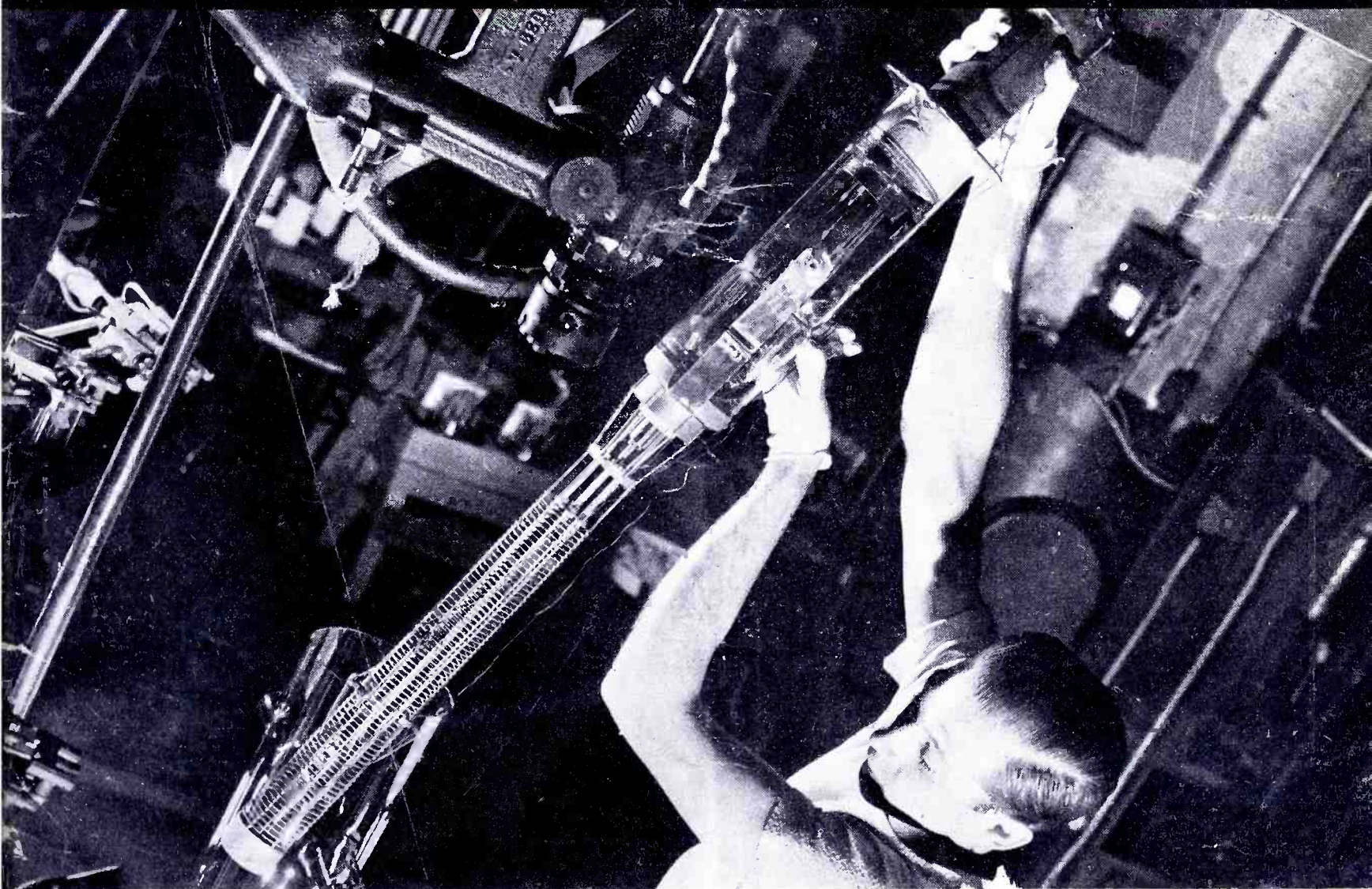


COMMUNICATIONS



- ★ RADIO ENGINEERING
- ★ ELECTRIC MEGAPHONES
- ★ SIMPLIFIED FILTER DESIGN METHODS

- ★ AERONAUTICAL COMMUNICATIONS
- ★ CALIBRATION OF DECIBEL METERS
- ★ TELEVISION ENGINEERING

JULY

1945

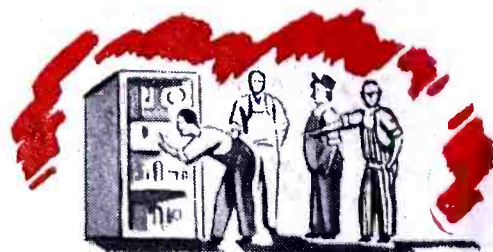
THE AMPEREXTRA FACTOR in INDUCTION HEATING

The Amperextra Factor is the longer operating life and lower maintenance cost of Amperex air and water cooled transmitting and rectifying tubes. In induction heating, a field in which our engineers have pioneered, this Factor adds considerably to the general efficiency of equipment using Amperex tubes.



LONGER LIFE . . .

. . . since the life of a tube is influenced by the equipment in which it is used, as well as by the inherent characteristics of the tube itself, we maintain a Special Engineering Application Department which constantly applies our tubes in actual circuits, and determines which conditions are conducive to prolonged life. Their findings are freely available to you.



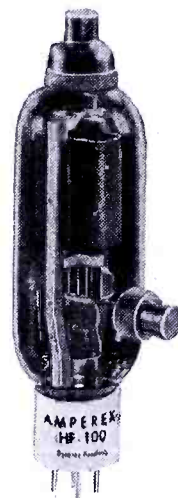
FIGURED . . .

. . . on the basis of the hours of maximum tube life, Amperex tubes are by far your best and most economical "buy."



LOWER MAINTENANCE COST . . .

. . . Amperex tubes offer more value per dollar invested. Down time is noticeably decreased, number of replacements minimized, overall costs reduced.



Amperex Type HF-100 Transmitting Tube. Filament Voltage, 10-10.5 volts. Filament current, 2.5 amperes. Amplification factor, 23. Grid to plate transconductance at 100 ma., 4200. Direct interelectrode capacitance: Grid to plate, 4.5 μ f; grid to filament, 3.5 μ f; plate to filament, 1.4 μ f. \$12.50, list price.

Amperex Type 889-R Transmitting Tube. Filament voltage, 11 volts. Filament current, 125 amperes. Amplification factor, 21. Direct interelectrode capacitance: Grid to plate, 20.7 μ f; Grid to filament, 19.5 μ f; Plate to filament, 2.5 μ f. \$260.00, list price.

AMPEREX TUBES . . .

. . . for induction heating applications range from small 50 watt types to "big boys" of 100,000 watts. Many of these tube types are now available through leading radio equipment distributors.

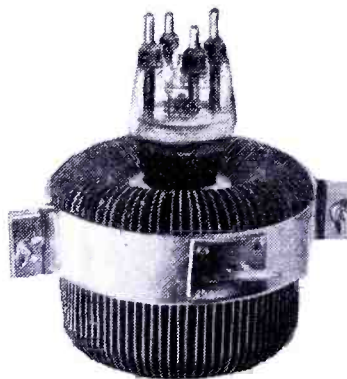
AMPEREX

. . . the high performance tube

The Amperex Special Application Engineering Department, another "Amperextra," will be glad to work with you on present or postwar problems.



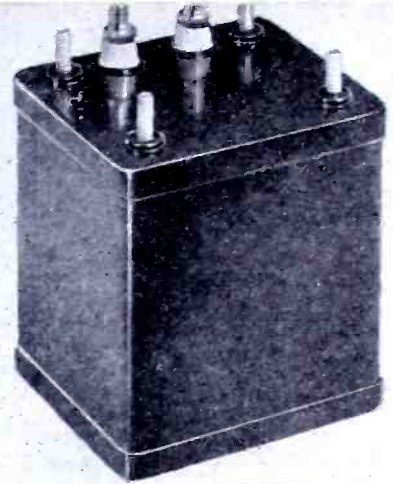
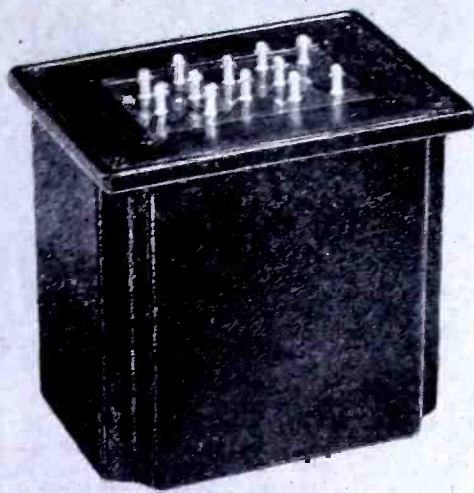
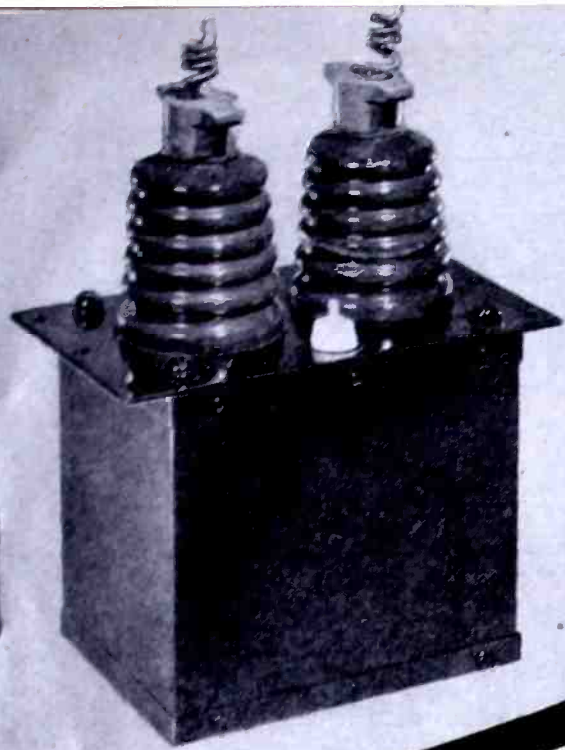
Amperex Type 575-A Mercury Vapor Rectifier. Filament AC voltage, 5.0 volts. Filament current, 10.0 amperes. Preheating period, before plate voltage is applied, 30 seconds. \$30.00, list price.



AMPEREX ELECTRONIC CORPORATION

25 Washington St., Brooklyn 1, N.Y., Export Division: 13 E. 40th St., New York 16, N.Y., Cables: "Arlab"

Canadian Distributor: Rogers Electronic Tubes, Limited • 622 Fleet Street West, Toronto

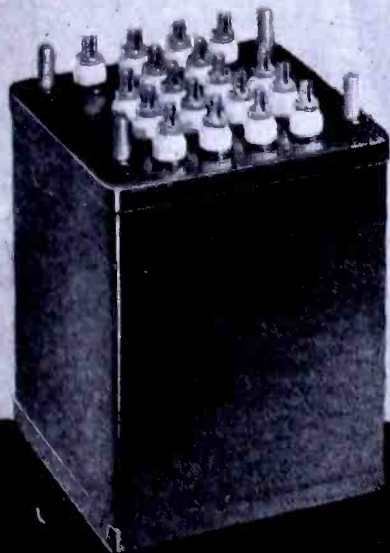
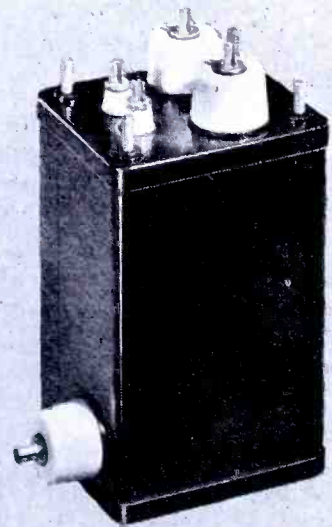
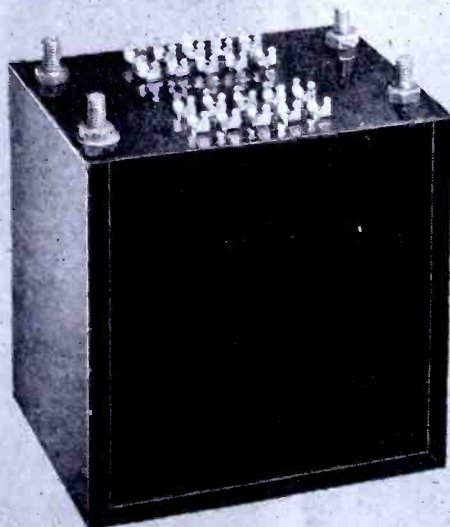
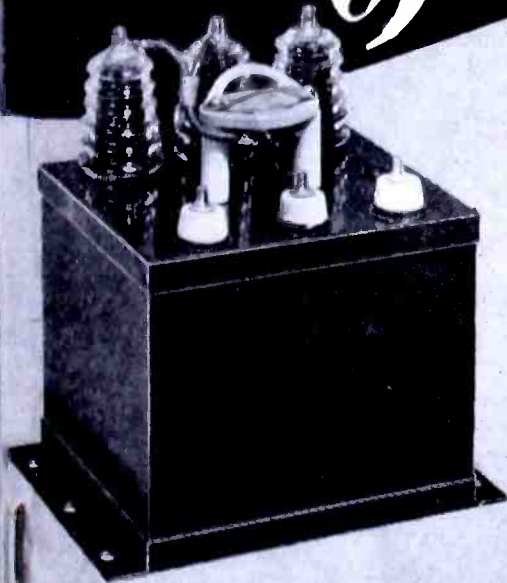


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We See...

COMMUNICATIONS

Including Television Engineering, Radio Engineering, Communication & Broadcast Engineering, The Broadcast Engineer. Registered U. S. Patent Office.
 Member of Audit Bureau of Circulations.

WITH THEIR RECENT V-H-F ALLOCATION and broadcast-band power rulings, the FCC have projected quite a program for the v-h-f and m-f communications engineer. The final f-m/television assignment shifting f-m to the 88-106-mc band and providing for three types of services . . . community, metropolitan and rural . . . with the necessary power radiation control, offers many interesting problems to solve. For instance, community station design will require a transmitter that will be limited to a maximum radiated power of 50 watts and a maximum antenna height of 250 feet over the average height of a 1,000 uv/m contour. These stations will operate between 92.1 and 93.9 mc. In the metropolitan station setup, a 20 uv/m signal will be required for the outer boundary of the service area. These stations will operate between 94.1 and 103.9 mc. The rural stations which will transmit between 104.1 and 105.9 mc will be able to transmit up to 500 uv/m for coverage of one metropolitan district.

Antenna-array designs, based on horizontal polarization, will occupy the attention of many engineers. Types of transmitters, for fixed or mobile operations using f-m or p-m, will also be an important item on the engineering analysis calendar. And there are the assorted special accessories that will also demand close engineering scrutiny for these new services.

The FCC ruling authorizing full-power operation of broadcast transmitters beginning September 1, during daytime hours, introduces another active engineering program. For, the first time in three years, it will now be possible to effect repairs and improvements to restore transmitters to full power operation. In many instances this will mean new antennas, new monitors, etc.

Yes, it appears as if communications engineers have a pretty busy series of days ahead of them.

CONGRATULATIONS TO THE NAB on the appointment of so able a man as Justice Justin Miller of U. S. Court of Appeals as president of NAB. This is indeed a wise choice!—L. W.

JULY, 1945

VOLUME 25 NUMBER 7

COVER ILLUSTRATION

Inserting cathode mount of a 100-kw transmitting tube into a vertical sealing machine.

(Courtesy General Electric)

SOUND ENGINEERING

Electric Megaphones.....	Arthur J. Sanial	33
Calibration of Decibel Meters.....	Paul K. Hudson	58

AERONAUTICAL COMMUNICATIONS

Communications System Aboard DC-3 Aircraft.....	Ralph G. Peters	36
---	-----------------	----

FILTER DESIGN

Multi-Section Filter-Design Procedure.....	Paul Selgin	40
--	-------------	----

POWER SYSTEM CONTROL

Producing Nearly Constant Alternating Voltages for Calibration	William Stockman	46
--	------------------	----

TRANSMITTER DEVELOPMENT

Remote Control of Output Level.....	Raymond P. Aylor, Jr.	49
-------------------------------------	-----------------------	----

RESISTIVE NETWORKS

Resistive Attenuators, Pads and Networks <i>(Part VI)</i>	Paul B. Wright	50
---	----------------	----

RAILROAD RADIO

Interplant RR Radio System.....		55
---------------------------------	--	----

V-H-F DESIGN

V-H-F Transmission Line Element Chart.....	Frederick C. Everett	66
--	----------------------	----

MONTHLY FEATURES

Editorial (We See).....	Lewis Winner	2
Veteran Wireless Operator's Association News.....		62
News Briefs of the Month.....		87
The Industry Offers.....		98
Advertising Index.....		104

Published Monthly by the Bryan Davis Publishing Co., Inc.

BRYAN S. DAVIS, President

F. WALEN, Secretary

PAUL S. WEIL, Vice Pres.-Gen. Mgr.

A. GOEBEL, Circulation Mgr.

Advertising and Editorial offices, 52 Vanderbilt Ave., New York 17, N. Y. Telephone, MUrray Hill 4-0170. Cleveland 6, Ohio: James C. Munn, 10515 Wilbur Ave.; Telephone, SWEetbriar 0052. Pacific Coast Representative: Brand & Brand, 816 W. Fifth St., Los Angeles 13, Calif.; Telephone, Michigan 1732. Wellington, New Zealand: Te Aro Book Depot. Melbourne, Australia: McGill's Agency. Entire Contents Copyright 1945, Bryan Davis Publishing Co., Inc. Entered as second-class matter Oct. 1, 1937, at the Post Office at New York, N. Y., under the act of March 3, 1879. Yearly subscription rate: \$2.00 in the United States and Canada; \$3.00 in foreign countries. Single copies, twenty-five cents in United States and Canada; thirty-five cents in foreign countries.

SYLVANIA NEWS

ELECTRONIC EQUIPMENT EDITION

JULY

Published by SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa.

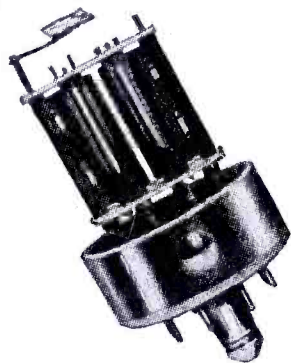
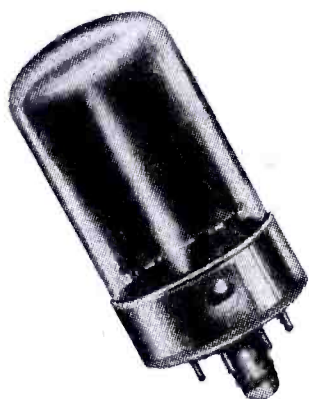
1945

NEW TUBE HAS SEPARATE CATHODES

Construction Permits

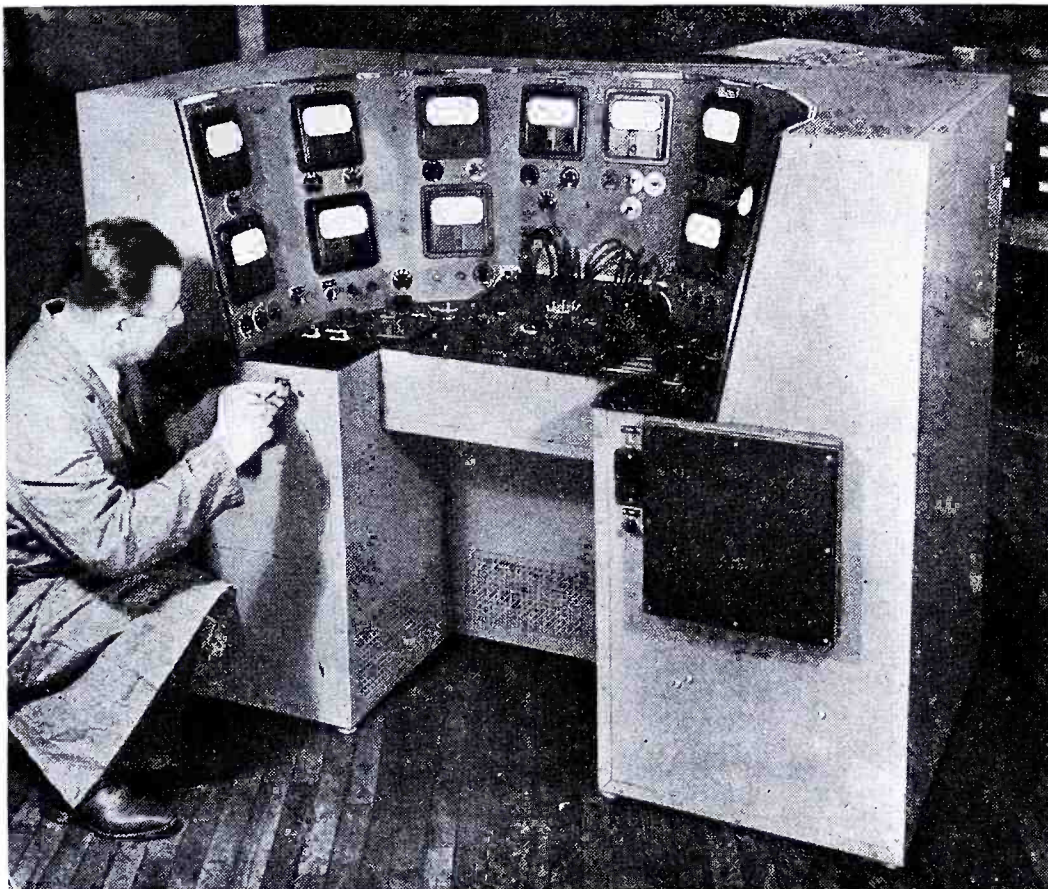
Use As A Discriminator

Sylvania Type 7K7 is a duo-diode high-mu triode differing from the usual diode-triode by having two separate cathodes, one for the triode and the other for the diodes.



This difference permits the tube to be used as a discriminator.

The cut-away view shows that although the construction looks like a duo-triode the second plate is really a shield around the two diodes.



SYLVANIA RADIO TUBE BRIDGE SET INSURES PERFECT PERFORMANCE

Measures Static And Dynamic Characteristics Of Vacuum Tubes

As ultra-high frequencies and a very wide range of intricate electronic applications make strict demands on tube performance and circuit designs, an accurate testing of tube and circuit characteristics becomes of the greatest importance.

One of Sylvania Electric's latest essential radio vacuum tube bridge test sets for precision engineering data is pictured above. Manufactured at Sylvania's plant at Williamsport, Pa., this equip-

ment measures static and dynamic qualities of radio tubes, such as plate current, filament voltage and current, screen current, gas current, plate resistance, power output, mutual conductance, and amplification factor, as well as the characteristics of electronic devices.

The set is compact, fully shielded, with well-filtered, self-contained power supplies, complete with voltage regulators except AC and DC filament voltages.

SYLVANIA ELECTRIC

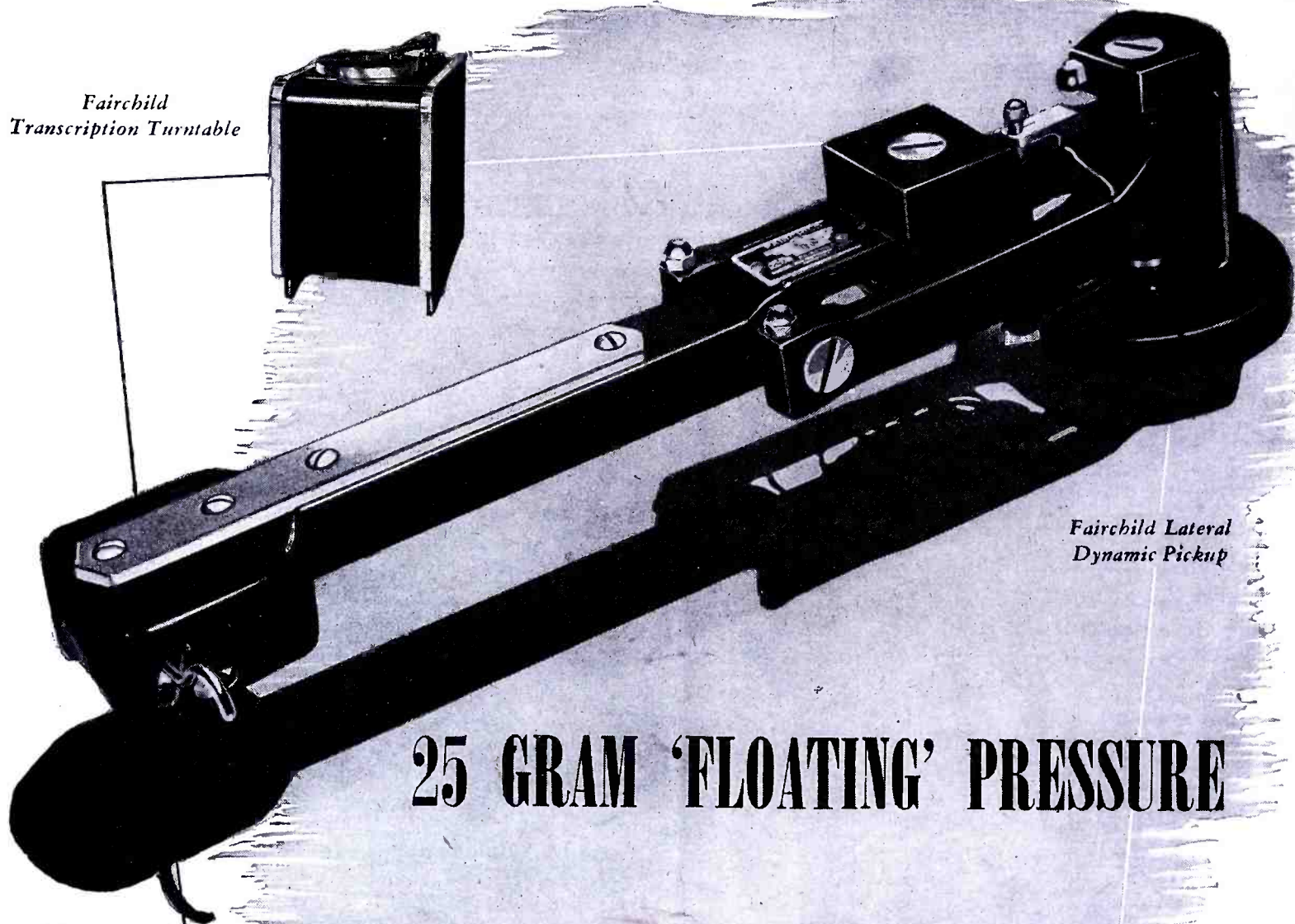
Emporium, Pa.

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, ACCESSORIES; ELECTRIC LIGHT BULBS

COMMUNICATIONS FOR JULY 1945 • 3

SOUND EQUIPMENT - precisionized - mechanically and electronically - for finer performance

Fairchild
Transcription Turntable



Fairchild Lateral
Dynamic Pickup

25 GRAM 'FLOATING' PRESSURE

Further Reduces Distortion and Record Wear

FAIRCHILD offers an unusually mounted 'floating' design for low-pressure, dynamic pickup. Designed for radio broadcast and other exacting transcription requirements, it reproduces all of the quality and natural beauty of recorded music or speech *with full naturalness*.

All microscopic undulations — that determine the quality of the transcription — are picked up without distortion *even from heavily modulated grooves*.

How? By means of several Fairchild patented design features: Let's start with

the 3 ounce cartridge mounted on a two-point suspension in the pickup head casting. It's the only vertical moving mass in the Fairchild assembly. High and low spots in the record disc need only displace its 3 ounce weight instead of the total weight of the entire mounting arm. This unusual mounting method affords a near-uniform stylus pressure of 25 grams — even under unfavorable playing conditions.

Next, the pickup head is mounted in the famous Fairchild tone arm with cone ball bearings. Lateral drag is reduced. And

still another important source of distortion and record wear is eliminated.

Finally, there is no *overhang* of the tone arm with consequent inertia — another cause of difficulty when playing warped records or on uneven turntables. The tone arm *floats* at any required adjustable height above the disc.

Descriptive and priority data on the newly perfected Fairchild Lateral Dynamic Pickup and Transcription Turntable are now available. Address *New York Office*: 475 - 10th Avenue, New York 18; *Plant*: 88-06 Van Wyck Blvd., Jamaica 1, N. Y.



Fairchild CAMERA
AND INSTRUMENT CORPORATION

SOUND
EQUIPMENT



Micronics



Designing UHF and SHF equipment is in large part a matter of electromechanical precision. Our engineers aptly call it *micronics*.* Micronics is an art at which we are adept. A part of our know-how stems from long experience in the design and manufacture of precision-machined hydraulic controls and actuators for military and commercial aircraft. It comes equally from the confidential basic design work our engineers have done in the field of micro-waves. And part comes from a pre-war background of experience in producing radio communication systems for a number of the country's major airlines. **Aireon's** micronic exactitude in all things electronic is a practice your engineers will appreciate—an aptitude our plants can translate into your precise wants. Your engineers and ours should talk it over.

*"Micronic" is a registered trade mark of Aireon Mfg. Corp.

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Our post-war production is *right* on the drawing board! We are ready to manufacture just as

soon as Uncle Sam gives the "go-ahead."

To aid the war effort against Japan, our engineers are standing by to consult on any problem of sound amplification. Until the day of final Victory, our resources will be devoted to the design and production of vital war equipment.

Let us send you a series of useful articles prepared by our engineering staff on the newest developments in amplification related to sound systems. Ask for Series 7-G.

Buy War Bonds



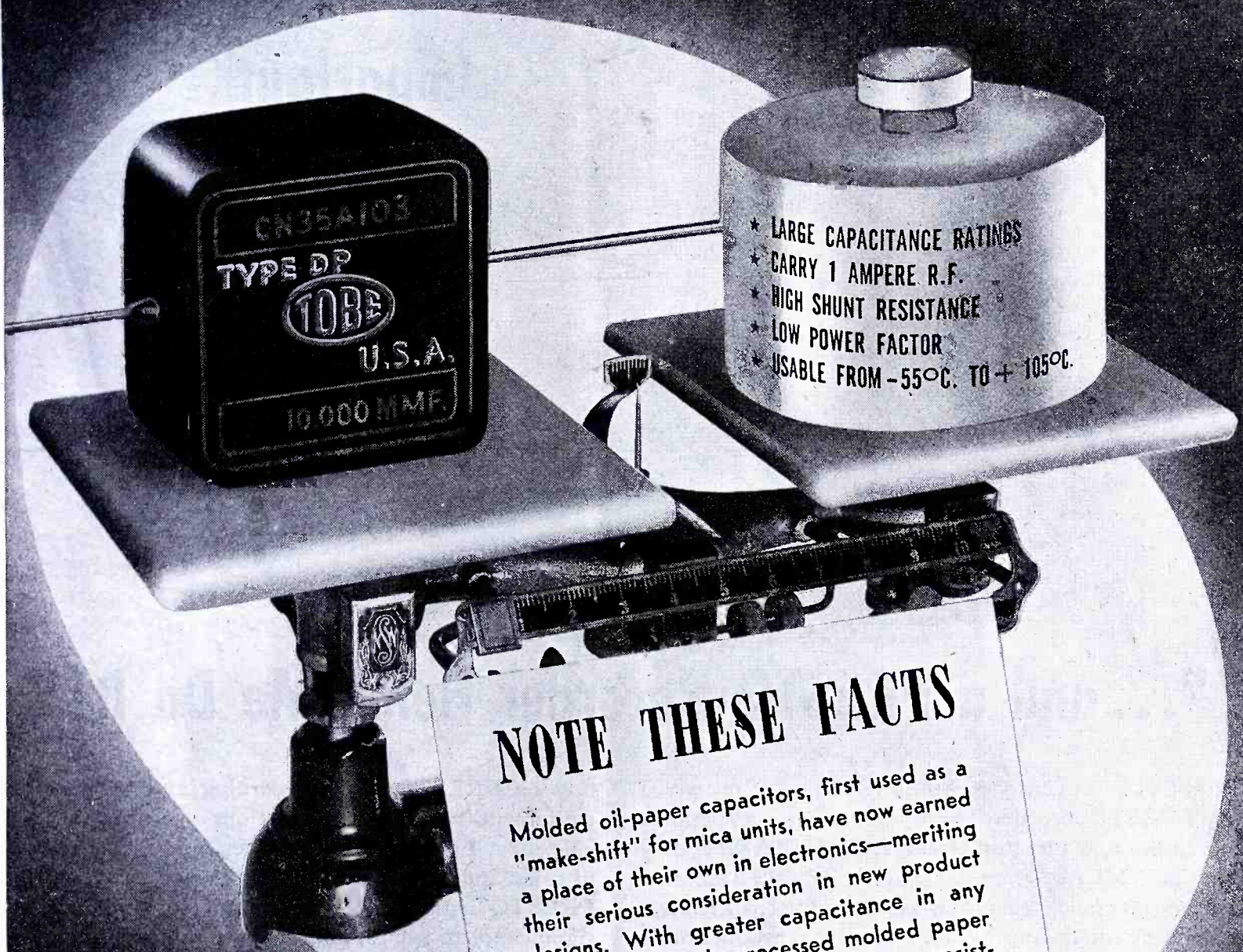
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Weigh the Advantages

of MOLDED OIL PAPER CAPACITORS



NOTE THESE FACTS

Molded oil-paper capacitors, first used as a "make-shift" for mica units, have now earned a place of their own in electronics—meriting their serious consideration in new product designs. With greater capacitance in any case size, properly processed molded paper capacitors have extremely low series resistance and can carry relatively large R.F. currents. Their high shunt resistance, maintained thru the moisture-proof sealing of all units, suits them to A.F. applications at all usual plate voltages.

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RECORDING EQUIPMENT
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Walter P. Downs Ltd., in Canada

NORELCO type 833A tubes undergoing static test—a check that is repeated on each tube after a 6-day holdover. Note mirror behind tube in rack, to show color of plate during test.



How Norelco Tubes Are Quality Controlled

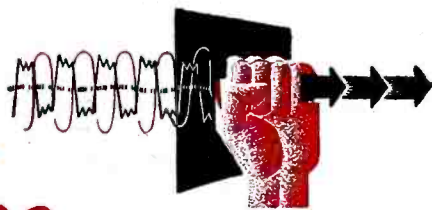
THE ability of North American Philips to produce difficult tube types of consistently uniform characteristics, high performance and long life stems in part from rigid test methods that provide a constant check on manufacturing technique.

A case in point is the 833A transmitting triode, produced in quantity by North American Philips. These tubes are given both static and dynamic runs in special test racks designed by our engineers. Following a holdover period of 6 days, the static and dynamic tests are repeated to spot any deviations from specifications that may have developed during the hold-over period.

This exacting control over quality is one reason why NORELCO electronic tubes hold such high reputation for performance and serviceability—and reason enough why manufacturers look to North American Philips as a reliable source of electronic tubes for their postwar requirements.

Although all the tubes we produce now go to the armed forces, we invite inquiries from prospective users. A list of the tube types we are especially equipped to produce will be sent on request.

Write today for interesting booklet describing the background of North American Philips in the science of electronics.



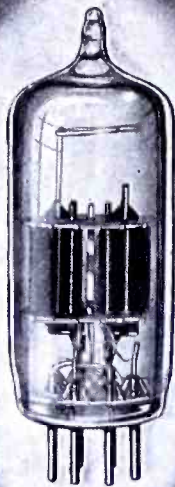
Norelco Electronic Products by

NORELCO PRODUCTS: Quartz Oscillator Plates; Amplifier, Transmitting, Rectifier and Cathode Ray Tubes; Searchray (Industrial X-ray) Apparatus; X-ray Diffraction Apparatus; Medical X-ray Equipment, Tubes and Accessories; Tungsten and Molybdenum products; Fine Wire; Diamond Dies. • We invite you to visit our office and showroom when in New York City

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RAYTHEON

TYPE 6J6

Miniature Dual Triode

For a considerable time Raytheon has been assigned a major role in supplying the essential requirements for a versatile, miniature, dual triode tube, type 6J6.

The precise manufacturing techniques which must be maintained are obvious when the physical structure of this tube is considered. Two high transconductance triodes are obtained from a single relatively large flat cathode, which also acts as a shield to prevent interaction between two separate half-grids. These are wound with extremely fine wire and are accurately spaced a few thousandths of an inch on either side of the cathode. Two individual half-plates complete the tube.

Applications utilizing Raytheon Type 6J6 are varied and numerous, ranging from a diode detector to an ultra high frequency push-pull oscillator capable of producing useful energy at frequencies of several hundred megacycles. Its unique construction lends itself to connection as a high permeance diode, a single very high transconductance triode or a dual triode with a common cathode. The 6J6 is also used in cathode follower service and high frequency mixer applications.

Raytheon's continuing development work and long manufacturing experience means *better tubes*. Use Raytheon High Fidelity Tubes in *your* postwar products!

SPECIFICATIONS OF 6J6

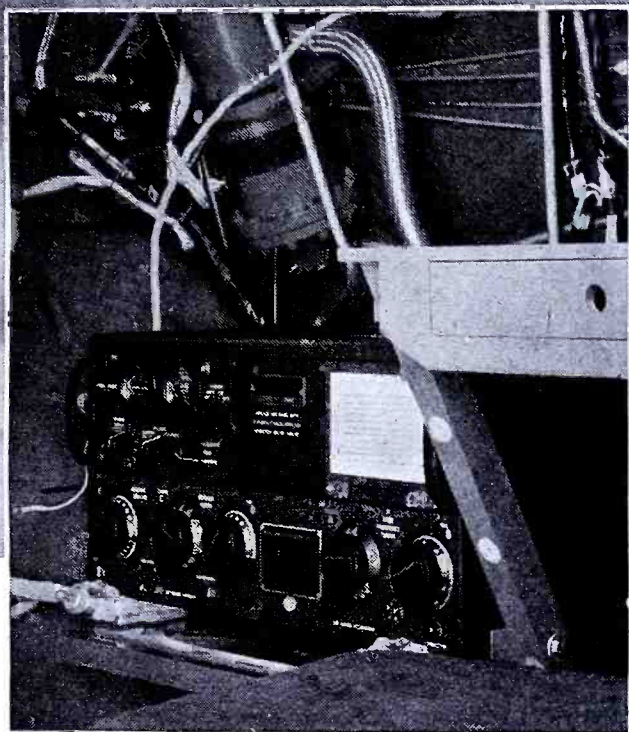
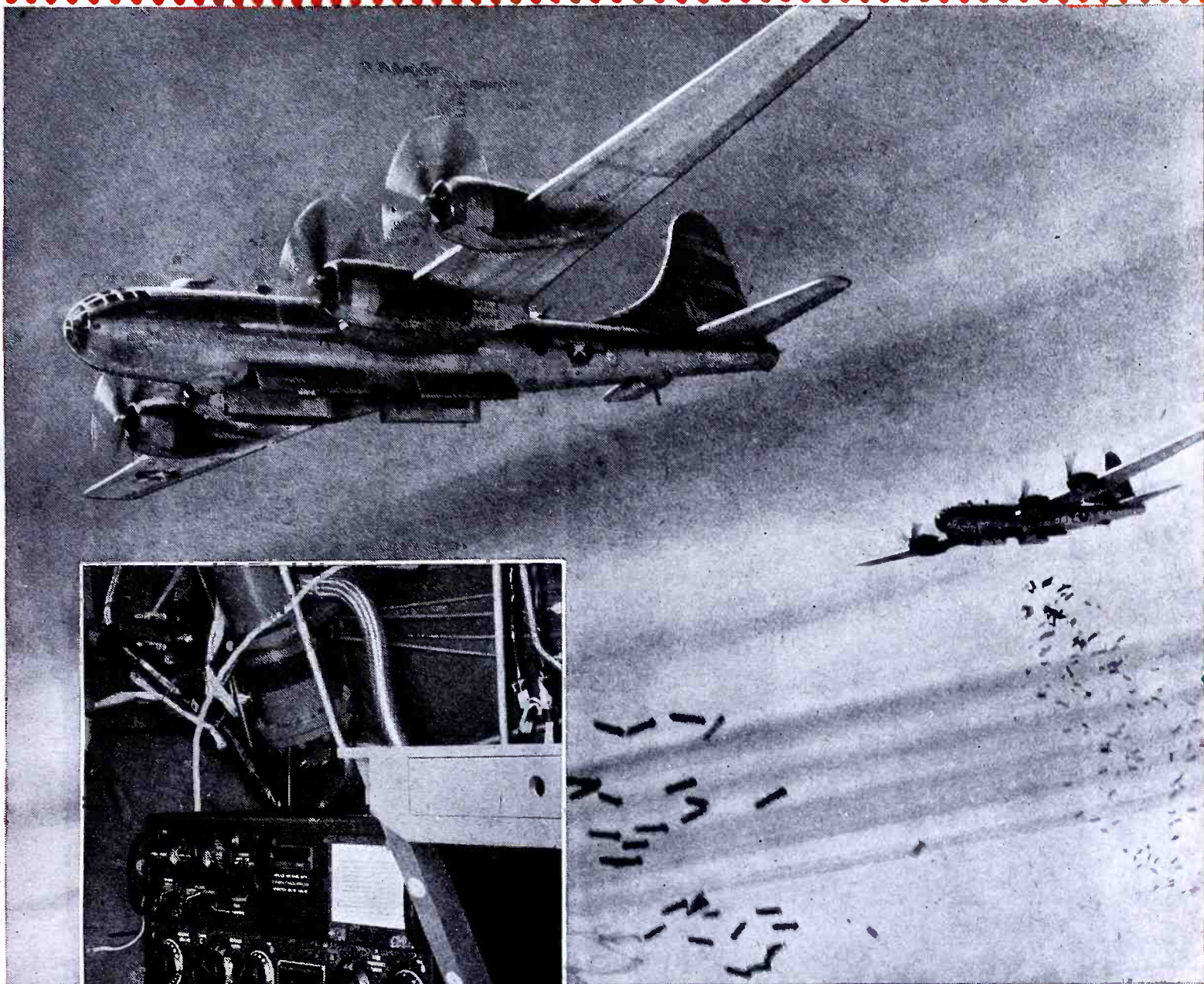
DIMENSIONS:		
Maximum Over-all Length	2 1/8	inches
Maximum Seated Height	1 7/8	inches
Maximum Diameter	3/4	inches
RATINGS:		
Heater Voltage	6.3	volts
Heater Current	0.45	amperes
Maximum Plate Voltage	300	volts
Maximum Plate Dissipation (per unit)	1.5	watts
DIRECT INTERELECTRODE CAPACITANCES (Approx. for each unit) — Unshielded:		
Grid to Plate	1.6	μft
Input	2.2	μft
Output	0.4	μft
CLASS A ₁ CHARACTERISTICS (Each triode):		
Plate Voltage	100	volts
Cathode Bias Resistor — Both units operating	50	ohms
Plate Current	8.5	ma
Transconductance	5300	μmhos
Amplification Factor	38	
Plate Resistance (Approx.)	7100	ohms

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 AMERICAN BROADCASTING CO.
 Every Monday Night
 Coast to Coast
 181 Stations


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 "E" with Stars

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RADIO RECEIVING TUBE DIVISION
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The Collins-designed transmitter as operator sees it from his station in a Superfortress. Boeing—Wichita Photo.

Superfortresses blast and roast Japs. Official photo U.S.A.A.F.

In the Boeing B-29 from the first

THE FIRST MESSAGE from the Army's first Boeing Superfortresses over Japan, on the Yawata mission of June 15, 1944, was transmitted by a Collins radio transmitter of the type shown above. From that time on, this transmitter has been standard equipment for all the Superforts, as it is also for the larger Naval aircraft.

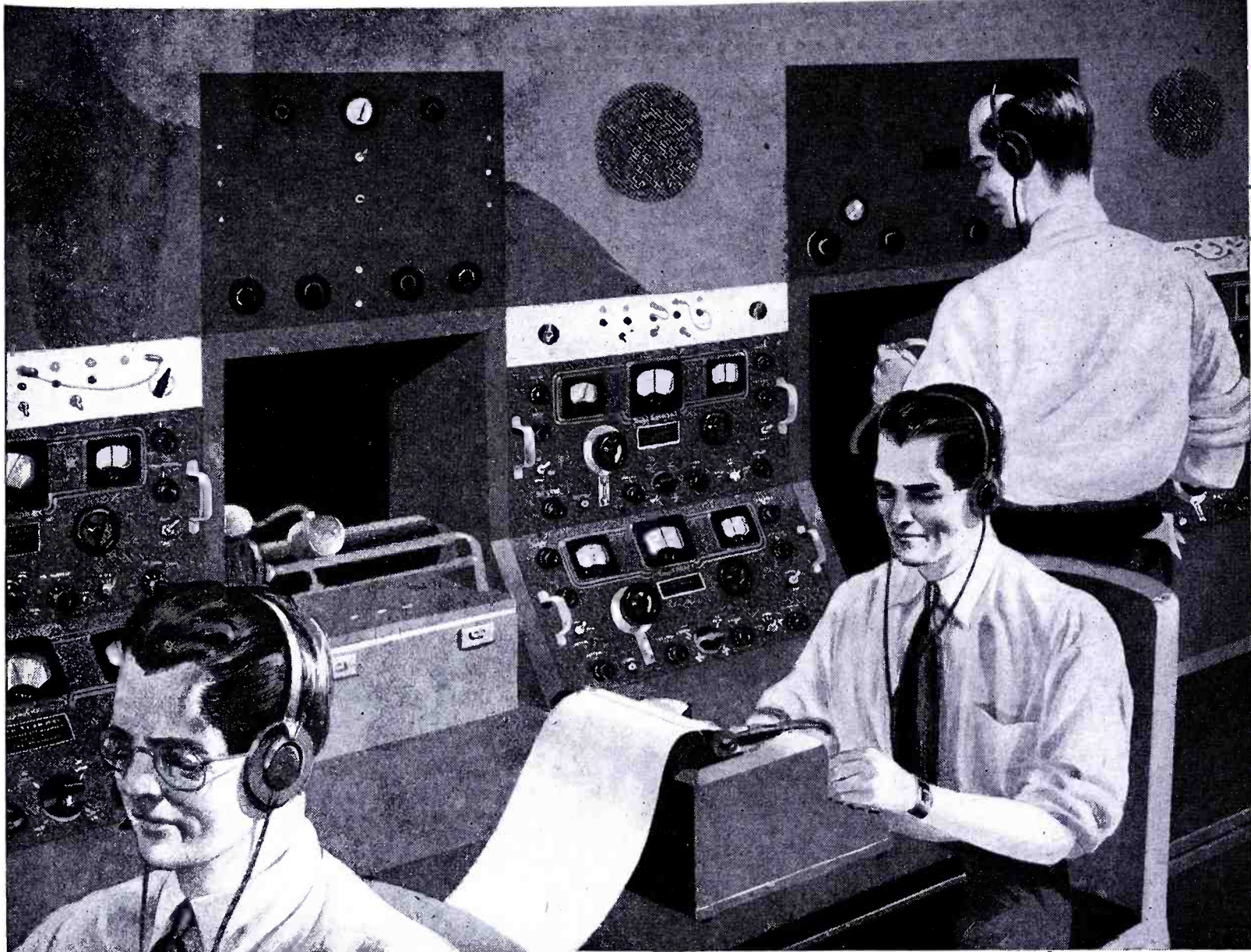
As the Army and Navy demand increased, requirements exceeded the capacity of the extensive Collins facilities, and other manufacturers of radio equipment were drawn into the production program, aided by Collins engineers. Total deliveries have been very large.

Collins engineering and production have gained much valuable experience during the war in providing reliable radio communications under all operating conditions in practically every quarter of the globe. This experience will be available to commercial and personal users as soon as military requirements permit. Collins Radio Company, Cedar Rapids, Iowa; 11 West 42nd Street, New York 18, N. Y.



IN RADIO COMMUNICATIONS, IT'S . . .



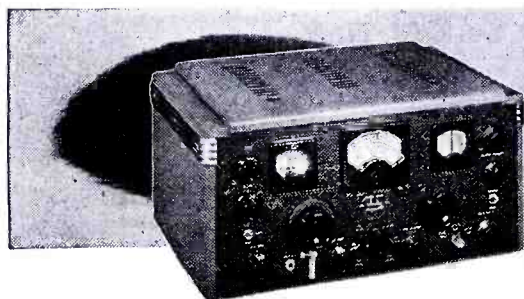


RID at work } HOW RADIO INTELLIGENCE DIVISION KEEPS WATCH...

● The radio amateur has distinguished himself outstandingly in the service of his country in time of war. One of his most important jobs is in the RID — Radio Intelligence Division of the Federal Communications Commission. Above you see sketches of typical hams at work in the intercept room of one of the RID's monitoring stations. With high powered, extraordinarily sensitive equipment like this, manned by experts, the RID patrols the ether, spots illegal transmitters, locates lost planes and keeps watch on the entire radio spectrum to guard home front

security. Vigilance like this has put more than 400 clandestine stations out of commission. About 70% of the personnel employed by RID consists of licensed amateur radio operators. For these exacting technicians Hallicrafters has developed the finest equipment that can be made. When the time comes Hallicrafters will be ready with a full line of HF, VHF and UHF communications equipment — designed specifically for the amateur and for all others who need the latest and best combined "in the radio man's radio."

COPYRIGHT 1945 THE HALLICRAFTERS CO.



This is a model SX-28A, a communications receiver operating on a frequency range of 550 kc to 42 Mc, continuous in 6 bands including regular broadcast band.



hallicrafters RADIO

THE HALLICRAFTERS CO., WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT, CHICAGO 16, U. S. A.

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(First produced Dec. 1941—Millions made to date)

First with **RESISTORS WOUND** with **CERAMIC INSULATED WIRE**
(Pioneered and perfected by Sprague many years ago)

First with **GLASS-TO-METAL SEALED RESISTORS** (Pioneered by Sprague in 1941, now produced commercially at the rate of thousands of seals per day)

First with **GLAZED CERAMIC SHELLS** and New Style End Seals for 5-, 10-, 25-, 50- and 120-watt resistors. (One type of Koolohm—the standard type—does the job under any climatic condition, anywhere in the world)

First and **STILL EXCLUSIVE** with **MEGOMAX** (The high-resistance, high-voltage resistors. Megohms of resistance operated at thousands of volts!)

One after another, Sprague Koolohm Resistors have established new performance records as proved indisputably by the record. One after another Koolohm Resistors have revolutionized traditional limitations to wire wound resistor usage—because radically different Koolohm construction permits a higher degree of physical protection, better electrical characteristics, smaller sizes, and easier mounting arrangements than are possible with conventional resistor types. Write for catalog.

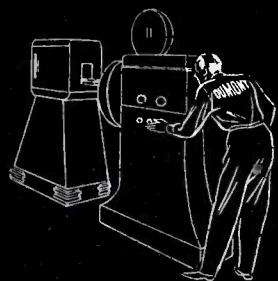


SPRAGUE KOOLOHM

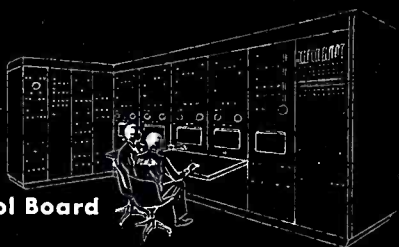
(Trademark Reg. U. S. Patent Office)

WIRE WOUND RESISTORS

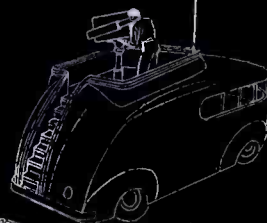
SPRAGUE ELECTRIC COMPANY
(Resistor Division) North Adams, Mass.



DuMont Projector and Film Pickup Camera



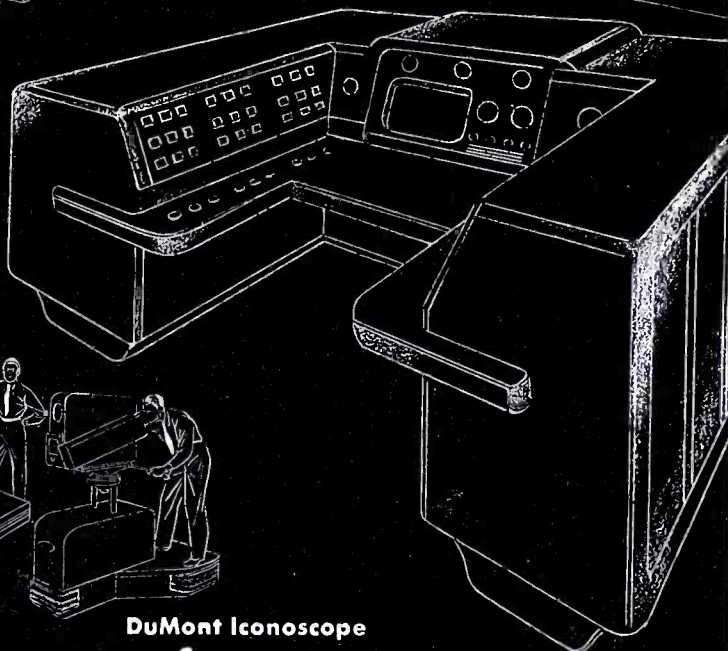
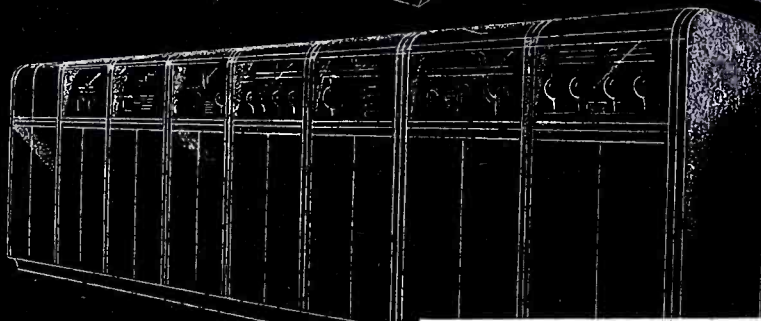
Master Control Board



DuMont-equipped Television Truck



Producer's Control Desk

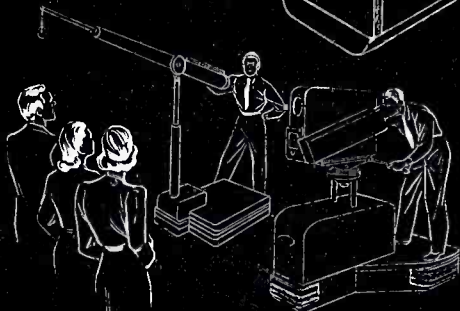


DuMONT TRANSMITTER CONTROL CONSOLE and DuMONT VIDEO-AUDIO TRANSMITTER

Only the DuMont Transmitter Console offers *all* these features:

1. 12" cathode-ray tube for observing picture quality.
2. Control buttons for individual transmitter stages.
3. Necessary meters for constant checks on operation.
4. Cathode-ray oscillographs for observing signals and individual stage operation.
5. Patch-in rack for checking individual stages and signal off the air.
6. Automatic and manual safety switches for emergencies.
7. Synchronized electric clock for time recording.
8. Automatic time recorder.
9. Intercommunication system microphone and loudspeaker.
10. Facilities for logbook and other records.

DuMont Sound Boom



DuMont Iconoscope Camera

DuMONT—FOR THE TOOLS OF TELEVISION

Simplified precision control is the design keynote of all DuMont Television Broadcasting Equipment. Typical of this bull's-eye concentration on basic essentials is the DuMont Transmitter Control Console. All meters and controls of the Video-Audio Transmitter are combined with the station monitor (formerly a separate unit) to achieve a new standard in safety, easy visibility and centralized operation. Operators can be quickly trained to attend it.

DuMont has equipped *more* television stations than any other company. Week-in, week-out, these

stations are demonstrating the high pickup and transmitting quality and efficiency, the extreme flexibility, rugged dependability and low operating cost of DuMont-engineered equipment.

DuMont has pioneered the profit pattern for peacetime commercial television...is setting the pace in television broadcasting equipment design. Climb aboard the television bandwagon today by using the DuMont Equipment Reservation Plan to insure early delivery of equipment and training of personnel. *Ride with the leader!*

Copyright 1945, Allen B. DuMont Laboratories, Inc.

DUMONT

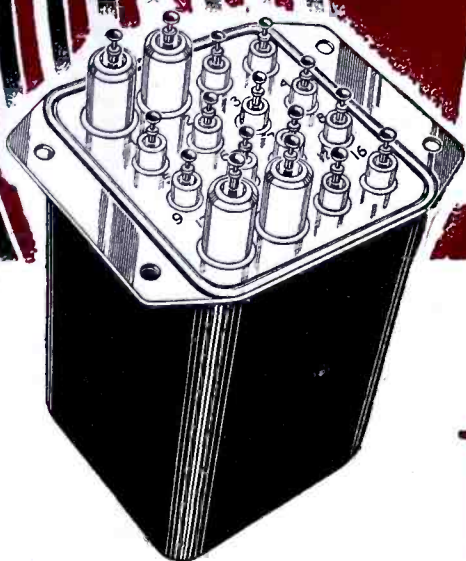


Precision Electronics and Television

ALLEN B. DUMONT LABORATORIES, INC., GENERAL OFFICES AND PLANT, 2 MAIN AVENUE, PASSAIC, N. J. TELEVISION STUDIOS AND STATION WABD, 515 MADISON AVENUE, NEW YORK 22, NEW YORK

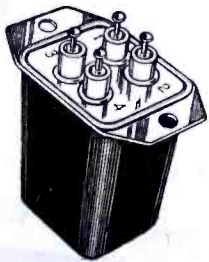
KYLE TRANSFORMERS

KK



{ Engineered to take advantage of latest trends in radio design

New products, new ways of doing things will require transformers engineered to take advantage of the latest trends in electronic equipment design and manufacture . . . Kyle Transformers built to meet exact specifications. ☐ Kyle engineers have constantly met and solved ever changing problems involving application of transformers to the wartime fields of radio communication, radar detection and electronic controls. ☐ Kyle Transformers are hermetically sealed to function perfectly under conditions they are designed to meet . . . whether for use in cold, temperate, or tropical climates. ☐ This alert, young-thinking organization is at your service. It is backed up by long experience in the manufacture of electric power distribution equipment. Kyle engineering, manufacturing, and plant facilities are top notch. It will pay you to send your transformer specifications to Kyle.



