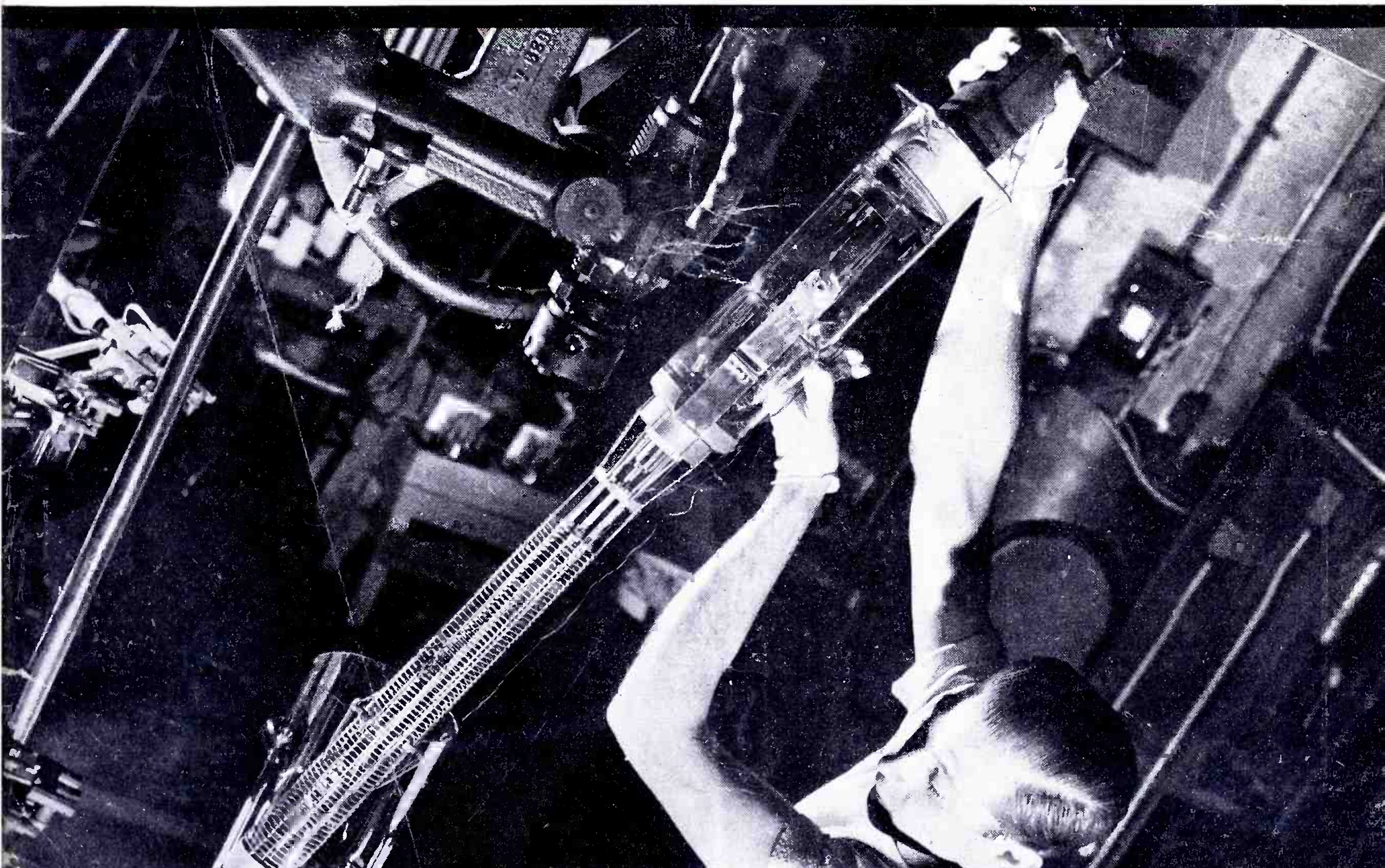
COMMUNICATIONS



JULY 1945

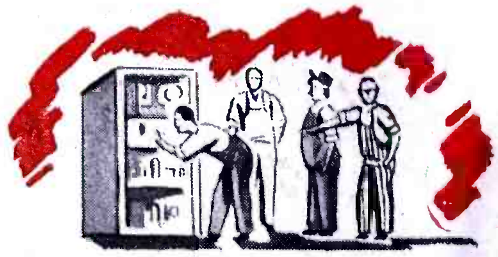
★ RADIO ENGINEERING
★ ELECTRIC MEGAPHONES
★ SIMPLIFIED FILTER DESIGN METHODS
★ AERONAUTICAL COMMUNICATIONS
★ CALIBRATION OF DECIBEL METERS
★ TELEVISION ENGINEERING

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.

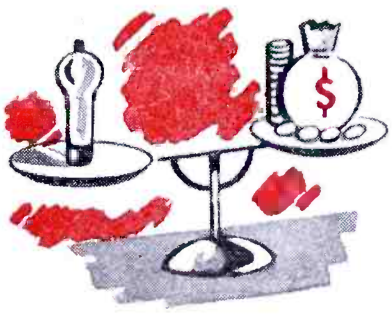
LONGER LIFE . . .

. . . 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.



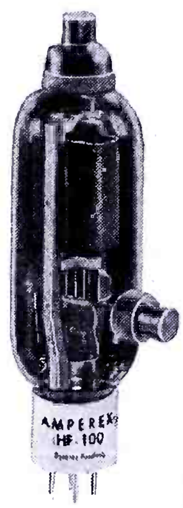
FIGURED . . .

. . . 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.

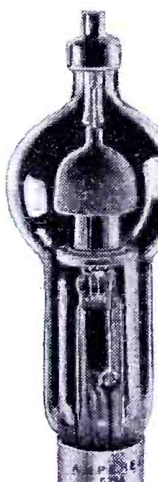


Amperex Type HF-100 Transmitting Tube. Filament Voltage, 10-10.5 volts. Filament current, 2.5 amperes. Amplification factor, 23. Grid to plate transconductance at 100 ma., 4200. Direct interelectrode capacitance: Grid to plate, 4.5 μμf: grid to filament, 3.5 μμf: plate to filament, 1.4 μμf. $12.50, list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

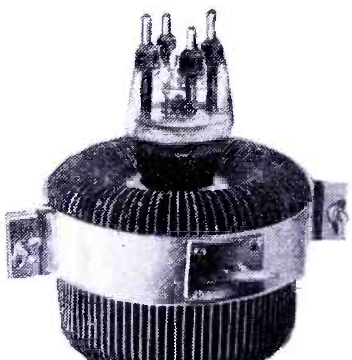
AMPEREX

. . . 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 Type 889-R Transmitting Tube. Filament voltage, 11 volts. Filament current, 125 amperes. Amplification factor, 21. Direct interelectrode capacitance: Grid to plate, 20.7 μμf: Grid to filament, 19.5 μμf: Plate to filament, 2.5 μμf. $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.

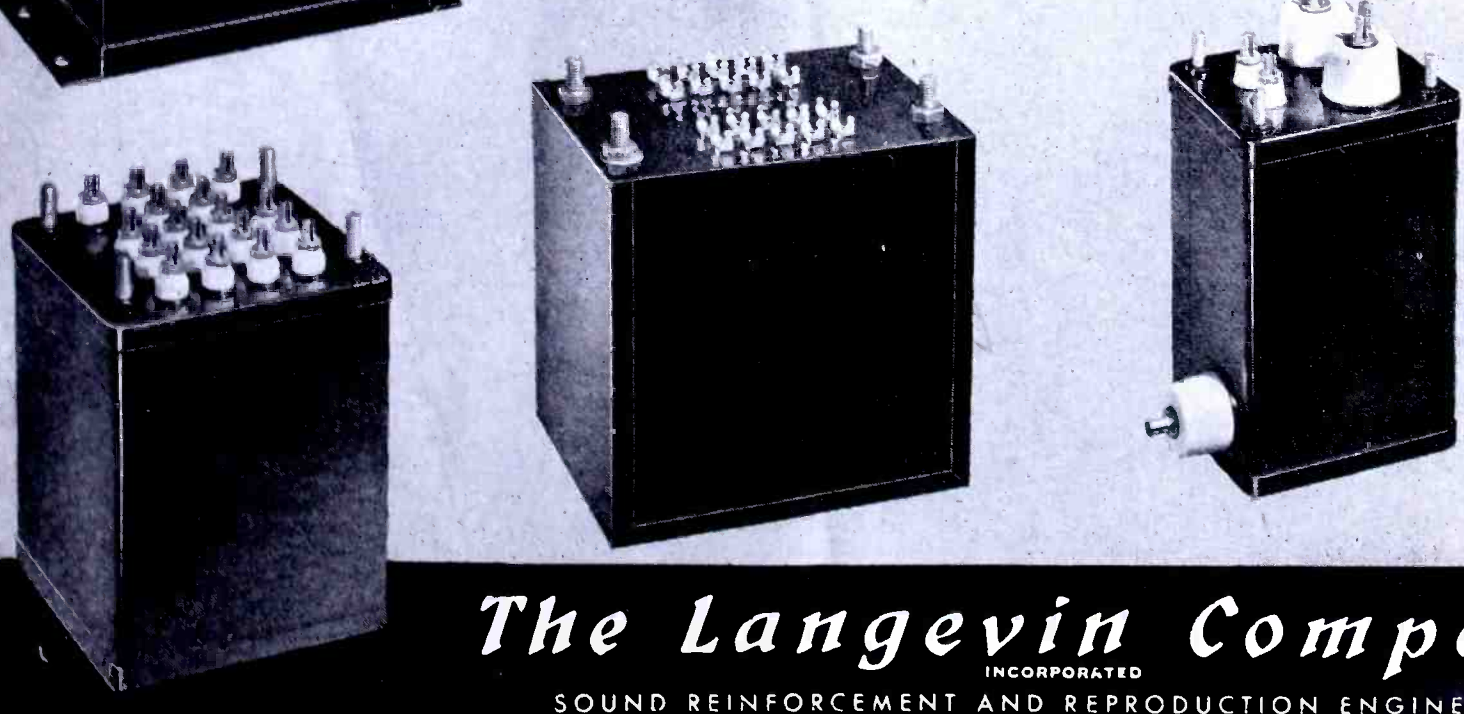
AMPEREX ELECTRONIC CORPORATION

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

TRANSFORMERS *of Special Design*

A few of the many high quality transformers manufactured to critical specification. Rigid control of material and process—*PLUS* conservatism in design insure a dependable long-life product. We solicit your inquiries. Sizes to 5 KVA.



The Langevin Company

INCORPORATED

SOUND REINFORCEMENT AND REPRODUCTION ENGINEERING

NEW YORK	SAN FRANCISCO	LOS ANGELES
37 W. 65 St., 23	1050 Howard St., 3	1000 N. Seward St., 38

LEWIS WINNER, Editor
F. WALEN, Assistant Editor

We See...

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.

COMMUNICATIONS

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

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)

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.

