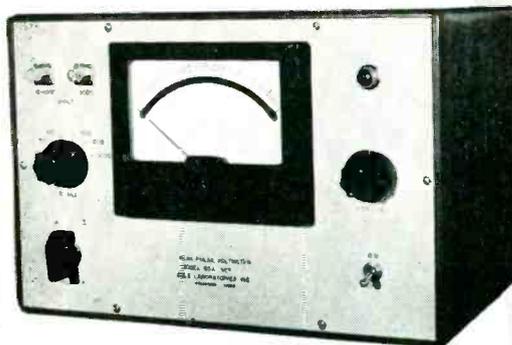
High pressure or low, there is a Giannini precision pressure transmitter that meets your requirements for remote indication, recording or control.

From less than 1 up to 10,000 psi, with various types of resistance and inductive output values, Giannini precision pressure transmitters are designed to withstand extremes of acceleration, temperature, vibration, while at the same time retaining their accuracy and their fast response characteristics. "They are standard with the Leaders." Write for booklet. G. M. Giannini & Co., Inc., Pasadena 1, California



**giannini**

## automatic slideback peak pulse



## VOLTMETER

Far more versatile than conventional types, the C.G.S. peak pulse voltmeter reads *rapidly* and *accurately* on pulse widths of .25 microseconds and at repetition rates of 10 pps. The instrument reads on either positive or negative pulses. Controls include an on-off, range selector and input polarity switch; zero set control. A switch which throws a D.C. restorer into the circuit provides accurate peak to peak measurements of sine and square waves.



### SPECIAL FEATURES —

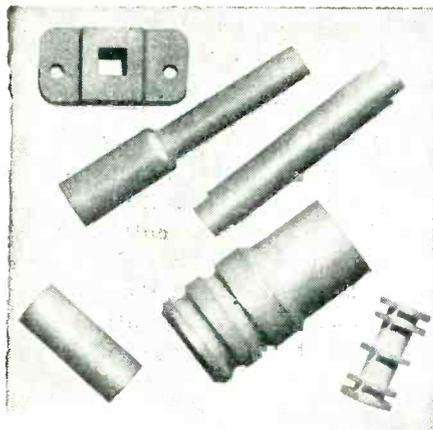
- Wide Voltage Range — 5 scales from .10 to 5000 volts full scale.
- Pulse Width 0.25 microseconds to 50 milliseconds.
- Accuracy  $\pm 3\%$  of full scale.
- Input Impedance 200,000 ohms.

Write for Catalog Sheet Giving Full Information — Or Contact Us Concerning Your Own Individual Problems. Our Staff is at Your Service. Write Dept. A



**C. G. S. LABORATORIES, INC.**  
LUDLOW STREET STAMFORD, CONNECTICUT

## Lavite STEATITE GERAMIC



Design engineers and manufacturers in the radio, electrical and electronic fields are finding in LAVITE the precise qualities called for in their specifications . . . high compressive and dielectric strength, low moisture absorption and resistance to rot, fumes, acids, and high heat. The exceedingly low loss-factor of LAVITE plus its excellent workability makes it ideal for all high frequency applications.

Complete details on request

**D. M. STEWARD MFG. COMPANY**

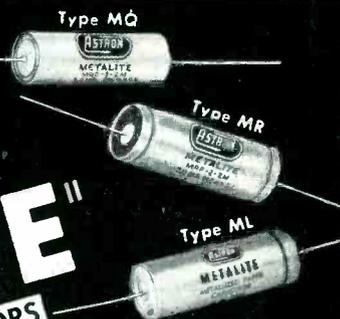
Main Office & Works: Chattanooga, Tenn.  
Needham, Mass. • Chicago • Los Angeles  
New York • Philadelphia



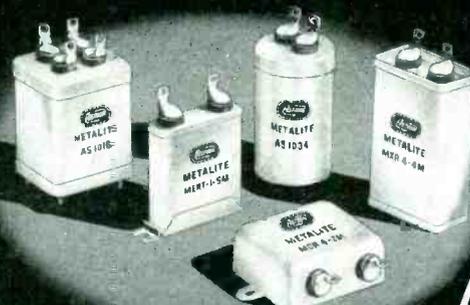
STARTLINGLY SMALL  
AMAZINGLY LIGHT WEIGHT  
UTMOST RELIABILITY

# "METALITE"

METALLIZED PAPER CAPACITORS



QUALITY MINIATURES — the space-saving solution to size reduction problems — save 50% to 75% in capacitor space — self-healing properties eliminate capacitor service problems — excellent RF characteristics — the "last word" in ultra-compact, miniature capacitor design — available in standard, JAN and special case styles.



ASTRON RF Interference filters with "METALITE" — is the answer to your RF Interference suppression problems

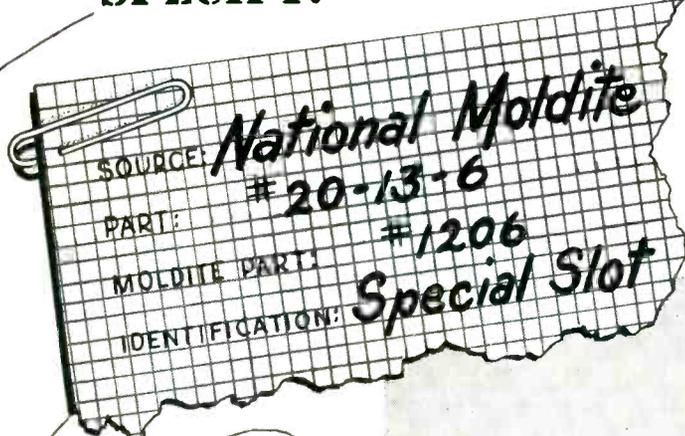
**ASTRON CORPORATION**

255 Grant Avenue East Newark, New Jersey

WRITE FOR  
CATALOG AC-2

Manufacturers  
HIGH QUALITY FIXED CAPACITORS AND FILTERS

**SPECIFY:**



Precision Controlled



Cores For Every



Electronic Use



Samples promptly submitted upon request for design, pre-production, and test purposes.

SEND FOR CATALOG 106

Jerry Golten Co.  
 2750 W. North Ave.  
 Chicago 22, Ill.

Perlmuth-Colman & Associates  
 1335 South Flower  
 Los Angeles, Cal.

(Northern N. Y.)  
 Martin P. Andrews  
 Garden City, N. Y.

Jose Luis Pontet  
 Cardoba 1472  
 Buenos Aires

... on  
 the principle  
 that it  
 costs less  
 to work with  
 the finest!

**NATIONAL  
 MOLDITE  
 COMPANY**

1410 CHESTNUT AVE., HILLSIDE 5, N. J.

tories are not known to this reviewer, those at the Physics Laboratories of Sylvania Electric Products Inc. are in agreement with Dr. Shockley's predictions.

*Other Transistors*

As previously mentioned, the type-A transistor is not the only variety of transistor, although it is the only kind so far adapted to reasonably reproducible manufacture. The filamentary transistor and the *p-n-p* transistor are of special interest as tools for the investigation of semiconductor phenomenon. One kind of crystal photodiode is sometimes called a phototransistor since its operation is quite analogous to that of the type-A transistor, hole injection in the former being accomplished by light. Dr. Shockley makes only brief mention of this most useful and interesting device, presumably because its operation is easily understood when the action of the type-A transistor and the creation of hole-electron pairs by means of photons has been explained.

In the book, discussion of the filamentary transistor precedes that of the type-A transistor because it is more basic; the order has been reversed in this review because the latter is more familiar to most readers.

*Filamentary Transistors*

The filamentary transistor is made by mounting a thin slab of single-crystal germanium on an insulating block and cutting it out as shown in Fig. 6. Broad-area contacts are made at the ends and an emitter point positioned as shown. The high impedance of the

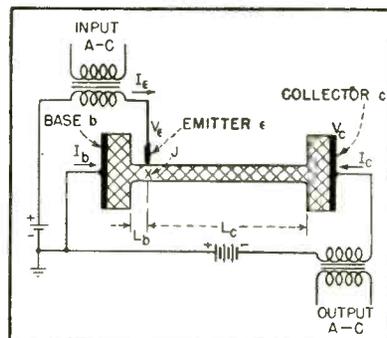
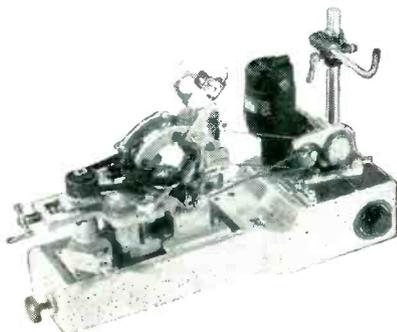


FIG. 6—Filamentary transistor (Courtesy D. Van Nostrand Company, Inc.)

# MICO

Precision Apparatus

## TOROID COIL WINDERS



Wide-range, laboratory-type machines available for winding samples and small production runs of toroid coils. Production machines built to meet specific requirements.

**MICO INSTRUMENT CO.**  
76E Trowbridge St., Cambridge, Mass.

WHEN YOU THINK OF  
**VERY  
LOW  
FREQUENCY**  
THINK OF

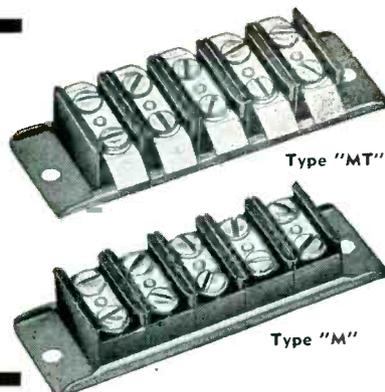
**SIE**

- **OSCILLATORS**  
1/100 CPS — 120,000 CPS
- **TRANSFORMERS**  
Miniature Hermetically Sealed
- **AMPLIFIERS**
- **DC AMPLIFIERS**
- **CARRIER AMPLIFIERS**
- **AC-DC VOLTMETERS**
- **RESISTANCE METERS**  
Write for Descriptive Bulletins

**SOUTHWESTERN INDUSTRIAL  
ELECTRONICS COMPANY**  
2831 Post Oak Road Houston, Texas

## 2 CONTROL MIDGETS

for  
**300 VOLTS  
15 AMP.**



## CURTIS TYPES "M" and "MT" TERMINAL BLOCKS

Designed to take up a minimum of space, these Curtis Terminal Blocks afford an economical and convenient way to simplify control wiring. Terminal assemblies are securely held in a metal channel. A solid base provides ample insulation from the mounting channel and eliminates terminal screw grounding. Danger of damage or breakage is kept at a minimum.

Both type "M" and "MT" Terminal Blocks have ample clearance and creepage distance for use in circuits carrying up to 300 volts, 15 amperes. Type "M" is without marking tags. Type "MT" is equipped with white fibre marking tags which increase insulation and provide circuit identification. Factory assembled in from 1 to 24 terminals.

Write for Bulletin DS-119 TODAY—or consult our condensed catalog in the McGraw-Hill Electrical Catalog for Product Engineers.

## CURTIS DEVELOPMENT & MFG. CO.

Terminal Block Sales—4522 West Madison Street, Chicago 24, Illinois  
Factory — Milwaukee 16, Wisconsin

# Measure Time Intervals



From 10 Microseconds to 3 Seconds

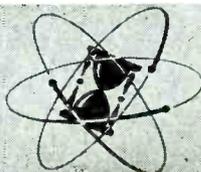
The time interval between any two components in electrical, mechanical or electro-mechanical systems can now be measured, simply and accurately, with American Chronoscope Equipment.

The Model 211 Input Adapter used in conjunction with the Model 110 American Chronoscope separates the functions of STARTING and STOPPING the measurement of time. Simply connect the Start and Stop leads from the adapter to any two components of a system under test. Only the first complete elapsed time interval presented is accepted. This reading is indicated on the Chronoscope and remains fixed until reset.

### PRICES

Model 110 Chronoscope . . . \$475  
Model 211 Input Adapter . . . \$265

For complete description on these and other Chronoscopes and Adapters, write for Bulletin 200A



**American Chronoscope**

CORPORATION  
316 WEST FIRST ST. MOUNT VERNON, N. Y.

**If your  
thermostat  
requirements  
are critical**



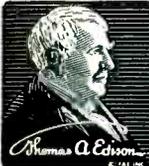
### **take a tip from Fairchild!**

Temperatures of  $-65^{\circ}\text{F}$ , or lower, would cause distortion between structural parts of their new high-altitude, precision mapping aerial camera. So Fairchild Camera & Instrument Corp. designed integral electric heaters into the equipment. In order to maintain an efficient operating temperature, they needed thermostats that would stand up under shock and vibration; provide long, dependable life—and above all—be absolutely explosion-proof: a “must” in aircraft service.

They chose Edison “Sealed-in-Glass” Thermostats for this important application because they *more* than met these requirements.

Edison Thermostats have many other features designed to meet a wide range of critical performance requirements. They are described in detail in our new Bulletin 3009, which also covers general considerations in thermostat selection and application, and lists specifications, including available mountings and their specific applications. Write for your copy today.

372 Lakeside Avenue



**INSTRUMENT DIVISION**  
**THOMAS A. EDISON, INCORPORATED**  
**WEST ORANGE, NEW JERSEY**

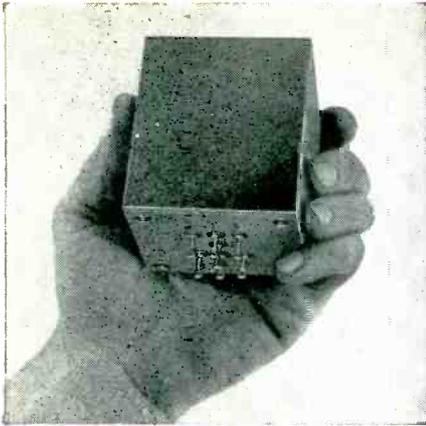
type-A transistor point-contact collector is absent in the filamentary type, although this is in part compensated by the length and the small cross-section of the filament. By placing the emitter well to the right of the broad-area base connection, any holes emitted at the base will have been lost by recombination near the base and the emitter is thus able to produce a current amplification. Since the collector is also a broad-area contact, the current gain is not high as in the type-A transistor, but will be very close to  $(1 + b)$  where  $b$  is the ratio of electron to hole mobility.

The discussion of positive feedback in transistors which Dr. Shockley gives at this part of the book is brief and much to the point; it is highly recommended reading for anyone who proposes to work with transistors, for the reason that they are so easily ruined if adequate provision is not made to prevent abnormal currents.

#### *Type p-n-p Transistors*

The *p-n-p* transistor has no point contacts in the usual sense; it “has the expositional advantage that a detailed mental picture can be formed of the distribution of all the atoms involved.” In Fig. 7 the *p-n-p* transistor is shown diagrammatically. A single crystal of germanium is used, having a narrow *n*-type zone in the middle, the end portions being *p*-type. As shown in Fig. 7E, there are more acceptor impurities in the end sections so that conduction is primarily by holes; in the center section there are more donor impurities, hence conduction is primarily by electrons. The extremely thin region where the germanium changes from one conductivity type to the other is called a *p-n* junction. In the figure there are two such junctions indicated by the dashed lines  $J_c$  and  $J_e$ .

As shown schematically in Fig. 7G, there are conduction electrons present in the *n*-type center or base region  $N_b$  and holes in the end parts  $P_e$  and  $P_c$  when no voltage is applied. When voltages are applied as in Fig. 7B, holes flow from  $P_e$  into  $N_b$  and, if  $N_b$  is very thin, the holes flow on into  $P_c$  where they add to the current in the collector



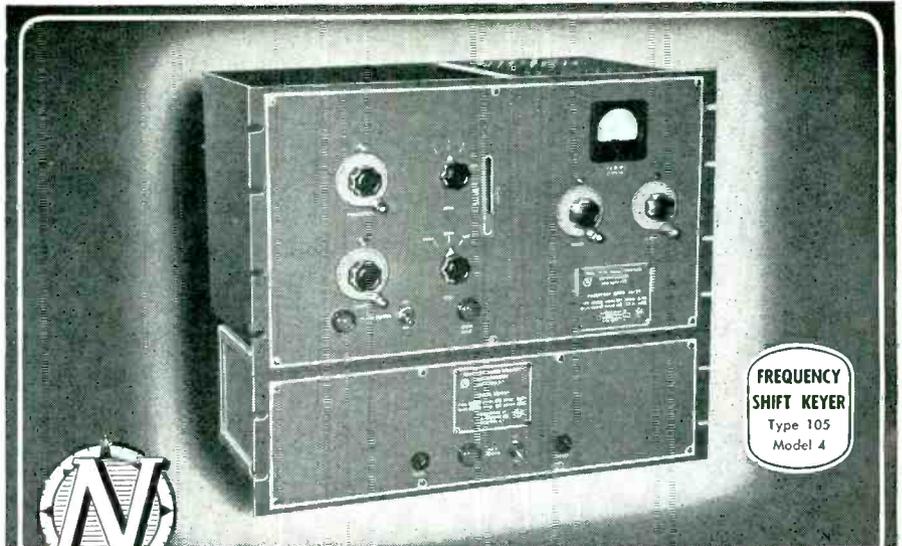
### Hermetically Sealed DELAY LINE

Acme has engineered many different types of delay lines to customers' requirements. Among them is this hermetically sealed unit for a radar system, tapped for various delays up to 4 micro seconds. We will be glad to discuss your problems.

**Acme**  
ELECTRONICS, INC.

300 No. Lake Ave., Pasadena 4, Calif.  
Formerly Acme Metal Die, Inc.

Wave Filters • Delay Lines • Magnetic Amplifiers • Special Transformers & Chokes • Toroidal, Universal & Solenoid Wound Inductors



**FREQUENCY  
SHIFT KEYS**  
Type 105  
Model 4



### HIGHEST STABILITY in Quality Communications

In today's high-speed telegraph, teleprinter and multi-channel radio communication systems—more than ever before—utmost stability is a vital need. Northern Radio's exclusive answer is the Type 105 Model 4 FREQUENCY SHIFT KEYS. Its highly stable oven has a temperature control of  $\pm 0.1^\circ\text{C}$  at  $60^\circ$ , with heaters on 4 sides of the inner oven—giving this unit frequency stability unmatched in the industry. And, greatest ease of operation is assured by its completely direct-reading dials.

See the specifications on this outstanding model in the 1950 Electronics Buyers Guide. For complete data on the precision-built Northern Radio line, write today for your free latest Catalog E-5.

**NORTHERN RADIO COMPANY, inc.** • 143-145 West 22nd Street  
New York 11, N. Y.

Pace-Setters in Quality Communication Equipment

Over 85% of the torque wrenches used in industry are

# STURTEVANT

## TORQUE WRENCHES

Read by Sight, Sound or Feel.

- Permanently Accurate
- Practically Indestructible
- Faster—Easier to use
- Automatic Release
- All Capacities

in inch ounces . . . inch pounds . . . foot pounds  
(All Sizes from 0-6000 ft. lbs.)

Every manufacturer, design and production man should have this valuable data. Sent upon request.

PA **STURTEVANT CO**  
ADDISON QUALITY ILLINOIS

# University

## LOUDSPEAKERS

### Quality and Dependability

... designed by  
**PROGRESSIVE ENGINEERING!**

Every UNIVERSITY product is built to traditional standards of quality that have earned a world-wide reputation for absolute dependability. Highest quality materials, skillfully fabricated, result in unsurpassed performance and extra reliability. "Progressive Engineering" assures the latest design improvements in every piece of UNIVERSITY equipment.

**MODEL 6201 COAXIAL SPEAKER**  
You'll find no compromise in the model 6201—a true coaxial system, completely self-contained with LC network and attenuator, at a sensible price. Full range response 45 to 15,000 cps, power capacity 25 watts. Highest quality construction throughout—separate Alnico V tweeter driver, exclusive UNIVERSITY "W" shape Alnico V "woofer" magnet, special cone edge treatment for longer life, minimum distortion; and even the famous UNIVERSITY wide angle "Cobra" tweeter horn for uniform dispersion of the "highs." Variable attenuator adjusts "balance" to personal preference.

The 6201 must be heard to be appreciated

Ask for your free copy of the **TECHNOLOG**

Handy technical catalog, published for engineers, installers, service men. Request yours today—write Desk 49

**UNIVERSITY**  
**LOUDSPEAKERS • INC**  
80 SO. KENSICO AVE., WHITE PLAINS, N. Y.

# P R E C I S I O N R E C O R D I N G W I T H T H E

## Variplotter



MODEL 205

The Model 205 Variplotter, highlighting accuracy, speed, and versatility, brings to industry and laboratory a new tool with a wide field of application. This instrument will present on a 30-inch square plotting surface a precise graphic representation of one variable as a function of another variable, requiring only that the variables be expressed by d-c voltages.

- ACCURACY**      The static accuracy is .05 percent of full scale at 70°F. The dynamic accuracy averages .05 percent of full scale plus the static accuracy at a writing speed of 8½ inches per second.
- SENSITIVITY**      The standard sensitivity of the Variplotter is fifty millivolts per inch with other ranges of sensitivity available.
- RESPONSE**      The maximum pen and arm accelerations are 350 and 150 inches per second squared, respectively. Slewing speeds of both pen and arm are 10 inches per second.

The Variplotter may be adapted for special use by the addition of accessories selected from our standard line—such as multiple variable conversion kits, low-drift d-c amplifiers, analog computer components; or components designed for your specific need.

YOUR INQUIRIES ARE CORDIALLY INVITED.

**ELECTRONIC ASSOCIATES, INC.**  
LONG BRANCH      NEW JERSEY

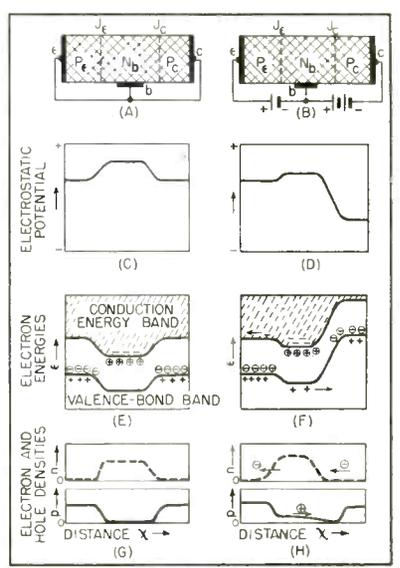


FIG. 7—The p-n-p transistor, showing potential, energy and charge density relations for zero current in (C), (E) and (G), and with current flowing in (D), (F) and (H) (Courtesy D. Van Nostrand Company, Inc.)

circuit. If a small a-c voltage is inserted in the base circuit (between  $N_b$  and the point where the two batteries are connected) the voltage across  $J$  is varied so that it produces a variation in hole current across this junction. This, in turn, varies the current in the collector circuit. The factors  $\beta$  and  $\gamma$  previously mentioned apply to the p-n-p transistor as in the type A transistor, and  $\alpha = \beta\gamma$ . The value of  $\alpha$  for such a transistor is obviously less than unity, but power gain can still result. Since electrons do not readily flow from  $P_e$  into  $N_b$ , the dynamic resistance  $r_c$  of the collector circuit is high when  $P_e$  is negative with respect to  $N_b$ . Conversely, the dynamic resistance  $r_e$  is low because the emitter section  $P_e$  is biased positive with respect to  $N_b$ , and a small change in voltage across  $J_e$  can produce a considerable change in hole flow. The power gain is approximately  $\alpha^2 r_c/r_e$ .

*Descriptive Theory of Semiconductors*

While a general idea of transistor action and semiconductor phenomena in general can be understood without recourse to the concepts of theoretical physics, the difficulty in reasonably interpreting the experimental data is considerable. Without an understanding of the principles of quantum mechanics, one

Specify **BREEZE "Monobloc"**  
Waterproof and Pressure Sealed  
**CONNECTORS**



The only APPROVED Monobloc System  
for Advanced Radar, Communications,  
and Electronic Equipment

Breeze "Monoblocs", with single piece plastic inserts offer outstanding advantages in assembly, wiring, mounting and service in the field.

- Removable contact pins
- Single hole panel mounting
- Pressure sealed to 75 psi, or higher when required

Breeze "Monobloc" Waterproof and Pressure Sealed Connectors available in aluminum, brass, steel . . . all sizes and capacities . . . fully tested and approved.

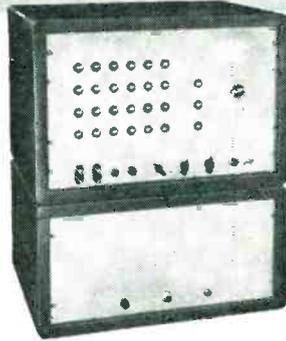
WRITE FOR DETAILS . . .

If you have a tough connector problem ask BREEZE for the answer.

**BREEZE**

Corporations, Inc.  
41K South Sixth St.  
Newark 7, New Jersey

**NEW!** FREQUENCY AND TIME MEASUREMENTS  
ACCURATELY . . . CONVENIENTLY!



Model 801  
by **Potter**

Now, the Potter Instrument Company offers all in one equipment, the features heretofore available only in separate counting systems. Two complete counting channels, a 100 kc crystal oscillator time base and unique gating circuits are combined to provide the new FREQUENCY-TIME COUNTER.

-using  $f = \frac{N}{t}$

ANY FACTOR  
MAY BE  
MEASURED  
FOR FIXED  
VALUE OF  
THE OTHER

Universal 6-in-One  
**MEGACYCLE  
FREQUENCY-TIME  
COUNTER**

FREQUENCY MEASUREMENTS	0 to 1 mc range by counting cycles per pre-selected time or by measuring time per pre-selected count. Accuracy 0.001% minimum.
TIME INTERVAL MEASUREMENTS	0 to 10 seconds $\pm$ 10 microseconds.
FREQUENCY RATIO MEASUREMENTS	Ratio of two external frequencies can be measured.
SECONDARY FREQUENCY	100 kc crystal oscillator with divided frequencies available at 10, 1 kc and 100, 10, 1 cps.
TOTALIZING COUNTER	Six decades, pulses 0 to 1 mc, sine wave 10 cps to 1 mc.
DIRECT RPM READING TACHOMETER	Through the use of an external 60 count per revolution photoelectric disc generator an accuracy of $\pm$ 1 rpm is obtained.

Please address inquiries to Dept. 6Z



**POTTER INSTRUMENT COMPANY**  
INCORPORATED  
115 CUTTER MILL RD., GREAT NECK, NEW YORK

*Linde*  
Trade-Mark

M. S. C.

(Mass Spectrometer Checked)

**RARE GASES**

HELIUM • NEON

ARGON • KRYPTON • XENON

LINDE Rare Gases are mass spectrometer checked to assure you gases of known purity and uniformly high quality. Available in commercial-size cylinders and glass bulbs.

LINDE, the world's largest producer of gases derived from the atmosphere, can meet your individual needs of purity...volume...mixture...containers...

**LINDE AIR PRODUCTS COMPANY**  
A DIVISION OF UNION CARBIDE  
AND CARBON CORPORATION

30 East 42nd Street **UCC** New York 17, N. Y.

In Canada:  
Dominion Oxygen Company, Limited, Toronto

The term "Linde" is a registered trade-mark of Union Carbide and Carbon Corporation

Depend on **INDUSTRIAL**

for **PROMPT  
DELIVERY**

- SOCKETS
- TERMINAL STRIPS
- BATTERY PLUGS
- ELECTRONIC Connecting Devices

Depend on **INDUSTRIAL** to keep your production rolling, to keep your costs down—by delivering **ON TIME** all of your requirements in standard electronic connecting devices.

As specialists in the field, we are prepared to place at your service our extensive facilities for the design and production of special connecting devices, including those required for military equipment.

Our representatives are located in principal cities throughout U. S. A. Call or write for samples and information.

Phone: OReagon 7-1881

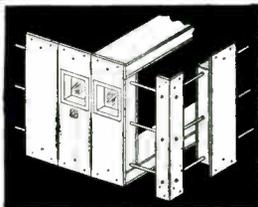
**INDUSTRIAL**  **HARDWARE**  
*Manufacturing Co., Inc.*

109 PRINCE STREET • NEW YORK 12, N. Y.

**NOW** Hot or Cold  
**WALK-IN ROOMS**  
anytime  
anywhere  
any size



with  
**BOWSER'S  
NEW  
Prefabricated  
Insulated  
Panels**



These new modular panels by Bowser now furnish all-purpose all-weather enclosures easy to assemble, knock down or transport. Controlled temperatures from  $-100^{\circ}\text{F.}$  to  $+200^{\circ}\text{F.}$  and relative humidity simulation from 20% to 95%. Bowser Walk-In Rooms are universally accepted for the storage and testing of foods, biologicals, equipment, etc. They feature metal clad interiors and exteriors and are of light weight hermetically sealed construction. Rooms can be expanded by the use of additional panels. With the addition of auxiliary instrumentation they will meet all Government test specs including MIL-T-27. Smaller rooms can be pre-assembled at the factory.

Also by Bowser, standard environmental simulation chambers. Wide range of sizes, performance ratings.

**BOWSER TECH. REFRIG., Terryville, Conn.**  
Send me more information on the following:

Walk-in Chambers	<input type="checkbox"/>	High Altitude Tests	<input type="checkbox"/>
High Temp. Tests	<input type="checkbox"/>	Mildew Resistance Tests	<input type="checkbox"/>
Low Temp. Tests	<input type="checkbox"/>	Sand & Dust Tests	<input type="checkbox"/>
Fungus & Humidity Tests	<input type="checkbox"/>	Explosion Proof Tests	<input type="checkbox"/>

Name \_\_\_\_\_ Pos \_\_\_\_\_  
Company \_\_\_\_\_  
Street \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

**BOWSER**  
**TECHNICAL REFRIGERATION**  
DIVISION BOWSER INC.  
TERRYVILLE • CONN.

NEW BOOKS

(continued)

could not hope to rationalize, for example, hole injection or the movement of electrons in a lattice.

Although one may have become familiar with some of the more basic implications of the theory, such as the principles of least action and the Pauli exclusion principle, it is often difficult to acquire a genuine feeling for some of the more abstract, but equally important, aspects of quantum theory. For example, most texts begin the discussion of wave mechanics by simply writing out Schroedinger's equation and leaving the student completely in dark as to the significance of  $\psi$ , stating merely that it is an unknown wave function. It is a pleasure to note here the manner in which Dr. Shockley proceeds to attach meaning to what, in many treatments of the subject, is most apt to remain but little more than an "unknown wave function". Mechanical analogies are used in the early discussion of the wave equation in such a manner that the concepts can be carried directly over to wave motion within the crystal.

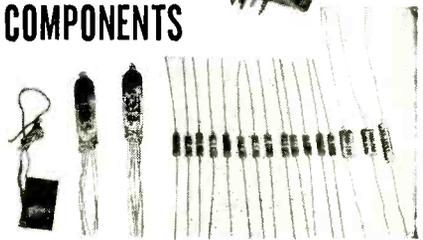
The Bloch functions, as proper solutions to the wave equations in a periodic system such as a crystal lattice, are introduced in an early part of the section. Explication of the Brillouin zones and periodicity of the functions complete the basic foundations for the complete picture of the nature of hole and electron flow and the theory of conduction and the Hall effect. The last fifty pages of Part II are devoted directly to applications of the theory to transistor electronics.

*Theoretical Section of Book*

Part III, entitled "Quantum Mechanical Foundations", is highly theoretical and to discuss its content in any detail would be outside the scope of this review. Apart from its specialized nature, however, it will be found very helpful in connection with the study of Part II. For example, in Part II the Bloch wave functions are simply set down as the eigenfunctions of the general wave equation as applying to a particular set of boundary conditions. For one who dislikes accepting solutions on faith, it is quite consoling to find

**Complete Engineering  
and  
Production Service  
for  
Manufacturers**

**PLASTIC  
EMBEDMENT  
of  
CIRCUITS  
and  
COMPONENTS**



Illustrated above is an example of Emerson & Cuming Co., plastic embedment showing component parts embedded.

Manufacturers and development engineers bring us their ideas, problems or designs and we translate them into the finished product.

Emerson & Cuming Co., 4-point Service Program to the Electronic Industry

1. Preparation of sample embedments in our laboratories at a nominal charge.
2. Production of embedments at our plant on a contract basis.
3. Engineering service to use plastic techniques for producing superior electronic equipment and/or components.
4. Direct sale of embedment plastics developed and manufactured at our plant.

*A few of the finished products are—*

Hermetically sealed precision resistors, polyethylene embedded antennas, molded synchro windings, high voltage bleeder assembly, polystyrene embedment of microwave systems, solid plastic impregnated components, heavy plastic coated transformers, complete plastic encasement of undersea electronic system.

Write for more information, specifically mentioning the problem at hand.

**Emerson & Cuming Co.**  
Engineers and Manufacturers



126 Massachusetts Avenue  
Boston 15, Mass.

**ENGINEERING PLASTICS  
FOR ELECTRONICS PRODUCTION**



**Fractional H.P. Electric Motors!**

*Precision Built*  
**for DEPENDABILITY**

Complete facilities for engineering, tooling and assembly of electric motors up to 6" maximum O.D. of the following types:

- Direct current—6 volts to 220 volts
- Universal motors—6 volts to 220 volts
- Induction motors—conventional voltages
- Shaded pole motors—conventional voltages

400 cycle motors of the smaller sizes  
Also precision electro mechanical assemblies

Experience and precision workmanship assure you of motors of dependable performance to fit your requirements—from 1/1000 H.P. up to 1/4 H.P.

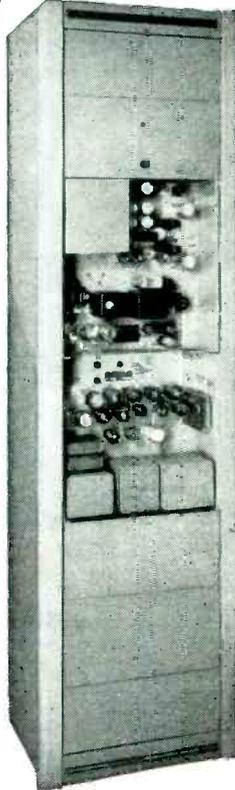
**QUARTER CENTURY OF EXPERIENCE IN BUILDING Fractional H.P. Motors**

Here is a seasoned, dependable source with a reputation for quality and a background of electrical engineering research and design.

**JOHN OSTER MFG. CO.**  
RACINE, WISCONSIN

# Polarad

## TELEVISION MONOSCOPE SIGNAL SOURCE



**Model PT-102**

Used in transmitting stations, laboratories and in receiver factories where a reliable standard video signal in the form of a test pattern is a prime requisite for testing overall video performance.

- Composite Video Signal.
- Wide Band Video Amplifier, 3 db down at 7 mc.
- Dual outputs for feeding two 75 or 100 ohm lines.
- Black positive or Black negative output.
- Resolution greater than 500 lines.

INPUT: Vertical and Horizontal Driving Pulses. Camera and Kinescope Blanking Pulses.

OUTPUT: Composite Video Signal, 2 Volts peak to peak. Complete with tubes, high and low voltage power units, cabinet rack.



100 Metropolitan Ave. • Dept. E-5 • Brooklyn 11, N. Y.

Engineers and consultants to the Nation's Great TV Stations

# 1st.. IN HIGH QUALITY RECORDING



STANDARD OF THE GREAT RADIO SHOWS

# AMPEX

**MAGNETIC TAPE RECORDERS**

SOLD BY . . .  
BING CROSBY ENTERPRISES, Inc., Hollywood  
AUDIO-VIDEO PRODUCTS CORP., New York City  
GRAYBAR ELECTRIC CO., Inc., Principal Cities  
THE HAWAIIAN NETWORK, Ltd., Honolulu  
RADIO PARTS, Inc., New Orleans  
Export: WESTREX CORPORATION, New York City

SEND FOR BOOKLET

**AMPEX ELECTRIC CORPORATION**  
San Carlos • California

## COMPOUNDS

Scientifically compounded for specific applications from waxes, resins, asphalts, pitches, oils, and minerals. Available in wide range of melting points and hardnesses. Special potting compounds are heat conducting and crack resistant at extremely low temperatures. Recommendations, specific data, and samples will be furnished on request.

for

**IMPREGNATING**

radio coils  
transformer coils  
ignition coils  
wire coverings  
paper tubes and forms  
porous ceramics

**DIPPING**

Coils  
Transformers  
Condensers

**SEALING**

condensers  
batteries  
switch base terminals  
socket terminals  
light fixtures

**POTTING**

Radio Transformers  
Light Units  
Loading Coils  
Condensers



## BIWAX CORPORATION

3445 HOWARD STREET  
SKOKIE, ILLINOIS

# PIX

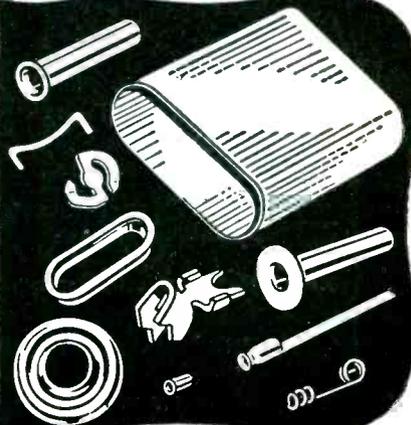
## WIRE FORMING SPECIALISTS

Precision Parts to meet your Production and Engineering needs. From .002" dia. to .125" dia. Radio tube parts—Stampings—Drawings Modern facilities, high-production equipment.

Metal Crystal Holder Parts

Send sketch or print for quotation.

**PIX MANUFACTURING CO., Inc.**  
24 Bedford St., Newark 3, N. J.



# NEW Alden Basic Chassis

It is extremely important to get equipment out and through to the user fast, and yet, the design should be kept economically feasible. Alden Products Company announces a new Basic Chassis Design that does away with extreme techniques to give rapid delivery in large or small volume . . . . . provides the manufacturer with a chassis assembly ideally suited to high-velocity production methods . . . . . the user with an accessible plug-in chassis that makes equipment easier to operate and maintain.



## Components for Plug-in Unit Construction

### WORK OUT INTO THE OPEN

Simplifying operations by bringing the work out into the open is the keynote . . . . . of how the Alden Basic Chassis Design and Terminal Mounting System can help to eliminate obstacles and really pick up production. . . . . Components and circuit elements are laid out and mounted on the Alden Terminal Cards which come with holes pre-punched, allowing the engineer to select optimum component layout. Miniaturized Alden Terminals staked in the layout hold components for soldering without pliers or twisting.

### CABLING IS NEAT UNIT PACKAGE

The next step—cabling is made as a unit sub-assembly—no mess or fuss—connectors and leads are a neat package. Again, because the work is out in the open and is easily accessible, connections are made to the terminal mounting board with speed and facility. Unit cabling allows instant continuity checks, rapid replacement in the field and eliminates many problems of malfunctions and excessive production costs.

### SUB-ASSEMBLIES MADE INDEPENDENTLY

While the component sub-assemblies are being processed, back connectors, sockets, switches, dial lights, etc., can all be mounted on the basic chassis and front panel, ready for joining to the sub-assemblies. The front panel can be detached to facilitate production. Joined to the chassis, it is hinged and opens forward for clear inspection and service in the field. The completely pre-wired terminal cards are quickly and easily mounted on the open-sided chassis and wired to the unit cable and Alden color-coded back connectors.

### COMPLETED ASSEMBLY NEAT AND EFFICIENT

The finished assembly is an efficient, plug-in, slide-in unit. Mounted in cabinet or panel rack in horizontal or vertical succession or in an individual unit housing for portable operation, chassis elements are always instantly accessible for check, service, or replacement. A simple twist of the handle and the Serve-A-Unit Lock backs the chassis off with fingertip ease. For re-assembly, chassis is slid in and piloted into locked position with the same facility.

### QUICK SERVICE TO YOU

The Alden Basic Chassis Design makes possible a wonderfully simple method of construction so that orders—large or small—can be started and with a minimum of stocking or storing, proceed rapidly to completion. Fabrication parallels the operation of a progressive die. The work proceeds as a flat piece as it is sheared and blanked and moves to plating or painting and assembly with little or no lost effort or waste material. This manufacture as a straight-line operation, gives speed and economy to completing the chassis and allows us to move into volume production fast.

Write Department E for catalogue "Components for Plug-in Unit Construction."



## ALDEN PRODUCTS COMPANY

117 N. MAIN STREET, BROCKTON 64, MASSACHUSETTS

them derived in Part III. The simple atom-transmission line analog should be an excellent means of gaining an insight into the rigorous derivation of solid-state functions.

### Conclusion

Technical and scientific books written by one who has not taught a course for some years on the subject of the book often fail miserably in logical presentation. In view of the newness of much of the material in Dr. Shockley's book, the degree of clarity he has achieved is noteworthy. The problems given at the ends of several of the chapters, plus frequent reference to older books and the periodical literature, provide additional means to insure that the more difficult parts can be understood.—G. D. O'NEILL, *Head, Solid State Section, Physics Laboratories, Sylvania Electric Products Inc., Bayside, N. Y.*

## THUMBNAIL REVIEWS

**ALTERNATING CURRENT CIRCUITS.** By R. M. Kerchner and G. F. Corcoran. John Wiley & Sons, New York, 1951, third edition, 598 pages, \$5.50. Junior class textbook for engineering colleges, revised to include elementary four-terminal communication networks, an additional method of wave analysis, design of tuned coupled circuits, and three-origin vector diagrams of polyphase circuits. Problems have been rather completely revised, new problems added, and minor changes made throughout text for clarification of principles.

**RADIATION MONITORING IN ATOMIC DEFENSE.** By D. E. Gray and J. H. Martens. D. Van Nostrand Co., New York, 1951, 122 pages, \$2.00. Background information on radiation hazards, based on data obtained from the Federal Civil Defense Administration and the Atomic Energy Commission, and semitechnical information on the basic construction, characteristics and uses of specific radiation detecting devices, along with instructions for operation and maintenance. Directed principally to the geigerman and others whose duties include responsibility for radiation safety of people in an emergency involving atomic energy hazards. Covers Geiger counter survey meters, ionization chamber survey meters, proportional alpha counters, pocket chambers, film badge dosimeters, and the AEC emergency monitoring kit.

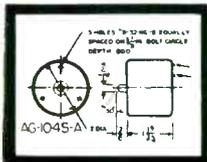
**ARINC SYNCHRO SYSTEM MANUAL.** Available in limited quantities from Aeronautical Radio Inc., 1523 L Street N.W., Washington 5, D. C., 1950, 59 pages, \$3.00. Presents a review of simple synchro systems, the theory of a set of recommended standards, and includes charts for design, testing and maintenance of a complete synchro system of instrumentation. Especially useful is the chart listing connection codes for synchro units produced by different manufacturers. A special section is devoted to a discussion of aircraft systems using synchros.

# PICKERING

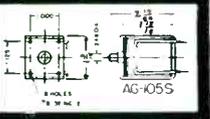
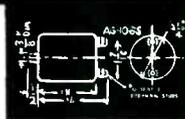


# SOLENOIDS

For DC Circuits



Pickering engineering service is available for special applications where Pickering standard Solenoids do not apply.



For details and literature address Department N  
**PICKERING & CO., INC.**  
 Manufacturers of world-famous electro-magnetic phonograph cartridges and audio equipment.  
 Oceanside, L. I., New York



# ALLISON RADAR

NAVIGATIONAL AID  
For MULTI-ENGINE

TRANSPORT AIRCRAFT  
& HELICOPTERS

MILITARY—CIVIL

SMALL—COMPACT  
LIGHTWEIGHT  
EFFICIENT

SEES Thru FOG  
DAY and NIGHT

- Sees Thunderstorm, Cores, Snow, Hail, Rain in advance.
- Promotes smoother flying for passenger safety and comfort.
- Warns of approaching aircraft in line of flight.
- Sees obstructions in true outline and/or direction.

**ALLISON  
RADAR CORPORATION**  
 11 W. 42 St. N.Y. 18 PEnn 6-5811-12

**Q**  
 QUALITY  
 QUANTITY  
 QUICKLY



## Radio Frequency CONNECTORS

• Our specialty is solving your special problem in connectors requiring precision machine work, high temperature and low loss insulation, silver soldered assemblies, silver plated bodies and contacts—waterproofed—pressurized.

**ARMED SERVICES APPROVED TYPE "N" CONNECTORS** (as illustrated) now in production.

We are prepared to meet your requirements for type "BNC", "MC", or any type RF connector—standard or special—can be set up quickly and produced efficiently.

Phone BLackstone 1330, or write **GEO. H. FATHAUER**

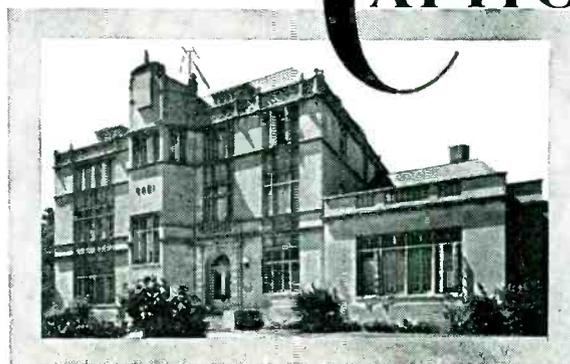
*Dage Electric Company*

4007 E. MICHIGAN ST., INDIANAPOLIS 1, INDIANA

An Accredited Technical Institute  
 Pioneer in Radio Engineering  
 Instruction Since 1927

# CAPITOL RADIO

## ENGINEERING INSTITUTE



- Advanced Home Study and Residence Courses in Practical Radio-Electronics and Television Engineering.

Residence Courses approved  
for Veteran Training

- Request your free home study or residence school catalog by writing to Dept. 285C.

16th & Park Road, N.W., Washington 10, D.C.

ROLLED TO EXACT SPECIFICATIONS FOR BLANKINGS...  
 MAX. WIDTH - 5"  
 MIN. WIDTH - 1/8"  
 THINNESS - .003"

SILVER  
NON-FERROUS METAL

### Laminated Silver Material ready for blanking

SILVER  
NON-FERROUS METAL

With laminated silver you obtain the high electrical and thermal conductivity characteristic of fine silver . . . yet the precious metal is only where you need it . . . non-precious base metal supplies the added strength and greatly reduces costs.

You will find the fast, dependable service of owner-management and our 53 years of experience a source of complete satisfaction.

*Your inquiries will be appreciated and replied to . . . promptly.*

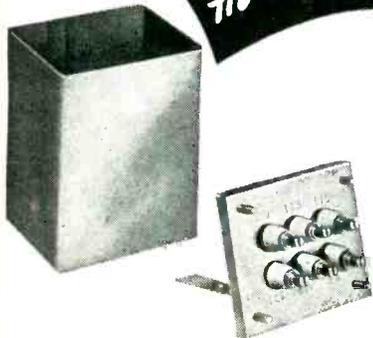
**The Home of IMPROVED Service**

**The IMPROVED SEAMLESS WIRE COMPANY**  
 INCORPORATED 1898  
 775 Eddy Street, Providence 5, Rhode Island

THESE ARE  
**STOCK  
ITEMS**

AT

*Heldor*



- NO TOOLING
  - NO DIE COSTS
  - FAST DELIVERY
- on  
**MIL-T-27 CANS!**

We can supply all standard sizes of MIL-T-27 cans with or without brackets, weld studs, centrifugal hot tinned, blind inserts, compression-type hermetic seal bushings on 3/8", 1/2", 5/8" 3/4" centers, and stamped ratings. Custom sizes can also be supplied.

Other HELDOR services include: special tube bending, specialized screw machine products, and complete hermetic seal assemblies.

Get complete specifications and price lists.



— Mail Coupon Today —

**HELDOR METAL PRODUCTS CORP.**  
225 Belleville Ave., Bloomfield, N. J.

Please send me prices and specifications on MIL-T-27 cans.

Name.....

Company.....

Address.....

LICENSED UNDER RAYTHEON MFG. CORP., U. S. PATENT No. 2,447,489 —  
CANADIAN PATENT No. 435,516

**HELDOR METAL PRODUCTS CORP.**  
**NOTE NEW ADDRESS:**  
225 Belleville Ave.,  
Bloomfield, N. J.

## BACKTALK

(continued from page 152)

chestra, which gave two chamber music concerts daily at the Philadelphia Radio Show of the same year. The performers were members of the Philadelphia Orchestra. Even this early attempt could hardly claim to be the first one as it was antedated by Theremin's concert at the Carnegie Hall, New York City, during the early part of 1931. The same period witnessed numerous similar concerts in Europe, featuring ensembles of electronic solo musical instruments developed by Martenot and Bertrand in France and by Mager, Lertes and Helberger, and Trautwein in Germany. Incidentally, Trautwein's electronic solo instrument, the "Trautonium", had the distinction of having special music written for it by Paul Hindemith, the well-known modern composer.

That the crank-operated solo instruments of the type described by Meachem were not commercially successful was probably due to the fact that they are not suitable for the execution of rapid musical passages. They were quickly superseded by solo instruments in which the selection of pitch is accomplished by keyboard control, as in the writer's Emicon, manufactured by Pratt, Read & Co. in Deep River, Conn. in 1932-33, or by displacement of a finger on a string, as in the Trautonium, manufactured by the Telefunken Company of Berlin, Germany in about the same period. Both of these early attempts were commercial failures, due to a variety of reasons. In the first place, the resistance of musicians, both professional and amateur, against an instrument requiring a completely non-conventional, although relatively simple, playing technique, was considerable. In the second place, the selling price of the instruments twenty years ago, when the quantity production of electronic devices was still in its infancy, was too high to permit reaching a sufficiently broad segment of the public. Finally, the development, manufacture and distribution of a practical and commercial electronic instrument of this type requires an unusual combination of electronic and musical talent which was impossible to find within the

distributors  
for 30 years  
of radio and  
electronic  
components for  
all your needs

**RADIO  
WIRE  
TELEVISION**  
INCORPORATED

**NEW YORK 13, N. Y.**

100 Sixth Avenue  
WAlker 5-8883

**NEWARK 2, N. J.**

24 Central Avenue  
MArket 2-1661

**BOSTON 10, MASS.**

110 Federal Street  
HUBbard 2-7850



Have you your copy? If not, we'll send you this 1250 page book for only \$1.50. Write: RWT, 100 Sixth Ave., New York 13, Dept. E.

## 10 CUBIC FOOT PORTABLE ELECTRIC OVEN



30" Wide  
25" Deep  
24" High



Model PL-1 \$92.<sup>50</sup>

### REMOVABLE SHELVES FOR PREHEATING—DRYING —BAKING

- An individual oven for each operator
- Eliminates handling and hauling
- Can be operated in groups or banks
- Costs less than 5¢ per hour to operate
- Plugs into any 110 V outlet
- Holds 8—2" x 12" x 23" drying pans (extra)

OTHER MODELS \$79.50 AND UP  
WRITE—WIRE—ORDER TODAY

**GRIEVE-HENDRY CO., Inc.**  
1650 W. Hadden Street  
Chicago 22, Illinois

# RESEARCH DEVELOPMENT PRODUCTION

The Electrona Corporation is staffed to provide years of outstanding experience in the following fields:

- Instrumentation for nuclear radiation measurements
- High-voltage stabilizer tubes
- Electrostatic generators
- Electric contacts
- Friction voltage generators
- Basic research on materials for electronics
- Light-weight power supplies

Facilities and staff available.

Inquiries will receive prompt attention.

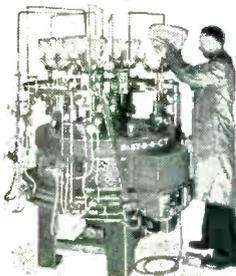
## THE ELECTRONA CORPORATION

1064-1070 Clinton Ave., Irvington 11, N. J. Telephone Essex 5-4617

## EISLER Television Tube MACHINERY

- ECONOMICAL
- MODERN DESIGN
- PRODUCTION  
FINANCING

### TV Sealing Machine



From 5" to huge 24"  
Television Tube

Machines for  
Manufacturing  
Incandescent  
Lamps, Radio  
and Electronic  
Tubes

RESISTANCE  
WELDERS  
1/2 to 300 KVA



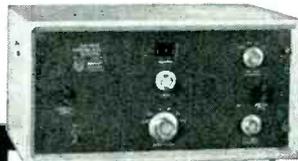
EISLER'S Electronic Equip-  
ment is especially De-  
signed and Built to your  
exact requirements.

EISLER TRANSFORMERS  
STANDARD • SPECIAL

WE INVITE YOUR INQUIRIES Sizes From 1/4 to 500 KVA



**EISLER ENGINEERING CO., Inc.**  
751 So. 13th St. Newark 3, N. J.



## MODEL 410-A ULTRA-LOW FREQUENCY OSCILLATOR

with frequency range of  
**0.02-20,000 cps**

### FEATURING:

1. BOTH SINE AND SQUARE WAVE.
2. COMPLETELY ELECTRONIC OPERATION.
3. EXCELLENT AMPLITUDE CONSTANTCY.
4. LOW DRIFT AND DISTORTION.

DESCRIPTION: This oscillator, Model 410-A, covers the sub-audio and the entire audio range. It provides both sine and square wave at any frequency range between 0.02 and 20,000 cps.

Precisely engineered and constructed, the Model 410-A is ideal for medical research, geophysical and seismological instruments, and design and development of servo-mechanisms and vibration controls.



**KROHN-HITE INSTRUMENT CO.**  
580 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS., U.S.A.

### SPECIFICATIONS:

1. FREQUENCY RANGE: 0.02 to 20,000 cps, continuously variable in six decade bands.
2. SINE WAVE AMPLITUDE: Varies less than ± 0.25 db (3%) over the entire frequency range.
3. DISTORTION & HUM: Less than 0.25% over the entire frequency range.

# FOR ORIGINALITY

LOOK TO **XCELITE**

## What's The Right Screwdriver To Use?

It's The One That's  
Made For The Job!



DID YOU KNOW that using the WRONG size or type blade harms both blade and screw? In the XCELITE line, you can get the RIGHT screwdriver for every job—genuine Phillips, standard, Reed & Prince, clutch type, in the size you need. All are unreservedly guaranteed. Have your dealer show you XCELITE for best work on your job!

**PARK METALWARE CO., INC.**

Dept. C

Orchard Park, N. Y.

Canadians Send Orders Direct to: Chas. W. Pointon, Canadian Warehouse Distributor,  
1926 Gerrard St., E., Toronto, Ont.





**TERMALINE  
DIRECT READING  
R. F. WATTMETERS**

(DUAL RANGE)  
MODEL 611—0-15 and 0-60 Watts  
MODEL 612—0-20 and 0-80 Watts  
IMPEDANCE—51½ Ohms

Models 611 and 612 are popular instruments in research and design laboratories, vacuum tube plants, transmitter manufacturing plants, and in fixed and mobile communication services.