KYLE

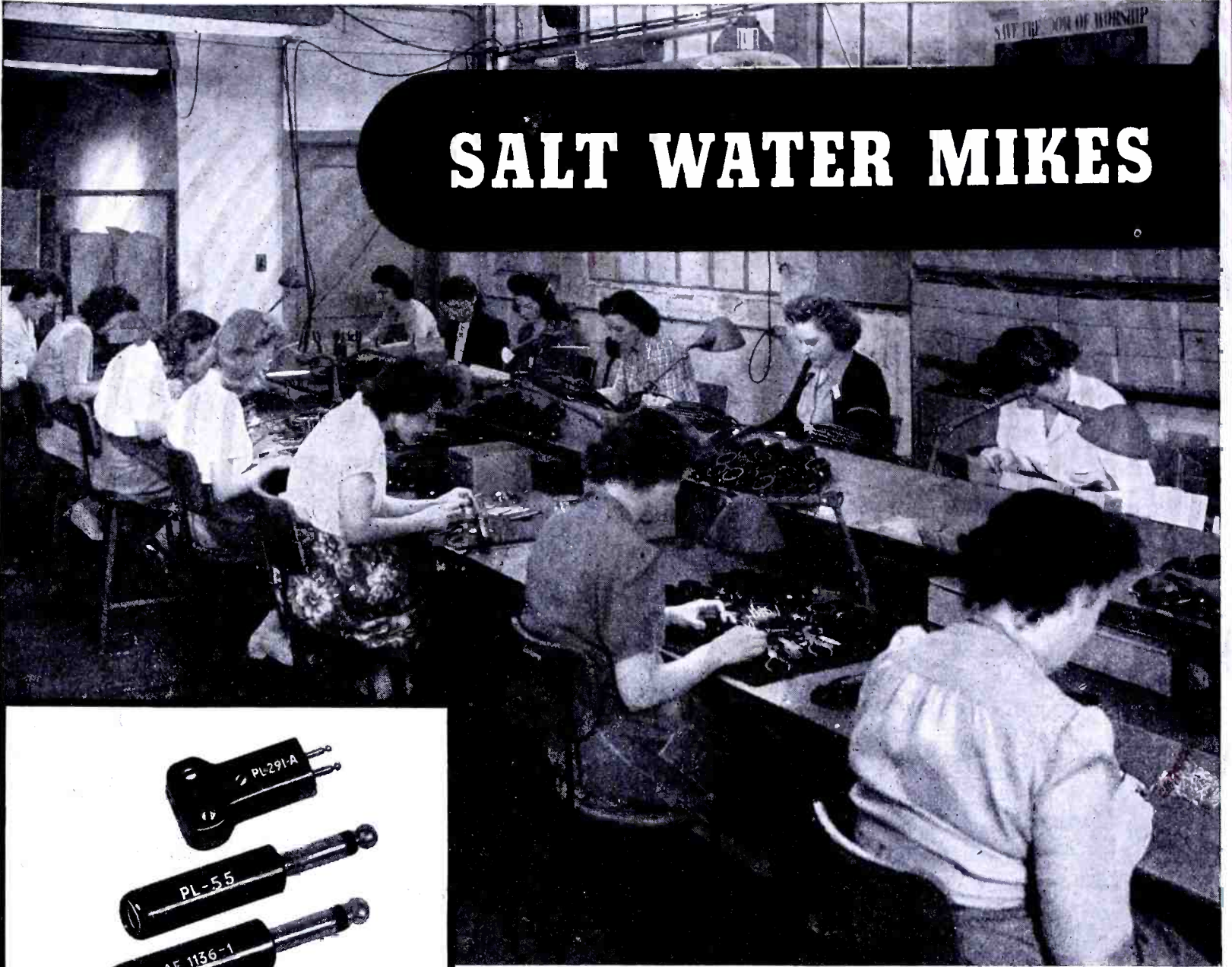


CORPORATION

SOUTH MILWAUKEE, WISCONSIN

COMMUNICATIONS FOR JULY 1945 • 15

SALT WATER MIKES



Marine microphone assembly. Plastic and metal parts designed, made and assembled by Remler to meet Navy and Merchant Marine specifications.



PLUGS & CONNECTORS

Signal Corps - Navy Specifications

Types :		PL			NAF	
50-A	61	74	114	150		
54	62	76	119	159		
55	63	77	120	160		1136-1
56	64	104	124	291-A		
58	65	108	125	354		No.
59	67	109	127			212938-1
60	68	112	149			

PLP		PLQ		PLS	
56	65	56	65	56	64
59	67	59	67	59	65
60	74	60	74	60	74
61	76	61	76	61	76
62	77	62	77	62	77
63	104	63	104	63	104
64		64			

OTHER DESIGNS TO ORDER

ONE REMLER ASSIGNMENT is the production of amplifying and transmitting systems for our Navy and Merchant Marine. Systems are complete—from shock-proof microphones, built to resist the corrosive action of salt air and water to transmitters and bull-horn speakers for baby Flat Tops. • Remler was organized in 1918 to manufacture ship wireless. Present activities in marine communications are a logical development of early activities in this field. The facilities and experience of this organization are at your disposal.

Further assignments in radio and electronics invited. Consult—

REMLER COMPANY, LTD. • 2101 Bryant St. • San Francisco, 10, Calif.

REMLER

SINCE 1918

Announcing & Communication Equipment



“HYTRON Tubes Are Good—SO WHAT!”

Sure, Hytron tubes are good — so what! All tubes made for Uncle Sam are good. They have to be, or he wouldn't accept them.

But Hytron goes further. Not satisfied just to meet Uncle Sam's JAN-1A specifications, it always sets factory testing specifications to tighter tolerances than the Services require. In this way, Hytron assures top quality

despite slight meter inaccuracies and the human element. When more uniform adherence to specifications can be attained, tests simulating actual equipment performance are added.

This same insistence on the best will continue after the war. Then, too, we shall say, "Hytron tubes are good — so what! They have to be good to be good enough for you."

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

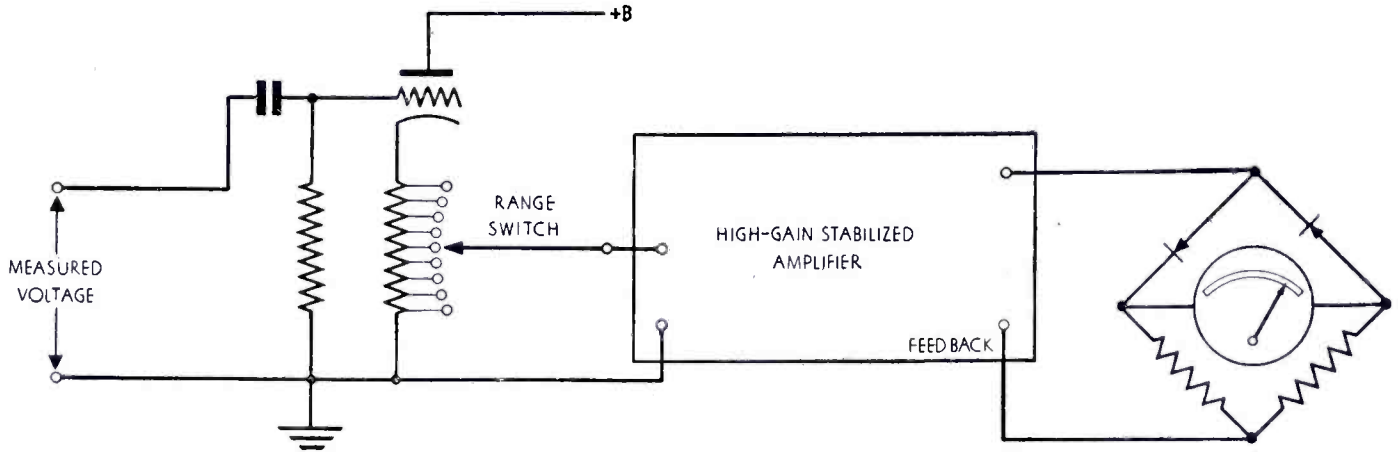
HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS
PLANTS: SALEM, NEWBURYPORT, BEVERLY & LAWRENCE



BUY ANOTHER WAR BOND



**-hp- Vacuum Tube Voltmeters
Employ This Cathode Follower Circuit**

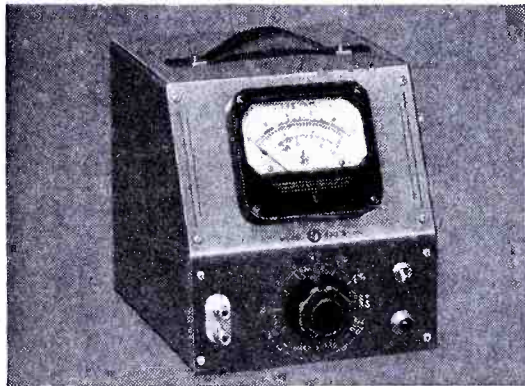
The advantages are many!

This cathode follower circuit provides an input impedance of 1 megohm and a useful means for varying the meter sensitivity. There are nine ranges, each related to the next by 10 db steps. No adjustment to zero position is required, and the ranges are instantly available by a switch on the panel.

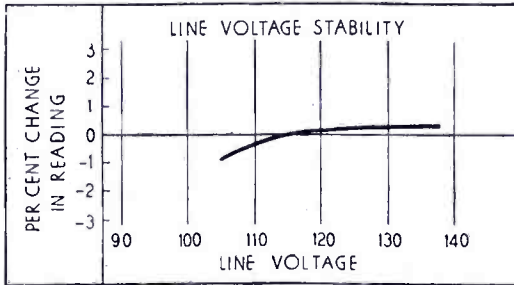
readings is independent of line voltage and tube characteristics.

Voltages as small as .005 and as high as 300 can be read with positive accuracy and the wide frequency range makes the instrument suitable for video measurements. The logarithmically related scales are also calibrated in db units. Ordinarily no precautions are necessary—wave form errors and "turn-over" effects are minimized—large overload voltages cause saturation of the amplifier which protects the meter.

The *-hp-* Model 400A is designed for the greatest amount of convenience. Its small physical size and large slanting scale make it desirable to use and easy to read. Power supply is completely contained. All-in-all, the *-hp-* Model 400A is probably one of the most useful, versatile instruments in the field. Write for further details.



The *-hp-* Model 400A Vacuum Tube Voltmeter consists of the above cathode follower circuit in conjunction with a full wave rectifier and a high gain amplifier. The full wave rectifier actuates a one-mil meter. The amplifier is of the broad band type and is substantially flat from 10 cps to 1 megacycle. Because the amplifier employs inverse feedback, it is extremely stable. Hence the accuracy of meter

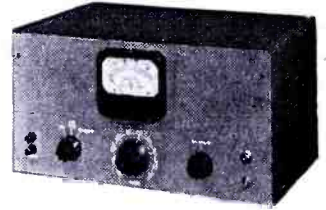


OTHER -hp- INSTRUMENTS



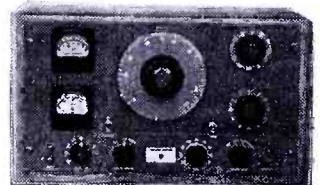
Noise and Distortion Analyzer

The Model 325B combines a vacuum-tube voltmeter with a set of fundamental elimination filters for general purpose measurements of total harmonic distortion, noise and voltage level.



Electronic Frequency Meter

Model 500A Frequency Meter is designed to measure the frequency of an alternating voltage from 10cps to 50kc.



Audio Signal Generator

The Model 205AG consists of a Hewlett-Packard resistance-tuned oscillator in combination with an input and output meter, attenuator and an impedance matching system.



Secondary Frequency Standard

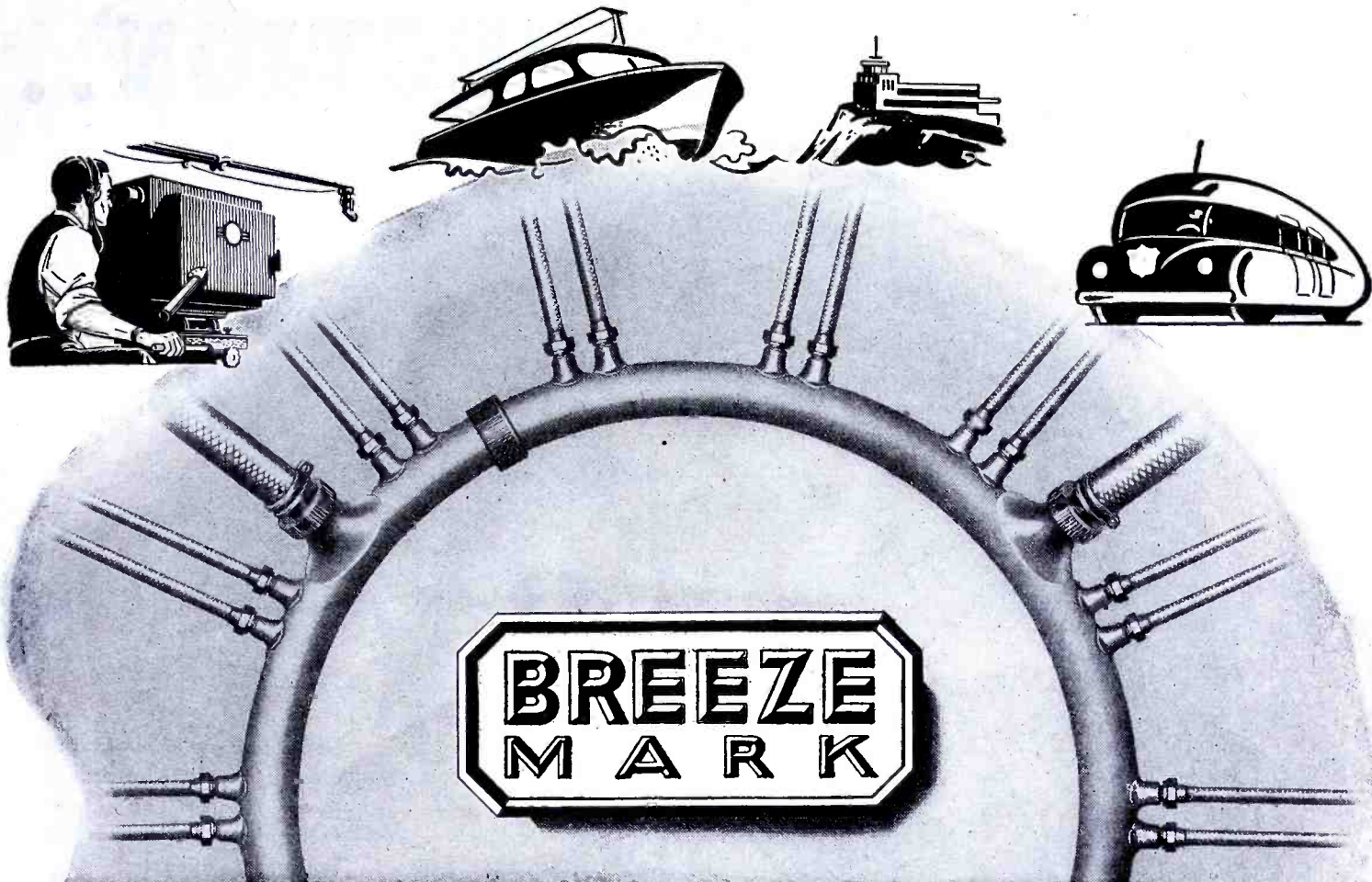
The Model 100B consists of a crystal controlled oscillator and a series of frequency dividers of the regenerative modulator type to provide standard frequencies of 100 kc, 10 kc, 1 kc and 100 cps.

HEWLETT-PACKARD COMPANY

Box 1047 E • Station A • Palo Alto, California



- Audio Frequency Oscillators
- Signal Generators
- Vacuum Tube Voltmeters
- Noise and Distortion Analyzers
- Wave Analyzers
- Frequency Meters
- Square Wave Generators
- Frequency Standards
- Attenuators
- Electronic Tachometers



G.H.Q. for Shielding Problems



In order to eliminate the radio interference caused by high-frequency impulses radiated from almost every type of electrical apparatus, Breeze pioneered the engineering and manufacture of shielding for aircraft, automotive, marine and industrial engines. Each application presented specialized

problems which Breeze, with its wide background of experience in the field, has been well equipped to overcome. Today Breeze Shielding has stood the tests of 18 years of service, and is constantly being improved to meet new needs.

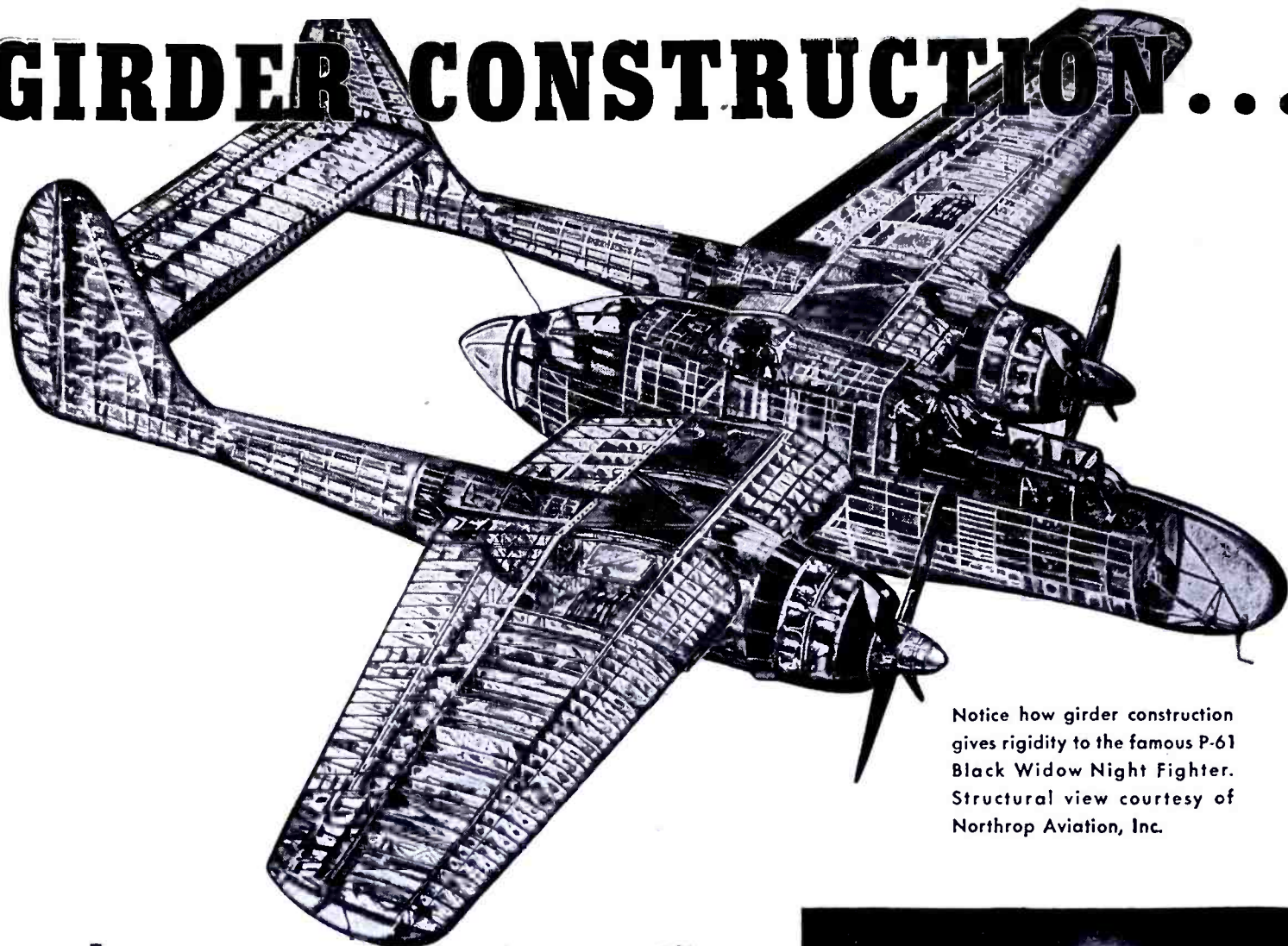
In the electronic age of tomorrow, the thorough shielding of electrical

equipment of all types will be of even greater importance. To manufacturers or users of such equipment, Breeze engineering and production facilities make it America's Headquarters for Radio Ignition Shielding. For a complete analysis and recommendation, call in a Breeze shielding engineer.



Breeze CORPORATIONS, INC. Newark, New Jersey

GIRDER CONSTRUCTION...



Notice how girder construction gives rigidity to the famous P-61 Black Widow Night Fighter. Structural view courtesy of Northrop Aviation, Inc.

gives greater strength to *Gammatron Tubes*

The same type of construction which gives strength and rigidity to a modern airplane, skyscraper, or bridge has been successfully incorporated into the design of the HK-854 and HK-1054 triodes. Compare the girder construction of the P-61 with the plate and grid supports of the HK-1054—the structural principles are identical! Note particularly how the heavy tripod plate support is welded to large diameter tubing, which in turn is firmly secured to the copper plate cup.

Because of their girder construction, HK-854 and HK-1054 Gammatrons stand up exceptionally well even when subjected to the vibration and stresses which usually accompany their use in such industrial applications as dielectric heating.

This superior internal strength is important since it prevents internal shorts, and variations in the characteristics of the tubes due to movement of the elements.

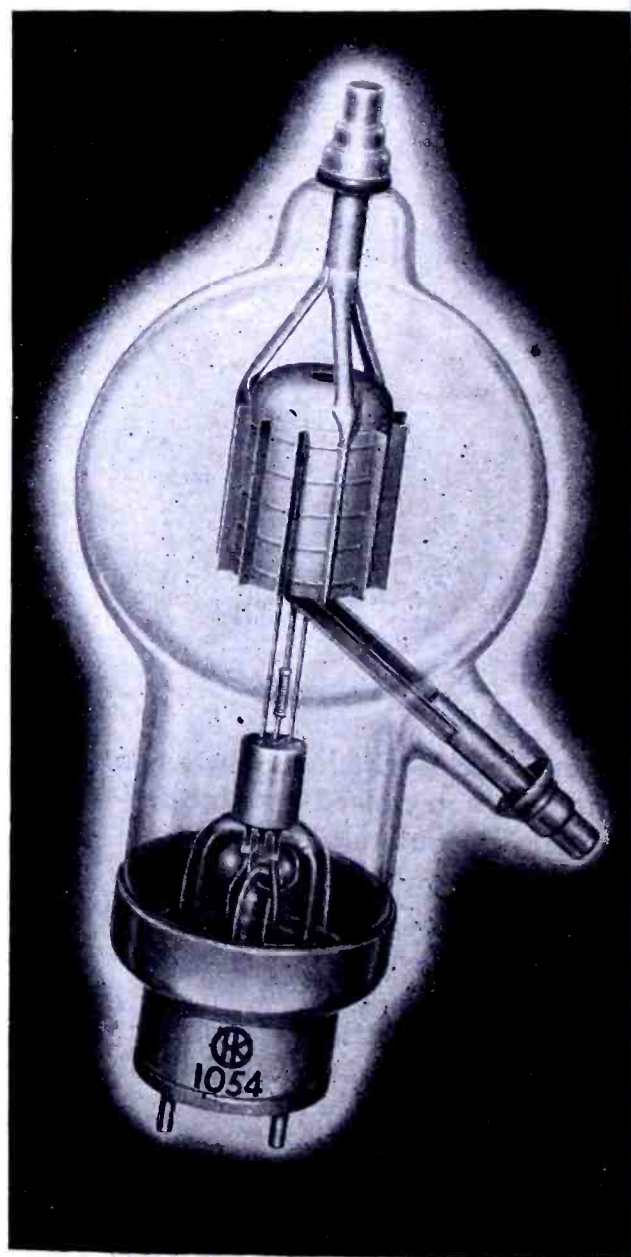
NEW LOW PRICES NOW IN EFFECT

TUBE TYPE	NEW LIST PRICE
HK 854-H (High amplification factor) . . .	Now only \$60.00
HK 854-L (Low amplification factor) . . .	Now only 60.00
HK 1054-L (Low amplification factor) . . .	Now only 135.00

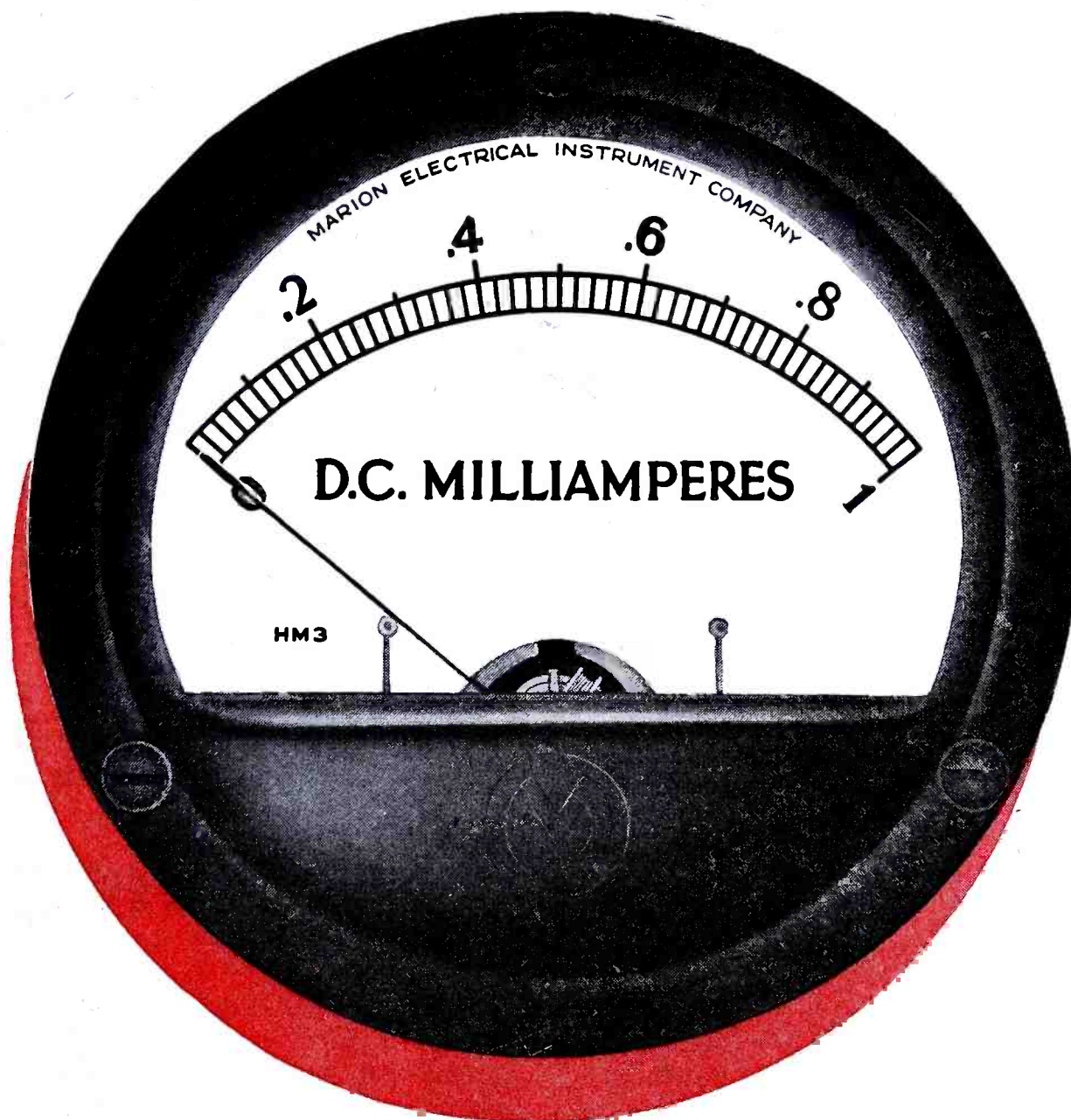
KEEP BUYING  WAR BONDS

HEINTZ AND KAUFMAN LTD.
SOUTH SAN FRANCISCO • CALIFORNIA

EXPORT AGENTS: M. SIMONS & SON,
25 WARREN STREET, NEW YORK CITY, U. S. A.



Marion Glass-to-Metal **Truly Hermetically Sealed** 2½" and 3½" **Electrical Indicating Instruments**



We've been *delivering them* since April 15, 1945!

Since April 15, 1945, we of Marion have been shipping our glass-to-metal hermetically sealed electrical indicating instruments to different branches of the Armed Services. They've been vacuum checked and inspected in accordance with latest test procedures recommended by the Services. Our capacity is continuously increasing, and essential users may, therefore, expect 60 to 90 day deliveries on most ranges. May we supply you with samples for your particular requirements and specifications? Deliveries, at present, on these is approximately 30 days. The same type of service that we are rendering in wartime will be in effect in peacetime, when Marion hermetically sealed instruments will help sustain the performance of radio and electronic equipment throughout the world.

They're *positively interchangeable*—and they cost no more than standard unsealed instruments.

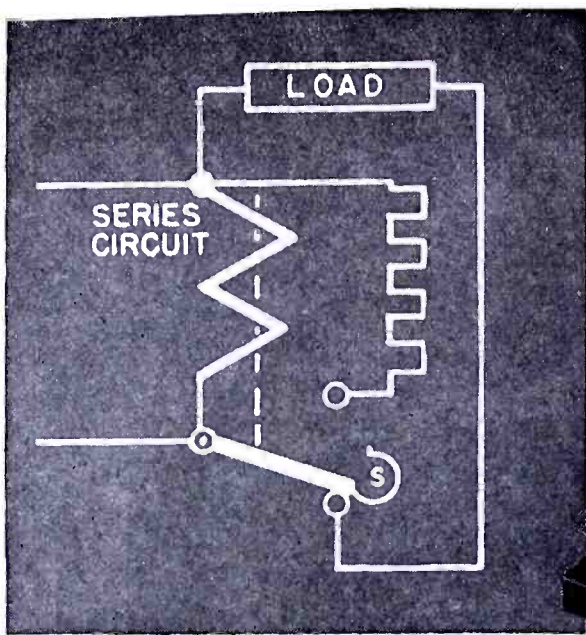
Write for our new, 12-page brochure. We welcome "jobs" calling for instruments with new and special characteristics for new and unusual applications.



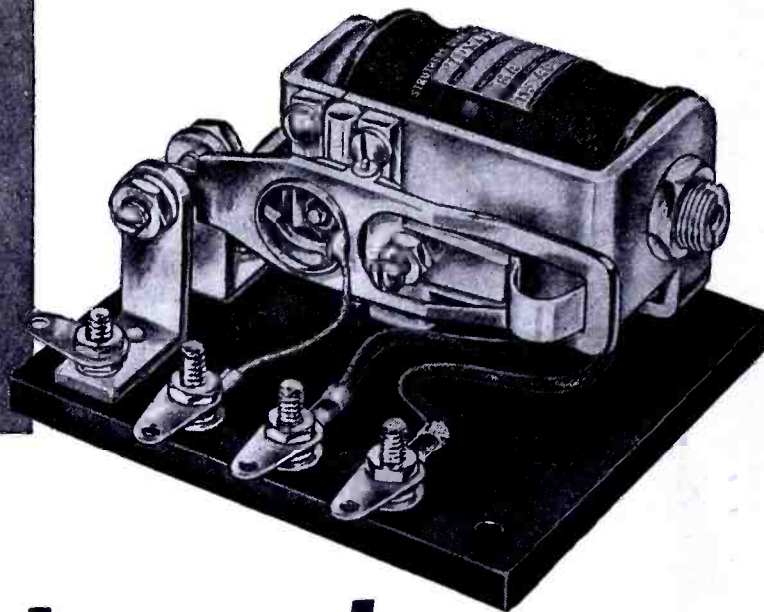
MARION ELECTRICAL INSTRUMENT CO.
MANCHESTER, NEW HAMPSHIRE

WASTEPAPER IS AMERICA'S NO. 1 CRITICAL WAR MATERIAL ... SAVE EVERY SCRAP

COMMUNICATIONS FOR JULY 1945 • 21



An extremely close differential application using a shunted coil circuit on the armature of a standard Struthers-Dunn Type 79XAX Snap-Action Relay.



Anything Less than EXACTLY THE RIGHT RELAY is Poor Economy

5,312
*Relay
Types*

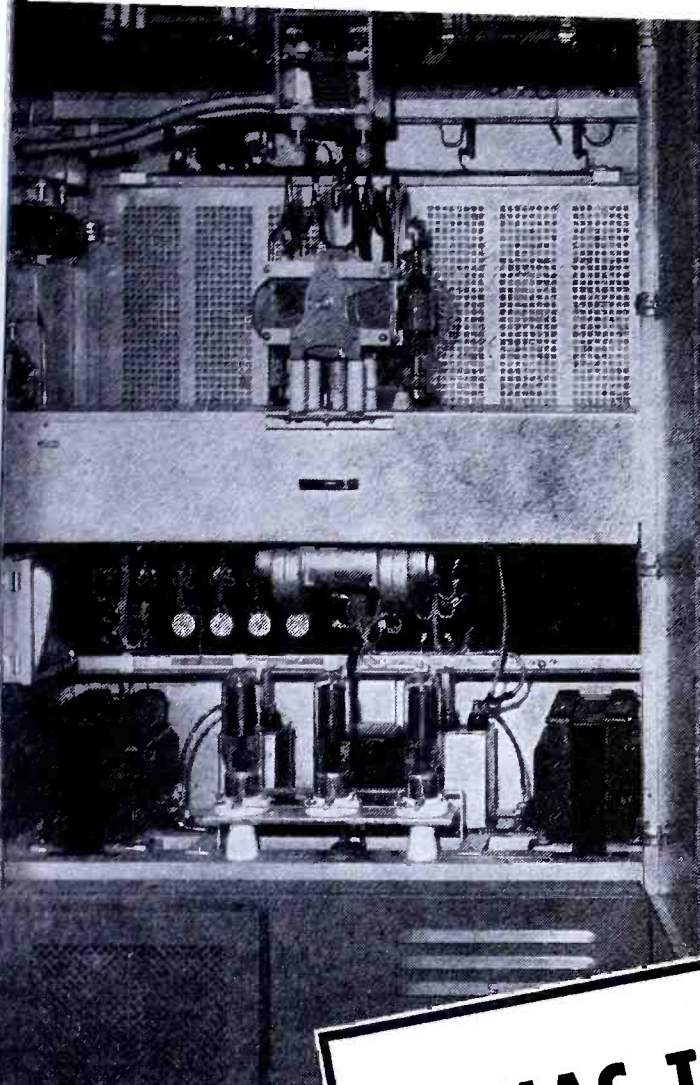
Don't waste time and money engineering "around" a relay or timer that is not EXACTLY suited to your application. Nine times out of ten Struthers-Dunn can fit you out with *standard* units ideally suited to your uses in every respect. Actually there are 5,312 *standard* Struthers-Dunn types from which recommendations can be made. Each one is subject to almost infinite design adaptations. Going beyond this, Struthers-Dunn engineering experience is such that no concern is better fitted to design custom built relays to meet your specific conditions.

STRUTHERS-DUNN, INC., 1321 Arch St., Philadelphia 7, Pa.

STRUTHERS-DUNN

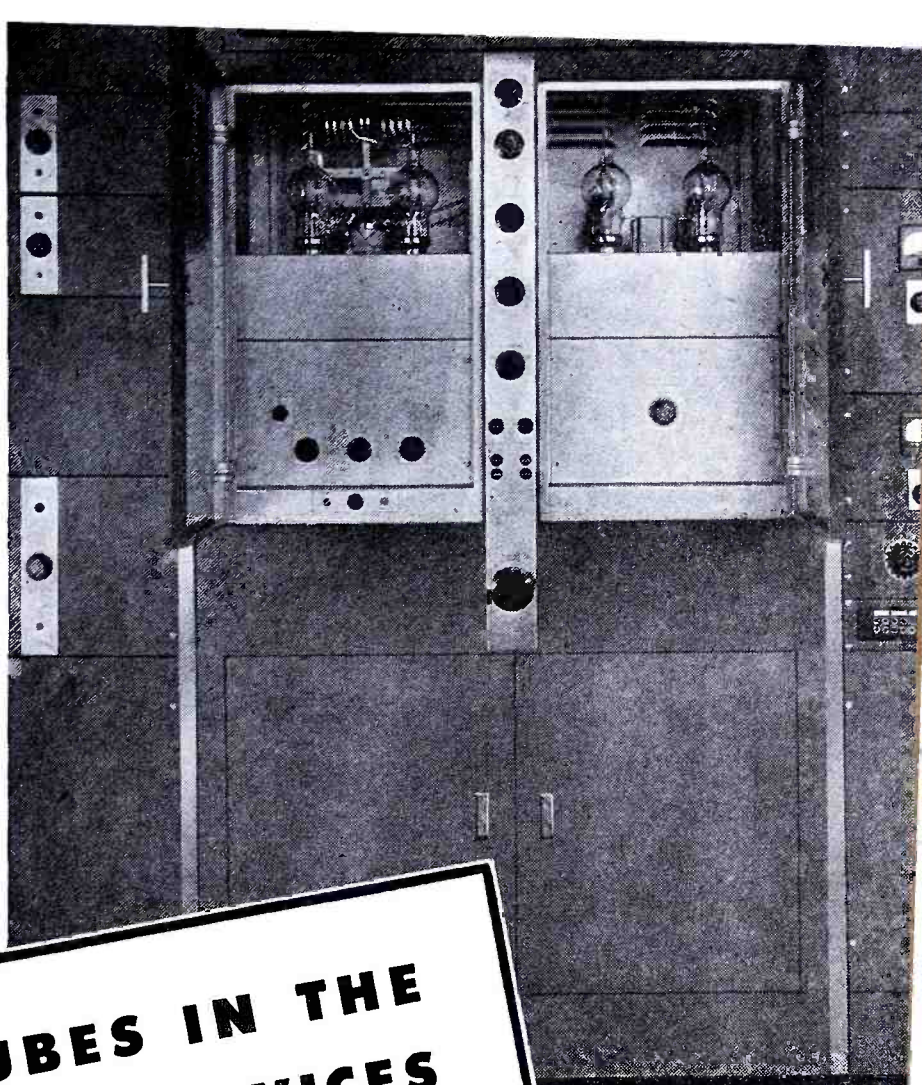
Relay and Timer Specialists Since 1923

DISTRICT ENGINEERING OFFICES: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND
DALLAS • DENVER • DETROIT • HARTFORD • INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL
NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO



... of Eimac 1000-T's give 3 KW
... in this Link-built FM trans-
... for the emergency services.

... a 500 watt supersonic test
... rator for operation at 1 to 300
... which uses Eimac 152-T tubes.

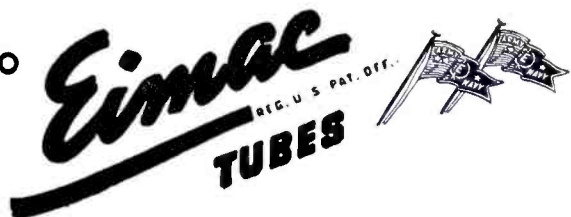


500 watt AM police trans-
mitter for 30-40 Mc opera-
tion, built by Fred M. Link,
using Eimac 250-TH tubes
in the final.

**EIMAC TUBES IN THE
EMERGENCY SERVICES
WHERE DEPENDABLE
PERFORMANCE COUNTS!**

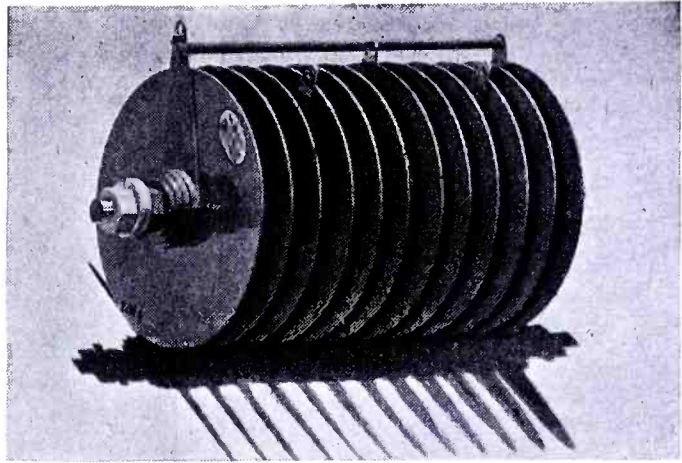
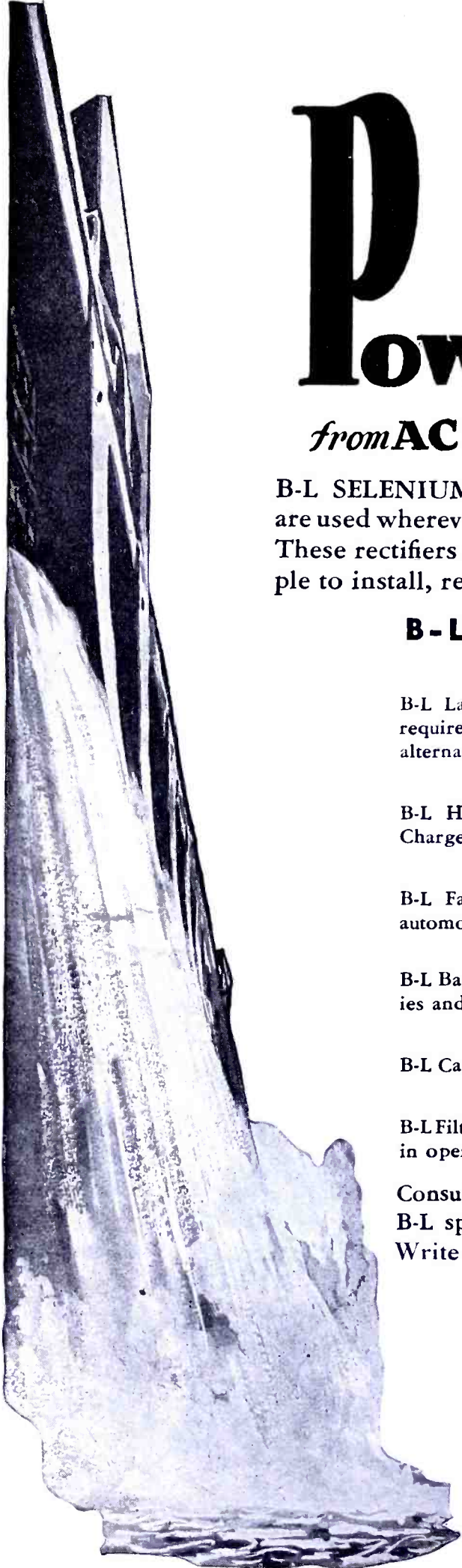
The transmitters shown on this page were developed and built for the emergency services — police, fire and transportation — by Link Radio Corporation of New York City. Recognition such as that enjoyed by the Link organization in this field is built upon sound engineering and the right choice of equipment components. That Eimac tubes occupy the important sockets in these vital transmitters is fitting acknowledgement of their inherently superior performance capabilities. That Fred M. Link specifies Eimac tubes is confirmation of the fact that Eimac tubes are first choice of leading electronic engineers throughout the world.

FOLLOW THE LEADERS TO



Get your copy of *Electronic Telesis* ... the sixty-four page booklet which gives the fundamentals of electronics. This little booklet will help electronic engineers explain the subject to laymen. It's yours for the asking ... no cost or obligation. Available in English and Spanish languages.

EITEL-McCULLOUGH, INC., 1033 San Mateo Ave., San Bruno, Calif.
Plants located at: San Bruno, California and Salt Lake City, Utah
Export Agents: Frazar & Hansen
301 Clay Street, San Francisco 11, California, U. S. A.



P OWER CONVERSION

from AC to DC with **B·L· RECTIFIERS**

B-L SELENIUM AND COPPER SULPHIDE ELECTRICAL RECTIFIERS are used wherever direct current is required from an alternating current source. These rectifiers are compact—durable—silent; have no moving parts; are simple to install, require no maintenance. Ratings from milliwatts to kilowatts.

B-L RECTIFIER TRANSFORMER ASSEMBLIES *are built for many standard applications:*

B-L Laboratory Rectopacs for supplying the required voltage of direct current from the alternating current source.

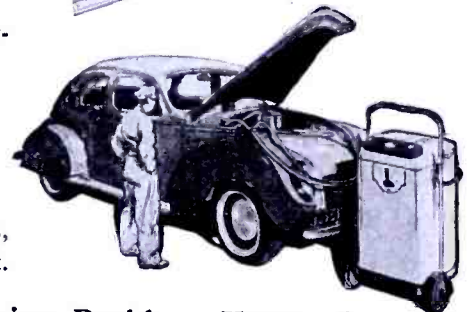
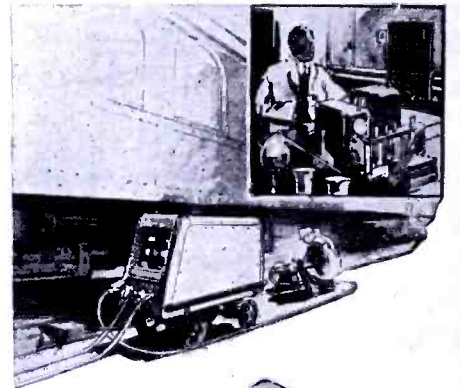
B-L Heavy Duty Portable Railroad Battery Charger, for use in terminals.

B-L Fast Battery Charger for "no removal" automotive battery service.

B-L Battery Booster for use in charging batteries and keeping them charged.

B-L Cathodic Protection for pipe lines.

B-L Filterpacs, eliminating the need of batteries, in operating 6-volt DC electrical equipment.



Consult us if you have a Power Conversion Problem. Twenty-five years of B-L specialized skill in AC-DC conversion problems is available to you. Write for Bulletin R38-e.

SELENIUM



**COPPER
SULPHIDE**

THE BENWOOD LINZE COMPANY
1815 Locust Street • • • St. Louis 3, Mo.
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Chicago 6, Illinois
Telephone CEntral 2379

Designers and Manufacturers of Selenium and Copper Sulphide Rectifiers, Battery Chargers, and DC Power Supplies for practically every requirement.

Again KAAR is FIRST!

fm

INSTANT

HEATING

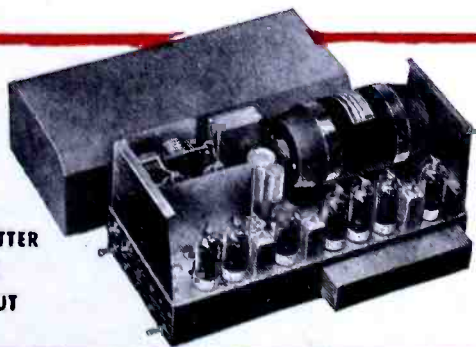


KAAR makes 50 and 100-watt mobile FM practical with instant-heating tubes

Kaar engineers—who pioneered instant-heating AM radiotelephones—have done it again! In presenting the new KAAR FM-50X and FM-100X, they now give you the advantages of FM *plus* instant-heating tubes... greater power and range

with lower battery drain! Standby current is zero. Yet the instant you press the button microphone, you are on the air with a full 50 or 100 watts output, improved voice quality, and minimum distortion—sending out a strong, clear message that insures excellent reception.

KAAR FM TRANSMITTER
MODEL FM-50X
50 WATTS OUTPUT



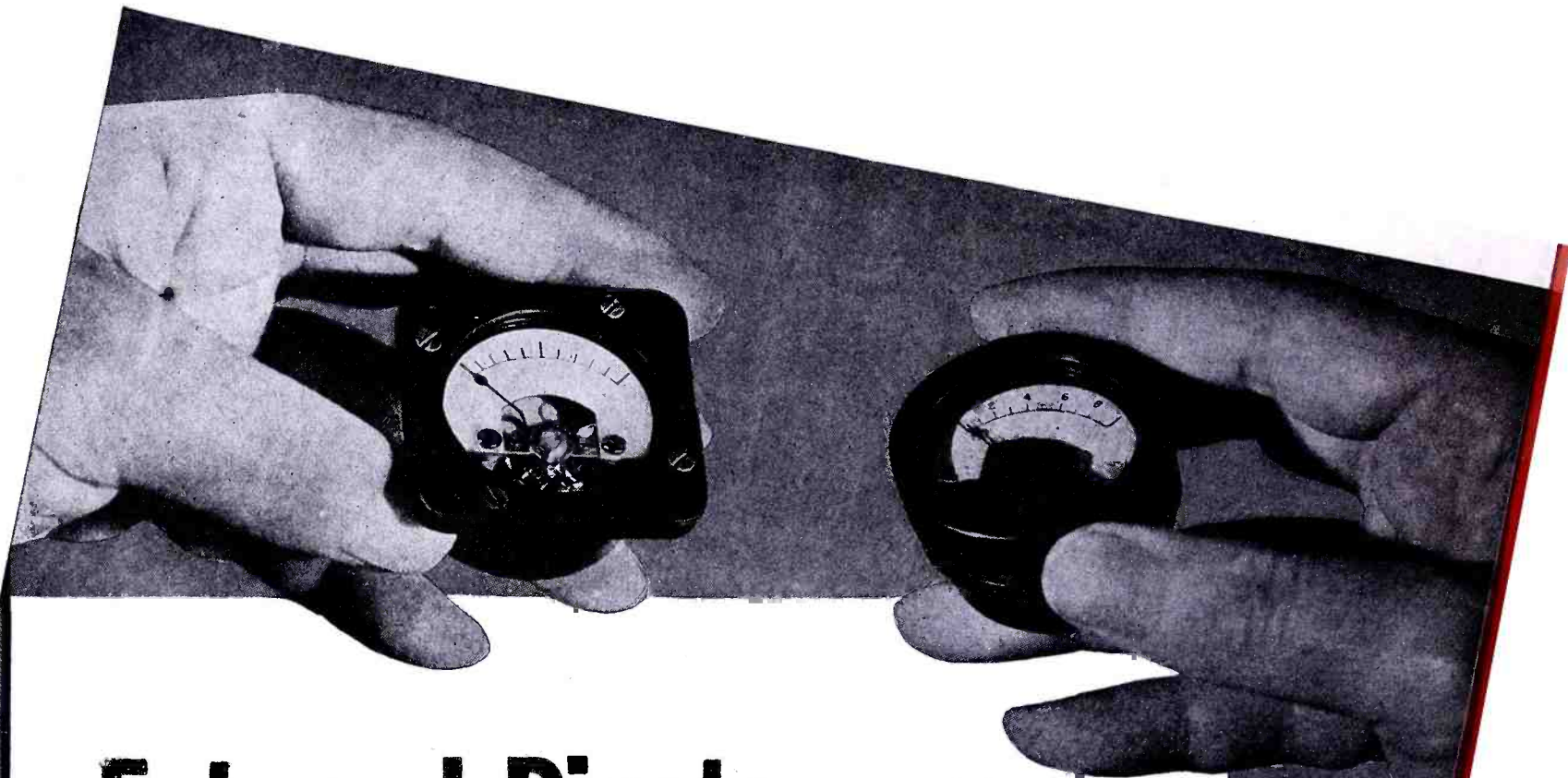
KAAR



ENGINEERING CO.

PALO ALTO • CALIFORNIA

Export Agents: FRAZAR & HANSEN • San Francisco, California



External Pivots

HELP THESE GREAT LITTLE METERS GIVE *A LOT* OF EXTRA PERFORMANCE!

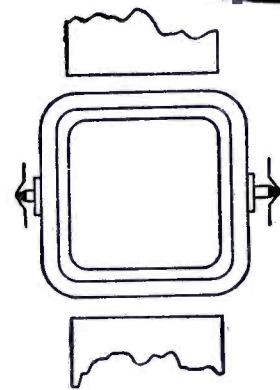
These two hermetically sealed 1½" DeJur Instruments — the Model 120 (right) and the Model 112 (left) — designed to aid in the development of small equipment for present and post-war applications, combine miniature size with the accuracy resulting from *external pivot* design.

External pivots used in both models, help provide better all-round performance because: external pivots provide maximum accuracy in mounting the moving element between the jewel bearings . . . prevent rocking of the pointer . . . reduce side friction between jewels and pivots . . . increase the life of bearing surfaces.

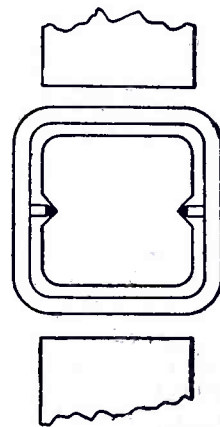
Alnico Magnets of the highest grade permit the use of high torque . . . afford instantaneous response under varying loads . . . insure stability . . . and provide protection against the damaging effect of surrounding magnetic fields.

Both Models are available either as D.C. or A.C. Instruments.

We are equipped to work with you on special models of all DeJur Products for present and postwar applications. Write for the latest DeJur catalog.



External pivots (above)—used in the design of DeJur 1½" Meters — provide greater accuracy in mounting the moving element between the jewel bearings. For this reason internal pivots (below) are not used in DeJur meters.



GIVE YOUR
FULL SUPPORT
TO THE
**SEVENTH
WAR BOND
DRIVE**

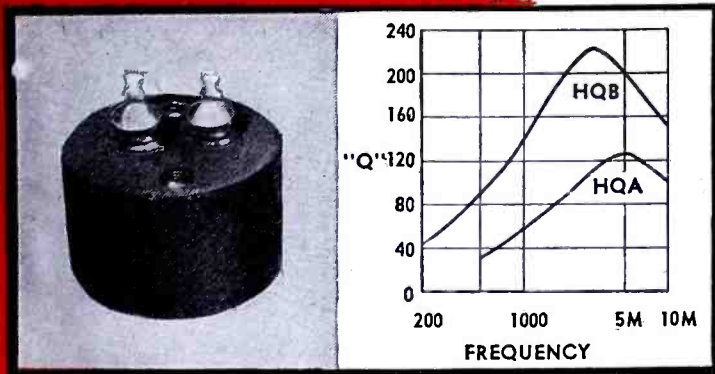


DeJUR - AMSCO CORPORATION

GENERAL OFFICE: NORTHERN BLVD. AT 45th STREET, LONG ISLAND CITY 1, N. Y.

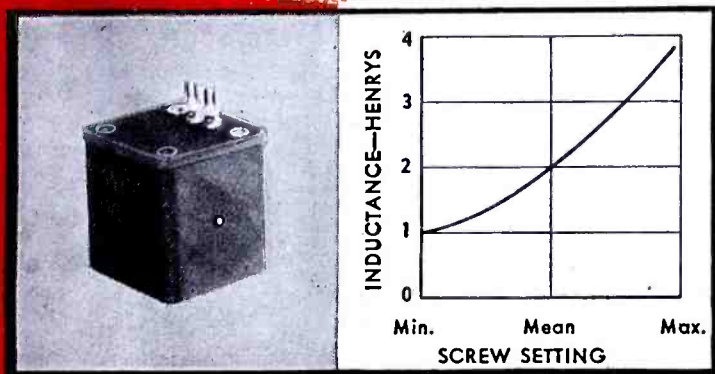


FOR INDUCTORS



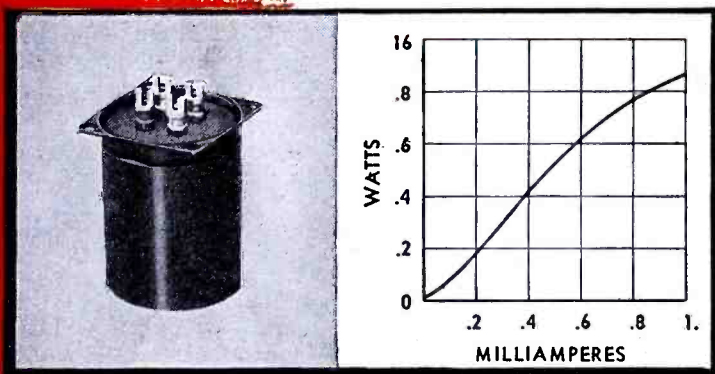
HQA AND HQB HIGH Q INDUCTORS

This series of toroid wound high stability inductors are available from 5 Mhy. to 2 Hys. Voltage stability is excellent, hum pickup is very low. Temperature effects are negligible. HQA units 1-13/16" in diameter by 1-3/16" high.



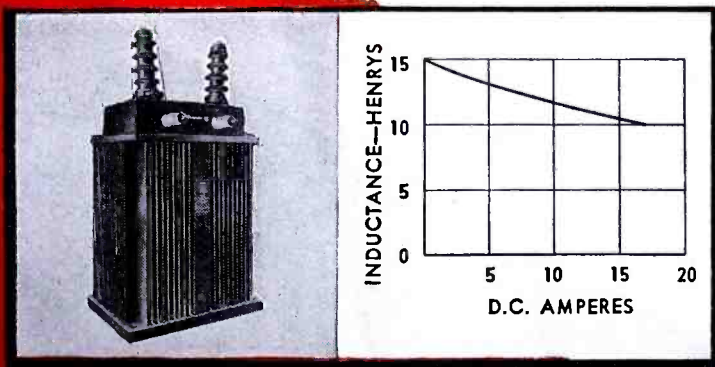
TYPE VI-C VARIABLE INDUCTORS

These inductors are available in optimum values from 10 Mhy. to 10 Hys. They are tunable over a wide range by inserting an Allen Head wrench in the adjusting screw. Units measure 1 1/4" x 1-7/16" x 1-7/16".



SENSITIVE SATURABLE INDUCTORS

UTC Saturable Inductors cover a wide range of application for magnetic amplification and control. These units are supplied to specific requirements. The curve shown illustrates a high sensitive type, showing DC saturation vs. AC watts into load.



POWER SUPPLY INDUCTORS

UTC supplies power supply components for every type of application, ranging from a one-third ounce reactor, which measures 5/8" x 7/16" x 3/4", to the 10,000 pound, broadcast station, plate supply reactor, illustrated.

May we cooperate with you on design savings for your applications...war or postwar?

ALL PLANTS



United Transformer Corp.

120 VARICK STREET

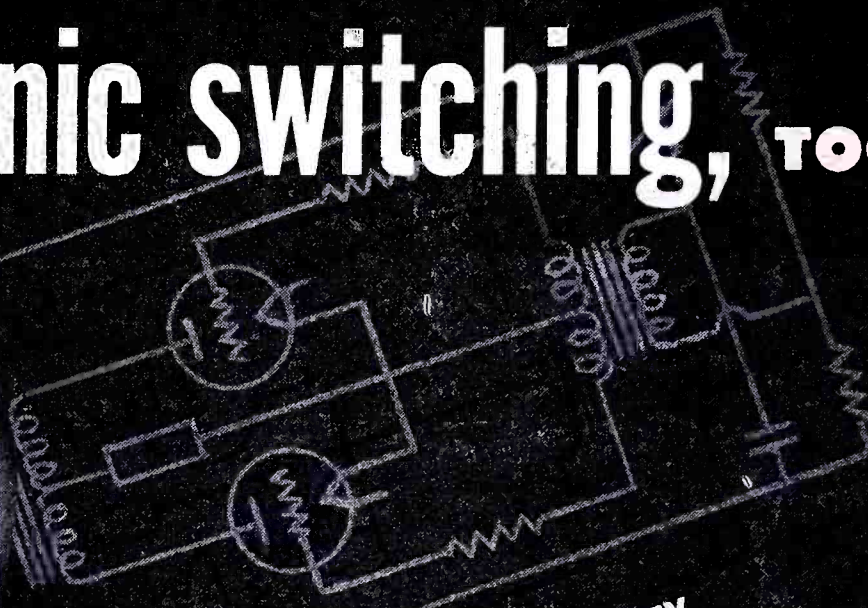
NEW YORK 13, N. Y.

EXPORT DIVISION 15 EAST 40th STREET, NEW YORK 16, N. Y.,

CABLES: "ARLAB"

ALL THIS, AND

electronic switching, TOO!



- HEAVY PLATE CURRENT CAPACITY
- CONTINUOUSLY VARIABLE OUTPUT
- HIGH INVERSE VOLTAGE RATING

E-E Type 17 Rectifier

for greater efficiency!

The electrical characteristics of the E-E 17 grid controlled rectifier have resulted in its wide adaptability in industrial applications. At condensed mercury temperature of 20 to 60° C, peak plate current is 2.0 amp.; peak inverse voltage 7,500. Heating Time is 30 seconds and deionization 1,000 microseconds and ionization time 10 microseconds.

