

ELECTRONIC DESIGN

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ELECTRONIC
DESIGN

JAN 14 1957

DESIGN '57

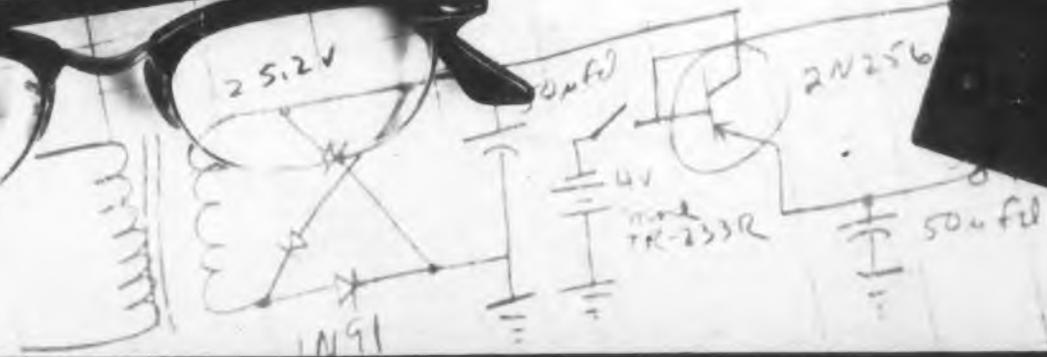
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$0.188 = 0.000575$

$4.1448 - 2375$

10.02 ohms is alright
8 ma will flow.



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MAGNETIC AMPLIFIERS AND SATURABLE TRANSFORMERS

FAST RESPONSE MAGNETIC AMPLIFIERS

2 \sim response Phase reversible

Cat. No.	Supply Freq. in C.P.S.	Power Out. Watts	Volt. Out. V. AC	AC or DC signal voltage req'd for full output.	
MAF-1	60	13	110	1.0	—
MAF-6	400	5	57.5	1.2	0.4
	400	10	57.5	1.6	0.6
MAF-7	400	15	57.5	2.5	1.0

SINGLE ENDED MAGNETIC AMPLIFIERS

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Sig. req'd for full outp. MA-DC	Total res. Contr. wdg. K Ω	Load res. ohms
MAO-1	60	4.5	3.0	1.2	3800
MAO-2	60	20	1.8	1.3	700
MAO-4	60	400	9.0	10.0	25
MAO-5	60	575	6.0	10.0	25

PUSH-PULL MAGNETIC AMPLIFIERS

Phase reversible

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Volt. Out. V. AC	Sig. req'd for full outp. MA-DC	Total res. Contr. wdg. K Ω
MAP-1	60	5	—	1.2	1.2
MAP-2	60	15	115	1.6	2.4
MAP-3	60	50	115	2.0	0.5
MAP-3-A	60	50	115	7.0	2.9
MAP-4	60	175	115	8.0	6.0
MAP-7	400	15	115	0.6	2.8
MAP-8	400	50	110	1.75	0.6

SATURABLE TRANSFORMERS

Phase reversible

Cat. No.	Supply Freq. C.P.S.	Power Out. Watts	Volt. Out. V. AC	Sig. req'd for full outp. MA-DC	Total res. Contr. wdg. K Ω
MAS-1	60	15	115	6.0	27
MAS-2	400	6	115	4.0	10
MAS-5	400	2.7	26	4.0	3.2
MAS-6	400	30	115	4.0	8.0
MAS-7	400	40	115	5.5	8.0

All units designed for 115V-AC operation

VARIABLE TEST VOLTAGE MEGOHMMETER NO. 1620



The Freed Type 1620 Megohmmeter is a versatile insulation resistance measurement instrument with a continuously variable DC test potential from 50 to 1000 volts.

Components such as transformers, condensers, motors, printed circuits, cables and insulation material can be tested at their rated voltage and above, for safety factor.

Resistance — 0.1 megohms to 4,000,000 megohms.

Voltage — variable, 50-1000 volts.

Accurate — plus or minus 5% on all ranges.

Simple — for use by unskilled operators.

Safe — high voltage relay controlled.

Self contained — AC operated.

OTHER MEGOHMMETERS AVAILABLE

Type 1620C Megohmmeter — a type 1620 with additional circuitry for testing capacitors.
Type 1020B Megohmmeter — a 500 volt fixed test potential. Range 1 megohm to 2 million megohms.
Type 2030 Portable Megohmmeter — battery operated, 500 volt test potential. Range 1 megohm to 10 million megohms

FOR PRECISION LABORATORY OR PRODUCTION TESTING



1110-AB INCREMENTAL INDUCTANCE BRIDGE AND ACCESSORIES

Accurate inductance measurement with or without superimposed D.C., for all types of iron core components.

Inductance: 1 Millihenry to 1000 Henry
Frequency: 20 to 10,000 Cycles
Accuracy: 1% to 1000 Cycles, 2% to 10KC
Conductance: 1 Micromho to 1 MHO
"Q": 0.5 to 100

Superimposed D.C.: Up to 1 Ampere
Direct Reading: For use by unskilled operators.

ACCESSORIES AVAILABLE:

1140-A Null Detector
1210-A Null Detector — V.T.V.M.
1170 D.C. Supply and 1180 A.C. Supply

MIL-T-27A POWER, FILAMENT, PULSE & AUDIO TRANSFORMERS

POWER TRANSFORMERS-STANDARD

All primaries 105/115/125 v., 60 c.p.s.

Cat. No.	Hi Volt Sec.	ct	DC Volts	DC Amps	Filament #1		Filament #2		MIL Case Size
					Volt	Amp.	Volt	Amp.	
MGP1	400/200	✓	185	.070	6.3/5	2	6.3	3	MA
MGP2	650	✓	260	.070	6.3/5	2	6.3	4	JB
MGP3	650	✓	245	.150	6.3	5	5.0	3	KB
MGP4	800	✓	318	.175	5.0	3	6.3	8	LB
MGP5	900	✓	345	.250	5.0	3	6.3	8	MB
MGP6	700	✓	255	.250					KB
MGP7	1100	✓	419	.250					LB
MGP8	1600	✓	640	.250					NB

FILAMENT TRANSFORMERS-STANDARD

All primaries 105/115/125 v., 60 c.p.s.

Cat. No.	Secondary		Test VRMS	MIL Case
	Volt	Amp		
MGF1	2.5	3.0	2,500	EB
MGF2	2.5	10.0	2,500	GB
MGF3	5.0	3.0	2,500	FB
MGF4	5.0	10.0	2,500	HB
MGF5	6.3	2.0	2,500	FB
MGF6	6.3	5.0	2,500	GB
MGF7	6.3	10.0	2,500	JB
MGF8	6.3	20.0	2,500	KB
MGF9	2.5	10.0	10,000	JB
MGF10	5.0	10.0	10,000	KB

PULSE TRANSFORMERS

Cat. No.	Block E. Osc.	Int. Coupl'g	Low. Pow. Out.	Pulse Voltage Kilovolts		Pulse Duration Microseconds	Duty Rate	No. of Wdgs.	Test Volt. VRMS	Char. Imp. Ohms
				0.25/0.25/0.25	0.25/0.25					
MPT1	✓	✓		0.25/0.25/0.25	0.2-1.0	.004	3	0.7	250	
MPT2	✓	✓		0.25/0.25	0.2-1.0	.004	2	0.7	250	
MPT3	✓	✓		0.5/0.5/0.5	0.2-1.5	.002	3	1.0	250	
MPT4	✓	✓		0.5/0.5	0.2-1.5	.002	2	1.0	250	
MPT5	✓	✓		0.5/0.5/0.5	0.5-2.0	.002	3	1.0	500	
MPT6	✓	✓		0.5/0.5	0.5-2.0	.002	2	1.0	500	
MPT7	✓	✓		0.7/0.7/0.7	0.5-1.5	.002	3	1.5	200	
MPT8	✓	✓		0.7/0.7	0.5-1.5	.002	2	1.5	200	
MPT9	✓	✓		1.0/1.0/1.0	0.7-3.5	.002	3	2.0	200	
MPT10	✓	✓		1.0/1.0	0.7-3.5	.002	2	2.0	200	
MPT11	✓	✓		1.0/1.0/1.0	1.0-5.0	.002	3	2.0	500	
MPT12	✓	✓		1.15/0.15/0.3/0.3	0.2-1.0	.004	4	0.7	700	

AUDIO TRANSFORMERS

Catalog No.	Application	AB Case Sizes A-J				
		Impedance	DC Current			
		Prim. Ohms	ct	Sec. Ohms	EL	
MGA1	Single or P.P. Plates — to Single or P.P. Grids	10K	✓	90K Split	✓	10 10 + 15
MGA2	Line to Voice Coil	600 Split		4, 8, 16		0 0 + 33
MGA3	Line to Single or P.P. Grids	600 Split		135K	✓	0 0 + 15
MGA4	Line to Line	600 Split		600 Split		0 0 + 15
MGA5	Single Plate to Line	7.6K 4.8T		600 Split		40 40 + 33
MGA6	Single Plate to Voice Coil	7.0K 4.8T		4, 8, 16		40 40 + 33
MGA7	Single or P.P. Plates to Line	15K	✓	600 Split		10 10 + 33
MGA8	P.P. Plates to Line	24K	✓	600 Split		10 1 + 30
MGA9	P.P. Plates to Line	60K	✓	600 Split		10 1 + 27

Staff

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Managing Editor (Acting) J. A. Lippke

Associate Editors E. T. Ebersol, Jr.
L. D. Shergalis
E. Burger

Assistant Editors S. Dresner
P. J. Lahey
D. S. Viebig

Washington Editor H. H. Rosen
National Press Bldg.
1346 F St., NW
Washington, D.C.
STERling 3-8912

West Coast Editor H. C. Jordan
5720 Wilshire Blvd.
Los Angeles, Calif.
WEBster 5-5158

Contributing Editors S. H. Hubelbank
J. M. Monstream
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Co-Publishers

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19 E. 62nd St.
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FREED TRANSFORMER CO., INC.

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ELECTRONIC DESIGN

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January 1, 1957

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The following are typical of components and systems available from Potter for satisfying your digital requirements:

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Data-Handling
Equipment*

- Digital Magnetic Tape Handlers
- High-Speed Perforated Tape Readers
- Digital "Teledeltos" Recorders
- Line-at-a-Time Printers
- Record-Playback Amplifiers
- Record-Playback Head Assemblies
- Magnistors
- Magnetic Core Memory Systems
- Magnistor Storage Arrays
- Translation Systems
- Random Access Memory
- Magnetic Shift Registers

*High-Speed
Counters,
Timers,
Controllers*

- General Purpose Interval Timers
- Preset Interval and Delay Generators
- Predetermined Electronic Counters
- Counter Chronographs
- Frequency-Time Counters
- Totalizing Counters and Scalars
- Plug-In Counter Decades
- Photoelectric Count Detectors
- Photoelectric Screen Detectors
- Translators and Printers

*Special
Systems*

- Multiple-Channel Recording Systems
- Doppler Data Translators
- Militarized Counters and Timers
- High-Speed Printing Chronographs
- Other Data-Processing Systems

You can buy Potter with complete assurance of reliability. As specialists in digital data-handling equipment, Potter engineers welcome an opportunity to study your requirements and to make recommendations for solving your data-handling problems.

Write for detailed technical literature on the above products and other digital equipment available from Potter. Your inquiry will receive prompt attention.

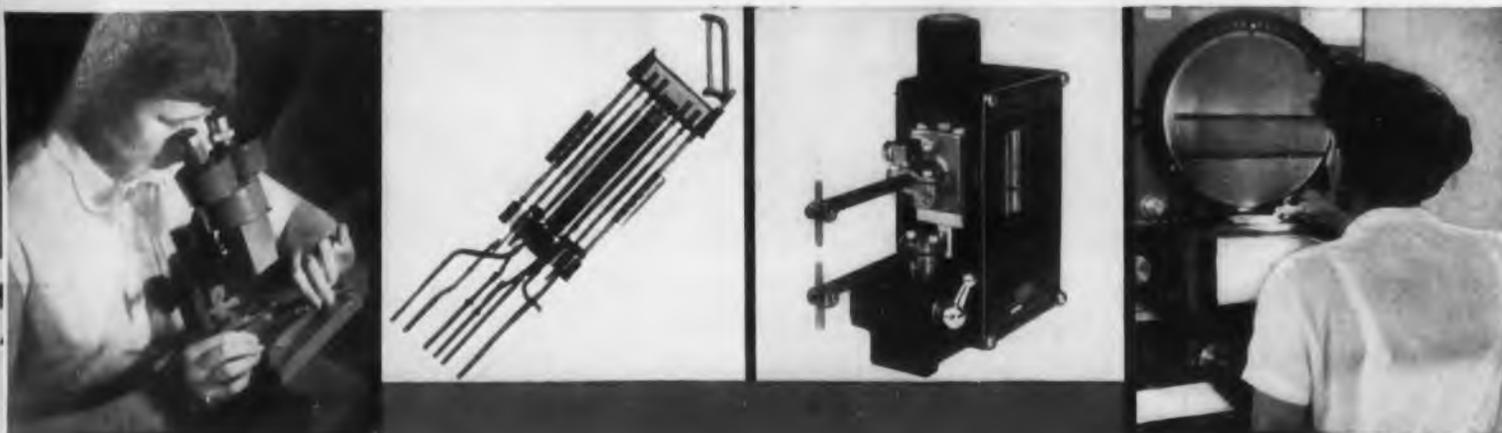


POTTER INSTRUMENT COMPANY, INC.

115 Cutter Mill Road

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RAYTHEON

Subminiature Tubes

RELIABILITY +

Raytheon Subminiature Tubes Give You Reliability Plus
Through Advanced Manufacturing Controls and Techniques
Beyond the Military Requirements



RELIABILITY + in Environment Control. Raytheon pioneered air conditioned dust and lint controlled manufacturing areas.

RELIABILITY + in Welding Control. Raytheon-developed welding equipments and techniques insure precision welds.

RELIABILITY + in Microscopic Inspection Control. Raytheon provides this control *during manufacture* of parts, sub-assemblies and completed tubes.

These **RELIABILITY +** features and others constantly being developed in Raytheon's unique Pilot Operation guarantee extra equipment protection beyond military specification requirements.

RELIABILITY + in Glass Control.

Raytheon-developed flat press construction provides maximum length, strain-free seals and minimizes burned leads and lead corrosion.

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Raytheon's new microscopic X-ray technique provides non-destructive prevention of latent catastrophic defects.

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Engineering supervision of inspection operations throughout the manufacturing cycle.

RAYTHEON

SPECIAL TUBE DIVISION

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Editorial

Between the Lines of Design '57

We became so immersed in documenting details in preparing this issue's features, Design '57, that we're not sure that some very important overall aspects stand out so as to be self-evident. There are several facets which made their mark on our minds.

Transistors are being investigated by practically every equipment manufacturer. Mostly for one reason. Not so much for the advantages in size, weight and power (mobile and aircraft design excepted), but in the search for greater reliability. It is not only the military that is pushing reliability. Instrumentation and control people designing for automatic process systems are looking for 100 per cent reliability. Computer people find reliability becoming more pressing. By programming advances, computer problem-solving duty cycle is increasing and there is less free time for maintenance. Faced with nonskilled maintenance people in the field, all commercial equipment designers are shooting for greater dependability and simplicity.

Needless to say, new tube developments are being spurred on by the military requirement for high-temperature components. Transistors will not fit all bills. The demand for high-temperature components brings us to almost an impasse. Today's insulating materials, magnetic materials, and many structural materials cannot withstand the high temperatures. For example, 400 F is practically top today for electro-mechanical magnetic devices with standard characteristics. Designs for 750 F are expected in some areas.

Every manufacturer we contacted made the plea for better communications—more feedback of test and application data. The fast tempo in engineering organizations seems to be the reason why more time is not spent in writing reports, filling in suppliers questionnaires, etc.

The engineering shortage really affects the design of today's products and equipment. Many chief engineers frankly stated that their products were not being improved as much as they could be simply because they didn't have enough competent engineers. Apparently talent exists in the engineer recently out of college, but the competence which comes with experience is lacking.

The most alarming factor, though, might well be the general harassed state of practically all chief engineers. There's just too much to be done with too little time. No solution or even partial remedy comes to mind. Isn't this suggestion worthwhile, though? Instead of worrying about so many details, set aside some time each day developing assistants to take on more responsibility.

All in all, though, the activity manifest in the industry should result in great progress for '57.

◀ CIRCLE 3 ON READER-SERVICE CARD

Engineering Review

For more information on developments described in "Engineering Review," write directly to the address given in the individual item.

Film System For Large Drawings

Reproduction of large engineering drawings up to 36 by 54 inches or longer has been achieved with a 105 mm film system developed by Micro-Master, Inc., Kansas City, Mo., in association with Keuffel and Esser Co., Hoboken, N.J. The postcard size negative makes possible direct viewing of the drawing for quick reference, a considerable advantage over smaller film systems. The negative yields full-size second originals on Photact papers, cloth, or Stabilene film of such high quality that the original pencil or ink tracing may be safely destroyed. The negative may then be filed affecting a considerable saving in storage space. The film has archival quality giving it a minimum storage life of 100 years.

Second originals made from the 105 mm negatives are often better in quality than the true originals, due to extremely careful differential controls exercised during exposure and development.

Smudges, dirt, and cracks do not show up in the second original. Dimensional accuracy is maintained by a special optical system in the camera and projector which were designed specifically for the reproduction of line drawings. The improved Mylar film base used has extremely high dimensional stability. The result is a system which yields distortionless reproductions of large drawings from postcard size to full size in large quantities.

The Micro-Master system has been in production use for some time with considerable success. More than 500,000 negatives have already been made for the U.S. Army Corps of Engineers, the Nebraska Highway Department, the New Jersey Turnpike Authority, and Trans-World Airlines. The photographic equipment, valued at about \$30,000, is not for sale or rent, but is leased on a franchise basis. Equipment to provide a nation-wide reproduction service is now being installed in key industrial centers in the United States and Canada.

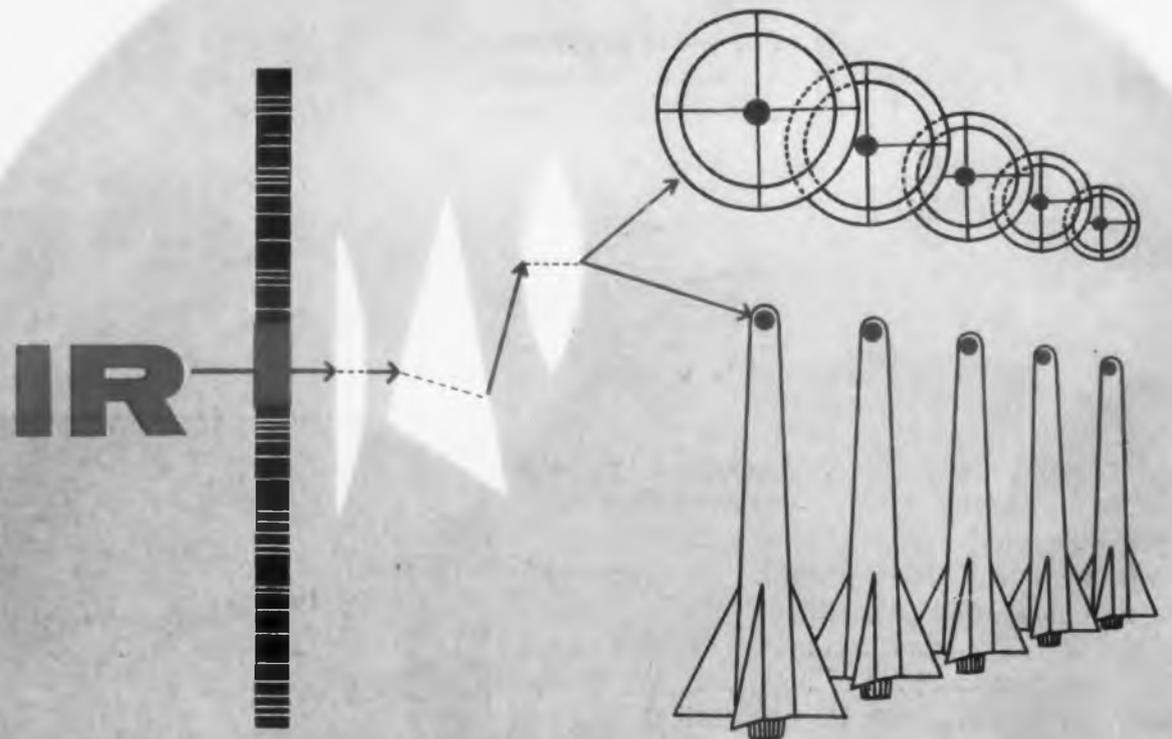


This projector is used for blowing up 105 mm negatives onto blueprint-size sheets of photopaper for exact reproductions of original engineering drawings.



World's Largest Electron Tube

A ten foot five inch klystron developed by Eitel McCullough, Inc., San Bruno, California is measured by company executives. It will be used in radar, linear accelerator applications, and other high power operations.



IR

INFRA-RED

1944...RESEARCH • 1956...MASS PRODUCTION

For 13 years Aerojet-General has pioneered the research and development of infra-red devices. Now, Aerojet and Aerojet alone has perfected the high-volume production of infra-red systems for:

GUIDANCE
WIDE-ANGLE SEARCH
AUTOMATIC TRACKING
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The General Tire & Rubber Company



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NEAR SACRAMENTO, CALIFORNIA

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Box 296D3, Azusa, Calif. or
Box 1947D3, Sacramento, Calif.

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Submarine-Launched Guided Missile

Regulus I is a proven surface-to-surface type guided missile which can be launched from a submarine within minutes after surfacing. Shown in the photo is the Regulus I, just before final release.

Satellites—Global TV Relay Stations

Four satellite stations, travelling 4000 miles high over the equatorial section of the earth, can serve as relays to offer world-wide TV coverage. This is the considered opinion of R. P. Haviland, Flight Test Planning Engineer, G.E. Philadelphia who believes that the satellite requires only good quality receivers and transmitters to make the system function properly.

The satellites would be equally spaced about the earth, be visible at any instant from the earth's equatorial region, and TV signals could be transmitted from a ground location to the nearest satellite. Present-day technology indicates that the system is feasible. Yesteryear's science-fiction is today's science-fact, almost.

Electronics Aids Movie Film Processing

To achieve optimum results from aerial reconnaissance films, a unique photographic processing machine has been developed which examines each individual negative electronically. The joint R&D venture by the Houston-Fearless Div., Color Corp. of America and the Eastman Kodak Co. was under USAF contract.

After partial development of the entire 200 or 400 ft roll of aerial film, the machine judges each single negative and then determines the additional chemical development time required for each individual negative. The machine then proceeds to complete the chemical processing, again on an individual negative basis, to achieve usable and uniform results.

Self-Guiding Torpedo

The sequence is rapid fire: submarine sonar detects enemy shipping, a homing fish torpedo is fired which guides itself in response to sounds made by the enemy motors. The weapon is similar in principle to airborne active seeker guided missiles. "Sighted enemy. Sank same" is the phrase which may well be written in US Navy logs, by virtue of this new killer-device.

Touchdown...

FLIGHT'S CRITICAL FRACTION-OF-A-SECOND

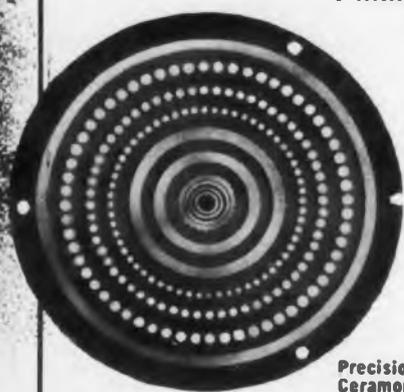
MONITORED PERFECTLY BY MYCALEX TM55 SWITCHES

At 10 feet or 100,000 feet, test teams rely upon telemetering for flight performance data. When signals fail vital information is lost forever.

Perfect commutation of these microsecond signals is an important job of MYCALEX TM55 switches, whose specially engineered design is setting new standards of dependable, low-noise-level performance — less than 1 millivolt peak-to-peak under most conditions.

Their extreme durability (more than 5,000 hrs. continuous operation at 600 rpm) significantly reduces down time.

Individually designed to your specifications. Write to Dept. 448 for complete information.



Precision-molded SUPRAMICA* 555
Ceramoplastic Commutation Plate

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for ceramoplastic material.

MYCALEX TM55 Commutation Switch

MYCALEX ELECTRONICS CORPORATION



Sweden Buys ALWAC Computer

The Autronic Computing Center in Stockholm has purchased an ALWAC electronic digital computer from Logistics Research Inc., which manufactures the unit. European aircraft companies, industrial, engineering, business firms, and universities will use the computer for scientific research and other problems. Dr. Waloddi Weibull and his son Bengt Weibull made the purchase. Dr. Weibull was formerly professor of Applied Physics at the Royal University of Stockholm and is now a U.S. Air Force Consultant. He has been visiting U.S. Aircraft centers to exchange scientific and engineering information. Bengt Weibull is general manager of the Computing Center where the computer will be installed.

NBC-RCA Expand TV Color Facilities

By next Fall, NBC will have doubled its present live color TV schedule of 40 hours monthly. Part of this expansion, included in this comprehensive 12 million dollar program, is the construction of two additional color studios, at NBC's Color City, Burbank, Calif., and Brooklyn, N.Y. The N.Y. Zeigfeld Theater will be converted into a color studio. All black and white facilities at NBC's Chicago station, WNBQ, will be converted into color. Four new color film chains will be added to the network's facilities. Equipment will be installed in Color City, Calif., for recording color films for rebroadcast. Latest-type master control centers will be constructed at Color City, for all West Coast originations, replacing the present master control at the Hollywood studios.

Reactor to Test Aircraft Parts

Tests to determine behavior of materials and components under varying thermal and radioactive conditions encountered in flight will be performed at Wright Air Force Base. The nuclear reactor will be constructed by ACF Industries, Inc. Irradiation cells on two sides of the reactor will be equipped with environmental chambers capable of simulating high-altitude conditions.

R&D Contractors Guide

Released recently by Lt. Gen. James M. Gavin, Chief of the Army's R&D, is an informative 36-page booklet of advice and instruction for contractors who seek to participate in the Army R&D program. Obtainable from the Office of Chief, Research and Development, Dept. of the Army, Washington 25, D.C., Attn: Technical Liaison Office, the guide establishes the procedure for developing and submitting an R&D proposal. Outlines in detail are the several areas of interest of the seven corps and services operating under Gavin.

First Private Nuclear Reactor

The first privately owned and operated nuclear research reactor in Canada will be built at McMaster University, Hamilton, Ontario, Canada.

The nuclear reactor, to be constructed by AMF Atomics (Canada) Limited, a subsidiary of American Machine & Foundry Company, will be of pool type design. It will be financed jointly by Canadian Government agencies, The Hydro Electric Power Commission of Ontario, and several Ontario industries.

Raised to Rank of Fellow

Harold Engstrom, Production Mgr., Plastics Div., Curtiss-Wright, Quakertown, Pa., has been elected to the rank of Fellow, American Institute of Industrial Engineers. Only two others in the field of management have been so singularly honored, Dr. Lillian Gilbreth and Herbert Hoover.

Portable P.A. System

A self-powered, portable public address system with fully transistorized 10 w amplifier has been introduced by John Ould, USA Ltd., Mount Vernon, N.Y.

The new unit is ideally suited for fairgrounds, sightseeing buses, local social, athletic and business affairs or other areas where cost or inconvenience make conventional P.A. systems impractical.

The transistorized amplifier, 8 in. loudspeaker, batteries and "press-to-talk" microphones are housed in one complete portable case.

CIRCLE 7 ON READER-SERVICE CARD ➤

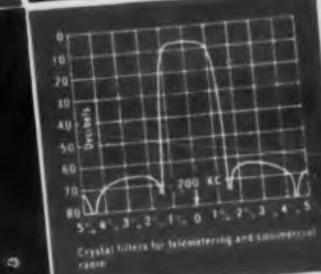
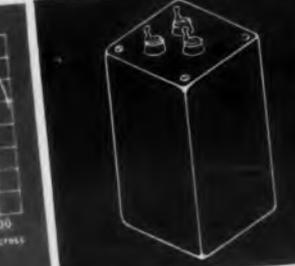
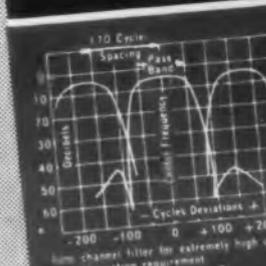
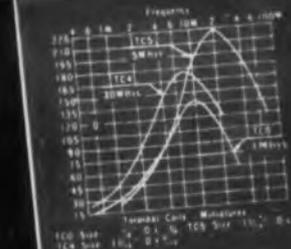
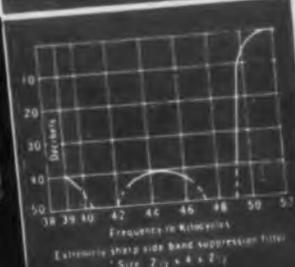
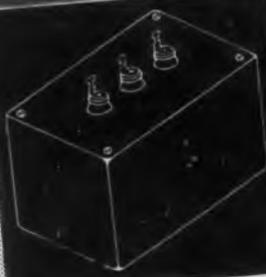
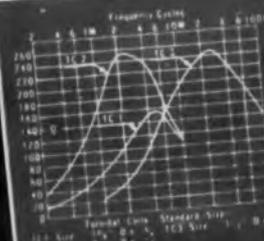
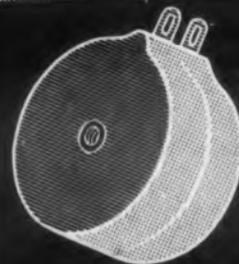
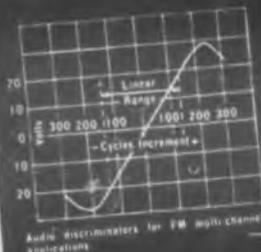
when you're

checked

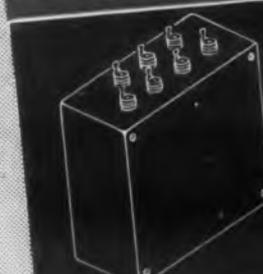
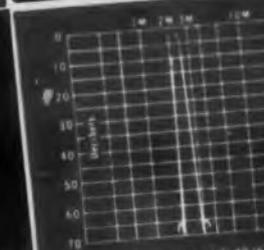
by network difficulties...

... don't get into an impossible position for want of specialized advice. Have your toroid and filter problems dealt with by the most advanced engineering in the field — by Burnell.

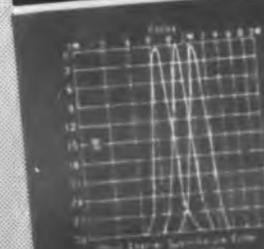
Can you see why the "checkmate" below is an impossible position?



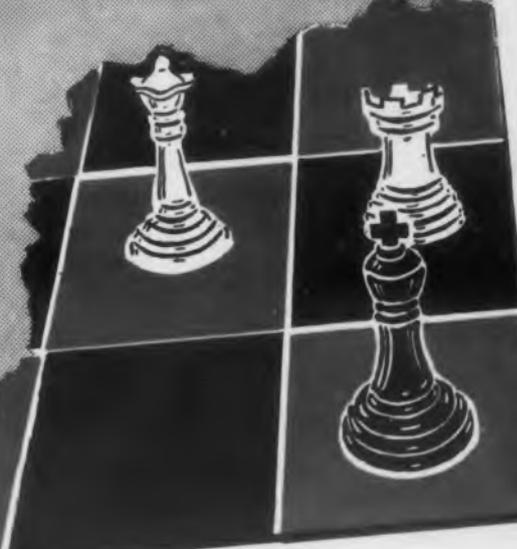
Write for technical information and free catalog. Your inquiries will be handled promptly.



Burnell & Co., Inc.
Best in toroids,
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TELETYPE: PASADENA 7878



Beneath the Ocean Floor

Specially designed to get echoes from beneath the ocean floor, this instrument is useful for offshore oil exploration, submarine pipeline construction, under-water salvage operations, and other purposes.

Called the Marine Sonoprobe, it will be made available to the oil industry and other users under arrangements recently completed by Socony Mobil Oil Co., the developers. Marine Sonoprobe surveys on a world-wide basis will be offered as a commercial service.

The instrument uses a special sound source which produces sound pulses of much lower frequency and much greater power than conventional echo sounders. These pulses penetrate bottom sediments and are reflected back from layers beneath the bottom.

The sea floor and layers beneath it are displayed on a small television picture tube and are also recorded as a continuous profile on electrosensitive paper.

Fuel Injection for Autos

Gasoline fuel injection system for use in automobiles has been developed on a production basis by the West German firm of Robert Bosch GmbH. The company has wide experience in diesel fuel injection systems and claims to be the first to produce gasoline injections systems for passenger cars past the experimental stage.

In the gasoline fuel injection system, individual cylinders are supplied with identical amounts of fuel evenly and quickly. Gasoline from the tank is pumped and forced directly into the combustion chambers through tiny nozzles. The actual mixing of fuel and air takes place in the combustion chamber, eliminating the usual bulky carburetor.

Correction

The patentee's name, for the article Producing 3D Visual Patterns which appeared in the November 15, 1956 issue, was misspelled. It should be Martin Ruderfer, 3531 Center View Avenue, Wantagh, L.I., N.Y.

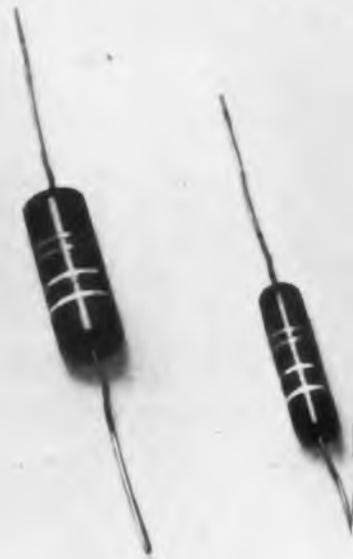
CIRCLE 8 ON READER-SERVICE CARD >



CAPACITORS

A high

E



Announcing

quality line of paper capacitors.

General Electric's molded

PVZ tubular
capacitors.



A new line:

General Electric's molded PVZ* tubular capacitors operate from -55 C to $+125\text{ C}$. . . yet are moderately priced

The new General Electric molded PVZ paper tubular capacitors meet the electronic designer's need for a high-quality line that offers, at a moderate price, characteristics similar to "K" of MIL-C-25A.

- Price of the units is less than one-half that of a comparable metal-clad tubular.
- They are designed for a minimum of one year's life, operating at 125 C, rated voltage.
- Insulated bodies are easy to locate in the chassis, and provide protection from other parts or ground.
- They are small, both physically and electrically, in order to aid equipment miniaturization.
- They are solid—resistant to shock and vibration.

In general, you will find these molded PVZ paper tubular capacitors suitable for use where you might normally expect to find either 85 C or 125 C metal-clad tubular capacitors; in computers, missiles, telephone equipment, and

other high-grade military and commercial electronic equipment.

Microfarad ratings extend *down* to .00047 μf —100 to 400 volts; *up* to .15 μf —100 volts, .1 μf —200 volts, .068 μf —300 volts, and .022 μf —400 volts. Capacitance ratings are available with $\pm 20\%$, $\pm 10\%$, $\pm 5\%$ tolerances.

In many instances, the units are physically smaller than equivalent metal-clad tubulars, especially if the metal-clads are insulated. PVZ capacitors range in size from .175" diameter \times $\frac{5}{8}$ " long to .375" diameter \times $1\frac{1}{16}$ " long. Nine different sizes are offered to accommodate the various ratings.

READY NOW: Stocks of most sizes and ratings of General Electric's new PVZ capacitors are on hand, ready for shipment. If you would like to receive technical data on the new line get in touch with your local G-E Apparatus Sales Office or write to the General Electric Company, Section 442-43, Schenectady 5, N. Y.

*A General Electric Trade-mark.

Parametronized Computer

A Japanese electronic computer with no tubes or transistors has just been completed. It uses parametrons. Parametrons, invented by Tokyo University scientist Eichi Goto, are magnetic ferrite switches. The parametron computer uses 4300 parametrons instead of vacuum tubes.

Advantages stated by its manufacturer, Japan Electronic Measuring Instrument Co., Tokyo, are that the machine has fewer parts requiring replacement, is more economical, durable and shock resistant, requires one-third normal power, and has an almost unlimited life span. The parametron computer adds and subtracts 1800 times a second, 10 times faster than the electric relay types. It multiplies and divides 150 times a second.

Besides the 4300 parametrons, the device consists of a tape-reader, printer, control board, and main works for controlling calculation.

A Better Mousetrap

The most recent step in the proverbial effort to build a better mousetrap is "The Electronic Cat," a plastic device which electrocutes up to five mice without resetting.

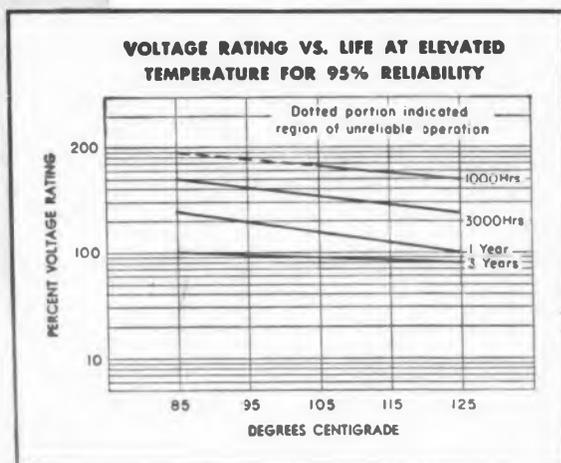
The key to its design is a newly developed process for spraying a thin, yet electrically conductive, metal film onto polystyrene.

The Electronic Cat kills mice instantaneously and bloodlessly. It is being used by poultry farms, greenhouses, granaries, and hotels, in addition to homeowners.

The device, produced by Admiration Plastic Co., Deerfield, Ill., consists of a plastic dome-shaped cage and floor, both coated inside with a zinc film which conducts electricity. When the cord is plugged into a household or industrial circuit, the interior of the cage is connected to one current pole, the floor surface to another.

The mouse crawls into a hole in the top of the cage seeking bait placed inside. Standing on the floor, he soon touches the interior of the cage with tail or nose, completing the circuit and electrocuting himself.

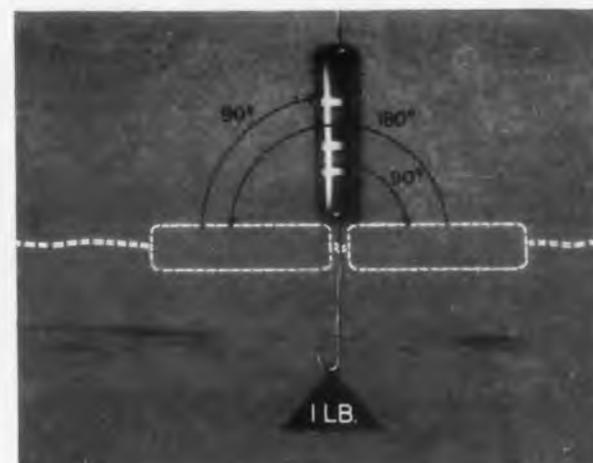
← CIRCLE 8 ON READER-SERVICE CARD



OPERATES FOR 1 YEAR AT 125 C Molded PVZ capacitors are designed for a minimum of one year's life at rated voltage and 125 C operation. Curves shown above are typical of performance.



EXCELLENT HUMIDITY CHARACTERISTICS Molded PVZ capacitors withstand stringent humidity tests, thanks to a combination of high-grade case material and carefully-controlled molding techniques.



HIGH LEAD BEND RESISTANCE The new capacitors withstand one-pound-vertical-pull test moving the body of the unit 90°, then 180° in the opposite direction, then back 90°, to the original vertical position.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

reduce costs

with

SOUTHCO

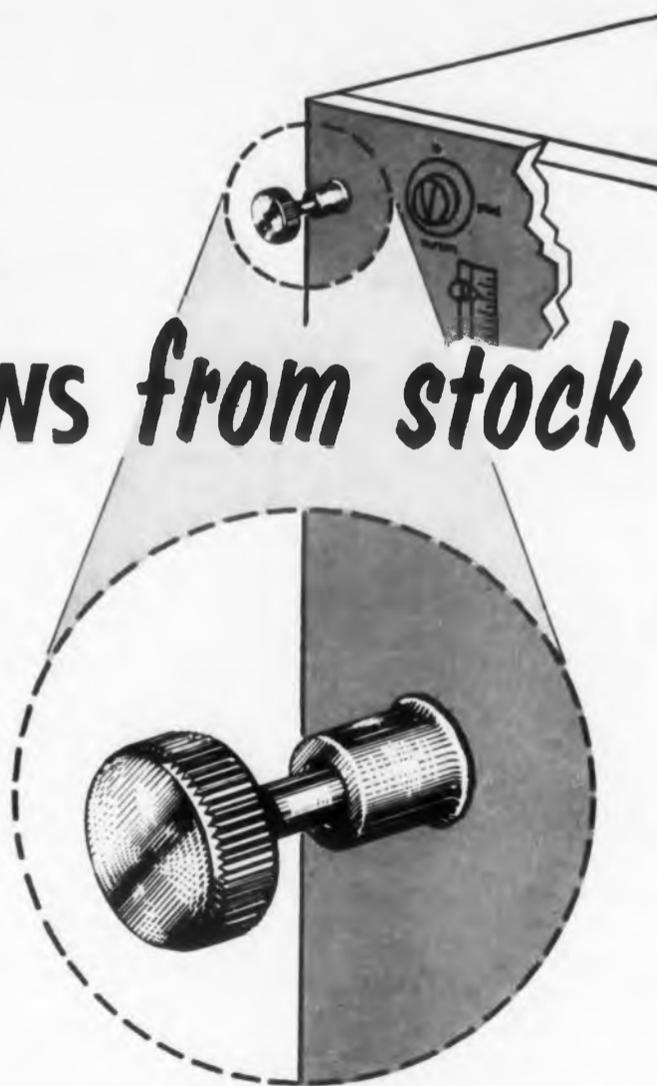
CAPTIVE PANEL SCREWS *from stock*

Here's a low-cost retractable screw fastener to save you assembly time and to eliminate the frequent need for costly special design fasteners. Unmatched for fast, economical use by assemblers of electronic units and other paneled cabinets.

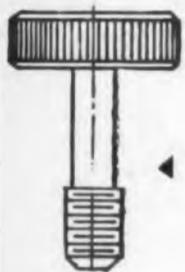
"Floating" screw insures easy alignment no matter how many screws are engaged in a single panel. No special skills or tools needed; installation fast and simple.

3 head sizes and 3 standard thread sizes available. On special order, slotted heads, stainless steel screws, and extra long screws.

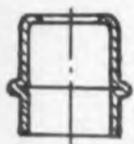
Write for complete information. Southco Division, South Chester Corporation, 235 Industrial Highway, Lester, Pa.



3 SIMPLE COMPONENTS



← SCREW



← STAND-OFF



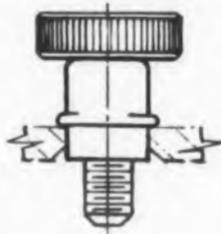
← RETAINING RING

EASILY INSTALLED

Stand-off is flanged into panel. Screw is inserted into over-size hole in stand-off and locked in place by retaining ring, which is passed over threads to seat behind last thread.

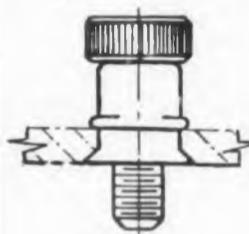
A SIZE FOR EVERY NEED

LARGE HEAD ($\frac{1}{4}$ " diameter)



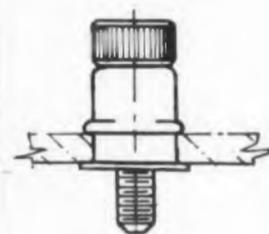
$\frac{1}{4}$ "-20 thread

MEDIUM HEAD ($\frac{1}{8}$ " diameter)



$\frac{1}{4}$ "-20 and
12-24 thread

SMALL HEAD ($\frac{1}{16}$ " diameter)



10-24 thread

Screw and stand-off are brass, nickel plated. Retaining ring is durable vinyl plastic.

Choice of stand-offs for each screw size to accommodate panel thicknesses from $\frac{1}{16}$ " to $\frac{1}{4}$ ".

SOUTHCO

FASTENERS

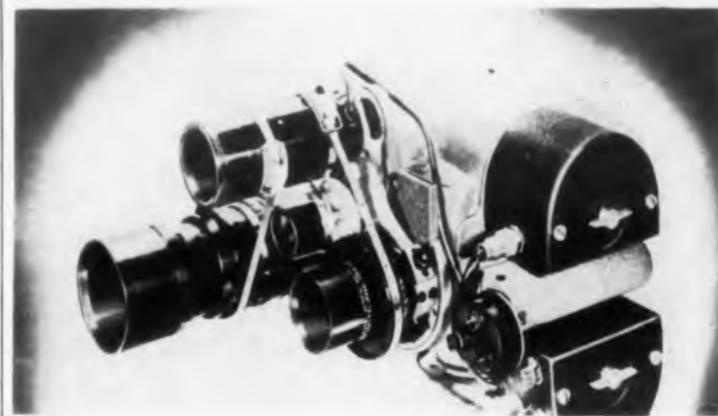
©1956

LION

CIRCLE 9 ON READER-SERVICE CARD FOR MORE INFORMATION

Navy Engineers Study Management

Senior engineers, scientists and training officers of the Navy Depts. in the Washington area and the Engineering School of George Washington University have worked out an evening educational 3-year program in management which leads to the degree of Master of Engineering Administration. The student is permitted, within a specified framework, to select his own courses in the realm of human relations, communications, finance and management. Borne wholly by the student, the present total cost is \$600, on a pay-as-you go basis in proportion to the courses taken.



The control head mounted on top of the turret of this camera contains a photocell and motor. A flexible tape drives the iris rings for automatic light compensation.

Automatic Film Exposure

Motion picture photographers now have an automatic aperture control at their disposal which is adaptable to many cameras and lenses. A transistorized unit provides the sensitivity and range required for color film or the fastest black-and-white film. A light-sensitive device operates a motor which turns the lens aperture ring through a steel-tape drive.

A useful feature of "Autex," developed by Flight Research Inc., Richmond, Va., is the Accent control which permits the photographer to deliberately change the aperture setting from the correct value in order to produce different effects.

Response speeds which provide full travel from f-2 to f-22 in as little as one second can be achieved. Completely self-contained, the unit weighs about 3-1/2 lbs, including the flashlight cells which drive it.

Computer Shortens Time

Scientists at the Aeronautical Chart and Information Center report that a Monrobot VI electronic computer completed a problem in 1-1/3 minutes which would take a high-speed desk calculator 1-1/2 hours.

The computer, made by the Monroe Calculating Machine Co. in Morris Plains, N.J. had the assignment of transforming 350 Hungarian Stereographic Grid Coordinates to Geographics. If done manually the problem would take over 500 hours.

Atomic Flashlight

An atomic flashlight which will provide light for many years without the aid of batteries or external power sources has been announced by the New England Nuclear Corporation. The flashlight uses a safe radioisotope to generate the light and is unaffected by climate, moisture, temperature and other external factors. By varying the chemicals and mix, the company has made lights with green, yellow or blue color. This makes possible the color coding of objects so that identification in the dark is possible. Unlike the radium, long used for dials, the new lights give off no harmful radiation and have a life that is years longer.

ICBM Test Sites

Four new separate facilities for testing the Air Force's Atlas intercontinental ballistic missile have been designated by Convair Division of General Dynamics Corporation, San Diego, California.

Two of the test bases are Convair facilities located in San Diego. The third, an Air Force facility, is at Edward's Rocket Base on the Mojave Desert, and the fourth is a part of the Air Force Missile Test Center at Patrick Air Force Base, Florida. Only a part of the total test personnel at the two Air Force facilities will be Convair employees.

No missiles will be launched at Edwards, although engines will be run and other systems of the missile will be operated.

The Atlas will be fired from Patrick over the missile range that extends far into the South Atlantic.

America's First Supersonic Bomber

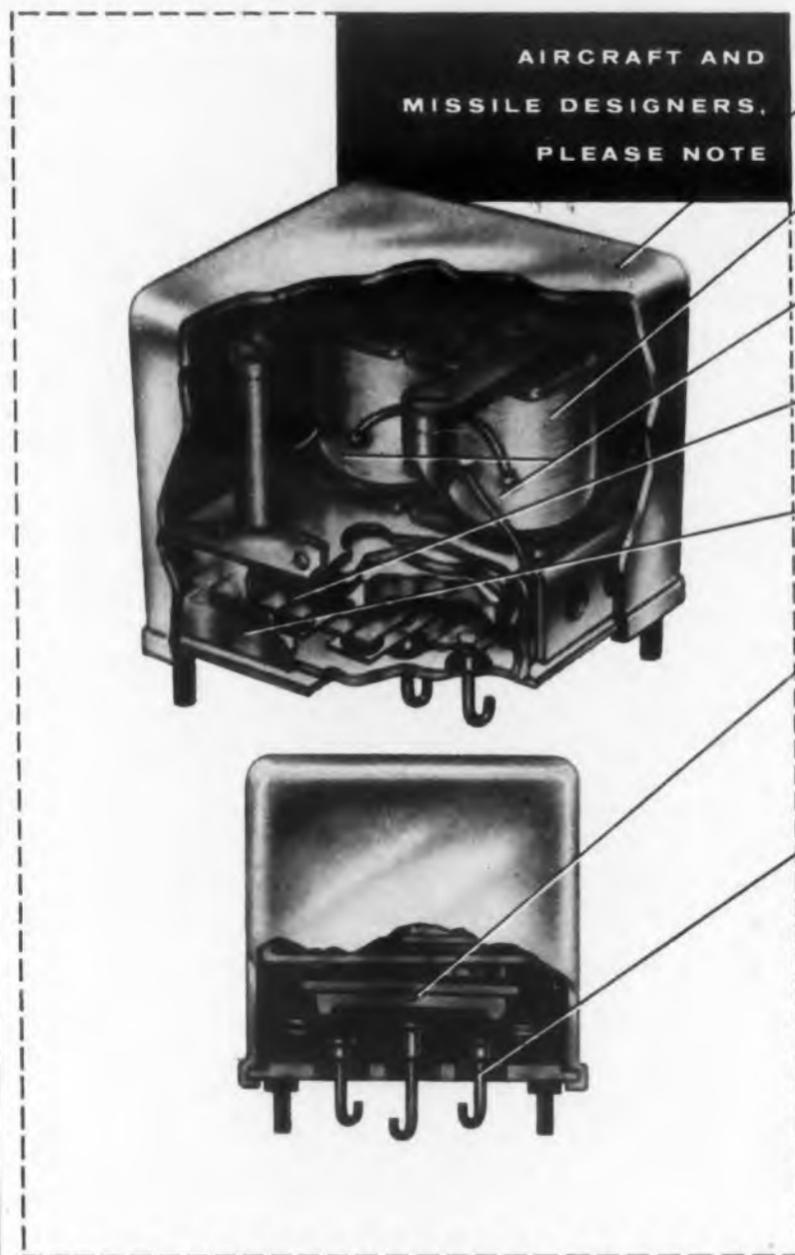
Designed for supersonic speeds above 50,000 ft, the B-58 "Hustler" has a wing span of approximately 55 ft, is about 95 ft long and 30 ft in height. It is powered by four General Electric J-79 turbojet engines and will carry a crew of three; pilot, navigator-bombardier and defensive systems operator.

The "Hustler" made its first taxi runs at the Fort Worth plant of the Convair Division of General Dynamics Corporation. Taxi runs are the final testing phase before the first flight of the delta-wing bomber.



Get unprecedented performance—

See for yourself why the new **LEACH BALANCED-ARMATURE RELAYS** outperform all other types in resistance to shock, acceleration and vibration



ONE-PIECE DIE CAST ALUMINUM HOUSING for maximum strength and vibration resistance with minimum weight.

MAGNET COIL wound with Teflon insulated magnet wire on one-piece Kel F bobbin assures reliability at elevated ambients.

DUAL COIL construction is the most efficient magnetic circuit for minimum height and maximum resistance to vibration and shock.

BIFURCATED CONTACTS assure high reliability in contact making circuits. Overtravel and high contact pressures produced by the pivoted armature result in immunity to shock and vibration.

ARC BARRIER of Kel F molded construction provides long arc path for use on 3 phase ac circuits, prevents phase-to-phase flashover.

BALANCED-ARMATURE DESIGN. In a *Balanced-Armature* construction, shock and vibration forces cannot cause the relay armature to move. This eliminates faulty operation of contacts due to vibration and shock forces.

HEADER AND CONTACT ASSEMBLY features simplified construction which eliminates internal wiring, lowers lead resistance, provides maximum resistance to vibration. Contacts and working parts are readily accessible throughout assembly, so that Leach is able to measure contact gap, contact pressure and overtravel, prior to sealing, on 100 per cent of production. Customers are assured of maximum performance from every production relay. Patent Pending.

MEETS ALL REQUIREMENTS OF THE MOST EXACTING OPERATING ENVIRONMENTS

The Leach Balanced-Armature Relays meet or exceed requirements of MIL-R-5757, MIL-R-6106, MIL-E-5272. Typical ratings include: vibration, 20 G's to 500 cps (higher ratings available); shock and acceleration, more than 50 G's; temperature, -50° to $+125^{\circ}$ C; life, 50,000 continuous operations minimum at rated load; coils, any resistance to 10,000 ohms—also available for 115 vac, 400 cps operation.

Write today for your copy of the *Leach Balanced-Armature Relay Catalog*.

LEACH CORPORATION

LEACH RELAY DIVISION

5915 AVALON BOULEVARD, LOS ANGELES 3, CALIFORNIA

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**HOW
LONG
WILL
THEY
LAST?**



These EL-MENCO Dur-Mica Capacitors will still be on the job!

In rigid life tests in which the applied voltage was $1\frac{1}{2}$ times rated voltage and the ambient temperature was 125° centigrade, El-Menco DM-15, DM-20 and DM-30 capacitors out-distanced all normal ratings with each lasting over 10,000 hours. Because of the acceleration of these tests, the life of these capacitors may be equivalent to 15 years or more under normal operating conditions.

New, toughened phenolic casing prolongs life, increases stability over wide temperature range. Made to meet environmental and electrical requirements of RETMA and MIL-C-5 specs. Parallel leads simplify use in television, computers, miniature printed circuits, guided missiles, and countless civilian and military applications.

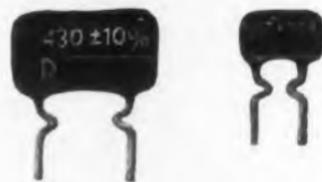
El-Menco Dur-Mica DM15, DM20, and DM30 Capacitors Assure:

1. Longer Life
2. Potent Power
3. Smaller Size
4. Excellent Stability — Silvered Mica
5. Peak Performance

We'll be glad to advise you on your specific needs. Put El-Menco Dur-Mica Capacitors to your own tests. See for yourself.



Write for free samples and catalog on your firm's letterhead.



FOR PRINTED CIRCUITS — DM 15 and DM 20 WITH CRIMPED LEADS. Crimped leads specially designed for printed circuits . . . Available for immediate delivery. And lead lengths cut to your specifications.

THE ELECTRO-MOTIVE MFG. CO., INC.

WILLIMANTIC, CONNECTICUT

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- tubular paper • ceramic

Arco Electronics, Inc., 64 White St., New York 13, N. Y.
Exclusive Supplier To Jobbers and Distributors in the U.S. and Canada

CIRCLE 11 ON READER-SERVICE CARD FOR MORE INFORMATION

British Radio to use "Forward Scatter"

A new range of radio transmitters and receivers being produced by Marconi Wireless Telegraph Co. of Chelmsford, England, are confidently expected by the company to constitute the greatest advance in radio communications in two decades.

The system is popularly known as "Forward Scatter." Instead of the radio beam being directed in a path parallel to the earth's surface, in "Forward Scatter" it is directed skywards for a height of fifty to seventy miles. There it bounces against the ionised layer and is deflected forward and downward, to return to earth at a point maybe a thousand miles distant.

Both transmitters and receivers are designed to operate in the 33 to 55 mcs frequency band. The transmitters have a power output of 20 kws. Usual procedure is to operate two in parallel—using a split aerial system.

Among advantages claimed for the "Forward Scatter" system are its high degree of reliability, day and night, and the fact it is unaffected by magnetic disturbances.

Corrosion-Resistant Finish

According to GE, Schenectady, air conditioning capacitors, having a new corrosion-resistant, granite gray finish and cadmium plated covers, have successfully withstood 2000 hr., 20 percent salt fog, 95 F environmental tests. Capacitors with the old finish and covers showed corrosion under seams and bushings and pinpoint corrosion on cases after only 250 hours of similar testing.



Capacitors being removed from test chambers.

Washington Report

Herbert H. Rosen

The UHF Battle

This past month some 83 licensees of uhf stations were asked to tell the Federal Communications Commission why they have not started to build their facilities. Commissioner Bartley believes that they have purposely delayed construction, and therefore should not have their permits extended. Commissioner Lee, dissenting, thought that since the uhf problem has not been resolved, the permits should be extended.

Witnesses before the Forand Subcommittee on excise taxation testified that the 10 percent tax on all TV receivers is a hardship to both the manufacturers and the broadcasters. They claim that the tax advantage given vhf receivers over all-channel receivers is delaying production of the latter type of set. Generally, the recommendations to the committee ask for a reduction of the excise tax to 5 percent on vhf sets and the elimination of the tax on all-channel and color sets. Chances of a tax reduction during the next session of Congress are thought to be poor, especially since the Treasury Department is strongly advising against it.

The FCC is not acting in this area. A technical committee has been set up—TV Allocation Study Organization (TASO)—under the sponsorship of the trade associations in the electronic industries. A director, George Town of Iowa State College, was named late in November. So far no recommendations have been made to the FCC nor are any expected for some time. The FCC is still seeking a solution to the uhf problem and perhaps a technical evaluation of the state of the art will afford one.

Navy Navigation Ship Commissioned

The Navy has a new ship—the *Compass Island*—fitted out with an inertial navigation system that promises to give all-weather, all latitude, day-and-night service. Basically, this elaborate system uses gyros, electromechanical devices, and much electronics to allow navigation without benefit of shore-based stations. It determines ship position, true north, and ship speed over the ground.

In checking the performance of SINS, as the navigation system is called, the Navy plans to use the principles of radio astronomy. Celestial radars will correlate SINS-plotted position with received radio emissions from stars. More than 10 years of research in this field has resulted in the determination of exact frequency emission from these bodies with respect to time and relative position in the sky. Charts and tables will guide the navy scientists in accurately determining the ship's position.

OOPS!

SIGHTS of rockets swooshing heavenward become more and more familiar as we thumb through today's industrial publications. The recalcitrant rocket shown on this page indicates that things *can* go wrong in research, and we don't claim that the absence of a Sanborn oscillographic recording system somewhere along the line was the reason for this disappointing trajectory.

What we do wish to say is that Sanborn equipment is playing an increasingly vital part in rocket development. Used in the laboratory to record flight behavior simulated by analog computers, and in plotting rooms at testing bases to tape down telemetered data, Sanborn "150's" are helping rockets to get and stay where they belong.

You can see Sanborn systems in many other places, too. Oil fields, electronic component production lines, machine tool plants, hydraulic testing laboratories, numerous aircraft manufacturers, computing facilities... are putting single to 8-channel Sanborn systems to work. (Most are housed in vertical mobile cabinets, while those in the "field" are often divided into portable packages for each instrument.) All of them give their users inkless, permanent recordings in true rectangular coordinates, one percent linearity, as many as nine chart speeds, and the efficiency (and economy) inherent in Sanborn unitized design. A dozen different plug-in preamps further extend their value, by making change-over to new recording inputs a quick and easy procedure.

SANBORN

COMPANY

CAMBRIDGE 39, MASSACHUSETTS



6-CHANNEL 4-CHANNEL 2-CHANNEL 1-CHANNEL 2-, 4-, 6-, 8-CHANNEL ANALOG COMPUTER SYSTEMS
CIRCLE 12 ON READER-SERVICE CARD FOR MORE INFORMATION

Which way rockets are going may not be a primary concern of yours. But if recording problems are, you're apt to find some interesting and useful answers in Sanborn's 16 page "150 System" catalog. Write to us for a copy.

Meetings

Jan. 14-15, 1957: Third National Symposium on Reliability and Quality Control in Electronics.

Hotel Statler, Washington, D. C., Sessions to be included are: System Reliability Analysis, Commercial Electronics Reliability, Reliability of Component Parts, and Quality Control in Production. Sponsored jointly by the IRE Professional Group on Reliability and Quality Control, the American Institute of Electrical Engineers, and RETMA. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

Jan. 16-18: Society of Plastics Engineers, Inc., Thirteenth Annual Technical Conference.

Sheraton-Jefferson Hotel, St. Louis, Mo. Sixty-eight advanced technical papers will be presented. For further information contact Jas. R. Davidson, Executive Secretary, Society of Plastic Engineers, Inc., Suite 116-18, 34 East Putnam Ave., Greenwich, Conn.

Jan. 21-25: Annual AIEE Winter General Meeting

Hotel Statler, Sheaton McAlpin New York, N.Y. Speaker will be F. R. Kappel, president of AT&T. The entire field of electrical engineering will be the subject of the meeting. For further information contact the American Institute of Electrical Engineers, 83 W. 39th St., New York, N.Y.

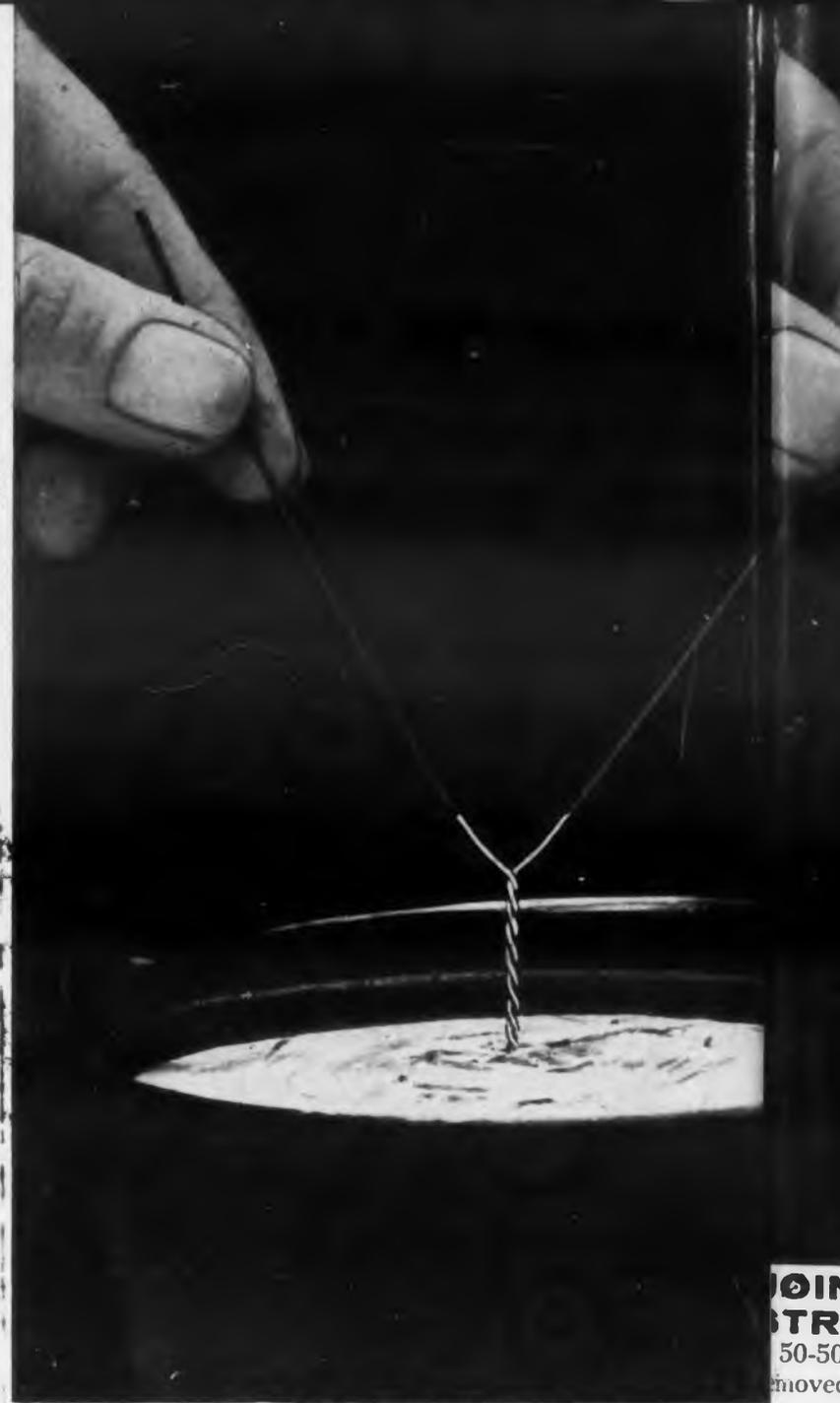
Jan. 23-25: 1957: Very Low Frequency Symposium

NBS Boulder Laboratories, Boulder, Colo. Co-sponsored by the Denver-Boulder chapter of the IRE PGAP and the Boulder Laboratories, National Bureau of Standards. The program is titled "Theoretical and Experimental Results in the Propagation and Radiation of Very-Low-Frequency Electromagnetic Waves (less than about 100 kc)." Authors are being requested to submit summaries for appraisal as soon as possible to Dr. J. R. Wait, Chairman, Denver-Boulder PGAP Chapter, National Bureau of Standards, Boulder, Colo. For further information, contact U. S. Dept. of Commerce, NBS, Boulder Laboratories, Boulder, Colo.

CIRCLE 13 ON READER-SERVICE CARD ►



TWIST WIRES ...



DIP IN SOLDER ...

Anaconda announces **Analac** an improved solder

New Analac* film-insulated, solderable magnet wire can be used similarly to Formvar or Plain Enamel—except that it is solderable without stripping!

Soldering by dipping, iron or gun produces a perfect joint—in just one second in finer sizes—without prior removal of the insulation. Analac reduces labor, saves time and money wherever many soldered connections are made, or where small diameter wire makes other means of insulation removal hazardous to the insulation or wire.

Not only this, Analac has the excellent abrasion resistance and other good mechanical properties of the enamel wire you're now using. It handles readily, per-

forms well in high-speed winding.

Analac is colored a bright red with stable dye used many years for identical applications—making it highly visible even in finest sizes. This helps operators feel more secure, results in higher quality work. Distinctive color simplifies its identification, too, from nonsolderable wires.

Analac is available in an exceptionally large range of sizes. The Man from Anaconda will be glad to give you more information and help with a production run in your plant. See "Anaconda" in your phone book—in most principal cities—or write: Anaconda Wire & Cable Company, Magnet Wire Headquarters, Muskegon, Michigan.

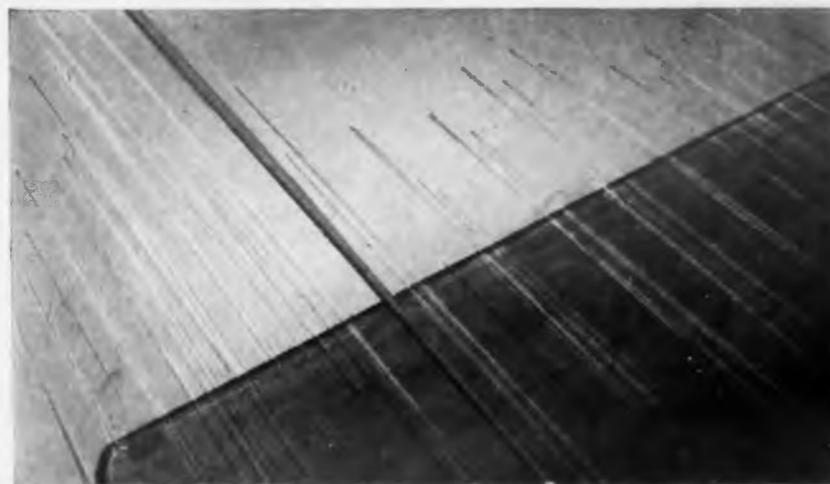
*Reg. U. S. Pat. Off.