They are ruggedly built for portable use, and are as simple to use as a D.C. voltmeter. The power absorbing load resistor is non-radiating, thus preventing transmission of unwanted signals which interfere with message traffic in communication services.

Frequency range: 30 to 500 MC (30 to 1,000 MC by special calibration)

Impedance: 51.5 OHMS—VSWR less than 1.1

Accuracy: Within 5% of full scale

Input connector: Female "N" which mates with UG-21 or UG-21B. Adapter UG-146/U is supplied to mate with VHF plug, PL259.

Special Scale Model "61s" are available as low as ½ watt full scale, and other models as high as 5 KW full scale.

Catalog Furnished on Request

same organization twenty years ago. However, it may well be that, apart from the present emergency, a similar venture may have better prospects for success at the present time.

NICHOLAS LANGER  
New York, N. Y.

**Author Replies**

DEAR SIRs:

THANK YOU FOR your invitation to reply to the comments of Nicholas Langer on my article "Electronic Music for Four" published in the February issue of ELECTRONICS.

I am grateful to Langer for his contribution of historical background. Not long ago I was hunting for such information, and although acquainted with Theremin's and Péchadre's patent, I found little else pertaining to instruments using continuously tuned oscillators.

If we assume it to be true, as Langer points out, that what I have lightly referred to as "the present state of the art" is actually similar to efforts of twenty years ago, then we must ask why there has been so little advance in these twenty years. The answer appears to be that efforts to establish "crank-controlled" devices as serious musical instruments met early discouragement, which caused interest to shift over to the keyboard type of control. The resulting electronic organ was quite successful and captured almost all the subsequent development effort. If this shift of interest had not occurred, the field would surely have been covered more thoroughly. Perhaps it is because it did occur that the Patent Office has found it possible to allow my application, Patent No. 2,544,466, which includes as one of its claims, "An electronic musical instrument comprising a plurality of self-oscillating electronic sources of electric waves, rotary manual means for independent frequency variation of each of said sources over a continuous range of at least one octave, means for independent amplitude variation of each of said sources, means for independent interruption of each of said sources,

**BIRD ELECTRONIC CORP.**  
*Termaline Coaxial Line Instruments*  
1800 East 38<sup>th</sup> Street • Cleveland 14, Ohio  
West Coast Representative • NEELY ENTERPRISES • Hollywood 46, Calif.

The leaders specify  
**Tensolite**  
TYPICAL  
MINIATURE WIRES and CABLES  
Plastic Insulated HOOK-UP  
SIZE 32 AWG (7/40)  
O.D.—.030"  
CODE 1507 A-1  
Cotton Covered SHIELDED LEAD  
SIZE 30 AWG (6/38)  
O.D.—.075"  
CODE 1919 D-1  
SHIELDED 4-Cond. TWISTED CABLE  
SIZE 27 AWG (7/35)  
O.D.—.120"  
CODE 2059 F-4  
OTHER CONSTRUCTIONS IN STRANDED  
SIZES FROM #40 TO #20 AWG

• Free wire samples and information on request. Special constructions made to your specifications.

**MINIATURE FLEXIBLE INSULATED WIRE & CABLE**  
CABLES { TWISTED PARALLEL BRAIDED }  
BARE COPPER } SHIELDS  
TINNED COPPER }  
SILVER PLATED }  
BRAIDS { COTTON NYLON PLASTIC\* }  
\*TENSOLITE'S exclusive plastic film-covered Fiberglas  
Leading engineers specify TENSOLITE Miniature Wire and Cable  
*because*—miniaturization programs demand less weight, less space and greater flexibility. Only TENSOLITE is devoted exclusively to this field—assuring you of faster service, lower cost, supreme quality, advanced design and know-how, and specialized facilities.

**TENSOLITE**  
INSULATED WIRE CO., INC.  
196 MAIN STREET, TARRYTOWN, N. Y.  
Tarrytown 4-2616

# Compact

dependable instruments

*Heiland*  
DENVER

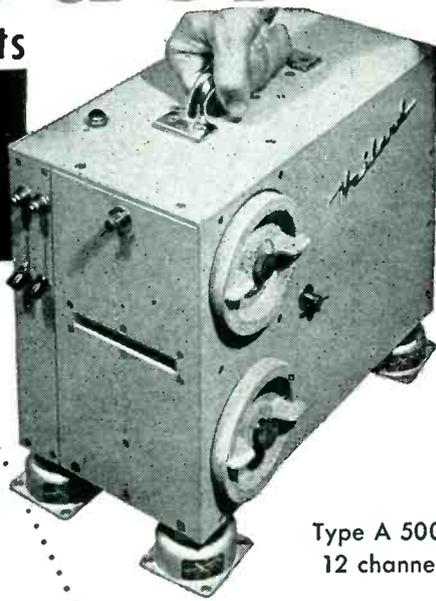
*Portable*  
**OSCILLOGRAPH**  
*Recorder*

Designed and developed for applications where a minimum of space and weight are required. Small size...6 3/4" x 9 7/8" x 12 3/4". Lightweight...33 lbs. Versatility of operation...for the recording of strain, vibration, displacement, acceleration, pressure and temperature.

The Heiland A 500 Portable Oscillograph Recorder has many features found only in larger instruments... easy loading...four quick-change paper speeds...trace identification...simultaneous viewing and recording...zero mirror...film movement indicator...up to 12 channels.

Write for complete detailed information

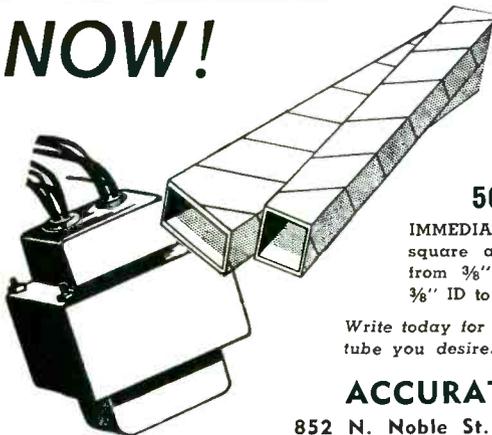
**HEILAND RESEARCH CORPORATION**  
133 E. Fifth Avenue Denver, Colorado



Type A 500  
12 channel

6 3/4" x 9 7/8" x 12 3/4"

**NOW!**



**ASBESTOS TUBES**  
for  
**CLASS B**  
**TRANSFORMERS**

**50,000 possible ARBOR sizes**

IMMEDIATE DELIVERY on "STOCK" sizes of square and rectangular Dielectric Kraft tubes, from 3/8" x 3/8" to 1 1/2" x 2 3/8". Round tubes 3/8" ID to 1" ID.

Write today for prices on ANY dimension or quantity of tube you desire. Ask about our cellulose acetate tubes.

**ACCURATE PAPER TUBE CO.**

852 N. Noble St. Chicago 22, Ill.

**Little thought-of facts about capacitors**

The short time breakdown voltage of a well-made D.C. capacitor is not less than 5 to 6 times the actual working voltage at 20°—

- $E = 5 \times e_{min}$
- E = Breakdown voltage
- e = Rated d.c. working voltage

INDUSTRIAL CAPACITORS are unvaryingly held to this formula.

Designed for maximum safety and the smallest possible volume, INDUSTRIAL CAPACITORS are the most widely used capacitor in industrial applications.

WRITE TODAY FOR DETAILED CATALOG

**INDUSTRIAL CONDENSER CORP.**



Watch this space for other capacitor facts that will help you.

Sales Offices in  
All Principal Cities  
3243 N. California Ave.  
Chicago 18, Illinois

Where the  
Requirements  
are Extreme...

Use  
**SILVER**  
**GRAPHALLOY**

For extraordinary  
electrical performance



THE SUPREME BRUSH  
AND CONTACT MATERIAL

for **BRUSHES**

- for high current density
- minimum wear
- low contact drop
- low electrical noise
- self-lubrication

for **CONTACTS**

- for low resistance
- non-welding character

Graphalloy is a special silver-impregnated graphite

Accumulated design experience counts — call on us!

**GRAPHITE METALLIZING CORPORATION**

1055 NEPPERHAN AVENUE, YONKERS 3, NEW YORK

**Try Remler for Service-Tested  
"Hard-to-Get" Components**



PL-294

**Custom Components**

Metal-plastic components designed and manufactured to order. Write for quotations specifying electrical and mechanical characteristics. Describe application. No obligation.

**PLUGS & CONNECTORS**

**BANANA PIN TYPES...JAN SPECIFICATIONS**

Multi-contact connectors and mating chassis counterparts. Melamine or alkyd insulation; steel or brass nickel-plated shells. Banana springs are heat treated beryllium copper. Unexcelled low resistance contact. Highest quality... good for thousands of connects and disconnects.

**Special Connectors to Order**—Miniatures; water tight and pressure proof types to JAN specifications.

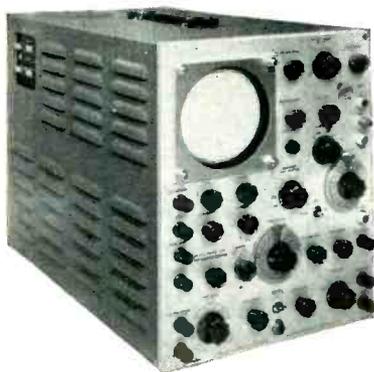
Remler Company Ltd. 2101 Bryant St. San Francisco 10, Calif.

*Remler*

Since 1918 PIONEERS IN ELECTRONICS AND PLASTICS

**SLOW SWEEPS**

**HIGH SENSITIVITY**



Type 512 Oscilloscope

- Band Pass—DC-2mc
- Sensitivity—5mv/cm maximum
- Sweeps—.3 sec/cm to 3 usec/cm

Accurate observation and measurement of slowly recurring phenomena is difficult, if not impossible, by conventional oscilloscopic techniques. The Tektronix Type 512 Cathode Ray Oscilloscope, combining as it does direct-coupled amplifiers, slow sweeps and high accuracy, is recognized by a constantly increasing number of researchers as being an indispensable laboratory tool. New and fruitful approaches to the problems encountered in research are permitted by these features. \$950.00 f.o.b. Portland, Oregon.

Write today for detailed specification of Type 512 and other Tektronix instruments.



**TEKTRONIX, INC.**

712 S.E. Hawthorne Blvd. Portland 14, Ore.

means for combining the electric waves of said sources, and an electromechanical transducer for converting the sum of said waves into sound, whereby a plurality of players, respectively controlling said sources, may produce polyphonic music". Incidentally the patents referred to by Langer do not show an ensemble type of instrument.

It seems to me that the most significant thing I have happened to come across in this matter is a surprisingly encouraging response by various samples of the public. The wobble organ started as a joke—a rather horrible novelty—and produced happy enthusiasm. People have asked where they might obtain one. They have made serious comments on such things as the "sympathetic" quality of the vibrato and blending. They have speculated on uses in hospitals and rehabilitation centers, and in musical education. This observed phenomenon is what has led me to carry the wobble organ up to the stage of an ELECTRONICS article.

Let's not be too serious about it. Let's never mention it in the same breath with the symphony or the pipe organ or the string quartet. Nevertheless, here it is for what can be made of it. Maybe the development of twenty years ago should be resumed.

L. A. MEACHAM  
Bell Telephone Laboratories  
Murray Hill Laboratory  
Murray Hill, New Jersey

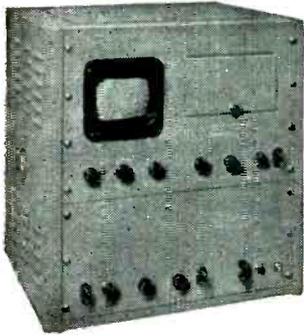
**Electronics Quiz**

THIS month's quiz was furnished by Emil M. Anderson of Detroit, Michigan. For his contribution, Anderson will receive our check for five dollars, as will all contributors whose problems are published.

*This Month's Problem*

Assume a superheterodyne receiver with a signal input to the converter of frequency  $f$ , and a local oscillator input of frequency  $(5/4)f$ . Then, in accordance with established principles of converter action, its output will contain the two input frequencies  $f$  and  $(5/4)f$ , and the sum and difference frequencies  $(9/4)f$  and  $1/4f$ . The intermediate frequency amplifier is, as usual, tuned to pass only the

# QUICK ANALYZING WITH AP-1



Panoramic Sonic Analyzer, Model AP-1 — Specially recommended for high speed analysis of harmonics, vibrations, noises, acoustics.

WRITE FOR FULLY DETAILED BULLETIN

## SPEEDS PRODUCTION FOR GENERAL ELECTRIC

Panoramic Sonic Analyzer, Model AP-1, is used for isolation of critical frequencies. "Very helpful," says GE Superintendent.

## QUICK ANALYSIS OF CRITICAL FREQUENCIES

in high speed rotors speeds the process of dynamically balancing air-borne gyroscopic instrument parts.

## PANORAMIC CAN HELP YOU

Wave analysis through the automatic analysis and spectrographic presentation of the audio spectrum is an invaluable asset in a variety of applications. Let a Panoramic specialist advise you on your individual production problems.

**PANORAMIC** RADIOD PRODUCTS, INC.

10 SOUTH SECOND AVENUE,



MOUNT VERNON, N. Y.

## instrument DIALS

SPECIAL CHECK LISTS

- LUMINESCENT
- BLACK & WHITE
- MADE TO YOUR SPECIFICATIONS

## PRECISION INSTRUMENT SERVICE

WE REPAIR, OVERHAUL AND STANDARDIZE LABORATORY AND PORTABLE INSTRUMENTS

Our laboratory is equipped with new Leeds & Northrup potentiometric standardization equipment calibrated in terms of the Absolute units which were adopted internationally as of January 1, 1948.

*Standard Products Inc.*

650 EAST GILBERT • WICHITA, KANSAS



## Quality—Specialty TRANSFORMERS

For years we have supplied leaders of the Electronic and Electrical industries with superior specialty transformers.

Let us quote on your special commercial and military requirements.

A reliable source since 1941

Write us today—or telephone Granite-4-8000

**AIRDESIGN, INC.**

241 Fairfield Avenue  
Upper Darby 2, Pa.

For AC CURRENT ANYWHERE . . . NO MAGIC just use

**ATR**

**INVERTERS**



STANDARD AND HEAVY DUTY

**INVERTERS**



For Inverting D. C. to A. C.

Specially Designed for operating A. C. Radios, Television Sets, Amplifiers, Address Systems, and Radio

Test Equipment from D. C. Voltages in Vehicles, Ships, Trains, Planes and in D. C. Districts.

NEW MODELS NEW DESIGNS  
NEW LITERATURE

"A" Battery Eliminator, DC-AC Inverters  
Auto Radio Vibrators

See your jobber or write factory

**ATR**

**AMERICAN TELEVISION & RADIO CO.**

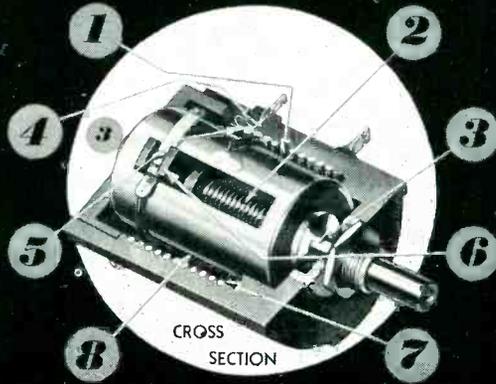
Quality Products Since 1931

SAINT PAUL 1, MINNESOTA—U. S. A.

# MICROPOT

PRECISION TEN-TURN POTENTIOMETER

1. You get permanent accuracy because the resistance wire is locked in place. It is precision positioned and moulded integrally with the housing.
2. You get permanently accurate settings, smooth action and low uniform torque provided by the stainless steel, precision ground, double thread lead screw guiding the moving contact.
3. You get precise positioning of the moving contact because of the two bearings supporting the rotor assembly.
4. You get good rigid terminals because they are moulded integrally with the housing.
5. Terminals soldered to ends of resistance element before moulding. Entire resistance circuit is an integral part of the housing.
6. You get accurate setting and resetting due to anti-backlash spring in contact guide.
7. You get a fine resolution because of the  $43\frac{1}{8}$ " length of resistance wire in the spiral element.
8. You get a resistance output directly proportional to shaft rotation within  $\pm 0.1\%$  of the total resistance. Every potentiometer is automatically machine tested for linearity at 101 points.



**LINEARITY ACCURACY  $\pm 0.1\%$**

Units for immediate shipment:  
1,000 to 30,000 ohm range.  
Special resistance values made to order.

WRITE TODAY FOR  
ENGINEERING INFORMATION



BORG EQUIPMENT DIVISION  
**THE GEORGE W. BORG CORPORATION**  
DELAVAN • WISCONSIN

BACKTALK

(continued)

difference frequency.

Now suppose that, instead of the local oscillator, we substitute a modulator. This modulator accepts the signal input of frequency  $f$  and modulates it with a voltage of frequency  $\frac{1}{4}f$ , taken from a point at or near the output of the intermediate frequency amplifier. In accordance with principles of modulator action, its output will contain the two input frequencies  $f$  and  $\frac{1}{4}f$ , two side-band frequencies  $(\frac{3}{4})f$  and  $(\frac{5}{4})f$ , and higher harmonics which may be bypassed and neglected. Note that the side-band frequency  $(\frac{5}{4})f$  is the same as the local oscillator frequency in the original receiver. The other side-band frequency  $(\frac{3}{4})f$  entering the converter would produce beat frequencies with the signal frequency, of which only the difference frequency  $\frac{1}{4}f$  would be accepted by the intermediate frequency amplifier.

### General Case

Extending the reasoning now to the general case for any ratio  $n$  of signal frequency to intermediate frequency, the output of the modulator contains the frequencies

$$f + \frac{f}{n} \text{ and } f - \frac{f}{n}$$

Considering the first of these two terms in the converter action, we obtain the following expressions for the sum and difference frequencies in its output:

$$(1) \left( f + \frac{f}{n} \right) + f = 2f + \frac{f}{n}$$

(rejected by i-f amplifier)

$$(2) \left( f + \frac{f}{n} \right) - f = \frac{f}{n}$$

(passed by i-f amplifier)

Considering the other modulator output frequency, we obtain for the sum and difference frequencies in the converter output:

$$(3) f + \left( f - \frac{f}{n} \right) = 2f - \frac{f}{n}$$

(rejected by i-f amplifier)

$$(4) f - \left( f - \frac{f}{n} \right) = \frac{f}{n}$$

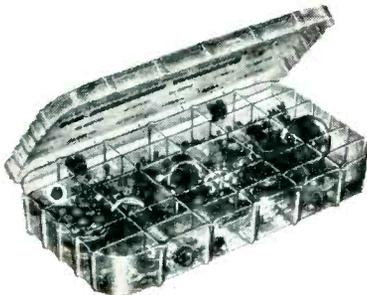
(passed by i-f amplifier)

Thus it would appear that we can construct a superheterodyne receiver with a modulator operating as described instead of a local

# E-I HERMETIC SEALING COMPONENTS

ENGINEERS, DESIGNERS, PURCHASING AGENTS! SAVE TIME AND EFFORT

with the **E-I SAMPLE KIT!**



New designers kit contains 81 standard terminals and 11 different headers. These mass produced, economy-priced standard parts solve practically all problems requiring hermetic sealing. Transparent case with labeled bins makes it easy to select the correct component for your needs. The E-I SAMPLE KIT is available at the nominal price of \$10.00. Send check with order or request the free E-I illustrated brochure today!

Write for these descriptive bulletins:

- 849 - Hermetically Sealed Terminals
- 850 - Hermetically Sealed Multiple Headers
- 851 - Gasket Type Bushings



**ELECTRICAL INDUSTRIES**  
INCORPORATED  
44 SUMMER AVENUE • NEWARK 4, N. J.

## SPECIAL NOTICE

Through a printers' error the street number of our address in our advertisement on page 287 of the April issue of **ELECTRONICS** was printed upside-down.

Write for Bulletin #350. Contains complete illustrated information on the New Carter Inductor Alternator, mechanical and electrical specifications, performance chart, etc. Yours FREE for asking!

# CARTER

## MOTOR CO.

2646 N. Maplewood Ave.  
Chicago, Illinois

Hundreds of standard  
**JONES**  
TERMINAL PANELS  
Complete equipment for  
**SPECIALS**



Send your specifications for prompt quotation

Several pages of Jones Catalog No. 17 illustrate standard and special panels we are constantly producing. Latest special equipment enables us promptly to produce practically any panel required. Send print or description for prices, without obligation. Hundreds of standard terminal strips also listed. Send for Catalog with engineering drawings and data.

**JONES MEANS**  
Proves **QUALITY**



**HOWARD B. JONES DIVISION**  
CINCH MANUFACTURING CORPORATION  
CHICAGO 24, ILLINOIS  
SUBSIDIARY OF UNITED-CARR FASTENER CORP.

# MICRODIAL

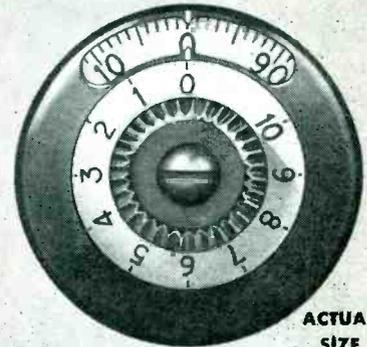
## TEN TURN-COUNTING DIAL

Microdial is composed of two concentrically mounted dials... one for counting increments of each turn and the other for counting turns. The incremental dial has 100 equal divisions and is attached rigidly to the shaft so there is no backlash. Thus the contact position is indicated to an indexed accuracy of 1 part in 1000. Rotation is continuous in either direction. There are no stops on the Microdial assembly.

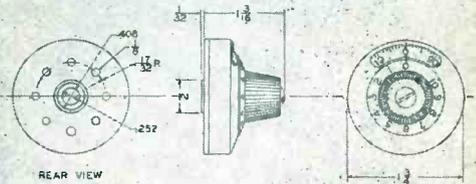
**COMPACT...** Microdial has same O.D. as Micropot... requires no more panel space.

**CLEAR READING...** Forced fast-reading tests showed only 1/20th as many errors with Microdial open window as with next most legible dial. Turn counter distinguishes between 0 and 10 turn readings, and accelerates to avoid confusion on readings near integral turns. Precise readings are made from larger dial with maximum separation of graduations and wide angle visibility.

**CONVENIENT...** delivered completely assembled with dials synchronized. Easily mounted in a few seconds. All dials may be locked.



ACTUAL SIZE



Microdial... turn-counting dial, primarily designed for use on Micropot ten turn linear potentiometers... use it on any multiturn device having ten turns or less.



BORG EQUIPMENT DIVISION  
**THE GEORGE W. BORG CORPORATION**  
DELAVAN • WISCONSIN

## SOLD TO WHOLESALE DISTRIBUTORS ONLY

Effective April 1, 1951

### ROTOR 4 CONDUCTOR WIRE

**\$25.00 per/M ft.—1000 ft. Metal Spools**

#### 300 OHM TV WIRE—POLYETHYLENE INSULATION

20 Gauge	80 Mil Web	\$22.50 per/M ft. Metal Spools
20 "	50-55 " "	20.00 " " " "
22 "	50-55 " "	17.50 " " " "
22 "	40 " "	15.00 " " " Cardboard Spools

TERMS: 30 Days Net—Rated Concerns—C.O.D. Non-Rated

## Jersey Specialty Company

LITTLE FALLS

Phones—L. F. 4-0784—1404—1405

NEW JERSEY

## CIRCUITS AND MICROWAVE ENGINEERS

Permanent Positions for Men with Several Years of Experience

A rapidly expanding organization with long range programs for commercial and government developments offers excellent opportunities in the field of general instrumentation including VHF, UHF, and microwave test equipment.

Our modern, well equipped laboratories are conveniently located in downtown Brooklyn and offer a stimulating and pleasant working atmosphere.

Men with Master's or Ph.D. degrees are preferred.



**RESEARCH and DEVELOPMENT CO. Inc.**

202 TILLARY STREET, BROOKLYN 1, N. Y.



**NOW! SAVE MONEY  
SAVE TIME**

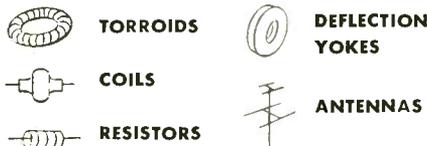
**WITH BI-SEAL  
SELF-BONDING  
POLYETHYLENE  
BASE TAPE**

**FORMS INTO A SOLID MASS OF  
INSULATION AND PRODUCES  
MOISTURE TIGHT SEALS**  
by means of a gasketing action  
on all materials.

**CHECK THESE EXCLUSIVE FEATURES:**

- ✓ Fuses into a non-laminar homogeneous mass.
- ✓ Excellent dielectric characteristics.
- ✓ A perfect moisture barrier and corona resistant. (Can be used from 175 deg. F to minus 30 deg. F.) Prolonged aging without deterioration.
- ✓ Will not corrode metals.
- ✓ Easy to apply — conforms readily to odd contours.
- ✓ S.I.C. 2.12, P.F. 0.004 @ 10 m.c.

JUST A FEW OF THE MANY BI-SEAL APPLICATIONS:



SEND TODAY for FREE SAMPLE Strips,  
Data and Specifications.

BISHOP MANUFACTURING CORPORATION  
254 West 31st Street, New York 1, N. Y.  
Please rush BI-SEAL Data.

Mr. ....  
Title .....  
Company .....  
Address .....

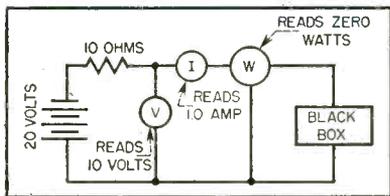
oscillator. The modulator would automatically provide the correct relationship of frequencies to make best use of the intermediate frequency amplifier characteristic and thereby do away with the tracking problems inherent in the tuning of an adjustable type of local oscillator.

What is the fallacy in this reasoning?

**Last Month's Solution**

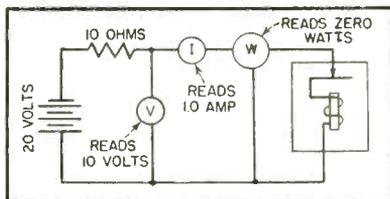
THE PROBLEM published last month was:

Consider the circuit diagram shown. The battery supplies 20 volts d-c with no internal resistance. The voltmeter, ammeter and wattmeter are average or rms indicating, and for this problem they



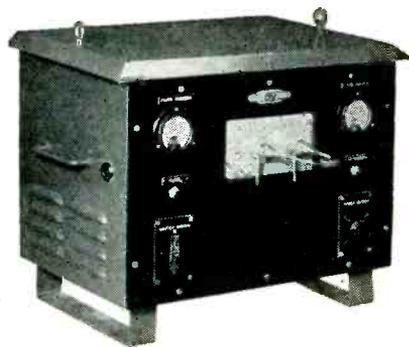
require no power to operate. The apparent power dissipation in the black box now is 10 watts according to the voltmeter and ammeter, but the zero wattmeter indication is a contradiction of this. What is in the little "black box?"

Solution. The box contains a magnetically-driven interrupter contact with 50-percent duty cycle, as shown in the revised circuit.



When contact is made  
 $I = 2.0$  amperes  $V = 0$  volts  
When contact is open  
 $I = 0.0$  amperes  $V = 20$  volts  
With a 50-percent duty cycle  
 $I_{average} = 1.0$  amperes  
 $V_{average} = 10$  volts  
and the real power dissipated is zero as confirmed by the wattmeter.

**2 KW  
VACUUM TUBE  
BOMBARDER  
OR  
INDUCTION  
HEATING UNIT**



For Only \$650.

Never before a value like this new 2-KW bench model "Bombarder" or high frequency induction heater . . . for saving time and money in surface hardening, brazing, soldering, annealing and many other heat treating operations.

Simple . . . Easy to Operate . . .  
Economical Standardization of  
Unit Makes This New Low Price  
Possible.

This compact induction heater saves space, yet performs with high efficiency. Operates from 220-volt line. Complete with foot switch and one heating coil made to customer's requirements. Send samples of work wanted. We will advise time cycle required for your particular job. Cost, complete, only \$650. Immediate delivery from stock.

Scientific Electric Electronic Heaters are made in the following ranges of Power: 1-2-3½-5-7½-10-12½-15-18-25-40-60-80-100-250KW.

*Scientific  
Electric*

Division of

"S" CORRUGATED QUENCHED GAP CO.

107 Monroe St., Garfield, N. J.

# PROFESSIONAL SERVICES

Consulting—Patents—Design—Development—Measurement

in

Radio, Audio, Industrial Electronic Appliances

**AMERICAN SPEEDLIGHT CORP.**  
(AFFILIATED WITH J. G. SALTZMAN, INC.)  
HARRY L. PARKER, PRESIDENT and  
CHIEF ENGINEER  
Specialist in Flash and Electronic Equipment  
for Photography.  
Consultation—Development—Design and  
Manufacture  
480 Lexington Avenue New York 17, N. Y.

**HANSON-GORRILL-BRIAN INC.**  
*Products & Mfg. Development*  
ELECTRICAL - ELECTRONIC  
HYDRAULIC - MECHANICAL  
One Continental Hill Glen Cove, N. Y.  
Glen Cove 4-1922

**ALBERT PREISMAN**  
*Consulting Engineer*  
Television, Pulse Techniques, Video  
Amplifiers, Phasing Networks,  
Industrial Appliances  
Affiliated with  
MANAGEMENT-TRAINING ASSOCIATES  
3308-14th St., N.W. Washington 10, D. C.

**CROSBY LABORATORIES, INC.**  
*Murray G. Crosby & Staff*  
Radio-Electronic Engineering,  
Research & Development  
FM, Communications, TV  
Test Equipment  
Offices, Laboratory & Model Shop at:  
126 Herricks Rd., Mineola, N. Y.  
Garden City 7-0284

**HOGAN LABORATORIES, INC.**  
John V. L. Hogan, Pres.  
*Applied Research, Development, Engineering*  
Est. 1929. Exceptionally competent staff.  
Electronics, Optics, Mechanisms, Facsimile  
Communication, Electro-sensitive record-  
ing media, Instrumentation.  
155 Perry Street, New York 14 CHelsea 2-7855

**SKINNER, HARLAN AND IRELAND, INC.**  
*Consulting Engineers*  
Specializing in Magnetic Materials and  
Their Application  
Office and Laboratory Indianapolis 7, Indiana

**DUBROW DEVELOPMENT CO.**  
*Design — Development — Mfr.*  
Quality Electronic Equipment  
347 High St. Burlington, N. J.  
Burlington 3-0446

**MEASUREMENTS CORPORATION**  
*Research & Manufacturing Engineers*  
Harry W. Houck Jerry B. Minter  
John M. van Beuren  
Specialists in the Design and  
Development of Electronic Test Instruments  
Boonton, N. J.

**The Robert H. Streeter Co.**  
*Electronic Design Specialists*  
Engineering Consultants  
Representing Manufacturers  
of Electronic Equipment  
in Southern United States  
Specialists in the design and construction of spe-  
cialized pieces of equipment for specific applications  
Tel. 97 Greenwood, Miss.

**EDGERTON, GERMESHAUSEN  
& GRIER, INC.**  
*Consulting Engineer*  
Research Development and Manufacture  
of Electronic and Stroboscopic Equipment  
Specialists in High-Speed Photography  
160 Brookline Avenue, Boston 15, Mass.

**Eugene Mittelmann, E.E., Ph.D.**  
*Consulting Engineer & Physicist*  
High Frequency Heating—Industrial Electronics  
Applied Physics and Mathematics  
549 W. Washington Blvd. Chicago 6, Ill.  
State 2-8021

**THE TECHNICAL  
MATERIEL CORPORATION**  
*Communications Consultants*  
Systems Engineering  
General Offices and Laboratory  
121 Spencer Place, Mamaroneck, N. Y.

**ELECTRONIC ENGINEERING  
CO. of CALIFORNIA**  
Radio and Electronic Consulting and  
Designing.  
180 S. Alvarado Los Angeles  
DUNKirk 2-7338 California

**NIAGARA ELECTRON LABORATORIES**  
CONSULTATION - DESIGN - CONSTRUCTION  
MFG. THE THERMOCAP RELAY  
Specializing in solution of problems of electronic  
and electro-physical instrumentation for the re-  
search or analytical laboratory. Industrial plant  
problems also invited.  
Andover, New York Cable Address: NIATRONLAB

**TELECHROME, INC.**  
*Electronic Design Specialists*  
COLOR TELEVISION EQUIPMENT  
Flying Spot Scanners, Color Synthesizers, Keyers,  
Monitors, Oscilloscopes and Related Apparatus  
J. R. Popkin-Clurman, Pres. & Ch. Engr.  
88 Merrick Rd. Amityville, L. I., N. Y.

**ERCO RADIO  
LABORATORIES, INC.**  
*Radio Communications Equipment*  
Engineering - Design - Development - Production  
Pioneers in Frequency Shift Telegraph  
Garden City • Long Island • New York

**PHYSICAL RESEARCH ASSOCIATES**  
*Consulting Physicists & Engineers*  
Arthur M. Vigilante, Director  
Research, Development, Design and Manufacture  
of Detection and Recording Systems. Industrial  
and Analytical electro-physical instrumentation.  
Dynamic Condenser Electrometers.  
#1 Azurelee Drive Malibu, Calif.  
Malibu 8444

**WHEELER LABORATORIES, INC.**  
Radio and Electronics  
Consulting—Research—Development  
R-F Circuits—Lines—Antennas  
Microwave Components—Test Equipment  
Harold A. Wheeler and Engineering Staff  
Great Neck, N. Y. Great Neck 2-7806

**EDWARD A. GAUGLER, Ph.D.**  
*Consulting Physicist*  
Magnetic Materials and their Applications  
419 Shepherd St. Chevy Chase, Md.  
Wisconsin 6106

**PICKARD AND BURNS, INC.**  
*Consulting Electronic Engineers*  
Analysis and Evaluation  
of Radio Systems  
Research, Development & Design  
of Special Electronic Equipment  
240 Highland Ave., Needham 94, Mass.

**YARDNEY LABORATORIES, INC.**  
*Research-Design-Development*  
Electro-Chemical Generators of Energy  
105 Chambers Street WOrth-2-3534, 35, 36  
New York 7, N. Y.

**THE  
REAL  
VALUE**

*of placing your unusual problem in the hands of a competent con-  
sultant is that it eliminates the elements of chance and uncertainty  
from the problem and provides real facts upon which to base decisions.*

put

# BACK ISSUES to work

Whatever you do with this magazine after you've clipped pertinent articles or advertisements, please don't destroy it.

## HERE'S WHY:

Churches, Boy Scouts, civic and veterans organizations will welcome all the wastepaper you have. They can get a good price for it. Increase their funds.

And, you can make a direct contribution to American mobilization by saving paper of all types—whether in magazine form or not. Since the Korean War began, there's been a great increase in the demand for products manufactured from wastepaper.

Save it for your favorite organization. Chances are they have scheduled pick-ups.

## HERE'S HELP

for technical and business men

## NEW 1951 Catalogue of McGraw-Hill Books



DESCRIBES OVER 2,000 BOOKS

Here is a guide to practical, expert information on many business and technical subjects. This catalogue contains clear, concise descriptions of of more than 2,000 books written by leaders of business, industry and research. Get your copy now. In it you will find an up-to-date listing of books that give you the facts—experience—data—you need in solving your particular problems.

McGraw-Hill books bring you the experience of experts in your field

MAIL THIS COUPON FOR YOUR FREE COPY

Readers Service Department  
McGraw-Hill Book Co., Inc.  
330 W. 42nd St., N. Y.

Send me a free copy of the New 1951 Catalogue of McGraw-Hill Books. I want to know more about: (Name subjects of most interest to you.)

Name .....  
Address .....  
City ..... State ..... FL-51

# CONTACTS

FOR THE FIELD OF ELECTRONICS

The nonmelting SILICONE  
insulating and waterproofing  
compound, stable at temper-  
atures from -70°F. to +400°F.



MEETS ALL REQUIREMENTS  
OF AN-C-128a

More water repellent than paraffin, Dow Corning 4 Compound is highly resistant to oxygen, ozone and to deterioration caused by corona discharge.

POWER FACTOR  
up to 10 megacycles... 0.001

VOLUME RESISTIVITY  
ohm centimeters... 10"

DIELECTRIC STRENGTH  
volts/mil... 500



for switches and contacts in the POWER INDUSTRY



for ELECTRONIC EQUIPMENT

Write Today!

for your copy of our new booklet on Dow Corning 4 Compound, Address Dept J



DOW CORNING CORPORATION, Midland, Michigan



FINE RIBBONS  
OF  
TUNGSTEN and Molybdenum

Quality and accuracy in our fabrication of Tungsten & Molybdenum Ribbons have characterized our service to the Electronic industry.

A development of  
**H. CROSS Co.**  
15 Beekman St., New York 7, N. Y.

SUB-CONTRACTING  
MILITARY and COMMERCIAL

receivers — test equipment  
transmitters — controls  
sub-assemblies

**TELETRONICS LABORATORY, INC.**  
Westbury, L. I., N. Y., Westbury 7-1028

ELECTRICAL  
**COILS**  
TO SPECIFICATIONS

Any type construction and materials wound to customer's exact requirements and government regulations. See us winding at the Universal Winding Co. Booths A. B. & C. I.R.E. SHOW.



**THE FIVE STAR CO.**  
110 Mixville Road  
West Cheshire, Conn.

MORE THAN 70  
DIFFERENT TYPES & SIZES

MINIATURE BALL BEARINGS for application in precision mechanisms minimize friction and wear. High load capacity. Least weight and space. Special designs and complete engineering service for your application. Write for catalog E.

**MPB MINIATURE Precision BEARINGS**  
INCORPORATED  
KEENE, NEW HAMPSHIRE, U.S.A.

Shorted Turn Indicator  
MODEL 101C BULLETIN 42  
HUNTINGTON BEACH, CALIF.

**KARTRON**



**FLUXES**  
SODERING  
BRAZING & WELDING  
L. B. ALLEN CO. INC. Chicago 31, Ill.  
6751 BRYN MAWR AVE.

ALUMINUM  
Sheets—Circles  
25/35/525

Mill Certification for Defense Orders from warehouse stock  
**HENRY B. LUST**  
310 West 85th St. New York 24, N. Y.  
Telephone: TRafalgar 7-6329

**EL-TRONICS, INC.**

Research, development, and manufacture of electronic equipment—a single model to large quantities.

Write Today for Free Resume of Our Plant Facilities  
Specialists in Geiger-Muller equipment  
2647-67 N. Howard St.-Phila. 33, Pa.-GARfield 5-2028

**EISLER** Manufactures Complete Equipment for:

SPOT WELDERS Electric, for 1/4 to 250 KVA.  
TELEVISION TUBE GLASS WORKING EQUIPMENT.  
TRANSFORMERS, Special and Standard Types.  
INCANDESCENT LAMP Manufacturing Equipment.  
FLUORESCENT TUBE Manufacturing Equipment.  
NEON SIGN MAKERS EQUIPMENT.  
ELECTRONIC EQUIPMENT, Vacuum Pumps, etc.  
WET GLASS SLICING and Cutting machines for Laboratory use  
EISLER ENGINEERING CO. Inc. 751 So. 13th St., Newark 3, N. J.



# SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

## UNDISPLAYED RATE

\$1.50 a line, minimum 4 lines. To figure advance payment count 5 average words as a line. **EMPLOYMENT WANTED & INDIVIDUAL SELLING OPPORTUNITY** undisplayed advertising rate is one-half of above rate, payable in advance.

PROPOSALS \$1.20 a line an insertion.

NEW ADVERTISEMENTS received at the N. Y. Office, 330 W. 42 St., N. Y. 18, by May 1st will appear in the June issue, subject to limitation of space available. The publisher cannot accept advertising in the Searchlight Section which lists the names of the manufacturers of resistors, capacitors, rheostats, and potentiometers or other names designed to describe such products.

## INFORMATION:

BOX NUMBERS count 1 line additional in undisplayed ads.

DISCOUNT 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

EQUIPMENT WANTED OR FOR SALE Advertisements acceptable only in Displayed Style.

## DISPLAYED—RATE PER INCH

The advertising rate is \$12.80 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured  $\frac{7}{8}$  inch vertically on one column, 3 columns—30 inches—to a page.

ELECT.

## WANTED FACILITIES & PERSONNEL

Old established electrical manufacturing concern is interested in acquiring facilities and technical personnel in the Selenium Rectifier field.

M-9313, Electronics  
330 W. 42 St., New York 18, N. Y.

## EMPLOYMENT SERVICE

SALARIED PERSONNEL, \$3,000-\$25,000. This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. L, 241 Orange St., New Haven, Conn.

## PATENTS

Consult: Z. H. Polachek,

Reg. Patent Attorney, 1234 Broadway, New York 1, N. Y.

## ELECTRONIC ENGINEER 10 YEARS TECHNICAL EDITING FIRE CONTROL MANUALS

Desires position affording part of year free time for writing own books.

PW-9264, Electronics  
330 W. 42 St., New York 18, N. Y.

## PACIFIC COAST

Sales Engineering Specialists accept representation of Eastern or Midwestern manufacturer in Electrical and Electronic Field.

Engineering Service plus Wide Sales Coverage is assured

Reply RA-9457, Electronics  
330 W. 42nd St., N. Y. 18, N. Y.

## If You Make MINIATURE CONTROL MOTORS OR ROTARY COMPONENTS FOR SERVO-CONTROL USE

a sales organization is available in the metropolitan area to supplement its present line of control-system components with your products.

Write or wire P. O. Box 246, New York 10, N. Y.

## TUBE REBUILDING Large Transmitting and Power types

Economical • Guaranteed

FREELAND PRODUCTS CO.

700 DRYADES ST., N. O., LA.

## TECHNICAL WRITING

Small group of electrical engineering professors available for technical report writing. Have industrial and laboratory experience, and familiarity with service specifications.

SS-9473, Electronics  
520 No. Michigan Ave., Chicago 11, Ill.

## SEMI-CONDUCTOR RESEARCH

The International Business Machines Corporation has an opening for a qualified physicist in an expanding program of research and development on semi-conductors.

Qualifications include Ph.D. or equivalent with extensive experience and fundamental background in Solid State Theory.

Applications with details should be sent to the Manager of the Engineering Laboratory, International Business Machines Corporation, Poughkeepsie, New York.

## PROJECT ENGINEERS

Five years or more of experience in charge of design and development of radio and communication equipment. Must be a graduate of a credited Engineering School. Well equipped laboratory in modern radio and television plant, with excellent opportunities for advancement.

Send resume of qualifications to Mr. S. F. Cascio, Personnel Director of the Hallcrafters Company

4401 West Fifth Ave., Chicago 24, Illinois

## SALES ENGINEER ELECTRONIC EQUIPMENT

Manufacturers' representative seeks associate to sell established lines of test equipment. Should have B.S. in E.E. or Physics. Located in Cleveland.

RW-9280, Electronics  
330 W. 42 St., New York 18, N. Y.

## WANTED SALES REPRESENTATIVES

Man experienced in component sales to television, industrial electronics, and communication equipment fields. Exclusive territories available.

RW-8598, Electronics  
330 W. 42 St., New York 18, N. Y.

## ENGINEERS

### ELECTRICAL—MECHANICAL

For work on radio, television and government projects. Opportunities exist for project and design engineers—senior and recent graduates—for design, development and research. Permanent positions with exceptional opportunity for advancement are available for qualified engineers with rapidly expanding industrial organization, one of oldest in the field of electronics. Splendid working conditions. Please send detailed resume and salary requirements to

Employment Office

### SYLVANIA ELECTRIC PRODUCTS INC.

Radio & Television Division  
254 RANO ST. BUFFALO, N. Y.

## ELECTRONIC ENGINEERS

SENIOR ENGINEERS or PHYSICISTS Degree and experience in Radar, Pulse Circuits, Digital or Analogue Computers, or Servomechanisms JUNIOR ENGINEERS and recent graduate in EE or Physics.

### ELECTRONIC ENGINEERING COMPANY OF CALIFORNIA

180 S. Alvarado St. Los Angeles 4, Calif.

## WANTED ENGINEERS

With power and transmitting tube design experience. State draft status and experience.

Write Direct To:

TAYLOR TUBES, INC.  
2312 W. Wabansia Ave. Chicago 47, Ill.

## MANUFACTURING SOURCE AND SALES OUTLET FOR YOUR PRODUCT

Financially responsible radio and television components manufacturer selling direct to set manufacturers desires inventions, ideas or any new developments applicable to the television, radio or electronic field, electrical or mechanical. Compensation will be made by purchase, royalty or percentage. All inquiries will be received in absolute confidence.

Address BO-9058, Electronics  
520 N. Michigan Ave., Chicago 11, Ill.

# MOTOROLA INC. NEEDS

**Electronic Engineers**  
**Television Engineers**  
**Circuit Engineers**  
**Microwave Engineers**  
**Radar Engineers**  
**Mechanical Engineers**  
**Electronic Technicians**  
**Draftsmen**

to

Join its rapidly expanding Military, Television, Car and Home Radio Engineering Departments.

The steady growth of MOTOROLA'S civilian and Military activities presents exceptional and permanent opportunities for highly qualified individuals.

**WRITE: PERSONNEL DEPT.**  
**MOTOROLA INC.**

**4545 W. Augusta Blvd. Chicago, Illinois**

## RADAR, COMMUNICATIONS and SONAR TECHNICIANS WANTED

For Overseas Assignments

*Technical Qualifications:*

1. At least 3 years' practical experience in installation and maintenance.
2. Navy veterans ETM 1/c or higher.
3. Army veterans TECH/SGT or higher.

*Personal Qualifications:*

1. Age, over 22—must pass physical examination.
2. Ability to assume responsibility.
3. Must stand thorough character investigation.
4. Willing to go overseas for 1 year.

Base pay, bonus, living allowance, vacation add up to \$7,000.00 per year. Permanent connection with company possible.

**Apply by Writing to**  
**A-1, P. O. Box 3414**  
**Philadelphia 22, Pa.**

Men qualified in RADAR, COMMUNICATIONS or SONAR give complete history. Interview will be arranged for successful applicants.

## POSITIONS AVAILABLE WITH VARIAN ASSOCIATES

San Carlos, California

**MICROWAVE AND ELECTRONIC DEVELOPMENT**

ENGINEERS, qualified for work in  
Microwave research and development  
Klystron tube design  
Circuit design  
Traveling wave tube design  
Nuclear induction

MICROWAVE TUBE TECHNICIANS  
TEST TECHNICIANS  
TECHNICAL REPORT WRITERS  
COMPUTERS

If you are qualified for one of these positions and are interested in a challenging opportunity with an expanding organization in an attractive environment, you are invited to send confidential details to the Personnel Director:

**VARIAN**  
*associates*

*99 washington st.*  
*san carlos, calif.*

## NATIONAL UNION RESEARCH DIVISION

The Research Laboratories of one of the nation's larger electron tube manufacturers have vacancies for electronic engineers and engineering physicists qualified in the following fields:

Vacuum tube development  
Electronic circuit design  
Electronic equipment

This organization can offer excellent prospects for security and personal advancement due to our continued growth. Our location is in the New York metropolitan area.

Whether you have a background of electron tube or circuit design, or are a recent graduate and interested in our field, we would like to hear from you. Send your resume to:

*Personnel Department*  
**National Union Research Division**  
**350 Scotland Rd. Orange, N. J.**

Engineers . . .  
 Physicists . . . .  
 Chemists . . . . .  
 Metallurgists . . . .

A Reminder

from

## GENERAL ELECTRIC

Tremendous material resources . . . the stimulation of highly creative work . . . long-range security and professional recognition . . . these are but a few of the assets General Electric offers you in unusual positions now available in: Advanced Development, Design, Field Service and Technical Writing.

If you have a Bachelor's or Advanced Degree in Electrical or Mechanical Engineering, Physics, Metallurgy or Physical Chemistry and experience in the Electronics Industry, you can expand your training and experience to the fullest in openings in connection with:

- .. MILITARY RADIO & RADAR
- .. MOBILE COMMUNICATION
- .. MULTIPLEX MICROWAVE COMMUNICATIONS
- .. ELECTRONIC COMPONENTS
- .. TELEVISION, TUBES and ANTENNAS.

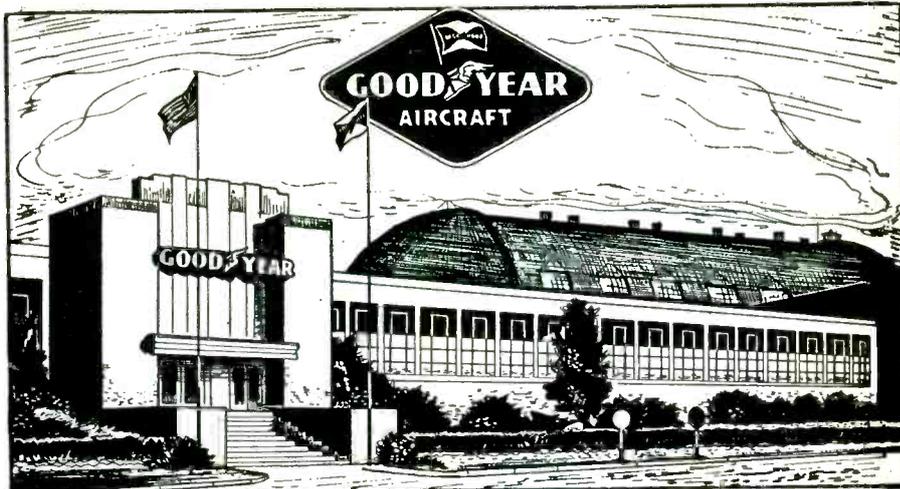
Please send resume to:  
 TECHNICAL PERSONNEL  
 ELECTRONICS PARK

**GENERAL  ELECTRIC**  
 Syracuse, New York

### Electronics Engineers Electromechanical Engineers Engineering Physicists

Several senior and junior engineers are required immediately for the direction of important research and design work by an organization specializing in all types of advanced armament development. This is an opportunity to participate in the growth of an exceptionally active group in a highly technical field. Direct inquiries to:

R. W. Sanford  
 AIRCRAFT ARMAMENTS, INC.  
 4415 Reisterstown Rd.  
 Baltimore 15, Md.



### RESEARCH - DEVELOPMENT - DESIGN

#### ENGINEERING WITH A FUTURE

The steady growth of several established research and development projects has created a number of exceptional engineering opportunities with a future.

#### PHYSICISTS—ENGINEERS

Positions are now available in our organization for qualified physicists and engineers with backgrounds in circuit analysis, microwaves, servomechanisms, analog computers, etc. Openings exist at several levels with salaries dependent on education, ability, and experience.

If you are qualified and interested in a position which combines stability and unusual opportunity, write, giving full details to Mr. C. G. Jones, Manager, Salary Personnel.

**GOODYEAR**  
 AIRCRAFT CORPORATION

Akron 15, Ohio

### AEROJET ENGINEERING CORPORATION World's Largest Rocket Plant Needs

Electronic and Electrical, Mechanical, and Chemical Engineers for research, design, and development work on rockets, rocket components, and guided missiles.

Give experience, education, age, work references, personal history, salary received and salary expected.

*All inquiries will be considered promptly and kept confidential.*

**AEROJET ENGINEERING CORPORATION**  
 P. O. BOX 296, AZUSA, CALIFORNIA

# electronic engineers and physicists

Organization established in 1942. Electronic research, development, and production must expand to meet long-term, pre-Korea commitments. Openings in all branches of electronics, including

RECEIVERS      TRANSMITTERS  
ANTENNAS      RADARS  
RELATED EQUIPMENT

*Positions available at all levels.*

Write or telephone Howard J. Gresens at

*Airborne Instruments Laboratory*  
INCORPORATED

160 Old Country Road, Mineola

Long Island, N. Y.

## SCIENTISTS AND ENGINEERS

for

challenging research and advanced development in fields of

RADAR  
GYROSCOPES  
SERVOMECHANISMS  
MECHANICAL SYSTEMS  
ELECTRONICS CIRCUITS  
APPLIED PHYSICS AND MATH  
PRECISION MECHANICAL DEVICES  
ELECTRICAL SYSTEM DESIGN  
GENERAL ELECTRONICS  
INSTRUMENTATION  
MICROWAVES  
COMPUTERS  
AUTOPILOTS

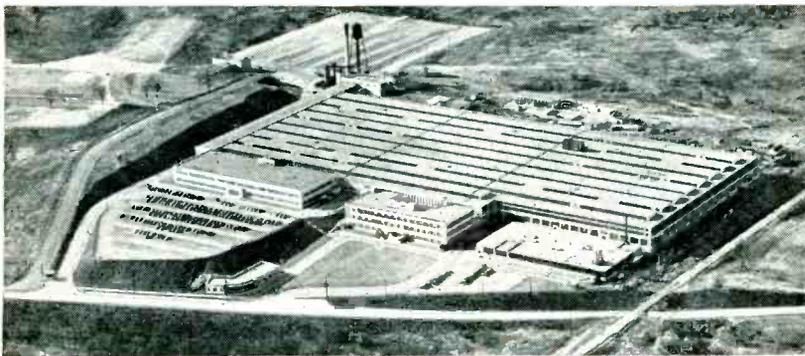
*Scientific or engineering degree, and extensive technical experience required.*

Write:

Manager, Engineering Personnel

**BELL AIRCRAFT CORPORATION**

P.O. Box 1, Buffalo 5, N. Y.



## Development Engineers for Electronic Aircraft Armament

ELECTRONIC INSTRUMENTATION • ELECTRONIC COMPONENTS •  
SERVOMECHANISMS • RADAR • ELECTRONIC PACKAGING •  
CALIBRATION AND TESTING ENGINEERS FOR PRODUCTION

Job openings range from recent graduates to Engineers with years of experience. Send complete resume, listing salary requirements and availability, to:

*Technical Employment Supervisor, Station 483*

**THE EMERSON ELECTRIC MFG. CO.**

8100 Florissant • St. Louis 21, Missouri

LEADERS IN THE ELECTRICAL INDUSTRY SINCE 1890

## ELECTRONIC ENGINEERS

Excellent opportunities are offered by one of the leading concerns in the electronic computer field to engineers with development or design experience in video and pulse circuitry or test and maintenance experience in the radar, television, or computer fields.