Desirable as the above characteristics are, the full measure of E-E17 efficiency must include consideration of ap-

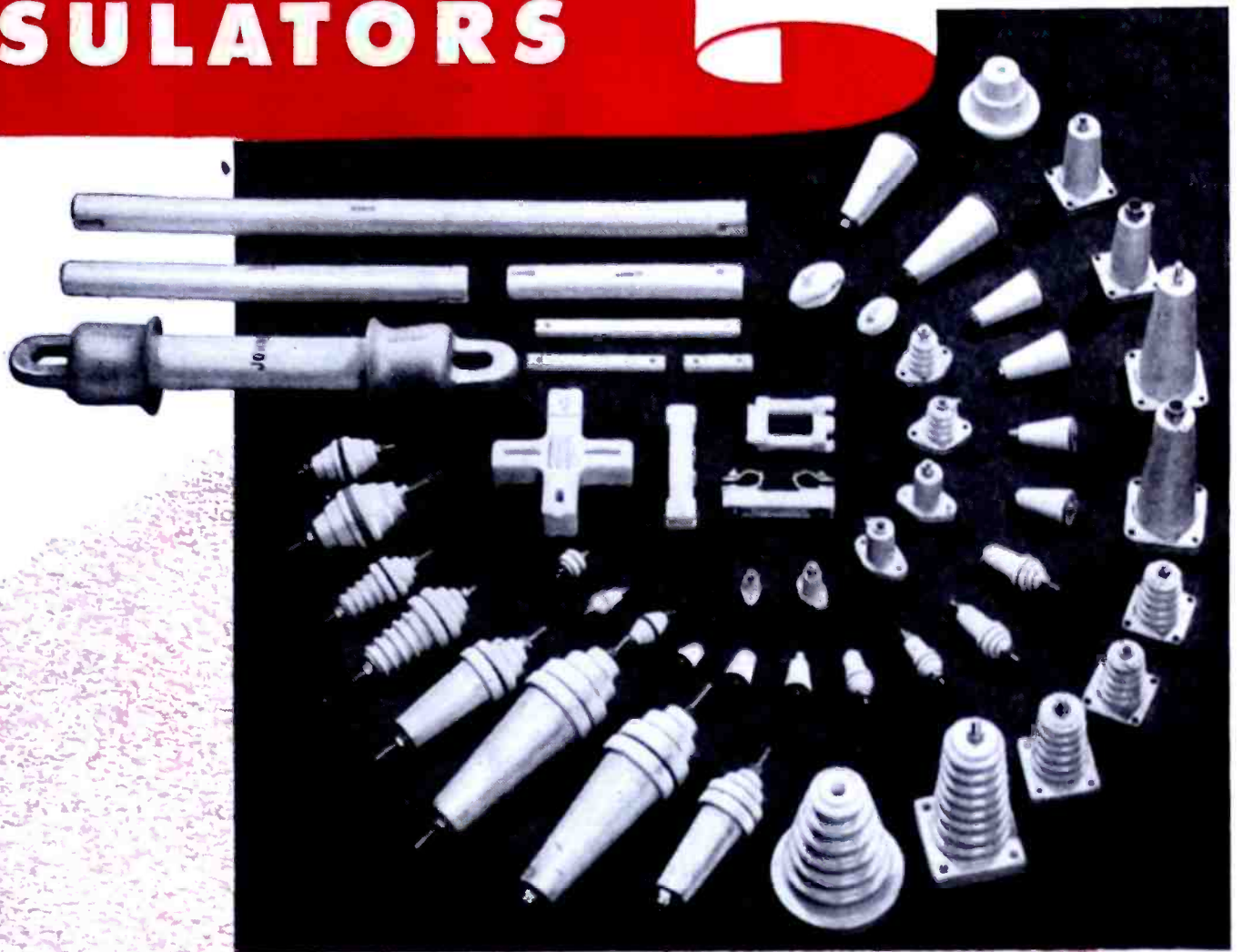
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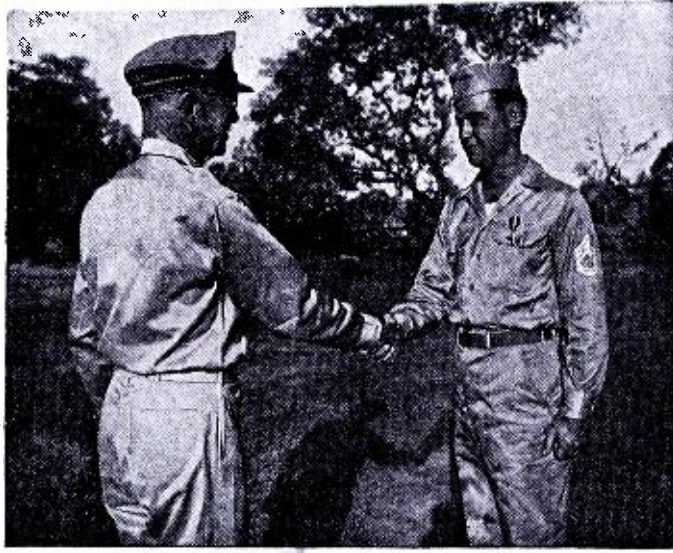


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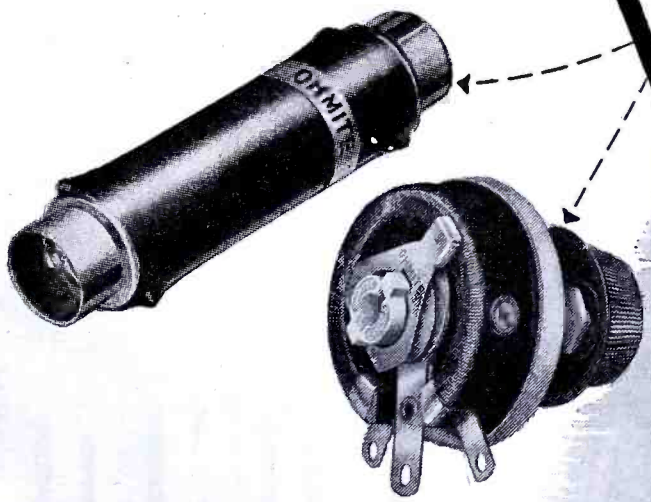
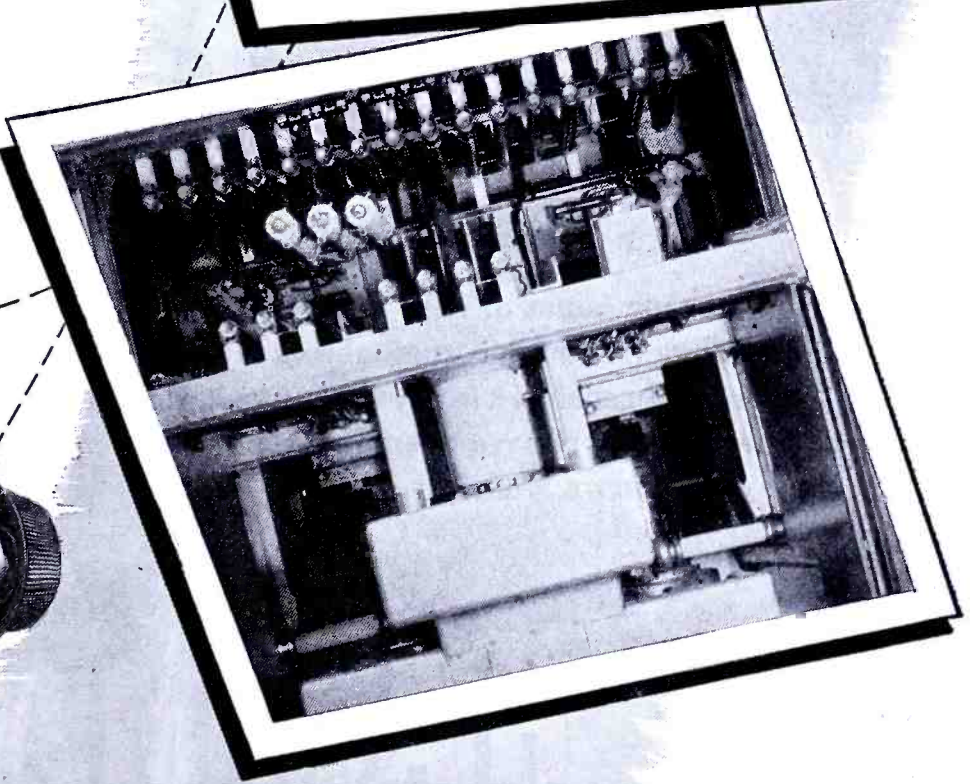
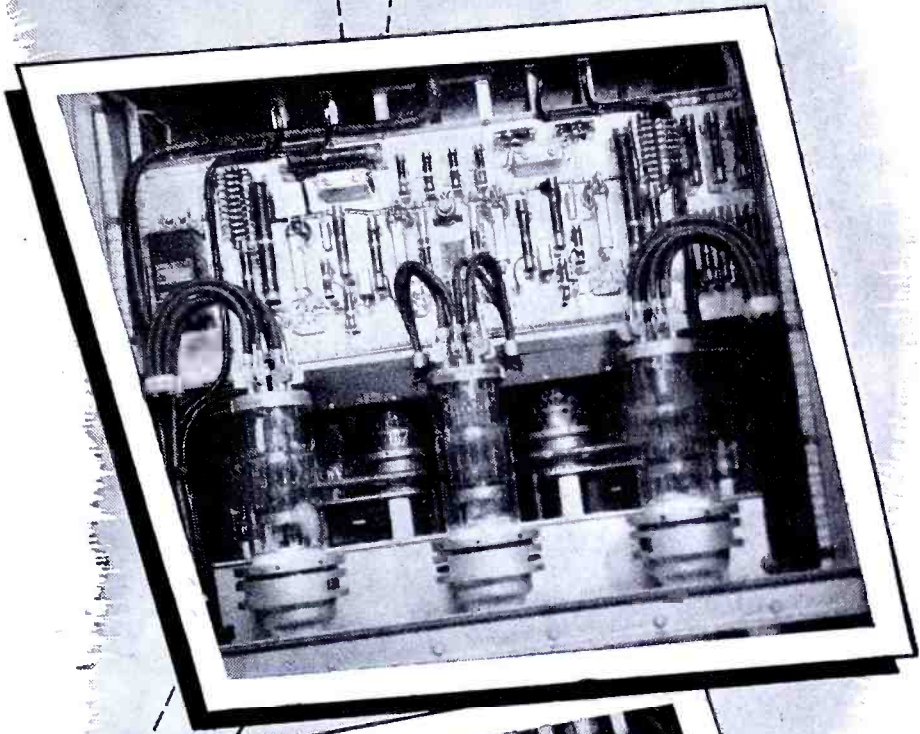
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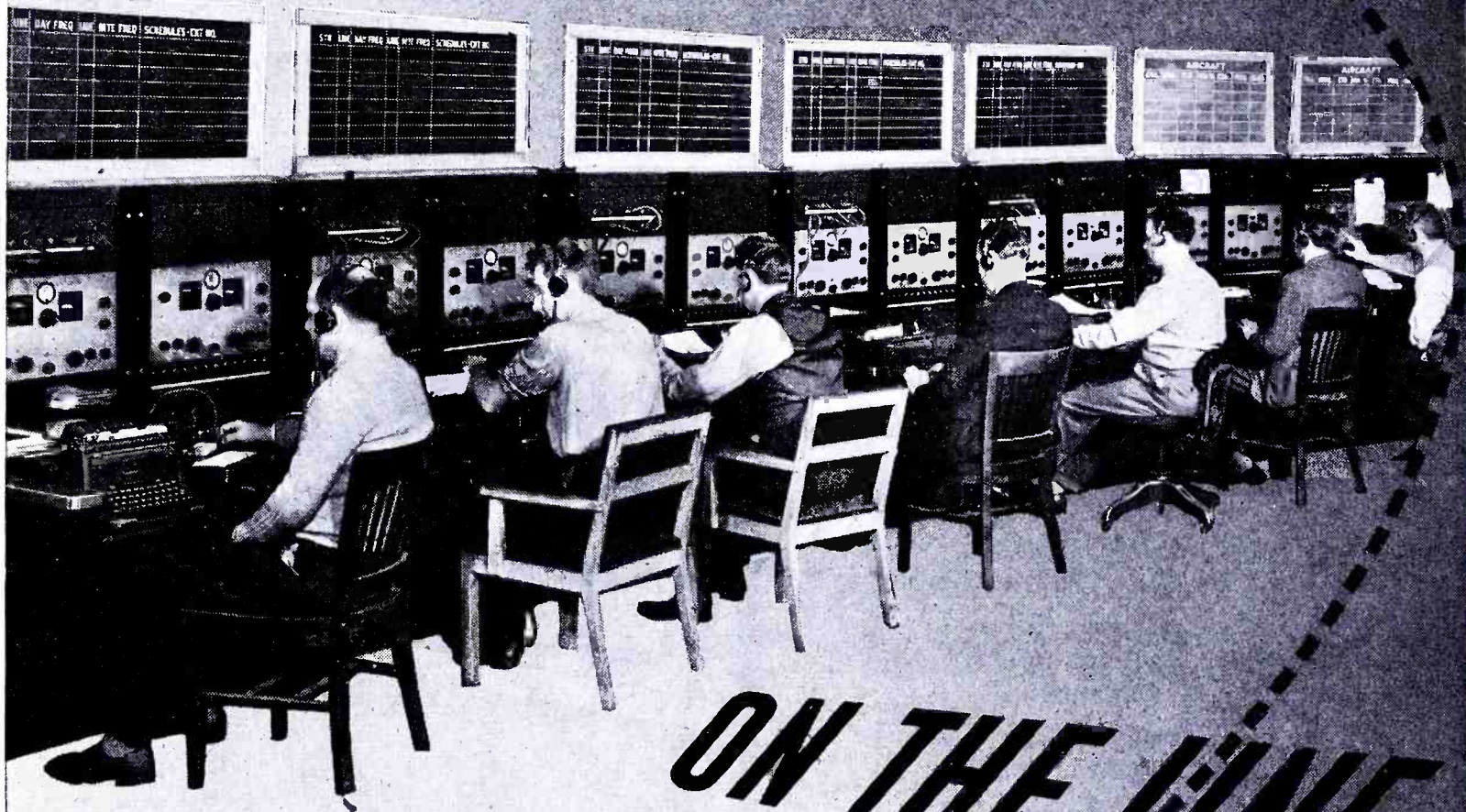


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COMMUNICATIONS

LEWIS WINNER, Editor

* * JULY, 1945 * *

•
A typical electric
megaphone.
•



ELECTRIC MEGAPHONES

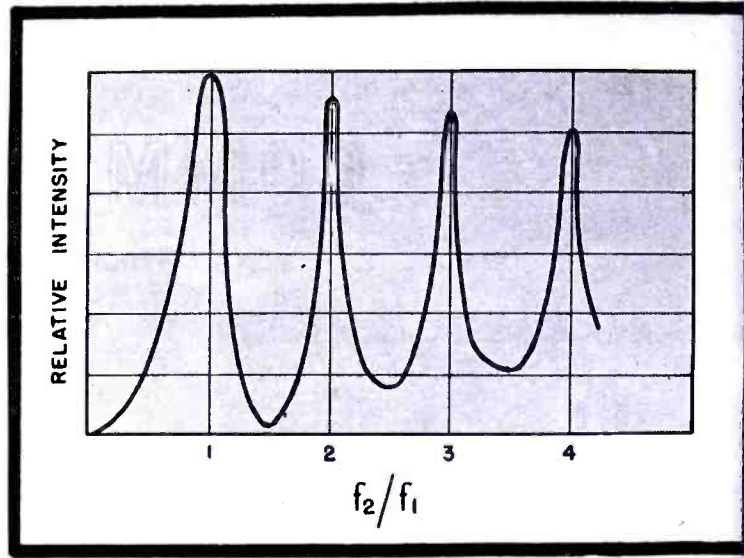
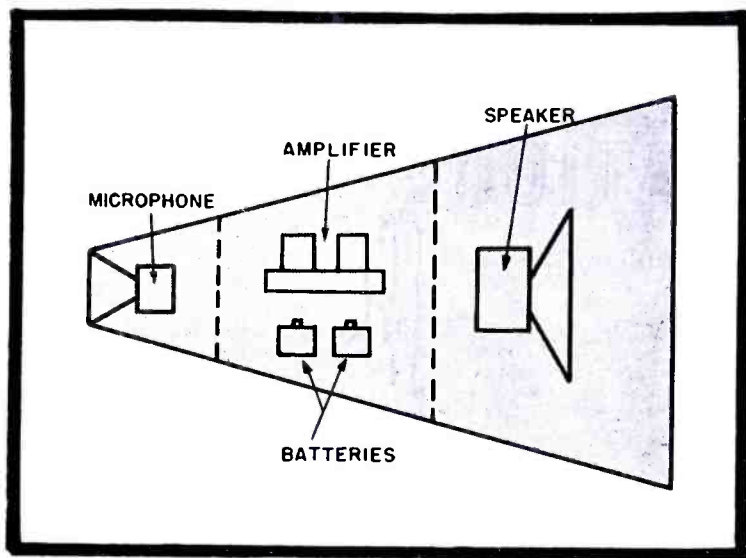
by **ARTHUR J. SANIAL**

Chief Engineer
Atlas Sound Corporation

PERHAPS one of the most unique additions to loudspeaker communications equipment in the last few years has been the electric megaphone. The potential usefulness of such equipment had been recognized by many, but practical design problems were numerous. Thanks to the recent advancements in the acoustic and electronic art, it was possible to overcome these problems. In the original developmental plans proposed by the writer, the electric megaphone design called for a portable unit which could be used in the same manner, and as readily as the familiar

and proven conical megaphone, but which would amplify the human voice many times more, and with greater fidelity. As far as I and my associates could ascertain at the time, no one had successfully combined a microphone and a loudspeaker in one small unit which, with a suitable electronic amplifier, would effect sufficiently great amplification of the voice to advantageously replace the old-fashioned mega-

phone. It is possible that any attempts which may have been made in this direction had indicated it to be useless to prevent the acoustic feedback or howling which always resulted from such a combination heretofore. This, then, was the chief problem to solve; to find how to reduce the causes of acoustic feedback to a minimum so as to permit sufficient electronic amplification to be used to magnify the hu-



Figures 1 (left, above) and 2 (right, above)
Figure 1, megaphone of A. Warmbier. Figure 2,
intensity amplification versus frequency of a
typical finite conical megaphone.

man voice well above normal level. Secondary, but important, problems were: (1)—to make the electric megaphone light in weight and small as possible, so that a person could hold it up to his mouth steadily under adverse conditions with one hand, (2)—to make the electro-acoustic efficiency of the megaphone as high as possible, and (3)—to design the smallest and lightest possible portable amplifier with sufficient gain and power capacity coupled with the greatest possible efficiency so as to attain maximum battery life with minimum battery weight and volume.

These problems were solved in developing the original electric megaphone to what was then a satisfactory degree. And in 1940, the writer filed a patent application on the device, which was issued two years later.¹ Only one other device was revealed in the action of the patent examiner that was in any way similar. This was a U. S. patent taken out by a German, A. Warmbier.² Subsequent examination of the claims and design disclosed that it was not possible to secure a practical degree of loss against feedback between the microphone and the loudspeaker components so as to permit a worthwhile amount of amplification to be used. This patent showed a microphone, an amplifier, batteries and loudspeaker all enclosed in a conical-shaped casing, Figure 1.

In the writer's patent, the megaphone was designed to give appreciable loss to feedback by the acoustic design, and further, the system as a whole was designed with selective transmission characteristics.

Patents for improvements on electric megaphones have been obtained by Silverman and others on the basis of different and novel features, but it appears that Warmbier's device is the first even though it was largely overlooked in this country.

Strangely enough, during the initial presentations it was difficult to convince those who would benefit by the use of the electric megaphone that it was more than a novelty. It was only by a great deal of pioneering work, including widespread demonstrations in the field and aboard ships, that its superiority over the old-fashioned megaphone was shown to outweigh its added complication.

The original electric megaphone was by no means the last word. Wide-

spread use of these electric megaphones showed the limitations of this equipment, and a demand arose for an electric megaphone system which would amplify the talker's voice to a much greater volume. It was the consensus that the size and weight of the equipment, particularly the megaphone itself, could be increased very little. To understand what was required of such an improved system, let us review some of the technicalities of the original system.

It might be well to digress at this point to discuss the question which arose so often when the electric megaphone was first introduced: "How is the electric megaphone better than an ordinary megaphone?" Many persons believed an electric megaphone to be no louder and intelligible than the ordinary shipboard megaphone, until demonstrated under adverse conditions. Actually, the acoustic output of a properly designed electric megaphone system is far greater than that produced by a megaphone, and the intelligibility is far better. In the first place, a conical megaphone amplifies only to the extent that it concentrates the talker's voice chiefly in a conical beam, the concentration of which is a direct function of the size of the megaphone, its proportions, and the frequency transmitted. It is true that if the megaphone is made extremely long with small angle of taper, a large effective amplification can be obtained, but practical megaphones average between 2' and 3' in length. A short conical horn of this order has a relatively low effective amplification, particularly since this occurs mainly at resonance peaks of the fundamental resonance frequency and harmonics of the conical pipe. The ratio of these peaks to the dips between is so great, that the an-

¹U. S. Patent No. 2,301,459; Nov. 1942. Assigned to Guided Radio Corp. by A. J. Sanial.
²U. S. Patent No. 2,218,389; Oct. 1940, A. Warmbier.

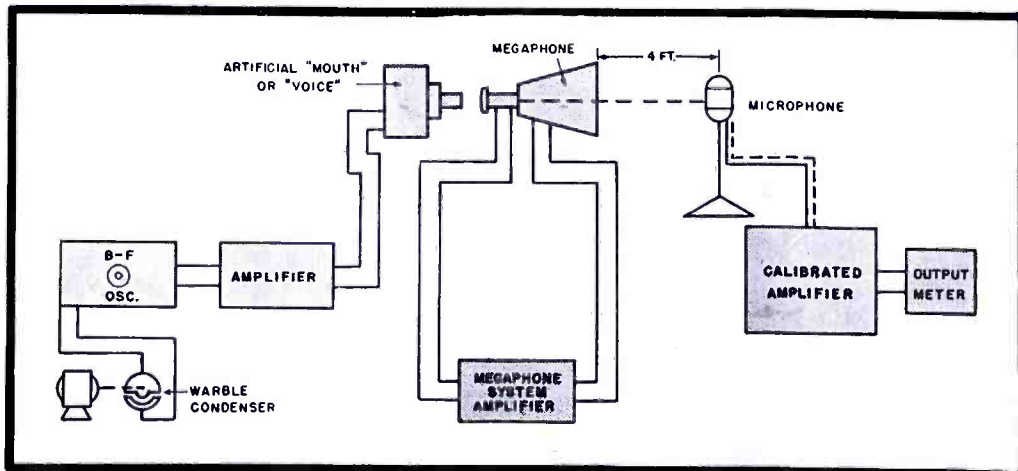


Figure 3
Setup used to test electric megaphones. Artificial mouth is driven by a warble tone of from 1250 to 1750 cycles.

ification at the dips is practically no, particularly at lower frequencies. Distortion of the voice is, therefore, high, and therefore intelligibility is considerably marred. The intensity amplification versus frequency of a typical finite conical megaphone is shown in Figure 2.³ Here we see the wide variations in output from a source of constant power.

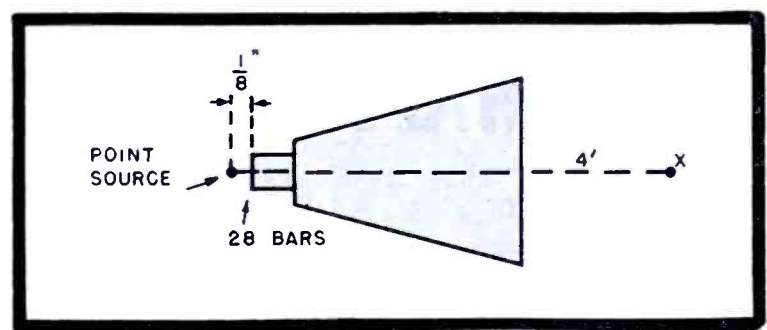
From a quantitative standpoint it might be estimated that an ordinary port megaphone would give an amplification, at the resonant peaks, of the order of 10 db. The average gain is much lower. In a well designed electric megaphone system, the voice may be amplified relatively uniformly in the speech band selected as adequate, just as in any loudspeaker system designed for a given application. The amplification of the talker's voice does not depend solely on the horn but chiefly on the gain and power output of the electronic system.

The original electric megaphone system was intended to produce 10 dynes per square cm at a point 4' directly in front of the megaphone, under standard measuring conditions. In making these tests the megaphone is first set up in an acoustically treated sound room having fairly high absorption in the speech frequency spectrum. Then an artificial mouth is placed directly opposite the microphone opening of the megaphone, and spaced so that when the mouth is operating, a known sound pressure is produced at a fixed distance from the plane of the microphone opening. The artificial mouth is driven by an audio-frequency warble tone, usually produced by varying a portion of a variable capacitor of a beat-frequency oscillator at a constant rate. The warble tone usually used is 1,250 to 1,750 cycles; these frequencies affording the results by which performance on voice may be gauged. The output of the megaphone is measured by a laboratory standard microphone and amplifier whose output is calibrated in terms of the pressure in bars at this microphone. The latter is placed 4' in front of the horn of the megaphone, and on the x axis. The setup is shown in Figure 3.

It is possible to secure a reading of the effective amplification the pressure 10 bars represents. It is necessary to assume a point source, quite unlike actual conditions, but justified for comparative purposes providing conditions at the input end are unchanged. Referring to Figure 4 let us assume 28 bars are produced 1/8" from a point source, and that this pressure exists at

Figures 4 (right), 5 and 6 (below)

Figure 4, Using a point source to secure an effective amplification reading. Figure 5, idealized directivity pattern of a loudspeaker. Figure 6, plot of acoustic feedback of loudspeaker and microphone; x indicates center of microphone diaphragm, small circle contour of an arbitrary lower sensitivity.



the input side of the megaphone. Assuming the megaphone to be 1' long then at a reference point x, 4' from the megaphone, the pressure when the megaphone is present and operating will be 10 bars. When the megaphone is removed, the pressure will be

$$P_1 = 28 \left(\frac{.125}{5 \times 12} \right) = .58 \text{ bar}$$

The increase of sound pressure of

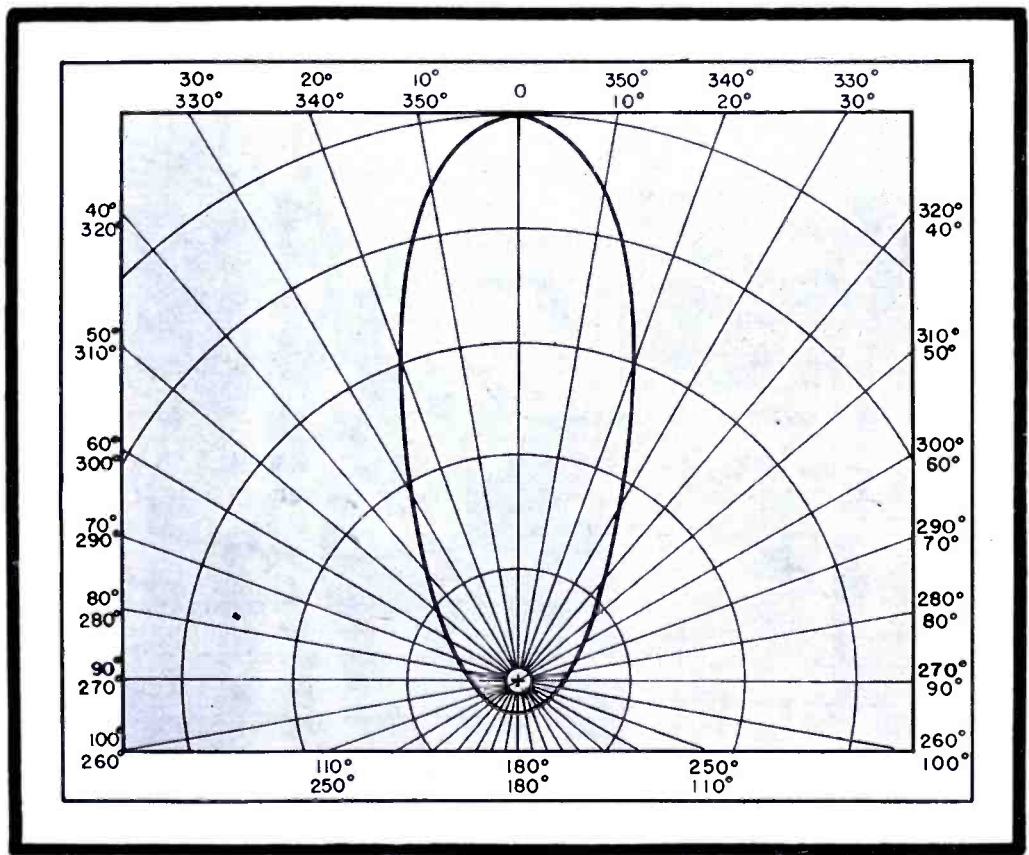
the voice is then in the ratio of

$$R = \frac{10}{.58} = 17.2$$

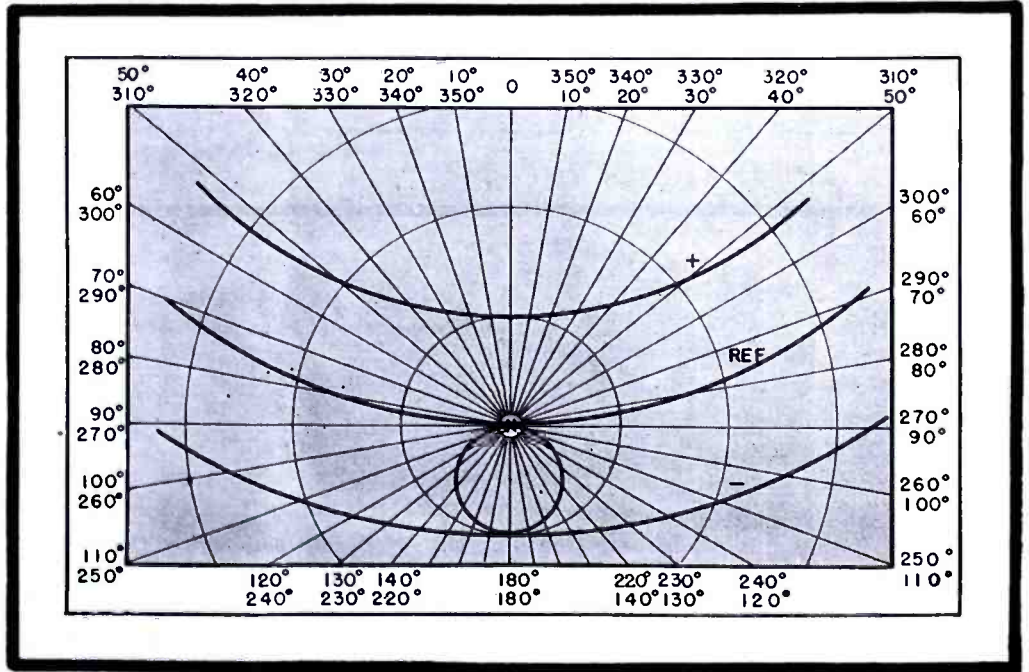
This is a considerable increase.

As for higher voice inputs, the output will increase in this ratio up to the limit of proportionality of the system. This brings up one of the factors which

(Continued on page 64)



Figures 5 (above) and 6 (below). See data above.



³Stewart and Lindsay, *Acoustics*, D. Van Nostrand.

COMMUNICATIONS SYSTEM

by RALPH G. PETERS

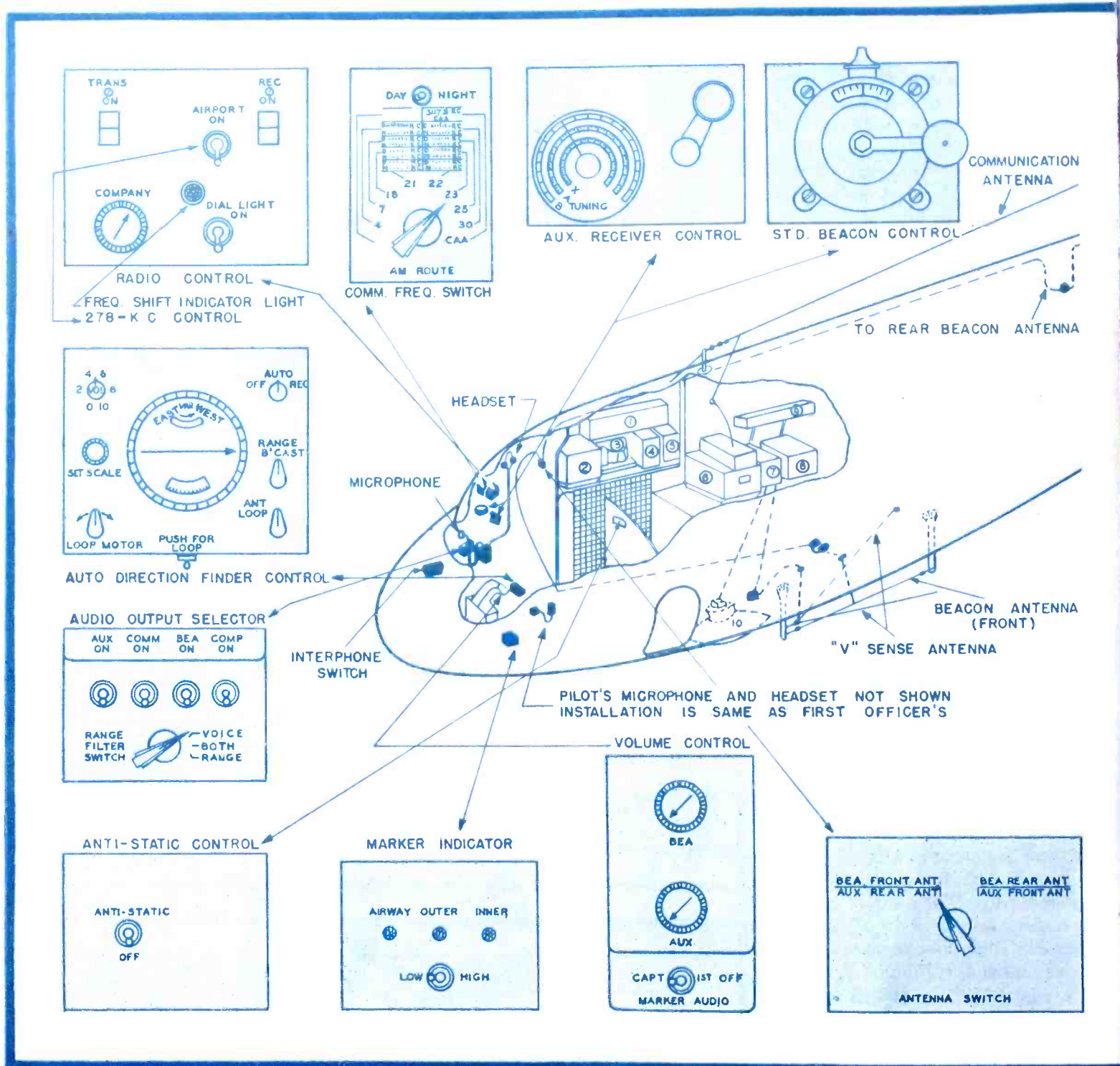


Figure 1

DC-3 communications-equipment location diagram.

brators, dynamotors, microphones and head sets.

Most of the apparatus has been specially designed for heavy duty aeronautical communications operations.

The communications receiver, a Western Electric 29A, has a 2-15 mc frequency range. Its sensitivity is 1 microvolt for a 50-milliwatt output at a signal-to-noise ratio of 6 db. Os-

cillator frequency is crystal-controlled. Distortion is 10% maximum at 30% modulation for signals below 1 volt.

Communications Receiver Tubes

Tubes used include a 6H6 as an input limiter; 6SK7, r-f amplifier; 6SA7, first detector; 6SK7's, i-f amplifiers; 6SQ7, second detector; 6SQ7 avc; 6K6's power amplifiers; 6J5's crystal and c-w oscillators.

The beacon receiver is also a West-

AN unusually complete communications system, with quite an assortment of equipment, is used aboard the huge DC-3 transports. In the equipment setup we find a communications type receiver; beacon and marker receivers; auxiliary receiver; automatic direction finder; transmitter with automatic frequency selection; anti-static control; audio output selector; interphone switch; communication, beacon and sense antennas; vi-

BOARD DC-3 AIRCRAFT

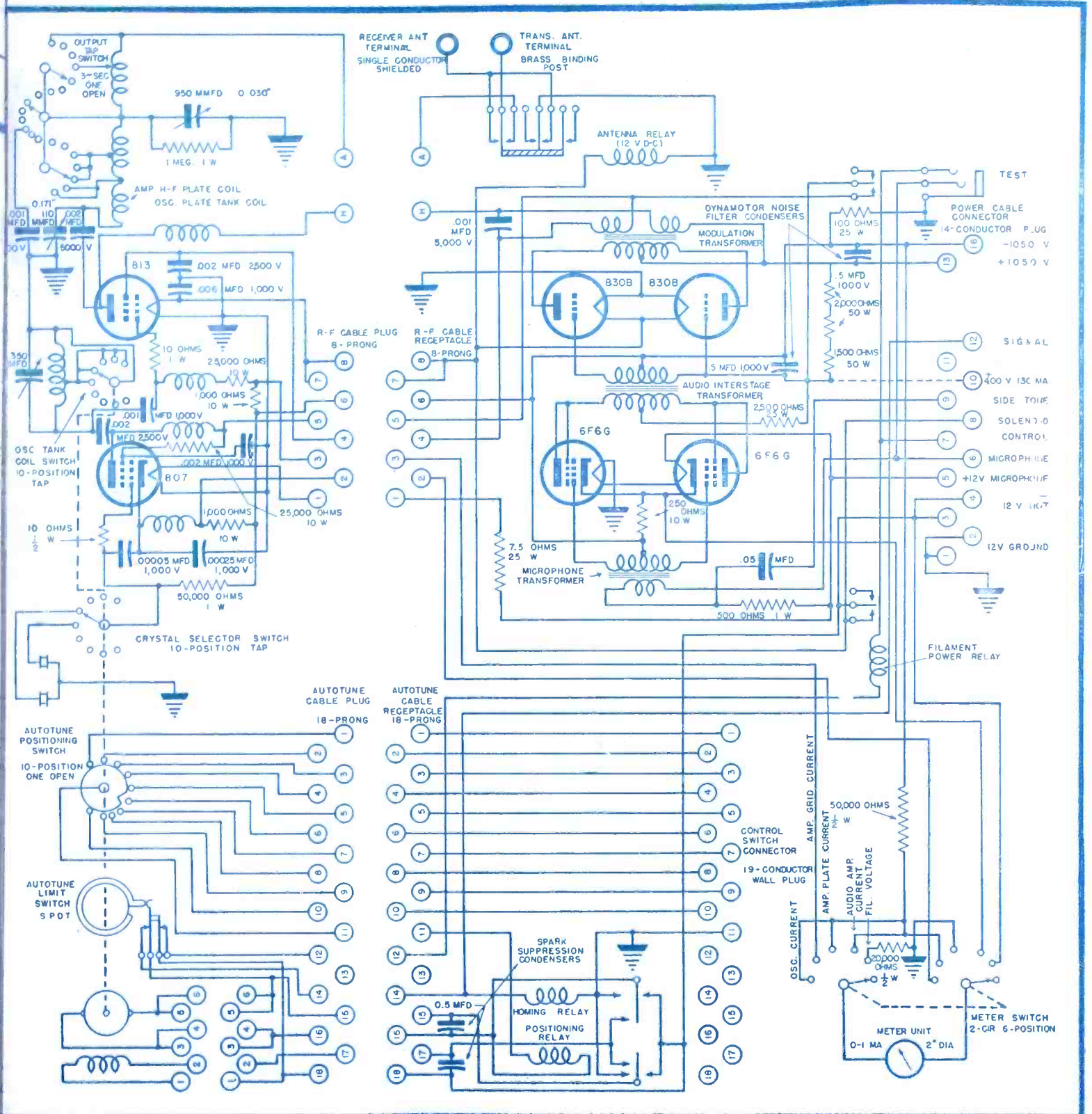


Figure 2
Schematic of Collins 17F-5 transmitter used aboard the DC-3 transports.

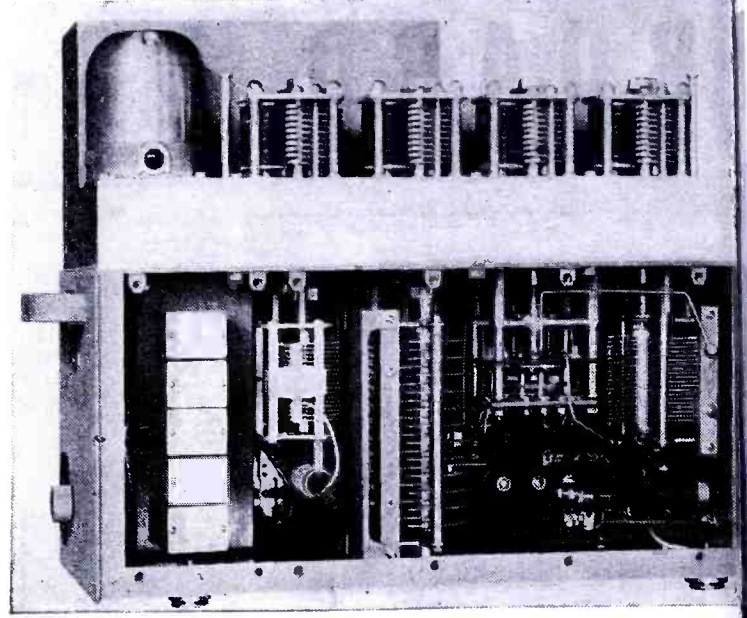
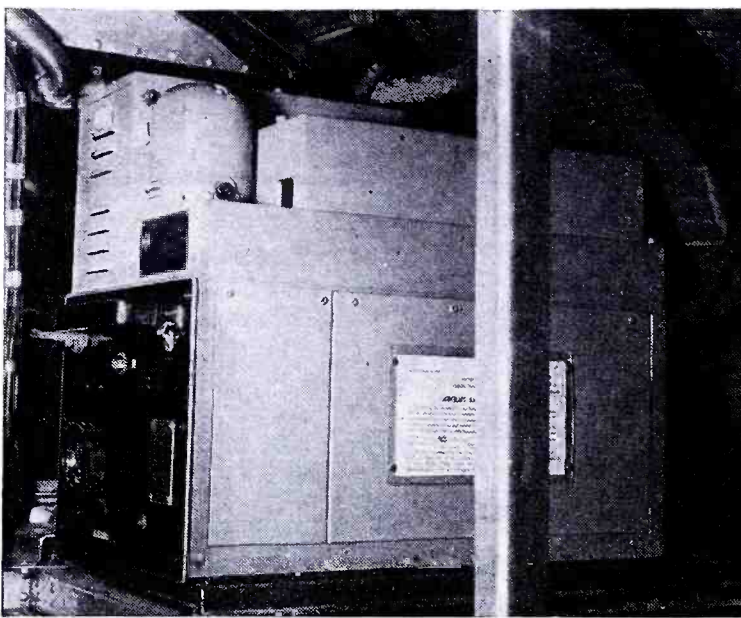
for 60 db attenuation) averages 12 kc. Tubes used in this receiver include a 6K7 as an r-f amplifier; 6A8, first detector; 6K7, first i-f; 6B8, second i-f, second detector and avc; and 6F7 output and cw oscillator.

The marker receiver, Western Electric 27B, operates on 75 mc and is used for reception of positive Z markers signals over range stations, posi-

tive fix fan airway markers and outer and inner markers of low approach and instrument landing systems. Marker signals are indicated visually on a marker light panel. There are three such signals: white (3,000 cycles), blue (400 cycles) and amber (1300 cycles).

The automatic direction finders are of the Sperry-RCA type and provide for visual direction finding or for reducing precipitation static interference in aural reception. They can also be

Electric, type 14B, and covers the 300-400 kc band. It is used for reception of radio range, weather broadcasts and airport control stations. An RCA, AVR7H, 3-band receiver is used as an auxiliary unit to supplement the communications or beacon receivers. Its third band covers the broadcast frequencies. This receiver has an average r-f sensitivity (average with antenna), for 10 milliwatt output on all bands, of 3 microvolts. Its r-f selectivity (kc off resonance



Figures 2 (left, above) and 3 (right, above)
Figure 2, Collins transmitter in mount position on a DC-3. Figure 3, right side view of transmitter, with autotune units at top.

used as an additional auxiliary beacon receiver.

The anti-static discharge unit is quite interesting. While it is not a *cure-all* for all types of precipitation static, it does offer a great deal of relief. Ordinarily it greatly reduces or limits those types of precipitation static experienced with outside air temperatures of approximately 20°F or less, but is generally of little effect or totally ineffective whenever the outside air temperature exceeds 20°F. It can be switched in and out by a small toggle switch.

One of the most interesting pieces of apparatus on the DC-3 is the 100-watt Collins transmitter, 17F. This transmitter operates on any of 10 frequency channels (3117.5; 3232.5; 3242.5; 3257.5; 3432.5; 5602.5; 5612.5; 5622.5; 5632.5, and 5672.5 kc) which are automatically selected by the Collins autotune system. This automatic frequency selection system is quite unique in that it provides selection of frequencies by adjustment of one 10-

position switch mounted remote from the transmitter. Anyone of the 10 predetermined frequencies may be set up within the short space of 5 seconds. The electrically controlled system provides for the mechanical repositioning of the necessary tap switches, variable inductors, capacitors and resistors in the transmitter circuits. The elements it controls in this transmitter are shown in figure 1.

Transmitter Circuit Features

The crystal oscillator in the transmitter uses an 807 in a harmonic oscillator circuit, crystal-controlled. Frequency of oscillation is independent of the plate circuit. Output may be obtained on harmonic frequencies as well as on the fundamental frequency of the crystal. The oscillator section is isolated from the power amplifier section without the use of a buffer stage. The output of the oscillator is coupled to the grid circuit of an 813 power amplifier.

High level modulation of the output class C r-f amplifier is another transmitter feature. Modulating voltage is obtained by a class B operated modulator stage, transformer coupled to plate and screen of the r-f final amplifier tube. This system of modulation requires no critical adjustment of output loading or r-f excitation values which might vary under operating conditions to produce distortion.

The 813 final amplifier requires no neutralization.

Audio System

The audio system is of special de-

sign particularly adapted to high-power aircraft use. The input transformer which couples a 75-ohm microphone circuit to the grids of push-pull 6 triode amplifiers has a high step ratio which makes possible the use only two audio stages. The class modulator stage consists of a pair 830B tubes. A special modulation transformer provides proper modulation and impedance match to completely modulate both the screen and the plate of the 813 amplifier. For the convenience of the operator, a sidetone circuit is provided in the speaker amplifier stage so that the transmission may be monitored in the telephone receiver circuits of the plane.

The audio system is designed for use with any ship's conventional microphone and inter-phone system. It provides a conventional single button microphone and provides complete high level modulation of the carrier. The frequency response of the system has a sharp cut-off below 200 cycles to exclude motor noise and vibration. The frequency response above 500 cycles is essentially flat throughout the voice range.

A pi-section output network is another transmitter feature. This is arranged so that it will tune to either a fixed or trailing antenna, or to a concentric transmission line. Additional loading inductance is provided so that the capacity reactance of short antennas may be tuned out.

Output Circuit Tuning

The output circuit may first be tuned approximately for each frequency with the antenna disconnected, tuning the amplifier tuning condenser to resonance as indicated by a minimum reading of plate current. When the antenna is connected, and for a given frequency (ordinarily frequencies lower than 4 mc) the tap on the antenna loading coil is varied until a rise in

(Continued on page 85)

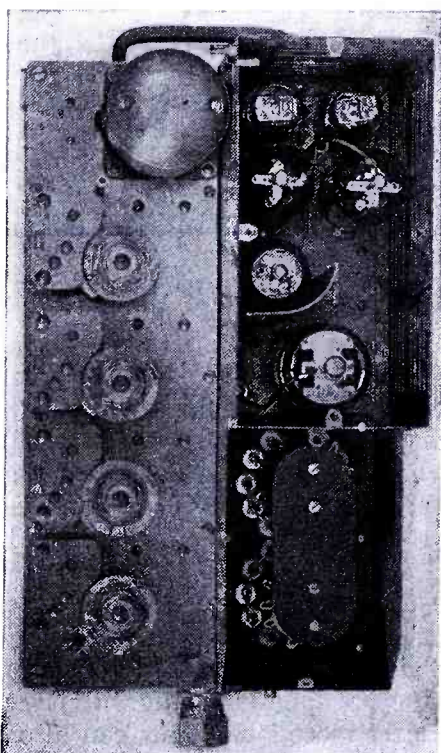
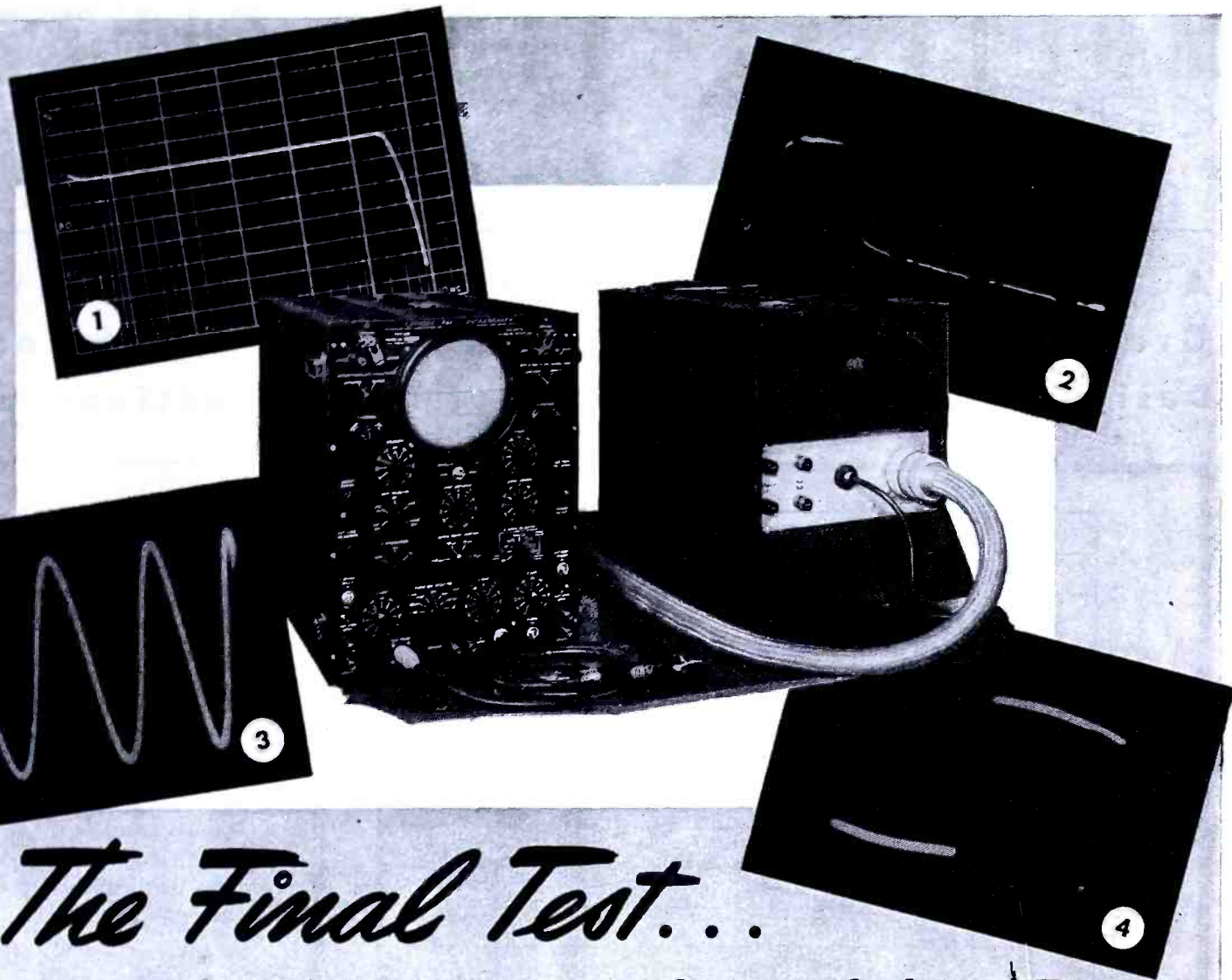


Figure 4
Top view of transmitter. At left, top to bottom, are autotune controls for exciter tuning, amplifier tuning, band switching and power-amplifier loading.



The Final Test...

These unretouched Oscillogram photos of the DuMONT Type 248 Oscillograph, tell the story best



This is the DuMont Type 248 Oscillograph. As is true of all other precision instruments, it must stand or fall on its performance. Because written specifications often give little indication of how well an oscillograph meets today's critical requirements, we believe the accompanying unretouched photos cover points of particular interest to those who work with modern electronic circuits. To wit:

① Sinusoidal frequency response curve of vertical amplifier. Free from irregularity. No rise caused by over-compensation at high end. Fall-off is gradual.

② The excellent transient response of this instrument is shown by absence of overshoot or other distortion in this pulse having

a rise time of about 1/10th microsecond. Here the driven (or "slave") sweep is triggered by the pulse itself, which is then delayed by a self-contained distortionless network so that the leading edge is not obliterated. The one microsecond markers (or others at intervals of 10 or 100 microseconds) are blanked into the trace by an internal marker oscillator. A beam-control circuit eliminates the bright spot of the beam rest position.

③ Continuous sweep circuit has a range when free-running of from 15 c.p.s. to 150 kc. When moderately synchronized with a signal of higher frequency, however, it will operate at much faster rates. This oscillograph shows a one megacycle sine wave at a sweep frequency of approximately 300 kc. Return trace is normally completely blanked but may be seen if necessary by fully advancing the intensity control. Notice the

good linearity of this time-base as well as that of the driven sweep in (2).

④ Correct compensation at the low end of the frequency range is illustrated by almost distortionless transmission of a 30 cycle square wave through the vertical amplifier. Compensating circuits for both low and high frequencies are carefully adjusted for optimum phase characteristics.

All of which, together with other equally convincing characteristics, boils down to this: The DuMont Type 248 Oscillograph, used on the bench or mounted on its matching streamlined truck, is an instrument without equal for laboratory, shop or production line.

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MULTI-SECTION FILTER

A Step-by-Step Procedure, Using Universal Grouping Charts, Eliminating Trial and Error from Design of Filters Composed of Three Sections or Less

by **PAUL SELGIN**

Senior Electronic Engineer
Halstead Traffic Communications Co.

THE synthesis of filter networks has received much attention from the literature, and substantial progress has been recorded since what is known as *classical* filter theory was first introduced.

It must be recognized, however, that the more recent methods of synthesis present mathematical difficulties which preclude their use in many situations.

Classical Method

As for the classical method, its basic weakness lies in the fact that the insertion loss of the filter differs from the overall attenuation (or match loss) by an amount which is difficult to determine. Another weakness is that the cut-off frequencies and the frequencies of maximum attenuation must be known before the section elements can be calculated. This information is not at hand whenever a design problem presents itself, and must therefore be arrived at by the time-consuming method of trial and error.

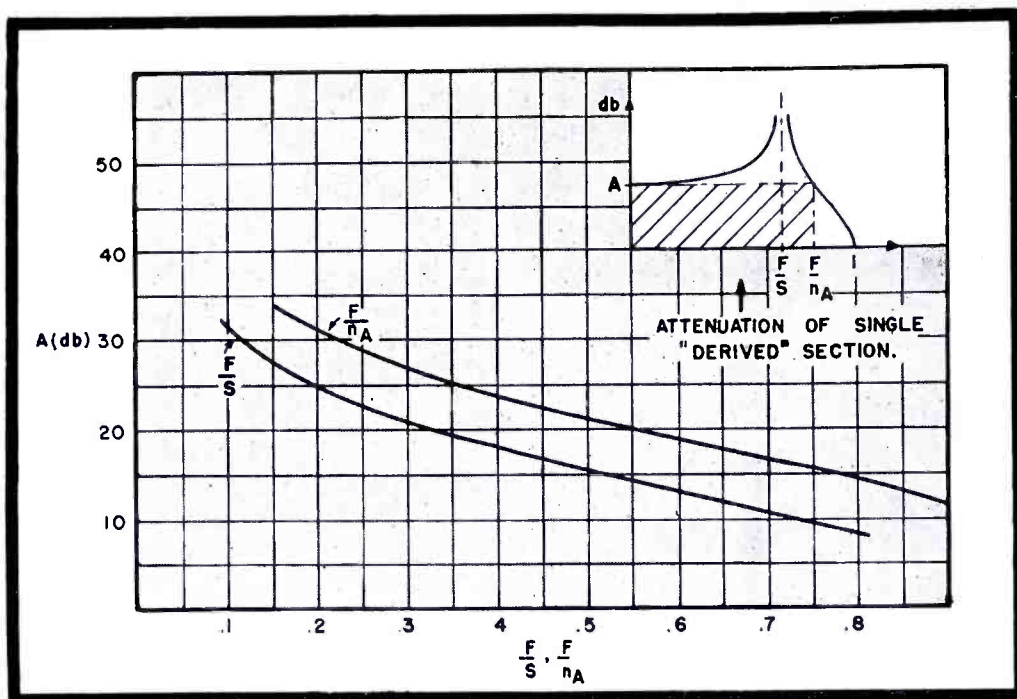
Six-Step Method

The method presented here, involving six steps, seeks to overcome both of these difficulties and remove all necessity for guesswork.

Requirements

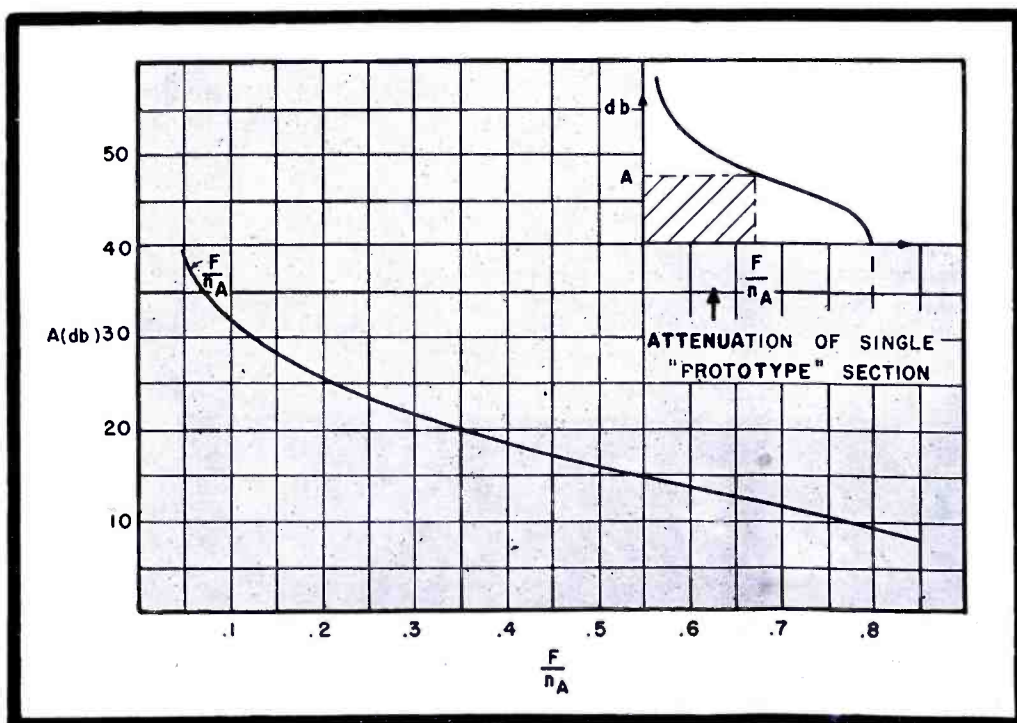
Two frequency ranges and two loss values are the only data required as a starting point. This information is presented graphically in step 1 of the design procedure. It is the most logical form under which the problem may be put to the designer.

In the second step, the frequency



Figures 1 (top) and 2 (bottom)

Figure 1, the No. 1 grouping chart for a single *derived* section. Data covering the use of these grouping charts appear in step 3 of the design procedure. The shaded areas in the insert attenuation plot shows the attenuation requirements. In Figure 2 we have grouping chart No. 2, for a single *prototype* section.



DESIGN PROCEDURE

ues of step 1 are converted into the responding frequency numbers.

Frequency Number

The frequency number is a function of frequency, which when substituted in the expressions for impedance or other functions, reduces these expressions to simple form.