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

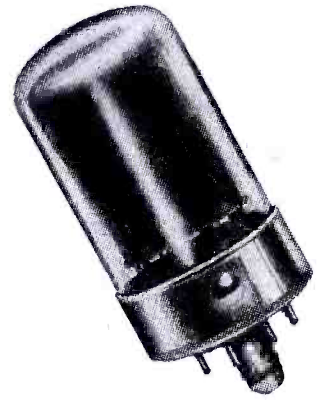
ELECTRONIC EQUIPMENT EDITION

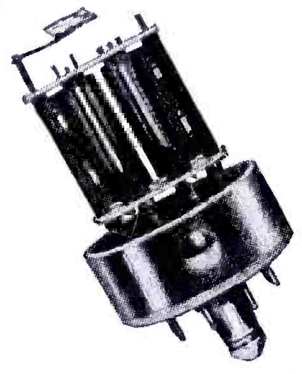
JULY *Published by* **SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa.** **1945**

NEW TUBE HAS SEPARATE CATHODES

Construction Permits Use As A Discriminator

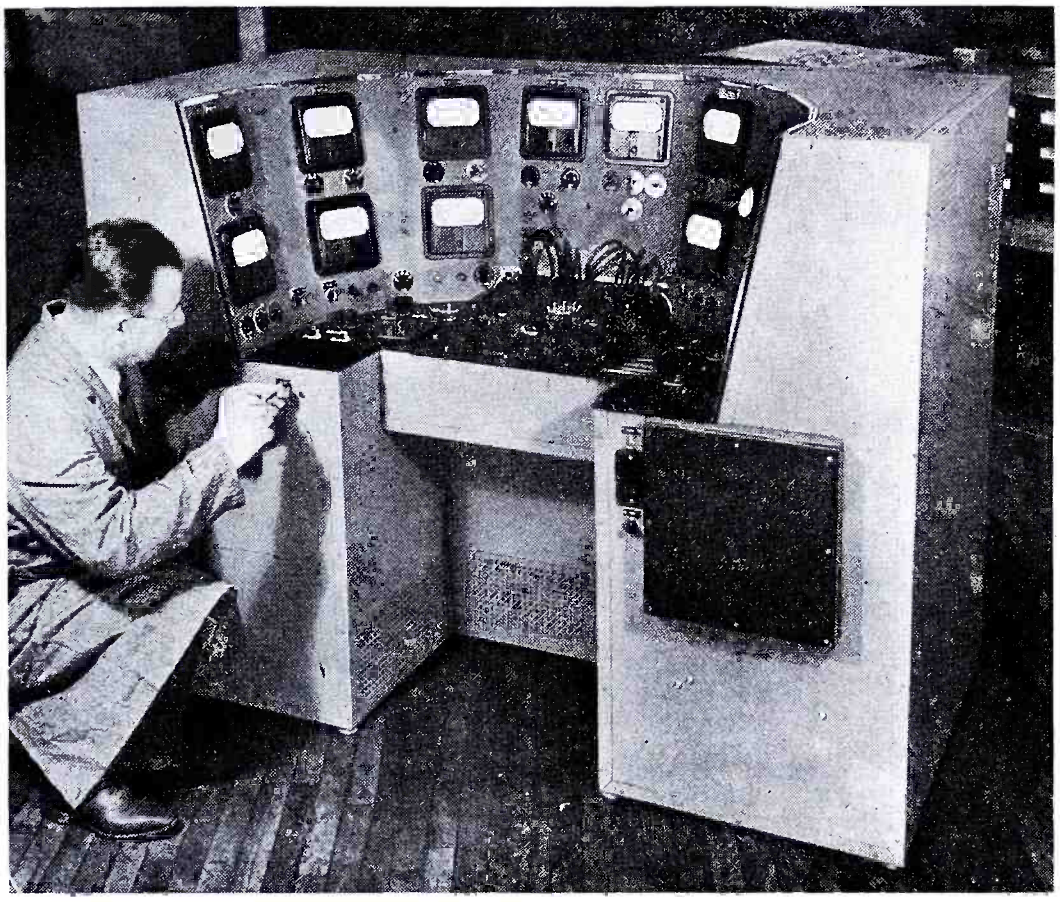
Sylvania Type 7K7 is a duo-diode high-mu triode differing from the usual diode-triode by having two separate cathodes, one for the triode and the other for the diodes.





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 equipment 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.

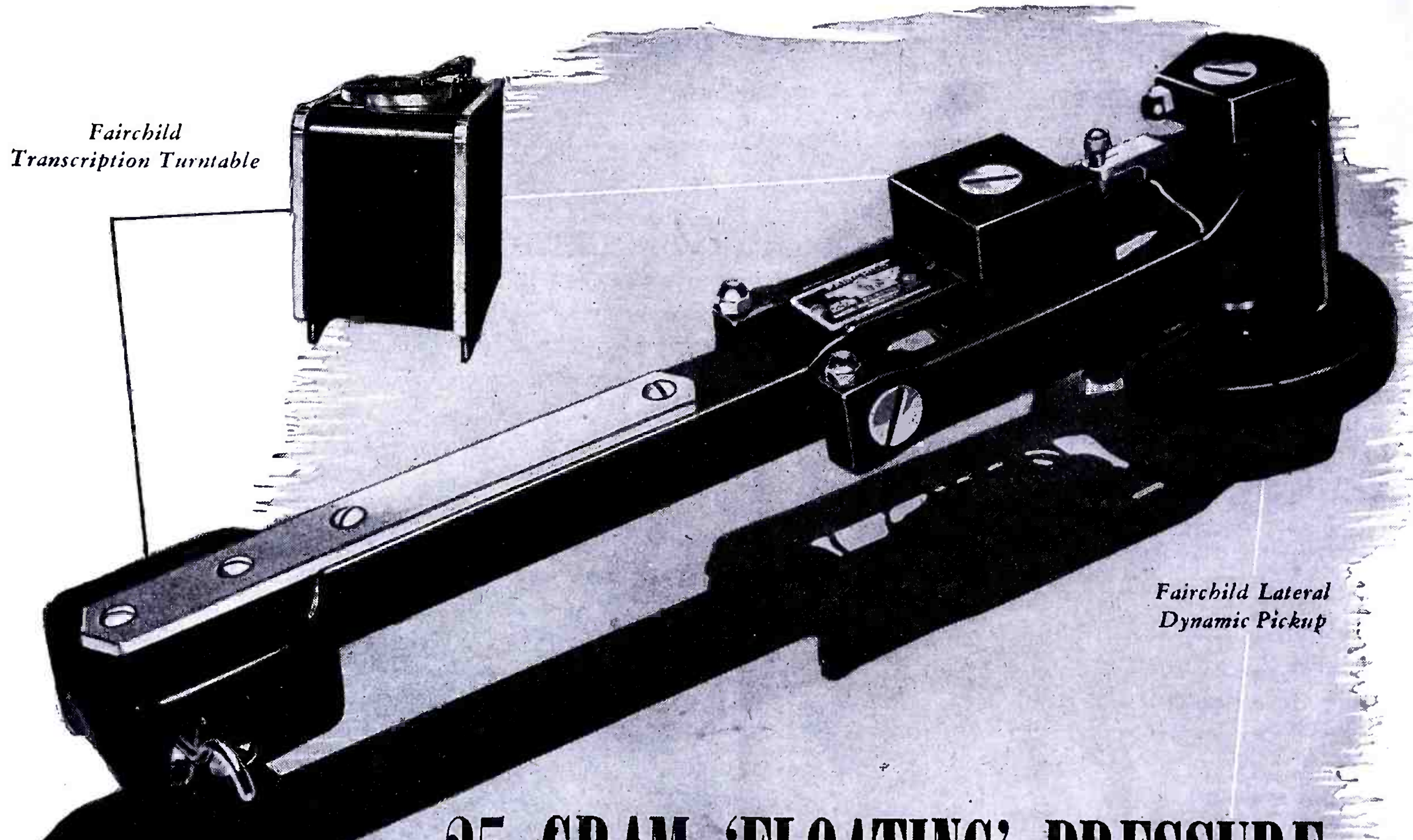
The set is compact, fully shielded, with well-filtered, self-contained power supplies, complete with voltage regulators except AC and DC filament voltages.

SYLVANIA ELECTRIC

Emporium, Pa.

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

SOUND EQUIPMENT – *precisionized* – **mechanically and electronically** – *for finer performance*



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.

SOUND EQUIPMENT

Fairchild CAMERA AND INSTRUMENT CORPORATION

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.

Aireon

MANUFACTURING CORPORATION

Formerly AIRCRAFT ACCESSORIES CORPORATION

Radio and Electronics • Engineered Power Controls

NEW YORK • CHICAGO • KANSAS CITY • BURBANK


Weigh the Advantages
of MOLDED OIL PAPER CAPACITORS
CN35A103
TYPE DP
TOBE
U.S.A.
10,000 MMF.
★ LARGE CAPACITANCE RATINGS
★ CARRY 1 AMPERE R.F.
★ HIGH SHUNT RESISTANCE
★ LOW POWER FACTOR
★ USABLE FROM −55°C. TO +105°C.
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.
CAPACITANCES: 1000 to 50000 mmfd.
WORKING VOLTAGES: 120 to 800 v.d-c
SIZES: CN20 and CN35
TOBE DEUTSCHMANN CORP.
TOBE
CANTON · MASSACHUSETTS
FIELD OFFICES IN NEW YORK CITY ● CHICAGO ● DETROIT ● GLENDALE, CALIFORNIA

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 holdover 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.

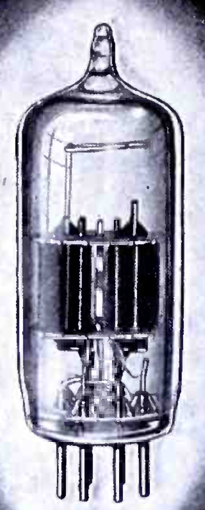
Although all the tubes we produce now go to the armed forces, we invite inquiries from prospective users. A list of the tube types we are especially equipped to produce will be sent on request.

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

NORELCO 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

Norelco Reg. U. S. Pat. Off. *Electronic Products by* **NORTH AMERICAN PHILIPS COMPANY, INC.**

Dept. E-7, 100 East 42nd Street, New York 17, N. Y.
Factories in Dobbs Ferry, N. Y.; Mount Vernon, N. Y. (Metalix Div.); Lewiston, Me. (Elmet Div.)



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.