Send complete resumes and salary requirements to:

Personnel Department

**ECKERT-MAUCHLY COMPUTER  
CORPORATION**

3747 Ridge Avenue, Philadelphia 32,  
Pennsylvania

*Subsidiary of Remington Rand Inc.*

## Immediate Openings for ELECTRICAL AND RADIO ENGINEERS

with experience in design of electronic circuits and construction of HF and UHF equipment for long range programs of design and development of piloted and pilotless aircraft. Liberal travel allowances, excellent housing facilities available.

Submit resume to  
ENGINEERING PERSONNEL SECTION

## CHANGE VUGHT AIRCRAFT

P. O. BOX 5907  
DALLAS, TEXAS

## POSITIONS IN THE WEST FOR ELECTRONICS ENGINEERS

For Work in Fields of

Radar

Servomechanisms  
Telemetry  
Microwaves  
Communications

**NOW**

Direct Inquiry To  
FIELD TEST DIRECTOR



Box 391  
Holloman Air Force Base, New Mexico

## ATOMIC ENERGY INSTALLATION NEEDS ELECTRONICS ENGINEERS

Two to ten years' experience in research, design, development or test. Patent history desirable but not necessary. A variety of positions open for men, with Bachelor's or advanced degree, qualified in one or more of the following fields:

- RELAYS
- PULSE CIRCUITS
- SERVO-MECHANISMS
- LOW POWER APPLICATION
- TELEMETERING
- UHF TECHNICIANS
- INSTRUMENTATION
- QUALITY CONTROL

TEST EQUIPMENT RELATING TO THE ABOVE

### CAREER DRAFTSMEN

EXPERIENCED CAREER  
DRAFTSMEN WITH NO  
COLLEGE DEGREE.

These are PERMANENT POSITIONS with Sandia Corporation in Albuquerque, New Mexico. Sandia Laboratory is operated by Sandia Corporation, a subsidiary of Western Electric Company, under contract with the ATOMIC ENERGY COMMISSION. This laboratory offers good working conditions and liberal employee benefits, including paid vacations, sick leave, and a retirement plan.

*Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. The "Heart of the Land of Enchantment." Albuquerque lies at the foot of the Sandia Mountains, which rise to 11,000 feet. Climate is sunny, mild and dry the year 'round.*

Make Application to:

## PROFESSIONAL EMPLOYMENT DIV. SANDIA CORPORATION

SANDIA BASE

ALBUQUERQUE, NEW MEXICO

## Physicists Mathematicians Electronics Engineers Mechanical Engineers

Cornell Aeronautical Laboratory, an affiliate of Cornell University, has permanent positions open for men of project engineer caliber with advanced degrees and experience in physics, applied mathematics, electronics, and instrument design. Assignments are varied and professionally challenging in fields of pure and applied physics.

The position of our laboratory is between those of universities and commercial research institutes. We believe it combines many of the traditional advantages of both.

Inquiries will be treated as confidential; they should be addressed to

Employment Manager  
Dept. H, Cornell Aeronautical Laboratory,  
P.O. Box 235, Buffalo 21, New York

### WANTED

Research and Development Engineers and Physicists with educational background in mechanical, electrical or electronic engineering, physics or engineering physics for openings in plant and laboratory instrumentation, physical measurements, geophysics, and industrial electronics. Prefer persons with two to four years experience in experimental research design and development of instruments, intricate mechanisms, electronic apparatus, optical equipment, servo-mechanisms or allied fields. Positions are of immediate and permanent importance to our operations.

Write Personnel Director

Research and Development Department  
PHILLIPS PETROLEUM COMPANY  
Bartlesville, Oklahoma

## BENDIX AVIATION CORP. PACIFIC DIVISION

OFFERS IMMEDIATE POSITIONS IN ENGINEERING FOR THE DEVELOPMENT OF GUIDED MISSILES, RADAR, SONAR. SALARY COMMENSURATE WITH EXPERIENCE, TRAINING & ABILITY.

### SENIOR ENGINEERS

Electro-mechanical. Designs for instrumentation, sensing instruments & servo-mechanisms.

### JUNIOR ENGINEERS

For laboratory design & tests & field tests of electronic equipment.

### SENIOR & JUNIOR ENGINEERS

For the design of servo-amplifiers, pulse circuits, amplifiers, antenna, VHF-UHF-transmitters & receivers.

Permanent employment in modern factory with excellent working conditions, including health insurance & vacation plan.

Periodic wage & promotion review.

Address Replies: ATT: ENGINEERING PERSONNEL MGR.

## BENDIX AVIATION CORP. PACIFIC DIVISION

11600 Sherman Way

No. Hollywood, Calif.

## ELECTRONIC ENGINEERS

For research and design of high-frequency antennas—microwave, radar, television, and many others.

Here is an opportunity for permanent employment in one of the world's leading antenna laboratories, now engaged in a long-range expansion program.

Excellent salaries and many benefits. Ideal working and living conditions in suburban Boston.

Write now to:

Mr. F. O. Staves  
The Workshop Associates,  
Incorporated  
Division of the Gabriel Company  
135 Crescent Road  
Needham Heights 94  
Massachusetts

## SENIOR PROJECT ENGINEER

Nationally known Manufacturing Concern, located in a pleasant suburban community on Long Island Sound, has permanent positions open for Senior Project Engineers, E. E. graduates with a minimum of 5 years experience on electro-mechanical devices required. Some electronic and fractional horsepower electric motor design desirable. Good salary, working conditions, and employee benefits. All replies held in strict confidence. Submit complete resume to

P-9505, Electronics  
330 W. 42 St., New York 18, N. Y.

## DEVELOPMENT ENGINEERS

Outstanding opportunities for engineers with development experience. Challenging positions available for B.S. or advanced degree graduates in E.E., M.E., physics or aeronautical engineering. More than two years experience required in research or development of electronic and electromechanical equipment.

Openings for project and senior engineers in d-c, audio and rf circuit design, servo-mechanisms, missile controls, electronic instrumentation, instrument and structures design, as well as practical and theoretical aerodynamics and meteorology.

Permanent positions with research and development laboratory engaged in important long-term government projects. Highly interesting and diversified work for men who are creative and resourceful.

COOK RESEARCH LABORATORIES  
1457 Diversey Parkway Chicago 14, Illinois

Your Inquiries to  
Advertisers Will  
Have Special Value . . .

—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publishers to secure more advertisers and—more advertisers mean more information on more products or better service—more value—to YOU.

## The W. L. MAXSON CORPORATION IS SEEKING Outstanding ENGINEERS AND PHYSICISTS with AMBITION to FURTHER PRESENT STANDING Immediately

Minimum Requirements are:

1. Five to ten years' experience in advanced electronics or in servomechanism and computer research and development.
2. Outstanding record of ingenuity.
3. Ph. D., M.S. or equivalent.

Those presently employed at their highest skill in defense work need not apply.

Please send resume and salary requirements to:

## The W. L. MAXSON CORPORATION

460 W. 34th St. New York 1, N. Y.

## RESEARCH OPPORTUNITIES

The University of Michigan is expanding its research organization and will have a number of excellent opportunities open in important research programs for engineers, physicists and mathematicians. Work classifications are in the fields of:

### ELECTRONICS

(Experience in circuit development and design on analog and digital computers, telephone switching equipment or cathode rays displays preferred.)

### SYSTEMS ANALYSIS SIMULATION

### OPERATIONAL ANALYSIS

Researchers have an opportunity to complete their requirements for graduate degrees while employed.

Salaries are commensurate with training and experience. Applicants are invited to send a resume of education and experience to:

PERSONNEL OFFICE  
UNIVERSITY OF MICHIGAN  
ANN ARBOR, MICHIGAN

## ELECTRONIC ENGINEER

At least three (3) years post-college experience in development, DC amplifier, digital computers, pulse and servo design. Established Company, New York City.

P-9418, Electronics  
330 W. 42 St., New York 18, N. Y.

METERS

3 MA DC 2 1/2" R—Simpson black scale	\$3.35
500 Microamps. DC—2 1/2" round Sun	4.30
1 ma. DC Fan type—1" scale (rem. from equip)	3.95
500 ma. DC 2 1/2" R.—General Electric	2.95
2 amp. RF 2 1/2" Sq.—Simpson	3.15
5 amp. AC 4 1/2" R.—JBT	4.11
50 VAC 3 1/2" R.—Simpson	2.95
10 amp. RF 3 1/2" R.—Simpson	4.95
50 amp. AC 3 1/2" R.—General Electric	4.11
3 amp. RF 3 1/2" R.—Weston	6.00

MAGNETRONS

2J21A	2J36	2J61	706BY
2J22	2J37	4J52	706CY
2J26	2J38	5J23	706FY
2J27	2J39	5J29	706GY
2J31	2J40	700B	714AY
2J32	2J41	700C	718AY
2J33	2J48	700D	720B/C/DY
2J34	2J49	706AY	725A
			730A

KLYSTRONS

2K23	2K33	707A	726A1
2K25	2K54	707B	726B
2K26	2K55	723A	5611
2K29	417A	723A/B	

OIL-FILLED HIGH VOLTAGE ISOLATION TRANSFORMERS

Pri. 460V 60 cy. Sec. 115V 200VA Insulated for 30KV  
 DC—G. E. Form E1R—36H x 13"D. \$125.00  
 Pri. 115V 60 cy. Sec. 115V 250VA Insulated for 35KV  
 DC—G. E. Form E1R—29"H x 12 1/2"D. \$125.00

VOLTAGE DIVIDER

G.E. Cat. 824886G-1 and 9001934G-1 17,246,400  
 ohms 35KV 70:1 ratio wire wound shielded oil  
 filled 40"H x 12"D. \$77.50

2 1/2" LOW INERTIA SERVO MOTORS

KOLLSMAN Type 936-0210—85/68V 100 cy 5 watts  
 2650 RPM—new \$12.95  
 DIEHL Type FPE-25-11 75V 68cy 4 watts—  
 new \$34.50

OIL FILLED CONDENSERS

MFD	VDC	Price	MFD	VDC	Price
2	600	\$ .45	2	2000	\$2.70
4	600	1.25	1	2500	4.49
4	600 (R'd)	1.25	1-1	2500	3.85
6	600	1.65	3x2	2500	15.80
8	600 (R'd)	1.39	3x2	4000	2.95
10	600 (R'd)	1.52	1	5000	4.88
8-8	600	1.49	.01-.03	6000	1.65
1	1000	.62	1	7000	1.79
2	1000	.89	2	12500	28.95
4	1000	1.65	.045	16KV	4.70
8	1000	2.45	.05	16KV	4.95
1	1500	.89	.075	16KV	8.95
4	1500	2.95	.25	20KV	18.95
1-5	2000	.87	.50	220VAC	3.95
1	2000	1.50	7	660VAC	4.25

HIGH VOLTAGE TRANSFORMERS

G.E.—Pri. 115V 60 cy  
 Sec. 6250V 60 MA—12.5 KV Ins. \$18.50  
 G.E.—Pri. 115V 60 cy. Sec. 6250/3850/2600V 56 MA  
 12.5 KV Ins. \$18.50  
 Raytheon—Pri. 115V 60 cy Sec. 8500/6450V CT 43  
 MA Hermetically sealed. \$22.50

CRYSTAL DIODES

IN21	\$1.19	IN23	\$1.49	IN34	\$ .79
IN21A	1.69	IN23A	2.55	IN45	.94
IN21B	3.75	IN23B	5.25	IN52	1.05
IN22	1.09	IN27	1.79		

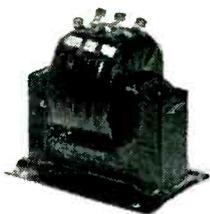
ANTENNAS

AT-38A/APT (70 to 400MC) \$13.70  
 AT-49/APR-4 (300 to 3000MC) 13.70  
 DZ-2 Loop antenna with pedestal 14.50  
 AN-74B (125 to 150MC) 1.65  
 AN-65A (P/O SCR-521) .95  
 AN-66A (P/O SCR-521) 1.15  
 A1A—3CM conical scan. 125.00  
 ASB Yagi—5 element 450 to 560MC. 7.00  
 ASB Yagi—Double stacked 6 element 12.70  
 ASA Yagi—Double stacked 370 to 430MC. 29.40

WESTINGHOUSE  
HYPERFIL  
TRANSFORMER

PRI-115V. 60CY 3/4 KVA  
 SEC #1 - 240V - 1.56A  
 SEC #2 - 240V - 1.56A  
 WT. 30 LBS.

\$14.50 EACH



Terms 20% cash with order, balance C. O. D. unless rated. All prices F.O.B. our warehouse, Phila., Penna., subject to change without notice.

COAXIAL CONNECTORS



83-1AG	\$ .42	83-1R	\$ .45	83-22AP	\$1.10
83-1AP	.30	83-1RTY	.65	83-22AR	.68
83-1F	1.30	83-1SP	.45	83-22SP	1.15
83-1H	.10	83-1SPN	.45	83-16F	.15
83-1J	.80	83-1T	1.30	83-185	.15

FULL LINE OF JAN APPROVED COAXIAL CONNECTORS IN STOCK

UHF		N		BN		BNC	
UG-7	UG-23	UG-37	UG-102	UG-175	UG-236		
UG-12	UG-24	UG-57	UG-103	UG-176	UG-254		
UG-18	UG-27	UG-58	UG-104	UG-185	UG-255		
UG-19	UG-27A	UG-83	UG-106	MX-195	UG-260		
UG-21	UG-29	UG-85	UG-108	UG-197	UG-264		
UG-21B	UG-30	UG-109	UG-109	UG-201	UG-274		
UG-22	UG-33	UG-87	UG-167	UG-206	UG-275		
UG-22B	UG-34	UG-88	UG-171	UG-290	UG-306		

M-358	MC-277	PL-259A	PL-325
M-359	MC-320	PL-274	SO-239
M-359A	PL-259	PL-281	SO-281
M-360		PL-293	TM-201
93-C	49120	D-163950	ES-685606-5
93-M	49121A	D-166132	ES-689172-1

TYPE "J" POTENTIOMETERS

Resis.		Shaft		Resis.		Shaft	
60	SS	5K	1/4"	50K	1/4"	50K	1/4"
60	9 1/16"	5K	3/8"	50K	3/8"	50K	3/8"
100	SS	5K	1/2"	50K	1/2"	50K	1/2"
100	1 1/4"	10K	SS	100K	SS	100K	SS
200	SS	10K	3/8"	100K	5/16"	100K	5/16"
250	1 8"	10K	1/2"	100K	3/8"	100K	3/8"
500	5 1/16"	15K	SS	150K	1/2"	150K	1/2"
500	1 2"	15K	1 2"	150K	3/8"	150K	3/8"
500	5 8"	20K	SS	200K	3/8"	200K	3/8"
650	1 2"	25K	SS	250K	SS	250K	SS
1K	SS	25K	1 4"	250K	3/8"	250K	3/8"
2K	3 8"	30K	1 1/8"	500K	SS	500K	SS
4K	SS	40K	SS	500K	1/4"	500K	1/4"
5K	SS	50K	SS	1 Meg	SS	1 Meg	SS

Dual "J" Potentiometers \$1.60 each 50 ohm SS, 100 ohm SS, 250 ohm SS, 330 ohm SS  
 Triple "J" Potentiometers \$1.95 each 100K/100K/100K—5% 20K/150K/15K—5%

SOUND POWERED TELEPHONES

U. S. NAVY TYPE M HEAD AND CHEST SETS  
 U.S.I. A-260 W.E. D-173013  
 A.E. GL832BA0  
 ANY TYPE—\$11.88 EACH  
 TS-10 Type Handsets \$8.92 ea.

F.W. BRIDGE SELENIUM RECTIFIERS

AC VOLTS INPUT - 18		AC VOLTS INPUT - 40	
DC VOLTS OUT - 14.5		DC VOLTS OUT - 34	
1.3 Amps	\$2.90	0.6 Amps	\$3.30
2.4	3.85	1.2	4.40
6.6	5.45	3.2	6.55
13.0	9.80	6.0	11.70
17.5	12.50	9.0	13.75
26	18.80	12	21.50
39	25.30	18	25.50
52	33.74	24	39.56
70	42.26	36	45.36

130 VAC 1/2 WAVE STACKS

75MA	\$ .88	150MA	\$1.30	250MA	\$1.75
100MA	1.10	200MA	1.57	400MA	2.60

CONSTANT VOLT. TRANSFORMERS

Federal—Input 95-135V 60 cy. Out 115V 210W \$34.00  
 Sola—Input 95-125V 60 cy. Out 15.8V 285VA. \$21.70

GENERATORS

● Eclipse-Pioneer type 716-3A (Navy Model NEA-3A)  
 Output—AC 115V 10-1A 800 to 1400 cy. 1 ϕ. DC 30  
 Volts 60 Amps. Brand New—Original Packing \$38.50  
 ● Eclipse-Pioneer type 1235-1A. Output—30 Volts  
 DC 15 Amps. Brand New—Original Packing. \$15.50

THYRATRONS & IGNITRONS

OAG	FG-41	FG-271	722A
ELC1A	FG-57	393A	873
1C21	FG-67	394A	884
2A4G	FG-81A	GL-415	885
2B4	91	KU-610	1665
2D21	FG-95	KU-623	1904
3C31	FG-105	KU-628	2050
4C35	FG-166	KU-634	2051
C5B	FG-172	WL-652	5550
C6J	FG-178	WL-672	5551
FG-17	RX-233A	WL-677	5552
FG-33	FG-235A	WL-681	5557
			5560

TEST EQUIPMENT

● I-222A Signal Generator	\$79.50
● I-724K Signal Generator	\$48.50
● Vibrotest Mod. 218 Menger	\$45.00
● TS-263/TPS-10—3CM FM Test Set	\$325.00
● TN-1B/APR-1 Tuning Unit	\$95.00
● C-D Quietone Filter Type IF-116 110/220 V AC/DC	\$9.00
20 Amps	\$9.00
● TS-127-U Freq. Meter w/spares	\$39.50
● TS-133/CPN Oscilloscope	\$95.00
● Dumont 175A Oscilloscope	\$225.00
● LM-20 Frequency Meter	\$49.50
● Gen. Radio 757-P1 Power Supply	\$27.00
● Gen. Radio 670-F Decade	\$38.00
● I-130 A Signal Generator	\$70.00
● TS-6/AP Frequency Meter	\$42.00
● L & N KS-7470 Null Volt Test Set	\$50.00
● A.W. Barber Labs. VM-25 VTVM	\$86.00
● TS-10A/APN Delay Line Test Set	\$45.00
● TS-19/APQ-5 Calibrator	\$75.00
● REL W-1156 Frequency Meter 160-220 Mc	\$32.95
● CW1-60AAG Range Calibrator for ASB. ASE.	
ASV and ASVC Radars	\$39.95
● CRV-13 Phantom Antenna for Transmitters up to 400 MC	\$11.75
3 CM. Pickup Horn Antenna	\$9.95
All Items New Except Where Noted (Exc. Used Condition)	

MISCELLANEOUS EQUIPMENT

Amperex IB98 Gamma Counter	\$ 9.87
Powerstat 1226—115/230V input—0-270V out @ 9 amp.	37.00
G.E. 20V2A Servo Amplifier	6.95
Sperdy A-3 Hydraulic Servos	3.95
EIMAC 35 TG Ionization Gauge	5.95
ATR Inverters 6VDC to 110 VAC 60 cy 75W	19.95
ID-6/APN-4 Indicator	29.50
R-7/APS-2 Receiver	49.50
R-7/APS-15 Receiver	49.50
SCR-522 Transceiver	36.95
RT-7/APN-1 Transceiver—less tubes	6.95
FL-8 1020 cycle filter	1.37
RM-29 remote control unit	8.95
RM-11 remote control unit	8.95
RTA-1B 12/24 V dynamotor	7.00
BC-1206-DM2 Receiver	40.95
CY-230/MFG-1 Radar Console	575.00
G.E. Klyne JP-1 portable current transformer	32.50
ASB-4 Radar equip. Complete	69.75
AN/APS-13 less tubes	12.95
T-9/APQ-2 less tubes	16.50
BC-645A complete	18.95
BGA AVR-15 Beacon Recvr	15.50
TSV Trans-Recv	29.95
Pioneer Type 800-1B Inverters—28VDC to 120V 800 cy 7 amp AC (used)	22.65
G.E. Inverter—28VDC to 120 VAC 800 cy 750VA 1 ϕ	39.50
Navy SD-3 Radar complete	\$1200.00
Navy DP-14 Direction Finder complete	\$385.00

PULSE TRANSFORMERS

UTAH	9262	UTAH	9318
G.E. 68G828	9278	AN/APN-4 Block Osc.	9340
G.E. 66G-627	9280	Philco 352-7149	9340
G.E. K-2499A		Philco 352-7150	9350
AN/APN-9 (901756-501)		Philco 352-7071	
AN/APN-9 (901756-502)		Philco 352-7178	
AN/APN-9 (352-7250)		Raytheon UX-7350	
AN/APN-9 (352-7251)		W.E. D-161310	
Westinghouse 132-AW		W.E. D-163247	
Westinghouse 232-AW2		W.E. D-163325	
Westinghouse 232-BW2		W.E. D-164661	

AN/APA-23 RECORDER

Sweeps any receiver through its tuning range and permanently records frequency and time of received signals on paper chart. Power input—(motor) 27V DC 1.5A, and (recorder) 80/115V AC 60-2600 cy 135W.  
 Originally designed to record pulse or sine-wave modulated signals received by AN/APR-1, AN/APR-2, AN/APR-4, AN/APR-5, BC-348, S-27, SX-28. Brand New \$147.50

SPRAGUE PULSE NETWORKS

7.5 E3-1-200-67P, 7.5 KV, "E" Circuit 1 microsec.	
200 PPS, 67 ohms impd., 3 sections	\$4.30
7.5 E3-3-200-67P, 7.5 KV, "E" Circuit 3 microsec.	
200 PPS, 67 ohms impd., 3 sections	\$6.75

# Reliance Specials

## NEW COAXIAL CABLES

Ohms	Price per 1,000 Ft.	Ohms	Price per 1,000 Ft.
RG-6/U	76	RG-35/U	71
RG-7/U	97.5	RG-37/U	55
RG-15/U	76	RG-39/U	72.5
RG-21/U	53	RG-41/U	67.5
RG-22A/U	95	RG-54/U	58
RG-24/U	125	RG-55/U	53.5
RG-25/U	48	RG-57/U	95
RG-26/U	48	RG-58/U*	53.5
RG-27/U	48	RG-59/U*	73
RG-29/U*	53.5	RG-77/U	48
RG-34/U	71	RG-78/U	48

\*No minimum order—others 250' minimum  
Add 25% for orders less than 1,000 feet

## COAXIAL CABLE CONNECTORS

**Angle Adapter** 30c  
M-359  
83-1AP

**Socket** 40c  
SO-239  
83-1R

**Hood** 9c  
83-1H

83-1AC	\$0.42	UG-13/U	.63	UG-85/U	.88
83-1F	1.30	UG-19/U	.67	UG-87/U	.79
83-1J	.80	UG-21/U	.67	UG-101/U	.85
83-1R	.40	UG-23/U	1.10	UG-167/U	2.00
83-1SPN	.50	UG-24/U	.67	UG-175/U	1.15
83-1T	1.12	UG-25/U	.60	UG-176/U	.15
83-22AP	1.10	UG-27/U	.68	UG-107/U	1.33
83-168	.15	UG-29/U	.83	UG-206/U	.63
83-185	.15	UG-33/U	14.80	UG-255/U	1.22
UG-7/AP	2.14	UG-34/U	16.00	UG-264/U	1.74
UG-12U	.63	UG-58/U	.63	UG-281/U	.60

### DIFFERENTIAL

115 V., 60 Cyc.  
#C78249

3 3/8" dia. x 5 3/8" long  
\$3.95 ea.

Used between two #C78249's as dampener. Can be converted to 3600 R/M Motor in 10 minutes. Conversion sheet supplied. (Converted).....\$4.50  
Mounting Brackets — (bakelite) for selsyns, and differentials shown above.....35c pair

### 2J1G1 SELSYNS

BRAND NEW  
400 Cycle  
Can be used on 60 cycle  
**\$1.90**

### JONES BARRIER STRIPS

Type	Price	Type	Price	Type	Price
2-140Y	\$0.13	4-141W	\$0.30	9-141Y	\$0.64
3-14034W	.19	5-141W	.26	10-141Y	.50
6-140	.25	5-1414W	.37	17-141Y	1.17
10-14034W	.53	7-1414W	.36	2-142	.15
2-141	.13	7-1414W	.49	3-142	.21
3-14134W	.24	8-1414W	.58	2-150	.39
3-141W	.24	9-141W	.64	3-150	.54

### UNIVERSAL JOINT

3/16" hole x 3/8" O.D.  
1 1/8" long  
Steel or Aluminum  
**50¢**

### EQUIPMENT

LAVOIE Micro Wave Freq. Meter. Model 105. 300 to 600 Mcs.	\$ 58.50
JACKSON Audio Oscillator. Model 655	95.00
FERRIS Standard Signal Generator. Model 47-A. 40 Mcs.	79.95
G. R. Standard Signal Generator. Model GR-P-350. 15-30,000 Kcs. Less Coils	45.00
BCA Advanced Voltohmyst. 10X Multiplier. Regular & 80 Kv Probes. Type WV-75A	85.00
RC-221-E Freq. Meter with 110V Power Supply	73.95
TS-343/U Sig. Gen. Measurements Corp.—Model 781B	39.95
BC-1016 Recorder	395.00
ASB-4 6 Units	30.00
BC-191-N (BC-375) Tubes—Tuning Unit	22.50
CLOUGH-BRENGLE—Model 230 Capacity Bridge Etc.	45.00

### TYPE "J" POTENTIOMETERS

Ohms	Shaft	Ohms	Shaft
200	1/2"	5K	5/8"
300	5/8"	10K	S.S.
400	3/8"	15K	3/8"
500	S.S.	30K	S.S.
1,000	S.S.	50K	3/8"
2,000	S.S.	80K	S.S.
2,600	S.S.	100K	7/16"
3,000	S.S.	250K	S.S.
4K	3/8"	1 meg.	S.S.

**\$1.00 Each**

## GEAR ASSORTMENT

100 small assorted gears. Most are stainless steel or brass. Experimenters dream! Only \$6.50

### VERNIER DIAL or DRUM (From BC-221)

DIAL—2 1/2" dia. 0-100 in 360°. Black with silver marks. Has thumblock. DRUM—0-50 in 180°. Black with silver marks. either, 85c

### BLOWER & MOTOR

Blower #1 1/2" motor 27 1/2 V.D.C., 1/100 H.P., 8,500 R.P.M. Continuous duty. Has mounting brackets. Navy Inspected .....\$3.50

### ALLEN SET SCREWS

4-40 x 1/8	8-32 x 1/8	8-32 x 5/16
4-40 x 3/16		8-32 x 3/8

ALL SIZES **\$1.50 per 100**

### NEEDLE BEARINGS

B108 1/2" wide	5/8"	13/16"	30¢
<b>Wrapped—BALL BEARINGS—New</b>			
Mfg	ID	OD	Width
Fafnir 33K5	3/16"	1/2"	5/32"
N.D. 5202C13M	1/2"	1 3/8"	1/8"
Fafnir 7308W	1 37/64"	3 9/16"	5/16"
Fafnir 545	2 1/16"	2 5/8"	15/32"
TIMKEN	4 5/16"	6 1/4"	29/32"

### CAPACITORS

#### POSTAGE STAMP MICAS

MMF	MMF	MMF	MMF	MMF	MFD	MFD
8.2	40	90	240	510	.0011	.0051
10	43	100	250	560	.0012	.006
15	47	110	300	580	.0013	.0062
20	51	120	330	600	.00136	.0065
22	56	125	350	620	.0015	.0068
24	60	130	370	680	.001625	.007
25	62	150	390	800	.002	.0075
26	68	160	400	820	.0026	.008
30	75	175	430	910	.0027	.0082
35	82	180	470	MFD	.003	.01
39	85	220	500	.001	.0033	

Price Schedule

8.2 MMF to .001 MFD	5¢
.0011 MFD to .001625 MFD	7¢
.002 MFD to .0052 MFD	12¢
.01 MFD	22¢

### SILVER MICAS

MMF	MMF	MMF	MMF	MMF	MMF	MFD
10	51	120	270	470	875	.00282
18	60	125	325	488	MFD	.002826
22	62	150	330	500	.001	.003
23	66	160	360	510	.001625	.0033
24	68	200	370	525	.0022	.0039
30	75	208	390	560	.0023	.005
39	82	225	400	660	.0024	.0051
40	100	240	410	680	.0028	.0056
50	110	430	700	750		.006
	115	466	750			.0082

Price Schedule

10 MMF to .001 MFD	10¢
.001625 MFD to .0024 MFD	20¢
.00282 MFD to .0082 MFD	50¢

### OIL FILLED

MFD.	V.D.C.	Price	MFD.	V.D.C.	Price
.125	35,000	\$34.95	.02	2,000	\$0.70
.125	27,000	28.95	6	1,500	2.25
.5	25,000	34.95	2	1,500	1.75
.05	16,000	2.95	1	1,500	1.50
.03	16,000	1.95	12	1,000	2.45
.1	12,000	1.95	6	1,000	1.79
.15-15	8,000	2.45	4	1,000	1.39
.02	8,000	1.69	3	1,000	.80
.05	7,500	1.50	2	1,000	.65
.03	6,000	1.40	1	1,000	.59
.1-1	7,000	1.69	1	1,000	.59
.025-.03	7,000	1.35	7	800	1.59
1	6,000	5.25	8-8	600	2.25
.03-.03	6,000	1.35	8	600	1.60
.03	6,000	1.25	7	600	1.45
.01-.03	6,000	1.35	5	600	1.20
2	5,000	4.65	4	600	.98
.25	5,000	2.25	4x3	600	1.95
3	4,000	4.50	2	600	.45
2	4,000	3.95	1	600	.39
3x.2	4,000	2.35	5	500	.35
.1	4,000	1.55	8	500	1.45
.06	4,000	1.35	4	500	.89
2	3,000	3.65	4	300	.59
.25	3,000	1.50	4	200	.39
.1	3,000	1.45			
4	2,500	4.25			
8	2,000	4.45			
6	2,000	4.25			
4	2,000	3.65			
3	2,000	3.50			
2	2,000	2.95			
1	2,000	1.95			
.5	2,000	1.60			
.3	2,000	1.35			
.25	2,000	1.05			
.1-1	2,000	.95			

2 mfd  
4,000  
V.D.C.  
G.E.  
SPECIAL  
\$3.95

### TIMING MOTOR 8 RPM

115V., 60 cyc., E. Ingraham Co. ....\$1.95

## WIRE WOUND PRECISION RESISTORS

2% OR BETTER

1/4 Watt—30¢			
2	10.84	13.52	62.54
2.5	11	13.89	79.81
3.5	11.25	14.98	105.8
5	11.74	15.8	123.8
6.68	12.32	16.37	125
10.48	13.02	32	147.5
			220.4
			301.8
			366.6
			414.3
			705
			2,193
			59,148
			100,000

1/2 Watt—30¢			
250	13.15	260	4,000
334	46	270	4,300
502	52	298.3	4,451
557	55.1	400	4,500
627	75	723.1	5,000
76	97.8	855	5,900
1.01	125	1,500	6,500
1.53	180	2,500	7,000
2.04	210	3,850	7,300
11.1	235	3,427	7,500
			100,000

1 Watt—35¢			
.5	15	3,000	9,000
1.01	270	3,300	10,000
2.58	420	7,000	12,000
3.39	1,000	8,250	23,000
5.21	2,000		
			55,000
			65,000
			70,000
			84,000

1 Watt—45¢			
100,000	130,000	260,000	320,000
105,000	132,000	270,000	345,000
120,000	200,000	296,000	500,000
128,000			700,000
			522,000
			520,000
			600,000
			700,000

### AN CONNECTORS

IMMEDIATE SERVICE  
PHONE! WIRE! WRITE! YOUR NEEDS

BC 348—H. J. L. O. P. Q —write for prices

### DELAY NETWORK—ALL 1400Ω

T 113—Approx. 1.2 micro sec. delay..... 95c  
T 114—Approx. 2.2 micro sec. delay..... each  
T 115 Similar to T 114 with tap brought out.....

### CHOKES

30 Henry 80 ma.	\$1.29	6 Henry 80 ma.	.79
-----------------	--------	----------------	-----

### 3AG FUSES

AMP	Per 100	AMP	Per 100
1/8	\$4.00	3/4	\$4.00
1/4	4.00	1	3.00
3/8	4.00	1 1/2	3.00
1	4.00	5	3.00

### 4AG FUSES

AMP	Per 100	AMP	Per 100
1/8	\$4.00	2	\$2.00
1/4	3.50	3	2.00
3/8	3.50	3.2	2.00
1	2.00	5	2.00

Fuse Holder—For 4AG Fuses.....25c

### Brand New METERS—Guaranteed

0-1 Amp. R.F. 2 1/2" \$3.29 0-80 Amp. D.C. 2 1/2" \$2.25  
0-300 V.D.C. 2 1/2" 3.50 0-7.5V. A.C. 3 1/2" 3.46

### SOUND POWER HANDSET

Brand New!  
Includes 6 ft. cord. No batteries or external power source used.  
**\$17.60 pr.**

Sound Powered Chest Set  
RCA—With 24 Ft. Cord  
**\$17.60 per pair**

### TIME DELAY RELAY

Ravthorn CPX 24166 KS 10193-60 Sec.  
• 115 V., 60 cycle • Adj. 50-70 Seconds

**MOTOR GENERATORS  
DYNAMOTORS, INVERTERS, ETC.**

**2.5 KVA MG SET.** Diehl Elec. Co. 120V DC to 120V AC, 60 cy. 1 Ph. Complete with Magnetic Controller, 2 Field Rheos and Full Set of Spare Parts including Spare Armatures for Generator and Motor. Full specs on request. New \$285.00

**2 KVA MG SET.** O'Keefe and Merritt. 115V DC to 120V AC, 50 cy. Idles at 3 Ph. syncs motor on 208V, 50 cy. New. Export crated \$165.00

**1.25 KVA MG SET.** Allis-Chalmers. 230 DC to 120 AC, 60 cy. 1 Ph. Fully enclosed. Splashproof Ball Bearings, centrifugal starter. New \$150.00

Kit of Spare Parts..... 25.00

**MG. Set.** Onan MG-075. Navy type PU/11. Input 115/230, 60 cy. 1 Ph. Output 115, 480 cy. 1 Ph. 5.3 amps and 26V DC at 3.8 amps. New... \$198.50

**MG Set.** Onan MG-215H. Navy type PU/13. Input 115/230, 60 cy. 1 Ph. Output 115, 480 cy. 1 Ph. 1200W and 26V DC at 4 amps. New... \$295.00

**MG SET FOR NAVY TBS TRANSMITTER.** Type CG-21302. 440V AC, 60 cy. 3 Ph, 1500 VA to 875 DC and 300V DV. New \$69.50

**DYNAMOTOR.** Navy-Type CAJO-211444. 105/130V-DC to 13V DC at 40A or 26V DC at 20A. Radio filtered. Complete with Line Switch. New \$69.50

**DYNAMOTOR.** Elcor. 32V DC to 110V AC, 60 cy. 1 Ph. 2.04 Amps. New... \$24.50  
Also available for 64 volts input. Same price.

**DYNAMOTOR.** Elcor. 32V DC to 110V AC, 60 cy. 1 Ph. 0.43 Amps. New... \$17.50

**DYNAMOTOR** — Type PE94C. For use with SCR522 Transmitter-Receiver. Brand new in export cases \$9.50

**AMPLIDYNE—G. E. Model 5AM21J7.** 4800 R.P.M. Motor Compound wound 150 Watts. Input: 27V. DC. Output: 60V. DC Sig Corps. U. S. Army MG-27-B. New... \$26.50

**AMPLIDYNE—Edison type 5AM31N18A.** Input: 27 volts 44 Amps., 8300 RPM. Output: 60V DC at 8.8 amps. 530 Watts. New... \$22.50

**INVERTER—G. E. Model 5D-21N13A.** Input: 24V. DC. Output: 115V. 400 cy. 485 Va. New... \$49.50

**INVERTER—Leland Elec. Co. Model PE206A.** Input: 28V. DC, 38 Amps. Output, 80V., 800 cy. 485 VA. New \$17.50

**PE 218 INVERTER—G. E. J8169172.** Input: 28V. DC. Output: 115, 400 cycles at 1.5 KVA... \$50.00

**GENEMOTOR—Carter 6V DC to 400 V DC at 375 mils.** New \$49.50

**D. C. MOTOR—G. E. Model 5BA 50LJ2A 0.5 HP.** Armature: 27V. at 8.3 Amps. Field: 60V. at 2.3 Amps. R.P.M. 400. New... \$22.50

**400 Cycle Generator.** Geophysical Inst. Co. Model 24-A. Delivers 15 kw single ph. or 25 kw-3 ph; reconnectable for 120 and 240 volts. Drive speed required—1714 RPM. Price \$325.00

**BC-348 RECEIVER PARTS**

Dial Mechanism assemblies. 1st, 2nd, 3rd, 4th I.F. transformers. C.W. osc. and xtal filter trans. with xtals. All R.F. coils. Front panels. Shock mounts. Large quantity misc. hardware sub assemblies, etc. Write your requirements.

**MISCELLANEOUS EQUIPMENT**

TS-127/U Lavoie Freq. Meter—375 to 725 MC.  
TS-47/APN Test Set—40 to 500 MC.  
213-A DuMont C.R. Modulation Monitor.  
BC1203B APN-4 Test Set.  
78B Beonton Sig. Gen.  
6255A H.P. Interpolation Osc.  
TS-102A/AP Test Set.  
TS-23/APN Test Set.  
TS-487/U Peak to Peak VTVM.  
BC-221AE Freq. Meter.  
LM-13 Freq. Meter.

All prices indicated are F O B Bronxville, New York. Shipments will be made via Railway Express unless other instructions issued.

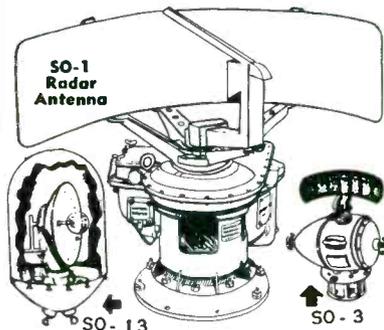
**MICROWAVE RECEIVERS**

AN/APR-1 Receivers and tuning units TN-1 (38 to 95 MC) TN-2 (76-300 MC) TN-3 (300-1000 MC)  
AN/APR-4 Receivers and tuning units TN- 16 (38-95 MC) TN-17 (76-300 MC) TN-18 (300-1000 MC)  
AN/APR-5A Receivers. 1000 to 6000 MC Range.

**MODEL AN/APA-10  
PANORAMIC ADAPTER**

Designed for use with receiving equipment AN/ARR-7, AN/ARR-5, AN/APR-4, SCR-587 or any receiver with I.F. of 455kc. 5.2mc. or 30mc. With 21 tubes including 3" scope tube. Converted for operation on 115 V. 60 cycle source.  
PRICE \$245.00  
AN/APA-10 80 Page Tech Manual..... \$27.75

**RADAR ANTENNAS**



**Type SO-1 (10 CM.)** Complete assembly with reflector, waveguide nozzle, drive motor and synchros, etc. New in original cases. \$279.50  
**Type SO-3 (3 CM.)** Surface Search type complete with reflector, drive motor, synchro, etc., but less plumbing. New in original cases. \$189.50  
**Type SO-13 (10 CM.)** Complete assembly with 24" dish with feedback dipole. Complete with synchros, drive motor, gearing, etc. New in original cases. \$149.50  
Also in stock—spare reflectors, nozzles, probes, right angle bends for SO-1 antennas.

**S. G. RADAR EQUIPMENT**

Navy Yard Spares for  
Model SG Radar

Consisting of the following

- 2—CRP-20ABM Rectifier Power Units for modulation generators.
- 2—CRP-20ABM Rectifier Power Units for Radar Receivers.
- 2—CRP-35AAH Modulation Generators.
- 2—CRP-36ABD-1 Radar Receivers. (including R-906 Gain Controls for Range and Train Indicators).
- 2—CRP-60AAN Signal Monitors.
- 2—Complete Transmitter I.F. System coupling assemblies including—10087 magnets and Duplexing tube cavity assemblies.
- 1—Complete Power Control Chassis.
- 2—Complete Driver and modulator assembly including driver chassis with delay line, Modulator and Driver Rectifier Tube Assembly and Driver Rectifier Power Unit.
- 2—Complete sets equipment spare parts consisting of R.F. Assemblies, motors and accessories, switches, interlocks, fuses, fuse holders, fuse links, relays, contacts, crystals, thermostats, R.F. Inductors, capacitors, sockets, test equipment, cables, resistors, etc., as listed in Navy Spare Parts List WX3385.

All above in new and unused condition packed in original metal spare parts boxes.

**RADAR COMPONENTS**

CRP-23AGC Load Dividers for use with S.G. Modernization Kits. New  
CRM-50AFO Navy type Radar Repeater Adapters. New and complete with 14 tubes, coax fittings, installation plans and wiring diagram.  
Synchro Amplifiers. New.  
Type CA1D 23A/CK Bearing Control Units. New.  
Type T.D.Y. SO-1, SO-13, SO-3 Radar Antenna Assemblies. New.  
Radar Crystals Raytheon 98.35 KC.  
Type SO-11 Radar Modulator.  
Type SO-1 Transmitter Receivers.

**400 CYCLE TRANSFORMERS**

AUTO. 400 cy. G.E. Cat No 80G184.  
KVA .945S—3201. Volts 460/345/230/115. New. \$4.95

FILAMENT. 400/2600 cy. Input: 0/75/80/85/105/115/120V. Output: 5V3A/5V3A/5V3A/5V3A/5V6A/5V6A/6.3V6A/6.3V6A. New \$2.95

THYRATHRON POWER. 400/1600 cy. Raytheon UX-8876. 400/1600 cy. Pri: 115. Sec: 50-0-50V at 1.5A, 6.3V at 1.2A. Test r.m.s. 1780. New... \$2.75

PLATE WECO KS9560. 400/800 cy. Pri: 115V. Sec: 1350-0-1350 at 057A (2700 V Total). Elecstat shlded. Wt. 2.3 lbs. New... \$2.95

Plate. Thordarson #T46889. 1650 VA. Pri: 105-120V. 500 cy. 1 PH. Sec: 5600V. Center tapped. 1.5KV insulation. Brand new... \$49.50

SCOPE PL. & FIL. WECO 9556. 400/2400 cy. Pri: 115. HV Wdg. 1125V at .008A. Fil. Wdgs. 6.4V4A/2.5V1.75A/6.4V.6A. Elecstat shlded. Wt. 1.4 lbs. New \$2.75

FILAMENT. 400/2400 cps. WECO KS9558. Pri: 115V. Sec: 8.2V1.25A/6.35V1.5A Elecstat shlded. Wt. 0.5 lbs. New \$1.95

PLATE & FIL. 400/2600 cy. Pri: 0/80/115V. Sec: 1=1200VDC at 1.5MA. Sec. 2=1000VDC at 130MA. Fil. Secs: 6.4V4.3A/6.35V0.8A. (Ins. 1500V)/5V2A/5V2A. \$4.95

RETARD. 400 cy. WECO KS9598. 4 Henry 100MA \$1.75

**60 CYCLE TRANSFORMERS**

FILAMENT. Raytheon Hypersil Core. Pri: 115V. Sec: 6.3V22A/6.3V2.4A/6.3V2.25A/6.3V0.6A Ins. for 1700V \$5.95

High Rectance Trans. G. E. type Y-3502A.—60 cy. Voltage 11200-135. Inductance H.V. Winding 135 Henries. Output: Peak Voltage 22.8KV. Cat. #31806G1. New \$89.50

High Voltage Trans. Westinghouse Pri: 115, 60 cy. Sec: 15,000 C.T., 60 MA. Good for Hi-Pot test set up \$32.50

**PULSE TRANSFORMERS**

PULSE. WECO KS-9563. Supplies voltage peaks of 3500 from 807 tube. Tested at 2000 Pulses/sec and 5000V peak. Wdg. 1-2=18 ohms. Wdg. 1-3=72 ohms. L of Wdg 1-3=073-.082H at 100 cps. \$5.00  
PULSE. WECO KS-161310. 50 KC. to 4MC. 1 1/2" Dia. x 1 1/2" high. 120 to 2350 ohms. New. \$3.95

**RAYTHEON VOLTAGE REGULATOR**

Adj. input taps 95-130V., 60 cy. 1 Ph. Output: 115V. 60 Watts. 1/2 of 1 1/2 Reg. Wt. 20 lbs. 6 1/2" H x 8 1/2" L x 4 1/2" W. Overload protected. Sturdily constructed. Tropicalized. Special... \$14.75

**HIGH VOLTAGE CAPACITORS**

.25 MFD., 20KV	\$26.50
.25 MFD., 15KV	22.50
.5 MFD., 25KV	34.50
1 MFD., 15KV	34.50
1 MFD., 7.5KV	12.50

**SOUND POWERED PHONES**

Western Electric No. D17312, Type O. Combination headset and chest microphone. Brand new including 20 ft. of rubber covered cable... \$17.50  
Automatic Elec. Co. No. GL843AO. Similar to above but including Throat microphone in addition to chest microphone. Brand new with 20 ft. rubber covered cable... \$13.50  
U. S. Instrument Co. Navy Type M. Dr. No. A-260 ALT. 1. Complete with 20' cable and navy plug. Brand new \$17.50  
W. E. type TS-10M Handset. New... \$16.50

**PARABOLOIDS**

Spun Magnesium dishes 17 1/2" dia. 4" deep. Mounting brackets for elevation and azimuth control on rear 1 1/2 x 1 1/2" opening in center for dipole. Brand new, per pair... \$8.75

**SWEEP GENERATOR CAPACITOR**

High speed ball bearings. Split stator silver plated coaxial type 5/10 mmfd. Brand new... \$2.50

**WESTERN ELECTRIC CRYSTAL UNITS**

Type CR-1A/AR. Available in quantity—following frequencies—fundamentals.  
5910—6350—6370—6470—6510—6610—6670—6690—6940—7270—7350—7380—7390—7480—7580—9720—Kilocycles.

\$1.25 each

**ELECTRONIC CRAFT  
INC.**

27 MILBURN ST. BRONXVILLE 8, N. Y.  
PHONE: BRONXVILLE 2-0044

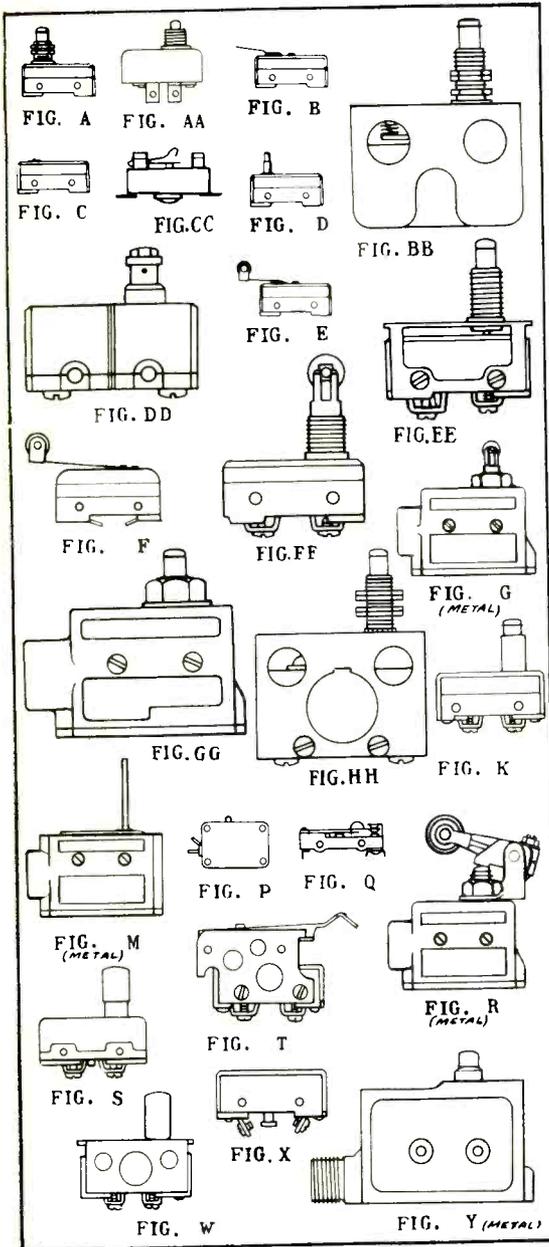
All merchandise guaranteed. Immediate delivery, subject to prior sale.

All Prices Subject to Change Without Notice

IMMEDIATE DELIVERY OF

# Top Quality MINIATURE SWITCHES

This list of brand new standard brand miniature switches represents only a few of many types in stock at Wells. Large quantities of most types are on hand for your immediate requirements. Write or wire for quotations on switches not listed.



Stock #	Mfr	Type #	Contact	Fig.	Price	Stock #	Mfr	Type #	Contact	Fig.	Price
41MC2	ACRO	2M03.1A	NO	P	50	41MD53	MICRO	WPSM5	NC	AA	50
41MM2	MU	AC2101BB	SPDT	W	85	41MC27	MICRO	WZ2RST	NC	D	55
41MC6	MU	APB236	SPDT	A	1 15	41MD48	MICRO	WZ2RT	NC	C	65
41MC26	MU	APG210	NO	A	80	41MD33	MICRO	WZ3PW2	NC	F	80
41MC17	MICRO	B-1	NC	Y	1 45	41MD16	MICRO	WZ7R	NC	C	55
41MC16	MICRO	B-1T	NC	OD	90	41MD43	MICRO	WZ7RQ1T	NC	A	70
41MC7	MICRO	B-14	NO	HH	1 70	41MC15	MICRO	WZ7RQ2T	NC	A	70
41MD62	MICRO	B-R	SPDT	C	70	41MD36	MICRO	WZ7RST	NC	D	55
41MD46	MICRO	B-RL18	SPDT	B	95	41MC24	MICRO	WZ7RQTN	NC	Y	1 45
41MD63	MICRO	B-RS36	SPDT	D	80	41MC23	MICRO	WZ7RQTN	NC	R	3 75
41MD23	MICRO	BD-RL32	SPDT	B	95	41MD54	MICRO	WZ8X	NC	X	80
41MLH	MICRO	BZRQ41	SPDT	W	85	41MC9	MICRO	WZ831	NC	C	65
41MD51	MICRO	BZ-R37	SPDT	C	70	41MD57	MICRO	WZ831	NC	T	70
41MD2	MICRO	BZE7RQ2T	SPDT	GG	1 70	41MD31	MICRO	WZ8D	NC	C	55
41MD21	MICRO	BZ-7RST	SPDT	D	80	41MD19	MICRO	WZ8L8	NC	B	70
41MD38	MICRO	BZE2RQ9TN1	SPDT	G	2 65	41ML3	MICRO	WZ8Q41	NC	W	65
41MD6	MU	CUM 24155	NO	E	80	41ML2	MICRO	WZV7RQ9T1	NC	G	2 25
41ML1	MU	D	NO	BB	1 50	41MC21	MICRO	X757	NC	C	55
41MC12	MICRO	D in case	NC	Y	1 45	41MD37	ACRO	XC1A	NC	C	55
41MD34	KLIXON	ES692070	NC	CC	50	41MC5	ACRO	XD45L	SPDT	B	95
41MD65	MICRO	G-R26	NO	C	60	41MD4	MICRO	YZ	NO	C	75
41MD60	MICRO	G-RL	NO	B	80	41MD40	MICRO	YA2RLE4D13	NO	B	70
41MC11	MICRO	G-RL 5	NO	B	80	41MD24	MICRO	YZ2YLT1	SPDT	B	95
41MD61	MICRO	G-RL35	NO	B	80	41MC1	MICRO	YZ2YST	SPDT	D	60
41MD41	MICRO	G-RL43	NO	B	80	41MD13	MICRO	YZ3R3	NO	C	60
41MD64	MICRO	G-RS	NO	D	55	41MD56	MICRO	YZ3RLTC2	NO	B	80
41MD66	MICRO	G-RS36	NO	D	60	41MC14	MICRO	YZ3RW2T	NO	F	90
41MC32	ACRO	HRO 7.1P2TSP1	NO	K	65	41MD49	MICRO	YZ7RQ9T6	NO	FF	.85
41MC19	ACRO	HRO 7.4P2T	NO	S	60	41MD32	MICRO	YZ7RST	NO	D	60
41MD8	ACRO	HRRC 7.1A	NC	C	55	41MC13	MICRO	YZ7RA6	NO	EE	1.00
41MD27	ACRO	HRRO 7.1A	NO	C	60	41MD25	MICRO	YZRQ1	NO	A	80
41MC31	MICRO	LN-11 HO3	SPDT	M	1 70	41MC20	MICRO	YZRQ4	NO	S	.60
41MC18	MU	MLB 321	SPDT	B	95	41MD59	MICRO	YZRQ41	NO	W	.75
41MD1	MU	MLR 643	NC	B	70	41MD20	MICRO	YZ7RQT	NO	K	.65
41MD55	PHAO	PS 2000	SPDT	C	85	41MD42	MICRO	YZRTX1	NO	X	.95
41MC28	ACRO	RC71P2T	NC	A	70	41MC27	MU	Z	NC	Y	1.45
41MD45	ACRO	RO1P2T	NO	A	.80	41MD44	ACRD	Blue Stripe	SPDT	C	.70
41MD22	ACRO	RO2M	NO	E	80	41MD52	MU	Blue Dot	SPDT	E	.90
41MD28	ACRO	RO2M12T	NO	E	80	41MC8	MU	Red Dot	NC	C	.65
41MC25	MICRO	R-RS	NC	D	.50	41MD18	MICRO	Open Type	SPDT	Q	.50
41MD47	MICRO	R-RS13	NC	D	.50	41MD39	MU	Green Dot	NO	B	.80
41MD9	MICRO	SW-186	NC	D	.50	41MC29	MU	Green Dot	NO	D	.55
41MC10	MICRO	WP3M5	NC	AA	.50	41MD26	MAXSON	Precision	SPDT	B	.95
41MC4	MICRO	WPSM3	NC	AA	.50						

Order Direct or Through Your Local Parts Distributor

PARTS SHOW VISITORS:

Be sure to visit our new Chicago Ave. display. Plenty of free parking.