As an example, let us take a series-resonant two-pole network, consisting of an inductance, L , and a capacitance, C . The impedance of the two-pole is

$$Z = j\omega L + \frac{1}{j\omega C} \quad (1)$$

Now if we let

$$W = f/f_0 - f_0/f$$

where

$$2\pi f_0 = \frac{1}{\sqrt{LC}}$$

Equation 1 may be written

$$Z = jW\sqrt{L/C} \quad (2)$$

which is a much simpler and more manageable form than 1. The admittance of a parallel $L-C$ combination is an equally simple function of W . The use of W in place of frequency simplifies the expressions for the image impedance and transfer constant of symmetrical band-pass filters; in this case, f_0 is the midband frequency of the filter. In the following design method, the square of W has been used, which eliminates confusion, having the same value for both cut-off frequencies and for both frequencies of peak attenuation of each derived section. This function is the frequency number of the band-pass filters. The frequency numbers for high and low-pass filters are also indicated in step 2.

Filter and Section Numbers

The third step of the design procedure is aimed at determining the cut-off frequencies of the filter (common to all sections) and the peak attenuation frequencies of each derived section, so as to obtain the specified loss A while keeping the loss within the transmitted band as low as possible.

In Figures 1 to 7 are offered grouping charts to serve this purpose. These charts have been prepared for the six possible combinations of no

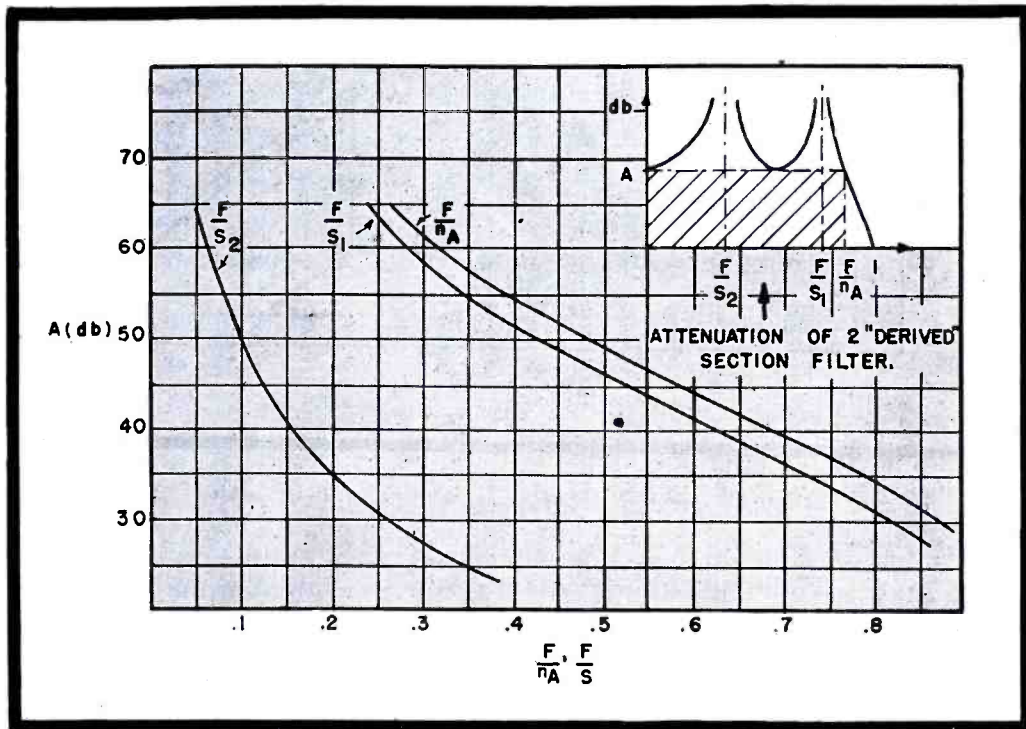
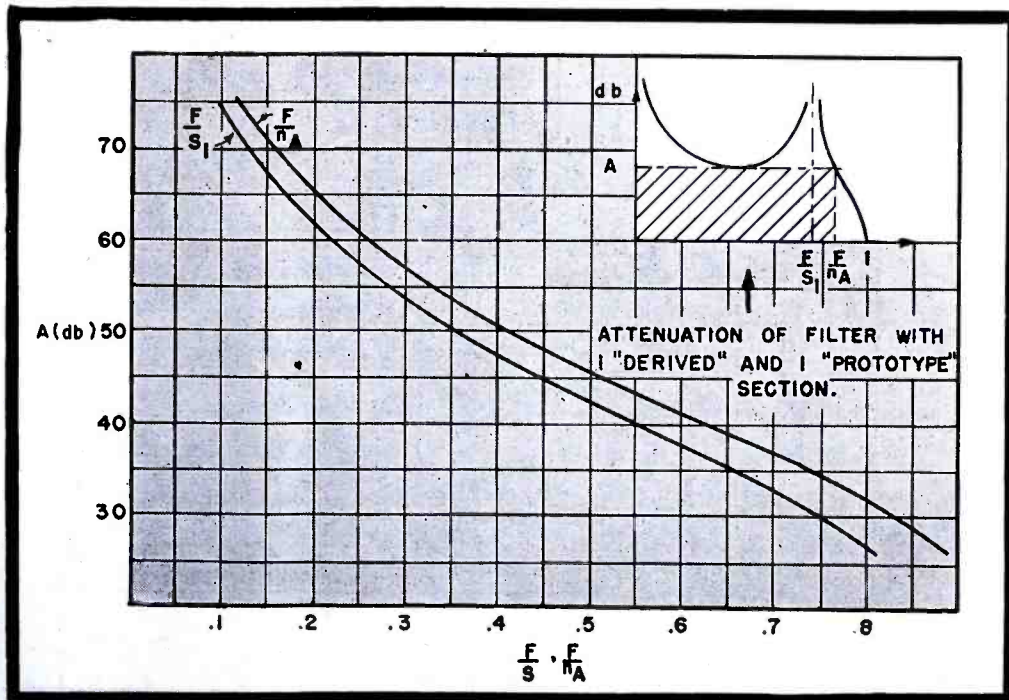


Figure 3 (above) and 4 (below)

Figure 3 offers No. 3 of the grouping charts for two derived sections. From these charts the designer obtains F , the filter number (frequency number of the cut-off frequency) and S_1, S_2, S_3, \dots the section numbers (frequency numbers of the frequencies of peak attenuation for the various derived sections). For prototype sections, $S = 0$. Subscripts identify the sections which make up the filter. Thus p denotes the prototype section, if present; t , the terminal section; j , the generic derived section. Figure 4 covers grouping chart No. 4 for one derived and one prototype section.



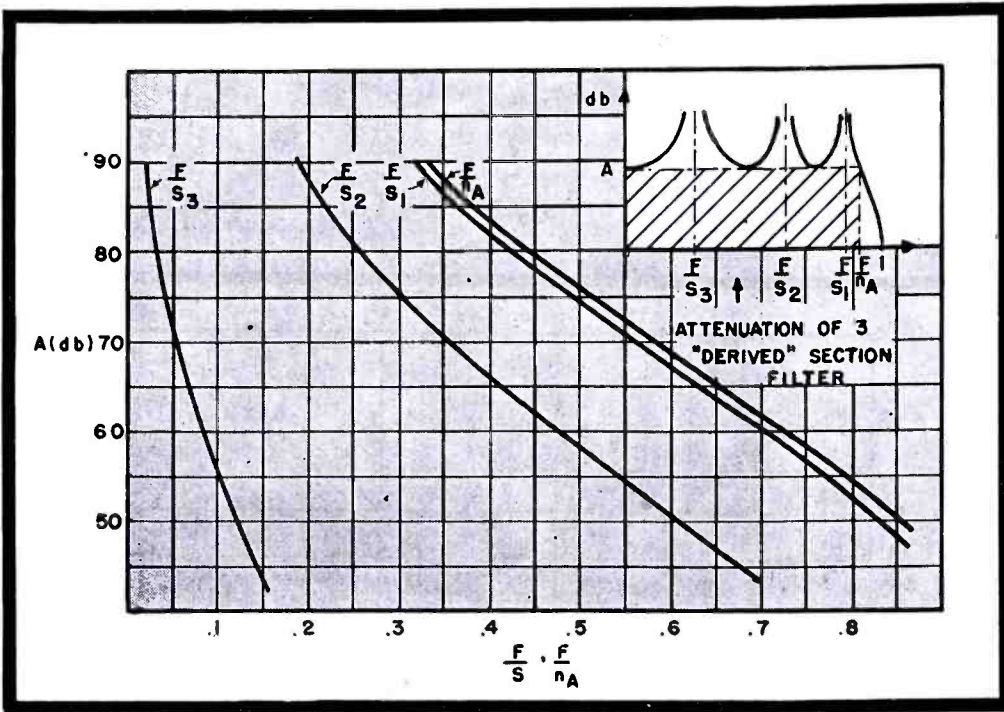


Figure 5

Grouping chart No. 5 for three-derived sections. Shaded areas show typical attenuation requirement.

positional all the numerical parameters upon which to base the computation of the actual filter elements.

Computation of Filter Element Values

To eliminate ambiguity arising from the factor 2 which enters in the evaluation of T and π section elements, the present method considers half sections, or L sections, as component parts of the filter. Values for the half sections are given in terms of F , R_0 and S_1, S_2 , in step 5. In $L-C$ combinations (parallel series), instead of expressing L as C , it has been found more convenient at this point to express $r = \sqrt{L/C}$ (for series combinations) $g = \sqrt{C/L}$ (for parallel combinations), and $w = 1/\sqrt{LC}$ (in both cases). This facilitates the task of merging together adjoining half sections, whether part of the same section or of different ones. This operation, leading to the final values for the assembled filter, is the object of step 6. The design of a 3-section bandpass filter is carried through all steps by way of example. The complete design presented in this paper took less than one hour, which is very little compared to the time normally required for such work.

Effect of Dissipation

The design problem is not fully solved by specifying inductances and capacitances. Dissipation cannot always be ignored, and the degree to which it may be tolerated depends on the data of the problem, particularly the pass-band loss a (step 1).

In another paper on this subject scheduled for early publication, the determination of the lowest permissible value of Q for the filter components will be discussed. This is the seventh and final step of the design procedure. In many cases this additional step may be omitted; unless the requirements are unusually strict, they will be met.

Figure 6

Grouping chart No. 6 for two derived and one prototype section. Shaded areas show typical attenuation requirement.

more than three sections, and no more than 1 prototype.

The drafting of the grouping charts is a lengthy process, involving a certain amount of trial and error, but this is justified since the charts, once drawn, are universally useful.

From the charts the designer obtains F , the filter number (frequency number of the cut-off frequency) and S_1, S_2, S_3, \dots , the section numbers (frequency numbers of the frequencies of peak attenuation for the various derived sections). For prototype sections, $S = 0$. Subscripts identify the sections which make up the filter. Thus, p denotes the prototype section, if present; t the terminal section; j a generic derived section.

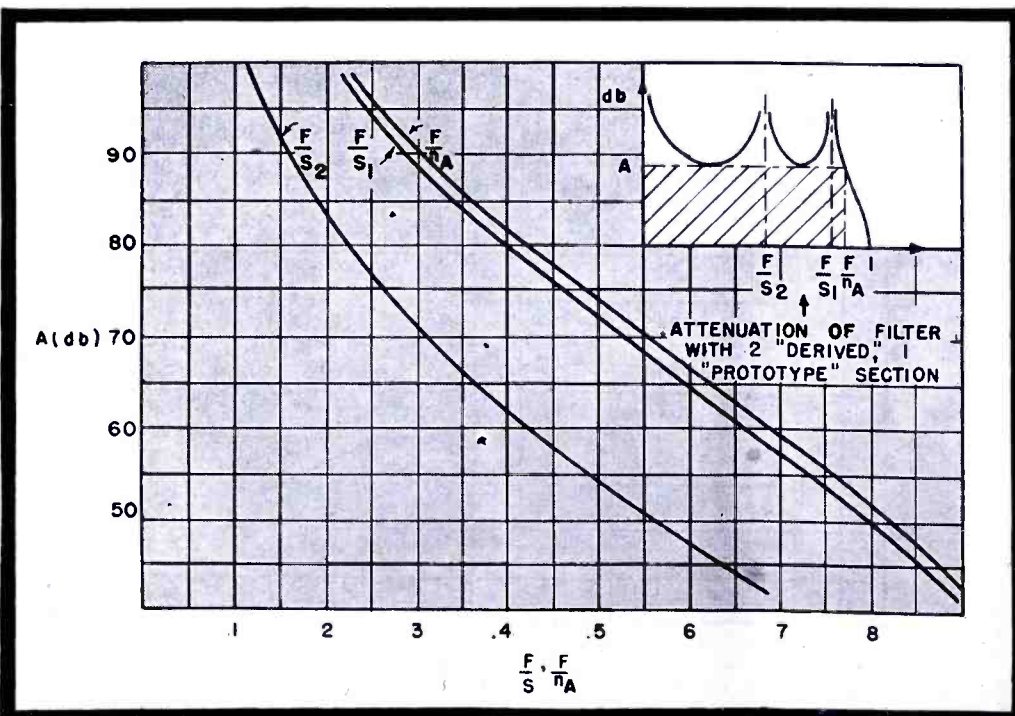
Terminating Sections

As mentioned before, the weak point of classical filter theory is the mismatch between the filter itself and its terminations, for which allowance

must be made in determining the insertion loss. In practice, the error introduced is of little consequence, except near the edge of the transmission band (frequency f_A , step 1) where the loss falls abruptly. The designer should therefore contrive, if possible, to eliminate the mismatch at this frequency, while minimizing it throughout the transmission band.

This is achieved in step 4 by selecting as the terminating section that for which the ratio F/S comes closest to 0.6, and by deliberately giving R_0 , nominal value of the filter impedance, a value different from the terminal impedance, so as to effect a perfect match at the edge frequency f_A . The terminal impedance R_t is considered to be a constant resistance in accordance with telephone practice. The choice of the proper value for R_0 is carried out by means of the impedance matching chart, Figure 7.

The designer now has at his disposal



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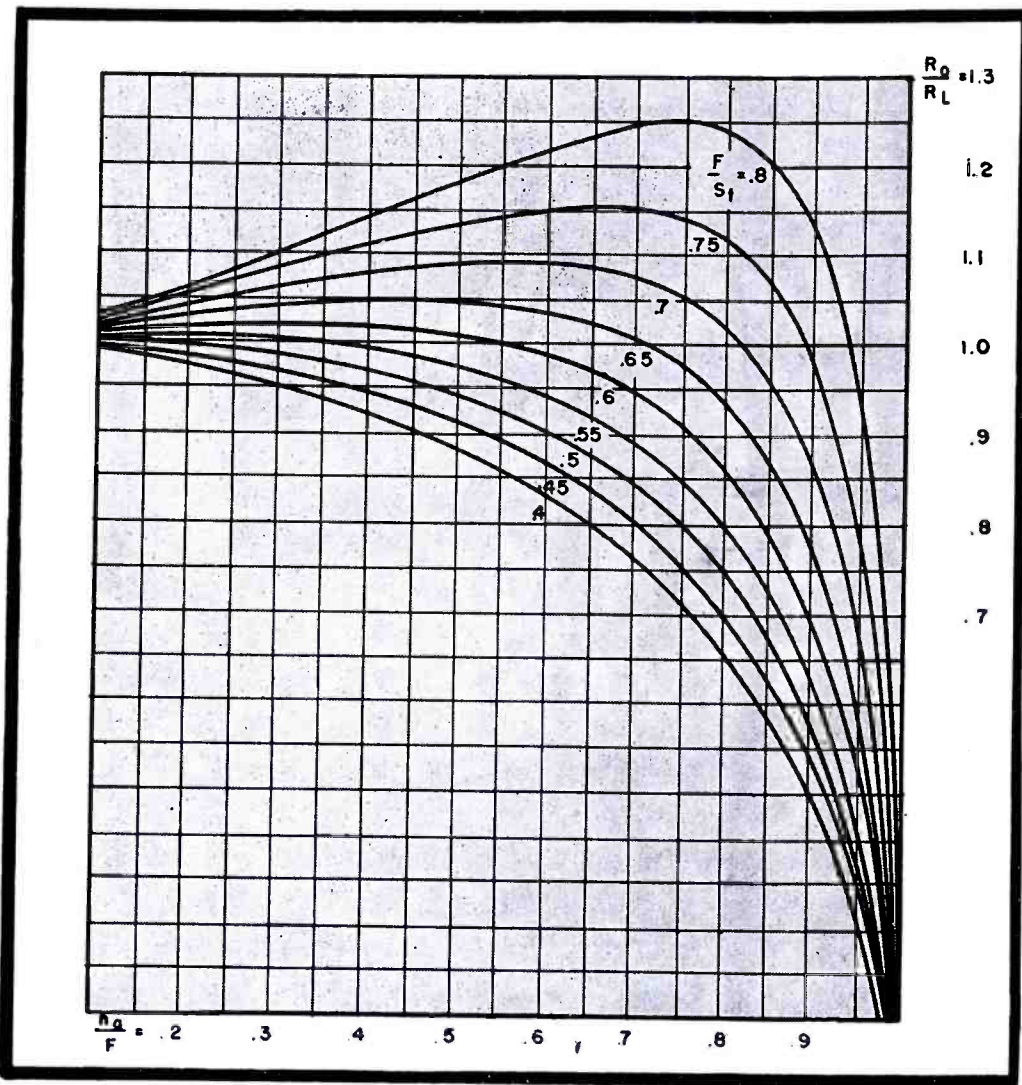


Figure 7
Impedance matching chart. See design procedure step 4.

3. Determination of Filter Number and Section Numbers from Grouping Charts

From grouping charts, we find values of F/n_A , F/S_1 , F/S_2 , for given A . For better results, select composition of filter so that values range between 0.2 and 1.0. Then we obtain filter number F (frequency number of cut-off frequency), section numbers S_1 , S_2 (frequency numbers of peak attenuation frequency).

$$F = (F/n_A)n_A; \quad S_1 = \frac{F}{(F/S_1)}; \quad \text{in general, } S_1 = \frac{F}{(F/S_1)}$$

We next select the section with the value closest to 0.6 as terminating section; its number S_t (for prototype section $S = 0$).

Example:

$$\begin{aligned} F/n_A &= 0.55; & F/S_t &= 0.525; \\ F/S_1 &= 0.31 \text{ (see Figure 14)} \\ F &= 0.55 \times 0.341 = 0.1875; \\ S_t &= 0.1875/0.525 = 0.358 \\ S_1 &= 0.1875/0.31 = 0.605 \end{aligned}$$

4. Determination of Nominal Filter Impedance R_0 (From Figure 7)

We first compute n_A/F (see 2 and 3). Then we select from Figure 7 a curve corresponding to correct value of F/n_A . On this curve we obtain the value R_0/R_L . Multiply by R_L , terminating impedance (see 1) to obtain R_0 .

Example:

$$\begin{aligned} n_A/F &= 0.134/0.1875 = 0.714; \\ R_0/R_L &= 0.86 \\ R_L &= 600 \text{ ohms (given)} \\ R_0 &= 0.86 \times 600 = 516 \text{ ohms} \end{aligned}$$

(Continued on page 70)

Figure 8

Attenuation characteristics of high-pass filter (left, below), low-pass filter (center, below) and band-pass filter (right, below).

without difficulty when components of standard quality are used.

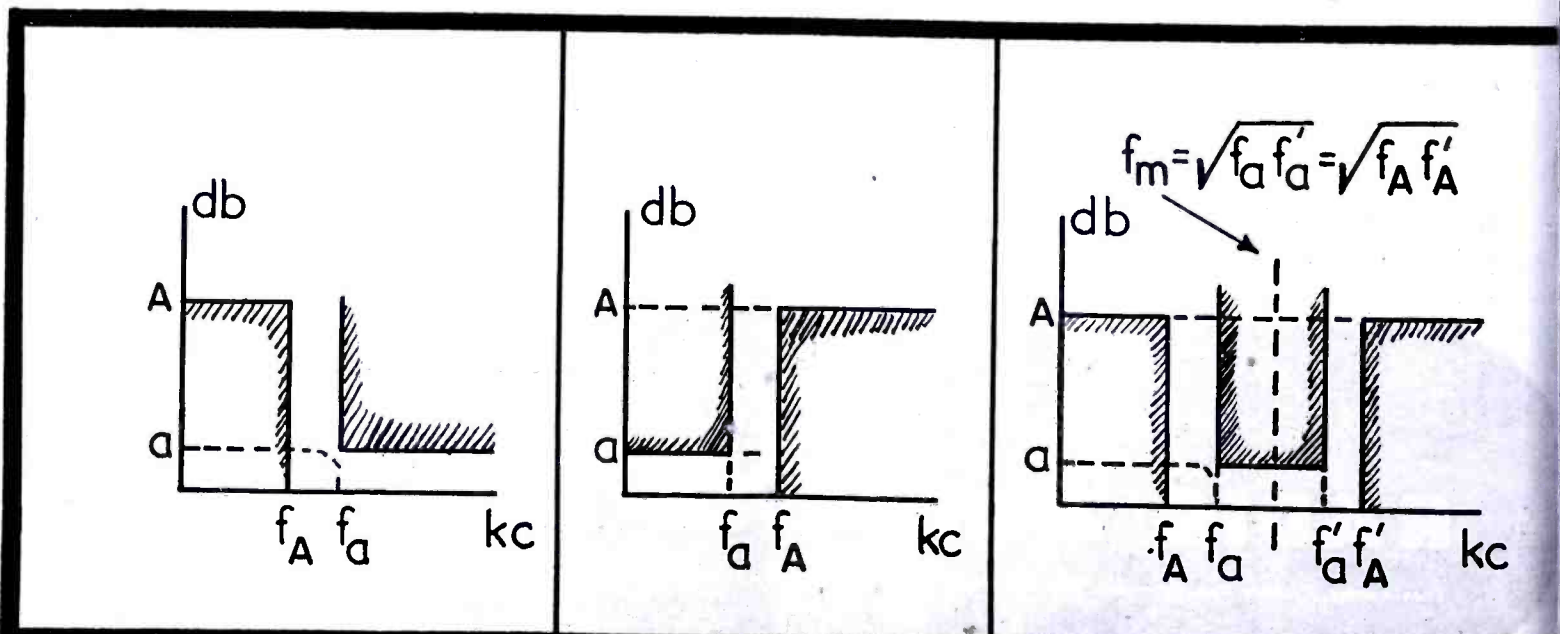
1. Statement of Specifications

In Figure 8 appear high-pass, low-pass and band-pass attenuation characteristics. The attenuation characteristic of filter is required to lie between shaded areas. This information may be given numerically. For example in the band-pass filter $A = 70$ db; $a = 2$ db; $f_A = 4.5$ kc; $f_a = 5$ kc; $f_m = 6$ kc; termination impedance: 600 ohms resistive.*

*It is convenient to express frequencies in kc throughout. Inductance values will be expressed in mh as a result; to obtain capacities in μ fd, resistances should be given in $K\Omega$.

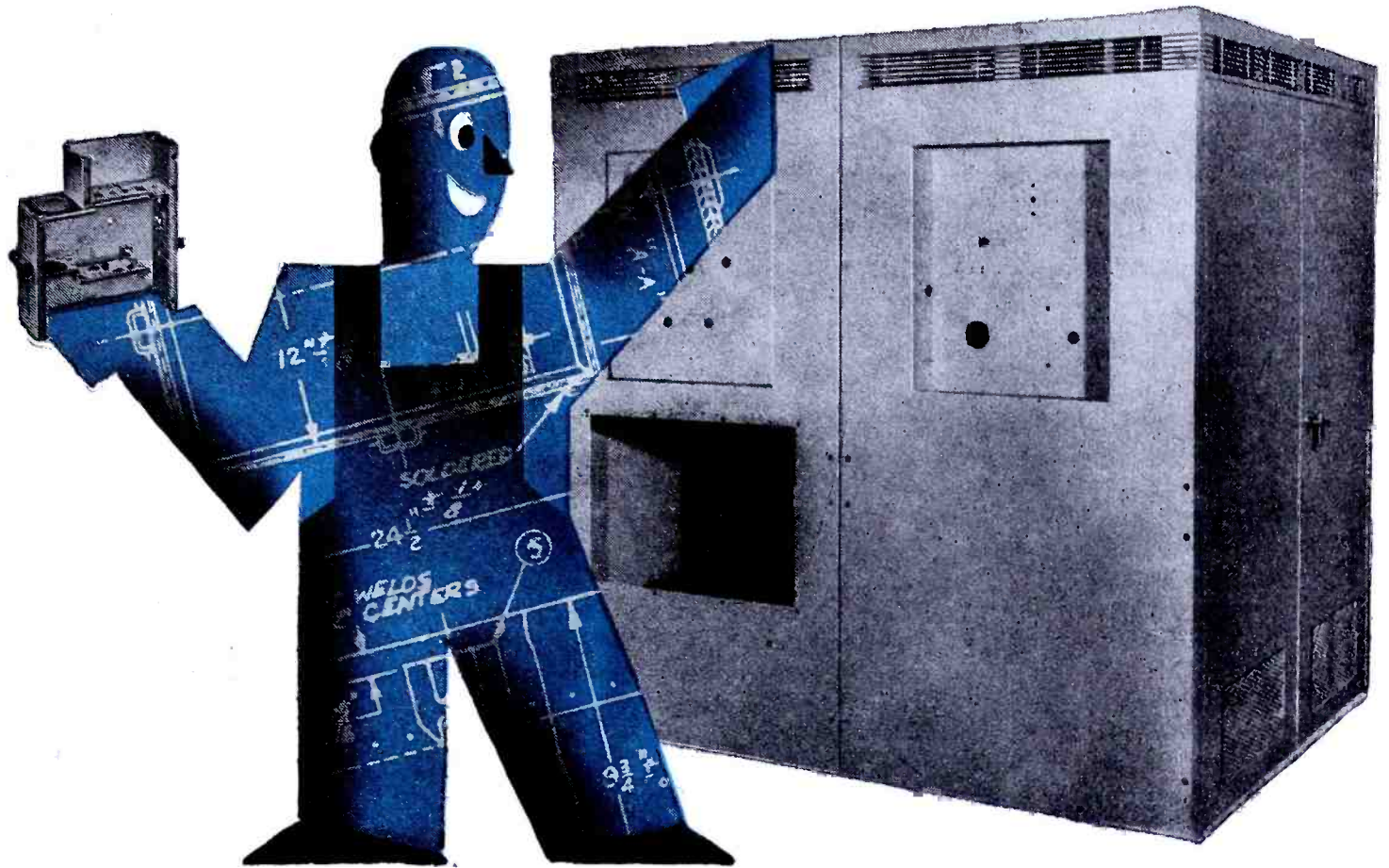
2. Conversion of Specified Frequencies Into Frequency Numbers

	$n_A = \frac{1}{4\pi^2 f_A^2}$
High-Pass	$n_A = \frac{1}{4\pi^2 f_A^2}$
Low-Pass	$n_A = 4\pi^2 f_a^2$
Band-Pass	$n_A = (f_A/f_m - f_m/f_A)^2$
Band-Pass	$n_A = (f_a/f_m - f_m/f_a)^2$
Example:	$n_A = 0.341$
Band-Pass	$n_A = 0.134$



TINY OR TITANIC

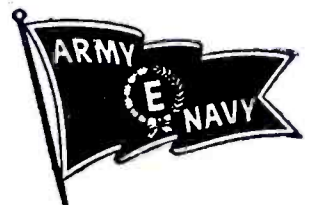
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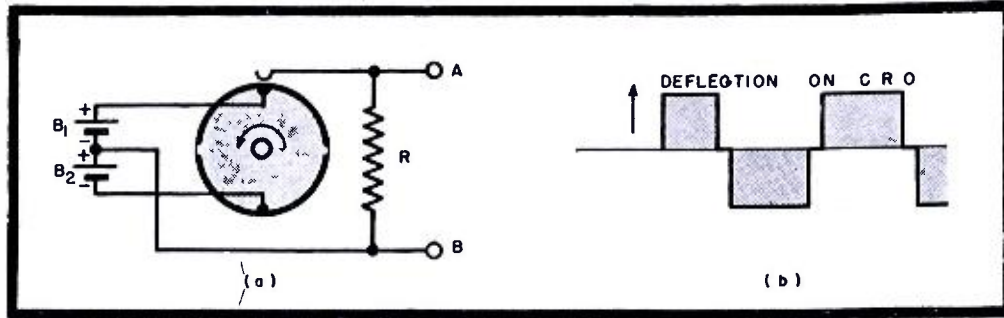


Figure 1

Commutator arrangement for the generation of a modified square-wave of constant amplitude. Curve in (b) is the square-wave curve plotted from the screen of a cro used in a piezoelectric combustion-engine indicator built by the writer.

IF the power line voltage remains constant it may be utilized directly for calibration purposes. When there are non-permissible variations in the line voltage, however, some sort of voltage-regulating circuit must be employed before the line voltage can be utilized as a calibration source. One simple method of obtaining a constant calibration voltage is to use an *iron-hydrogen*** resistance. The voltage drop across the resistor provides the desirable calibration voltage. However, it is sometimes more convenient to obtain the alternating voltage from a source of constant direct voltage. This can be done by means of a rotating capacitor, or by means of the rotating commutator, Figure 1.

Non-Sinusoidal Wave Forms

Most devices used for constant calibration voltage produces a non-sinu-

soidal wave form. This is not a serious limitation, however, since the peak value is the reference quantity.

Rotating Commutator

The rotating commutator method has been used effectively when rotating parts are not objectionable.¹ When this method is used to calibrate an amplifier in a cathode-ray-oscillograph the amplifier must pass the square-wave without seriously changing its shape.

Voltage Sources

Therefore the commutator speed must be chosen to meet this requirement. The direct-voltage sources B_1 and B_2 may be dry cells or storage batteries, and for many purposes a single battery is sufficient. A reduced square-wave voltage may be obtained by

means of a tap on the resistor R .

The speed of rotation does not have to be very constant and it is therefore possible to replace the driving motor by some sort of a push-button arrangement.

Diode Voltage Stabilizer

The calibration voltage source developed by the writer is shown in Figure 2. The arrangement with two clipping diodes is well known in the field of control circuits, and is employed, for example, in the General Radio square-wave generator, 769-A. The system shown in Figure 2 has, in addition, a compensation circuit that provides better stabilization and also improves the wave-form of the calibration voltage. Component-value development, particularly R_2 , afforded this interesting effect.

Circuit Data

In the circuit, E_1 is the line voltage and E_2 the desired calibration voltage. T is a line transformer, and D_1 D_2 a double diode of a commercially available type, such as 6H6. The batteries B_1 and B_2 are bias sources, and R_1 and R_2 are fixed resistors. If R_2 were infinitely large, the voltage E_2 would be a squarewave with the amplitude determined by the value of the bias voltages, and by other factors. The clipping takes place because of the excessive voltage drops in R_1 during the periods of conduction.

Calibration Voltage Curves

Figure 3 shows various curves for the stabilized calibration voltage E_2 .

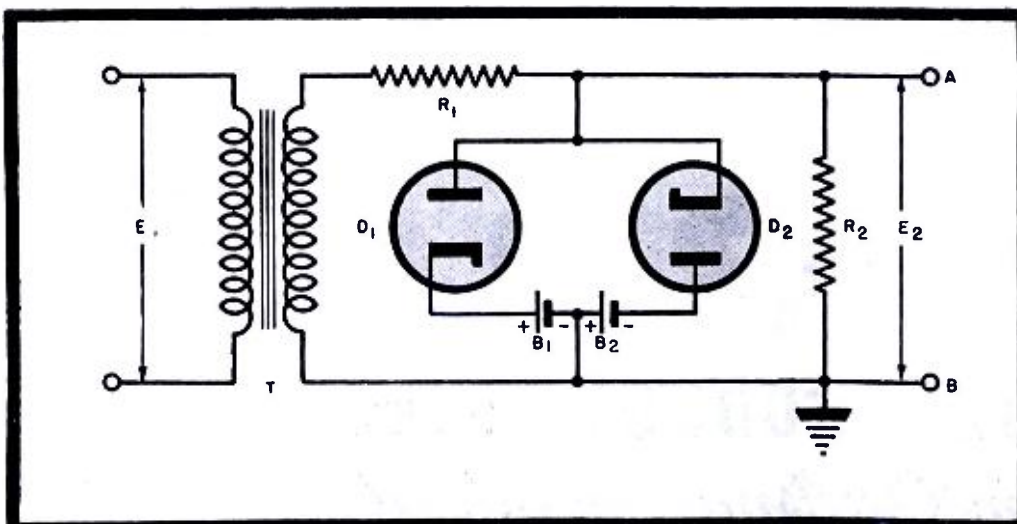
¹Beale and Stansfield, *The Standard-Sunbury Engine Indicator*, Engineer; December 13, 20 and 27, 1935.

²The curve in Figure 1 is the square-wave curve plotted from the screen of the cros used in piezoelectric combustion-engine indicator built by the writer.

**Resistance unit, in use in Europe, resembling our ballast tube in action. Device contains a thin iron filament in a glass bulb containing hydrogen. Resistance varies so as to maintain current constant. Calibration voltage is then obtained across a fixed resistance in series with the iron-hydrogen resistance.

Figure 2

Alternating voltage stabilizer. The secondary voltage of the transformer is approximately 60 volts rms and the resistor R_1 one megohm. For the value of R_2 see Figure 3.



ALTERNATING VOLTAGES FOR CALIBRATION

Voltage stabilization circuit, used to maintain an alternating voltage nearly constant, uses a pair of diodes as amplitude limiters and a special neutralization circuit. The amplitude can be preset to desirable value by means of a direct voltage source.

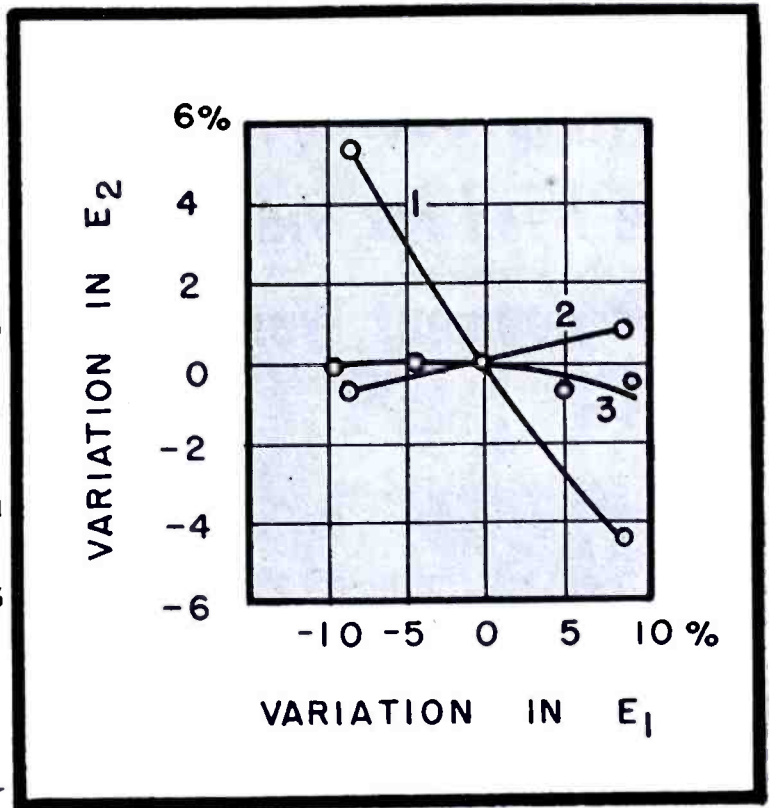


Figure 3

Various degrees of stabilization obtained with the arrangement in Figure 2. Curve 1 represents conditions when the diode heaters are fed from the line and curve 2 when they are fed from a direct voltage source; R_2 in both cases being one megohm. Curve 3 illustrates line heating with $R_2 = 20,000$ ohms; the proper value for neutralization.

versus the line voltage E_1 . Curve 1, obtained for a large value of R_2 , one megohm, represents conditions when R_2 is infinitely large. The stabilization is poor and the waveform rectangular. It can be seen that an increase in E_1 causes a decrease in E_2 . This is because the heater voltage of the diodes, which is obtained from the line, varies with the line voltage E_1 . When the cathodes are heated from a storage battery, curve 2 is obtained. We note that the stabilization effect is much better than in curve 1; E_2 now varies only 1% when E_1 varies 10%, and the variations are in the same direction.

Neutralization Circuit

Using the voltage from the line for the heaters provides a very practical arrangement. There are methods available for improving stabilization on line-heated filaments. If a potentiometer, R_1 , R_2 , were employed without any clipping diodes, and if R_2 were so small that E_2 remained at the same order of magnitude as previously, we would have sinusoidal calibration voltage, varying in the same direction as the line voltage remaining unstabilized. The variation is therefore opposite in sign to the one represented by the curve 1. Then the combined effects of the nonlinear potentiometer $R_1 \dots D_1$, D_2 , and the linear potentiometer $R_1 \dots R_2$, in combination, would give an essentially sinusoidal waveform and a cali-

bration voltage almost independent of line-voltage variations. Measurements performed by the writer prove that such an action is obtained; curve 3 represents one possible combination of component values. Equilibrium was obtained at all measured points. It should be noted that curve 3 does not represent the best possible result, but still yields a variation of only 1% in E_2 for a variation of 10% in E_1 . The desired calibration voltage in this case was 1.5 volts, while the actual value was 1.54 volts at normal line voltage. The emf of each bias dry cell was 1.58 volts and there was a variation in bias voltage of ± 0.01 volt due to charging of the dry cells during the interval of calibration.

Discussion of Results

Measurement of the heater voltage revealed that the diodes were operated with a heater voltage 5% below the value recommended by the tube manu-

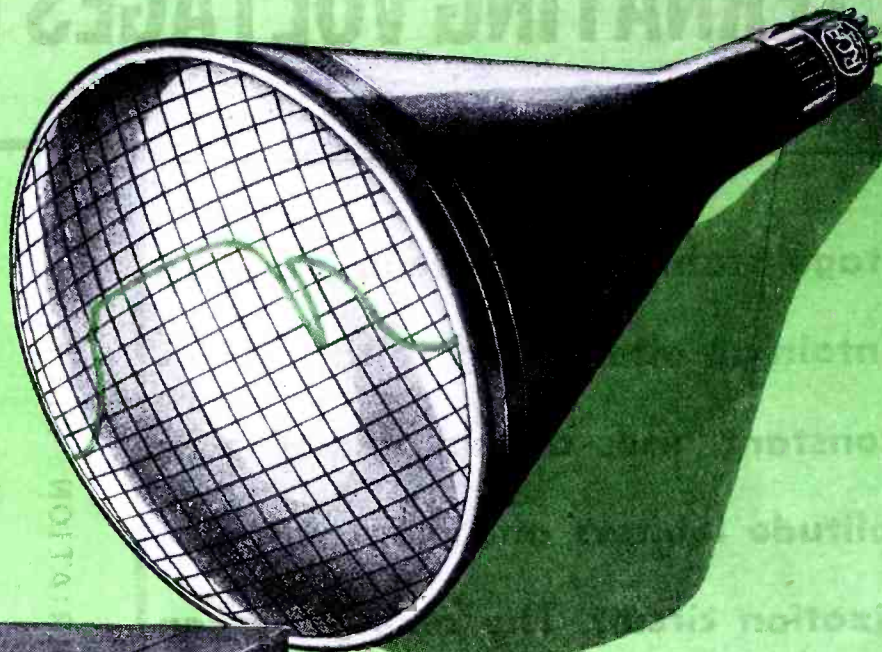
facturer. Since the heater voltage was obtained from the line it may be expected that the general nature of curve 1 should show up in curve 3.

Error Source

A source of error in the calibration voltage is the gradual charging of the dry cells employed as bias batteries.³ The charging effect is created by the weak diode currents. The slight effect it has on the accuracy of the calibration may be removed if the diode plate circuits are closed only at the instant of calibration. With reference to rapid variations in line voltage, an error may be introduced due to the thermal inertia of the diode cathodes. This source of error is generally not serious and the arrangement with direct heater voltage, curve 2 in Figure 3, is always available as a substitute in difficult cases.

³It is known that dry batteries may be charged to some extent and in this way may be made useful during a longer period of time.

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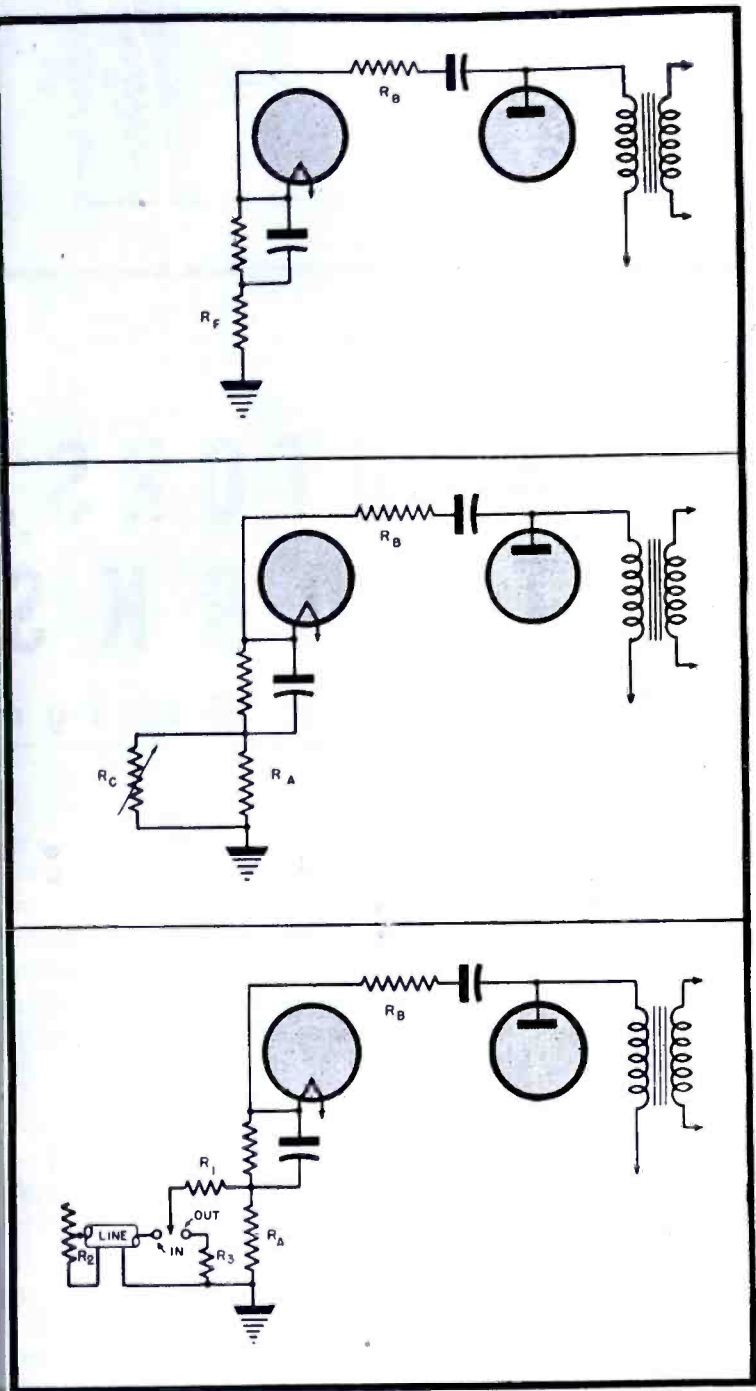


Figure 1

Circuits illustrating voltage-feedback type of output amplifier which is quite useful in the feedback-control system described in paper. Circuit has been used successfully through 40' of cable without frequency distortion or other discrepancies.

by **RAYMOND P. AYLOR, JR.**

Formerly Chief Eng., WGH

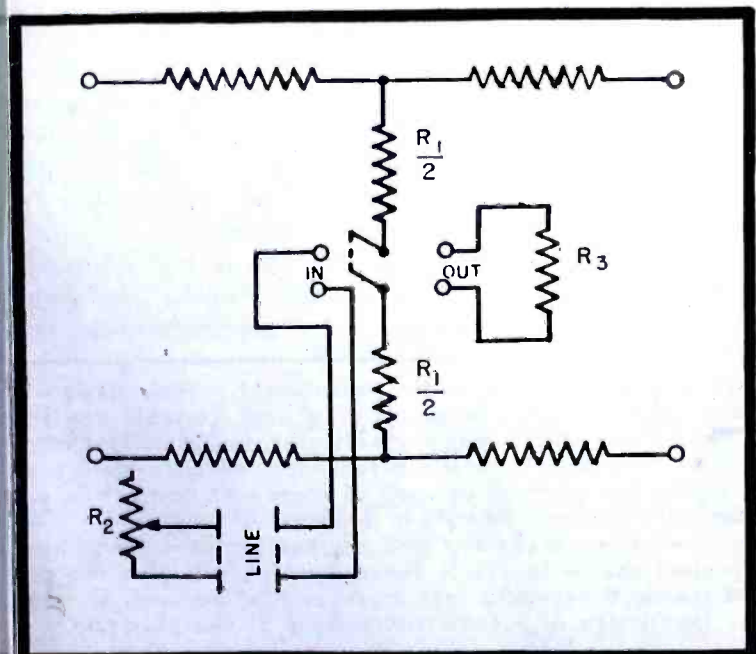
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FREQUENTLY, in broadcasting or in commercial systems, a remotely operated control is needed for fine adjustment of output level. Usually it is desired to make this adjustment from a central control location, rather than to reset the amplifier at the equipment bay. For example, it may be necessary to control the output of a program-limiting amplifier in such a manner as to make an adjustment at the point at which limiting begins. With older transmitters not employing gain stabilizing feedback, this is a very frequent adjustment during the day's operation. Because of the additional wiring, it is often not

(Continued on page 81)

Figure 2

Variable pad-control circuit that is also effective in remote-control system. To secure a fairly linear resistance-loss characteristic over a ± 1 -db range the pad insertion loss should be at least 10 db, the range of control being from 9 db to 11 db.



The views expressed in this paper are solely those of the writer and do not reflect the opinion of, or constitute a verification by, the U. S. Maritime Service.

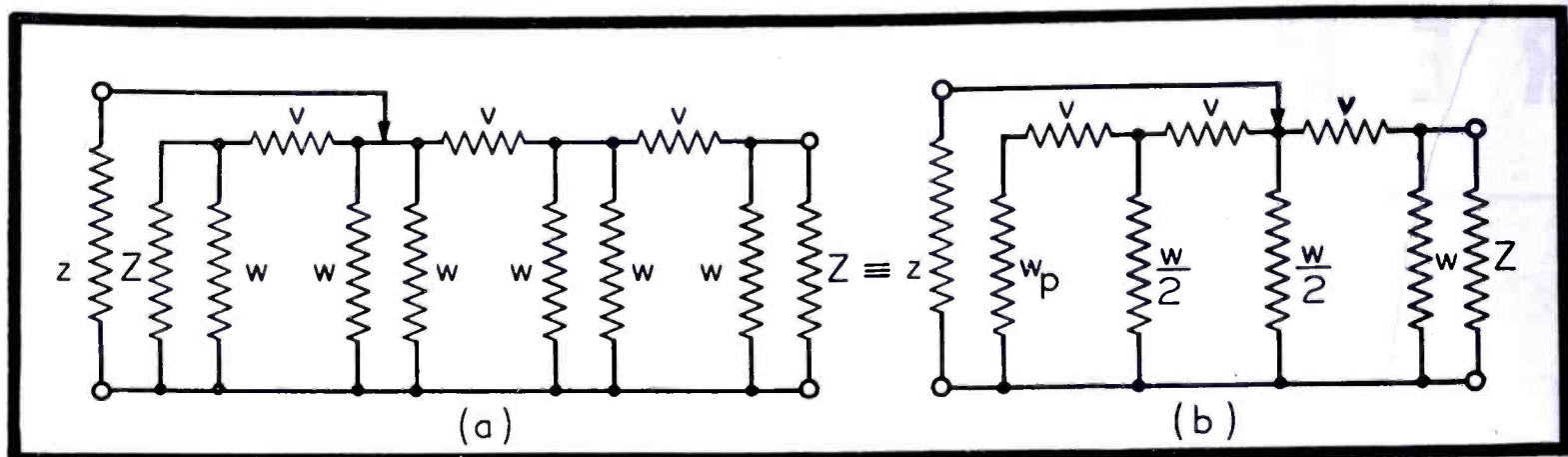


Figure 1

Illustrating the basic method of combining standard sections together to form a ladder network. $w_p = \frac{wZ}{w+Z}$

RESISTIVE ATTENUATORS, PADS AND NETWORKS

An Analysis of Their Theory and Design

[Part Six of A Series]

by PAUL B. WRIGHT

Communications Research Engineer

IN this installment the design of ladder networks¹ is discussed. The manner in which the impedances of these networks vary is illustrated by examples using the conventional tandem π -connected sections and also by an alternative method based upon common circuit theory. Examples are also used to show the insertion losses for a few types of these networks. The simplification of formulae and design which results from normalizing the network structures or placing upon a unit basis is brought out by the examples given. These examples illustrate how numerical steps are minimized when designing many sections of tandem-connected networks. They also show the advantages gained, both in impedance variations and low insertion losses, by using the alternative design method offered over that of the standard network configuration performing the same desired function. The standard types possess the great

advantages of quicker design results, utilizing the tables of hyperbolic functions published previously in this series¹ and the resultant duplication of elements of both the series and shunt-arms. This very materially reduces the cost of manufacture, particularly where small numbers of networks are involved.

Ladder Networks

The ladder network was so named because of the geometrical appearance of its electrical schematic representation providing a resemblance to an ordinary climbing ladder. It is composed of tandem connected sections which may be derived in a variety of ways from the standard L , π , bridged T or straight T types of networks. Figures 1 to 4 illustrate a few of the ladder structure types of networks. Instead of combining standard sections together to form a ladder network, an alternative design procedure follows the method of utilizing an infinite chain of recurring sections having equal impedances at successive junc-

tion points and unequal losses per section. This method leads by straightforward circuit analysis to what are known as recurrence formulas from which the series and shunt elements may be calculated by passing from the general formulas for the r -th section to the particular section numbers taken successively as desired for the given design.

The proper design procedure to follow to find the element values which will be required for a given application depends upon a number of factors. The most important among these are; (1)—cost of production; (2)—impedance relationships required for the input and output of the network; (3)—insertion loss; (4)—attenuation per step or per degree of rotation of the control knob if continuously variable; (5)—noise level caused by the contacts both in the operating position and in the transfer or switching instant when going from step to step in the step type networks, or from turn to turn in the tapped resistor types; (6)—power required to be dissipated; (7)—accuracy of calibration. The factors mentioned may not however follow the order given in order of importance since that

¹May, 1945; COMMUNICATIONS.

An analysis of the design of ladder networks of the purely resistive type is offered in this installment. Their design is shown to be considerably simplified by making use of the Tables of Hyperbolic Functions of a Real Variable and the network charts presented in earlier installments of this series. Further, by normalizing the networks, the numerical work involved in carrying out the calculation of tandem connected sections of networks is minimized. This consists merely of reducing all terminations and network elements to a unit basis by taking the quotient of each of them with respect to the smaller of the two terminal impedances of the network. Since ladder networks may be built in a number of ways, there is no perfectly general and unique design procedure to follow. However, since economics and engineering expediency both enter into the problem of manufacture of such networks, the simplest design to use is the one which will give the desired insertion losses with required tolerances. This dictates that standard networks such as the π type be used, or some straightforward design technique utilizing recurrence formulas for the design of successive sections of the networks.



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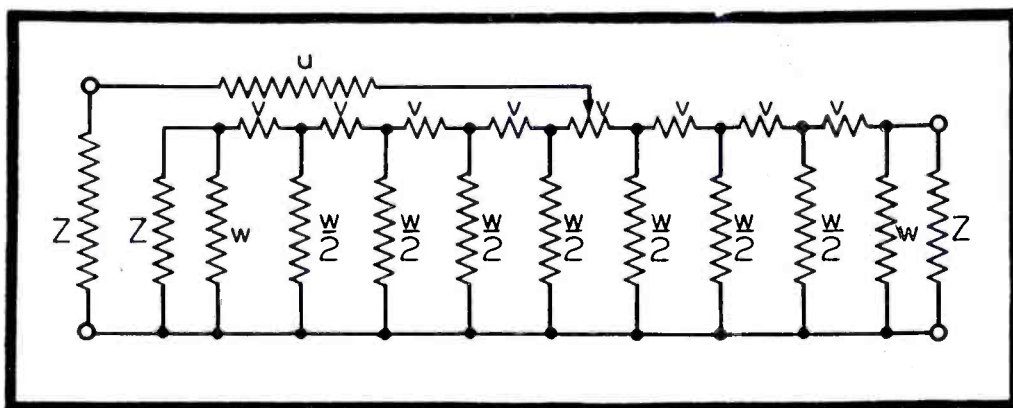


Figure 2
A ladder network composed of a tapped slide wire; $u = Z/2$.

will be determined from the requirements to be met in the circuit where the network is to be used.

Ladder Network Use

The ladder type of network has found its greatest usage as a mixer control in program channels and has been used quite successfully for high-level mixing for many years. During recent years, however, the ladder network has been used also for low-level mixing. This has been accomplished largely through improved materials and workmanship. The material improvement has been brought about through metallurgical advancements, featuring an alloy made of beryllium and copper. These new metals provided greater resistance to abrasion of contacts and wiper arms, at the same time reducing contact potentials to very low values. The improved workmanship has brought about more rugged and reliable mechanical assemblies which have assisted in maintaining uniform contact pressures and eliminated bumps and jerks in passing from step to step, or from turn to turn. Better shielding against electrical interference, and isolation of contacts from dust and abrasive grit have also very materially assisted in reducing noise to a very low level.

Advantages and Disadvantages of Ladder

The greatest advantage of the ladder type of attenuator is its low cost. It has, however, two important disadvantages which should be carefully considered before choosing it in prefer-

ence to some of the other standard attenuator types. These are: (1)—either one or the other of the terminal impedances may be made by design to appear substantially constant, but not both. In fact, neither impedance will appear constant except at certain points dependent upon the design; (2)—except for some special types of networks, the insertion losses may be prohibitive for many applications. The catalogs of reputable manufacturers should be consulted carefully when buying a ladder attenuator to make certain that the condition of impedance and loss variation do not exceed requirements. When the impedance ratio of the terminations is 1:1, the insertion loss is 6 db; when the ratio is 1:2, the insertion loss is a minimum of 2 and a maximum of 4.6 db, depending upon the circuit arrangements and network losses involved. Fortunately, very few program systems are operated so close to the upper limit of their amplifier gains that these losses cannot be tolerated. The same remark applies to the reflection losses which are unavoidably present in the use of these attenuators. In the cases of either long cable loops or even shorter ones which have been made electrically long by equalizing the frequency versus loss characteristics of the cable or line used, frequently insufficient marginal gain

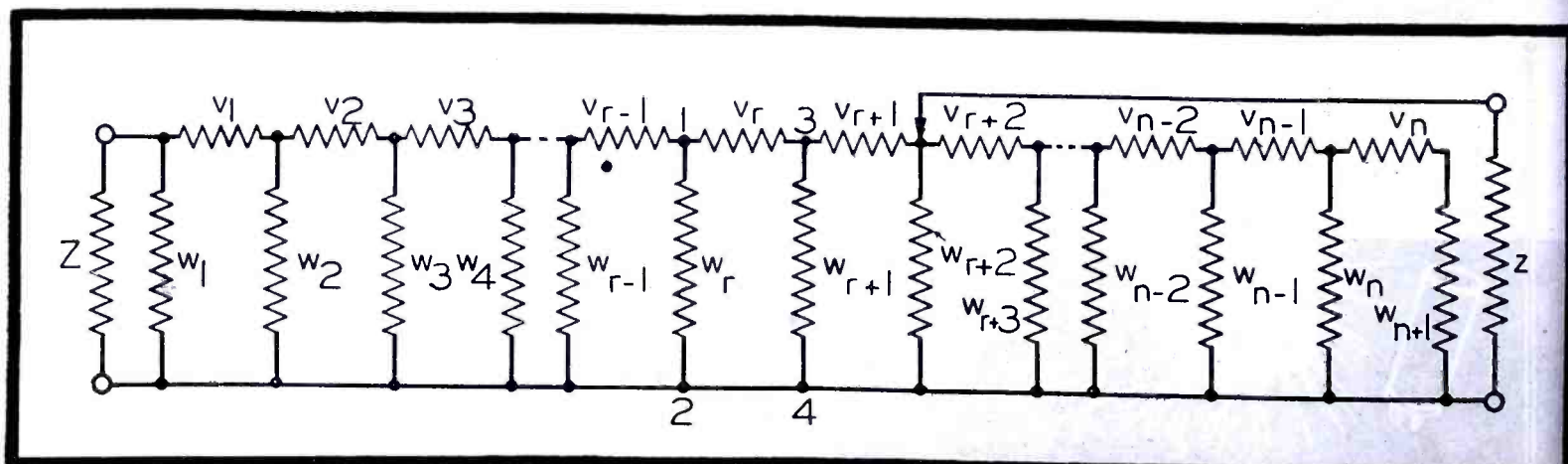
will be available to tolerate the insertion loss which these attenuators normally provide. Hence, we must study carefully the selections of attenuator for pick-up program service. One further item should be considered. That is the ultimate or overall effect upon the signal-to-noise ratio. If sufficient gain is not available to maintain the proper operating level in spite of the insertion losses of the mixer controls then either a choice of a different attenuator or some additional gain is indicated.

Network Ratios

To avoid the variety of impedance which it would be possible to have by design of these networks, manufacturers have selected those which cover most of the ranges of impedances normally used in practice and are usually offered in ratios of either 1:1 or 1:2. Other ratios may be obtained by special order and in some few cases are offered directly by the manufacturers as stock ratios. Some of these have nearly constant input with variable output impedance, while others have nearly constant output with variable input impedance. A number of variations from these limits may be had by choosing a network meeting the requirements for the application in which it is to be used. A good general criterion to use in judging how far one may go in matching impedances, involving purely resistive networks, is to make use of the hyperbolic function $\cosh^2 \theta$, where θ is the propagation function equal numerically to $0.115129 \times \text{no. (db)}$. The minimum loss possible is given by this function in the db column, while the maximum impedance ratios which may be matched are given by the E column which is the symbolical notation used for the function itself. These were given in the second

Figure 3

A ladder type network which may be designed by use of the tabulated *Hyperbolic Functions of a Real Variable* as described in the paper.



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RESISTIVE NETWORKS

(Continued from page 52)

set of tables which appeared in this series.² In addition to this minimum loss for any zero setting of the attenuator, there will be the insertion loss to consider.

Mixer Circuit Requirements

For mixer circuits, it is necessary to have a continuous and smooth fading out of the program material as the loss approaches about 30 to 35 db; then a rapid rate of loss is usually added at about 25 to 45 db per step. This fades the program signal down so that for all practical purposes, the loss is considered to be infinite. For this reason, mixer dials are usually calibrated on a linear loss versus degrees of rotation basis until the last few steps when the loss jumps to high values very rapidly, with the last marking showing infinite loss.

Voltage Divider Use

As a voltage divider, the ladder type network is often useful and is frequently used in such applications as signal generators where the output is usually given in some decimal or integral multiple of ten times a reference voltage. For this case, the same type of electrical design may be followed and the same formulas used (equations 1 and 2). However, the value of θ to use is determined by referring to the

table which appeared in *Part I*³. In application, it is first necessary to specify the value of the voltage ratio by either the k or r column. On the same line or by interpolation, the corresponding value of the number of decibels is then found. Having the number of decibels loss corresponding to any ratio of voltages desired, the formulas of equations 1 and 2 are applied to find the required elements. These are read either directly or by interpolation from the tables accompanying *Part II*,⁴ under the symbolical headings of A and d . These give the series and shunt elements respectively of the normalized or unit π -type network.

In the design of ladder networks, it is also necessary to remember that for a given impedance desired at the junction of each connecting pairs of sections, the impedance level of the network design should be twice this impedance, since the two sections are in parallel at the junction points. Hence, if 600 ohms are desired at the junction points, the networks should be designed for 1,200-ohms image impedance.