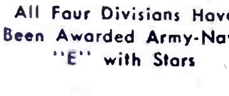
Applications utilizing Raytheon Type 6J6 are varied an numerous, ranging from a diode detector to an ultra hig frequency push-pull oscillator capable of producing usefu energy at frequencies of several hundred megacycles. I unique construction lends itself to connection as a hig permeance diode, a single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

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

SPECIFICATIONS OF 6J6

DIMENSIONS:		
Maximum Over-all Length	2⅛	inches
Maximum Seated Height	1⅞	inches
Maximum Diameter	¾	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	μμf
Input	2.2	μμf
Output	0.4	μμf
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

Listen to
"MEET YOUR NAVY"
AMERICAN BROADCASTING CO.
Every Monday Night
Coast to Coast
181 Stations

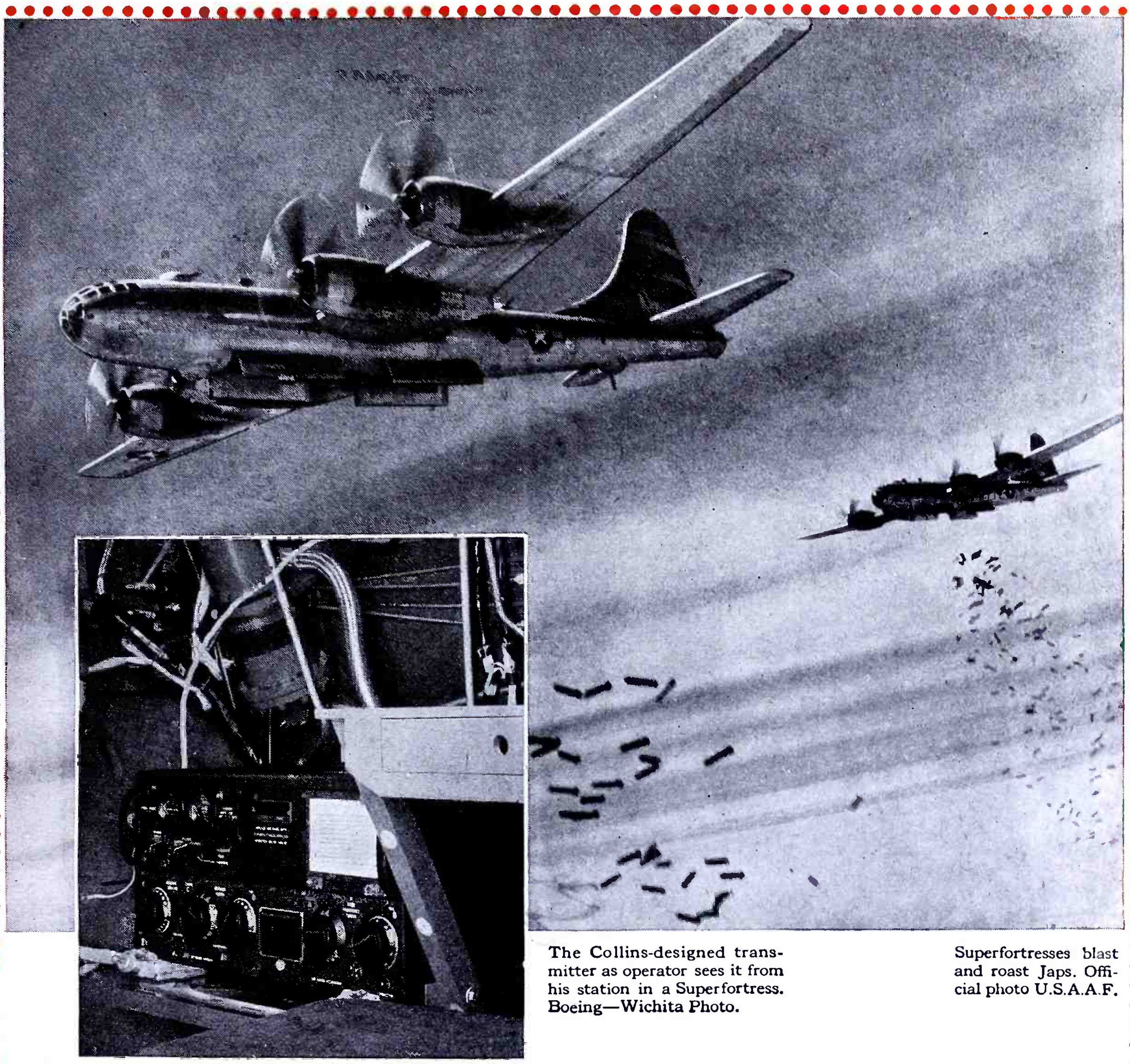


All Four Divisions Have Been Awarded Army-Navy "E" with Stars

RAYTHEON

MANUFACTURING COMPANY
RADIO RECEIVING TUBE DIVISION
NEWTON, MASSACHUSETTS — LOS ANGELES
NEW YORK — CHICAGO — ATLANTA

DEVOTED TO RESEARCH AND THE MANUFACTURE OF TUBES AND EQUIPMENT FOR THE NEW ERA OF ELECTRONIC



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

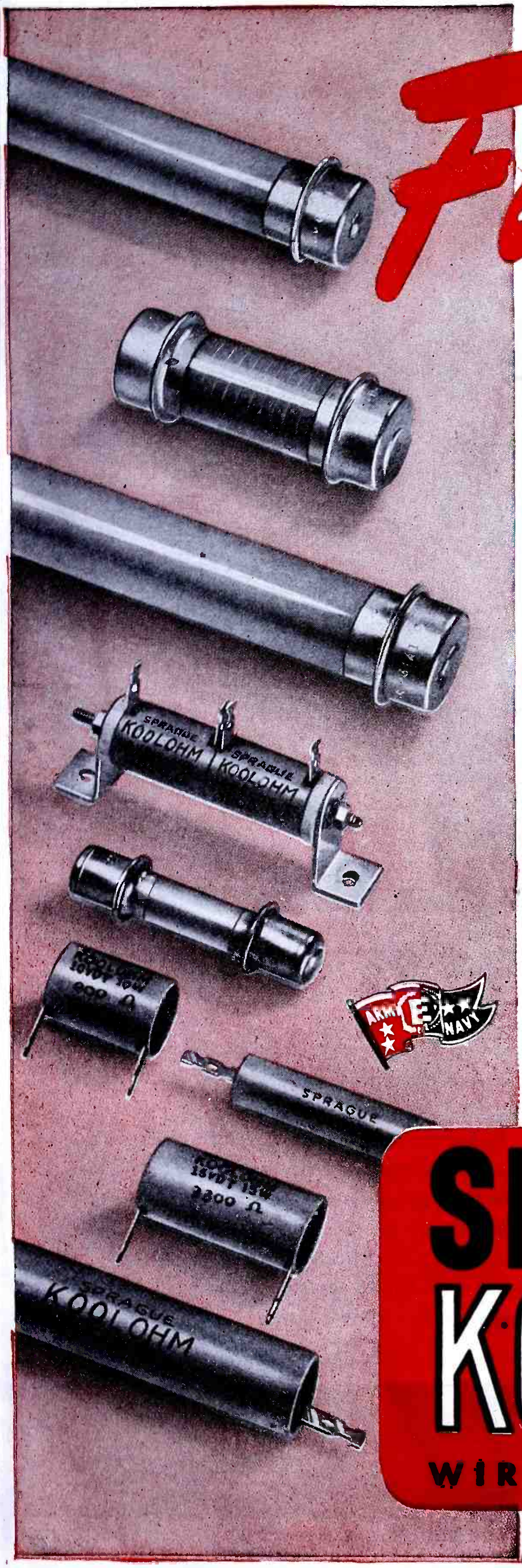
THE FIRST MESSAGE from the Army's first Boeing Superfortresses over Japan, on the Yawata mission of June 15, 1944, was transmitted by a Collins radio transmitter of the type shown above. From that time on, this transmitter has been standard equipment for all the Superforts, as it is also for the larger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

ARMY E NAVY

IN RADIO COMMUNICATIONS, IT'S . . . COLLINS



First with GRADE 1, CLASS 1 RESISTORS

(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!)

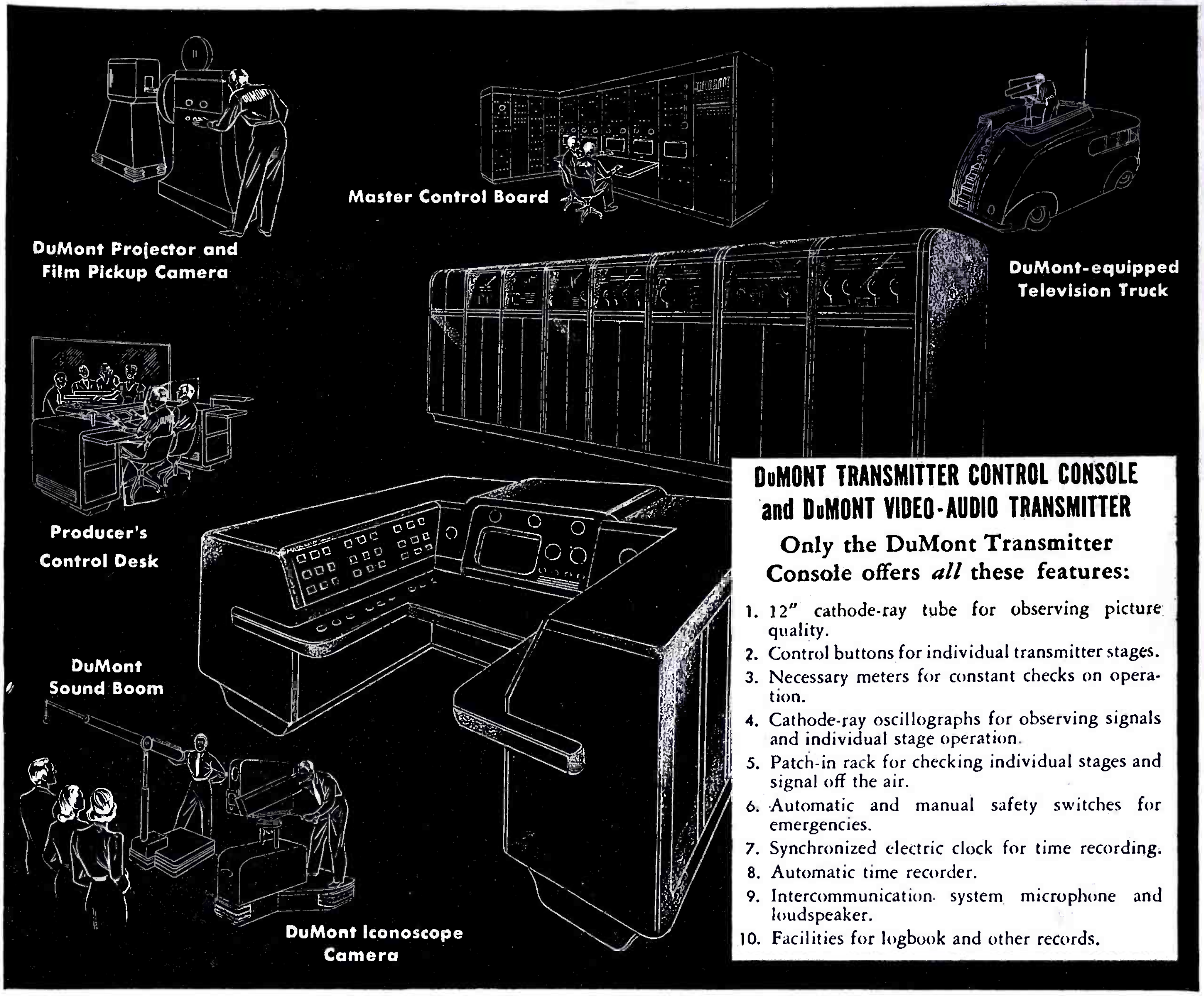
One after another, Sprague Koolohm Resistors have established new performance records as proved indisputably by the record. One after another Koolohm Resistors have revolutionized traditional limitations to wire wound resistor usage—because radically different Koolohm construction permits a higher degree 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 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—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.