**SEeley 8-4143**

## WIDE SELECTION OF ELECTRONIC COMPONENTS AT WELLS

- Tubes • Resistors • Condensers • Wire and Cable
- Volume Controls • Co-ax Connectors • Relays • Rectifiers
- Transformers • Chokes • Micro Switches, Toggles • Antennas
- Accessories • Electronic Assemblies • Dial Light Assemblies



833 W. CHICAGO AVE., DEPT. SL, CHICAGO 22, ILL.

SOLVE YOUR

# RADAR

CALL PAUL J. PLISHNER

# SONAR

SUPPLY PROBLEMS

## 3000 MC. BENCH TEST PLUMBING

**SIGNAL GENERATOR**, using 417A Klystron, 2700-3300 mc. Output approx. 50 mw. 115 vac power supply. With tubes, new... \$425

**10 CM RF PACKAGE**, using 2J22 magnetron, freq. range 3267-3333 mc, complete with power supply and pulser giving approx. 20 kv @ 30 A. 1 used, 1000 PPS. Power output 265 kw. 7/8" rigid coax plumbing thru out. Uses 417A Klystron mixer, 6A27 (pram). Pulser is 715 B HARD TUBE. Complete RF unit, pulser unit, receiver front end, new, with tubes. Requires 115v, 400 cy ac primary source... \$385

**RECEIVER POWER SUPPLY** for GL 446 type lighthouse tubes (2C40, etc.) 115 vac, 60 cycles. Panel mounting. Less tubes... \$32.50

**10 CM DISH AND DIPOLE ASSY**, approx. 30" parabola, with 360 deg. rotating mechanism, and approx. 10 deg. tilt mechanism. Operating from 24 vdc. With selvsyn... \$85

**10 CM LOW POWER TUNABLE LOAD** with circ. cover... \$225

**COAX. CRYSTAL MOUNT**, type N connectors... \$17.50

**RT-39/APG-5 10 CM** light house RF head c/o Xmtr. Recv-Ttl cavity, compl. rtr & 30 MC 1F strip using 6AK5. (2C40, 2C43, 1B27 lineup) w/Tubes.

721A TR BOX complete with tube and tuning plungers... \$12.50

**MENALLY KLYSTRON CAVITIES** for 70B or 2K28. Three types available... \$4.00

**F 29/SPR-2 FILTERS**, Type "N" input and output... \$12.50

**WAVEGUIDE** to 7/8" rigid coax "Doorknob" Adapter, Choke Flange, Silver Plated Broad Base... \$27.50

**WAVEGUIDE DIRECTIONAL COUPLER**, 27 do, Navy type CABV 47AAN, with 4 in. slotted section... \$32.50

**SO. FLANGE** to rd choke adapter, 18 in. long OA 1 1/2 in. x 3 in. guide type "N" output and sampling probe... \$27.50

**AN/APR5A 10 CM ANTENNA** equipment consisting of two 10 cm waveguide sections, each polarized 45 degrees... \$5.00 per set

**POWER SPLITTER**, 728 Klystron input dual "N" output... \$5.00

**MAGNETRON COUPLING FOR TYPE 720 MAG.** to 1 1/2" x 3" Waveguide... \$35.00

**10 CM WAVEMETER WE** type B43549 Transmission type. Type N Fittings Vee-rod Root Micrometer dial, Gold Plated W/Calib Chart P/O Freq. Meter N69491-A. New... \$99.50

**AS14A/AP-10 CM** Flex. Dipole with "N" Cables... \$47.50 ea.

**LHTR. LIGHTHOUSE ASSEMBLY** Part of RT39 APG 5 & APG 15. Receiver and Trans Cavities w/assoc. Tr Cavity and Type N CPLG. To Recv. Uses 2C40, 2C43, 1B27. Tunable APX 2400-2700 MCN. Silver Plated... \$49.50

**BEACON LIGHTHOUSE CAVITY** 10 cm with miniature 28 volt DC PM motor. Mfr. Bernard Rice... \$47.50 ea.

**MAGNETRON TO WAVEGUIDE** Coupler with 721A Duplexer Cavity, gold plated... \$45.00

### 7/8" RIGID COAX.—3/8" I. C.

**7/8" RIGID COAXIAL TUNING STUBS** with vernier stub adjustment. Gold Plated... \$17.50

**7/8" RIGID COAX ROTARY JOINT**, Pressurized, Sperry #S10917 Gold Plated... \$25.00 ea.

**DIPLOE ASSEMBLY**, Part of SCR-584... \$35.00 ea.

**ROTARY JOINT**, Part of SCR-584... \$35.00 ea.

**RIGHT ANGLE BEND**, with flexible coax output pickup loop \$8.00

**SHORT RIGHT ANGLE BEND**, with pressurizing nipple... \$3.00

**RIGID COAX** to flex coax connector... \$3.50

**STUB-SUPPORTED RIGID COAX**, gold plated 5" lengths Per length... \$5.00

**RT. ANGLES** for above... \$2.50

**RT. ANGLE BEND 15" L. CA.**... \$3.50

**FLEXIBLE SECTION**, 15" L. Male to female... \$4.25

**MAGNETRON COUPLINGS** to 7/8" rigid coax, with TR pickup loop, gold plated... \$7.50

**FLEX COAX SECT.** Approx. 30 ft... \$16.50

**CG 51/U-4** foot flexible section 1/2" IC pressurized... \$15.00

**7/8" RIGID COAX**, Bead Supported... \$1.20

**SHORT RIGHT ANGLE BEND**... \$2.50

### 6000 Mc to 8500 Mc BENCH TEST PLUMBING

**1 1/2" x 3/4" Waveguide**

**KLYSTRON MOUNT**, DB356 complete with shield and tunable termination... \$125.00

**FLAP ATTENUATOR**, DB361... \$45.00

**VARIABLE STUB TUNER**... \$90.00

**WVGD. TO TYPE "N" ADAPTER**... \$18.50

**WAVEMETER TEE**, DB352... \$32.50

**MAGIC TEE**... \$80.00

**DIRECTIONAL COUPLER**, two hole 25DB coupling, type "N" output... \$25.00

**PRECISION CRYSTAL MOUNT**, Equipped with tuning slugs and tunable termination... \$125.00

**TUNABLE TERMINATION**, Precision adjust... \$70.00

**LOW POWER LOAD**... \$35.00

### 4000 to 6000 Mcs BENCH TEST PLUMBING

**2" x 1" Waveguide**

**FLAP ATTENUATOR**... \$48.00

**VARIABLE STUB TUNER AND LOW POWER TERMINATION**... \$48.00

**WAVEMETER TEE**... \$48.00

**ADAPTERS:**

Choke to choke... \$18.00

Cover to cover... \$14.00

Choke to cover... \$16.00

**WAVEGUIDE TO TYPE "N" ADAPTER**... \$45.00

**DIRECTIONAL COUPLER**, Two hole type "N" output... \$48.00

**KLYSTRON MOUNT**, Equipped with tunable termination and micrometer adjust. Klystron antenna tuning... \$110.00

**CRYSTAL MOUNT**, Equipped with tunable termination and micrometer adjust crystal tuning... \$125.00

**TUNABLE TERMINATION**, Precision adjust... \$90.00

### 23,000 to 27,000 Mc BENCH TEST PLUMBING

**1/2" to 1/4" Waveguide**

**LOW POWER LOAD**... \$20.00

**SHUNT TEE**... \$35.00

**WAVEGUIDE LENGTHS**, 2" to 6" long, gold plated with circular flanges and coupling nuts... \$2.25 per inch

**APS-34 ROTATING JOINT**... \$49.50

**RIGHT ANGLE BEND**, H Plane, specify combination of couplings desired... \$12.00

**45° BEND**, E or H Plane, Choke to cover... \$12.00

**MITRED ELBOW**, cover to cover... \$4.00

**TR-ATR-SECTION**, Choke to cover... \$4.00

**FLEXIBLE SECTION** 1" choke to choke... \$5.00

**"S" CURVE CHOKE** to cover... \$4.50

**ADAPTER**, round to square cover... \$5.00

**FEEDBACK** to Parabola Horn with pressurized window... \$27.50

**90° TWIST**... \$10.00

**"K" BAND DIRECTIONAL COUPLER**... \$49.50 ea.

## APS-2

## APS-3

## APS-4

## APS-6

## APS-6A

## APS-10

## APQ-13

## APS-15

## APS-31

## CPN-8

## CXHX

## FD MK 4

## MARK 10

## SA

## SC

## SD

## SE

## SF

## SG

## SI

## SK

## SL

## SM

## SN

## SO

## SQ

## SW

## SCR

## 518

## SCR

## 520

## SCR

## 533

## SCR

## 545

## SCR

## 663

## MAGNETRONS

- Tubes
- 2J27
- 2J31
- 2J21 A
- 2J22
- 2J26
- 2J32
- 2J37
- 2J38
- 2J39
- 2J40
- 2J49
- 2J34
- 2J61
- 2J62
- 3J31
- 5J30
- 714AY
- 718DY
- 720BY
- 720CY
- 725-A
- 730-A
- 728
- 700
- 706

## KLYSTRONS

- 723A
- 707B
- 417A
- 2K41

## TEST SETS

- TS 12
- TS 33
- TS 35
- TS 36
- TS 45/
- APM 3
- TS 62 3CM
- TS 108

## SCR 584

## PARTS AVAILABLE

- BC1056A
- BC1058A
- BC1086B
- RA71A
- BC1090A
- BC1090B
- BC1096A
- BC188B
- BC105BB
- BC1094A
- BC1088A

## SONAR SYSTEMS

- QBF
- QBG
- QC
- QCJ
- QCL
- QCO
- QCS
- QCU
- WEA

## 8500—9600 Mc Bench Test Plumbing

### 1" x 1 1/2" Waveguide

**3 CM SIGNAL GENERATOR** and thermistor bridge, using 723AB oscillator, calibrated variable attenuator, direct reading power meter; reg. 115 vac 60 cy power supply. Complete with tubes \$425

**3 CM SLOTTED LINE**, with probe, and including accessories, i.e. low power load, adapters, etc. TS 12/Trit 2... \$385

**AN/AP5-15A "X"** Hand compl. RF head and mod. inch 725-A mag. and magnet, two 723A/B Klystrons (local osc. & beacon) 1B24, TR, rev amp, duplexer, HV supply blower, pulse xmr. Peak 1/2r Out: 45 Kw apx. input: 115, 400 cy. Modulator pulse duration 5-2 microsec. apx. 13KV. PK. Pulse, with all tubes incl. 715B, 829B, BKR 73, two 72's. Complete pkg... \$375

**COMPLETE 3 CM. RADAR SYSTEM**, 40 KW peak transmitter, pulse modulator, receiver, using 723AB, power supply operating from 115V 800 Cycle, antenna system. Complete radar set neatly packaged in less than 16 cubic feet. Less receiving Type Tubes, but including all other, in used but excellent condition—\$350.00. This price for laboratories, schools, and experimental purposes only.

## MAKE SURE YOU SEE OUR SPECIAL AD NEXT MONTH

**2J42 PULSE MODULATOR**, 14 Kw max. rating, 7kw min. Plate voltage pulsed 5.5 kv, 6.5 amp. .001 duty cycle, 2.5 use pulse length max, filament 6.3 v, .5 amp. Includes magnetron mfg. and blower. Requires 3C45 and 2-3B21... \$75

**3 CM SECTOR SCANNING ANTENNA**, 18" dish, cutter feed dipole... \$75

**APS-3 RADAR**, new and complete, using 725A magnetron... \$950

**TS 36 X BAND POWER METER** 1 1/2" x 5/8" waveguide; thermistor bridge with indicating meter, complete... \$175

**TS 33 X BAND COAX FREQ. METER** with resonance indicating meter crystal mount, type N fitting... \$225

**WAVEMETER**, \$500 to 9400 Mcs., with calibration. Micrometer adjust head. Reaction type... \$85.00

**90 DEGREE ELBOWS**, 7" or 11" slugs, silver... \$2.50

**90 DEGREE TWIST**, 6" long... \$8.00

**BULKHEAD FEED-THRU ASSEMBLY**... \$15.00

**PRESSURE GAUGE SECTION**, 15 lb. gauge and press nipple... \$10.00

**PRESSURE GAUGE**, 15 lbs. \$2.50

**DUAL OSCILLATOR-BEACON MOUNT**, P/O APS10 Radar for mounting two 723A/B Klystron with crystal mts. matching slugs, shielded... \$42.50

**DUAL OSCILLATOR MOUNT**, (Back to back) with crystal mounting, tunable termination attenuating slugs... \$18.50

**DIRECTIONAL COUPLER**, TR-40/TR Take off 20 DB \$17.50

**ROTARY JOINT** Choke to Choke... \$10.00

**2K25/723 AB RECEIVER** local oscillator Klystron Mount, complete with crystal mount. Iris coupling and choke coupling to TR... \$22.50

**TR-ATR DUPLEXER** section for above... \$8.50

**CU 105/APS 31** Directional Coupler 25 DB... \$25.00

**723AB MIXER** - Beacon dual Osc. Mnt. w/airal holder \$12.00

**TR-ATR SECT APS 15** for 1B24 w/724 ATR cavity w/1B24 & 724 Tubes. Complete... \$21.00

**STABILIZER CAVITY** with bellows... \$21.50

**3 CM 180° BEND**, with pressurizing nipple... ea. \$6.00

**3 CM 90° BEND**, 14" long 90° twist with pressurizing nipple... ea. \$6.00

**3 CM "S" CURVE** 18" long... ea. \$5.50

**3 CM "S" CURVE** 6" long... ea. \$3.50

**3 CM. RIGHT ANGLE BENDS**, "E" plane 18" long cover to cover... ea. \$6.50

**3 CM. CUTLER FEED DIPOLE**, 11" from parabola mount to feed back... ea. \$8.50

**3 CM. DIRECTIONAL COUPLER**, One way waveguide output... ea. \$15.00

**CIRCULAR CHOKE FLANGES** solid brass... 55c

**SO. FLANGES**, Flat Brass ea. 55c

**AP5-10 TR/ATR DUPLEXER** section with additional iris flange... \$10.00

**"X" BAND PREAMPLIFIER**, consisting of 2-723 A/B local oscillator-beacon feeding waveguide and TR-ATR Duplex sect. incl. 60 pfc. RF amp... \$47.50

**15 DEG BEND** 10" choke to cover... \$4.50

**5 FT SECTIONS** choke to cover. Silver plated... \$14.50

**18" FLEXIBLE SECTION** \$17.50

**TR CAVITY** for 724 A TR Tube... \$3.50

**724 TR Tube** (11 TR 1)... \$2.50

**SWR MEAS. SECTION**, & L with 2 type "N" output probes MTD full wave apart. Bell size guide. Silver plated \$10.00

**ROTARY JOINT** with slotted section and type "N" output pickup... \$17.50

**WAVEGUIDE SECTION** 12" long choke to cover 45 deg. twist & 2 1/2" radius, 90 deg. bend... \$4.50

**TWIST 90 deg. 5"** choke to cover w/pres nipple... \$6.50

**WAVEGUIDE SECTIONS**, 2 1/2" long silver plated with choke flange... \$5.75

**ROTARY JOINT** choke to choke with deck mounting... \$17.50

**3 CM. MITRED ELBOW** "E" plane, unplated... \$12.00

**1 1/2" x 5/8" WAVEGUIDE TUNABLE TERMINATION** Precision adjust... \$65.00

**LOW POWER TERMINATION**... \$25.00

**MAGIC TEE**... \$45.00

**90 DEGREE ELBOWS**, E or H plane... \$11.00

**WAVEGUIDE LENGTHS**, Cut to size and supplied with 1 choke, 1 cover, per length... \$2.00 per ft.

**BI DIR-COUPLED W/G** output calibrated—25 db nominal... \$17.50

**FLEX SECTIONS**, 12" Rubber Coated... \$14.50

**MITRED ELBOW** H Plane 1/8" UG52... \$12.00

**6" ST. SECT. choke to choke**... \$3.50

**APQ 13** Constant Z Irtal Jnt... \$22.50

**CG 98B/APQ 13** 12" Flex. Sect. 1 1/2" x 3/4" OD... \$10.00

**WAVE GD. RUN** 1 1/2" x 3/4" Gd. consists of 4 ft sect. w/RT angle bend on one end, 2" 45 deg bend on other end... \$8.00

**X BAND WAVE GD.** 1 1/2" x 3/4" O.D. 1/16" wall aluminum (Available in 10FT to 15 ft. lengths or smaller)... \$8.50 each

## WAVEGUIDE

- 1 1/2" x 3/4" ID... \$1.00 per foot
- 1 1/2" x 3/4" OD... \$1.50 per foot
- 5/8" x 1/2" OD... \$1.65 per foot
- 3/4" x 1/2" OD Aluminum... \$75 per foot
- 1 1/2" x 3/4" OD... \$3.00 per foot
- 1 1/2" x 3/4" OD... \$3.50 per foot
- 1 1/2" x 3/4" OD... \$4.00 per foot
- 1 1/2" x 3/4" OD... \$1.20 per foot
- 7/8" right coax 1 1/2" IC... \$8.50 each

All merch. guar. Mail orders promptly filled. All prices, F.O.B. N.Y.C. Send M.G. or Chk. Only shipping chgs. sent C.O.D. Rated concerns send P.O.

**MIN. ORDER \$3.00**

**COMMUNICATIONS EQUIPMENT CO.**

**131 Liberty St., New York, N. Y. Dept. E5** P. J. PLISHNER **Phone: Main 4-8373**

**MIN. ORDER \$3.00**

**SEARCHLIGHT SECTION**



**UPRIGHTS**

Mfd.	Volt	Type	Cat. No.	Price
.0025	1500	2TT	D164209	30¢
.03	600	2ST	R03	25¢
2.0515	600	2BT	616M	30¢
.05	400	2BT	C51481918-20	28¢
.05	600	2BT	7700BR	28¢
3x.05	300	3BT	N3OACA195	30¢
3x.05	300	3BT	CA195	30¢
.125-.05	400	2TT	CM1481380-10	35¢
.1	600	2BT	G16M-14842	35¢
.1	400	2BT	R11-616MB	35¢
.1	400	2BT	418CB	30¢
.1	600	2BT	7701BR	35¢
.1	600	2BT	CP69B1AF104K	35¢
.1	400	2BT	NM148194-1	30¢
.1	600	2BT	C69B1AF104	35¢
2x.1	600	2BT	P9711	39¢
3x.1	400	3BT	CA255	39¢
3x.1	400	3TT	ROBC	39¢
3x.1	400	3BT	C168B5EF104V	42¢
3x.1	600	3BT	7710BR	42¢
3x.1	600	3BT	CD516	42¢
2x125	400	2TT		
.25	800	2WTT		69¢
.4	600	2BT	M-7725BR	30¢
.25	600	2BT	C168B1EF251K	30¢
.5	600	2BT	S01	30¢
.5	600	2BT	PO8	30¢
.5	400	2TT	416T	32¢
.5	600	2BT	G16MB	32¢
2x.5	250	2TT	A-8B515	30¢
2x.5	400	3BT	418MB	35¢
2x.875	400	2BT	CVS-17-27076-303	35¢
1	400	2TT	305-1605S	35¢
1	600	2BT	G16MB	38¢
1	600	2BT	YAB6100	38¢
1	250	2TT	CBV4855-153	30¢
1	100	1BT	101M59	25¢
1	600	2BT	G16MB	32¢
1	400	2BT	418CB	32¢
1	400	2BT	418CB	35¢
1.75	50	2TT	CRV48661	45¢

**Oil Condensers Famous Makes Brand New**

Mfd.	Volt	Price
5	50	1.45
5	50	1.45
15	220AC	2.00
5.5	400	.50
1	500	.40
1	600	.45
6	600	1.05
7	600	1.05
20	600	2.10
.5	750AC	1.69
1	1K	.69
2x.5	1K	.70
1	1K	.75
1.5	1K	.75
2	1K	.99
4	1K	.98
3x.1	1.2K	1.35
.0016	1.5K	1.25
1.25	1.5K	1.00
1.5	1.5K	.89
1.6	1.5K	.95
2	1.5K	1.05
2x.1	2K	1.10
2	2K	1.10
2	2K	2.25
3	2.2K	2.45
.5	2.5K	1.35
1.5	2.5K	1.35
.1	2.5K	1.20
1	3K	1.45
1.5	4K	2.95
.11.1	4.8K	2.95
.4	5K	2.95
.015	6K	2.25
.1	6K	2.75
15.15	6K	3.75
1.5	6K	9.75
.11.1	7K	2.49
.1	7.5K	2.95
.1	7.5K	12.95
.15.15	8K	4.95
.1	10K	14.95

**1% PRECISION RESISTORS**

.6	7500
1.01	8500
5	10,000
5.05	10,000
10.1	10,000
18	12,000
43.5	12,000
50	17,000
75	17,000
82	20,000
120	25,000
125	30,000
128	33,000
129	40,000
250	50,000
300	75,000
430	84,000

**30¢ each**

468	100,000
800	120,000
920	120,000
1100	150,000
4300	220K
5000	220K

**40¢ ea.**

**1 Meg. 75¢ ea.**

**10 Meg. \$2.10 ea.**

**PHOTO PRINT-DRYERS**

Consists of microme element insulated from open frame 9 1/4"x10" 110V 60 cy ..... 75¢

**Xmfrs VFO** 4-5.3 Mc \$5.95

**Drivers** 5.3-7 MC \$5.95

**Output** 7-9.1 MC \$13.95

**274N** Used Good Cond.

**(ARC5)**

**GIBSON GIRL**

The Emergency Radio Transmitter Sends S O S signals automatically. Range 150-mile. No batteries required. Hand-driven. Hand-driven generator, tubes, wires. New. only ..... \$4.25

**BATHTUBS**

Mfd.	Volt	Type	Cat. No.	Price
.01	600	2ST		25¢
.02	600	2ST		30¢
.02	1600	2ST	HC 3755	30¢
.03	1000	2ST	BA31227-E	45¢
.06-1	1500	2TT	W3-94	45¢
3x.05	600	3ST	305-1526S	30¢
.05	600	2TT	C5F50SOPSO3V	30¢
.05	600	2TT	CSF-481391-10	30¢
.05	600	2TT	DYR 6005	30¢
2x.05	600	3ST	CGP431513-10	40¢
2x.05	600	3ST	DYR 60055	40¢
.1	600	2TT	A-8B3-373	25¢
.1	600	2TT	63PT	25¢
.10	600	1ST	NDN	25¢
.1	1000	2ST	CAW48197-B10	30¢
2x.1	400	2BT	1571	25¢
2x.1	400	2TT	1572	25¢
2x.1	600	3ST	CBY48678	30¢
2x.1	400	2TT	305-1133	30¢
2x.1	600	3BT	CSF48680-A20	30¢
2x.1	200	2ST	CP-201D P11	20¢
2x.1	600	3ST	CQ448313-B10	30¢
2x.1	600	2ST	CQ448712B-10	30¢
2x.1	600	3ST	DYR611	30¢
2x.1	600	2ST	CQ448712-B10	30¢
2x.1	600	3BT	305-1133	30¢
2x.1	600	3ST	2XDMRW6-1	30¢
2x.1	600	3ST	CP50841EF101X30	30¢
2x.1	600	3BT	305-1133	30¢
2x.1	600	3BT	CAV48709	30¢
3x.1	600	3TT	7890481-P1	35¢
3x.1	600	3TT	CQ448713-B10	35¢
3x.1	600	3TT	305-1683S	35¢
3x.1	600	3BT	22F462	35¢
3x.1	600	3TT	3XDPRTMW6-1	35¢
3x.1	400	3BT	CAV48709	35¢
3x.1	600	3ST	A-18983-1	25¢
.13	600	2TT	630MT	25¢
.25	400	2TT	430T	30¢
2x.25	400	2ST	7253775	25¢
2x.25	100	2TT	K-7101880	40¢
3x.25	400	3BT	CY48709	35¢
3x.25	120	2TT	C226806-2	25¢
.5	600	2TT	305-1154	25¢
.5	400	1TT		23¢
.5	200	2ST	NDMR2-5	20¢
.5	600	2ST	DYR6050G	25¢
.5	400	2ST	14862	25¢
.5	600	2BT	CS48704-A20	25¢
.5	400	2TT	RO5	23¢
.5	400	2ST	48205A	23¢
.5	200	2ST	8A31231-C2	20¢
.5	400	2TT	1573	23¢
.5	100	3ST	K-215563-5	25¢
2x.5	250	2TT	A-8B5-5	25¢
2x.5	400	2ST	T1065A	25¢
2x.5	300	3TT	511B	25¢
2x.5	400	2BT	1575	30¢
3x.5	400	3BT	CBY48703	30¢
1	200	1TT	7157	25¢
1	600	2TT	59307	35¢
1	600	2BT	305-1391	35¢
1	400	2ST	A-8B-361	33¢
1	600	2TT	305-1507SND0	35¢
1	600	Test	2ST NDPS	30¢
1	400	2ST	A-8B-1104	30¢
2x.1	600	2ST	W-5-13	35¢
2x.1	200	4ST	W226671-1	35¢
2x.1	200	4ST	W-226671-2	35¢
2.5	100	2ST	K7101881-P1	30¢
4	500	2ST	678687-5	25¢
8	500	2ST	5383	75¢
30	150	2ST	D11206	1.15
25	2BT			
5-20	3TT			
.025	600	2ST	5417	35¢
2x.1	400	3BT	P9887	25¢
2x.1	600	3TT	CP52B4EF104V	30¢
2x.1	600	3BT	CP52B4EF104V	30¢
2x.1	600	3BT	NKPS	25¢
2x.1	600	3TT	CMR-4849-A	35¢
3x.1	400	3ST	CP608NE104V	30¢
3x.1	400	3ST	CP608NE104X	30¢
3x.1	600	3TT	CSF48709-A20	30¢
.1	400	2TT	CD-1066-11V	23¢
.1	600	2BT	NKP	25¢
.5	600	1TT	7283	30¢
6	400	2TT	CE64B060Q	1.00

**EE89A Telephone Repeater**

Used to extend range of field telephones. Simplex Teleg. and 20 cycle ringing possible over lines equipped with unit. Phone supplied. (Featherweight) \$9.59

**COLLINS ART. 13 FREQ MULT UNIT**

2-18 Mc for two 1625 Tubes. Comp. Assy less Tubes & Coils w/ ckt. dia. \$8.95

**400 MA 12 HY**

90 ohms Herm. sealed. Special \$3.75

**CHOKE SWINGING**

9/6011V 400/.05 Amp. 10000V ins. Mfg. Super. \$5.95

**T. U. for BCAR230 or 430**

3.2-1MC

5-6.2MC

1.2-1.5MC

1-1.2MC

Price 95¢ ea.

4-5MC W/ 495KIC

XTAL \$1.69

**CONDENSER TUNING UNITS FOR BC 91T or 375**

Write up in OCT QST for Conv to hf freq meter

TU 7-4500 to 6200 KC 370

TU 8-6200 to 7700 KC 372

TU 9-7700 to 10600 KC 374

TU 26-200 to 500 KC 375

Price \$2.49 ea.

**TUNING UNITS FOR BC 223 XMITTR**

TU17A 2000-3000Kc. ....	\$2.75
TU18 3000-4500Kc. ....	2.25
TU25 3500-5200Kc. ....	2.25

**ANTENNA MAST**

Are you in a dead spot? If you can't get a good T. V. Picture, Here is a Sig. Corp. Ant. mast 30" high of rugged plywood construction to solve your problem. It telescopes into 3 sections for easy storage. EASY TO Mnt. Comp. with stakes & rods. Ea. \$19.95.

**CRYSTALS Low Frequency**

FT-241. A holder 1/2" pin spacing, for ham and general use. Xtal controlled Signal Generators, marked in army Mc. harmonic frequencies—Directions for deriving fundamental frequencies enclosed. Listed below by fundamental frequency, fractions omitted.

370	424	472	505	537	447
372	425	473	506	530	448
374	426	474	507	531	450
375	427	475	508	532	451
376	429	476	509	533	453
377	430	477	511	534	454
378	431	478	512	535	455
380	433	480	513	536	456
381	434	481	514	537	457
383	435	483	515	538	463
384	436	484	516	400	465
385	437	485	518	401	498
386	438	486	519	402	500
387	440	487	520	403	501
388	441	488	522	404	538
412	442	490	523	405	540
413	443	491	525	406	each
414	444	492	526	407	each
415	445	493	527	408	each
416	446	494	529	409	each
418	448	495	530	411	each
419	461	496	531	each	
420	462	497	533	each	
422	469	503	534	each	
423	470	504	536	each	

**69¢**

**CONDENSERS**

**AMPLIFIER**

AM-32/PMSI less batt w/carry case for Mine Detector AN-PRSL Price ea. \$5.95

**762 FIL XFRMR**

Pr: 115-125V 60cy Sec: 2x2.5/20A \$6.95

**OHME XFRMR**

Pr: 110V 60 cy Sec: 24V/1A \$1.25

**POWER XFRMR**

Pr: 110V 60 cy Sec: 4V/16A 2.5V/1.7A Ideal for 2x2 & 2x3 Tubes

**XMTG. Micac Tapped Holes**

Mfd.	Price
2500 V Test	\$0.0001
	\$0.0025
	.25
	.0005
	.00075
	.0001
	.25
	.0015
	.25
	.0004
	.25
	.0005
	.30
	.00075
	.30
	.00085
	.30
	.001
	.30
	.0015
	.30
	.0016
	.30
	.002
	.50
	.0023
	.50
	.003
	.65
	.005
	.65
	.006
	.65
	.0063
	.65
	.0069
	.65
	.007
	.65
	.0075
	.65
	.0076
	.65
	.01



**IMMEDIATE DELIVERY**

**Servo-Tek**

**FULLY GUARANTEED**



**ANTENNA TILT INDICATOR**

D-C Selsyn type tilt indicator. G.E. 8DJ29AAK. 24 volt. Stock #SA-296. Price \$3.75 each.



Gyro and Housing Mirror Assembly. For K-14A sighting head. Gyro stabilized mirror assembly. Stock #SA-294. Price \$6.75 each.

**BODINE NSHG-12 MOTOR**

Constant speed



27 v. D-C Governor controlled 3600 rpm. 1/30th hp. Stock #SA-39. Price \$17.50 each.



**REVERE CAMERA MOTOR**

27 v. D-C. Split field series. Approx. 2 1/2" sq. x 2 1/2" lg. Stock #SA-315. Price \$6.75 each.

**SYNCHRONOUS MOTOR**



W.E. S-1283228. For 2 phase 240 cycle operation. 55 volts.

Stock #SA-317.

Price \$9.75 each.



**DC MOTOR**

High speed 27 v motor with high inertia flywheel. Ideal for gyro demonstrations.

Stock #SA\*S-313

Price \$9.75 each.

**SWEEP GENERATOR CAPACITOR**



Hi-speed bearings. Split-stator. Silver-plated coaxial type. 5-10 mmf.

Stock #SA-167

Price \$2.75 each

**MINIATURE DC SELSYN**

**INDICATOR**



G.E. miniature indicator. 24 v. d-c operation with G.E. Position Transmitter or with Ohmite 360° type potentiometer. Has iron

plug for zero dial adjustment. Stock #SA-268. Price \$11.50 each.

**RECORDER**



Brown Instrument Co. "Elektronik Recorder" 12 in. chart. One rev. per 10 min. Center O. 200 micro volts DC for full chart. Use as recording galvanometer, or modify for use with strain gauges, etc. Charts included. Operates from 110 volts 60 cycle line. Unit supplied complete with amplifier and tubes. Stock #SA-261.

Price \$199.50 each

**400 Cycle Generator**



G. E. 5ASB1JJ3, 400 cycles out at 115 volts 7.2 amps. Ideal for lab. 6" lg. x 6" diam. 8000 rpm. Stock #SA-292. Price \$79.50 ea.

**PRECISION AUTOSYN**



Pioneer Type AY-150 Control Autosyn. Precision type. 26 v. 400 cycle. Stock #SA-297. Special low price \$14.50 each.

**A-5 Autopilot Indicator**



Autosyn Type Pilot Indicator for A-5 Autopilot. 26 v. 400 cycles. Stock #SA-299. Price \$12.50 each.

**3/4 HP DC MOTOR**

Electric Specialty Co. HCA315T. 24 volts DC. 3800 rpm. Stock #SA-321. Special Price \$24.50 each.

**ARMA 5A MOTOR**

10 Watt Servo Motor—2 phase 115 v. 60 cycles. 3 1/2" lg. x 3 1/2" diam. 1" shaft ext. 0.250 diam. one end, other ext. 1/2" lg. 0.250 diam. Stock #SA-231. Limited quantity. Price \$49.50 each.

**400 CYCLE AIRCRAFT ACTUATORS**

Manufactured by AirResearch. 115 volt 406 cycle operation. 2 1/2" linear travel. Stat. load 200 lbs. Ten. 75-100 lbs. Comp. 75-100 lbs. Stock #SA-326. Price \$21.50 each.

**WINCO DYNAMOTOR**



Model 41S6. 18 v D-C in. @ 13 A. Output 250 v @ 0.60 A and 300v @ .225 A. Stock #SA-323. Price \$9.50 ea.

**MAGNETIC AMPLIFIER ASSEMBLY**

Sperry 661824. Saturable reactor type output transformer. Designed to supply one phase of 400 cycle servo motor. Stock #SA-266. Price \$6.75 each.



**Autosyn Indicator**

I-82F Compass Indicator. 0-360°-5 in. dial. 26 v 400 cv. 8-12 v. 60 cv. Ideal position indicator. Stock #SA-284.

Price \$6.50 each

**DC SERVO MOTOR**



Elinco Type B-64. 1/165 hp at 3100 rpm. Field volts 27.5 Max. armature voltage 80. Ideal for thyatron servo control. Stock #SA-211. Price \$16.50 each

**Pioneer Servo Motors**



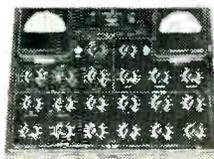
Type 10047-2A. 2φ 400 cycle low inertia. 26 v fixed phase. 45 v max. variable phase. Stock #SA-90. Price \$12.50 each.

**PIONEER CK-17**



400 cycles 2 phase, 26 v fixed phase. 45 v max. variable base. Built in gear reduction. Output shaft speed approx. 4 rpm. Stock #SA-287. Price \$16.50.

**LOAD & BALANCE COMPUTER**



C-54B Aircraft load computer. Totals load and locates center of gravity. Voltage divider type computer. Ideal for classroom. Stock #SA-334. Price \$49.50 each.

**INVERTER**



Pioneer 12130-4-B Input 28 VDC at 14 amps. Output 120 v. 400 cy. Single Phase at 1.15 amps. (140 V.A.) Voltage and frequency regulated. Made 1949. Stock #SA-304. Price \$89.50 each.

**MICROPOSITIONER**

Barber Colman AYLZ-2133. Polarized dc relay. Double coil differential current sensitive. Alnico PM polarized field. 24 v. Contacts 0.5 amps 28 v. Use for remote positioning, synchronizing, control, etc. Sens. 1.25 ma. diff. Use to 100 cy. Stock #SA-290. Price \$12.50 each.

**JA1 MOTOR (D-C)**



Electric Specialty. 1/4 hp. 24 v. D-C. (Wing flap motor.) Stock #SA-325. Price \$19.50 ea.

**SYNCHROS**

Navy Types



1G, 1F, 1CT, 5G, 5F, 5CT, 5DG, 5HCT, 5SF, 5HSF, 5SDG, 6DG, 6G, 6DG, 7G, etc.

Prices on Request

WRITE FOR LISTING

Prices F.O.B. Paterson  
Phone ARmory 4-3366

**Servo-Tek**

products co.  
4 Godwin Ave. Paterson, N. J.

SPECIALISTS IN FRACTIONAL HORSE POWER MOTOR SPEED CONTROL

# A LEADING SUPPLIER OF ELECTRONIC & AIRCRAFT EQUIPMENT

**IMMEDIATE DELIVERY -- FULLY GUARANTEED**

## A C MOTORS

5071930 DELCO, 115 V., 60 Cy., 7000 RPM. PRICE \$6.50 EA.  
TELECHRON SYNCHRONOUS MOTOR, Type B3, 110 V., 60 Cy., 4 W., 2 RPM. PRICE \$5.00 EA.  
TELECHRON SYNCHRONOUS MOTOR, Type BC, 110 V, 60 Cy., 6 W., 60 RPM. PRICE \$4.00 EA.  
EASTERN AIR DEVICES, Type J33, Synchronous, 115 V., 400 Cy., 3  $\phi$ , 8000 RPM. PRICE \$15.00 EA.

## HAYDON TIMING MOTORS 110 V., 60 CY.

TYPE 1600, 2.2 W., 4/5 RPM. PRICE \$3.00 EA.  
TYPE 1600, 2.2 W., 1/240 RPM. PRICE \$3.00 EA.  
TYPE 1600, 2.3 W., 1 RPM. PRICE \$3.00 EA.  
TYPE 1600, 2.2 W., 1-1/5 RPM. PRICE \$3.00 EA.  
TYPE 1600, 3.5 W., 1 RPM. With shift unit automatic engaging and disengaging shaft. PRICE \$3.75 EA.  
TYPE 1600, 2.2 W., 1/60 RPM. PRICE \$3.00 EA.

## SERVO MOTORS

CK1, PIONEER, 2  $\phi$ , 400 Cy. PRICE \$10.00 EA.  
CK2, PIONEER, 2  $\phi$ , 400 Cy. PRICE \$14.00 EA.  
CK2, PIONEER, 2  $\phi$ , 400 Cy., with 40:1 reduction gear. PRICE \$15.50 EA.  
10047-2-A, PIONEER, 2  $\phi$ , 400 Cy., with 40:1 reduction gear. PRICE \$10.00 EA.  
MINNEAPOLIS HONEYWELL Type B, Part No. G503AY, 115 V., 400 Cy., 2  $\phi$ , built-in reduction gear, 50 lbs. in torque. PRICE \$10.00 EA.  
MINNEAPOLIS HONEYWELL Amplifier Type G403, 115 V., 400 Cy. Used with above motor. PRICE \$10.00 EA, WITH TUBES

## REMOTE INDICATING COMPASSES

26 V., 400 CY.

PIONEER TYPE AN5730-2 Indicator and AN5730-3 Transmitter. PRICE \$40.00 PER SET  
KOLLSMAN TYPE 680K-03 Indicator and 679-01 Transmitter. PRICE \$15.00 PER SET

## D C MOTORS

DELCO TYPE 5069625 Constant Speed, 27 V. D.C., 120 RPM. PRICE \$10.00 EA.  
JOHN OSTER TYPE C-28P-1, 27 V., 0.7 Amp., 7,000 RPM, 1/100 H. P. PRICE \$5.00 EA.  
JAEGER WATCH CO. TYPE 44K-2 Contactor Motor, 3 to 4.5 V. Makes one contact per second. PRICE \$2.50 EA.  
GENERAL ELECTRIC TYPE 5BA10AJ52C, 27 V., 0.65 Amp., 14 oz. in torque, 145 RPM. PRICE \$6.50 EA.  
GENERAL ELECTRIC TYPE 5BA10AJ37, 27 V., 0.5 amps., 8 oz. in. torque, 250 RPM. PRICE \$6.50 EA.  
GENERAL ELECTRIC TYPE 5BA10J18D, 27 V., 0.7 Amps., 110 RPM, 1 oz. ft. torque. PRICE \$6.50 EA.  
BARBER-COLMAN CONTROL MOTOR, Type AYLK 5091, 27 V., 0.7 Amps., 1 RPM. Contains 2 adj. limit switches, 500 in. lbs. torque. PRICE \$6.50 EA.  
WHITE RODGERS ELECTRIC CO., Type 6905 No. 3, 12 V., 1.3 Amps., 1 1/2 RPM, torque 75 in. lbs. PRICE \$10.50 EA.

## RECTIFIER POWER SUPPLY

GENERAL ELECTRIC TYPE 6RC146. Input 230 V., 60 Cy., 3  $\phi$ , adjustable input taps. Output 130 Amps., at 28 V. D.C. Continuous duty. Size 46" high, 28" wide and 17.5" deep. PRICE \$225.00 EA.

## INVERTERS

WINCHARGER CORP. PU-16/AP, MG750. Input 24 V. D.C., 60 Amps. Output 115 V., 400 Cy., 1  $\phi$ , 6.5 Amps. PRICE \$75.00 EA.  
HOLTZER CABOT TYPE 149 H, Input 24 V. D.C. at 44 Amps., Output 26 V. at 250 V.A., 400 Cy., and 115 V., 400 Cy., at 500 V.A., 1  $\phi$ . PRICE \$55.00 EA.  
HOLTZER CABOT TYPE 149F, Input 24 V. D.C. at 36 Amps., Output 26 V. at 250 V.A., 400 Cy., and 115 V., 400 Cy., at 500 V.A., 1  $\phi$ . PRICE \$55.00 EA.  
PIONEER TYPE 12117. Input 12 V. D.C., Output 26 V., 400 Cy. at 6 V.A. PRICE \$30.00 EA.  
PIONEER TYPE 12117. Input 24 V. D.C., Output 26 V., 400 Cy. at 6 V.A. PRICE \$25.00 EA.  
PIONEER TYPE 12116-2-A. Input 24 V. D.C. at 3 Amps. Output 115 V., 400 Cy., 1  $\phi$  at 45 watts. PRICE \$100.00 EA.  
GENERAL ELECTRIC TYPE 5D21NJ3A. Input 24 V. D.C. at 35 Amps. Output 115 V., 400 Cy., 485 V.A., 1  $\phi$ . PRICE \$25.00 EA.  
LELAND PE 218. Input 24 V. D.C. at 90 Amps. Output 115 V., 400 Cy., 1  $\phi$  at 1.5 K.V.A. PRICE \$47.50 EA.

## PIONEER AUTOSYNS

TYPE AY1, 26 V., 400 Cy. PRICE \$8.50 EA.  
TYPE AY5, 26 V., 400 Cy. PRICE \$8.50 EA.  
TYPE AY14G, 26 V., 400 Cy. PRICE \$15.00 EA.  
TYPE AY14D, 26 V., 400 Cy. PRICE \$15.00 EA.  
TYPE AY54D, 26 V., 400 Cy. PRICE \$10.00 EA.  
TYPE AY131D Precision Autosyn. Price \$35.00 EA.

## PIONEER AUTOSYN POSITION INDICATORS & TRANSMITTERS

TYPE 5907-17. Dial graduated 0 to 360°, 26 V., 400 Cy. PRICE \$25.00 EA.  
TYPE 6007-39. Dual Dial graduated 0 to 360°, 26 V., 400 Cy. PRICE \$40.00 EA.  
TYPE 4550-2-A Transmitter, 26 V., 400 Cy., 2:1 gear ratio. PRICE \$20.00 EA.

## VOLTAGE REGULATORS

LELAND ELECTRIC CO. TYPE B, Carbon Pile type. Input 21 to 30 V. D.C. Regulated output 18.25 at 5 amps. PRICE \$6.50 EA.  
WESTERN ELECTRIC TRANSTAT VOLTAGE REGULATOR Spec. No. V-122855, Load K.V.A. 0.5. Input 115 V., 400 Cy. Output adjustable from 92 to 115 V. PRICE \$10.50 EA.

## RATE OR TACHOMETER GENERATORS

EASTERN AIR DEVICES J36A, .02 V. D.C. per RPM. Max. speed 5000 RPM. PRICE \$12.50 EA.  
ELECTRIC INDICATOR CO. TYPE B68 Rotation Indicator, 110 V., 60 Cy., 1  $\phi$ . PRICE \$14.00 EA.  
ELECTRIC INDICATOR CO. TYPE PM-1-M. Same as Type B35, 2 V. D.C. per 100 RPM. Max. speed 5000 RPM. PRICE \$14.00 EA.  
GENERAL ELECTRIC TACHOMETER GENERATOR TYPE AN5531-1. Variable frequency, 3  $\phi$  output. PRICE \$20.00 EA.  
GENERAL ELECTRIC TACHOMETER GENERATOR TYPE AN5531-2. Variable frequency, 3  $\phi$  output. PRICE \$25.00 EA.

ALL PRICES  
F. O. B.  
GREAT NECK  
N. Y.

## SYNCHROS

1F SPECIAL REPEATER, 115 V., 400 Cy. PRICE \$15.00 EA.  
2J1F3 GENERATOR, 115 V., 400 Cy. PRICE \$5.50 EA.  
2J1G1 CONTROL TRANSFORMER, 57.5/57.5 V., 400 Cy. PRICE \$3.50 EA.  
2J1F1 GENERATOR, 115 V., 400 Cy. PRICE \$4.00 EA.  
5SDG DIFFERENTIAL GENERATOR, 90/90 V., 400 Cy. PRICE \$20.00 EA.  
5G GENERATOR, 115 V., 60 Cy. PRICE \$50.00 EA.  
W. E. KS-5950-L2 Size 5G, 115 V., 400 Cy. PRICE \$10.00 EA.

## D C ALNICO FIELD MOTORS

DIEHL TYPE S.S. FD6-23, 27 V., 10,000 RPM. PRICE \$6.50 EA.  
DELCO TYPE 5069466, 27 V., 10,000 RPM. PRICE \$15.00 EA.  
DELCO TYPE 5069370, 27 V., 10,000 RPM. PRICE \$15.00 EA.  
DELCO TYPE 5072400, 27 V., 10,000 RPM. PRICE \$10.00 EA.

## BLOWER ASSEMBLIES

JOHN OSTER TYPE MX215/APG, 28 V. D.C., 7,000 RPM, 1/100 H.P. PRICE \$8.50 EA.  
WESTINGHOUSE TYPE FL, 115 V., 400 Cy., 6,700 RPM, Airflow 17 C.F.M. PRICE \$7.50 EA.  
DELCO TYPE 5068571 Motor and Blower Assembly, P.M. Motor, 27 V., 10,000 RPM. PRICE \$15.00 EA.

## GENERAL ELECTRIC D C SELSYNS

8TJ9-PAB, TRANSMITTER, 24 V. PRICE \$4.00 EA.  
8DJ11-PCY, INDICATOR, 24 V. Dial marked -10° to +65°. PRICE \$6.00 EA.  
8DJ11-PCY, INDICATOR, 24 V. Dial marked 0 to 360°. PRICE \$7.50 EA.

## MISCELLANEOUS

SPERRY A5 AMPLIFIER RACK, Part No. 644890. PRICE \$20.00 EA.  
SPERRY A5 CONTROL UNIT, Part No. 644836. PRICE \$7.50 EA.  
SPERRY A5 AZIMUTH FOLLOW-UP AMPLIFIER, Part No. 656030, with tubes. PRICE \$5.50 EA.  
SPERRY A5 DIRECTIONAL GYRO, Part No. 656029, 115 V., 400 Cy., 3  $\phi$ . PRICE \$25.00 EA.  
PIONEER TYPE 12800-1 GYRO SERVO UNIT, 115 V., 400 Cy., 3  $\phi$ . PRICE \$20.00 EA.  
ALLEN CALCULATOR TYPE C1 TURN & BANK INDICATOR, Part No. 21500 28 V. D.C. PRICE \$15.00 EA.  
TYPE C1 AUTO-PILOT FORMATION STICK, Part No. G1080A3. PRICE \$15.00 EA.  
PIONEER GYRO FLUX GATE AMPLIFIER Type 12076-1-A, 115 V., 400 Cy. PRICE \$40.00 EA.

**INSTRUMENT  
ASSOCIATES**

Write for Catalog NE100

363 GREAT NECK ROAD, GREAT NECK, N. Y.  
Telephone GReat Neck 4-1147

U. S. Export License-2140

Western Union address:  
WUX Great Neck, N. Y.

UNUSED

# AN PLUGS AN RECEPTACLES

We own and offer all parts listed.  
Immediate delivery from our Baltimore Warehouse!