Design of Ladder Attenuators

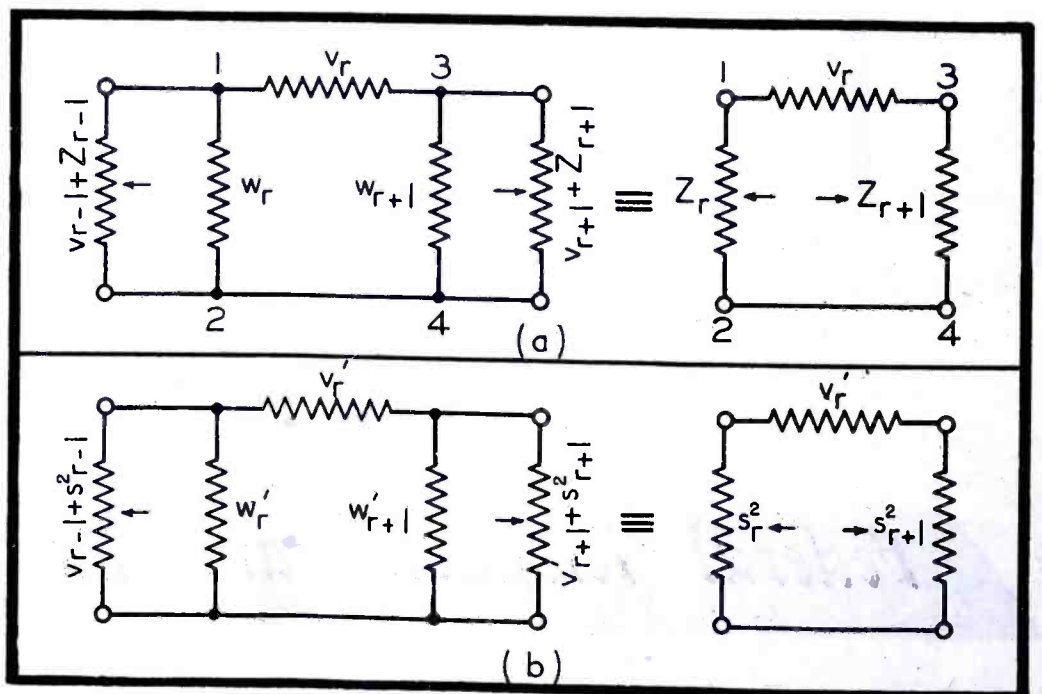
The standard network most commonly used for design purposes is the π type. If the ladder is to be balanced, the π will become the θ type or balanced π , while if the ladder is to be unbalanced, the unbalanced form of the π is used.

Normally, the standard π networks

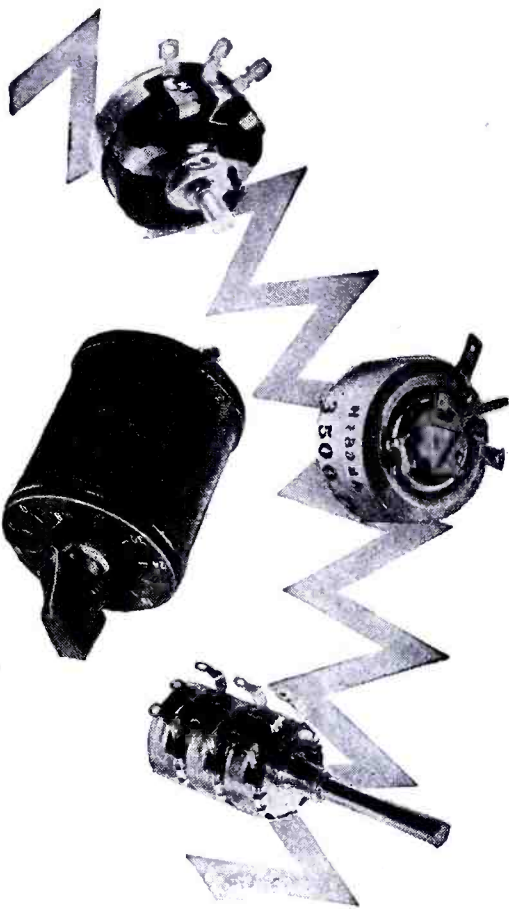
(Continued on page 56)

Figures 4 (a) and 5 (b)

In Figure 4 we have the equivalence of the network shown in Figure 3, as viewed at the r -th section. Figure 5 shows a normalized view of the network of Figure 4. All elements are on a unit basis.



²Oct. 1944; COMMUNICATIONS
³August, 1944; COMMUNICATIONS.
⁴October, 1944; COMMUNICATIONS.



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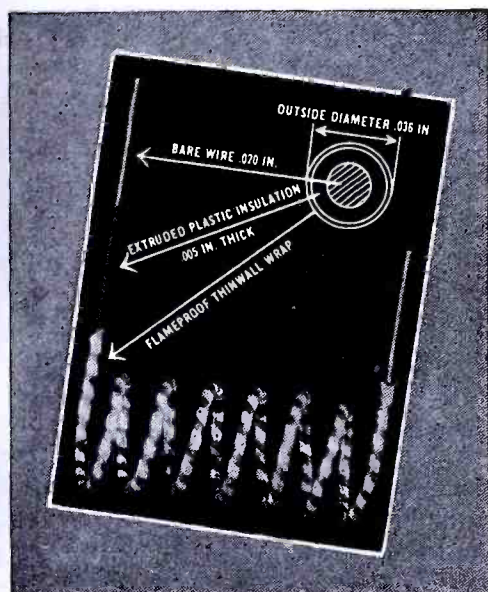


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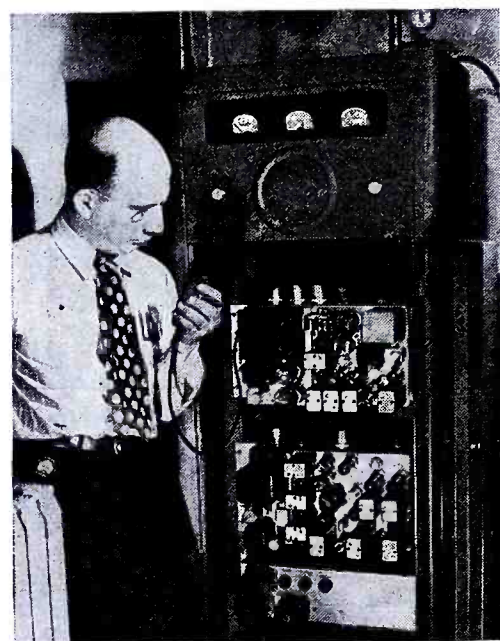
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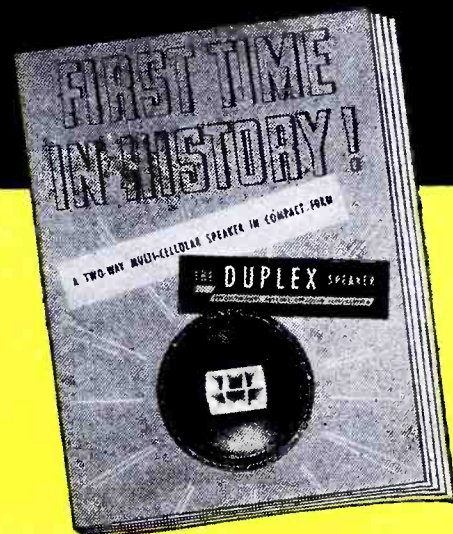


Below, dispatching switching orders via the f-m system. Incidentally the main transmitter is located in the famous "K" building, from which the first regularly scheduled broadcast was made in 1920; Harding-Cox presidential election returns.



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RESISTIVE NETWORKS

(Continued from page 54)

chosen will all have the same image impedances at both ends of the network. This simplifies the design considerably since the tables of hyperbolic function of a real variable may be used directly on a unit basis to give the unit values of the elements of the sections it is desired to use for the complete attenuator.

Symbolical Formulas

The symbolical formulas that should be used for the network element were given in chart form in Part 3,⁵ but are repeated here for reference. On a unit basis, these may be written

$$u' = w' = d = 1/d \quad (1)$$

$$\text{and} \quad v' = A \quad (2)$$

where: $d = \coth \frac{\theta}{2}$, $D = \tanh \frac{\theta}{2}$ and

$$A = \sinh \theta$$

The method of combining these standard sections together is shown, for equal loss sections, in Figures 1a and 1b. In the case of unequal loss sections, the shunt elements at each junction point may be conveniently combined together by adding admittances, which are in this network, merely the conductances of the shunt paths. From equation 1, the conductance of each shunt is given on a unit basis by $D = 1/d$. As an example, let us assume that a 5-db section is to be followed by a 10-db section; then the unit impedances or resistances in shunt at the junction of the two sections are 3.56982 and 1.92494, respectively. The admittance or conductances are found from column *D*, giving 0.280126 and 0.519496, respectively. Adding these together, the total conductance is 0.799622. The reciprocal of this is given by column *d* as 1.250 by interpolation. By more accurate calculation, 1.25059 is obtained. Figures 8a, b and c illustrate one method of combining standard π sections to form a ladder network.

Design Table

For convenience in design, the table in Figure 6 has been prepared. This table will facilitate the design of the ladder type network by combining π sections such as those of Figure 8. These data have been taken from the table presented in Part 2.²

Alternative Method Design

The alternative method mentioned in

the introduction of this paper utilizes straightforward circuit analysis to arrive at a ladder network by a somewhat different procedure than that used when designing them by means of standard sections.

Let us consider Figures 5a and 5b, which shows the *r*-th section of an infinite recurring network chain of sections such as those of Figure 3.

For simplicity, let us assume that all elements and terminations are normalized or placed on a unit basis referred to the small impedance, *z*. Further, let it be assumed that the network will have a power ratio of k_r^2 per step, or per fixed degrees of rotation. When the output is taken off of either terminals 1 and 2 or 3 and 4, for a constant output impedance, we must have

$$\frac{s_r^2 (v'_r + s_{r+1})}{\Delta} = \frac{s_{r+1}^2 (v' + s_r^2)}{\Delta} = 1 \quad (3)$$

where: $\Delta = s_r^2 + s_{r+1}^2 + v'_r$, or $s_r^2 = s_{r+1}^2$ (4)

This result could have been deduced by inspection directly from Figure 5b from the requirement of a constant impedance at the junctions of the network.

²October, 1944 COMMUNICATIONS.
⁵January, 1945 COMMUNICATIONS.

No. db per Section	<i>v'</i>	<i>w'</i>	<i>1/w'</i>
1.....	0.115384	17.3908	0.057501
2.....	.23230	8.72419	.114624
3.....	.35230	5.84797	.170999
4.....	.47696	4.41942	.226274
5.....	.60797	3.56982	.280126
6.....	.74707	3.00948	.332283
7.....	.89602	2.61454	.382476
8.....	1.05689	2.32285	.430505
9.....	1.23178	2.09989	.476215
10.....	1.42303	1.92494	.519496
11.....	1.633146	1.78489	.560259
12.....	1.864943	1.67090	.598480
13.....	2.121482	1.57689	.634158
14.....	2.406174	1.49852	.667325
15.....	2.722782	1.43259	.698038
16.....	3.075539	1.37668	.726384
17.....	3.469103	1.32898	.752457
18.....	3.908691	1.28805	.776364
19.....	4.400154	1.25277	.798233
20.....	4.950000	1.22222	.818186
21.....	5.56553	1.19569	.836336
22.....	6.25491	1.17257	.852625
23.....	7.02729	1.15238	.867772
24.....	7.89282	1.13469	.881298
25.....	8.86328	1.11917	.893520
26.....	9.95125	1.10553	.904547
27.....	11.17128	1.09351	.914485
28.....	12.53953	1.08292	.923427
29.....	14.07418	1.07357	.931469
30.....	15.79558	1.06531	.938691
31.....	17.72658	1.05800	.945177
32.....	19.89281	1.05153	.950994
33.....	22.32298	1.04580	.956206
34.....	25.04940	1.04072	.960875
35.....	28.10819	1.03621	.965056
36.....	31.53990	1.03221	.968797
37.....	35.39017	1.02866	.972143
38.....	39.71007	1.02550	.975134
39.....	44.55694	1.02270	.977808
40.....	49.99500	1.02020	.980198
45.....	88.9112	1.01131	.988816
50.....	158.1123	1.00634	.993696
55.....	281.1699	1.00356	.996450
60.....	499.99950	1.00200	.998002

Figure 6

This table gives the element values on a unit basis for standard unbalanced π network sections, where:

v' = series element.
w' = shunt element.
1/w' = conductance of the shunt element.

The power transmission ratio is defined as the ratio of the power available at any two successive junctions of the network. For the *r*-th section, this is

$$k_r^2 = \frac{E_r^2 / s_r^2}{E_{r+1}^2 / s_{r+1}^2} = \frac{E_r^2}{E_{r+1}^2} \cdot \frac{s_{r+1}^2}{s_r^2} \quad (5)$$

but $s_{r+1}^2 = s_r^2$; hence, taking the positive square root, for $k_r \geq 1$.

$$k_r = \frac{E_r^2}{E_{r+1}^2} = \frac{E_r^2}{E_r^2 \left(\frac{s_{r+1}^2}{s_{r+1}^2 + v'_r} \right)} = 1 + \frac{v'_r}{s_{r+1}^2} \quad (6)$$

The series element of the network is therefore

$$v'_r = s_{r+1}^2 (k_r - 1) = s_r^2 (k_r - 1) \quad (7)$$

From equations 3 and 7, we find that

$$s_r^2 = (k_r + 1) / k_r = 1 + \frac{1}{k_r} = 1 + r_r \quad (8)$$

where $r_r = 1/k_r \leq 1$.

Using 8 in 7 to eliminate s_r^2 .

$$v'_r = (k_r - 1) / k_r = k_r - r_r = 2 \sinh \theta_r = 2 A_r \quad (9)$$

The shunt impedance of the network at the *r*-th junction is composed of the value of the shunt element in parallel with the remainder of the network to the left of it, or

$$s_r^2 = \frac{w'_r (v_{r-1} + s_{r-1}^2)}{w'_r + v_{r-1} + s_{r-1}^2} \quad (10)$$

Solving this equation for the shunt element, it is found that

$$w'_r = \frac{s_r^2 (v_{r-1} + s_{r-1}^2)}{v_{r-1} + s_{r-1}^2 + s_r^2} = \frac{(1 + r_r)(1 + r_{r-1} + 2A_{r-1})}{r_{r-1} - r_r + 2A_{r-1}} \quad (11)$$

Equations 8 and 9 may be obtained directly from the tables given in Part 1³ and Part 2³ for any given value of loss desired. By using these values in equation 11, the shunt elements for the successive sections of the network may be calculated by assigning integer values of 1 to *n* sections to the subscripts.

Tabulation Data

The accompanying table, Figure 11, shows a convenient form of tabulation for the work of design utilizing the formulas 8, 9 and 11. The tabulations are given for an attenuator having a

(Continued on page 60)

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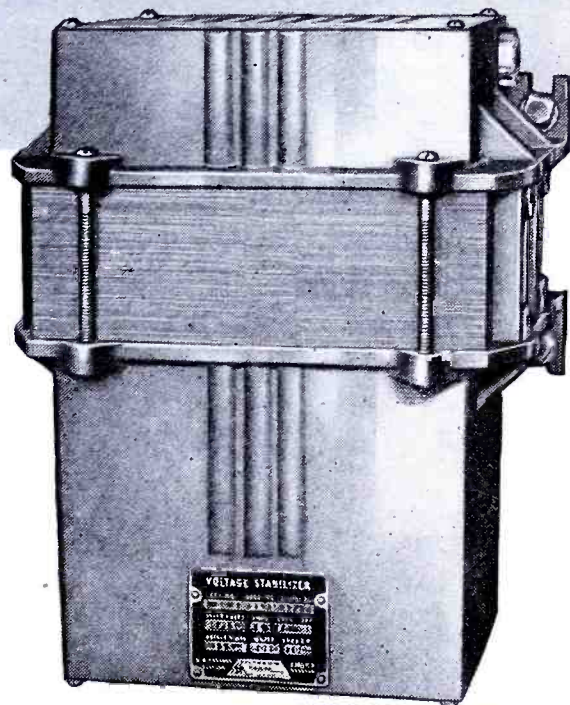
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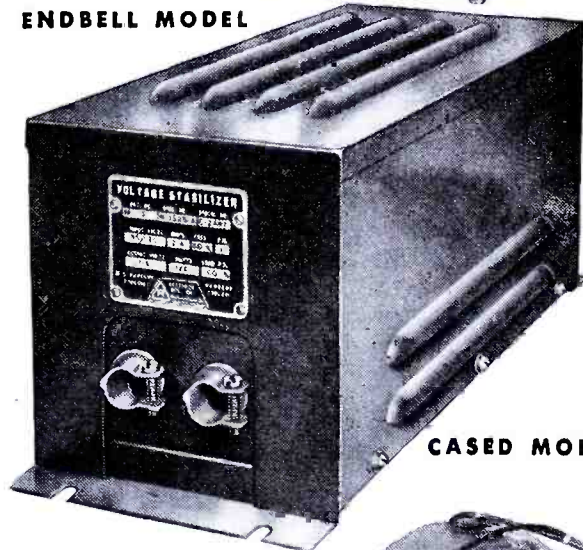
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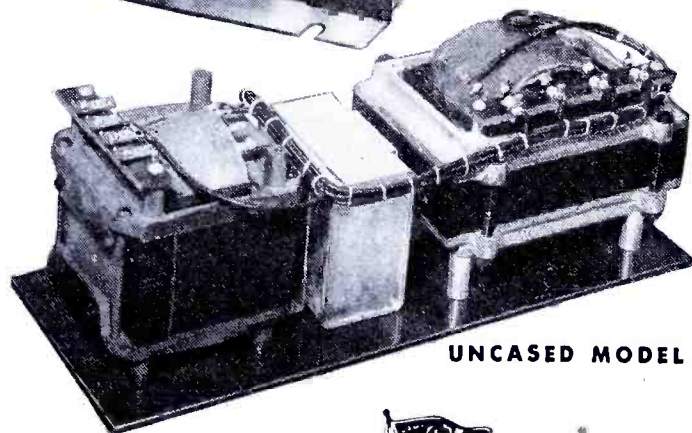
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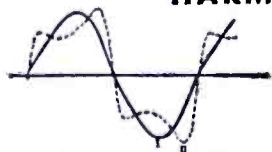


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The output wave form is illustrated in the accompanying figure and table.

ANALYSIS OF OUTPUT VOLTAGE

Curve No.	Input Volts	Percentage Harmonic			
		1st	3rd	5th	7th
I	95	99.4	7.1	2.2	Trace
II	131	96.8	24.0	7.0	3.6

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CALIBRATION OF

by PAUL K. HUDSON

Associate Professor of Electrical Engineering
University of Idaho

[On leave to the Naval Research Laboratory]

CONVENTIONAL db meters are voltmeters that are especially designed to make the db scales linear. However, ordinary high-resistance voltmeters can also be calibrated as db meters.

In this paper are presented data that will . . . (a)—simplify measurements with db meters and (b)—make it possible to calibrate high-resistance voltmeters as db meters, rapidly and accurately.

Definition of Decibels

Although the word *decibel* is frequently used in connection with many different types of measurements, the fundamental definition of decibels is

$$db = 10 \log_{10} \frac{P_2}{P_1} \quad (1)$$

In this equation P_1 and P_2 are any two power levels. However, they are usually the input power and output power respectively of an electrical device.

Zero DB Reference Levels

As shown in equation 1, decibels are proportional to power ratios and not absolute powers. Therefore, an absolute power must be expressed as a certain number of decibels above or below some zero db power level. Also, since db meters are voltmeters, the power corresponding to zero db must be expended in some standard resistance, to give a standard voltage. The two most widely used zero reference levels are: (a)—one milliwatt expended in 600 ohms and (b)—six milliwatts expended in 500 ohms.

The scale of a db meter is correct only with reference to the zero reference level for which it is calibrated. If a db meter has a zero reference level of one milliwatt in 600 ohms, it will give an incorrect reading if connected across a resistance of any other value. The amount of the error will be

$$db = 10 \log_{10} \frac{R_x}{600}$$

The DB Meter Chart

The four curves shown in the chart are special plots of the general db equation (equation 1).

Since

$$db = 10 \log_{10} \frac{P_2}{P_1} \quad (1)$$

and

$$P = \frac{E^2}{R} \quad (2)$$

therefore

$$db = 10 \log_{10} \frac{\frac{E_2^2}{R_2}}{\frac{E_1^2}{R_1}} \quad (3)$$

$$db = 10 \log_{10} \frac{E_2^2}{E_1^2} - 10 \log_{10} \frac{R_2}{R_1} \quad (4)$$

Curve 1

Curve 1 on the chart is a plot of equation 4 when the zero reference level of one milliwatt in 600 ohms is used, and R_1 equals R_2 .

Since

$$E^2 = PR$$

then

$$E_1^2 = P_1 R_1 \text{ (zero level values)}$$

$$E_1^2 = 0.001 \times 600 = 0.6 \text{ volt}^2$$

Also since R_1 equals R_2 the second term on the right hand side of the equation becomes zero. Equation 4 then becomes

$$db = 10 \log_{10} \frac{E_2^2}{0.6}$$

The db scale is at the left of the chart and the volt (E_2) scale is at the top of the chart.

Curve 1 is to be used to change volts to db (above or below the zero reference level of one milliwatt in 600 ohms) when the voltage is measured across a 600-ohm resistor.

Curve 2

Curve 2 was plotted in the same way as curve 1, with the exception

that the zero reference level was changed to six milliwatts in 500 ohms. Equation 4 then becomes

$$db = 10 \log_{10} \frac{E_2^2}{3.0}$$

Curve 2 is to be used to change volts to db (over the zero reference level of six milliwatts in 500 ohms) when the voltage is measured across a 500-ohm resistor.

Curve 3

Curve 3 is a plot of equation 4 when the zero level of one milliwatt in 600 ohms is used and E_1 equals E_2 . Equation 4 then reduces to

$$db = -10 \log_{10} \frac{R_2}{600}$$

Curve 3 is to be used to find the error caused by connecting a db meter (or voltmeter) with a zero reference level of one milliwatt in 600 ohms, across a resistance of any value other than 600 ohms.

Curve 4

Curve 4 is plotted in the same way as curve 3, with the exception that the zero level was changed to six milliwatts in 500 ohms. Equation 4 then becomes

$$db = -10 \log_{10} \frac{R_2}{500}$$

Curve 4 is to be used to find the error caused by connecting a db meter (or voltmeter) with a zero reference level of six milliwatts in 500 ohms, across a resistance of any value other than 500 ohms.

Examples

Problem 1: A db meter is calibrated for a zero level of one milliwatt in 600 ohms. It is connected across a 6000-ohm resistor. What correction must be applied to any reading taken from the meter?

Solution: Refer to curve 3. The ohms scale is at the bottom of the

(Continued on page 86)

DECIBEL METERS

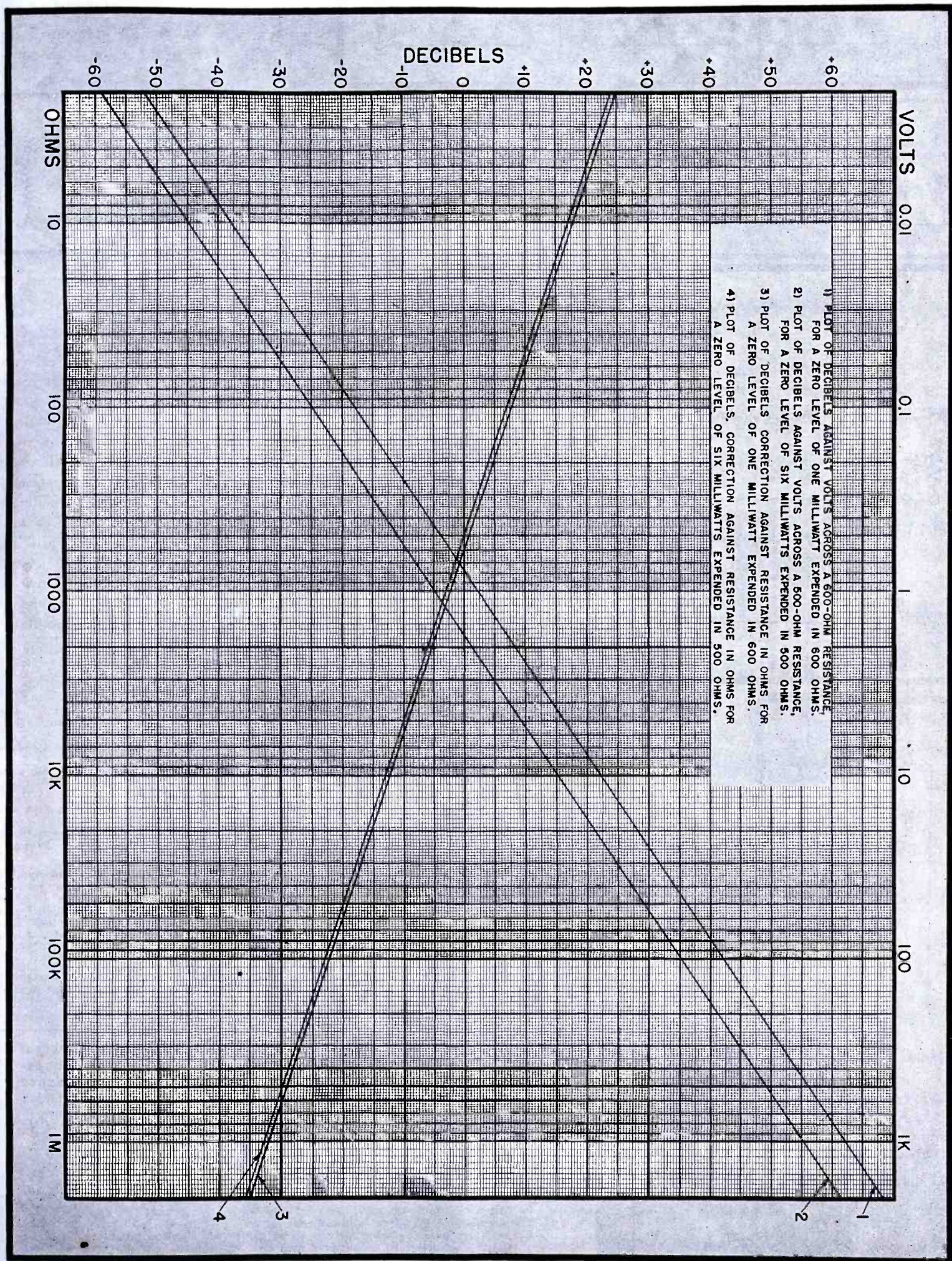
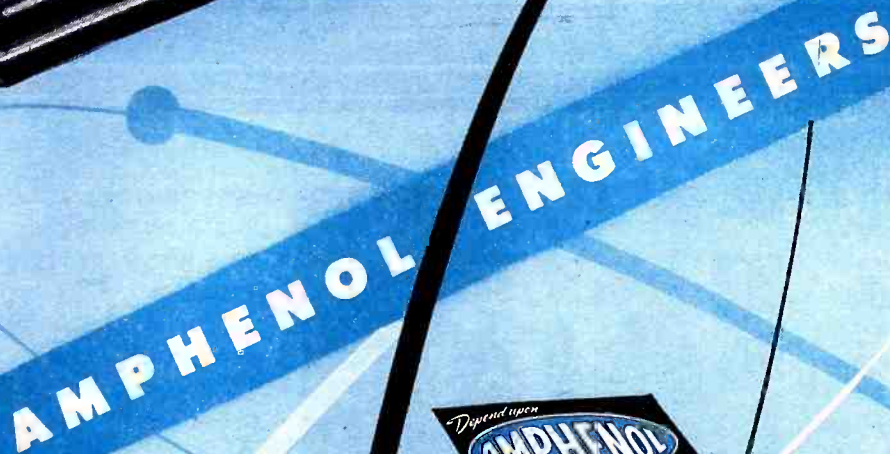
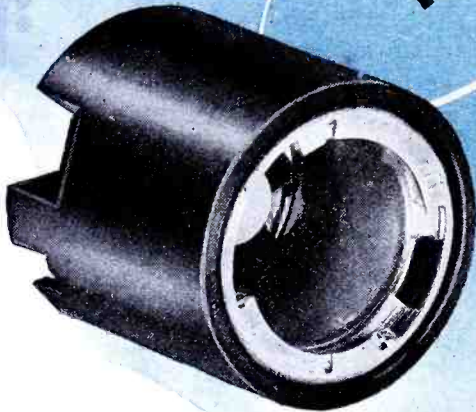


Chart with combined plots of decibels-volts and decibels-ohms. The db-volt scales are for use with curves 1 and 2; db-ohm scales are for use with curves 3 and 4. Plot data may be combined to provide a corrected meter reading, as indicated by examples in the paper.

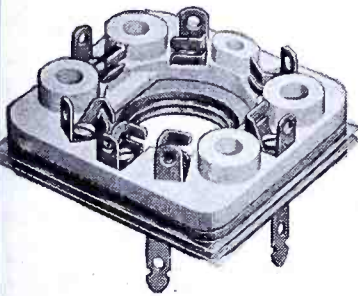


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GEORGE H. CLARK, Secretary

TED McELROY visited N. Y. recently after a session at sea as Lieut. (S. G.) in the Maritime Service. He served as wireless officer on one of last convoy ships that was attacked by German submarines before V-E Day. . . . Ted's son Jackie sailed recently as Engineer Cadet on a tanker for the Pacific War zone after four months training at the Merchant Marine Officers Training School at Kings Point, N. Y. He had just previously passed, with flying colors, the entrance examination for West Point. . . . Good luck, Jackie. . . . Peter Podell, one of our founders, has two sons in the service. Recently, when both happened to be in the Philippines, an Army public relations officer brought them together for a chat which was subsequently broadcast over WNYC, the municipal broadcasting station of New York City. . . . Bill would never tell you but we happen to know that life member Bill Halligan has one son in the Navy, in radar, who has seen considerable service overseas. And after months of silence, he has been reported safe and sound. Another of the Halligan boys is a cadet at West Point and well, too. . . . We all trust that F. P. Guthrie's son, a Captain in the U. S. Army, last seen being taken aboard a Japanese submarine in the Indian Ocean, will turn up safe and sound as a prisoner of war. . . . Paul K. Trautwein's son, in the U. S. Army, was with Paul at our twentieth anniversary cruise. . . . Martell E. Montgomery, a real old-timer, more recently with Federal Telephone and Radio Corporation in New York, has returned to a previous stamping ground, Brazil, for a two-years' stay. While flying down to Rio he stopped off in San Juan and had a pleasant visit with VWOA director Commander Fred Muller. Fred is now supervising radio activities in the Tenth Naval District which pretty well covers the Caribbean area. Fred said he'd like to hear from some of his old friends in the States. . . . Bill Simon is taking a well-earned vacation at his summer home out near Rocky Point, RCA's trans-Atlantic transmitting headquarters. . . . Glad to hear that C. D. Guthrie, who has probably



Lieut. (S.G.) Ted McElroy of the U.S. Maritime Service during a recent high-speed listening session.

held a directorship in VWOA for the longest consecutive period, is recovering from his recent illness. . . . Bob Frey continues active as radio supervisor of the Bull Steamship Lines in between RTPB and other committee meetings. . . . Thompson H. Mitchell, v-p and g-m of RCA Communications, has been commuting between Washington and N. Y., discussing international communications with the State Department. . . . Two thrilling stories about radio and radiomen appeared recently in *Liberty*. One covered the story of George Tweed, the Navy radioman who outwitted the Japs for three years on Guam. The other was Ensign Richardson's story (a condensation appears in the *Reader's Digest*) of Guerilla activities in the Philippines. He tells of the splendid part radio played in advising MacArthur of the disposition of Japanese troops in the Islands before his recent triumphant return. In this connection General MacArthur saluted us during our annual dinner with a stirring message: "On this twentieth anniversary of the Veteran Wireless Operators Association, those of you who helped lay the groundwork for our great communications system may be justly proud of your individual and cooperative contributions toward the fulfillment of our promise to return to the Philippines." . . . We suggest that everyone, individuals and companies,

participate in the Institute of Radio Engineers Building Fund activity. This is truly a progressive step that will benefit all. Our own VWOA director Arthur H. Lynch is quite active on the committee and asks your solid support. . . . George W. Bailey, assistant to the president of VWOA, and president of ARRL, is the new executive secretary of IRE. A grand arrangement. . . . Glad to see Bill Marshall of the N. Y. Telephone Company radio staff back after a prolonged illness. . . . Honorary member W. A. Ready, president of the National Company, is recuperating from an extended illness. We regret to report that the National Company's chief electrical engineer Dana Bacon, died recently. . . . J. F. Rigby, personnel director of RCA Communications and VWOA life member, has recently served on labor management panels with distinction. . . . When you feel you would like to drop someone a note, remember Doc Forsyth, now totally blind, at Sailor's Snug Harbor, Staten Island, N. Y. . . . Among the new members we have Robert W. Hale, who first operated aboard the *Mundelta* of the Munson Steamship Company and later saw service with National Air Transport and the American Airlines in radio. He now holds a First Telegraph and First Telephone ticket and is engaged in the development of railway radio communications equipment. . . . It is a genuine pleasure to welcome 25-year veteran wirelessman Robert Parker Herzig, Radioman First Class, U. S. Navy, who has served aboard the *George Washington*, *Manoa*, and *Pelican*, the *Yacht Invader*. He has also seen service at Red Salmon, Alaska. A commendable record. . . . Ben Titow, RCA business office manager, was at the recent fall meeting. Ben was a very active member in New York before his assignment to other states and cities for the commercial department of RCAC. Welcome back, Ben, let's see you often. . . . We were delighted to receive acknowledgement of the receipt of honorary membership certificate from Admiral Luke McNamee, president of Mackay Radio. We are proud to include him among our illustrious honorary members.

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ELECTRIC MEGAPHONES

(Continued from page 35)

limited the original electric megaphone system. A small portable battery-operated amplifier was furnished as one of the components. This amplifier used a single 1J6G in the output stage and from data published then we note that the output was 1.6 watts at 10% distortion. This small amplifier will drive the megaphone so as to produce the required 10 bars at acceptable distortion content, although close to 20 bars could be obtained but with an ap-

preciable increase in distortion, by increasing the input signal. The a-c/d-c amplifier also described in this release as having an output of 6 watts, resulted in an output pressure of 40 bars, approximately, without feedback effects.

Output Limits

With the output limited to these values, the original electric megaphone system was not capable of attaining the

performance which experience with these systems showed to be desirable. It was necessary that the acoustic output pressure be double or triple these values in order to make the electric megaphone a really practicable device under the adverse conditions encountered in field use. To accomplish this it was necessary to use more amplified power with increased amplification. The latter immediately would require that the discrimination against acoustic feedback be increased in some manner. These results had to be accomplished without undue increase in weight of the portable equipment (megaphone and portable amplifier) or sacrifice in battery life. It was also necessary to increase the intelligibility, if possible, as the original system was by no means perfect.

With these requirements, it was apparent that not only considerable design changes would be necessary but the design would have to be built up on a new basis. Accordingly every possible factor which might increase the feedback margin, and the efficiency, while keeping the weight, size, etc., low, was considered.

Intelligibility Factors

One of the most important points to consider during development work of this nature is the effect of the various factors that influence speech intelligibility under conditions that megaphones are generally used. Then by using the minimum frequency band necessary, shaping the amplitude characteristic, allowing maximum permissible distortion, etc., some advantages can be gained in increasing the practical efficiency, reducing weight, and minimizing feedback effects.

In a previous article by the author,⁴ it was shown as a result of analysis plus experience, that in marine loudspeaker systems with given sizes of loudspeakers and available amplifier power, the optimum speech articulation in the presence of the usual noise conditions is obtained with a frequency band limited largely to between 500 and 4,000 cycles. In addition the amplitude-frequency response requires a rising slope of 6 to 10 db per octave. Below 500 cycles, the attenuation is much more rapid, with very little output at 200 cycles and lower. These findings were the result of work completed several years ago. It is interesting to note that the experience of others with amplified speech transmission systems is in accord with these results. An excellent discussion of the

⁴Acoustic Considerations in 2-Way Loudspeaker Communications, COMMUNICATIONS; June 1944.

ors in *emphasized* loudspeaking
 ems (i.e. with a markedly rising
 onse) and the advantages accru-
 s, appeared in a recently published
 sen pamphlet.⁵

Reproduction

n electric megaphones of practical
 and shape, it is advantageous to
 rict low-frequency reproduction as
 ch as possible, without degrading
 elligibility too greatly. This is neces-
 ry because the sound radiated from
 horn continues to diverge more and
 e as the frequency is decreased.
 atively more acoustic power is radi-
 l-back to the microphone, resulting
 a greater tendency to feedback
 ustically. Thus to the other advan-
 es of an *emphasized* response, cited
 ove, is added the advantage of re-
 ing one of the main sources of feed-
 k in an electric megaphone. A low
 quency of 500 to 700 cycles is ac-
 table as a design point, since only a
 atively small decrease in either in-
 ibility or loudness is effected even
 he response were cut off sharply at
 t point (this is seldom the case un-
 e a high-Q high-pass filter is inten-
 ally added to the transmission
 ruit.)

Acoustic Feedback Margin

n trying to improve the acoustic
 eedback margin (which is the main
 roblem) in this type of system, it is
 ll to consider what had been accom-
 lished before. It is evident that one
 the most important factors is the
 unate operating requirement that
 microphone be located behind the
 ne of the reproducer mouth, and
 ang in the opposite direction. The
 eration distance is important, but
 ractical considerations require it to
 as little as possible. At these short
 eration distances (of the order of
 other effects (due apparently to
 rial distances between reproducer
 uth and microphone, being of the
 er of wavelength multiples of par-
 ular frequencies transmitted, such
 standing waves, Fresnel effects, and
 like), indicate that increase in feed-
 k margin is not necessarily propor-
 al to increase in separation dis-
 ce. Experiments have shown that
 ome cases an actual decrease in the
 eing between microphone and re-
 roducer mouth has reduced the feed-
 k somewhat. For some designs, it
 ossible to find a *best* separation dis-
 ce within the limitations, although
 usually indicates an unstable sys-

(Continued on page 68)

The Effective Reproduction of Speech, Jensen
 Technical Monograph 4; 1944.

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V-H-F TRANSMISSION-LINE ELEMENT CHART

by **FREDERICK C. EVERETT**

Engineer, Radio Facilities Group, NBC

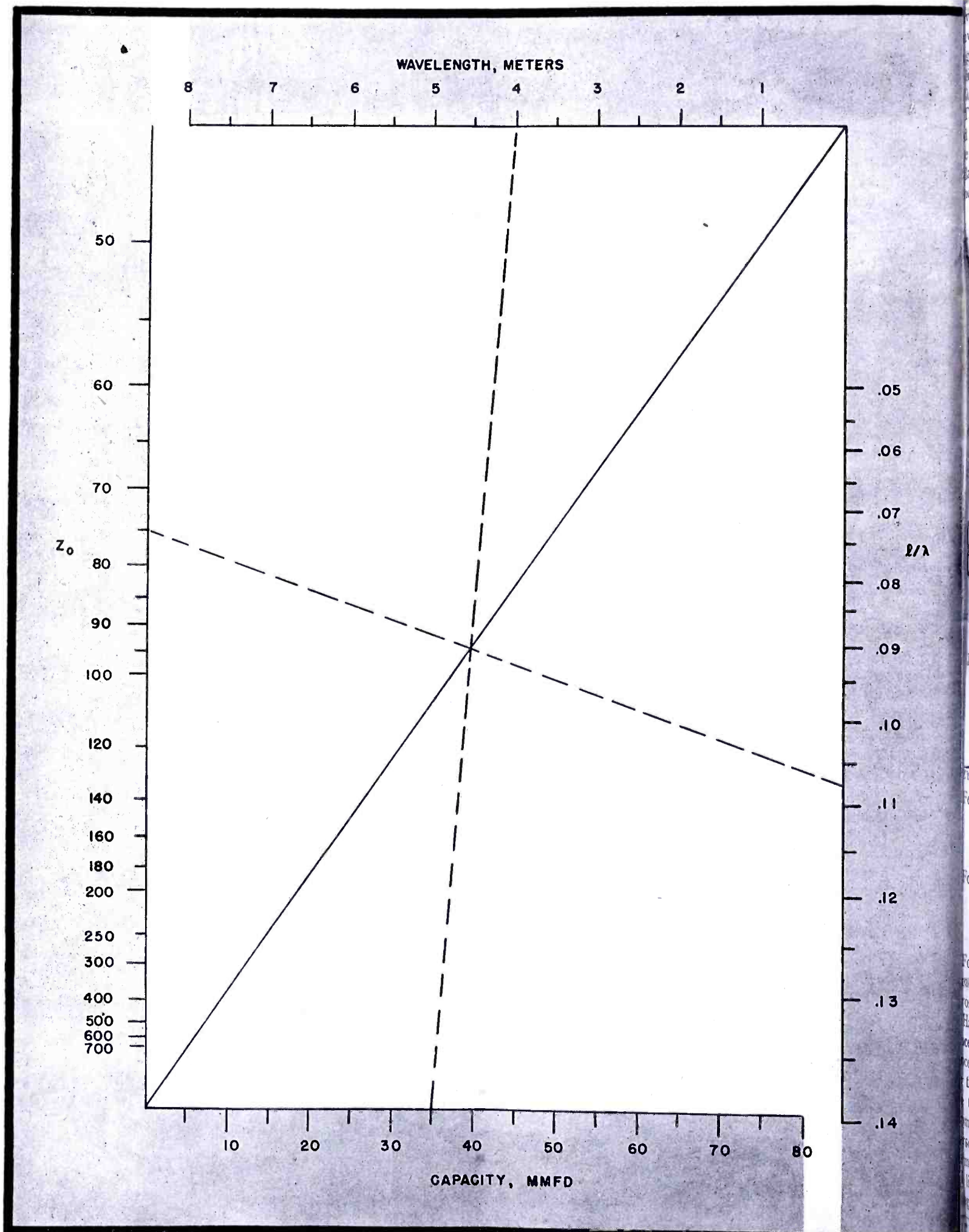


Figure 1

At high frequencies the shorted transmission line is used considerably as a tuning element instead of a coil. If used alone, its length would be $\lambda/4$, but as a tuned circuit it is a variable condenser and tube capacitance shunted across the open end. Further, the line length at the longer wavelengths would be too long for convenience. This means that the line length is considerably fore-shortened; ordinarily to something of the order $\lambda/8$.

The general equation for the sending impedance Z_s of a transmission line of length x with characteristic impedance Z_0 and terminated in impedance Z_r is

$$Z_s = Z_0$$

$$\frac{Z_r \cosh x \sqrt{ZY} + Z_0 \sinh x \sqrt{ZY}}{Z_0 \cosh x \sqrt{ZY} + Z_r \sinh x \sqrt{ZY}}$$

$$Z_s = Z_0$$

$$\frac{Z_r \cosh(a + jb) + Z_0 \sinh(a + jb)}{Z_0 \cosh(a + jb) + Z_r \sinh(a + jb)}$$

For a low-loss line, if α is nearly 0, then if

$$\alpha l = 0 \quad b = \beta l \quad \beta = \frac{2\pi}{\lambda}$$

$$Z_s = Z_0$$

$$\frac{Z_r \cosh j 2\pi l/\lambda + Z_0 \sinh j 2\pi l/\lambda}{Z_0 \cosh j 2\pi l/\lambda + Z_r \sinh j 2\pi l/\lambda}$$

$$Z_0 \left[\frac{Z_r \cos 2\pi l/\lambda + Z_0 j \sin 2\pi l/\lambda}{Z_0 \cos 2\pi l/\lambda + Z_r j \sin 2\pi l/\lambda} \right]$$

If the line short is circuited $Z_r = 0$

$$Z_s = Z_0 \left[\frac{Z_0 j \sin 2\pi l/\lambda}{Z_0 \cos 2\pi l/\lambda} \right]$$

$$Z_s = Z_0 j \tan 2\pi l/\lambda$$

\bar{Y} = propagation constant (complex) = $a + j\beta$

For a 2-wire line*

$$Z_0 = 276 \log \frac{S}{r}$$

For a concentric line*

$$Z_0 = 138 \log \frac{r_1}{r_2}$$

For resonance this must equal the reactive reactance of the condenser across it, which is $1/2 (\pi f C)$.

Having selected a tuning capacitance, and added to it the tube capacitance and a characteristic impedance of the line, it is possible to determine the tuning range and length of line from a chart, Figure 1, page 66. Conversely we can use such a chart to determine the capacitance and the length of line necessary for a given wavelength.

For other configuration see S. Frankel, *Transmission Lines*, COMMUNICATIONS, March,



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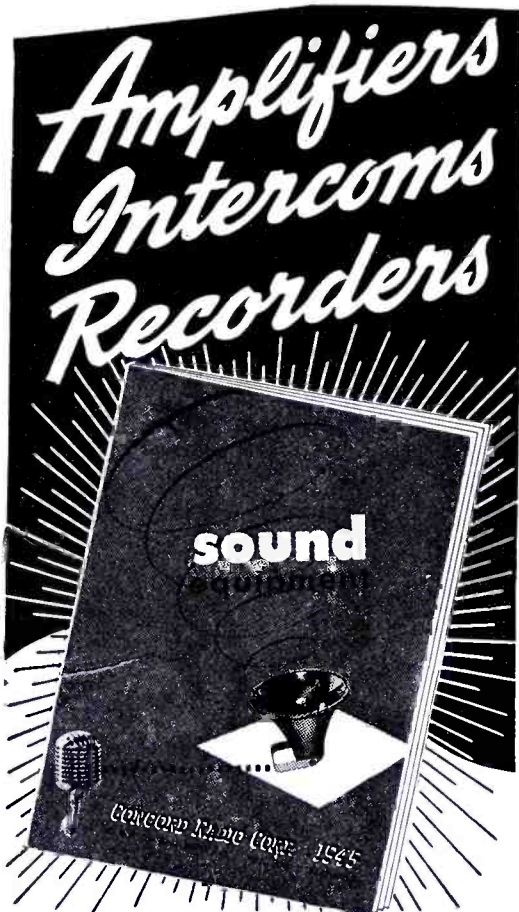
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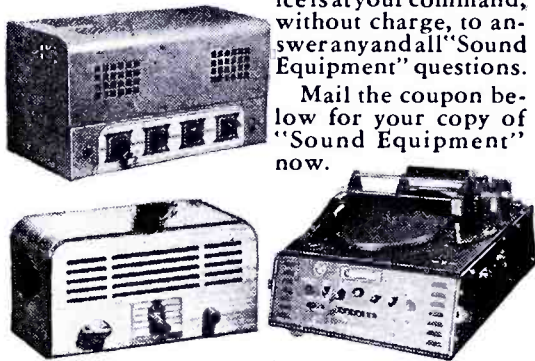
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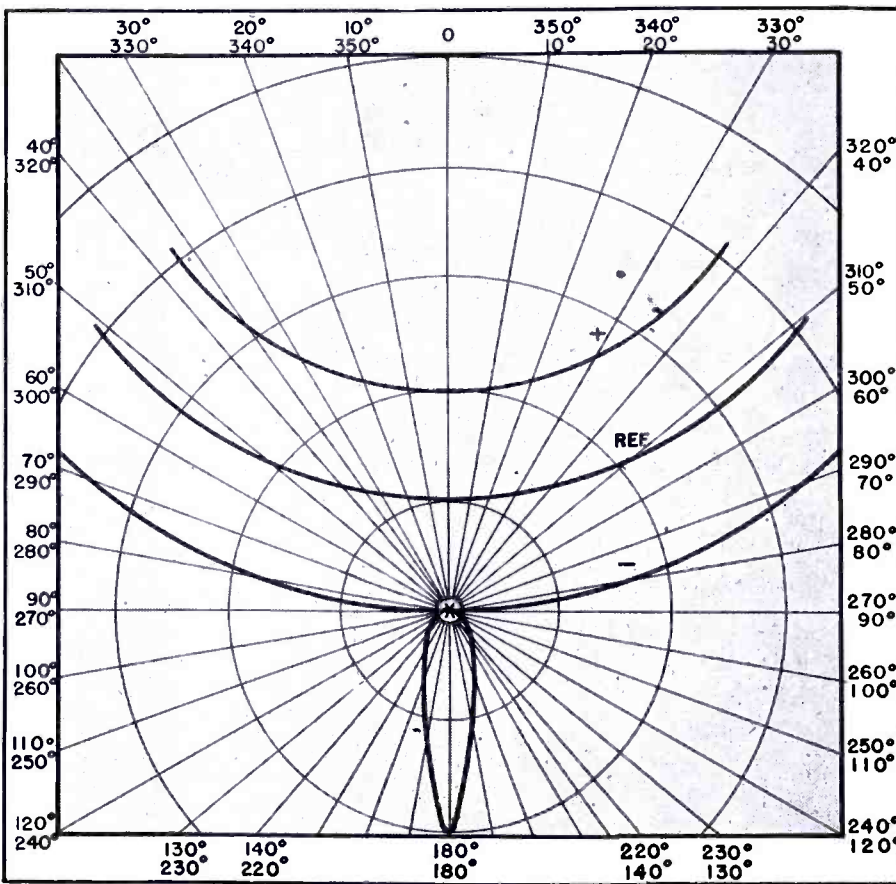
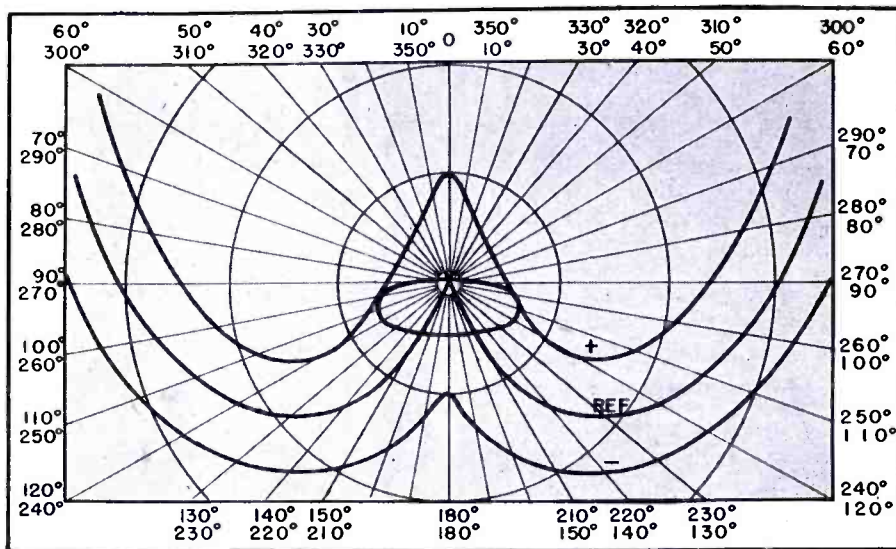
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Figures 7 and 8
Figure 7. Speaker isobars with loops in rear radiation pattern. Figure 8. Sharp directivity pattern of microphone.

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ELECTRIC MEGAPHONES

(Continued from page 68)

which will feed back if the megaphone is moved with respect to objects, faces, etc., which may be in the vicinity.

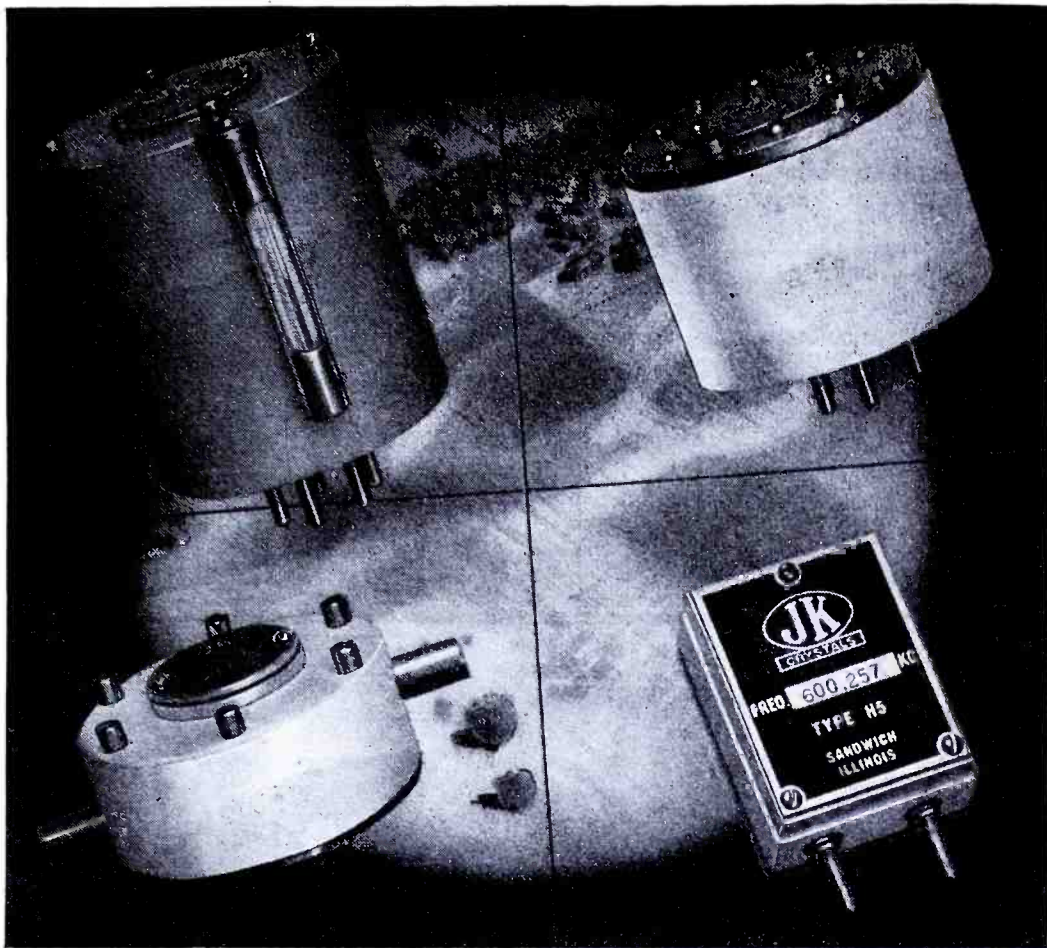
Directional Sensitivity Patterns

In addition to the separation factor, increasing the acoustic feedback in the design of the megaphone proper consists in reducing both back radiation sound from horn mouth to the greatest degree, and ability of microphone to respond to sound other than originating at mouth of talker. To illustrate the importance of approaching unidirectional sensitivity patterns in both components let us consider the possible cases, simplified for clarity.

Suppose that we represent the sensitivity patterns in a manner similar to a field strength plot, in which each contour line represents a definite sound pressure from the loudspeaker, a point on the line being directly proportional to the distance from the source. Similarly, the lines about the microphone represent contours of equal sensitivity in space. Let Figure 5 be an idealized directivity pattern of a loudspeaker; for our purpose only the outer portion will be used. In Figure 6 a point x indicates the center of the microphone diaphragm, assuming it to be the point of maximum sensitivity. Let the small circle be the contour of an arbitrary lower sensitivity. If the loudspeaker isobar passing through x is called the reference pressure, the isobar marked + represents a higher sound pressure and that marked - a lower sound pressure. It can be seen that the acoustic feedback between the loudspeaker and the microphone can be computed if this reference sound pressure and the microphone sensitivity and effective amplification are known. If, for instance, with a given amplification between microphone and loudspeaker in the transmission circuit, a source of 50 bars, at a known frequency, at x produce 45 bars in the reference isobar, howling or singing will not occur. If the amplifier gain is increased so that only 45 bars or less at x are required to produce 45 bars (or greater) in the reference isobar, acoustic feedback will start. In the above figure, contours representing microphone sensitivity, due to points on them being farther away from the microphone diaphragm, cross speaker isobars of lower pressure, a condition representing less tendency to feedback.

Now let us take a condition in which for one reason or another the loud-

(Continued on page 76)



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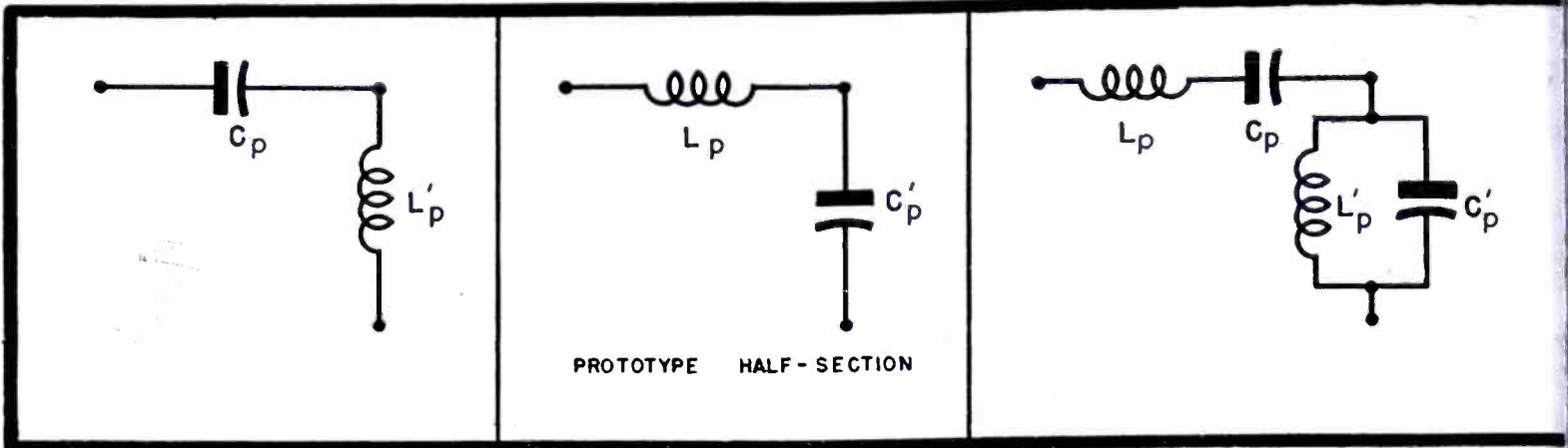
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Crystals for the Critical

MULTI-SECTION FILTER DESIGN PROCEDURE

(Continued from page 44)



5. Values of Component Half Sections

Note: Resonant L-C combinations are identified by the values of:

$$r = \sqrt{\frac{L}{C}}$$

(for series combinations), or

$$g = \sqrt{\frac{C}{L}}$$

(for parallel combinations), and

$$w = \frac{1}{\sqrt{LC}}$$

This notation simplifies further computation.

In Figure 9 we have a prototype half-section. For the high pass filter (a),

$$C_p = \frac{\sqrt{F}}{R_o}$$

$$L'_p = R_o \sqrt{F}$$

For the low-pass filter (b),

$$L_p = \frac{R_o}{\sqrt{F}}$$

$$C'_p = \frac{1}{R_o \sqrt{F}}$$

For band-pass filters (c),

$$r_o = \sqrt{\frac{L_p}{C_p}} = \frac{R_o}{\sqrt{F}}$$

Figure 9

The prototype half section of a high-pass filter, a, (left, above); low-pass filter, b, (center, above); and band-pass filter, c, (right, above).

$$w_p = \frac{1}{\sqrt{L_p C_p}} = 2\pi f_m$$

$$g'_p = \sqrt{\frac{C'_p}{L'_p}} = \frac{1}{R_o \sqrt{F}}$$

$$w'_p = \frac{1}{\sqrt{L'_p C'_p}} = 2\pi f_m$$

In Figure 10 we have the derived half-section (subscript j identifies section). For high-pass filters (a),

$$C_j = \frac{1}{R_o \sqrt{\frac{1}{F} - \frac{1}{S_j}}}$$

$$r'_j = \sqrt{\frac{L'_j}{C'_j}} = R_o \sqrt{\frac{F}{S_j - F}}$$

$$w'_j = \frac{1}{\sqrt{L'_j C'_j}} = \frac{1}{\sqrt{S_j}}$$

Figure 10

Derived half section of a high-pass filter, a, (left, below); low-pass filter, b, (center, below); and band-pass filter, c, (right, below).