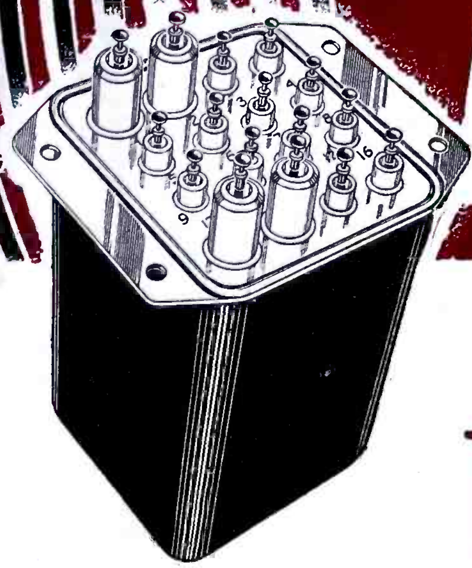
DuMont has equipped *more* television stations than any other company. Week-in, week-out, these stations are demonstrating the high pickup and transmitting quality and efficiency, the extreme flexibility, rugged dependability and low operating cost of DuMont-engineered equipment.

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!*

DUMONT *Precision Electronics and Television*

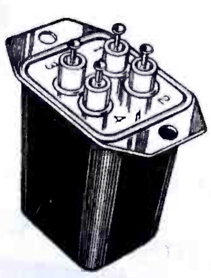
ALLEN B. DuMONT LABORATORIES, INC., GENERAL OFFICES AND PLANT, 2 MAIN AVENUE, PASSAIC, N. J.
TELEVISION STUDIOS AND STATION WABD, 515 MADISON AVENUE, NEW YORK 22, NEW YORK

KYLE TRANSFORMERS



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

"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

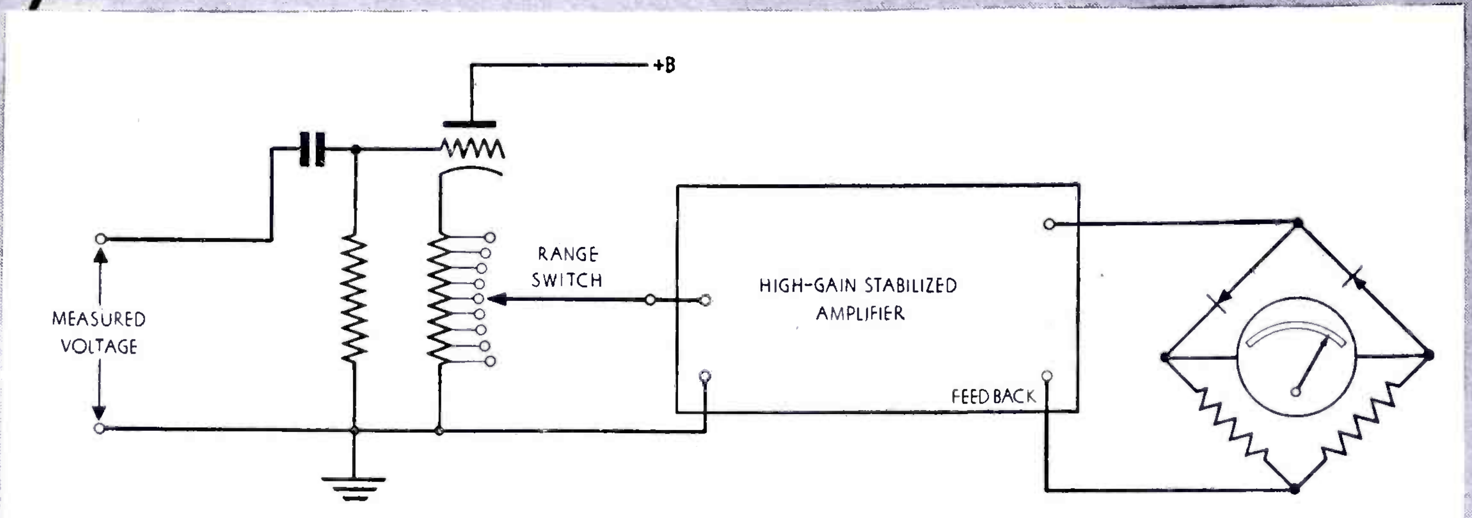
HYTRON

RADIO AND ELECTRONICS CORP.

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

BUY ANOTHER WAR BOND

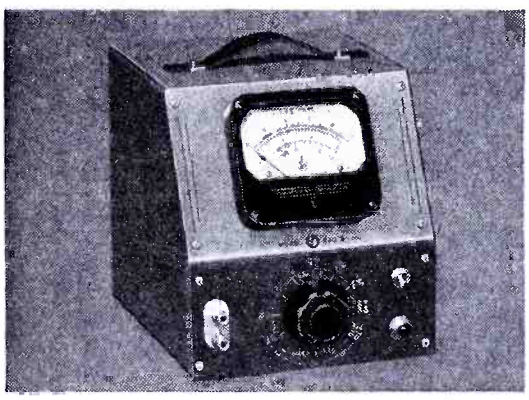
laboratory instruments for speed and accuracy



-hp- Vacuum Tube Voltmeters Employ This Cathode Follower Circuit

The advantages are many!

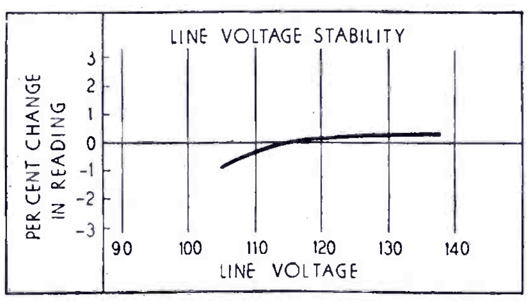
This cathode follower circuit provides an input impedance of 1 megohm and a useful means for varying the meter sensitivity. There are nine ranges, each related to the next by 10 db steps. No adjustment to zero position is required, and the ranges are instantly available by a switch on the panel.



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 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.

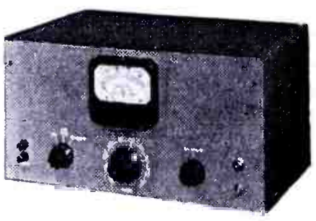
The *-hp-* Model 400A is designed for the greatest amount of convenience. Its small physical size and large slanting scale make it desirable to use and easy to read. Power supply is completely contained. All-in-all, the *-hp-* Model 400A is probably one of the most useful, versatile instruments in the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



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.

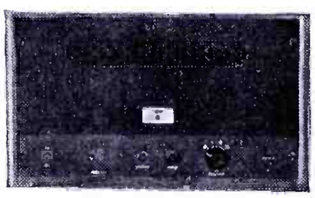


Electronic Frequency Meter

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.

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1047

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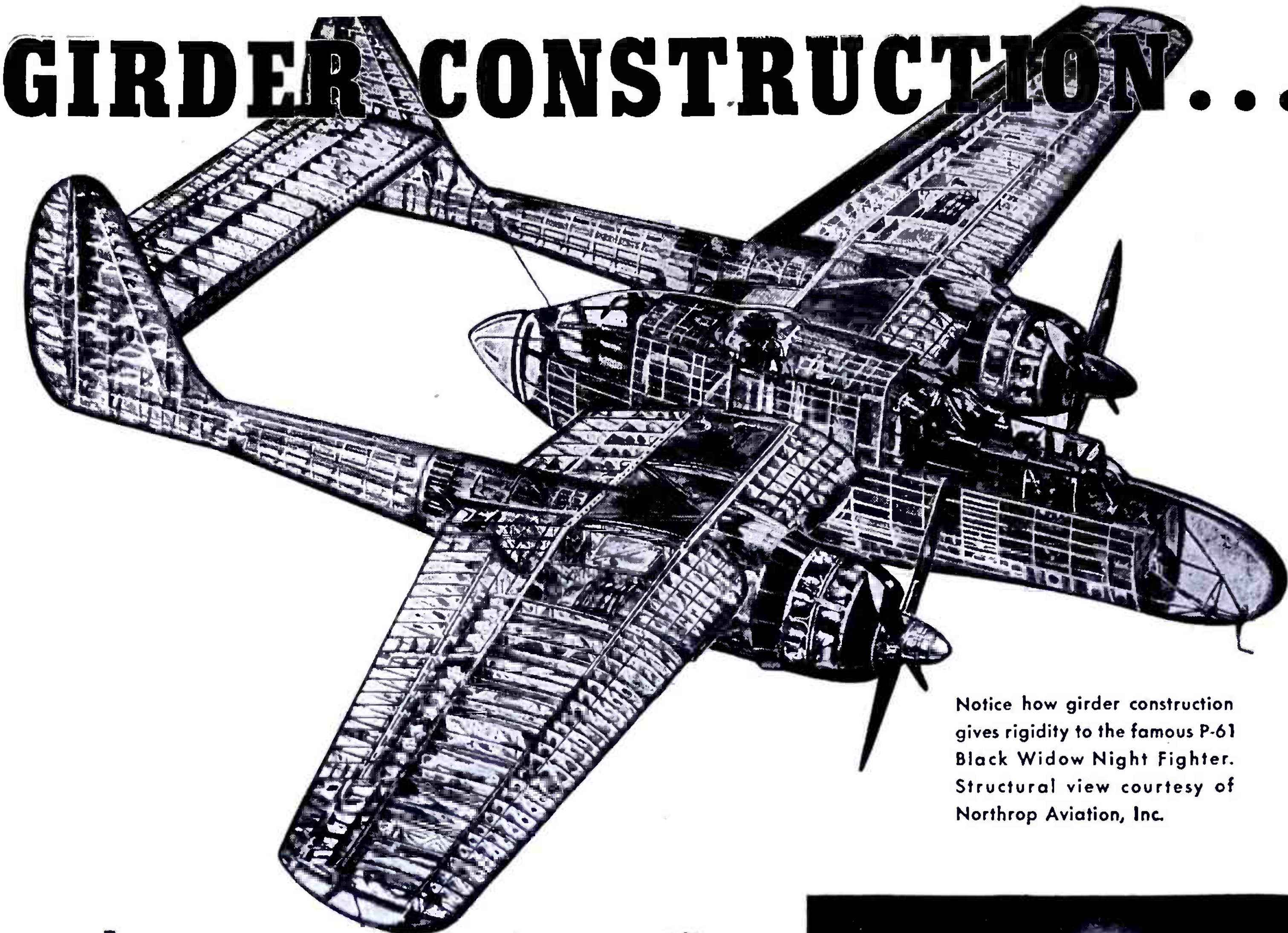
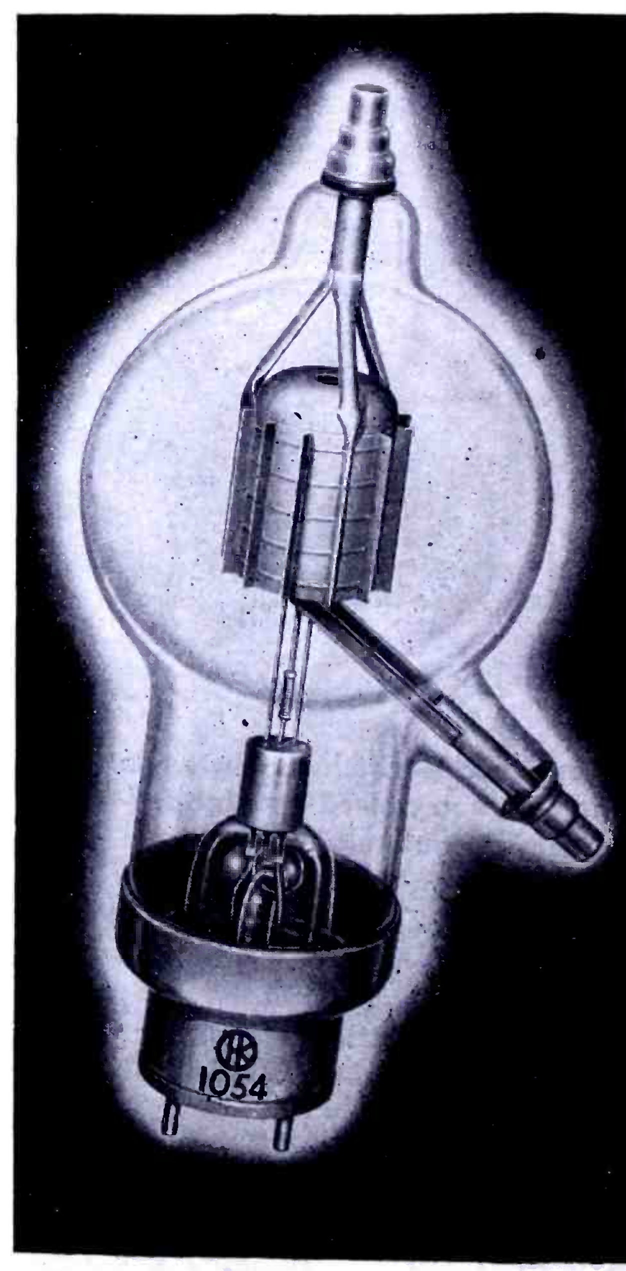