JOINT IS COMPLETED WITHOUT STRIPPING WIRE with Analac wire dipped in 50-50 tin-lead solder at 360°C (680°F). The insulation is removed at the temperature of molten solder.

ready-to-solder magnet wire



1. STRONG JOINTS—as strong as the same joints made in bare copper wire—are produced. Here in laboratory test, joint holds under high stress.



2. EXCELLENT ABRASION RESISTANCE of Analac is shown in this test. It has the same high windability normally associated with Formvar, Plain Enamel.



3. MOLDED-PLASTIC CASES — designed and developed by Anaconda—protect spools of Analac from damage during shipping. Result: no breaks due to bent spools.

See the Man from
ANACONDA[®]
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 magnet wire



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NAME & TITLE

COMPANY

ADDRESS

CITY, ZONE, STATE

Feb. 5-7: Twelfth Reinforced Plastics Division Conference.

Edgewater Beach Hotel, Chicago, Ill. Latest developments in both technical and practical aspects of reinforced plastics. Subject matter will range from reports on research and testing to product design to production methods to marketing techniques. A complete program, listing papers and speakers, registration forms for the three day conference and hotel reservation blanks will be available after December 26. Those interested should write now to The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.

Feb. 7: Annual Symposium of the New York Section of the ISA.

Garden City Hotel, Garden City, N. Y. Short papers on "Practical Accuracy of Measurement" will be presented followed by a discussion. Afternoon session will be on "Data Handling." For further information contact G. Newberg, Publicity Chairman, Fairchild Engine Division, Fairchild Engine & Airplane Corp. Deer Park, L. I., N. Y.

Feb. 7: Operations Research Symposium.

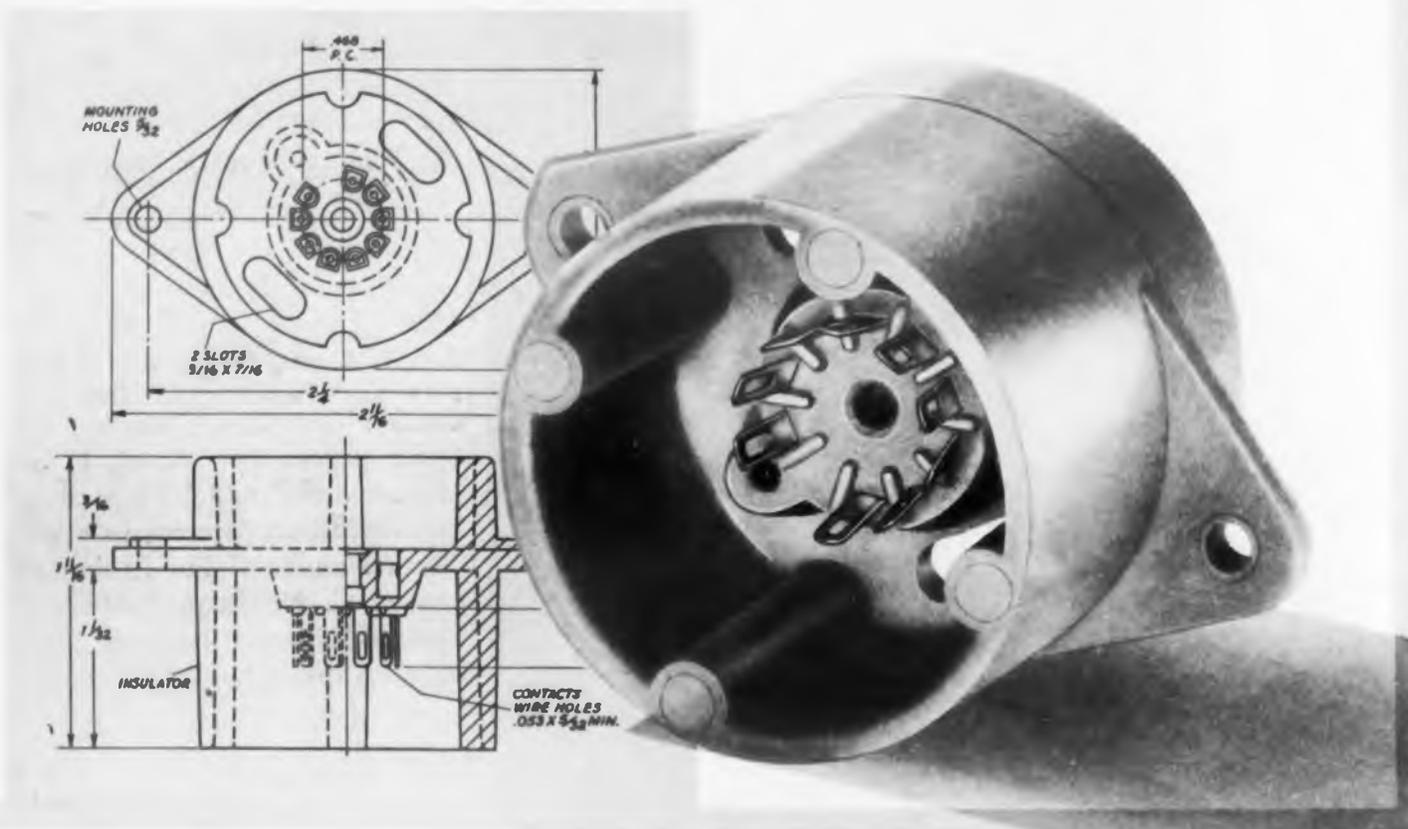
University Museum Lecture Hall, University of Pennsylvania. Sponsored jointly by the Professional Group on Engineering Management of the Philadelphia Section of IRE and the Society of Industrial and Applied Mathematics. Major theme will be Mathematical Models in Management Decision Making. Contact Haydn Ringer, 1303 Highland Ave., Palmyra, N. J.

Feb. 7-8: Special Conference on Nucleonics in Industry

Hotel Statler, New York, N. Y. Principle subjects for discussion will be the present and prospective profitability of atomic investment. Sessions will cover industrial applications as the use of nuclear energy for processing purposes, development of auxiliary power, and the uses of isotopes. Conducted by the American Management Association, 1515 Broadway, New York, N. Y.

◀ CIRCLE 13 ON READER-SERVICE CARD

NEW 9-PIN Anti-Corona Socket



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Sylvania's new 9-pin anti-corona socket meets the designer's need for effective protection against high voltage disturbances in miniaturized equipment where space is at a premium.

Full-molded in arc-resistant Urea, this 9-pin socket is similar in design to Sylvania's popular octal anti-corona socket. It features a deep re-enforced well which affords extra protection against corona by extending above and below pin contacts.

Top or bottom chassis mounting can be employed and provision is made for easy insertion of a shield ring. Socket can be supplied with or without a center shield.

In addition to meeting your needs in electronic components, Sylvania Parts Division offers you complete facilities for metal parts, custom molded plastics, and plated and clad specialty wires. Write for the Portfolio of 4-Way Service to Designers.

SYLVANIA

PARTS DIVISION

Sylvania Electric Products Inc., Parts Division, Warren, Pennsylvania



CIRCLE 14 ON READER-SERVICE CARD FOR MORE INFORMATION

February 14-15: 1957 Transistor and Solid State Circuits Conference.

University of Pennsylvania, Philadelphia, Pa. Sponsored by the Institute of Radio Engineers, American Institute of Electrical Engineers, and the University of Pennsylvania. For further information contact G. H. Kunstadt, Radio Corp. of America, Defense Electronic Products, Camden 2, N.J.

Feb. 14-15: ASQC Mid-Atlantic Conference

Ben Franklin Hotel, Philadelphia, Pa. Sponsored by the American Society for Quality Control.

Feb. 25-27: Special Conference on Electronics In Action

Statler Hotel, New York, N.Y. Several major companies will show electronic data-processing equipment in action through closed-circuit television. Sponsored by the American Management Association's Finance Division, 1515 Broadway, New York, N.Y.

Feb. 26-27: Third Conference on Radio-Interference Reduction

Chicago, Ill. Sessions include equipment design techniques, instrumentation and measurement techniques, practical interference reduction methods, and special suppression components. For further information contact Armour Research Foundation of Illinois Institute of Technology, Technology Center, 10 West 35th St., Chicago 16, Ill.

Feb. 26-28: Western Joint Computer Conference.

Statler Hotel, Los Angeles, Calif. The Conference is under the joint sponsorship of the IRE, AIEE, and ACM. Theme of the meetings will be "Techniques For Reliability." For further information contact S. Dean Wanlass, Aeronutronic Systems, Inc., 13729 Victory Blvd., Van Nuys, Calif.

March 11-15: The 1957 Nuclear Congress

Convention Hall, Philadelphia, Pa. Exhibits and conference sessions covering latest developments relating to the utilization of atomic energy in its various non-military forms for civilian use. For further information contact Atomic Exposition Office, 304 Architects Bldg., Phila. 3, Pa.

March 18-21: The 1957 SPI Annual National Conference and Pacific Coast Plastics Exposition.

Hotel Biltmore, Los Angeles, Calif., sponsored by the Society of the Plastics Industry, Inc. Sessions will cover plastics in the fields of electronics, aircraft and defense, building, and processing. Exposition will be held at the Shrine Exposition Hall. Further information may be obtained from the Society of the Plastics Industry, Inc., 250 Park Ave., New York, N. Y.

CIRCLE 400 ON READER-SERVICE CARD

March 18-21: IRE National Convention

Waldorf-Astoria Hotel and New York Coliseum, New York, N. Y. Twenty-three technical subjects such as Telemetry, Antennas and Propagation, Circuit Theory, Electron Devices and Receivers, Computers, Information Theory, Automatic Control Microwave and Instrumentation, Manufacturing Electronics, Audio and Broadcast, Aeronautical, Communication and Military Electronics, Ultrasonics, Medical and Nuclear Electronics will be presented at the convention. For further information on exhibits, contact Mr. William C. Copp, IRE Advertising Dept., 1475 Broadway, New York, N.Y. Contact the IRE, 1 East 79th St., New York, N.Y. for other information.

May 1-3: Electronic Components Conference

Hotel Morrison, Chicago, Illinois. Sponsored by the IRE, AIEE, and RETMA. Further information may be obtained by contacting the IRE, 1 East 79th St., New York, N.Y.

April 8-11, 1957: Fourth National Electrical Industries Show.

71st Regiment Armory, New York, N.Y. Sponsored by the Eastern Electrical Wholesalers Association. For more information, contact William S. Orkin, Co-Producer, The American Electrical Industries Expositions, Inc., 19 W. 44th St., New York, N.Y.

April 11-13, 1957: Southwestern IRE Conference and Electronics Show.

Houston, Texas. Sponsored by the Houston Section of the IRE. This conference will be augmented by the National Simulation Conference which will be sponsored by the IRE Professional Group on Electronic Computers. For information, write to Ninth Southwestern IRE Conference and Electronics Show, P. O. Box 1234, Houston 1, Texas.

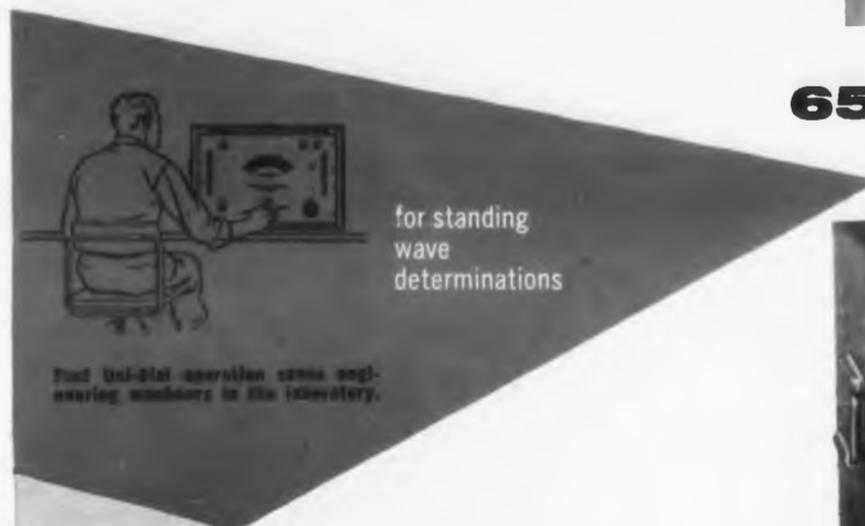
April 23-25: International Symposium on the Role of Solid State Phenomena in Electrical Circuits.

Auditorium of the Engineering Societies Building, New York, N. Y. Symposium will cover recent developments in application to electrical circuits on systems of unusual physical effects in solids. For information write to the Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N.Y.

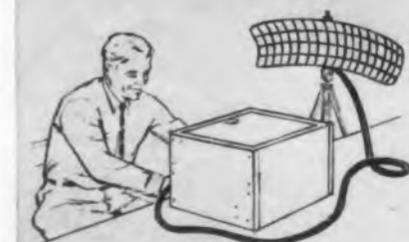
May 16-18: Eighth Annual Conference and Convention, American Institute of Industrial Engineers. New York City, Hotel Statler. For information write to AIIE, P.O. Box 8, Substation 135, The Bronx 53, New York.

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for antenna and transmission loss measurements



for testing microwave components on the production line



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MINIMUM POWER AVAILABLE (mw)	LOW RANGE	100	80	50	15	13	Available on Special Order
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	HIGH RANGE	400	150	60	15	20	

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CIRCLE 15 ON READER-SERVICE CARD FOR MORE INFORMATION

DESIGN '57



Digital Computer Trends

What problems face electronic designers in 1957? How many are expected to be licked? Are there nettlesome obfuscations plaguing progress? How can you help the progress of the electronic industries? Answers to these questions are contained in this ELECTRONIC DESIGN report on Design '57.

Where did the answers come from? ELECTRONIC DESIGN went to over a hundred leading technical spokesmen in various fields and asked them to comment on some of the major problems facing them in the immediate future. We also asked questions regarding specific improvements to be made in 1957, offering to hold the source of the answer in confidence if the data was company confidential. We have consolidated the many answers into one set of answers for each field. Frequently, authoritative quotes accompany the report. We thank all who participated.

Are there any significant new uses to which digital computers can be put?

Definitely yes. In addition to general-purpose scientific computing and business data processing, the role of the digital computer as a control element, as a simulator, and as a general data handler looms big.

What are some uses as a control device?

They have been used for several years in airborne navigation equipment, of course. Reduced cost and increased reliability coupled with the greatly increased requirements of military aircraft are providing the impetus for greater use. Commercial uses are probably still 5 to 10 years away, however. Nearly all later guided missiles systems will include digital computers somewhere in the system, either on the ground or in the vehicle itself.

Industrial process control by computers is increasing along with the advances in measuring and control devices, and the organization of processes to allow efficient use.

What are recent new applications of the digital computer as a simulator? Isn't simulation better done by analog computers?

The simulation of man-machine systems such as the control (by human pilots) of aircraft. This application, traditionally in the domain of analog computers, is being invaded successfully by the digital computer.

By data handling, do you mean such tasks as making airline, railroad and hotel reservations?

Yes. As many as a half-dozen automatic airline reservation systems will soon be in operation. In another direction, the automatic, high-speed reduction of data of commercial aircraft operation, missile firings, and missile system components tests are burgeoning mightily. Millions of datum points are accumulated where a small fraction were handled before. One government agency plans to operate *two* large-scale digital computers of the million dollar class in parallel in a real-time (as fast as it happens) reduction of data telemetered from the missile tested.

You just can't connect a computer to a machine tool, or to an aircraft to pilot it. What is involved? How costly is it?

Auxiliary or peripheral equipment is as complex and as expensive as the computer itself. Low-cost, reliable analog-digital converters are necessary in all these applications. In some cases these converters are of low-cost and low-accuracy, as in some of the man-machine system simulations, but in most cases rather severe accuracy and speed requirements must be met. Converters with 10-bit accuracy transferring information at 2000 (10-bit numbers) per second rates are not unusual.

The data reduction system requires tape drives, filters, discriminators, analog-digital converters and magnetic tape units to record the digital information prior to handling by the computer. Equipments which handle the translation from one medium to another (e.g., punched cards to magnetic tape) are as expensive and complex as they are important to high-speed operation. One government agency plans the development of equipment at a cost of about \$200,000 to translate between four or five different media for computer input-output.

Such emphasis makes it sound like reliability is of great concern. Is it?

The computer must work reliably independent of temperature and vibration extremes. Power and size are important. Power dissipation must be forced lower to allow application in situations where air conditioning is impractical. Sub-miniaturization allows applications in airborne equipment where space is at a premium and will eventually allow lower costs of production. Reliability techniques to allow operations under extreme climatic conditions over long periods of time are developing rapidly. This implies extensive use of sealed packages for components and chassis.

Can computers be used to help decide how to best develop these new computers and equipment?

Yes. New investigation techniques in circuit design to allow greater safety margins are now carried out on general purpose scientific computers.



Dr. W. F. Bauer
Head, Digital
Computer Center
Computer Systems Div.
The Ramo-Woolridge Corp.

"The most interesting and challenging phase of computer development and use—a phase which will show by far the greatest percentage gains in the next few years—is that of automatic control, simulation, and data handling. As might be expected, the equipment auxiliary to the computer will be as complex and as expensive as the computer itself."



Irven Travis
Vice President for
Research and
Engineering
Burroughs Corp.

"By increasing use of solid state techniques, great strides in miniaturization are anticipated. For example, one transistor-magnetic core decimal counter has been reduced to 2 per cent of its vacuum tube counterpart."



Dr. W. L. Barrow
V.P. for R & D
Sperry Gyroscope

"The present annual value for business data-processing, general-purpose computers, is about \$125 million. It is likely that this will grow to about a \$500 million to \$600 million business within the next ten years. At present, it is estimated that there is a backlog of orders of about \$450 million for this type of equipment . . . uses not initially thought of are being realized, . . . contribute heavily toward smoother operation of the using organization. These advantages . . . are destined to play an important role in expanding the market."

What about programming the general purpose digital computer? Can these problems be solved any faster or easier?

Computing speeds for scientific computers have been the paramount interest of designers. The design of components and circuits to allow even greater speeds with no loss of reliability tolerances is still urgent. In many situations, however, the over-all effectiveness of the computer is increased through more elaborate, higher speed, and more flexible input-output equipments. Whereas five years ago one per cent of the computer cost was for input-output, today 15 per cent or more of the cost is for that purpose.

There is an important trend in scientific computing: the increased facility to handle full alphanumeric data rather than just numbers. This comes about through extensive uses of automatic programming techniques. A short time ago the computer program was written in hard-to-understand numerical terms; today it is often written in terms such as "find sin x, where x equals 0.1 and 0.2 in." The total effect here is to increase the computer cost and complexity while decreasing the problem cost and programmer cost.

Is the business computer able to handle the problems of businessmen?

The greatest needs occur in faster, more reliable, and more flexible input-output equipment. The greatest trend in evidence is the confluence of the design streams of the scientific computer and the business data processor; the most modern scientific computers are good business data processors and tomorrow's will be excellent for that purpose. Many important developments in business data processing are associated with the third computer phase; for example, equipments are being developed to accommodate business data handling between remotely located installations.

The newer computer, using its myriad of components, can operate without any error for an average of 20 hours or more, and this degree of reliability is usually adequate.

Analog Computer Trends

New analog computers are continually being announced. Is this just for the interim? Will digital computers replace analog computers in time?

Analog computers have found their rightful place in the computation field. The old controversy of "digital vs. analog" in computers has almost died down. Predictions several years ago that analog computers would be replaced entirely by digital machines were simply wrong.

DESIGN '57

"We at Beckman/Berkeley feel so confident [about the role the analog computer will play] that we have invested considerable development and engineering time to produce a new line of analog computers which feature new automatic input and readout, higher accuracy, and more flexibility. We are certain that in 1957 and for many years to come, the electronic analog computer will play an increasingly important role as an engineering tool in design, simulation, and computation."



George A. Bekey
Chief Engineer
Los Angeles Computation Center
Berkeley Div. of
Beckman Instruments

What is the ratio of analog computers to digital computers?

Analog computers will never equal the dollar volume of the digital computer, but they are being used in an ever-widening series of applications. It is expected the total sales of electronic analog computers in 1957 will be about double the 1956 value. This increase will probably continue for several years.

What will be the major trend in 1957 in the design of analog computers?

Cross-fertilization of the analog and digital fields will continue in 1957. There will be new techniques for interconnecting analog and digital machines for the solution of certain types of complex problems. New analog machines will utilize more digital input and output equipment than ever before, such as punched-tape setting of potentiometers and silicon diode function generators, scanning and printout systems, and punched tape programming. Automatic check out features will be incorporated.

Will solid-state devices be used to replace tubes?

Solid-state devices will be used more and more. Approaches will be conservative and new components introduced if they contribute to greater reliability.

Would you like to see improvements in any components?

Capacitors with better dielectric, less "memory" and less leakage would be helpful. More stable resistors are desirable.

What about accuracy of multipliers and function generators?

There will be considerable improvement in these areas. Electronic multiplier accuracy will be generally extended by a factor of ten.

Will there be any major breakthrough in the art?

It is very possible all-electronic resolvers will become practical.

Will computers be used as actual controllers in process control?

Yes. Analog computation components have already increased in accuracy and reliability sufficiently to be extremely desirable as actual controllers in a variety of processes in modern industry. Among the important reasons for this trend are the following: 1. the increased speed of response of electronic components; 2. the need for better transient response of the process controller; 3. the need for more accurately controllable nonlinearities; and 4. the possibility of wide ranges of variation in the controlling parameters. Electronic controllers which can handle and compensate for system nonlinearities with high sensitivity and inherently fast response are ideal for control systems requiring very small dead bands and large ranges of gain and time constant variation.

In what areas will the analog computer play a more important role?

Increased utilization of analog computer components and techniques in process control will come about. During 1957, computers will find new applications in areas where their cost has been prohibitive up to now. It is now possible to rent computer time at a number of installations throughout the country.

The foregoing suggests that special purpose computers will figure in prominently, does it not?

Special purpose analog computers will find increased use as portions of automation systems.

Printed Circuits



To increase the use of printed circuits, can printed circuit subassemblies be used in more instances in a conventional assembly?

Printed wiring boards are most effectively used in electronic assemblies when the entire design of the assembly or subassembly in which the board is used is built around the use of printed wire. Applications are rare where conventional wired subassemblies can simply be replaced with a printed wiring board of the same size, and with the same system for mounting, without sacrificing many of the possible advantages of using printed wiring.

"Several years ago, our work on missile guidance, and on inertial guidance systems in general, emphasized the fact that the development of precision gears had seriously fallen behind other states of development. . . . Sperry embarked upon a program to develop and produce ultra-precision gears. This program involved . . . design and manufacture of new ultraprecision machines and tools, the design of advanced measurement and inspection equipment and procedures, and the training of personnel to think and work, in tolerances of millionths of an inch and seconds of arc. Now a hobbing machine . . . is capable of generating spur gear teeth of an accuracy of 10 seconds of arc and a concentricity of 10 microinches on a 4 in. diameter gear blank."



L. L. Wheeler
Chief Engineer
Sperry Gyroscope

Can a designer convert conventionally wired existing equipment to printed wiring easily?

Usually the physical form of a printed wiring assembly, when designed according to the best engineering practice, is considerably different from the hand wired chassis which does the same job. It should be supported in a different manner; connections to and from it should be made in a different manner.

Can small-run production make use of printed wiring efficiently?

Yes. You still save assembly labor time. Some companies making military products use printed circuits on runs of a few hundred or even less. You always have the advantage of easy reproducibility should another small order be placed.

Have dip soldering techniques been improved?

More and more is being learned. Optimum solder pot temperature has been worked out. Contamination is a nuisance, and the best answer now is just to replace with new solder. New machines are being developed which force solder only on joints where solder is needed. This virtually eliminates bridging or board warpage.

There is a fair amount of literature on guides in designing boards. Is there any aspect which should be stressed more?

What influence the form of the board has on the complete design is important. The shape of a small printed wiring board is often the major determining factor in the over-all size and shape of even such large devices as room-sized electronic data-processing machines.

Where can printed circuits be used to advantage where they are not now being used?

Printed circuits properly plated for abrasion resistance can be functional parts of switches. The future may see heavy duty printed circuits carrying high currents in electrical power systems. Behind-dashboard printed circuits could be used by the automotive industry. The aircraft manufacturers could use printed circuits in their distribution systems.



F. L. Swiggett
Vice President
Photocircuits

"The design engineer in 1957 should be concerned not so much with deciding whether or not printed wiring should be used, but in exercising his ingenuity so that it is used to the best possible advantage. The shape of the smallest printed wiring board can influence greatly the over-all size and shape of the equipment."

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The KAY LAB Model 203 is a combination DC microvolt-ammeter and amplifier. It provides an exceptionally wide range of measurements. Fifteen voltage ranges cover from 100 microvolts full scale to 1000 volts full scale, with 100 megohms input impedance. Ten current ranges cover from 100 micro-microamperes full scale to 100 milliamperes full scale. As little as 10 microvolts or 10 micro-microamperes may be measured with accuracy. The uncluttered zero-center meter face instantly indicates polarity on a mirrored scale. When used as a DC amplifier, the instrument features exceptionally low drift with high gain, very high input impedance and low output impedance. Gains up to 80 db with less than 10 microvolts drift may be obtained. The Model 203 utilizes KAY LAB's unique chopper stabilized circuit to provide high sensitivity with previously unobtainable drift-free stability and high input impedance.

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30 megohms at 30mv,
100 megohms above 30mv
Impedance Accuracy..... \pm 1.5%

Accuracy on All Ranges..... \pm 3% of full scale
Maximum Gain as Amplifier..... 80 db \pm 1.5%
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DESIGN '57

Automatic Assembly and Automation



Instruments

What do instrument designers feel is their biggest problem in 1957?

Answers were split between design of equipment for ease of maintenance by relatively unskilled technicians and design for greater dependability—that is, reliability: Two approaches to the same problem.

Other problems discussed were: to keep down the complexity of instruments while meeting more stringent performance requirements, and to keep prices from spiralling upward by using labor-saving designs.

What changes will come about?

More precise instruments, restyled for easier use. Less variation with temperature and humidity change is sought.

What is the trend in electrical meters?

To try to lower cost. Emphasis of many manufacturers is on simplifying design so that labor-saving devices can be used. Meters are generally called upon to meet greater environmental ranges than test instruments. There is great emphasis on reliability, life testing, etc.

Are instruments available to do all the desired jobs?

The requirements of the military have, in the past, been a traditional spark plug for increasing the range of performance of existing units and setting new standards of performance for future designs. It is certainly not anticipated that this trend will decrease during 1957, particularly with the heat problem to be overcome in ultrasonic flight. If this is to be associated with the problems of nuclear radiation in aircraft, whole new concepts of instruments will be needed in the not too distant future. It is probable, with the advent of new high-thrust propulsion units in aircraft, that limitations of instrumentation may well be in the position of deciding future progress in aircraft. Large scale problems require better instrument integration.

What is the implication of integration?

Imperative is the study of complex instrument procedures to improve the required presentation, allowing full utilization of the effective judgment of the operator (which is overtaxed in the case of fighter pilots). This will probably be a major accent in 1957, in which it is not enough to supply a large amount of information, but rather to use it effectively. This will mean that for military systems, more and more computers will be used, to make as easy as possible the routine calculations of systems, yet leave judgment to the operator in all cases. Similar progress in this direction will be required in an increasing amount of facilities concerned with processing, whether in the chemical or industrial fields.

A. J. Talamini, Jr.
Engineering
Manager, Technical Products
Division
Allen B. Du Mont
Labs., Inc.



"The vacuum tube is one of the weakest links in reliability. Better circuit design can overcome tube variations. The big problem is to both improve dependability and to make sure maintenance is improved. The shortage of trained technical personnel will influence future design requirements."

R. C. Langford
Assistant Chief
Engineer
Weston Electrical
Instrument



"The heat problem to be overcome in ultrasonic flight, coupled with the problems of nuclear radiation in aircraft, will require whole new concepts of instruments in the not too distant future. It is probable, with the advent of new high-thrust propulsion units in aircraft, that limitations of instrumentation may well be in the position of deciding future progress in aircraft. This leads directly to a substantial field of material progress required in 1957, that of integration. It is not enough to supply a large amount of information, but rather to use it effectively."

Are there any developments or trends that will make mechanized assembly of value to producers of limited quantity products?

Recent developments in semiautomatic machines will swing many small and medium-sized producers to mechanized assembly in 1957. Increased use of printed circuits will make semiautomatic assembly machines in demand.

What problems face the producer of automatic assembly equipment?

Component standardization and insufficient advance planning in the electronic industry on how, when, and where to mechanize assembly operations is one of our biggest problems. Biggest problem in 1957 will be to design production machinery with sufficient flexibility to accommodate component variations between suppliers.

Automatic processes will affect companies' products. Will there be an effect on the over-all company operations?

The greatest advances in automation in 1957 will not be the approaching of the automatic factory, but will undoubtedly take place in the field of data processing. That is, the more efficient use of personnel in handling incoming sales orders, ordering parts from the factory, inventory and cost control, delivery, and the like.

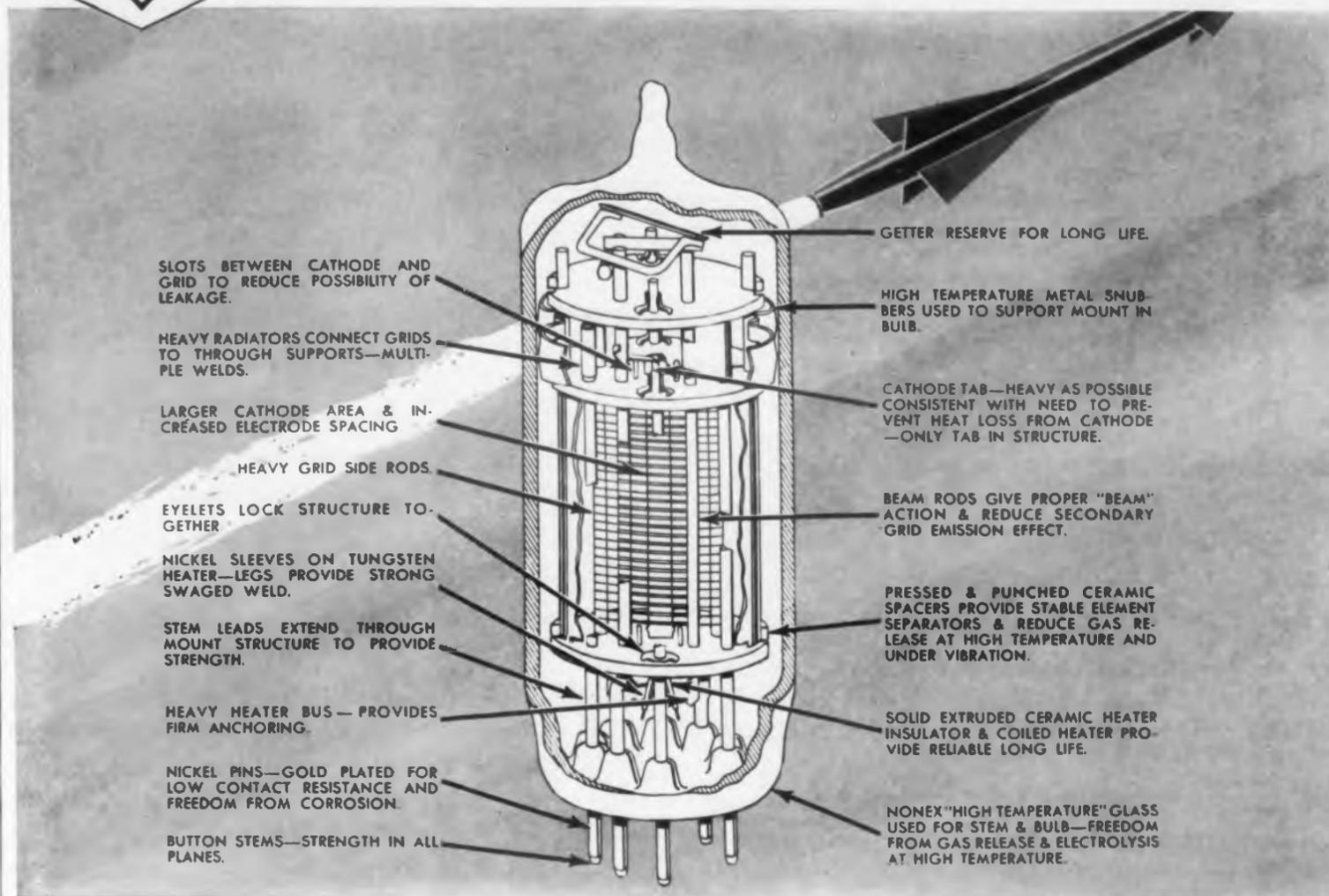
R. W. Daniels
Manager,
Dynasert Dept.
United Shoe Machinery Corp.



"Our biggest problem in 1957 will be to design production machinery with sufficient flexibility to accommodate component variations between suppliers."



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Specifically, Bendix HY-G-300's are designed to withstand the following environmental conditions—bulb temperatures up to 300° C; vibration up to 20G's over the range of 5-2000 cycles; and shock of 200G's having 20-millisecond duration.

For full information about the HY-G-300 line . . . the surest answer to electron tube applications in jet aircraft, missiles and rockets . . . write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY. *TRADEMARK

West Coast Sales and Service: 117 E. Providencia, Burbank, Calif. * Export Sales and Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y. * Canadian Affiliate: Aviation Electric, Ltd., P. O. Box 6102, Montreal, Que.

HY-G-300

TUBES ARE AVAILABLE FROM STOCK

Bulb Size	Dbi. Triodes Volt Amp.	R. F. Pentodes	Gate Pentodes	Rectifiers FullWave	Beam Power	Power Triodes Passing
T-12	—	—	—	—	—	6080WB 6082A
T-11	—	—	—	—	6384 6889	—
T-9	—	—	—	6853	—	—
T-6½	6851 6854 6900	6582A	6486A	6754	6094	6877 6900

Retma Type No.	Retrofit For	Generic Type	E _f	I _f	Bulb	Bendix Type No.
6080WB	6080 6080WA	6080	6.3	2.5	T-12	TE-46
6094	—	6AQ5-6005	6.3	0.6	T-6½	TE-18
6853	6106 5Y3	5Y3	5.0	1.7	T-9	TE-45
6384	6AR6 6093	6AR6	6.3	0.9	T-11	TE-27
6854	6385	2C51 5670	6.3	0.5	T-6½	TE-47
6486A	6486	6AS6	6.3	0.25	T-6½	TE-43
6582A	6582	6AK5	6.3	0.25	T-6½	TE-44
6754	412A	—	6.3	1.0	T-6½	TE-36
6851	5751	—	6.3	0.5	T-6½	TE-42
6877	—	Half of 6080	6.3	0.8	T-6½	TE-48
6900	5687	5687	6.3	0.9	T-6½	TE-54
6889	—	—	6.3	0.9	T-11	TE-52
6082A	6082	6082	26.5	0.6	T-12	TE-55

Red Bank Division



CIRCLE 17 ON READER-SERVICE CARD FOR MORE INFORMATION

DESIGN '57

Servomechanisms

To what extent will designs of servos be improved?

Increased versatility of electronic amplifiers to provide standardized designs with decreased size, increased reliability and resistance to environmental extremes.

What will the improvements in reliability be?

Improved circuit design, higher quality of components and more encapsulation.

What improvements in electrical characteristics are expected?

Increased amplifier gain, improved damping circuits, and circuit refinements all lead to considerable simplification of servo systems.

Will transistors be used more?

Yes. Both transistors and magnetic amplifiers will find greater use for improved reliability.



Kenneth L. King
Director of Research and Development
Norden-Ketay

"We are pushing reliability, miniaturization and extended environmental capability. Because of the high temperatures required for new aircraft, there is a requirement for better magnetic and insulating materials for use in our components. Currently 400 F designs are being produced, and designs for use at higher temps. are being studied."

Components

What is being done to improve the design of 1957 components?

Continuation of research and development on materials and processes, and closer coordination with users to better meet their requests.

What will improvements in reliability be?

Closer control, and therefore decrease in range of variables. In general, heavy test programs are being undertaken to improve quality control and to better understand deficiencies.

How much will the environmental ranges such as temperature, shock, etc., be extended?

Very little for 99 per cent of requirements or orders; and very greatly for 1 per cent, primarily missiles, etc. In missiles, high temperature is being stressed, of course. Effects of radiation are also being studied.



Louis Kahn
Technical Assistant to the President
Aerovox Corp.

"Probably the biggest design problems facing us are a sealing problem and reliability. Major limiting factor in the state of the art is materials. Evaluation of new material requires considerable time, and there are few new materials available."

To what further extent will products be miniaturized?

No great changes, except for a few special items. In areas such as connectors, more miniaturization work is being done.

What improvements in electrical characteristics are expected?

More uniformity.

What is the effect of radiation on components?

So far very little is really known. First tests are being made to see what effect there is on materials that go into components.

To what extent will automatic processes be used in 1957 and how will they affect the design of products?

Major changes in components have taken place already, and 1957 will see refinements such as the tightening of many tolerances.

What problems do component manufacturers face in 1957 that others in the electronic industries can help solve?

Reduction in types and variety of ratings now used. In other words, standardization and use of preferred values.

What are some temperature limits for components?

Top safe limit for some electromechanical components is now about 400 F. Beyond this, insulation resistance drops. Curie point of magnetic materials is reached, for example.

Are shock and vibration requirements being met?

New military requirements demand components to withstand vibration at higher frequencies. Extensive tests are necessary to determine exactly what the status is.



R. Bowen
Chief Engineer
Cannon Electric

"There is great emphasis on special connectors. The goal is greater reliability, extreme environmental ratings—particularly high temperature, and miniaturization. Programs for the study of radiation effects are under way. Extensive tests of all kinds are being made."

Modern Network Synthesis

Can modern network synthesis be used by the engineer in 1957? We often glibly say that there is a ten year gap between theory and practical engineering; is this the case?

The procedures of modern network synthesis introduce a great deal of flexibility into the design of reliable systems. For example, ladder networks can be designed that contain the minimum possible number of elements and yet achieve some form of optimum characteristics.

What are some other unexploited areas where modern network synthesis can help?

It is not widely appreciated that voltage gain can be achieved with a passive network that contains only resistances and capacitances. It is possible to change the impedance level of half of a symmetrical network without changing the system function except in its constant multiplier. In these examples a tube and a transformer have been eliminated.

After a network has been realized, it may be found that the spread of element values is too large or that the values do not correspond to readily available standard sizes. Simple matrix manipulations may accomplish a decrease in the spread of element values and/or the conversion of all elements of a single type to one standard value.

Resistance-capacitance networks of any complexity may be designed as one complete passive network without the use of buffer tubes.



G. A. Crowther
Chief Engineer
Ford Instrument
Division of Sperry
Rand Corp.

"One of the limiting factors in instrumentation today is the physical size of power and data transmitting elements such as servo motors and synchros. It is believed that elimination of manual operations by the use of automatic winding equipment should result in extremely small size inexpensive rotary units; on the order 3/10 inch outside diameter."

6 new Dressen-Barnes power supplies

—designed to speed laboratory work and for use in original equipment

model 4K-100B



High Voltage, Excellent Regulation

Output 400-4000 V.D.C. continuously variable without switching.

Current 0-100 MA

Regulation NL to FL, 2000-4000 V: 0.1%; 400-2000 V: 0.25%

Bulletin 1014

model .5-1MB



Low Voltage, High Current, Fast Response

Output 0-50 V.D.C. Provides full output current throughout entire range.

Current 0-1 Amp.

Regulation 105-125 V. line: 50 MV; NL to FL: 20 MV.

Bulletin 1015

model D1-100B



For Precision Measurements

Output 0-100 V.D.C.—linear control throughout full range.

Current 0-100 MA—no derating necessary.

Regulation 20 MV throughout entire range.

Voltage Control Settable to 0.1 V.

Bulletin 1016

model 5-300XA



A Compact Adjustable Unit-Regulated

Output 300-500 V.D.C.—adjustable by simple internal changes.

Current 0-300 MA.

Regulation 105-125 V. line: 0.5%; NL to FL: 1%

Size W: 5"; L: 12½"; H: 6"

Bulletin 1017

model .28-5MX



28 V.D.C.—5 Amps — Adjustable

A compact source of 28-volt power. Filtered for operation of relays, motors and similar equipment. Transformer taps permit adjusting to 28 volts for varying conditions of line and load. Size: 4" wide, 12½" long, 6" high. Low priced.

Bulletin 1018

model .28-5MXR



28 V.D.C.—5 Amps — Regulated by Mag. Amp

You get the dependability and long life of a magnetic amplifier in this unit. Regulation—for 105-125 V. is ±.25V; NL to FL: ±.25V. Size: 4" wide, 12½" long, 7" high.

Bulletin 1019

Each unit features simplified design, highest quality components, easy-to-trace wiring, and ample working room under the chassis. Components are derated to run cool and last longer. Write for literature on any or all models.

Dressen-Barnes

DRESSEN-BARNES CORP., 250 N. Vinado Ave., Pasadena, Calif.

CIRCLE 18 ON READER-SERVICE CARD FOR MORE INFORMATION

DESIGN '57

Vacuum Tubes



With all the emphasis on military tubes, what portion of the total is involved?

Total volume in the receiving tube industry should be more than \$400 million in 1957—of which \$300 million will be in commercial types and \$100 million in military types. Television requirements will continue to be the largest of any in the commercial market. In this field, color television types may increase slightly in proportion to monochrome types.

Do television picture tubes represent a good portion of this?

We estimate that 14 million television picture tubes will be manufactured in 1957, of which 6.8 million will be for replacement purposes.



C. E. Ramich
Manager, Engineering Dept.
Electronic Tube Div.
Westinghouse Electric Corp.

"There is one area that consistently seems to plague the tube manufacturer, and that is the purity or impurity of incoming raw materials. Many of our measuring instruments in this field do not seem to detect small traces of impurities which are detrimental to a finished tube."



K. E. Weitzel
Manager, Commercial Engineering Tube Sales
General Electric

"Receiving tube development will revolve, to a great extent, around designs for military metal-ceramic tubes. While research efforts concentrate on improving emitters, vacuum techniques and basic tube materials, growth in the industry's manufacturing facilities will emphasize the 'Snow White'—clean factory—approach."



Walter A. Weiss
General Manager
Radio Tube Div.
Sylvania Electric Products, Inc.

"To improve reliability, Sylvania will in 1957 subject entertainment tubes to similar type tests given electronic tubes for military applications, such as temperature shock tests."

Will 12 v B+ tubes for auto radios continue to be developed?

The design of automobile radios will shift completely to vibratorless receivers, and improved auto radio tubes which operate directly from the vehicle battery will be introduced in 1957.

There have been several announcements of shorter 110-degree deflection TV picture tubes being available. Will they see wide use?

The major development expected in this field will be improved 110-degree deflection designs that will permit shallower and lighter weight tubes.

Any improvements in picture quality or contrast?

Image orthicon manufacturing improvements have been announced. Sonic cleaning can remove foreign particles that cause blemishes. Microphonics have been reduced. Thus better pictures can be telecast.

What about color kinescopes?

There is still feverish activity in research laboratories to design, for production, an inexpensive color kinescope of satisfactory performance for color TV.

What is the demand for higher power tubes? Will the smaller customer find more types available?

Power tube markets should increase 10 per cent in 1957, and double within the next ten years. The growth of this branch of the tube industry will arise from higher power requirements in military electronics systems, increased automation and plant expansion, the use of industrial television, and expansion of domestic cooking and industrial heating. The power capabilities of rectifiers and control tubes will increase to match expansions in such heavy industries as aluminum and railroads.

Undoubtedly reliability and higher temperatures are still major goals for military tubes, are they not?

The problems of high reliability and high temperatures take first place in the design and production of electronic tubes of the future. Much progress has been made in these fields in the past year, and it is expected that 1957 will see additional significant advances to meet the ever increasing number of critical applications for tubes in both defense and industrial electronics.

What do we need to know to design more reliable tubes?

Studies aimed at defining electronic tube reliability will continue throughout the industry in an effort to synthesize ever more completely the chemistry, metallurgy, physics and mechanical know-how that is required in the tube industry. Research efforts will concentrate on improving emitters, vacuum techniques and basic tube materials. Industry's manufacturing facilities will emphasize the 'Snow White'—clean factory—approach. Purity of raw materials is important. It is a difficult problem to detect all impurities which might be detrimental to the tube.

Will ceramics be used extensively?

Receiving tube development will revolve, to a great extent, around designs for military metal-ceramic tubes.

TV and Audio Equipment



What about the appearance of TV sets?

Printed circuits will be used much more extensively partly to get smaller size. The shorter, (and probably lighter) 110-degree deflection picture tube will help.

What is the biggest design problem facing the TV industry?

The longer time required to design a TV set which uses printed circuit boards. Design of color TV is of course, a big problem. Sale of color TV will have to step up to accelerate design activity.

What about transistors in TV sets?

Experimentation is going on to see how successful transistors are in difficult circuits such as deflections circuits. It is doubtful if transistorized sets will be on the market in 1957.

Will there be improvements in audio equipment in 1957?

Perhaps the most change will be in stability. Research seems to be leading to greater stability of performance.

Will there be major styling changes?

Probably not noticeably drastic ones. Lack of imagination, as exemplified by equipment of several years ago, has been overcome, and no radical changes are expected.



C. J. LeBel
Chief Engineer
Audio Instrument
Co., Inc.



V. C. Jackson
Engineering Service, Mgr.
Motorola Inc.

"Reduction in assembly costs to compensate for rising labor charges, without loss in quality, is our problem. There is a need for better reliability of contact in low-cost phenolic wafer switches which are the mainstay of the instrument field."

"Automatic processes will be more extensively used than 1956. From a design standpoint, this means continual progress in the reduction of size. Main steps will be using printed circuit boards and machine insertion."

ACTUAL SIZE

Clevite diodes are used for the giant Remington Rand UNIVAC computer.

High Conductance Types
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All CLEVITE gold bonded subminiature glass diodes feature high forward conductance . . . high inverse resistance . . . fast pulse recovery . . . and fast forward switching time.

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CHARACTERISTICS

TYPE	Forward Current at +1V (ma. Min.)	Inverse Current at Specified V (µa. Max.)	Continuous Inverse Operating Voltage	DESCRIPTION
CTP-301	40	25 @ -50V	50	Inverse recovery time meas. 1.0 µ sec
CTP-307	300	20 @ -30V	40	Inverse recovery time meas. 1.0 µ sec
CTP-309	300	20 @ -6V	20	Forward recovery time 0.1 µ sec
CTP-318	50	500K between -10V & -50V	60	Inverse recovery time 0.3 µ sec Forward 0.1 µ sec
CTP-319	150	500K between -20V & -90V	90	Inverse recovery time 0.3 µ sec
CTP-320	5	50 @ -50V	80	Inverse recovery time 0.3 µ sec
CTP-328	7.5	500K between -10V & -60V	60	Inverse recovery time 0.3 µ sec
IN34A	8.5	30 @ -10V 500 @ -50V	60	General Purpose
IN279	100	200 @ -20V	30	General Purpose
IN116	5	100 @ -50V	60	General Purpose-

Clevite Divisions: • Brush Electronics Co. • Cleveland Graphite Bronze Co. • Clevite Harris Products Inc. • Clevite Research Center • Clevite Ltd.

CIRCLE 19 ON READER-SERVICE CARD FOR MORE INFORMATION

DESIGN '57

Transistors



What appears to be foremost in the minds of transistor manufacturers?

Cost reduction, high temperature reliability, and development of new manufacturing techniques for increased power and frequency ratings, etc., all appear to be paramount.

How will cost reductions come about?

Automatic processes and semiautomatic operations are expected to bring costs down. Automatic processes will be used about 50 per cent more in 1957 than in 1956 in some plants.

Does not automatic processing offer advantages in addition to cost reduction?

Use of automatic machinery will force standardization of case sizes, etc. It will improve reliability.

What's being done about improving reliability?

Life tests and high temperature tests will be stepped up. Data obtained will be helpful in improving reliability. Close control in manufacturing techniques will improve uniformity.

Will transistors with new characteristics be announced?

Frequency, power and voltage ratings are all expected to advance. Diffusion techniques or the several variations of it will play an important part. Such techniques also improve uniformity. It is likely that all lines will be extended.

What will upper temperature limits be?

At least one manufacturer feels that silicon transistors will move up to 200 C rating. There will be no change in ratings for germanium, and some feel there will be little change in silicon devices.

Will packaging be changed?

Look for standardization of lead placement for P-C boards and miniaturization. Look for complete transistor circuits in packages smaller than current power transistor cases.



H. R. White
Sales Manager,
Mobile Department
Federal Telephone and
Radio Co.

"New 'Split Channel' assignments impose severe desensitization and intermodulation requirements on mobile receivers. Integration of vacuum tubes and transistors in a single design is also still a major problem.

"Our new mobile receiver equipment will utilize latest filter network designs for application in r-f stages."



H. L. Owens
Chief Design Engineer,
Semiconductor Components Div.
Texas Instruments, Inc.

"Diffusion in conjunction with other presently available techniques will make possible more uniform transistor characteristics and improved high-frequency performance."



H. B. Fancher
General Manager,
Semiconductor Products Dept.
General Electric

"Use of automatic processes will be about 50 per cent greater in 1956. . . . Life tests and high-temperature tests are important design tools. We expect silicon devices to move to 200 C."

Microwaves and Test Equipment

What aspects will receive most attention in 1957?

Increase of both frequency and power in the microwave area, with the greater performance requirements of modern development.

What specific materials are critical?

Ferrites are of key importance. Big suppliers do not furnish materials with the proper characteristics for microwave work, and the industry is forced to do basic research.

As power increases, will size also increase?

Not necessarily. More efficient materials can keep size down. Dummy loads using ferrites, for example, are getting smaller and smaller.

What are problems in power measurements?

Reduction of custom and increase of standardized production of apparatus and components, notwithstanding the fact that the past year has been one involving requirements for tremendous power and frequency capabilities. Design precedes field experiences. Redesign and continuing development will follow such experiences. Thousands of watts average power and many megawatts peak power are now being measured.

Many tunable magnetrons have been announced. What will be their effect?

R-f systems and waveguides, and components used with waveguides, should be designed for the fullest bandwidth possibilities. More traveling wave tubes and backward wave oscillators are available, and designers can make use of them to reduce the size of equipment and increase electrical characteristics.

What about transmission of microwaves?

Microstrip continues to be used extensively. Antennas and scanning techniques are receiving much attention. Non-mechanical scanning techniques are being worked on. The effect of out-of-tolerance configuration of reflectors is being studied.

Countermeasures are getting more and more attention. What does this mean to the designer?

Tuning for search and intercept is being worked on. Analyzing systems are getting more complex.

What is the status of microwave transistor devices?

Concentration has been on two-terminal negative impedance units. So-called diffusion delay diodes and avalanche diodes are approaches.



W. C. Vergara,
Chief Engineer
Mobile Products
Bendix Radio
Bendix Aviation

"The impact of transistors on design philosophy is probably the area receiving most attention in mobile communications."



Defense Department Needs

What do you as a military customer want from your suppliers in 1957?

An increased appreciation by industry of the serious compromises to our military effectiveness resulting from less than the best equipment design.

Equipment reliability under operational conditions is of top order priority. There have been few realistic operational requirements which have defied a technical solution, but the reliability of the end product has too frequently limited its operational effectiveness.

How much will the environmental ranges such as temperature, shock, etc., be extended for specific products?

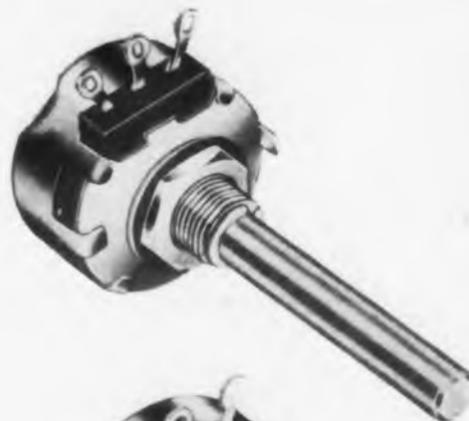
We are in an era of extensive electronic component development with resulting extension of the environmental limits of operability. These improvements influence design considerations and allow expansion of operational capabilities.

What are problems caused by increasing speeds and altitudes?

Aerodynamics heating and some vibrations are becoming more intense. The future will see a need for electronic components which can survive and operate in nuclear radiation fields.

To what further extent will your products be miniaturized?

As the complexity and variety of electronic equipment for military use increases, the premium on available space and weight likewise increases. This situation demands an acceleration of the trend to equipment transistorization and miniaturization.



Better molded composition-element potentiometers by CLAROSTAT

2-watt molded composition-element potentiometers meeting MIL-R-94A specifications. Totally enclosed against moisture and dust. High stability under extreme climatic and operational conditions. Stainless steel shaft. Gold-plated terminals. Completely non-ferrous construction. Wiper assembly of one-piece construction. Carbon-to-carbon contact results in very low noise. 1 1/16" diameter; 3/16" deep. Available from 50 ohms to 10 megohms. In various shaft and bushing designs; shaft and mounting seals; with switch; in dual or dual-concentric units.

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CONTROLS AND RESISTORS

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CIRCLE 20 ON READER-SERVICE CARD FOR MORE INFORMATION

DESIGN '57



What improvements in electrical characteristics are expected?

Improvements in the electrical characteristics of components and equipment must keep pace with the increasing severity of high speed aircraft and missile environments.

Will there be any major breakthroughs in present limiting factors?

The combined advances which will make possible the control of, and communications with, satellites and ballistic missiles can be considered a major breakthrough. It will be the combined results of radical concepts of cooling combined with new components which can operate under extremely severe environmental conditions.

To what extent will automatic processes be used in 1957 and how will they affect design?

The application of automatic processes to military electronics is influenced by the low production rate required on most programs. Adaptability to automatic processes is an important consideration in the design of new equipment.

What do you consider to be the biggest design problem facing you in 1957?

The biggest design problem facing the Department of Defense today is the problem of design itself. Designs must be matured, equipment fully developed and of proven producibility prior to its acceptance for service use.

If you can't get 100 per cent reliability, what can be done to improve maintainability?

New testing techniques and good test equipment are part of the answer. Module packaging with an integrated means for quickly isolating the defective unit is a promising approach.

Based on statements made by James M. Bridges, Director for Electronics, Office of Assistant Secretary of Defense; Col. Richard J. Meyer, USA Chief, Research and Development Division Office, Chief Signal Officer; and Col. Gordon T. Gould, Jr., USAF Chief, Communications and Electronics Division, Headquarters Air Research and Development Command.

Military Electronics

Guided missiles, satellites, and navigation schemes have received most mention in the news in 1956. What about radar, sonar, etc.? What's happening in these areas?

Air defense early warning radar will continue to be implemented and kept up to date. Don't forget anti-missile defense. Fire-control equipment is being worked on extensively. The SAGE system encompasses a tremendous amount of auxiliary equipment. Display and control equipment for the system will receive attention. Designers have not reached the ultimate in any area. In sonar, for example, barium titanite may soon replace magnetostriction devices.



John M. Wilson
Chief Engineer,
Brown Instrument Div.
Minneapolis-Honeywell
Regulator Co.

"Long-period stability as well as dependability is extremely important in instrumentation and control, especially for continuous-process systems. Accuracy must not suffer because of shifts in characteristics due to aging. More use of magnetic amplifiers, and proper choice between transistors and vacuum tubes is called for.

"We must constantly study new commercial transistors with the aim of evaluating their long-term characteristics."

The nose cone of ballistic missiles holds top priority. What is being done to solve the problem?

Research is being conducted in such new fields as aerothermodynamics, aeroballistics, and hypersonics. Old fields of physics, chemistry and electronics are being pushed to the utmost. Laboratories and all research facilities, including wind tunnels, shock tubes, etc., will be expanded.

What is being done to improve the design of 1957 equipment?

Incorporating new materials and components. Elimination of vacuum tubes. There will be great emphasis on cooling techniques and packaging design. Electromechanical equipment may be reduced as much as 50 per cent.



W. L. Barrow
Vice President
for Research
and Development
Sperry Gyroscope

"The concept of 'weapons systems' in military development and procurement has already been well established. We are now on the threshold of the concept of 'industrial systems' in which all parts of an industrial complex are designed to achieve the optimum over-all efficiency. The successful company of tomorrow must comprehend this concept and be prepared to cope with it effectively."

What will the improvements in reliability be?

There will be intensive study of such factors as cooling, quality control, and optimum circuit design.

What design emphasis is needed for better maintenance of the ever more complex electronic systems?

The equipment must be designed in modular and submodular construction, to permit servicing and maintenance by the substitution of submodules.

Testing procedures, which must be coordinated with the submodule construction plan, must be devised to permit the determination of modular failure by following routine procedures in instruction manuals.

Are there bottlenecks to progress?

Shorter delivery time of components is needed. Miniature rotary components are a bottleneck. It is believed that elimination of manual operations by the use of automatic winding equipment should result in extremely small-size inexpensive rotary units; on the order 3/10 in. outside diameter.

Are new developments being worked into existing equipments and systems satisfactorily?

Applying new principles is always a big task. For example, one company is looking for ways of applying a new, gearless direct drive having extremely high accuracy. The use for water-activated batteries is being sought.



George F. Metcalf
General Manager,
Missile and
Ordnance Systems Dept.
General Electric



Fritz A. Gross
Manager, Wayland Laboratory
Raytheon Manufacturing Co.

"To produce the [strategic missile] nose cone . . . research is being conducted in such new fields as aerothermodynamics, aeroballistics, hypersonics and others. The frontiers of technology in older, more basic fields such as physics, chemistry and electronics are being extended."

"There is a tremendous increase required in performance of equipment crowded into small space. Ambient conditions are more stringent. These objectives must be achieved with increased reliability and easy maintenance."



A. V. Astin
Director, National
Bureau of
Standards

D. R. Tashjian
Manager of Engineering, Electronics Div.
Westinghouse
Electric Corp.



Elden H. Olson
Director of Engineering, Aeronautical Div.
Minneapolis-Honeywell
Regulator Co.

"Within budgetary limitations, and to the extent which does not impair its other responsibilities, the National Bureau of Standards program for 1957 reflects an expansion in research and service related to the electronics industry."

"It is my belief that the military customer . . . must more promptly adopt and fully utilize ideas and improvements which are generated by industry. Such a course of action not only provides rewards for creative thinking, but the evaluation results, when rapidly obtained, provide a very sound basis for continued creation. . . . The dividends will be found in lowered development costs and new designs made operational at an earlier date."

"Virtually unknown effects of re-entry shock, higher G acceleration and a variety of vibrations on inertial guidance systems and engine controls in high-performance applications have become particularly acute and complete just within the past few months. In the gyroscopic field, for example, while vibrations have always been a major problem, a previously unknown vibration effect recently led to the discovery of a new phenomenon about integrating gyroscopes.

"Electronic devices used in the latest jet aircraft are being subjected to acoustical vibrations of a high magnitude. Tubes, for instance, become worse than useless because of microphonics: they act as transducers, changing the acoustical vibrations into undesirable electrical signals . . . tubes can shatter; miniaturized electronic components flake to pieces; and metals and plastics crack."

Electronic Standards



Will the National Bureau of Standards offer any new services to the electronic industries?

NBS is aware of the rapid growth and progress of the electronic industries, and of their extending importance to other industrial and scientific activities. The awareness carries with it a responsibility for meeting the increasing requirements of the industry for improved standards of physical measurement, more precise measurement techniques, better methods and instrumentation for making measurements of electronic devices and components, and increased publication of data on these problems.

This expansion may be noted in three separate examples from the Bureau's programs: 1. the plans for an NBS Calibration Center; 2. expansion of the Bureau's electronic information service; and 3. extension of the data-processing systems program.

When will the Calibration Center be completed and what will it offer?

The Electronics Calibration Center will be completed about July, 1957 at the NBS Boulder, Colorado, laboratories. Eventually the Calibration Center aims to measure and standardize all electrical and radiometric quantities from m0 to 100,000 mc. To begin, calibration will be done at frequencies already in wide use up to 10,000 mc. As the need arises, these measurements will be extended to higher frequencies. The Center will provide a primary calibration service for electronic instruments to be used by military organizations in acceptance testing and in maintenance of reliability of electronic equipments.

What new information services will be offered?

The tube information service is being extended to cover transistors. The Bureau continues to make available detailed information on the design and performance of additional preferred circuits to augment those already published.

How does the data-processing-systems program help the industry?

In addition to previously available services, the program also includes considerable Bureau research on automatic systems, basic computer circuitry, components, and auxiliary equipment. A pilot electronic computer is now being designed by the Bureau for use as a central multi-used device for undertaking a large variety of differing data-processing problems on a trial or test basis. This pilot machine, when completed, will serve various government agencies in resolving their special problems relating to the conversion of certain operations to automatic handling.

DIRECTIONS in RESEARCH

Is basic and fundamental research being supported adequately to provide a continuing foundation for the advancement of advanced electronic weapons systems? That question is of foremost concern to the Defense Department. Various consultants to the Office of the Assistant Secretary of Defense, Research and Development, were asked to suggest basic research areas. They were asked, "Where is the 'state of the art' limiting advances . . .?" Under the leadership of Dr. W. L. Everitt, replies were made by top scientists and engineers. Basic research needs were outlined without necessarily having regard for anticipated weapons applications. As a consequence of the thorough and broad effort of the contributors, the report, "Basic Research in Electronics," is extremely comprehensive in coverage. The Office of the Assistant Secretary of Defense feels the report should be available to the electronic industries.

ELECTRONIC DESIGN is very pleased to be able to present extensive portions of the original report to electronic designers. The inclusion of this 'Directions in Research' section adds much perspective to appreciating the problems described in our 'Design '57' section.

Below are contributors to the Office of the Assistant Secretary of Defense report. Although much of the wording in this issue is that of the original authors, the editors of ELECTRONIC DESIGN assume responsibility for any inadvertent alteration of technological implications resulting from extensive editing.

- Solid State Physics—Frederick Seitz, University of Illinois
- Materials in Electronics—W. O. Baker, Bell Telephone Labs., Inc.
- Wave Propagation—C. H. Wilcox, Hughes Aircraft Co.
- Radiating Electromagnetic Energy—R. S. Elliott, Los Angeles, Calif.
- Generation of Electromagnetic Energy—J. R. Pierce, Bell Telephone Labs., Inc.
- Information Theory—R. M. Fano, MIT
- Data Processing—A. L. Samuel, IBM Corp.
- Network Theory—D. F. Tuttle, Jr., Stanford University
- Primary Power Sources—H. K. Ziegler, Signal Corps Engineering Labs.
- Nuclear Radiation Effects—C. L. Stec, BUSHips
- Plasma, Electron and Ion Dynamics—A. V. Haeff, L. M. Field, Roy Gould, Hughes Aircraft Co.
- Atomic and Molecular Resonance—J. R. Zacharias, MIT
- Surface Phenomena—J. R. Zacharias, MIT
- Fundamental Problems in Acoustics—Leo L. Beranek, MIT
- Mathematical Methods—T. C. Fry, Bell Telephone Labs., Inc.

Materials in Electronics

Metals, ceramics and organic compounds determine to a large extent, the present characteristics of electronic components. Assessment of the future possibilities of these materials will be discussed here. Discoveries in materials not covered here may have an important impact, of course.



W. O. Baker
Bell Telephone
Labs., Inc.

"Controlled oxidation of this [resistivity 30,000 ohm/cms] silicon can give high-quality insulators and capacitors, whereas other treatment can yield resistors and, by the new diffusion techniques, diodes, transistors and other components. We can imagine complete circuits diffused, etched and printed on tiny silicon slabs. Advances of this revolutionary size will, of course, be slow and tedious, but, based on new understanding of chemical bonding and physical structure, they are by no means impossible."

Metals

New Strengths Possible . . . Metallurgists are just beginning to get the glimpse that native strengths of materials may be clearly 10 to 50 times their practical values. For electronics, more knowledge of creep and relaxation in small metal structures is essential. Such information might affect, for example, solderless connectors, tube filaments and grids, and transistor leads.

The frontier is knowledge of the generation and control of atomic perfection in metal crystals. The orderly dispersion of impurities through certain ele-

ments of the structure may make big differences. Improvements in corrosion and resistance and high-temperature stability are expected.

Revolutionary Joining Methods . . . Electroplating may be used in new ways. Entirely new joining methods, such as temperature gradient zone melting may be widely applied in electronic assemblies. For example, a vast grid of connections, such as for computer memories, could be laid in place by a machine and then, a thermal wave comprising the passage of a large gradient over it, make permanent connection.

Ceramics

Where We Stand Now . . . These materials are important because of their combination of extraordinary physical and electrical stability with the versatile electronic functionality that is appearing in the ferrites, ferroelectrics and oxide semiconductors. Ceramics containing both ferroelectric and ferromagnetic oxides suggest a medium for electromagnetic wave propagation, important in both antennas and lenses and in circuit elements themselves.

Where We're Going . . . Purely structural ceramics are growing in importance, examples being high alumina terminals, deposited resistor substrates, tube elements, and so forth. Great strides can be expected in ceramic encapsulation and envelope making. Printed circuits on high aluminum structures could have surface resistivities of 10^{15} ohms per cm.

Must Restudy Glasses . . . Glasses themselves deserve new investigation. They can organize our knowledge of heat treatment and ultimate capabilities of glass fibers, rods and the minor glassy phase in all ceramics. Tremendous challenge awaits in this latter area; since the glassy phase is presumably the continuous matrix in ceramics, and since a strength of nearly a million lbs per sq. in. has been found in certain specifically treated silicates, a period of enormously strong, rigid ceramics for all kinds of electrical uses may lie ahead. Needles or whiskers may be made from zinc oxide with new strengths.

Organic Compounds

The Present Status . . . Polyester, epoxide and polyurethane casting resins for encapsulating electronic components are replacing other insulating and structural parts ordinarily made from plastics and synthetic rubbers.

New Directions . . . Simple casting methods or by combinations with glass or other fabric may be the base of construction of complicated housings and supports. Emphasis will be on heat stability and resistance to oxidation. Adhesives may replace rivets and brazing or soldering operations.

New Electrical Characteristics . . . The discovery of "isotactic" polymers, wherein compounds as poly-

styrene are polymerized so regularly that highly microcrystalline plastics of high melting point and improved strength and rigidity result, are important. Polystyrene, with a melting point greater than 250 C would have a new effect on dielectric waveguides, capacitors, coaxial insulators, semiconductors and tube mountings. The future can see experimental production of silicon having specific resistivity of 30,000 ohms per cm. Insulators, capacitors and new types of resistors can result. One can imagine complete circuits diffused, etched and printed on tiny silicon slabs.

Solid State Physics

There is scarcely a facet of modern technology which does not involve the properties of solids in an essential way. Electronics figures heavily in all of these. Broadly, there are four major areas of solid state research at the present time; 1. macroscopic properties, 2. the lattice and electronic properties of perfect crystals, 3. the imperfection-determined properties and 4. surface properties. Each of the four areas has its own well-developed discipline; each is in turn tightly integrated with the other three.



Frederick Seitz
University of
Illinois

"In particular, the systematic study of factors which influence the barrier layers on metals and semiconductors holds the promise of revolutionizing the entire electronics industry. Until recently, the means for controlling the properties of surfaces were principally empirical and relatively ineffective. It now appears that new advances in vacuum techniques, when combined with new methods for preparing exceedingly pure and perfect crystals, will give us exceedingly powerful tools for advancing the science of the surface properties of solids."

Macroscopic

History . . . Systematic study of macroscopic properties has led to materials making use of piezoelectric properties, anisotropic elastic properties, anisotropic diffusion and electrical and magnetic properties.

Possibilities . . . As new chemical and physical methods are developed for preparing pure materials in more rigidly controlled form, additional useful knowledge will be forthcoming.

Lattice

Where We Are . . . Continuous study of the lattice properties by X-ray and electron and neutron diffraction and the similar study of electron properties with the use of thermal, sonic, electromagnetic and particle

radiations have broadened our understanding of the known useful solids.