For low-pass filters (b),

$$L_j = R_o \sqrt{\frac{1}{F} - \frac{1}{S_j}}$$

$$r'_j = \sqrt{\frac{L'_j}{C'_j}} = R_o \sqrt{\frac{F}{S_j - F}}$$

$$w'_j = \frac{1}{\sqrt{L'_j C'_j}} = \sqrt{S_j}$$

For band-pass filters (c),

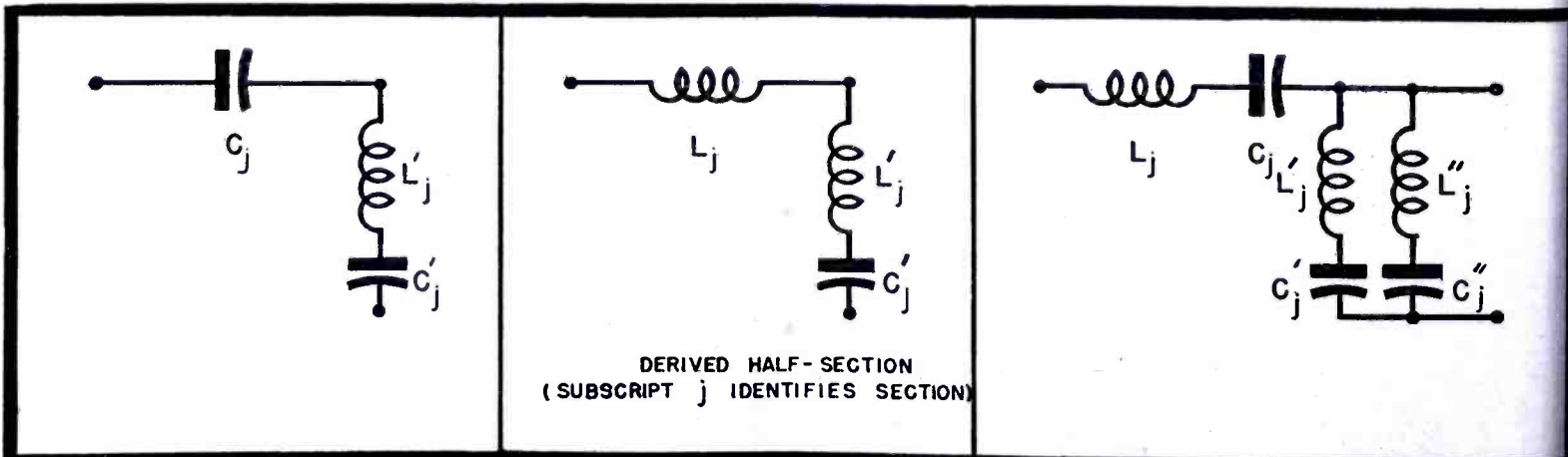
$$r_j = \sqrt{\frac{L_j}{C_j}} = R_o \sqrt{\frac{1}{F} - \frac{1}{S_j}}$$

$$w_j = \frac{1}{\sqrt{L_j C_j}} = 2\pi f_m$$

$$r'_j = r''_j = \sqrt{\frac{L'_j}{C'_j}} = \sqrt{\frac{L''_j}{C''_j}} = R_o \sqrt{\frac{F(S_j + 4)}{S_j}}$$

$$w'_j = \frac{1}{\sqrt{L'_j C'_j}} = 2\pi f_m \frac{\sqrt{S_j + 4} - \sqrt{S_j}}{2}$$

$$w''_j = \frac{1}{\sqrt{L''_j C''_j}} = 2\pi f_m \frac{\sqrt{S_j + 4} + \sqrt{S_j}}{2}$$



DERIVED HALF-SECTION (SUBSCRIPT j IDENTIFIES SECTION)

Examples

Prototype section:

$$\frac{516}{\sqrt{0.1875}} = 1190; \quad w_p = 2\pi \times 6 = 37.7$$

$$f_p = \frac{1}{516 \times \sqrt{0.1875}} = 4.47 \times 10^{-3};$$

$$w'_p = 37.7$$

Derived section (1):

$$516 \sqrt{\frac{1}{0.1875} \frac{1}{0.605}} = 990; \quad w_1 = 37.7$$

$$\sqrt{S_1} = \sqrt{0.31} = 0.556;$$

$$\sqrt{S_1 + 4} = \sqrt{4.605} = 2.15]$$

$$r''_1 = r''_1 = 516 \times 0.556 \times 2.15 = 618$$

$$= 37.7 \frac{2.15 - \sqrt{0.605}}{2} = 25.95;$$

$$w''_1 = 37.7 \frac{2.15 + \sqrt{0.605}}{2} = 55.2$$

Derived section (t) (terminal):

$$516 \sqrt{\frac{1}{0.1875} \frac{1}{0.358}} = 822; \quad w_t = 37.7$$

$$\sqrt{S_t} = \sqrt{0.525} = 0.725;$$

$$\sqrt{S_t + 4} = \sqrt{4.358} = 2.09]$$

$$r''_t = r''_t = 516 \times 0.725 \times 2.09 = 782$$

$$= 37.7 \frac{2.09 - \sqrt{0.358}}{2} = 28.15;$$

$$w''_t = 37.7 \frac{2.09 + \sqrt{0.358}}{2} = 50.7$$

Values of Assembled Filter

Figures 11, 12, 13 and 14 appear data shunt arm of prototype T section, shunt arm of derived T section, and series arm formed by two adjoining sections. Position of terminal section in filter is shown.

Example (values in μ fd and mh)

$$\frac{r'_t}{w'_t} = \frac{782}{28.15} = 27.8 \text{ mh};$$

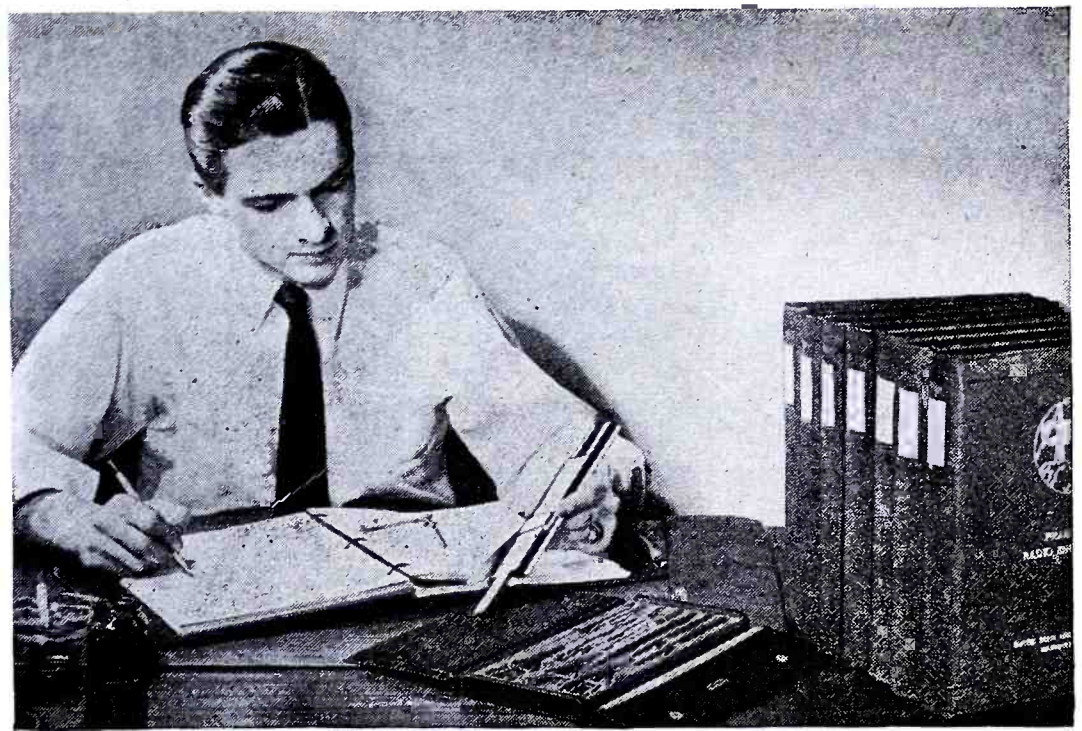
$$\frac{1}{r'_t w'_t} = \frac{1}{0.782 \times 28.15} = 0.0455 \mu\text{fd}$$

$$\frac{r''_t}{w''_t} = \frac{782}{50.7} = 15.4 \text{ mh};$$

$$\frac{1}{r''_t w''_t} = \frac{1}{0.782 \times 50.7} = 0.0252 \mu\text{fd}$$

$$\frac{r_t + r_p}{2\pi f_m} = \frac{822 + 1190}{37.7} = \frac{2012}{37.7} = 53.3 \text{ mh};$$

See note, page 72.
(Continued on page 72)



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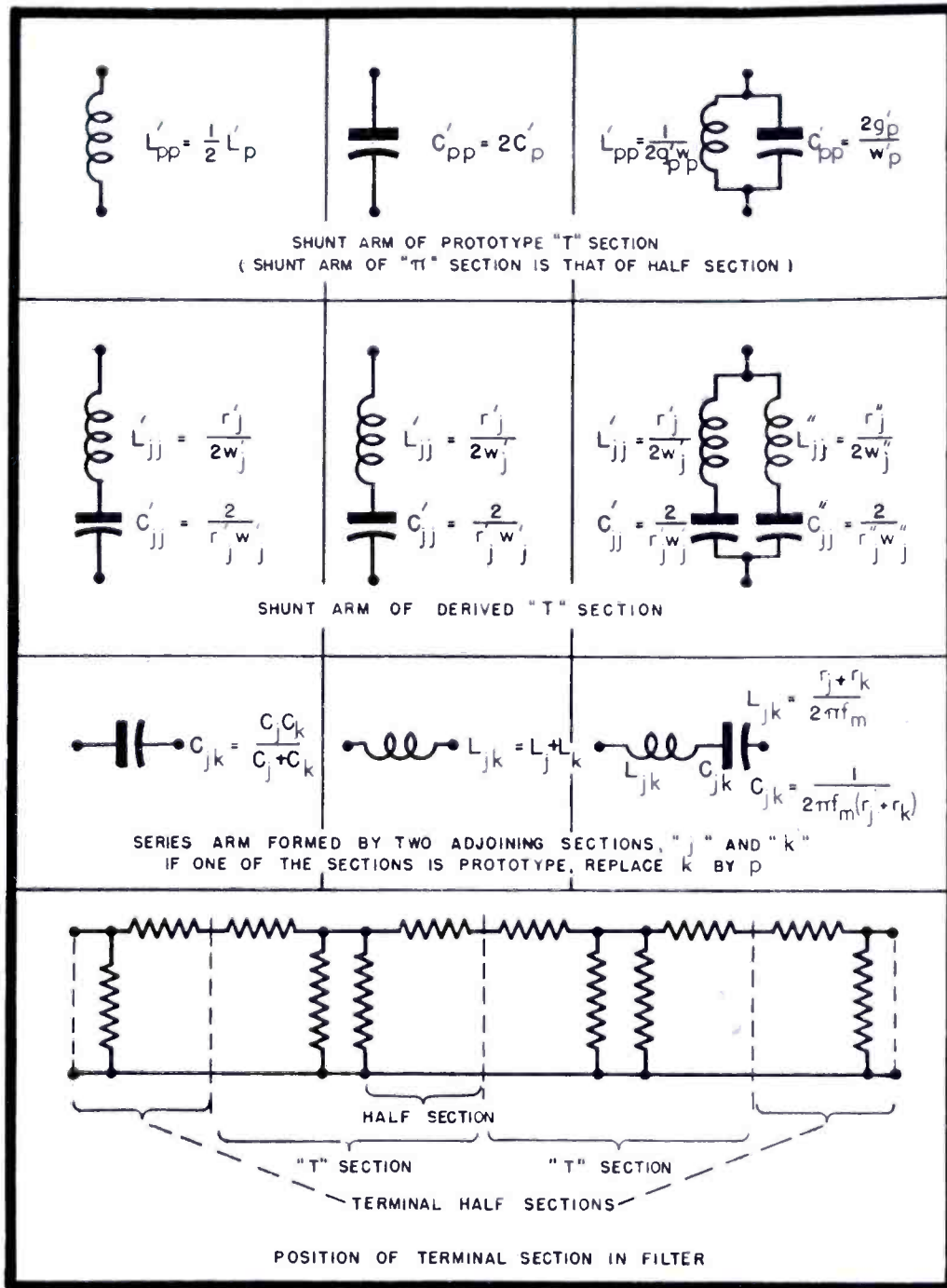
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MULTI-SECTION FILTER DESIGN PROCEDURE

(Continued from page 71)



$$C_{tp} = \frac{1}{2\pi f_m (r_t + r_p)} = \frac{1}{37.7 \times 2.012} = 0.0132 \mu\text{fd}$$

$$L'_{pp} = \frac{1}{2g'_p w'_p} = \frac{10^9}{2 \times 4.47 \times 37.7} = 2.97$$

$$C'_{pp} = \frac{2g'_p}{w'_p} = \frac{2 \times 4.47}{37.7} = 0.237 \mu\text{fd}$$

$$L_{pi} = \frac{r_p + r_i}{2\pi f_m} = \frac{1190 + 990}{37.7} = 57.8 \text{ mh}$$

$$C_{pi} = \frac{1}{2\pi f_m (r_p + r_i)} = \frac{1}{37.7 \times 2.18} = 0.01218 \mu\text{fd}$$

$$L'_{ii} = \frac{r'_i}{2w'_i} = \frac{618}{2 \times 25.95} = 11.9 \text{ mh}$$

$$C'_{ii} = \frac{2}{r'_i w'_i} = \frac{2}{0.618 \times 25.95} = 0.1247 \mu\text{fd}$$

$$L''_{ii} = \frac{r''_i}{2w''_i} = \frac{618}{2 \times 55.2} = 5.6 \text{ mh}$$

$$C''_{ii} = \frac{2}{r''_i w''_i} = \frac{2}{0.618 \times 55.2} = 0.0586 \mu\text{fd}$$

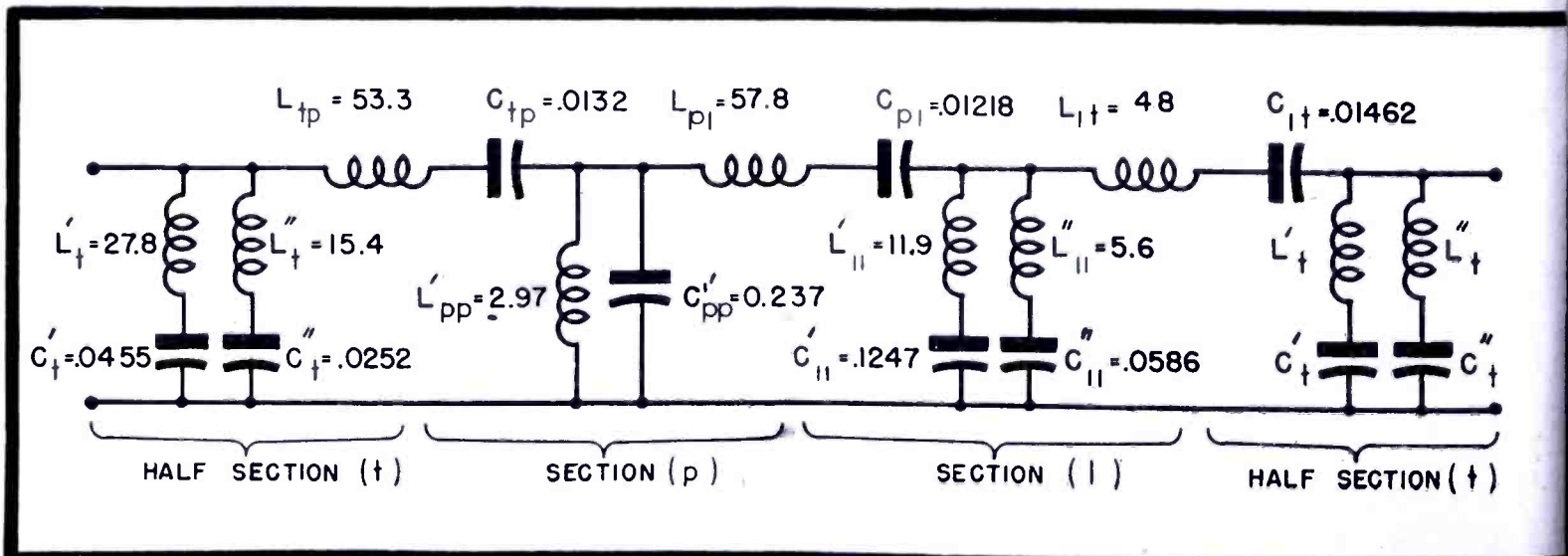
$$L_{it} = \frac{r_i + r_t}{2\pi f_m} = \frac{990 + 822}{37.7} = 48 \text{ mh}$$

$$C_{it} = \frac{1}{2\pi f_m (r_i + r_t)} = \frac{1}{37.7 \times 1.812} = 0.01462 \mu\text{fd}$$

(Continued on page 74)

*Resistance r'_t is expressed in $K\Omega$ (0.782 $K\Omega$) to obtain C'_t in μfd .

Figures 11, 12, 13 and 14 (above, top to bottom) and 15 (below)
In Figures 11 to 14, we have the values of an assembled filter. Filters at left of Figures 11 to 13 are high-pass; at center, low-pass; and right, band pass. In Figure 15 we have design data for a filter.



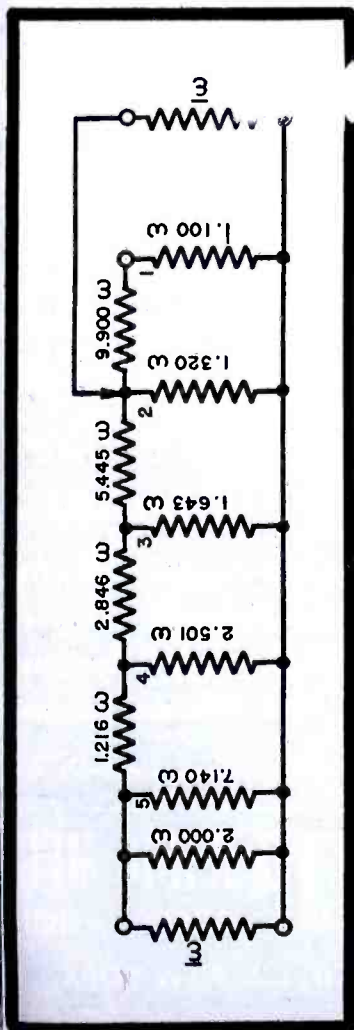
RESISTIVE NETWORKS

(Continued from page 60)

Impedance mismatch at the output terminals of the network system. No correction is necessary because of this, however, since all output voltages are changed by the same percentage without causing any deviation in the relative values of them for the different attenuator settings. The input impedance of the network is normally matched to the voltage source impedance, but the output impedance of the network as seen from the load side is equal to the quotient of the nominal design value of the equal image impedances of the individual section outputs and the number of outputs it is desired to use. If, for example, the attenuator networks were designed to have an output impedance of 225 ohms, the complete attenuator output impedance would be $225/3 = 75$ ohms. Such systems are very useful for the testing of coaxial and cable feeder units by means of a microvolter signal generator, as well as for general test purposes where it is desired to regulate the output in terms of relative voltage instead of decibels.

Figure 12

Illustration of the application of the alternate method given for the design of ladder networks. This network has a total loss of 20 db with 5 steps having 5-db per step for 4 steps and an insertion loss of 3.46 db on the fifth step.

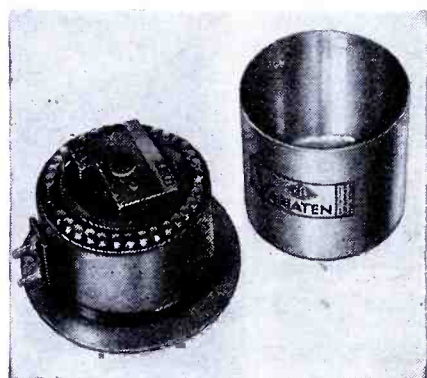


FLAT Contacts

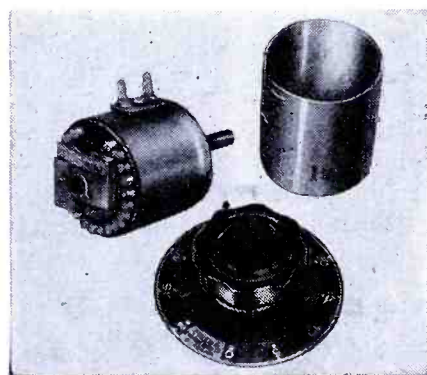
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MULTI-SECTION FILTER DESIGN

(Continued from page 72)

APPENDIX

Mathematical Basis of Multi-section Filter Design Procedure

As is well known, the transfer constant of a T network is given by

$$\Theta = \ln \frac{\sqrt{1+P} + \sqrt{P}}{\sqrt{1+P} - \sqrt{P}}$$

where P is the product ZY of the series-arm impedance times the shunt-arm admittance of the basic L section; the T section like the π being the result of placing two L sections together.

Now when $P < (-1)$, the real part of Θ or the attenuation α , is found to be unity. When $P > (-1)$ α has a value which is a function of P only.

Simple Reactive Networks

For relatively simple reactive networks P may be reduced to a form which lends itself to the use of universal charts. This fact, although known, has not been fully exploited. It can be shown that for the three basic derived structures (high, low and band-pass) which are the subject of this paper (the prototype being included as a particular case), P is given by

$$P = \frac{F}{S} \frac{F}{n}$$

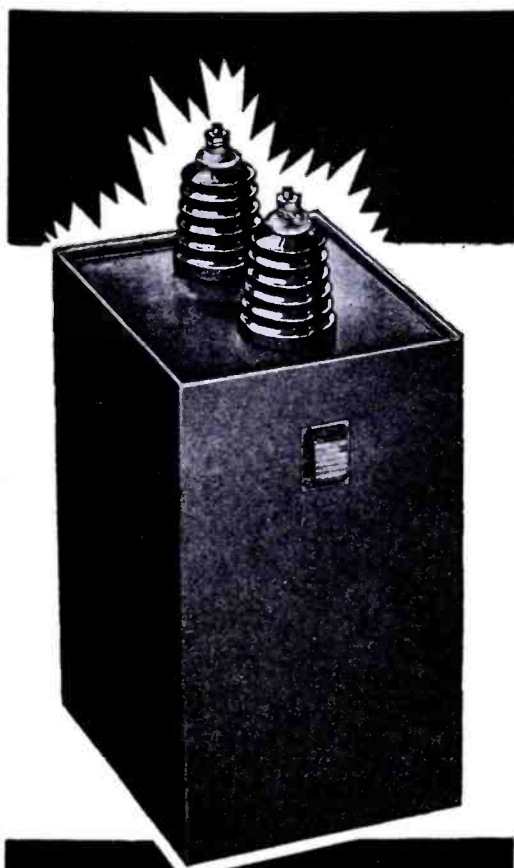
where F , S , and n are all the same function of frequency, except that for n the frequency is the generic value for which P is required; for F the frequency has the cut-off value, and for S it has the peak-attenuation value. The function, n , called the frequency number differs for each of the three basic types as explained in step two.

Universal Charts

Now it is clear that P , hence also α is a function of only two variables namely: F/S and F/n . Therefore it can be given as a family of universal curves each of which corresponds to a value of F/S , hence to a particular value of what the literature calls the derivation factor, m .

Grouping Charts

The grouping charts are obtained by adding the ordinates of two or three of the universal curves so selected that



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the resulting curve has equal minima. The grouping charts themselves are lots of this minimum value against the values of F/S for each of the various universal curves which have been added together, and the value F/n_A whose significance is best explained by the explanatory diagrams inserted in figures 1 to 6.

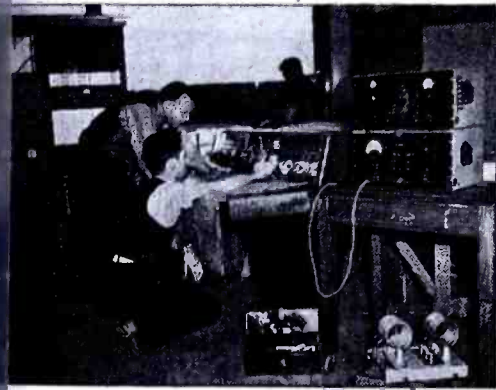
Cauer Parameters

It might be said in conclusion that the method substitutes the graphical effort of compiling the *grouping charts* for all to the mathematical effort of determining the Cauer parameters which must be repeated each time.

Simplified Method

The calculation of the elements is made simpler and more logical than heretofore by the elimination of all parameters with the exception of the particular values taken by the *frequency number*.

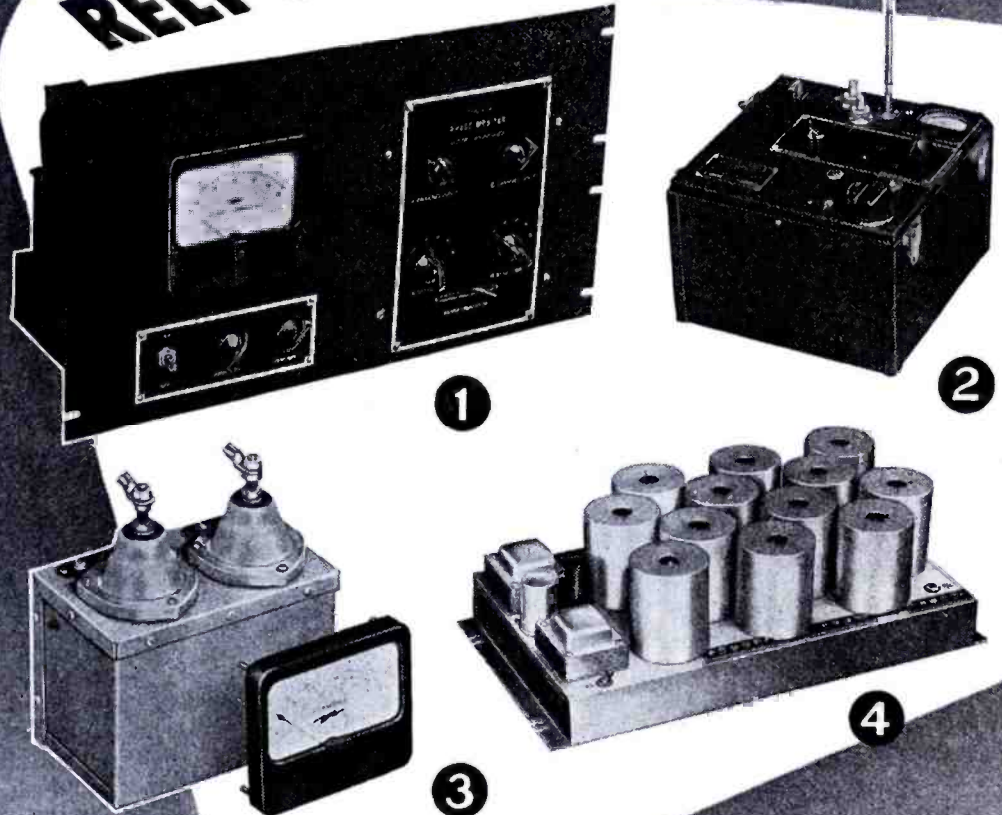
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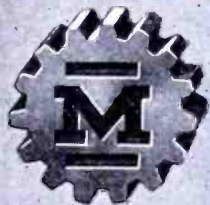
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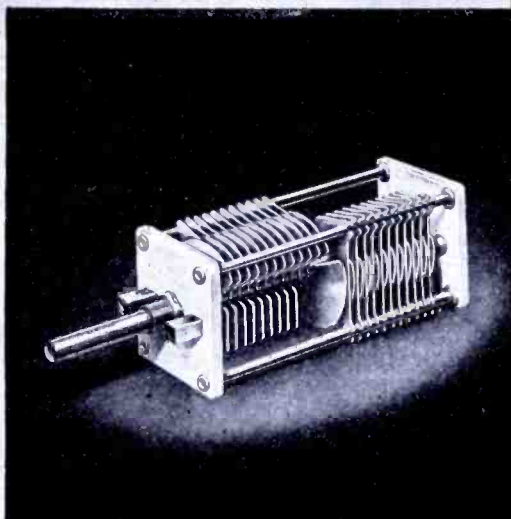
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ELECTRIC MEGAPHONES

(Continued from page 69)

speaker isobars have cusps or loops in the rear radiation pattern, as shown in Figure 7, and further that the microphone sensitivity contours are broad. In this case, even though the reference isobar of the speaker passes through *x*, the next lowest sensitivity curve of the microphone intersects the next highest speaker isobar. If conditions are such that the sensitivity gradient of the microphone (with distance from *x*) is less than the pressure gradient between speaker isobars in the same distance, then this system will break into oscillation, acoustically, more readily than that of Figure 6 (assuming the same reference pressure and microphone sensitivity as before). This may be an abnormal condition to assume, but peculiar field patterns of this nature (but more complex) can effectively exist where reflections, diffraction, pressure doubling effects, etc., are introduced due to the physical shape of the structure, particularly on or around the microphone

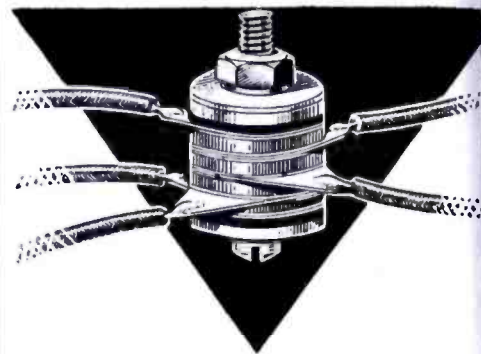
Directivity Pattern Microphone

It is best, therefore, for the designer to aim for the sharpest possible microphone directivity pattern as shown in Figure 8, for example, and to avoid causes tending to distort it or that of the loudspeaker, in the vicinity of the microphone. Likewise the speaker pattern should be kept as free of loops as possible in its rear radiation, and the actual pressures in this region be made as small a per cent as possible of the forward radiation (Figure 8.) The importance of giving due consideration to these effects in any design is further emphasized by the fact that even with the best possible arrangement, the proximity of the talker's mouth and face to the microphone tends to distort

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the field patterns, usually in the direction which reduces the feedback margin. It is perhaps superfluous to point out that any cavities, tubes, or other structures which have definite resonance properties in the transmission band, must be avoided.

Horn Mouth Design

The most important factor in making the back radiation from the loudspeaker a minimum is to design the horn mouth for greatest forward directivity. This means making the mouth diameter as large as possible, and experience has shown that it is imprac-

ral, from the user's standpoint, to
 make this diameter greater than about
 2". An equivalent piston of this
 diameter radiates the greater propor-
 tion of sound in a narrow cone about
 the axis, above 2,000 cycles. However,
 the directivity becomes relatively broad
 as the frequency is reduced below 2,000
 cycles, so that considerable sound is
 radiated between 90° and 270° from
 the forward axis at low frequencies.
 At 500 cycles, for instance, the equiv-
 alent piston produces a pressure at 90°
 only about 2 to 3 db down from axial
 pressure, while at 2,000 cycles it is ap-
 proximately 22 to 23 db down. The
 relative pressure at 180° depends upon
 the configuration of the diffraction pat-
 terns existing around any given device,
 but even making the simple assumption
 that the same difference in loss exists
 at 180° as at 90°, it can be seen that in
 a system having an overall uniform re-
 sponse, the loss against acoustic feed-
 back is of the order of 20 db less at
 500 cycles than at 2,000 cycles. This
 difference can be reduced considerably
 by using an *emphasized* system equalized
 to give a rising response of between
 3 db and 10 db per octave.

Acoustic Feedback Loss Limits

To illustrate how the acoustic feed-
 back loss limits the sound pressure
 amplification of a megaphone, let us
 take a simplified example. Assume a
 megaphone 1' long connected to a suit-
 able amplifier so that with 28 bars
 output at the microphone, 100 bars can
 be produced by the horn at 4' on its
 axis, Figure 9 (page 78).

Examples

Assuming output power versus dis-
 tance follows the inverse square law,
 for purposes of illustration, the sound
 pressure at 1' from the horn would be
 400 bars. If the directivity loss at 180°
 in a radius of 1' from the center of the
 horn mouth is 22 db down from the
 axial pressure, i.e. 400 bars, at this
 radius the pressure at the microphone
 diaphragm P_M due to the horn pressure
 P_H is found as follows:

$$20 \log_{10} \left(\frac{P_H}{P_M} \right) = 22$$

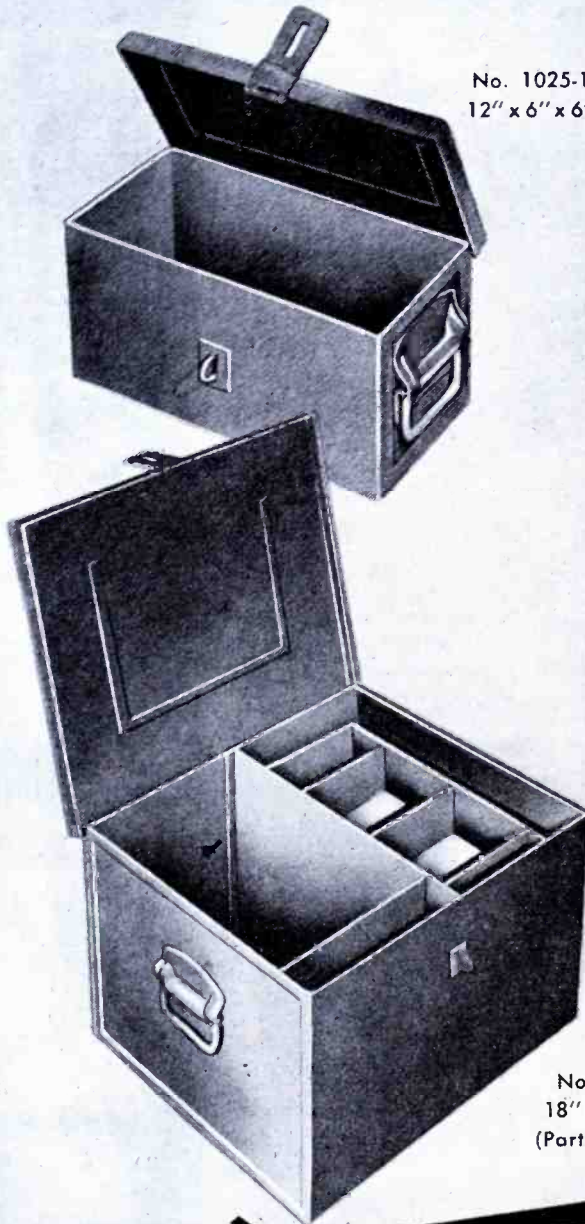
$$\left(\frac{P_H}{P_M} \right) = \log^{-1} \left(\frac{22}{20} \right) = 12.6$$

$$P_M = \frac{400}{12.6} = 31.7 \text{ bars}$$

As this pressure is higher than that
 being fed into the microphone, the sys-
 (Continued on page 78)

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1025-8	18	6	6
1025-9	18	15	9
1025-10	18	12	6
1025-11	18	15	12
1025-12	18	12	12
1025-13	18	18	12
1025-15	24	15	12
1025-16	24	15	15
1025-17	24	18	12
1025-18	24	18	15
1025-19	24	18	18
1025-20	24	12	9
1025-23	30	15	9
1025-14	30	15	12
1025-22	36	12	9
1025-21	42	9	9
1025-24	42	12	9

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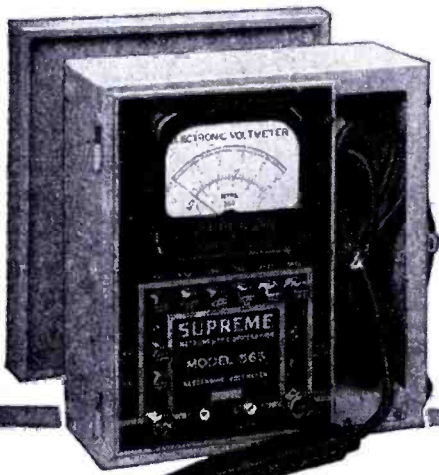
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ELECTRIC MEGAPHONE

(Continued from page 77)

tem will feed back. Either the amplifier gain must be decreased to reduce the output pressure, or the feedback loss must be increased to a value greater than

$$20 \log_{10} \left(\frac{400}{28} \right) = 23 + \text{db}$$

to assure stable operation.

Decreasing Back Radiation

Designing the loudspeaker horn to decrease the back radiation will increase the feedback loss. In general, this means sharpening the directivity pattern to radiate more sound, proportionately, in the forward direction particularly at the lower frequencies. With dimensions limited, one possible method is to take advantage of the increased directivity of a ring-shaped radiating mouth. By increasing the outside diameter of the horn mouth somewhat, a *blob* can be designed to fill part of the center area, without reducing the total area of the horn mouth for,

$$D_A = \sqrt{D_B^2 + D_M^2}$$

where D_M = original diameter of circular mouth

D_B = diameter of center blob

D_A = diameter of bell to maintain original mouth area

and if D_B is small compared to D_M , the increase in D_A is small. It is preferable, however, to strike a compromise, either by increasing D_A , or allow-

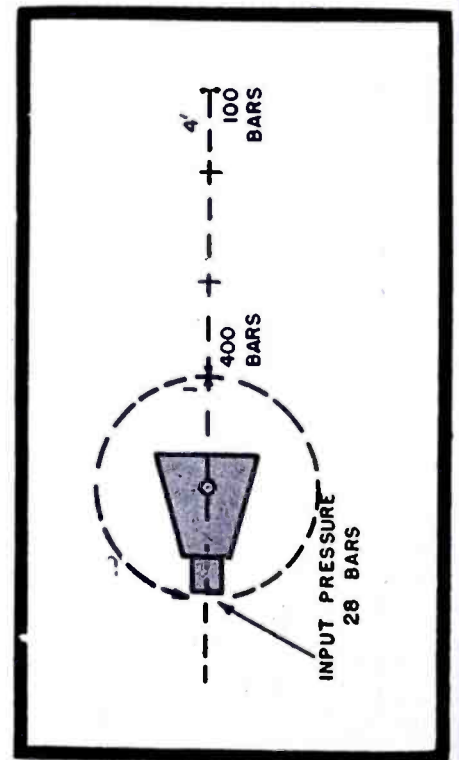


Figure 9

Illustrating how the acoustic feedback loss limits the sound pressure amplification of a megaphone.

some decrease in the area of the mouth, so as to increase the directivity. The effectiveness of the ring radiator in this respect is most marked when

$$\frac{D_A - D_B}{2} \ll \frac{D_A + D_B}{2}$$

the ring is thin compared to its diameter. Massa⁹ and others have shown the comparative increase in directivity of ring radiators over circular pistons. Taking the diameter of the horn mouth as the diameter of the equivalent piston, when $D_M = \frac{\lambda}{2}$, the

increase in directivity of a thin ring over a circular piston is shown to be about 4 db at 90° off the central radiating axis.

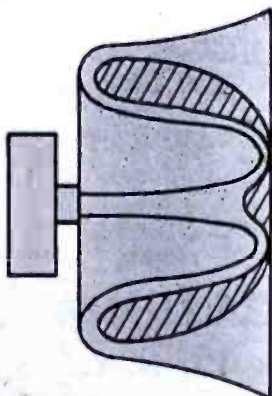
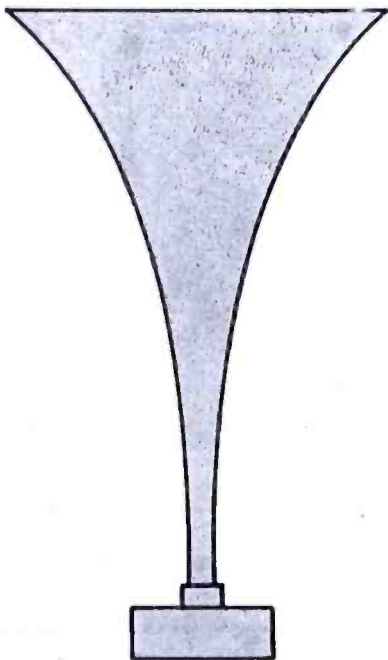
At higher frequencies where λ is less than $2 D_M$, the increase in directivity of the ring over the piston is greater, except where secondary or

(Continued on page 80)

⁹Frank Massa, *Acoustic Design Charts*, The Lakiston Co.

Figure 10

straight exponential trumpet (above) and folded reflex horn (below) with large center blob formed by the first two sections of horn column, used to study directivity patterns.



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PLUG PL-204

Hand set. A special plug wherein both a modified plug, PL-55 and PL-68, are held in place by a phenolic case. Same specifications as PL-55 and PL-68.

PLUG PL-54, PL-540, PL-354, N.A.F. 215285-2

Short sleeve, two-conductor plug, mate to Jack JK-26. Same specifications as PL-55.



PLUG, STYLE "D"

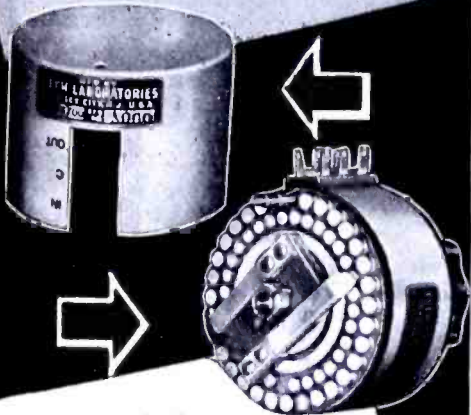
Two-conductor, special type plug for use with Neoprene or Buna S molded cords. Same specifications as PL-55.

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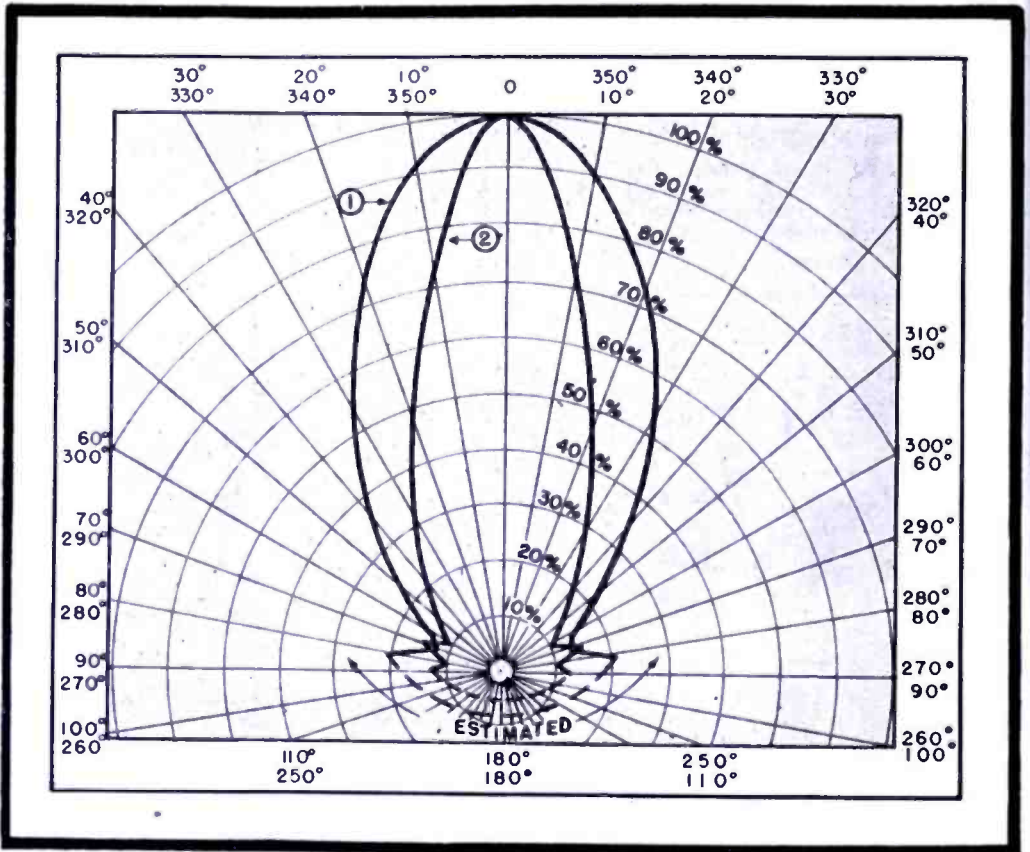
(Continued from page 79)

diffraction loops develop in the pattern. To a first approximation, however, it is evident several db can be added to the feedback loss using a thin ring-shaped horn mouth, and this has been borne out in horns designed by the writer. Directivity curves taken on two horns (p a horns, not megaphones) illustrate the effect of changing the horn mouth somewhat along the above lines. Each bell was about 2' in diameter, one horn being a straight exponential trumpet, the other a folded or reflex horn with a large center blob formed by the first two sec-

tions of the horn column, Figures 10 a and b. Both were taken at the same frequency (approximately 1,000 cycles) curve 1 (Figure 11) being that of the straight trumpet, curve 2 that of the folded horn. The increased directivity of the latter is quite noticeable even though its radiating mouth only roughly approximates a thin ring shape. Note that these curves are plotted in per cent of maximum sound pressure at 0° (i.e., on the geometric axis at a fixed distance; the other points are obtained by rotating the horn on a vertical axis through the plane of the mouth, the pick-up microphone remaining fixed). Actually, with the same driver power, the acoustic output pressure of the reflex horn was about 50% greater than that of the trumpet, on the zero axis.

Figure 11

Directivity curves of straight trumpet (curve 1) and folded horn (curve 2). Curves were taken at 1000 cycles.



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52 Vanderbilt Ave., New York 17, N. Y.

REMOTE GAIN CONTROL

(Continued from page 49)

Desirable to run the risk of failure or crosstalk from carrying all lines back through the control point. Stepping relay systems, other than being complicated and expensive, require frequent service and are susceptible to trouble. Two *direct-control* methods have been found to solve the foregoing problems. These are the feedback-type control and variable-pad control.

Feedback Type Control

If the output amplifier is of the voltage feedback type, Figure 1, it is very convenient to use a feedback control. This circuit has been used successfully through 40' of cable without frequency distortion or otherwise noted discrepancies. It could probably be used over greater distances with special design considerations.

Adequate DB Range

In the average broadcast application, 1 db is considered adequate after the amplifier has been set properly at the rack. In setting up the circuit, the general feedback expression

$$A_{FB} = \frac{A}{1 - A \left(\frac{R_F}{R_F + R_B} \right)}$$

is applied to the amplifier at normal gain and at 1 db above and below normal gain, to solve for three values of R_F .

Normal Gain With Feedback

For example, if the normal gain with feedback is to be 30 db, values of R_F for gains of 29, 30, and 31 db will be required. R_F can either be made variable or as a safety measure split into two resistances, R_A and R_C , making one of these variable.¹ In making up the parallel circuit, it can be seen that it is preferable to keep the variable portion of R_C small with respect to the lines' capacitive reactance. Otherwise, the capacity in the line would tend to shunt out high-frequency components of the feedback, giving the amplifier a rising characteristic. The line should be a low-capacity crystal-microphone cable or flexible concentric transmission line. After correct proportioning of R_A and R_C , R_A becomes

(Continued on page 82)

¹Taylor, *Combining Components*, COMMUNICATIONS, March 1945.



*Higher
and Higher*

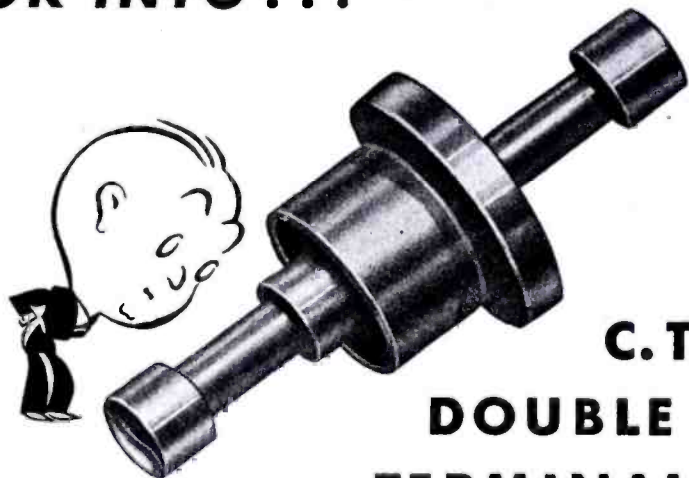
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brass — heavily silver plated, and stocked to fit 3/32" terminal boards. Quantity orders filled to your specifications.



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CAMBRIDGE THERMIONIC CORPORATION

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REMOTE GAIN CONTROL

(Continued from page 81)

the permanent replacement for R_1 while R_C is solved to give the several values of R_C found above. R_2 is made equal to the total range of variation of R_C ; $R_{C_{max}} - R_{C_{min}}$. R_1 is made equal to $R_{C_{min}}$.

Cutout Switch

A cutout switch is provided at the equipment rack to return the circuit to normal operating values while making the pre-set adjustment. For this purpose, R_3 is selected as the normal gain value of R_C minus R_1 (mid-range), which should correspond roughly to the midscale setting of R_2 . While R_1 is not strictly linear in operation, because of parallel circuit control, this can be offset by use of a tapered control.

Long Line Lengths

In extreme cases where an appreciable length of line must be used, it may be necessary to redesign the feedback circuit. New values of R_F and R_B of reduced magnitude must be obtained, in order to reduce the effect of the line capacity upon the feedback control.

Total Gain Control

In the operation of the control, the feedback of the amplifier is varied 1 db (or desired range) above or below normal feedback, being additive or subtractive in relation to the total gain.

Avoiding Hum and Noise

Special care should be taken in the routing of the cable to avoid introduction of hum or noise into the feedback circuit. If possible, the shielded ground return should be insulated and grounded only at the normal feedback ground point. In the selection of variable control resistance R_2 , an average volume control could be used since a very small portion of the cathode current flows through it. As an alternative measure, a 10- or 11-point shorting type tap switch could be utilized with proper resistances.

Variable Pad Control

Another circuit well adapted to this application is one employing a variable attenuator of the H design. A circuit arrangement of this type may be used in cases where the amplifier is not readily adaptable to the feedback control. While this circuit can be used with greater lengths of cable, it does

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have the disadvantage of introducing a loss into the channel. However, the loss is not appreciably greater than the recommended minimum isolation pad loss.

Pad Design Circuit

Referring to Figure 2, it is seen that a conventional design pad is used. To assure a fairly linear resistance/loss characteristic over a ± 1 db range, it is considered advisable to make the pad insertion loss at least 10 db, the range of control being from 9 db to 11 db.

500-Ohm Terminals

Assuming the use of 500-ohm terminal facilities, the series elements are found to be 130 ohms and the shunt element solves as 351 ohms (10 db loss). The shunt element is also solved for 9 db and 11 db since it is the coupling mesh, giving resistances of 406 and 306 ohms, respectively. Thus, it is noted that there is a 100-ohm variation in shunt element R_2 . Accordingly, a variable resistance of 100 ohms is chosen for this section of the shunt element, normal operating resistance (mid-scale) to be 50 ohms. R_1 would be selected as 351 minus 50 or 301 ohms. For proper capacitive balance, R_1 should be split into two series resistances.

Adjustment Control

A cutout switch is provided at the track to return the circuit to normal for adjustment purposes. R_3 is selected as the mid-scale value of R_2 , or 50 ohms.

Load Variation

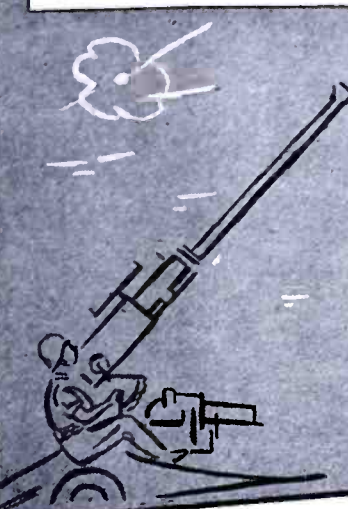
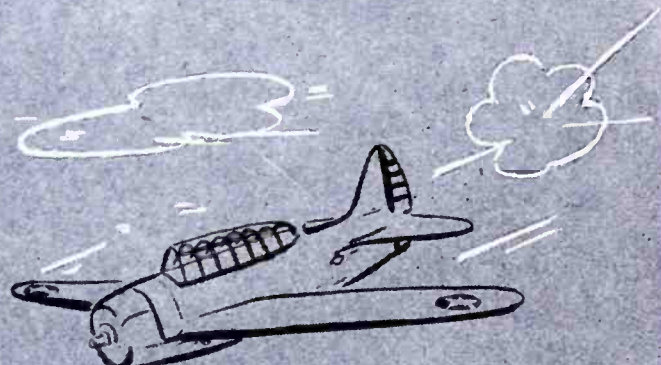
While it can be seen that making this shunt element variable would cause a variation of the amplifier load, the load circuit can be solved in each case. It will be found that the load variation is less than $\pm 5\%$ with the values given above, which is within practical limits.

Program Bridge

In less critical applications, such as in a program bridge for a monitoring amplifier, the range of control can be broadened considerably. The input series sections would be of somewhat higher resistance, as in normal bridging procedure. R_1 would be eliminated entirely, while R_2 and the output series sections would be designed for some normal operating level. The high-resistance input sections would isolate

(Continued on page 84)

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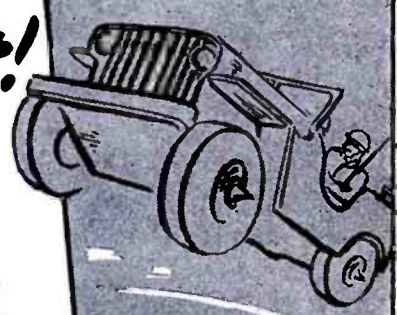

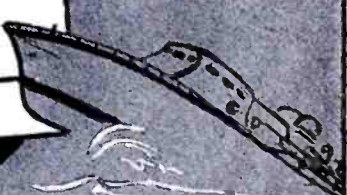
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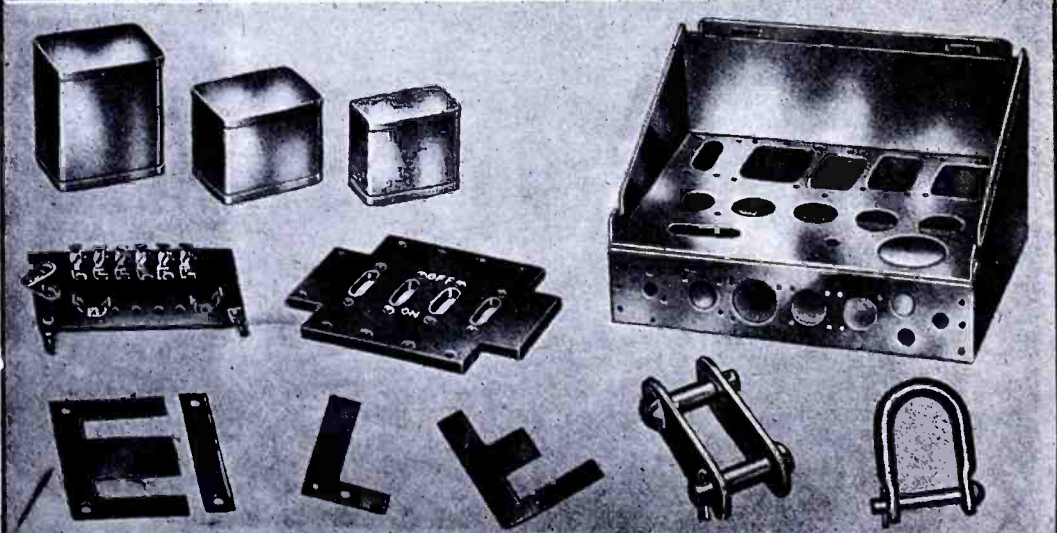
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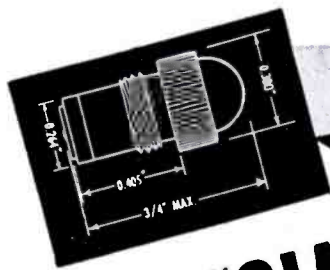
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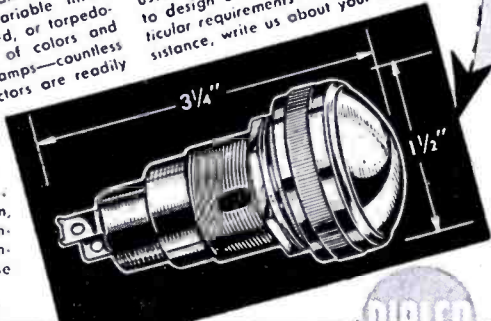
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REMOTE GAIN CONTROL

(Continued from page 83)

any noticeable load variation from the bridge tap.

FCC Compliance Solution

The choice of the circuit will depend upon the specific application. With ordinary care in design and installation, either should give thoroughly reliable service. The fact that many stations were not utilizing their full dynamic range was emphasized by FCC several years ago in their rulings regarding modulation peaks. This paper is the result of a convenient solution of the problem of compliance.

TELEVISION MOTION PICTURE



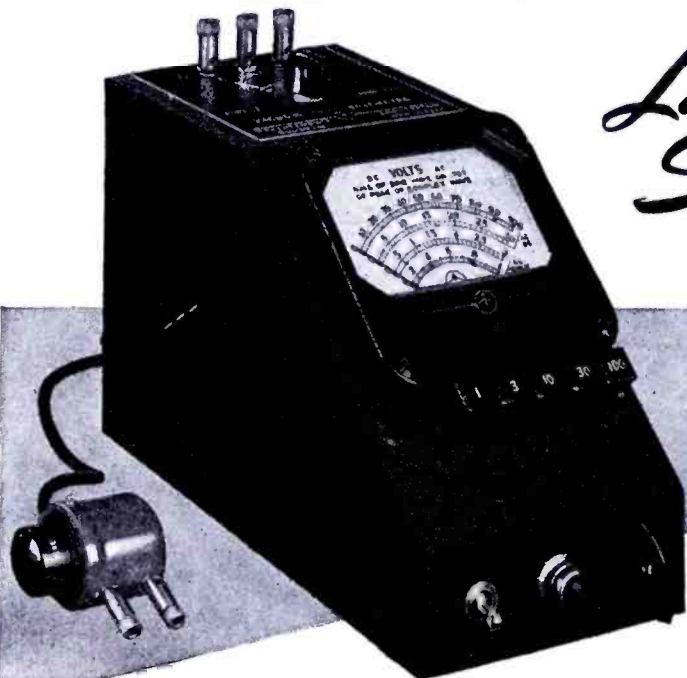
Scene from an 8-minute sound motion picture, *Tell It With Television*, recently produced by Jam Handy, Detroit, for American Central Manufacturing Company, Indiana. Film showed studio and station facility interiors of DuMont station in New York City.

MIDGET WIRE RECORDER



Pocket-type wire recorder developed for the Milwaukee Journal editorial staff. Smaller models being developed for portable use will employ hearing-aid tubes and will provide recording and play-back facilities.

Laboratory Standards



MODEL 62

VACUUM TUBE VOLTMETER

SPECIFICATIONS:

- RANGE:** Push button selection of five ranges—1, 3, 10, 30 and 100 volts a. c. or d. c.
- ACCURACY:** 2% of full scale. Useable from 50 cycles to 150 megacycles.
- INDICATION:** Linear for d. c. and calibrated to indicate r.m.s. values of a sine-wave or 71% of the peak value of a complex wave on a. c.
- POWER SUPPLY:** 115 volts, 40-60 cycles—no batteries.
- DIMENSIONS:** 4 3/4" wide, 6" high, and 8 1/2" deep. **WEIGHT:** Approximately 6 lbs.
- PRICE:** \$135.00 f.o.b. Boonton, N. J. Immediate Delivery

MEASUREMENTS CORPORATION
BOONTON, NEW JERSEY

(Continued from page 38)

plate current is noted. The tap is then permanently attached to the turn of the coil giving maximum plate current.