Notice how girder construction gives rigidity to the famous P-61 Black Widow Night Fighter. Structural view courtesy of Northrop Aviation, Inc.

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.

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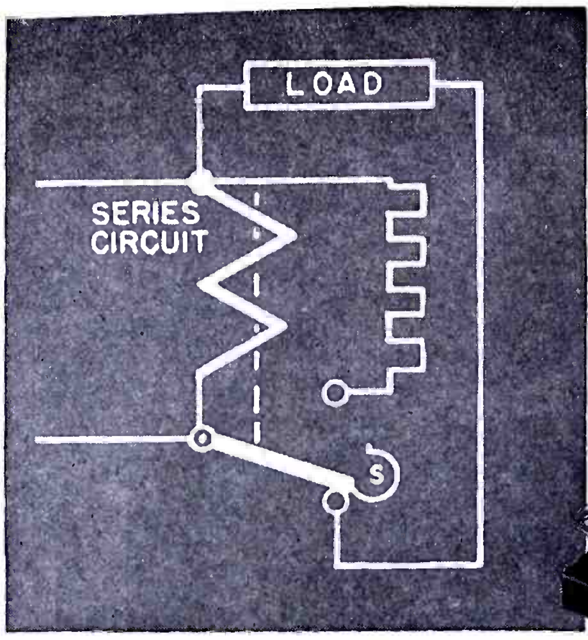
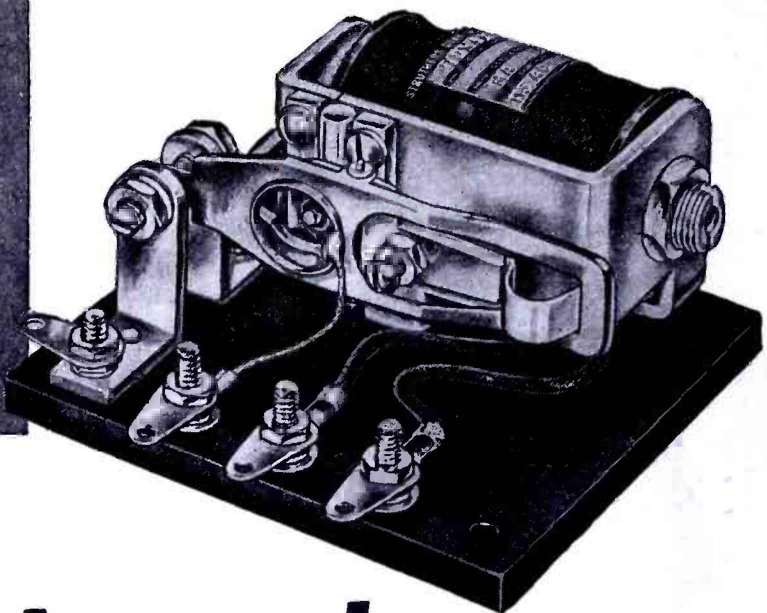


An extremely close differential application using a shunted coil circuit on the armature of a standard Struthers-Dunn Type 79XAX Snap-Action Relay.



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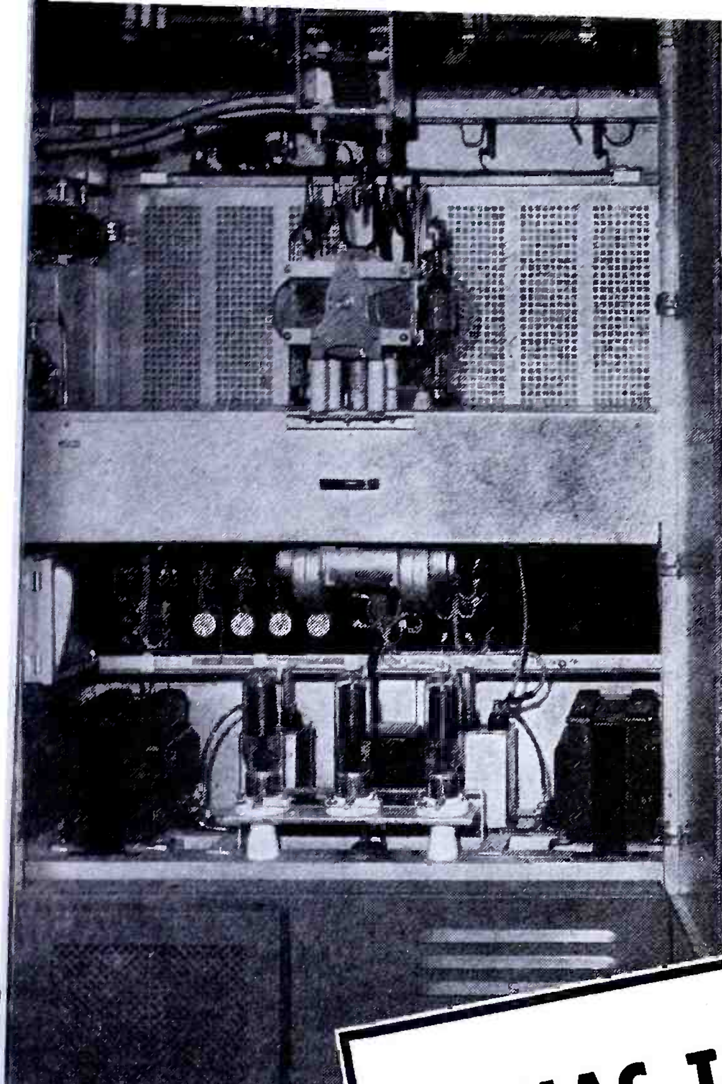
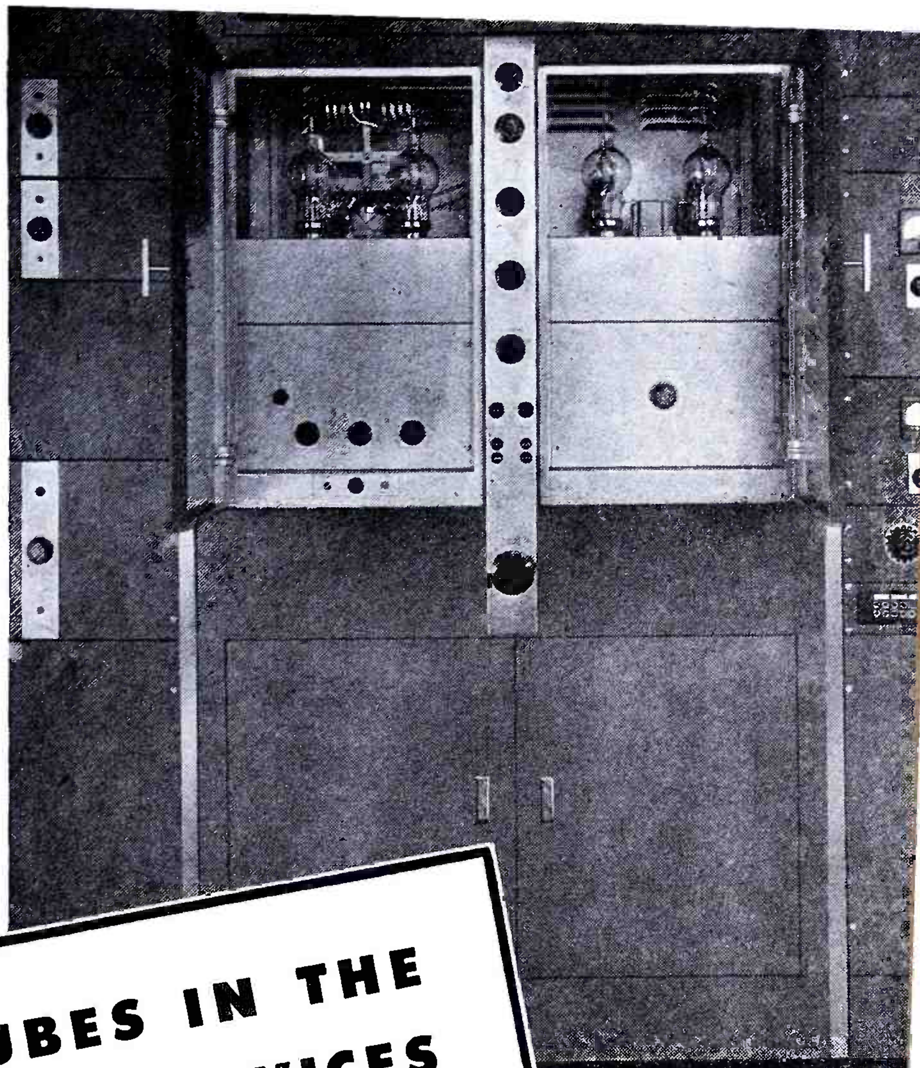
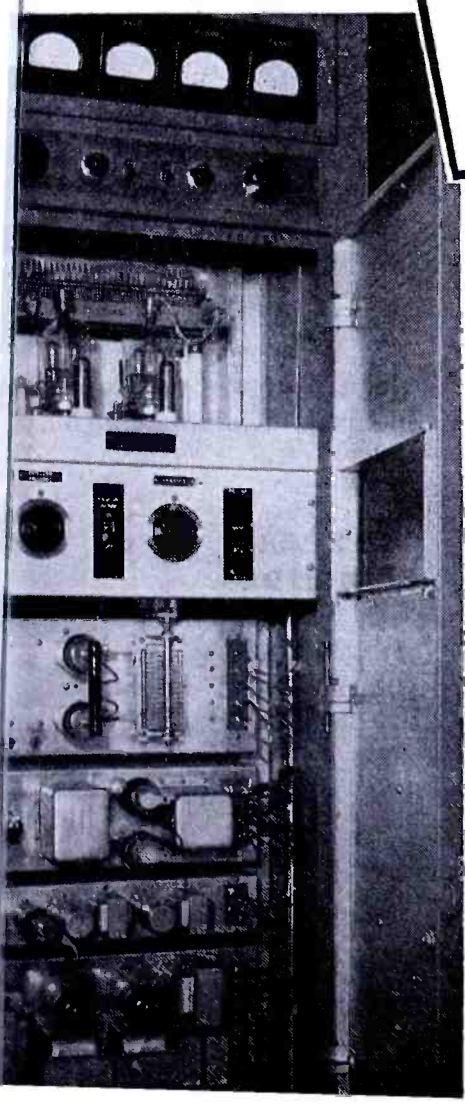