Future . . . New useful substances have resulted, and more are expected. Crystals completely free of imperfections have properties that are exceedingly different from those of normal crystals which contain an abundance of imperfections.

Imperfections

What They Mean . . . A large part of the useful technology relating to metals, ceramics, semiconductors and salts involves the means of controlling the presence and behavior of the imperfections of crystals.

What the Future Holds . . . Each new advance of understanding of imperfections leads to an improvement in quality of useful materials and to new methods of exploiting previously unused materials.

Surfaces

State of the Art . . . Many of the most useful properties of solids are determined by their surface structure. Phenomena involved are catalysis, adhesion, friction and electrification. Until recently, the means for controlling the properties of surfaces were principally empirical and relatively ineffective.

Implications for the Future . . . Systematic study of factors which influence the barrier layers on metals and semiconductors holds the promise of revolutionizing the entire electronics industry. It now appears that new advances in vacuum techniques, when combined with new methods for preparing exceedingly pure and perfect crystals, will give exceedingly powerful tools for advancing the science of the surface properties of solids.

Network Theory

Network theory means the analysis and synthesis of lumped physical systems. That is, of systems characterized by ordinary, as opposed to partial, differential equations. The analysis of linear, constant, passive systems is well understood. Synthesis can be done readily, for example, on the filter or LC networks in general. There remain such topics as the synthesis of RLC networks in an orderly general fashion, networks without mutual inductance and equivalent-network theory (systematic methods of selecting the best among all possible equivalent networks), all of which might profitably be investigated.

Where Study Is Needed . . . In contrast, linear, constant, active systems are not readily synthesized. This area includes vacuum tubes, transistors, servos and the like. There must be tremendous research in this field.

DIRECTIONS in RESEARCH

Radiating Electromagnetic Energy

The state of the art of the subject of coupling energy to space and antennas is discussed here in terms of frequency ranges.

Below VHF

The Problem . . . Below vhf, analytical tools are very limited. Antennas are short with respect to wave length. Their surroundings seriously affect pattern and impedance. The design of the antennas is chiefly empirical, extensive use of matching networks being made.

What Has To Be Done . . . Knowledge of the scattering cross sections of the geometric shapes around an antenna has an important bearing. Results of study are encouraging here. The shortcomings of antenna pattern and impedance can be reduced by wider application of circuit techniques. For example, the control of vertical directivity of an hf array would minimize fading caused by interference between sky and ground wave. Development of automatic tuning circuits with quick response and low hunting should be undertaken as a solution to the matching problem.

VHF to L-Band

Status . . . In the frequency range vhf to L-band, array techniques are well understood and put to good use. However, military needs for high-power, high-gain antennas require antennas so large that mechanical rotation cannot be considered.

Where Emphasis Should Be Placed . . . Electronic phase-shifting is thus becoming more important. Basic network is needed. For example, the best place to insert the phase-shifters should be determined. Fundamental relationships between the amount of delay per unit length of a delay line and its loss per unit length should be studied.

Microwaves

The Picture Today . . . In the microwave region, analytical tools are diverse, including optical approaches. Continuous aperture radiators are feasible in addition to antenna arrays of discrete elements. Trapped-wave antennas will continue to play an important part along with reflectors, lenses, linear and planar slot arrays, and horns and their derivatives.

The Future . . . There is a need to gain a better understanding of slow-wave antennas and to broaden their application.

Wave Propagation

The most critical areas for research are in the fields of scatter propagation, communication by meteor echoes, the observation and interpretation of high-altitude ionization (meteors, aurora and other more recently discovered forms), and the effective use of transmission through the earth's atmosphere for communication or observation.

Where We Are and What's Needed . . . Tropospheric, hf and propagation modes are better understood. In tropospheric forward-scatter propagation, the chief research task is to investigate the maximum range of useful propagation. More air-to-air scatter experiments are needed. The range may be greater than originally thought. This may revise the theoretical description.

More reliability in ionospheric forward-scatter propagation must be worked for. The answer might lie in improved coding techniques.

Higher powers might make propagation via meteor trail reflections more significant.

Much more knowledge is needed about various refraction and scintillation effects in the troposphere and ionosphere. Experiments in radio astronomy, satellites and high-altitude rockets should give more information. Experiments with high-power, high-gain, narrow-beam radar should help determine the nature of electron distribution in the hf region. Statistical measures of multipath amplitude, phase and duration should be determined. More study of diurnal variation is required. More "Whistler" experiments should give us more information. Reliability will be improved by better coding.

Generation of Electromagnetic Energy

State of the Art—Cm . . . It seems likely that at centimeter range and longer wave lengths, almost any power and rapid-tuning capabilities may be had. Further research and adequate development in the fields of magnetrons, klystrons and traveling-wave devices is needed, but the problem appears straightforward. Efficiencies will be improved and weights decreased.

Most Needed Improvements . . . The most needed improvements are in electron focusing, attaining higher cathode current densities, and in improving the mechanical, thermal and electrical design of tubes to make them better, and for easier manufacturing.

The study of interactions between electrons and electromagnetic waves must be continued. So must the study of the focusing of electron streams, and of circuits that are adequate from the point of view of loss and heat dissipation. Needed is the development of a cathode capable of supplying with good life many times the present attainable d-c current density of around an ampere per square centimeter.

What About MM Generation . . . Scientists are apparently stuck in the generation of electromagnetic energy somewhere between 1 and 3 millimeters. Limitations imposed by circuit loss, cathode current density and heat dissipation result in rapidly decreasing efficiency and power output, going to zero at about the middle of the range. Improved circuits and improved forms of electron interaction advanced the art from 10 centimeters to around 2 millimeters. Experts feel it improbable that there will be further startling advances of this particular sort, unless, as the art is pushed as far as it will go, something new shows up.

New Concepts Needed . . . Unconventional means of generation may become important at millimeter wave lengths. Regarding gas tubes, these appear at the present time to be unstable and unpromising.

Molecular generators (the Maser) are promising for producing small power, but with extremely stable frequency. Availability of simple, highly stable sources may make important new systems possible. It is probable that spin resonance in solids can be used in generation.

Other suggestions make use of phenomena associated with the magnetic properties of ferrites and with Hall effect and magneto resistance. The production and use of incoherent radiation has not yet been completely discarded. Success by unconventional means will require that exceptionally gifted physicists and engineers concentrate on the job. Casual investigation is unlikely to turn up anything significant and might actually deter progress.

Basic research will undoubtedly include studies of highly bunched beams, undulators, Cerenkov radiation, relativistic effects and TW ideas to solids.

Plasma, Electron and Ion Dynamics

Basic research in electron and ion dynamics and plasma phenomena carries into many major areas of interest. Some of the fields are indicated here.

Basic Research

The attempt of the following listing is to be broad. Headings are not mutually exclusive. Their titles suggest applications: 1. Interaction of charged particles and fields (dc and ac). This may lead to new amplification mechanisms. 2. Basic processes in plasma (plasma waves, space charge phenomena, mixture of electrons and ions in high pressure gas discharge). 3. Radio noise generation processes. 4. Noise in electron beams.

5. Gas discharges. 6. Particle interaction and plasma effects in solids. 7. Emission of electrons and ions from solids. 8. Generation and focusing of high current beams. 9. Electron, ion and molecular optics. 10. Mm wave generation. 11. Laboratory particle accelerators.

What's Being Done . . . Work is not going on in all phases extensively, but foresight indicates that it undoubtedly will.

Primary Power Sources

Research in the power sources field aimed at the creation of the most suitable, efficient and reliable sources is an extremely important factor inseparable from our new weapons or weapons systems.

Battery-type power sources (electrochemical power generation) are at present most important. Critical factors of characteristics are 1. power capacity per unit of weight (efficiency), 2. their capability to preserve initial capacity during long periods of storage and 3. variation of performance characteristics under varying temperatures.

New Prospects

In recent years, knowledge of batteries has been increasing. Research in the field of electrochemical kinetics may yield good results. Only a small number of the possible variety of electrochemical systems have been investigated. Organic materials have hardly been touched. Use of gasses in so-called "Fuel Cells" is of interest. Nonaqueous solvent, fused and solid electrolyte systems show promise and represent an entirely new research area.

Electromagnetic or nuclear radiation schemes may become prime sources of energy.

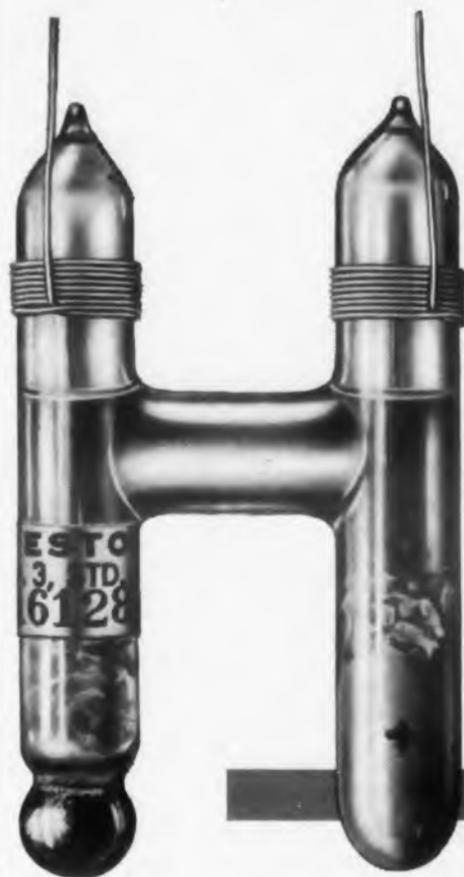
Thermoelectricity

Thermoelectricity, a possible source, has been limited because of the low efficiency—4 to 7 per cent. Advances in fields of solid state can change this, although no major results have yet come forth. The efficiency of converting sunlight to electrical power has improved in the past two years by an order of magnitude. The photovoltaic cell, operating at 10 per cent efficiency when illuminated by the entire spectrum of the sun, could, theoretically, offer an efficiency of 30 to 40 per cent when illuminated by a properly matched monochromatic light. Efficient frequency conversion within the radiation spectrum is a desirable goal.

Nuclear Sources

Two basic methods are indicated by nuclear radiation as a power source: The first is the collection of radiation ionization products or utilization of interaction in solid-state devices, as caused by nuclear radiation. The second approach would utilize nuclear radiation to produce heat and then employ thermoelectric effects to arrive at the final electrical power. Much research must be done.

DRIVER-HARRIS ALLOYS AT WORK IN PRODUCT ADVANCEMENT



HOW TO BE SURE A VOLT IS A VOLT...



The Weston Standard Cell Comparator Model 1000, made by Weston Electrical Instrument Corp., Newark, N. J., with associated milliameters, dry cells, main galvanometer, and auxiliary standard cell.*

This H-shaped object, the saturated or "normal" form of the Weston Standard Cell, is the standard reference for electrical measurements. It is essentially a mercury cadmium wet cell hermetically sealed in glass. When kept at 20 degrees C., it maintains its voltage of 1.018636 volts for years. A bank of these cells at the Bureau of Standards in Washington, kept under oil at a constant temperature, is the basic electrical standard of the United States. This, however, is not the cell used by scientists and engineers in their daily work. Since the normal cell must be maintained at a constant temperature for accurate results, the unsaturated or "working" cell, which is portable and is not materially affected by temperature, is ordinarily used.

These working cells must be periodically checked against a bank of normal cells through the use of a comparator system. In the past only a few comparators existed outside the Bureau of Standards. However, the Weston Electrical Instrument Corporation has produced a simplified Standard Cell Comparator which provides the user of working cells, in conjunction with his own bank of temperature controlled normal cells, with an accurate means of standardizing these right in his own plant . . . at a great saving in time, cost and convenience.

THE WESTON COMPARATOR

The Weston Standard Cell Comparator is a specialized

potentiometer wherein the voltage of a working cell under test is opposed to that of a normal cell to produce a voltage difference which, when added algebraically to the normal cell voltage, indicates directly the voltage of the cell under test. With a known normal cell voltage as a reference, the Comparator will measure to well within 5 microvolts the open circuit voltage of any cell in good condition.

With an instrument calibrated to such excellent accuracy as this one, it is worthy of note that Weston uses Driver-Harris Manganin wire for critical resistance networks in its system. Says Weston: "The success of the entire circuit, given accuracy of adjustment, depends upon the permanency of the Manganin, and upon its extremely low temperature coefficient of resistance and its low thermal emf to copper".

Your work may or may not need the extreme degree of accuracy that is a prerequisite here. Either way, Driver-Harris has an alloy that can reliably fill your needs. Manganin is only one of 112 special purpose alloys, produced by Driver-Harris. And each of these was originally custom-made . . . produced exactly to the specifications of someone who needed it. Put your specifications in our hands. You will gain the benefits of the 57 years of experience which has developed the largest variety of alloys ever made by any one company.



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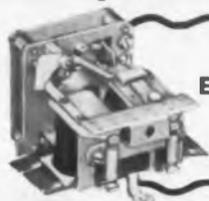
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DIRECTIONS in RESEARCH

Information Theory

There is always the hope that new, more reliable and more efficient communication systems will result from better knowledge of communication processes. More investigation of natural systems involving man's written and spoken word may result in better insight into coding schemes. Here are the areas information theorists are working on:

Statistical Prediction

Where Are We . . . The separation of signals from noise when both have a statistical character has been a major occupation for the last ten years. The ability to predict and detect small signals from additive noise has probably reached its optimum.

What's Needed . . . Greater attention and effort is needed to the problem of detecting signals in the presence of nonadditive random disturbances such as those arising in ionospheric propagation.

Coding

Background . . . It is a fundamental theorem that any degree of message reliability can be achieved as long as the rate of transmission is smaller than channel capacity. Probability of error decreases exponentially with the length of the message for a constant rate and channel capacity, provided the message is encoded properly; but, no systematic encoding scheme has yet been devised.

What Would Help . . . The discovery of such an encoding scheme, coupled with knowledge as to how it works, would be a major breakthrough in the communication art.

Building reliable systems out of less reliable components could result. Increased over-all reliability of digital computers might result from suitably encoding the programming.

Natural Sources

The Problem . . . Speech sounds and pictures, when transmitted directly through a communication channel, make inefficient use of the transmission channel.

The Answer . . . Suitable encoding of the signal before transmission would increase efficiency. The experimental identification of suitable signal properties is a major aspect.

Pattern Recognition

What About Machine Translation . . . Machine recognition of temporal and spatial patterns, such as speech sounds and written characters, has begun to

receive a great deal of attention. The work in this area has been primarily experimental, but it is approaching a stage in which some of the theoretical questions can be formulated and attacked.

What Can Be Done . . . Cooperation between psychologists, neurophysiologists, linguists and information theorists should prove very fruitful.

Multiple Measurement

What Kind of a Problem . . . This problem needs to be more clearly defined. It might hold the key to considerable progress in radar surveillance, electronic passive reconnaissance and nonmilitary applications such as radio astronomy. The problem is to organize observations when large amounts of information are to be obtained about a given system.

Does the Problem Suggest a Solution . . . A simple problem, for example, would be the determination, with a minimum number of observations, of squares in a chess board which are occupied when the probability of being occupied is the same for all squares. If the measuring instrument were limited only to telling whether the number of squares occupied is even or odd, the problem is identical to that of designing binary error-correcting codes. This has not yet been solved.

Other Areas

The behavior of communication networks involving several channels has to be studied much more. Communication channels, data-processing equipment, etc., are now looked at as noisy devices with multiple inputs and outputs. Each output is functionally related in a known manner to a number of inputs, apart again from errors introduced by internal disturbances. New information should be forthcoming from this area.

Mathematical Methods

There are many opportunities for mathematics to help estimate military effectiveness—planning, estimating the field performance of systems, and relating them properly to technological advances. Any method of dealing generally with any complex systems, of estimating orders of magnitude of results and of determining which parameters are sensitive and which insensitive to the over-all situation may be helpful. Game theory, linear programming, the various abstract formulations of operations analysis and simulation means of studying complex situations by computers (using Monte Carlo and other techniques) are some. What must be

dealt with is a field of problems and not a collection of more or less interesting specialties.

Beyond Engineering . . . Some of these critical problems are essentially of the character of applied mathematics, as contrasted to engineering, because they lay so much emphasis on the formulation of the problem, the isolation of the essential questions and the construction of adequate mathematical models. Many engineering subjects owe their genesis primarily to mathematics. These include, for example, such subjects as computer theory, information theory and network theory (nonlinear and time-variable elements). Many problems may best be handled by going back to original mathematics.

More Mathematics . . . Pertinent topics not already mentioned include theory of probability, theory of nonlinear differential equations, and principles of organization of problems in forms appropriate for computation. Small-signal approximation of physical phenomena leading to linear differential equations are seldom adequate today. Addition to our knowledge of nonlinear differential equations is important.

Data Processing

Present-day data-processing equipment is vulnerable to failure. Areas requiring intensive investigation and development particularly important to designers are as follows:

Components

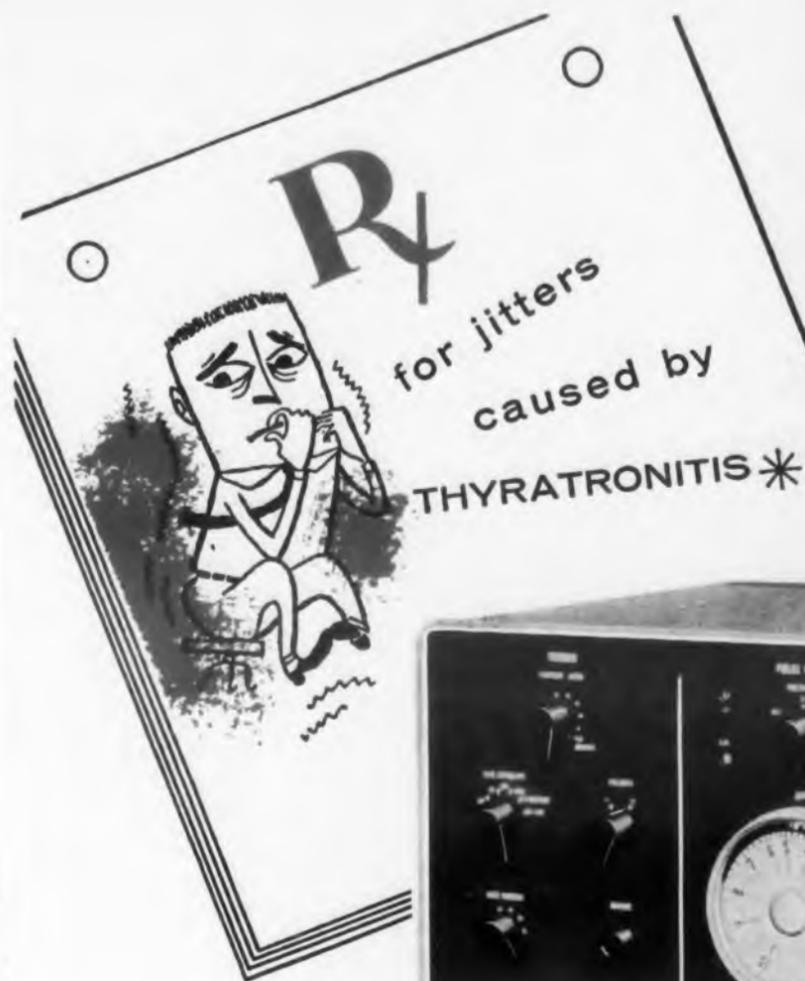
Semiconductors, ferromagnetics, ferroelectrics and electroluminescence must be studied more extensively, as they show promise of long life and simplicity. New memory phenomena must be discovered; and techniques must be developed which will allow faster, larger capacity random access memories. Units capable of storing several billion bits with access times below $1/2 \mu\text{sec}$ should be sought.

Versatile Inputs

A need exists for the development of mechanisms which will directly read written documents and will correctly interpret spoken words.

New Emphasis

Urgently needed computer equipment is now too long delayed in development. It appears feasible to devise means whereby substantial portions of this design effort can be carried through by previous data-processing machines. Efforts should be directed toward the use of digital computers for 1. converting algebraic specifications into preliminary logical designs, 2. optimizing component values in circuit designs so as to achieve increased reliabilities, 3. ensuring that each segment of the system is not operating outside specifications, 4. laying out final pluggable units, panels and cables and 5. simulating new logical designs, component malfunctions and diagnosis techniques.



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Hard Tube Circuitry: Hard tube circuits assure jitter-free relationship between pulse and synchronizing triggers.

Repetition Rate: 100,000 PPS to single pulse with either positive or negative polarity.

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* **DEFINITION:** A common ailment of an hereditary nature, common to certain species of pulse generators. **Symptoms:** bumps, squiggles, and twitches in pulse. **Cause:** nervous triggering of pulse due to too much hydrogen in thyatron (or something like that).

PRESCRIPTION: Hard tube circuitry for pulse generation.

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Pulse Output: Nominally 50 volts across 50 ohms. Attenuator provides up to 60 db attenuation in 40 db increments. Attenuator accuracy: $\pm 1\%$. Overshoot less than 3% positive or negative pulse polarity.

Pulse Duration: Width, 0.02 μsec to 100 μsec continuously variable; rise or fall time less than 0.02 μsec ; 400 cycles, 10%. Automatic built-in overload protection.

Repetition Rate: Internal, external or manual. Internal 20 cps to 100,000 cps, continuously variable. Facilities for external trigger up to 100 kc. Manual push button for single pulse operation.

Trigger Output: 25 volts across 50 ohms, positive or negative. Rise time less than 0.05 μsec ; width, 0.1 μsec .

Pulse Delay: -2 to $+2 \mu\text{sec}$ with respect to internal or manual trigger; continuously variable.

404* *Slightly higher for 50 cycle waves.
Cat. No. 40134 Description 133-A, March 1957

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DIRECTIONS
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RESEARCH

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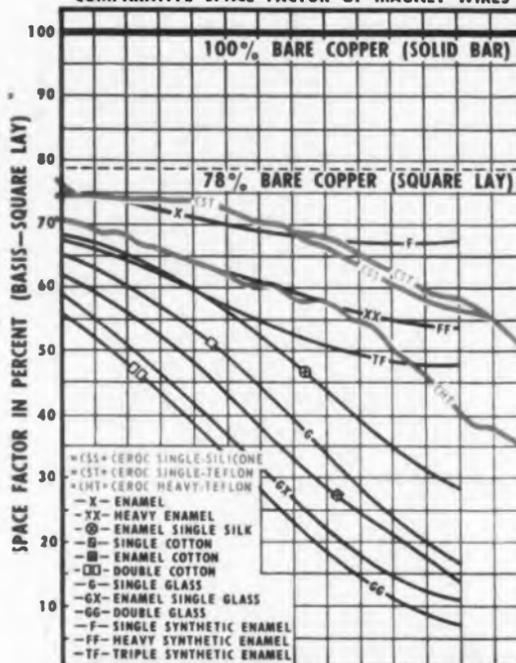
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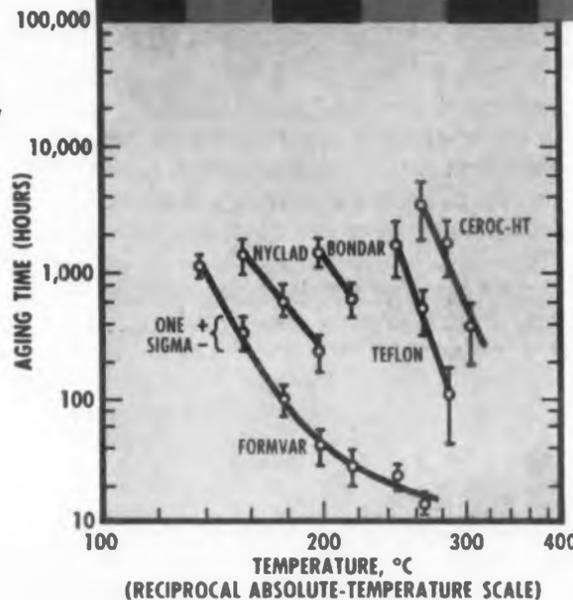
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COMPARATIVE SPACE FACTOR OF MAGNET WIRES



COMPARATIVE SPACE FACTOR OF MAGNET WIRES



AGING CHARACTERISTICS OF MAGNET WIRE INSULATIONS

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Fundamental Problems of Acoustics in Air

Although the subject of acoustics has been investigated as far back as the 19th century, new aspects have arisen out of the growth of aviation and communication. Both basic and applied problems exist.

Problems That Exist . . . The cause and behavior of boundary layer noise are not well understood. Noise levels in high-speed, jet-propelled aircraft are created by boundary layer noise. Boundary layer noise is transmitted through panels. There is a practical need to determine the optimum design of panels to reduce such radiation into aircraft interiors.

Fields requiring work are acoustic turbulence and thermoacoustic noise. Low-density acoustics, or the study of the transition between acoustics and kinetic theory, needs study. This affects the application of sound transmission around missiles in the upper atmosphere at high-speed flight.

There is not much known on sound-shock interaction. The determination of the interaction of sound waves with standing and moving shock waves should be studied more.

Fatigue of structures by noise and vibration is important. The parameters governing sound attenuation in nonlinear lumped and distributed filters should be explored. These are only a few. There is a whole gamut of sound-propagation studies still to be made.

Nuclear Radiation Effects on Electronics

The problem of determining the effects of radiation on electronics is a major one. An integrated program determining the radiation effects on electronic equipment is required. Specific limitations of various materials must be determined.

What Is Known . . . Known areas of vulnerability include gas tubes of voltage regulator or thyatron type, including T-R types; plastic materials, which are vulnerable to the point of disintegration, especially under vibration; glass, which, although good, discolors on being subjected to radiation and occasionally loses its mechanical strength; and semiconductor devices. Thus far, measurements have been made at levels where relatively short time effects are available.

What is Unknown . . . Data on the relation and effects of lower levels of radiation for longer periods of time are needed. Calibrating sources, especially those built into measuring instruments, may on a long-time basis affect the performance of the measuring instruments. The relative effects of atmospheric pressure change with altitude in any application of nuclear energy to airborne power plants and equipment must be determined.

SPRAGUE

ELECTRIC COMPANY

97 MARSHALL ST. · NORTH ADAMS, MASS.

CIRCLE 24 ON READER-SERVICE CARD FOR MORE INFORMATION

Atomic and Molecular Resonance

Atomic and molecular resonance phenomena have been put to practical usefulness recently. Witness the atomic clock. The field is of such broad and varied application, that the citing of examples is necessary to give some idea of the implication of research work in this field.

Proton Resonances

Proton resonances are being used for analysis of organic compounds and a study of the structure of organic molecules. Better magnets with strong magnetic fields uniform in space and time are needed, though. The gyromagnetic ratio of the proton has long been used as the standard for measuring magnetic fields. It is now possible to observe minor disturbances in the magnetic field caused by submarines.

Frequency Standards

Many molecules other than the usually thought of ammonia have properties making them suitable for molecular frequency standards. New ones should be sought out. The study of the electromagnetic radiation from the trajectory in a molecule, the effect of molecules on frequencies in the microwave region, etc., is doing much to illustrate the structure of molecules. The very observing of frequencies of radiation steadily increasing up to many hundred thousands of megacycles may result in techniques that will be useful in their own right.

New Components

Generation of millimeter waves directly by molecules in a cavity shows promise for many future developments. It is conceivable that power can be generated with extreme spectral purity.

The collections of the molecules in selected energy states can be used as narrow-band, virtually noiseless amplifiers.

Surface Phenomena

The gas surface interface is one of the most important, yet one of the least understood subjects. The range of application is broad. However, more research is necessary. An example of interest to electronic design engineers might include emission of electrons from a hot cathode.

What To Expect

New heights in supervacuum may make it possible to obtain a better understanding of this fundamental action in all vacuum tubes. Secondary emission of electrons from surfaces must be understood better. "Free" amplification that one can obtain through secondary emission has not been widely utilized. Surface phenomena in metals is, of course, important to advances in semiconductors, rectifiers and transistors.

HUBBELL *Interlock* PLUGS and TERMINAL STRIPS



Close-up of Analyzer's junction box. Note how Type "A" Interlock Plugs lock securely into Hubbell Terminal Strips. Wires cannot be disconnected accidentally, yet plugs will release quickly and easily when intended.

Help to **TEST**
THOUSANDS OF FEET
OF WIRE *IN MINUTES*
FOR *TWA*

Automatic Locking — Quick Disconnect Plugs
in **DIT-MCO** Circuit Analyzer*
Provide Accurate Readings for
Aircraft Circuits

Interlock Plugs and Jacks provide a positive, locked connection between each aircraft circuit and the Circuit Analyzer to assure accurate readings every time. Hundreds of circuits can be connected or rearranged in minutes with these automatic-locking, quick-disconnect plugs.



Hundreds of aircraft electrical circuits, adding up to thousands of feet of wire, are tested in minutes by an analyzer connected by Hubbell Interlock Plugs. Only a locking contact, such as Interlock provides, can assure the uninterrupted flow of current and accuracy required for this vital circuit testing . . . and only plugs that disconnect so quickly and easily, when circuit changes are necessary, would be feasible in a mass wiring set-up such as this, used by Trans World Airlines, Inc. Hubbell Interlock Plugs and Connectors play an important part in this, as in a wide variety of applications that require absolute accuracy of readings. They are used by some of the world's largest manufacturers of electrical and electronic equipment.

*Circuit Analyzer manufactured by DIT-MCO, Inc., Electronic Division, Kansas City, Mo.

For Complete Information On
Other Interlock Products, Write



HARVEY HUBBELL, INC.

Interlock Electronic Connector Dept., Bridgeport 2, Conn.



CIRCLE 25 ON READER-SERVICE CARD FOR MORE INFORMATION



Hughes Quality means Highest Quality in

HIGH-CONDUCTANCE SILICON DIODES

Hughes, long the leader for quality and reliability, has added another new series of Silicon Junction Diodes to the expanding line of Hughes Semiconductors.

Available now: HIGH-CONDUCTANCE SILICON JUNCTION DIODE TYPES HD6571, HD6572, HD6573, HD6574, HD6575 . . . HIGHER VOLTAGES . . . HIGHER CURRENTS . . . EXTREMELY HIGH BACK RESISTANCE . . . BREAKDOWN VOLTAGES TO 400V . . . HIGH FORWARD CURRENT . . . HIGH-TEMPERATURE OPERATION.

The first five types in this new series have been especially established to fill specific applications requiring relatively moderate speed, with high voltage and high current. Examples: high-current clamping; magnetic amplifiers.

The entire series is packaged in the world-famous Hughes subminiature glass envelope, impervious to moisture and to other external contaminants.

ACTUAL SIZE, Diode Glass Body: Length: 0.265-inch, max. Diameter: 0.105-inch, max. Color: Opaque black enamel.

OPERATING TEMPERATURE RANGE: From -75°C to $+150^{\circ}\text{C}$.

Our field sales engineers near you are ready to assist you in selecting the one Hughes germanium or silicon diode type best suited to your specific application. For further information, or for specifications covering the new Hughes High-Conductance Silicon Junction Diodes, please write:

SEMICONDUCTOR DIVISION
HUGHES PRODUCTS

International Airport Station, Los Angeles 45, California

HUGHES PRODUCTS

HUGHES



SEMICONDUCTORS

© 1957. HUGHES AIRCRAFT COMPANY

Time-Delay

PROVIDING instantaneous recycling in a miniature package, this time-delay relay features the use of transistors and RC time-constant circuit elements. This arrangement achieves high reliability and inherently good accuracy of delay over the range of 0.1 to 5.0 sec.

A gate circuit is the key element of this time-delay relay developed by Tempo Instrument Co., 5 Centre St., Hempstead, N.Y. Two inputs—timing and biasing—control the gate, which is in series with the relay coil. Upon application of input voltage, bias is immediately established through voltage dividing action of r_1 and r_2 (see diagram). The timing voltage, initially zero, builds up as the capacitor charges. When it equals the bias voltage, the gate closes and the relay actuates.

There is an auxiliary circuit in the gate that causes a low impedance to be seen by the timing capacitor when input signal is removed. This discharges the capacitor and recycles the timer within a few milliseconds.

The time delay is controlled entirely by the gate and the circuit constants of the passive networks. The characteristics of the relay in no way affect the accuracy of the delay. By using close-tolerance, conservatively-rated, high-stability components in the passive networks, accuracy of timing is within $\pm 10\%$ of the nominal delay time from -55 to $+125$ C. By using transistors in the gate circuit, action is instantaneous as there is no need for heater warm-up.

This time-delay relay is hermetically sealed in an inert atmosphere. There are no resonant points in the range from 10-500 cps. Although size is only 1 x 1 x 1.5 in. and weight only 2 oz, it is well protected against effects of vibration.

CIRCLE 67 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1, 1957

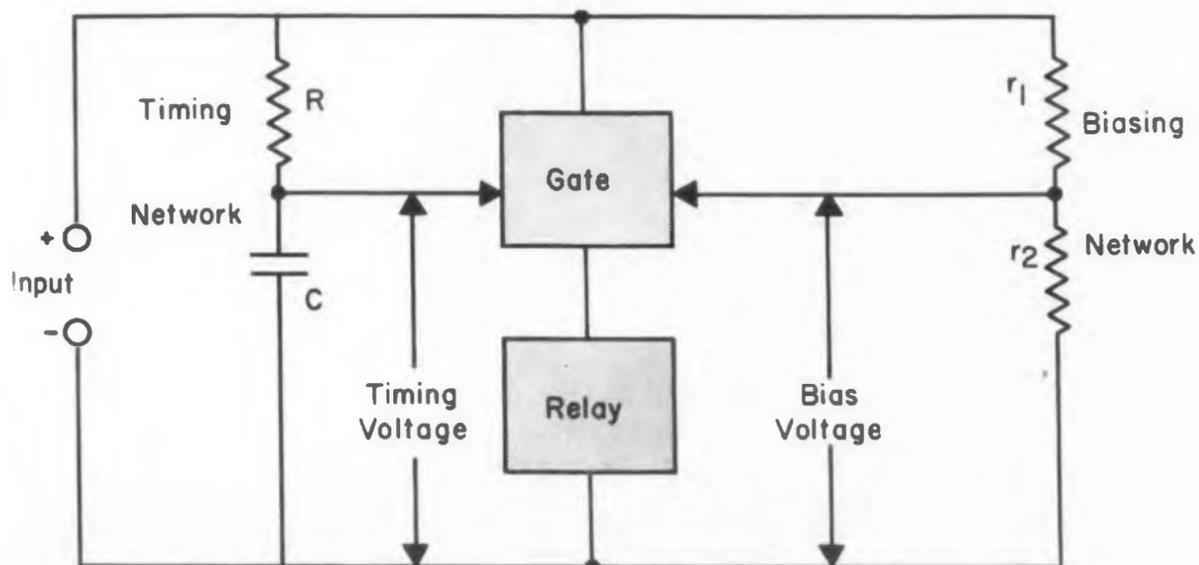
Relay



Both ac and dc models are available in a wide range of voltages and frequencies. The relay itself has dpdt contact arrangement, and contacts will handle a 2 amp resistive load. Power consumption is only 0.5 w.

Among suggested fields of application for this time delay relay are: computers, air-data reduction, navigation, testing operations where delay is required, aircraft data measurement and motor controllers.

For additional information on this product, fill out the Reader's Service Card and circle No. 28.



Technical
assistants
for...

Electron

Tubes

The Electron Tube Laboratory is engaged in research and development in the fields of direct-viewing storage tubes and microwave tubes. The personnel comprises men with many years' experience in the field of electron tubes and their applications.

Very new developments in microwave and display tubes have created a number of openings at the research and development level for Laboratory Assistants. At Hughes, engineers, scientists and technicians develop their ideas from inception to quantity production. Thus, assistants working with electron tube products have unlimited scope for applying their talents and skills to a wide range of military and commercial uses.

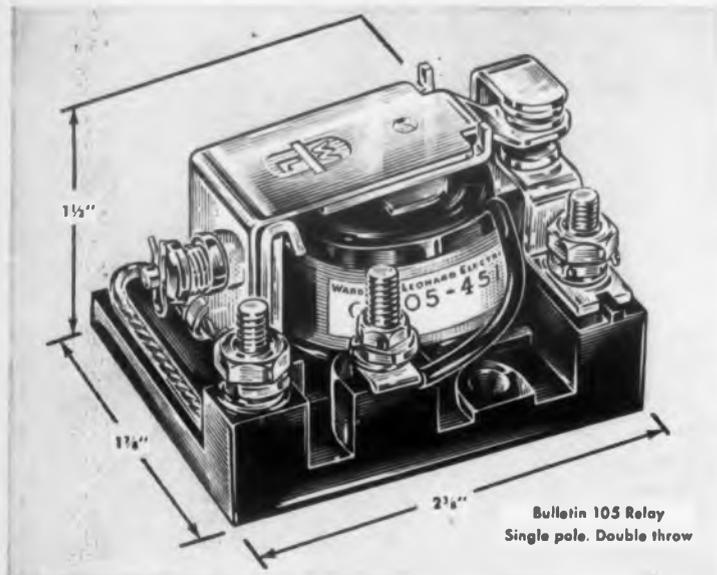
You should qualify in any 3 of the following areas:

Electron Circuitry and Test
Equipment Construction
Mechanics and Benchwork Skills
Tube Fabrication Techniques
High Vacuum Techniques
Microwave Testing
Tube Chemistry
Precision Assembly

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES
SCIENTIFIC STAFF RELATIONS
Hughes Aircraft Company, Culver City, California

Compact power relay... high contact ratings



More relay for your money—that's the big thing you get when you specify Ward Leonard's Bulletin 105 for light power switching jobs.

No delicate, misapplied telephone- or instrument-type relay, the 105. From rigid phenolic base to ample silver-to-silver, self-cleaning contacts, the 105 is built to deal with power . . . just like the larger Ward Leonard relays and contactors. And yet it's extremely compact and low in cost.

You'll find the Bulletin 105 relay—in SPST, SPDT, DPST, and DPDT types—ideal for controlling power to electric heaters, signals, pumps, radio and TV transmitters and public address systems.

Check your catalog file today for Bulletin 105. If it's missing write to: Ward Leonard Electric Co., 77 South Street, Mount Vernon, N. Y. (In Canada: Ward Leonard of Canada Ltd., Toronto.)

7.5

ENGINEERING DATA SINGLE POLE BULLETIN 105 RELAY

Contact Ratings

Volts	D.C. Amps.*		A.C. Amps.*	
	N.O.	N.C.	N.O.	N.C.
0-24	20	15	20	15
25-125	1/2	1/2	20	15
126-250	—	—	15	10

*Ratings are non-inductive.

COIL VOLTS: 6, 8, 10, 12, 24, 32, 48, 115, 230

AVG. COIL WATTS: 2 D.C., 3.75 A.C.

PICK-UP: 85% or less of rated voltage
WEIGHT: 5 ounces
TERMINALS: Stud type

LIVE BETTER...Electrically

WARD LEONARD ELECTRIC CO.

Result-Engineered Controls Since 1892

RESISTORS RHEOSTATS RELAYS CONTROLS DIMMERS



CIRCLE 30 ON READER-SERVICE CARD FOR MORE INFORMATION



Typewriter-Run Analog Computer

PUNCHED tape control makes the analog computer available for much more problem solving. By enabling the operator to automatically set up and check out computer settings, such as coefficients, the typewriter controlled automatic input cuts down on pre-solution time.

The stumbling block of analog computers has been rapid and accurate programming. Engineering problems of today are increasingly complex, requiring more and more equipment to adequately simulate given systems. The first major improvement was the prepatch panel—a receptacle unit at which all computing elements are tied together by means of a removable problem board.

Even with this improvement, the set up to solution ratio of computers was about 10 or 15 to 1. This meant that it might take 10 or 15 hours to set up a problem that would require only one hour for solution. Rather poor utilization of an expensive piece of equipment! Engineers at the Berkeley Division of Beckman Instruments were faced with the problem of cutting down this wasted time, which was expensive in terms of dollars and even more valuable in engineering man-hours. Their solution was a typewriter operated punched tape input system.

In their system the Flexowriter typewriter, a product of Commercial Controls Corp., converts information represented as punched holes on tape into electronic pulses. These pulses activate relays, stepping switches and a potentiometer servo system to obtain the desired results. This might range from setting up a computer problem to reading a pot coefficient.

Coefficient potentiometers can be set automatically from a previously punched and checked paper tape. A minimum machine time will then be required for the potentiometer set operation. In punching the tape the letter "p" is the signal for the computer to set a particular pot to a certain value. Following the command to set the pot is the address and magnitude of the voltage. For example, if we wished to set pot 11 to 46.29 volts, this would appear printed in black as p11 4629. After the servo system has set the pot for the proper voltage the typewriter prints in red the pot address and actual pot voltage. The completed print appears as p11 4629 11 4629. This serves as both a permanent record of the setting and a check on the potentiometer.

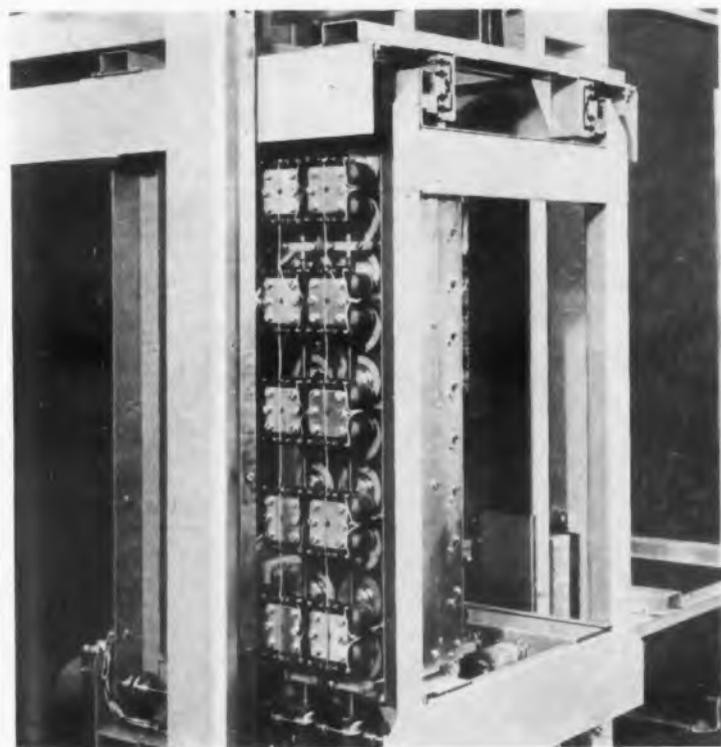
The letter "r" is the signal for the system to read a pot. This is followed by the address of the pot to be read. For example, if it was desired to read the coeffi-

cient voltage on pot 17, r17 would be typed. This would appear in black. When the system had read the voltage on pot 17 the typewriter would record in red 17 4629, meaning the voltage on pot 17 is 46.29 v. Simultaneously this information is punched into a tape.

If it becomes necessary to interrupt a problem solution a tape can be automatically prepared. At a later time the tape and the patchboard can be used to quickly restore the problem conditions that existed at interruption.

Completely automatic parameter variation studies can be made since the Flexowriter can remotely control the computer—switching it to compute, reset etc. For instance, a complete set of stability data can be computed by the machine for a guided missile for variations in altitude. The total machine time required to do this could vary from hours to days yet the computer by means of prepared tape, could complete the entire study without the services of the engineer.

Other features of the computer include a simple servo drive for setting the potentiometer and a highly stable temperature control oven. The clutch, which connects the proper potentiometer, is a relay which pulls a disc against a revolving wheel. The drive has very little backlash and is capable of setting the potentiometer to one wire in 12,000. All computing resistors and capacitors are housed in the stable oven which has a maximum temperature variation of 0.8 F.



Potentiometer setting assembly—Servo-driven magnetic clutch system can set, to an accuracy of better than 0.01%, anyone of 100, 10-turn potentiometers in less than 3 seconds.

ASCOP

PW DATA SYSTEMS

MULTICHANNEL DATA TRANSMISSION OR RECORDING, USING RF CARRIER, FM SUBCARRIER, OR SINGLE MAGNETIC TAPE TRACK

Pulse width coding and time division multiplexing techniques result in systems of large numbers of data channels, excellent accuracy, and exceptional simplicity of operation.

TYPICAL SYSTEM PERFORMANCE

NUMBER OF DATA CHANNELS...	26	41	86
SAMPLES/CHANNEL/SECOND.....	30	20	10
FREQUENCY RESPONSE, CPS.....	5	3.3	1.6
Linearity.....	Better than 0.5% of full scale		
Stability.....	Long term drift less than 1% of full scale		



F SERIES MISSILE TELEMETERING SETS

For short life applications, where the ultimate in compactness, ruggedness, and performance are required. Standard packages as shown are available for 30x30 and 45x20 operation. Special configurations, using standard functional components may be ordered. Some components are sold separately.

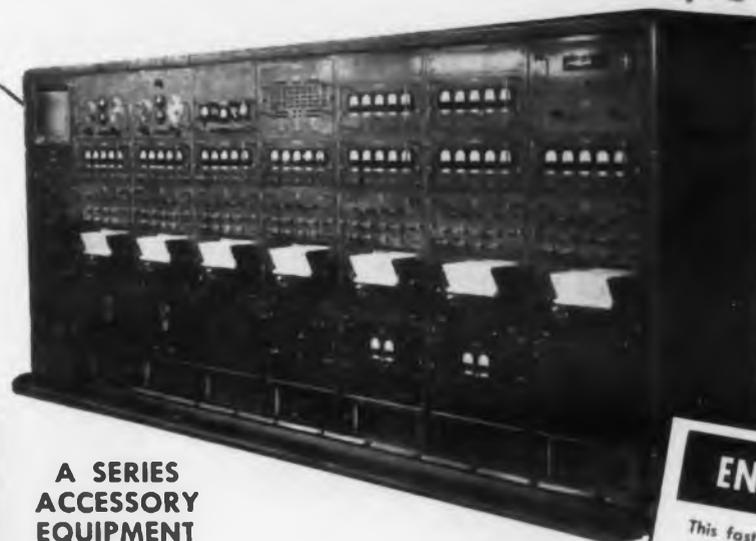
D SERIES MULTICODERS AND TELEMETERING SETS

For applications where repeated use is required. Available for 30x30, 45x20, and 90x10 operation, 0 to 5 volt or 0 to 30 millivolt sensitivity, 28 volt DC or 115 volt 400 cycle primary power, for RF carrier, FM subcarrier, or magnetic tape recording. 45 watt RF power amplifier available.



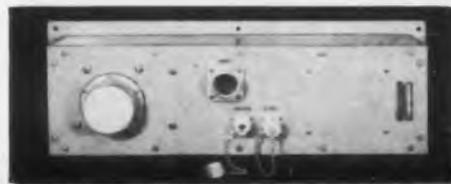
M SERIES PW GROUND STATIONS

Operate on pulse width signals from RF receiver, Subcarrier discriminator, or magnetic tape playback unit to produce visual monitoring of all data channels and reduced graphic output records of selected channels, in real time.



A SERIES ACCESSORY EQUIPMENT

RF Preamplifier units, for greatly increased receiving range, and RF Multicoupler, for operation of up to 4 receivers from a single Preamplifier or antenna. Broad band operation 215 to 235 megacycles.



G SERIES FIXED INSTALLATION MULTICODERS (Not shown)

PW Multicoders for multichannel tape recording or transmission from fixed installations. Operate from standard 60 cycle power lines... Designed for long life... easy accessibility.

ENGINEERS

This fast growing organization has immediate openings for:

Systems & Product Engrs.

Senior R. F. Engrs.

Transistor Engrs.

Sales Engrs.

Send Resumes to our Princeton office

APPLIED SCIENCE CORP. OF PRINCETON

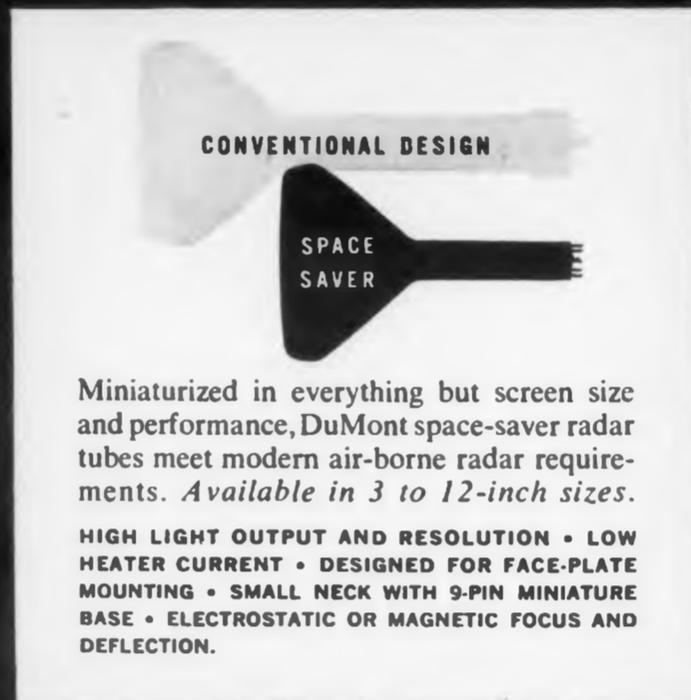
P. O. Box 44, Princeton, N. J. • Plainsboro 3-4141

1641 S. LaCienega Blvd.
Los Angeles, Calif., Crestview 1-8870



CIRCLE 31 ON READER-SERVICE CARD FOR MORE INFORMATION

DU MONT SPACE-SAVER RADAR TUBES



Miniaturized in everything but screen size and performance, DuMont space-saver radar tubes meet modern air-borne radar requirements. Available in 3 to 12-inch sizes.

HIGH LIGHT OUTPUT AND RESOLUTION • LOW HEATER CURRENT • DESIGNED FOR FACE-PLATE MOUNTING • SMALL NECK WITH 9-PIN MINIATURE BASE • ELECTROSTATIC OR MAGNETIC FOCUS AND DEFLECTION.

DU MONT®

Industrial Tube Sales, ALLEN B. DU MONT LABORATORIES, INC., 2 Main Ave., Passaic, N. J.

CIRCLE 32 ON READER-SERVICE CARD FOR MORE INFORMATION

GAIN of 100,000 from two miniature tubes is a feature in itself which makes this servo amplifier noteworthy. The fact that the same basic circuit and package are used for various specific applications make the unit a desirable, easy-to-use building block. The small flexible package is available in many alternate combinations, which meet practically all amplifier characteristics, required by various system specifications. The ac, 6.1 w size is 2 x 2 x 2-3/4 in. high with 1/2 in. projections on two sides for mounting. If 12 w or a chopper (for dc) is needed, the unit becomes one inch wider—2 x 3 x 2-3/4 in.

Up to four separate inputs may be provided on the unit, produced by F. B. MacLaren & Co., 15 Bay Drive West, Huntington, L.I., N.Y., each having a resistance of one megohm maximum. A chopper may be incorporated when operation with dc error signal is required.

The standard two miniature tube units produce an available gain of 100,000 for a single input. Although this is entirely adequate for most systems, a third tube may be added (if no chopper is called for) when still further amplification is required. Connections are provided for an external potentiometer gain control when remote adjustment is desired.

Any value of carrier phase shift from zero to 90 degrees lagging may be specified. However, increased phase shift results in lower available gain for the same number of tubes. Carrier phase shift



Standardized Servo Amplifier

is used because harmonic content of control winding voltage is reduced, and source impedance to motor is not increased. Phase shift of input transducers can be taken into account in setting.

The standard two tube unit may be factory set to drive any servo motor wound for plate-to-plate operation with up to 6.1 w on the control field. A three tube model is also available for power output of 12 w maximum.

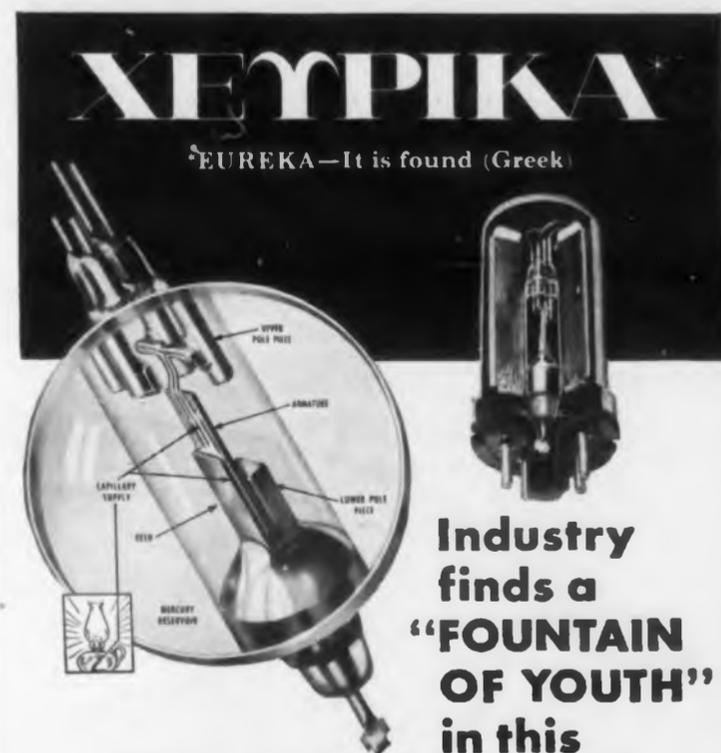
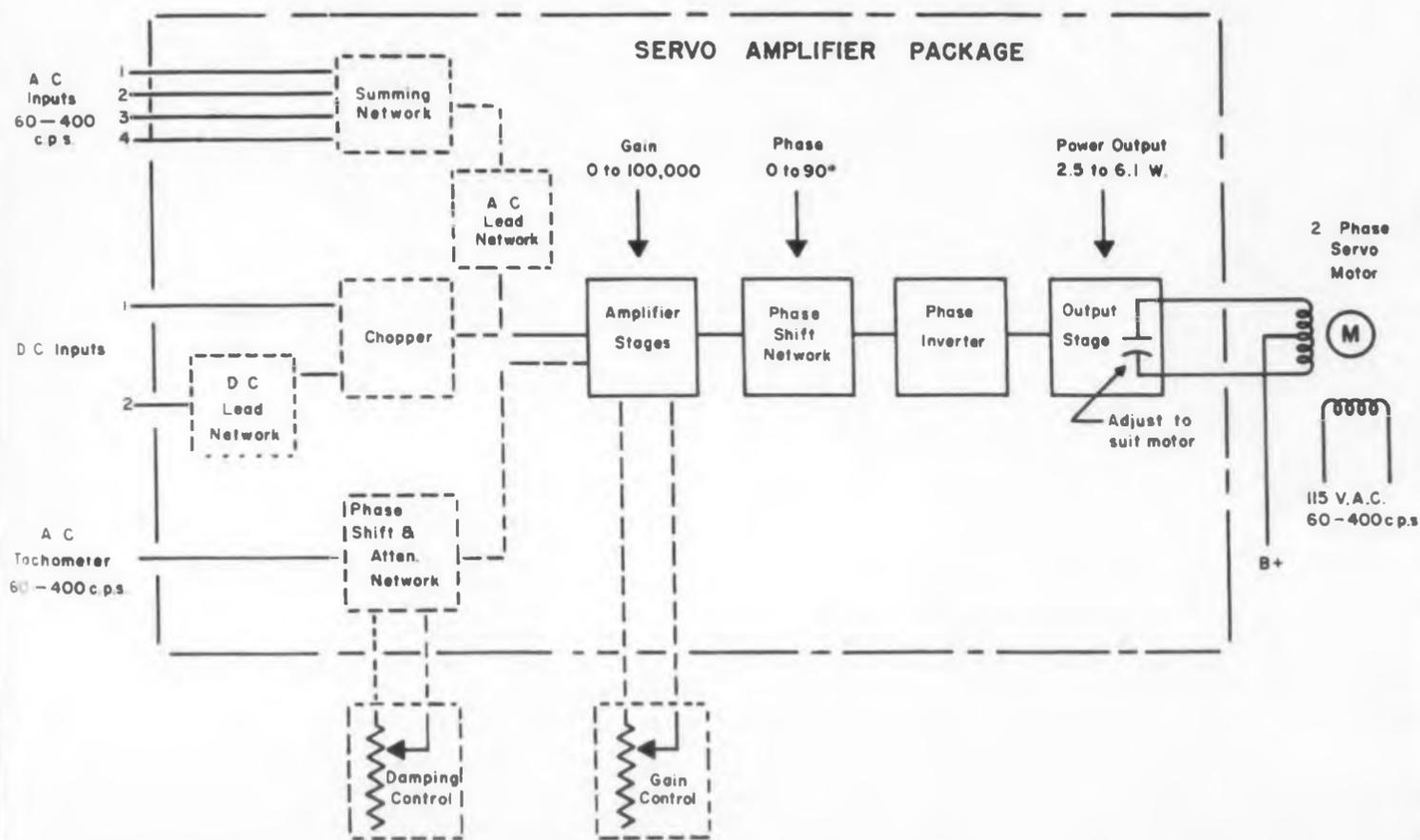
A separate input is available on all units for introducing either fixed or adjustable tachometer damping signals. Ac or dc lead networks may also be incorporated within the amplifier to provide factory set or adjustable error derivative damping, with corresponding gain compensation.

Standard units are available for 400 cy as well as 60 cy operation, with no change in size. All com-

ponents except tubes and chopper are encapsulated in epoxy resin, and the assembly is completely enclosed in an aluminum housing. Three quick-acting panel fasteners are used for mounting, and electrical connections are made through a 15-contact plug on all units.

The use of high-temperature components plus encapsulation of the entire circuit assembly provides excellent resistance to extremes of temperature, humidity, salt spray, altitude, vibration, and shock. Heat conducting tube clamps in intimate contact with the glass envelopes greatly reduce bulb temperatures, which is a primary factor in extending tube life.

Further information on these "Standardized Design" amplifiers systems may be obtained by turning to the Reader's Service Card and circling 33.



Industry finds a "FOUNTAIN OF YOUTH" in this SELF-REJUVENATING CLARE RELAY

Ponce de Leon failed in his quest for a "fountain of youth," but modern design engineers find rejuvenation an accomplished fact in CLARE Mercury-wetted Contact Relays... capable of billions of operations.

Contacts of these relays are constantly renewed. By capillary action, like that of a lamp wick, a new film of mercury coats the contacts with every make and break.

The magnetic switch is sealed in a high-pressure hydrogen atmosphere in a glass capsule. Surrounded by the operating coil, the capsule is enclosed in a vacuum-tube-type steel envelope.

Unlike ordinary relay contacts, these contacts never wear out; never get dirty; never lock or weld; never get out of adjustment; never bounce.

Drawings (left) from stroboscopic photographs show the cycle. (a) Filament of mercury forms between the contacts as they separate. (b) This becomes narrower in cross section and (c) finally parts at two points, allowing a globule of mercury to fall out. Mercury flows up the capillary path to replace the amount lost and restore the equilibrium. (d) The momentary bridging of the parting contacts—and the extremely fast break that ends it—minimizes the arc and adds greatly to contact load capacity. Contact closure between the two liquid surfaces bridges mechanical bounce and prevents any chatter from appearing in the electrical circuit.

Send for CLARE Engineering Bulletins No. 120 and 122. Address C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare & Co., 659 Bayview Avenue, Toronto 17. Cable Address: CLARELAY.



CLARE RELAYS

FIRST in the industrial field

CIRCLE 34 ON READER-SERVICE CARD FOR MORE INFORMATION

METER-RELAYS: Construction and Operation

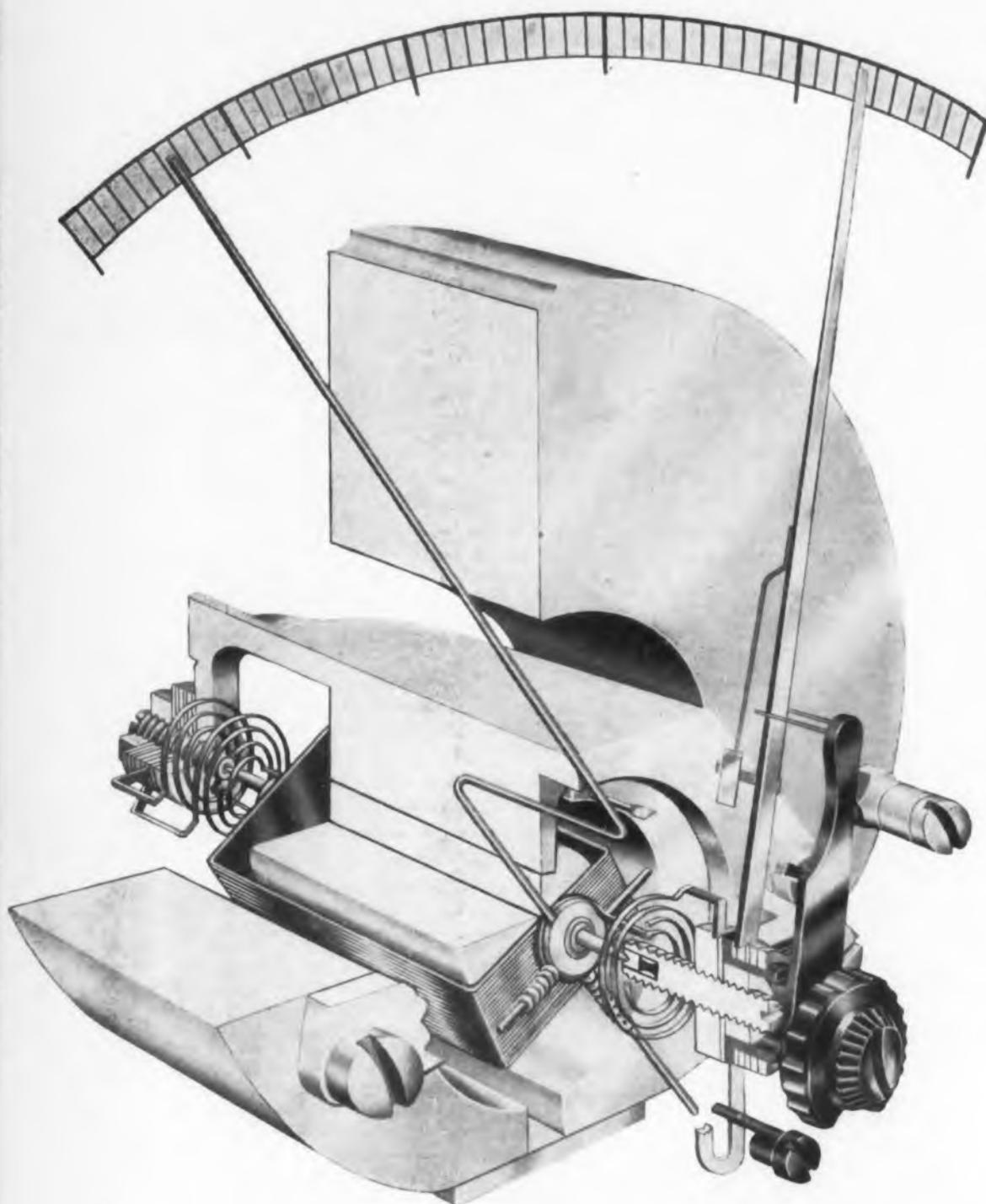
Adjustable pointer with plate contact, foreground, is mounted in bracket. Moving pointer, with contact, is part of conventional D'Arsonval-type meter movement. The moving coil and pointer assembly is pivoted in cushioned jewels, and rotates in the flux of a permanent magnet. The coil is connected to hairsprings.

Since the torque of the moving coil is too low for reliable contact operation, locking coil (wound on the moving coil) develops additional torque to close contacts with 1 to 3 grams pressure. Reset can be manual or automatic. It consists of opening the locking circuit. Built-in spring action kicks contacts apart forcibly. Meter-relays can be built with two adjustable pointers for high-low control.

Write for 40-page Catalog 4B for circuitry, specifications and prices.



Model 255-C
Single Contact, High Limit
0-100 Microamperes, D.C.
Price \$46.00



AUTOMATIC CONTROL

Control action is initiated when the indicating pointer makes contact with the adjustable pointer. Many different functions or conditions, such as pressure, heat, speed, radiation, current, voltage, etc. can be controlled with better than 2% accuracy. Prices range from \$30 to \$110. Used in atomic installations, radar warning (DEW LINE), and hundreds of industrial applications. Ranges from 0-5 Microamperes to 0-50 Amperes; 0-5 Millivolts to 0-500 Volts; -400 to + 3000° F.

Chassis Kits

for

Fast Mock-Ups

RAPID set up of electronic circuitry using simple hand tools is possible with these chassis kits which utilize a punched phenolic board and push-in terminals. The main wiring deck consists of a sheet of grade XXXP phenolic board having a uniform punched pattern of holes into which the terminals are pushed. The deck is mounted on U-shaped aluminum channel members by means of self-tapping screws. Other strips may be mounted at right angles or in decks parallel to the main deck for more efficient use of space. Brackets are provided for attaching potentiometers or other controls to the board. Components such as transformers and encased capacitors may be mounted on the aluminum channel members.

Suitable for laboratory or experimental use, the Experimenter's Chassis Kits, manufactured by the Vector Electronic Co., 3352 San Fernando Road, Los Angeles 65, California, uses formed strip brass terminals which spring snugly into the holes. After pushing in terminals at the required positions, circuit components may be installed and wired quickly. Although a soldering iron is needed for some connections, most small resistor and capacitor leads may be pushed into the serrated terminals and held without soldering, at least for preliminary testing. Since the terminal is tubular, wires may be pushed through for connections beneath the deck. The terminals may be staked in permanently with a pair of diagonal cutting pliers.

Structures of several decks may be mounted on the chassis. Although deck strips for permanent assemblies are generally mounted with long screws and spacers, it can be more convenient for experimental work to assemble multilayered decks by fastening riser wires to terminals on each deck. The riser wires may be used as electrical conductors as well as structural supports. This method is fast, convenient, and amply strong when soldered.

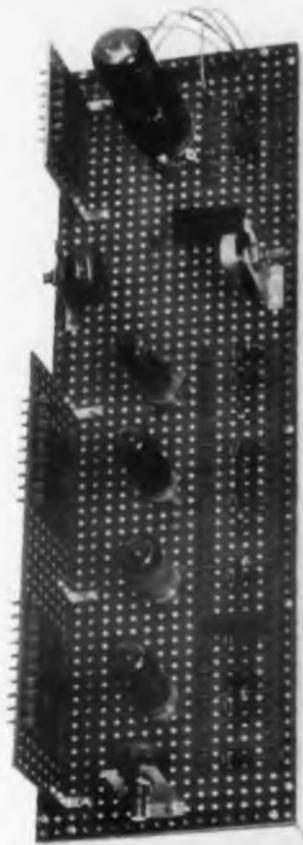


ASSEMBLY PRODUCTS, INC. Mail Address: Chesterland 17, Ohio

Wilson Mills Road
Chesterland 17, Ohio
Telephone (Cleveland, Ohio)
HAmilton 3-4436

69-873 Dillon Road
P.O. Box 308
Desert Hot Springs 17, Cal.
Telephone 4-3133 or 4-2453

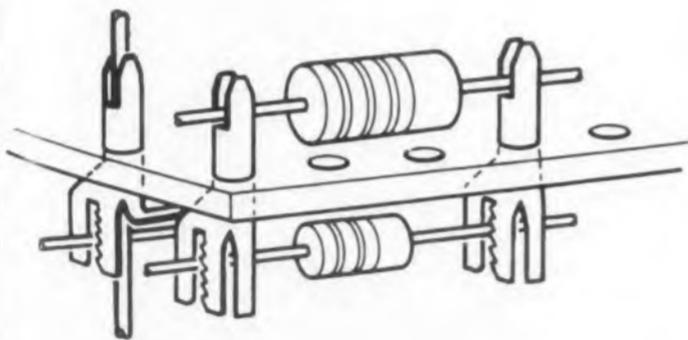
Cleveland Electronics Show, Feb. 16-17, Masonic Auditorium
CIRCLE 35 ON READER-SERVICE CARD FOR MORE INFORMATION



Assembled chassis kit showing mounting of various items.