At the high-frequency end of the transmitter's range (ordinarily frequencies higher than 4 mc), the antenna reactance may be essentially zero or positive (inductive), when the loading coil should be shorted out.

Speech Amplifier and Modulator

The gain of the speech amplifier is fixed to provide full modulation under normal close talking by the operator into a W. E. single-button carbon microphone.

Another item of interest is the inclusion of a complete metering system as an integral part of the transmitter. The metering system consists of a single 0-1 ma meter together with a suitable switch and multiplier resistors to read voltages across fixed resistors in various circuit branches. In this system of metering there are no closed circuit metering jacks upon whose proper functioning the transmitter is dependent.

Relays in Transmitter

A total of only four relays is used in the transmitter. Two relays control the autotune motor, one relay applies filament power to modulator and analog amplifier tubes and the fourth relay switches the antenna from receiver to transmitter. Wiring of these relays is such as to provide complete interlock of autotuning and operating sequences.

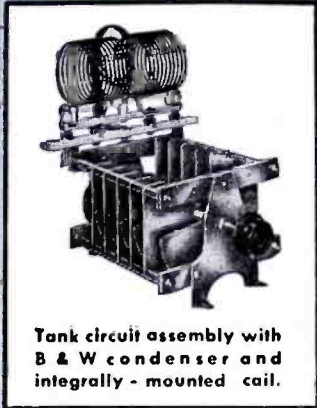
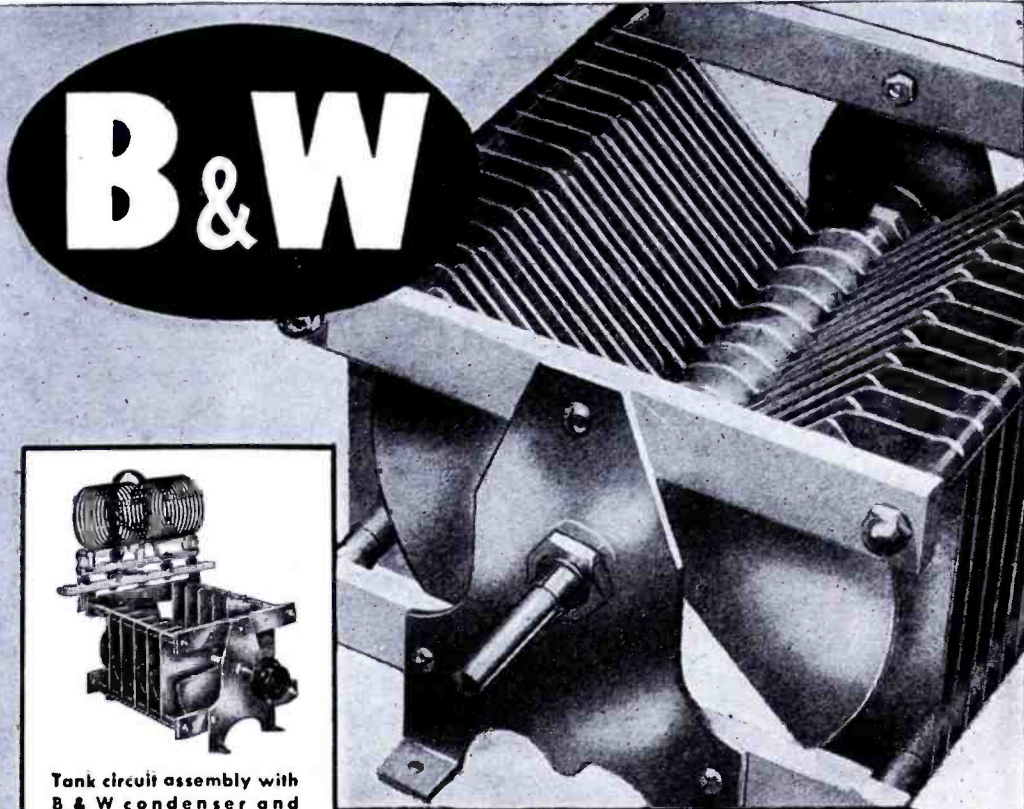
Standard type relays perform the antenna changeover function, bring the modulator and amplifier filaments up to full voltage and apply plate power by means of an external solenoid, when the microphone button is pressed by the operator. A connection is provided through the autotune circuit to the control leads so that the circuit of the dynamotor-starting solenoid circuit is broken during the frequency change cycle. Thus frequency changes are never accomplished with plate power applied to the transmitter.

Antenna

When the transmitter is mounted in the rear of the fuselage, the ships use a simple type of antenna consisting of a fixed 35-foot trailing wire extending from the tail of the ship and connected to the transmitter directly by means of an insulated lead-in wire.

Credits

The author is grateful to Stan Ervin of American Airlines for his kind assistance in the compilation of this paper.



Tank circuit assembly with B & W condenser and integrally-mounted coil.

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W M C Rules Observed

DECIBEL CALIBRATION

(Continued from page 58)

chart and the *decibels* scale is at the left of the chart. At 600 ohms the decibel correction is found to be -10 db, or in other words 10 db must be subtracted from any reading taken from the meter.

Problem 2

Problem 2: A db meter is calibrated for a zero level of six milliwatts in 500 ohms. It is connected across a 100-ohm resistor. What correction must be applied to any reading taken from the meter.

Solution: Refer to curve 4. The *ohms* scale is at the bottom of the chart and the *decibels* scale is at the left of the chart. At 100 ohms the decibel correction is found to be $+7$ db, or in other words 7 db must be added to any reading taken from the meter.

Problem 3

Problem 3. Eighty volts is measured across a 2000-ohm resistor. How many db is this over a level of one milliwatt in 600 ohms?

Solution: First, refer to curve 1. The *volts* scale is at the top of the chart and the *decibels* scale is at the left of the chart. At eighty volts the decibels is $+40$.

Next refer to curve 3. At 2000 ohms the correction is found to be -5 db. Then we add algebraically $+40$ to -5 and we get $+35$ db for the answer.

Problem 4

Problem 4: A voltage of 0.1 is measured across a 50-ohm resistor. How many db is this over a level of six milliwatts in 500 ohms?

Solution: First, refer to curve 2. At 0.1 volt the decibels is -25 .

Next, refer to curve 4. At 50 ohms the correction is found to be $+10$ db. Again we add algebraically, -25 to $+10$, and we get -15 db for the answer.

Conclusions

It is seen from the preceding discussion that the chart can be used to change *volts* (across any resistance) to db (above either zero reference level). The chart can be used to obtain these data much more rapidly and with greater ease than by obtaining it by mathematical calculations.

NEWS BRIEFS

RAYTHEON RECEIVES N. Y.-BOSTON H-F STATION PERMITS

Raytheon Manufacturing Company has received FCC authorization to construct five 100-watt experimental radio-relay stations (operating between 1,900 and 26,500 mc) to be installed at New York City, Lexington, Mass., Bristol and Middletown, Conn., and Webster, Mass. This New York-to-Boston circuit is the first leg of Raytheon's proposed nation-wide communications system, which will follow the airline routes from New York to Cleveland, Detroit and Chicago to the Pacific Coast.

Raytheon has also received FCC permission to erect two developmental f-m stations in New York City on top of the 700 Lincoln Building, using frequencies of 105 and 107 mc. The call letters of these stations are W2XRA and W2XRY. Transmissions from these stations will be co-ordinated with the FCC f-m summer tests.

One of the f-m stations will direct its transmission southward on 105 mc, for observation by the Commission's field stations extending from Philadelphia to Atlanta. The second transmitter will be directed on 107 mc toward Chicago, for observation by western points.

WATCH NOW WASHINGTON RCA FREQUENCY BUREAU MANAGER

James P. Veatch, formerly with the FCC in charge of the Treaty Section of the International Division, has been appointed manager of the Washington office of the RCA Frequency Bureau, 1625 K Street, N. W., Washington, D. C.

Mr. Veatch will handle matters pertaining to frequency allocations and station licenses for RCA, its subsidiaries and services.

HALLICRAFTERS APPOINTS SHERWOOD S-M

J. J. Sherwood has been named sales manager of the Hallicrafters Company, Chicago. Mr. Sherwood was formerly assistant to the president of General Dry Battery, Inc., Cleveland.



TEEGARDEN TO HEAD RCA CENTRALIZED TUBE DIVISION

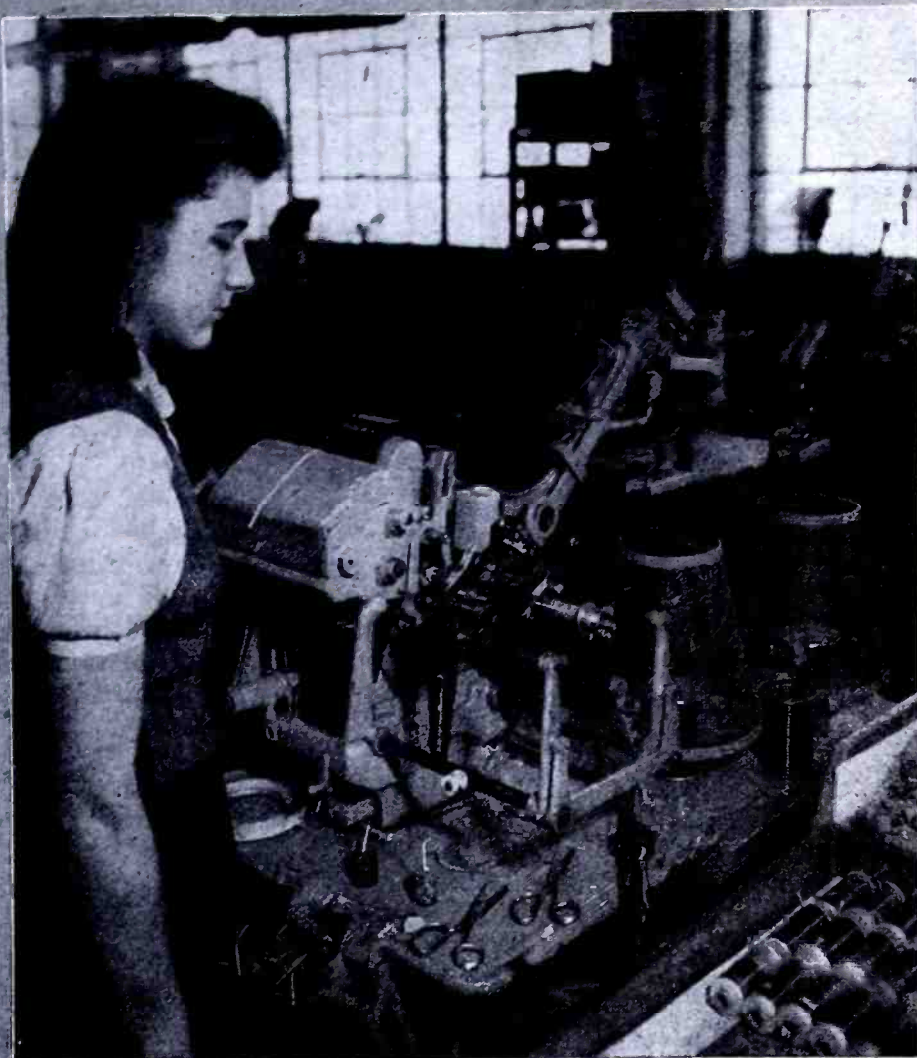
A new tube division providing for centralization of tube equipment engineering, manufacturing, and sales activities, with L. W. Teegarden as general manager, has been announced by RCA.

Plans call for the transfer of the division's
(Continued on page 88)

MECK HANDIE-TALKIE



Civilian type 460-470 mc handie-talkie developed by John Meck, Industries, Chicago.



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This machine produces a coil of the familiar "cotton inter-weave" type where appearance or special applications require such construction. Glass or silk yarns are also used as a binder and insulator instead of cotton when their special qualities require it.

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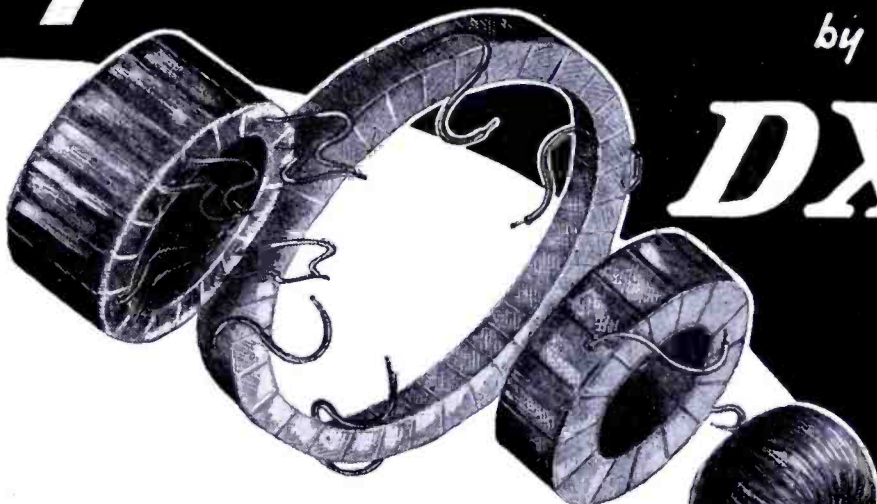
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NEWS BRIEFS

(Continued from page 87)

headquarters from Camden to Harrison, N. J., in the future.

Dr. G. R. Shaw has been appointed chief engineer of the new unit.

**COSGROVE REELECTED
RMA PRESIDENT**

R. C. Cosgrove, of Crosley, was reelected president of RMA for another year. Two new vice presidents, M. F. Balcon of Sylvania and George Lewis of I. T. & T. were elected by the RMA board to succeed David T. Schultz of Newton, Mass., and Walter Evans of Baltimore, Md., respectively. All other RMA officers were reelected.

Eleven RMA directors were reelected by proxy ballot cast by the respective division chairmen, and one new director, H. J. Hoffman, Machlett Laboratories, Norwalk, Conn., was elected for a two-year term to succeed W. P. Hilliard of Baltimore, whose term expired.

E. A. Nicholas, Farnsworth Television & Radio Corporation, Fort Wayne, Ind., was reelected chairman of the set division; M. F. Balcom, Sylvania Electric Products Inc., Emporium, Pa., was elected chairman of the tube division, to succeed D. T. Schultz, Raytheon Manufacturing Company, Newton, Mass.; C. J. Burnside, Westinghouse Electric Corporation, Baltimore, was reelected chairman of the transmitter division; R. C. Sprague, Sprague Electric Company, North Adams, Mass., was reelected chairman of the parts division; Lee McCann, Stromberg-Carlson Company, Rochester, N. Y., was elected chairman of the amplifier and sound equipment division, succeeding T. A. White, Jensen Radio Manufacturing Company, Chicago, whose term expired. Mr. White was elected chairman of the division's executive committee.

Ten new members have been elected to the RMA.

These are: Argus, Inc., Ann Arbor, Michigan; The Astatic Corporation, Conneaut, Ohio; Call-A-Phone Mfg. Company, Chicago, Illinois; Gates Radio Company, Quincy, Illinois; Littelfuse Incorporated, Chicago, Illinois; Madison Electrical Products Corp., Madison, N. J.; Standard Coil Products Co., Chicago, Illinois; Teletone Radio Company, New York, New York; Thomas & Skinner Steel Products, Indianapolis, Ind.; and Thordarson Electric Mfg. Co., Chicago, Illinois.

**WCEMA HOLD LOS ANGELES
MEETING**

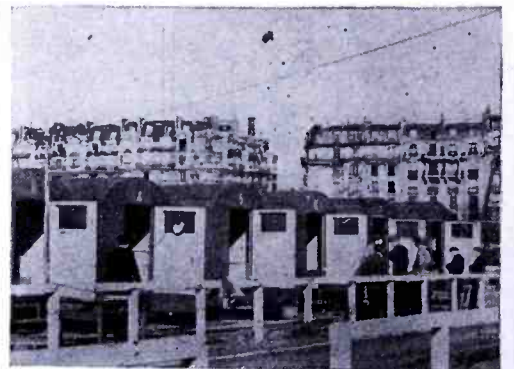
The Los Angeles council of the West Coast Electronic Manufacturers Association held a meeting recently to discuss WPB control during reconversion; wage and labor problems during the reconversion period; application of OPA regulations to existing war contracts; withholding California income tax on wages of non-resident employees and the future policy of the council.

In attendance were Howard Thomas (Packard, Bell Co.), chairman of the council; Lew Howard (Peerless Electrical Products), vice chairman of the council and James L. Fouch (Universal Microphone Co.) treasurer of the council and of the association.

**KOHLHAAS BECOMES
ASST V.-P. AT I. T. & T.**

Herman T. Kohlhaas, editor of *Electrical Communication*, technical journal of the Interna-

**60-KW MOBILE SIGNAL CORPS
STATION**



Trailers housing 60-kw transmitter and receivers used by the Signal Corps for Europe-to-America contact and transmission to our troops in Europe. Equipment, contained in 17 mobile units, was built by Le Materiel Telephonique, French associate of I. T. & T.

national Telephone and Telegraph Corporation, has been appointed assistant vice president.



WIRE RECORDER DEVELOPMENT CORP. MOVES

The Wire Recorder Development Corporation, which handles all licensing activities for the Armour magnetic wire sound recorder, has moved to the Field Building, 135 South LaSalle Street, Chicago, Ill.

CARL F. HANSON DEAD

Carl F. Hanson, chief consulting engineer of Irvington Varnish & Insulator Co., died recently.

WESTINGHOUSE BUYS KEN-RAD LAMP ASSETS

The Westinghouse Electric Corporation has purchased the lamp business of the Ken-Rad Tube and Lamp Corporation, Owensboro, Ky. Westinghouse will continue the Ken-Rad brand. The new unit will be known as the Ken-Rad lamp division of the Westinghouse Electric Corporation.

TAYLOR TUBE SPECIAL TUBE DEP'T

A special service tube department to follow through on unusual design specifications has been initiated by Taylor Tubes, Inc., 2312 Wabansia Avenue, Chicago.

AVIATION CORP. BUYS CROSLLEY

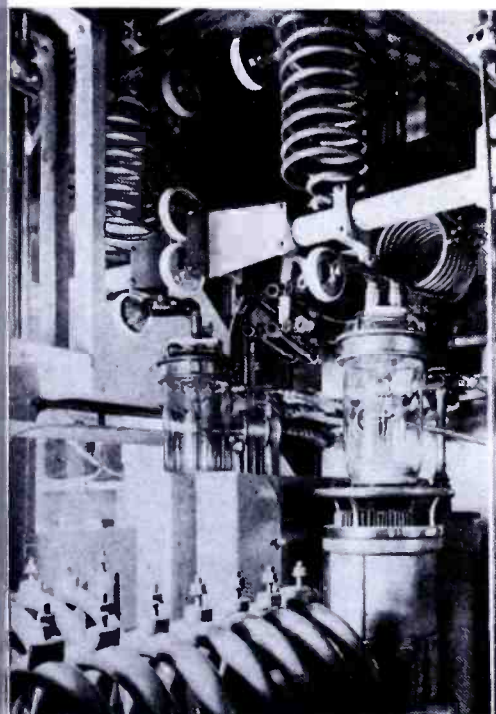
Powel Crosley, Jr. and members of his family have sold their controlling interest in The Crosley Corporation to The Aviation Corporation.

Mr. Crosley will now manufacture Crosley automobiles.

The sale affects only a transfer in ownership of the corporation.

R. C. Cosgrove will retain his position as vice-president and general manager and also
(Continued on page 90)

POWER AMPLIFIER OF 60-KW STATION



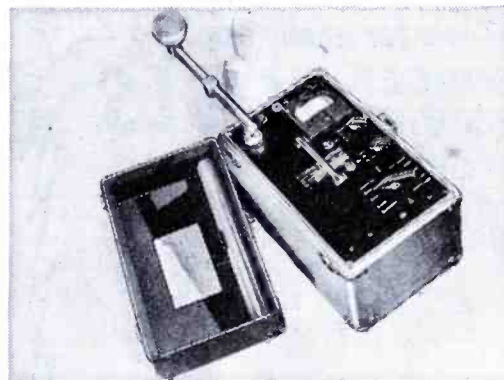
Intermediate power amplifier of I. T. & T. 60-kw Signal Corps station, known as Sig-Circus. Two v-h-f transmitters, receivers, facsimile transmitters, wire-film-disc recorders, and other allied equipment are also housed in trailers.

PORTABLE POWER PROBLEMS

THIS MONTH—THE SOUND-LEVEL METER



BURGESS INDUSTRIAL BATTERIES meet every power requirement for the conveniently portable sound-level meter. Used for qualitative measurement of sound, the meter consists essentially of a sound pickup, a special electronic amplifier and an indicating instrument. Burgess Industrial Batteries give dependable, long service life in hundreds of electronic industrial applications—they meet every requirement for test and control instruments.



ENGINEERS CHOOSE BURGESS Industrial Batteries for the operation of portable instruments—recent surveys of dry battery preferences reveal that Burgess is the first choice of electronic experts! Burgess engineers will develop batteries for any special problem you may have, although most needs can be readily served from the standard line available through your Burgess distributor. *Burgess Battery Company, Freeport, Illinois.*

CAREFUL BUYING KEEPS PRICES DOWN!



BURGESS BATTERIES

VOTED FIRST BY ENGINEERS
IN NATION-WIDE INDUSTRIAL BATTERY SURVEY

—Recognized as the MOST COMPLETE LINE of dry batteries

AMPERITE

THERMOSTATIC METAL TYPE DELAY RELAYS PROVIDE DELAYS RANGING FROM 1 TO 120 SECONDS

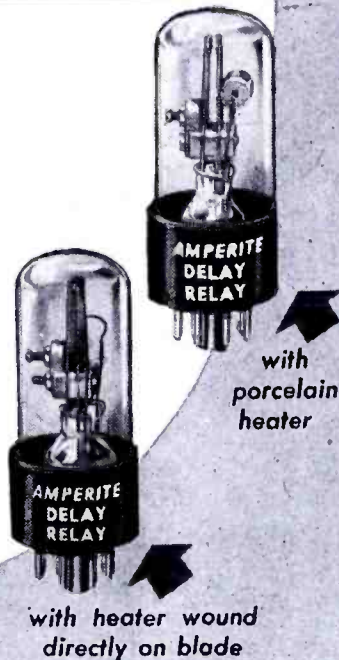
Other important features include:—

1. Compensated for ambient temperature changes from -40° to 110° F.
2. Contact ratings up to 115V-10a AC.
3. Hermetically sealed — not affected by altitude, moisture or other climate changes . . . Explosion-proof.
4. Octal radio base for easy replacement.
5. Compact, light, rugged, inexpensive.
6. Circuits available: SPST Normally Open; SPST Normally Closed.

WHAT'S YOUR PROBLEM? Send for "Special Problem Sheet" and Descriptive Bulletin.

AMPERITE CO. 561 BROADWAY
NEW YORK 12, N. Y.

In Canada: Atlas Radio Corp., Ltd.
560 King St. W., Toronto



NEWS BRIEFS

(Continued from page 89)

will continue as a member of the board of directors. J. H. Rasmussen, remains as general sales manager of the Crosley manufacturing division.

A. T. & T. TELEPHONE SERVICE TO AUTOS AND TRUCKS

Plans for a general 2-way (152-162 mc) mobile radiotelephone service for all drivers of all types of motor vehicles have been announced by A.T.&T.

Applications have been filed with the FCC for authority to install 250-watt radiotelephone stations in Baltimore, Chicago, Cincinnati, Columbus, Denver, Houston, Milwaukee, New York, Philadelphia, Pittsburgh, St. Louis, Salt Lake City and Washington, D. C.

In addition, surveys are being made to determine the need for and the feasibility of mobile radiotelephone service in many other cities.

According to the plan the general telephone system will be linked to mobile units using 15-watt transmitters so that a subscriber to the service would be able to talk from an equipped vehicle to any telephone served directly by or connected with the Bell companies.

In large metropolitan centers it is probable that a number of fixed receiving stations will be employed, located throughout the area so that the relatively low-powered units will be within range at all times. Three classes of mobile service have been proposed:

(1) A general two-way telephone service between any regular telephone and any mobile unit, with a three-minute initial period and the usual one-minute overtime period.

(2) A special two-way dispatch service between a particular telephone at the dispatching office and specified mobile units. A direct line from the dispatcher to the telephone central office would be furnished as part of this service. A one-minute initial period and the usual one-minute overtime period would probably apply here.

(3) A one-way signaling service to mobile units, to notify the operator of the unit that he should comply with some prearranged instruction, such as calling his office from the nearest public telephone.

C. F. MILLER JOINS PRICE BROTHERS

Dr. C. Frank Miller, formerly of the electrical engineering staff of Johns Hopkins University has been appointed chief engineer of Price Brothers Company, Frederick, Maryland.



CANADIANS' 1944 RADIO PRODUCTION REACHED \$200,000,000

In 1944 the Canadian radio industry produced

PROJECTION TELEVISION RECEIVER



G.E. 16" x 22"-screen television receiver, using Schmidt optical system, recently demonstrated in New York City.

UTC JUST ARRIVED—The Little Tools for Really Big Jobs UTC

UNIVERSAL MIDGET SERVICE TOOLS

USE UNIVERSAL MIDGETS WHERE OTHER TOOLS WON'T GO

SET A

NEW UNIVERSAL OPEN END WRENCHES
4 Wrenches — 8 sizes in pocket roll \$3.95

DEAL 1

NEW UNIVERSAL Miniature Mite 1/4" Square Drive 11 pc. Socket Set—7/32" to 7/16" MITEY-HANDY \$7.95

SET B

NEW UNIVERSAL 6 pc. Midget Punch and Chisel Set in pocket roll ONLY \$4.95

DEAL 2

NEW UNIVERSAL Midget 1/4" Square Drive Socket Set—12 pc. 3/16" to 1/2" New Socket Starter A-HONEY \$12.95

SET C

NEW UNIVERSAL 5 pc. Set—3 Midget Pliers, Screwdriver and Screw-holder \$6.95

DEAL 3

NEW UNIVERSAL 3/8" Cub Square Drive—12 pc. Socket Set—3/8" to 3/4" ONLY A-DANDY \$19.95

5 Sets A, B and C Plus Deals 2 and 3, Complete 39 Pc. Set, with all steel case ONLY \$48.75

ORDER TODAY! EASY AS ABC—123

Send names of 3 friends needing tools now and you will receive a useful gift.



From the Heart of America—

Overnight by Air to Anywhere in U. S. A.

UNIVERSAL TOOL CO. O. B. Dematteis President

1527 Grand C Kansas City 8, Mo.

Canada and its allies \$200,000,000 worth of radio equipment. The annual prewar production rate was approximately \$15,000,000.

**PRAGUE PULSE SERVICE
CAPACITOR NOMOGRAPH**

pulse service capacitor nomograph, No. 11, has been prepared by the engineering department of the Sprague Electric Company, North Adams. Although the nomograph is primarily designed for determining the volt-amperes through a capacitor used in rectangular pulse service, it first, as an intermediate step, finds the d-c (unit pulse) energy content which, in some cases, may be sufficient.

**DEVILLE MILLER NOW WITH
ARMY-NAVY LIQUIDATION OFFICE**

Deville Miller, former president of the National Association of Broadcasters, has joined the staff of the office of the Army-Navy Liquidation Commissioner.

He will serve as special assistant to the Commissioner for surplus disposal activities of the armed forces in the Mediterranean Theater of Operation, the African-Middle East Theater, the Persian Gulf Command and the India-Pakistan Theater.

G. ERSKINE DEAD

G. Erskine, chairman of the board of directors and former president of Sylvania Electric Products, Inc., died suddenly recently.



AEROVOX NAMES

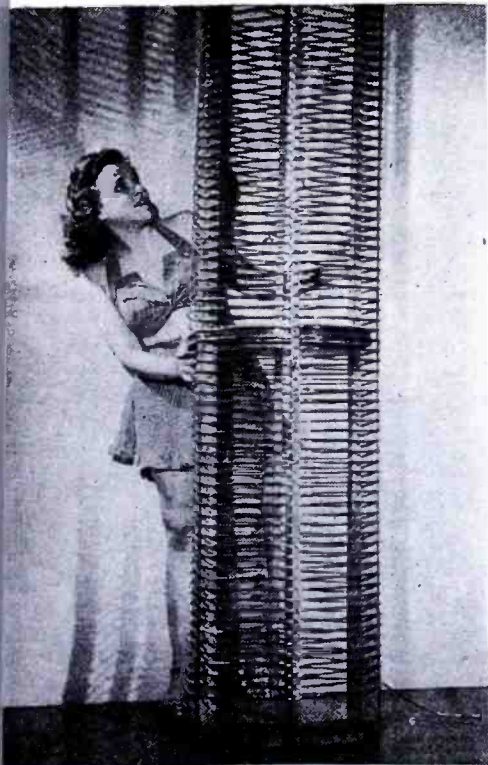
FRANK L. MARSHALL ASS'T S-M

Frank L. Marshall, former assistant sales manager of Bundy Tubing Company, Detroit, has become assistant sales manager at Aerovox Corporation, New Bedford, Mass. He will handle sales to equipment manufacturers.

CA SOUND SYSTEM BROCHURE

Describes sound systems in industry, institutions. (Continued on page 92)

**PHASE-MONITORING COAXIAL
INDUCTANCE**



Coaxial inductance designed and built by Andrew Co. for WRDW, Augusta, Georgia. Chief Engineer Harvey Aderhold uses coil to transmit samples of r-f energy for phase monitoring from a phase sampling loop on one of the vertical tower radiators to a phase monitor in transmitter room.

NOW IT CAN BE TOLD!



**Comco builds
the smallest combat
WALKIE-TALKIES**

Comco Walkie-Talkies are not "war babies." They were first built for *civilian* use . . . for use by mounted policemen . . . *before* the war.

That's why Comco Walkie-Talkies for war boast so many practical superiorities. They are the smallest, most compact of all combat Walkie-Talkies. Their weight complete is *less than eight pounds!*

Comco has built thousands of these remarkably compact units for our fighting forces. And Comco is prepared to build peacetime Walkie-Talkies to meet a wide variety of needs, some of which are suggested in the column at the right:

Comco engineers and craftsmen, in the peacetime ahead, will also produce many other types of radio and electronic equipment—all CUSTOMIZED for dependability and lasting satisfaction.

WRITE! Just a note on your company letterhead outlining your exact requirements. We'll give you the benefit of our specialized experience. We can supply a wide variety of CUSTOMIZED equipment on priority NOW. We are accepting non-priority orders for post-war delivery.

Customized
FOR MANY
POST-WAR USES

Fire Fighters

Railroading

Forest Service

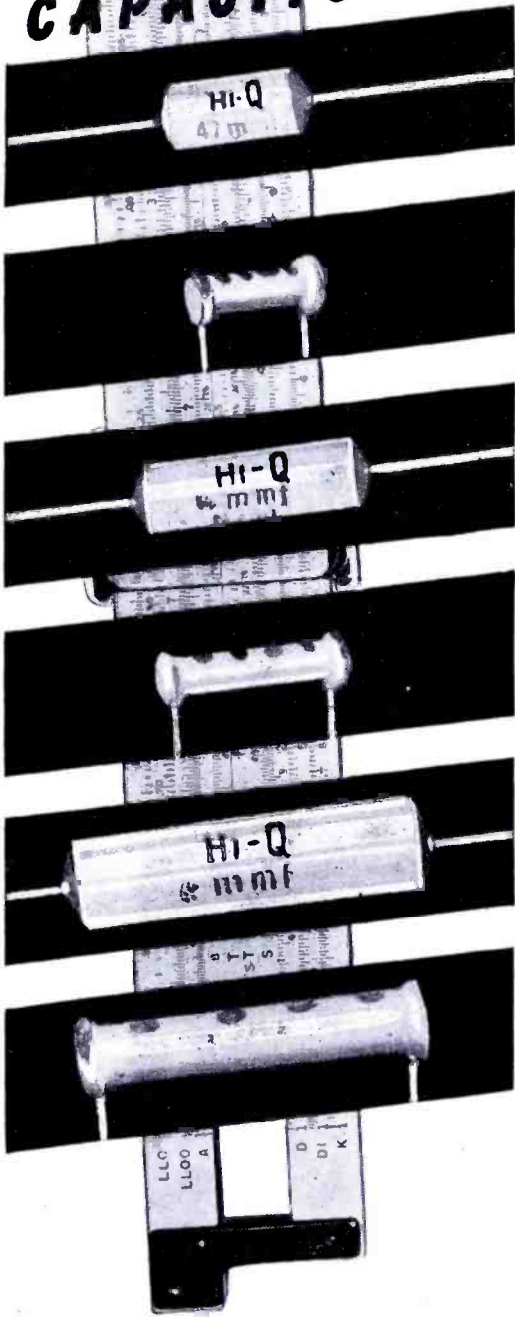
Public Utilities

MANUFACTURERS OF RADIO  & ELECTRONIC EQUIPMENT

COMMUNICATIONS COMPANY, Inc.
CORAL GABLES 34, FLORIDA

ENGINEERED TO THE APPLICATION

HI-Q
**CERAMIC
CAPACITORS**



**ELECTRICAL
REACTANCE
CORPORATION**
FRANKLINVILLE, N. Y.

NEWS BRIEFS

(Continued from page 91)

and commercial organizations are discussed in an illustrated brochure recently published by RCA.

Block diagrams are used to present graphically the special services rendered by sound and the arrangement of control consoles, microphones, and loudspeakers in different kinds of installations.

CONCORD RADIO EXPANDS

Concord Radio Corporation plans to move to larger quarters at 227 to 233 W. Madison Street, Chicago, Ill.

DUFFENDACK AND KELLY WIN PHILIPS PROMOTIONS

Dr. O. S. Duffendack, director of research for North American Philips Company, Inc. has been appointed vice president and director of research and engineering E. J. Kelly, at present manager of manufacturing, has been named vice president and general factory manager.

Dr. Duffendack, was formerly professor of physics at the University of Michigan. During the war he has been a director of research with the National Defense Research Committee and serves as chief of one of its sections.

Mr. Kelly was formerly works manager of the Camden plants of RCA.

WESTERN FIBERGLAS TO REPRESENT BENTLEY, HARRIS

Western Fiberglass Supply, Ltd., 739 Bryant Street, San Francisco 7, California have been appointed West Coast representatives for Bentley, Harris Manufacturing Company, Conshohocken, Pennsylvania.

FANSTEEL RECTIFIER DATA

A 16-page manual, RDP-107, on Fansteel selenium rectifiers has been published by Fansteel Metallurgical Corporation, North Chicago, Illinois.

Offered are data on principles, properties and construction. Efficiency, regulation, temperature range, voltage and current characteristics, forward and reverse resistance characteristics, rating at elevated temperatures are also provided.

RCA FORMS INTERNATIONAL DIVISION

An international division has been formed by the Radio Corporation of America to supervise foreign sales and other activities of the company and its subsidiaries outside of the United States. John G. MacKenty, vice president and general manager of Radiomarine Corporation of America, has been appointed managing director. Headquarters will be in New York.

AIR DIFFUSION CATALOG

A 72-page loose-leaf catalog covering air diffusers has been announced by the W. B. Connor Engineering Corp., 116 East 32nd Street, New York 16, N. Y.

Data includes selection, application, location,

assembly, erection, adjustment and testing of air diffusers.

GLYCO WAX DATA

A 16-page bulletin entitled "A High Melting Point Synthetic Wax" has been released by the Glyco Products Co., Inc., 26 Court Street, Brooklyn, New York. Described are synthetic waxes, their applications, etc.

PUNCH-LOK CLAMP BULLETIN

An 8-page catalog on Punch-Lok clamps and fittings has been published by Punch-Lok Company, 321 North Justine Street, Chicago 7, Illinois. The B. F. Goodrich Company, Akron, Ohio, are national distributors of the product.

KLOSE GOES TO GIANNINI CO.

A. J. Klose, has joined G. M. Giannini and Company, Inc., Pasadena, Calif., as vice-president and chief engineer.



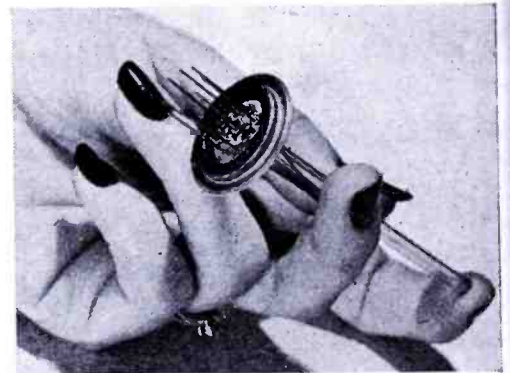
HARRY ADELMAN OPENS EXPORT OFFICE

Harry Adelman, former advertising and sales promotion manager for Sun Radio and Electronics Co. has opened an export office at 53 Park Place, New York City 7, under the name, The Radelma Company.

IRE HEARS DU MONT ON DIRECT-VIEWING RECEIVERS

An analysis of direct-viewing television systems was presented by Dr. Allen B. DuMont,

STEEL-TO-GLASS METAL TUBE SEAL



Steel header insert of metal tube, using new steel-glass fusing process to provide airtight seal. (Courtesy RCA)

HOPP
Plastic
NAME PLATES
SCALES, GAUGES, CHARTS,
CALCULATORS, DIALS, ETC.

- Impervious to moisture, grease, oils, acids, alkalis.
- Printing guaranteed not to wash or rub off.
- Non-inflammable, non-corrosive plastic.
- Printed and laminated vinylite and cellulose acetate.

SAMPLES AND ESTIMATES GLADLY SUPPLIED ON REQUEST
WRITE DEPARTMENT C

THE HOPP PRESS, INC.
PRINTING - FABRICATING - FORMING
460 W. 34th STREET, N. Y. C.
ESTABLISHED 1893

a recent N. Y. IRE meeting. Dr. DuMont said that direct-viewing cathode-ray tubes offer high-light brilliance, better contrast range, wide angle viewing, lower accelerating voltage, longer life, better resolution, less alignment difficulty, and simplicity of the focusing system. However, he said, the disadvantage of the direct-viewing system is a light curvature of the screen and the need for a special mounting arrangement to reduce the depth of the television receiver in the larger bulb sizes.

Continuing the analysis, Dr. DuMont said: "Taking up the various characteristics of direct-viewing, we find that the high-light brightness of the 20" tube is in the order of 100 foot lamberts as compared with approximately 3.5 foot lamberts for the most efficient projection system now in use. In both cases the size of the picture is considered to be 12" x 18".

"One of the big advantages of the higher light brilliance is the fact that the 20" tube receiver can be used satisfactorily in a quite brilliantly illuminated room and an ambient light level as high as 5 foot lamberts can be tolerated without seriously impairing the picture quality. On the other hand, with the projection system only about .5 foot lamberts average ambient light can be tolerated. It is interesting to compare the brilliance of the 20" picture with that of the normal commercial 5 mm screen, which averages between 6 and 10 foot lamberts.

"As regards the brightness ratio, or contrast range, the 20" tube has a contrast range of approximately 35 as compared with a contrast range of 17 for the projection system.

"As to directivity (maximum viewing angle from the normal-angle at which the apparent brightness decreases to 50% of its value in normal direction) we find that the 20" tube can be viewed from $\pm 80^\circ$ whereas the projection system screen can only be viewed from $\pm 15^\circ$. It of course is possible to widen this angle somewhat in the projection system but in so doing the high-light brightness will decrease from its already low value.

"In making these comparisons we have assumed an accelerating voltage on the 20" tube of 15 kilovolts, and 30 kilovolts on the 5" flat face tube of the projection system."

**ROBINSON-HOUCHIN NAMES
C. A. VOLF RESEARCH DIRECTOR**

Dr. Christian A. Volf has been appointed director of research in the electronic and acoustic division of the Robinson-Houchin Optical Company Columbus, Ohio.

JAMAICA, L. I., TO HAVE EXPERIMENTAL TELEVISION STATION SOON

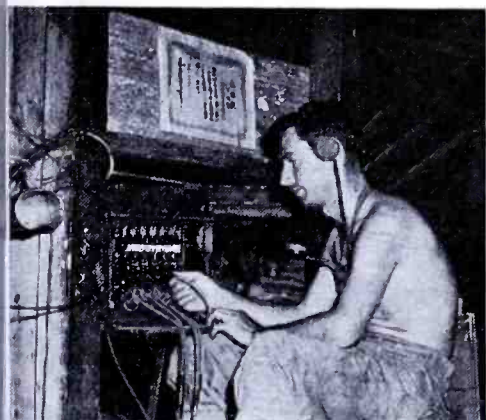
W2XJT (600-watts peak video, 150-watts audio) being installed at 148-18 Jamaica Avenue, Jamaica, Long Island, by William B. Still, is expected to be on the air soon on Channel 13, 230-236 megacycles.

Its facilities are expected to include studio for live broadcasts, motion picture film equipment, control room containing three video monitors, two turntables and audio and video consoles.

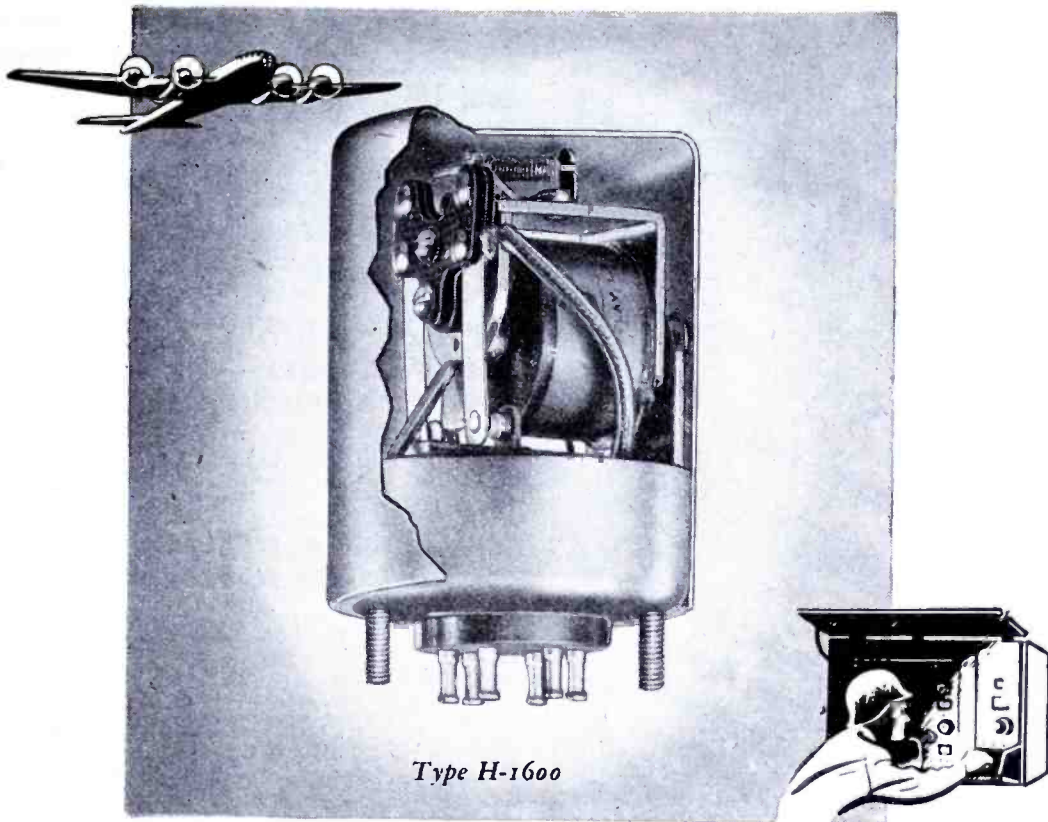
**BROPHY REELECTED CANADIAN
ARMA PRESIDENT**

R. M. Brophy, president of Rogers Majestic Limited and Rogers Electronic Tubes Limited, has been reelected president of the Radio Manufacturers Association of Canada. S. L. Capell, (Continued on page 94)

OKINAWA COMMUNICATIONS



Pvt. Earl G. Gleason, Ponca, Neb., operating communications unit in the 105th Infantry message center located in a deserted building which was taken on northern Okinawa during the mop-up drive by the 27th Division, part of the U. S. 10th Army. (Official U. S. Army photo.)



Type H-1600

HERMETICALLY SEALED

HERMETICALLY SEALED Advance Relays maintain their original efficiency under conditions that soon ruin or dangerously impair other types of relays. Dust, moisture, oil or fungus can't reach the precisely adjusted parts. The low atmospheric pressure of high altitudes can't cause failure through arcing or condensation. That these relays are tamper-proof is another advantage. And basically, like all Advance Relays, they have the stamina to resist the severe shock and vibration of battle, as has been so abundantly proved on all war fronts.

TYPE H-1600

Double pole, single throw. (May be had in single pole, double throw.) Full-floating armature suspension minimizes friction between frame and armature. Pure silver contacts are standard, with palladium or platinum alloys on special order. Wiping contacts insure clean contact surfaces. All steel parts cadmium plated to withstand the 200-hour Salt Spray Test. All brass and bronze parts nickel plated. All laminated phenolic parts moisture-and-fungus-proofed. Coil is wound with highest grade enamel wire and insulated with 100% cellulose acetate with a final vacuum varnish impregnation. Dimensions are: height of case only, 2"; diameter 1-5/8". Mounting screws and solder lug terminals project 5/16" below case.

Any Advance Relay can be furnished in hermetically sealed containers on special order. When you select Advance, you will have relays exactly as you want them. Our engineers are at your service. Write today for full information.



ADVANCE ELECTRIC & RELAY CO.
1260-1262 W. Second Street, Los Angeles 26, Calif.

PARTS!
ORDER TODAY FROM...

R. W. T.
WORLD'S LARGEST
Radio Supply House • Founded 1922

For Industrial Organizations
Laboratories • Purchasing Agents
Radio Dealers & Service Men
Training Schools • Expeditors
Amateur Operators and Experimenters

10,000 PARTS
immediately available. (Some no longer
need priorities.) Selected and shipped
same day your order is received.

**Radio Wire
Television Inc.**
100 SIXTH AVE. (DEPT. T-7) NEW YORK 13
BOSTON, MASS. NEWARK, N. J.

Originators of the
Lafayette Radio
soon in production again

NEWS BRIEFS

(Continued from page 93)

was reelected vice president. Mr. Capell is vice president and general manager of Philco Corporation of Canada, Limited.

FCC GRANTS EXPERIMENTAL TELEVISION STATION PERMIT TO SHERRON ELECTRONICS CO.

A construction permit for an experimental television station, W2XDK, has been granted to Sherron Electronics Company, Brooklyn, N. Y. by the FCC.

AMPEREX APPOINTS ROGERS, LTD., DISTRIBUTOR

Rogers Electronic Tubes, Limited, 622 Fleet Street West, Toronto, Canada, has been appointed exclusive Amperex distributor in the Dominions of Canada and New Zealand.

CHAMBERLAIN NOW CLAROSTAT ASSISTANT SALES MANAGER

Fran Chamberlain has been named assistant sales manager of the jobber division at Clarostat Mfg. Co., Inc., Brooklyn, N. Y. Mr. Chamberlain served for four years with the Tank Corps in the European theatre. In other Clarostat sales appointments, Wood and Anderson Company, 915 Olive St., St. Louis, Mo., and Henry P. Segal Company, 143 Newbury St., Boston, Mass., will represent Clarostat in their respective territories.

AIREON PROMOTIONS

Arthur E. Welch, has been elected vice president and treasurer of Aireon Manufacturing Corp., Kansas City, Mo. Ralph E. Middleton, formerly chief engineer, was elected vice president in charge of engineering at the hydraulics division, in Burbank, California.



A. Welch



R. E. Middleton

LENZ DIAL LIGHT SOCKET CATALOG

A 16-page catalog, 101, describing dial light sockets has been released by Lenz Electric Mfg. Co., 1751 N. Western Avenue, Chicago 47, Illinois. Specifications and dimensions for 28 different standard mounting brackets are supplied.

SPRAGUE WINS QUALITY CONTROL RATING

Sprague Electric Company, North Adams, Mass., received an approved quality control rating from the Air Service Technical Command recently.

WARREN OF RCA COMMUNICATIONS DEAD

Frank B. Warren, general counsel of RCA Communications, Inc., died recently.

PERMOFLUX CORP. ENLARGES

Two new sections have been added to the Permoflux Corporation at 4900 West Grand Avenue, Chicago 39, Illinois.



C. P. COE BECOMES HEAD OF RCA LABORATORIES PATENT DEPT.

Conway Peyton Coe, formerly United States Commissioner of Patents, has been elected vice

Permanent
MAGNETS

By
Thomas & Skinner

ALL SHAPES... ALL SIZES
Cobalt • Chrome • Tungsten
Stamped, Formed or Cast.
ALNICO
(Cast or sintered, under G. E. license)

Also: LAMINATIONS for output transformers of highest permeability. Standard stocks in a wide range of sizes for Audio, Choke, Output and Power Transformers. Write for dimension sheet. . . . TOOLS . . . DIES . . . STAMPINGS . . . HEAT TREATING.
44 YEARS' SPECIALIZED EXPERIENCE

Thomas & Skinner
STEEL PRODUCTS CO.
1113 E. 23rd St., Indianapolis 5, Ind.

**NO
PRIORITY**

**For Harco Radio
MASTS & TOWERS**

Revocation of Order M-126 permits manufacturing from surplus inventories. We have adequate surplus stocks to make...

**IMMEDIATE
SHIPMENTS**

**HARCO
CO. INC.**

ELIZABETH 4, NEW JERSEY

Catalog mailed on request

ident in charge of the patent department RCA Laboratories. Mr. Coe had been Commissioner of Patents since 1933. He had been appointed by the late President Roosevelt.



MAGUIRE BUYS MEISSNER, FERROCART AND MICRO PRODUCTS

The Meissner Manufacturing Company, Mt. Carmel, Ill., has been purchased by Maguire Industries, Inc. Meissner will continue its operations as an independent division of Maguire Industries. James T. Watson and George V. Rockey, former principal stockholders, will continue to head the Meissner management and all other key personnel will remain the same. Mr. Watson has been elected vice president. Glen F. Jester continues as sales manager of the radio-phonograph division; Ray Hutcher continues as Mr. Jester's assistant and Jeffrey Wetterlow as eastern sales manager. The Ferrocart Corporation of America and the Micro Products Corporation have been merged into a new division of Maguire Industries, the Micro-Ferrocart products division. Harry A. Ford, founder and president of the two firms, has become a vice president and general manager of the new division. Plant operations have been moved from Hastings-on-Hudson to one of the Maguire plants at 375 Fairfield Avenue, Stamford, Conn. The Thordarson Electric Manufacturing Company of Chicago, purchased by Maguire Industries a few months ago, has been consolidated into a transformer manufacturing division of Maguire Industries. L. G. Winney, formerly first vice president and treasurer of Thordarson, has been elected vice president and will be general manager of what will be known as the Thordarson Electric Manufacturing division.



Harry Ford

GENERAL RADIO CELEBRATES 30TH YEAR

The 30th anniversary of the General Radio Company, Cambridge 39, Massachusetts was celebrated recently. A special 30th anniversary issue of the "Experimenter" for June offers a discussion of the G-R engineering department.

ANDREW RHOMBIC TRANSFORMER BULLETIN

A rhombic antenna coupling transformer is described in bulletin 31 recently released by the Andrew Company, 363 East 75th Street, Chicago 19, Illinois. Coaxial plugs and jacks are also described in the bulletin.

R. BURROWS JOINS CORNELL UNIV.

Dr. Charles Russell Burrows of Bell Telephone Laboratories has been appointed professor of electrical engineering and director of the School of Electrical Engineering at Cornell. He will assume his new duties about September 1.

MEHRAD LOW-RADIATION RECEIVER DATA

A 8-page folder describing a low-radiation type receiver, LRR-5, has been prepared by Technical Radio Company, 275 Ninth Street, San Francisco, California.

TAYLOR TUBE CATALOG

A 16-page tube catalog has been released by

VALPEY CRYSTALS

TODAY ARE DETERMINING THE EFFICIENCY OF TOMORROW'S COMMUNICATIONS

No more rigorous test than war can be applied to the delicately made, precision ground crystals and other crystionics units produced by Valpey. These "fighting units" are proving their worth and their ruggedness. Their application to postwar developments for the benefit of man are now being planned . . . by you and by science.

CRYSTIONICS

-- MEANS ONE THING

POSTWAR

-- MEANS SOMETHING ELSE . . .

—because crystionics as developed by Valpey experts, is a useful branch of specialized electronics today, applied to the myriad needs of war communications and instrument control. In the postwar period . . . and from then on . . . crystionics will come into full play in the improved communications . . . in serving industry, homes, medicines, many phases of daily life, of the future.

Write now for crystionics information.

VALPEY
Crystal Corp.
HOLLISTON, MASS.

Taylor Tubes, Inc., 2312 Wabansia Avenue, Chicago.

Presented are data on 35 types of Taylor tubes. A chapter on tube and transmitter design by Harner Selvidge is included.

G. E. TRANSMITTING TUBE DATA

A handbook, 12, listing all transmitting tubes and their applications has been issued by the electronics department of G. E.

OPERADIO ELECTRONICS BOOK

A 32-page illustrated booklet entitled "Can Electronics Improve Your Product?", has been published by the Operadio Manufacturing Company, St. Charles, Illinois.

Basic organization for electronics product development is illustrated and described.

ASCO SWITCH CATALOG

A 16-page catalog describing automatic trans-

fer switches, remote control switches and magnetic relays, has been released by the Automatic Switch Company, 41 East 11th Street, New York City.

KATOLIGHT FOLDER

A 4-page folder describing the Katolight revolving field generator has been released by the Kato Engineering Company, Mankato, Minnesota.

RCA TO CONTINUE LICENSING UNDER PHILIPS AMERICAN PATENTS

A new agreement granting RCA the right (non-exclusive) to continue licensing other manufacturers under United States patents of the N. V. Philips' Gloeilampenfabrieken (Philips Incandescent Lamp Works Company), formerly of Eindhoven, Holland, has been signed. The agreement became effective on July 1 and remains in force until December 31, 1954.

RCA is also granted similar rights to li-

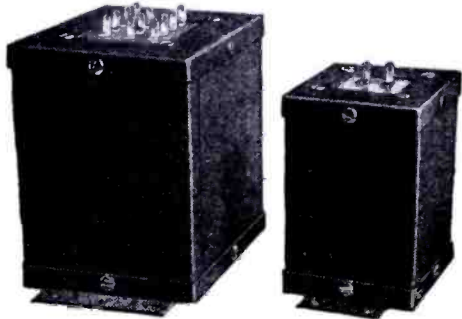
(Continued on page 96)

ACME

PRECISION-BUILT TRANSFORMERS

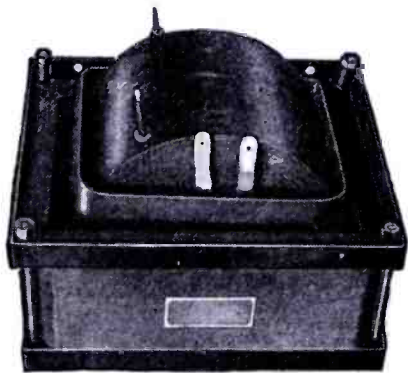
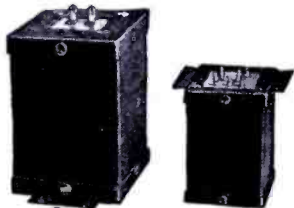
FOR ELECTRONIC PERFORMANCE

Controlling electrons to a useful purpose requires transformers of exact performance characteristics. Acme precision-built transformers for electronic applications, when submitted to unbiased tests, invariably win top honors for performance. If your electronic application is out of the ordinary, let Acme transformer engineers help in its solution.

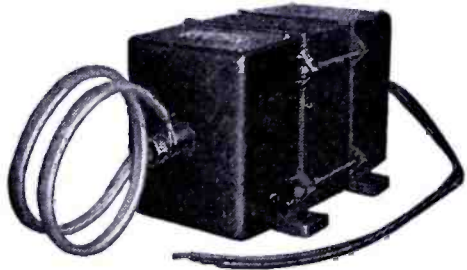


FOR EXAMPLE

Acme compound-filled transformers for short wave communication, public address systems and other radio applications are preferred for their serviceability under temperature variations from -40° to +120°.



And preferred for rugged construction, trouble-free long-life. Typical, high voltage plate supply transformer for transmitter. 33,000 volts, 1.8 ampere secondary.



ISOLATING TRANSFORMERS

For use wherever radio, communication, or other electrical equipment must be tested with complete freedom from outside interference. Shielded secondary winding and shielded secondary cable isolate primary fluctuations and interference. Write for details.

THE ACME ELECTRIC & MFG. CO.
65 WATER ST. CUBA, N. Y.

Acme Electric
TRANSFORMERS

• COMMUNICATIONS FOR JULY 1945

NEWS BRIEFS

(Continued from page 95)

cense the United States Government directly for the duration of hostilities and six months thereafter.

REEVES-ELY LABS. CONSOLIDATION

Offices and plants of five subsidiary companies and operating divisions . . . Reeves Sound Laboratories, Hudson American Corporation, American Transformer Company, The Winsted Hardware Manufacturing Company, and The Waring Products Corporation . . . have all been consolidated under the name Reeves-Ely Laboratories, Inc.

Executive offices are at 25 West 43rd St., N. Y. City.

WAKEMAN NOW MAGNAVOX AD MAN

Del Wakeman has been appointed advertising manager of The Magnavox Company, Fort Wayne, Indiana.

Mr. Wakeman was formerly vice president and manager of Keeling & Co., Indianapolis, Indiana advertising agency.



PRECISION SCIENTIFIC TEMPERATURE CONTROL CABINET DATA

A 48-page catalog, 325, covering electrically heated ovens for laboratory drying operations, plastics, preheating, conditioning, rubber aging; sterilizers, incubators, paraffin embedding ovens, low temperature cabinets, humidity control cabinets; steam-heated explosion-proof cabinets; vacuum ovens and combustion-tube furnaces for laboratory use, has been released by Precision Scientific Co., 1750 N. Springfield Ave., Chicago 47, Ill.

AKIN BECOMES LITTELFUSE AD-SALES DIRECTOR

Russell G. Akin has been appointed director of sales and advertising of Littelfuse Incorporated.

Mr. Akin has been manager of sales.

N. U. NAMES J. J. CLUNE DISTRIBUTOR DIVISION S-M

J. J. Clune has been appointed sales manager of National Union's distributor division. Mr. Clune will combine his new activities with those as head of National Union war service, which department he has directed since the outbreak of the war.



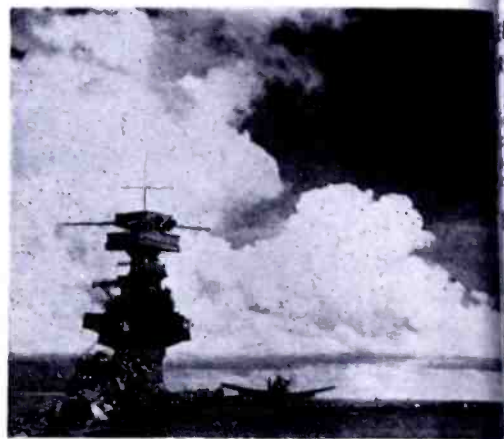
AMERICAN STEEL NAMED EXPORT AGENTS FOR SUPREME INSTRUMENTS

Supreme Instruments Corporation, Greenwood, Miss., have appointed American Steel Export Company, Inc., 347 Madison Ave., New York 17, N. Y., as their export agents. W. G. Maitland, manager of the American Steel radio division, will handle sales in all foreign countries, with the exceptions of Canada and Alaska.

PLASTIC COATING BOOKLET

A 16-page booklet describing the use and prop-

PREMAX



Premax . . . Again!