Pieces	Part No.	Insert	Pieces	Part No.	Insert	Pieces	Part No.	Insert
53	AN3100-85-1P	M	38	-32-7P	M	32	-16S-4S	B
10	-85-1S	M	62	-32-15P	M	450	-16S-5P	B
15	-10SL-3P	B	34	AN3106-85-1P	M	65	-16S-5S	M
81	-12S-3S	B	61	-85-1P	B	152	-16-11S	M
650	-12-5P	B	12	-85-1S	M	137	-16-11S	M
2098	-12-5S	B	116	-85-1S	B	2947	-18-4P	B
586	-14S-1S	B	809	-10S-2P	M	12	-18-4S	B
69	-14S4P	B	275	-10S-2P	B	147	-18-4S	M
141	-14S-6P	M	177	-10S-2S	B	1437	-18-5P	B
73	-14S-6S	M	50	-10S-2S	M	11	-18-5S	B
65	-14S-7S	B	466	-10S-2S	B	404	-18-6S	B
96	-14S-7S	B	500	-10SL-3S	B	233	-18-9P	B
328	-16S-4S	B	2737	-10SL4S	B	97	-18-11S	M
41	-18-4S	B	248	-12S3S	B	35	-18-90P	M
99	-18-8S	B	373	-12S-4P	B	38	-22-14S	B
448	-18-12S	B	351	-12S-4P	M	556	-22-19P	B
314	-18-12S	B	13	-12-4S	B	30	-24-2S	B
28	-18-15S	B	22	-12S-4S	B	19	-24-2S	B
70	-18-22P	M	250	-12S-4S	M	15	-24-10P	M
50	-20-21S	M	191	-12-5S	B	25	-24-10S	M
92	-22-2S	M	10	-14S-4P	M	42	-28-1S	M
698	-22-5S	B	68	-14S-7S	B	26	-28-9P	M
16	-22-14P	M	138	-16-2S	B	235	-28-12S	B
32	-22-21P	M	12	-16S-4P	B	106	-28-16P	B
15	-24-2S	M	62	-16S-4S	B	169	-28-17S	M
14	-24-5P	M	200	-16S4P	M	20	-32-1S	M
65	-24-5P	M	45	-16-13S	M	24	-32-6P	M
37	-32-6P	B	200	-18-1S	B	70	-32-7S	M
45	-32-7P	B	269	-18-5P	B	54	-32-13S	M
98	-PR32-7P	M	32	-18-5S	M	40	-32-13P	M
314	-32-7S	M	4711	-18-6S	B	152	-32-14S	B
281	-32-14P	B	278	-18-10S	M	30	-36-6P	B
132	-32-14S	B	90	-20-5P	B			
26	-36-7P	M	898	-20-12S	B			
358	-36-19P	B	12	-20-23S	B			
77	AN3102-85-1P	M	49	-20-25S	M			
440	-10S-2S	B	56	-20-27S	B			
898	-10S-2S	M	20	-22-3P	B			
31	-10S-8S	M	12	-22-5P	M			
577	-12S-3P	M	510	-22-19P	B			
70	-12S-3S	B	72	-22-27S	B			
172	-12S-3S	M	14	-24-2P	B			
34	-16S-1P	B	78	-24-3P	B			
330	-16S-5P	B	38	-28-12P	B			
32	-16S-8S	M	22	-32-7P	M			
10	-16-11S	B	173	-32-7S	B			
734	-16-13P	B	155	-32-14S	B			
1428	-18-4S	B	43	-32-16S	M			
1607	-18-5S	B	25	-36-10S	M			
38	-18-12S	M	68	-44-1P	B			
25	-18-22P	M	146	AN3108-85-1S	B			
1122	-20-3P	B	324	-85-1S	M			
17	-20-5P	B	1013	-10S-2S	M			
16	-20-14P	M	815	-10S-2S	B			
207	-22-1S	B	36	12S-3S	B			
227	-22-5S	B	72	-12-5P	B			
349	AN3102-24-1S	B	13	-12-5S	M			
82	-PR28-1P	M	102	-14S-2P	M			
20	-28-11P	B	1062	-14S-2S	B			
34	-28-11S	B	12	-14S-7S	M			
70	-32-1P	B	14	-14S-10P	M			
154	-32-1S	B	438	-16S-1S	B			
66	-32-6P	M	411	-16S-4P	B			
20	-32-6S	M	1759	-16S-4P	M			

M—Melamine  
B—Bakelite

UNUSED ELECTRONIC COMPONENTS		
Pieces	Part No.	Description
35	RA-10-DB	Receiver
20	TA12B	Transmitter
150	DA-1F	Dynamotor
162	3611-B	Amplifier
35	MR-9B	Control Box
7	AS27A/ARN-5	Antenna
9000	45	Bulb
11000	1667	Bulb
1000	987	Bulb
300	AN3135-1	Bulb
87	MR16D	Filter
97	FT213	Mount
54	FT293	Mount
80	BX42-7	Dynamotor

WRITE — WIRE — PHONE

## COMMERCIAL SURPLUS SALES CO.

4101 CURTIS AVENUE, BALTIMORE 26, MARYLAND

TELEPHONE: CURTIS 3300

1000 KC crystal BT cut.....\$3.95  
 3" scope shield.....1.29  
 2 speed dial drive for 3/4" shaft ratios 5:1 to 1 .39  
 ATC 100 mmd air trimmer screwdriver shaft......29  
 Centralab 850 S 50MMF 5KV BUTTON COND......39  
 500 watt 12.5 ohm power rheostat.....3.49



6v. 12v vibrators any type.....\$ .98  
 Rotary switch Mycalex. 2 deck SP3T......39  
 1 mfd 5000v oil condenser.....2.98  
 2 mfd 3000v oil condenser.....3.25  
 3 mfd 4000v oil condenser.....3.95  
 24 mfd 1500v DC 3KV flash. Excellent for speed lamp.....3.95

**TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!**

0A3/VR75 \$1.69	3C23 \$ 9.95	204A \$59.50	809 \$ 2.45	8012 \$ 3.95	0A2 \$	6SN7GT \$	12SJ7 \$
0B1/VR90 1.29	3C24/24G 3.49	21A \$6.69	811 \$ 2.95	8013 \$ 2.95	0A4G \$	6SR7GT \$	12SK7 \$
0C1/VR105 1.49	3C30 2.95	212E \$49.50	812 \$ 2.95	8020 \$ 1.29	0B2 \$	6SS7 \$	12SN7 \$
0D3/VR150 1.29	3C31/C1B 3.49	215A \$1.19	813 \$ 2.95	8025 \$ 5.95	01A \$	6ST \$	12SQ7 \$
1B22 3.45	3C35 1.75	217C \$1.95	814 \$ 2.95	8031 \$ 2.25	0A7 \$	6S7GT \$	12SR7 \$
1B23 12.50	3CP1 2.25	227A 5C27 5.95	815 \$ 2.95	8002 \$ 1.49	1A4P \$	6SV7 \$	12Z3 \$
1B24 6.95	3CP1-S1 2.95	249C 3.95	816 \$ 2.95	9003 \$ 1.45	1A6T \$	6T7 \$	14A4 \$
1B25 17.75	3DP1 4.95	250R 12.95	817 \$ 2.95	9004 \$ 1.45	1A8T \$	6U8 \$	14B7 \$
1B27 24.50	3DP1A 6.95	250TH 21.50	818 \$ 2.95	9005 \$ 2.35	1A9T \$	6U5G \$	14B6 \$
1B29 2.75	3DP1-S2A 8.95	250TL 21.50	819 \$ 2.95	9006 \$ 2.35	1B3 8016 \$	6U6GT \$	14F7 \$
1B32 2.75	3D21A 14.95	254A 5.50	820 \$ 2.95	9007 \$ 2.35	1B3 8016 \$	6U7G \$	14F8 \$
1B34 24.96	3E1 5.95	276A 9.95	821 \$ 2.95	9008 \$ 2.35	1B4 \$	6V5 \$	14H7 \$
1B38 32.50	3E1P1 5.95	276B 9.95	822 \$ 2.95	9009 \$ 2.35	1B5/25S \$	6V6 \$	14H7 \$
1N21 Xtal 1.25	3E1P2 3.95	293A 2.98	823 \$ 2.95	9010 \$ 2.35	1C7G \$	6V6GT \$	14J7 \$
1N21A Xtal 2.25	3E1P3 3.95	293B 5.29	824 \$ 2.95	9011 \$ 2.35	1C7GT \$	6V7G \$	14J7 \$
1N21B Xtal 3.25	3E1P4 3.95	300B 9.95	825 \$ 2.95	9012 \$ 2.35	1C7GT \$	6V7G \$	14J7 \$
1N22 Xtal 1.35	4-125A 14.21	304TH 27.50	826 \$ 2.95	9013 \$ 2.35	1D6GT \$	6V8 \$	14J7 \$
1N23 Xtal 2.25	4-250A 29.95	304TL 29.95	827 \$ 2.95	9014 \$ 2.35	1D6GT \$	6V8 \$	14J7 \$
1N23A Xtal 3.25	4-250A 29.95	305A 34.95	828 \$ 2.95	9015 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
1N23B Xtal 4.95	4AP10 4.95	307A/RK75 5.95	829 \$ 2.95	9016 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
1N27 1.69	4B22/EL5H 4.95	310A 8.05	830 \$ 2.95	9017 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
1N34 1.40	4B24/EL5H 4.95	316A 6.65	831 \$ 2.95	9018 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
1N34A 1.40	4B25/6C7 8.95	323A/B 24.50	832 \$ 2.95	9019 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
1P23 1.49	4B24/2000 26.95	324TH/CG3 47.50	833 \$ 2.95	9020 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
1P24 1.79	4B28 4.95	328A 13.95	834 \$ 2.95	9021 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
1P26 2.95	4B32 9.95	331A 12.95	835 \$ 2.95	9022 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
1S31 1.69	4B32 9.95	331A 12.95	836 \$ 2.95	9023 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2AP1 8.95	CV92 49.50	350R 2.95	837 \$ 2.95	9024 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2AP5 6.95	4C35 29.50	368AS 7.95	838 \$ 2.95	9025 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2C1/RK33 12.95	4D32 12.95	371B 9.98	839 \$ 2.95	9026 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2C22/7193 4.95	4D32 14.95	371B 9.98	840 \$ 2.95	9027 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2C26A 4.49	4E27 17.95	388A 2.75	841 \$ 2.95	9028 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2C34/RK44 24.50	5B7B 3.69	394A 4.95	842 \$ 2.95	9029 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2C40 4.95	5AP1 3.69	417A 12.95	843 \$ 2.95	9030 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2C43 14.95	5BP4 3.69	446A 4.95	844 \$ 2.95	9031 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2C44 7.50	5CP1 4.95	446A 4.95	845 \$ 2.95	9032 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2C46 7.50	5CP1 4.95	446B 1.79	846 \$ 2.95	9033 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2D31 1.75	5C22 49.55	450TL 44.50	847 \$ 2.95	9034 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2E22 1.95	5D21 24.50	527 12.75	848 \$ 2.95	9035 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2E24 4.89	5E1P1 4.95	527 12.75	849 \$ 2.95	9036 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2E30 2.29	5E1P2 24.45	575A 13.95	850 \$ 2.95	9037 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J21A 8.25	5E1P3 12.95	701A 13.95	851 \$ 2.95	9038 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J26 29.50	5E1P4 12.95	702A 7.95	852 \$ 2.95	9039 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J27 29.50	5E1P5 12.95	703A 7.95	853 \$ 2.95	9040 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J30 39.50	5E1P6 12.95	704A 7.95	854 \$ 2.95	9041 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J31 39.50	5E1P7 13.95	706BY 39.50	855 \$ 2.95	9042 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J32 39.50	5E1P8 13.95	706BY 39.50	856 \$ 2.95	9043 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J33 39.50	5E1P9 13.95	706BY 39.50	857 \$ 2.95	9044 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J34 39.50	5E1P10 13.95	706BY 39.50	858 \$ 2.95	9045 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J35 39.50	5E1P11 13.95	706BY 39.50	859 \$ 2.95	9046 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J36 39.50	5E1P12 13.95	706BY 39.50	860 \$ 2.95	9047 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J37 39.50	5E1P13 13.95	706BY 39.50	861 \$ 2.95	9048 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J38 12.75	7B17 8.95	709A 1.75	862 \$ 2.95	9049 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J39 39.50	7B17 8.95	710A/8011 3.95	863 \$ 2.95	9050 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J40 39.50	7B17 8.95	710A/8011 3.95	864 \$ 2.95	9051 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J41 39.50	7B17 8.95	710A/8011 3.95	865 \$ 2.95	9052 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J42 39.50	7B17 8.95	710A/8011 3.95	866 \$ 2.95	9053 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J43 39.50	7B17 8.95	710A/8011 3.95	867 \$ 2.95	9054 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J44 39.50	7B17 8.95	710A/8011 3.95	868 \$ 2.95	9055 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J45 39.50	7B17 8.95	710A/8011 3.95	869 \$ 2.95	9056 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J46 39.50	7B17 8.95	710A/8011 3.95	870 \$ 2.95	9057 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J47 39.50	7B17 8.95	710A/8011 3.95	871 \$ 2.95	9058 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J48 39.50	7B17 8.95	710A/8011 3.95	872 \$ 2.95	9059 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J49 39.50	7B17 8.95	710A/8011 3.95	873 \$ 2.95	9060 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J50 39.50	7B17 8.95	710A/8011 3.95	874 \$ 2.95	9061 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J51 39.50	7B17 8.95	710A/8011 3.95	875 \$ 2.95	9062 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J52 39.50	7B17 8.95	710A/8011 3.95	876 \$ 2.95	9063 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J53 39.50	7B17 8.95	710A/8011 3.95	877 \$ 2.95	9064 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J54 39.50	7B17 8.95	710A/8011 3.95	878 \$ 2.95	9065 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J55 39.50	7B17 8.95	710A/8011 3.95	879 \$ 2.95	9066 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J56 39.50	7B17 8.95	710A/8011 3.95	880 \$ 2.95	9067 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J57 39.50	7B17 8.95	710A/8011 3.95	881 \$ 2.95	9068 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J58 39.50	7B17 8.95	710A/8011 3.95	882 \$ 2.95	9069 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J59 39.50	7B17 8.95	710A/8011 3.95	883 \$ 2.95	9070 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J60 39.50	7B17 8.95	710A/8011 3.95	884 \$ 2.95	9071 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J61 39.50	7B17 8.95	710A/8011 3.95	885 \$ 2.95	9072 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2J62 39.50	7B17 8.95	710A/8011 3.95	886 \$ 2.95	9073 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2K25 29.50	7D14 17.95	715C 24.50	887 \$ 2.95	9074 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2ZAB 24.95	7E1 4.95	717A 1.69	888 \$ 2.95	9075 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2K28 39.50	7E1 4.95	717A 1.69	889 \$ 2.95	9076 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
2K29 39.50	7E1 4.95	717A 1.69	890 \$ 2.95	9077 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
3AF1 9.90	7E1 4.95	717A 1.69	891 \$ 2.95	9078 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
3B22 2.95	7E1 4.95	717A 1.69	892 \$ 2.95	9079 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
3B23 4.85	7E1 4.95	717A 1.69	893 \$ 2.95	9080 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
3B24 5.95	7E1 4.95	717A 1.69	894 \$ 2.95	9081 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
3B24W 4.65	7E1 4.95	717A 1.69	895 \$ 2.95	9082 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
3B25 3.95	7E1 4.95	717A 1.69	896 \$ 2.95	9083 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
3B27 3.95	7E1 4.95	717A 1.69	897 \$ 2.95	9084 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
3B28 3.95	7E1 4.95	717A 1.69	898 \$ 2.95	9085 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
3B29 3.95	7E1 4.95	717A 1.69	899 \$ 2.95	9086 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
3B31 8.95	7E1 4.95	717A 1.69	900 \$ 2.95	9087 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$
3C22 64.50	7E1 4.95	717A 1.69	901 \$ 2.95	9088 \$ 2.35	1E5GT \$	6V9 \$	14J7 \$

809 \$ 2.45	8012 \$ 3.95	0A2 \$	6SN7GT \$	12SJ7 \$
811 \$ 2.95	8013 \$ 2.95	0A4G \$	6SR7GT \$	12SK7 \$
812 \$ 2.95	8020 \$ 1.29	0B2 \$	6SS7 \$	12SN7 \$
813 \$ 2.95	8025 \$ 5.95	01A \$	6ST \$	12SQ7 \$
814 \$ 2.95	8031 \$ 2.25	0A7 \$	6S7GT \$	12SR7 \$
815 \$ 2.95	9002 \$ 1.49	1A4P \$	6SV7 \$	12Z3 \$
816 \$ 2.95	9003 \$ 1.45	1A6T \$	6T7 \$	14A4 \$
817 \$ 2.95	9004 \$ 1.45	1A8T \$	6U8 \$	14B7 \$
818 \$ 2.95	9005 \$ 2.35	1A9T \$	6U5G \$	14B6 \$
819 \$ 2.95	9006 \$ 2.35	1B3 8016 \$	6U6GT \$	14F7 \$
820 \$ 2.95	9007 \$ 2.35	1B3 8016 \$	6U7G \$	14F8 \$
821 \$ 2.95	9008 \$ 2.35	1B4 \$	6V5 \$	14H7 \$
822 \$ 2.95	9009 \$ 2.35	1B5/25S \$	6V6 \$	14H7 \$
823 \$				

# ELECTRO - THE BEST FOR ELECTRONIC SURPLUS

## Amertran "TRANSTATS" Voltage Regulator



11.5 KVA 50/60 cy. Commutator range 0-115 V. Max. Amps. 100. Reconnection diagram available for 230 V. 50 A operation. BRAND NEW. Factory Cases ..... \$225.00  
 .25 KVA Fixed winding 115/160. Commutator range 103-126 V. Max AMPS. 2.17 ..... \$9.45  
 .5 KVA Fixed Winding 115/1400 Commutator range 92-115 V Max Amps. 6.5 ..... \$4.50

## TRANSFORMERS

### All have 110V 60cy Primary

Hammond RF14032. Sec. #1 thru 4: 5V @ 2A; Sec. #2: 5V @ 6A ..... \$4.25  
 Amertran #7589. Sec. 2: 5VCT @ 25VA ..... \$3.95  
 KV Trans #1523. Sec. #1: 5V @ 20A; Sec. #2: 5V @ 10A ..... \$12.50  
 Amertran 32918. Sec. 24.4V @ 15A ..... \$7.50  
 Hammond RFL10350. Sec. #1: 580VCT @ 55MA; Sec. #2: 5V @ 2A; Sec. #3: 6.3V @ 2A ..... \$3.95  
 Raytheon UX8724. Sec. 0.5V @ 0.5MA ..... \$1.35  
 Federal W15-38. Sec. #1: 300V @ 10MA; Sec. #2: 25V @ 500MA; Sec. #3: 6.3V @ 630MA; Sec. #4: 6.3V @ 450MA ..... \$3.95  
 Thordarson T92R21. Sec. #1: 770VCT @ 200MA; Sec. #2: 6.3VCT @ 3A; Sec. #3: 6.3V @ 1.5A; Sec. #4: 5V @ 3A ..... \$5.50  
 W.E. #KS8606. Sec. #1: 108V @ 177MA; Sec. #2: 5.15V @ 4A; Sec. #3: 6.3V @ 1A; Sec. #4: 2.5V @ 7.5A ..... \$3.95  
 Westinghouse Type GF. Sec. 20V @ 200VA ..... \$5.25  
 Raytheon U7420. Sec. #1: 225V @ 180MA; Sec. #2: 6.3V @ 2.5A ..... \$3.25  
 Bendix 530178. Sec. 1.5V @ 005 MADC ..... \$1.25  
 Raytheon UX6900A. Sec. #1 & #2: 6.3V @ 600MA; Sec. #3: 6.3V @ 2.5A ..... \$4.25

### The following 115V 400 cy Primary

Raytheon UX8547. Sec. 1000V @ .0025A; Sec. #2: 6.15V @ 700MA ..... \$3.95  
 Sperry 702719. Sec. #1: 700 VCT @ 315MA; Sec. #2: 200VCT @ 100MA; Sec. #3: 18V @ 600MA; Sec. #4: 6.3V @ 15A; Sec. #5: 5V @ 6A ..... \$4.35  
 Raytheon UX8302C. Sec. #1: 6.3V @ 4.7A; Sec. #2: 5V @ 3A; Sec. #3: 6.3V @ 6A ..... \$3.50  
 Sperry #7010. Sec. #1: 1800VCT @ 60MA; Sec. #2: 350VCT @ 120MA; Sec. #3 & #4: 5V @ 3A; Sec. #5: 6.3V @ 5A; Sec. #6: 6.3V @ 2A ..... \$5.25  
 Sperry #702523. Sec. #1: 740V @ 12MA; Sec. #2 & #3: 2.5V @ 3A; Sec. #4 & #5: 6.3V @ 2.25A ..... \$3.25  
 W.E. #SP1035. Sec. #1: 900V @ 410MA; Sec. #2: 875V @ 410MA; Sec. #3: 780V @ 410MA ..... \$3.25  
 Federal #RA4041. Sec. #1: 650/0/165/550 @ 200MA. Secs. #2 & 3: 5V @ 3A; Sec. #4: 6.3V @ 2A; Sec. #5: 25V @ 2.2A ..... \$4.00  
 W.E. #KS8986. Sec. 990/875/780VCT @ 420MA \$3.25  
 Raytheon UX8486A. Sec. 5V @ 5A 13.5KV Test \$3.50  
 Raytheon UX7358. Sec. 1-6500V @ .005A ..... \$4.25  
 Stancor Modulation A3871. For single 6L6 (class) A1. Pri: 4500 Ohms; Sec: 8500 Ohms ..... \$1.75  
 Raytheon Output UX7489A. Pri: 3600 Ohm 70MA; Sec: 720 Ohm 0-MA ..... \$1.75  
 Raytheon Pulse WX5137. Pri: 4KV 1 Mu. Sec: Sec: 16KV 16A ..... \$6.75  
 G.E. #680457. Pri: 1/1.5/3/6/8/10V; Sec: 50-50V 100W ..... \$2.95  
 Raytheon #U7658B. Pri: 270V 60 cy; Sec: 13.5V @ 450MA ..... \$2.00  
 G.E. #69G500. Pri: 450V; Sec: 6V @ 3VA ..... 95c  
 Federal RA6403-1. Audio. Pri: 8000 Ohm @ 6MA; Sec: 600 Ohm ..... \$1.65  
 Federal RA6408-1. Audio. Pri: 2500 Ohm; Sec: less than 1-Ohm ..... \$1.65  
 Amertran 23882 Audio. Output. Pri: 4000/1000 Ohms @ 0-MA; Sec: 4000 Ohms. DB level: +28 ..... \$1.95  
 Raytheon Interstage UX8442. Pri: -40V; Sec: +40V ..... \$1.00  
 W.E. Oscilloscope Input #ES67584-1 SC#4G1670A/75 ..... 95c  
 Federal Driver RA6407-1. Pri: Tapped Unbalanced 15000 Ohms @ .006A DC; Sec: 1770 Ohms; 200 to 5000 cy. -1 1/2 DB ..... 1.75

## G.E. COPPER OXIDE RECTIFIER MODEL 6RC120

P12. Primary: 230V 60cy 3ph 8A. OUTPUT: 6VDC at 300 AMPERES. Unit complete with volt and ammeters, voltage control. 1 7/8" D 2 1/4" W 3 7/8" H. Rebuild like new. \$250.00  
 FEDERAL TEL & RADIO DC POWER SUPPLY. Input: 220 volts 60 cy 3ph. Output: 28 volts DC 130 Amperes. Complete w/meters. Like new. \$275.00  
 HAMMETT ELECTRIC RECTIFIERS MODEL SPS-100B. Input: 220 volts 60 cy 3 ph 13A. Output: 15 volts at 100 Amperes. 30 Volts at 65 amperes. Complete w/volt and ammeters. Like new. \$225.00  
 MALLORY RECTOSTARTER TYPE APS-20. Input: 230 volts 60 cycle 3 ph. Output: 12 VDC at 60A for 1 min. 200A for 1 hr., 130A cont. Output. 24VDC at 300A for 1 min. 100A for 1 hr., 65A cont. Complete w/volt and ammeters. Like new. \$225.00

## MINE DETECTOR SCR 625



Detects metallic objects (ferrous or non-ferrous) to a depth of approx. 6 ft. Find outboard motors on the bottom of lakes, locate underground piping, treasure, metallic fragments in lumber, etc. New, complete with inst. book, \$65.00. Used but like new ..... \$45.00

## MOTORS AND GENERATORS

G.E. Model 5BA10A622, 24VDC, 0.55A, 10 oz/in torque 1400RPM ..... \$5.95  
 Universal Elec. #523, 115VDC, 1.2A 5000RPM. \$4.95  
 W.E. #KS6603, 24VDC, 0.6A, 5000RPM, Shunt wound ..... \$2.95  
 G.E. #541P28, Permanent Magnet type, 140VDC, 0.25A 1800RPM ..... \$4.95  
 EMC, SPN37952, 32VDC, 1/30HP, Gear reduced to 21RPM ..... \$12.95  
 Gen'l Industries, 115VAC, 60cy, .65A 80RPM geared to 20-30RPM ..... \$3.95  
 Elec Spec. Type JAL, 24VDC, 15A 4HP, 3000 RPM ..... \$14.95  
 Warren Syncl. Type B3, 115VAC, 60cy, 4V, 12 RPM ..... \$5.95  
 Ecor #M24718, 24VDC, 0.32A, 1800RPM ..... \$5.95  
 Flyer Type 1623, 110VAC, 25cy, 30W 78RPM, gov. cont. ..... \$7.95  
 Dynamic HI-Press Axial Flow Fan, Mod 586SCH1, 24VDC, 1/2HP, 3000RPM, 225CFM, Used ..... \$8.95  
 Oster #C004, 24VDC, 1.5A 7500RPM SW ..... \$8.95  
 Oster Shunt Motor, Type E-7-5, 27 1/2 Volts DC, 1/20 HP 3650 RPM ..... Price \$7.50  
 Oster Series Motor, Type C-2BP-1A, 27.5 Volts DC, 1/100 HP 7000 RPM ..... Price \$8.50  
 Westinghouse #1171391, 27VDC, 1/2HP, 6.5A, 5000 RPM, Series ..... \$9.95  
 Emerson #1610212, 24VDC, 160 oz/ft torque, 100 RPM ..... \$9.95  
 Elinco F-16 Rate Generator, 2 ph 1.3 volts/100 RPM ..... \$17.95  
 Autosyns, Pioneer AY-59D ..... \$24.95

## DC SERVO MOTORS



White Rodgers Elec. Co. (6905X-46). 24 VDC @ .65 Amps. Torque 50 in/lbs. 1/2 RPM reversible, comp. w/limit switches, relays and selenium rectifiers on top of motor, to keep AC out of motor: \$12.95

## Westinghouse Watthour Meters

Type CS, 240V/60cy/1ph 15 Amp., 3 Wire, new \$12.50  
 Type CS, 120V/60cy/1ph 15 Amp., 2 Wire, new \$9.50  
 Type CA, 120V/60cy/1ph 15 Amp., 2 Wire, new \$9.50

## RECTIFIERS

IT&T Selenium, Bridge, #EE29, 10 plates 1" dia. Input 18VAC Output 14VDC @ 15A ..... \$2.25  
 IT&T Selenium, Half Wave, #FE4, 4 plates 1 1/8" dia. Input 18VAC Output 7.5VDC @ .45A ..... \$1.00  
 Westinghouse #103B, Copper Oxide, Half Wave, 1 plate 1 1/8" dia. Input 4VAC Output 3VDC @ 25A \$1.75  
 G.E. Model 6RS5P10, Selenium, Full Wave, 24 plates 1" dia. Input 5VAC Output 36VDC @ .2A ..... \$3.95  
 B-L #R1202S1, Selenium, Full Wave, 24 plates 1" dia. 220VAC Output 180VDC @ .0075A ..... \$3.95  
 Westinghouse #854029A, Copper Oxide 13 plates 9/8" dia. Bridge. Input 65VAC Output 45VDC @ .32A ..... \$9.95  
 G.E. SIGNAL GENERATORS TVFL EX-1A, designed for aligning 152-162MC FM receivers. Complete crystal ..... \$24.50  
 JACK BOX BC-1366, contains plugs, selector switch, potentiometer etc. ..... 25c  
 DIRECTIONAL GYRO CONTROL for Mk 4 Automatic Pilot. FSSC #8US10 Sperry Gyroscope #R88-U-170 ..... \$4.95  
 G.E. VOLTAGE REGULATOR MODEL #GV4D11B6, for use w/115V 60 cy supply, 23-55KV complete w/10 Tubes ..... \$49.95  
 CONVERTERS PU-16/AP, input 28VDC; output 115 VAC 400 cy, 6.5A ..... \$59.50  
 INVERTERS PU-7/AP, input 28VDC; output 115 VAC 400 cy, 21.6A ..... \$59.50  
 INVERTERS PE-218, input 28VDC; output 115VAC, 400 cy at 1.5 KVA ..... \$29.95

## WIRE WOUND RHEOSTATS Standard Brands

=241D, 250/250 ohms 50W w/1/2" shaft ..... 95c  
 =241D, 300/300 ohms 50W w/1/2" shaft ..... 95c  
 =241D, 400/400 ohms 50W w/1/2" shaft ..... 95c  
 =501D, 30/30 ohms 50W w/1/2" shaft ..... 1.25  
 Model J, 16/16 Ohms 50W w/1/2" shaft ..... 95c  
 Model J, 0.5 Ohms 50W ..... 95c  
 Model J, 75 ohms 50W ..... 95c  
 Model J, 150 ohms 50W ..... 95c  
 Model J, 800 ohms 50W ..... 1.25  
 Model J, 1000 ohms 50W ..... 1.25  
 Model J, 6000 ohms 50W ..... \$1.45  
 Model H, 60 Ohms 25W ..... 75c  
 60 Ohms 25W ..... 65c  
 Model H, 100 Ohms 25W ..... 75c  
 Model H, 175 Ohms 25W ..... 75c  
 Type PR, 15 Ohms 25W ..... 75c  
 All size potentiometers and rheostats in stock. Write us your requirements on all carbon or wirewound.

## DECK ENTRANCE INSULATORS (Bowl and Flange Type)



Mfd. by Ohio Brass Co. heavy galv. metal flange 10 1/2" D., porcelain bowl set in rubber gaskets. Top bell 7/8" D. brass feed thru rod 10 1/2" L. Insul. dist. between top bell and flange 6 1/2" ..... \$3.95

## HEAVY DUTY TRANSFORMERS

G.E. Cat. #7479965. Pri: 230V 60 cy Sec: 16.4/8.2VCT: 11/5.5V @ 60A, 8 1/2 H 9 1/2 W ..... \$25.00  
 G.E. Cat. #79G365. Pri: 203.5V 60 cy Sec: 6.3V @ 250 Amperes ..... \$39.50  
 G.E. Cat. #7479971. Pri: 230/208V 50/60 cy. Sec: 1365/1300/1235VCT 735VA, 7 1/2 x 5 1/2 x 8 1/2 ..... \$29.50  
 G.E. Cat. #7479972. Pri: 230/208V 50/60 cy. Sec: 2450/2350/2210VMS, 2.85 KVA ..... \$19.50  
 G.E. Cat. #7475695. Pri: 115V 60 cy. Sec: 3530/3720/3910 V, M.S. 1.31KVA ..... \$47.50  
 Maloney Elec. REL10383. Pri: 115/230V 50/60 cy. Sec: 0/21000 Volts @ 100 MA DC, Half Wave, 0.1 Filled, 16"D 16 1/2"W 20"H ext. of ins. .... \$125.00

## HIGH VOLTAGE CAPACITORS Standard Brands

Cat. #26F628 rated 0.1 Mu-F @ 12kV DC ..... \$ 4.95  
 Cat. #14F64 rated 0.25 Mu-F @ 20KV DC ..... 17.50  
 Cat. #14F71 rated 0.25 Mu-F @ 25 KV DC ..... 35.00  
 Cat. #A7548 rated 2x.25 Mu-F @ 6000 VDC ..... 12.50  
 Cat. #120663 rated 0.65 Mu-F @ 12.5 KV DC ..... 37.50  
 Cat. #14F63 rated 1.0 Mu-F @ 20 KV DC ..... 45.00  
 Cat. #14F35 rated 1.0 Mu-F @ 15 KV DC ..... 37.50  
 Cat. #A66734 rated 1.0 Mu-F @ 25 KV DC ..... 55.00  
 Cat. #14F425 rated 3.5 Mu-F @ 10 KV DC ..... 35.00  
 Cat. #14F38 rated 4.5 Mu-F @ 7500 VDC ..... 25.00  
 Cat. #14F13 rated 5.0 Mu-F @ 10 KV DC ..... 45.00

## REACTORS AND CHOKES

G.E. Cat. #7479974. Rated 2.5H @ 2.3A DC ..... \$37.50  
 G.E. Cat. #7479964. Rated 50H @ .025A DC ..... \$27.50  
 Ind. #CK3016. Rated @ 20H @ 60MA DC ..... \$2.95  
 Thordarson #T4853. Rated 5H @ 80MA DC ..... \$1.50  
 Raytheon #U-7423. Rated 1.2-1.6H @ 0.03A DC \$2.25  
 Raytheon #U6313. Rated 0.016H @ 14A DC ..... \$5.50  
 Raytheon #UX8887D. Rated 30H @ .03A DC 12000 Volt Test ..... \$5.25  
 G.E. Cat. #7472403. Rated 5H @ .035A DC 4KV Test ..... \$2.35  
 Thordarson #T45921. Rated 7H @ 0.9A DC 10KV Test ..... \$19.50  
 Raytheon UX9114A. Rated 0.100H @ 1.4A DC ..... \$3.00  
 Zenith 95G40. Rated 150H @ 1.0 MADC ..... \$2.25  
 Raytheon UX9116. Rated 0.30H @ 2.0A DC ..... \$3.00  
 Raytheon WX-5148. Dual. Rated 1.75/1.75 @ 3.50 0.25A DC

W.E. Sine Wave Generator KS5913L02 16V 2 Ph. 1725 RPM, driven by W.E. motor KS5913L01. 115V 60 cy. 1 Ph. 1/50 HP 1725 RPM ..... \$17.95

Pioneer Gen.-E. Motor Dynamotor #SS2669. Input 18V; Output 450V @ 150MA ..... \$3.95

W.E. Test Set I-115 ..... \$9.50

MT/ARCS MOUNTING BASE, provides anti-shock nut for any 3 units Trans or Rec. of the ATA or ARCS series. Western Electric ..... \$1.00

WESTERN ELECTRIC PRECISION CRYSTALS, 40 meter band, 7270kc. .... 75c

HEAVY DUTY EXTENSION LIGHT, 25 ft., switch on handle, metal bulb protector. .... \$1.75

SCR-178 TRANSMITTER-RECEIVER, 2400-3700kcs. 10W, 1 phone & CW opt. .... \$32.50

## RELAYS

G.E. #CR2701-B100J4, 3PDT, 6VDC, 15A Contacts ..... \$1.25  
 Allied D09D28, 3PDT 6VDC, 15A contacts ..... \$1.35  
 Leach Type 1054ARV, 3PST on make, SPST on break, 20-32 VDC, 15A contacts ..... \$1.25  
 G.E. #CR2701-B100F3, DPDT, 24 VDC 5A contacts 75c  
 G-M #13913, DPDT, 24 VDC, 15A Contacts ..... 95c  
 Price #311, DPDT, 28 VDC, 10 Amp cont. 1900 ohm coil ..... 95c  
 G-M #13020, DPST on make, 3PST on break, 24VDC, 15A contacts ..... \$1.25  
 Allen Bradley X89309, SPST double make, 24VDC 20W A ..... \$2.50  
 A-B Bulletin X95545, type B6R, SPST Double Make, 24 VDC, 200 Amp. .... \$2.50  
 Dunco Thermal Time Delay 115 VAC 60 Cy, SPST, 1 min delay ..... \$1.95

## DAVEN SOUND ATTENUATORS



Type 350-A, Network, ladder, linear, impcd, 30/30 ohms. 2DB attenuation, 10 W dissipation ..... \$3.95

ALL MERCHANDISE BRAND NEW UNLESS OTHERWISE NOTATED

ALL PRICES F.O.B. BOSTON. ORDERS ACCEPTED FROM RATED CONCERNS ON OPEN ACCOUNTS NET 30 DAYS. MINIMUM ORDER \$3.00



Dept. E 110 PEARL STREET

BOSTON 10, MASS.

LIBerty 2-7890

# Over 200,000 RELAYS in our Vast Stock—Guaranteed—HERE'S A FEW

## ALLIED RELAYS



Part No.	Description	Price
BO6D40	77VDC, DPDT, 2380 ohm.	#R356 \$2.25
BO6A55	55VAC, (or 12VDC), DPDT	#R211 1.69
RO6D35	24VDC, DPDT, 240 ohm	#RO4 1.75
RO6B35	24VDC, DPDT, 240 ohm	#RO4B 1.69
BO13D35	24VDC, SPST, double make, 240 ohm	#RO6 1.25
DO9D28	6VDC, 3PDT, 14 ohm.	#R225 2.25
BO9D35	24VDC, 3PDT, 230 ohm	#R357 2.25
BJX-4Z	12 or 24VDC, SP DBLE Break, 240 ohm C.T.	#R226 *.89
55837	24VDC, Double make, 250 ohm	#R108 1.50
BO1535	24VDC, Double make, & Break 240 ohm	#R238 1.30
BO1332	12VDC, 80 ohm, C,il & Frame only (no contacts)	#RC358 .40
HOYX3	1VDC, SPST, n.o., 1 1/2 ohm	#R359 1.50
HOY13D	20VDC Double make 1, break 1, 550 ohm	#R360 1.95

DIFFERENTIAL 803476 DUAL 8000 ohm 2.5 ma. coils. Armature pivoted between ETAOIN ETAOINN normally open. SPDT 5A. contacts III-speed. Suitable for P. P. bridge or balanced circuits where differential action is required #R362.....\$4.95

## ANTENNA SWITCHING



ADVANCE Type 400, 110 VAC, DPDT, large ceramic base, 15A contacts #R355...\$4.75 ea.  
LEACH 1077-BF WM11, 24VDC, DPDT, 250 ohm, ceramic insul. #R361.....\$2.50 ea.  
G. E. #37843 12VDC, DPDT & SPST n. c., ceramic insul. 50 ohms, 10A. contacts #R57 \$1.95 ea.  
ADVANCE 4001B 75VDC, DPDT & SPST, ceramic insul., 2500 ohms, 15A. contacts #R227...3.95 ea.  
G. E. CR 2791D107F3, 24VDC, DPDT, ceramic insul., 100 ohms, 5A. contacts #R229 5.95 ea.

## A. C. RELAYS

A. B. T. C1070, 110V 60cyc., Coin release mechanism #R262 \$1.69 ea.  
ADVANCE Type 400, 110V 60cyc., DPDT, Large ceramic base, 15A. contacts #R355...\$4.75 ea.  
GUARDIAN 12-24 VAC, Make 2, Break 1, 5A. contacts #R273 \$1.10 ea.  
GUARDIAN 12-24 VAC, SPST n. o., 5A. contacts #R274 \$1.98 ea.  
ALLIED BO6A55, 55 VAC, DPDT, 10A, contacts #R211 \$1.69 ea.  
12VAC DPST, n. o., 5A contacts, #R275 \$1.98 ea.

## POWER POTENTIOMETERS



Ohms	Watts	Type	Each
0.87*	150	pot	\$3.95
7.5	150	pot	3.95
12	50	pot	1.98
25	25	pot	1.25
25	25	rheot	1.25
25	50	pot	1.98
50	50	pot	2.49
50	75	pot	3.25
60*	25	pot	1.25
80	50	rheot	1.98
185	25	rheot	1.25
250	25	rheot	1.25
370	25	rheot	1.25

\*Screwdriver shaft †with off position

9006 Jan Tubes—Bulk...\$.35 each

## ROTARY SWITCH

40 circuit, 2 position, bakelite insul. 10 decks, 4 ckt./deck, non-shorting Mallory #S24.....\$2.75 ea.

## 400 CYCLE INVERTER

Leland PE218 22.5V 92A in: 115 VAC 400 cyc. 1500 VA 0.9P.F. out: 8000 RPM.....\$29.50 ea.

## MINIATURE RELAYS



AMER. TOTALIZATOR A8045, 24VDC, DPDT, 300 ohm #R351.....\$1.25 ea.  
CLARE #A21577, 24VDC, DPST, 250 ohm #R352 \$1.15 ea.  
LEACH P2 (Pair on Board) Ea Relay, 6 VDC, SPDT, 125 ohm #R353 \$1.25 ea.  
GUARDIAN—24VDC, SPST n.o., 300 ohm, ceramic insul. Anti-capacity contacts #R106...\$.59 ea.  
ALLIED—55837 24VDC, Double make, 250 ohms #R108 \$1.50 ea.  
G. E. 55837 Same as #R108 #R108G.....\$1.25 ea.  
RBM 55837 Same as #R108 #R108R.....\$1.25 ea.  
CLARE—A13415, 12VDC, DPST n.o., 120 ohms #R146.....\$1.25 ea.  
ARC-7252, 24VDC, DPST n.o., 300 ohm, ceramic insul. Anti-capacity contacts #R354.....\$1.25 ea.  
CLARE—R35226, 24VDC, 4PST n.o., 300 ohm #R135.....\$1.35 ea.

## MISCELLANEOUS RELAYS

G. E. CR2791B106J3, 12VDC, 3PDT, 180 ohms, 3A contacts #R237 \$1.25 ea.  
G.M. 12792-1 18-24 VDC, 3PDT, 100 ohms, 10A. contacts #R240 \$1.75 ea.  
LEACH 2069 (G.E. M742280) 12 24VDC, 3PDT, 130 ohms, 15A. contacts #R341 \$1.50 ea.  
AMPERITE TIME DELAY 24N02 24VAC or DC, SPST, n.o. 5A contacts, 2 sec. delay at 24V; can operate from 110 V with 1250 ohm resistor or larger for longer delay #R316.....\$3.98 ea.  
G. E. CR2791-B100J4 4-6VDC 3PDT, 12 ohm, 3A contacts #R361.....\$1.25 ea.  
G. E. CR2791-G100K4 24VDC, 4PST n.o., 300 ohm, 10A contacts #R362.....\$1.95 ea.

## SENSITIVE PLATE CIRCUIT

POTTER & BRUMFIELD—2500 ohm, 9ma., SPDT #R364 \$1.25 ea.  
CLARE—A12342, 3600 ohm, 7ma., DPDT & DPST n.o. #R363 \$3.95 ea.  
DUMONT—5000 ohm, 5ma., SPST n.o. 10A contacts #R230 \$1.98 ea.  
G. E. CR2791B109P36 10,000 ohm, 9 ma, double make and break, 5A. contacts #R231.....\$1.98 ea.

## H-F TIE POST



Low-Loss Yellow Bakelite Insulation, pictured actual size (40-40 Thread) \$7.50/C \$10.00/M

## HI-VOLTAGE GLASS TO METAL SEALS (FEEDTHRU)

1/4" Hole 3/8" Overall #841 8.00/c  
3/16" Hole 1/2" Overall #341 70.00/M  
3/16" Hole 1/2" Overall #356 Any Size

## HI-RESISTANCE GLASS OHMS

Hermetically sealed glass ferrule types  
1 megohm 10" long 1 1/4" diam.....\$1.98 ea.  
10 megohm 5 1/2" long 1 1/4" diam.....2.40 ea.  
15 megohm 10" long 1 1/4" diam.....3.98 ea.

## S.S. WHITE DENTAL LAB RESISTORS

1K, 4K, 60K, 100K, 500K. All 1 watt \$10.00/C

## LARGE STOCKS OF

- AN Connectors
- APC's
- Binding Posts
- Cable
- Capacitors
- Ceramicons
- Ceramics
- Chokes
- Circuit Breakers
- Coils
- Controls
- Crystals
- Filters
- Fuses
- Hardware
- Iron Core Slugs
- Knobs
- Potentiometers (sine-cosine)
- Pulse Xfmrs.
- Relays
- Resistors
- Servo Xfmrs.
- Shock-Mounts
- Sockets
- Spaghetti
- Switches
- Transformers
- Tubes
- And Others

Write Us Your Needs for Immediate Quote PRICES FOB OUR PLANT Min. Order \$5.00



324 Canal St., N. Y. C. WA lker 5-9642

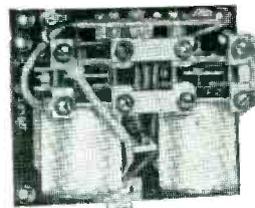
## TELEPHONE RELAYS

AUTOMATIC — 1300 ohm, 5ma., SPST n.o. #R103 \$1.25 ea.  
STROMBERG-CARLSON P32505 12VDC, SPDT n.o., 200 ohm, Anti-vibration contacts #R92 \$1.49 ea.  
STROMBERG-CARLSON P32504 6VDC, SPST n.o., 100 ohm, Anti-vibrational contacts #R02 \$1.49 ea.  
COOK 102 8-12VDC Copper slug, slow release, SPDT, 200 ohm #R365.....\$2.49 ea.



## SOLENOIDS

ALLEN BRADLEY H5A, 24VDC, SPST, 50 A, 100 ohms #R105 \$1.95 ea.  
G. E. CR9533K100A2, 24VDC, 2 SWITCHETTES, DPST n.c. & SPST n.o.; extra long throw #R132 \$9.95 ea.  
HART M569A, Cat #694R19, 24VDC, SPST, 200A, 75 ohms #R127 \$2.95 ea.  
AUTOLITE B8 SPEC., 32424A 24VDC, SPST, 200A, 6 ohms #R150 \$2.75 ea.  
CUTLER-HAMMER B8, 6041H139A, 24VDC, SPST, 200A, 10 ohms #R130 \$3.95 ea.  
EPCO 847D, 12VDC, SPST, 25A, 35 ohms #R122 \$1.95 ea.  
ECLIPSE D1EA53538, 24VDC, 200A, 6 ohms #R126 \$2.95 ea.  
RBM BN5 24VDC, 50A, 200 ohms #R224...\$1.95 ea.  
G. E. #CR2800384A3, 24VDC, Double Make, 50 ohm 200A #R59B.....\$3.95 ea.



AUTOLITE, SSK 4001, 12VDC, Double make, 20 ohm, 100A. #R74 \$1.25 ea.  
GUARDIAN 34585 Dual latching, 24 VDC each section. Double make one, double break one & alternate double make one, break one, 2100A, 24 ohms #R223 \$4.75 ea.

## CAPACITORS

### TRANSMITTING TYPE 4

MFD	VVDC	TEST	Each
.00003	1200	2500	.25
.00006	1200	2500	.25
.00011	2500	1000	.35
.001	600	1200	.15
.003	600	1200	.23
.01	600	1200	.25
.02	600	1000	.35
.025	600	1000	.40
.04	600	1000	.50

## TS2A VARIABLE CERAMICONS

CAPAC. 1.5 to 7; 1.5 to 7.5; 3.5 to 30; 5 to 40 .28 ea., \$25.00/c

## Ceramic & Feedthru CAPACITORS

Type	No.	MMF Tol.	Ea.	per C
Button CB	500	±10%	.18	15.00
Button Standoff	240	±10%	.18	15.00
Standoff	2000	±10%	.10	30.00
Standoff	324	1000 ±10%	.12	10.00
Feedthru	55	±10%	.10	9.00

## SILVER MICAS

M.M.F	TOL.	EA.	Per/10
8.5	±10%	.09	57.00
25	±5%	.12	10.00
100	±10%	.10	8.50
125*	±1%	.10	8.50
250	±10%	.09	7.50
375	±10%	.09	7.50
1500	±1%	.35	30.00
1700	±10%	.15	12.50
2500	±10%	.15	12.50

\*On mounting block

WIRE WRITE PHONE CABLE COME IN

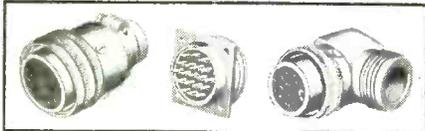


from the

# LARGEST INVENTORY IN THE COUNTRY

over 3,500,000 to choose from

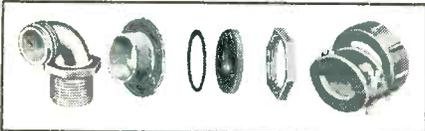
*We Invite Inspection of Our Complete Line of:*



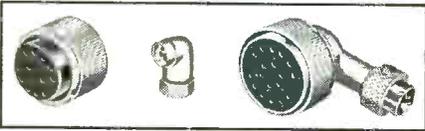
## K CONNECTORS



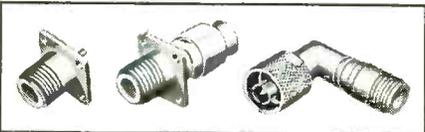
## AN CONNECTORS



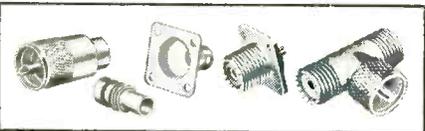
## AN CLAMPS AND HARDWARE



## BRITISH PLUGS



## UG CONNECTORS



## UHF COAXIAL CABLE "83 SERIES" CONNECTORS



## ARC-NAF-PL PLUGS

**WRITE, PHONE or WIRE Your Needs AT ONCE**

TELEPHONE  
**BEekman**  
**3-5780**

Prices quoted on request; simply state type and quantities required. All inquiries receive PROMPT ATTENTION. Industrial needs served ACCURATELY and EFFICIENTLY.

# AVNET

**ELECTRONIC SUPPLY CO.**  
**6 WEST BROADWAY N.Y.7,N.Y.**

**ELECTRONIC, TELEVISION & RADIO COMPONENTS**

# CONDENSERS

IN COMMERCIAL QUANTITIES - IMMEDIATE DELIVERY



FOR STYLE OF MOUNTING SEE SYMBOL

## OIL CONDENSERS—NEW

Symbol	Capacity	Voltage	Price
B	.005-.005-.01	10KV	3.50
	.012	25KV	15.90
	.02	20KV	12.90
E	.03	10KV	8.75
B	.075-.075	7500V	9.75
B		12.5KV	12.75
F	.1	1500V	.49
B	.1	2000V	.39
F	.1	2500V	.59
G	.1	7000V	1.75
E	.1	7500V	1.25
B	.1	7500V	1.79
B	.1-1	7500V	2.35
B	.1	10KV	7.95
B	.1	15KV	12.50
B	.2	10KV	8.95
B	.25	3000V	1.75
E	.25	6000V	1.50
B	.25	18KV	17.50
B	.25	20KV	21.95
B	.25	25KV	31.95
B	.25	32.5KV	31.95
B	.5	10KV	9.95
B	.5	750VAC	.75
B	.5	1500V	1.10
B	.5	2500V	1.75
B	.5	3000V	2.35
B	.5	25KV	29.95
F	.5-1	2000V	.89
B	.1	1000V	.59
B	.1	1500V	.98
B	.1	2000V	1.75
B	.1	2500V	2.25
B	.1	3000V	2.75
B	.1	5000V	3.25
B	.1	6000V	4.50
B	.1	15KV	Quote
B	.1	20KV	Quote
B	.1	25KV	48.95
D	.2	600V	.45
D	.2	600V	.50
G	.2 TLAD	600V	
B	.2	1000V	.79-1.25
B	.2 TLAD	1000V	1.35
B	.2	1500V	1.75
B	.2	2500V	2.75
B	.2	5000V	10.95
B	.2	10000V	17.50
B	2-2 4 Terms	600V	.89
B	.3	600V	.42
B	.3	2000V	3.95
B	.3	4000V	5.25
B	.4	400V	.65
B	.4	600V	.95-1.35
G	.4 TLAD	600V	1.65
B	.4 TLA	600V	1.25
B	.4	1000V	1.69
B	.4	1500V	2.75
B	4-4-4	600V	1.30
B	.4	2000V	3.15
B	.5	600V	1.10
B	.5	330VAC	1.25
F	5-5	400V	.57
B	.6	330V	1.55
B	.6	600V	1.35
B	.6	1500V	2.95
B	.7	600V	1.45
B	.7	800V	1.65
F	.8	500V	1.20
B	.8	600V	1.65
B	.8	1000V	2.30
F	10	600V	1.10
B	10	600V	1.85-2.50
B	10	330VAC	2.25
B	10	1000V	3.25
B	12	1000V	3.50
B	15	1000V	4.25

## BATHTUB CONDENSERS—NEW

Large Stock—Inquiries Solicited

Special—2 mfd—1000V ST	.....	\$ .19
Special—2x.1 mfd—400V TT	.....	\$ .15
Special Bathtub Kit	.....	15 @ \$1.00

## CHANNEL CONDENSERS—NEW

Large Stock—Inquiries Solicited

Special .5 mfd—400V. TT	.....	\$ .19
Special .007—1000V. Rev. Bkt.	.....	\$ .18

## NEW MICA CONDS.

6, 8, 10, 15, 25, 34, 39, 50, 70, 75, 100, 140, 150, 185, 200, 230, 240, 250, 300, 350, 390, 400, 500, 510, 600, 650, 750, 1000, 1500, 2000, 2400, 3000, 3700, 3900, 4000, 4700, 5000, 6200, 7960, 9100, 6 mmfd to 750 mmfd .045, 100<sup>u</sup> mmfd to 2400 mmfd .065, 3000 mmfd to 9100 mmfd .10.  
Special Mica Kit.....100 @ \$3.50

## NEW SILVER MICA CONDS.

Inquiries Solicited

Special Silver Mica Kit.....100 @ \$5.95

## MOLDED PAPER CONDS.

.004, .01, .05—600V.....	\$4.50 per "C"
.01, .03, .05—400V.....	\$3.50 per "C"

## METAL TUBULAR OIL CONDS.

.02 & .03 mfd—400V @ .12  
.05, .25 & .1 mfd—600-1000V .16  
Other Types Available.

## TYPE "J" POTS. \$1.00—\$1.15\*

Ohms	Shaft	Ohms	Shaft
50	1/8 S	25,000*	1/8 LS
50	1/2 R	25,000	1/8 S
300	3/8 S	50,000*	1/8 LS
500	3/8 S	50,000	1/8 S
1000	1/8 S	50,000	1/4 S
1500	1/8 LS	100,000*	1 1/2 R
2000	1/8 LS	100,000*	1/8 LS
2000	1/2 R	150,000*	2 1/8 R
2500	1/2 R	200,000*	1/8 LS
2500	1/8 LS	200,000*	9/16 R
3000*	1/8 LS	250,000*	3/4 R
5000*	1/8 LS	250,000*	1/8 S
10,000*	3/8 R	500,000*	1/8 LS
20,000*	1/8 S	1 Meg*	1/8 LS
20,000*	1/8 LS	1 Meg*	1/8 S
20,000*	1 1/4 R		

## TYPE "JJ" POTS.—\$2.25

Ohms	Shaft
1500 (Dual)	¼ R
1 Meg (Dual)	½ R
2 Meg (Dual)	½ R
E—Round	
S—Screwdriver	
LS—Locking Shaft	

## Condenser Specials—New

5—5 mfd—600 V.—\$1.10	Symbol "F"
8—8 mfd—600 V.— 1.45	Symbol "O"
3—3 mfd—150 V.— .25	Symbol "B"

## 25 WATT POWER RHEOSTATS

Ohms	Shaft	Price	Ohms	Shaft	Price
1.3-1.3	1/8 S	1.00	225	1/4 S	.89
15	1/2	.79	225	1/8 LS	.89
20	1/2	.79	300	1/2	.89
25	1/2	.79	500	1/4 S	.89
50	1/8 S	.79	500	1/8 S	.89
50-50	1/2	1.50	1500	1/2 S	.99
75	1 0	.79	2000	3/8	.99
100	1/2	.79	2500	1/2	.99
125	1/2 S	.89	5000	1/8 S	1.15
175	1/2	.89	5000	1/2	1.15

## BAKELITE TOGGLE SWITCHES

SPST 3A. 250V. ¾" bushing, Bat Handle....\$.14  
DPST 3A. 250V. 7/16" bushing, Bat Handle....\$.48  
DPST CH BB23K4 7/16" bushing, Bat Handle....\$.55  
DPDT AH & H ¾" bushing, Bat Handle.....\$.58

## COAX CONNECTORS

83-1AP	.....	\$ .20	83-1J	.....	\$.64
83-1SP	.....	\$.39	83-1SPN	.....	\$.39

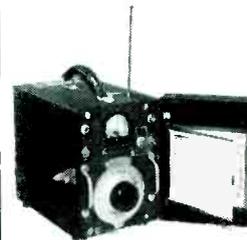
## TUBES—NEW

3C24	.....	\$.59	832A	.....	\$10.50
CK 1006	.....	.50	838	.....	3.25
954	.....	.29	872A	.....	1.95
1016	.....	1.25	12CB	.....	.98

## NEW—BC 906

## FREQ. METER—NEW

Range 150-225  
MC—Bat. operation with precision velvet vernier dial, tuning charts, 0-500 D.C. microammeter, diode-Triode and plug-in antenna. Contained in black aluminum carrying case 12½ x 8½ x 6½. Price \$15.95.



## RESISTORS

Watts	Ohms	Price	Watts	Ohms	Price
5	100	.10	10	1000	.18
5	240	.10	10	2000	.18
10 Var.	2	.12	10	4000	.18
10 Var.	25	.15	10	5000	.18
10	50	.15	10	15000	.18

## MISCELLANEOUS SPECIALS

Trans Mica .01 mfd—15KV.....	\$39.50
Var. Ceramic Trimmer 1-3.5 mmfd.....	.18
Pilot L. Assem. Grn & Blue.....	.25
Choke 165 M.A., 5 Hen. 160 ohm D.C.....	.89
Trans. A.F. Driver, Prim. 400 ohms	
Sec. 2250 Used in 13C 395-C.....	2.25
Oetol Socket, Bakelite (Complete).....	.07
Oetol Socket, Ceramic (Complete).....	.17

# MONMOUTH RADIO LABORATORIES

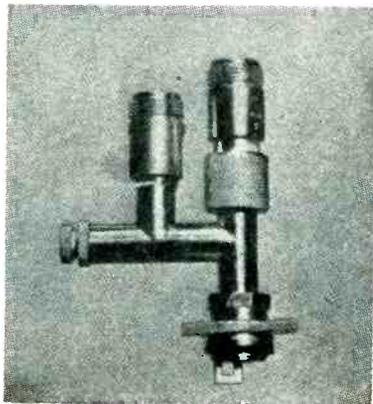
BOX 159

OAKHURST, N. J.

ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE

# TEST EQUIPMENT

- X Band Spectrum Analyzer 8500-9600 Mc., calibrated linear below cut-off attenuator, calibrated frequency meter, tuned mixer, 4 i.f. stages, 3 video stages overall gain 125 db., reg. power supply. \$150.00
- S Band Spectrum Analyzer 2700-3900 Mc., similar to above. \$12.00
- K Band Test Load, low power... \$20.00
- X Band Test Load, 50 watts, average power 1/2" x 1" waveguide. Sand load TS 108 ..... \$35.00
- HI POWER X BAND TEST LOAD, dissipates 350 watts of average power for 5/8" x 1 1/4" waveguide, VSWR less than 1.15 bet. 7 and 10 KMC. .... \$150.00
- S Band Test Load TPS-55P/BT, 50 ohms \$12.00
- HI POWER S BAND TEST LOAD, dissipates 1000 watts of average power, for 1 1/2" x 3" waveguide. Range 2500 to 3700 MC.
- Dummy Load, DA-21/U, X Band, High Power Load, VSWR less than 1.15, 7 to 10 KMC. Dissipates 280 watts average power.
- Dummy Load, TS-338/U2, S Band, High Power Load, 2500 to 3700 mc. Dissipates 600 watts average power. For 1 1/2" x 3" waveguide.
- X Band VSWR TEST SET, TS-12/AP, complete with linear amplifier, direct reading VSWR meter, slotted wave guide with gear driven travelling probe, matched termination and various adapters, with carrying case.
- X Band Pick-up Horn, AT-48/UP with coaxial fitting ..... \$10.00
- X Band Below Cut-Off Wave Guide Attenuator, with calibrated dial, type N input connector, output connects to 1/2" x 1" wave guide ..... \$55.00
- TS-62 X Band Echo Box with r.f. cable and pick-up antenna.
- TS-33 X Band Frequency Meter, 8500-9600 Mcs. Crystal detector and 50 micro-amp. meter. Indicates Resonance. Connection for scope available.
- TS-45A-APM-3 Signal Generator, 8700-9500 mc., 110 V. 60-800 cps.
- 30 MC I.F. STRIP, VIDEO, and AUDIO AMPLIFIER AND 110 Volt 60-2600 cps POWER SUPPLY, Bandwidth 10 mc, new, part of SPR-2 Receiver.
- AMPLIFIER STRIP AM-SSA/SPR-2 contains I.F. amplifier, detector, video amplifier, pulse stretcher and audio amplifier and Rectifier Power Unit PP-155A/SPR-2 bandwidth 10 mc, center frequency 30 mc, sensitivity 50 microvolts for 10 milliwatts output. Power supply 80/115 V ac, 60-2600 cps 1.3 amps. Send for schematic... \$65.00 less tubes
- S Band Signal Generator Cavity With Cut-Off Attenuator, 2300-2950 mc., 2C40 tube, with modulator chassis... \$30.00
- UPN-1 S Band Beacon Receiver-Transmitter ..... \$75.00
- TS-155 S BAND SIGNAL GENERATOR and Power Meter.
- S Band Mixer, tunable by means of slider, type N connector for the R.F. and local oscillator input, U.H.F. connector for the I.F. output, variable oscillator injection. \$30.00



S Band Crystal Mixer, variable oscillator injection, illustrated ..... \$17.50

- TS-110 S Band Echo Box 2400-2700 mc, portable ..... \$110.00
- X Band Thermistor Mounts, VSWR less than 1.4 8500-9600 MC Fixed triple tuned, 1/2"x1" waveguide. .... \$40.00
- Fixed triple tuned 5/8"x1 1/4" waveguide \$50.00

Frequency Meter, 8500-9600, variable, absorption type for either 1/2"x1" or 5/8"x1 1/4" waveguide, with calibration, ± 4 MC, precision ground thread... \$150.00

X Band Crystal Mount, 1/2"x1" waveguide \$25.00

X Band Attenuator, double van type, VSWR less than 1.4 8500-9600 MC 0-30 db, calibrated for 1 1/4"x5/8" waveguide \$80.00

1/2"x1" to 5/8"x1 1/4" adapter, UG80/U \$5.00

TS-203/AP CALIBRATED SELSYN. \$10.00

GENERAL RADIO PRECISION WAVE-METER TYPE 724A, range 16 kc to 50 mc. 0.25% accuracy, V.T.V.M. resonance indicator, complete with accessories and carrying case NEW... \$175.00

HEWLETT - PACKARD - AUDIO SIGNAL GENERATOR 205A ..... \$230.00

ESTERLINE Angus recording Milliammeter 60 cycles, 110V. AC 1 ma full scale. \$150.00

TS-89 Voltage Divider for measuring high video pulses, ratios 1:10 and 1:100 transmission flat within 2 db 150 c.p.s. to 5 mc., with cable for attaching to syndroscope ..... \$30.00

Waveguide Below Cut-off Attenuator L 101-A U.H.F. Connectors at each end calibration 30-100 db ..... \$15.00

WAVEGUIDE BELOW CUT-OFF ATTENUATOR same as above except input is matched in range of 2200-3300 mc. VSWR less than 1.2 ..... \$54.00

PULSE TRANSFORMER 132-AWP... \$8.00

HYPERSIL CORE CHOKE, 1 Henry, Westinghouse L-422031 or L 422-32... \$3.00

PULSE INPUT TRANSFORMER, permalloy core. 50 to 4000 kc., WE-D161310, impedance ratio 120 to 2350 ohms. \$3.00

## REAL VALUES!

### CABINET CH-118

Olive drab in color, this cabinet has a full length interlock access door on the rear. The front takes the standard 19" panels with 60 inches of height and 20 inches deep. It is shock mounted on a heavy steel platform and has a two inch protrusion fully covering one side to accommodate wave trap and wiring. Lower doors allow air circulation top and bottom..... \$34.50

ea. F.D.B. Chicago

### CONDENSERS

1 mfd 6000 VDC. OIL FILLED.....	Each \$1.98
.00025 mfd. 25000 VDC OIL FILLED.....	2.95
50 mmfd—5KV—5 AMP Vacuum Cond.....	1.19

### T23/ARC5

Brand New Transmitter for VHF \$29.95

### RA 52—RECTIFIER

A Transtat controlled rectifier to produce high voltage DC from a 110 VAC 60 cycle source. Up to 11,500 volts DC at 50 watts. Metered high voltage (0-15 KV) and current \$74.50 (0-20 MA) New

### MISCELLANEOUS SPECIALS!

	Used	New
RA 10 DA Receiver.....	\$17.50	\$24.95
RT7/APN 1 Transceiver.....	6.95	9.95
BC 347 Interphone Amplifier.....	—	2.95
APS 13 UHF Antenna, Pair.....	—	2.95
FL 8 Filter.....	—	9.95
I-97 Bias Meter.....	3.95	4.95
RL 42 Antenna Gearbox Motor and Reel.....	4.95	7.50
BC709 Battery operated lightweight interphone amplifier, Complete with tube and shock mount, but less battery.....	—	3.95
C-18—Antenna coil assembly slug tuned used in BC 603 receiver. Frequency range 20-27.9 Mc. fully shielded.....	—	New 10 for \$1.95
I 82 F—Five Inch 360 degree compass indicator and Selsyn receiver.....	—	\$4.95
A-51-2 Transmitter Selsyn for I82 Indicator.....	—	2.45
(Both I82F & Trans. Selsyn for \$7.00)		

### TUBE SPECIALS

1625.....	.39	807.....	1.89
1626.....	.39	813.....	8.95
211.....	.59	837.....	1.19
805.....	3.29	860.....	4.95

### CATHODE RAY TUBES

3FP7.....	\$1.95	5BP4.....	3.95
3GP1.....	1.95	5FP7.....	3.95
4AP10.....	1.95	5GP1.....	3.95
5BP1.....	3.95		

### AS-138/ARN

10 INCH STREAMLINE LOOP as used with direction finding receivers. Fixed position, is ideal for planes, boats. \$1.95 automobiles ..... New

### SCR 625 Famous Army Mine Detector

Complete kit, brand new in original suitcase style carrying case. \$79.50 Less Batteries

### TS/10

Sound powered phones—Brand New \$10.00 ea. 2 for \$17.95

### TEST EQUIPMENT

No. M-652 Jackson Audio Oscillator.....	used \$29.50
No. 155 A RCA Oscilloscope.....	used 75.00
No. M-840 Triumph Oscilloscope.....	used 39.95

### PRICES UPON REQUEST

I-98-A.....	TS3/AP
I-114 P/O RC-68.....	TS10A/APN
I-135 P/D IE-17.....	TS16/APN
I-167 Weston Anal. = 772.....	TS19/APQS
I-183 Freq. Meter.....	TS27/TSM-1
I-185 Oscillator.....	TS36/AP
I-187 Synchronizer.....	TS59/APN-1
I-189 Calibrator.....	TS62/AP
IE-19.....	TS126/AP
	TS-251 Less Xtal

All shipments FOB warehouse. 20% Deposit required on all orders. Minimum order accepted —\$5.00. Illinois residents, please add regular sales tax to your remittance.

## ARROW SALES, Inc.

Dept. 16

712-14 S. Michigan Ave., Chicago 16, Ill.

PHONE: MARRISON 7-9374

## ELECTRO IMPULSE LABORATORY

62 White Street

Red Bank 6-0404

Red Bank, N. J.

# TEST EQUIPMENT! Complete Line!

- DUMONT 224-A OSCILLOSCOPE  
 TS-36/AP TS-102A/AP  
 TS-108 TS-184A/AP  
 1-77 HICKOK TUBE CHECKER  
 UPM-1 COMPLETE TS-250/APN  
 BC-221 FREQUENCY METER  
 RPC MODEL 644 MULTIMETER  
 FERRIS MICROVOLTER MOD. 188  
 TS-111/CP I-212  
 TS-117/GP TS-5/AP  
 TS-3/AP TS-19/APQ-5  
 TS-100/AP TS-61/AP  
 TS-170/ARN-5 TS-10B/APN  
 TS-182/UP TS-375 U  
 TS-127/U TS-15A/AP

## TELEVISION CAMERA



3350 line resolution. Easily converted to present RMA standards. Circuits available with camera. Complete, like new.

RC-184 IFF EQUIPMENT  
 BRAND NEW, COMPLETE  
 SCR-584 PARTS

APS-4 RADAR COMPLETE

APS-6 RADAR COMPLETE  
 MARK 16 RADAR COMPLETE

MG19A NEW

MK20A/UP, NEW, INDIVIDUALLY BOXED

BC-1100-A TRANSMITTER  
 WITH REMOTE CONTROL. 125 W.  
 115 VDC OR AC.

WE WANT THIS EQUIPMENT:

- BC-348 ART-13  
 BC-611 ARC-1  
 RTA-1B ARC-3  
 BC-1000 R5A/ARN7

## COLUMBIA ELECTRONICS LTD.

524 S. SAN PEDRO ST.  
 LOS ANGELES 13, CALIF.

11816 VENTURA BLVD.  
 N. HOLLYWOOD, CALIF.

Cable Address: COELECT

All items subject to prior sale

# BRAND NEW

U. S. GOV'T.  
 SURPLUS

# GUARANTEED

## POWER RHEOSTATS



Ohms watt ea.	Ohms watt ea.	Ohms watt ea.	Ohms watt ea.
.5 25 1.24 200 25 1.24	.5 50 2.34 200 100 3.29	.5 150 4.45 225 50 2.10	.5 50 2.34 250 25 1.86
1 50 2.34 250 50 1.49	2 100 3.51 300 50 2.11	2 225 4.95 300 100 3.29	2 300 6.32 350 25 1.24
3 100 3.51 350 100 3.28	3 225 4.95 370 25 1.24	3 x 3 300 29.70 378 150 4.95	4 225 4.95 400 25 1.24
5 25 1.24 400 75 2.95	5 100 3.51 500 25 1.24	6 25 1.86 500 75 2.95	6 50 2.10 500 50 1.49
6 25 1.86 500 100 3.29	7 25 1.24 500 150 3.51	8 50 1.49 585 150 4.95	10 25 1.86 750 25 2.11
10 100 3.29 750 150 4.45	12 25 1.86 1000 25 1.24	12 50 1.49 1000 150 4.45	15 25 1.24 1200 225 5.40
15 75 2.95 1250 50 2.22	22 50 2.10 1250 150 4.45	25 25 1.86 1500 25 2.11	25 100 3.29 1500 50 2.22
25 150 4.21 1800 150 4.68	50 25 1.24 2000 25 2.10	50 50 1.49 2000 50 1.49	60 25 1.24 2250 150 4.95
60 25 1.24 2250 150 4.95	75 25 1.86 2500 25 2.11	75 75 2.95 2500 25 2.11	75 100 3.29 2500 50 2.22
75 150 4.21 2500 100 3.51	80 50 2.10 3000 25 1.24	80 50 1.49 3000 100 3.51	100 25 1.24 5000 25 2.11
100 25 1.24 5000 25 2.11	100 50 1.49 5000 50 2.34	100 100 3.29 5000 100 3.75	125 25 1.86 7500 50 2.34
125 50 1.49 7500 100 3.98	125 50 2.10 10000 50 2.34	150 50 2.10 10000 100 4.21	175 25 1.87 15000 25 2.11
185 25 1.24 20000 150 6.32			

Specify whether shaft required for knob or screwdriver adjust.

## OIL CONDENSERS



Mfd.	Volts	Avail.
.1	3-6-20K	
.25	2-3-3-4-5K	
.5	600-1-1-2-5-5	
2	400-600-1-1-1-2	
3	3-4K	
4	600-700-1-1-1K	
6	400-600-1-1-2K	
8	600	
10	600-2-1K	
15	600-1K	
30	90-vac. 3-ph	
100	230-vac. 3-ph	
3x4	500	
3x8	600	
4x3	600	
4x8	600	
3x10	90-vac	

Special Prices on Request

## BATHTUBS



Mfd.	Volts	Avail.
.033	400	
.05	2-4-600	
.1	4-6-1K	
.15	600	
.25	2-4-600	
.35	400	
.5	4-6-1K	
.75	600	
1	1-2-4-6-1K	
2	4-600	
4	50-100	
8	500	
25	25-50-75	
40	25	
50	25	
100	15	
200	12	
300	6	

## SELECTOR SWITCHES

Pole	Pos.	Deck	Type	Each
1	11	1	Bak-n/shtg	.60
1	21	3	Bak-n/shtg	.89
2	2	1	Cer-shtg	.50
2	6	2	Bak-n/shtg	.60
2	11	2	Bak-shtg	.75
3	4	2	Bak-n/shtg	.58
5	8	2	Cer-n/shtg	.98
6	11	6	Bak-n/shtg	1.95
10	5	5	cer-shtg	2.25
16	2	4	Bak-n/shtg	1.35

(Many other types in stock)

## "AN" CONNECTORS



Large Variety Available  
 At Great Savings  
 Send your specs and let us quote

## BIRTCHEE TUBE CLAMPS

#926-A	#926-B22
#926-A1	#926-C
#926-A14	#926-C1
#926-B	#926-C5
#926-B1	#926-C10
#926-B7	#926-C24

35c.



## MICROSWITCHES

- A-#W2-RS13 SPST "S" plunger, metal housing norm. op. .59  
 B-#B-RS10 SPDT type "S" plunger, 2-circuits: one op and one cl. 59  
 #WZ-RL8 (not illus.) SPST leaf actuator, norm. cl. .59  
 #R-RLT (not illus.) SPST 10ba 125 vac roller plunger, norm. closed .59  
 C.G.E. SWITCHETTE 10a/115volts AC  
 #CR1070-C103A3 SPST closed .59  
 #CR1070-C103E3 SPST open .59  
 #CR1070-C103R3 SPST closed .59  
 #CR1070-C1233 DPST op/cl. .59  
 (Many other types in stock)

## SHOCKMOUNTS



100P-1	1 lb.	.15
100P-2	2 lb.	.15
100P-3	2 lb.	.15
100P-4	3 lb.	.15
100P-6	6 lb.	.20
150P-4	4 lb.	.20
150P-8	8 lb.	.45
150P-15	15 lb.	.49
156P-6	6 lb.	.35
200PD-15	15 lb.	.59
200PHN-35	35 lb.	.75
204P-112	112 lb.	.98

## TERMINAL BOARDS

5 terminal	.98
8 terminal	1.67
12 terminal	2.49

HUNDREDS OF OTHER ITEMS AVAILABLE

Open a/c to Rated Concerns. Prices net FOB our whse NYS and subject to change without notice

# ALEXANDER MOGULL CO., INC.

161 Washington St., N. Y. 6, N. Y. Worth 4-0865

## TYPE "J" POTENTIOMETERS

TYPE "J" \$1.50		TYPE "JJ" \$2.50	
ohms	ohms	ohms	ohms
50*	2500*	100K*	500-500*
65*	4000*	100K*	600-600*
200*	5000*	125K*	1500-1500*
300*	10K*	200K*	2000-2000*
400*	15K*	250K*	2000-50K*
500*	20K*	250K*	2200-24K*
600*	25K*	500K*	20K-2000*
750*	30K*	1meg*	25K-10K*
1000*	50K*	1meg*	35K-5000*
1500*	80K*	2meg*	50K-50K*
2000*		2meg*	100K-100K*

\* 3/8" screwdriver slotted shaft. + Knob type shaft.

## TRANSMITTING MICAS

mfd.	vw	type	ea.	mfd.	vw	type	ea.
.00001	600	4	.36	.0015	600	4	.36
.00003	600	4	.36	.00162	600	4	.42
.00005	600	4	.29	.002	600	4	.39
.00005	2500	9	.57	.0025	1200	4	.72
.0001	600	4	.29	.0025	600	4	.39
.00015	600	4	.36	.004	600	4	.45
.0002	600	4	.29	.005	1200	9	.99
.00025	600	4	.29	.0047	600	4	.47
.0005	600	4	.29	.005	2500	9	1.86
.0005	2500	4	.75	.006	600	4	.54
.0005	2500	9	.77	.01	600	4	.65
.0006	2500	9	.85	.01	1200	9	1.41
.0007	600	4	.36	.02	600	4	.92
.00075	600	4	.36	.02	1250	9	2.12
.0008	600	4	.36	.025	600	4	1.08
.0009	600	4	.36	.03	300	4	.99
.001	600	4	.36	.03	600	4	1.34
.001	1200	4	.54	.043	600	4	1.75
.001	1200	9	.57	.05	300	4	1.19

(Many other sizes in stock)

## "UG" and "UHF" CONNECTORS



UG-9/U	UG-25/U	83-1AP
UG-10/U	UG-27/U	83-1RTY
UG-12/U	UG-27/AU	83-1SF
UG-14/U	UG-27/U	83-1R
UG-15/U	UG-58/U	83-1D
UG-16/U	UG-88/U	83-1SPN
UG-18/U	UG-123/U	83-22R
UG-19/U	UG-185/U	83-22SP
UG-20/U	UG-260/U	83-25
UG-21/U	UG-280/U	83-25P
UG-21B/U	83-1AC	
UG-22/U	83-1F	
UG-24/U	83-1J	

PRICES QUOTED ON REQUEST

## Jones Connectors Jones BARRIER STRIPS

P-101-1/4	.25
P-101-3/8	.30
S-101-D-MOD	.33
S-302-AB	.13
S-304-CCT	.12
P-305-AB	.33
P-306-CCT-L	.33
S-306-FHT	.24
S-308-AB	.21
P-312-AB	.24
P-312-CCT-L	.40
P-312-FHT	.40
P-315-EB	.30
P-315-CCE	.40
S-315-AB	.36
S-318-AB	.43
P-324-FHT	.74
P-324-EB	.58
S-330-AB	.84
S-404-AB	.33
P-406-AB	.33
S-406-CCT	.98
S-408-CCT	.69
S-2408-SB	.53
P-2412-SB	.61
S-2412-CCE	.87
S-502-DB	.97
P-508-CE	2.55
P-510-CE	3.04
P-512-CE	3.22
S-512-CE	3.95

Many other types in stock

## MALLORY PUSH SWITCH

#2001	S.P., make cont., non-L.	.45
#2003	S.P.D.T., non-lock	.48
#2003L	S.P.D.T., lock	.48
#2004	D.P., make 2 non-L	.55
#2004L	D.P., make 2 non-L	.55
#2006	D.P.D.T., non-lock	.65

# BRAND NEW — GUARANTEED — SURPLUS — METERS !!

## D.C. MICROAMMETERS

- 100 MICROAMPERES, WESTON 643, 3/4" Round flush bakelite case (red line at 80) @ \$21.00
- 400 MICROAMPERES, WELCH, SWITCHBOARD MOTOR, 7 5/8" Round flush metal, with internal resistor & sc. calib. for 40 volts D.C. @ \$17.50
- 500 MICROAMPERES, GENERAL ELECTRIC DO-53, 3" Square flush bake. sc. calib. 0-15 kiloVolts @ \$9.95
- 500 MICROAMPERES, SIMPSON 6103, 2 1/2" Round flush bakelite, approx. 300 ohms resistance @ \$4.50

## D.C. MILLIAMMETERS

- 1 MILLIAMP, WESTINGHOUSE NX-35, 3 1/2" Round flush bake (JAN type MR 35W01DCMA) approx. 53 ohm resistance @ \$7.50
- 2 MILLIAMPS, WESTINGHOUSE NX-35, 3 1/2" Rd flush bake case (JAN MR35W02DCM) @ \$5.50
- 3 MILLIAMPS, GRUEN GW-587, 2 1/2" Rd. flush bake, scale calib. 30 & 450 MA & 3000 Volts @ \$3.50
- 5-0-5 MILLIAMPS, WESTERN ELECTRIC D-185647, 3 1/2" Rd. fl. bakelite concentric style movement, approx. 160° deflection, scale calib. 50-0-50 @ \$4.00
- 15 MILLIAMPS, SIMPSON 26, 3 1/2" Rd. flush bake case (JAN type MR25W015DCMA) @ \$6.00
- 20 MILLIAMPS, GENERAL ELECTRIC DO-53, 3" Sq. flush bake @ \$5.50
- 50 MILLIAMPS, GENERAL ELECTRIC DO-41, 4 1/2" Rd. flush bake @ \$4.95
- 150 MILLIAMPS, ELECTEL 350, 3 1/2" Rd. flush bake, made by Elect. Div. US Time Corp @ \$4.00
- 150 MILLIAMPS, TRIPLET, 2" Square flush bake, black scale @ \$3.95
- 200 MILLIAMPS, MARION, 3 1/2" Round flush bakelite case, knife edge pointer @ \$4.00
- 200 MILLIAMPS, GENERAL ELECTRIC DO-41, 3 1/2" Rd. fl. bake @ \$5.50
- 500 MILLIAMPS, GENERAL ELECTRIC DW-41, 2 1/2" Rd. fl. bake, black scale (18-22) @ \$3.95
- 500 MILLIAMPS, DEJUR AMSCO 312, 3" Square fl. bakelite @ \$5.00
- 800 MILLIAMPS, DEJUR AMSCO 312, 3" Round flush bakelite case, SC Stock # 3F980 @ \$4.50
- 1000 MILLIAMPS, WESTERN ELECTRIC D-55049, 3 1/2" Round fl. bakelite concentric style movement with 190° scale length @ \$4.00

## A.C. AMMETERS

- 100 MILLIAMPERES, WESTON 476, 3 1/2" Round flush bakelite case, 400 cycles @ \$7.50
- 500 MILLIAMPS, WESTON 476, 3 1/2" Round flush bakelite case, 400 cycles @ \$7.50
- 75 AMPS, BURLINGTON 32 C, 3 1/2" Rd. flush bakelite @ \$4.95

## R.F. AMMETERS

- 1 AMP, GENERAL ELECTRIC DW-52, 2 1/2" Round flush metal @ \$4.50
- 1.5 AMP, WESTON 507, 2 1/2" Round fl. metal black scale @ \$4.50
- 2 AMPS, SIMPSON 137, 2" Sq. flush bake, made for Collins Radio Company @ \$4.50
- 2.5 AMPS, SIMPSON 35, 3 1/2" Rd. flush bakelite case @ \$5.50
- 2.5 AMPS, WESTON 425, 3 1/2" Rd. flush bakelite case @ \$8.50
- 3 AMPS, WESTON 425, 3 1/2" Round fl. bakelite case, with external thermocouple @ \$9.50
- 5 AMPS, GENERAL ELECTRIC DO-44, 3 1/2" Round flush bakelite, with ext. thermocouple @ \$8.50
- 8 AMPS, WESTON 425, 3 1/2" Round fl. bakelite case @ \$10.50

## A.C. VOLTMETERS

- 8 VOLTS, WESTON 476, 3 1/2" Round fl. bakelite case @ \$4.95
- 15 VOLTS, WEST. NA-35, 3 1/2" Round flush bakelite case (JAN type MR35W015ACVV) @ \$5.50
- 75 VOLTS, WESTON 517, 2" Rd. flush metal, ring-clamp type intg. non-flashed @ \$3.50
- 300 VOLTS, BURLINGTON 22A, 2 1/2" Rd. flush metal case @ \$6.00
- 300 VOLTS, TRIPLET 232-C, 2 1/2" Rd. flush metal case @ \$6.00

## D.C. VOLTMETERS

- 40 VOLTS, SUN 3AP593, 3 1/2" Rd. fl. bake, 100 ohms per V, made for Mallory Co. @ \$5.95
- 300 VOLTS, WESTON 732, 3" Square flush bakelite case @ \$11.00
- 500 VOLTS, WESTON 506, 3 1/2" Round flush bakelite, 1 MA movement, complete with ext. Weston type 8 resistor box (JAN type MR 23W500 DUVV) @ \$9.50
- 2 KILOVOLTS, GENERAL ELECTRIC DO-53, 3" Sq. flush bake, 1 MA movement complete with 1000 ohms per Volt precision ferrule-type multiplier @ \$10.95
- 20 KILOVOLTS, GENERAL ELECTRIC DO-41, 3 1/2" Round fl. bake, 1 MA with multiplier @ \$27.95

## D.C. AMMETERS

- 1 AMP, WESTINGHOUSE NX-35, 3 1/2" Rd. flush bake case (JAN type MR34W001DCAA) @ \$6.00
- 5 AMPS, GENERAL ELECTRIC DO-41, 3 1/2" Round fl. bakelite @ \$5.95
- 15 AMPS, TRIPLET 0321-T, 3 1/2" Rd. flush bakelite case @ \$4.50
- 200 AMPS, GENERAL ELECTRIC DO-41, 3 1/2" Rd. fl. bakelite, complete with ext. 50 M.V. shunt @ \$9.50

## ONLY A PARTIAL LISTING

OVER 75,000 METERS IN STOCK

AMMETERS  
VOLTMETERS  
MILLIAMMETERS  
MICROAMMETERS  
SPECIAL METERS

## A.C.—D.C.—R.F. ORDER NOW

UN CV 49598  
ADAPTER KIT

### OD and OQ TEST SETS

This adapter kit consists of four special adapters and clip lead to enable the model OD & OQ Transconductance Tube Testers to accommodate radar tubes type 316A, 703A, 707A and B, 715A, 446 and similar tubes. Complete in portable oak chest (approx. 7" x 4" x 3") with instruction sheet & test data. Weston Model 9909 **ONLY \$9.50**

**TRANSMITTER, POSITION INDICATING ASSEMBLY, AF type A-3, AN part # 5785-1.** For wheel and flap position indication. To be used with indicators AN 5780-1 or AN 5780-2. Mfg. by Weston Electric Instrument Corp. Part # 108525 @ \$6.00

**VOLTAGE RELAY, -20% to 0 to +20%.** A suppressed zero instrument with 2 adjustable pointers to control operating limits. There is a potential difference of 80 M.V. from -20% to end scale (+20%) with zero center scale equal to 150 M.V. at 150 M.A. Roller Smith type CMR-2. Measures 5" L x 3 1/2" W x 3 1/2" D, surface mounted case... AT \$4.95

**CARBON PILE D.C. VOLTAGE REGULATOR 20 AMPS MAX.,** 110 load volts max., 140 line volts max. Mfg. by Safety Car Heating & Lighting Co. Catalog # 29540 type S 700 E, Dimensions 16 1/8" W x 16 3/8" H x 10" D @ \$85.00

## METER TRANSFORMERS MULTIPLIERS SHUNTS

WE CARRY A LARGE STOCK OF METER ACCESSORIES IN ALL TYPES AND RANGES. LET US KNOW YOUR REQUIREMENTS AND WE SHALL BE PLEASSED TO SEND YOU OUR QUOTATION.

## MARITIME SWITCHBOARD INSTRUMENTS—ACCESSORIES

338 Canal St., N. Y. 13, N. Y.  
Worth 4-8217

We specialize in electrical instruments. Over 75,000 meters in stock. Send for our latest circular showing our complete line of Surplus-New Guaranteed meters.

Orders accepted from rated concerns, public institutions and agencies on open account, others please send 25% deposit, balance C.O.D. or check with order. All prices FOB our warehouse, N.Y.C.

## TEST EQUIPMENT

- |       |        |        |          |              |
|-------|--------|--------|----------|--------------|
| TS-3  | TS-59  | TS-146 | BC-978   | OAV-1        |
| TS-6  | TS-61  | TS-153 | BC-1236  | W-1158       |
| TS-10 | TS-62  | TS-155 | BC-1277  |              |
| TS-14 | TS-74  | TS-159 | CLQ-60   | Trans.       |
| TS-15 | TS-76  | TS-174 | D-150637 | APQ-2        |
| TS-16 | TS-91  | TS-203 | I-143    | APT-1-2-5-5A |
| TS-19 | TS-92  | TS-206 | I-196    | ARQ-8        |
| TS-23 | TS-98  | TS-218 | I-203A   | ART-2-7      |
| TS-24 | TS-100 | TS-226 | I-208    | AXT-2        |
| TS-26 | TS-102 | TS-268 | I-212    | TPS-2        |
| TS-27 | TS-111 | APA-11 | I-223    |              |
| TS-33 | TS-118 | BC-221 | LM-8     | RECVRS.      |
| TS-35 | TS-125 | BC-376 | LM-15    | APN-9        |
| TS-36 | TS-126 | BC-638 | LS-1     | APR-5A       |
| TS-45 | TS-127 | BC-905 | LW       | ARN-8        |
| TS-47 | TS-131 | BC-906 | OAP-1    | ARQ-8        |

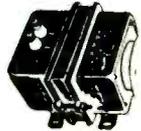
RECEIVERS CPN-3 RA 10 DB TPS-2 RT-48ATPX-1  
COMMUNICATIONS, BEACON, LORAN, IFF AND RADAR  
SCR-717B; SCR-720; APS-(2)(3)(4)(15); APQ-13  
MAGNETRONS POWER UNITS ANTENNAE INDICATORS  
TURBO AMPLIFIERS CONTROL AND JUNCTION BOXES, Etc.

## LERU LABORATORIES, INC.

360 BLEEKER ST. NEW YORK 14, N. Y.  
ORegon 5-3525

## COMPARE THESE VALUES!

**FILAMENT TRANSFORMERS, 5V, 115 Amps—** for welding and pipe thawing. 2 of these paralleled are great for spot welding. **SPECIAL! \$12.95 \$19.95** ea. or 2 for \$35.00  
**UTC LS-73 POWER TRANSFORMER 1000-800 CT** at 500 M.A., 140 CT at 50 M.A., 5 filament windings  
**UTC LS-191 POWER TRANSFORMER, 650-500 CT** at 125 M.A., 3 filament windings, tapped primary..... **\$5.95**



### POWERFUL BEAM MOTORS

With Complete Operating Instructions for Use on 110V, 60 cycles. **\$3.95** Postpaid in U.S.A.  
We've sold thousands of these powerful, highly geared motors for TV aerials and Ham stations, Barbecue pits, etc. Compare this price anywhere!

### CONDENSERS

.5 mfd. 5000 volts.....\$2.50 each  
or 5 for \$10.00

### GRID DIP METER KIT

Tells where your equip. is in the radio spectrum. 635 OSC. Range approx. 3 to 170 mega. For phone or CW monitor, harmonic indicator, absorption wavemeter, measured tuned circuits, antennas, etc. FB for TVI checking. Few requirements. 6.3 filament 150 V DC. With instructions on calibrating coils.  
**\$7.95** Postpaid in U.S.A.



WE BUY EQUIPMENT Top dollar for all types aircraft, radio, test equip. Send us your list, condition, asking price. Prompt replies!

Fully Staffed FOREIGN DEPT. to handle all Export orders and inquiries in all languages. Write "Foreign Dept. Alvaradio".

ORDER DIRECT FROM THIS AD: Prompt shipment. Cash with order. Min. order \$3.00. 25% deposit on all C.O.D. orders. Shipments by truck or RR Express collect. Calif. buyers add state sales tax. Prices subject to change—Walse subject to prior sale.  
SEE OUR JAN., FEB., MARCH ADS FOR OTHER MONEY SAVINGS BUYERS NOT LISTED HERE!

## ALVARADIO SUPPLY CO.

Dept. L-13, 341 S. Vermont Ave. Los Angeles 5, Calif. DUNKIRK 8-2211

**SPECIAL CASH WITH ORDER PRICES**

**COMMAND AND/OR ARCS TRANSMITTERS and RECEIVERS**

BC-412 Antenna Relay, Less Vac. Cond.	USED NEW	\$ 1.95
BC-450 3 Receiver Control		1.49
3-6 MC Receiver		5.95 \$11.95
6-9.1 Receiver		6.95 9.95
Triple Receiver Rack		\$1.95
V.H.F. ARCS Transmitter, Complete w/tubes		29.95
2.1-3 MC Transmitter w/tubes		14.95
4-5.3 MC Transmitter w/tubes		5.95
5.3-7 MC Transmitter w/tubes		5.95
7-9.1 MC Transmitter w/tubes		9.95
3-4 MC Transmitter w/tubes		18.95
2.8 Receiver Command Dynamotors		\$0.97

<b>MODULATORS</b>		
BC-456 with Tubes, less dyn.		2.95
MD-7/ARCS Plate Modulator		7.95
MD-7 Modulator Dynamotor, 28V.		3.95
<b>USED NEW</b>		
BC-433 Receiver—w.o. tubes		\$12.95
—with tubes		24.95
MN-26C Compass Receiver		24.95 \$39.50
BC-1206 Receiver 200-400 kc.		5.95 9.95
BC-357 Marker Beacon Rec. W.O. Tubes		\$18.95 24.95
BC-733D w/o tubes		6.95
w/tubes		19.95

BC-375 Trans. 100 Watt Voice, CW, MCW, freq. range 200 kc to 12 mc, uses Plug-in Tuning units listed complete with tubes, less Tuning Units		\$18.95 \$24.95
<b>TUNING UNITS for BC-375 or 191 Trans.</b>		
TU-7 4500-6200 kc		\$2.49
TU-8 6200-7700 kc		2.49
TU-9 7700-10000		2.49
TU-10 10000-12500		2.49
TU-22 A, TU-28 200-500 kc, each		4.50
FT-151 Shock Mounting for BC-375 or 191		2.95
BC-306 Antenna Loading		1.95

**GP-7 NAVY TRANSMITTER:** 100 watt master os. Can use on any freq. from 350-9050 kc. by using proper plug-in. Comes with 1 tuning unit. **\$13.33**

**LOOP ANTENNAS**

DU-1 Has 2 tube amplifier	New	\$25.95
MM-20-E	New	7.95
LP-21 A	New	9.95
FL8 Filters—A's, B's, C's	New	\$ 1.95
FL5 Filters	New	.79
Hand Keys—J 38	New	.79
TSC TRANSMITTER & RECEIVER with 12V Power Supply and Cables. Good—used		179.50
Heinemann Circuit Breakers, 115 V. 20 amp.		1.39
Prop Pitch Motors	New	13.95
Prop Pitch Motors—with Transformer	New	19.95
Prop Pitch Transformer, only	New	6.95
RT-7APN-1 Transceiver, tubes & dyn. Used		9.95

**TRANSFORMERS**

3200V 300 ma NCP	\$8.95	Pair \$15.95
12V 24V 2am 110V primary		2.95
ARC-4 2 Meter Transceiver, tubes—good, used		\$39.00
522 2 Meter Transceiver with tubes—good, used		59.50
BC-434 Control	Used—\$1.95	New 2.95
Code Practice Tapes for TG-10 15 rolls, New		7.95
BC-906 Absorption Type Freq. Meter, Range 150-225 mc. 0-500 DC Microammeter		\$11.50
Used		New 14.95
Field Phones E-E 8's. Used \$15.95 pr. New \$34.50 pr.		

**DYNAMOTORS**

PE-103 NEW, ORIGINAL CASE		\$29.95
PE-103 NEW, Less Base—Dynamotor		19.95
DM-32A Input 28V. Output 250 DC. .06 amps.	Used	1.95
DA-14 Input 28V @ 1.6 amps. Output 230 DC @ 1 amp	Used	5.95
PE-73 29V @ 20 amps, output 1000V @ 350 amps	New	5.95
PE-77 14V @ 40 amps output 1000V @ 350 amps	New	15.95
SPECIAL 27V @ 400V @ 7.50 mill 750 V 350 mil	New	12.95
PE-94 or SCR-522 24V Used.		\$5.95 New 14.95
PE-94 Dynamotor only		4.95
DM-34 12V @ 2.8 amps. Output 220V @ 160 amps	New	9.95
SPEC. 9V @ 450V output @ 80 ma.	New	5.95
SPEC. 12V @ 320V output @ 80 ma.	New	4.95
SPEC. 6V @ 250V output @ 80 ma.	New	5.95
SPEC. 12V @ 410V output @ 200 ma.	New	8.95
ARC-1 DY-9/ARC-1	Used	11.50
ARC-1 DY-10-12V	Special	9.50

683 FM Receiver 26 to 39 mc FM Receiver with tubes—used—\$29.95. New \$39.50  
RL-42B Antenna Reel Assen. Less wire. New 9.95

**OIL CONDENSERS**

<b>Standard Makes—New</b>			
2 mfd 600V	\$ 4.49	10 mfd 600V	\$ 1.95
4 mfd 600V	1.39	2 mfd 2500V	2.95
1 mfd 1000V	.89	2 mfd 4000V	5.95
3 mfd 4000V	7.95	2 mfd 5000V	8.95
2 mfd 10000V	24.95	2 mfd 7500V	19.95

**HEAD SETS**

HS-30	New—\$1.69
HS-33	New—\$1.69
HS-23	Used—\$1.19; New 2.95
Matching Transformers for HS-30	.69
BC-348 Mounting Base	\$2.49
RG-7U Coax Cable, 97.5 ohms. 1 foot.	.08
MIKE CHEST SET. "F-1" button	New—2.95

**CASH WITH ORDER. PRICES SUBJECT TO CHANGE WITHOUT NOTICE. MANY MORE ITEMS.**  
California Orders Please Include 3 1/2% Sales Tax

**SAM'S SURPLUS**

1310 BOND ST., LOS ANGELES, CALIF.

**THE BEST IN ELECTRONIC SURPLUS**

AVAILABLE FROM OUR STOCK FOR IMMEDIATE DELIVERY

**SF-1 Radar Eqpts.** 10 Centimeter, Brand NEW with complete spares to insure over 10 years of continuous operation. Includes motor generator set in each, all wave-guide plumbing, instruction books, etc. 19 cases per set, export packing.

**PRICE, EACH \$2,500.00**  
**Beachmaster, 250 watt Portable Sound Amplifier Systems,** with nine speaker rack, tubes, mike, cables, and spares. Operation from 110 volts, one phase, 60 cycle AC. Excellent and New condition.

**PRICE, EACH \$485.00**  
Case of spares for above. **PRICE \$100.00**  
**Western Electric Model HLAS, 500 watt Sound Amplifier Systems,** consisting of 10 watt Pre-Amplifier; 500 watt Power Amplifier with built-in power supply, expander-compressor circuit, internal blower-ventilation, 30 kc erasing oscillator circuit for magnetic tape recording, volume and meter controls, two speaker racks, each with 6-60 watt dynamic horn units. Operation from 115/3/60 AC. New, Unused. Complete with tubes, cables, connectors and instruction manual. **EACH \$895.00**

**Wilcox 36A Rectifiers,** single cabinet unit containing 4 separate transformer rectifier power supplies, capable of supplying DC voltage to one or more 96C Transmitters and one or more Wilcox 50A Modulators (which are designed to modulate a 96C 3 KW RP Output Transmitter). Has terminal connections for 5 96C Transmitters, and for local or remote operation. Measures: 7 1/2" high, 29 1/2" wide, and 2 1/2" deep. Operates from 220/3/60 AC. NEW eqpt., complete with control relays, tubes, power transformer (moved for shipment), instruction manual. **WRITE FOR PRICE.**

**RMCA, Model 8010 I.F. Ship Main Radio Transmitter,** 325 to 500 KC, types CA & E. Excellent condition. Less motor generators. **\$475.00**

**PRICE, EACH \$475.00**  
**RMCA, Model 8019A/H.F. Ship Transmitter,** complement to 8010 above, for I.F. transmission A1 and A2, 200 watts output. Excellent Condition, less tubes and MG (mg with 8010 powers this unit). **PRICE, EACH \$400.00**

**RMCA, 8003 Emergency Transmitter, 500 KC, 50 watts output with 12/115 V. DC. motor generator set and battery charging unit.** Excellent Condition. Complete with tubes. **PRICE, EACH \$275.00**

**RMCA, 8707 Direction Finder, (Int. Freq.)** consisting of receiver, loop, shaft, rotating wheel. Excellent Condition except shaft housing not available (can be easily improvised). With tubes. **PRICE \$750.00**

**Mackay, Model 150-AY, I.F. Ship Transmitter,** 325 to 500 KC, A and A2 emission. Excellent Condition. Complete with MG. **PRICE, EACH \$350.00**

**PRICE without MG, EACH \$275.00**  
**RC-163 Radio Beacon Eqpt. 20-40 MC.** Converts SCR-508/528/608/628 to directional transmitters and receivers. Ideal for airports or for homing application. NEW and complete equip. Export packed. **EACH \$96.00**

**SCR-511 "Pogo Stick" Walky-Talky,** Portable low power AM radiotelephone for 2 to 6 mi. operation with 13 plug-in tuning coils containing crystals for crystal control of both receiver and transmitter. Transmitter-Receiver BC-745 of this SCR-511 includes telescopic antenna and "Press-Talk" Switch as well as all cables. Range 5 miles, plus. With PE-157 Vibrator Power Supply, 2-motor battery (less electrolyte). T-17 mike, ready for immediate operation. **PRICE, EACH \$95.00**

**32 Volt DC to AC Rotary Converter, mfd. by Kato.** For yachts, workboats, or farm installation. Output 110 V., 60 cycles AC, rated 225 watt but good to 300 watts. All NEW Units. **\$39.95**

**Deck Entrance Insulators, bow and stern type 8 1/2" dia. with heavy galvanized metal flange and bell. Top bell 6 1/4" dia. x 1 1/2"; brass feed thru rod. Very high voltage insulation. Individually packed in cartons, all NEW. 12 FOR \$24.00**

**Generator Electric Amplidyne M. G. Set, general type 2V58787; motor type 273AB58. Navy CG 21-1BU, 115/230V. 60 cycles AC. Motor battery (less electrolyte). HP. generator output 250 V. DC at 375 watts. NEW. PRICE, EACH \$75.00**

**T9/APQ2 Radio Transmitters.** Noise-modulated Jamming Transmitter, using Electron-Multiplier Photocell. For Jamming certain types radar eqpt. New unused transmitters only, with Electron-Multiplier tube. **PRICE, EACH \$350.00**

**SB-23/GTA-2 & SB-14/GY Switchboards & Power Supply,** for operation from 110V, 60 cycles AC (with storage batteries). Each in individual metal cabinet. NEW. Price, Each Set \$450.00

**BC-319-A Transmitter, CW only 300 watts output.** Freq. range 4.0 to 13.4 mc. Operates from 110/220 volts, 60 cycles AC. Excellent condition. Less tubes. **PRICE, EACH \$300.00**

**Wilcox, 96-200A, 2-KW RF section 115 to 525 KC.** Large cabinet with complete RP set containing two VFO, intermediate sections and PA stage. Almost new but lacks PA inductance. Less tubes. **PRICE \$300.00**

**RADAR TRAINING SET—MARK V**

For Student, Schools, Labs, or actual radar application. Operates in the 580 to 765 mc region, designed especially to illustrate how radar eqpt. functions, and permits making numerous experiments to put over radar fundamentals. Uses above described receiver; separate transmitter using 8025 triode with 1.5 watts at antenna, with 400 KC internal modulator using two 811 tubes; External modulator, generating audio frequencies of 16,000, 4,000, and 1,000 cycles, and RF at 750, 350, and 175 KC, with selection switch for modulation frequency and wave form control, using 3 tubes, 807, 6N7, and 6J5; set of Antenna Dipole rods. Supplied with full instruction sheets, diagrams, calibration curves, tubes, NEW unused surplus. **PRICE, Per Set \$175.00**

Prices quoted are net, FOB N.Y.C. our warehouse. Export packing extra, except where included in specifications. All material is guaranteed as represented, and offered Subject to prior sale.

**TELEMARINE COMMUNICATIONS COMPANY**

CABLE ADDRESS: 540 W. 27th St., N. Y. 1, N. Y. TELEMARINE, N. Y.

**"SNOOPERSCOPE" TUBE**

Infrared Image Converter Tube (British) to make "Snooperscopes," "Shipscopes," and other devices that see in the dark. Has many useful industrial applications. Operates with invisible infra-red rays, without scanning or amplifiers. Supplied with technical data and diagrams. Every tube guaranteed!

6 for	\$5.50
6 for	\$30.00

**BAUSCH & LOMB Front-End Lens Assembly,** for best images. F2.1. 3.5 in. I.F. **EACH \$10.00**  
**MOUNTED LENS UNIT,** also for front-end, results as good as B & L unit. Speed F1.9 f. 1. 91.44 mm. outside dia. at one end 60 mm. length of mount 64 mm. **PRICE, EACH \$7.00**

**Link FM Transmitter-Receiver, 70-100 mc. 50 watts output.** Model 1498 DC. Wall style cabinet containing transmitter, receiver and 14 V.D.C. power supply, handset. Dim: 3 1/4" x 2 1/4" x 1 1/4". NEW Condition. Complete with tubes, crystals, special telescopic antenna, instruction book. **\$500.00**

**AN/CRT-1A Sonobuoy Transmitters,** for mine and submarine detection. With parachute, tubes, etc., ready for operation (except standard types dry batteries). Operates at 61.7 mc. Excellent to New condition. **PRICE, EACH \$55.00 and up.**

**20-40 MC FIELD STRENGTH AND WAVEMETER**

Uses a 0-100 Micro-ammeter with a 1S4 Pentode, to receive signals in the 20-40 mc range. 1.5 volts battery required. Tuning dial has dial lock, for fixing position, and telescopic Antenna permits adjusting for strong or weak signals. Calibration must be self-performed. Complete with instruction sheet and diagram NEW, unused eqpts. Dim: 6 1/2" x 4 1/4" x 5 1/2". **PRICE, EACH \$14.95**

**TDE-2, Ship Transmitter.** IIF and IF bands, for 230V, DC operation. With internal mg supply, and all tubes. NEW, unused condition. **\$600.00**

**BC-348 Receivers, like NEW condition, complete with tubes and dynamotor. EACH \$140.00**

**BC-221 Frequency Meters. Excellent to LIKE NEW condition, with calibrated charts, tubes and crystal. EACH \$85.00**

**TS-11 Handsets, for SCR 194 & 195. NEW. \$6.95**  
**TS-4AP Echo Boxes. UNUSED. EACH \$20.00**  
**SCR-584 Sector Scan Units. UNUSED. EACH \$9.00**  
**QBE-3 Control Rectifiers, Type CBM-20223. UNUSED. EACH \$27.50**  
**BC-689A Radio Transmitters, Unused. Less tubes. EACH \$22.50**

**TS-47/APR4**

**Signal Generator, 40 to 115 mc and 115 to 500 megacycles, butterfly condenser tuning with direct precision calibration. Solid construction and shielding, with built-in power supply which operates from 80 to 220 volts AC. 50 to 2600 CPS. Complete with instruction sheets, tubes, and connectors. NEW and like new units. EACH \$140.00**

**580-765 MC SUPERHET RECEIVER, WITH WAVEMETER**

Easily modified for Citizen's Band reception, or for experimental use on VHF Television. Uses a 955 Autodyne detector-oscillator into 3-stage resistance-coupled IF amplifier. Output is for headphones. Includes VR-150 voltage regulator tube, 6F5 tuning-eye, and 5Y3 rectifier. For 115 volts, 50/60 cycles AC. Calibrated Wavemeter mounted as separate portion, with variable tuning rod and hand-plotted calibration curve for each, permits checking frequency of incoming signal. NEW unused surplus, with instruction sheets and diagram, plus calibration curve, and tubes. **PRICE, EACH \$75.00**

**YI-1 I.F.F. Eqpt.** Consists of dual transmitters and dual receivers, each working in "A" and "B" bands, 176 and 515 mc respectively. Includes power supply (115-230 volts, 60 cycles AC) and tubes, all in one metal cased unit. UNUSED eqpt. **PRICE, EACH \$165.00**

**RMCA, 8600X Auto Alarm Receivers, 500 KC Automatic SOS (4-second dash actuated) Alarm Unit.** Complete with Relay, Control Box and warning light. For 110 V. DC operation. Excellent Condition, with tubes. **PRICE, EACH \$250.00**

**TBK-10, 500 watt, 2-18.1 MC, CW Telegraph Transmitter** designed for ship installation. Almost new condition, complete with tubes, less MG set and accessories. **PRICE, EACH \$350.00**

**LIMITED QUANTITIES Following: R-89/ARN-5A Receivers, new; APN-4 Indicators; TBY 2 Portable 28-80 mc Transceivers; TA-12B Transmitters; Model NAA Underwater Ultrasonic Beacon Transmitters; Model ZB-3 Aircraft Homing Adapter Equipment; Portable Test Oscillators for ZB Eqpt: RT-3/ARN-1 Aircraft Receiver-Receiver; Receivers for DP-12 or 13 D.F. Receiving Eqpt: Radio Receivers BC-733-D; Model ATD Aircraft Transmitters; BD-72 Switchboards; 500 Watt, 110 DC to 110 AC, 60 cps motor-generators. Also, BC-603 Receivers, BC-604 and BC-684 Transmitters, BC-620 and BC-659 FM Transceivers, PE-97, 117, and 120 Power Supplies; Ship-to-Shore Radio Telephones for 32 V. & 110 V.D.C. operation. Large quantities of transformers, power and audio, filter chokes, Radar fittings and accessories.**

MAIL ORDER ADDRESS  
1060-2 N. ALLEN AV.  
PASADENA 7, CALIF.  
SYCAMORE 4-7156  
RYAN 1-8271

# PHOTOCON SALES

MAY SPECIALS

RETAIL SALES STORE  
1240 EAST COLORADO ST.  
PASADENA 1, CALIF.  
SYCAMORE 6-7217

## WRITE FOR OUR LARGE SURPLUS CATALOGUE

One of the largest and most complete electronic surplus stocks in the country. We have thousands of tubes, capacitors, plugs, accessories, transmitters-receivers, test equipment, etc. Send us your requirements.

APR4 Receiver with TN-17—New—Write for prices.  
BC-375 Transmitters, Complete with tuning units, plugs, dynamotor, mountings, microphones. Export packed. . . . . LIKE NEW \$ 89.50

Mine Detector SCR625 for locating metal underground pipes, prospecting, etc. With manuals . . . USED \$39.50. NEW 69.50

BC-464 Target Receiver—5 channel remote, sensitive relays, battery case, antenna—68-73MC. . . . . BRAND NEW 14.95

APR5AX Receiver . . . . . LIKE NEW 250.00

RU-19 Receivers—Complete . . . . . NEW 29.50

RA-10 Bendix Compass Receiver. LIKE NEW 19.50

BC-640 Transmitter—50 watt rack type—Same frequency as SCR-522. . . . . GOOD 695.00

Crystal and coil sets for Handy-Talkie—3885, 4280, 4840, 5327.5, 5337.5, 5500 KC. 2 crystals and 2 coils per set. . . . . SET 1.95

APN-1 Altimeter Indicator, basic movement 0-1 ma., 5 ma. shunt, 250° dial. An excellent movement for constructing meters. NEW 1.95

HS-23 Hi Imp Headset. . . . . NEW 3.95  
HS-33 Lo Imp Headset. . . . . NEW 4.95

Sound Powered Head & Chest Sets—Manufactured by U. S. Instrument Co. EXCELLENT USED. \$4.95 Each. . . PAIR 8.50  
PAIR USED . . . . . 2.95 Each. . . PAIR 5.00

Teletype Paper—3 1/4" wide x 3 1/2" dia. Rolls—White—Single . . . . . .50

BC-1060 Oscillograph—Same as DuMont #224 . . . . . LIKE NEW 150.00  
TS-224 DuMont Oscillograph. GOOD USED 125.00

- Insulation Tester—Superior Model 610B, 200 megohms. Complete . . . . . NEW 39.00
- I-100A Test Set for ARN-7 and 269 compass . . . . . LIKE NEW 595.00
- IE-19A Test Set for SCR-522 Complete with manual, original factory packing. . . . . NEW 325.00
- LM Frequency Meter with calibration books, crystal, tubes . . . . . EXCELLENT 79.50
- BC-221 Frequency Meters, Complete with calibration books, crystal, tubes . . . . . EXCELLENT 79.50
- TS-16/APN Test Set. . . . . GOOD CONDITION 47.50
- Standard Signal Generator — Measurements Corp. Model 78-B 15-25MC. 100-250MC. EXCELLENT 89.50
- Tube Checker—Model CHI-60067—115V. 60 cycles . . . . . EXCELLENT 39.50
- Sweep Generator—Model M for AN/APG13. Made by M.I.T. Radiation Laboratory EXCELLENT 49.50
- Weston Model 506 Voltmeter 0-20.000 volts with 4 Model 505 multipliers. . . . . NEW 39.50
- LU-1 Radar Test Set. . . . . NEW 49.50
- BC-906 Frequency Meter. . . . . EXCELLENT 14.50
- Matching Transformer for HS-30. . . . . NEW .40
- Weston Electrical Tachometer Model 545 for use with 724 Generator 0-2000RPM Ratio 2:1 0-5 M. A. . . . . NEW 14.50
- TS-24A/ARR2 Test Oscillator. EXCELLENT 19.50
- Engine Cylinder Thermometer Tester—Wheelco Inst. Co. Iron-Constantan, Copper Constantan, Chromel-Alumel 0-1400°C EXCELLENT 69.50
- Engine Cylinder Thermometer Tester—Mark II Wheelco Inst. Co. Iron-Constantan, Copper-Constantan 0-350°C . . . . . EXCELLENT 49.50
- Output Meter CWI 60ABJ 115V. 60 cycles. P.O. ASB Radar with manual EXCELLENT 29.50
- Delco Motor—27 volts 2-4 amps—3600 RPM Constant Speed. Model A-7155 Governor Type Shunt . . . . . NEW 4.95
- RA-62 Rectifier Power Supply for SCR-522 115V. A.C. . . . . EXCELLENT 120.00

- PE-73 Dynamo Power Supply for BC-375 1000V. D.C. Output. EXCELLENT. . . . . 5.95
- FL-8 Range Filters. . . . . NEW 1.95
- BC-709 Interphone Amplifier, tubes, battery operated. . . . . NEW 3.95
- Transformer—High voltage, General Electric No. 6949191, Single phase. Plate 15.550 volts—5.2KVA. Input 115 volts 50/60 cycles. Filament 5V.—.065KVA. Input 60cy. 100V. . . . . EXCELLENT COND. 50.50
- Variac—General Radio Type 50A 115V. 60 cycles—5KVA. . . . . EXCELLENT COND. 95.00

Selsyn Transmitter—Pioneer Inst. AY 14 excellent for indicator. . . EXCELLENT 3.50  
Low Inertia Motor Type No. 10047 2A 24 volt—Pioneer Inst. Precision Type. . . . . 2.50

Onan Motor Generator Set MG G-1 Generates 115V. AC 5.3 amps, 26 D.C. 100 watts, 480 cycles 3.8 amps. Motor 115-230V. 80 cycles. Single phase, 2450 RPM 10.5 amps NEW 170.00

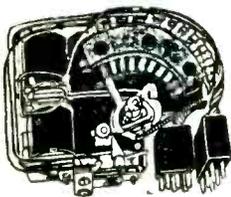
PE-94 Dynamotor Power Supply for SCR-522 USED . . . . . \$3.50. NEW . . . . . 5.50

PE-206 Inverter 800 cycles — Will power APN4 and APN9 24V. D.C. Input: NEW . . . . . \$6.95; USED . . . . . 3.95

WE WILL BUY YOUR NEW OR CLEAN USED ELECTRONIC SURPLUS: ARC-1, ARC-3, BC-224, BC-348, BC-312, BC-342, ATC, ART-13, AFS-13, BC-221, LM's, TS-12, TS-23, TS-34, TS-35, IE-19A, I-222, SCR-522, TS-100, I-100, or any BC, I, IE, TS, APN.