The construction is highly flexible and parts can be readily cut to make other sizes than those supplied. Kit 20X provides a low cost sampler with wiring decks 4-3/4 x 8-1/2 x 3/32 in. and a small assortment of accessories. Kit 21X supplies a larger deck 4-3/4 x 17 x 3/32 plus a larger number and variety of accessories for more elaborate assemblies. If larger sizes are desired, additional chassis may be butted together and joined. For more permanent use, the structures may be mounted on racks or in cabinets with suitable adapter plates.

For additional information on this product turn to the Reader's Service Card and circle No. 36.



Push-in terminals clip component wires in place without soldering.



FIXED MOLDED RESISTORS—In 1/10, 1/2, 1, and 2 watt ratings at 70C ambient. Available in standard RETMA values.



The Allen-Bradley type of packaging prevents leads from tangling or bending.

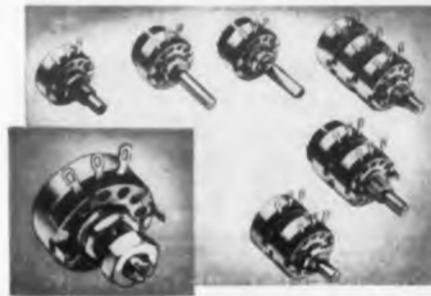


Reel packaging on pressure sensitive tape for automatic assembly lines.



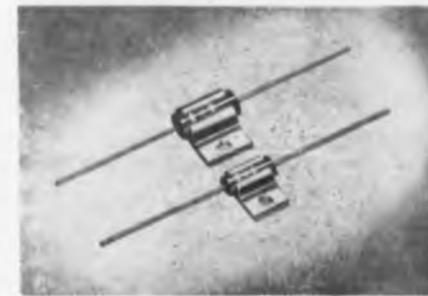
HERMETICALLY SEALED RESISTORS—Composition resistors sealed in a ceramic tube. 1/8 And 1 watt, 10 ohms to 500,000 megohms.

WHERE ELECTRONIC RELIABILITY IS A "MUST" ... STANDARDIZE ON THESE ALLEN-BRADLEY COMPONENTS



VARIABLE RESISTORS—Type J molded resistors, rated at 2 watts at 70C ambient. Total resistance values from 50 ohms to 5 megohms. Outstanding for low noise characteristics. Taps can be provided at 40, 53, and 68% of effective rotation. Metal parts are corrosion-resistant. Have solid molded resistor element.

COPPER-CLAD FIXED RESISTORS—Type GM rated at 3 watts at 70C and 4 watts at 40C. Type HM rated at 4 watts at 70C and 5 watts at 40C. Mounted in heavy copper clamps. Must be mounted on steel panel to radiate heat. Will not open circuit or exhibit erratic changes in resistance. Send for Bulletin 5002.



VARIABLE RESISTORS—Types G and F molded resistors are 1/2 inch in diameter. Total resistance from 100 ohms to 5 megohms. Ideal for use in printed circuits. The Type G all metal variable control is rated 1/2 watt; Type F control with molded end is rated 1/4 watt. Standard tapers.

CERAMIC CAPACITORS—Available in nominal capacitance values from 10 mmfd to .022 mfd in continuous d-c voltage ratings of 500, 1000, 2500, and 5000 volts. Also available in ceramic enclosures for greater mechanical strength and higher insulation dielectric strength. Operate up to 150C ambient temp.



VARIABLE RESISTORS—Type T solid molded resistors for rheostat and potentiometer applications. The molded plastic actuator serves also as the cover which makes this unit extremely flat and compact. Rated at 1/2 watt at 70C ambient. Available in maximum resistance values from 100 ohms up to 5 megohms.

FEED-THRU & STAND-OFF CAPACITORS—These rugged capacitors exhibit no parallel resonance effects normally encountered with tubular capacitors in the VHF and UHF frequency ranges. Available in standard nominal values from 4.7 mmf to 1000 mmf with solder tabs or with screw-thread mountings.



INDUSTRIAL POTENTIOMETERS—Type H rated at 5 watts at 40C ambient. Resistance range 50 ohms to 2 megohms. Good for 100,000 cycles with less than 10% resistance change. Derate to zero at 120C. Maximum voltage 750 v, d-c. After 100 hrs. at 40C and 98% humidity, resistance change not more than 5%.

FERRITE CORES—In various shapes and sizes to fit needs of black and white, color television and general applications. There are U and L cores for color convergence and O cores for color convergence shields; also U and E cores for flyback transformers, and QR cores for deflection yokes. Many other shapes available.



Allen-Bradley Co.
1344 S. Second St., Milwaukee 4, Wis.

Please send me technical data on _____
Name _____
Address _____
City _____ State _____

CIRCLE 37 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Transistorized Preamplifier With Impedance Matching



An all-transistorized, impedance - matching pre-amplifier permits the direct use of low-impedance, low-gain cartridges and microphones with high-impedance tape-recorders and amplifiers. Micamp, which provides 30 db gain, with no hum pick-up, and no distortion at normal levels, ensures a frequency response within 1.5 db from 20 to 20,000 cps. There is no appreciable loss in signal strength or frequency response over more than 1500 feet of wire between the microphone and the amplifier. Input impedance is from 50 to 250 ohms, output impedance is 18,000 ohms, signal to noise is better than 50 db. Distortion is non-measurable at average output, less than 0.75 per cent at full output, and hum is absolute zero.

Madison Fielding Corp., Dept. ED, 863 Madison St., Brooklyn, N.Y.

CIRCLE 38 ON READER-SERVICE CARD FOR MORE INFORMATION

DC Gating System Fast Transition



This single-pole double-throw switch is capable of transition in a few microseconds. Pulse-controlled, its high degree of isolation between control and signal circuits permits fast and accurate switching between points at high signal potential differences from ground.

Very small dc errors make it ideally suited for multiplexing analog signals in 0.1 per cent systems. The device is completely stable in either state and is particularly useful for non-periodic operation. Long life, very low power consumption and freedom from drift are features of this completely transistorized design.

Dynamics Instrumentation Co., Dept. ED, 1931 No. Bway., Los Angeles 31, Calif.

CIRCLE 39 ON READER-SERVICE CARD FOR MORE INFORMATION

Audio Beat Oscillator Transistorized



The audiolator, a fully - transistorized beat frequency audio oscillator, is powered by mercury or pen-light batteries. A single sweep of the dial covers the audio range of 50 cy to 15 kc. A dial is provided for zero beat adjust and fine frequency control over the entire range. The oscillator features constant output, built-in-stability, no hum and flat output constant with frequency. No grounds are needed for the instrument and it can be placed across any transmission system. Output voltage is 1 v at 600 ohms. Output impedance is 600 ohms. Output flatness is 1 db over entire range, attenuation is 0 to maximum, continuously variable. Dimensions are 6 in. x 2 in. x 3-3/4 in.

Kay Electric Co., Dept. ED, 14 Maple Ave., Pine Brook, N.J.

CIRCLE 40 ON READER-SERVICE CARD FOR MORE INFORMATION

Q-Meter Range 50 Kc to 75 Mc



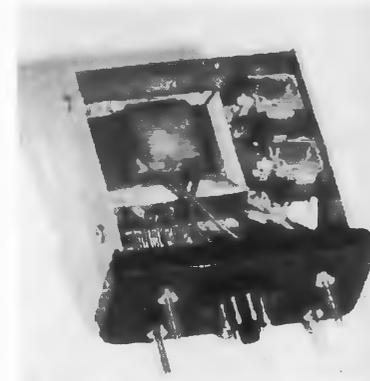
The Model 162 Q-Meter has no thermocouple to burn out, and it is almost impossible to damage the indicating meter with overloads, thus allowing this instrument to be used by inexperienced personnel without fear of damage. Other features are its wider frequency range of 50 kc to 75 mc, internal regulation on both 110 and 220 v operation, an injection voltage of 20 mv that is readily monitored, and the use of a single indicating meter.

Among the application of this new Q-Meter are the measurement of Q of rf coils and the determination of their affective inductance, measurement of Q of capacitors, insulating materials, coil forms and for incoming inspection and production line testing.

Alpha Instrument Co., Dept. ED, 43 Hempstead St., New London, Conn.

CIRCLE 41 ON READER-SERVICE CARD FOR MORE INFORMATION

Plug-In Control Pack For Meter Relays



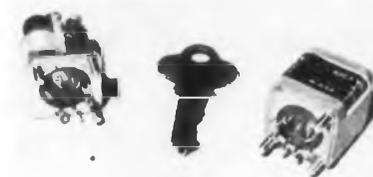
A miniaturized plug-in control pack, containing all the basic control circuitry needed for use with contact meter-relays, measures approximately 4 x 2 x 4 in. A large number of circuit variations are available in the control pack. The standard minimum parts include an isolation transformer, a dc power supply (including rectifiers), and slave relays to provide 5 amp ac 115 v contacts. Frequently an interrupter or sampling circuit is also included.

The new control pack is especially adapted to replacement as a unit, since the accompanying meter-relay is mounted separately. The unit plugs into standard 11 pin octal type sockets.

Tipp-Tronic, Dept. ED, Tipp City, Ohio.

CIRCLE 42 ON READER-SERVICE CARD FOR MORE INFORMATION

Subminiature Relay Stands 100 G Shock



Exceptional vibration and shock resistance marks the VG relay series developed for missile and aircraft applications. Designed to meet MIL-R-5757C, shock test II, the relay has a vibration rating at 15 G's from 55 to 2000 cps. Shock is rated at 100 G's. It measures about 3/4 cu in., and weighs 1.3 ozs with a DPDT contact arrangement.

It operates from -65 C to +85 C, but will be available for operation at 125 C. Standard coil operation is at 24-29 v dc, and a maximum coil voltage of 38 v dc continuous, with pull-in voltage rated at 18 v dc maximum over the temperature range. Operating time is 6 msec at 26.5 v dc. Life performance is 100,000 operations minimum at rated load.

Elgin National Watch Company, Dept. ED, Elgin, Ill.

CIRCLE 43 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Amplifier From DC to 1000 cps



Although designed for self contained 400 cps input signals, this dc-ac magnetic amplifier is adaptable to input signals from dc to 1000 cps with the addition of a reference transformer. It

does not require any vacuum tube or transistor driving stage in a normal servo loop. The No. C-150-223, employing no tubes or transistors, is designed for use in instrument and computing servo systems. It is potted and hermetically sealed in a MIL-T-27A size HA can.

The circuit is of full-wave design. This amplifier meets shock and vibration requirements of MIL-STD-202 and is suitable for driving BuOrd Mk 7 or Mk 8 Servo Motor or equivalent.

Average characteristics are: Frequency 400 cps, line voltage 115 v, voltage output (phase reversible, rated load) 50 v, power output (rated load) 15 w, voltage gain (rated load) 100, input impedance 10,000 ohms, corner frequency 25 cps, damping factor 1.00, temperature range -30 to +65 C, weight 46 oz.

The Ahrendt Instrument Co., Dept. ED, 4910 Calvert Rd., College Park, Md.

CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Consoles Modularized



This complete line of steel electronic test consoles and electronic test benches is based on a modular

"building block" principle. Design permits continuous row and interchangeable arrangement. Pedestal units are available, providing drawers, storage or roll-out relay racks. Drawers and relay racks are all mounted on top quality ball bearing slides. Work surfaces are available in tempered Masonite, Formica or copper. Three types of instrument backs provide a selection of raceways, instrument housing and/or instrument shelves. These units can be supplied with complete electrical systems including coaxial cables and signal circuits, to specification.

Mech-Tronics Corp., Dept. ED, Ojai, Calif.

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION



VOLTAGE REGULATED POWER SUPPLIES

for Transistors • Strain Gages
Relays • Filament Power

MODEL	Volts	Current	Regulation		Ripple	Recovery Time*	Stability For 8 Hours	Output Impedance		Dimensions			Price
			Line 105-125	Load 0-Max.				DC-20 v	20~100 KC	W	H	D	
2600	0-60	0-2 Amp.	5 Mv.	5 Mv.	1 Mv.	50 μ sec.	10 Mv.	0.002 Ω	0.0005 Ω	19"	10 1/2"	17"	\$690
2650	0-60	0-5 Amp.	5 Mv.	5 Mv.	1 Mv.	50 μ sec.	10 Mv.	0.001 Ω	0.0002 Ω	22 1/2"	28"	18"	\$1190

Good stability
Fast recovery time
Low output impedance
Excellent regulation
Low ripple

POWER REQUIREMENTS: 105-125 volts, 60 cycles.
FUSE PROTECTION: Input and output fuses on front panel. Time delay relay is included to prevent unregulated voltage from appearing at the output terminations.

OUTPUT TERMINATIONS: DC terminals are clearly marked on the front panel. Either positive or negative terminal of the supply may be grounded. DC terminals are isolated from the chassis. A binding post is available for connecting to the chassis. All terminals are also brought out at the rear of the unit. Two terminals are mounted at the rear of the chassis to provide for picking up the error signal directly at the load. This connection compensates for the voltage drop in the wires (and ammeter) connecting the power supply to the load.

METERS: Ammeter: 0-2 amperes, 4" rectangular for Model 2600
0-5 amperes, 4" rectangular for Model 2650

Voltmeter: 0-60 volts. 4" rectangular

CONTROLS: Power on-off switch, DC on-off switch, remote error signal on-off switch, coarse and fine voltage controls. The coarse voltage control is a ten turn potentiometer which varies the voltage from 0-60 volts. The fine voltage control is a ten turn potentiometer which varies the voltage 1 volt. The voltage divider network allows a 61 volt variation in output voltage.

*Recovery time is less than 50 microseconds. The excursion in the output voltage during the recovery period is less than 50 millivolts for line fluctuations from 105-125 volts or load variations from 0-to maximum current.



FOR COMPLETE LINE
WRITE FOR CAT. B-568



KEPCO LABORATORIES, INC.

131-38 SANFORD AVENUE • FLUSHING 55, N.Y. • INDEPENDENCE 1-7000

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

GENERAL TRANSISTOR TESTING ASSURES COMPUTER RELIABILITY

Precision manufacturing is not enough! says GT. So General Transistor constantly tests. Along every production step keen eyes, highly skilled technicians, and special instruments check and recheck each transistor. These tests, developed by GT for every specific purpose and characteristic vital to computer reliability assures accuracy and dependability throughout. Whatever your circuit needs, call in General Transistor —one of the largest suppliers of transistors for computers.



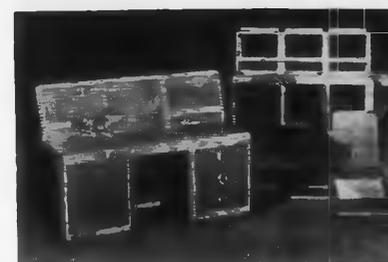
GENERAL TRANSISTOR CORP.



Richmond Hill 18, N. Y. — Virginia 9-8900

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

Cabinet Enclosures In Building Blocks



Selections from 75 mass-produced building-block metal cabinet enclosures and work with 125 different sub-parts can yield many varieties of cabinets to house instrumentation, automation, electronic, and electro-mechanical equipment.

Panels use Tinnerman speed nuts, and Phillips head screws. Conventional cup washers are replaced with ornamental head screws with undercut heads.

Built of cold rolled, heavy gauge steel, and finished in a two-tone gray baked enamel with a Bonderite base, the cabinets have been designed to meet nuclear decontamination requirements and have high air venting characteristics. Components ordered from stock, and all sub-assembly work is done at the factory with all panels bolted in place, and drawers, and doors inserted. The over-all assembled components have to be bolted together to make the finished console or control cabinet. The cabinets can be ordered enamel finished in the standard two-tone gray colors, in special colors, or can be secured unpainted.

Elgin Metalformers Corp., Dept. ED, 630 Congdon Ave., Elgin, Ill.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Wide-Band Sweep Generator

Flat Output 200 Kc to 250 Mc



A wide-band sweep frequency generator, Model 900, supplies a sweep signal at any frequency from 0.2 mc to approximately 1000 mc, with sweep widths as high as 300 mc or as low as 0.1 mc. The rf output, which is monitored by matched crystal diodes feeding a two-stage AGC amplifier, is flat within ± 0.5 db over the entire vhf range of 200 kc to 250 mc. At a sweep width of 300 mc, the total rf output variation of the uhf range, 250 mc to 1000 mc, is less than ± 3 db.

A built-in detector circuit is provided with matched crystal diodes, for checking the sweep, and a built-in amplifier provides a gain of 100 times between the detector output and the scope's vertical input.

Jerrold Electronics Corp., Dept. ED, 23rd & Chestnut Streets, Philadelphia 3, Pa.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Meter

Range of 2.4 to 10.2 Mc



The frequency range from 2350 to 10,500 mc in the Model 802 frequency meter covers the range of the most-used microwave frequencies. A Veeder-

Root digital counter system is used for indicating frequency readings.

Two cavities are tuned by turning a precision lead screw with ground threads, each cavity having its own screw or turning shaft. Both tuning shafts are driven, through a set of bevel gears, by a single knob on the front panel. In addition, the two tuning shafts are geared, by means of precision spur gears, to the digital counter, so that the single knob actually tunes both cavities while actuating the counter. The counter reading is referred to a universal nomograph-type calibration chart. Frequency in megacycles is obtained without written interpolation at any point in the entire frequency range to an accuracy of 0.2 per cent.

The Narda Corp., Dept. ED, Mineola, N.Y.

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

Sweep Generators

Cover 22-225 Mc Range



Two portable wide-band Sweep Generators, designed to cover the frequency spectrum from 22 mc to 216 mc, contain an all-electronic sweep circuit, of the saturable reactor type, with a sweep range of approximately 5 to 1. The rf output of

both models is held constant throughout its operating range by a highly effective AGC circuit.

The Model 220 supplies a sweep signal at any frequency from 50 mc to 225 mc, with sweep widths as high as 175 mc and as low as 2.0 mc. Output voltage is 0.7 v rms (into 75 ohms) with a variation at maximum sweep widths of ± 0.5 db.

The Model 95, which has the same mechanical features as the Model 220, has a frequency range from 22 mc to approximately 110 mc. A high voltage output of 1.5 v rms is maintained across this band to within ± 0.5 db.

Jerrold Electronics Corp., Dept. ED, 23rd and Chestnut Sts., Philadelphia, Pa.

CIRCLE 51 ON READER-SERVICE CARD FOR MORE INFORMATION

The British Electronics Industry is making giant strides with new developments in a variety of fields. Mullard tubes are an important contribution to this progress.

Principal Characteristics

	61SV	61RV
Peak spectral response	2.5 μ	2.5 μ
Spectral range	0.3 to 3.5 μ	0.7 to 4.5 μ
Cell resistance (average)	4M Ω	100K Ω
Max. applied voltage	250V	100V

Sensitivity

a. Tungsten light source at 2700°K	3.0mA/lumen	300 μ A/lumen
b. Black body at 200°C (radiation energy 5.82 μ W; chopper frequency 800c/s; amplifier bandwidth 50c/s)	180V r.m.s./W peak to peak	1.66V r.m.s./W peak to peak

61SV/61RV

Supplies available from:—

in the U.S.A.

International Electronics Corporation,
Dept. ED-1, 81 Spring Street, N.Y. 12,
New York, U.S.A.

in Canada

Rogers Majestic Electronics Limited,
Dept. JA, 11-19 Brentcliffe Road,
Toronto 17, Ontario, Canada

Mullard



Mullard is the trade mark of Mullard Ltd., and is registered in most of the principal countries of the world. MEV 44

ELECTRONICS IN BRITAIN



extra-sensitive infra-red photoconductive cells

Important among recent British achievements is the introduction by Mullard of two new photoconductive cells, the 61SV and the 61RV. These cells, specially designed for detecting infra-red radiations, combine an unusually high order of sensitivity with an extremely fast response, peaked at a wavelength of 2.5 microns. Their spectral range extends beyond the usual limits of infra-red detectors down to the red end of the visible spectrum.

The high signal-to-noise ratios of the 61SV and the 61RV make them ideal for measuring small temperature variations of relatively low heat sources down to 100°C. Additionally, their small size and rugged construction qualify them for the majority of infra-red applications in industry.

For further technical information and advice on the use of these outstanding photocells please write to either of the companies listed here.

ELECTRONIC TUBES *used throughout the world*

MULLARD OVERSEAS LTD., MULLARD HOUSE, TORRINGTON PLACE, LONDON, ENGLAND

CIRCLE 52 ON READER-SERVICE CARD FOR MORE INFORMATION

ALSiMAG[®]

PRECISION CERAMICS

produced to precision tolerances

New equipment and techniques are constantly added to improve precision. Few people—few engineers—are aware of the close tolerances which are now possible. There are 3 main reasons for this progress:

COMPOSITIONS. Widest range in the industry. Some AlSiMag materials are hard as sapphire—more wear resistant than tool steel—and are non-magnetic and chemically inert. New Alumina "super ceramics" perform unbelievable feats of strength, thermal and mechanical shock resistance plus excellent electrical characteristics at ultra high frequencies and temperatures. Improved characteristics promote ruggedization, permit miniaturization.

CONTROLS. In preparation of raw materials, designing and building dies, calculating shrinkages . . . at every manufacturing step—forming, firing, inspecting. Over 55 years of experience—where precision in ceramics was pioneered!

FINISHING. Equipment plus skill. Every machine for precision finalizing. Thoroughly trained personnel who consider difficult specifications a personal challenge.



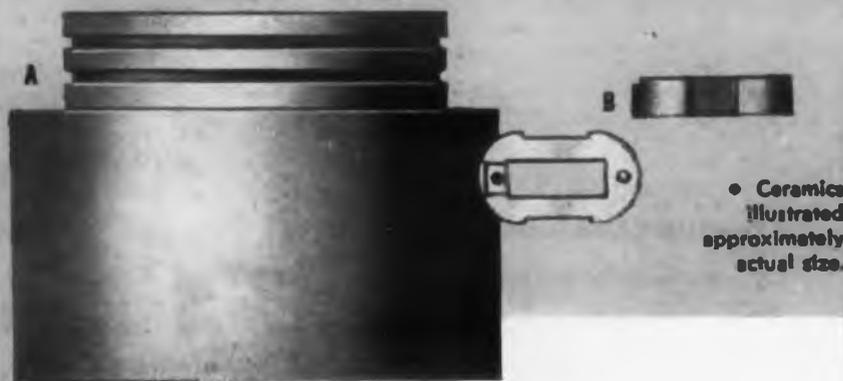
Tell us about your component problems. AlSiMag Precision Ceramics may do a better job for you. Send us a blueprint or sketch with an outline of the operating procedure for complete details.

A Subsidiary of
Minnesota Mining and
Manufacturing Company

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENN.
55TH YEAR OF CERAMIC LEADERSHIP

For service, contact Minnesota Mining & Manufacturing Co. Offices in these cities (see your local telephone directory): Atlanta, Ga. • Boston: Newton Center, Mass. • Buffalo, N. Y. • Chicago, Ill. • Cincinnati, O. • Cleveland, O. • Dallas, Texas • Detroit, Mich. • High Point, N. C. • Los Angeles, Calif. • New York: Ridgefield, N. J. • Philadelphia, Pa. • Pittsburgh, Pa. • St. Louis, Mo. • St. Paul, Minn. • So. San Francisco, Calif. • Seattle, Wash. Canada: Minnesota Mining & Manufacturing of Canada, Ltd., P. O. Box 757, London, Ont. All other export: Minnesota Mining & Manufacturing Co., International Division, 99 Park Ave., New York, N. Y.

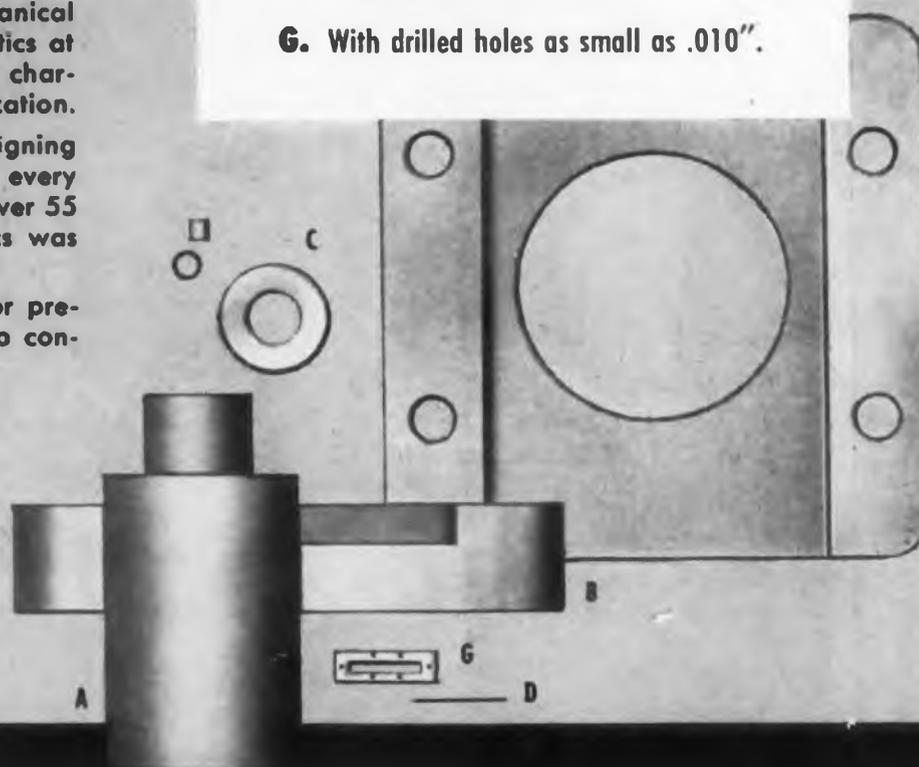


• Ceramics illustrated approximately actual size.

Do you know

that ceramics can be supplied, in quantity: To tolerances generally associated with precision metal work.

- A. Pistons and cylinders with maximum clearance of as little as .0015".
- B. With faces parallel within .0005".
- C. In flatnesses within light bands.
- D. In thicknesses from .007" up.
- E. In tubular form as small as .015" OD, .008" ID.
- F. Threaded screws as small as 2-56 thread.
- G. With drilled holes as small as .010".



UHF Waveguide Components

Slotted Lines

The total line of equipment consists of slotted lines, rigid waveguide, standard horns, directional couplers water loads, line stretchers, terminations, variable flap attenuators and others.

One assembly has a slotted line, adjustable short, slide screw tuner and waveguide to coax adapter for accelerated measurements where the VSWR must be at a minimum level. Waveguide and waveguide components are available from WR770 to WR2400.

General Bronze Corp., Dept. ED, 200 Central Ave., Newark 3, N.J.

CIRCLE 54 ON READER-SERVICE CARD

Nail Posts

For Harness Boards

A new line of nails designed specifically for harness board wiring applications will find use in the aircraft and guided missile industries.

The nails, or posts, have a collar-type stop 5/8 in. from the pointed end to prevent them from being driven in too far. Nails are made of corrosion-resistant cadmium-plated steel and are available from stock in above-collar lengths of 1, 1/2, 2, 2-1/2 and 3 inches.

John Hassall, Inc., Dept. ED, Westbury, N.Y.

CIRCLE 55 ON READER-SERVICE CARD

Release Agent

For Parting Epoxies

A new release agent can be rubbed to an imperceptible film after application for easy parting of epoxy resin castings from plaster molds, or from metal, wood, or epoxy masters. In addition, the agent seals surface pores to exclude water vapors and is effective in parting plaster from plaster or gypsum cements.

Following application, Seal-Release may be rubbed down to a thin film, eliminating surface irregularities resulting from uneven application.

Smooth-On Mfg. Co., Dept. ED, 572 Communipaw Ave., Jersey City, N.J.

CIRCLE 56 ON READER-SERVICE CARD

◀ CIRCLE 53 ON READER-SERVICE CARD

Beam Power Tube For Vertical-Deflection

The 6CZ5 is a high-perveance beam power tube of the 9-pin miniature type. It is designed primarily for use as a vertical-deflection amplifier in TV receivers having diagonal deflection angles of 110 deg. and operating at anode voltages up to 18,000 v. A feature of its design is a 6.3 v 0.45 amp heater having controlled warm-up time. The 6CZ5 has a maximum peak positive-pulse plate voltage of 2200 v (absolute); a maximum peak cathode current of 140 ma, and a maximum plate dissipation of 10 w.

Radio Corp. of America, Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 57 ON READER-SERVICE CARD

Junction Transistor For Switching

The 2N269 is a junction transistor of the germanium pnp type designed for use in low-level, medium-speed, "on-off" control circuits with particular reference to bistable (flip-flop) and gating circuits of electronic computers. The 2N269 has a maximum emitter current of 100 ma, a maximum collector current of 100 ma, a minimum large-signal dc current-transfer ratio of 35 at a collector-to-emitter voltage of -0.15 v, and a minimum alpha-cutoff frequency of 4 Mc. The 2N269 is hermetically sealed, utilizes an insulated metal envelope and has flexible leads. It is 0.240 in. in diameter and 0.405 in. in body height.

Radio Corp. of America, Semiconductor Div., Dept. ED, Somerville, N.J.

CIRCLE 58 ON READER-SERVICE CARD

Ultra-Thin Copper Tape For Water-Type Coils

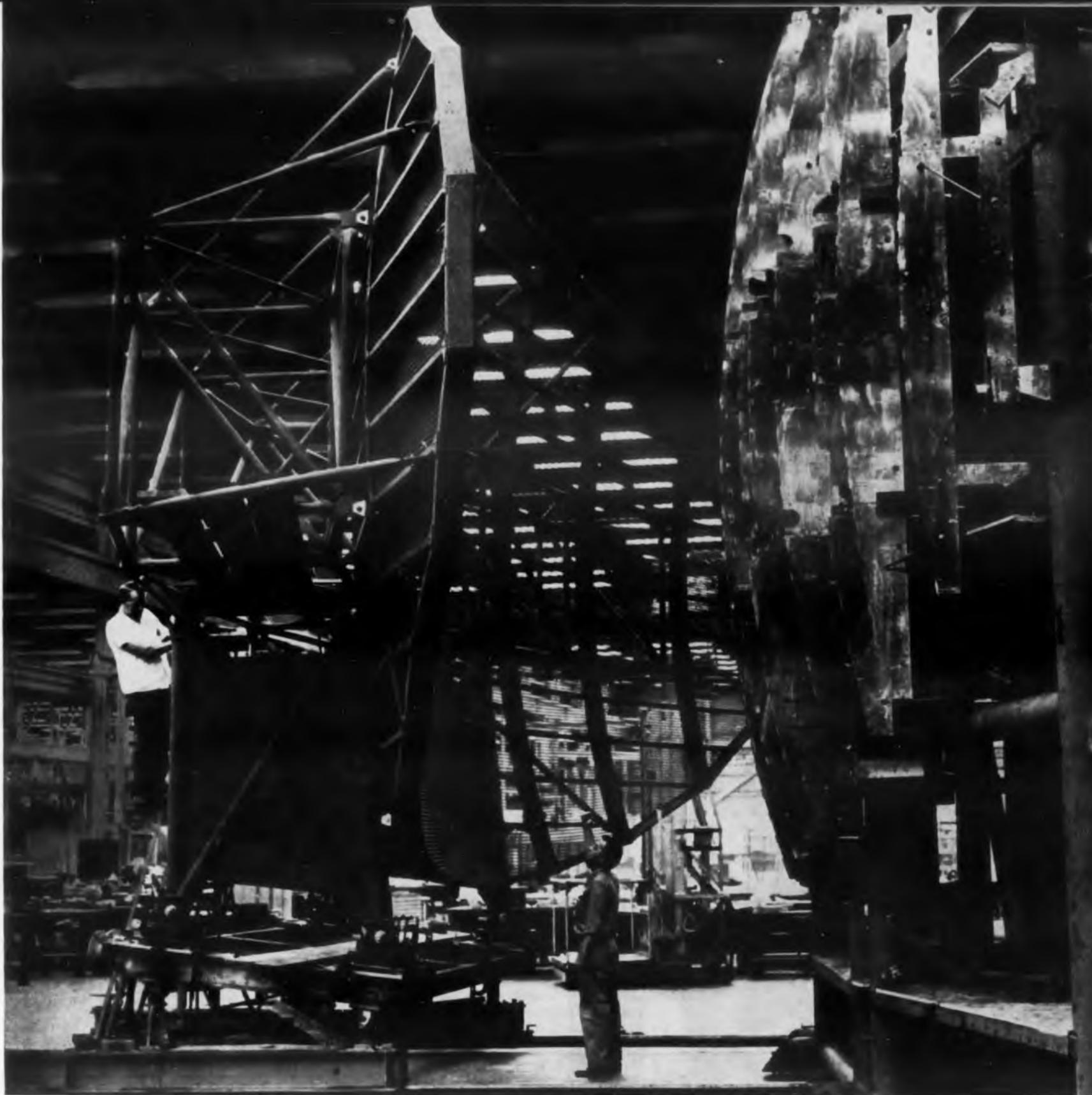
Copper tape is now available in thicknesses as low as 0.00015 in. in pilot quantities.

This ultra-thin copper tape replaces wire formerly employed in wafer-type coils. Ultra-thin copper tape weighs less than the equivalent amount of wire, occupies less space, and further cuts volume by introducing a favorable "stacking factor."

American Silver Co., Dept. ED., 36-07 Prince St., Flushing 54, N.Y.

CIRCLE 59 ON READER-SERVICE CARD

CIRCLE 60 ON READER-SERVICE CARD ➤



PRECISION JIG (RIGHT) GAGES ACCURACY OF HUGE ANTENNA SURFACE TO 1/100 OF AN INCH—PROOF THAT LARGE OR SMALL . . .

General Electric Antennas Are Engineered to Give Your Radar System Top Reliability and Accuracy

Backed by more than two decades of experience and proven reliability, General Electric antennas are thoroughly engineered to your specific needs.

Whether your radar system calls for extensive research and development—for component manufacturing—or simply for production of your antenna design, G.E.'s advanced facilities and intensive engineering programs are your assurance of the finest antenna work available!

Examine *your* antenna needs, now. Large or small, simple or complex—General Electric engineering can answer them. Simply contact your local G-E Ap-

paratus Sales Office. An antenna specialist will be glad to give you specific information. General Electric Co., Section 223-6, Schenectady, N. Y.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

CURRENT WL-6198



TOP VIEW



The side appendage will no longer be necessary thanks to advanced Westinghouse design.

NOW! NEW WL-6198A



TOP VIEW

New orientation markings on the 6198A permit use of the full photo surface area.

NEW AND IMPROVED DESIGN FROM WESTINGHOUSE

Westinghouse first with redesigned Type 6198 Vidicon Camera Pick-Up Tube . . . first to bring you these important improvements!

IMPROVED MECHANICAL DESIGN. Since the side appendage has been deleted, yoke construction can be greatly simplified because a slot does not have to be provided.

IMPROVED ELECTRICAL DESIGN. This advanced new design permits use of full-length deflection coils in the yoke, and provides focus uniformity to materially improve picture shading. Further, the new WL-6198A permits the introduction of a more uniform photo-sensitive surface to reduce the mottling effects in the picture.

IMPROVED PERFORMANCE FEATURES. Now that mottling is reduced and picture shading improved, the resultant picture is of more uniform clarity . . . with a truer image . . . closer by far to the actual subject being observed and transmitted by the camera.

ENGINEERS! For challenge, security, growth potential, investigate career opportunities now being offered by Westinghouse Electronic Tube Division. Write Technical Placement Director, Westinghouse Electric Corp., Electronic Tube Division, Elmira, N. Y.

You will want full details on this new Westinghouse Vidicon Camera Pick-Up Tube. Get detailed technical data by writing to Commercial Engineering Dept., Westinghouse Electric Corp., Elmira, N. Y.

WATCH WESTINGHOUSE
WHERE BIG THINGS ARE HAPPENING FOR YOU!

6ET-4118

CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION

S-Band Cavity Oscillator For Pulse or CW



This is a miniaturized, grid separated, double coaxial line cavity oscillator, utilizing the GL-6442 tube. It is suitable

for aircraft due to its light weight and mechanical strength.

As a pulse cavity oscillator, the Series 500 has a tuning range in excess of 200 mc in the S-Band region with a peak power output of 1 kw in upper range and 2 kw in lower range, operating under a duty cycle of 0.001. Its plate voltage is 2000 v at 4 amps. As a CW cavity oscillator, it has a tuning range in excess of 200 mc in the S-Band region with a power output of 50 mw in upper range and 100 mw in lower range. Plate voltage is 200 v dc at 35 ma. Plate tuning is accomplished by screw driver adjustment. The unit weighs only 25 oz with tube.

Amerac, Inc., Dept. ED, 116 Topsfield Rd., Wenham, Mass.

CIRCLE 62 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Filter For Vibration Analysis



The Model 1065 variable filter is designed for use with IRD vibration analyzers and provides the facility for analyzing vibration at all frequencies in the range of 300 to 300,000 cy per min. Used with IRD

analyzers, the filter measures amplitude and phase of each vibration frequency causing trouble or incipient failure in rotating machinery.

The variable filter is housed in a portable cabinet containing unitized electronic components, power supply, tuning circuits and associated controls. The band width throughout the range is approximately ± 5 per cent of the nominal frequency to the 3 db down points. This extreme sharpness is very advantageous for pinpointing the various frequency components which are present in a complex vibration. The electronic filter is inserted between the IRD velocity pickup and the vibration analyzer which is being used. Response of the filter when tuned to a given frequency is accurate within 5 per cent up to 30,000 cpm and within 10 per cent from 30,000 to 300,000 cpm.

International Research & Development Corp., Dept. ED, 797 Thomas Lane, Columbus, Ohio.

CIRCLE 63 ON READER-SERVICE CARD FOR MORE INFORMATION

Servoamplifier Has High Gain



This compact, portable, high gain servoamplifier is designed to power the control winding of a small, two-phase motor in an LVDT-controlled servo system. The SA60C-4 servoamplifier is used for applications in which the amplification of minute 60 or 400 cps signals is required to produce up to 4 w of controllable power to actuate relays, power small motor windings or for any suitable load sensitive to phase inversion.

Specifications are: line power, 105 to 130 v 60 or 400 cps; maximum carrier output, 4 w; minimum input for full output power, 90 μ v; input impedance, 20 megohms shunted by less than 25 μ fd, carrier frequency, 60 or 400 cps.

Schaevitz Eng., Dept. ED, P.O. Box 505, Camden 1, N.J.

CIRCLE 65 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Delay Unit Fused Quartz Medium



Using a fused quartz medium the AD1 delay unit accepts a pulsed input signal and delivers a delayed pulse output. Operating at repetition rates up to 1 mcps, the units may be specified for delay periods up to 1100 μ sec. The maximum storage capacity of 1100 bits of information places the AD1 unit in the medium capacity category where acoustical transmission is an economical storage method. Units feature gating circuits for synchronization and reshaping of delayed pulse trains. The AD1 memory unit may be used with several types of digital equipment operating at a 91 ohm impedance level.

The units are packaged for 19-inch relay rack mounting and require only 1-3/4 inches of vertical rack space. Delay periods may be changed without modifying rack installations by unplugging the quartz delay medium and associated printed circuitry from the rear of the panel.

The quartz delay medium is temperature-controlled for delay accuracies of ± 0.1 μ secs and may be adjusted by an internal thermostat setting to provide fine control of the delay period.

Computer Control Co., Inc., Dept. ED, Wellesley, Mass.

CIRCLE 66 ON READER-SERVICE CARD FOR MORE INFORMATION

HUGHES PRODUCTS

presents 3 unusual new

STORAGE TUBES

MEMOTRON

The MEMOTRON, a direct-display cathode ray storage tube, retains traces and transients until intentionally erased. Analysis and comparison are possible without photography because MEMOTRON visually displays successive transient writings. All displays occur at uniform brightness, regardless of writing speeds, so are easily photographed for file records. Applications: viewing transients in shock testing, read-out of solutions from analog computers, curve plotting at high and low speeds, electrocardiography, vectorcardiography and heart sounds.

General Specifications:

RESOLUTION...50 to 60 written lines per inch.

WRITING SPEED...0 to at least 100,000 inches/second.

BRIGHTNESS...50 foot-lamberts.

USABLE SCREEN DIAMETER...4 inches.

DIMENSIONS...

Over-all length: 18 1/2 inches \pm 1/2 inch.

Bulb diameter: 5 5/8 inches maximum.

Neck diameter: 2 1/4 inches \pm 3/32 inch.



Photos show single transient pulses, 20 microseconds wide with a one microsecond rise time, showing writing capabilities of one million inches per second. These photos were taken in full daylight without a hood.

TONOTRON

The TONOTRON, another exclusive Hughes direct-display cathode ray storage tube with a 5-inch screen, presents a complete spectrum of grey shades. The high light output makes a hood unnecessary, even when viewing in full daylight. TONOTRON's length of persistence and rate of decay are controllable. Superior presentation of the grey scale assures "high fidelity" picture reproduction. Applications: radar, Narrow Band Television, instrumentation, etc.



Photos: Left, weather radar with brilliant halftone picture on TONOTRON. Right, TONOTRON freezes action picture until intentionally erased.

TYPOTRON

The TYPOTRON is the first commercially available storage tube for displaying printed data rapidly. A choice of 63 characters is available for the presentation of data in words, numbers or symbols. As a high-speed digital read-out device, the TYPOTRON writes characters 1/8 inch in size at speeds of at least 25,000 characters per second. The written information remains visible indefinitely without fading or blooming, until intentionally erased. This feature makes TYPOTRON an ideal read-out device in many digital computer applications.



Photo: Presentation of all available characters.

HUGHES PRODUCTS

A DIVISION OF THE HUGHES AIRCRAFT COMPANY

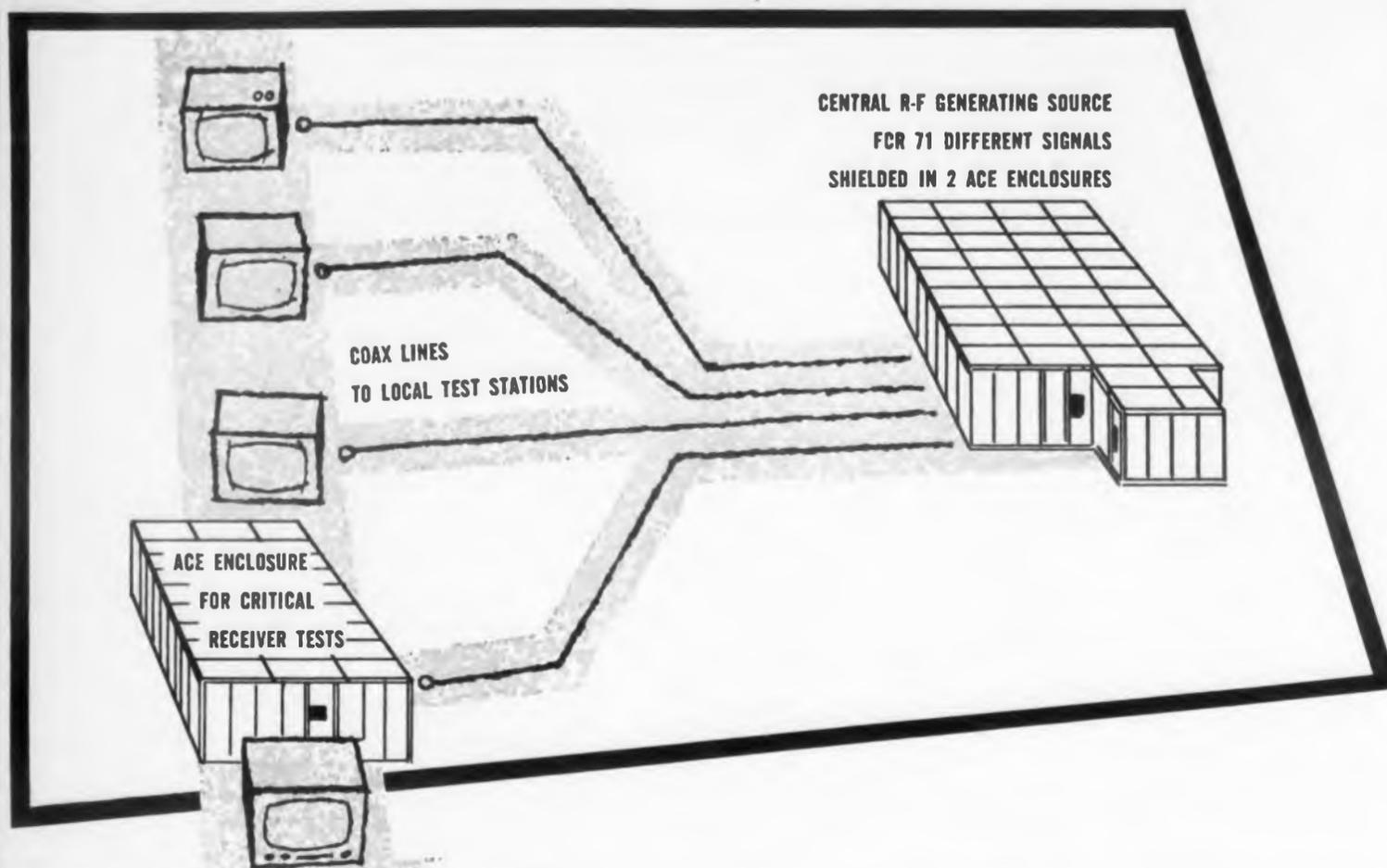
ELECTRON TUBES

Our applications engineers invite your inquiries regarding specific uses of these tubes. For further information and descriptive literature please write to:

HUGHES PRODUCTS • ELECTRON TUBES
International Airport Station
Los Angeles 45, California

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CIRCLE 27 ON READER-SERVICE CARD FOR MORE INFORMATION



HOW RCA SHIELDS CENTRAL R-F SOURCE FOR INTERFERENCE-FREE LOCAL TESTING

Almost all of the 70-odd r-f signals needed to test receivers in RCA's modern plant at Indianapolis, Indiana, are generated at a central location. These signals are then piped via coaxial cables to testing sites throughout the plant. This novel approach to production line testing and aligning decreases r-f interference . . . allows more precise adjustment of the receivers.

For this system to work, however, the central r-f generators must be shielded properly. Otherwise, direct radiation of the oscillators would interfere with the receiver tests. In addition, certain critical tests require that the receivers themselves be shielded from all sorts of miscellaneous electrical interference associated with a large manufacturing plant.

To achieve its testing needs, RCA installed three Ace solid sheet metal enclosures (RFI Design)*. Two measure over 30 feet by 16 feet, stand ten feet high, and house the powerful signal generators. The third is used for analyzing the television receivers.

All of the rooms are equipped with air-conditioning, and two personnel access doors. Coaxial and electrical cables enter the enclosures through special filter traps designed to eliminate any possible stray radiations.

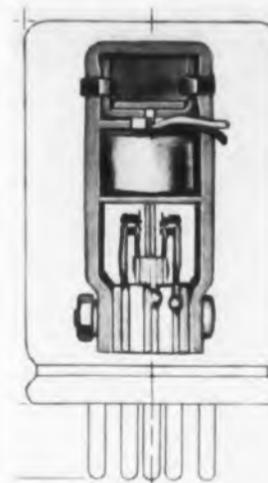
In addition to supplying a guaranteed 100 db attenuation from 14 kc to 1000 mc. (they have been known to hit 128 db), these rooms offer RCA several distinct advantages:

*Lindsay Structure

1. They may be easily moved in the assembled state if the plant should be rearranged.
2. Their dimensions may be altered, if necessary, by adding or removing interchangeable panels.
3. They are designed for exceptionally long life with no decrease in attenuation due to aging.

The Indianapolis installation shows just one of the ways in which Ace enclosures are being used today in industrial, military, and medical applications. An Ace Sales Engineer would be glad to show you how you can solve your interference problems with comparable success. Write for further information—a free catalog on standard enclosures is yours for the asking.

Instrument Chopper For Low-Level Signals



Designed for systems with moderate low level signal requirements the chopper model C-1800 is a SPDT chopper with a 6.3 v, 60 cps driving coil; the base is a standard octal type with neoprene seal. Electrical specifications include: coil current, 175 ma max; phase lag, 26 ± 7 deg; contact on time, 150 ± 15 deg; contact symmetry, 15 deg; contact bounce, 4 deg max in initial 10 deg on time; contact rating, 50 v; life 1000 hours nominal; residual noise, 1 mv as measured into 1 megohm impedance.

James Vibrapowr Co., Dept. ED, 4050 N. Rockwell, Chicago 18, Ill.

CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION

20 Watt Servo Motor High Torque/Inertia Ratio



This new power servo has a high torque to inertia ratio and is capable of delivering 20 w output. The stall torque is min. 32 oz in. The torque to inertia ratio is 50,000, the weight only 4 lbs. The motor can be stalled continuously. The control phase can be wound for single phase or centertapped for push-pull operation. Full rotor without slots results in smooth operation. 10, 20 and 30 w servo motors are also available.

Bekey Electric Co., Inc., Dept. ED, 1327 S. Main St., Los Angeles 15, Calif.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

Circuit Breaker Vibration Resistant



These miniature magnetic circuit breakers withstand 10 g at 55 to 1000 cps. The trip level is 135 per cent of rated load current. Units are available for interrupting 50 dc volts at currents from 0.05 to 10 amp and for interrupting 120 rms volts, 60 or 400 cps., at current from 1.0 to 10 amp. The toggle bushing of this breaker is the same as on conventional On-Off switches, enabling it to replace switches on electronic equipment.

Airpax Products Co., Dept. ED, Baltimore 20, Md.
CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION



First and Finest in Shielded Enclosures

ACE ENGINEERING & MACHINE CO., INC. 3644 N. Lawrence St. • Phila. 40, Pa.

CIRCLE 69 ON READER-SERVICE CARD FOR MORE INFORMATION

Expanded Scale Meters AC and DC Voltmeters



These expanded scale voltmeters embody a design which expands the useful portion of the conventional scale and eliminates the rest. The expansion is accomplished by means of a stable non-linear bridge, which is in balance at

only one value of the voltage. Any deviation from this value results in bridge unbalance, which is applied to a standard microammeter movement.

Eight models in various ranges are now available. The 2-1/2 in. wide and 3-1/2 in. wide meters are available in either round or square custom models, or in a round, ruggedized military version.

Beckman/Helipot Corp., Dept. ED, Newport Beach, Calif.

CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION

DC Power Supply Adjustable, Regulated



This regulated sub-chassis-mounted dc power supply has an output of 500 v dc at 300 ma max, which may be adjusted to any voltage between 300 and 500 v dc. The

unit also supplies 6.3 v ac filament voltage at 6 amps max. Regulation for a line voltage of 105 to 125 v ac is 0.5 per cent change in output voltage; for NL to FL, output voltage change is 1 per cent. Ripple is below 10 mv rms for any voltage or load within ratings. Model 5-300XA is 12-1/2 in. long, 5 in. wide, 5-3/8 in. above chassis and 2 in. below chassis. Weight: 23 lbs.

Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena, Calif.

CIRCLE 74 ON READER-SERVICE CARD FOR MORE INFORMATION

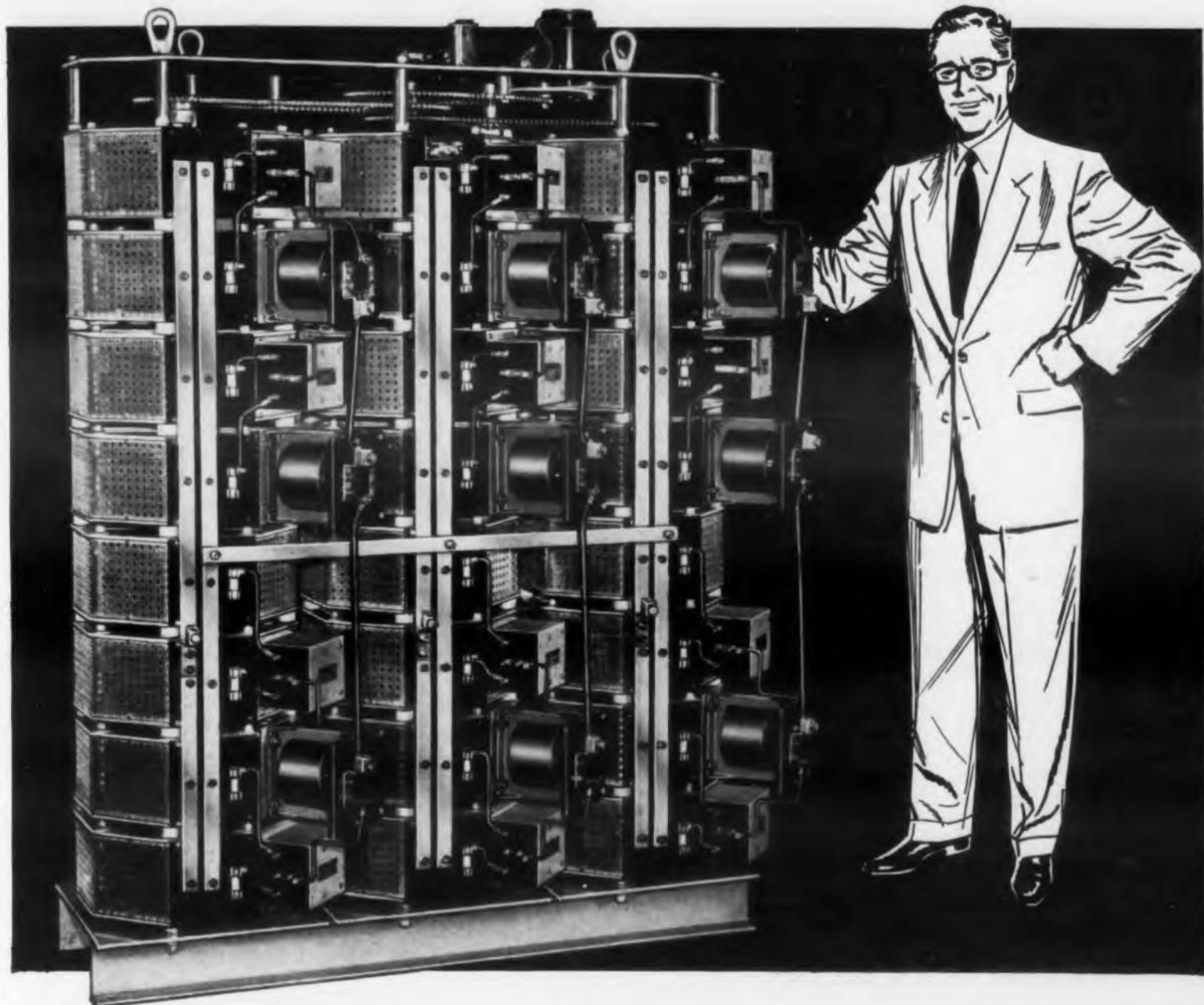
CRT Exterior Coating Very Low Resistance

A new CRT exterior coating with extremely low resistance claims a resistance of only about 50 ohms per sq in. or about 10 per cent of products normally marketed, and the product is prepared with an exceptionally good bond, rapid drying, and the ability to contract and expand with the glass to eliminate cracking. The product is known as Graphilm L-R Cathode Ray Tube Exterior Coating.

Charles Pettinos, Inc., Dept. ED, 1 East 42nd St., New York 17, N.Y.

CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION

POWERSTAT[®] Variable Transformers



...for heavy duty applications

As the leader in its field, The Superior Electric Company offers the widest selection of variable a-c voltage control apparatus. Standard POWERSTATS are available in ratings from 150 to 160,000 volt-amperes. For heavy duty requirements, POWERSTATS in gangs of 6, 8, 9, 12, 15, 18 or more provide the same fast accurate adjustments to fractions of a volt as the smallest rated unit.

Generally, heavy duty POWERSTATS are motor-driven for effortless control from remote "raise-lower" switches or positioner stations. Standard heavy duty POWERSTATS are supplied for single or three phase; 120, 240 or 480 volt service with current ratings up to 400 amperes.

For more information on POWERSTATS for heavy duty applications, use the coupon below.

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Have your representative call

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Company.....
Street.....
City..... Zone..... State.....

CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors For Ultrasonics



The type U line of capacitors developed especially for ultrasonic applications, are characterized by small size and low cost. Non-inductively wound and swedged with heavy terminal leads, the new type U capacitors utilize a high-breakdown plastic film dielectric and have high insulation resistance. Capacitance stability is of the order of 0.5 per cent. As a result, optimum Q and stability can be maintained in the ultrasonic circuits themselves. A typical capacitor rated at 0.07 μ f is 1-1/2 in. D x 1-1/2 in. L and can carry 100 circulating volt-amperes.

Film Capacitors, Inc., Dept. ED, 3400 Park Ave., New York 56, N.Y.

CIRCLE 77 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Video Detector Crystal Stands 150 C



This microwave video detector crystal for military applications will operate at temperatures up to 150 C over a wide frequency range. A small tripolar crystal designated type 1N630, it operates over a frequency of 1000 to 12,400 mc, providing a tangential sensitivity of minus 40 dbm over the range and at 150 C. The tripolar crystal provides for a second signal terminal on the coaxial crystal in contrast to the ordinary single-ended construction.

Sylvania Electric Products Inc., Dept. ED, 1740 Broadway, New York 19, N.Y.

CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION

Contour Heating Elements Sprayed-On Film



These sprayed-on film type heating elements are engineered to fit individual design and are used on missiles, aircraft, and in industry. They are light weight,

1/10 lb per sq ft, and thin, approx. 0.015 in. The heating element is resistant to electrolytes, water, oils, abrasion, and weather.

Electrofilm, Inc., Dept. ED, P.O. Box 106, No. Hollywood, Calif.

CIRCLE 79 ON READER-SERVICE CARD FOR MORE INFORMATION

New miniature diode construction for cool operation

Shown
actual
size



Now, designers can incorporate Sylvania's new miniaturized diode in equipment where space is at a premium. It meets the standard Retma outline of .105" maximum diameter and .265" maximum over-all length and meets requirements for automatic production methods. Its construction inherently assures greater reliability and superior performance.

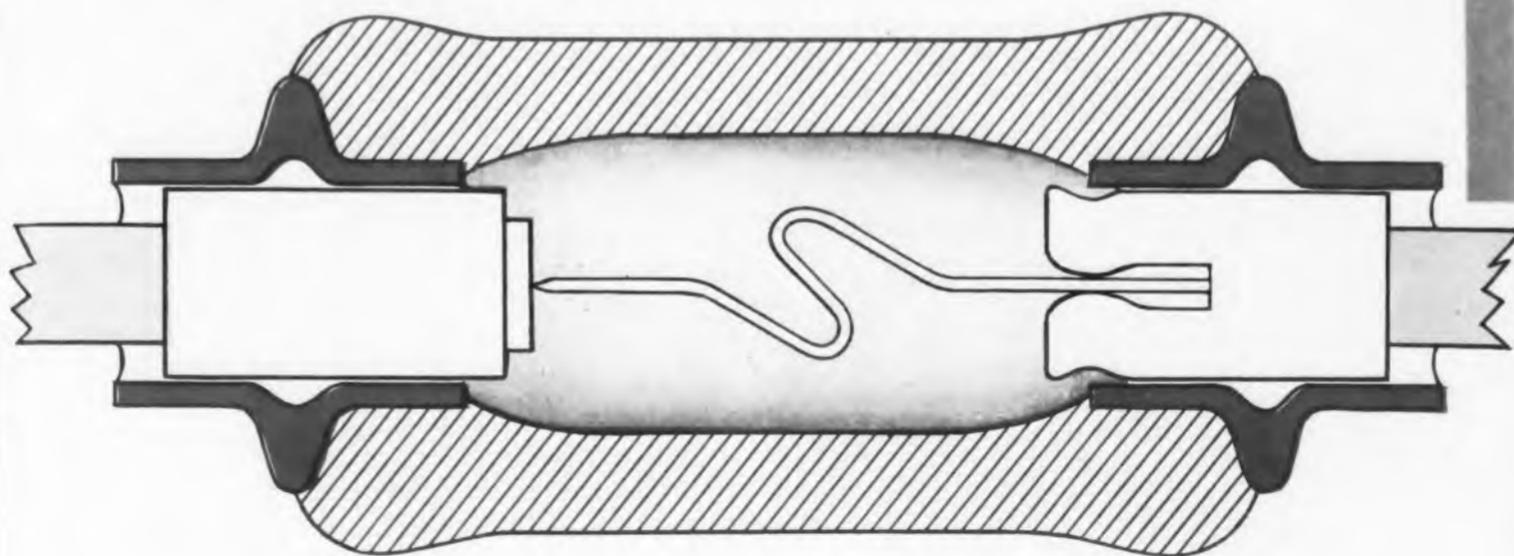


Metal eyelet—fused to glass tubing—provides strong construction and builds in provision for cooler operation. In Sylvania's metal to-glass package, heat is dissipated by the eyelets and leads.



Preassembled cartridge—By pre-assembly of the diode cartridge, the metal-to-glass design affords another advantage. The whisker and die of the diode are not subjected to excessive sealing heats. There is no danger of breaking down the conductive characteristics of the diode.

features metal-to-glass ruggedness and



Nickel-plated Steel pin—butt-welded to copper lead adds structural strength and provides coupling between the internal diode structure and the metal eyelet for greater heat dissipation. Nickel plating insures strong welds, and good solder sealing.



New whisker mounting—The use of a crimp hold rather than impulse weld to mount the whisker eliminates the possibility in production of overheating the tungsten whisker. Thus, the conductive properties remain undisturbed, assuring more reliable performance over longer life.



Smooth Solder Seal—is possible only with glass-to-metal construction. It adds reliability by preventing cracks and chips when leads are bent at right angles for mounting in printed circuit boards.

Write for complete details on this
important new diode development.
Address Dept. A22R

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
Shell Tower Bldg., Montreal



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CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Oven Lightweight



The JKO-12 crystal oven weighs only 4.6 oz and is capable of meeting a specification of less than ± 1 C temperature variation over a temperature range of 55 C to +75 C.

It has a bifilar low-inductance heater winding and radio interference filter. The oven plugs into an octal base and is available in a choice of heater voltages from 6.3 v to 115 v, ac or dc. Its warm-up time is 15 minutes at 55 C and has a maximum power consumption of 40 w.

James Knight Co., Dept. ED, Sandwich, Ill.

CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

Hysteresis Gear Motor 400 Cycle Synchronous



This 400 cy motor designed for airborne strip chart recorders and other applications, physically interchangeable with Holtzer-Cabot RBC-2505 60 cy motors, is designed for 115 v, 400 cy, 100 rpm, 7.5 oz in., continuous duty rating.

The motor will also be available with other speeds, both synchronous and induction, with ratings adjusted to corresponding gear reductions.

National Pneumatic Co., Inc., Holtzer-Cabot Motor Div., Dept. ED, 125 Amory St., Boston 19, Mass.

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

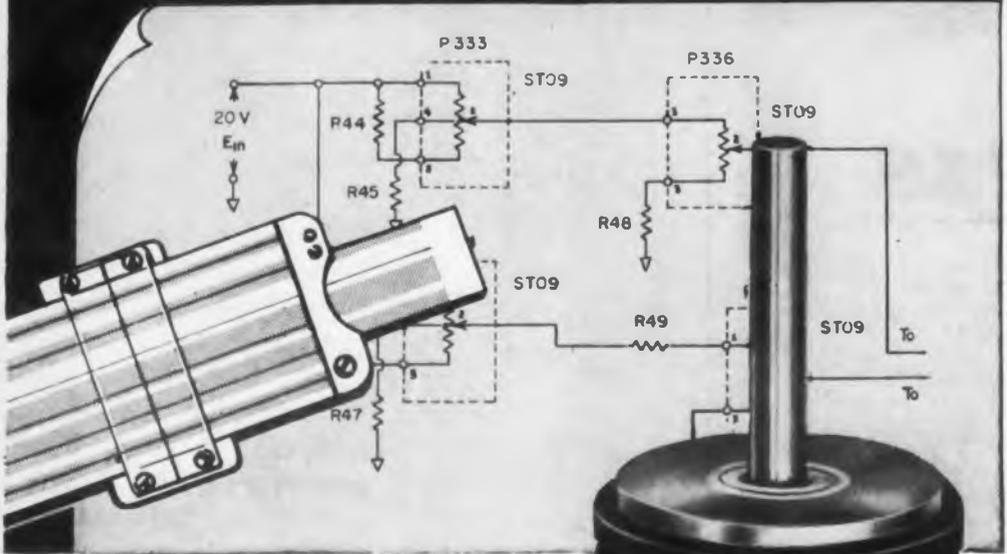
Component Oven For Temperature Control

Design for control of temperature of crystals and electronic circuitry, a standard unit is available for use on 115 v circuits, having a 35 w heater and bi-metal thermostat control. The oven has inner and outer metal cans with Terne plate finish to facilitate hermetic sealing. The space between the cans is insulated with glass wool and asbestos. The standard unit will control to 5 C at a setting of 75 C in an ambient of 0-60 C. Inside dimensions of the standard unit are 3-5/16 x 3-1/2 x 5-3/16 deep.

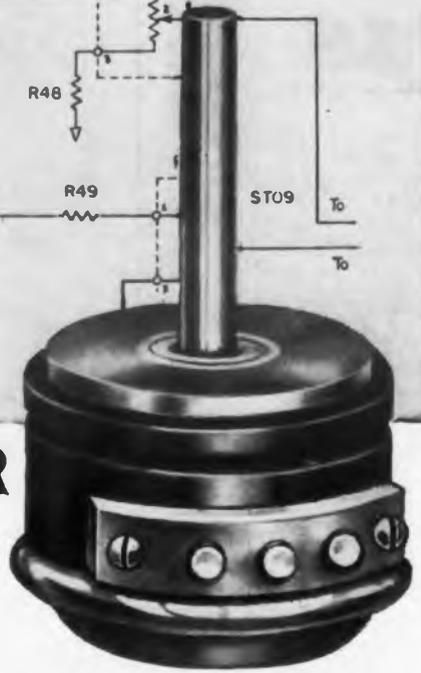
Williamson Development Co. Inc., Dept. ED, West Concord, Mass.

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

Where specs are tight...



**SPECIFY SUPERIOR
BALL-BEARING
POTENTIOMETERS
BY**



Designed for those applications where less than the best means failure . . . by the world's first and leading manufacturer of precision single-turn wire-wound potentiometers. Advanced production and quality-control techniques by the pioneer in mass production of precision potentiometers offer unequalled delivery . . . of prototype and production quantities.

All models of the TIC Ball-Bearing Series are designed to the latest industrial dimensions. Servo mounting is AIA standard. Stainless-steel ball-bearing construction is used for low-friction . . . low-torque operation. Other precision-mechanical features include precious-metal slider contacts . . . centerless-ground stainless-steel shaft . . . and one-piece stainless-steel clamp ring developed by TIC for simple, precise phasing of individual units of ganged assemblies.

Designed for precision applications in automatic control systems, the subminiature ST09, for example, features standard independent linearity of $\pm 1\%$ (0.3%, special) of the total resistance, and $\pm 5\%$ standard total resistance accuracy. High resolution . . . equivalent noise resistance less than 140 ohms . . . wide standard temperature range (-55°C to 80°C) increases application versatility. ST09 is available in standard resistances of 100, 200, 500, 1K, 2K, 5K, 10K, and 20K.

Full specification on the ST09 and other units of the TIC precision ball-bearing series available upon request.

TECHNOLOGY INSTRUMENT CORP.

555 Main Street, Acton, Mass., COLonial 3-7711
West Coast Mail Address, Box 3941, No. Hollywood, Calif., POplar 5-8620

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

Solenoid Air Valve for 100 psi Pressure



This solenoid valve for air pressures up to 100 psi, the Electroflo, may be secured with a full 3/8 in. or 3/4 in. orifice. Continuous duty solenoids are available from 6 v dc to 440 v ac. The overall length of the 3/8 in. valve is 2-17/32 in.; the 3/4 in. valve, 3-3/4 in. The inlet center to top dimension of the 3/8 in. valve is 4-3/8 in.; the 3/4 in.

valve, 5-1/32 in. The coil diameter of either size valve is 2 in.

Hays Manufacturing Co., Dept. ED, 307-A, West 12th St., Erie, Pa.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

Accelerometer For Low Frequencies



Based upon a differential transformer transducer principle, this series of instruments measures slowly varying environmental phenomena, from steady state to

40 cps. The Glennite ADT-700 Series accelerometers includes units with range of from 1 g to 10 g, linearity within 1 per cent and sensitivities from 10 mv per g per volt input to 100 mv per g per volt input. Additional specifications include hysteresis of less than 0.25 per cent output impedance of 1900 ohms at 400 cps and a weight of 3 ozs.