On the "Flat-top," the "Battle Wagon," the LST and PT . . . as well as in commercial installations on land and on sea . . . you'll find Premax Tubular Metal Antennas doing an outstanding job.

They're available in standard and special designs.

Premax Products

Division Chisholm-Ryder Co., Inc.

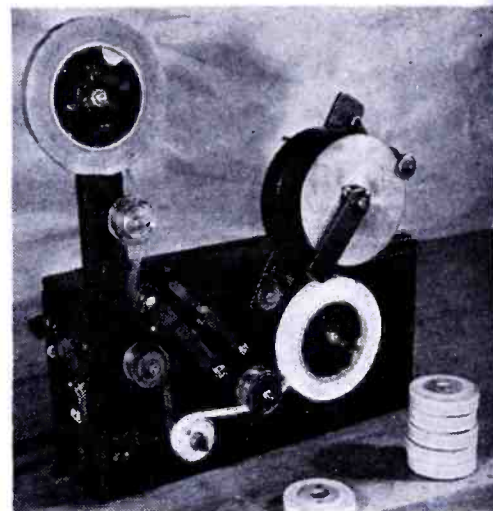
4501 Highland Avenue, Niagara Falls, N. Y.

erties of a peelable plastic film, "Liquid Envelope," has been released by Better Finishes and Coatings, Inc., 168 Doremus Avenue, Newark, N. J.

SOLAR AIRCRAFT BUYS B. F. HIRSCH

Solar Aircraft Company, San Diego, Calif., has purchased the precision casting division of

CELLOPHANE TAPE PRINTER



To print up cellophane tape as needed, members of the Army division electrical and tubing departments at the Glenn L. Martin Company, Baltimore, Maryland, developed the tape printer shown above. Printer consists of a keyed wooden take-up spool, two feed spools to hold transparent and white cellulose tape, respectively, a printing roll with interchangeable hardened type permitting any number desired to be printed, and various guides and inking rolls. The entire device is powered by an air-driven motor and contained in a box 7½" high x 4" wide x 15" long with the feed and take-up spools mounted on the outside.

The printing mechanism consists of 3 rollers; one mica, one rubber, and one roller holding the interchangeable type.

F. Hirsch, Inc., New York, N. Y. The new unit, to be known as Solar Precision Casters, Inc., will be headed by Edmund T. Rice, president of Solar Aircraft. B. L. Vinson, until now vice-president and general manager of B. F. Hirsch will have the same posts in the new unit.

LEEDS & NORTHRUP RESISTANCE COCHURE

36-page catalog, E-53, listing d-c resistance bridges, standards, galvanometers, accessories, etc. has been published by Leeds & Northrup, 4934 Stenton Avenue, Philadelphia 44, Penna.

" AWARDS

A white star has been added to the "E" flag of the United Transformer Corporation, 150 Brick Street, New York.

The third white "E" flag star has been awarded to the Bendix Radio division of Bendix Aviation Corporation.

The Cherry Rivet Company, 231 Winston Street, Los Angeles, Calif., has won an Army-Aviation "E".

EDWARD KINGDON JOINS EISLER ENGINEERING

Edward E. Kingdon has been named chief engineer and manager of the transformer department of the Eisler Engineering Company, Newark, N. J.



COMMUTATORS AND SLIP RING DATA

A catalog listing over 3,000 variations of commutators and slip rings has been published by the Toledo Standard Commutator Co., Toledo, Ohio, and the Homer Commutator Corp., Cleveland.

EUGENE SYKES DEAD

Eugene O. Sykes, member of the first Federal Radio Commission, died recently.

REPRESENTATIVES HOLD ANNUAL DINNER IN NEW YORK

The metropolitan chapter of the Representatives held their annual dinner in New York recently. Representatives of leading manufacturers, distributors and the press attended. Harry Camber, president of the Representatives, addressed the group.

MARION INSTRUMENT BOOKLET

A 12-page booklet describing the history, uses and advantages of glass-to-metal hermetically sealed electrical indicating instruments, has been released by the Marion Electrical Instrument Company, Manchester, New Hampshire.

CHERRY RIVET POCKET MANUAL

A 20-page pocket manual, D-45 describing basic types of self-plugging and hollow rivets, installation methods and applications, has been announced by Cherry Rivet Company, 231 Winston St., Los Angeles 13, Calif. Also described and illustrated are application guns G-15RB pneumatic and the hand guns G-10, G-25, G-35 and G-20, with angle adapters, cut-face nippers and Cherry Rivet kits.

AMPEREX RADIATOR PERFORMANCE DATA

A bulletin describing the radiator performance characteristics of forced air-cooled copper-clad tubes has been released by the Amperex Electronic Corporation, 25 Washington Street, Brooklyn 1, N. Y.

GUARDIAN RELAY CATALOG

A 56-page catalog, No. 10, offering electrical and mechanical data on a-c, d-c, locking, latching, radio type, time delay, underload and overload relays; solenoids, thermostats and magnetic contactors; contact switches and special assemblies, has been prepared by the

ANTENNAS

EST.



1906

For every radio purpose

BRACH ANTENNAS

since the beginning of radio broadcasting have been pace-makers in their field

IN WAR



IN PEACE



BRACH Antennas, tested and perfected to meet Army and Navy standards, are doing their part for victory on land, on sea, and in the air.

After the war, BRACH Puratone* Antennas will again resume their established leadership for Home and Auto Radios, Television, Marine, F.M. and other services.

TODAY AND IN THE FUTURE

FOR *antennas* REMEMBER

*Reg. Patent Trade Mark



World's Oldest and Largest Manufacturers of Radio Antennas and Accessories

Guardian Electric Manufacturing Company, 1400 Washington Boulevard, Chicago 7, Illinois.

NILSSON LABS. FACILITY BOOKLET

A 16-page booklet discussing instrument manufacturing and service facilities has been released by the Nilsson Electrical Laboratories, 103 Lafayette Street, New York 13, N. Y.

DU MONT C-R PHOTOGRAPHY SCREEN DESIGNATION BULLETIN

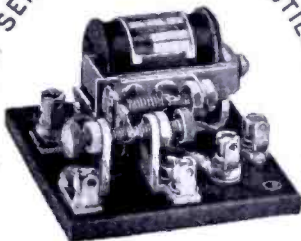
A bulletin entitled "New Designations of Screens for Cathode-Ray Photography," has been published by Allen B. Du Mont Laboratories, Inc., Passaic, N. J.

Discussing the two general types of blue screen materials used commercially for photographic work, the bulletin says that both had been designated as P5. It has now become apparent, however, that these materials, each offering distinct advantages in certain photographic applications, are sufficiently different

to warrant different type designations. These two types of screen materials are sulphide and calcium tungstate. RMA and the Armed Services have agreed to designate the screens having the characteristics of calcium tungstate as P5, and those of sulphide as P11. Du Mont tubes in the past have used the sulphide type screen. Therefore, the change to the P11 designation will not represent a change in screen material to those who have been getting P5 photographic screens from Du Mont.

The general characteristics of P5 and P11 screens compare as follows: Both are of the short persistence, blue fluorescent type, and of high photographic activity. The main difference is the considerably higher photographic and visual efficiency of the P11, and the shorter persistence of the P5. P11 is advantageous for all still photographic applications particularly high-speed phenomena, and for continuous moving-picture recording up to the limit where persistence produces blurring of the picture (approximately 10,000 cps). The use of the P5 screen is recommended only for high-speed continuous motion-picture recording above the limit of the P11, or up to 60 kc without blurring.

"KURMAN SENSITIVE" OF 1930 STILL THE BEST



New Features added to KURMAN RELAYS

Microphone
Hummer
Type Z-7200



The Well-Known KURMAN SENSITIVE RELAY

the first to demonstrate the superior magnetic properties of hydrogen-annealed nickel alloy 15 years ago—again introduces an outstanding new feature:—

CHATTERLESS OPERATION

—obtained through cushioning of contacts in an energy absorbing material. This feature enables keying up to 150 words p. m. Mica insulation of the armature makes the relay suitable for keying 50 m. c. RF signals.

25 YEARS' EXPERIENCE,

a thoroughly competent staff of Development and Design Engineers, and complete manufacturing facilities are at your service when you submit your Relay problems to us.

Write for details on:

- KURMAN LINE OF RELAYS
- KURMAN VIBRATOR CONVERTERS
- KURMAN MICROPHONE HUMMERS

KURMAN ELECTRIC CO.

35-18 37th STREET • LONG ISLAND CITY 1, N. Y.



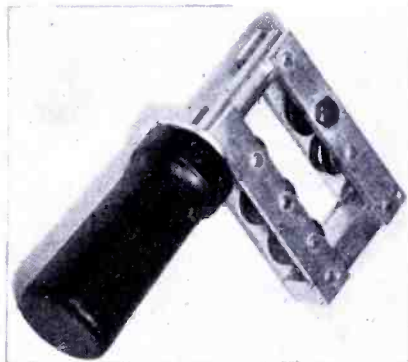
For trouble-free operation in any climate and at any desired altitude.

HERMETICALLY SEALED

relays are available, either of plug-in type or equipped with solder lugs. Some of these relays take as little space as 2" x 1 1/4" dia., and have up to 10 amps current capacity due to the special atmosphere introduced into the container under pressure.

ANDREW COAXIAL CABLE GROOVING TOOL

A grooving tool for soldering splices on 3/8" coaxial cable has been announced by Andrew Co., 363 E. 75th St., Chicago 19, Illinois. The tool makes spun-in grooves in the splicing sleeve that grip the outer conductor. Tool is also equipped with a cutting wheel for cutting outer conductor.



OLYMPIC TRANSFORMER CASES

A line of standardized transformer cases, with or without studs, pierced covers, brackets or channels, has been announced by the Olympic Tool and Manufacturing Co., Inc., 39 Chambers Street, New York 7, N. Y.

Sizes range from 1 1/4" x 1 1/8" x 2 1/8" to 5 1/2" x 4 3/4" x 6-19/32"

UNIVERSITY DIRECTIONAL SPEAKERS

Directional loudspeakers, B-6, that are said to have a range of approximately one mile over open country and two miles over water, have been designed by University Laboratories, 225 Varick Street, New York 14, New York.

Primarily designed for speech reproduction, it has a frequency range of 300 to 5000 cps and handles 150 watts of audio power.

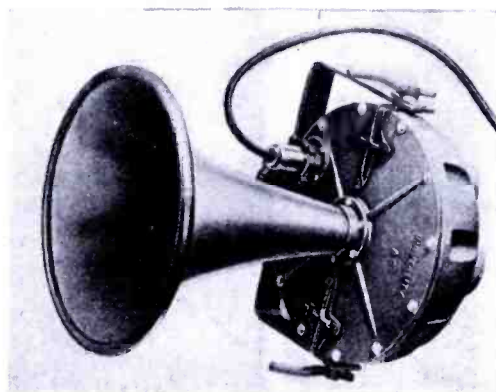
Six driver units power the speaker. These are connected in series with a high-impedance reactor shunted across each coil. Failure of a coil due to an open connection results in

THE INDUSTRY OFFERS . . . —

automatic lowering of the shunt reactor impedance and continued functioning of the remaining driver units. Speaker will thus operate even with only a single undamaged driver unit; acoustic output will of course drop proportionally. Features water-proof construction.

Diameter, approximately 18", length overall 24"; weight, 60 pounds.

A collapsible tripod type of stand is available for mounting.



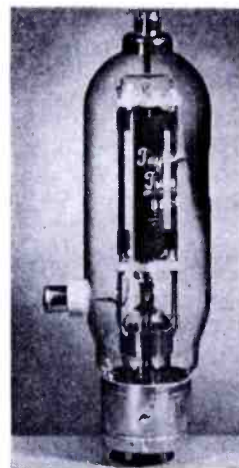
TAYLOR TUBE 822-S TRIODE

A high-power triode, 822 S, for use up to 30 mc has been developed by Taylor Tubes, Inc., 2312 Wabansia Avenue, Chicago.

Tubes in push pull will furnish up to 1 kw in class B at 3000 volts and .5 ampere on the plates. As a class C amplifier maximum rating is 405 watts with 2000 volts at .250 ampere on the plate and 13.7 watts driving power.

Electrical characteristics: Filament, 10 volts at 4 amperes; amplification factor, 30; plate

dissipation, 200 watts; interelectrode capacities, grid/plate—13.5 mmfd, grid/filament—8.5 mmfd, plate/filament—2.1 mmfd. Maximum overall length, 9"; maximum glass diameter 2 3/4". Base, standard 50-watt.



IDEAL ELECTRIC MARKER

An electric marker, 6" long and weighing 10 ounces, has been announced by the Ideal Commutator Dresser Company, 4025 Park Avenue, Sycamore, Illinois.

Operates like a small electric hammer; makes 7200 cutting strokes per minute. For iron, steel, bronze, aluminum, ceramics, tile, marble, lead, plastics, porcelain, glass, etc.

For average marking, a hardened alloy point is furnished as standard. If extra hard materials from 54 to 64 Rockwell hardness scale C are to be marked, a diamond point is recommended. For a-c use.

VICTORY BLIND BOLT ASSEMBLY

A plastic fastening device, Des-bolt, composed of a molded plastic expansion sleeve has been developed by Victory Manufacturing Company, 1105 South Fairroads Avenue, South Pasadena, Calif. The sleeve is composed of three thin fingers with an inside taper extending approximately three-fourths of their

**INSTRUMENTS
THAT STAY ACCURATE**

Simpson

SIMPSON ELECTRIC COMPANY
5200-18 W. Kinzie St. Chicago 44, Illinois

Filters and Transformers ...for Unusual Jobs

Our new Catalog covering the specialized line of ADC Transformers, Filters, Equalizers, Key Switches, Jacks, Plugs and other electronic components is now ready.



Write for ADC Catalog No. 14.

Audio Development Co.

2833 13th Ave. S., Minneapolis, Minn.

Long Scale, Wide Range Volt-Ohm-Milliammeter



DOUBLE SENSITIVITY D.C. VOLT RANGES

0-1.25-5-25-125-500-2500 Volts, at 20,000 ohms per volt for greater accuracy on Television and other high resistance D.C. circuits.

0-2.5-10-50-250-1000-5000 Volts, at 10,000 ohms per volt.

A.C. VOLT RANGES

0-2.5-10-50-250-1000-5000 Volts, at 10,000 ohms per volt.

OHM-MEGOHMS

0-400 ohms (60 ohms center scale)
0-50,000 ohms (300 ohms center scale)

DIRECT READING OUTPUT LEVEL DECIBEL RANGES

- 30 to +3, +15, +29,
+43, +55, +69 DB

TEMPERATURE COMPENSATED CIRCUIT FOR ALL CURRENT RANGES D.C. MICROAMPERES

0-50 Microamperes, at 250 M.V.

D.C. MILLIAMPERES

0-1-10-100-1000 Milliamperes, at 250 M.V.

D.C. AMPERES

0-10 Amperes, at 250 M.V.

OUTPUT READINGS

Condenser in series with A.C. Volts for output readings.

ATTRACTIVE COMPACT CASE

Size: 2½" x 5½". A readily portable, completely insulated, black, molded case, with strap handle. A suitable black, leather carrying case (No. 629) also available, with strap handle.

LONG 5" SCALE ARC

For greater reading accuracy on the Triplet RED .DOT Lifetime Guaranteed meter.

SIMPLIFIED SWITCHING CIRCUIT

Greater ease in changing ranges.

HERE'S THAT NEW
**TRIPLETT
625-N**

Triplet



ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

length from the flanged head. The head is a flange with a cored hole to accommodate the bolt shank and countersunk to receive standard countersink type of bolts, with three sharp ribs attaching the flange and sleeve. These thin ribs wedge into the work and prevent the sleeve from turning.

Sizes range, in present production, from ¼" to ¾" in diameter by ¼" to 3" in length. Victory engineers say that the work being fastened can vary as much as 50% of the length of the sleeve without adversely affecting the application or security of the fastening. Slot or Phillips type bolt heads may be used.



LANGEVIN POWER SUPPLIES

A series of P-S units, type 201-A, designed to furnish filament and plate currents to line amplifiers, has been produced by the Langevin Company, Inc., 37 West 65th Street, New York 23, N. Y.

Delivers 275 v at 75 ma/6.3 v at 8 a. Length 10½", width 5½". Maximum height, 5½" (5½" above, 1" below mounting chassis).

PIEZO UNIVERSAL LINK JOINT

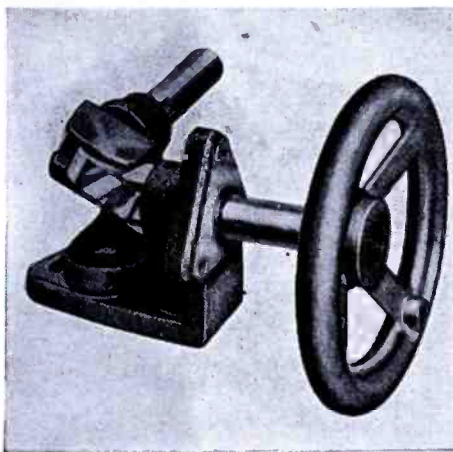
A universal link joint with an adjustable link mechanism to transmit rotary motion around corners, that is said to permit the operation of shafts at angles adjustable from a straight line, 0° to a right angle, 90°, has been developed by Piezoelectric Corporation, 110 East 42nd Street, New York 18, New York.

Output shaft of joint is said to turn in the exact angular rotation as the input shaft, giving an input turning angle equivalent to the output turning angle.

The joint is mounted by three screws. The

bearing arm which holds the adjustable shaft may be hinged from 0° to 90°.

For hand operation and slow speed power drives.



DU MONT MULTI-BAND C-R TUBE

A 5" multi-band cathode-ray tube type 5RP, with a 17,500-volt accelerating potential, has been announced by Allen B. Du Mont Laboratories, Inc., Passaic, N. J. Tube is said to permit recording at writing rates in excess of 2500 km/sec (using a 35-mm camera with an f:1.9 lens) corresponding to sine wave transients at 40 mc.

The tube is of the hot-cathode, permanently-sealed, high-vacuum type. Deflection-plate leads brought out through the glass neck instead of the base.

SELENIUM RECTIFIERS

A selenium rectifier, type K, for applications on sea and at high humidity has been announced by the Selenium Corporation of America, 1719 W. Pico Blvd., Los Angeles 15, Calif.

Rectifier said to withstand effects of salt spray because of new assembly method and coating technique. Salt-spray tests run to check

resistivity included one for 100-hours at 50° C. Rectifiers were sprayed for 3 minutes with a 20% salt solution at 55° C, followed by a 3-minute air blast at 55° C, the cycle being repeated continuously throughout the 100-hour test. A strong ultraviolet light was continuously played on the rectifiers during the length of the test.

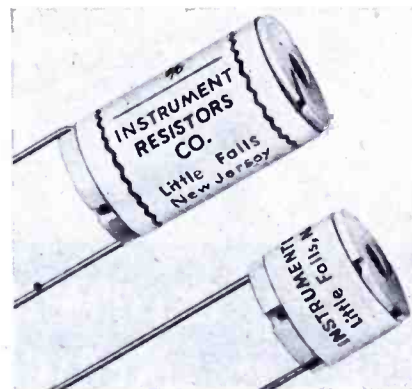
IN-RES-CO NON-INDUCTIVE RESISTORS

Non-inductive resistors, RL and SL, are now being made by Instrument Resistors Co., 25 Amity Street, Little Falls, N. J.

Types RL are rated at ½ watt maximum; resistance 500,000 ohms. Size ½" diameter x ½" long. Unit drilled for 6/32 screw clearance. 1½" tinned copper leads.

Type SL similar to RL except that maximum resistance is 1 megohm. Size is ½" diameter x 15/16" long.

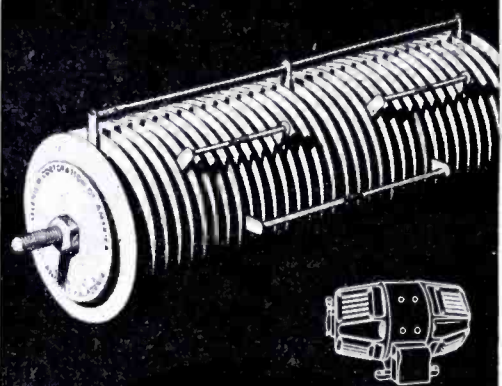
Both resistors are furnished with standard tolerance of ½%.



PAUL HENRY TEMPERATURE CONTROLS

Temperature controls, Cam-stat, for -100° to +600° F with double break enclosed contacts, have been produced by The Paul Henry Com-

(Continued on page 100)



DC
means
SC

DC means SC...

Selenium Conversion for magnetic chucks. In a typical case, a Selenium rectifier, assembled on 3 days notice and operating directly from a 3 phase line without transformers, supplied 220 volts DC to magnetic chuck. Less space, lower cost, higher efficiency, better operation proved DC means SC...Selenium Conversion. If you use DC, get the facts on SC!

SEND FOR BULLETIN

SELENIUM CORPORATION of AMERICA

1719 WEST PICO BOULEVARD
LOS ANGELES 15, CALIFORNIA

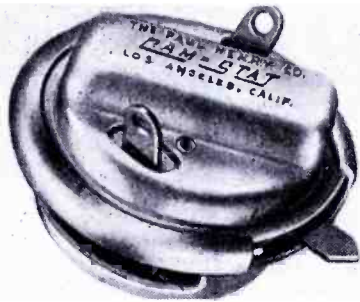
EXPORT DIVISION: FRAZAR & HANSEN
301 CLAY STREET, SAN FRANCISCO, CALIFORNIA

CANADA: BURLIC LTD., TORONTO 13, ONTARIO, CANADA

THE INDUSTRY OFFERS . . .

(Continued from page 99)

pany, thermal division, 2037 South La Cienega Boulevard, Los Angeles 34, California. Made in single-pole single-throw, single-pole double-throw or independent circuit double throw. Contact openings from .010" to .060". Controls are furnished with operating differentials to 1° F.



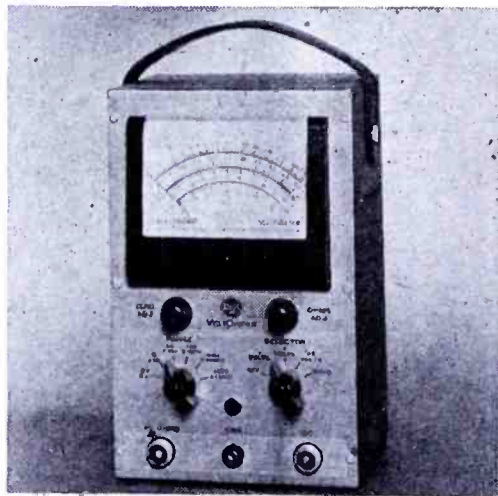
IRVINGTON COLD SETTING PLASTICS

A liquid cold setting plastic, cardolite 5616, for filling of junction boxes, stuffing boxes, pot-heads and similar void spaces encountered in electrical work, has been developed by the Irvington Varnish & Insulator Company, Irvington 11, New Jersey. The liquid, mixed with Irvington 5612 setting agent, gels approximately four hours after mixing. After several days, the end product becomes a rubbery mass which according to Irvington will not flow under heat nor become brittle in the cold. The set compound is said to be insoluble in water, oil, acids and alkalis. Although cardolite 5616 will adhere to metal, it can be stripped away.

RCA 6-WAY VOLTOHMYST

A test unit, 195-A volt ohmyst, for measurement of d-c or a-c voltages, resistances, audio levels, and f-m discriminator balance, has been announced by the RCA Victor division of RCA.

The instrument combines a 6-range d-c voltmeter, ohmmeter reading from .1 ohm to 1000 megohms, 6-range a-c voltmeter, linear a-f voltmeter, audio-level meter, and f-m discriminator balance indicator. Other features include a diode for a-c measurements, linear a-c scale for all ranges, plastic meter case with one-piece unbreakable front, and a shielded a-c cable and probe.



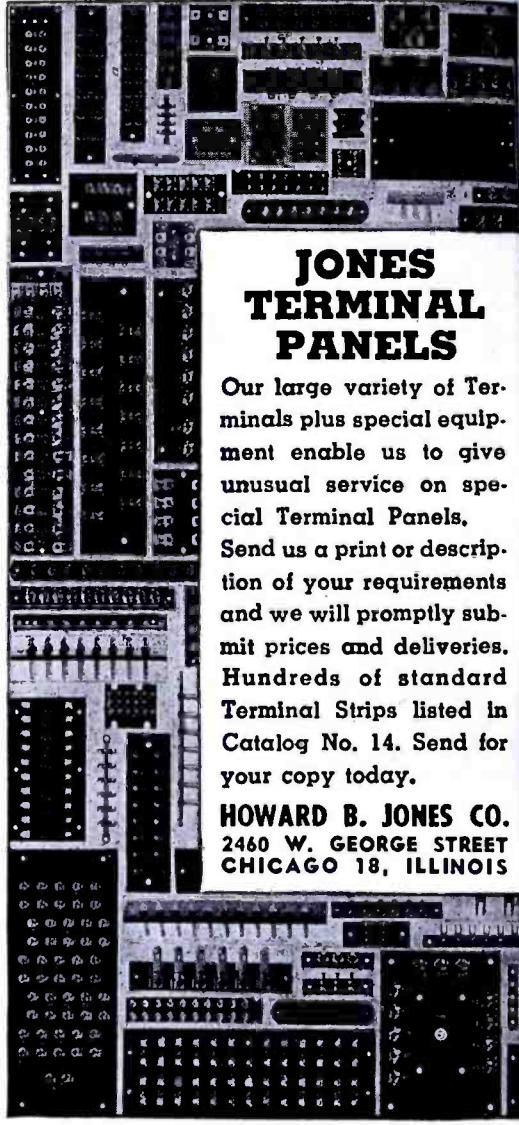
BOGUE MOTOR-GENERATOR SETS

Light weight sealed-type two-bearing motor-generator sets have been announced by Bogue Electric Company, 40 Kentucky Avenue, Paterson 3, New Jersey. Built for d-c operation but can be furnished with either d-c or a-c driving motors. Provides a-c and several different specified d-c voltages from 12 to 2000.

ASSOCIATED RESEARCH RESISTOR LIMIT BRIDGES

A low-range limit bridge, model 81, for the rapid comparison of large quantities of resistors having comparable values, has been produced by Associated Research, Inc., 231 S. Green Street, Chicago 7, Ill.

Overall adjustable range is from 1/4 ohm to 10,000 ohms, with adjustable ratio arm, sensitivity control, production type test fixture with automatic on-off switch. Sensitivity control



JONES TERMINAL PANELS

Our large variety of Terminals plus special equipment enable us to give unusual service on special Terminal Panels. Send us a print or description of your requirements and we will promptly submit prices and deliveries. Hundreds of standard Terminal Strips listed in Catalog No. 14. Send for your copy today.

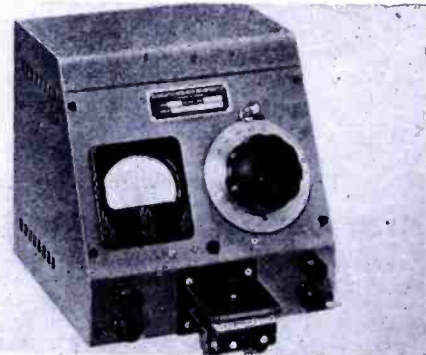
HOWARD B. JONES CO.
2460 W. GEORGE STREET
CHICAGO 18, ILLINOIS

RADIO ENGINEERS . . .

Advanced Amateurs, Ex-Signal Corps or Air Corps Technicians. Permanent positions are open in long established Connecticut plant and its New York laboratories. Now engaged as Prime Contractors on urgent War Contracts involving interesting research and development. Large projects in many phases of radio and industrial electronics will follow, to meet peacetime business now on books. Write L. R. Ripley, President, explaining your experience. Your letter will be held in complete confidence—no further investigation without your express permission.

UNITED CINEPHONE CORPORATION
NEW LITCHFIELD STREET
TORRINGTON, CONNECTICUT

range is from ±1/4% to ±10%. Indicator is a sensitive zero center galvanometer. Battery-operated unit measures 8" x 8" x 12"; weight, 18 pounds.



AMERLINE POCKET CIRCUIT TESTER

A vest-pocket all-purpose circuit tester has been produced by Amerline, 1753 North Honore

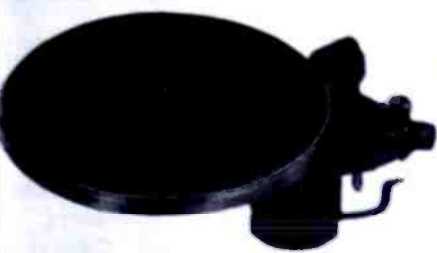
HARVEY

is taking orders for the newly improved

REK-O-KUT

RKD-16

DUAL SPEED 16-INCH RECORDING MOTOR ASSEMBLY



To essential users*, HARVEY can now supply the famous RKD-16, with new features that materially increase the life and performance of the unit. Its rugged construction and precise assembly have made this REK-O-KUT instrument generally preferred by major broadcasting stations and recording studios. A heavier turntable, closer machining tolerances and an improved lubrication system now add to its efficiency.

Three week delivery—\$148.38

Features of the REK-O-KUT RKD-16

- Lathe turned, 25 lb. cast iron turntable, balanced, with disappearing drive pin and rubber turntable pad.
- Turntable fitted with one inch diameter polished steel shaft, with special oil grooves for force feed lubrication when operating. Rotates on a single ball bearing at the bottom of the turntable well.
- 1/20 H. P. General Electric constant speed motor.
- A positive repeat speed change at all times.
- The turntable attains full speed in less than one revolution.
- Easy alignment of the REK-O-KUT overhead mechanism with the turntable.
- Improved lubrication system.

*AA-5 Priority or Better!

NOTE: Since our monthly allotment is subject to WPB regulations, we suggest that you send your order without delay.

Telephone: LONgacre 3-1800

IDENTITY RADIO COMPANY
HARVEY

33 WEST 43rd ST., NEW YORK 18, N. Y.

St., Chicago 25, Illinois. Indicates voltages from 90 d-c, and 60 a-c, to 500 volts a-c or d-c. Neon lamp on top glows in varying intensities indicating circuit conditions. No glow indicates a dead line. Lamp is said to be activated by currents as low as 1 microampere.



G. E. PORTABLE CURRENT TRANSFORMERS

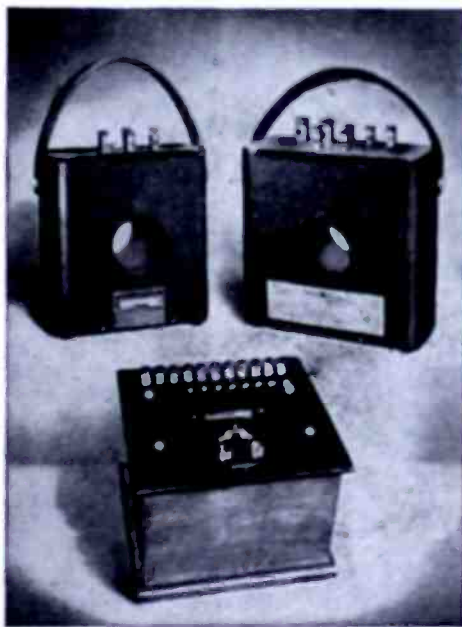
Portable current transformers, types JP-2, -3, and -4, has been announced by G. E.

The JP-2 and -3 units are said to meet the accuracy requirements of the ASA 0.1 accuracy class with Burdens R.O.I., .02, and .04 at 60 cycles. Both units are of the through window type construction. JP-2 not supplied with a primary winding, but there is a hole in the core through which a cable or conductor can be passed. However, there is a tapped secondary winding, and the terminals on top of the case are all secondary terminals.

JP-3 unit is designed with a combination of wound-primary and through-primary construction. Ratings of 100 amperes and below are obtained by a wound-primary with the terminals on top of the transformer. By passing a conductor through the transformer window once, 1000- and 1200-ampere ratings may be obtained. Additional ratings may be gained in both units by passing the conductor through the window two or more times.

Both JP-2 and -3 units are insulated for use on circuits not exceeding 300 volts. They can, however, be used over cables on higher voltage circuits, provided the cable is insulated for the circuit voltage.

Cases of aluminum. Type JP-4 is of wound-primary construction with taps in the primary coil for the different ratios. Secondary terminals are provided with a short-circuiting switch, and also with a thyrite protector to guard against accidental opening of the secondary circuit.



VIO-RAY BLACK LIGHT LAMPS

Black light lamps that are said to provide near ultra-violet radiation in the region of 3650 Angstrom units, has been announced by Vio-Ray Manufacturing Company, 5022 N. Kedzie Ave., Chicago 25, Illinois.

Lamps operate with standard fluorescent equipment, and are said to provide an efficient source of near ultra-violet radiation for all applications requiring excitation of fluorescent pigments and materials.

U.M.C. VELOCITY MICROPHONES

A streamlined model of the 808 velocity microphone has been announced by the Universal Microphone Company, Inglewood, Calif.

Has a 5 millimeter ribbon element. Impedance is 40,000 ohms; frequency response, 40-10,000 cps; output level, 63 db below one volt per bar. Shipping weight two pounds.

Has a bi-directional response. The 808 model (Continued on page 102)

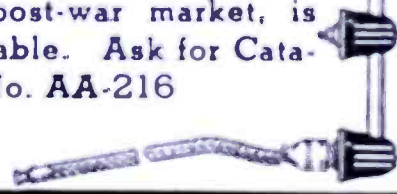


BE WITH YOU IN A MINUTE—

The Insuline Corporation is still 80% in war production. In fact, it has received its third Army-Navy Award, and is out to earn a fourth. Still the ICA Plant is geared to swing into full peace-time production almost instantly.

The radio industry, planning for the post-war market, will want to investigate the now-famous line of battle-tested ICA Auto Antennas. Careful engineering makes them rattle-proof; all-brass construction makes them rust proof.

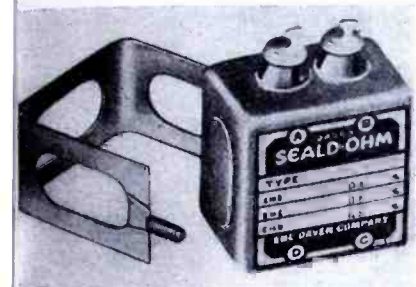
A catalog, detailing everything that's news in antennas designed for the post-war market, is available. Ask for Catalog No. AA-216



INSULINE
CORPORATION OF AMERICA
Quality Products Since 1921
INSULINE BUILDING
LONG ISLAND CITY, N. Y.

resistor windings are spool, or mica-card depending upon engineering requirements; inductively wound. Any desired resistance value may be had; maximum 1,600,000 depending upon the type of resistance employed.

Accuracy is said to be $\pm 0.1\%$ to $\pm 10.0\%$. Resistors are available with two terminals at one or two terminals at each end. A single terminal unit is designed to take up to separate spool-type resistors of different sizes and accuracies. Dimensions are: $19/16''$ wide, $1\frac{1}{2}''$ high, $7/8''$ add terminal height, $9/16''$; studs on mounting bracket, $1\frac{11}{16}''$ between centers.



HERINGTON SWITCHES

Switches for both industrial and aircraft use total movement of $7/16''$, that are said to be environment proof have been produced by Robert Hetherington & Son, Inc., Sharon, Pa. Two methods are used in the proof-process. One places a bellows on the outer end of the switch and the other is to place a rubber boot over the plunger. At temperatures down to 40° below zero, the rubber boot has been satisfactory under many conditions. However, where hydraulic fluids, gasoline or other solvents are present, or where the switch will meet extremes of heat and cold, the metal bellows is recommended. All switches are sealed, back and front and made for a-c or d-c. Contacts are double contact type, solid silver.



TOBE BROAD-BAND FILTERS

A low-loss filter for use with screen-rooms that is said to prevent entrance of objectionable noise at all frequencies from 150 kilocycles to 400 megacycles, has been announced by the Filterette division of the Tobe Deutschman Corporation, Canton, Massachusetts. It is said to provide attenuation better than 20 db over the entire band. Filter is designed for continuous operation at 500 watts d-c or a-c at a full load current of 100 amperes. Filter is available for installation in two-wire and three-wire circuits. The three-wire filter is $23''$ long x $12''$ wide x $4\frac{1}{4}''$ deep;

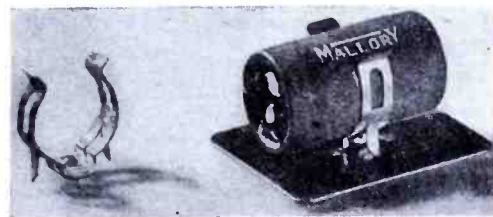
two-wire filter is $20''$ long x $8''$ wide x $4\frac{1}{4}''$ deep. Electrical connection is made to $5/8''$ threaded studs at opposite ends of the internal assembly.



MALLORY MOUNTING CLIP

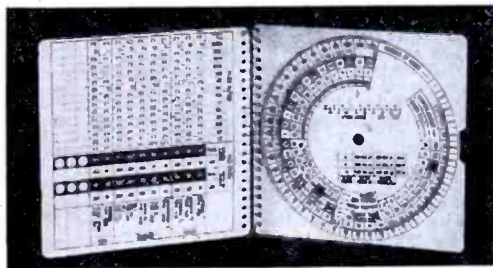
A new capacitor mounting clip that requires no tools for assembly has been announced by P. R. Mallory & Co., Inc., Indianapolis, Indiana.

This clip, originated by Mallory and made by Prestole Division of the Detroit Harvester Co., Toledo, Ohio, is now available in five sizes from $5/8''$ to $1\frac{1}{2}''$. Catalog number is Mallory type TH or Prestole series 500.



HOPP PHOTOGRAPHIC COMPUTER

A photographic computer $4'' \times 4''$, for motion picture cameras, of laminated transparent vinylite sheet, has been produced by the Hopp Press, Inc., 460 West 34th Street, N. Y. 1, N. Y. Surface is dull or matte finish, permitting pencil or ink notations.



BENDIX VHF ANTENNA

A broad-band dipole antenna, MS-105A, for the 108 to 132-mc range, has been produced by Bendix Radio, Baltimore, Md.

Antenna will match into a 52-ohm coaxial transmission line. According to Bendix engineers no more than a 1.5:1 standing wave ratio will be produced; frequency range of 100-156 mc can be used with a standing wave ratio of never more than 2:1.



THERE IS NO SUBSTITUTE FOR EBY SPRING BINDING POSTS

From the product designer through to final assembly and use in the field, the Eby Spring Binding Post line offers top service based on dependability.

The spring binding post offers unique advantages that can't be duplicated:

1. No screw cap to tighten or come loose with vibration.
2. Constant, even pressure on the wire at all times in all positions.
3. Easy one-hand feeding of wire into the post.
4. Corrosion-resistant, long-life springs.
5. Complete range of sizes, stem lengths, and accessories for every application.

Replace with Eby Spring Binding Posts — Write today.

HUGH H. EBY
INCORPORATED
18 W. CHELTON AVE.
PHILADELPHIA, PA.



LOUD SPEAKER ENGINEER

Large Eastern component parts manufacturer needs graduate engineer with several years design and development experience on loud speakers. Should be capable of handling developments through complete engineering design. Excellent post-war opportunity. Salary open. State full particulars, age, education and experience.

BOX 1745, COMMUNICATIONS
52 Vanderbilt Ave., New York 17, N. Y.

AUDAX

RELAYED-FLUX

Microdyne

The Importance of SPECIALIZATION

Aside from outstanding and long-acknowledged technical skill — our "Specialization Formula" is probably as fully responsible for the world-renowned AUDAX quality as any other single factor.

We proudly concentrate all our energies and resources upon producing the FINEST pick-ups and cutters. Because we are specialists in this field, much more is expected of us. Because the production of fine instruments like MICRODYNE is a full time job, it stands to reason that we could not afford to jeopardize our reputation—EVER—by making pick-ups a side-line.

After Victory, you may expect AUDAX improvements, refinements . . . master-touches to heighten the marvelous *fac simile* realism of AUDAX reproduction.

AUDAX COMPANY

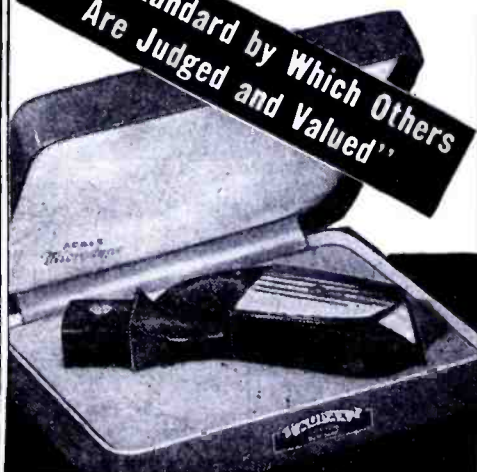
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Creators of Fine Electronic-Acoustical Apparatus Since 1915

Send for complimentary copy of our informative "PICK-UP FACTS"

★ BUY WAR BONDS

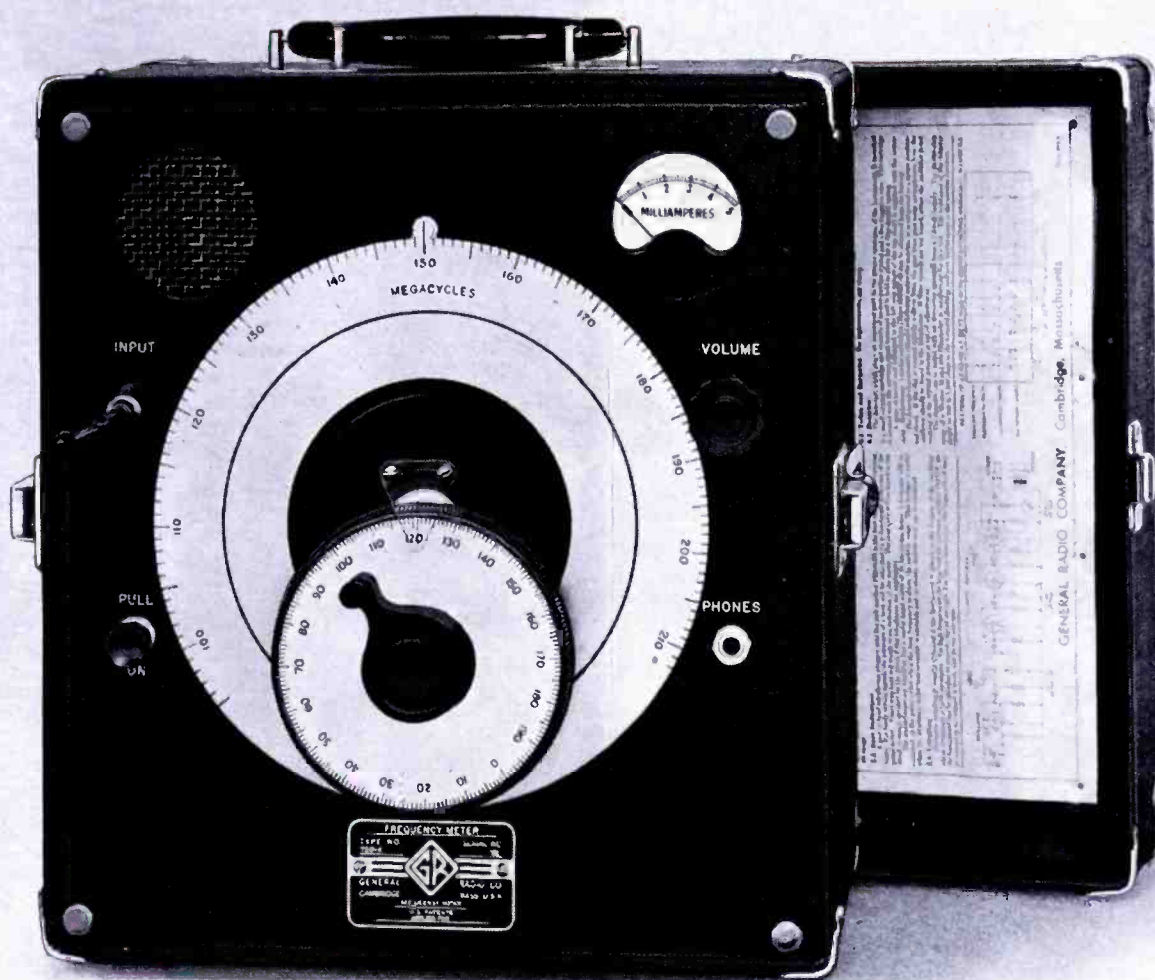
"The Standard by Which Others Are Judged and Valued"



ADVERTISERS IN THIS ISSUE

COMMUNICATIONS — JULY, 1945

ACME ELECTRIC & MFG. CO.....	96	THE HOPP PRESS, INC.....	92
Agency: Scheel Adv. Agency		Agency: Gallard Adv. Agency	
ADVANCE ELECTRIC & RELAY CO.....	93	HYTRON RADIO & ELECTRONICS CORP.....	17
Agency: Riordan & Messler		Agency: Henry A. Loudon—Advertising	
AEROVOX CORPORATION.....	74	INSULINE CORPORATION OF AMERICA.....	101
Agency: Austin C. Lescarboursa & Staff		Agency: S. R. Leon & Co.	
AIREON MFG. CO.....	5	ISLIP RADIO MFG. CORP.....	74
Agency: Erwin, Wasey & Co. of the Pacific Coast		Agency: Thè Kotula Co.	
ALTEC-LANSING CORP.....	55	E. F. JOHNSON CO.....	29
Agency: Erwin, Wasey & Co. of the Pacific Coast		Agency: David, Inc.	
AMALGAMATED RADIO & TELEVISION CORP.....	79	HOWARD B. JONES CO.....	100
Agency: Shappe-Wilkes Inc.		Agency: Merrill Symonds, Advertising	
AMERICAN CONDENSER CO.....	82	KAAR ENGINEERING CO.....	25
Agency: Michael F. Mayger		Agency: The Conner Co.	
AMERICAN PHENOLIC CORP.....	61	KARP METAL PRODUCTS CO.....	45
Agency: Evans Associates, Inc.		Agency: Rose-Martin, Inc.	
AMPEREX ELECTRONIC CORP..... Inside Front Cover		THE JAMES KNIGHTS CO.....	69
Agency: Shappe-Wilkes Inc.		Agency: Turner Adv. Agency	
AMPERITE CO.....	90	KURMAN ELECTRIC CO.....	98
Agency: H. J. Gold Co.		Agency: H. J. Gold Co.	
ANDREW CO.....	75	KYLE CORPORATION.....	15
Agency: Burton Browne, Advertising		Agency: Hamilton Adv. Agency	
THE AUDAX CO.....	104	LANGEVIN CO., INC.....	1
Agency: Hart Lehman, Advertising		Agency: Terrill Belknap Marsh Associates	
AUDIO DEVELOPMENT CO.....	98	Agency: Turner Adv. Agency	
Agency: Turner Adv. Agency		MCELROY MFG. CORP.....	102
BARKER & WILLIAMSON.....	85	Agency: Shappe-Wilkes Inc.	
Agency: The Harry P. Bridge Co.		MARION ELECTRICAL INSTRUMENT CO.....	21
THE BENWOOD LINZE CO.....	24	Agency: Shappe-Wilkes Inc.	
Agency: Major Adv. Agency		MEASUREMENTS CORPORATION.....	84
L. S. BRACH MFG. CO.....	97	Agency: Frederick Smith	
Agency: United Adv. Agency		METALLIC ARTS CO.....	64
BREEZE CORPORATIONS INC.....	19	Agency: Cory Snow, Inc.	
Agency: Burke Dowling Adams		JAMES MILLEN MFG. CO.....	76
BURGESS BATTERY CO.....	89	MYCALEX CORPORATION OF AMERICA.....	102
Agency: Howard H. Monk & Associates		Agency: Rose-Martin, Inc.	
BURSTEIN-APPLEBEE CO.....	102	NATIONAL UNION RADIO CORP.....	43
Agency: Frank E. Whalen Adv. Co.		Agency: Hutchins Adv. Co., Inc.	
CAMBRIDGE THERMIONIC CORPORATION.....	82	NORTH AMERICAN PHILIPS CO., INC.....	9
Agency: Walter B. Snow & Staff		Agency: Erwin, Wasey & Co., Inc.	
CAPITOL RADIO ENGINEERING INSTITUTE.....	71	OHMITE MFG. CO.....	31
Agency: Henry J. Kaufman & Associates		Agency: Henry H. Teplitz, Advertising	
CENTRALAB.....	102	PETERSEN RADIO CO.....	102
Agency: Gustav Marx Adv. Agency		PREMAX PRODUCTS DIV. CHISHOLM-RYDER CO., INC.....	96
CINAUDAGRAPH SPEAKERS INC.....	86	PRESTO RECORDING CORP.....	8
Agency: Michael F. Mayger		Agency: The M. H. Hackett Co.	
CINEMA ENGINEERING CO.....	73	RADIART CORPORATION.....	51
Agency: Riordan & Messler		Agency: Kenneth H. Kolpien	
CLAROSTAT MFG. CO.....	54	RADIO CORPORATION OF AMERICA.....	48
Agency: Austin C. Lescarboursa & Staff		Agency: Kenyon & Eckhardt, Inc.	
COLE STEEL EQUIPMENT CO.....	77	RADIO RECEPTOR CO., INC.....	63
Agency: Ehrlich & Neuwirth		Agency: Shappe-Wilkes Inc.	
COLLINS RADIO CO.....	11	RADIO WIRE TELEVISION, INC.....	94
Agency: McCann-Erickson, Inc.		Agency: Diamond-Seidman Co.	
COMMUNICATIONS CO., INC.....	91	RAYTHEON MFG. CO.....	10
Agency: Moran & Webb		Agency: Burton Browne, Advertising	
CONCORD RADIO CORP.....	68	RAYTHEON MFG. CO.....	57
Agency: E. H. Brown Adv. Agency		Agency: Sutherland-Abbott	
COTO-COIL CO., INC.....	87	REK-O-KUT CORP.....	67
Agency: Frank E. Dodge & Co., Inc.		Agency: Shappe-Wilkes Inc.	
D-X CRYSTAL CO.....	88	REMLER CO., LTD.....	16
Agency: Michael F. Mayger		Agency: Albert A. Drennan	
DeJUR-AMSCO CORP.....	26	SCHAUER MACHINE CO.....	76
Agency: James Thomas Chirurg Co.		Agency: Rudolph Krebs	
DIAL LIGHT COMPANY OF AMERICA.....	84	SELENIUM CORPORATION OF AMERICA.....	100
Agency: H. J. Gold Co.		Agency: Erwin, Wasey & Co. of the Pacific Coast	
DRAKE MFG. CO.....	88	SIMPSON ELECTRIC CO.....	98
Agency: The Vanden Co., Inc.		Agency: Krelecker & Meloan, Inc.	
ALLEN B. DuMONT LABORATORIES, INC.....	39	SPRAGUE ELECTRIC CO.....	13
Agency: Austin C. Lescarboursa & Staff		Agency: The Harry P. Bridge Co.	
ALLEN B. DuMONT LABORATORIES, INC.....	14	STRUTHERS-DUNN, INC.....	22
Agency: Buchanan & Co., Inc.		Agency: The Harry P. Bridge Co.	
EASTERN AMPLIFIER CORP.....	6	SUPREME INSTRUMENTS CORP.....	78
Agency: Roberts & Riemers, Inc.		Agency: O'Callaghan Adv. Agency, Inc.	
HUGH H. EBY, INC.....	103	SURPRENANT ELECTRICAL INSULATION CO.....	55
Agency: Renner Advertisers		Agency: G. Jerry Spaulding, Inc.	
EITEL-McCULLOUGH, INC.....	23	SYLVANIA ELECTRIC PRODUCTS INC.....	3
Agency: L. C. Cole, Advertising		Agency: Newell-Emmett Co.	
ELECTRICAL REACTANCE CORP.....	92	TECH LABORATORIES.....	80
Agency: Scheel Adv. Agency		Agency: Lewis Adv. Agency	
ELECTRONIC ENGINEERING CO.....	78	THOMAS & SKINNER STEEL PRODUCTS CO.....	94
Agency: Burton Browne, Advertising		Agency: The Caldwell-Baker Co.	
ELECTRONIC ENTERPRISES, INC.....	28	THORDARSON ELECTRIC MFG. CO.....	68
Agency: George Homer Martin		Agency: Duane Wanamaker—Advertising	
ELECTRONIC WINDING CO.....	81	TOBE DEUTSCHMANN CORP.....	7
Agency: Burton Browne, Advertising		Agency: Franklin-Bruck Adv. Corp.	
FAIRCHILD CAMERA & INSTRUMENT CORP.....	4	TRIPLETT ELECTRICAL INSTRUMENT CO.....	99
Agency: G. M. Bastford Co.		Agency: Western Adv. Agency, Inc.	
FEDERAL TELEPHONE & RADIO CORP.....	86	THE TURNER CO.....	65
Agency: Commerce Agency, Inc.		Agency: The W. D. Lyon Co.	
FEDERAL TELEPHONE & RADIO CORP.....	53	U. S. TREASURY DEPT.....	30
Agency: Marschalk & Pratt		UNITED CINEPHONE CORPORATION.....	76, 100
GENERAL RADIO CO..... Inside Back Cover		Agency: Wilson & Haight, Inc.	
HALLICRAFTERS INC.....	12	UNITED TRANSFORMER CO.....	27
Agency: Burton Browne, Advertising		Agency: Shappe-Wilkes Inc.	
HAMMARLUND MFG. CO., INC.....	32	UNIVERSAL TOOL CO.....	90
Agency: Roeding & Arnold, Inc.		Agency: R. J. Potts-Calkins & Holden	
HARVEY RADIO CO.....		VALPEY CRYSTAL CORP.....	95
Agency: Shappe-Wilkes Inc.		Agency: Cory Snow, Inc.	
HARCO STEEL CONSTRUCTION CO., INC.....	94	WARD LEONARD ELECTRIC CO.....	102
Agency: Lewis Adv. Agency		Agency: E. M. Freystadt Associates	
HARVEY RADIO CO.....	101	WESTINGHOUSE ELECTRIC CORP..... Back Cover	
Agency: Shappe-Wilkes Inc.		Agency: Fuller & Smith & Ross, Inc.	
HEINTZ & KAUFMAN LTD.....	20	WILLOR MFG. CORP.....	83
Agency: The Conner Co.		Agency: Sternfield-Godley, Inc.	
HEWLETT-PACKARD CO.....	18	ZOPHAR MILLS, INC.....	74
Agency: L. C. Cole, Advertising		Agency: Copp Adv. Agency	



For Measuring Frequencies Between 30 and 3,000 Mc

The new G-R Type 720-A Heterodyne Frequency Meter has all the operating conveniences of a broadcast-band type instrument, with a range of 30 to 3,000 Mc. Heterodyne methods offer several advantages over the conventional resonant type of meter. The fundamental frequency can be low enough to insure stability difficult, or impossible, to obtain with the resonant-circuit instrument. The heterodyne meter has much greater sensitivity and consequently requires much less r-f power to operate.

The fundamental frequency of this new instrument is continuously variable between 100 and 200 Mc. Frequencies above and below this range are measured by the use of harmonics. The tuning element is a butterfly circuit with rotor ball-bearings and no sliding contacts. The fundamental range is direct-reading in megacycles with a dial scale-length of 15 inches. One division of the auxiliary dial corresponds to a frequency change of 100 parts per million.

The built-in detector is a silicon crystal Type 1N21B. Usually no auxiliary pick-up is needed except when frequencies above 1,000 Mc are being measured it may be necessary to adjust the input antenna which is mounted on the front panel.

A three-stage amplifier is provided to produce indication on the panel meter when strong signals are received. Audible beats are simultaneously heard in the small speaker mounted behind the panel. A jack is provided for plugging in headphones for weak beat notes.

The complete instrument is self-contained. Its price, with batteries and spare crystal is \$250.00. At present this meter is available only for top-priority war orders. Reservation orders for future delivery, however, are being accepted.

For complete information see the G-R EXPERIMENTER for July, 1945.



GENERAL RADIO COMPANY

Cambridge 39,
Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 1000 N. Seward St., Los Angeles 38

TIME-TESTED
WESTINGHOUSE INDUSTRIAL DETAILS



**BUILD ACCEPTANCE
 ASSURE PERFORMANCE
 IMPROVE APPEARANCE**
 OF INDUSTRIAL ELECTRONIC APPARATUS

These Westinghouse details can help you equip electronic apparatus for the heavy-duty requirements of industrial service. Engineers and operating men in the central station and manufacturing industries are familiar with them and their predecessors—they have set the specifications for them over years of operating experience—expect to find them on equipment they select. By using them on your electronic apparatus you will immeasurably increase acceptance.

Westinghouse industrial details are simple, rugged, and positive in operation. Rapid assembly . . . and improved appearance (when this doesn't sacrifice smooth functioning) are major considerations.

Other available details include pushbuttons, knife switches, test switches, card holders, terminals, etc. For more information, write your Westinghouse office. Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

J-60598-A



Westinghouse
 PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

INDUSTRIAL DETAILS

THESE WESTINGHOUSE INDUSTRIAL DUTY DETAILS SAVE TIME IN BUILDING ELECTRONIC APPARATUS

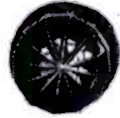
INDICATING LAMPS



Round Minalite—A medium-drain lamp especially suited for miniature steel panels . . . gives maximum illumination for the smallest panel space. Makes an attractive combination with the Minatrol switches below.



Rectangular Indicating Lamp—A low-drain lamp for extreme angular visibility and compact mounting. Of medium size, it is especially suited for installation with switches shown below.



Large Indicating Light—Provides high illumination and can be universally mounted. Has comparatively high drain but gives maximum visibility at greater distances.

These indicating lamps, for mounting on panels up to 2 inches thick, operate on a-c or d-c, from 25 to 250 volts. Lenses are available in clear or opalescent and in red, green, blue, amber. For additional information, ask for Catalog Section 37-200. For suggested panel drilling layout of switches and groups of indicating lamps, write your Westinghouse office.

CONTROL SWITCHES



Minatrol—A compact switch, with small dimensions, to save space on miniature panels. Has heavy-duty contacts which eliminate interposing relays in most circuits. Available for control, instruments, temperature indicators, etc.



Type W Switch—A standard heavy-duty control switch available in a variety of full-hand grips—removable, keyed type; pull-out lock type, automatic-return-to-neutral type; and stay-out types. Used for control, instruments, temperature indicators, etc.



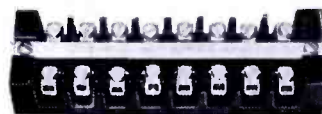
Auxiliary Switch—Similar to Type W, except it is mechanically actuated by levers. Can be actuated by doors or moving mechanisms—and is commonly used for safety interlocks, sequence or process controls. Special mounting provisions and housings, including an outdoor type, are available.



Selector Switch—Locks into each position, and can be operated by one hand—thus leaving other hand free for other operations. Handle is pushed in for release to turn. Circuit is broken by auxiliary contacts. Available in 4 to 24 single-pole, or up to 8 double-pole arrangements.

For additional information on the Minatrol switches ask your Westinghouse office for Catalog Section 37-175, for Type W and auxiliary switches ask for Descriptive Data 37-150.

TERMINAL BLOCKS



8-circuit black terminal block with high-pressure connectors.



Cover partially removed, showing clamp type terminals on 8-circuit terminal block.

These terminals are used extensively in Westinghouse products and are available in a variety of molded bases, terminal constructions and number of terminals. The three commonly used combinations are:

1. 4, 5, 8 or 12 terminals per block—with standard or captive high-pressure terminals or hardware. This is a standard type board with black molded plastic base of high impact strength and very low moisture absorption.
2. This block is specified for Navy electronic equipment. Black molded plastic base has high impact strength, low moisture absorption and high fire resistance. Hardware includes binder head screws and shakeproof washers.
3. This block is specified for Navy switchgear—has 4, 8 or 12 terminals, and standard hardware. Has black molded plastic base of high impact strength, low moisture absorption, and high fire resistance.