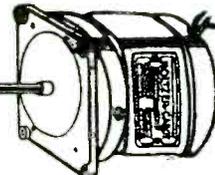
WE NEED TUBES 304TH, 250TH, 810, 811, 813, 814, 815, etc.  
WE WILL BUY YOUR EXCESS NEW TUBES IN QUANTITY. PLEASE LIST EQUIPMENT, EXACT HONEST CONDITION, AND YOUR LOWEST PRICE.

TERMS: Prices f.o.b. Pasadena, Cal. 25% on all C.O.D. orders. Californians add 3% Sales Tax.



**Automatic Electric**  
**2 Decks 10 Points**  
**TELEPHONE RELAY**  
24 Volts D.C.  
**\$11.00**

**NEW HOLTZER-CABOT**  
**TOTALLY ENCLOSED MOTORS**  
50 R.P.M. Reversible Single Phase Capacitor-Run type. 115 Volts AC 60 cycle 0.3 Amp. Torque 100 oz. Inches. 3/4" shaft 5/8" dia.  
**\$17.50 each**



**ANNUNCIATOR DROP**  
250 ohms, will drop on 12 volts or more  
**\$1.00**

HOLTZER-CABOT M.G. 218. CONVERTER  
**400 CYCLE 110V A.C. 1 AMP** \$49.50  
1/2 H.P. D.C. 110V MOTOR  
EST. 1923 **BLAN** EST. 1923  
64 Dey St., New York 7, N. Y.

WE 24 & 12 volt Telephone lamp. . . doz. **\$1.50**  
CH 4 pole 35 ampere 115v. AC relay. **\$4.90**  
GE 3 ampere Mercury Switch  
1/2" glass tube. . . . 3 for **\$2.50**

**Genuine TELECHRON Motors**  
2 RPM . . . . . \$2.90  
3.6 RPM . . . . . 3.15  
1 RPM . . . . . 3.95  
60 RPM . . . . . 4.30  
One of Each \$12.00

Stevens-Arnold Resonant Relay. Only two types in stock. 442 and 240 CPS either one. . . . . **\$4.50**  
Both for \$8.00

**ALNICO** **LUCKY** **7% COBALT**  
PURCHASE ENABLES US TO OFFER YOU THESE Actual **MAGNETS**  
**39¢ EACH** **3 FOR \$1.00**

**ISOLATION TRANSFORMER \$1.95**  
Nat. known Mfrs. 50 watt 2 windings, 115 V. to 115 V. 60 cy. Ideal to prevent shocks from small radios and medical and electronic devices.

**ELAPSED TIME METERS** **\$15.50**  
**GONIOMETERS**  
Micro Switch  
Solenoids  
Relays  
Electric Counters

### FOR IMMEDIATE DELIVERY

450 ea.—AN/CRW 2 RECEIVERS with 3—6SL7; 1—6SN7; 1—6SG7; 1—6J5; plus Dynamotor DM 32; compensating relays and numerous condensers, resistors, chokes, etc., etc.,  
**Each—\$7.50**

350 ea.—AN/CRW2A RECEIVER with 3—12 SN7; 1—9002; 1-9003; plus Dynamotor DM 32; 3 Sigma relays, 8000 ohms; plus numerous misc. components such as resistors, chokes, condensers, etc., etc.,  
**Each—\$8.50**

1000 each BRAND NEW DM 32A DYNAMOTORS—  
**Each—\$8.50**

2000 ea.—CD318A—CORD assembly, 7' length, with SW141 switch plus JK48 jack and PL68 plug **Each—56 cents**

300 ea. CD605 cord assembly with PL55 plug and C410 xformer  
**Each—56 cents**

2000 ea. GE SELENIUM Rectifiers 2 plates 1" sq., input 12V a/c output 6V DC—150 m.a.  
**Each—49 cents**

1000 ea. UTC Transformers, subouncer Type SO-4. Pri 30,000 ohms, sec. 50 ohms. 1 ma winding, wt. 1/3 oz.  
**Each—\$1.29**

5000 ea. Min. Sensitivity Control Wirt #WC 807—2 to 15 ohms.  
**Each—6 cents**

TUBES Standard Brand—Ind. Boxed.  
OZ-4 . . . . . .72 117Z3 . . . . . .72  
35L6 . . . . . .82 6SN7 . . . . . 1.25

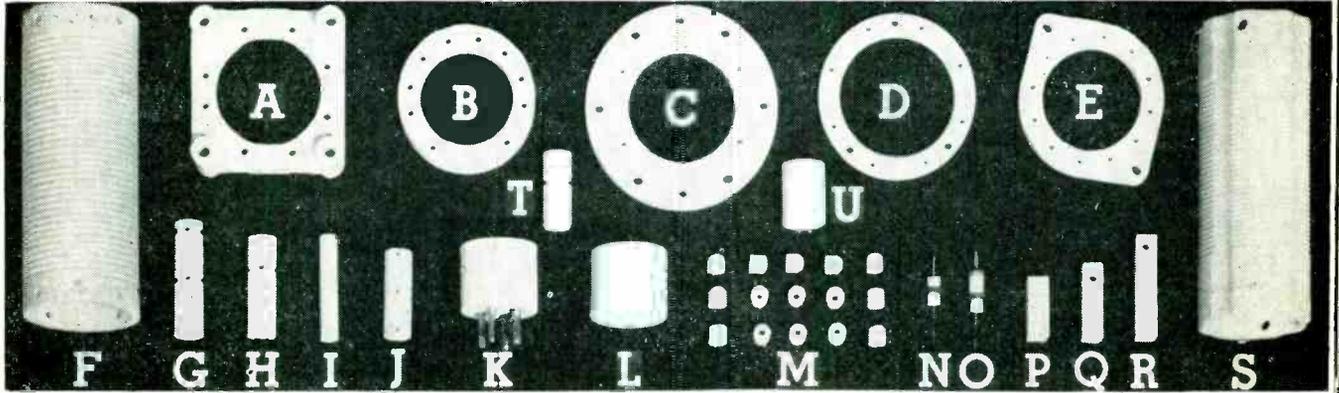
**WANTED**  
ANY QUANTITY EE-8 FIELD TELEPHONES  
State condition and price

Tel: Rector 2-1591

**ELECTRONIC SURPLUS BROKERS**  
148 Chambers Street New York 7, N. Y.

**10 MFD . . . . . 600 VOLTS . . . . . 57 CENTS**  
Although rated at 400V against an operating temperature of 72°C, these nationally famous 5+5 MFD capacitors will meet all commercial specifications and operate at 600V provided that the operating temperature does not exceed 40°C. Measuring 3 5/16 x 2 x 3 25/32 and packed 24 to a carton, weighing 42 pounds this item fills the need for an excellent filter and power correction device. Long lasting, extremely low in dielectric leakage and available in sufficient quantity for a large manufacturer. Small quantities—\$.57. Carton quantities—\$.45. Samples upon request.  
**WESTON LABORATORIES** Weston 93, Massachusetts

# "GIGANTIC" Ceramic CLEARANCE



TYPES A,B,C,D,E BASES FOR VARIOUS TUBE SOCKETS YOUR CHOICE .05

F - COIL FORMS 2" DIA 4 7/8" LONG. 35 GROOVES - - - - - .10

G - STANDOFF INS. 1/2" X 2 7/8" THREADED HOLE ONE END - - - - .02

H - STANDOFF INS. 1/2" X 1 5/8" AND 1/2" X 2" THREADED HOLE BOTH ENDS .02

I - INSULATED SPACERS 5/16" X 1 3/4" THREADED HOLE BOTH ENDS - .015

J - COIL FORMS 1/2" X 1 1/2" 28 GROOVES - HOLLOW - - - - - .02

K - 4 PRONG TUBE BASES - STANDARD - - - - - .10

L - 4 PRONG TUBE BASES LESS ALL PINS - - - - - .05

M - COAXIAL BEADS 5/16" X 3/8" - 1/8" HOLE (PER 1000) - 1.50

N - HIGH VOLTAGE FEED THRU INSULATORS 1/2" LONG 1 1/2" OVERALL - .02

O - HIGH VOLTAGE FEED THRU INSULATORS 3/4" LONG 1 5/8" OVERALL - .03

P - SQUARE INSULATED SPACERS 3/8" X 1" THREADED BOTH ENDS - .02

Q - SQUARE INSULATED SPACERS 3/8" X 1 1/4" THREADED ONE END - .02

R - SQUARE INSULATED SPACERS 3/8" X 1 3/4" THREADED ONE END - .02

S - THREADED COIL FORMS

YOUR CHOICE	10¢ EACH	Dia.	No. of Ribs	Winding Length	Overall Length
		2"	9	1-3/4"	5"
		2"	14	1-3/8"	5"
		2"	6	1"	5"
		2"	34	1-7/8"	5"
		2"	11	1"	5"
		2"	13	2-1/2"	5"
		2"	9	1-5/8"	5"
		2"	15	1-3/4"	6-3/8"
		3"	55	4-1/2"	5-1/4"

SEND FOR OUR LATEST BULLETIN ON CURRENT SPECIALS

T - ROUND INSULATED SPACERS 1/2" X 1 1/4" THREADED BOTH ENDS - .02

U - ROUND INSULATED SPACERS 3/4" X 1" THREADED BOTH ENDS - .03

SAMPLES SENT TO BONA-FIDE MFG. ONLY

MINIMUM ORDER 10.00



## UNIVERSAL RADIO SUPPLY CO.

1729 So. Los Angeles St. Los Angeles 15, Calif.



### TRANSMITTING MICA CONDENSERS

1 .01 MFD—1200v. DCW .45 ea.	
2 .003 MFD—2500v. DCW .45 ea.	
3 .0011 MFD—5,000v. . . . 2.00 ea.	
4 .005 MFD—5,000v. . . . 3.50 ea.	

### BATHTUB CONDENSERS

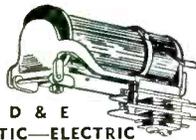
2x.05 MFD 600v. TT .30	.5 MFD 400v. ST .25
.25 MFD 600v. TT .25	.5 MFD 600v. TT .30
2x.25 MFD 600v. TT .35	1.0 MFD 400v. ST .30
.25 MFD 1,000v. ST .45	1.0 MFD 600v. TT .40

### UPRIGHT CONDENSERS

.1 MFD 600v. TT .25	1.0 MFD 1,000v. .45
1.0 MFD 600v. TT .35	1.5 MFD 330v. AC .40

2X2 Low Loss Tube Sockets .19

### TELEPHONE RELAYS



CLARE, TYPES C, D & E  
COOKE, AUTOMATIC—ELECTRIC  
ALL TYPES of COILS and PILE-UPS

Send Us Your Specifications For Our Quote  
SEND US YOUR NEEDS FOR OUR QUOTE

# Chase

Electronic Supply Co.  
105-07 225th St.  
Queens Village, N. Y.  
HOLLIS 4-5033

# - CONNECTORS -

AN

"3100"

"3101"

"3102"

"3106"

"3108"

101 & 102

A & B

Shell Types

In Stock

Black  
and  
Mellomyne  
Inserts  
in Stock

CLAMPS—ALL SIZES

Catalog On Request

QUICK SERVICE OUR SPECIALTY

# WILGREEN

99 Murray St., New York 7, N. Y.

For Immediate Delivery

Write or Phone - WORTH 2-7423-4-5



# WE HAVE LARGE QUANTITIES OF RADIO TUBES

TYPE	OUR PRICE	TYPE	OUR PRICE	TYPE	OUR PRICE	TYPE	OUR PRICE
OZ4A	\$0.80	6B8	\$0.93	6SK7	\$1.04	42	\$0.76
1A5GT	0.70	6B8G	0.93	6SK7GT	1.04	VR150/30	1.00
1G6GT	0.72	6BE6	1.20	6SN7GT	1.50	2E22	2.50
1LN5	0.90	6C4	0.95	6SS7	1.05	3AP1	8.75
1R5	1.60	6C5GT	0.51	7Q7	0.80	6C21	30.00
1S4	0.96	6C6	0.85	12A6	0.48	357A	22.50
1T4	0.96	6D6	0.68	12SG7	0.85	803	3.00
5U4G	1.40	6H6	1.04	12SH7	0.96	805	2.90
5V4G	1.58	6J5	0.86	12SK7	0.98	807	1.59
6AB7	1.20	6J5GT	0.51	12SQ7GT	1.22	808	1.70
6AC7	1.65	6K6GT	0.91	12SR7	0.90	813	7.00
6AK6	1.65	6K7GT	0.70	35Z4GT	0.85	830B	3.00
6AL5	1.24	6SG7	1.40	35Z5GT	1.15	866A	1.49
6AQ5	1.40	6SH7	0.80	50L6GT	1.30	9005	1.50

All tubes are brand new standard brands. This offer subject to change without notice and prior sale. Terms: 25% deposit with order, balance C.O.D. \$25.00 minimum order.

**MANUFACTURERS: Interested in EXPORT?**  
**CONTACT: MICHEL LEVIT**

## METROPOLITAN OVERSEAS SUPPLY CORPORATION

MANUFACTURERS AND DISTRIBUTORS OF ELECTRONIC PRODUCTS

1133 BROADWAY, NEW YORK 10, N. Y.

CHELSEA 3-1105

**RADAR**  
 SCR 545A Search and Track. Complete trailer, power supply and spare parts. Nearly new. Write for description and price.  
**PORTABLE PUMP ASSEMBLY**  
 Leland, 110 v. 60 c. 1 ph., 1/3 H.P. motor and D. Roper #2 hydraulic pump. 300 lbs PSI max., 125 lbs. PSI continuous @ 3.25 gallons per min. \$52.00

**SEARCH LIGHT**  
 Signaling, 12" Curtis Lighting, Inc. 115 v. a-c or d-c. 1000 watt. Complete w/bulb. Comes w/mounting assembly that gives 360° horizontal rotation and 180° vertical rotation. \$27.50

**AUTO-DRY-IRE**  
 Model 220. 115 v. 60 cy. for pressurizing high altitude electronic equipment. \$160.00

**MOTORS**  
 General Electric geared, 27 v. d-c @ 0.7 a., 110 RPM, 1 oz/ft torque. \$4.75  
 Electric 1/15 H.P., 115 v., 60 cy. 1 ph. 1800 RPM \$4.75

**GENERATOR**  
 Bendix model NEA3. Output 115 v. a-c 10.4 amps, 800 cy. SP. and 28.5 v. d-c, 80 amps @ 2400 RPM. Self excited, splined drive. New. Orig. packing. \$27.50

**BATTERY CHARGER TRANSFORMER:**  
 G. E. Cat. #WS-99316. Pri. 105-115-125 v. 60 c. Sec. 105-90-75-60-45-30 v. @ 6 amps. each side of center tap. Voltage reduced 10% and 20% thru tapped primary; two x 5v. 18 amp. C.T. (Tungar filaments) and two x 7 v. 10 amp. 7 1/4" h. x 8 3/4" w. x 5 1/2" d. Wt. 56 lbs. New, orig. packing. G. E. price \$52.00. \$17.50 for 30.00

**POWER SUPPLY COMPONENTS TRANSFORMERS**  
 Plate, American Transformer Co. Spec. 29108. Pri. 115 v. 60 cy. 10.4 KVA. Sec. 17,600 v., 520 amps., 35 KVA test. \$65.00  
 Plate, American Transformer Co. Spec. 29108. Same as above but center-tapped to handle 1 amp @ 8800 v. \$75.00

Filament, American Transformer Co. Spec. 29106. Type WS, .050 KVA, 50/60 cy. SP., 35 KVA test, 12 KV d-c operating. Pri. 115 v., Sec. 5 v., 10 amps. w/integral stand-off insulator and socket for #371, 872, etc. rectifier tubes. \$12.50  
 2 for \$22.50—4 for \$40.00

**CAPACITORS**  
 9.12 mfd., 1265 v. 60 c. a-c or 4000 v. d-c power factor correction 5.0 KV. A.R. Cat. #252908. \$17.50  
 25-.25, 6000 v. d-c or 125 @ 12,000 v. d-c. Past Cat. #A7548, oil. \$3.75  
 1.25/1.25 mfd., 7500 v. Cat. #26F360 \$12.50  
 2x.15 mfd. @ 8000 v. or .075 mfd. @ 16,000 v. Vitamin Q. \$2.90

**RESISTORS**  
 Fixed, w.w. 160,000 ohm. 200 w. ferrule ends \$1.00  
 Fixed, w.w. 5,000 ohm. 200 w. ferrule ends \$1.00

**METERS**  
 Meter only, less multiplier. \$4.95  
 Ammeter, a-c 3" Westinghouse NA-35 or Weston Model 478, 3 amps. f.s. deflection; scale calibrated 0-120, includes doughnut type current transformer w/200-5 ratio at 25-133 cy. \$8.50

**RELAY**  
 Magnetic overload, Allen-Bradley #810, 6.3-18.1 amps. 600 v. max. \$7.95

**WIRE**  
 Simplex type S. 600 V. (19) conductor #18 A.W.G. Approx. 1000' reels. \$170.00/M'

**RECTIFIER:**  
 Dry Disc, 6.5 v. a-c FWCT 2.2 v. d-c @ 3 amps. \$0.75 4 for \$2.00

**TRANSTAT:**  
 115/230 v. 50/60 c. 0-260 v. 2.5 amp output. \$17.50 2 for \$30.00

**CONTACTOR**  
 Allen-Bradley & Westinghouse, 115 v. 60 cy. coil, DPST, 15 amps. \$4.95

**HIGH VOLTAGE RECTIFIER POWER SUPPLY**  
 Variable output 0-15,000 v. d-c @ 500 ma. Input 115 v. 60 cy. SP. Army type RA-38. Size 6 3/4" x 5 3/4" x 5 5/8". Wt. 2040 lbs. Units are new, complete with spare tubes and remote control. Write for detailed information.

**NEW!**

- low prices
- values
- equipment
- components

Note: All merchandise not designated as new is guaranteed to be in excellent to new condition.

**EPCO**

1527 E. 7th St.  
 Los Angeles 21, Calif.

### JUST CHECK THESE BIG RED ARROW BARGAINS!

**SPECIAL!**  
 300 OHM TWIN LEAD TV LINE.  
 \$3.89 per hundred ft.  
 (\$35.00 per thousand ft.)

**TRANSMITTING MICAS—TYPE F2L**  
 .0001 @ 5000 V. .49c each  
 .00025 @ 5000 V. .49c each

**CORDS**  
 CD478—5 ft. long with Alligator Clips can be used as test leads. .19c pair  
 CD307A with PL55 and JK26. .69c each

**FP TYPE CONDENSERS**  
 10 MFD @ 400 V, 20-20 MFD @ 50 V. .49c  
 1000 MFD @ 15 V, 49c 10 MFD @ 250 V, 39c

**DYNAMOTORS**  
 PE 73—used, F/BC 375. \$4.95  
 PE 94—used, F/SCR 522. 4.95  
 DM 33A—brand new, original carton. 4.95

**LAST MINUTE SPECIALS!**  
 Tuning Equipment Test Set IE-6A, Excellent Condition. only \$59.00  
 BC-1160—Brand New. 49.00  
 BC-659 Receiver-Transmitter with Power Supply PE-120, Excellent Condition. 59.95  
 BC-1277 Signal Generator, Excellent and New Condition. 250.00  
 SCR-625 Mine Detectors, Brand New, Export Packed. 59.95  
 SCB-322, Excellent Condition. 39.95  
 BC-654 with PE-103A and 1 antenna bag with Antennas. 79.95

**MINIMUM ORDER \$2.00**  
 Immediate Delivery. Send 25% deposit with order, balance C.O.D. Shipped F.O.B. N.Y.C.  
 (N. Y. C. residents add 2% sales tax.)



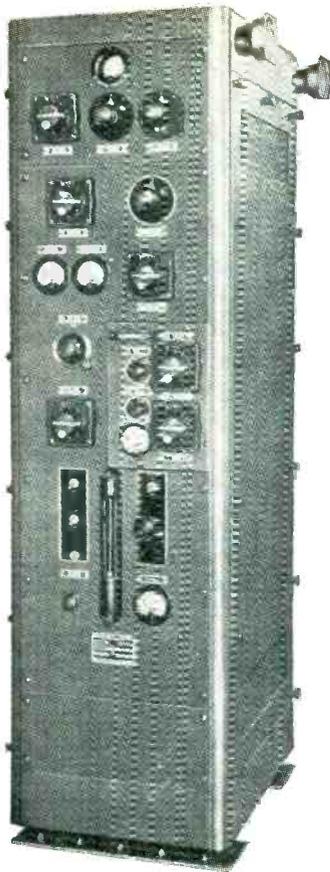
**SALES COMPANY**  
 Dept. T, 63 East Broadway, N.Y.C. 2, N.Y.  
 Phone—COrtlandt 7-5425

### RESISTORS

Immediate delivery from largest stocks of carbon domestic resistors 1/2, 1, 2 and 4 watt tolerances in 5—10 & 20%.

**STANLEY ENGINEERING AND MFG. CO.**

114 Liberty St., New York 6, N. Y. Phone Digby 9-0454



RCA Model MI-8167

## TRANSMITTERS

All NEW packed for export, LARGE QUANTITIES AVAILABLE for IMMEDIATE DELIVERY.

Freq. Range: 2000 to 20,000 Kcs.

Output: 350 Watts C. W.

250 Watts Radiophone

Input: 190 to 250 Volts AC 50/60 cps.

The MI-8167 was made for US Army point-to-point ground communications use. Extremely compact (Size: 60" high, 17" wide, 27" deep) and shock mounted. High speed keying and High Level Class "B" 100% modulation incorporated. No external coils needed—built-in band switching, antenna tuning, all front panel instantaneously operated. Complete with ten new tubes, (8C7s-813s-805s-866s) built-in shielded Master Oscillator Unit fully metered, with external speech amplifier. Net Wt. 595 lbs. Crystal oscillator also available.

Modern design and current model. Can be installed quickly and easily on land, on ships, or on mobile trucks. QUANTITY DISCOUNTS. Prices on request.

★ ★ ★ ★ ★ ★ ★ ★

### TRANSMITTER-RECEIVER COMBINATIONS

R.C.A. 10 Watt portable—mobile—aircraft. Receiver and transmitter; phone—CW, 6 or 12 volt input. NEW COMPLETE.

COLLINS TCS. 12 Volt DC or 110/220V AC input to transmitter and receiver. Complete with all accessories and remote control—speaker, spares available.

BENDIX 70 watt transmitter and receiver for 24/28 volt DC input. Complete and New, with spares.

R.C.A. Speech scrambler. New.

Other choice selected combinations for all purposes and power outputs.

Handy - Talkies, Walkie - Talkies, Portable Radar, Also Available. Pictorial Listings on Request.

## Communication Devices Co.

2331 Twelfth Ave. N. Y. 27, N. Y.  
Cable: COMMUNIDEV Tel: AD-4-6174, 5

## SELENIUM RECTIFIERS and ASSOCIATED COMPONENTS

### SINGLE PHASE Full Wave Bridge

Input: 0-26 VAC Type No.	Current	Output: 0-20 VDC Net Price
C1B1	.750	\$3.08
D1B1	1.5	4.00
E1B1	3.5	6.48
F1B1	6.0	8.64
G1B1	10.0	12.00
G1B2	20.0	31.80
G1B3	30.0	40.00
G1B4	40.0	40.00
G1B5	50.0	47.00

Input: 0-52 VAC Type No.	Current	Output: 0-40 VDC Net Price
C2B1	.750	\$5.84
D2B1	1.5	7.60
E2B1	3.5	12.38
F2B1	6.0	16.34
G2B1	10.0	22.40
G2B2	20.0	40.00
G2B3	30.0	54.00

Input: 0-130 VAC Type No.	Current	Output: 0-100 VDC Net Price
C5B1	.750	\$12.60
D5B1	1.5	16.20
E5B1	3.5	26.46
F5B1	6.0	33.84
G5B1	10.0	47.00

Input: 0-156 VAC Type No.	Current	Output: 0-126 VDC Net Price
C6B1	.750	\$14.16
D6B1	1.5	18.24
E6B1	3.5	30.02
F6B1	6.0	37.80
G6B1	10.0	54.00

### Full Wave Center Tap

Input: 13-0-13 VAC Type No.	Current	Output: 0-9 VDC Net Price
F1C1	6.0	\$ 4.50
G1C1	10.0	7.00
G1C2	20.0	12.00
G1C3	30.0	18.00
G1C4	40.0	22.40
G1C5	50.0	28.00

All ratings are maximum values for continuous duty to resistive loads. For capacitive, battery charging, or inductive loads, reduce these ratings by 20%.

### Powerstats



Smooth, efficient voltage control 0 to 35V. output from 115V. AC line.

Type 20 3 Amps. .... \$12.50  
Type 116U (illus.) 7.5 Amps. .... 18.00  
Type 1126 15 Amps. .... 46.00  
Type 1156 45 Amps. .... 118.00

Also available for 230 volt input.

Write for descriptive literature.

## POWER SUPPLIES



GENERAL PURPOSE low voltage DC power supplies, with variable outputs. Rugged—Dependable—Precision Control.

- ✓ Features
- ✓ Long life FULL WAVE SELENIUM RECTIFIERS
- ✓ Output voltage continuously adjustable from zero to maximum
- ✓ 3" Voltmeter and Ammeter—2% accuracy
- ✓ Stepless control
- ✓ 5-Way Binding Post
- ✓ Instant Power—no warm-up period
- ✓ Dimensions: 9x17½x9"
- ✓ Assembled and Ready to Operate
- ✓ For 115 VAC 60 cycles

Write for descriptive bulletin GPA  
Model Voltage Current  
GPA810 0-8 VDC 10 Amps.  
GPA1210 0-12 VDC 10 Amps.  
GPA2810 0-28 VDC 10 Amps.

### FILTER CAPACITORS

CF-1	1000 MFD	15 VDC	\$ .98
CF-2	2000 MFD	15 VDC	1.69
CF-3	1000 MFD	25 VDC	1.69
CF-19	500 MFD	50 VDC	1.95
CF-21	1200 MFD	90 VDC	3.25

Mounting clamps for above Capacitors in stock

### FILTER CHOKES

Type No.	Hv.	Amps DC	Res.	Price
HYX6	.055	.600	2.0	\$1.80
HY3A	.028	5.0	.2	6.30
HY10A	.014	10.0	.05	11.95
HY20A	.07	20.0	.02	16.75

### TRANSFORMERS

Type No.	All Primaries 115 VAC 60 Cycles	Volts	Amps	Shpg. Wt.	Price
TXF36-2	36	2.0	6 lbs.	\$5.95	
TXF36-5	36	5.0	8 lbs.	7.80	
TXF36-10	36	10.0	12 lbs.	11.95	
TXF36-20	36	20.0	25 lbs.	21.54	
XFC18-14	18VCT	14.0	10 lbs.	8.34	
XFC18-50	18VCT	50.0	17 lbs.	22.74	

All TXF Types are Tapped to deliver 32, 34, 36 Volts. XFC Types are tapped to deliver 16, 17, 18 Volts Center-tapped.

### ATTENTION MANUFACTURERS!

Extend your I/O rating to expedite delivery. We will do our very best to fill non-priority orders at the earliest possible date.

Minimum order \$5.00

All prices are FOB our Factory and subject to change without notice. Send M.O. or check. ONLY shipping charges sent COD. Rated concerns send P.O. Terms Net 10 days.

*Opad-Green*  
**COMPANY**

71-2 WARREN ST., NEW YORK 7, N. Y. PHONE: BEekman 3-7385-6

## DEPENDABILITY IN ELECTRONICS

WE ARE NATIONAL DISTRIBUTORS OF PARTS, TUBES AND EQUIPMENT. WE SOLICIT INQUIRIES FROM ORGANIZATIONS WHO APPRECIATE INTELLIGENT SERVICE AND HONEST PRICES, PARTICULARLY AT THESE CRITICAL TIMES.

**NORMAN RADIO DISTRIBUTORS INC.**  
94-29 MERRICK BOULEVARD JAMACIA, N.Y. - REpublic 9-4651

**RADAR MFGS. ATTENTION**

1000 pieces in stock of 7BP7 long persistence cathode ray tube. Original cartons.

**RG8/U COAXIAL CABLE**, poly. 1200 ft. reels 14¢ per foot. Less at 16¢ per foot.

**CHOKE**. Conservatively rated 165 MA, 5 Henries 160 ohm dc. 2 Inch High. 3 3/4" Mtg. Ctr. Worth \$3. **SALE PRICE**

**89 cents**

**POWER SUPPLY, PE204A**. Radiart to operate from 12 volts DC to supply plate & screen & DC filament volts to telephone repeater EE39 & TY14. Sealed in original packing cases with spare vibrator, cable, schematic, etc. \$9.95

**ANTENNA AN80-A, SC ZA-275** w MC299 connector for BC 645, 418 in stock.....\$ .98



**25 WATT WIRE WOUND POTENTIOMETERS**

Refer to Jan. Electronics for description. 2, 3-3, 15, 20, 25, 30, 50, 75, 100, 350, 500, 800 ohm—reg. \$3.12. **SALE PRICE**.....\$1.04  
1K, 3K, 5K.....\$1.20, 20K.....\$1.40

**PRECISION POTENTIOMETERS**

Leading Manufacture, Wire Wound 10, 12 ohm #301.....\$1.20  
15K, 2K, 5K, 20K-8 watt.....\$1.70  
100K 25 watt.....6.50

**CTS Wirewound POTENTIOMETERS**

These excellent controls were made to sell for \$2 each. They are the finest ww potentiometers made in the two and four watt size. The four watt has a 1-9/16" dia. x 1 1/16" metal body. The two watt has a 1-1/4" x 9/16" bakelite body. Both use DUAL wipers for extra quiet action. **SPECIAL PRICE**.....\$ .45

Four watt: 6, 30, 50, 100, 750, 1K, 1.5K, 2K, 3K, 4K, 7.5K, 10K, 15K, 20K ohm.  
Two watt: 20, 75, 200, 255, 300, 350, 500, 750, 1000, 2K, 5K, 10K ohm.  
Four watt TT also fine control with mica filled bakelite body: 2K, 5K, 10K, 20K. (Over 2000 each 5K in stock).....\$ .45



Special High Voltage Glass to Metal Seal for 3/16" hole 1 1/4" overall. #356.....\$ .10  
1000 for.....\$80-#356

**GLASS to METAL HEADER**, eight different color seals in 1x1x5/16" metal cap, Fusite #267535 our stock # 345. 1400 in stock.....\$ .22

**DIFFERENTIAL** Computer type Alum. body 1-13/16" O.D. x 7/16" thick. Overall length 1 3/4" with two ball bearings. No. 643268.....\$3.95

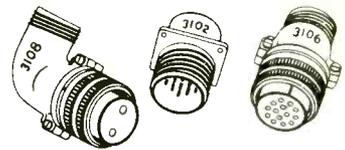
**VARIABLE SPEED DRIVE** cont. variable from 120 RPM in one direction through zero to 120 RPM in other. Uses differential & double ball & disk. 2vdc @ 1/2A input. 24 tooth 16 pitch gear output. #S67722-G1.....\$14.95

Widely Known for Fair Dealing and Good Service

**HAROLD H. POWELL**

632 Arch Street Philadelphia 6, Pa.  
Market 7-5650

**AN CONNECTORS IN STOCK AT 50% DISCOUNT**



3100, 3101, 3102, 3106, 3108 with any of following suffixes:



Insert	14S-12P	18-8P	20-9S	22-5P	22-29P	28-3P	32-9P
	16S-1S	18-9S	20-9P	22-6S	22-30S	28-4S	32-10S
	8S-1S	16S-1P	18-9P	22-6P	22-30P	28-4P	32-10P
	8S-1P	16-2P	18-10S	22-8S	22-36S	28-5S	32-16S
	10S-2S	16S-3S	18-10P	22-8P	24-1S	28-5P	32-16P
	10S-2P	16S-3P	18-11S	22-9S	24-1P	28-6S	32-20S
	10SL-3S	16S-4S	18-11P	22-9P	24-2S	28-6P	32-20P
	10SL-3P	16S-4P	18-12S	22-10S	24-2P	28-7S	36-1S
	10SL-4S	16S-5S	18-12P	22-10P	24-3S	28-7P	36-1P
	10SL-4P	16S-5P	18-13S	22-11S	24-3P	28-8S	36-3P
	12S-3S	16S-6S	18-13P	22-11P	24-4S	28-8P	36-7S
	12S-3P	16S-6P	18-16S	22-12S	24-4P	28-9S	36-7P
	12S-4S	16-7S	18-16P	22-12P	24-5S	29-9P	36-8S
	12S-4P	16-7P	18-20S	22-13S	24-5P	28-11S	36-9P
	12-5S	16S-8S	18-20P	22-13P	24-7P	28-11P	36-10S
	12-5P	16S-8P	18-22S	22-14S	24-9S	28-12S	36-10P
	14S-1S	16-9S	18-22P	22-14P	24-9P	28-12P	36-11S
	14S-1P	16-9P	18-30S	22-15S	24-10S	28-15S	36-15S
	14S-2S	16-10S	18-30P	22-15P	24-10P	28-15P	36-15P
	14S-2P	16-10P	18-31S	22-16S	24-11S	28-16S	36-19S
	14-3S	16-11S	18-31P	22-16P	24-11P	28-17S	40-1S
	14-3P	16-11P	20-1S	22-17S	24-12S	28-17P	40-1P
	14S-4S	16-12S	20-1P	22-17P	24-14S	28-18S	40-2P
	14S-4P	16-12P	20-2S	22-18S	24-14P	28-18P	40-9S
	14S-5S	18-1S	20-2P	22-18P	24-15S	28-19S	40-11S
	14S-5P	18-1P	20-3S	22-21S	24-15P	28-19P	44-1S
	14S-6S	18-2S	20-3P	22-22S	24-16S	28-20S	44-1P
	14S-6P	18-2P	20-4S	22-22P	24-16P	28-20P	44-4S
	14S-7S	18-3S	20-4P	22-23S	24-17S	32-1S	44-4P
	14S-7P	18-3P	20-5S	22-23P	24-18P	32-1P	44-9S
	14S-9S	18-4S	20-5P	22-1S	24-19P	32-6S	48-3S
	14S-9P	18-4P	20-6P	22-1P	24-20P	32-6P	
	14S-10S	18-5S	20-6P	22-2S	24-21S	32-7S	
	14S-10P	18-5P	20-7S	22-3S	24-28S	32-7P	
	14S-11S	18-6S	20-7P	22-4S	22-26P	28-2S	
	14S-11P	18-6P	20-8S	22-4P	22-27S	28-2P	
	14S-12S	18-8S	20-8P	22-5P	22-27P	28-3S	

**ONE OR A THOUSAND PIECES IMMEDIATE DELIVERY BRAND NEW PRODUCTION QUANTITIES**



1. 0-25 MILL DC METER—2 1/2" square "Hi-Tork" magnetic movement. Scale marked 3 V., may be reversed to expose blank white dial face. Complete with zero adjuster and mtg. clamp. \$1.25 each. 2. G. E. RELAY #CR2791-B109P36, 10 M ohm coil pulls in @ 8 ma. Plastic dust cover enclosed. S.P.D.T. double break contacts rated 3 amps. Non-sticking design good for 110 or 220 v.d.c. operation. 2" x 1 1/2" x 1 1/4". \$1.25 each. 3. 2MFD. @ 600V.—Oil filled MICAMOLD—2" diam. mtg. bracket for any position. Two stand-off terminals and hardware. 3 1/4" ht. \$5.95 for TEN. 4. SIX POLE DOUBLE THROW RELAY—Allied Control #BN-18D-39. Snap action operation @ 25 mills dc. 3000 ohm coil will operate on 75 volts. Contacts rated 10 amps. 5" x 2 1/4" x 1 3/4" \$3.95 each. 5. 1.2mfd. @ 600V.—Oil Filled SPRAGUE—Non inductive type. Can is common. Mtg. holes spaced 7/8". 1 1/2" diam. 1 1/2" high. \$2.50 for TEN. 6. D.C. SOLENOID—ECLIPSE AVIATION-TYPE 945 Model 1. Operates on 2 volts, 10 lbs. pull although rated for 24 V., 30 lbs. force @ 11 amp max. Stroke 1/2", push or pull. 2 1/2" x 3", wt. 3 lbs. \$4.95 each. 7. FIVE POLE ON-OFF SWITCH—A. H. & H. heavy duty marine type provides continuous rotation. Rated 10 amps. @ 125v. and 3 amps. @ 450v. Sections readily modified to give different switching sequence as one circuit on, four off; two on, three off etc. Complete with knob and indicator plate. \$1.49 each. 8. MICA LAB STANDARD—0.4 mfd @ 600 V. eff. 5% tol. Rated 25 amps @ 1 m.c., Aeronox. 3" x 3" x 2 1/4". \$4.95 each. 9. D.P.D.T. RELAY—ALLIED #B0635. 24V.D.C. coil, 230 ohms, contacts rated 10 amps. 1 1/4" x 2" x 1 1/4" \$1.49 each.

WRITE, WIRE OR PHONE Minimum Order \$5.00 Lister 5-0488

**RADIO DEVELOPMENT & SALES CO.**

323 Atlantic Ave. Dept. E Brooklyn 2, N. Y.

**SELENIUM RECTIFIERS**

Full-Wave Bridge UP TO 18 VOLTS AC INPUT UP TO 14 1/2 VOLTS DC OUTPUT  
2 Amps...\$2.50 8 Amps...\$6.00  
4 Amps...4.00 12 Amps...8.00

MANY OTHERS AVAILABLE Full Wave C.T., 3φ, Volt. DBLR, and 1/2 Wave Types Special rectifiers made to order Inquiries invited

**BARRY ELECTRONICS CORP.**  
136 Liberty St., N. Y. 6, N. Y.  
Phone: Rector 2-2563 Cable: Barrylect, N. Y.

**LOW FREQUENCY SQUARE WAVE GENERATOR**

**\$14.95**

Fundamental range—10 to 30 cycles Wave shape perfect steep sided & flat topped. This device is the answer to the problem of securing perfect low frequency square waves for testing the low frequency response of video and audio amplifiers.

**ELECTRONIC SPECIALTY PRODUCTS CO.**  
92 East End Ave. New York 28, N. Y.

**TUBE SPECIALS**

VR-150	1.05	394-A	4.50
1B38	30.00	5BP1	4.50
1LC6	1.15	5CP1	4.25
ILH4	1.15	6SJ7	1.50
307-A	4.95	707-B	22.50

**ARCBY ELECTRONICS**  
103 West Liberty  
Louisville, Ky.

# NEW YORK'S RADIO TUBE EXCHANGE

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
OA2	3.00	3C24	2.50	323A	25.00	722A	3.95	876	1.90
OA3	1.50	3C45	13.95	327A	3.95	723A B	18.95	878	1.95
OA4	1.35	3DP1 A	10.95	350A	7.95	724A	4.95	884	1.95
OB2	3.00	3E29	15.50	350B	5.95	724B	6.95	885	1.75
OC3	1.75	SN4	5.50	357A	27.50	725A	9.95	889R	199.50
OD3	1.50	4A1	1.75	368AS	6.95	726A	6.95	913	12.95
CI A	4.95	4C27	25.00	371B	1.95	726B	56.00	914	75.00
G1B	6.95	4J25	199.00	385A	4.95	726C	69.00	931A	8.95
1B21A	2.75	4J26	199.00	388A	2.95	728AY	27.00	954	25
1B22	3.95	4J27	199.00	393A	8.95	730A	4.95	955	.55
1B23	9.95	4J30	395.00	394A	8.95	801A	1.00	956	.69
1B24	17.95	4J31	99.00	MX408U	.75	802	3.60	957	.19
1B26	2.95	4J32	99.00	417A	17.55	803	5.95	958A	.49
1B27	19.50	4J33	99.00	434A	0.95	805	5.95	959	.69
1B32	4.10	4J37	99.00	446A	1.95	807	1.69	975A	17.95
1B38	33.00	4J38	89.00	446B	2.95	808	4.95	991	.45
1B42	19.95	4J39	99.00	450TH	45.00	809	2.45	1280	1.95
1B56	49.95	4J41	99.00	450TH	45.00	810	11.00	1611	1.95
1B60	69.95	4J52	350.00	464A	9.95	813	7.95	1613	1.08
1N21	1.35	C51	2.95	471A	2.75	814	3.95	1616	2.95
1N21A	1.75	5BP4	4.95	527	15.00	815	5.25	1619	.89
1N21B	4.25	5CP1	4.95	WL530	22.50	829	9.95	1620	5.95
1N22	1.75	5CP7A	15.00	750	7.50	829A	11.95	1622	2.75
1N23	2.00	5D21	27.50	701A	7.50	829B	15.95	1624	2.00
1N23A	3.75	5J23	45.00	703A	6.95	830B	11.50	1625	.45
1N23B	7.00	5J29	705A	705A	3.95	832	5.95	1629	.69
1N27	5.00	5JP1	27.50	706AY	48.50	832A	9.95	1851	1.95
1N48	1.00	5JP2	17.50	706CY	48.50	833A	49.95	2051	1.80
1S21	6.95	5JP4	27.50	707A	17.50	834	7.95	8012	4.25
2B32	4.95	5LP1	18.95	707B	27.00	836	4.95	8013	2.95
2B4	3.75	6C21	29.50	714AY	5.95	837	2.95	8013A	5.95
2C34	.85	6C6A	3.95	715A	7.95	838	4.95	8014A	29.95
2C39	32.00	6C6J	7.95	715B	15.00	845	5.95	8020	3.50
2C40	27.00	7BP7	7.95	715C	25.00	849	52.50	8025	6.95
2C43	27.00	7DP4	10.00	717A	1.75	851	89.50	9001	1.75
2C44	.90	12AP4	55.00	718AY EY	48.50	860	4.95	9002	1.50
2D21	1.75	15R	.95	719A	29.50	861	39.50	9003	1.75
2E22	3.75	NE16	.45	720A B/C/D	95.00	866A	1.79	9004	.75
2E30	2.75	FGI7	6.95	721A	3.95	869B	29.50	9005	1.90
2J26	17.75	RX21	3.95			872A	3.95	9006	.35
2J27	29.95	35T	4.95						
2J31	39.95	RK39	2.95						
2J32	69.95	RK72	1.95						
2J36	105.00	RK73	1.95						
2J38	17.95	100TH	9.00						
2J42	150.00	FG105	19.00						
2J49	109.40	F123A	8.95						
2J50	69.50	203A	8.95						
2J61	75.00	211	19.75						
2J62	75.00	217C	18.00						
2K25	47.50	242C	10.00						
2K28	47.50	249C	4.95						
2K29	27.50	250TH	19.95						
2K45	299.50	274B	3.00						
2Y3G	2.10	304TH	15.00						
3B21	5.50	304TH	14.50						
3C24	2.50	307A	4.95						
EL3C	5.95	310A	7.95						
3C22	72.00	312A	3.95						

**ATTENTION PURCHASING AGENTS AND BUSINESS MANAGERS**

WE BUY—WE SELL—WE EXCHANGE—WILL PAY CASH FOR YOUR INVENTORY NO MATTER HOW SMALL OR LARGE. —TURN YOUR OVERSTOCKED ITEMS INTO CIRCULATION

**Microwave K Band 24,000 MC.**  
 TSK1-SE Spectrum Analyzer 8.95  
 K Band Flap Attenuator .55  
**X Band**  
 4X X Band Spectrum Analyzer .69  
 TS 12 Unit 1 USWR Measuring Amplifier, 2 channel .49  
 TS 12 Unit 2 Plumbing for above .69  
 TS 33 X Band Power and Frequency Meter 17.95  
 TS 35 X Band Pulsed Signal Generator .45  
 TS 36 X Band Power Meter 1.95  
 TS 45 Band Signal Generator 1.95  
 TS 146 X Band Signal Generator 1.08  
 TS 263 Navy Version of TS 146 2.95  
 TS 62, TS 102, TS 168 .89  
 X Band Magic T Plumbing 5.95  
 X Band Tunable Crystal Mounts 2.75  
 TVN #3EV Bridge 2.00

**S Band**  
 4S S Band Spectrum Analyzer .69  
 TS3A/AP S Band Power and Frequency Meter 1.95  
 TS 125, TS 155 1.80  
 RF 4 Electrically Tuned S Band Echo Box 4.25  
 BC 1277/60ABQ S Band Pulsed Signal Generator 2.95  
 PE 102 High Power S Band Signal Generator 5.95

**L Band**  
 Hazeltine 1030 Signal Generator 145 to 235 Megacycles 3.50  
 Measurements Corp. type 84 Standard Signal Generator 6.95  
 TS 47, 40 to 400 MC Signal Generator 1.75  
 TS 226 1.50

**Broadcast Wave Bands**  
 162C Rider Chanalyst 1.75  
 Short Wave Adapter for 162C .35  
 TS 174 Signal Generator

**Oscilloscopes**  
 TS 239A Lavoie ATAI0, ATA28  
 BC 1287A used in LZ sets TS 34 Oscilloscopes WE Supreme 564

**Audio Frequencies**  
 RCA Audio Chanalyst  
**Other Test Equipment and Meters**  
 TS 15/A Magnet Flux Meter  
 General Radio V T Voltmeter 728A  
 Calibrator WE 1-147  
 General Radio 1000 cycles type 213  
 Limit Bridges  
 Boonton Standard Inductances  
 Weston Meters types 430, 429, 741  
 Model 40 Prometer  
 Rawson, meters 0-10 Microampere 0-2 Millivolt  
**RADAR Sets & Parts**  
 APS 3—APS 4—SCR 284  
 R-111/APR5A Receivers

WE 701A can be used for a Super 813

\$25.00 Minimum Order



LIBERTY ELECTRONICS, INC.

PHONE WORTH 4-8262

135 LIBERTY ST., NEW YORK 6, N.Y.

## ASTRO COMPASS

The Astro Compass is a precision instrument measuring 8 1/4" high x 5 1/4" wide. Furnished in Carrying Case. Designed to provide accurately a. True heading of Aircraft or boat. b. True bearing of a distant object. c. The relative bearing of distant objects.



Of special interest to Astronomers & Experimenters.

\$8.75 Each

## TELEPHONE RELAYS

Clare type C

1—3300 ohms 2 n.o. 1 n.c. .... \$1.35 ea.  
 2—4 ohms 1 n.o. .... 1.35 ea.  
 Double Coil, 12 or 24 volts 210 ohms each coil. Contacts 3 make 2 break ..... 1.25 ea.

## G. E. LAMP #1142

12-16 volts 21 C.P. Auto. Rayonet Base  
 Box of 10 ..... .42 per box

## DIEHL Pilot Motors #802077

SSPDE-14-2 24V DC 1 1/2" Diam. x 2 1/2" long. Shaft 1/4" x 1" ..... 3.95 ea.

## HAYDON SYNCHRONOUS TIMER

Having a 30 minute on and 30 minute off cycle 10 Amp. capacity. Totally enclosed in metal case. 2 1/2" diam. x 2 1/2" high with 3/4" mounting flange. 110v AC 60 Cye. 5.10 ea.

Minimum order \$2.00.

All prices, net FOB New York  
 Immediate Delivery

## B & B DISTRIBUTORS

222 Fulton St. New York, 7, N. Y.  
 Rector—2-0432

## Brand New Standard Brand RADIO TUBES

1B3	5U4G	6AL5	6J6	7F8	19T8
1X2	5V4G	6AU6	6K6	7Z4	35B5
1R5	5Y3G	6BG6	6SN7	12AT7	35W4
1S5	6AC7	6BH6	6T8	12AU7	50B5
3Q5	6AG5	6BJ6	7A8	12BE6	50L6

THIS IS ONLY A PARTIAL LISTING. WE HAVE A VIRTUALLY COMPLETE LINE OF ALL TYPES IN STOCK. PRICES ON REQUEST. TERMS: 25% DEPOSIT WITH ORDER, BALANCE C.O.D.

## TELETUBE CORP.

136 LIBERTY ST. NEW YORK 6, N. Y.

Phone: Digby 9-0968-9

Cable: Teletubes, N. Y. C.

## WHOLESALE ONLY

ELECTRONIC COMPONENTS  
 AIRCRAFT EQUIPMENT  
 HYDRAULICS

RADIO & ELECTRONIC SURPLUS  
 13933-9 Brush St. Detroit 3, Mich.  
 Phone Townsend 9-3403

## ELECTRONIC TUBE-MAKING MACHINERY

For manufacturing radio tubes, electronic tubes, cathode-ray tubes, lamps. New and used. Reasonably priced, satisfaction guaranteed.

AMERICAN ELECTRICAL SALES CO.  
 67 E. 8th St. New York, N. Y.

## WESTINGHOUSE HIPERSIL CORES

OVER 20,000 UNITS IN SEVERAL DIMENSIONS. AVAILABLE FOR IMMEDIATE DELIVERY. SEND FOR LIST WITH COMPLETE DESCRIPTIONS.

## RAYTHEON MFG. CO.

Surplus Sales Dept. Waltham, Mass.  
 Tel. Waltham 5-5860—Ext. 2

# BRAND NEW STANDARD BRAND TUBES

OB3 VR90	\$1.25	3A4	.55	7F7	.95	530	12.50	802	4.49	869B	39.50	8011	.98	CATHODE RAY TUBES	
OC3 VR105	1.25	3E7 1291	.49	10Y	.75	531	3.95	803	3.95	872A	2.39	8013A	4.95	3CP1/S1	1.95
OD3 VR150	1.05	3H22 ELIC	2.75	24G	1.95	533	175.00	804	9.95	874	1.49	8020	1.50	3DP1	4.95
1B22	3.25	3H26	3.75	39 44	.49	559	3.95	805	3.95	876	.59	8021	2.89	3FP7	1.95
1B23	8.50	3C24	1.95	45 Spec	.35	700A	27.50	807	1.69	879	1.43	8025	4.95	4AP10	4.95
1B24	8.75	3C28	4.95	100TH	8.75	701A	4.95	810	10.95	931A	5.75	8025A	7.95	5AP1	3.49
1B26	2.75	3D6 1299	.49	152TH	19.95	702A	3.49	811	2.95	954	.35	9001	1.95	5CP1	3.95
1B27	19.95	3D23	4.95	205B	3.95	703A	7.49	812	2.95	955	.55	9002	1.49	5CP7	3.95
1B29	4.75	4A1	1.75	211	.75	704A	1.00	813	8.49	956	.69	9003	1.25	5CP7	3.95
1B36	23.75	4H28 S2894	4.75	217C	18.00	705A	2.89	814	3.95	957	.35	9004	.45	7BP5	18.95
1B56	47.50	4E27 257B	15.95	250R	18.95	707A	12.95	815	2.49	958A	.49	9005	1.90	7BP7	6.95
1D8GT	.89	4J22	149.50	250TH	23.25	707B	17.50	829	11.95	959A	.69	9006	.35	7BP7	12.95
114	.89	4J26	159.75	250TL	19.95	708A	4.75	829B	14.95	1608	4.95	C5B	8.95	9LP7	18.95
1R4 1294	.69	4J34	195.00	285A	10.95	710A/8011	.98	830B	3.75	1609	4.95	C6A	6.95	101P4	21.50
2C22 7193	.35	4J35	195.00	286A	18.95	713A	1.25	832A	9.95	1613	.99	C6I	5.95	12LP4	22.25
2C26	.39	4J42 700A	27.50	304TH	18.95	714AY	12.95	832B	8.95	1616	.95	CRP72	1.98	12LP4A	26.50
2C34 RK34	.29	5D21	24.50	304TL	19.95	715A	6.95	836	2.95	1619	.45	E1148	3.35	14BP4	37.00
2C40	4.95	6A15	2.25	307A	5.75	715B	12.75	838	2.95	1624	1.75	FG81A	7.69	16DP4A	34.00
2C44	1.49	6R8	.98	310A	6.95	715C	24.50	843	.75	1625	.45	FG104	19.95	16RP4A	37.00
2J22	7.95	6C8	.88	316A	1.50	721A	4.95	846	49.95	1626	.45	HY114B	.75	17AP4A	62.00
2J26	24.50	6C21	19.95	329A	8.95	722A	2.49	851	49.50	1629	.38	HY615	.29	19AP4B	62.00
2J36	89.50	6F4	5.75	331A	11.95	722A/B	19.95	860	5.95	1636	3.25	REL5	175.00	20CP4	68.50
2J61	48.75	6J4	5.95	353A	4.95	723A/B	3.75	861	24.50	1642	.98	RK25	3.95	TUNGAR BULBS	
2J62	48.75	7A7	.89	371B	.95	724B	12.95	864	.75	1851	1.75	RK34	1.65	6 AMP	
2K25	24.95	7C4	.49	388A	1.50	725A	13.95	865	1.39	2051	.95	RK73	1.65	#289414	4.75
2V3G	.98	7E5	.79	450TH	39.50	730A	13.95	865	1.39	2051	.95	VT98	175.00	Westinghouse Rectigon	
2X2	.75	7E6	.69	450TL	44.50	801A	.49	866A	1.35	7193	.35				

## MARITIME INTERNATIONAL COMPANY

11 State Street, New York 4, N. Y.

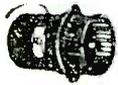
Cable Address "Foxcroft"

Phones: Dlgby 4-3192-3



Cap. 10% "L", 5% "H", 3% "W".... \$7.50 ea.

AMMETER, 150/300 dual range Triplet 341A 3 1/2" rectangular flush bakelite 5 amp Movement @ \$4.95 with external current transformer for 150 amp. Only \$7.50



**DELCO BLOWER** — sirocco type D.C. Flange diameter 3 1/2" blade 3-3/16" RPM @ 12 volts 3400 RPM @ 6 volts 1600 ..... \$3.95



G. E. Model 6RS 5FB3 full wave 3 plate bridge (12 plates) maximum A.C. input 54 volts maximum D.C. output 40 volt D.C. current 0.150 ..... \$1.15 ea.



**SILVERPLATED REFLECTOR**—Overall Dimensions 4 1/2", Reflecting Surface 4 1/4", Depth 1 1/2". Individually boxed 25¢ ea. \$20.00 per 100.



Miniature lamp T1 1/4, 3 volt .19 amp. Airplane Indicator, Amb. Ctd. 10 for ..... \$1.00 100 for ..... \$8.50

**VOLTMETER** Weston 833 130v. A.C. 400 cycles 2 1/2" flush bakelite Aircraft mounting black scale Fluorescent numerals removed from new equipment..... \$3.50

SEND FOR FREE BULLETIN

Telephone Dlgby 9-2188-9



**A. Cottone & Company** ELECTRONIC MECHANICAL & OPTICAL COMPONENTS 336-340 CABEL ST., NEW YORK 9, N.Y.

ALL PRICES F.O.B. N. Y. CITY

### SURPLUS COMPONENTS FOR SALE

Bathtubs, oils, micas, xformers, chokes, relays, trimmers, sockets, odd items, etc.