Gulton Industries, Dept. ED, 212 Durham Ave., Metuchen, N. J.

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

400 cps Chopper Operates to 125 C

Type 310 choppers for operation at temperatures from -65 C up to 125 C have been operated successfully in dc amplifiers and servomechanisms, and are now available in production quantities.

The chopper is rated for operation at 400 cps, contacts handle up to 2 ma at 100 v. Phase angle lies between 50 and 80 electrical degrees lagging from -20 C to +100 C, between 50 and 88 electrical degrees from -65 C to -20 C, and between 45 and 80 electrical degrees from +100 C to +125 C. Drive coil is rated for 6.3 v rms. Units are permanently adjusted and hermetically sealed.

The Airpax Products Co., Dept. ED, Baltimore, Md.

CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

An Engineer Speaks Out...



...about the Answer to a Major Production Problem

The Problem: Procurement of electro-mechanical components (couplings, shafts, gears, etc.) to meet design specs and tight production schedules.

The Answer: Production quantities of Servoboard[®] precision parts.

The precision parts of the flexible Servoboard electro-mechanical assembly kits, in addition to bread-boarding pilot models, also serve as permanent, integral components of a system or instrument. Included in the array of over 250 standard Servoboard parts are: spur gears, anti-backlash gears, mitre and bevel gears, adapter spur gears, shafts and shaft adapters, couplings, component hangers, clutches and differential, switch assemblies, etc. You can place your order with us for any quantity of these precision Servoboard parts to perfectly match design specifications for production runs.

You'll have no tooling up or production testing to do... there's no lost production time... and no worry

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20-20 Jericho Turnpike,
New Hyde Park, L.I., New York

CIRCLE 88 ON READER-SERVICE CARD

Precision Voltage Calibrator DC or Pulse



The Model 1080 precision voltage calibrator delivers a calibrated output voltage, either a direct voltage or a pulse, determined by direct reading from a ten turn potentiometer. The accuracy of output voltage is assured through reference to a self-contained mercury cell, and all output voltages are derived from a heavily regulated internal dc power supply.

Voltage ranges are 0 to 100 v, 0.1000 v per division, 0 to 10 v, 0 to 1 v, and 0 to 0.1 v, 0.0001 v per division.

Accuracy is ± 0.3 per cent minimum overall range. Output is positive or negative at ground level, dc or low duty-factor pulse ac at line frequency.

When the instrument is operated with pulse output, frequency is line frequency but duty-factor is limited to a few per cent.

Rese Engineering, Inc., Dept. ED, 731 Arch St., Philadelphia 6, Pa.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

Sealed Snap Switch Subminiature



This precision switch operates in a temperature range of -65 F to $+250$ F. A built-in metal leaf actuator allows for actuation at any point and provides protection for the neoprene housing. Hermetically sealed, this entirely new switch is environment proof and explosion proof. Switches are

available in single pole double throw; single pole normally open, and single pole normally closed. The dimensions are: $7/8$ in. long, $5/8$ in. high and $3/8$ in. wide. The electrical ratings are: 5 amp at 125/240 v ac, 4 amp at 30 v dc, resistive at sea level.

Mounting bracket is supplied and standard wire leads are 12 in. long or can be ordered in any desired length.

Milli-Switch Corp., Dept. ED, 1742 Berkeley St., Santa Monica, Calif.

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION

The "Career's Section" with home reply service only obtained in **ELECTRONIC DESIGN**—most timely and most complete of any electronic publication.

ACTUAL SIZE

complete with selector switch...

TRIPLET

ELECTRICAL INSTRUMENT CO.
Bluffton, Ohio



• 20,000 ohms per volt. D.C.

• BANANA-TYPE JACKS—positive connection and long life.

• EXCLUSIVE SELECTOR SWITCH speeds circuit and range settings. The first and only miniature VOM with this exclusive feature for quick, fool-proof selection of all ranges.

• 5,000 ohms per volt. A.C.



CARRYING CASE

Handsome leather carrying case with adequate space for Model 310 tester and accessories. Trousler belt slips through loop on back of the case for out-of-the-way carrying. MODEL 369 CASE—U.S.A. Dealer Net \$2.90

Model **310** MIGHTY MITE

the only complete miniature
V-O-M (AC-DC)

LOOK AT ALL THESE RANGES

DC VOLTS: 0-3-12-60-300-1200 at 20,000 Ohms/Volt.
AC VOLTS: 0-3-12-60-300-1200 at 5,000 Ohms/Volt.
DC MICROAMPERES: 0-600 at 250 Millivolts.
DC MILLIAMPERES: 0-6-60-600 at 250 Millivolts.
OHMS: 0-20,000-200,000 (200-2000 at center scale).
MEGOHMS: 0-2-20 (20,000-200,000 Ohms at center scale).
OUTPUT: Convenient chart in instruction book.

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AND IT'S ONLY ONE OF TRIPLET'S MIGHTY NINE VOM LINE!

ONLY \$29⁵⁰

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All-Purpose
V-O-M



630-A
A Good Lab and
Production Line
V-O-M



630-T
For Telephone
Service



666-HH
Medium Size
For
Field Testing



625-NA
The First V-O-M
With 10,000
Ohms/Volt AC



666-R
Medium Size
With
430 Features

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- New Robots and Jigs
- Warning System
- Man for the Commencement

NACA Shows New Rockets and Jets

Transistor Transmits Music First Over Sea Cable

Science Study Scheduled in Management and Engineering

Science Before Pines in Communist Drama

Vacuum Transfer Relay 25 KV Operating Voltage



The Type RE4 single pole double throw vacuum relay has three high voltage terminals that are equally spaced on a 2-1/8 in. diameter glass bulb. Its operating voltage rating is 25 kv peak and for high altitude operation at this voltage it is provided

with a flange that can be soldered to the side of an oil filled or pressurized container. Its 26.5 v dc, 5 w actuating coil can still be removed from below the flange mount. It is especially well suited for antenna switching, dc pulse switching, and straight dc switching in airborne equipment.

The vacuum dielectric and high-temperature processing insure clean non-sticking contacts. Small contact actuating mechanisms resist vibration and shock forces.

Jennings Radio Mfg. Corp., Dept. ED, P.O. Box 1278, San Jose, Calif.

CIRCLE 93 ON READER-SERVICE CARD FOR MORE INFORMATION

DC-DC Converters All-Semiconductor



Four all semiconductor dc-dc converters are available with inputs of 12 and 28 v dc and filtered dc outputs of 325 v at both 100 and 200 ma. These supplies are hermetically packaged in cans 3-1/16 x 3-3/16 x 2-5/8 in. and are designed for efficient, reliable operation. The units can be operated in ambi-

ents from -55 to +75 C with efficiencies as high as 90 per cent. Typical applications are missile beacon power supplies and mobile communications equipment.

High conversion efficiency over widely variable load conditions is maintained by use of a transistor control circuit.

Regulation on the standard units is 20 per cent. Better than 0.5 per cent regulation and special input and output voltages with capacities up to 500 w can be provided on a custom basis.

The supply uses two power transistors in an oscillator to interrupt the dc input. Silicon power diodes and high-reliability capacitors are in the rectifier circuit.

Power Sources, Inc., Dept. ED, 6 Schouler Court, Arlington, Mass.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION



MICRO SWITCH Precision

... FIRST IN PRECISION SWITCHING

small ... accurate ... reliable ... precise
MICRO SWITCH Precision Switches
meet wide range of modern
electronic control requirements

Design engineers find MICRO SWITCH precision switches to be ideal components for computers, high speed switching devices and other industrial devices.

Whether the requirement is for an individual switch—or a complete switch assembly—MICRO SWITCH Engineering is at your service. Development of precise, reliable switching components is our sole business. Our switching

specialists have met successfully many knotty problems of switch design and application. This long, practical experience will save YOU time and money.

A call to the nearest MICRO SWITCH branch office will put MICRO SWITCH Field and Factory Engineering to work on your specific problem. This cooperation can be your short cut to improved design.



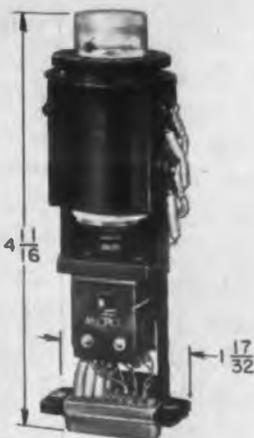
CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

Switches have uses unlimited



3-LIGHT PUSH BUTTON SWITCH FOR COMPLEX CONTROL PANELS

Here is a new, unique indicating push button switch which lights in three different colors. It is the latest MICRO SWITCH development for use in complex console panels. This compact assembly is ideal for applications where absolute dependability is required. It has a reliable operating life through hundreds of thousands of operations. Use is simplified by a pre-wired connector plug.

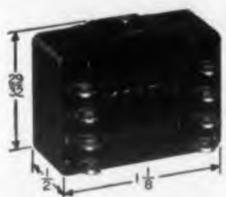
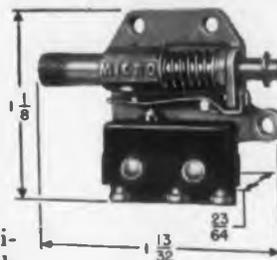


(Send for Data Sheet 110)

SUBMINIATURE SAFETY SWITCH DEVICE FOR HAZARDOUS EQUIPMENT

This MICRO SWITCH Subminiature door interlock switch assembly is designed for use as a safety device on such hazardous equipment as radio, radar, and X-ray cabinets. Installed on the cabinet door the switch automatically cuts off the power circuit when the service door is opened. Assembly shown uses a MICRO SWITCH Subminiature basic switch with single-pole, double-throw contact arrangement.

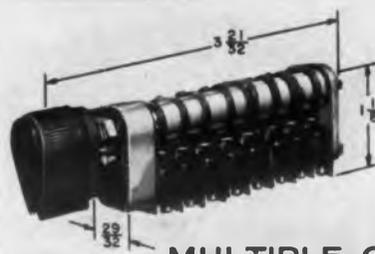
(Write for Data Sheet 108)



FOUR-CIRCUIT SWITCH FOR CONTROL OF COMPLEX CIRCUIT

Here is a four-circuit double-break switch for simultaneous control of four isolated circuits. This small switch is ideal in complex circuit applications where space and weight are prime factors in switch selection. Two snap-action springs are operated with each actuation of the plunger. This provides quick make and break of the contacts in each of the four double-break circuits. Electrical rating is 10 amperes 115-230 volts a-c; 10 amperes 30 volts d-c.

(Write for Catalog 78)



SUBMINIATURE ROTARY SELECTOR SWITCH FOR MULTIPLE-CIRCUIT CONTROL

This assembly is an 8-gang, 8-position rotary selector switch. It consists of 8 single-pole, double-throw Subminiature basic switching units operated by cams on a common shaft. Any combination of the 8 basic switching units may be actuated in any of the 8 positions if cams are set to specifications at the factory. Variations with from 2 to 8 single-pole, double-throw basic switches are available.

(Write for Catalog 75 "Subminiature Switches")

SEALED PUSH BUTTON SWITCH FOR PANEL MOUNTING APPLICATIONS

This MICRO SWITCH push button switch for panel mounting is outstanding because of its very small size and ease of installation. After the push button is mounted on a panel, the switching unit can be wired and then easily snapped into place on the end of the button assembly behind the panel. In addition, the push button is sealed to keep dirt and moisture from penetrating to the back of the panel. Switch has operating force of 3 lbs., weighs but .05 lbs.

(Write for Catalog 75 "Subminiature Switches")



SMALL HONEYWELL MERCURY SWITCH MEETS SMALL LOAD CIRCUIT DEMANDS

The small Honeywell Mercury Switch shown here is especially designed for reliable service in low-energy circuits. This switch meets the requirements of applications where space and economy are critical factors. Mercury switches are widely used in animated displays, control and indicating devices, home freezer units, alarms and hundreds of other tilt-motion, low-force applications. Ratings available down to micro-volt, milli-ampere ranges.

(Write for Catalog 90 on "Mercury Switches")



MICRO SWITCH, a division of Honeywell, is the pioneer in the manufacture of precision snap-action switches.

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS



CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

Stacked Switches Single Actuator



A new system of precision stacking of Class 1 TyniSwitches makes it possible to obtain a single actuator switch capable of switching two or more completely in-

dependent circuits, with considerable space savings. Each individual switch action can be double throw, single throw normally open or single throw normally closed.

Maximum pin movement from the first contact actuation of all contacts is .015 in. Double pole switches are considered as standard and are available with any standard Class 1 actuator. Switches with three or more poles can be built to specifications.

Type B switches are listed at 15 amps. 125 or 250 v ac 1/2 HP, Type D switches are listed at 10 amps. 125 or 250 v ac.

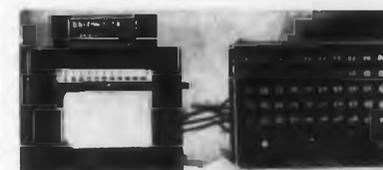
The multipole stacked TyniSwitches are Underwriter's Laboratories approved. Detailed information or descriptive literature is available.

TyniSwitch Dept., Dept. ED, Detroit Controls Corp., 800 Union Ave., Bridgeport, Conn.

CIRCLE 98 ON READER-SERVICE CARD FOR MORE INFORMATION

50-Point Scanning Recorder

For Strain Gages



The 50-point automatic scanning recorder for SR-4 strain gages and SR-4 transducers can accommodate both

two and four arm strain gage bridges permitting automatic measurements either with such SR-4 transducers as standard load cells or with resistance wire strain gages.

In any combination up to the limit of 50 bridges, the recorder will step in sequence through each channel, plot a point for each and then stop. The equipment plots a complete sequence of 50 points in 30 to 90 seconds, depending on strain levels.

It will accommodate strain gage resistances ranging from 60 to 500 ohms with gage factors from 2.25 to 1.77. Each of the 50 channels has an individual zero potentiometer and the recorder has a selector switch to index zero at right, left or center on the chart.

The recorder is equipped with a chart skipping mechanism to conserve paper when less than 50 channels are being scanned.

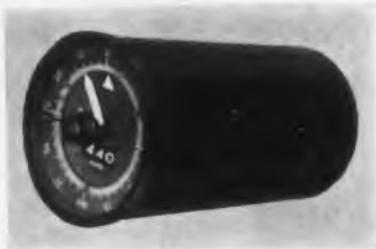
Baldwin-Lima-Hamilton Corp., Dept. ED, Waltham, Mass.

CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION

4 Intercoupled servo loops



weight less than 2 lbs.*



This indicator, part of an Automatic Navigational System, contains 6 synchros, 2 motors and 2 motor generators—all Clifton Size 10 units.

These units (and 2 mechanical differentials) are built into 4 independent, intercoupled servo loops. Weight of these 4 loops plus gears and gear plates is less than 2 lbs.

The main reason for the lightness of Clifton synchros, and hence the lightness of systems built around Clifton components, is that no unnecessarily heavy materials are used in their manufacture.

When it is a question of highest accuracy with the least bulk and weight, look to CPPC rotary components.

* If this system had been built with our latest Size 8 synchros, weight would have been brought to about 1½ lbs.

Look to CPPC for Synchro Progress

cppe

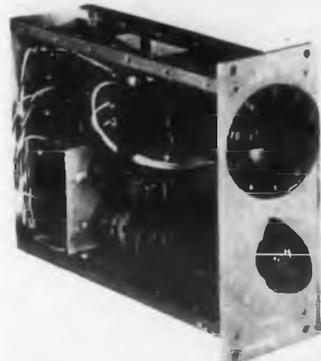
CLIFTON PRECISION PRODUCTS CO., INC.

Clifton Heights, Pa.

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION

For the Latest News in Employment Opportunities, See ELECTRONIC DESIGN'S "Career's Section" Every Issue.

Totalizer Register Plug-In Strip



The Model 166 plug-in strip totalizer unit provides an accurate register in programs where speeds are too great for mechanical counters.

It has a scale factor of from 1 to 10, maximum speed of 4 kc and resolution of 250 μ secs. Input requirements are a minimum amplitude of +15 v, minimum rate of rise of 1 v per μ sec and minimum pulse width of 100 μ secs. Input impedance is 220 K.

Power requirements range from 400 v dc at 0.5 ma to 6.3 v ac (-125 v dc) at 0.6 amp.

It is suitable for use involving velocities, pressure, temperature, flow rate, viscosities, gages, sheet counts and stacking counts.

Baird Associates-Atomic Instrument Co., Dept. ED, 33 University Rd., Cambridge 38, Mass.

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Power Divider Range 16 to 17 Kmc



This Ku band divider was designed to operate over the frequency range of 16 to 17 Kmc. It presents a maximum input mismatch of 1.2 and a maximum insertion loss of less than 1/2 db. The unit

incorporates a variable phase shifter in one of the common arms of two short slot hybrids connected in parallel. By varying the difference in phase of the two equal input signals driving the output hybrid, it is possible to make use of the characteristics of the short slot side wall coupler.

The phase shifter in this divider consists of a short slot hybrid with adjacent arms, terminated in movable short circuits, shifting over 90 degrees and more. Since the mechanical shorts can be positioned accurately with the aid of a micrometer head, a precise calibration of phase shift, and hence power division, is obtained. It also acts as a high-powered, variable mismatch whose electrical phase can be varied over 180 degrees.

Airtron, Inc., Dept. ED, 1103 W. Elizabeth Ave., Linden, N.J.

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION

PORTABLE

DC VTVM

has 200 microvolt sensitivity
and 10^{14} ohms input

THIS little instrument measures transistor and electrochemical potentials, voltages of charged capacitors and dc amplifiers, and voltages at the summing points of analog computers. It can be most useful in measuring low currents in semiconductors, ion chambers, and photocells. It also may be used to test insulation leakage and volume resistivity.



KEITHLEY
MODEL 200B
DC VTVM

BATTERY-OPERATED. the Model 200B has voltage ranges of 0.008, 0.02, 0.08, 0.2, 0.8, 2, 8 and 20 volts full scale of either polarity. Accuracy is within 2%. Accessories permit measuring currents as low as 5×10^{-14} ampere, resistances above 10^{16} ohms, and voltages up to 20 kv.

DESIGN FEATURES include excellent zero stability, a polarity reversing switch, 500 hours useful battery life, and a constant zero from range to range.

DETAILED DATA on the Model 200B is now available in Keithley Engineering Notes, Vol. 4 No. 1. Your copy will be sent promptly upon request on your company letterhead.

KEITHLEY
INSTRUMENTS, INC.

12415 Euclid Ave., Cleveland 6, Ohio

CIRCLE 103 ON READER-SERVICE CARD

how you
can now
solve
Silicone
rubber
problems . . .
large and
small



Production Problems—New facilities for injection molding and extrusion are now available at Minnesota Silicone. You can have the same precision, close-tolerance production that has characterized 6 years of silicone fabrication experience . . . in less time, at lower cost than ever before.

Design Problems—To assist you in applying the unique properties of silicone rubber to your needs, we now offer the facilities of our newly expanded laboratories. Compound selection and molding to your most exacting requirements are just part of the complete product development and production service.

We'd be happy to make a thorough and prompt analysis of your problem or supply a quotation from your print or sample. No obligation of course. Just write:

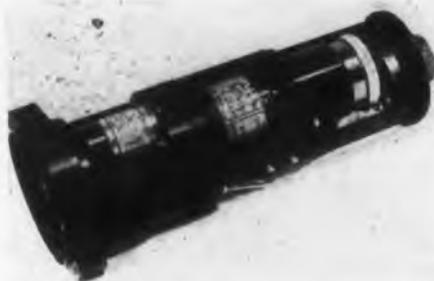
Dept. 311

MINNESOTA SILICONE RUBBER, INC.

5728 West 36th St., Minneapolis 16, Minn.
Affiliated with Minn. Rubber & Gasket Co.
Offices in principal cities

CIRCLE 105 ON READER-SERVICE CARD

Data Repeaters Servo-Type Units



A line of servo-type data repeaters with high accuracy and fast response are designed for use as flight-test instrumentation.

The repeaters provide remote indication of angular position and of ac and dc voltages, and mount in standard aircraft panels with output dials arranged for visual observation or photographic recording.

One of two basic types is the synchro-data repeater, with a two-speed follow-up servo employing standard Bureau of Ordnance, Mark 54 Mod 2, synchro transmitters. The repeaters are available with four different speed ratios between synchros.

The second basic type is the potentiometer-data repeater, a position servo which utilizes a precision ten-turn helipot as the follow-up transducer. There are two models of this repeater, one for ac and one for dc voltage data. Thermostatically controlled viscous-coupled inertia damping is used to achieve high-velocity constants. The units employ vacuum tube preamplifiers and magnetic output stages in the servo amplifiers.

Feedback Controls, Inc., Dept. ED, 905 Main St., Waltham 54, Mass.

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Relay Telephone Type



This miniature, telephone type multi-contact relay is suited for aircraft, computers, and data processing equipment. The Type 9 relay measures 1-5/32 in. long by 23/32 in. wide. It is available as a hermetically sealed unit,

measuring 2-1/8 in. x 1-5/8 in. x 1 in. overall.

Coil is dc only, single or double wound, resistance is up to 14,000 ohms, and wattage is 3 watts maximum dissipation.

The relay is available with a wide choice of contact materials, and with a maximum of 18 springs. Springs are phosphor bronze for long life.

Many variations in contact arrangements and contact materials are available.

Phillips Control Corp., Dept. ED, Joliet, Ill.

CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW THERMISTORS CAN HELP YOU



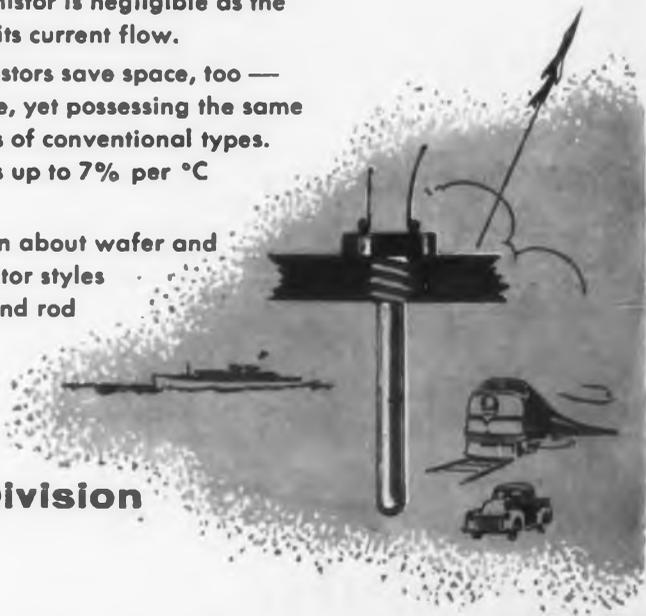
MA

Measuring Engine Block Water Temperature with GLENNITE® Thermistors

An accurate, economical method of measuring the temperature of water in an engine block has recently been devised. In the simple electrical diagram show above, the GLENNITE Wafer-in-probe Thermistor inserted through the engine block varies its resistance inversely to the rise or fall in engine block water temperature. The resultant increase or decrease in current flow is read directly on a milliammeter calibrated as a thermometer. Self-heating of the thermistor is negligible as the resistor in the circuit limits current flow.

GLENNITE Wafer Thermistors save space, too — occupying 1/5 the space, yet possessing the same power handling abilities of conventional types. Temperature coefficients up to 7% per °C are available.

For complete information about wafer and other GLENNITE Thermistor styles including bead, probe and rod units, write today.



Thermistor Division

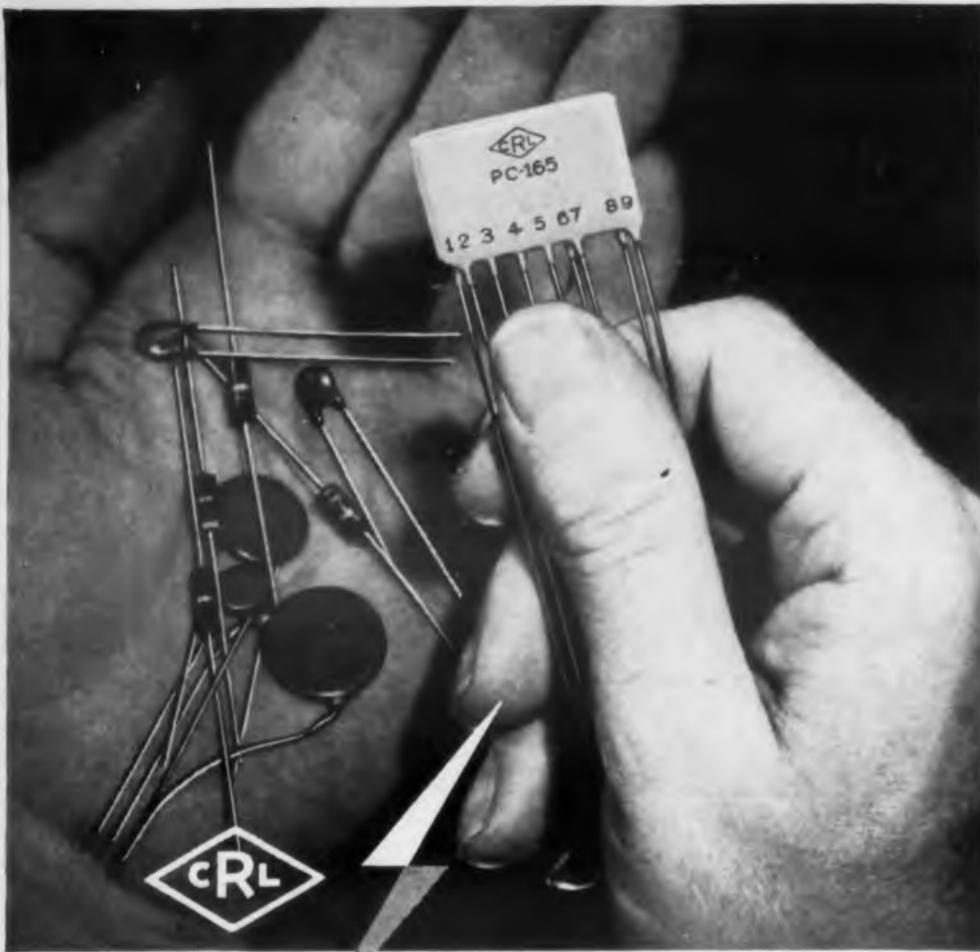
Gulston Industries, Inc.



METUCHEN, NEW JERSEY

CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

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1 packaged electronic circuit replaces 9 separate components!

Write for Centralab
Printed Electronic
Circuit Guide No. 3 —
and Technical Bulletin
42-227.



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Centralab

A DIVISION OF GLOBE-UNION INC.

960A East Keefe Avenue • Milwaukee 1, Wisconsin
In Canada: 804 Mt. Pleasant Road, Toronto, Ontario



CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

60,000,000 Centralab P.E.C.'s like this — in various component values — are being used by leading manufacturers

◆ A Centralab Packaged Electronic Circuit is a complete circuit which includes capacitance, resistance, and often inductance — in addition to wiring.

◆ Design one compact package into your equipment, instead of several individual parts, to . . .

- ... reduce inventory
- ... reduce size
- ... reduce weight
- ... eliminate wiring errors
- ... reduce assembly cost
- ... improve circuit stability

◆ Centralab P.E.C.'s pass all Mil-R-11A and Mil-C-11015A requirements within their range.

◆ Over 160 standard P.E.C. designs are available for your immediate use. For special requirements, call on Centralab engineers — but early in the planning stage, before you've "frozen" your design.

Temperature Transducers

Have High Output



Designed for telemetering and applications requiring high signal levels, these unique resistance-type temperature transducers give outputs up to 5 v without amplification. Models are available in various physical configurations for measurement of surface, fluid, and air temperatures. Standard units are available ranging from -320 F to $+500$ F with ± 2 per cent linearity. Special units are available to 1600 F. Nominal resistance values offered are 100 to 20,000 ohms. Units may be used in ac or dc bridge circuits.

When used with manufacturer's miniaturized companion TME system, 20 K transducer gives 5 v output for as little as 150 F change. Each probe is supplied with serialized calibration curve. Units meet MIL-E-5272 Specs.

Arnoux Corp., Dept. ED, 11924 W. Washington Blvd., Los Angeles 66, Calif.

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

3 Minute Synchros Size 23 Units



These 3 minute size 23 synchros meet all performance requirements specified in FXS 1066, Rev. 4, Mil-S-16892 (BuOrd) and Mil-S-12472 (ORD). Especially valuable in airborne applications requiring accuracy with minimum bulk and weight. In many instances, 3 minute synchros eliminate the need for two-speed synchrosystems—thereby effecting appreciable economies in weight, size, complexity and gearing problems. Matched pairs of synchros are available to provide even greater system accuracy.

These 3 minute synchros are equivalent to military types 23CX6, 23CX6a, 23CX4, 23CX4a, 23CT6, 23CT6a, 23CT4, 23CT4a, except for increased accuracy.

These units are engineered to enable designers to increase the accuracy of their control and data transmission systems and servo mechanisms.

Norden-Ketay Corp., Dept. ED, Commerce Rd., Stamford, Conn.

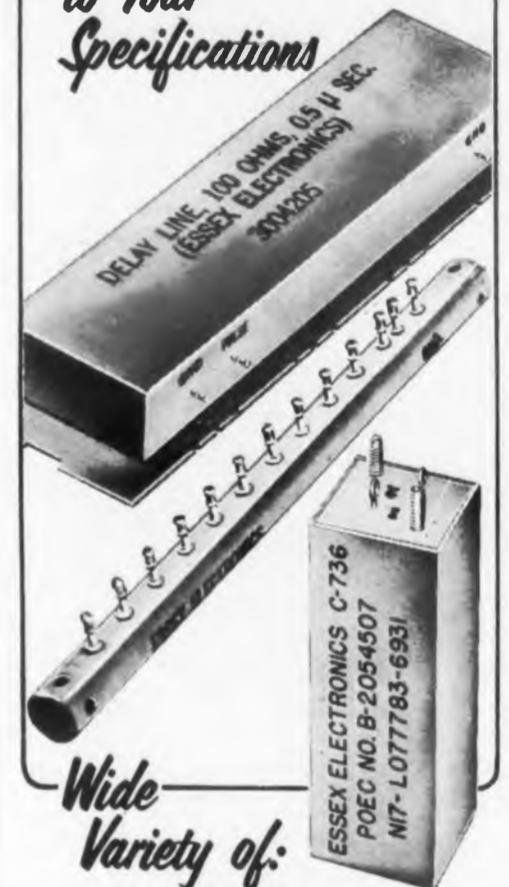
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ESSEX

Custom-Designs

ENCAPSULATED AND
HERMETICALLY SEALED
DELAY LINES

to Your
Specifications



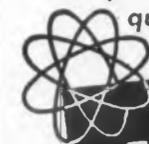
Wide
Variety of:

DISTRIBUTED CONSTANT DELAY LINES designed for fast rise time and low attenuation made in flexible, metal-shielded and stick types.

LUMPED CONSTANT DELAY LINES feature high fidelity as well as compact size.

The name, Essex Electronics, is your reassurance of highest possible product quality, efficiency, performance and satisfaction.

Send specifications as detailed as possible for prompt cost quotations.



ESSEX ELECTRONICS

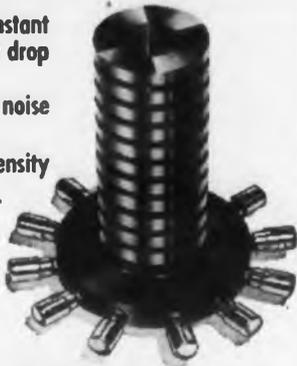
Exec. Off. & Main Plant
Berkeley Heights, New Jersey
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Other Plants at:
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LOW and constant
contact drop
LOW
electrical noise
HIGH
current density
LONG life...



HIGH PERFORMANCE



BRUSHES CONTACTS SLIP RINGS

& Slip Ring Assemblies

BRUSH HOLDERS, CONTACT ASSEMBLIES,
BRUSH ASSEMBLIES



USED EXTENSIVELY IN:

**SERVOS • GUN-FIRE CONTROLS
TELEMETERING • ROTATING
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GAGE CIRCUITS • ROTATING
JOINTS • DYNAMOTORS**

Wide range of grades available for standard and special applications. Call on our 40 years of design experience to help solve your problems.

OTHER GRAPHALLOY

PRODUCTS: Unique (oil-free) self-lubricating Bushings and Bearings (applicable -450° to +700°F; with expansion coefficient half that of steel will not seize shaft at low temperature); Oil-free Platen Rings, Seal Rings, Thrust and Friction Washers, Pump Vanes.



GRAPHITE METALLIZING CORPORATION

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- Please send data on Graphalloy BRUSHES and CONTACTS.
 Send data on BUSHINGS.

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COMPANY _____

STREET _____

CITY _____

ZONE _____

STATE _____

CIRCLE 116 ON READER-SERVICE CARD

Pressure Switches For Aircraft



These switches are devices for switching electrical circuits in response to pressure changes in gases, liquids, and the atmosphere. They will perform in any position, and are designed for the environmental requirements of the appropriate MIL specifications. The cap-

sular elements which operate the snap-action switch have been specifically designed for this application. A variety of mounting arrangements are possible.

The switches are available in two sizes: regular size for pressures between 5 psi and 150 psi, and miniature size for pressures of from 2 to 100 psi, each in absolute, gage, or differential as specified. Both types are regularly supplied in spdt snap-action type.

Contact ratings are 5 amp or 10 amp at 30 v dc or 115 v ac. Normal ambient operating temperature range is -65 to 250 F. They are hermetically sealed.

Design provides high resistance to vibration and excellent overpressure protection.

The Bristol Co., Dept. ED, Waterbury 20, Conn.

CIRCLE 117 ON READER-SERVICE CARD FOR MORE INFORMATION

Light Compensator For TV Cameras



This wide range automatic light compensator (ALC) electronically compensates for variations in video signal level caused by variations in illumination, thereby eliminating the need for

manual or remote resetting of the TV camera lens iris or control generator.

The ALC can automatically compensate for light variations as great as 150:1. The ALC is connected between the camera and its control generator. The ALC has four controls: Output Level, Video/Target Ratio, Video AGC, and Power-Off.

Any variation in light intensity making for increased video signal level electronically sets the automatic video gain circuit of the ALC into operation so as to keep the output signal level constant.

The cable from the camera plugs into the ALC input. A second short cable connects the ALC output to the control generator.

Blonder-Tongue Laboratories, Inc., Dept. ED, 526-536 North Avenue, Westfield, New Jersey.

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Ace can meet your requirements in quality and delivery of **NONLINEAR POTENTIOMETERS**

Nonlinear precision wire-wound potentiometers in standard and sub-miniature sizes are now available in prototype or production quantities from Ace Electronics Associates . . . and you can be sure of delivery.

These new Ace nonlinear units incorporate the same advanced engineering, precision craftsmanship, and controlled quality which have made ACEPOT linear potentiometers standards of excellence.

A new Division directed by highly qualified engineers, special prototype section, and mass production facilities are at your service to meet your requirements for quality and delivery of nonlinear precision potentiometers.

For complete information . . .

Call or write William Lyon or Abraham Osborn, Nonlinear Division, outlining your requirements. Your inquiry will receive prompt attention . . . and you will get delivery as specified.



Featuring!

Highly developed design techniques achieve high resolution and close conformity for your unique nonlinear requirements.

* trademarks applied for

ACEPOT*
ACETRIM*

ACE ELECTRONICS ASSOCIATES, INC.

Dept. ED, 101 Dover St. • Somerville 44, Massachusetts

Telephone: MOnument 6-4804 • Engineering Representatives in Principal Cities

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wherever

HIGH OPERATING TEMPERATURES

are a matter of fact

Then it's time to face the facts. Just any insulated wire or cable won't meet the test. But you can be sure that there's a Continental heat-resistant wire or cable that will. And when you meet high operating temperatures combined with moisture and corrosive vapor problems, the fact of the matter is ONE Continental wire that offers insulated advantages to meet your requirements all ways.

ELECTRONIC INSTRUMENT INSULATED WIRE

600-3000 volt service. Sizes: 32 AWG to 6 AWG inclusive. CONSTRUCTION: stranded tinned copper, polyvinyl insulation with or without nylon jacket. Maximum operating temperature: 100°C.

CONFORMS TO: MIL-W-16878B

COLOR CODED: 1, 2, or 3 spiral stripes over polyvinyl insulation.



FACT-FILLED CATALOG

NEW, COMPLETE CATALOG OF CONTINENTAL INSULATED WIRE AND CABLE AVAILABLE ON REQUEST. WRITE TODAY.

Continental

WIRE CORPORATION

WALLINGFORD, CONNECTICUT • YORK, PENNSYLVANIA

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For Inquiries Concerning Employment
Use **ELECTRONIC DESIGN'S** Home Reply Service

Synchronous Dial Drives For Automatic X-Y Plotting



This new X-Y drive makes it possible to use a two-axis plotter to obtain permanent and precise recordings of data. Plotting point by point values is thus eliminated.

Two sizes of drives are available, one for 4 in. and the other for 6 in. general radio gear-driven precision dials. In each size two speeds are offered, one 8 times the other. All models use synchronous motors. A power switch as well as a disengaging control are provided, and manual setting of the dial can be made by means of a knob. This knob is mounted on one end of a potentiometer shaft which remains engaged with the dial. The potentiometer included in the X-Y dial drive is used with a source of dc to provide a dc voltage proportional to the independent variable. The output characteristic as a dc signal is used to drive the Y axis of the recording pen.

General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION

Vacuum Transfer Relay For High Altitudes



The Type JGF-RE2 single pole double throw vacuum relay is designed for antenna transfer switching applications in high altitude aircraft. It is a Type RE2 vacuum transfer relay that has been welded into a rugged gas-filled steel housing so that it can be

mounted in exposed locations. Ceramic bushings and corona rings make possible 5 kv operating voltages at altitudes up to 50,000 feet.

Its continuous current rating at 24 mc is 10 amp rms and the relay will not be damaged if it is accidentally switched "hot." Vacuum dielectric and high temperature processing insure a contact resistance of less than 0.02 ohms.

Jennings Radio Mfg. Corp., Dept. ED, P.O. Box 1278 San Jose, Calif.

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DO YOU NEED

a really

RUGGED*
COMPACT
SENSITIVE
LIGHT-BEAM

GALVANOMETER



*Will take
25 G's!

this is it...

Here is a new series of light-beam galvanometers that were developed to withstand the extremely severe conditions of shock and vibration encountered in field servicing and testing of jet aircraft.

Through unique folding of the light beam, great compactness is achieved while retaining sensitivity to the highest degree...equal to that of laboratory instruments!

These Howell Galvanometers feature excellent readability. They are readily adaptable to existing instruments. They are competitively priced.

SPECIFICATIONS:

Sensitivity to .105 microamperes per millimeter Resistances: 20, 100, 500 and 1000 ohms. Short period; high speed response. SIZE: ONLY 2.6" x 3.62" x 3.615" Sealed construction.

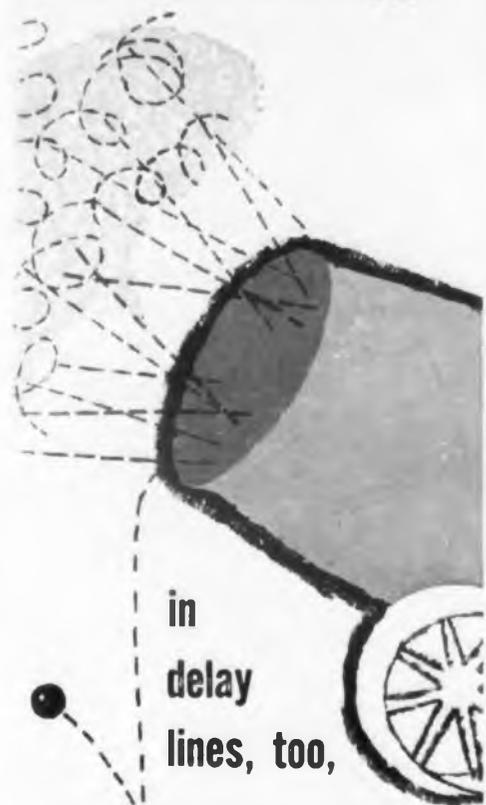
For full information
please write or wire



HOWELL INSTRUMENT Company
3101 Trinity St. • Fort Worth 7, Texas

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you don't need a Cannon
to shoot a B-B...



in
delay
lines, too,

you waste money
when you
"over-specify"

If you are sometimes unsure as to how much tolerance is required for your delay line applications, do not take chances on expensive "over-specification".

Avoid the costly pitfalls of "over-specification" of custom-designed delay lines by taking advantage of the engineering service and lab reports offered by ESC. As pioneer manufacturers and specialists in this field, ESC offers complete follow-through on the equipment applications of fixed and variable delay lines. "You tell us the problem . . . we'll recommend the realistic and economical specifications for your delay line requirements." The well-rounded equipment background of the ESC Engineering Staff makes this possible.

A lab report, submitted with the ESC prototype, will include your submitted electrical requirements, photo-oscillograms, which indicate input and output pulse shape and output rise-time; the test equipment used, and evaluation of the electrical characteristics of the prototype.

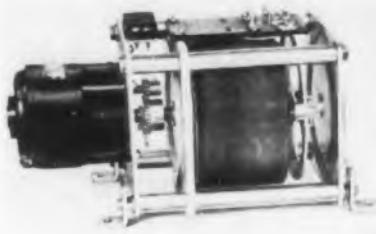
Write ESC for an informative catalog and complete information.

ESC
CORPORATION

336 BERGEN BOULEVARD, PALISADES PARK, N. J.

CIRCLE 126 ON READER-SERVICE CARD FOR

Motor Driven Variacs Can Be Ganged



Motor drives in a wide variety of speeds, suitable for servo work as well as for remote positioning applications, are offered for the Type W2 and W5

variatic autotransformers. Ganged variacs or single units can be supplied with motor drives in open or completely enclosed mountings.

Full-scale traverse rates of 4, 8, 16, 32, or 64 seconds are available on all models, and a 2-second traverse can be had on the Type W2, W2G2, or W5 variacs.

The 2-second and 4-second drives are intended for servo operations and use a motor with low moment of inertia and high angular acceleration.

Medium-speed drives use this same motor with different gearing. Microswitch stops are always used on the 43 and 64-second drives but are optional on the other models.

The gear reducer motor is attached to a mounting plate which in turn is ganged to the variac. Ball bearings are used on all the units.

General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 127 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Rate Converters For Tachometer Generators



The FR series converters measure the frequency of turbine flowmeter or tachometer

generator signals, converting to a dc signal proportional to the frequency of the input. The converters are available in either relay rack or cabinet enclosures.

Up to ten input channels for display on a single built-in indicator are available. Voltage output to operate electronic indicators, recorders, or controllers is included on all models. Input frequency range is 5 to 3000 cy.

Five internal calibration checking frequencies are provided. The linear and stable electronic circuit is free from effects due to input waveform or voltage, line voltage changes, or ambient temperature changes.

The units are part of the company's line of pulse rate converters for use with turbine flowmeters.

Waugh Engineering Co., Dept. ED, 7842 Burnet Ave., Van Nuys, Calif.

CIRCLE 128 ON READER-SERVICE CARD FOR MORE INFORMATION

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FOR

2 different methods
2 different requirements



**AEROVOX
PRINTED
WIRING**

You are now offered the choice of TWO different printed-wiring methods: (1) The Aerovox exclusive **Pressed Silver** or (2) The Aerovox **Etched Copper**. Each has its particular field of applications.

Furthermore, Aerovox also offers a choice of different base materials, such as: Phenolic-paper Base, Phenolic Fabric, Epoxy Glass, Melamine Glass, Teflon Glass, Polystyrene and Methacrylate, each with certain characteristics for given usages.

PRESSED SILVER

Produced by a hot die-stamp process in which the conducting pattern is mechanically embossed in one or both sides of the selected base material. Does not rely on any adhesive agent for the bond between conductive and base materials. Pure silver conductors are partially imbedded in base support. Compared with copper, the silver is more resistant to oxidation, solders more readily, and provides superior electrical contact surface with greater resistance to wear, particularly for switching applications.

ETCHED COPPER

Produced by applying an etch-resistant pattern on to a metal foil, usually copper clad. Unprotected metal areas of printed pattern are then etched away leaving desired wiring pattern. The resistant enamels may be applied by (a) Direct photographic means, or (b) Screen printing. The former achieves maximum definition of lines held to close tolerances at relatively modest costs; the latter effects cost savings where extremely fine detail is of secondary importance.

PRINTED WIRING PRIMER . . .

Write on your business stationery for this practical guide on printed wiring. And let our printed wiring specialists collaborate on your particular applications.



AEROVOX CORPORATION

SPECIAL PRODUCTS DIVISION
NEW BEDFORD, MASSACHUSETTS

In Canada: AEROVOX CANADA LTD., Hamilton, Ont.

CIRCLE 129 ON READER-SERVICE CARD FOR MORE INFORMATION

Need MULTIPLE CABLES...



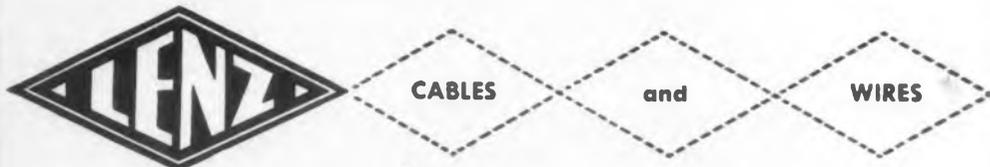
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Whether for Electronic Control Equipment, Public Address or Inter-Com Systems, you'll want a cable that is just right for the job. Whatever your mechanical or electrical requirements, Lenz will meet them.

Organized in 1904, with a half century of wire and cable engineering experience behind us, we can help you select a standard cable from our catalog or supply you with cables built to meet your special requirements.

Send us your specifications! Remember, a Lenz Cable is a Quality Cable!

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LENZ ELECTRIC MANUFACTURING CO.

1753 North Western Avenue

Chicago 47, Illinois

In Business Since 1904

CIRCLE 131 ON READER-SERVICE CARD FOR MORE INFORMATION

Rotary Servo Actuator For Airborne Use



The D-9 permanent magnet type rotary servo actuator, for airborne applications, is designed for continuous operation at an output rating of 70 in-lbs at 8.5 rpm. Theoretical acceleration at stall is 40,000 radian/sec² and dynamic motor braking is incorporated. The unit has a weight of 1.9 lbs, diameter of 3-5/16 in. and an overall length of 4-7/8 in. including the AN connector. Included are limit and centering switches and a potentiometer for feedback of position information. The servo meets MIL-E-5272A and MIL-I-6181B.

The high power to weight ratio of this actuator will find wide application in the airborne electro-mechanical field.

White-Rodgers Co., Dept. ED, 4407 Cook St., St. Louis 13, Mo.

CIRCLE 132 ON READER-SERVICE CARD FOR MORE INFORMATION

Computing Aid For Resonant Circuits

Problems involving frequency, inductance and capacity can be solved with the calculaide frequency computer which correlates, in one setting, the natural frequency and wave length of a circuit comprising a coil and condenser with the physical dimensions of the coil and the capacity of the condenser.

All answers are given at a single setting. Inductance values can be determined for widely varying physical dimensions of coils, such as high-power transmitting coils or small single-layer receiver coils.

The computer's range covers frequencies from 400 kc to 300 mc and wave lengths from 0.1 to 600 meters. It handles condensers of capacity between 1 and 1000 μ f and inductance values from 0.05 to 1500 μ h.

The device performs calculations with coils of various sizes and wires. Produced from three sheets of Vinylite plastic, all markings are heat-sealed into the plastic. It is 6-1/4 in. in diameter, and semi-flexible.

All scales appear on one side of the system. The computer also simplifies resonant circuit calculations.

American Hydromath Corp., Dept. ED, 25-20 43rd Ave., Long Island City 1, N.Y.

CIRCLE 133 ON READER-SERVICE CARD FOR MORE INFORMATION

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0-30 V.D.C.
5 Amps.

RIPPLE: 1/2% at Maximum Load
REGULATION: 1/10 Load, 34.5 V.
Full Load, 30.0 V.

RACK MODEL KM75
BENCH MODEL (illus.) KM75B

Request Bulletin No. 93



OUTPUT
0-30 V.D.C.
10 Amps.

RIPPLE: 1% at Maximum Load.
REGULATION: 1/10 Load, 35 V.
Full Load, 30 V.

RACK MODEL (illus.) KM81
BENCH MODEL KM81B

Request Bulletin No. 96



OUTPUT
0-28 V.D.C.
20 Amps.

RIPPLE: 1% at Maximum Load.
REGULATION: 1/10 Load, 33 V.
Full Load, 28 V.

RACK MODEL (illus.) KM88
BENCH MODEL KM88B

Request Bulletin No. 100



DUAL OUTPUT
0-32 V.D.C.
40 Amps.
0-64 V.D.C.
20 Amps.

RIPPLE: Less than 1%.
REGULATION: 1/10 Load, 36.5/73V.
Full Load, 32.0/64V.

RACK MODEL KM95
BENCH MODEL (illus.) KM95B

Request Bulletin No. 103

UNFILTERED MODELS AVAILABLE
Request Bulletin No. 178



New O-PAC
Self-Contained DC Power Pack

OUTPUT
30 V.D.C. ± 6.5%
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MODEL
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\$45.00

RIPPLE: Less than 1%.
INPUT: 115 V.A.C. 60 cy.
DIMENSIONS: 4 3/4 x 6 x 6 1/2"

Request Bulletin No. 185

Opad

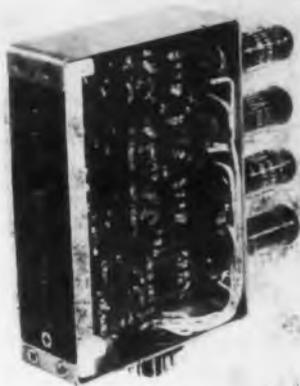
ELECTRIC COMPANY

19-16 MURRAY STREET • NEW YORK 7, N. Y.
Telephone: BEekman 3-7548

CIRCLE 136 ON READER-SERVICE CARD

Digital Decade Counter

Low Power Reliability



This counter, available in two models, the 369A and 369B, utilizes premium type tubes, conservative printed circuit design and few components. Power requirements are 6.3 v ac at 1.2 amps and 150-160 v dc at 7.5 ma. It will accept input pulses at rates varying from 0 to 100,000

counts per second while generating one pulse at the output for each 10 input pulses. The count is indicated visually by means of neon lights on a low-glare numerical screen.

The model 369A has an octal base and analog staircase output. The model 369B has an eleven pin base and four-line code output.

Designed for use in an electronic digitizing system, the counter can be used as replacement for the Brush BD-100 AN and BD-100 BN.

Franklin Electronics Inc., Dept. ED, E. 4th St., Bridgeport, Pa.

CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Potentiometers

Wire-Wound Subminiature

New Acepot sub - miniature precision wire-wound potentiometers have resistance ranges from 10 ohms to 250 K and the extremely fine linearity of ±0.3 per cent.



Only 1/2 in. x 1/2 in. in size, specifications of Acepots include: resistance range from 10 ohms to 250 K standard; weight 1/4 oz; power 2 w for 60 C rise; extremely high resolution; ambient temperature -55 C to 150 C; case is one-piece precision machined aluminum; available in standard threaded bushing, servo or flush mountings, and ganged units.

All units are fully sealed, moisture-proofed, and anti-fungus treated; they meet applicable portions of JAN specifications and MIL-E-5272A standards.

Designed for ultra-compact space and weight saving equipment. Extremely fine wire and special testing makes for precision units.

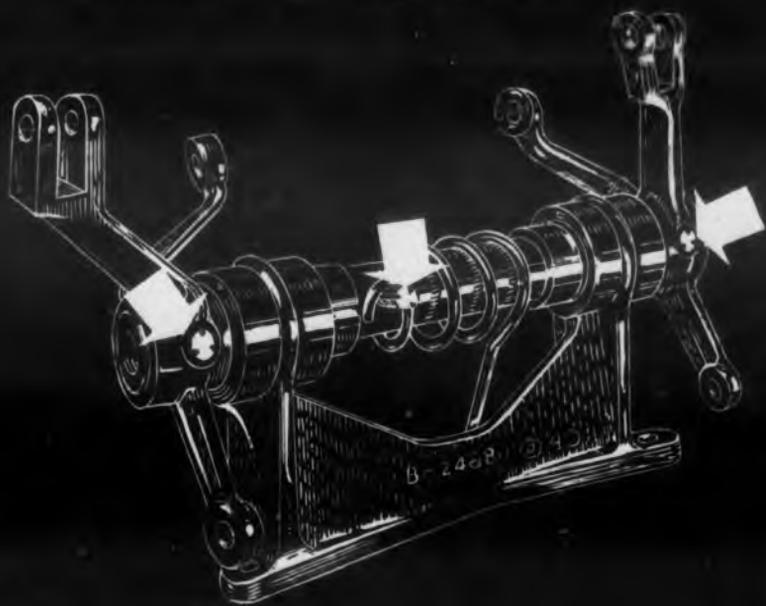
Ace Electronics Associates, Inc., Dept. ED, 103 Dover St., Somerville, Mass.

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION

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...Groov-Pins, the original press fit design

Groov-Pins were used in this brake assembly of a 1929 automobile to provide a positive locking press fit at three important shock and wear-absorbing points. Because their original design was fundamentally perfect, Groov-Pins are still used in essentially the same form today, in a wide variety of industrial applications.

These cylindrical metal pins (usually cold rolled steel) are cut from bar or coil stock. Longitudinal grooves are rolled or pressed into the body to deform the stock within controlled limits. When the Groov-Pin is forced into a hole of correct diameter, the constraining action of the wall causes the displaced material to flow back and make a locking fit within its elastic range.

Groov-Pins are assembled in straight drilled holes. No tapping, reaming, peening, or milling are required. They can be driven by hand hammer, air cylinder or hydraulic press.

Many prominent manufacturers are taking advantage of the opportunities Groov-Pins afford for substantial savings in manufacturing and maintenance costs, design simplification and customer satisfaction.



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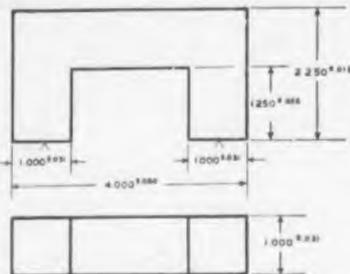
Representatives in principal cities throughout the U. S. A.

IN CANADA: Metal and Wood Fastening Devices Co., Valois, Montreal

CIRCLE 139 ON READER-SERVICE CARD FOR MORE INFORMATION



HIGHER EFFICIENCY H-F POWER TRANSFORMERS



THIS IS A TYPICAL FERROXCUBE
MAGNETIC CORE DESIGN

Smaller, lighter and less costly H-F power transformers of outstanding efficiency are being designed around Ferroxcube magnetic cores. The unique advantages of Ferroxcube are particularly marked in transformers required to handle up to 2 kilowatts of power in the frequency range from 2 kilocycles to 2 megacycles.

Ferroxcube-cored transformers are being used successfully in ap-

plications as diverse as ultrasonic power generators and rectifier power packs operating from an aircraft's normal a-c supply. In the latter application, the low leakage field of Ferroxcube eliminates the need for external shielding — for further reduction in transformer size and weight.

Ferroxcube cores are designed and produced to specifications. Our engineering department offers a complete, prompt service to assist in the design of Ferroxcube cores for specific applications. Your inquiry will receive immediate attention. ★ ★ ★ ★ ★



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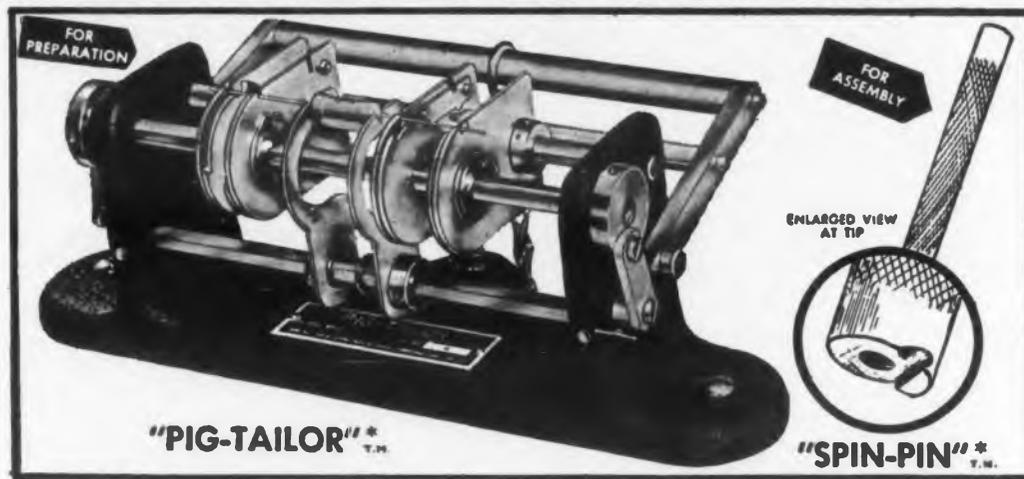
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CIRCLE 141 ON READER-SERVICE CARD FOR MORE INFORMATION

"PIG-TAILORING"

... a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.



The "PIG-TAILOR" plus "SPIN-PIN" — Accurately Measures, Cuts, Bends, Ejects and Assembles both leads simultaneously to individual lengths and shapes — 3 minute set-up — No accessories — Foot operated — 1 hour training time.

PIG-TAILORING provides:

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|-------------------------------------|-------------------------------------|
| 1. Uniform component position. | 6. Individual cut and bend lengths. |
| 2. Uniform marking exposure. | 7. Better time/rate analysis. |
| 3. Miniaturization spacing control. | 8. Closer cost control |
| 4. "S" leads for terminals. | 9. Invaluable labor saving. |
| 5. "U" leads for printed circuits | 10. Immediate cost recovery. |

PIG-TAILORING eliminates:

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| 1. Diagonal cutters. | 6. Broken leads. |
| 2. Long-nose pliers. | 7. Short circuits from clippings. |
| 3. Operator judgment. | 8. 65% chassis handling. |
| 4. 90% operator training time. | 9. Excessive lead tautness. |
| 5. Broken components. | 10. Haphazard assembly methods. |

* PATENT PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to ED-1P

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CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION

Circle the appropriate key number or numbers in the shaded section of the Reader Service card you ordinarily use. Replies will automatically be sent to the non-business address you write in the space provided.

Digital Counter Transistorized



Extremely dependable operation is achieved by using transistors instead of vacuum tubes.

Small size and moderate cost are obtained by employing printed circuit boards and modular construction. Total power consumption of the counter is 2 w.

Counting frequency is 15,000 cps, with higher speed provided as a special. Input power is 60 cy, 85 to 140 v, resolution is 10 μsecs. Size is 4 in. high x 11-5/8 in. wide x 9-1/8 in. deep. The counter can be preset anywhere from 1 to 500 for batch counting.

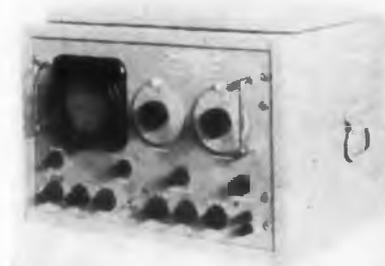
In operation, the output of a suitable transducer is sent to flip-flops within the counter. When the desired number is reached, these cause an output relay to function.

Unit is conservatively designed with transistors operating well below their maximum ratings. It is reliable and has low maintenance.

Nader Mfg. Co., Dept. ED, 2661 Myrtle Ave., Monrovia, Calif.

CIRCLE 143 ON READER-SERVICE CARD FOR MORE INFORMATION

Spectrum Analyzer 0-100 Kc Band



A 0-100 kc wide-band spectrum analyzer, Model SS-100, will give an instantaneous fourier analysis of noise, vibration and harmonics. Special features include an automatic optimum resolution, bandpass input filter, continuously variable center frequency and sweep width controls, front end overload protection, a flat faced 5 in. cathode ray tube, and camera mount bezel.

Specifications include: frequency, 13.5 cy to 110 kc; sweep width variable from 200 cy to 20 kc; resolution to 27 cy; a 60 db dynamic range; linear and 3 decade log voltage scale with a ± 1 db accuracy, and a 500 μv to 500 v full scale input range.

It has special application in telemetering, aircraft, filter, acoustic, and medical fields.

Probescope Co., Dept. ED, 44-05 30th Ave., Long Island City, N.Y.

CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION

For automation programming... Stromberg-Carlson push-type keys

In addition to strips of 20 keys, as illustrated, you may order combinations of 7, 10 or 12 strip-mounted keys. "Make," "break," "break-make" and "make-before-break" combinations may be applied as the program requires.

Constructed around a rigid steel framework, our multiple push buttons are available in white or colors. Push buttons may be furnished blank or with letter or numerical designations as desired.

Standard spring combinations are furnished with

Form A, C or D contacts. Or you may order special strips with intermixed contacts.

STROMBERG-CARLSON

A DIVISION OF GENERAL DYNAMICS CORPORATION

Telecommunication Industrial Sales, 110 Carlson Rd., Rochester 3, N. Y.

Complete technical details are contained in our key catalog, available without charge. Just write.



Recording Potentiometer Two Pen Miniature Unit



A two pen, 11 in. recording potentiometer designed for laboratory and field applications features a 3 speed selsyn motor chart drive which provides 1, 2, or 5 in. chart travel for 100 turns of the selsyn, or synchronous motor chart drives to provide standard chart speeds.

The recorder requires 17.4 by 9.9 in. panel spacing and is 12.5 in. deep for mounting in a standard relay rack panel, or table top mounting.

Standard features include: 2-1/2 second pen speed with full scale travel on each pen; continuous electronic standardization of potentiometer bridge voltage; ranges of 10 mv or greater; 0.1 per cent sensitivity; 0.25 per cent accuracy; null balance system.

Externally connected amplifiers can be supplied for custom mounting. This model supplements a line of 5 inch miniature recorders.

Westronics, Inc., Dept. ED, 3605 McCart, Ft. Worth, Tex.

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

H-V Power Supply Closely Regulated



This closely-regulated, high-voltage power supply is designed for use with high-voltage tubes. Output range is 400 to 4000 v dc, continuously variable without switching; current rating is 0 to 100 ma. Regulation for output voltage range of 2000 to 4000 v dc is 0.1 per cent NL to FL; below 2000 v dc the regulation is 0.25 per cent NL to FL. For line voltage of 115 v ac ± 8 per cent, the change in output voltage from 2000 to 4000 v dc is 0.15 per cent. Below 2000 v dc the change is 0.3 per cent. Ripple and internal noise are below 5 mv rms for any voltage or load.

Model 4K-100B is equipped with positive or negative grounding switch, and 3-turn Helipot for vernier adjustment of output voltage.

Designed for standard 19 in. relay rack panel mounting. The instrument is 19-1/4 in. high and 18 in. deep.

Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena, Calif.

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 146 ON READER-SERVICE CARD

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Stackpole Resistors meet or surpass today's critical performance requirements including MIL-R-11A specifications.

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CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION

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Junction Transistor For Audio Applications

The 2N206 is a junction transistor of the germanium pnp alloy type intended for use in audio-frequency amplifier applications. It is designed to meet military requirements. The 2N206 is hermetically sealed, utilizes a metal envelope with external insulating coating, and has flexible leads which can be soldered or welded into the associated circuit. Temperature-cycling and moisture-resistance tests are made on this type. In a common-emitter type of circuit with base input, the 2N206 has a current transfer ratio of 47, a low-frequency power gain of 46 db, a noise factor of 9 db, and a maximum collector dissipation of 75 mw for an ambient temperature of 25 C.

Radio Corp. of America, Semiconductor Div., Dept. ED, Somerville, N.J.

CIRCLE 152 ON READER-SERVICE CARD

Sharp-Cutoff Pentode Premium Type

The 5725 is a "premium" sharp-cutoff pentode of the 7-pin miniature type intended particularly for use in gated amplifier circuits, delay circuits, gain-controlled amplifiers, and mixer circuits. Constructed to perform under conditions of shock and vibration, this premium tube, which is similar to the 6AS6, is especially suited for use in mobile and aircraft equipment. The 5725 includes separate base-pin terminals for grid No. 1 and No. 3. Each of these grids has a sharp-cutoff characteristic and can be used independently as a control electrode. A pure tungsten heater having high mechanical strength gives long life under conditions of frequent "on-off" switching. Life tests are made with a minimum bulb temperature of 165 C.

Radio Corp. of America, Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 153 ON READER-SERVICE CARD

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12 Volt Tubes High Current

Eight receiving tubes are tailored for 12 v plate supply operation directly from an automobile storage battery. This line for auto radio complements includes the Type 12J8, a 9 pin miniature detector-driver tube designed to produce high current at low plate voltage for power coupling to the output transistor; the 7 pin miniature pentode RF amplifiers 12AC6 and 12AF6; the 7 pin miniature penta-grid converter 12AD6; the multi-unit 12F8, a 9 pin miniature containing two diodes and a remote cut-off pentode; the 7 pin miniature space charge tetrode driver 12K5; the 9 pin miniature audio amplifier 12AE6 and the medium mu 9 pin miniature double triode 12U7. Type 12J8 has a 12.6 v, 350 ma heater. Type 12K5 has a 12.6 v, 400 ma heater. The remaining six types have 12.6 v, 150 ma heaters.

Sylvania Electric Products, Inc., Dept. ED, 1740 B'way, New York 19, N.Y.

CIRCLE 155 ON READER-SERVICE CARD

IF Crystal Filter Sub-Miniature

This sub-miniature if crystal filter for 455 kc is designed to operate from high mu pentode (220 K ohms) to grid. The 9 kc wide pass band permits the use of this filter in practically any communications or highly selective receiver with good fidelity of operation.

The pass band is smooth and monotonic and the filter contains no spurious responses that could permit the passage of other channels, images or harmonics. The insertion loss is 12 db and the attenuation is 50 db at a band width of less than 20 kc. Size is 15/16 x 1-5/16 x 2-1/4 in. high, weight is 4-1/4 ounces. Designed to meet applicable portion of MIL-T-27 and other Government specifications. The No. S-17976 filter can be inserted in any interstage circuit with no circuit modification necessary.

Burnell & Co. Inc., Dept. ED, 5 Warburton Ave., Yonkers, N.Y.

CIRCLE 156 ON READER-SERVICE CARD

CIRCLE 157 ON READER-SERVICE CARD

International Silicon Diodes

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in full production!

PIV ratings up to 16,000 volts . . .

for high reliability

over a wide temperature range



Write on your letterhead for bulletins on any or all types illustrated. If you have a particular problem, our Application Advisory Group will be happy to submit a prompt evaluation and recommendation.

International Rectifier

C O R P O R A T I O N

EXECUTIVE OFFICES: EL SEGUNDO, CALIFORNIA • PHONE OREGON 6-8281

NEW YORK: 222 E. 70TH ST., TRAFALGAR 9-3320 • CHICAGO, 200 W. WACKER DR., FRANKLIN 2-3005

IN CANADA: ATLAS RADIO CORP., LTD., 20 BRIMLEY AVE. W., TORONTO, ONTARIO, RU 3-4134

THE WORLD'S LARGEST SUPPLIER OF INDUSTRIAL METALLIC RECTIFIERS



USE 'DIAMOND H' SERIES R RELAYS

Where the temperature hits 200°C ... or drops to -65° ... where a dry circuit is downright arid ... or a power circuit employs 10 amperes (or even 20 amps for a short life need) ... your best bet for reliability is a "Diamond H" Series R miniature, hermetically sealed, aircraft type relay. Their shock and vibration resistance you may take for granted.

Variations on the basic 4 PDT Series R relay perform outstandingly over such a broad area that they are frequently used to do many different types of jobs in a given application, with resultant savings in spare part inventories. The range of possible characteristics covers:

Various brackets of vibration resistance from 10 to 2,000 cps, coil resistances from 1 to 50,000 ohms, operational shock resistances of 30, 40, or over 50 "G"; mechanical shock resistance to 1,000 "G", contact capacities from 350 V., D.C., 400 MA, to 10 A., at 30 V., D.C., as well as signal circuits.