ir of Eimac 1000-T's give 3 KW ut in this Link-built FM trans- r for the emergency services.

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

's a 500 watt supersonic test rator for operation at 1 to 300 which uses Eimac 152-T tubes.



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.

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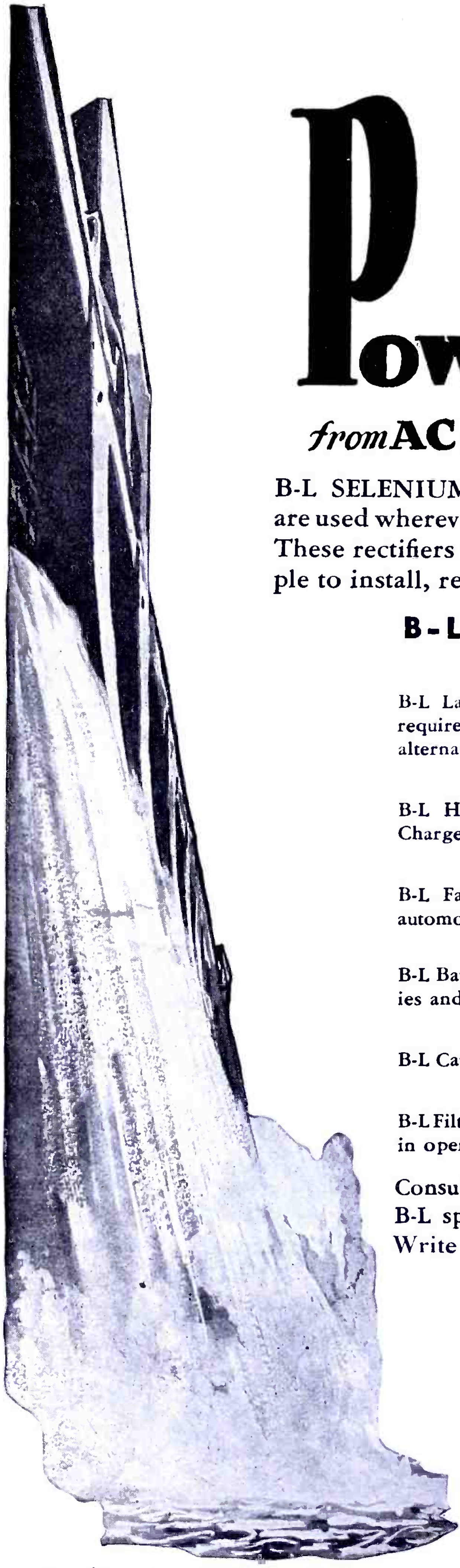

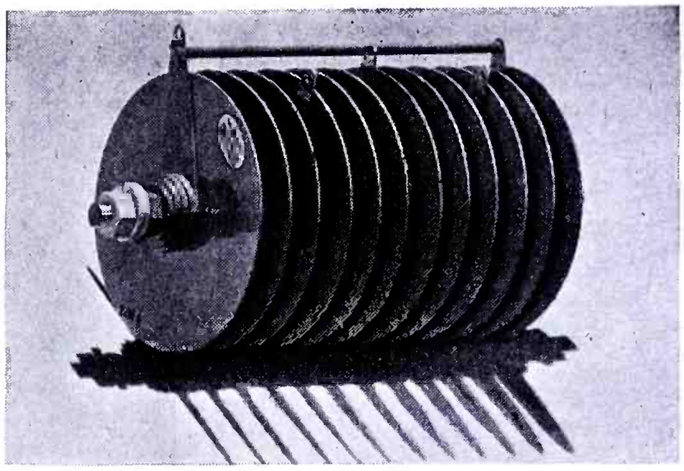

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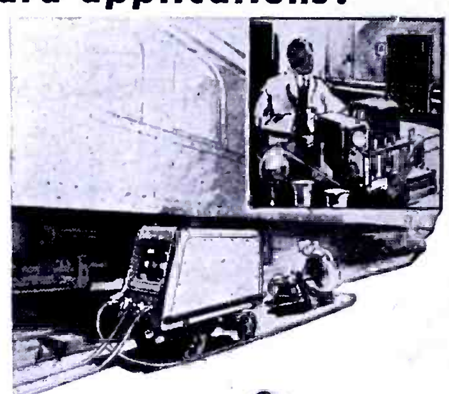

B-L Laboratory Rectopacs for supplying the required voltage of direct current from the alternating current source.

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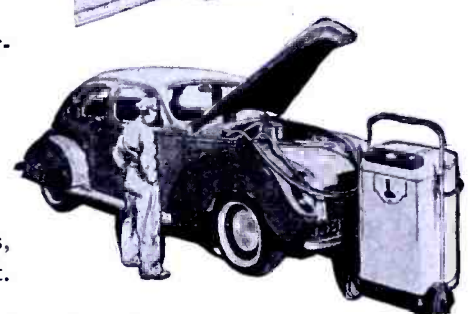

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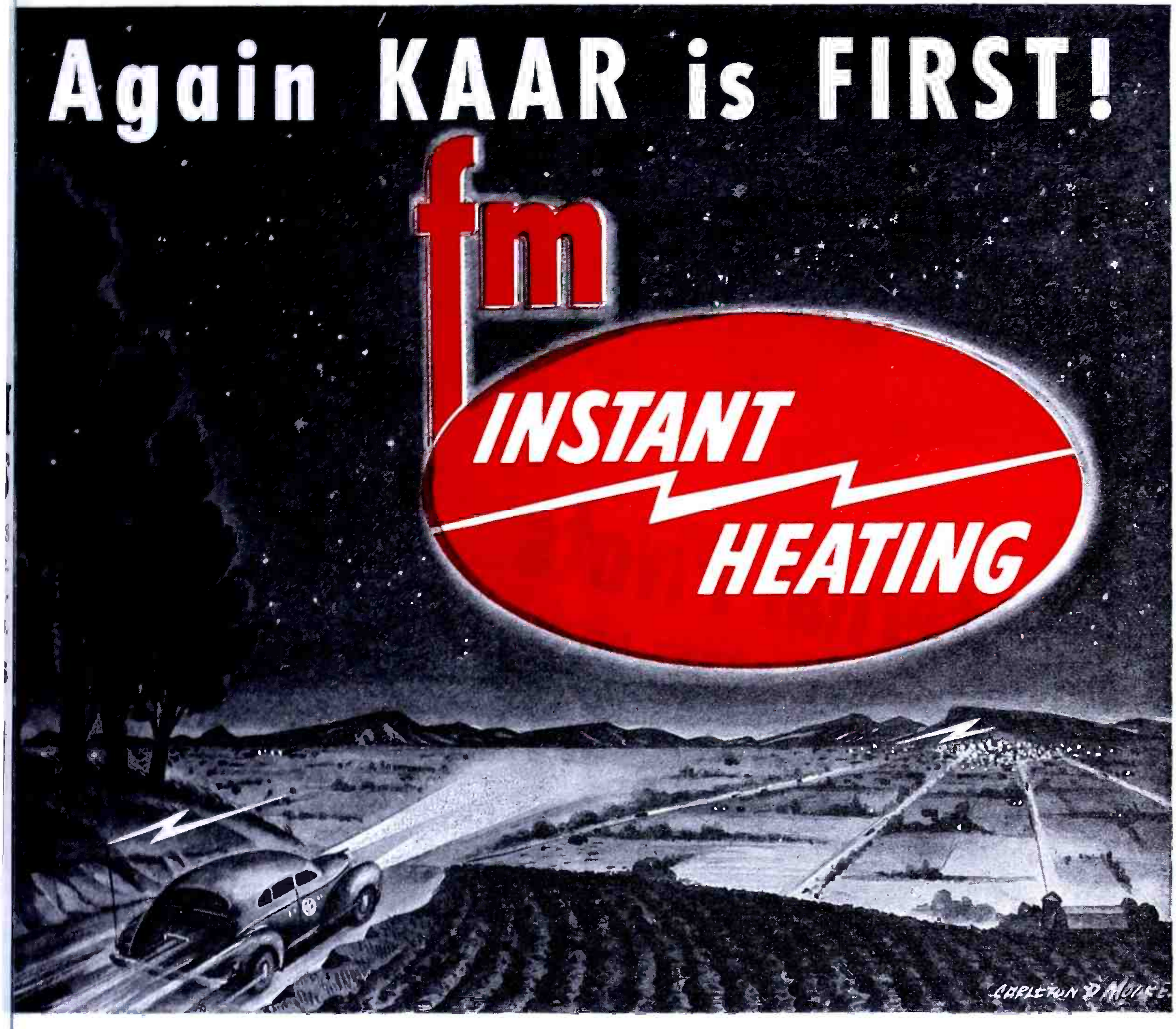

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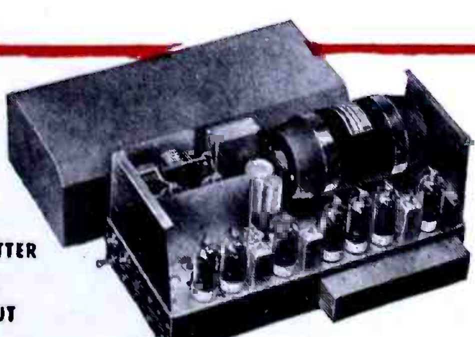