Surplus lots purchased.

**EMPIRE ELECTRONICS**

Box 41, Midwood Stat., Brooklyn 30, N. Y. Phone BRyant 9-1220

### SHEET METAL MACHINERY

NEW & USED — COMPLETE LINE OF

Box Brakes, Press Brakes, Notchers, Shears, Punches, Rolls, Spot Welders — Di-Acro, Pexto, Whitney Equipment, etc.

**B. D. BROOKS, INC.** 361 Atlantic Ave. Boston, Mass. Tel. HANcock 6-5200

## FOR SALE FIELD TELEPHONE EE108

IN LEATHER CASES

SOUND POWERED

No Batteries Needed

BRAND NEW

\$20.00 Each

**TALLEN CO., INC.**

562 ATLANTIC AVE.

BROOKLYN 17, N. Y.

## BRAND NEW TUBES

1B22	\$2.95	354	.98	707B	14.95
1B27	17.95	4C35	29.95	717A	1.49
1B38	29.95	4J31	89.50	723A/B	14.95
2C40	4.49	6AB7/1852	1.39	724B	2.75
2C44	1.44	6AN5	4.95	725A	6.95
2C51	4.95	6BE	1.39	726C	49.50
2D21	1.59	6SH7GT	.89	832	5.95
2J21A	14.95	12A6	.98	832A	9.95
2J22	22.95	12H6	.89	837	1.95
2J31	34.50	32L7GT	.79	872A	1.95
2J32	37.50	250R	9.95	884	1.75
2J33	37.50	304TL	22.95	1616	1.38
2J34	37.50	446A	1.19	1619	.29
2J62	41.50	446B	1.65	1625	.45
3B24	3.50	700A/B/D	16.95	8020	1.98
3E29	19.95	706CV	39.50	8025	4.95
3Q4	.98	706GY	49.50	9003	1.75
9001	1.75	19002	1.50	19005	1.75

Send us your inquiries! We carry a complete stock of Radio and TV Receiving Tubes. We also buy surplus stocks in tubes!

**J. S. H. SALES CO.**

Dept E 7552 Melrose Ave., Los Angeles 46, Calif.

### CONNECTORS - CLAMPS

WK—1—32.5

4—21—

GK—9—21—

C.4—21.C—

SK—L.3—21—

C.16—32—5

RFK—10—24.C

IN STOCK

**DAVID GREENBERG**

99 Murray St.

N. Y. 7, N. Y.

Barclay 7-4862

**M-359 . . . 35c ea**

per 100—\$29.50

**IN STOCK**

## "AN"

Ferrules

CONNECTORS

Clamps

etc.

3100

3057-3

3050

3101

3057-4

3051

3102

3057-6

3052

3106

3057-8

3053

3108

3057-10

3054

3057-12

3055

3057-16

3056

3057-20

3060

3057-24

3061

3057-28

3062

3057-32

3063

3057-40

3064

97-3057

3066

10-6

3068

ALL TYPES OF "AN" HARWARE

Phone or write

Immediate Delivery



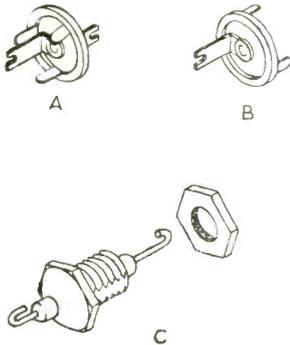
## Somebody—Somewhere,

needs your idle equipment! Reach that buyer quickly and economically thru the

**"SEARCHLIGHT SECTION"**

The meeting place of Used Equipment Buyers and Sellers

# CERAMIC FEED THRU CAPACITORS



Type A—300 mmf—100 for \$20.00  
 Type B—300 mmf—100 for \$20.00  
 Type C— 55 mmf—100 for \$10.00

## ELECTRO IMPULSE LABORATORY

62 White St. Red Bank, N. J.

### TEST EQUIPMENT WANTED

Because the nation's defense efforts are being accelerated, an unusual opportunity exists to dispose of high quality test gear at high prices. If you own any of the following pieces, please write or call us collect. We will promptly advise you of our best offer.

LAE	TS14	TS100	TS239
LAF	TS33	TS111CP	TS263
LAG	TS33A	TS155A/AP	TS268
1208	TS34/AP	TS155B/AP	TS270A
1222	TS34A/AP	TS173/UR	TS323
TS3/AP	TS35	TS174	TSK-45E
TS12	TS36	TS175	TS5-45E
TS13	TS47APR	TS195	TSX-45E

We will also purchase Rad-Lab equipment, GR, Ferris, Boonton, Stoddart, Dolittle, Hewlett-Packard, etc. Prompt replies assured.

**WESTON LABORATORIES**  
 Weston 93, Massachusetts

### 1951 TUBE HQ

2E24	\$ 3.95	RK65	24.95
2J26	5.00	71P4	\$ 18.50
2J36	89.95	10BP4	24.00
2J48	13.50	12LP4A	25.00
2J61	25.00	14BP4A	26.25
2K45	150.00	16HP4A	33.00
(3 Cm. Klystron)		16RP4A	33.00
3DP1-A	3.50	17BP4A	34.00
5D21	19.95	20CP4A	57.50
5J23	9.95	024/024G	.90
5JP1	22.50	1B3GT	1.50
6D4	5.00	1X2/1X2A	1.65
6F4	5.95	3S1	1.10
6J4	5.00	5W4G	1.30
715-C	19.95	5X4G	.95
813	8.95	6J5GT	.70
832-A (RCA)	10.95	6J7M	1.50
832	5.75	6T8	1.50
872-A	2.95	6AL5	1.00
892-R	200.00	6AH6	2.20
100-TH	9.50	6AU5GT	1.95
250-TH	19.50	6BY5G	2.15
304-TH	19.95	12BH7	2.00
450-TH	29.95	12AT7	2.40
RK38	19.95	25L6GT	.95
RK63	19.95		

ALSO MANY OTHER TYPES IN STOCK—INCLUDING TV TYPES YOUR REQUIREMENTS?

Maguire Deluxe Mobile 75 Meter Xmttr, New, Complete. Just right for Aircraft and C.A.A. \$25.00

Phone: REctor 2-2563 Cable: Barrylect, N. Y.

*Barry Electronics Corp.*  
 Dept. E-325

136 Liberty Street, New York 6, N. Y.  
 25% Deposit with Orders—Or Send full remittance to Save COD charges.  
 All Merchandise Fully Guaranteed.

## SURPLUS EQUIPMENT

### BODINE GEAR HEAD MOTORS



10:1 Gear Ratio; Motor operates: 24 VDC, 2 Amps, 1/50th H.P., 5000 RPM.  
 New . . . . . \$12.50 ea.

### RATE GENERATORS

J-36 DC Voltage Generators Eastern Air Devices (Mfg.)  
 Like New . . . . \$10.00 ea.



### PIONEER AUTOSYNS

AY-1 . . . . . 26 volt-400 cycle . . . . . \$4.95  
 AY-5 . . . . . 26 volt-100 cycle . . . . . \$5.95  
 (Has hollow shaft)

### KERMIN SYNCHRONOUS 4 RPM MOTOR

NEW . . . . . \$2.95 ea.



NOISE FILTERS . . For 153H Holtzer Cabot Inverters (Mallory & Co.) . . LIKE NEW \$4.50 ea.

### INVERTERS . . . . .

#### PE 218 LELAND ELECTRIC

Output: 115 VAC; single phase PF 90; 380/500 cycle; 1500 VA.  
 Input: 25-28 VDC; 92 amps; 8000 RPM; Exc. volts 27.5.

Brand New . . . \$39.95 ea.

#### 12116-2-A PIONEER

Output: 115 VAC; 400 cycle; single phase; 45 amp.  
 Input: 24 VDC; 5 amp. . . . . \$90.00

#### 12130-1-A PIONEER

Output: 115 VAC; Single phase; 400 cycle; Amps S8; 100 VA. Input: 18-28 VDC; 20 Amps.  
 \$80.00 ea.

#### 10486 LELAND ELECTRIC

Output: 115 VAC; 400 cycle; 3 phase; 175 VA; .80 PF. Input: 27.5 DC; 12.5 Amp; Cont. Duty.  
 \$90.00 ea.

#### F15-1 JACK & HEINTZ

Output: 115 VAC; Single or 3 phase; 400 cycle; 250 VA with voltage adjustment. Input: 27.5 VDC; 20 amp . . . . . \$120.00 ea.

#### 12130-1-B PIONEER

Output: 122.5 AC; Single phase; 400 cycle; 141 VA  
 Input: 20-30 VDC; Amps 12-18. . . . . \$30.00 ea.

#### TYPE 778-4 ECLIPSE

Output: 26 VAC; 400 cycle; 60 Va. Output: 115 VAC; 400 cycle; 190 VA. Input: 24 VDC. . . . . \$35.00 ea.

#### 10563 LELAND ELECTRIC

Output: 115 VAC; 400 cycle; 3-phase; 115 VA; 75 PF. Input: 28.5 VDC; 12 Amp. . . . . \$80.00 ea.

5D21N3A GENERAL ELECTRIC: Output: 115 VAC; KVA 485; PF 1; 400 cycle; single phase. Input: 27 VDC; 35 Amps. . . . . \$25.00 ea.

EQUIPMENT FULLY GUARANTEED

ALL PRICES F.O.B. PASADENA UNLESS OTHERWISE SPECIFIED

PLEASE ENCLOSE FULL AMOUNT WITH ORDER

**C and H Sales Company**

BOX 356-E EAST PASADENA STATION • PASADENA 8, CALIFORNIA

## WE ARE NOT IN THE PLUMBING SUPPLY BUSINESS

— But yet we have 1/4 million bathtubs —

This is only a partial listing of oil bathtub cased capacitors in our stock.

.02 - .05 - .1 - .25 - .5 - 1.0 - 2 & 4 MFD  
 at 50 - 100 - 200 - 400 - 600 - 1000 VDCW

Single - Dual - Triple cased units with top, side & bottom terminals. Most types in very large quantities. Send us your requirements.

### ELECTRONIC SPECIALTY SUPPLY CO.

92 East End Ave.

New York 28, N. Y.

### SORRY, NO RETAIL

375 Telekeys, cast base (quality key).  
 50M Moulded Bushings for Pencil Flashlights.  
 30M Two-prong Sockets (for batteries).  
 1800—Jan 559 RCA Boxed Tubes.  
 1500—371A & 371B Jan Tubes.  
 1500—800 RCA — 2000—1630 RCA Boxed Jan.  
 75—1AP10 CR Tubes—15—5 CPI Tubes CR.  
 50—Dynamotor AD-2—14V.—3A.—220V.—06A.  
 1050—Altitude Warning Signal Type H3. Each unit consists two DPDT Relays; two Micro SW. — BZ-R-101, 15A-22HV. SPDT. One Amphenol Connector: AN-3102-15S-8S. One High-Altitude Wafer Cell. One Low-Altitude Wafer Cell. Blue Anodized Alum Housing 5" x 4" x 3".  
 400—2-tube Ampl. (Chassis only, no Tubes or Soker).  
 600—3-tube Ampl. Chassis (partly assembled).  
 500—Dual Coil Sets (F & N Ranges) for RU-17 Aircraft.  
 500—Coil Sets CW 47135 (Range 2000-2500 KC).  
 50M—Pilot Lights, Screw Base—4 & 6 volt.  
 3000—2650 Mfd., 3 VAC, Sprague & Solar FP.  
**GOULD GREEN**  
 252 Greenwich St. N. Y. C. 7

### D.C. MICROAMMETERS

0-200 ua 3" sq. G.E. DO 50 . . . . . \$ 9.00  
 0-100 ua 3" sq. G.E. DO 50 . . . . . 10.00  
 0-50 ua 3" sq. G.E. DO 50 . . . . . 12.00

### PRECISION PORTABLE INSTRUMENTS

Single or multi-range

D.C. Microammeters, from 5 ua full scale. Thermo-couple Milliammeters, from 1.5 Ma. Thermo-couple voltmeters.

### Precision Electrical Instrument Co.

146 Grand Street New York 13, N. Y.

# TUBES LARGE STOCK

Most All Types

Write Us Your Needs

Subject to Prior Sale

## NAT ADELMAN

168 Washington St., N.Y. 6, N.Y.

C07-6091

We Buy Surplus Stocks of  
Tubes and Electronic Parts

**PRECISION RESISTORS**  
1% TOLERANCE

Wirewound types.....49c.	10/\$4.50
120K WW3	15K WW3
95K WW1	10K WW3
80K WW4	8K WW1
50K WW4	7.5K WW3
30K WW3	5K WW3
25K WW4	4K WW3
20K WW3	2.2K WW3

**RELAYS—Sensitive Miniature Types**

#H7334-4, SPDT plus SPST, 10,000 coil—4Ma.	\$1.25
Price #TB302—DPST plus SPST, Cer. Ins., 24 Volt	.95
Cook #55520—SPDT plus SPST, Cer. Ins., 24 Volt	.85
Sigma SPDT—2 Volts, 130 Ohms	1.95
Sigma SPDT—10,000 ohms, 2 Mils.	2.95

**ROTARY SWITCHES—**

2P3T \$ .35; 3P6T \$ .40; 1P11T \$ .40	
2P11T \$ .55; 7P4T \$ .50	

SPEC.—GF KW Hr Demand Tot. Meter—Has 1 RPM Synchron. Motor—120 Volts, 60 Cy. Less case..... \$1.25

**F. M. ELECTRONICS COMPANY**  
92 East End Ave. New York 28, N. Y.

## I-208 FM Signal Generators

A limited number of this finest available laboratory instrument is offered subject to prior sale. Specifications are:  
Range: 1.9-4.5 mc. & 19-45 mc.  
Deviation: 0-5 kc. each side of center frequency in first range and 0-50kc. each side in second band.  
Modulation: internal 150, 400, 1000, 2500, or 5000 c.p.s. Provision for external source.  
Accuracy: .03% with aid of internal 500kc. crystal calibrator.  
Output: up to 100,000 microvolts calibrated with internal V.T.V.M., .84 volts uncalibrated.  
Termination: 30 ohm line.  
Power source: 12 volts dc or 115 volts 60 cycles.

Further details can be obtained by writing

FS-9447, Electronics  
330 W. 42nd St., New York 18, N. Y.

**CONDENSERS**  
**OUR SPECIALTY**  
OIL FILLED & TRANSMITTING MICA TYPES  
All Values and Voltage Ratings  
We Invite Your Inquiries

**TECHNICAL RADIO PARTS CO.**  
557 McDonald Ave., Brooklyn 18, N. Y.

## NEED MOULDED CAPACITORS?

Range .005 — 1.00 MFD  
Voltage 100 — 600 V  
New Firm setting up machinery. Will be in operation around June 1st. Would like to contact customers with D.O. order, requiring quick delivery.

FS-9320, Electronics  
330 W. 42 St., New York City

# WANTED

**WANTED**  
Tubes, Test equipment, Condensers, & general inventories. Highest prices paid.

W-7965, Electronics  
330 W. 42nd St., New York 18, N. Y.

## WANTED

RT18/ARC-1  
T67/ARC-3  
R77/ARC-3  
T47/ART-13

RADIO RECEIVERS OR TRANSMITTERS  
CONTROL BOXES — ANTENNAS  
RELAYS — CORDS — PLUGS  
HEADSETS — HANDSETS  
TUBES — TELEPHONE MATERIALS  
ARC-1 — ARC-3 — ART-13

WE PAY TOP MONEY  
WE BUY ANYTHING  
WHAT HAVE YOU

## TALLEN CO., INC.

562 ATLANTIC AVE.  
BROOKLYN 17, N. Y.

## WILL BUY

**MN-26-K or -J**  
COMPASS RECEIVERS

APN-9, TS-67, R-89B/ARN-5, ARC-1, ARC-3, ART-13, BC-221, BC-348, SCR-522, MN-53, MN-61, RA-1, MN-31 MI-32 ARN-7, ANY BENDIX OR AIRCRAFT RADIO EQUIPMENT, DYNAMOTORS, INVERTERS, TEST EQUIPMENT WITH "TS-" OR "I-" PREFIXES

State Condition and Best Price

**AIRCRAFT RADIO INDUSTRIES, INC**  
274 Madison Ave., New York City

**WANTED**  
Teletypewriters complete, components or parts. Any quantity and condition.

W-6864, Electronics  
330 W. 42nd St., New York 18, N. Y.

## WESTERN ELECTRIC VACUUM TUBES

Types 101F, 102F, 272A, 274A or B, 310A or B, 311A, 313C, 323A, 328A, 329A, 348A, 349A, 352A, 373A, 374A, 393A, 394A, 121A Ballast Lamps.

W-6863, Electronics  
330 W. 42nd St., New York 18, N. Y.

**WANTED**  
400 cycle, 115 volts, 2 to 5 kw output  
MOTOR ALTERNATOR  
60 cycle input  
MR. MERSEREAU  
EASTERN AIR DEVICES  
585 Dean Street Brooklyn 17, N. Y.

## \$

### WE PAY CASH

for all types of  
RADIO, RADAR, ELECTRONICS  
OR GOV'T. SURPLUS EQUIPMENT

Regardless of condition. Top dollars for:

- ART-13 Xmitter
- DY-17 Dynamotor
- TS-12 Test Sets
- TS-13 Test Sets
- Signal Generators
- Lab. Test Equipment
- I-100 Test Sets
- BC-348 Revr. (AC or 28 V)
- BC-788C Trans.-Revr.
- I-152C Indicator
- Microvolters

Plus anything and everything you have in Electronics Equipment. Send description and asking price to:

**WEST REGION ELECTRONICS**  
New correct address (if your correspondence was returned, remit to:) Dept. EI 1437 S. Norton Ave., Los Angeles 19, Calif.

**\$50,000 IN SPOT CASH**  
Available For  
SURPLUS RADIO AND ELECTRONICS  
EQUIPMENT

We want large or small quantities and we'll pay HIGHEST spot cash prices. Write, wire or telephone details to

**NEWARK SURPLUS, Market 3-7472**  
324 Plane St., Newark 1, New Jersey

**WANTED**  
"S O" TYPE RADAR PARTS  
Write or Phone  
World Wide Packing & Shipping Co.  
350 Pearl St. Brooklyn, N. Y.  
MA 4-8371

**WANTED**  
YOUR SPARE SURPLUS EQUIPMENT  
DYNAMOTORS • SELSYNS • AUTOSYNS • INVERTERS • TRANSMITTERS  
RECEIVERS • TEST EQUIPMENT  
Please send list stating condition and lowest price.  
No Quantity Too Small or Too Large!  
C & H SALES COMPANY  
BOX 356-SE EAST PASADENA STATION PASADENA 8, CALIFORNIA

**WANTED**  
**DYNAMOTORS**  
DM-34, DM-35, DM-36 and DM-37.  
Must be new. Any quantity.  
W-9414, Electronics  
330 W. 42 St., New York 18, N. Y.

# INDEX TO ADVERTISERS

Accurate Paper Tube Co.	295
Ace Engineering & Machine Co., Inc.	271
Aene Electronics, Inc.	285
Aeronautical Communications Equipment, Inc.	265
Air Associates Incorporated	163
Airdesign, Inc.	297
Airpax Products Company	170
Alden Products Co.	290
Allen-Bradley Co.	42
Allen Co., Inc., L. B.	302
Allied Control Company, Inc.	36
Allied Radio Corp.	251, 277
Allison Radar Corporation	291
Allmetal Screw Products Company, Inc.	232
Altec Lansing Corp.	236
American Chronoscope Corporation	283
American Gas Accumulator Company	256
American Lava Corp.	49
American Phenolic Corporation	156
American Relay & Controls, Inc.	178
American Television and Radio Co.	297
American Time Products, Inc.	180
Ampex Electric Corporation	289
Andrew Corporation	266
Arcturus Electronics, Inc.	30
Arma Corporation	28
Arnold Engineering Co.	59
Arrow Electronics, Inc.	202
Art Wire & Stamping Company	269
Astron Corporation	281
Audio Devices, Inc.	145

Ballantine Laboratories, Inc.	176
Barry Corporation	78
Beady Chain Manufacturing Co.	265
Beaver Gear Works, Inc.	240
Belden Manufacturing Co.	56
Bell Telephone Laboratories	203
Bendix Aviation Corporation Eclipse-Pioneer Division	272
Red Bank Division	205
Bentley, Harris Manufacturing Co.	32
Bird & Co., Inc., Richard H.	252
Bird Electronic Corp.	294
Bircher Corporation	174
Bishop Manufacturing Corporation	300
Bivax Corporation	289
Billey Electric Company	152
Bogue Electric Mfg. Co.	191
Boonton Radio Corporation	141
Borg Corporation, George W.	298, 299
Bowser, Inc.	288
Breeze Corporations, Inc.	287
Bridgeport Brass Co.	165
Brush Development Company	55
Burlington Instrument Co.	170
Burnell and Company	39

C.G.S. Laboratories, Inc.	281
Cambridge Thermionic Corp.	218
Cannon Electric Co.	234
Capitol Radio Engineering Institute	291
Carboloy Company, Inc.	70
Carborundum Company, The	153
Carter Motor Company	299
Centralab, Div. Globe-Union, Inc.	9, 10, 11
Centronics Co.	277
Chase Brass & Copper, Sub. of Kennecott Copper Corp.	2
Chicago Telephone Supply Corpora- tion	44, 45
Chicago Transformer, Div. of Essex Wire Corp.	228
Cinch Manufacturing Corp.	133
Cinostat Mfg. Co., Inc.	69
Cleveland Container Company	197
Clippard Instrument Laboratory, Inc.	263
Cohn Corporation, Sigmund	269
Consolidated Engineering Corporation	198
Continental Screw Company	256
Cornell-Dubilier Electric Corp.	31
Corning Glass Works	159
Corry-Jamestown Mfg. Corp.	246
Coto-Coil Co., Inc.	267
Cross Co., H.	302
Curtis Development & Mfg. Co.	283

Dage Electric Company	291
Dano Electric Company	265
Daven Co.	Third Cover
Delco Radio Division, General Motors Corporation	167
Dial Light Company of America	250
Distillation Products Industries	157
Donnelly Mfg. A., Div. of John Donnelly & Sons	244
Dore's, Inc., John L.	178
Dow Corning Corporation	302
Driver Co., Wilbur B.	199
Driver-Harris Company	61
Dumont Electric Corporation	254
DuMont Laboratories, Inc., Allen B.	41, 74

Eastern Specialty Company	275
Eastman Kodak Company, Industrial Optical Sales Div.	193

Edin Company, Inc.	255
Edison, Inc., Thomas A.	284
Edo Corporation	213
Eisler Engineering Company, Inc.	293, 302
Etitel-McCullough, Inc.	57
Electra Mfg. Company	252
Electric Auto-Lite Company, The	171
Electrical Industries, Inc.	298
Electrical Reactance Corp.	30
Electro Development Corp.	265
Electro Motive Mfg. Co., Inc.	204
Electro-Voice, Inc.	302
El-Tronics, Inc.	293
Electrona Corporation, The	267
Electronic Associates, Inc.	286
Electronic Tube Corporation	188
Emerson & Cuming Co.	288
Erie Resistor Corporation	65

Fairchild Camera & Instrument Corp.	195
Fairchild Engine & Airplane Corp.	233
Federal Telephone & Radio Corporation	38
Fidelity Chemical Products Corp.	258
Filtrol Co., Inc., The	7
Five Star Co.	302
Ford Instrument Company	236

Gamewell Company	174
Gates Radio Company	16
General Electric Company, Apparatus Dept.	46, 47, 58, 117, 175, 243
Chemical Dept.	161
General Electric Company, Electronics Dept.	15, 24, 25, 29, 73, 220
Lamp Dept.	231
General Radio Company	169
Glanni & Co., Inc., G. M.	281
Gramer Transformer Corp.	297
Grant Pulley & Hardware Co.	252
Graphite Metallizing Corp.	295
Green Instrument Co.	279
Grieve-Hendry Co., Inc.	293
Guardian Electric Mfg. Co.	189

Hamilton Institute, Alexander	186
Hathaway Instrument Co.	276
Haydon Company, A. W.	166
Heiland Research Corporation	295
Heinemann Electric Co.	34
Helder Metal Products Corp.	292
Heli-Coil Corporation	253
Hellpot Corporation	67
Hermite Seal Products Company	68
Hewlett-Packard Company	20, 21, 37
Hi-Test Chemical Corporation	277
Hickok Electrical Instrument Co.	264
Holtzer-Cabot Division of National Pneumatic Co., Inc.	63
Hudson Wire Company	158
Hycron Mfg. Co.	236
Hytrol Radio & Electronics Corp.	63

Improved Seamless Wire Company	291
Industrial Condenser Corp.	295
Industrial Electronics, Incorporated	158
Industrial Hardware Manufacturing Co., Inc.	287
Instrument Resistors Company	178
International Nickel Company, Inc.	217
International Rectifier Corporation	185
International Resistance Co.	5
Irvington Varnish & Insulator Company	75

JFD Manufacturing Co., Inc.	251
Jeffers Electronics, Inc.	235
Jelliff Manufacturing Corporation, C. O.	262
Jensen Manufacturing Company	17
Jersey Specialty Company	299
Jones Div. Howard B. Cline Mfg. Corp.	299
Joy Manufacturing Company	260

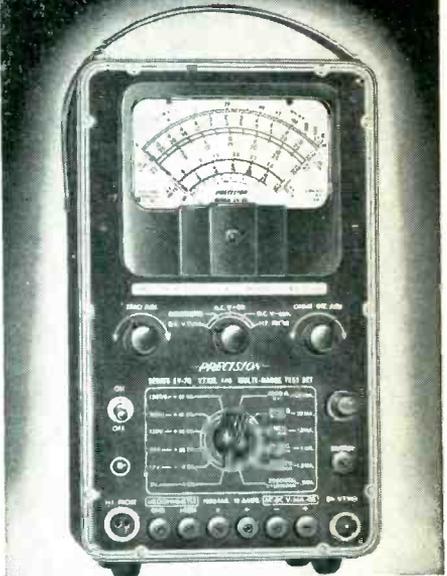
Kahle Engineering Co.	275
Karp Metal Products Co., Inc.	43
Kartron	302
Kay Electric Company	247
Kenyon Transformer Company, Inc.	162
Kepeo Laboratories, Inc.	8
Kester Solder Company	137
Knights Co., James	256
Kollman Instrument Corp.	52
Krohn-Hite Instrument Co.	293

Lambda Electronics Corporation	273
Lapp Insulator Co., Inc.	51

## The NEW -PRECISION- SERIES EV-20

**VTVM and Multi-Range Test Set**  
TRUE ZERO-CENTER on ALL VTVM ranges  
PLUS Direct Reading High Frequency Scales

**48 RANGES TO**  
1200 Volt\*, 2000 Megohms, 12 amperes, ± 63DB  
\*D.C.—VTVM ranges to 12,000 and 30,000 Volts when  
used with Series TV Super-High Voltage Test Probe.



### Range Specifications

- ★ SIX ALL ZERO CENTER VTVM RANGES: — 13½ Megs. Constant Input Resistance. ± 3, ± 12, ± 30, ± 120, ± 300, ± 1200 volts. Direct Reading to ± 12 KV and ± 30 KV with Series TV Super-High Voltage Test Probe.
- ★ SIX SELF-CONTAINED OHMMETER-MEGOHMMETER RANGES: 0-2000-200,000 ohms. 0-2-20-200-2000 Megohms.
- ★ FOUR DIRECT READING HIGH FREQUENCY VTVM RANGES: 0-3-12-30-120 volts. (When used with RF-10A High Frequency Vacuum Tube Probe, Net Price \$14.40. No crystal rectifiers employed.)
- ★ SIX AC-DC AND OUTPUT VOLTAGE RANGES at 1000 ohms/volt. 0-3-12-30-120-300-1200 volts.
- ★ EIGHT D.C. CURRENT RANGES: 0-300 microamps. 0-1-2-3-12-30-120-1200 milliamps. 0-12 Amperes.
- ★ SIX DECIBEL RANGES from — 20 to + 63 DB. Calibrated for 600 ohm, 1 mw., zero DB reference level.

### Important Features

- ★ VOLTAGE REGULATED — BRIDGE CIRCUIT
- ★ DIRECT READING, ALL ZERO-CENTER VTVM eliminates frequent and inefficient shifting of test leads.
- ★ HIGH IREQ. VOLTAGE SCALES — DIRECT READING.
- ★ DUAL-BALANCED ELECTRONIC BRIDGE OHMMETER-MEGOHMMETER.
- ★ 4% RECTANGULAR METER — 200 microamperes, ± 2%. Double-Sapphire, D'Arsonval construction.
- ★ 1% Film type, Metallized and Wire-Wound resistors.
- ★ Heavy gauge, louvred steel case with plastic handle. Etched, anodized, aluminum panel.

**Net Selling Price \$68<sup>25</sup>**

Complete with coaxial Circuit Isolating Test Probe, Shielded Ohmmeter Test Cable, Standard Test Leads, Ohmmeter battery. Case dimensions — 10½" x 6¼" x 5".

Also ask to see the "Precision" Series EV-10, DeLuxe VTVM—Megohmmeter with extra-large 7" meter, 59 Self-contained ranges to 6000 volts and 70 DB, on display at leading radio parts distributors.

Write for latest catalogue.



Export: 458 B'way, N.Y.C., U.S.A. Cables: MORHANEX  
In Canada: Atlas Radio Corp. Ltd., Toronto, Ontario

# TAB

THAT'S A BUY

# TUBES

TESTED—GUARANTEED

OA2	1.69	2C40	4.95	5X4G	90 6K8	1.07 774	87 31
OA3 VR75	1.56	2C43	26.75	5Y3GT	.69 6L5G	.89 10Y	79 HY31Z
OA4G	1.33	2C43/464A	16.95	5Y4G	.79 6L6	2.43 12A	.89 32
OB2	1.70	2C44	1.20	5Z3	1.09 6L6G	3.15 12A5	1.39 FG32
OB3 VR90	.28	2C50	3.69	5Z4	1.35 6L6GA	2.98 12A6	1.69 VE215A
OC3 VR1051	.32	2D11	6.95	C6A	7.45 6L7	1.45 12A7	1.89 227A
OD3 VR1501.08	2C52	3.06	6A4	1.65 6N4	2.39 12A8GT	2.15 FG33	18.98 227A
OY4	2.53	2D21	7.74	6A4	1.89 6N6G	1.95 12A9GT	1.39 231
OZ4	.86	2E5	1.16	6A5G	2.30 6N7GT	1.26 12A15	1.00 244A
C1A	9.75	2E22	1.65	6A6	.98 6P5GT	.98 12A16	9.95 247A
O1A	.68	2E24	5.05	6A7	1.39 607	.98 12A17	1.11 24913
I13	1.13	2E25A/	6.88GT	1.05 6R7	.98 12A18	1.11 35C5	1.11 2507H
I14P	.89	2HY65	5.15	6A8A	1.39 6R8	1.44 35D5	21.29 832A
I15GT	.85	2E26	3.85	6AB5/6N5	1.33 6S4	.98 12A19	21.29 836
I16	1.59	2E30	2.70	6AB7/1853	1.42 6S7	.98 12A16GT	1.00 HK254
I17GT	1.19	2J21	10.69	6AC5GT	1.19 6S8GT	.98 12A17	3.98 838
I18A	1.80	2J21A	9.75	6AC7	1.61 6SA7GT	1.65 12A16	3.98 838
I18B/8016	1.47	2J22	11.95	6AD7	1.60 6SB7GT	1.20 12A17	3.98 838
I19	.89	2J26	37.50	6AE5	.89 6S7	1.45 12A16	1.50 845
I15 25S	.98	2J27	37.50	6AEG	.79 6D7GT	1.45 12A16	60.00 CK574X
I17GT	.98	2J30	49.50	6AF5G	.89 6SF5	.98 12B26	49.95 CK584X
I181-471A	2.85	2J31	38.50	6AF6G	1.33 6SF7	.98 12B6	49.95 CK584X
I182	3.25	2J32	69.95	6AG5	1.47 6SH7	1.45 12B6	1.39 CK542DX
I183	9.90	2J33	39.50	6AG7	1.98 6SH7GT	1.07 12B7	1.75 CK543DX
I184	6.25	2J34	49.50	6AH5G	1.49 6S7	1.19 12B8	1.75 CK544DX
I184Sv	36.00	2J36	125.00	6A15	2.17 6S7GT	1.19 12F5	2.45 CK547DX
I185	3.98	2J37	18.95	6A15	1.49 6S7GT	1.25 12H6	1.98 WL121A
I187	24.00	2J38	25.50	6AK5	1.98 6SN7GT	1.22 12J5GT	1.98 CK548DX
I189	4.75	2J39	49.50				JRP5676
I182/532A	3.98	2J40	49.50				CK5678
I186	29.95	2J48	28.50				CK5697
I187	18.00	2J49	39.45				CR202
I188	32.25	2J50	27.50	6AK6	1.98 6SN7VGT	1.90 12J7GT	1.98 RP404
I189	4.95	2J52	24.50	6AL5	1.05 6SO7GT	1.00 43	5829
I141	49.95	2J54B	49.50	6AL7GT	1.89 6SR7	1.08 12K8	1.80 5875
I142	5.90	2J55	139.00	6AN5	5.95 6S8T	.90 12O7GT	1.80 5875
I146	6.25	2J56	249.50	6AO5	1.11 6S7	1.33 12S8GT	1.80 5875
I153	49.95	2J61	59.50	6AO6	1.25 6S7GT	3.37 12S8GT	1.80 5875
I154	79.95	2J62	49.45	6A07GT	1.23 6S7	1.05 12S7GT	1.80 5875
I156	45.95	2K23	49.45	6AR5	.91 6T7G	1.05 12S7GT	1.80 5875
I159	12.95	2K25	49.95	6AR6	5.49 6T8	2.45 12SF7GT	1.80 5875
I160	64.95	2K25	6AS5	1.39 6T4GT	.95 12S7GT	.95 12S7GT	1.80 5875
I161C	3.40	723AB	49.95	6AS6	2.49 6T5 6G5	.98 12SH7	1.80 5875
I165GT	.79	2K28mtd	37.25	6AS7GT	4.98 6T6GT	1.05 12S7GT	1.80 5875
I166	.79	2K29	37.25	6AS7GT	.83 6T7G	.79 12S7GT	1.80 5875
I167	.89	2K33	395.00	6AUS7GT	1.47 6T6	2.25 12S7GT	1.80 5875
I165GP	.89	2K45	175.00	6AU6	1.11 6V6GT	1.25 12S7GT	1.80 5875
I167GT	.89	2V3G	1.29	6AV5GT	1.47 6V6GT	1.65 12S7GT	1.80 5875
I168GT	.89	2W3GT	.98	6AV6	.93 6V7G	1.18 12SR7	1.80 5875
I169	.98	2X2	.69	6AW6	1.98 6V4GT	1.08 12X3	1.80 5875
I170	.98	2X2A	1.89	6AN5GT	1.25 6V4WGT	1.48 12Z3	1.80 5875
I171	.69	3A4	.98	6B5GT	1.25 6V4WGT	1.48 12Z3	1.80 5875
I172	.69	3A5	1.69	6B5	1.25 6V4WGT	1.35 14X7 12B7	1.08 52
I173	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I174	.98	3A5	1.69	6B5	1.25 6V4WGT	.89 XXD	1.18 55
I175	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I176	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I177	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I178	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I179	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I180	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I181	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I182	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I183	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I184	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I185	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I186	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I187	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I188	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I189	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I190	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I191	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I192	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I193	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I194	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I195	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I196	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I197	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I198	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I199	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875
I200	.98	3A5	1.69	6B5	1.25 6V4WGT	1.33 14X7	1.80 5875

Prices Subject to Change

25Y5	90 F127A	15.89	802	4.69	8013A	5.98	6-20	15.98				
25Z5	87 CV148	4.98	803	3.00	8020	1.98	12-20	9.98				
25Z6GT	91 1507	14.50	804	8.45	9001	1.68	50-20	15.98				
	70 RC166	49.00	805	4.98	9002	1.98	50-20	9.98				
	27 FG172	42.50	807	1.98	9003	1.98	50-20	9.98				
	FG27A	8.70	182B	1.20	9004	7.75	20	19.00				
	RK28A	6.95	FG190	12.80	9005/RC4B	1.95	100-20	19.00				
	28D7	1.39	200	22.98	9006	27	6-32	18.75				
		89 203A		5.98	9007	3.25	SubMiniatures	12-32	12.75			
		95 205B/VT2		1.68	9008	2.31	50-20	12.75				
		205 RC106		3.15	9009	1.75	2E36	49	50-32	12.98		
		49 211 VT4C		1.89	9010	3.95	2E43	1.39	75-32	22.75		
		790 RX215		9.95	9011	3.98	CK501AX	1.26	100-32	22.75		
		1.69 VE215A		15.816	866Jr	1.29	CK502AX	1.79	Tungar Bulbs			
		18.98 227A		2.65	826	.98	CK505AX	1.79	20X672	2.95		
		59 231		1.20	SD828	.98	CK509AX	1.29	9483 120V	3.98		
		79 242C		7.20	829	12.98	CK512AX	1.98	Ballast			
		1.00 244A		4.15	829B	14.98	CK522AX	1.79	IP1	.49		
		9.95 247A		9.95	832	10.98	CK525AX	1.79	PM3	.98		
		1.11 35B5		1.11	24913	12.98	CK526AX	1.98	PM4	.98		
		1.11 35C5		1.11	2507H	21.29	832A	48.90	CK529AX	1.98		
		1.11 35D5		1.11	2507L	21.29	836	4.98	CK529AX	1.98		
		1.00 HK254		15.99	837	1.39	CK531DX	.98	PM5	.49		
		4.95 262B		3.98	838	3.98	CK532DX	.98	PM6	.98		
		69 262B		3.98	842	2.75	CK533AX	1.39	PM7	.98		
		87 271A		9.95	843	.29	CK534AX	.89	PM8	.98		
		90 274B/5R4		1.50	845	5.95	CK536AX	.89	9-3	.49		
		75 282B		8.49	851	60.00	CK537AX	4.98	10-4B	.49		
		54 316A		27.95	850	4.98	CK540AX	1.98	10-4B	.49		
		50 304TH		24.98	861	49.95	CK539DX	.98	20-4	.39		
		65 304THL		24.98	864	.38	CK541DX	1.98	KA9A	.46		
		69 307A/		.865		1.39	CK542DX	.98	M55B	.36		
		69 RK75		6.45	866A	1.75	CK543DX	.98	K55B	.36		
		69 310A		6.98	869	25.98	CK544DX	.98	L62A	.49		
		54 316A		9.98	872A	2.45	CK545DX	1.98	10-4B	.49		
		79 323B		12.75	GE872A	4.98	CK547DX	1.98	WL121A	2.61		
		79 327A		2.50	873	15.98	CK548DX	1.98	C376	2.98		
									JRP5676	1.49	ZB583	3.98
									CK5678	2.48	876	.29
									CK5697	5.98	Mazda Pilots	
									CR202	8.95	4B Box 10	.50
									CRP404	7.79	49 Box 10	.60
									5829	5.98	64 Ea.	.07
									5875	1.98	S6/T4/3W	.18
									C Ray Tubes	100W 20V	.25	
									2A1	6.90	31 Box 10	.36
									2AP5	6.90	31 Box 10	.36
									3AP1	12.95	31 2BV	.15
									3BP1	7.95	323 3V	.25
									3BP1A	14.98	Sylvania	
									3CP1-SI	2.85	S6 6W 120V	.15
									3DP1	4.85	WSTGHS C7	.75
									3DP1-S2	1.98	10-4B	.49
									3DP1	5.85	Med/Screw Base	
									3FP2	3.85	15W/125V	.08
									3FP2A	14.98	25W/125V	.08
									3GP1	4.89	Neon Bulbs	
									3HP			

Leeds & Northrup Co., Inc.	223
Lenz Electric Manufacturing Co.	6
Lewis & Kaufman, Inc.	168
Lewis Engineering Co.	271
Lewis Spring & Manufacturing Co.	174
Liberty Mirror Division, Libby-Owens-Ford Glass Co.	261
Linde Air Products Co., A Division of Union Carbide & Carbon Corp.	280, 287
Litton Industries	173
Lockheed Aircraft Corporation	275
Lord Manufacturing Company	224
Lust, Henry B.	302

Magnecord, Inc.	181, 237
Mallory and Company, Inc., P. R.	80, 135
Markem Machine Company	166
Martin Company, Glenn L.	269
McGraw-Hill Book Co.	151, 302
Measurements Corporation	279
Metal-Cal Division C&H Supply Co.	33
Metal Textile Corporation	275
Metals & Control Corp., General Plate Div.	239
Meco Instrument Co.	283
Milten Mfg. Co., Inc., James	35
Milo Radio & Electronics Corp.	222
Miniature Precision Bearing, Inc.	302
Minneapolis-Honeywell Regulator Co., Industrial Division	19
Mitchell-Rand Insulation Co., Inc.	201
Mosinee Paper Mills Company	248
Muirhead & Co., Ltd.	3
Myalex Corporation of America	54

National Company, Inc.	250
National Moldite Company	282
National Varnished Products Corporation, The	79
Neo-Sil Corporation	25
New York Transformer Co., Inc.	238
Ney Company, J. M.	162
North American Aviation, Inc.	166, 260
North Electric Mfg. Co.	212
Northern Radio Co., Inc.	285
Nothelfer Winding Laboratories	279

Offner Electronics, Inc.	221
Ohmite Mfg. Co.	16A, 16B
Onan & Sons, Inc., D. W.	240
Oregon Electronics Mfg. Co.	242
Oster Manufacturing Co., John	289
Owens-Corning Fiberglas Corp.	209

Panoramic Radio Products, Inc.	297
Paramount Paper Tube Corp.	254
Park Metalware Co., Inc.	293
Peerless Electrical Products Div., Altec Lansing Corporation	262
Phalo Plastics Corp.	206
Philamon Laboratories	216
Pickering & Co., Inc.	291
Pix Manufacturing Co., Inc.	289
Polarad Electronics Corp.	289
Polytechnic Research & Development Company, Inc.	299
Potter Instrument Co., Inc.	287
Precision Apparatus Co., Inc.	337
Precision Metal Products Co. of Malden	273
Precision Paper Tube Co.	250
Premax Products, Div. Chisholm-Ryder Co., Inc.	236
Presto Recording Corporation	278
Pyramid Electric Co.	76

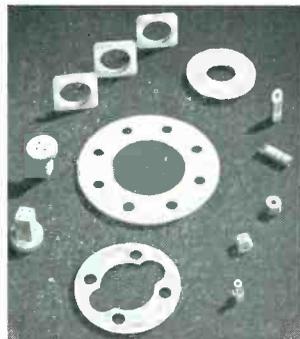
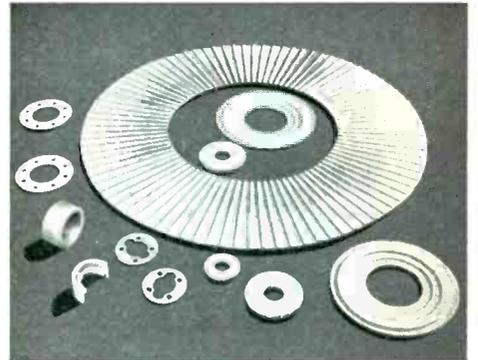
Radio Corp. of America, 179, 200, Back Cover	
Radio Materials Corporation	14
Radio Receptor Company, Inc.	62
Radio Wire Television Incorporated	292
Railway Express Agency, Air Express Division	229
Rauland Corporation	177
Rawson Electrical Instrument Co.	271
Raytheon Manufacturing Co.	143, 274
R-B-M Division, Essex Wire Corp.	160
Remler Company, Ltd.	296
Revere Copper & Brass, Inc.	22
Rome Cable Corporation	259
Ruzsel Cord & Wire Co.	277

Sanborn Company	150
Sangamo Electric Co.	18
Scientific Electric Div. of "S"	
Corrugated Quenched Gap Co.	300
Scintilla Magneto Division of Bendix Aviation Corp.	26
Saxon Metals Corporation	236
Servo Corporation of America	267
Shakeproof, Inc.	183
Shallcross Manufacturing Co.	27
Shure Brothers, Inc.	268
Sigma Instruments, Inc.	79

# TEFLON

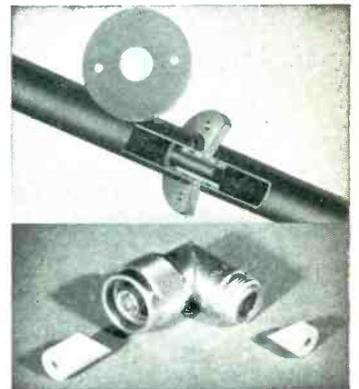
## ELECTRONIC PARTS

Teflon's outstanding electrical properties make it an ideal insulating material for high-voltage, high-temperature, high- or ultra-high-frequency service. Component parts fabricated of Teflon are finding a steadily increasing number of applications in radio, radar, TV and other electrical and electronic equipment.



Teflon's loss factor is less than 0.0005; its dielectric constant only 2.0—at all frequencies measured to date. Teflon is serviceable throughout the entire temperature range of  $-110^{\circ}\text{F}$ . to  $575^{\circ}\text{F}$ . with negligible change in critical electrical characteristics. Teflon is tough, somewhat resilient, weather-proof, has zero water absorption and is absolutely non-corroding.

We manufacture all types of molded or machined Teflon parts including coaxial spacers and coaxial connectors for electronic equipment, component parts for switches, relays, and contactors, as well as tube sockets, high-voltage brackets for power resistors, gaskets, specialties, etc. For more information request Catalog No. 400. Also available — Teflon sheets, cylinders, rods, tubing and bars. *We are the country's foremost manufacturer of Teflon products.*



### Teflon Products Division

# UNITED STATES GASKET CO.

600 N. 10th Street • CAMDEN, NEW JERSEY

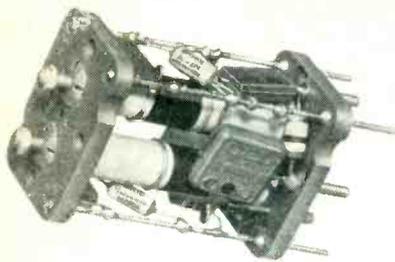
#### Typical Properties of "Teflon"

Tensile Strength @ 77 F	1500 to 2500 psi.	Specific Heat	0.25 Btu./lb./deg. F
Elongation @ 77 F	100 to 200%	Heat Distortion Temperature for 66 psi.	270 F
Flexural Strength @ 77 F	Did not break (D790-44T)	Surface Arc-Resistance	Does not track even after 1200 seconds of exposure ASTM D 495-42
Stiffness @ 77 F	60,000 psi.	Volume Resistivity	$10^{15}$ ohm-cm.
Izod Impact Strength @ 70 F	2.0 ft.-lb./in.	Surface Resistivity @ 100% Rel. Hum.	$3.6 \times 10^6$ megohms
77 F	4.0 ft.-lb./in.	Dielectric Constant, 60 to 10 <sup>8</sup> Cycles	2.0-2.05
170 F	6.0 ft.-lb./in.	Power Factor, 60 to 10 <sup>8</sup> Cycles	0.0005
Durometer Hardness	55 to 70	Water Absorption	0.0%
Compressive Stress @ 0.1% Deformation	1700 psi.	Flammability	Nonflammable
Deformation under Load @ 122 F, 1200 psi., 85 hr.	4 to 8%	Resistance to Weathering	Excellent
Coefficient of Linear Thermal Expansion from 77 to 140 F	$5.5 \times 10^{-5}$ per deg. F	Specific Gravity	2.1 to 2.3
Thermal Conductivity	1.7 Btu./hr./sq. ft./deg. F/in.		

# FOR SERVICE IN COILS

No matter what your coil needs may be, you'll find in U.S.E. a dependable source of supply. For further details write for catalog today.

- Cathode Trap Coils • I.F. Transformers • Width Control Coils
- Heater Choke Coils • Video Peaking Coils • R.F. Coils
- Horizontal Linearity Control Coils • Horizontal Oscillator Coils
- Oscillator and Solenoid Coils • Sound Discrimination Transformers
- Sound I.F. Transformers • Picture I.F. Transformers.



# United States Electronics

CORPORATION  
Lyndhurst, New Jersey

Simpson Electric Company	249
Sorensen and Company, Inc.	12, 13
Southwestern Industrial Electronics Company	283
Specialty Battery Company	271
Spencer-Kennedy Laboratories, Inc.	273
Sponge Rubber Products Company	66
Sprague Electric Company	139
Stackpole Carbon Co.	172
Standard Piezo Company	158
Standard Pressed Steel Co.	170
Standard Products, Inc.	297
Standard Transformer Corp.	182
Staver Company, Incorporated	273
Steward Manufacturing Co., D. M.	281
Stoddard Aircraft Radio Co.	214
Stupakoff Ceramic & Manufacturing Company	219
Sturtevant Co., P. A.	285
Superior Electric Co., The	40
Superior Tube Company	241
Sylvania Electric Products, Inc.	77, 149
Synthane Corporation	187
Syntron Co.	236

Technology Instruments Corp.	270
Tektronix, Inc.	296
Telechron, Inc.	211
Telectronics Laboratory, Inc.	302
Tenney Engineering, Inc.	196
Tensolite Insulated Wire Co., Inc.	297
Terpening Company, L. H.	208
Tetrad Co., Inc.	260
Thomas & Skinner Steel Products Co.	194
Transcoil Corporation	257
Transradio, Ltd.	162
Triplett Electrical Instrument Co.	192
Tung-Sol Lamp Work, Inc.	32A, 32B
Turner Company	48

Ulanet Company, George	258
Ungar Electric Tools, Inc.	279
Union Carbide and Carbon Corp.	
Linde Air Products Co.	280, 287
United States Electronics Corporation	340
United States Gasket Co.	339
United Transformer Co.	Second Cover
University Loudspeaker, Inc.	285

Varian Associates	230
Voeder-Roof, Inc.	61
Victoreen Instrument Company	150

Waldes Kohinoor, Inc.	227
Ward Leonard Electric Company	164
Waterman Products Co., Inc.	152
Webster Electric Company	210
Western Lithograph Co.	215
Westinghouse Electric Corp.	245
White Dental Mfg. Company S.S.	190, 258
Whitehead Stamping Company	252
Wilton Tool Mfg. Co.	267
Winchester Electronics, Inc.	269
Workshop Associates, Inc.	184

Zetka Television Tubes, Inc.	60
Zophar Mills, Inc.	262

## PROFESSIONAL SERVICES 301

## SEARCHLIGHT SECTION (Classified Advertising)

EMPLOYMENT	
Positions Vacant	303-308
Selling Opportunities Offered	303
Positions Wanted	303
Selling Opportunities Wanted	303
Employment Services	303

## SPECIAL SERVICES

Rebuilding	303
------------	-----

## BUSINESS OPPORTUNITIES

Wanted	303
--------	-----

## EQUIPMENT

(Used or Surplus New)	
For Sale	309-338

## WANTED

Equipment	336
-----------	-----

## ADVERTISERS INDEX

Adelman, Nat.	336
Aerojet Engineering Corp.	305
Airborne Instruments Laboratory, Inc.	306
Aircraft Armaments, Inc.	305
Aircraft Radio Industries, Inc.	336
Alvarado Supply Co.	326
American Electrical Sales Co.	333
Archy Electronics	332
Arrow Sales Co., Inc.	324
Avnet Electronic Supply Co.	322
B & B Distributors	333
Barry Electronics Corp.	332, 335
Bell Aircraft Corp.	306, 307
Bendix Aviation Corp., Pacific Div.	308
Blan	328
Brooks Co., Inc., B. D.	334
C & H Sales Co.	335, 336
Chance Vought Aircraft	307
Chase Electronics Supply Co.	329
Columbia Electronics, Ltd.	325
Commercial Surplus Sales Co.	318
Communication Devices Co.	331
Communications Equipment Co.	313, 315
Cook Electric Co.	308
Cornell Aeronautical Laboratory	307
Cottone & Co., A.	334
Eastern Air Devices	336
Eckert-Mauchly Computer Corp.	306
Electro Impulse Laboratory	324, 335
Electro Sales Co.	320
Electronic Engineering Co. of Calif.	303
Electronic Specialty Supply Co.	332, 335
Electronic Surplus Brokers	328
Electroncraft, Inc.	311
Emerson Electric Mfg. Co.	306
Empire Electronics	334
EPCO	330
F. M. Electronics Co.	336
Freeland Products Co.	303
General Electric Co.	305
Goodyear Aircraft Corp.	305
Green, Gould	335
Greenberg	334
Hallicrafters Co.	303
Instrument Associates	317
International Business Machine Corp.	303
J. S. H. Sales Co.	334
Lelectron Research Laboratories	309
Leru Laboratories, Inc.	326
Liberty Electronics, Inc.	333
Maritime International Co.	334
Maritime Switchboard	326
Maxxon Corp., The W. L.	308
Metropolitan Overseas Supply Corp.	330
Mogull Co., Inc., Alexander	325
Monmouth Radio Laboratories	323
Motorola, Inc.	304
National Union Radio Corp.	304
Newark Surplus Co.	336
Norman Radio Distributors Inc.	331
Opad-Green Co.	331
Phillips Petroleum Co.	307
Photocon Sales	328
Powell, Harold H.	332
Precision Electrical Instrument Co.	335
Radio & Electronic Surplus	333
Radio Development & Sales Co.	332
Radio Ham Shack, Inc.	319
Raytheon Mfg. Co.	333
Red Arrow Sales Co.	330
Reliance Merchandizing Co.	310
Sam's Surplus	327
Sandia Corp.	307
Servo-Tek Products Co., Inc.	316
Stanley Engineering & Mfg. Co.	330
Stevens Aircraft Corp., The	334
Sylvania Electric Products Inc.	303
Tab	338
Tallon Co., Inc.	334, 336
Taylor Tubes, Inc.	303
Technical Radio Parts Co.	336
Telemarine Communications Co.	327
Teletube Corp.	333
Universal General Corp.	321
Universal Radio Supply Co.	329
University of Michigan	308
Varian Assoc.	304
Wells Sales, Inc.	312
Weston Laboratories	328, 335
West Region Electronics	336
Wilgreen	329
World Wide Packing & Shipping Co.	336
Workshop Associates	308

This index is published as a convenience to the readers. Every care is taken to make it accurate, but ELECTRONICS assumes no responsibility for errors or omissions.