For complete information send for a copy of Bulletin R-250.

THE HART MANUFACTURING COMPANY
210 Bartholomew Avenue, Hartford, Conn.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION



*patent pending, trademark property of 3C

- simple and easy to use; up to 2" cables can be wrapped
- inexpensive; one size answers all your needs
- holds wires together tightly but allows flexibility for forming cable
- provides excellent insulation and protection over entire cable length
- easily unwound to allow wires to be added, taken out, or re-located

Free Sample

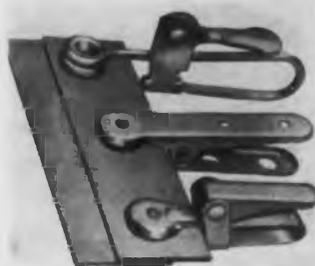
New SPIRAP is a modern idea that eliminates hours of tedious work. It is ideal for both prototype and production construction. Standard material is white polyethylene. Immediate delivery through your local distributor. Write us for free sample and complete information.

COMPUTER CONTROL COMPANY, inc.
92 Broad Street — Wellesley 57, Massachusetts

CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

Industrial Clamp

Fast Operating



Manufacturers in industries such as aircraft and electronics can use these clamps to replace screws and bolts ordinarily used for holding materials in position during assembly or processing. There are 4 types: flat spring-steel clamp with cam lever lock; spring grip clamp (clothes pin type); spring wire clamp with cam lever lock and the conveyor clamp with 3 prong saw-tooth steel jaws (stationary or swivel) with cam lever lock. With the exception of conveyor clamp, all are equipped with rubber jaws.

Specifications are as follows: flat spring-steel clamp has an over-all length of 2-1/8 in. and clamping capacity of 0 in. to 5/32 in.; spring grip clamp is 2-5/8 in. long with a clamping capacity of 0 in. to 5/16 in.; spring wire clamps available from 3-1/4 in. to 4-3/8 in. long, with a clamping capacity of 0 in. to 1-3/4 in.

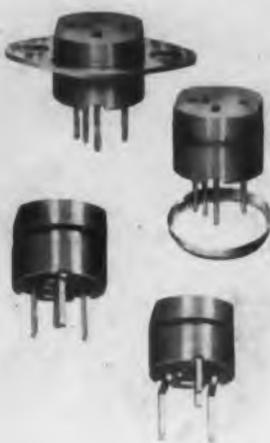
These clamps are particularly useful for dipping, flange work, edge work, bench, or wall use.

Wedglock Corp., Dept. ED, 5446 Satsuma Ave., No. Hollywood, Calif.

CIRCLE 161 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Socket

In-Line or Triangular Pins



This multi-purpose socket may be used for 3 pin transistors with in-line pins or with pins on a 0.200 in. diameter pin circle, accommodating triangular pin configuration, eliminating the need for stocking different types of sockets. The insulator body is made of low loss mica-filled phenolic, type MFE, in accordance with MIL-

P-14. Contacts are beryllium copper, gold plated over silver plate to pass the 48 hour salt spray test per QQ-M-151a, and afford excellent contact resistance values.

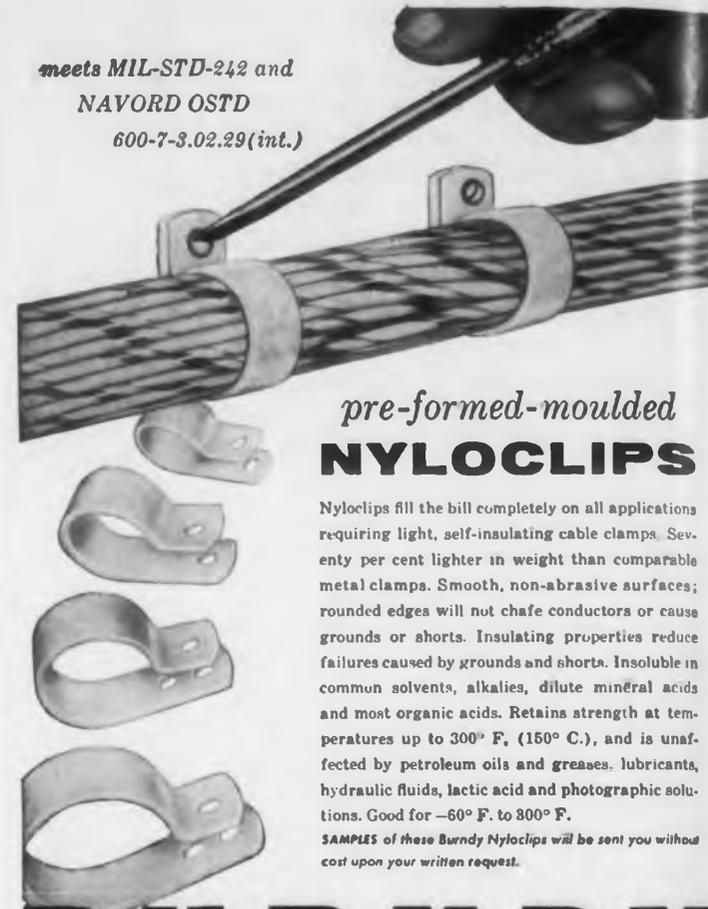
Sockets are available for mounting with flat saddle or mounting ring in standard wiring applications, or in stand-off type for use in printed wiring applications.

Current rating is 1 amp, withstanding voltage is 1200 v rms at sea level. Insulation resistance is 1000 Megohms minimum.

Elco Corp., Dept. ED, "M" St. below Erie Ave., Philadelphia 24, Pa.

CIRCLE 162 ON READER-SERVICE CARD FOR MORE INFORMATION

meets MIL-STD-242 and
NAVORD OSTD
600-7-3.02.29(int.)



pre-formed-moulded NYLOCLIPS

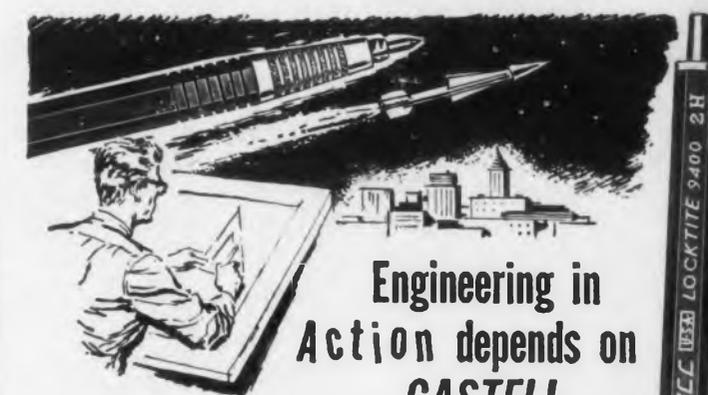
Nyloclips fill the bill completely on all applications requiring light, self-insulating cable clamps. Seventy per cent lighter in weight than comparable metal clamps. Smooth, non-abrasive surfaces; rounded edges will not chafe conductors or cause grounds or shorts. Insulating properties reduce failures caused by grounds and shorts. Insoluble in common solvents, alkalis, dilute mineral acids and most organic acids. Retains strength at temperatures up to 300° F. (150° C.), and is unaffected by petroleum oils and greases, lubricants, hydraulic fluids, lactic acid and photographic solutions. Good for -60° F. to 300° F.

SAMPLES of these Burndy Nyloclips will be sent you without cost upon your written request.

BURNDY

Waltham, Conn. • Toronto, Canada • Other Factories: New York, Calif., Toronto • Export: Philips Export Corp.

CIRCLE 163 ON READER-SERVICE CARD FOR MORE INFORMATION



Engineering in Action depends on CASTELL

LOCKTITE Holder and Imported CASTELL Lead

CASTELL LOCKTITE Holders, armed with long sticks of graphite-saturated imported CASTELL 9030 lead, are used in practically every engineering and design office. Busy Pros are keen about LOCKTITE because it has a gun-rifled clutch that holds the lead like the jaws of a bull dog, preventing slipping or turning. They are keen about imported 9030 CASTELL lead, because it is identical to lead which made CASTELL wood pencil world famous.

Have you seen LOCKTITE 9800, with the patent-pending Degree Indicator. A turn of a brass collar indicates the degree in use. Pick one up from your Dealer today.

A.W. FABER-CASTELL

PENCIL CO., INC. NEWARK 3, N. J.



CIRCLE 164 ON READER-SERVICE CARD FOR MORE INFORMATION

Compact, Dependable,
Moderately-Priced
UHF Oscillator

900 to
2,000
Mc



Delivers 200 mw into 50-ohm load . . . direct-reading to $\pm 1\%$ with precision slow-motion drive . . . warm-up frequency drift 0.1% . . . sine, square-wave pulse or frequency-variation modulation can be applied . . . for general-purpose laboratory use with power and shielding adequate for driving bridges, slotted lines and other impedance-measuring equipment.

This Oscillator can be sweep-driven with G-R Synchronous Dial and X-Y Dial Drives or with the G-R Sweep Drive. Several Unit Power Supplies are available.

Type 1218-A UHF Oscillator: \$465.00

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

Broad Avenue at Linden, Ridgefield, N. J. NEW YORK AREA 920 S. Michigan Ave. CHICAGO 5

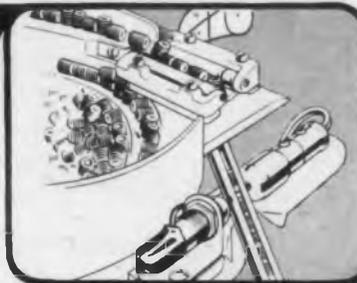
1150 York Road, Abington, Pa. PHILADELPHIA

855 13th St., Silver Spring, Md. WASHINGTON, D. C. 1000 N. Seward St. LOS ANGELES 38

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION

Preview!

**SET
SCREW**



AUTOMATION

... See How Setko System[®]
Saves 80 to 90% Operational Time!

A new Setko movie on hopper feeding of headless set screws "demonstrates" an exciting approach to assembly automation. This 12 minute, 16-mm color film previews the opportunities for automa-

tion in inserting and driving headless set screws as small as #2 (.086" x 1/8").

Users of this revolutionary new system report cuts in operational time of 80% to 90% . . . elimination of floor waste . . . drastic reduction in floor area.

Setko innovations include application of air feed, micro-switches and photo-electric cells. The Setko system is adaptable to individual requirements including vertical or horizontal feeding, semi-automatic or full automatic work feeding, installation on rotary indexing work tables, drill presses, vertical tapping machines, etc.

FREE DEMONSTRATION!

This new film is available for a "demonstration" in your plant or office. There's no obligation involved. For information about the film, or for a free copy of Catalog 21 which describes the Setko System, write direct.

**Set
Screw
& Mfg. Co.**

* Pat. Pend.

265 Main Street, Bartlett, Illinois (Chicago Suburb)

Specialize in Solving Puzzling Set Screw Problems

CIRCLE 167 ON READER-SERVICE CARD FOR MORE INFORMATION

**Ferrite Yoke Cores
For TV Picture Tubes**



This ferrite "full-round" deflection yoke core for use in TV picture tube assemblies is pressed as a ring of perfectly uniform section and circularity. It is then "cracked" into two halves for

later assembly over deflection coils and fitting to the tube. Inner and outer surfaces are always perfectly concentric and parallel. The result is better convergence, greater color purity, and reduced assembly time.

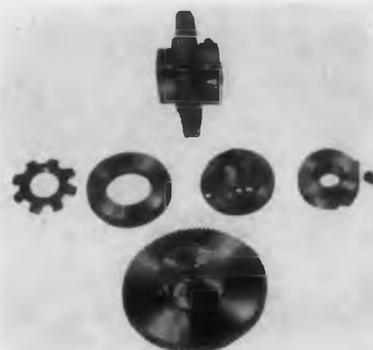
The "full-round" cores, designated as the T series, interchange with the Q quarter-round series.

The mated halves are shipped held together to avoid position damage in transit.

Allen-Bradley Co., Dept. ED, 136 W. Greenfield Ave., Milwaukee 4, Wisc.

CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION

**Miniature Slip Clutch
Adjustable Torque**



These miniature slip clutches are manufactured in 48, 64, 72, 80, 96 and 120 diametral pitch, ranging from 0.750 in. thru 1.500 in. pitch diameter. The overall is 0.562 in. with a choice of 0.1250 or 0.1875 bore.

The center member is 303 stainless steel, clutch plate is oilite bronze, selected gear is 303 stainless steel and clamp is 303 stainless steel with 2-56 socket head cap screw.

Torque setting is attained through the use of an adjustable threaded locking clamp, which can be set to any desired torque reading. All units are manufactured to Precision Class I tolerance.

These items have been added to the E-88 Dynaco Precision Stock Gear Catalog, available for additional information.

Dynamic Gear Co., Inc., Dept. ED, 20 Merrick Rd., Amityville, N.Y.

CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION

For the Latest News in Employment Opportunities, See **ELECTRONIC DESIGN'S "Career's Section"** Every Issue.

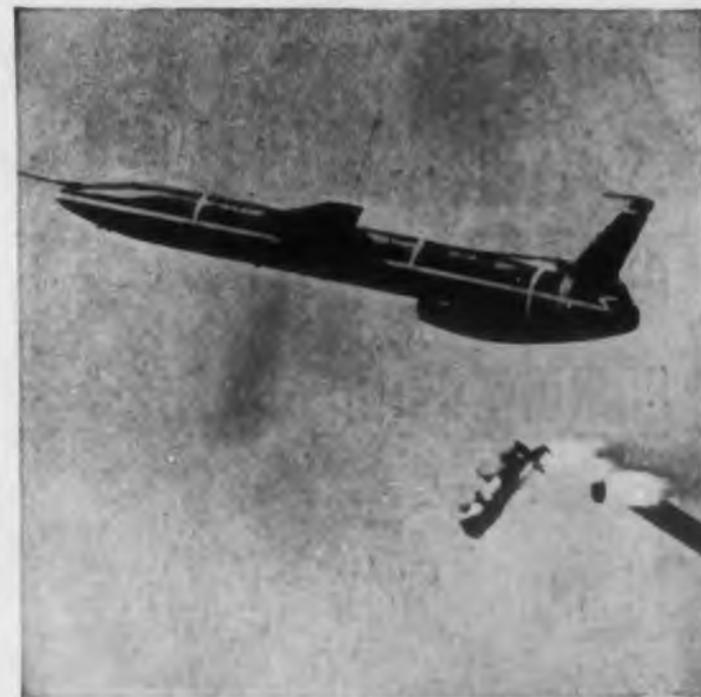


Photo courtesy of Northrop Aircraft, Inc.

**High-speed control for
high-speed missiles**

Nowadays, target, aircraft, and missile speeds are too fast for human reactions. Automatic equipment makes ready, radar eyes take aim and a computer pulls the trigger.

Replacing men with machines on the firing line gives us a better chance for an interceptor kill or successful missile shot. And, today, we can't afford to miss. That's why reliability of every component is so important in modern fire control gear. And reliability is the main reason engineers—like those designing Northrop Aircraft's Snark missile (above)—so often pick Bristol's[®] Syncroverter[®] High-Speed relays (or the very similar Syncroverter chopper).

These high-speed relays have a normal life of billions of operations in dry circuit applications. They're available in SPDT and DPDT models with the typical characteristics listed below and in many variations.

And, of course, many critical applications other than fire control—such as air-to-ground telemetering, analog and digital computers, aircraft or missile navigation equipment, carrier current switching—can benefit from the outstanding reliability of Bristol's Syncroverter line. Write for complete technical data today. The Bristol Company, 151 Bristol Road, Waterbury 20, Conn.

TYPICAL CHARACTERISTICS

Temperature range: -55°C to 100°C
Operating shock: 30G; 11 milliseconds duration
Vibration: 10-55 cps (see below, Mounting); 10 G
Contact ratings: up to 35v, 45 microamperes
Stray contact capacitance: less than 15 mmfd
Pull-in time (including bounce):
as low as 200 microseconds
Drop-out time: 300 microseconds
Life: Billions of operations
Mounting: Octal tube socket; others available, including types for vibration to 2000 cps.

BRISTOL FINE PRECISION INSTRUMENTS
FOR OVER 67 YEARS

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW

OHMITE

offers the ONLY
complete line of
RESISTORS
to meet MIL-R-26C
characteristics

Y

HIGH TEMPERATURE
350C CHARACTERISTIC

HIGH INSULATION RESISTANCE

V

HIGH TEMPERATURE
350C CHARACTERISTIC

AND

G

**TAB-
TERMINAL
TYPE**

Characteristics
V and G

Style	Over-all Length	Diameter	*Watts	††Watts
RW-29	1 3/4"	1/2"	8	11
RW-30	1"	19/32"	8	11
RW-31	1 1/2"	19/32"	10	14
RW-32	2"	19/32"	12	17
RW-33	3"	19/32"	18	26
RW-35	4"	29/32"	38	55
RW-36	4"	1-5/16"	54	78
RW-37	6"	1-5/16"	78	113
RW-38	8"	1-5/16"	110	159
RW-47	10 1/2"	1-5/16"	145	210

**TAB-
TERMINAL
TYPE**

Characteristic
Y

Style	Over-all Length	Diameter	*Watts	††Watts
RW-30	1"	19/32"		11
RW-33	3"	19/32"		26
RW-37	6"	1-5/16"		113
RW-47	10 1/2"	1-5/16"		210

**FLAT TAB-
TERMINAL
TYPE**

(Stack Mounting)
Characteristics
V and G

Style	Over-all Length	Width and Thickness of Core	*Watts	††Watts
RW-20	2 1/2"		15	21
RW-21	3 1/4"	1-3/16"	22	31
RW-22	4 3/4"	x	37	53
RW-23	6"	1/4"	47	68
RW-24	7 1/4"		63	91

**AXIAL-
TERMINAL
TYPE**

Characteristics
V and G

Style	Length of Core**	Diameter	*Watts	††Watts
RW-55	1 3/8"	15/32"	5	7
RW-56	2"	15/32"	10	14
RW-57	1"	5/16"	5	6.5
RW-58	1 1/8"	11/32"	8	11
RW-59	1/2"	3/16"	2.5	3

*Watts free air MIL Characteristic "G."
†Watts free air MIL Characteristic "Y."
††Watts free air MIL Characteristic "V."

**1-1/2" wire leads.

Load Isolator

12.4 to 18 K Mc

A broad-band Uniline load isolator, the Model KU-143, covers a frequency range of 12.4 to 18.0 K mc, over which VSWR is less than 1.10, insertion loss 0.5 db.

Load isolation is 20 db at band center, 13 db at band edges. Power rating is 100 w average, 100 kw peak. Waveguide is RG91/U (.702 in. x .391 in.). Flanges are UG419/U.

Cascade Research Corp., Dept. ED, 53 Victory Lane, Los Gatos, Calif.

CIRCLE 171 ON READER-SERVICE CARD

Rubberized Fiber

in Sheets or Pads

Corotex is a liner of rubberized fiber, vulcanized into sheets or pads and die-cut into shapes to fit product contours, providing protection for precision parts, electronic tubes, against breakage or damage during shipment.

It is a highly resilient, lightweight fiber of uniform consistency, offering the advantages of being dust-free, non-abrasive to moisture and fungus, and non-corrosive to metal. It meets Military Specs MIL-P-6064A and MIL-C-7769.

Greenwood Packaging Supply Co., Dept. ED, 859 Summer Ave., Newark 4, N.J.

CIRCLE 172 ON READER-SERVICE CARD

Transparent Labels

Pressure Sensitive

Printed on acetate, these transparent pressure sensitive labels are being used to save time in making changes on vellums used for blue prints and engineering drawings and for the quick addition of other information.

The transparent labels are furnished plain or printed to provide ruled or columnar data. They can be drawn on, written on or typewritten on. Once affixed to a vellum, they stay firmly in place for any required number of printing operations.

Archer Label Co., Dept. ED, 783 Kohler St., Los Angeles 21, Calif.

CIRCLE 173 ON READER-SERVICE CARD

CIRCLE 174 ON READER-SERVICE CARD

Even including resistors wound with the finest wire size (.00175)

The Ohmite resistor types shown in the table above can withstand a continuous operating temperature of 350C—the high temperature requirement of MIL-R-26C. Char. "V." These resistors also meet Characteristic "G." The new Char. "Y" combines all requirements of Char. "V" and "G" plus extremely high insulation resistance at the end of the moisture-resistance test. Under all three Char., "V," "Y," and "G," Ohmite resistors have to satisfy severe moisture-resistance tests, thermal shock tests, vibration tests, and many others. The Ohmite line of wire-wound resistors is the most extensive available in the industry.

ALL CHARACTERISTICS

ALL SIZES

ALL RESISTANCE VALUES



PATENTED, ALL-WELDED CONSTRUCTION

RHEOSTATS
RESISTORS
RELAYS
TAP SWITCHES
TANTALUM CAPACITORS

Be Right with **OHMITE**

OHMITE MANUFACTURING COMPANY, 3643 Howard Street, Skokie, Illinois

New Rhodium Plate Won't Curl, Crack or Peel!



RHODEX

A rhodium plating process that produces *Compressively Stressed deposits . . . developed specifically for industrial applications. RHODEX will materially increase the fatigue resistance of the metal over which it is deposited.

*Patent Pending

SEL-REX CORPORATION

Precious Metals Division

155 Manchester Place • Newark 4, N. J.

Please rush descriptive literature and technical data on Sel-Rex RHODEX (Compressively Stressed Rhodium.) ED-1

NAME _____

COMPANY _____

ADDRESS _____

CITY _____

ZONE _____ STATE _____

CIRCLE 175 ON READER-SERVICE CARD

Vibration Mount For Airborne Equipment



A series of 210-type Class A vibration mounts for airborne electronic equipment meet the requirements of MIL-C-172B. These Class A mounts are designed in three separate load ranges, from 2-1/2 to 5, 5 to 10, and 10 to 20 lbs, which gives them wide

application. The mount's design is basically the Belleville spring type, consisting of two load-carrying springs, a circular coil spring and two wire mesh pads.

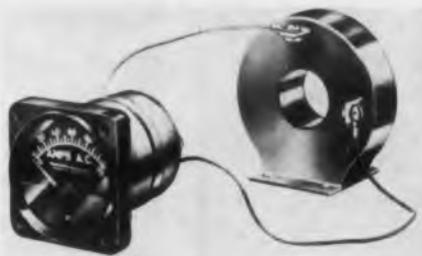
It has a natural frequency of 10 cps and a magnification factor of 1-1/2 at resonance. Of all-metal construction, these mounts weigh 3-1/2 ozs, and are the captivated type. They are available with short or long studs.

Ninety percent of the electric gear now on aircraft can be isolated with one or more of the mounts in this series, it is claimed.

T. R. Finn & Co., Inc., Electronic Div., Dept. ED, 200 Central Ave., Hawthorne, N.J.

CIRCLE 176 ON READER-SERVICE CARD FOR MORE INFORMATION

Linear Scale Ammeters For 3-Phase 400 cps



The dial markings on these linear scale ammeters are evenly spaced, and the deflection of the needle is directly

proportional to the amperage. The standard model is designed for use on a 200/115 v, 3-phase, 400 cps system.

The ammeter is supplied with a transformer that converts ac current to the 5 ma level. As its primary, the transformer uses a generator-output bus bar or other current conductor.

Accuracy is ± 2 per cent, volt-ampere consumption is less than 0.05 va at full scale deflection, breakdown potential is 2000 v and overload capacity 300 per cent. The meter range is from 0 to 115 amperes.

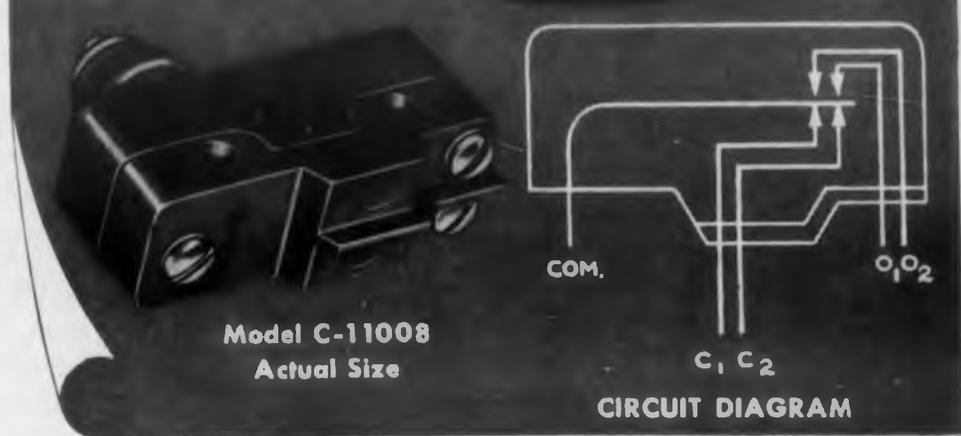
The fluorescent luminescent dial markings are visible from all angles with no distortions or shadows.

Helipot Corp., Dept. ED, Newport Beach, Calif.

CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION

Designed for versatility— Built for long life . . .

NEW ACRO *Split Contact* SWITCH



*Tested up to 40 million
actuations without failure!*

An important addition to the well-known Acro line is this new split contact snap-action micro switch. It features high capacity—up to $\frac{3}{4}$ hp, and dual circuitry—five terminals. In this design, the rugged, time-proven Acro rolling spring snap-action principle is utilized to assure long life and precision performance.

The Model C-11008 shown above is a normally closed switch. However, the double-throw arrangement in the diagram can control two single pole single throw circuits or can be used for double make or break in a single circuit. It's rated at 15 amps and is available with pin plunger or with various leaf and roll leaf bracket actuators to suit your individual application.

If you're looking for a way to improve your product's performance *and* to lower your costs, more than likely this new Acro switch or one of Acro's many other designs is just what you need. We'll be glad to send descriptive literature—without obligation.

ACRO

MANUFACTURING COMPANY

SWITCH DIVISION

Columbus 16, Ohio

Plants at Columbus and Hillsboro

REPRESENTATIVES IN PRINCIPAL CITIES

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION



THE \$20,000 DELAY

For want of a simple nameplate, the Automatic Temperature Control Co., Philadelphia, had to hold up shipment of \$20,000 in control equipment.

Now, a portable Engravograph (size of a typewriter) makes individual nameplates on the premises. Cost, per label, less than 50¢—with unskilled labor.



Engravo-graph
Keeps skilled labor at skilled jobs. Solves many marking problems. 16,000 now in use. Pays for itself.

WRITE FOR LITERATURE DEPT. IM-88

new hermes Engraving Machine Corp.
1319 University Pl., New York 3, N.Y.

CIRCLE 181 ON READER-SERVICE CARD FOR MORE INFORMATION

Grid-Controlled Indicator Tube Monitors Transistor Circuits



KP-125, Actual Size

The KP-125 is a subminiature, grid-controlled indicator tube which operates with small signal voltages and negligible current. A gas-filled triode of the glow-discharge type, the KP-125 provides a visual glow which may be viewed end-on or from the side. Both the filament (very low drain hearing aid type) and the anode may be operated from the AC line and consume power in the milliwatts region. The tube glows with 0 volts on the grid and extinguishes with -3 volts on the grid. Flying leads are provided for direct soldering into circuits, such as on printed boards. The characteristics of the KP-125 make it useful in computer transistor circuits as an indicator of current conditions which does not load the circuit under test. Additionally it serves as an indicator for monitor service in remote control panels. For details on this and other special purpose electron tubes, write:

KIP ELECTRONICS CORPORATION

Dept. E, Stamford, Connecticut

CIRCLE 182 ON READER-SERVICE CARD FOR MORE INFORMATION

Photometer

Photomultiplier Type



Combining high sensitivity, accuracy, and low drift, the Model PH-200 photometer is capable of utilizing the maximum performance characteristics of any commercially available photomultiplier or photoelectric tube. Incorporating a highly-regulated electronic power supply, the instrument is completely self-contained and portable.

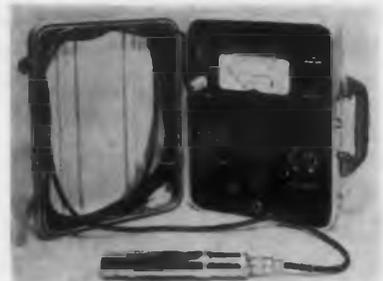
Provision is made for separate zero and dark-current adjustments as well as both decade and continuously variable sensitivity controls, and for oscilloscope and graphic recorder readout. The instrument is 10 in. high, 7-1/2 in. wide, 9 in. deep and weighs 12 lbs.

The instrument is supplied with tube base, tube holder, connecting cables, and one type 931-A photomultiplier tube.

El Dorado Electronics Co., Dept. ED, 1401 Middle Harbor Rd., Oakland, Calif.

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

Radiation Monitor Alpha-Beta-Gamma



An all-purpose laboratory radiation detection monitor is designed for use in detecting alpha, beta (including Carbon 14 and Sulphur 35), and gamma radiation dosage, leakage, accidental spillage, and contamination.

This lightweight unit can operate 24 hours a day, and can be pre-set to sound a loud warning alarm and flash a light at a predetermined level of radioactivity.

It operates from either 110 v ac, current, or as a portable unit from batteries; reads up to 50,000 cpm; and weighs just 6 lbs. It is provided with 25 feet cable.

The instrument is available in sloping front console (420A), and in a watertight aluminum suitcase (420B).

An additional cable is available for using the lightweight unit anywhere in the laboratory.

Universal Atomics Corp., Dept. ED, 143 E. 49 St., New York 17, N.Y.

CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

you can
DIAL your
ADJUSTMENT
on this
AGASTAT[®]
time/delay/relay



Frequent time adjustments are no problem with the dial head available on AGASTAT time/delay/relays. They provide a complete range of adjustment with 1 revolution of the dial. Dial markings permit easy calibration for accurate adjustment. And you can spot each of the 4 timing ranges quickly because they are color coded: blue from 30 seconds to 15 minutes; red from 10 seconds to 2 minutes; yellow from 0.1 to 10 seconds; white from 0.1 to 3 seconds.

Like all AGASTAT relays, units with dial heads are solenoid actuated, pneumatically timed. Each model is available with either dial head or needle valve adjustment. Where frequent readjustment of timing is necessary, dial head adjustment should be specified. For bulletin on all popular AGASTAT time delay relays, write to: Dept. A28-124.

AGA
DIVISION

Elastic Stop Nut Corporation
of America

1027 Newark Avenue, Elizabeth, New Jersey
Pioneers in pneumatic timing

CIRCLE 185 ON READER-SERVICE CARD FOR MORE INFORMATION

ALLIED the world's largest supplier of ELECTRON TUBES for industry

ALL BRANDS IN STOCK
AMPEREX
EIMAC
GE
ELECTRONS, INC.
RCA
RAYTHEON
SYLVANIA
TAYLOR
TUNGSO
WESTINGHOUSE
and others

Immediate delivery from stock
saves you time, effort and money

At ALLIED, we constantly stock for quick shipment the world's largest inventory of special-purpose electron tubes. We specialize in supplying the electron tube needs of industry, broadcast stations, laboratories, schools and government. Save time, effort and money on your electron tube orders—phone, wire or write us anytime for expert, immediate shipment from stock.

ALL TYPES IN STOCK
Power
Transmitting
Rectifier
Phototube
Radiation
Sub-Miniature
Oscilloscope
Ignitron
Thyratron
Image Orthicon
Klystron
and all others

Refer to your ALLIED
Catalog for everything
in electronic supplies.
Copies of our latest
356-page 1957 edition
are available FREE on
request.

ALLIED RADIO

100 N. Western Ave.
Dept. 69-A-7, Chicago 80, Ill.

EVERYTHING IN ELECTRONICS FROM ONE DEPENDABLE SOURCE

CIRCLE 186 ON READER-SERVICE CARD FOR MORE INFORMATION

Circle the appropriate key number or numbers in the shaded section of the Reader Service card you ordinarily use. Replies will automatically be sent to the non-business address you write in the space provided.

Moisture Monitor

For Gaseous Mixtures



A portable instrument for accurately measuring minute quantities of moisture in gaseous mixtures, the Type 26-301 moisture monitor, will measure water content accurately

down to one ppm, and permit precise meter readings over the full-scale range of 0 to 1000 ppm by means of a 5-step attenuator. The output of the analyzer can be telemetered to a remote recorder for monitoring or control.

An electrolysis cell in the instrument continuously absorbs and electrolyzes all water present in a sample stream. Sample flow, at temperatures up to 100 C and pressures of 5 to 100 psig, is precisely controlled at a selectable flow rate of about 100 cc/min. Adjustable output voltage to recorder is 10 to 110 mv full-scale.

The unit is 7-1/2 in. wide, 6 in. high, and 10 in. deep, weighs 15 lbs.

The electrolytic cell is removed through the front panel. Adjustment is provided for remote recorder calibration.

Consolidated Electrodynamics Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 188 ON READER-SERVICE CARD FOR MORE INFORMATION

Flashlight Continuity Tester



This combination spotlight electrical circuit continuity tester, No. 1618CT, is an industrial flashlight with built-in jack. The test leads use plug and clips for

instant attachment. This tester, which works through a three volt battery supply has many uses, such as checking wiring, controls, circuits or fuses. By using two testers in a series, it is possible to check wiring or controls and cables of a reasonable length (approximately 1000 ft 18 gauge copper tinned wire to 5000 ft 12 gauge copper tinned wire), at two different places, or where two men cannot see or hear each other.

Bright Star Industries, Inc., Dept. ED, 600 Getty Ave., Clifton, N.J.

CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION



MODEL MS-4

MULTISCOPES MEET THE PROBLEM

By use of Tinker & Rasor Multiscopes it is now possible to rack mount oscilloscope indicating units more compactly than heretofore. Rack mounting achieves neatness, efficiency and greater convenience with oscilloscope tubes grouped for instant observation of trace variations. You may order Multiscopes indicating units (without sweep wave forms) in 1, 2 or 4 tube multiples compactly mounted in a standard 19-inch rack panel fully supported from the panel face. If you would like further information on Multiscopes and applications - Write for data sheets to -



Makers of electronic testing apparatus, indicating and signal recording equipment for field and laboratory

TINKER & RASOR

417 AGOSTINO RD., P. O. BOX 281, SAN GABRIEL, CALIF.

Telephone: ATLantic 7-7842

CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION



20 WATT SERVOMOTOR

POWER SPEED

THIS NEW SERVO HAS 32 OZ. IN. STALL TORQUE AND UNEXCELLED TORQUE TO INERTIA RATIO:

50000 RAD PER SEC.²

WRITE FOR ILLUSTRATED FOLDER WITH COMPLETE SPECIFICATIONS.

BEKEY

ELECTRIC COMPANY, INC.
1327 S. Main St., Los Angeles 15, Calif.

CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION

A MIGHTY MITE FOR FREQUENCY MEASUREMENT...

MINIATURE, SEALED TYPE FRAHM[®] RESONANT REED FREQUENCY METER



Hermetically sealed construction makes the Frahm Miniature Frequency Meter practically indestructible and foolproof in conditions of heavy moisture or fine dust. Design engineers who try Frahm Sealed Type Frequency Meters specify them

repeatedly for land, sea and airborne equipment because they withstand dirt, fungus attack, humidity and other destructive atmospheric conditions. The "miniature" is available in 2 1/2" and 3 1/2" sizes. WRITE FOR BULLETIN 32P2-ED.

ALSO AVAILABLE IN STANDARD OR SPECIAL MODELS FOR PANELBOARD OR PORTABLE USE

Frahm Resonant Reed Frequency Meters are available in a variety of standard shapes and sizes to indicate alternating current frequency from 15 up to 1500 cycles per second. They are applicable to pulsating or interrupted D-C as well as A-C supply circuits. If you have special design requirements for range, methods of activating, scale graduations, etc., we invite your correspondence. We are confident we can meet your specifications.

WRITE FOR BULLETIN 32-ED.



FRAHM RELAYS AND OSCILLATORS

Frahm Resonant Reed Relays and Oscillators open a new era to designers of electro-mechanisms. The transmission of a number of control signals over a single communication circuit of any type is simplified by the use of these components. WRITE FOR BULLETIN 33-ED (FRAHM RELAYS) AND BULLETIN 34-ED (FRAHM OSCILLATORS).

James G. Biddle
1316 Arch St., Phila. 7, Pa. ED
Please mail following bulletins:
 32P2 32 33 34

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PHILADELPHIA 7, PA.

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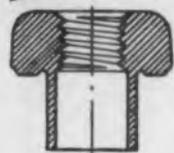
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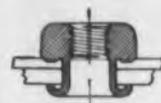
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CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW Tubular's 2 in 1 fastener PERMA-NUT



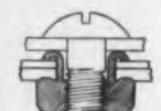
1. makes a **PERMANENT** rivet fastening with threaded **NUT** head
2. provides convenient and fast **ASSEMBLY** or **DISASSEMBLY** of parts
3. fastened **AUTOMATICALLY** with **TUBULAR'S** Automatic Riveting Machines



PERMA-NUT after Setting with a Roll Check



PERMA-NUT Clench Mounts 2 Parts



PERMA-NUT Fastens 3 Parts, Uses Clinch for Spacer, Fastens 3rd Part into Nut

- functions as a rivet, permanently fastening two or more parts, making nut available to fasten other parts.
- permanently clinches nut to a single part for fastening of other parts.
- prevents loss of nut.
- allows installation of nuts in hard-to-reach locations or which become "blind" after assembly.
- eliminates drilling and tapping certain holes.
- prevents nut from turning — sixteen radial serrations bite into part when PERMA-NUT is clinched.
- will not pull out of rivet clinch when properly set — clinch is stronger than the threads of nut head.

Available in steel, brass or 5066 aluminum, PERMA-NUTS are supplied in standard thread sizes of: 3-48NC-2, 4-40NC-2, 5-40NC-2, 6-32NC-2, 8-32NC-2, 10-24NC-2 and 10-32NF-2. PERMA-NUTS of special sizes or with various kinds of plating can be supplied to meet special applications.

Send for sample, design data and specifications of standard PERMA-NUTS.

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See your local classified directory for phone numbers

CIRCLE 196 ON READER-SERVICE CARD FOR MORE INFORMATION

75 V Stabilizer Tube High Stability



A new 75 v stabilizer tube, the 75C1, has been developed for application where low voltage stabilizers are normally employed. Mechanically strong, it combines zirconium electrodes and the sputtered envelope technique. A special uranium oxide coating ensures that the maximum striking voltage is 110 v in both daylight and darkness. The 75C1 has a current range of 2 to 60 ma with a regulation of only 9 v and a variation of burning voltage of less than 1 per cent per 1000 hours.

The burning voltage of 75C1 tubes at 20 ma is confined within the extremely close range of 73 to 79 v. The design gives a combination of high stability and good regulation in one tube.

International Electronics Corp., Dept. ED, 81 Spring St., New York 12, N.Y.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

Audio Line Transformers Constant Voltage Type



These transformers are designed expressly for the distribution systems commonly referred to as 70 v constant voltage systems. They draw a pre-determined amount

of power from a 70 v line. All are mountable in W-1 weatherproof transformer cases with the exception of the ZC-3514.

Types ZC-100, ZC-200, ZC-300 and ZC-400 are equipped with terminal board with a handy pin jack adjustment for the desired input power. Screw terminals are provided for speaker and line connection.

The transformers are impregnated and dip processed for operation in outdoor and industrial atmospheres.

These transformers are part of a series for commercial loudspeakers and accessories for industrial, institutional and public address applications.

Jensen Mfg. Co., Dept. ED, 6601 S. Laramie Ave., Chicago, Ill.

CIRCLE 198 ON READER-SERVICE CARD FOR MORE INFORMATION

You Get Things Done Better By Seeing What's Happening



BOARDMASTER VISUAL CONTROL

- ★ Gives Graphic Picture of Your Operations in Color.
- ★ Easy to Use. Type or Write on Cards, Snap on Board.
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Complete Price **\$49⁵⁰** Including Cards

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Without Obligation

GRAPHIC SYSTEMS, 55 West 42nd St., New York 36, N.Y.

CIRCLE 199 ON READER-SERVICE CARD FOR MORE INFORMATION

Cool that Electronic Cabinet

USE McLEAN CABINET COOLING FANS

- Rack Mounted For Easy Assembly
- Fit Standard 19" Racks
- Wide Range Of Air Deliveries

High temperatures make tubes die young . . . make crystals, transistors and other sensitive electronic equipment perform erratically. That is why leading manufacturers are installing McLean Fans in Computers, Control Systems, Data Processing Systems, etc. McLean Fans are small packaged units that prescreen the cabinet with filtered air, keeping dust out. They are complete in one unit and ready for use. Standard RETMA notching allows mounting on rack . . . no cutting or fitting necessary. All units contain an easily replaceable filter. Smart stainless steel grilles add beauty and eliminate necessity of matching cabinet finishes.

3 Models For Popular Panel Heights
• Small Size (6 1/4" high x 19" wide). Use this when space is at a premium. Two ingenious blowers deliver 160 cfm.
• Medium Size (7" high x 19" wide). Contains 2 powerful blower units. Delivers 300 cfm.
• Large Size (10 1/4" high x 19" wide). Contains double shaft centrifugal blower. Delivers 800 cfm.



Send for our new catalog featuring complete line. Ask about our industrial fan line.

McLEAN ENGINEERING LABORATORIES
PRINCETON, NEW JERSEY

CIRCLE 200 ON READER-SERVICE CARD FOR MORE INFORMATION

Curve Follower

For X-Y Recorders

The Model 210 curve follower is an integral, internal attachment for use on Electro Instrument X-Y recorders.

In operation, the pen of the recorder is replaced with a pick-up coil. This coil is made to follow a fine wire which is bonded to the graph paper. No physical contact is made between pick-up coil and curve. The wire is electrically excited by internal source. Connections are made at both ends of the curve by miniature connectors.

Output is obtained from a potentiometer connected to the pen axis. Other shaft-operated devices, such as digitizers, synchros, can be easily connected.

Overall static accuracy is 0.25 per cent full scale, except near very sharp corners and at slopes greater than 75 degrees.

Electro Instruments, Inc., Dept. ED, 3794 Rosecrans, San Diego, Calif.

CIRCLE 202 ON READER-SERVICE CARD

Cast Teflon Film

In 4-mil Size

An extra-heavy 4-mil cast teflon film is made by the process of depositing sub-micron-sized particles of teflon on a highly polished metal substrate. This extra-tough 4-mil teflon film is produced in a series of sequential operations consisting of the dipping, drying and complete fusing of each of 12 separate layers of teflon. The 3-mil cast teflon film is made by the same casting technique out of 9 separate teflon layers.

An important feature of this process is that the films, comprising a multiplicity of layers, are free of voids, pinholes and physical surface disturbances. The film produced therefrom possesses higher dielectric strength as well as longer dielectric life.

Since teflon is the ideal dielectric, being among the chemically and electrically most inert substances known, cast teflon film has an extremely wide variety of applications, ranging from capacitor dielectric to wire insulation.

D'lextrix Corp., Dept. ED, Allen Blvd. & Grand Ave., Farmingdale, L.I.

CIRCLE 203 ON READER-SERVICE CARD

CIRCLE 204 ON READER-SERVICE CARD

Transitron

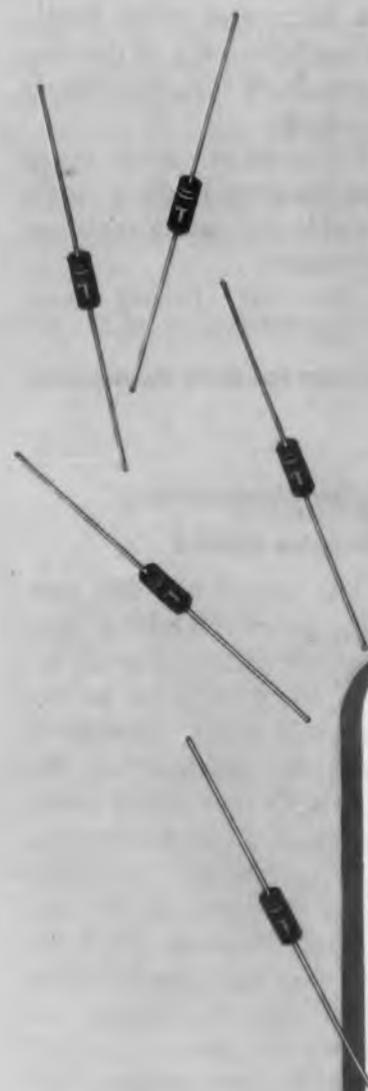
Fast Switching SILICON DIODES

Featuring

- Recovery times under $.3 \mu s$
- High conductance
- High voltage ratings
- Operation to $150^{\circ} C$

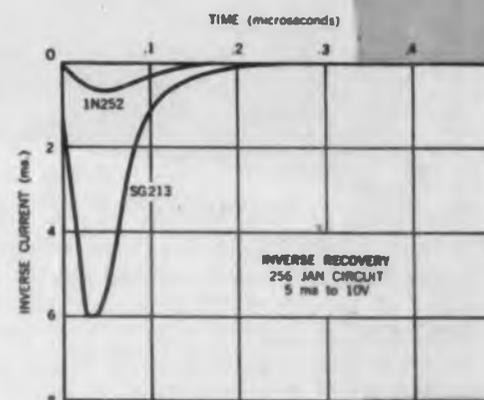
Transitron's fast switching silicon diodes are intended for medium and high speed circuits in which diode recovery characteristics are important. These new types are considerably faster in recovery time than other silicon and germanium diodes. They are particularly useful in computer and similar applications.

In addition to excellent static and dynamic properties, reliable performance is assured through close process control and all glass encapsulation.



Type	Minimum Forward Current at 1.5V (ma)	Maximum Inverse Current (μa)	Maximum Inverse Voltage (Volts)	Maximum Recovery Time* (μsec)
SG228	100	.25 @ 175V	200	1
SG226	100	.25 @ 60V	80	1
SG223	30	.25 @ 175V	200	.5
SG221	30	.25 @ 60V	80	.5
SG213	5	.25 @ 175V	200	.3
SG211	5	.25 @ 60V	80	.3
Low Capacitance Types				
1N251	5 @ 1V	.1 @ 10V	30	.15
1N252	10 @ 1V	.1 @ 5V	20	.15

*Measured in the 256-JAN Recovery Circuit



Send for Bulletin TE 1350C

Transitron

electronic corporation

wakefield, massachusetts



Germanium Diodes

Transistors

Silicon Diodes

Silicon Rectifiers

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CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION

VARIABLE ELECTRONIC FILTERS Frequency 0.02 to 20,000 cps



Models 330-A and 330-M

The gain of the Models 330-A and 330-M VARIABLE ELECTRONIC BAND-PASS FILTERS is unity in the pass band and drops outside the pass band at a rate of 24 db/octave. The use of peaking reduces the attenuation at the corner frequencies by 8 db and permits a band width as narrow as one octave without attenuation in the center of the pass band. Both the high and low cut-off frequencies are independently adjustable from 0.02 to 2,000 cps in the 330-A and from 0.2 to 20,000 cps in the 330-M. This provides maximum flexibility of adjustment of both the band center frequency and the band width. By using two electronically regulated supplies the internal hum and noise is reduced to less than 100 microvolts. Calibration accuracy is $\pm 5\%$. Price, \$475.00 F.o.b. factory.

For Further Details Write

KROHN-HITE INSTRUMENT CO.

Dept. ED, 580 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 207 ON READER-SERVICE CARD FOR MORE INFORMATION

For the Latest News in Employment Opportunities, See ELECTRONIC DESIGN'S "Career's Section" Every Issue.

Pulse Generator Drives 10 Registers



The Datakor 200 series of pulse generator circuits are designed to drive the Datakor 100 series of magnetic shift resistor units. The DK 202 employs only solid state components featuring a combination of transistors for switching elements which provide gain and magnetic cores with rectangular hysteresis loops to control pulse width, regulate pulse currents, absorb power, and discriminate against unwanted signals. It uses three magnetic cores and four transistors.

Able to drive ten DK101 units at speeds up to 50 kc, the DK202 may be connected into a single register, ten separate singlebit circulating registers, or any intermediate combination.

Airtronics, Inc., Dept. ED, 5522 Dorsey Lane, Washington 16, D.C.

CIRCLE 208 ON READER-SERVICE CARD FOR MORE INFORMATION

High Power Pulse Modulator Has Adjustable Pulse Widths



The Model No. 233 soft-tube pulse modulator provides a continuously adjustable range of pulse widths from 0.75 to 3.0 μ secs while using a thyratron as the switch. Output pulses up to a peak of 25 kv at 22 amps peak current are produced, and a maximum duty cycle of 0.003 makes available 1650 w of maximum average power. Included among the features of this equipment are a built-in oscillator for internally controlling the

repetition frequencies, variable from 20 to 4000 pps, a tapped loading resistor to allow matching the primary circuit to the load, and a separate filament supply for energizing the tube to be modulated. A viewing circuit is provided so that the output pulses may be monitored on a synchroscope.

All controls, meters, and jacks are arranged in a logical layout on the front panel.

Manson Laboratories, Dept. ED, 207 Greenwich Ave., Stamford, Conn.

CIRCLE 209 ON READER-SERVICE CARD FOR MORE INFORMATION

get this FREE BOOK TODAY!



ALL ABOUT ENVIRONMENTAL TEST EQUIPMENT

This 20 page digest of the M & M line of environmental test equipment gives you quick facts on the application, performance and economics of Murphy & Miller equipment. Illustrates and describes the industry's most modern units—provides tips on selection and use of all types of environmental test units. Write for it today.



MURPHY & MILLER, INC.

1350 South Michigan Avenue
Chicago 5, Illinois

CIRCLE 210 ON READER-SERVICE CARD FOR MORE INFORMATION



What's new in Commutators and Slip Rings?

We've perfected several new design and manufacturing techniques that are sure to interest you if your project calls for a rugged, precision commutator or slip ring assembly... at a price that will pleasantly surprise your purchasing agent!

The techniques we're so proud of involve a wide choice of insulating materials including fiberglass-epoxy "Tuff-Tube"; seamless conductors of copper, silver, nickel, and gold; amazingly accurate screening, etching; and plating methods; separate or continuous circuits... all combined to result in precision components providing minimum friction and brush noise along with maximum life and accuracy.

Forward your specs and drawings, or better still... call on us for preliminary design recommendations. Sample and prototype orders are welcome.



LAMTEX INDUSTRIES, INC.
51 State Street • Westbury, New York

CIRCLE 211 ON READER-SERVICE CARD FOR MORE INFORMATION

Thomas A. Edison
GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

This relay



... in place of an amplifier

Edison sensitive magnetic relay

The Edison Sensitive Magnetic Relay is ideal for use as a null detector in d-c bridge circuits or for aircraft temperature warning systems with simple lock-in device in contact circuit. Available in SPST or SPDT, hermetically sealed or gasket seal. Contacts rated at 1/3 ampere, 28 volts d-c.

- magnifies power 500,000 times
- operates on input current of 30 microamperes
- takes overload of 10,000 times power input
- repeatability averages $\pm 1.5\%$
- takes 50 g shock
- polarized or differential operation

For full information write for Bulletin 3037.

Thomas A. Edison

INCORPORATED

INSTRUMENT DIVISION
55 LAKESIDE AVENUE
WEST ORANGE, NEW JERSEY

CIRCLE 213 ON READER-SERVICE CARD FOR MORE INFORMATION

Positioning Control Automatic Setting



This device provides automatic positioning control for industrial applications employs an unusual application of bridge circuitry which provides positioning accuracy of 0.5 per cent and repeatability of 0.25 per cent.

This is obtained without the use of vacuum tubes or photocells. The Model AS control will select the shortest route from any position to the desired control point by turning the control knob to the desired "position" number and pressing the "start" button.

Industrial applications include the remote positioning of valves and dampers; remote instrumentation in conjunction with indicating instruments; and as control element in automatic selection equipment.

Cost of the unit is low, and only two manual operations set the motorized control into action.

Wallson Associates, Ltd., Dept. ED, Newark, N.J.

CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION



CPC
PLASTIC CLAMPS

20 SIZES
1/8" to 3"

ALL SIZES, SHAPES and MATERIAL

- FASTER
- SAFER
- TOUGH
- SIMPLER
- MORE SECURE
- ENDURING

For wires, cables, conduits, tubing, light hose. Name the use and Commercial has a clamp ... or will design one. Pioneering "know-how" and advanced production methods of CPC offer unmatched quality ... and at a saving, too! Send for sample clamps and prices.



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COMMERCIAL PLASTICS Co.

CIRCLE 217 ON READER-SERVICE CARD FOR MORE INFORMATION

molded Black Nylon screws and nuts

Insulate and Fasten without bushings, washers, etc. In Stock 4-40, 6-32, 8-32, 10-32 and 1/4-20.



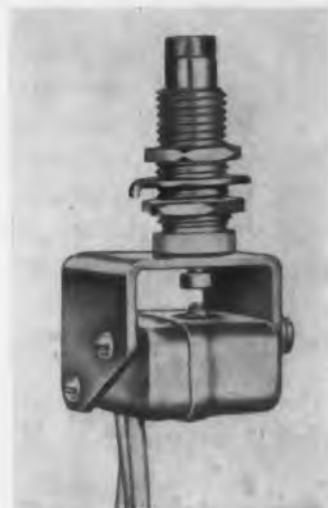
Black Nylon "NyGrip" cable clips

Light-weight non-conducting support for wiring, tubing, etc. In Stock 1/16" to 1 1/2" Dia.

Free samples • write **WECKESSER CO.**
5703-05 Northwest Hwy. • Chicago 30, Ill.

CIRCLE 214 ON READER-SERVICE CARD FOR MORE INFORMATION

Sealed Switch Has Potted Wires



Primarily for use on aircraft and missile applications, this hermetically sealed switch, No. 9129 has a threaded actuator plunger guide sleeve which permits mounting the switch actuator button flush or extended any distance from the mounting board up to 7/8 in. The switch is hermetically sealed, filled with dry, inert gas and is moisture

and dustproof. Switches tested have passed the 50 G shock MIL specification.

The actuator button will flex satisfactorily at minus 90 F as well as at 285 F. The switch is bonded to the switchover and will withstand 100 psi pressure differential inside to outside.

Switch No. 9129, mounted on actuator, has 1/8 in. overtravel with 1/8 in. pre-travel along the plunger.

Haydon Switch Inc., Dept. ED, Waterbury, Conn.

CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION

CLOSURES

- Metal or Plastic Caps or Plugs to protect threads, tubes, machined parts, reamers, cutters, tools.
- Protect against thread damage, dust, dirt, and moisture.
- For inside and outside application.
All sizes. Immediate delivery.

Clover closures are made in metal and tough plastic polyethylene. They are made in caps, plugs and special shapes to fit parts tightly, offering completely sealed protection during manufacture, shipping and storage. Backed by years of closure experience. Write for low prices and complete information.

Send coupon today!

Gentlemen:

Please send samples and prices of closures in
Polyethylene Aluminum

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Address.....

City.....

METAL
Threaded caps for AN & SAE external threaded parts.

PLASTIC
Tapered parts for use either as a cap or plug.

METAL
Threaded plugs for AN or SAE internal threaded parts.

PLASTIC
(L.T. Series)
Non-threaded push-on caps for tubing, AN & SAE fittings, reamers, etc.

CLOVER INDUSTRIES, INC. 584 Young Street
Towanda, N.Y.

CIRCLE 218 ON READER-SERVICE CARD FOR MORE INFORMATION

New Shielded Coil Forms

Miniature but rugged



Now CTC brings you miniaturized shielded coil forms that have all the ruggedness you expect from larger sizes but which snuggle perfectly into "tight spots."

CTC's LS-9 is $\frac{1}{16}$ " diameter x $\frac{1}{2}$ " high. LS-10 is $\frac{5}{8}$ " diam-

eter x $\frac{1}{16}$ " high and LS-11 is $\frac{5}{16}$ " x $\frac{1}{32}$ ". All sizes are when mounted, including terminals. Each mounts by a single mounting stud. All are constructed to CTC's rigid step-by-step quality control to the highest standards. All are highly shock resistant with mechanically enclosed, protected coil windings. They are ideal for use in IF strips, or as RF coils, oscillator coils, etc. Order them as coil form assemblies, or they can be wound to your specifications. For complete information and prices write Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Massachusetts.

CIRCLE 223 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW—self-locking UNBRAKO button head cap screws



The Nylok* self-locking feature locks these screws securely in place. They won't work loose. Can be used repeatedly.

Tough, resilient nylon locking pellets permanently installed. Successfully withstand temperatures ranging from -70 to 250°F . Low, streamlined heads with accurate hex sockets for positive nonslip drive and freedom from marred or mutilated heads. Heat treated alloy steel, continuous grain flow lines, fully formed Class 3A threads for maximum strength and exact fit. Pellets act as liquid seals. Standard sizes #6 to $\frac{3}{8}$ ". Write for Bulletin 2193. Unbrako Socket Screw Division, STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

*TM Reg. U.S. Pat. Off., The Nylok Corporation

UNBRAKO SOCKET SCREW DIVISION

STANDARD PRESSED STEEL CO.

SPS

JENKINTOWN PENNSYLVANIA

Unbrako Products are sold through Industrial Distributors

CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION

Current Pulse Amplifier

For Magnetic Loads



The Model 1070 Current Pulse Amplifier is designed expressly for application to problems involving pulsed magnetic loads. The instrument com-

prises a voltage amplifier-pulse shaper, a feedback clamp, and a current switch or current amplifier. The feedback clamp makes output amplitude independent of duty-factor. Five front panel controls permit linear or exponential control of rise time, and exponential control of fall time.

The current amplifier offers pulse amplitudes continuously variable to 2 amp, and output is a positive or a negative pulse at ground level. Rise time is $0.1 \mu\text{sec}$ at 1 amp, fall time is $0.3 \mu\text{sec}$ at 1 amp and maximum average pulse current is 450 ma. Input pulse is positive, 10 v min, 1 μsec rise time min.

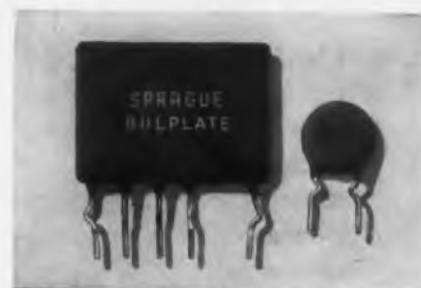
The unit has ten-turn vernier control of amplitude. Amplitude is insensitive to duty factor.

Rese Engineering, Inc., Dept. ED, 731 Arch St., Philadelphia 6, Pa.

CIRCLE 221 ON READER-SERVICE CARD FOR MORE INFORMATION

Hooked Leads

For Ceramic Capacitors



A new design of disc and plate ceramic capacitors and printed circuits for use on printed wiring boards feature a hook or kink in the capacitor or

printed circuit leads as they emerge from the ceramic body.

This assures bottoming of the part on the printed wiring board with sufficient length topeen the leads onto the conducting surface.

The hooked leads allow peening in any direction with positive contact to the conducting surface.

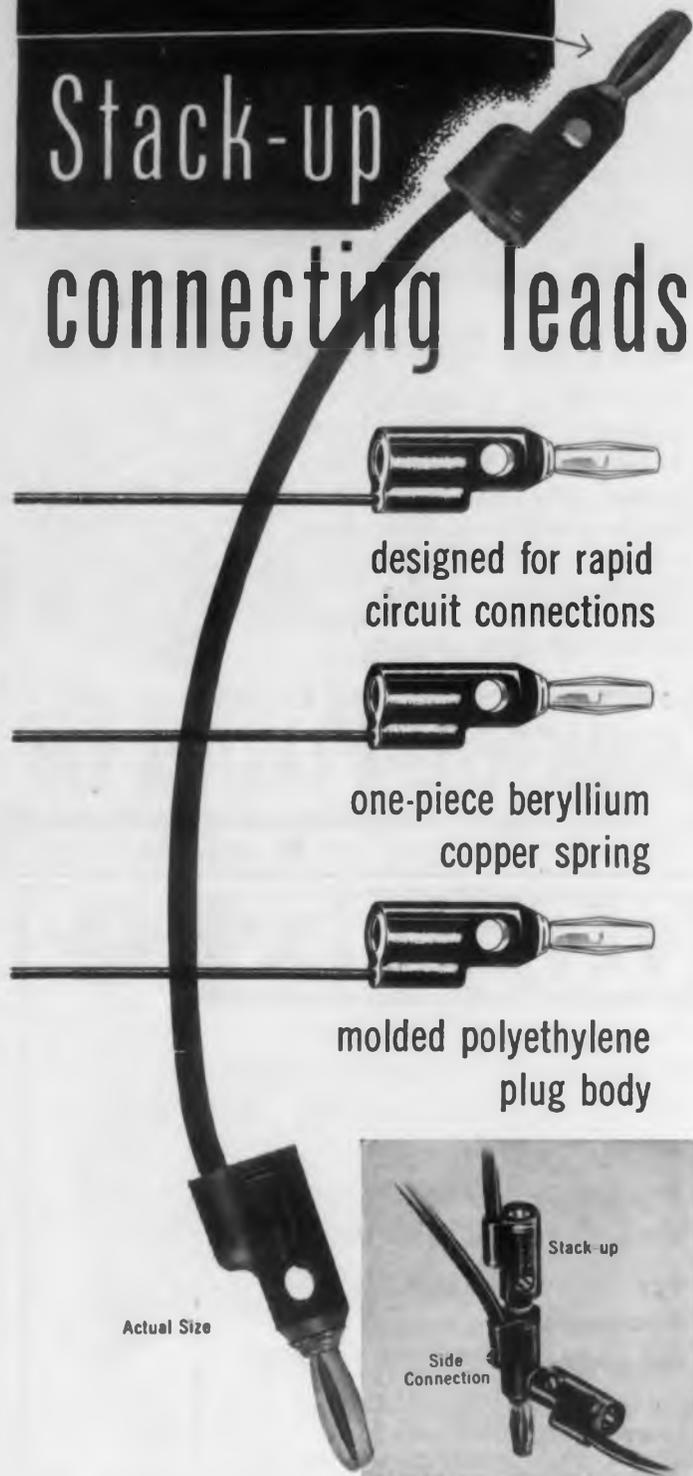
In addition, no ceramic or electrode surface is exposed, preventing long-term degradation of the surface insulation resistance.

This design results in very little additional cost as it uses standard techniques and does not require special coating with protective resin.

Sprague Electric Co., Dept. ED, Marshall St., North Adams, Mass.

CIRCLE 222 ON READER-SERVICE CARD FOR MORE INFORMATION

Stack-up connecting leads



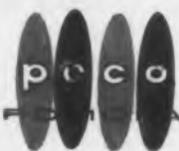
designed for rapid circuit connections

one-piece beryllium copper spring

molded polyethylene plug body

Actual Size

Now in coded colors, Red, Black, Green, Orange, Blue, Yellow, Brown. Six standard lengths, 4"-8"-12"-18"-24"-36". Parallel operation of several instruments are easily made. Stack-up connection permits stacking as many leads as desired at one point.



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ENGINEERS!

FOR ECONOMY AND EFFICIENCY
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PRECISION GLASSWARE!

To keep costs down and yet get the maximum efficiency in electronic parts and sub-assemblies, more design engineers are turning to glassware.

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If you design electric or electronic devices of any kind such as wave guide tubes, UHF tuners and cavities, voltage regulators, capacitors, dashpots, etc., investigate the economy and efficiency of precision glassware. Our engineers welcome the opportunity of discussing any of your design problems with you. Send for our new bulletin today.

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Miniature Indicator Displays Two Functions



This electrical indicating instrument developed for aircraft use features a dual display in a case only 1-9/32 in. diam. by 2 in. long. The indicator has application wherever two functions must be displayed in minimum space, in an environment of high shock and vibration. Mounting is accomplished by AN 5808 type clamps.

The instrument meets MIL-E-5272A Procedure I requirements for both vibration and shock and features a true glass-to-metal hermetic seal.

The HCM 1-1/4 instrument include availability in all ranges normal to dc moving coil instruments; operating temperature range of -55 C to +85 C; weight 4 oz; standard AN connector.

The instrument was originally designed to indicate trim position and to provide alarm for a fail-safe circuit by means of pointer and flag.

Marion Electrical Instrument Co., Dept. ED, Grenier Field, Manchester, N.H.

CIRCLE 228 ON READER-SERVICE CARD FOR MORE INFORMATION

Heterodyne Frequency Meter Has Interpolation Dial



The Wide Range Type 504 heterodyne frequency meter is equipped with an interpolation dial which avoids ambiguity. Visual presentation is facilitated by a two inch CRT, and headphones can be used to determine zero beat. The instrument measures frequencies from 100 to over 10,000 mc. It can also be used as a calibration instrument because it generates frequencies from 500 mc to over 10,000 mc.

The accuracy is better than 0.03 per cent over the whole range and 0.002 per cent at 5 mc crystal check points. Since it is portable, it can be used for field testing of transmitters, receivers, and signal generators.

The instrument has wide range, accuracy, and a price low enough for production as well as engineering departments.

Polytechnic Research & Development Co., Dept. ED, 202 Tillary St., Brooklyn 1, N.Y.

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OK ELECTRONICS

THERMAL TIME DELAY RELAYS

Hermetic Sealing

Guarantees Maximum Stability

MORE SIMPLE

MORE PRECISE

MORE ECONOMICAL

MORE RUGGED

- Actuated by heater . . . hermetically sealed. Unaffected by moisture, altitude, or dust. Perfect for use in military, commercial and communications equipment.

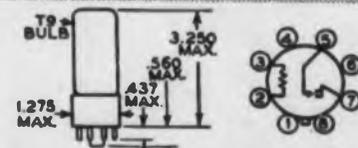
- O.K. delay relays operate on A.C., D.C., or Pulsating currents . . . 2 seconds to 5 minute delay periods.

- Lightweight, simple, trouble-free! Vibrations and shocks will not damage O.K. relays.

- When subjected to ambient temperature changes from -60°C to +85°C, the relay delay interval varies slightly from room temperature delay period.

- Whether relay operation is intermittent or continuous, all O.K. relays are assured a useful longevity.

- Rapid installation is made possible by use of the standard intermediate shell 8-Pin Octal Base.
- Special heater voltages for special requirements.



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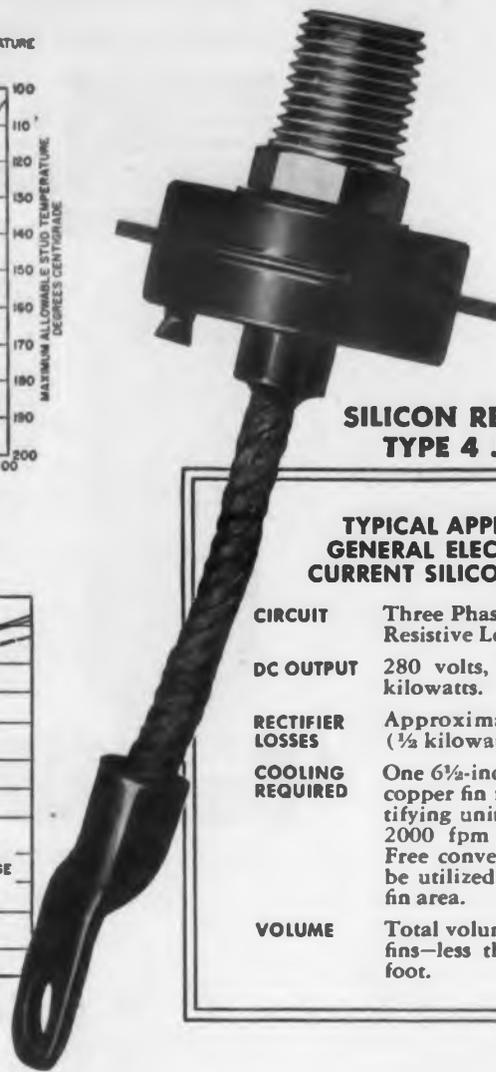
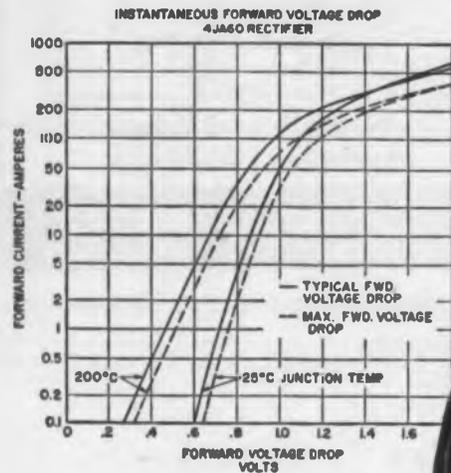
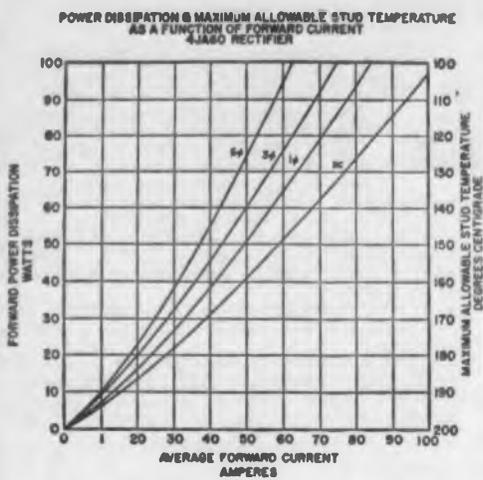
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AND OTHER COLD-HEADED
FASTENERS AND SPECIALTIES

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ELECTRONIC DESIGN • January 1, 1957

DESIGN PROBLEM:

More Rectifier Power per Dollar?