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50 WATTS OUTPUT

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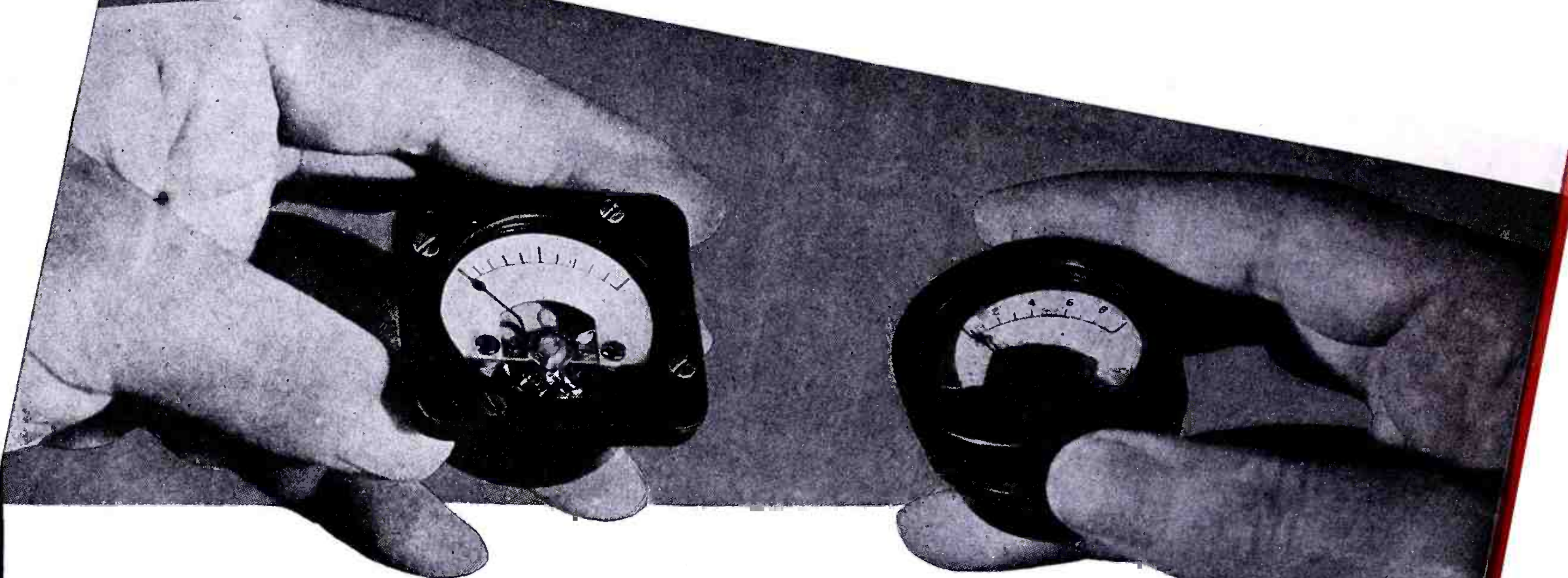

External Pivots

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.

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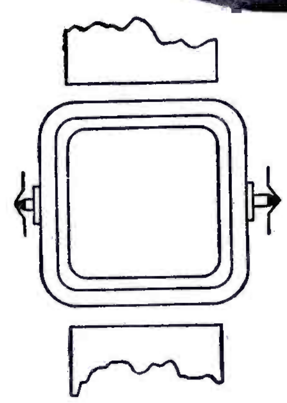
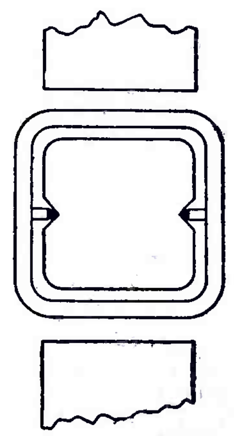


External pivots (above)—used in the design of DeJur 1½″ Meters — provide greater accuracy in mounting the moving element between the jewel bearings. For this reason internal pivots (below) are not used in DeJur meters.



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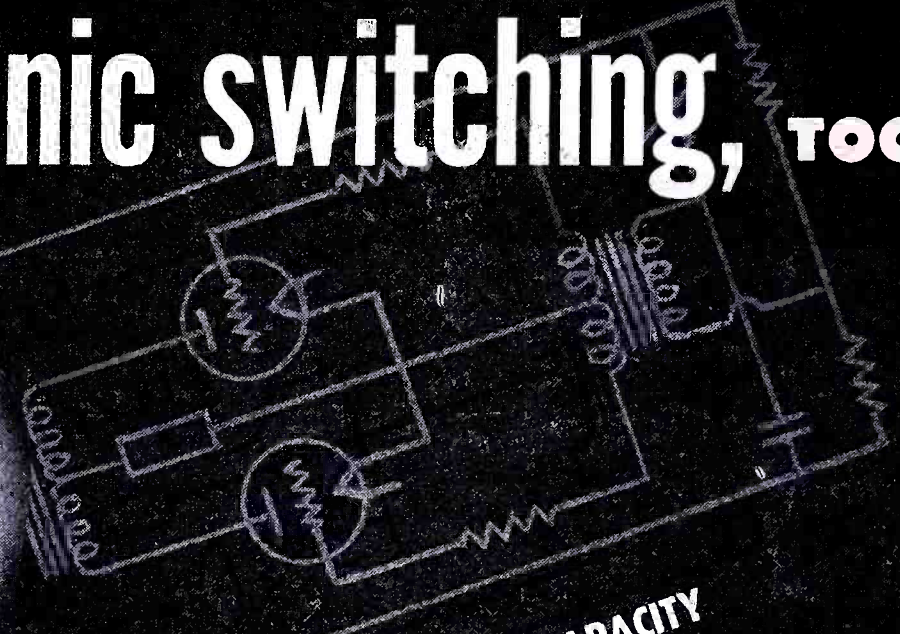

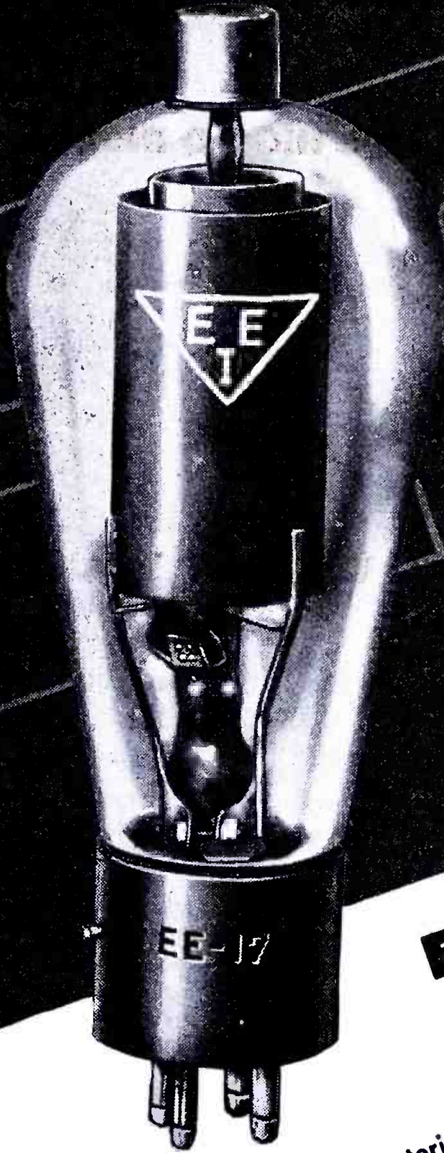

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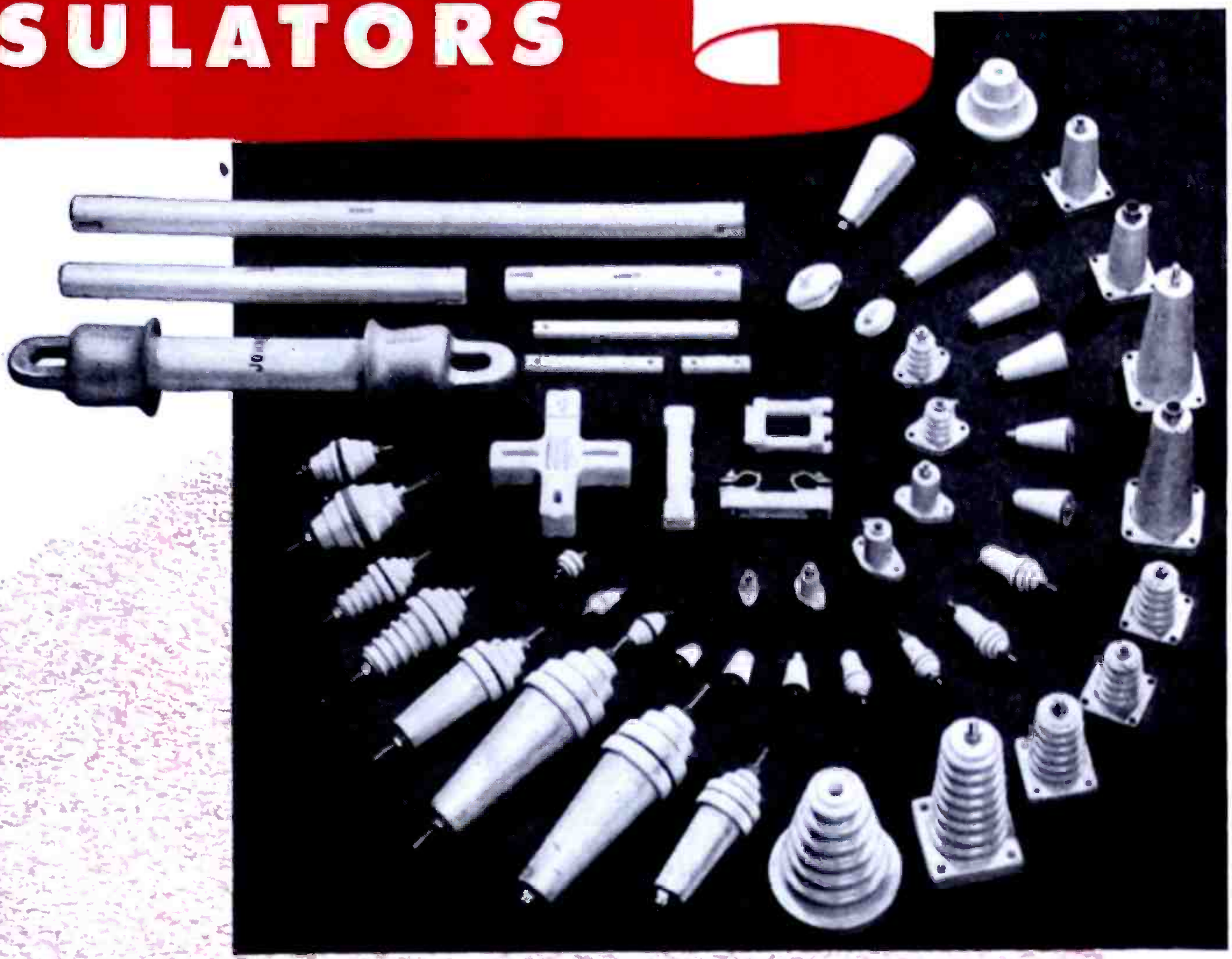

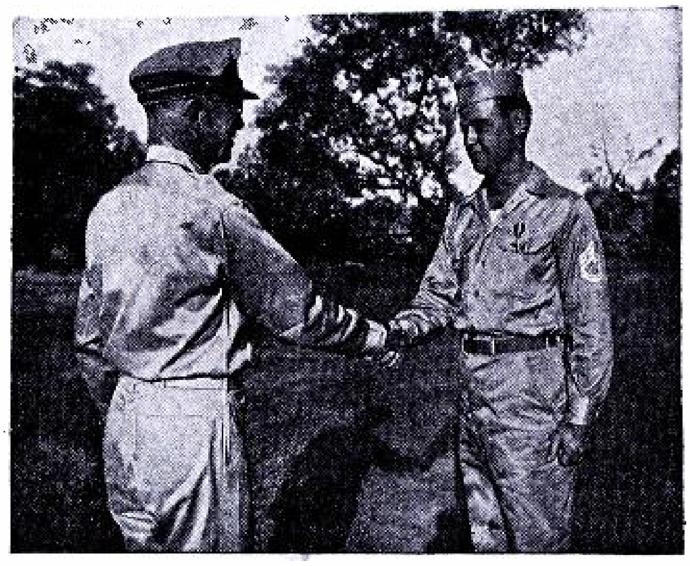

The Pace of Victory Permits Only A Congratulatory Handshake!