**SILICON RECTIFIER
TYPE 4 JA60**

TYPICAL APPLICATION GENERAL ELECTRIC HIGH CURRENT SILICON RECTIFIER

CIRCUIT	Three Phase Bridge Rectifier, Resistive Load.
DC OUTPUT	280 volts, 215 amperes, 60 kilowatts.
RECTIFIER LOSSES	Approximately one percent ($\frac{1}{2}$ kilowatt).
COOLING REQUIRED	One $6\frac{1}{2}$ -inch square $\frac{1}{4}$ " thick copper fin for each of six rectifying units when used with 2000 fpm 30°C forced air. Free convection cooling may be utilized by increasing the fin area.
VOLUME	Total volume of rectifiers and fins—less than $\frac{1}{4}$ of a cubic foot.

High Current SILICON RECTIFIERS, available now, cost less than other rectifying devices!



High Capacity Silicon Rectifiers—with rating up to 85 amps at 300 volt operating levels—now cost no more than other junction type rectifiers. These high-efficiency silicon rectifiers are produced using the alloy technique developed by General Electric research. Extended life tests show no deterioration in rectifier characteristics when operated at full rated condition.

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Work Anywhere. General Electric Silicon Rectifiers can be

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used in *any* rectifier application. They are being installed now in many applications including:

Arc Furnaces	Magnetic Devices
Cathodic Protection	Shop DC Supply
DC Motor Supply	Welding Equipment

All General Electric Silicon Rectifiers meet rigid military requirements. They are now available in four voltage ranges. For detailed application engineering information, consult your General Electric representative, or write to *General Electric Company, Semiconductor Products, Section X74126, Electronics Park, Syracuse, New York.*

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Circle the appropriate key number or numbers in the shaded section of the Reader Service card you ordinarily use. Replies will automatically be sent to the non-business address you write in the space provided.

Magnetic Shift Register Operates Up To 500 Kc



Designed for reliable operation at speeds up to 500 kc with maximum digit repetition rate above a megacycle, the Datakor DK107 is a high-speed magnetic shift register unit using two-cores-per-bit. All components including the two cores and four gold-bonded germanium diodes are mounted on a miniature tube base and encapsulated in epoxy.

Units can be provided with solder lug headers instead of plug-in tube bases.

The DK100 series includes a variety of units covering a range of speeds, power levels, and signal levels.

Airtronics, Inc., Dept. ED, 5522 Dorsey Lane, Washington 16, D.C.

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Disc-Type Thermostat Snap Action



A snap-acting, disc-type thermostat for applications where maximum shock and vibration resistance are required, feature a disc thermal element, fine silver electrical contacts, and a complete hermetically sealed assembly.

A copper-nickel plated steel casing protects all parts from contamination and moisture to assure precise circuit operation. Applications are especially recommended in aircraft controls and guided missiles.

The C7216 Unit is specially plated for corrosion resistance, and is miniature in size. Standard temperature settings which are fixed, range from -20 F to 400 F. The C7216 Thermostat is available with No. 20 Copper Wire Leads.

Suitable where weight and cost considerations are involved. Applicable to servomechanisms, gyroscopes, and electronic circuitry.

Metals & Controls Corp., Spencer Thermostat Div., Dept. ED, Attleboro, Mass.

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TRANSISTOR ENGINEERING
REFERENCE HANDBOOK**

by *H. E. Marrows*

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Increasing transistor applications in electronic equipment of all kinds have made necessary an easy reference handbook for use in engineering, scientific research, and manufacturing of transistor devices.

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Section 3: Physical specifications, electrical specifications and manufacturer type number and part number of all components — capacitors, transformers, batteries, thermistors, miscellaneous items — designed for use with transistors. List of transistor test sets.

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Calorimeter Bridge

Self-Calibrated



This direct reading calorimeter bridge has a frequency range of DC-4000 mc (coaxial) and 1000-12,000 mc (wave-

guide). The calorimeter bridge is continuously self-calibrated by means of an auxiliary ac standard load and an ac wattmeter. The VSWR of the rf load resistor is less than 1.25, up to 4000 mc. The total error in power measurement is less than 5 per cent.

Electro Impulse Lab., Inc., Dept. ED, 208 River St., Red Bank, N.J.

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Motor-Gear-Train

Operates at -55 C



This size 18 low speed high torque motor-gear-train can be operated in temperatures as low as -55 C. Overall length is 2.8 in., output torque is 25 oz-in. at

1.7 rpm min unloaded. Type 5602-02 is rated for continuous duty at 115 v 60 cy. It utilizes a single phase capacitor or 2 phase servo motor with an operating temperature range from -55 C to +97 C. Single phase no load current is 0.065 amps max and no load input power 7.5 w max.

John Oster Mfg. Co., A-V-ionic Div., Dept. ED, Racine, Wisc.

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Paper Capacitors

Rated Up to 125 C

A new line of molded PVZ paper tubular capacitors, which operate from -55 C to +125 C without voltage derating, are for applications in computers, missiles, telephone equipment and other high grade military and commercial equipment.

They are available in 100, 200, 300 and 400 v ratings, and can be supplied from 0.00047 to 0.22 µf in the 400 v range, and from 0.00047 to 0.15 µf at 100 v.

Nine different sizes of the PVZ capacitors are offered to accommodate the various ratings. The PVZ capacitor is impregnated with a high temperature organic material which is polymerized into a solid resin.

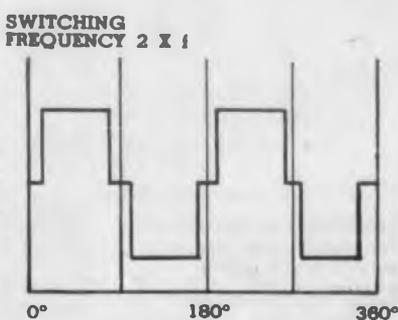
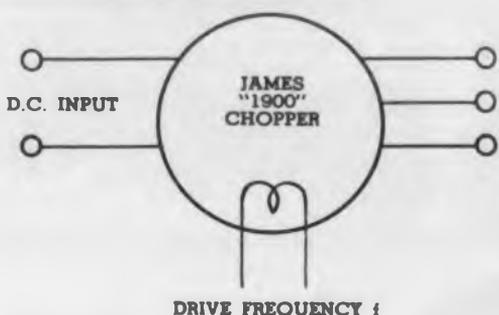
General Electric, Dept. ED, Schenectady 5, N.Y.

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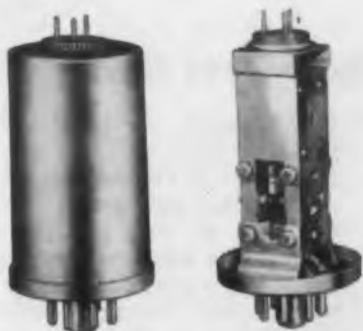
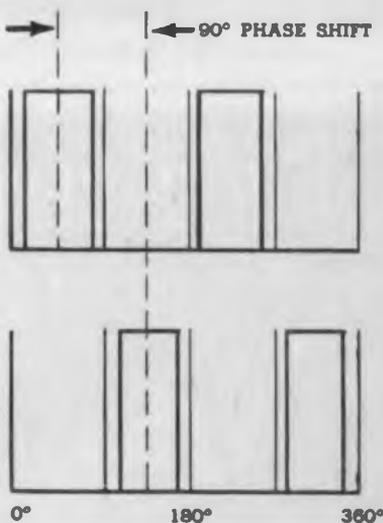
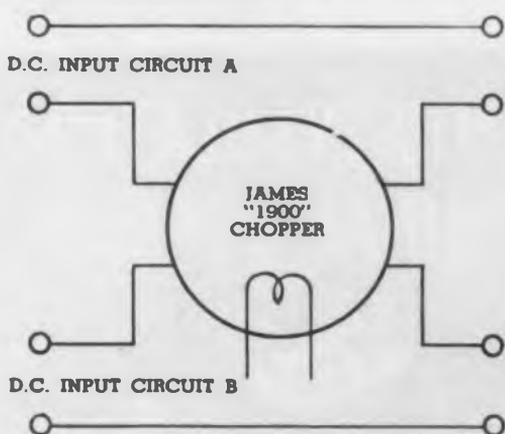
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Introducing the new JAMES "1900" Series Chopper with unique switching characteristics. Below are just two new circuit applications made possible by this component. It is polarized, non-resonant and capable of frequency doubling or providing two circuits 90° apart in phase.

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Made of special ceramic material and silicone coated, they are extremely resistant to moisture and heat and are fungus-proof. Because

they furnish no continuous path for a short, arcing is minimized. Even in the event of a flash-over, there is no permanent damage to the part, as with phenolic boards. Longer life and fewer replacements mean lower true cost. Their type of construction permits positive, neat connections at terminals. Write for detailed literature.

Dependable Airborne Electronic Equipment Since 1928

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New Literature

Plastic Properties Chart 243

The "National Basic Materials Properties Comparator Chart" is intended to help designers and engineers select and specify the best material for a particular application. Thirty-four basic grades of vulcanized fiber and laminated plastics are compared. Twenty-three material property ratings are given for each grade. Instead of the usual numerical evaluation, materials are rated as excellent, good, fair and poor. In addition, the chart gives the comparative price for each grade. National Vulcanized Fibre Co., 1056 Beech St., Wilmington 99, Del.

Corrosion-Resistant Tape 244

With illustrations, an 8-page booklet points out the advantages of polyvinyl tape for covering and protecting pipes, valves, frames, racks and metal surfaces against corrosion both above and below ground. Technical data, characteristics and performance specifications are detailed. Descriptive text, drawings and photographs provide practical information to help users determine applications. Johns-Manville Dutch Brand Div., 7800 S. Woodlawn Ave., Chicago 19, Ill.

Scientific and Engineering Tables 245

Publication of first supplement to booklet "Selected Scientific and Engineering Tables and Data," has been announced. It contains a variety of technological information in the fields of chemistry, physics, engineering, plastics, bacteriology, leather, psychometrics and textiles. The booklet designed as a reference handbook for technicians in these fields, provides standard formulae, charts and definitions in brief and concise form. United States Testing Co. Inc., 1415 Park Ave., Hoboken, N.J.

Pressure Sensitive Tapes 246

"Manual of Pressure-Sensitive Products" is designed as a handbook for designers, production engineers, purchasing agents and material-handling men. Among the features of the manual is a 4-way "tape finder" which enables the user to select tapes by government specification, manufacturer's product number, tape type and specific application within 134 industrial classifications. Illustrated in 4 colors as well as black and white, the manual describes a line of pressure-sensitive products including industrial adhesives. Mystik Adhesive Products, 2635 No. Kildare Ave., Chicago 39, Ill.

Autotransformers 247

Continuously-adjustable autotransformers and motor drives which attach to them are catalogued in Bulletin "0." Photographs, dimensional diagrams, text and detailed specification tables serve to describe a wide variety of models and combinations with input voltages ranging from 115 to 460 v. Cased and uncased single units and 2 and 3-gang assemblies with series and parallel windings are listed. Also illustrated are motor driven units and motor speed controls. A cutaway is labeled to show the construction of a typical model. The 24-page booklet ends with a comprehensive cross-referenced table which gives specifications and prices. General Radio Co., Cambridge 39, Mass.

Servo Production Facilities 248

Production facilities are described in 4-page brochure now released. It includes engineering laboratory facilities for research, model shop, quality control, assembly plant, test equipment, optical manufacturing and development and machine shop. Servo Corp. Amer., 20-20 Jericho Turnpike, New Hyde Park, L.I., N.Y.

Wire Drawing 253

Just released 28-page price schedule which doubles as reference data handbook in the wire drawing industry, and gives prices, cutting extras, packaging and other information. The data handbook contains charts and tables on normal chemical analysis, mechanical, electrical and magnetic properties, as well as useful reference data for production and design engineers. Tech-Alloy Co., Inc., Rahns, Pa.

Electric Motor Laminations 254

A 22-page illustrated catalog of imported "Pre-Tooled" electric-motor and generator laminations and stacks, is now available. The laminations are manufactured from high-grade electrical sheet that gives a very low watts per pound loss. Laminations Co., P. O. Box 13, Stamford, Conn.

Steel Furniture 255

The 1957 "Reference Manual of Steel Equipment" No. 485 is announced. This 48-page book analyzes all types of steel shelving, drawers, lockers, work benches and tables, and other storage, store, office, warehouse, and shop equipment. Equipto, Aurora, Ill.

Carbide Blanks 256

A 35-page price list for cemented carbide blanks and cylinders has been compiled. Labeled GT-314, the book has three sections, one for semi-standard unground blanks, a second for modified blanks, and a third for solid cylinders. Diagrams show available shapes. A list of district offices appears on the back cover. General Electric Co., Metallurgical Prods. Dept., Detroit 32, Mich.

Pressure Operated Valves 257

High pressure linked multi-line propellant valves designed for fuel-oxidizer flow control are described in Tech Bulletin 24. Attention is given to technical design features, and a tabulation of characteristics includes line sizes, pressures, temperatures and weights. In the 4-page brochure, photographs and dimensional diagrams illustrate typical models. Hydromatics, Inc., Cedar Grove, N.J.

Fixed Composition Resistors 258

Type BT fixed composition resistors are described and illustrated in Bulletin B-1A. Comprehensive data on construction, characteristics, solderability, heat dissipation, color coding, resistance values and tolerances are presented. The 12-page booklet also cites design features and reliability data. Detailed charts and graphs expand the text. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pennsylvania.

Alumina Ceramic 259

Pamphlet announcing the applications of the Alumina Body G-73 has been released. It lists the advantages of the G-73, which include high-strength, low electrical loss, and excellent resistance to thermal shock. Dependent on shape and related dimensions, it shows that sizes range from $\pm .010$ in. to $\pm .005$ in. Electro-Ceramics Inc., 975 E. Fifth So. St., Salt Lake City, Utah.

Aircraft Thermistor Detectors 260

MC-134, a 4-page brochure describes thermistor-actuated overheat detectors for temperature control and overheat detection in aircraft. It gives the unique advantages of sensing temperature with thermistor elements, applications and installation techniques, and lists all physical, performance and military specification data. Fenwal Inc., Ashland, Massachusetts.

Miniature Threads and Tools 261

An illustrated catalog on a line of miniature taps, dies, screws, drills and tools is being offered. The 4-page booklet contains dimensional data on all sizes in a range of 56 to 160 threads per in. It also lists prices of stock items and outlines special order facilities. J. I. Morris Co., 394 Elm St., Southbridge, Mass.

X-Band Transmitter 262

Illustrated and described in a 2-page leaflet is the CTI Model 119 X-Band antenna-pattern transmitter, an rf source designed particularly for antenna-pattern measurements. Comprehensive specifications cover the antenna assembly, the modulator, and the remote control unit. Color Television Inc., 1439 Old County Rd. Belmont, Calif.

WIDE BAND ELECTRONIC SWITCH

DC to 15 MC DUAL TRACE
OSCILLOSCOPE PRESENTATIONS



Model ES-180A



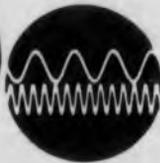
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Amplitude
Comparisons



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of Related
Waveforms



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Display of
Non-Sync.
Signals

● Alternate-sweep or alternate-sample displays, switching rate up to 400 kc

● Amplifier rise-time .023 microseconds, megohm input, 93 ohms load impedance

● Unity-gain, feedback, regulated power supplies for linearity and stability

● Index trace calibrated in volts and % amplitude eliminates parallax errors

● Time-signal input allows accurate and rapid measurement of pulse parameters



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Precision - Produced MATERIALS for TRANSISTORS and DIODES

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★ INDIUM electroplated base or precious metal wires.

★ WELDED RIBBONS — Dissimilar metal ribbons of the same width can be continuously welded together, within close overlap tolerances.

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HI-TEMP SOLENOID

Hi Temp solenoid, to 600°F.
Adjustable plunger travel.
Push or pull types. 18 to 30 volts.
Continuous duty.
Plunger cavity pressure sealed.

This model, or its modification, may fit your needs. WESCO engineers can include one or all of these special design features in a solenoid to fit your specifications. Hundreds of additional aircraft designs available. Write today.

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HIGH POWER C-BAND ROTARY JOINT



Model 7565



The L-type Rotary Joint illustrated is one of three configurations available for use at C-band employing Canoga designed transitions. The L-type Rotary Joint was designed for convenient packaging in radar systems and antenna pedestals. In-line transitions on both ends of the rotary joint may improve packaging in certain applications. Conventional rotary joints with right angle transitions on both ends are also available.

TECHNICAL SPECIFICATIONS

- Frequency: 5400 to 5900 mc
- Power Handling: 500 KW peak (min) unpressurized
- VSWR: 1.2:1 max. over band
- VSWR Variation: with rotation less than 0.04 total
- Phase Shift: with rotation less than 2° total
- RPM Rating: 100
- Torque Required: .01 inch pounds
- Waveguide: 2" x 1" (RG-49/U or RG-95/U)
- Flanges: UG 149A/U, UG-148B/U or UG 407/U, UG-406A/U

Similar rotary joints are produced for other C-band frequencies as well as for the S and X bands.

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Precision Potentiometers 267

Two data sheets recently released illustrate and list specifications, construction, coil characteristics and available modifications of precision potentiometers. The 1-1/4 in. diam series 5300 potentiometer is covered in sheet 54-39 and the 2 in. diam series 5600 in sheet 54-49. Helipot Corp., Newport Beach, Calif.

Hook-Up Wires 268

Bulletin No. 1991 has been published describing new extruded teflon hook-up wires. The bulletin includes constructions of various gage sizes built to meet requirements of Military Specification MIL-W-16878, types E and EE, and gives ordering information. Revere Corp. of America, Wallingford, Conn.

Counting Rate Meter 269

A new technical bulletin has been released on the Model 2850 counting rate meter. This meter is used for g-m or scintillation counting and provides up to 100,000 counts per minute. Included are an illustration, description, and complete specifications. Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif.

Fluorocarbons 270

An 8-page brochure has been published, describing forms, properties and uses of a wide range of fluorocarbon products, from plastic resins to acids and dielectric fluids. Detailed in the booklet are the types and grades available of each form of fluorocarbon products and their suggested uses. M. W. Kellogg Co., P.O. Box 469, Jersey City, N. J.

Frequency Converter 271

A data sheet has recently been issued describing the 60 to 360 cycle converter, suitable for power tool operation. Immunity to damage by short-circuit is discussed, together with the reasons for this feature. The ability to tolerate overloads and to protect associated equipment under such conditions is also treated. Georator Corp., Manassas, Va.

Miniature A-C Voltmeters 272

An engineering data sheet covers a line of miniature, expanded scale ac voltmeters. Listed are uses, ranges and available models. Additional data sheets for each model give mounting dimensions, case descriptions, and standard and special resistances. International Instruments Inc., P.O. Box 2954, New Haven 15, Conn.

Magnetic Shielded Enclosures 273

Data sheet 117 contains information on Fernetec Co-Netic leakproof shielded enclosures with telescopic door or lid, heliarc welded joints and a 5000 to dc frequency range. Complete data includes bench sizes, large sizes, prefabricated room information, applications, air conditioning method and construction. Perfection Mica Co., 20 No. Wacker Dr., Chicago 6, Ill.

Fastening Device 274

A 4-page bulletin is now available describing a fastening device. This fastening device, SPHERELOCK, presents possibilities as a substitute for conventional staking or fastening devices such as nuts, bolts and cotter pins used in assemblies. Bulletin includes line drawings of device. Powell-Gayek, Inc., 2216 Penobscot Bldg., Detroit 26, Mich.

Hipot Testers 275

A booklet has been published describing the "H" series of sensitive hipot testers. Hipot testing can be utilized for production testing by: either preset pass-reject method or by exploratory methods; for preventive maintenance on electrical equipment; or for over-voltage testing. Peschel Electronics, Inc., 16 Garden St., New Rochelle, N. Y.

Cooling 276

Information on equipment, installation and automatic controls accumulated during the years of residential air conditioning is presented in the handbook "Fundamentals of Air Conditioning Controls." It includes complete sections on control applications and electrical distribution practices. Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.

- 272 **Capacitors** 277
 A 16-page catalog has been released describing capacitors of the tubular type, having casings of ceramic and organic materials. The catalog covers units designed for radio-television instrument applications and contains impregnant charts, dimensional drawings, color-code charts and rating tables. Aerovox Corp., New Bedford, Mass.
- 273 **Meter Relays** 278
 A 2-color, comprehensive flyer has been issued describing the firm's line of 2 and 3" meter relays. Included is information on construction, terminals weight, dial, and scale arc for Models 85 and 185. Details of calibration, movement, contacts, insulation breakdown, and temperature ranges are also given. Simpson Electric Co., 5200 W. Kinzie St., Chicago, Ill.
- 274 **Receiver** 279
 A bulletin describing the Type 1502 special purpose receiver is now being offered. This is an extremely sensitive version of the Type 1501 special purpose receiver operating in the frequency range of 55-260 megacycles, fm-am and cw. Included are complete specifications and description of receiver. Nems Clarke Inc., 919 Jesup-Blair Dr., Silver Spring, Md.
- 275 **Threads Made Clear** 280
 A 4-page folder has been prepared explaining the profile origins of the unified threads adopted by the U.S., Britain and Canada; the minor changes in threads per inch from American Standards, and the advantages of thread tightness and interchangeability are given. The Cleveland Cap Screw Co., Box 102, 2917 E. 79th St., Cleveland 4, Ohio.
- 276 **Rubber Parts Manufacture** 281
 Plant facilities and procedures for the manufacture of industrial rubber parts are illustrated in a 16-page booklet. A special section describes silicone rubber products development and manufacturing equipment. Oliver Tire & Rubber Co., Industrial Rubber Products Div., 4341 San Pablo Ave., Oakland 8, Calif.
- Precision Potentiometer** 282
 Noise and life expectancy specifications for the T-10-A laboratory precision potentiometer are included in Data Sheet 54-87. Superseding 54-86, this illustrated sheet mentions several changes in the T-10-A and gives dimensions for case length and height. Helipot Corp., Div. of Beckman Instruments, Inc., Newport Beach, Calif.
- Choppers and Inverters** 283
 Choppers, circuit breakers, inverters, transformers and vibrators are some of the devices specified in a recent 8-page booklet. Illustrations are added to a text which gives performance and specification data for all units. Company facilities are briefly outlined, and district sales offices are listed. Airpax Products Co., Middle River, Baltimore 20, Md.
- British Scientific Instruments** 284
 The 1956 Directory and Handbook of the Scientific Instrument Manufacturer's Association of Great Britain contains a 268-page listing of member manufacturers and their products. A classified index of products is included with a French, German and Spanish Glossary. Waterlow & Sons, Ltd., 26 Great Winchester St., London, E.C.2. Price \$3.50.
- Pressure Sensing Instruments** 285
 Brochure illustrating miniature and standard temperature and pressure sensing instruments is available. It outlines uses and specifications for pressure probes, surface thermocouples, connectors, terminations, and fittings. Also includes revised information on Swaged MgO thermocouples and conductors. Aero Research Instrument Co., 315 N. Aberdeen St., Chicago 7, Ill.
- Supersonic Autopilot** 286
 A 6-page pamphlet describes Automatic Flight Control System which is the first electronic autopilot system developed for supersonic aircraft. Weighing 98 pounds, the MB-3 has more than 5000 different individual parts. Minneapolis-Honeywell Regulator Co., Aeronautical Div., Minneapolis, Minn.

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Recent AMPHENOL "firsts" in RF connectors and cables include Captivated Contact* and Subminax connectors, Teflon tape coaxial cable, Subminax Teflon coaxial cable and Teflon cable with non-magnetic conductors. AMPHENOL leads in the manufacture of approved RG-/U Teflon dielectric coaxial cables.

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Miniature Sealed Switches 290

Available is Catalog No. 5 designed as a handy folder on switches. Included are hermetically sealed and sub-miniature switches, the standard single and double blade, and a page of special switches for custom applications. Also standard and special actuators which may be adapted to special applications.

Complete data is given for component and electrical specifications on each switch with typical schematic drawings included for each series with engineering data. Haydon Switch Inc., Waterbury, Conn.

Elapsed Time Indicators 291

Bulletin A.W.H. ET 600 brings a complete line of basic elapsed time indicators up to date. The 2-page sheet lists and describes the 7500 series dc units, the 12500 series 50 to 60 cy ac units and the 24200400 cy ac units. Specifications, a photograph and a dimensional diagram serve to describe each series. The A. W. Haydon Co., Waterbury, Conn.

X-ray Microscope 292

Information on an x-ray microscope just developed is available in a well illustrated brochure. It features an electrostatic optical focusing instrument which employs x-rays for shadow projection to magnify and reveal detailed internal structure of specimens opaque to light or electrons. Listed among the advantages is the greater penetration, large depth of field and stereographic presentation of image.

Also included in the catalog are many applications in the fields of metallurgy, chemistry, textiles, plastics and rubber. General Electric Co., X-Ray Dept., Milwaukee 1, Wis.

Pyrometers and Thermocouples 293

Pyrometers with standard ranges between 0 to 300 F and 0 to 2000 F are presented with text and illustrations in Bulletin 4257. A variety of thermocouples and rigid and flexible extension arms to be used interchangeably with the pyrometers are also considered. The 12-page treatment covers applications, specifications and prices. Full-size arcs show standard Fahrenheit scale ranges. Illinois Testing Labs., Inc., 420 N. LaSalle St., Chicago 10, Ill.

◀ **CIRCLE 289 ON READER-SERVICE CARD**

Fused Quartz and Silica 294

Fused quartz and silica for use in furnaces, laboratory equipment, lamps, optical assemblies, and chemical apparatus are described in a brochure now available. It shows the properties of these materials in detail and explains the various processes by which they are formed into usable products. Amersil Co., Inc., Engelhard Industries, 685 Ramsey Ave., Hillside 5, N.J.

Connectors and Cables 295

In Catalog IEC 2 there are 16-pages of listings, descriptions, illustrations and specification tables covering a wide variety of electronic components. Among the items offered are AN and rf connectors, rack and panel connectors, coaxial cables and diverse sockets. The booklet is printed in 4 colors. Amphenol Electronics Corp., 1830 S. 54th Ave., Chicago 50, Ill.

Receiving Tubes

Booklet RU-020A contains 44 pages of essential data on receiving tubes for engineers. The more than 450 types described represent over 95 per cent of the tubes involved in radio and television. Large clear tube socket diagrams appear with associated data. Bold tube type numbers speed location, and open style data make easy reading. The booklet is 35 cents. Westinghouse Electric Corp., Electronic Tube Div., Route 17, Elmira, N.Y.

Glass and Quartz Fibers 297

Three kinds of flame-blown glass fiber insulations used for thermal and acoustical applications are described in brochure No. WPD-12. Included are charts illustrating the acoustical and thermal values of Micro-lite, Super Fine and Microtex insulating blankets. L.O.F. Glass Fibers Co., 1810 Madison Ave., Toledo 1, Ohio.

Template Drill Bushings 298

Bulletin DB-855 is a 12-page catalog on self-clinching template drill bushings. Four types are offered for all drill sizes from No. 55 to 1/2 in. Installation procedure and pertinent engineering data are clarified with diagrams. Penn Engineering & Mfg. Co., Doylestown, Penna.

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94 Waveguide Equipment 301

An illustrated 12-page, 2 color catalog just published lists waveguide and coaxial test equipment. Tees, tuners, attenuators, couplers, crystal mixers, crystal mounts, probes and loads are shown with pertinent specifications. Test equipment is furnished for military, industrial and communications users of electronics. Admittance-Namco Corp., Farmingdale, L.I.

95 Fabricated-Metal-Products 302

A fabricated-metal-products brochure suggesting solutions for variety of electrical and electronic manufacturing problems is now available. Illustrated, it describes products to be produced on a custom basis. Included are slip-ring assemblies, microwave assemblies, button-welding and crossbar contacts, and contacts stamped from laminated flat stock. D. E. Makepeace Co., Division Plate & Wire Co., Pine & Dunham Sts., Attleboro, Mass.

96 Epoxy Resin Adhesives 303

Engineering data on high strengths epoxy resins adhesives is available in an 11-page technical bulletin.

The booklet contains information on five representative epoxy resin adhesives which are divided into two groups: a) Room temperature curing types:—Suggested uses for EC 1294 and EC 1474 include the permanent positioning of metal sleeves, bushings, plastic parts, and tool repairing compound, sealer and crack filler, while EC 1472 is suggested for field applications where easy mixing is required and shock is encountered. b) Elevated temperature curing types: EC 1386 is designed for general purpose metal to metal bonding where high strengths are desired. It is used for industrial and aircraft application where high sheer strengths at room temperature and 180 F are necessary. EC 1469 with good strength properties at temperatures of 300 F is used in both metal to metal and honeycombs sandwiches structure.

Also included in this bulletin is general information, product description, tables showing various strengths, applications and curing procedures, and a summary of performance data on competitive epoxy adhesives. Minnesota Mining and Manufacturing Co., 411 Piquette Ave., Detroit 2, Michigan.

Electron Microscopes 304

Data on the construction, specifications and operation of electron microscopes is given in a 12-page brochure now available. In color, the booklet is illustrated and covers such items as electron-optical system, pumping unit, electronics, high voltage, column, gun, magnetic beam alignment, condenser and aperture, beam wobbler, objective lens and astigmator.

Also included is information on the wide field scanner, diffraction lens, intermediate lens, projector lens, reflection-diffraction sample manipulator, 35 mm camera, front-end plate camera, 2 x 2 plate camera, insert screen with binocular viewer, image brightness comparator, and operating controls. North American Philips Co., Inc., Instruments Div., 750 So. Fulton Ave., Mt. Vernon, N.Y.

Chromatographic Analysis 305

Glass and metal fractionating columns, accessories and adsorbents for chromatographic analysis are shown in a 4-page Bulletin, No. 834. Exclusive features of column design are explained, and glass and metal columns, both filled and unfilled, are offered in catalog style for ordering convenience. Column accessories for temperature control, including a thermocouple, lead wire, a temperature indicator and a variable transformer, are pictured and listed. Adsorbents are listed in two classifications: solid or surface types for the analysis of gases, and partition type for liquids. Inert powders, properly sized, are listed for labs interested in preparing their own adsorbents for analysis by partition. Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

Laminated Magnetic Film Tracks 306

Laminated magnetic tracks for motion picture film are discussed in Bulletin 33. The 4-page booklet illustrates standard track widths and positions which can be applied to 16 and 8 mm movie film using the "Scotch" brand magnetic laminate system. Also shown are ten standard magnetic recording films made in 16, 17-1/2 and 35 mm widths. Details of the laminating process are described and physical and magnetic characteristics of "Scotch" No. 121 laminate tape are outlined. The bulletin also lists seven processors equipped to laminate film. Minnesota Mining & Mfg. Co., 900 Fauquier St., St. Paul 6, Minn.

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TOBE pulse-forming networks have an excellent record of performance, in radar, and in seasoning and test equipment for magnetrons and hydrogen thyratrons. Our design experience and production facilities assure deliveries to your schedule requirements.

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CIRCLE 313 ON READER-SERVICE CARD FOR MORE INFORMATION

Spring Design

314

"Spring Design and Selection—in Brief" is a quick, lucid presentation of design fundamentals with enough detail to guide product designers through the initial stages of spring design problems. The 8-page brochure gives basic stress and deflection formulas, commonly used spring materials, typical applications, and certain limitations for each of various types of springs: round wire compression springs, square wire compression springs, rolled or rectangular wire compression springs, volute springs, conical compression springs, high duty compression springs, torsion bars, extension springs, round and rectangular wire torsion springs, cantilever and elliptical type flat springs, spiral or brush springs made of flat wire, control springs, high temperature springs, clock or motor power springs, Belleville spring washers, wavy spring washers, curved spring washers, and hair-springs. A table lists the tensile, torsional, and other physical properties of common spring materials with notes on the process for manufacture and the chief uses of each. Fifteen charts and graphs round out the analysis. Associated Spring Corp., Bristol, Conn.

Cathode-Ray Tube

315

A firm lists and describes all of its industrial cathode-ray tubes in a catalog of 168-pages. Detailed specifications and circuit data for CR tubes used in precision laboratory equipment, radar and general industrial applications are included. Where revisions have been made on tubes, they are noted. Illustrations, graphs, and circuit diagrams help to describe each tube. Also listed are general characteristics (electrical and mechanical), maximum ratings, typical operating conditions, and circuit design values. Requests for the catalog should be on company letterheads addressed to the Industrial Tube Sales Dept. Allen B. Du Mont Labs., Inc., 2 Main Ave., Passaic, N.J.

Vinyl Dispersion Finishes

316

Release No. 21 indicates primers that greatly improve the adhesion of vinyl dispersion coatings to metal and glass. The development of these primers mean that flat sheet metal can be coated with plastisol or organosol systems and then stamped or formed without loss of adhesion or rupture of the finish. Union Carbide & Carbon Corp., Bakelite Co. Div. 260 Madison Ave., New York 16, N.Y.

Porcelain Insulators

317

Standard wet and dry process porcelain insulators are featured in a recent catalog. Included are illustrations and specifications for screw type wire holders, house bracket spools, split and solid knobs, tubes, cleat antenna insulators, guy strain insulators, telephone knobs and pipe thread bushings. The catalog also has complete data on transformer bushings and cable supports for electric signs. Tabulated specifications for each insulator type give appropriate dimensions, weight, a specific description and standard packaging quantities. Universal Clay Prods. Co., 1528 First St., Sandusky, Ohio.

Plastic Parts Production

318

Plastic parts, their advantages, and facilities for producing them are announced in a 4-page folder. Illustrations show some stock items and machining processes. E. Presser & Co., Charlotte, N. C.

Data Processing System

319

A circular entitled "New Developments in Elecom 125 System" has been released. It describes an electronic computer which includes internal memory size up to 10,000 words and buffering of magnetic tape on both input and output. Also featured is a high-speed line printer which operates at 900 lines per minute, and a simultaneous collate-select-separate operation on the File Processor. The circular is illustrated and shows various tables of operating characteristics, speeds, internal operations and input-output operations. Underwood Corp. Electronic Computer Div., 35-10 36th Ave., Long Island City, N.Y.

Hermetically Sealed Switches

320

Designed as a handy, permanent switch idea folder, Catalog No. 5 may be dropped into a vertical file for quick reference. Shown are hermetically sealed, sub-miniature, and standard single and double blade switches. The booklet also lists switches for custom applications and standard and special actuators. Complete data are given for component and electrical specifications on every switch. Typical schematic drawings and engineering data are included for each series. Haydon Switch Co., Waterbury, Conn.

Pressure-Sensitive Teflon Tape 326

A 4-page illustrated folder describes the use of a pressure-sensitive Teflon tape for class H insulation and non-stick facing. The folder states properties and prices of tapes .006 and .013 in. thick and 1/4 to 12 in. wide. The Connecticut Hard Rubber Co., 107 East St., New Haven 9, Conn.

Rectangular Recording 327

Bulletin 203 is a page of data on a multi-channel oscillograph and its recording capabilities. The sheet lists specifications of the Model G2 Galvanometer for recording linear and curvilinear recording. It also points out features of ink and hot stylus tracing methods. Photron Instrument Co., 516 Detroit Ave., Cleveland 2, Ohio.

Aircraft Heater Controls 328

Eight different configurations of aircraft heater controls and a rate-of-rise control are described in a 4-page brochure. With illustrations, the literature describes the operating principle of the temperature controls and lists all pertinent data on temperature range, current ratings, physical dimensions and mounting methods. Typical applications in current aircraft are illustrated. Fenwal Inc., Ashland, Mass.

Motor-Operated Shut-Off Valve 329

A 2-page illustrated data sheet describes a series of motor operated shut-off valves. Designed for high pressure control functions, the valves handle liquid oxygen, rocket fuels and oxidizers, jet fuels, hydraulic fluids, and high pressure pneumatics. Using photographs and diagrams, Tech Bulletin 23 provides a detailed description of the valve design. Dimensions and operating specifications are also given. Hydromatics, Inc., Cedar Grove, N.J.

Time Delay Relays 330

Bulletin AWH TD403 has been issued to supersede pages 1 and 2 of a current catalog. The 2-page sheet contains details on the function of three basic time delay relays, along with catalog part numbers for the standard ranges and voltages in ac, 100 and 400 cy. Illustrations include photos of the models and diagrams to show wiring, principle of operation, and overall mounting dimensions. The A. W. Haydon Co., Waterbury, Conn.

Silicon Junction Transistors 331

Data sheets on NPN grown junction silicon transistors types 2N117, 2N118, 2N243, 2N244, 951, 952 and 953 have just been released showing illustrations, tables of typical design characteristics and curves, grades and physical dimensions. 2N117 and 2N118 transistors have been built to Navy Specs, MIL-T-19112A (Ships) and MIL-T-19502 (Ships). Types 2N243 and 2N244 feature controlled beta spreads of 3 to 1. The data sheets of 951, 952 and 953 have been revised and give additional information. A price list on all the types is included. Texas Instruments Inc., 6000 Lemon Ave., Dallas 9, Texas.

Tube Cap Connectors 332

A complete guide to tube cap connectors for every type of tube has been designed as an insert section for the Alden Handbook. The 17-page booklet lists designs for airborne and missile equipment, power supplies and transmitters, color television and radar equipment, and radio and television sets. The guide is easy to use. Tube cap connectors are classified by cap size, then grouped by types. Insulation charts point out the tube cap insulation best suited for electrical and environmental conditions. Specifications and a line drawing accompany a description of each type. Alden Products Co., Main St., Brockton, Mass.

Silicon High Current Rectifiers 333

ECG-148A is an 11-page collection of application notes on the 4JA60 series of silicon rectifiers. Recently placed in mass production, these small high current rectifiers are capable of handling 10 kw in a three phase bridge circuit. The notes include characteristic curves for power dissipation, instantaneous forward voltage drop, and maximum allowable surge current at maximum rated load conditions. Also shown are curves for fin size requirements under various ambient conditions for both free convection and forced convection of air. In addition, information is presented to help the engineer design for fault currents, determine maximum forward current under various conditions, evaluate methods of cooling, and make thermocouple measurements. A labeled outline drawing shows dimensions & construction. General Electric Co., Semiconductor Prods. Dept., Electronics Park, Syracuse, N.Y.



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Lest confusion reign

Once there was a Prospect who wanted a small, fast relay that would respond to the direction of flow of current, and which would do it at least a few million times. He journeyed from Source to Source, asking his questions with straightforward hopefulness. But everywhere the answers were equivocal, with nary a single "Yes" or "No." There were moments when he *thought* a center off type for differential operation was just what he wanted, but he became uncertain after losing the ability to distinguish between spring bias and the everyday human variety. At other times, also, in the company of other Sources, his hopes rose when answers about "speed" began "will handle 750 pulses per second..." (here was the way *he* liked to hear people talk), only to sink again when followed by such words as "... depending, of course, on the amount of excitation expressed as a net pulse level." Long before, he had abandoned Pinning Down, and had begun a desperate attempt at Keeping Up. But finally he realized he sought in vain; a relay to meet his requirements could not possibly be described simply. He wandered away, head bowed — crumpled fragments of data sheets fluttering after him.

Series 72 HIGH SPEED RELAY

With what may seem like undue pride, we only wish this wretched soul had stumbled on one of our devices, namely the Sigma 72 relay. Not that the language of our literature is so pristine, wholly untouched by the Jargon of the Trade, but we could have told him that our 72

Is an SPDT relay which responds to direction of current flow.

In correctly designed circuits, takes about 0.2 milliseconds for transferring its contacts and is intended for high speed switching up to 500 pulses per second.

Gives practical value to its high operating speed by switching a 60 ma. 110VDC inductive load half a billion times on the average without maintenance.

Allows repair and adjustment by the user (detailed manual and test set available).

By comparison, takes up little space (1 7/16" dia. x 2 5/8" high) and is lightweight.

Bulletin on request.



SIGMA

SIGMA INSTRUMENTS, INC.,

40 Pearl Street, So. Braintree, Boston 85, Massachusetts

CIRCLE 337 ON READER-SERVICE CARD FOR MORE INFORMATION

Mechanically Interlocked Felts 338

Mechanically interlocked felts made wholly from synthetic fibers are discussed in a recent technical bulletin. Specific uses in electronic and other fields are recommended. The booklet cites the peculiar advantages of these felts along with their specifications. American Felt Co., Glenville, Conn.

Closed-Circuit TV 339

Using photographs, diagrams and sketches, a 28-page guidebook details equipment and systems for closed-circuit television service in medical, educational, industrial, and business fields. Featured are a medical color TV camera which mounts in an overhead surgical lamp fixture, color and monochrome live and film camera systems, auditorium-size color and black-and-white TV projection systems, and mobile units for remote origination of color and monochrome programs. Also described and illustrated are signal distribution systems, control consoles, and special-effects equipment. The booklet presents case-histories of typical closed-circuit TV installations. Requests for "RCA High-Fidelity Television" should be made on letterhead stationery. Radio Corp. of America, Camden, N.J.

Fluorocarbon Coatings 340

The proper choice and use of fluorocarbon coatings is discussed in detail in a 16-page technical report "How to Apply and Sinter Fluorocarbon Coatings." It is the latest on coatings based on polytetrafluoroethylene and polymonochlorotrifluoroethylene resins.

Illustrations are given and the report discussed the use of fluorocarbons where severe corrosion, extreme temperatures, electrical insulation, abrasion, "sticking" and other factors, singly or in combination are problems.

It includes typical applications, descriptions and specifications, and it shows the user how to select fluorocarbon to best overcome a problem with the preparation of the surfaces. Gene Bartzak Associates, 119 Soifer Ave., North Bellmore, L.I.

Decade Resistance Units 341

Publication 1742-A tells about the D-805 decade resistance units. Its 2-pages contain information on the accuracy, switches, windings, connections and mounting of the equipment. A photograph of the unit and a diagram showing mounting details comprise the illustrations. A table lists specifications. Muirhead & Co., Ltd., Beckenham, Kent, England.



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Remember the benefits promised by Circuitry . . . savings in time, effort, and costs in your production. You will get them if your circuits are produced by economical mass production techniques. If they are uniform in quality. If they are delivered on schedule.

It makes sense to pick a supplier who promises these and more. **CRONAME DOES.** Mass production has tripled our production in one year. Our circuits are covered under Underwriters' Laboratories Recognition program for UL listed items. Specify **CRONAME** "printed circuitry processing" for your circuits.

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CIRCLE 342 ON READER-SERVICE CARD FOR MORE INFORMATION

Precious and Base Metals 347

Brochure lists and describes precision-rolled solid and laminated precious and base metals for industry. The illustrated booklet contains exhaustive technical information for jewelry manufacturers as well as producers of a variety of chemical and electrical equipment. Items covered include solid and laminated flat stock and tubing, raised and spot lay, waveguide and special tubing, wire, contour rolled stock, and precious-metal solders. D. E. Makepeace, div. Union Plate & Wire Co., Pine and Dunham Sts., Attleboro, Mass.

Floor Boxes 348

A four-page folder describing the "800" series Floor Box, component parts and service fillings is now available. Included in the folder are dimensional data, photographs and descriptions of component parts and service fittings of the series.

Listed among the features are: fully adjustable, removable top, rubber collar seal to keep out moisture, holes for tying down to concrete forms and a standard four-inch Octagon box of various depths. National Electric Products Corp., Gateway Center, Pittsburgh 22, Pa.

Epoxy Resin Curing Agents 349

A technical bulletin (F-8665A) on epoxy resin curing agents which are used in the manufacture of adhesives or laminates for bonding a variety of materials has been published.

The bulletin indicates that amines are extensively used as agents for curing epoxy resins. The variety of amines available offers epoxy resin formulators a broad range of useful working time—from a few minutes to an hour or more. There are included tables, formations and curves describing various applications of the agents. Carbide and Carbon Chemical Co., Div. Union Carbide and Carbon Corp., 30 East 42nd St., N.Y.C.

Silicones 350

1957 Reference Guide on silicones has just been published. Almost 150 commercially available silicones are described in this catalog, and the products are grouped by usage; water-repellents, dielectrics and release agents. The catalog is well illustrated with applications, and emphasis on charts comparing various silicones. Dow Corning Corp., Midland, Mich.



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All-Electronic Broad Band Sweeping Oscillator

Designed for continuous coverage from 2 to 220 mc with sweep width to 30 mc plus, and with high output automatically held constant over both frequency sweep and tuning range.

SPECIFICATIONS

Range: Fundamental frequency 2 to 220 mc, continuously variable in ten switched overlapping bands. Direct reading frequency dial calibrated to $\pm 2\%$. RF Output: 1.0 v rms into 75 ohms, metered. Flat within ± 0.5 db. over widest sweep and over frequency band. Sweep width: Continuously variable $\pm 2\%$ to 30% of center frequency to maximum of at least 30 mc. Sweep rate: Continuously variable 10 to 60 cps. locks at line frequency. Attenuator: Switched 20,20,10,6 and 3 db plus continuously variable 6 db. Price: \$695. F.O.B. Plant.

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130 **TRIMPOT**[®] solder-lug type



You can solder your hook-up wire direct to this instrument, and eliminate splicing. Terminals are standard flat, slotted lugs to provide fast, secure connections.

The silver-plated solder lugs are extremely rugged. Instrument is not affected by soldering iron temperatures.

205 **TRIMPOT**[®] for printed circuits



Round pin terminals on this unit may be plugged into holes in your printed circuit boards for dip soldering. Terminals are gold-plated copper, 1/2" long, .028" diameter, and spaced in multiples of 0.1". Mounting is accomplished by 2-56 screws through body eyelets, or by pins only.

BOTH UNITS PROVIDE a usable potentiometer range of 98%, and low residual resistance either end, 0 to 1%. Low temperature coefficient wire is utilized in the precision wirewound resistance elements.

In all other design features, these instruments are similar to the original Model 120 TRIMPOT. Each is subminiature in size (1 1/4" x 3/8" x 1/4"), and weighs only 0.1 oz. Other characteristics include 25-turn screwdriver adjustment, self-locking shaft, and excellent performance under extreme shock, vibration and acceleration. Units meet or exceed most government specifications. Delivery from stock on standard resistances. Send for Bulletins 130 and 205.



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**MULTIPLIER
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*plugboard
programming*

new jumper-wire system
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Now! In one operation at his desk,
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... another startling new
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Do modified and improved electrical sys-
tems throw your testing section into a tailspin?
Normally, it means existing test machinery (or
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Circuitry can now be connected to the tester
by the most convenient point-to-point method.
Connecting wires (adapter cables) do not have
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This is just one advantage offered by this
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Arma Corporation • Douglas Aircraft Com-
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Division • Goodyear Aircraft Corporation •
Martin, Baltimore • Naval Ordnance Labora-
tory, White Oaks, Maryland • Northrop Air-
craft, Inc. • Motorola, Inc. • Temco Aircraft
Corporation • Trans World Airlines • Con-
vair • Chance Vought Aircraft • Servomech-
anisms, Inc. • Radio Corporation of America
• Pacific Mercury Television Mfg. Corp.

CIRCLE 359 ON READER-SERVICE CARD FOR MORE INFORMATION

Controlling Catalog

360

Short Form Catalog on electronic counting, timing and controlling instruments is now available. The instruments are illustrated with the important features, applications and specifications highlighted. Included are Universal counter-timers, frequency and period counters, time interval meters, decade and preset decade counting units. It also shows the adaptability of an instrument to a particular need. Computer-Measurements Corp., 5528 Vineland Ave., North Hollywood, Calif.

Ventilating Systems

361

A 12-page comprehensive brochure on corrosion-proof ventilating and exhaust systems has just been released. It covers such items as thermoplastic corrosion-proof centrifugal fans, ducting and fittings and hoods. Also included is a discussion of polyethylene and non-plasticized polyvinyl chloride centrifugal fans with detailed specifications on various models. Various positions and arrangements to meet specific operating conditions is shown. The brochure is well illustrated and all data is arranged in chart form for ease of reference. American Agile Corp., P.O. Box 168, Bedford, Ohio.

Fluxes

362

Three types of fluxes are described in a technical bulletin just released which gives information on mild, non-activated and activated rosin fluxes.

The bulletin includes complete descriptions of each, their applications, which are of particular interest to those involved in the problems of electronic, dip and printed circuit solderings, and the advantages to the users. Accurate Specialties Co., Inc., 9-01 43 Ave., Long Island City, N.Y.

Polyester Laminates

363

Comprehensive chart listing 28 electrical and physical properties of 11 standard grades of fibreglas-reinforced polyester laminate has just been published. The chart divided into three sections—a) rigid laminate grades, b) flexible laminate grades, c) phenolics, is designed to help users of electrical insulations select material for Class B temperature applications. It lists electrical insulation properties, such as swelling in humidity and after heat; flexure as received after heat and when hot; and rigidity as received and when hot. This Grade TS is a low-cost glass-mat laminate insulation meeting NEMA GPO-1 standards. The Glastic Corp., 4321 Glenridge Rd, Cleveland 21, Ohio.

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ADJUSTABLE — HERMETICALLY SEALED TIME DELAY RELAYS

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Bulletin AWH TD401 Describes
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24300 Series — 400 cycle units
Nominal Range of Adjustment: 8-1
Timers supplied with:
AN connector
Hermetic Adjusting Knob
Glass Window and Calibrated Dial



Design and Manufacture of Electro-Mechanical Timing Devices

CIRCLE 364 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1, 1957

362 Motors and Counters

Fractional horse power shaded pole gear motors and counters are described in catalog now available. It features output rpm torque and mounting with input volts, amps, and temperature rise made to specifications. The gears are made of nylon moulded, powder metal, cut or stamped steel and are available in three sizes of laminates, allowing for torques up to 1/30 horse power, and with or without clutch. Electro-Counter and Motor Co., 1713 No. Ashland Ave., Chicago 22, Ill.

363 Double-Coated Tapes

A brochure is available which describes the advantages and shows the uses of double-coated paper and cloth tapes. This material is a high-tack pressure-sensitive tape with adhesive on both sides, with a liner on top side to prevent it from adhering to the roll. Quick and easy to apply, it can be used in place of tacks, clamps, glue or cements in many holding, splicing and bonding operations to cut costs, speed assembly and processing and increase output on production line. Manville Dutch Brand Division, 7800 South Woodlawn Ave., Chicago 19, Ill.

368 Remote Positioning Controls

Bulletin No. J-100 covers Electrical Remote Positioning Controls for both push button and automatic operation.

It features a new shaft mounted control gear motor with or without potentiometers for built-in remote indication or for use in automatic follow-up systems. The remote positioning control is fast acting with follow-up control for valves, gates, variable speed drives and displacement pumps. Also a blender, punchcard reader and load controller are discussed. The Jordan Co., Inc., 3235 West Hampton Ave., Milwaukee 9, Wisc.

369 Fibre and Phenolic Plastic

Information on fabricated parts and components is contained in a 12-page booklet which deals with the cost advantages gained by dealing with a single source for fabricated parts made from vulcanized fibre, phenolite laminated plastic, nylon and combinations of these materials.

Illustrations show machining operations and products made; property and application charts help designer or engineer select the best grade of these engineering materials. National Vulcanized Fibre Co., 1056 Beech Street, Wilmington 99, Del.

370

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*A computing element
of great accuracy*



Linearity of this tachometer is within 0.02% expressed as a percentage of the output voltage at any speed from near zero to 4000 rpm. Unique design features maintain ripple voltages between 100 rpm and 4000 rpm at less than 0.04% of the output voltage and the magnitude of the ripple voltage decreases appreciably at speeds below 100 rpm.

Note these specifications:

Output Voltage (volt/1000 rpm)	8.75
Linearity (percent)	0.02
Maximum Speed (rpm)	4000.
Armature Inertia (oz. in. ²)	3.7
Friction Torque (oz. in.)	1.
Weight (lbs.)	8.



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NEWS for design engineers



ACTUAL SIZE

UNION

DIGITAL INDICATOR

A new lightweight Digital Indicator for data display has been developed by Union Switch & Signal that has many uses in aviation and other industries. It is designed for either local or remote use, on a direct wire basis, and responds to binary code. The indicator reads out directly and has a non-dissipating storage facility. Data can be printed out if necessary. Write for Bulletin 1011.

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GENERAL APPARATUS SALES



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CIRCLE 377 ON READER-SERVICE CARD FOR MORE INFORMATION

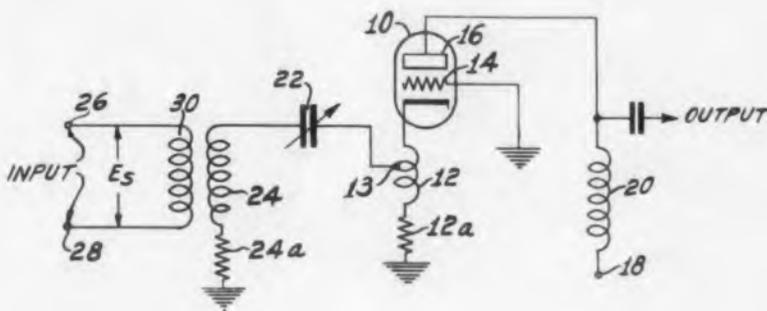
Patents

Tunable Frequency Systems of Constant Band Width

Patent No. 2,743,356 G. C. Sziklai (Assigned to Radio Corp. of America)

Many amplifiers, such as used in TV and other circuits, require that the circuit be tuned over a wide range of frequencies and yet maintain the bandwidth substantially constant. With particular reference to TV, there are 13 channels in the 54 to 216 mc range. Throughout this range, the bandwidth frequency should be approximately 6 mc and this bandwidth should remain substantially constant throughout

grounded. The resistance 24a and 12a are the resistive components of the inductive elements 24 and 12. The effective resistance in series in the tuning circuit should have a value equal to $2\pi L$ times the pass bandwidth of the acceptance frequency, which for TV would be approximately 6 mc. The inductance L is the total inductance of the tunable circuit. Normally the resistance in the circuit is greater than the value required so that the tunable circuit should be coupled into the grid circuit of the amplifier tube by a transformer. As an example, a circuit would require a 6 to 1 ratio for a top frequency in the tunable range of 213



the range. At these higher frequencies, the problem has been to maintain the bandwidth throughout the receiver frequency range.

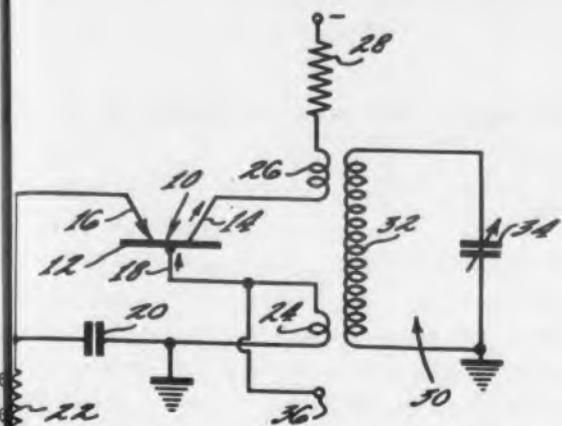
The patentee secures this result in the circuit illustrated. The resonant circuit comprises an inductance 24 having a tunable capacitance 22 in series therewith which is coupled into the cathode circuit of an amplifier tube 10. The coupling shown in the circuit is by connection with an inductance 12 in the cathode connection of the tube. The amplifier tube has its grid

mc, using the smallest tuning capacitance of about 4 μf and with a cathode impedance of 180 ohms. This transformation ratio may be secured by selecting a tap 13 on the cathode inductor 12. The input signal is applied to the inductor 24 from the input terminals 26 and 28 through the primary winding 30.

The patent sets forth the mathematical analysis by which the circuit elements may be determined. It also shows a typical TV circuit as well as a circuit for a superheterodyne form of signal detector.

Stabilized Semi-conductor Oscillator Circuit
 Patent No. 2,757,287. T. O. Stanley. (Assigned to Radio Corp. of America)

Oscillator circuits have been devised using transistors. The circuits use either the point contact transistor or the junction transistor. Transistor oscillator circuits do not maintain constant amplitude over a wide



range of frequencies in that usually the amplitude decreases at the high frequency end of the range or increases at the low frequency end of the range. These circuits are also subject to some frequency instability.

The patentee has devised a circuit, a simple form of which is shown in the figure, which improves on the performance of these prior circuits. In the collector electrode circuit there is provided a winding 26 which is closely coupled with a winding 24 in the base electrode circuit for regenerative feedback. A tuned circuit 30 has a winding 32 coupled to windings 24 and 26 and a tuning condenser 34. Additional regenerative feedback is provided if the winding 32 has a relatively greater number of turns and is closely coupled with the two windings 24, 26. The frequency of the oscillations generated by the transistor circuit is approximately the resonant frequency of the tuned circuit. The tuned circuit has an added result in that it contributes in securing amplitude stability at the higher frequencies.

A resistor 28 in the collector circuit increases its potential drop upon any increase in the amplitude of the current through the circuit, the effect of which is to make the collector electrode more positive. This reduces the bias on the collector electrode 14 and thereby compensates for any increase in amplitude, particularly at the lower frequencies. This resistor also compensates for variations in frequency caused by variations in the emitter bias voltage.

Additional amplitude stability at higher frequencies is secured by connecting a condenser 20 between the emitter electrode 16 and ground. Upon increasing the frequency of the oscillator, the reactance of the condenser decreases, causing a decrease in the impedance of the emitter circuit. Since the feedback here is degenerative, the decrease in the impedance compensates for decreasing amplitude and maintains the amplitude over the whole range of frequencies. The condenser 20 has a reactance which is equal to or about equal to the resistance of the emitter circuit.

Demodulator

Patent No. 2,755,380, Norman P. Laverty and Walter E. Peterson (Assigned to Northrop Aircraft, Inc., Hawthorne, Calif.)

This patent describes an FM detector which operates in the following manner: (a) the sinusoidal input is passed through a limiter to produce a square wave of the same frequency as the input, (b) the square wave is converted into a sawtooth wave whose amplitude is proportional to the signal frequency, (c) the amplitude on the sawtooth is converted into a dc voltage whose magnitude is thus proportional to the signal frequency.

Interconnection of Transmission Lines

Patent No. 2,755,445, Harold A. Rhodes. (Assigned to American Tel. and Tel. Co.)

A method of connecting six communication lines without unwanted interference; each communication line contains two transmitting wires and two receiving wires. The circuit is so arranged that each of the six transmitting legs is coupled to the five receiving circuits of the other communication lines, but is not coupled to the transmitting circuits or to its own receiving circuit. These six line units may then be interconnected to provide interconnection between any number of four wire lines.

Ground Track Indicator

Patent No. 2,755,464, Britton Chance, and Ivan A. Greenwood, Jr., (Assigned to the United States of America)

This patent describes a control system for a radio object locating system. The circuit provides for either of two possibilities. (a) The antenna drive mechanism directs the antenna in a direction which is set on an electrochemical control device, (b) The antenna rotates at a constant speed and supplies an output pulse when the direction of the antenna coincides with the direction which is set on the control device.

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*du Pont's trademark for its tetrafluoroethylene resin.
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* M-500 Silicon Rectifier by Sarkes Tarzian is designed to convert ac to dc in radio and television receivers and other electronic devices.

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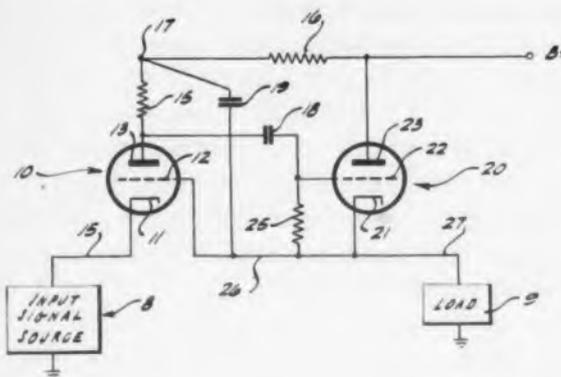
In Canada: 700 Weston Rd., Toronto 9. Tel. Rogers 2-7535 • Export: Ad Auriema, Inc., New York City
CIRCLE 379 ON READER-SERVICE CARD FOR MORE INFORMATION

Unity Gain Amplifying System

Patent No. 2,743,325 H. R. Kaiser et al
(Assigned to Hughes Aircraft Company)

There are situations where it is desirable to provide a circuit having unity gain, such as in providing an impedance match or to isolate the input source from the load. This form of circuit should also compensate for changes in the circuit elements. Unity gain circuits are known, but they consist of three tubes and require special filters for the attenuation for high and low frequency response. Such filters are necessary in order to avoid self-oscillation, but as a consequence the frequency range is restricted.

In the circuit shown, the input signal is applied to the cathode of the first tube 10. The output signal at the anode, which is transmitted through condenser 18 to the control grid of the tube 20, is in phase with



the input signal. The control grid of the first tube 10 is connected with the cathode of the second tube 20, and hence with the load 9, which is in the cathode circuit of the second tube or in cathode follower relation. There is, therefore, no phase reversal between the output signal and the input signal.

If the circuit is considered initially without the condenser 19, there is then a signal at the anode of the first tube 10 which consists of two components, one of which is related to the original input signal and the other component is related to the difference of potential between signal voltages at the grid 12 and cathode 11. If the grid voltage is less than the input signal, the polarities of the two components are the same and increase the signal on the anode. If the grid voltage is greater than that of the cathode signal, this second component has an opposite polarity and thereby reduces the signal at the anode.

With the condenser 19, connected as shown, a third component is added to the signal appearing on the anode 13. This third component has a polarity and ampli-

tude related to the output signal of the second tube. The condenser decreases the sensitivity of the circuit and the gain more nearly approaches unity. The capacitor 19 may be substituted by other coupling networks and in addition may apply only part of the output signal appearing at the junction 17, so that the gain of the circuit may be greater than unity.

Impulse Excited Magnetic Reflection System

Patent No. 2,743,392 A. W. Friend (Assigned to Radio Corp. of America)

There are many applications for a sawtoothed wave, the most common of which is for the control of the sweep of the beam of a cathode-ray tube. Sawtooth wave generators provide a damper in order to give the wave linearity. However, some loss of energy occurs with the use of a damper. Gaseous conduction tubes were used in such circuits in order to improve their efficiency. A sawtooth wave generator more recently developed, stored the energy which is normally lost in the damper circuits and used this stored energy to assess a so-called B boost in the voltage. This circuit ordinarily used a coupling transformer which is a relatively expensive component and there are, necessarily, power losses as well.

The circuit devised by the patented secured a B boost dispenser with a transformer and provides an efficient circuit. Between the power source terminals is a series circuit composed of an inductor, a gaseous diode, having its anode connected with the inductor, and a storage capacitor. The storage capacitor is charged from the source and the diode serves as a unidirectional switch. A discharge circuit is connected between the junction of the diode and the storage capacitor, and the negative terminal of the power source which includes the beam reflection winding for the cathode-ray tube and a thyatron in series. A B boost condenser is provided between the junction of the inductor and diode, and the anode of the thyatron. The voltage is too low to cause any effective current flow through the beam reflection windings during the charging cycle. The voltage across the condenser is generally sinusoidal.

In operation, the storage condenser is charged through the inductor and diode. When the storage condenser is about fully charged, the potential across the diode becomes too low for conduction, and

charging ceases. At the same time a synchronizing pulse is applied to the control grid of the thyatron, which makes this conductive. The charge stored on the storage condenser then discharges through the beam deflection coil and a thyatron, with a linearly varying current, and thereby creates the changing magnetic field which controls the sweep of the beam. When the storage condenser is discharged, its voltage swings negative which restores potential of the thyatron to below conduction potential and the thyatron becomes non-conducting for a second cycle of operation. The B boost condenser provides a damping circuit for the energy stored for the magnetic field of the deflection coil after the thyatron has ceased conducting, and also provides additional voltage after repeated cycles to boost the voltage across the storage capacitor to a value slightly less than the sum of the voltage of the source and the voltage across the B boost condenser.

Power Supply Protector

Patent No. 2,758,273. Hugh H. Martin (Assigned to General Electric Company, New York)

This patent describes a modification to the conventional series regulated power supply that effectively disables the regulator tube for a prescribed time interval after the power is applied. An RC circuit is connected across the output circuit and has its midpoint connected to a neon glow tube. The other terminal of the glow tube is connected to the grid of the series regulator tube and thus maintains a low potential on this grid when the neon tube is ionized and the capacitor is uncharged. As the voltage is first applied to the regulator, this neon tube is ionized, but eventually the capacitor charges up and the tube is extinguished. This circuit thus protects the regulator against initial overload without affecting the steady state operation.

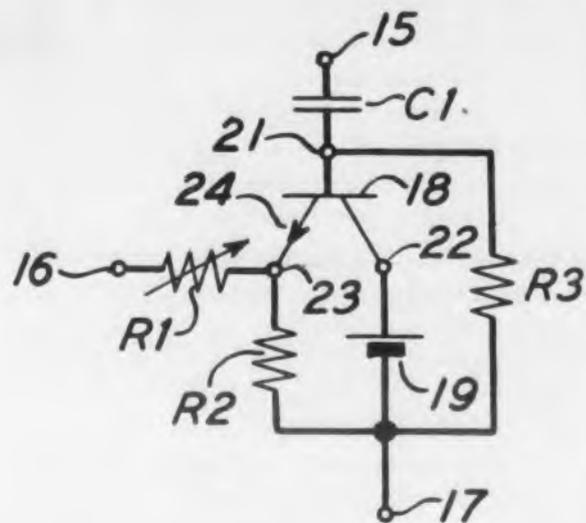
Wave Transmission Network Using Transistor

Patent No. 2,733,415. J. T. Bangert. (Assigned to Bell Telephone Laboratories, Inc.)

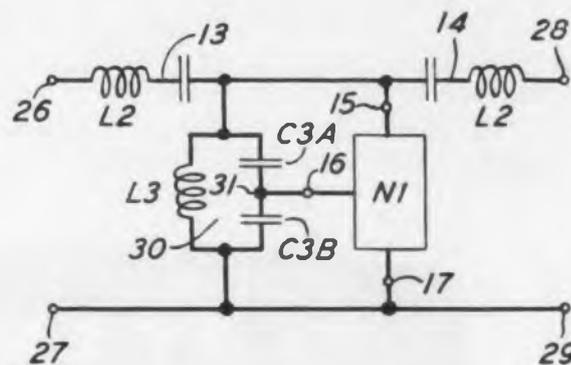
A network using a transistor to provide a shunt negative resistance results in a network which is simpler, lighter, has a longer life and dispenses with a cathode heater which is necessary when the circuit uses a vacuum tube. This network also may be designed to compensate for the losses neces-

sarily appearing in the network branches.

The basic network is shown in Fig. 1



which has three terminals 15, 16 and 17. The network uses a condenser $C1$ in the branch between the terminal 21 for the base electrode of the transistor and network terminal 15. A battery 19 is provided in the



branch between the collector electrode terminal 22 and the network terminal 17. Three resistors are provided in the manner shown in the figure, the resistor $R1$ preferably being adjustable so that the magnitude of the negative resistance may be adjusted.

The basic transistor circuit of Fig. 1 may be used in numerous forms of network such as band elimination, high-pass, confluent band pass and m derived band pass filters. The negative resistance of the basic network may be used in either the series or shunt branch of the filter. In the confluent band pass filter of Fig. 2 the basic network is connected between the condensers $C3A$ and $C3B$. The patent discloses other forms of filters in which the basic network may be used.

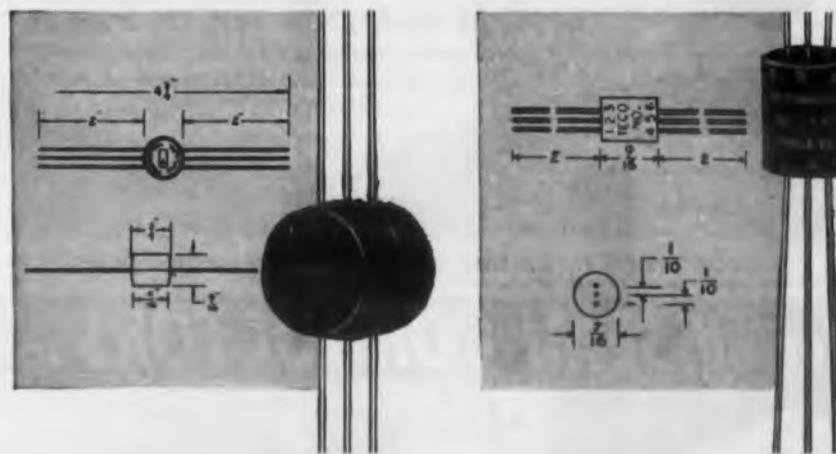
With the basic network a number of advantages result such as sharpening of the cutoff and an increase in the attenuation in the suppressed bands, and reducing the loss in the pass band. As mentioned above, the network may be designed to compensate for the losses in other branches of the filter.

pulse transformers

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Books

Industrial Engineering Handbook

Edited by H. B. Maynard, McGraw-Hill Book Co., 330 West 42 St., New York, N.Y., 1510 pages. Price: \$17.50.

Electronic engineers can profit from this handbook, intended primarily for industrial plant personnel. Perceptive insight is afforded to understand better the climate of the industrial scene and the factors which tend to make up this environment, at times vastly different from a strictly R&D activity. In addition, the discussions of industrial engineering practices, in the planning and controlling techniques of daily work, can be readily adopted or adapted with ease by the electronic engineer. The scientific approach to problems is not to be confined to any one type of engineer.

Introduction to Solid State Physics (Second Edition)

Charles Kittel. John Wiley & Sons, 440 Fourth Ave., New York 16, N.Y. 617 pages. Price: \$12.00.

This book covers a large part of the field of solid state physics at an introductory level. It emphasizes the areas of active research in solids which may be discussed in terms of simple physical models. The second edition includes fuller explanations of the basic concepts in the areas of symmetry and energy band theory. New material has been added on diffusion, dislocations, alloys, semiconductors, photoconductivity, luminescence, and imperfections in solids. Contains numerous graphs and tables of experimental data.

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Progress in Semiconductors, Vol. I

Edited by A. F. Gibson, P. Aigrain, and R. E. Burgess. John Wiley & Sons, Inc., 440 Park Ave., New York 16, N.Y. 220 pages. Price: \$8.00.

The first of a proposed annual series, this collection of important review papers represents an attempt to help the busy engineer keep abreast of important developments in the semiconductor field. The volume contains articles for both the specialist and those working in allied spheres. For example, to interest the specialist, there is an article on photo-magneto-electric effect in semiconductors; while a paper on the design of transistors to operate at high frequencies should serve the circuit designer and give him some indication of the problems to be faced in meeting his requirements. A paper on recent advances in silicon is a sweeping review of a large field. Other articles in the book deal with the germanium filament in semiconductor research, the theory of the Seebeck effect in semiconductors, the electrical properties of phosphors, and the field effect in semiconductors. The collection is an international one, and incorporates the work of leading specialists.

Spectroscopy at Radio and Microwave Frequencies

D. J. E. Ingram. Philosophical Library, New York, N.Y. 332 pages, 73 illustrations. Price: \$15.00.

Although approaching the subject in a general way, considerable space is given to the design of experimental apparatus for those who wish to set up spectrometers, but a balance is maintained between fundamental and applied research. Contents include waveguide techniques, microwave spectrometers, results and theory of gaseous spectroscopy, paramagnetic resonance, ferromagnetic resonance, radio-frequency spectroscopy, and applications.

Engineering Inspection Manual

Henry A. Roy. Chemical Publishing Co., Inc., 212 Fifth Avenue, New York, N.Y. 160 pages. Price: \$5.75.

An aid to inspectors engaged in machine tool, aircraft, and other mechanical inspection, emphasizing quality control procedures and efficiency. The book discusses micrometer techniques, the use of various gages, and inspection setups. Contains various useful tables and a glossary.

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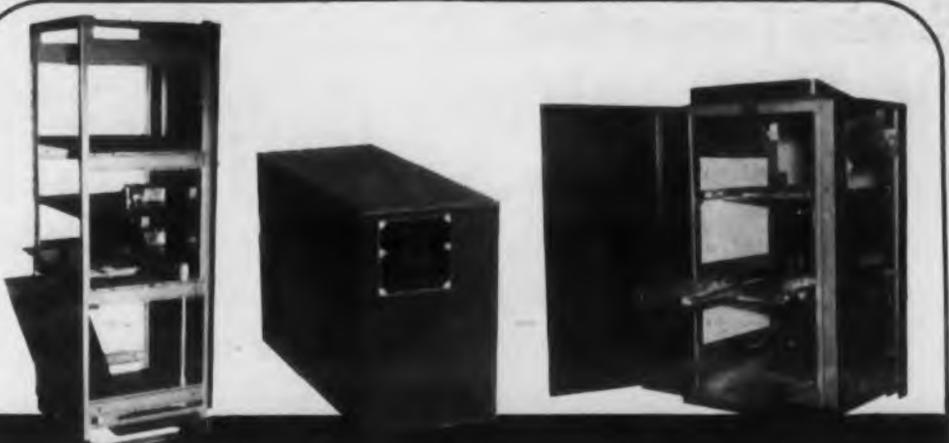
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What The Russians Are Writing

J. George Adashko

Contents of *Avtomatika i Telemekhanika*, No. 6, 1956

Analysis of Processes Occurring in Non-Linear Intermittent-Regulation Systems, Ia. Z. Tsyarkin (13 pp, 16 figs, 3 tables).

Analysis of a sampling-control system where the control-pulse duration is proportional to the error, and where the system is essentially non-linear for finite errors.

Use of Germanium Transistors in Apparatus for Protection, Remote Control and Communication Circuits for Power Systems, G. K. Martynov, V. V. Pavlov (11 pp, 10 figs, 3 tables).

Survey of transistor circuits and tabulation of transistor characteristics.

Characteristics of Magnetic Amplifiers with Feedback, N. M. Tishchenko (8 pp, 9 figs).

Derivation of approximate equations for a saturated-core amplifier feeding a resistive load. The equations take into account the core materials and dimensions, the load resistance, and the parameters of the semiconductor rectifiers used. By allowing for these factors it is possible to establish more accurately the conditions contributing to higher amplifier stability.

Magnetic Amplifiers with Parallel Loads and their Use in Relay Protective Circuits, G. V. Subbotina (9 pp, 8 figs).

Parallel-load magnetic amplifiers are of interest in relay circuits, where the source of power may be a current (current-transformer) rather than a voltage source. The article discusses the duality of the series-loaded and parallel-loaded magnetic amplifier with respect to several design parameters. Refers to articles by A. G. Milnes (New Theory of Magnetic Amplifiers), *Proc. IEE*, vol 97, No 58, p II, 1950), and Edegley and Hamilton (The application of Transducers as Relays to Protective Gear, *Proc. IEE*, vol 99, No 70, p II, 1952).

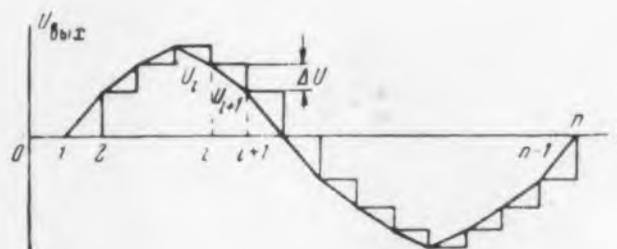
Delay Block Employing Operational Amplifiers and Capacitors, Ia. I. Grinia, P. N. Kopai-Gora (8 pp, 11 figs).

Delay is produced with a memory network comprising a group of capacitors charged and discharged electromechanically at set intervals. The distinguishing feature of this particular block is the

use of an operational amplifier to read the voltage across the memory capacitor, thus eliminating the difficulties involved in similar devices.

The input signal is fed through an input network to the memory network. The held values of the input voltage are read by two read-out devices, the outputs of which are time-shifted staircase approximations of the input voltage. A network reads the output voltage without noticeably discharging the capacitors.

To smooth the resultant staircase function it is necessary to add a suitable (positive or negative) ramp function to each step of the staircase (see figure). This is done by a circuit which also contains an alternate operating mode (mode 2), in which the staircase voltage is smoothed directly by integration and inversion in amplifiers.



Other Articles in This Issue:

"Application of Canonical Expansions of Random Functions to the Problem of Determining the Optimum Linear System," V. S. Pugachev, (11 pp); "Force of Jet against Flap in Pneumatic and Hydraulic Control Devices," V. N. Dmitriev, A. G. Shashkov, (11 pp, 13 figs); "Analysis of Behavior of Thermistor in a Thermal-Control System Based on the Use of the 'Relay Effect,'" G. I. Pavlova, I. T. Sheftel'.

Contents of *Elektrosvyaz'*, No. 5, 1956

Accumulation of Noise and Fading in Radio-Relay Lines, V. I. Siforov (12 pp, 6 figs).

Quantitative statistical analysis of the relationship of the signal-to-noise ratio at the output of a line to the parameters of the individual line elements. The author gives a general method for determining the probable distribution of the signal-to-noise ratio, given the probable distribution (which obeys either the Rayleigh or the gamma distribution law) of the signal field intensity.

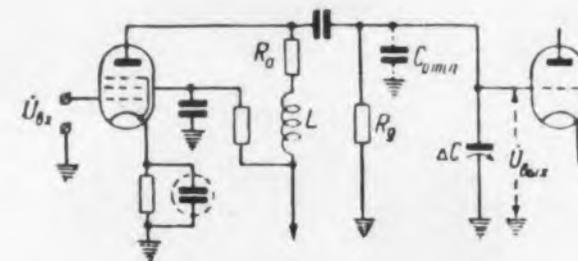
On the Reception of Weak Signals, A. A. Kharkevich (4 pp, 1 fig).

Generalized communication-theoretical discussion of the presently-known methods (accumulation, auto-correlation, coherent-reception, filtering) used for the reception of weak signals. The author shows why all methods yield approximately the same gain and derives a limiting relationship for optimum reception. Refers to papers by Lee-Cheatham-Wiesner, Hampton, Fano, Tucker-Griffith, Rudnick, and S. F. George.

On the Design of Amplifier Stages with Simple HF Compensation, G. S. Ram (5 pp, 3 figs, 1 table).

Analysis of the circuit for the case when load resistance R_a is not negligible compared with

$R_i R_g = \frac{R_i R_g}{R_i + R_g}$. This article will be abstracted in future issue of *ELECTRONIC DESIGN*.



Long-Distance Propagation of UHF by Scattering in the Troposphere, A. I. Kalinin (8 pp, 11 figs).

Survey of foreign advances in the field.

Other Articles in This Issue:

"Low-Noise Radio-Telegraph Lines," A. A. Pirogov, (11 pp, 5 figs); "Analysis of Optimum Constant for Symmetrical Trunk-Line Cables," I. I. Grodner and E. F. Ukstin, (10 pp, 13 figs, 2 tables); "Comparative Analysis of Regenerative Methods for Reception of Telegraph Pulses," A. P. Chepikhov, (12 pp, 13 figs); "Automatic Panoramic Ionospheric Station," E. V. Ryzhkov, L. M. Shur, A. I. Rakin, (10 pp, 9 figs) (abstracted elsewhere in this issue).

Contents of *Radiotekhnika*, No. 6, 1956

Self-Excited Oscillator with External Applied Driving Force, S. I. Evtianov (10 pp, 3 figs).

A new approach, called the "modulation-characteristic" method, is used in this theoretical

analysis. The frequency of the external applied voltage is analyzed into its Fourier components, which can be thought of as being modulated by the bias voltage at the self-excitation frequency. The "modulation characteristics" represent the dependence of the amplitude of each harmonic on the bias voltage and are approximated from the static characteristics of the tube.

The article is devoted to a thorough analysis of this method, which is also applicable to a self-excited oscillator with two degrees of freedom and without external driving force.

Single Sideband Modulation with the Aid of Phase Networks, B. B. Shtein (14 pp, 2 figs, 2 tables).

If a three-phase system of hf currents (or voltages) is modulated with a three-phase system of lf currents, it can be readily shown that when the currents are added vectorially, all but the upper or lower sideband frequencies (depending on the phase rotation) cancel out. The author has determined experimentally that application of this method to single-sideband telephone makes possible more than 20 db suppression of one sideband.

Power Relationships in a UHF Vacuum-Tube Oscillator, L. N. Kolesov (16 pp, 12 figs, 1 table).

Derivation of the fundamental power relationships in a triode uhf oscillator, accounting for the effect of the inertia of the electrons and of the parameters of the oscillating system. The relationships derived are valid over a wide range of operating frequencies, electrode voltages, and plate loads. This relationships permit prediction of the behavior of vacuum-tube oscillators used as power amplifiers, frequency multipliers, and amplitude modulators.

Calculation of Field Strength in Shadow and Penumbra Zones in UHF Propagation along Earth's Surface, A. I. Kalinin (7 pp, 7 figs).

A single approximation is derived for the shadow and penumbral zones. The results obtained by ordinary diffraction theory yield fairly accurate values for the shadow zone only.

Maintaining Identical Tuning Characteristics in Multi-Band Receivers in which the Bands have Unequal Ratios of Maximum to Minimum Frequency, L. Kharinski, N. I. Svetlov (8 pp, 3 figs, 1 table).

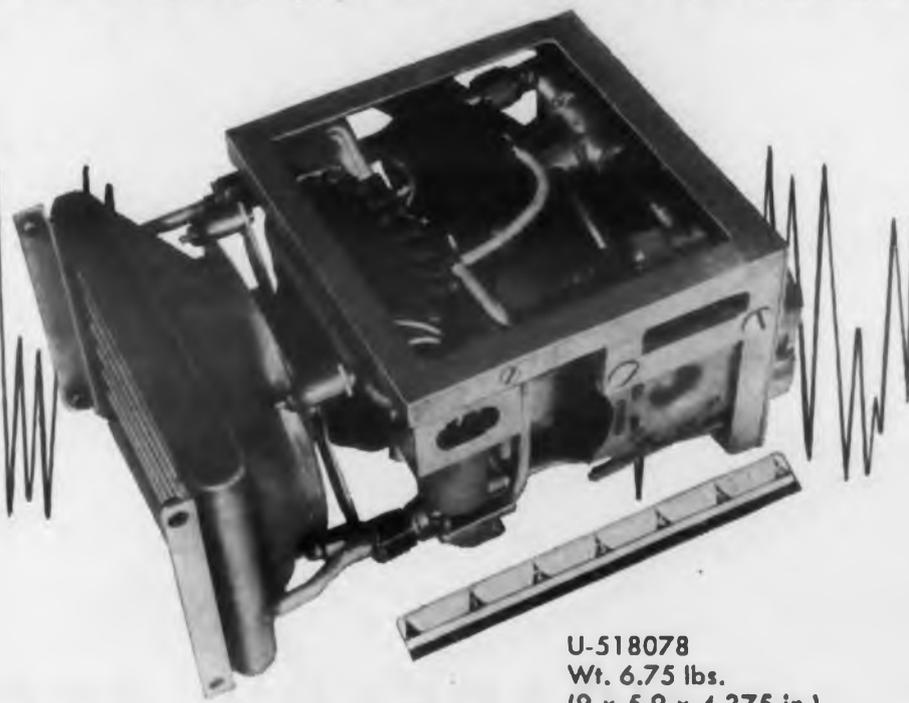
Discusses improved tracking and simplified tuning of multi-band broadcast superheterodyne receivers.

Other Articles in This Issue:

"Positive Current Feedback in Low Frequency Amplifiers," G. I. Gurovich (5 pp, 4 figs), (*abstracted*, Dec. 15, 1956, p 116); "Determination of Rate Change of a Pulse at the Time of Switching," V. Rudnyi, (3 pp, 3 figs); "On the Accuracy with which Total Impedance can be Measured with the Aid of Long Lines," R. M. Dombrugov, (5 pp, 5 figs).

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(begins on page 121 this issue)

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Be sure to see ELECTRONIC DESIGN's new "Career's Section" which begins on page 121 of this issue. All employment opportunities and editorial relating to employment have been consolidated into a single reading section for your convenience. Note the Confidential Reply Form to simplify and insure the privacy of your individual inquiries. To inquire about the opportunities offered in a personnel advertisement, use the same Reader Service card you now use—merely circle the appropriate Reader Service number (in shaded area) and fill in your home address in the space provided. Your reply will be treated with complete confidence.

Avtomatika I Telemekhanika, No. 6, 1956

Electronic Analogue of Backlash, S. P. Onufriuk
A. A. Fel'dbaum (11 pp, 12 figs, 2 tables).

Simulation of automatic-regulation systems is frequently complicated by the presence of backlash, the effects of which depend on the relative values of inertia and friction in the system.

A typical shaft coupling with backlash is illustrated in Fig. 1, (where the rotation is symbolically represented by translation). Let x_0 be the angular coordinate of (driving) shaft A, and x the angular coordinate of (driven) shaft B. If the two shafts are engaged, one of the following two relationships holds:

$$x = x_0 - \epsilon_1 \text{ or } x = x_0 + \epsilon_2$$

where ϵ_1 and ϵ_2 are constants.

The equations of motion of the coupled shafts are

$$(J_1 + J_2) \frac{d^2x_0}{dt^2} = (J_1 + J_2) \frac{d^2x}{dt^2} = M_1 + M_2$$

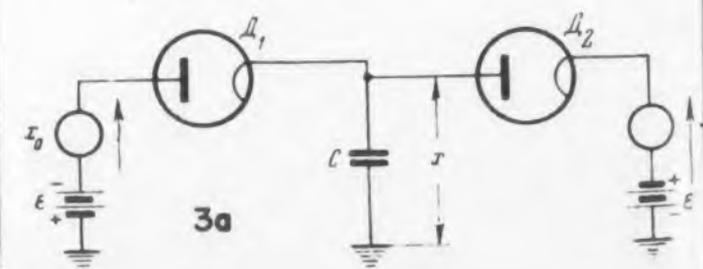
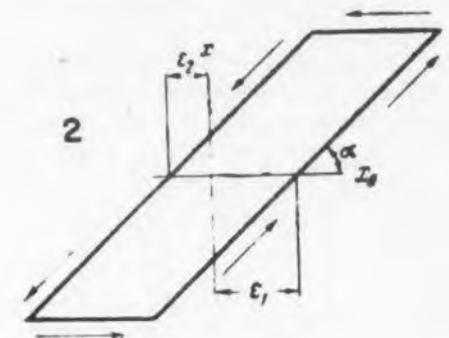
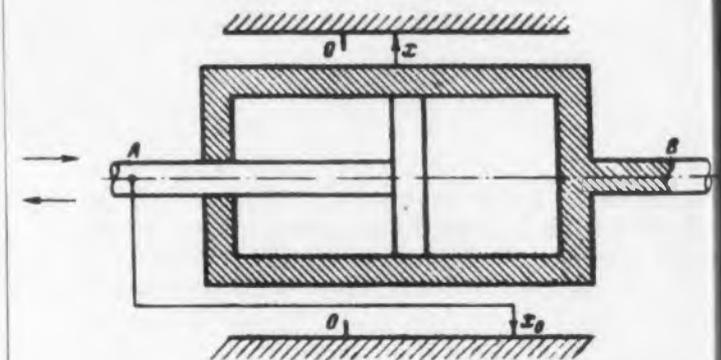
where J and M represent the moment inertia and the torque, while subscripts 1 and 2 refer to shafts A and B respectively.

If x lies within the interval

$$-\epsilon_1 < x_0 - x < \epsilon_2$$

which we call the backlash zone, the shafts are disengaged and the equations of motion become:

$$J_1 \frac{d^2x_0}{dt^2} = M_1; \quad J_2 \frac{d^2x}{dt^2} = M_2.$$



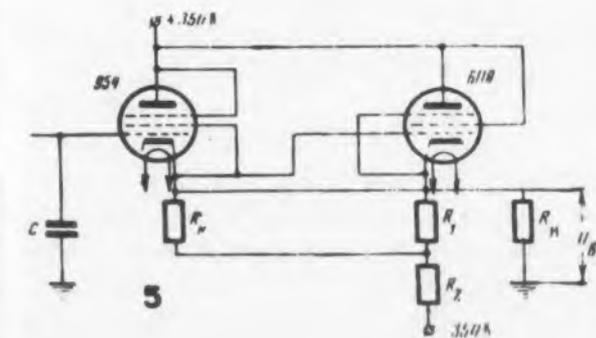
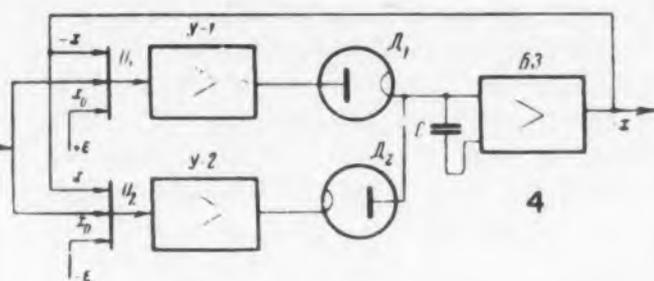
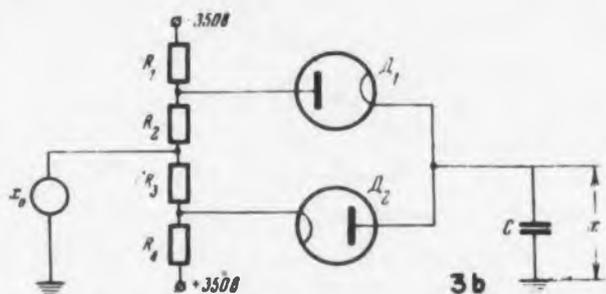
The most interesting practical cases are:

956 (a) Torque is applied only to shaft A, i.e., $M_a = 0$, $M_b \neq 0$. Shaft B then moves in the backlash zone at the same speed as at the instant of disengagement (neglecting friction).

(b) Shaft B has torque applied, but has low inertia, thus stopping practically the moment it is disengaged. The relationship between x and x_0 can then be represented by the loop of Fig. 2.

The simplest electronic analogue (for case b) is shown in Fig. 3a, where capacitor C charges only when the output of generator x_0 exceeds the fixed battery voltage ϵ_2 (Fig. 3b is a practical realization of 3a). The usefulness of such a scheme is limited by errors introduced by the output pick-off (which should be of the infinite-impedance type) and by the errors due to the lower knee of the diode characteristic. It is therefore advantageous to use a circuit such as shown in Fig. 4. Here the input x_0 is fed to two high-gain (1000 and more) amplifiers Y-1 and Y-2, the outputs of which are connected through two diodes to a "memory block" (B3), which "freezes" the charge on capacitor C whenever the circuit is in the backlash zone. If the circuit is not in the backlash zone (one of the diodes is conducting) the memory block becomes an amplifying or integrating link.

Several modifications of the backlash simulator are possible, depending on the type of memory block employed. Fig. 5 shows the actual memory circuit used.



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A WIDE-RANGE ionospheric station developed and built at the M. A. Bonch-Bruевич Leningrad Electrotechnical Institute is described in this article, abstracted from *Elektrosviaz* No. 5, 1956.

Operating in the frequency range of 0.5-20 mc, the station has a pulse power of 2.5-5.0 kw, a pulse repetition frequency of 12.5, 16.66, 25, 50, and 100 cycles, and a rectangular pulse duration of 20-200 μ secs. The receiver sensitivity is 5 μ watt, with a signal-to-noise ratio of not less than 3. It has a linear sweep indicator for observations up to 4000 km and a panoramic indicator for observations up to 1500 km, with semi-logarithmic frequency sweep. The duration of scan covering the frequency range from 0.5 to 20 mc is 30 sec in automatic mode.

A program device plots a high-frequency characteristic 1.2 or 4 times per hour. The ionospheric station is made up of 9 separate units on a common frame 70 x 120 x 150 cm, with a total weight of about 500 kg.

Russian Translations

Automatic Panoramic Ionospheric Station

J. George Adashko

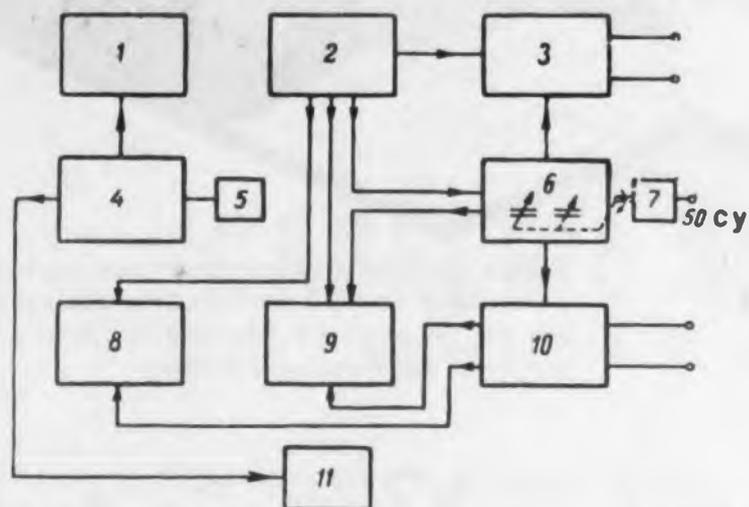


Fig. 1—Block diagram of automatic panoramic ionospheric station for vertical sounding. 1—power supply; 2—modulator; 3—transmitter; 4—automatic-control block; 5—electric clock; 6—master oscillator; 7—motor; 8—indicator with linear sweep (A); 9—panoramic indicator (B); 10—receiver; 11—photographic recorder.

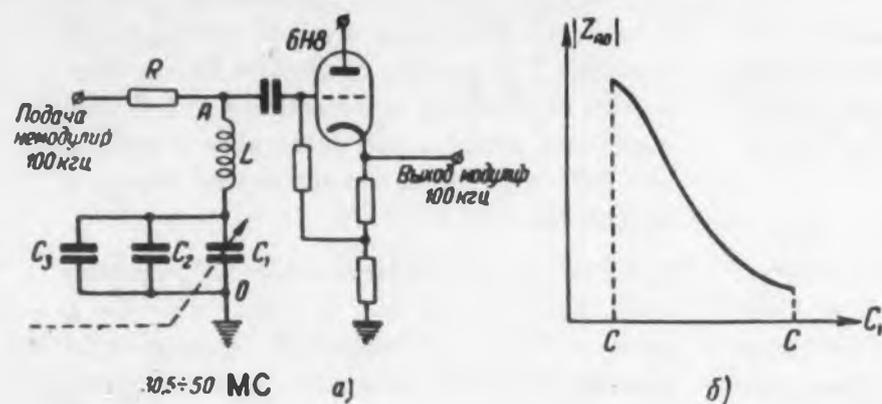


Fig. 3—Sweep-frequency modulator (a) and variation of load $|Z_{AO}|$ (b).

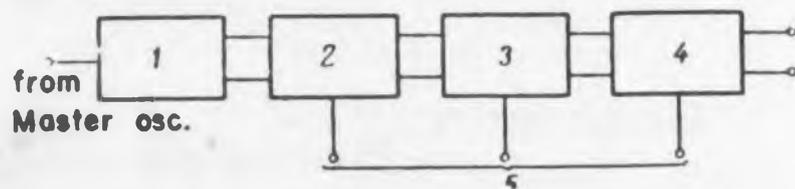


Fig. 5—Transmitter. 1—amplifier; 2—modulating amplifier; 3—intermediate modulating stage; 4—final modulating stage; 5—negative bias and positive pulses from modulator.

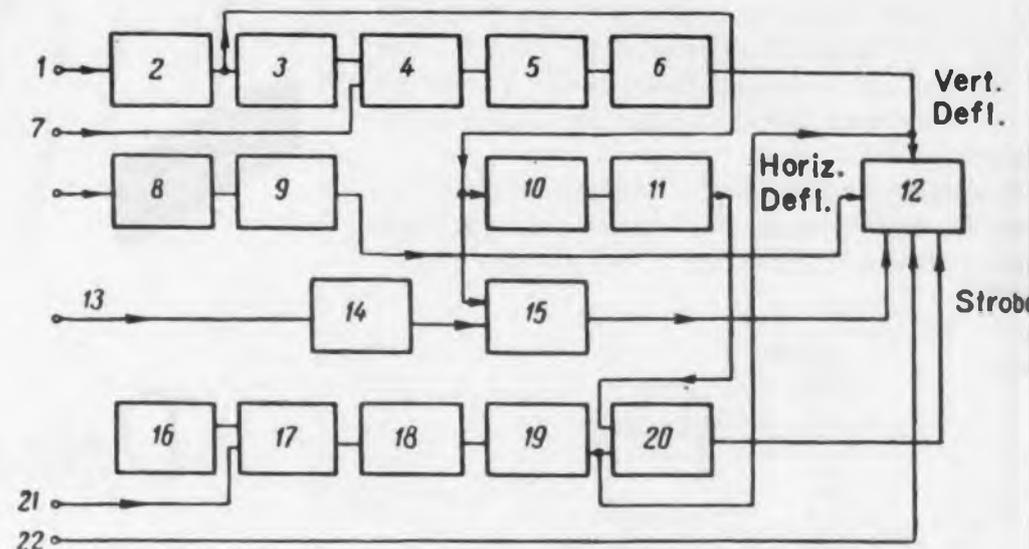


Fig. 2—Master Oscillator. 1—starting pulses from modulator; 2—900 kc shock-excited oscillator; 3—balanced converter; 4—converter with aperiodic load; 5—cathode follower amplifier; 6—0.5-20 mc pulses to transmitter; 7—crystal oscillator; 8—cathode follower; 9—29.1 mc to second converter of receiver; 10—30.5 mc mechanically-tuned oscillator; 11, 12—cathode followers; 13—30.5-50.0 mc to first converter of receiver; 14—crystal oscillator; 15—mechanical modulator; 16—frequency-sweep modulated 100 kc to panoramic (B) receiver; 17—30.5-50 mc to panoramic (B) indicator frequency marker; 18—100 kc "carrier" of B-indicator vertical sweep.

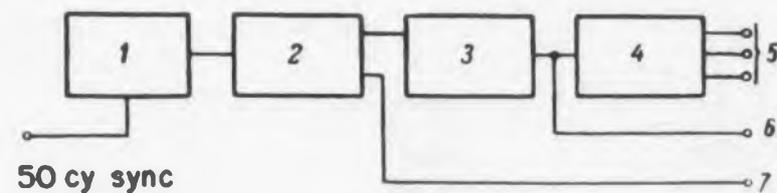


Fig. 4—The modulator sets the PRF and pulse duration and also initiates the sweep of the A-indicator and the vertical sweep of the B-indicator. 1—blocking oscillator, scanning frequency; 2—delay multivibrator; 3—duration multivibrator; 4—amplifier and cathode follower; 5—modulating pulses to transmitter; 6—starting pulses to master-oscillator block and indicators; 7—starting of sweep of A-indicator control.

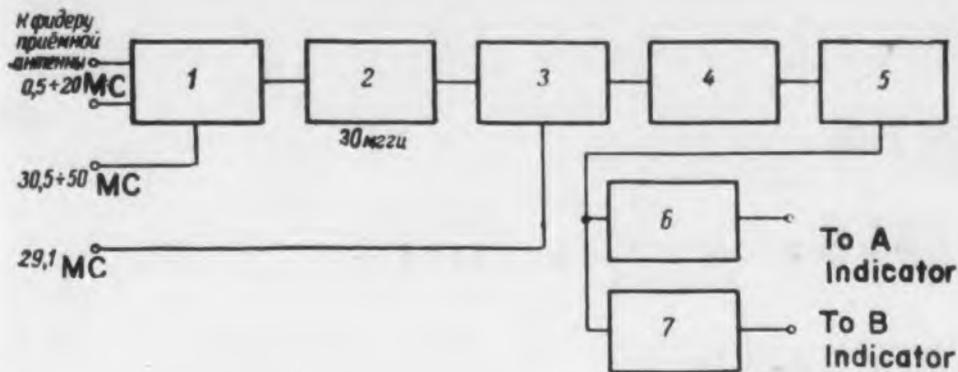


Fig. 6—Receiver. 1—balanced converter; 2—1st IF; 3—converter; 4—2d IF; 5—detector; 6—video channel of A-indicator; 7—video channel of B-indicator.

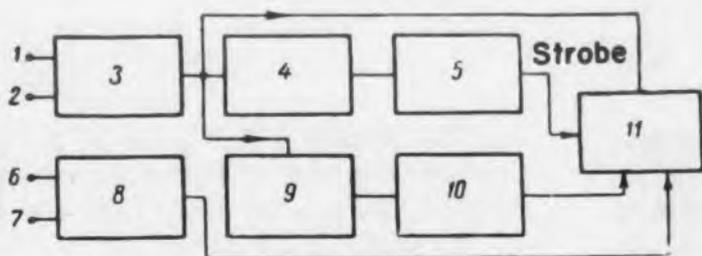


Fig. 7—A-indicator, used to measure the altitude of the reflections and the waveform of the reflected pulses. Also used as station control oscillograph. 1—"operate" signal from modulator; 2—"control" signal from modulator; 3—duration multivibrator, controls indicator sweep duration (can be set at 1000, 3333, 6667, 10,000, and 26,667 μ secs, corresponding to reflection altitudes of 150, 500, 1000, 1500, and 4000 km); 4—sweep generator; 5—horizontal amplifier; 6—from receiver; 7—control flexible shaft; 8—vertical amplifier; 9—elevation-marker generator; 10—marker-forming circuit; 11—indicator CRT.

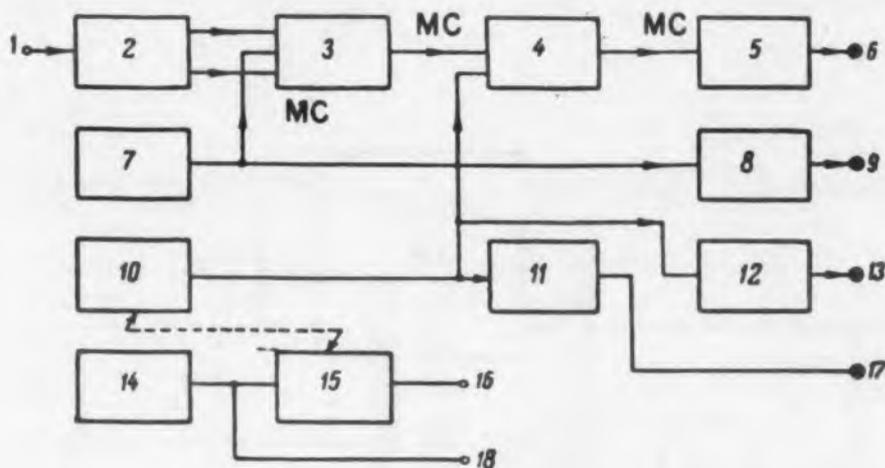


Fig. 8—B (panoramic) indicator used to observe and photograph hf characteristics. 1—input from modulator; 2—duration multivibrator; 3—vertical-sweep oscillator; 4—diode modulator; 5—vertical-sweep amplifier; 6—rectifier-doubler; 7—100 kc (unmodulated) from master oscillator; 8—frequency-sweep amplifier; 9—rectifier-doubler; 10—altitude-marker generator; 11—marker shaper; 12—indicator CRT; 13—from receiver; 14—signal limiter; 15—strobe mixer; 16—1 mc crystal oscillator; 17—mixer; 18—amplifier-shaper (peaking amplifier) for frequency markers; 19—frequency-marker multivibrator; 20—coincidence stage for mixed markers; 21—30.5-50 mc from master oscillator; 22—from master oscillator (excitation of flyback).

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Transistor Equivalent Circuit

A. Jorysz

A NEW equivalent circuit of the transistor is derived which does not contain a fictitious current or voltage generator. The parameters of the matrix representation can be determined by simple measurements. The new circuit demonstrates clearly the impedance transformation and power amplification properties of the transistor.

The matrix relating input voltage and input current to the corresponding output quantities in a common emitter circuit is given by (1)

$$\begin{aligned} e_1 &= a_{11}e_2 + a_{12}i_2 \\ i_1 &= a_{21}e_2 + a_{22}i_2 \end{aligned} \quad \text{or} \quad \begin{vmatrix} e_1 \\ i_1 \end{vmatrix} = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} \begin{vmatrix} e_2 \\ i_2 \end{vmatrix} \quad (1)$$

The parameters a_{12} , a_{21} , and a_{22} can be replaced by expressions containing a_{11} and the three impedances z_{10} , z_{1s} and z_{2s} . The latter are the transistor input impedances measured with the output open

and shorted and the transistor output impedance z_{2s} with the input terminals shorted. A_{11} is the input to output voltage ratio with the output current zero. The new matrix, which can be easily obtained from (1), is given in (2)

$$\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = \begin{vmatrix} a_{11} & a_{11} Z_{2s} \\ \frac{a_{11}}{Z_{10}} & a_{11} \frac{Z_{2s}}{Z_{1s}} \end{vmatrix} \quad (2)$$

Expression (1) also yields the following relationship between the input and output impedances:

$$Z_{10} Z_{2s} = Z_{1s} Z_{20} \quad (3)$$

Fig. 1 shows the circuit used to measure the four impedances mentioned above, with the dotted lines indicating the location of the short circuits needed to find z_{1s} or z_{2s} .

The amplitude and phase of a_{11} may be determined using Fig. 2. The circuit constants indicated refer to a frequency range from 4 kc to 20 kc.

By splitting the matrix (2) into the product of three matrices and a scalar factor, one finds

$$\begin{vmatrix} a_{11} & a_{11} Z_{2s} \\ a_{11} \frac{1}{Z_{10}} & a_{11} \frac{Z_{2s}}{Z_{1s}} \end{vmatrix} = K \begin{vmatrix} 1 & Z_{1s} \\ \frac{1}{Z_{10}} & 1 \end{vmatrix} \begin{vmatrix} \sqrt{\frac{Z_{10}}{Z_{20}}} & 0 \\ 0 & \sqrt{\frac{Z_{20}}{Z_{10}}} \end{vmatrix} \begin{vmatrix} a_{11} m & 0 \\ 0 & a_{11} m \end{vmatrix} \quad (4)$$

$$K^2 = \frac{Z_{10}}{Z_{10} - Z_{1s}} \quad (4a)$$

$$m^2 = \frac{Z_{20} - Z_{2s}}{Z_{10}} \quad (4b)$$

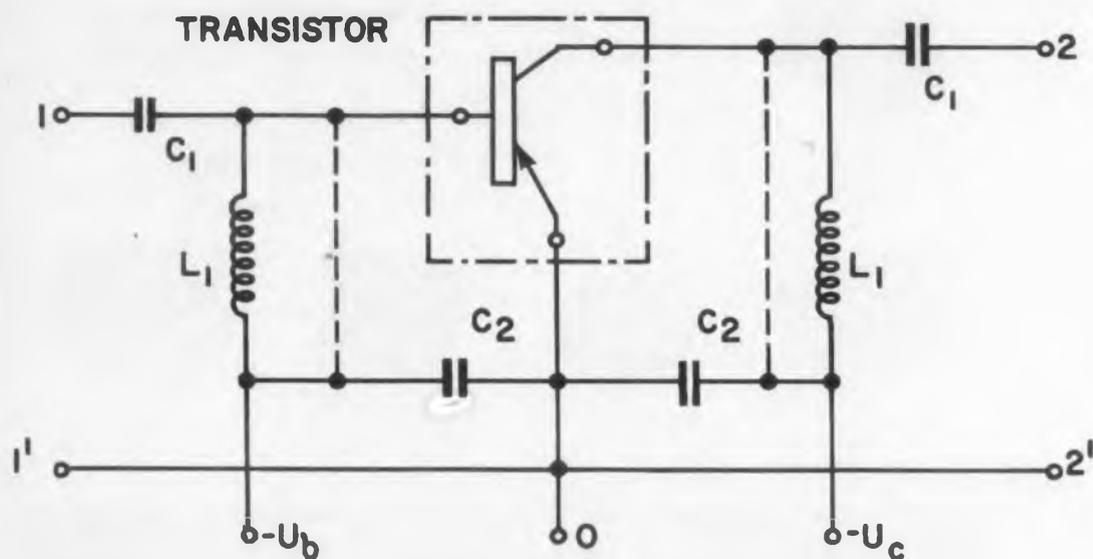


Fig. 1. Circuit for impedance measurements, $C_1 = 2 \mu\text{f}$, $L_1 = 30 \text{ H}$, $C_2 = 50 \mu\text{f}$.

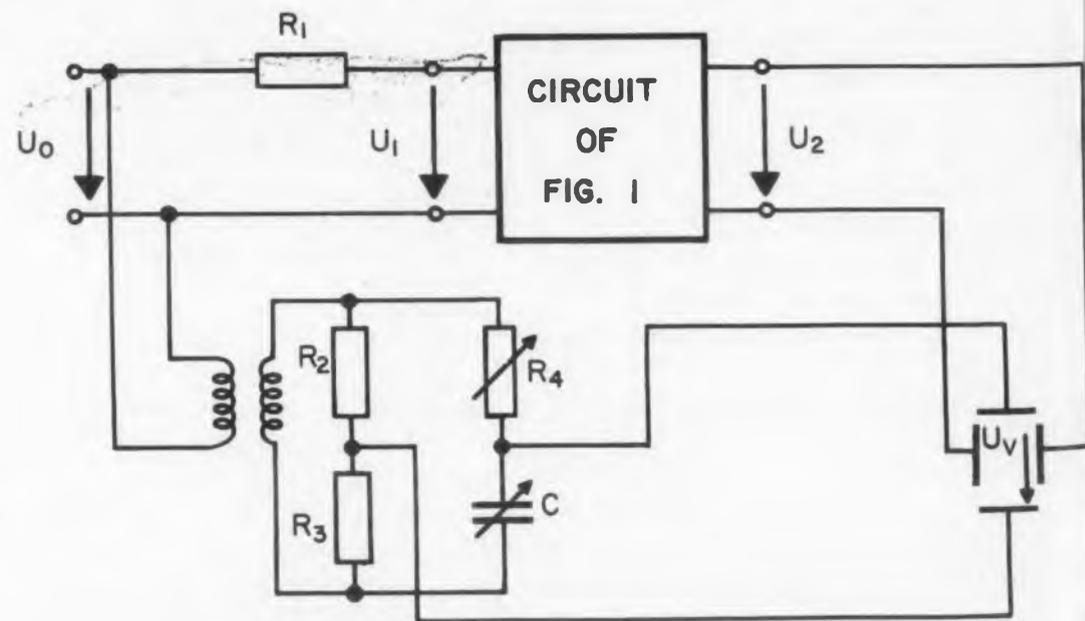


Fig. 2. Circuit for determination of coefficient a_{11} , $R_1 = 150 \text{ K}$, $R_2 = R_3 = 2 \text{ K}$, $R_4 = 1 - 10 \text{ K}$, $C = 0 - 100 \mu\text{f}$.

FIRST silicon transistors meeting NAVY SPECS



The first matrix times k is represented by the symmetrical T network in the new equivalent circuit of Fig. 3. The two series arms are equal to $\sqrt{z_{10}(z_{10}-z_{1s})}$ and the shunt arm is $z_{10}(z_{10}-z_{1s})$. The center matrix is that of an ideal transformer and the third matrix, being similar to the second, represents a fictitious "ideal" transistor. In the "ideal" transistor matrix the two matrix elements are equal, in the ideal transformer matrix they are inverse quantities. The square of one diagonal element represents the input to output impedance ratio in the ideal transformer matrix, but it is the input to output power ratio in the "ideal" transistor matrix.

Fig. 3 therefore contains the three basic elements of each transistor. The T network, which determines the fourpole attenuation, the ideal transformer, which represents the impedance transformation inherent in any transistor, and finally the "ideal" transistor, which produces the theoretical power amplification of the unit. It is clear that the presence of the T network prevents full realization of the ideal power gain.

The article also contains formulae permitting computation of common base and common collector matrices based on the same impedance representation, since direct impedance measurements for these circuits are much more difficult.

Abstracted from an article by T. Scheler & H. W. Wecke, "A contribution to the theory and measurement technique of the transistor as a Linear Quadpole," Frequenz, vol. 10, pp. 107-116; April 1956.

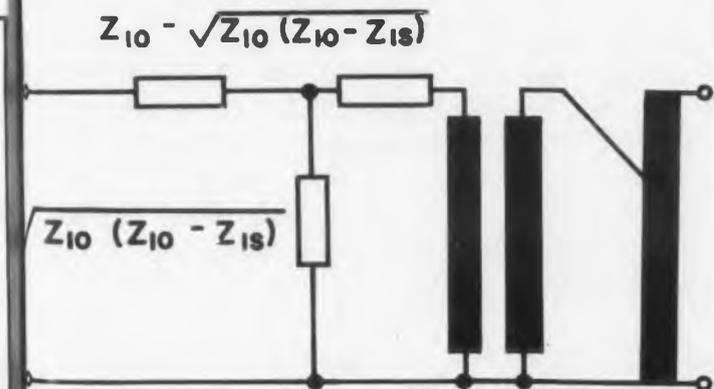


Fig. 3. Complete equivalent circuit of the transistor.

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vibration fatigue	60 cps at 10 G	32 hours, each x, y, and z plane	
shock	40 G, 11 milliseconds	3 shocks, each x, y, and z plane	} $h_{ob} = 2\mu mhos$ maximum
temperature cycle	-55°C to +150°C	10 cycles	
moisture resistance	MIL-STD-202	240 hours	} $h_{fb} = -0.88$ minimum for 2N117
life, intermittent operation	$P_c = 150$ mW, $V_c = 30V$	1000 hours, accumulated operating time	
life, storage	150° C, ambient	1000 hours	} $h_{fb} = -0.94$ minimum for 2N118
salt spray	MIL-STD-202	50 hours	
			no mechanical defects interfering with operation

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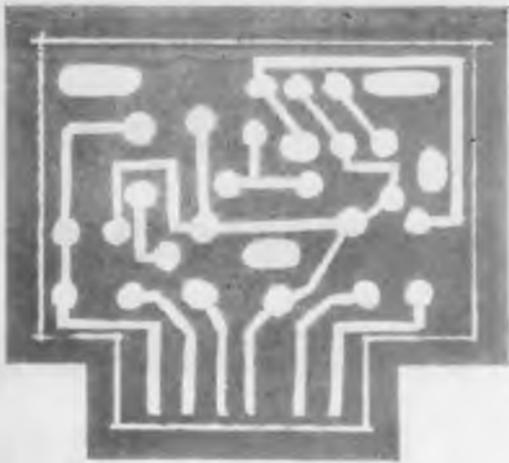
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Abstract

Electroplating Print

BARE etched copper patterns produced by normal print and etch processes may be electroplated after etching if all the segments are connected electrically. It is often possible to design patterns with interconnecting segments or lines so that all parts of the conductor pattern which it is desirable to plate can be connected to a border

Plating	Properties	Applications
Silver—flash immersion.	Short-term protection against oxidation of the copper surface.	None that we can think of—although it may look better for a short time it is hard to solder after the silver becomes sulfided.
Gold—flash immersion.	Improve the appearance of patterns, better solderability.	Circuits which must be stored for extended periods prior to assembly and dip soldering.
Silver electroplated .0003 to .002 in.	Corrosion resistance, low contact resistance.	Primarily used in printed switches and other printed patterns where contact must be made to the pattern by pressure. The advantage is that sulfides or oxides of silver are comparatively good conductors.
Gold electroplated .0001 to .0002 in.	Excellent corrosion resistance. Low contact resistance.	Used in switches or portions of printed circuits which plug in to connectors, where low contact resistance is extremely important.
Nickel .0003 to .0010 in. plus gold .000030 to .000050 in.	Hard, wear resistant contact surface where low contact resistance is important.	Plug in printed circuit boards and certain types of switches.
Nickel .0003 to .0010 in. plus rhodium .000010 to .000050 in.	Hardest wear resistant wiping contact surface—but contact resistance higher than gold.	High speed, long wearing switches. Plug in contact fingers.
Solder—60%, tin—40%, lead—.0003 to .0002 in.	Improved solderability. Long-term protection against corrosion.	Plated through holes boards, or other boards where turret lugs, pins or eyelets must be joined to the conductor patterns simply by heating and fusing the solder.

ngPrinted Circuits

around the panel or portion of the pattern near the edge which is easily contacted by a plating clamp or rack.

These interconnecting lines may be removed in the final fabrication or the printed circuit either by punching or drilling holes, or by cutting the border away from the panel. It may, too, be practical to design jigs, clamps or plating racks so that electrically isolated portions of the printed pattern are contacted. Where these conditions can be met, the plating procedure is relatively simple. The printed and etched panel is buffed to the desired surface finish, cleaned properly, attached to the plating hook or rack and made the cathode in a plating bath.

To interconnect electrically all the portions of the printed pattern is not always possible. The plating procedure must be such that the plating can be applied when the entire foil area is present on one or both surfaces of the sheet.

Comparatively new is the method of plating through holes. When printed conductors are used on both sides of the board in order to make a large number of cross-overs, or where space on one side of the board is limited, through connections from one side of the board to the other must be made. Although these connections can be made by wire leads, eyelets or rivets inserted into the board, they are usually more economically and reliably made by the plating through process. Dip solder joints between the component leads and conductor pattern are much stronger when plated holes are used because the solder flows up around the component wires in the holes and forms fillets on both the top and bottom of the board. These solder joints have great shock and vibration resistance.

It is felt that plating through holes offers a considerably greater degree of reliability than can be achieved with any other type through connection.

The tabulation shown lists the various metals used commercially in plating printed circuits, together with a few of their purposes, properties and applications. *Abstracted from Electroplating Printed Circuits, R. L. Swiggett, Photocircuits Corporation, Glen Cove, New York, presented at Formica Printed Circuit Forum, Cincinnati, Ohio, October 1956.*

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G. D. Schott (center), Flight Controls Department head, discusses a rocket control system with Group Engineer R. A. Fay (right) and F. G. Hudson, missile components research specialist.

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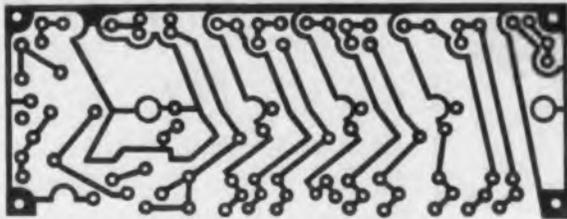
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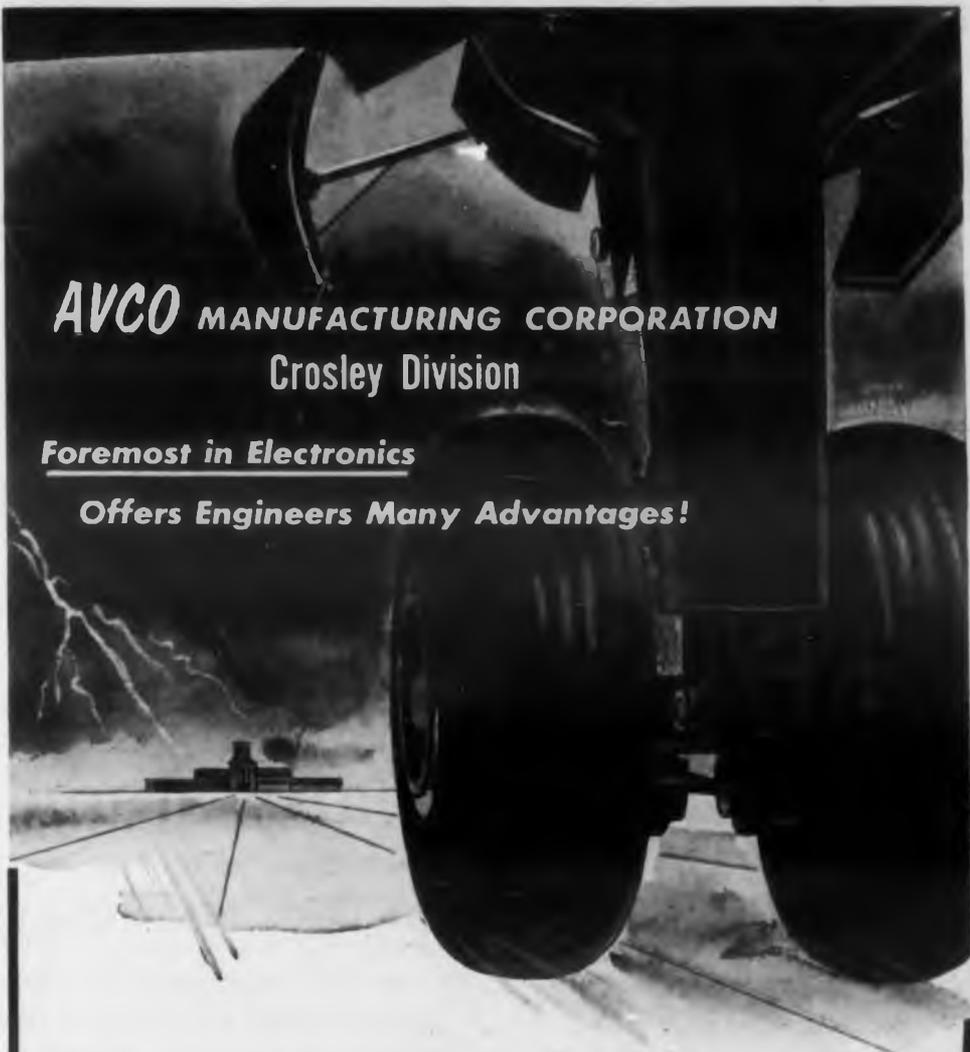
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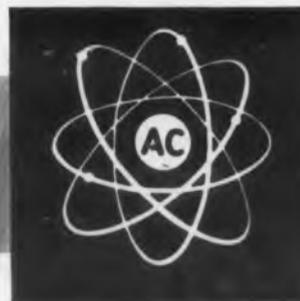


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Technical Reports

Vacuum Evaporation of Heavy Metallics

Described is the development and operation of vacuum evaporation equipment capable of forming metallic films 10 to 40 times the thickness obtained in commercial practice. The primary requirement for the evaporation of a heavy film is a source of comparatively large area; a flat tantalum dish heated by electronic bombardment was so devised. Important aspects of the development include the design of a water-cooled fixture to hold the evaporation dish, an electronic circuit breaker to control the bombardment power supply, and an electrical thickness gage to record the film thickness as it is evaporated. The method is believed to be applicable to a wide range of metals, alloys and non-metals. *PB 121175 Vacuum Evaporation of Heavy Metallic Films, W. R. Turner, NAVORD Report 3948, NOL, White Oak, Maryland, OTS, U.S. Dept. of Commerce, Washington 25, D. C., June 1955, 30 pp, \$1.00*

Analysis of BaO Emission

Study of the effects of field penetration and donor mobility on the chemical potential of BaO have been computed by using a nondegenerate single-donor level semiconductor model. The calculations predict that the pulsed emission starts lower but increases with field more rapidly than given by simple Schottky theory, actually being capable of exceeding the theoretical Schottky emission. The dc emission level is always lower than the pulsed emission, the difference being more pronounced at higher fields and less active cathodes. *PB 121270 An Analysis of the DC and Pulsed Thermionic Emission From BaO, George A. Huas, NRL Report 4780, OTS, U.S., Dept. of Commerce, Washington 25, D. C., July 1956, 17 pp, \$0.50.*

Miniature Variable Air Capacitors

Final report of the study to establish designs for a series of miniature variable air capacitors having long rotational life, and capable of satisfactory operation over a temperature range of -55 to $+85$ C. *PB 121239 Miniature Variable Air Capacitors, E. T. Machuga, Signal Corps Project #2006A, OTS, U.S. Dept. of Commerce, Washington 25, D. C., Sept. '55, 63 pp, \$1.75.*

Making and Projecting Stereopictures

Keeping in mind the use of stereoscopic viewing as an aid to research and engineering, the USAF has prepared a practical, easy-to-follow guide to the best presentation of stereopictures. The report explains techniques for proper picture-taking, slide mounting for hand-operated or automatic projectors, and stereoprojection.

Design of a jig for correctly aligning, positioning, rotating, locating, and framing pictures for use in a completely automatic projector is described. "Eyestrain", sometimes experienced by stereopic- ture viewers is explained briefly. *PB 121282 Techniques For Making And Projecting Stereoscopic Slides*, C. W. Kendal and W. H. Richards, Wright Air Development Center, OTS, U.S. Dept. of Commerce, Washington 25, D.C., Jan. 1956, 35 pp, \$1.00.

DC Microammeter Compensator

This is brief report on voltage-drop compensators for dc microammeters. Chapter headings are: Advantages of a Compensating Device, Devices Exhibiting Negative Apparent Resistance and Devices of the Cathode-Follower Type, Theory of the Balanced Cathode-Follower Circuit, Performance of the Balanced Cathode-Follower Circuit, Number of Balanced Two-Tube Circuits Usable as Compensators. *PB 111723 Voltage-Drop Compensators For DC-Microammeters*, W. Poppelbaum, OTS, US Dept. of Commerce, Washington 25, D. C., Sept. 1954, 11 pp, 50 Cents.

Preparation of Sendust

This bulletin contains detailed description of the metallurgical preparation of high quality cast Sendust cores. Included are details of processes of melting, precision casting of cylinders, and a cut-off grinding technique for cutting magnetic test rings from cast cylinders. *PB 121164 The Metallurgical Preparation of Fe-Si-Al Alloys (Sendust) For The Determination of Magnetic Properties*, Nachman and Huehler, NOL, OTS, US Dept. of Commerce, Washington 25, D.C., June 1953, 24 pp., 75 Cents.

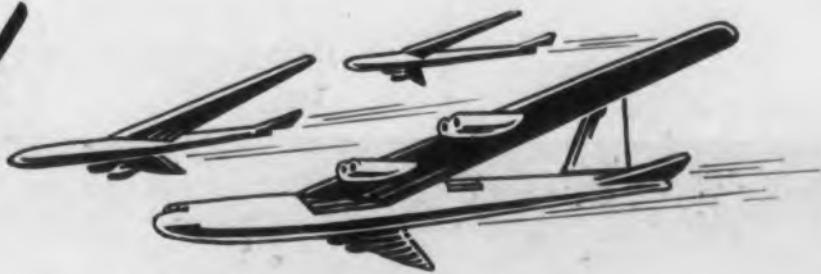
Heat Transfer in Equipment

This publication encompasses a survey of present-day and underdevelopment methods of heat transfer in electronic equipment. The scope of the originally planned survey was broadened, due to recent advances in electronic cooling, to include not only a bibliographical study, but also a thorough survey and inspection of techniques and methods now in use at prominent facilities throughout the nation. #D211.2:E12/2 *Heat Transfer in Miniaturized Electronic Equipment*, Govt. Printing Office, Washington 25, D. C., 1956, 85 pp, \$1.25.

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The Jet Propulsion Laboratory pioneered in central recording of rocket engine measurements when in 1948 the Laboratory established its first system serving five engine test cells.

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Standards and Specs

Sherman H. Hubelbank

This department surveys new issues, revisions, and amendments, covering military and industry standards and specifications. Our sources of information include the Armed Services Electro-Standards Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, IV, American Standards Association (ASA) and other standards societies.

Solder Sticks

MIL-F-12784A, FLUX, SOLDERING (STEARINE COMPOUND IC-3), AMENDMENT 1, 6 SEPTEMBER 1956

Minimum diameter of flux sticks is now 7/8-inch instead of 1-inch. The sticks will now weigh 1/4 pound each unless the unit quantity is specified in the procurement contracts in pounds, or in allowable lengths with corresponding weights in excess of 1/4 pound.

Test Bar

PT-1, TENSILE TEST BAR, CAST TO SIZE, 1956

The design of a cast-to-size test bar suitable for the tensile testing of investment cast metallic materials is covered in this newly released spec. Copies are available from the Investment Casting Institute, 27 East Monroe Street, Chicago 3, Illinois.

T-11 & T-12 Bulbs

RETMA ET-105C, DIMENSIONAL CHARACTERISTICS OF ELECTRON TUBES

T-11 and T-12 bulb outlines have been submitted by JTC-8, Committee on Mechanical Standardization and by JETEC Council for standardization. Contact the RETMA Engineering Department, 11 West 42nd Street, New York 36, N.Y. and request Standards Proposal 516, if you would like to comment on this proposed revision.

Power Distribution

AIEE No. 952, ELECTRIC POWER DISTRIBUTION FOR INDUSTRIAL PLANTS, OCTOBER 1956

The important features of well-designed electric distribution systems are covered in this manual. Included in this publication is information on system planning, voltage considerations, system protection, fault calculations, grounding, power factor, power equipment, instruments, conductors and terminators, and the relative cost of industrial distribution systems. Basic information is included to determine the approximate load requirements of industrial plants, the type of distribution system, the distribution voltages, and voltage regulation. General information as to the selection of transformers, circuit breakers, relays, fuses, meters, cables, bus,

and other miscellaneous equipment is also included. This is not an AIEE standard, and the recommendations are not restrictive or mandatory. Copies of the booklet are available from the American Institute of Electrical Engineers, 33 West 39th St., New York 18, N.Y. for \$3.50 per copy.

Correction

Some printer's errors were made in the mathematics of the article Designing Iron-Core Inductances, With Superimposed Direct Current by J. H. Davis, Nov. 15, 1956, pp. 44-47. The expressions should be:

$$R = \frac{l_c}{A_c \mu} \quad \text{p. 44 middle}$$

$$N = \frac{L I_{dc} 10^8}{A_c \times B_{dc}} \quad (4) \quad \text{p. 45 bottom}$$

"ratio" not "value" p. 45 middle

"l_m" not "m" p. 46, col. 1, top

$$\frac{B_{ac}}{B_{dc}} = \frac{0.120 \sqrt{2}}{0.750} = 0.225 \quad \text{p. 46, col. 2, top}$$

$$N = \frac{1}{I} \sqrt{\frac{A_c}{R_c}} \quad (7) \quad \text{p. 46 middle}$$

$$CT = \frac{2 \times 0.7602 \times 10^8}{6500} = 17.8 \times 10^3 \quad \text{p. 46 middle}$$

$$G = \frac{0.4 \times 3.14 \times N^2 \times 19.76}{2 \times 10^8} = 0.170 \text{ cm} \quad \text{p. 46 middle}$$

$$I = \sqrt{(0.75)^2 \times 12^2} = 0.760 \text{ amp} \quad \text{p. 46 bottom}$$

$$L = \frac{0.4 \times 3.14 \times 1310^2 \times 19.76}{10^8 \times 0.170} = 2.46 \text{ henries} \quad \text{p. 46 bottom}$$

$$W = 17.8 \times (0.7602)^2 = 10.2 \text{ watts} \quad \text{p. 46 bottom}$$

$C_R, C_T =$ figures of merit of a stack lamination p. 47 top

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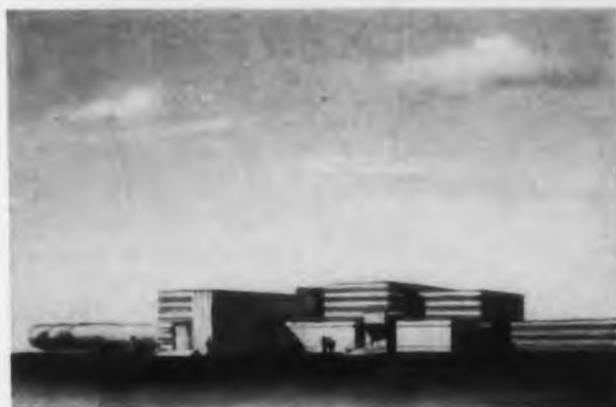
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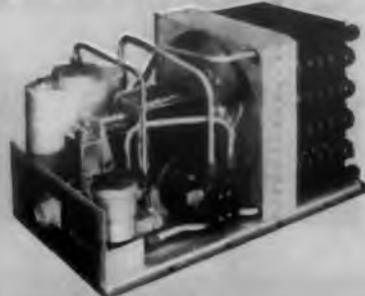
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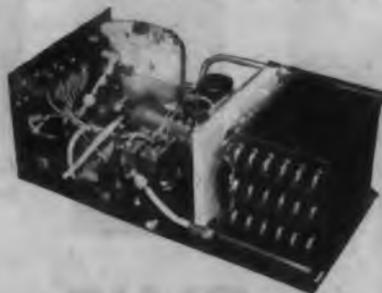
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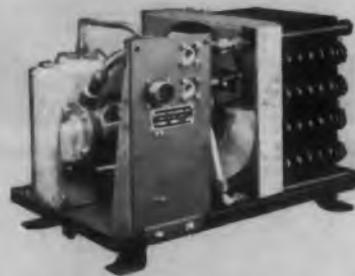
MODEL MB-175, TYPE 200 DISSIPATION: 2,000 watts. **ALTITUDE RANGE:** sea level to 50,000 feet. **POWER REQUIRED:** 28 volts D.C. **WEIGHT:** 25 pounds. **SIZE:** 10" x 15-15/16" x 10 1/4" high.



MODEL E/HT-205, TYPE 200A DISSIPATION: 1600 watts. **ALTITUDE RANGE:** sea level to 5,000 feet. **POWER REQUIRED:** 28 volts D.C. **WEIGHT:** 25 pounds. **SIZE:** 10" x 21" x 10" high.



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MODEL E/HT-200, TYPE 201 DISSIPATION: 1,000 watts. **ALTITUDE RANGE:** sea level to 50,000 feet. **POWER REQUIRED:** 28 volts D.C. **WEIGHT:** 14 1/2 pounds. **SIZE:** 10" x 10" x 6" high.



MODEL NO. 5-A DISSIPATION: 1,000 watts. **ALTITUDE RANGE:** sea level to 5,000 feet. **POWER REQUIRED:** 100 to 110 volts D.C. **WEIGHT:** 10 pounds. **SIZE:** 7 1/4" x 13 1/2" x 9-1/16" high.

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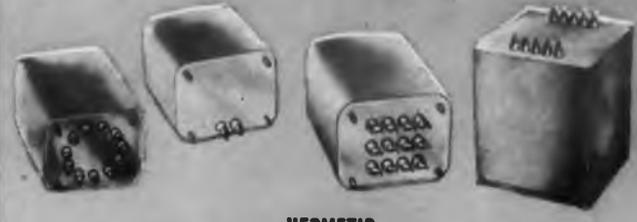
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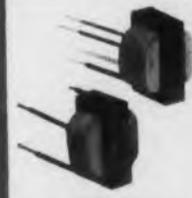
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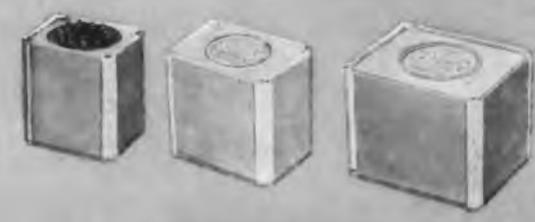
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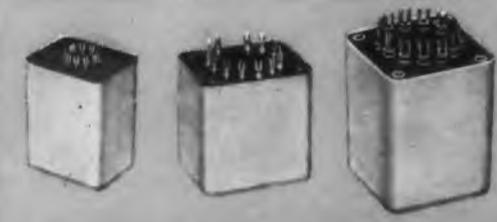
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