American Industry well merits a decoration for its brilliant record in the Mighty 7th! But, as our newly decorated Pacific heroes quickly return to combat, so industrial leaders aren't resting on their laurels. ***Back into Bond action***—they are now busy consolidating recent Payroll Savings Plan gains!

First, many executives are now patriotically working to retain the substantial number of new names recently enrolled during the 7th War Loan. By selective resolicitation, they are urging all new subscribers to maintain Bond buying allotments.

Second, many are also employing selective resolicitation to urge every worker who increased his or her subscription in the 7th to continue on this wise, saving-more-for-the-future basis.

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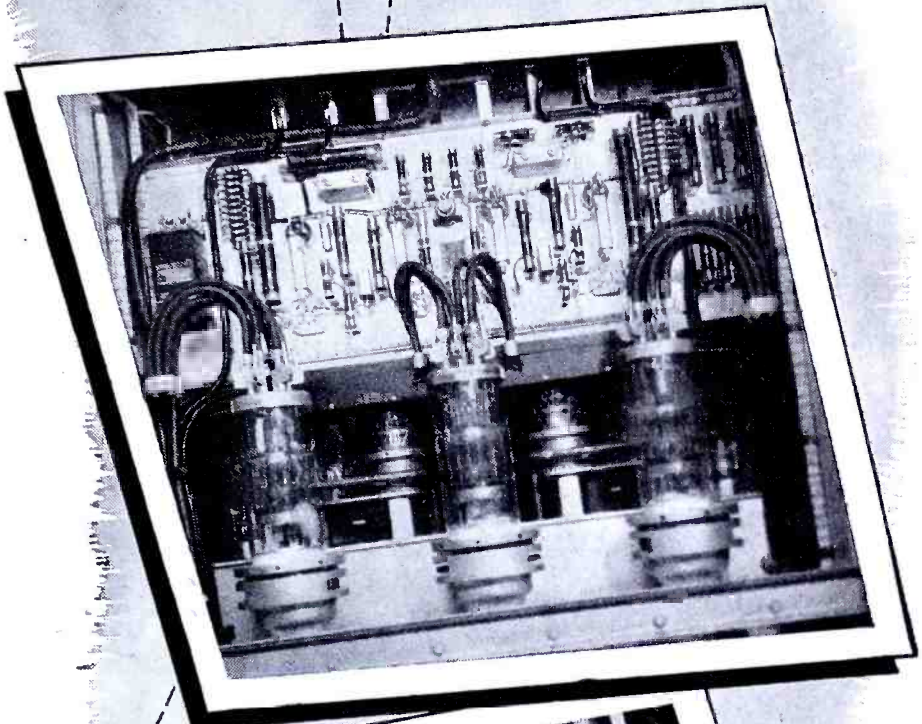

From six of the world's mightiest shortwave stations, the "Voice of America" shoots "bullets of truth" to combat enemy lies. These transmitters, 200 KW each, located in Bethany, Ohio, were designed and built for the OWI by the Crosley Corporation.

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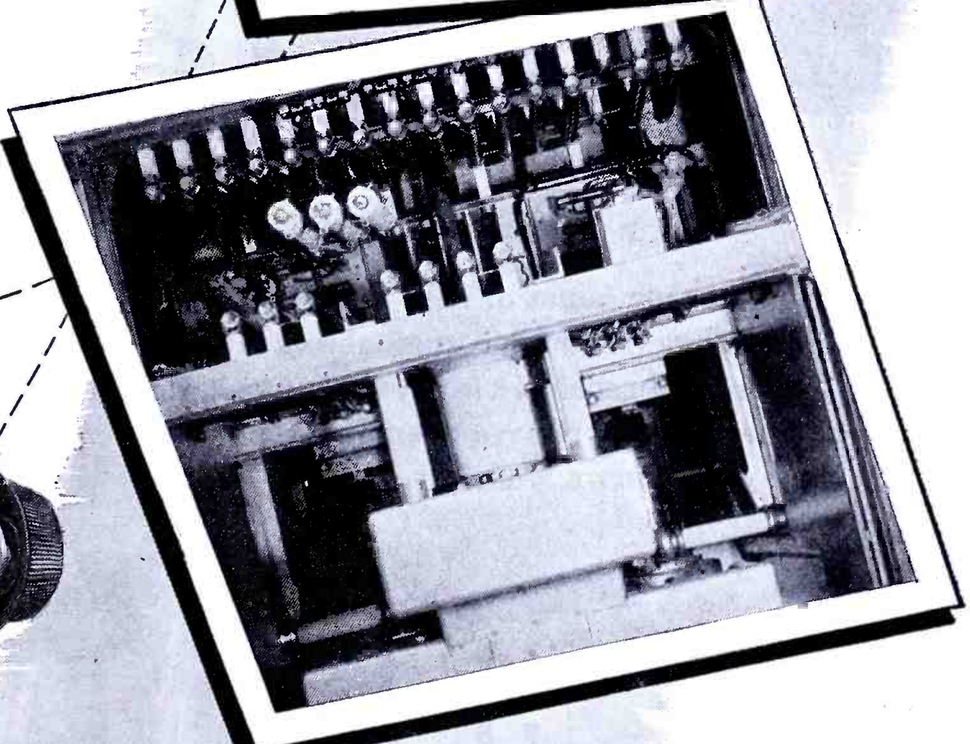

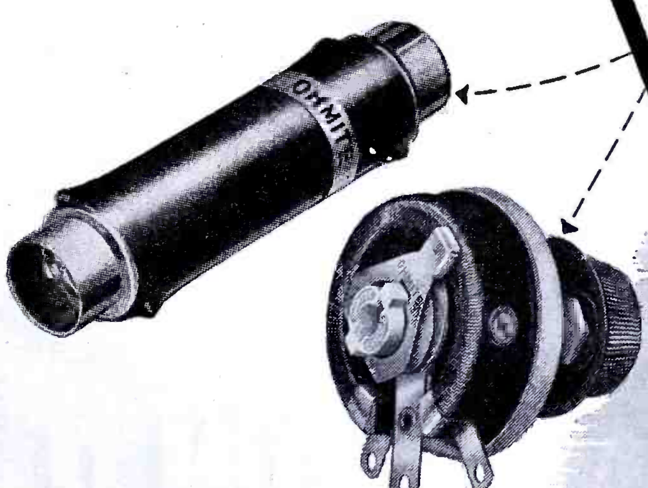

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COMMUNICATIONS

LEWIS WINNER, Editor

* * JULY, 1945 * *

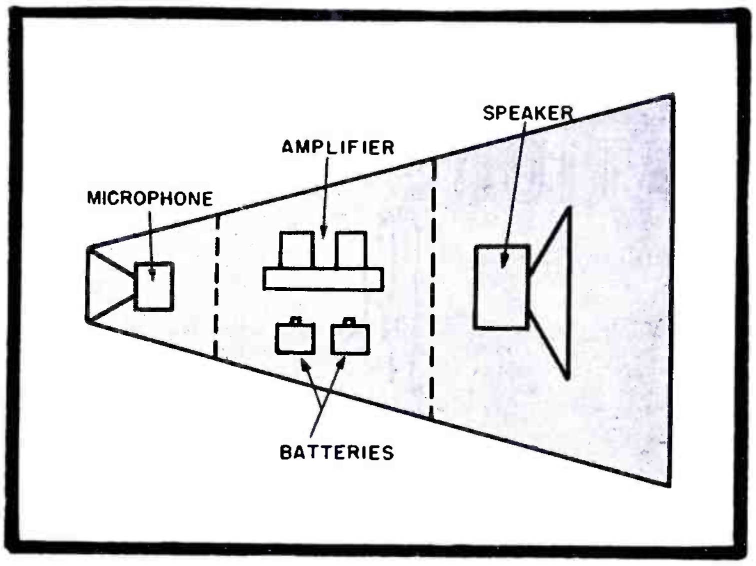
A typical electric megaphone.

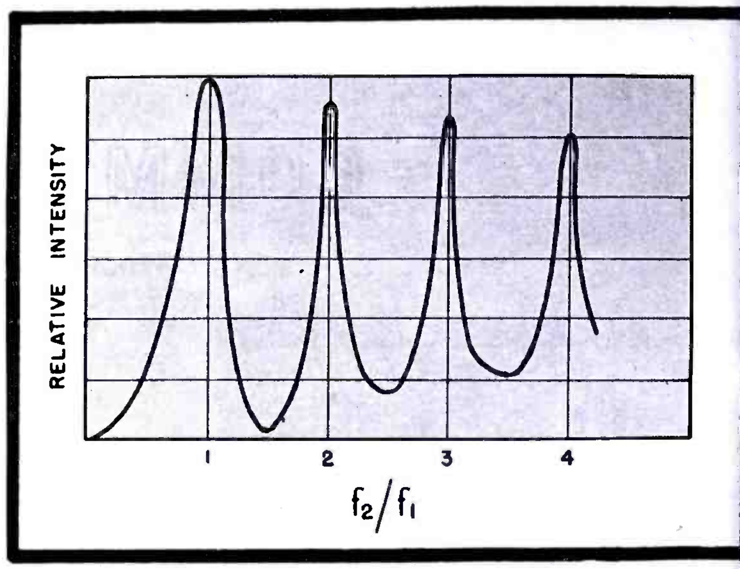
ELECTRIC MEGAPHONES

by ARTHUR J. SANIAL

Chief Engineer
Atlas Sound Corporation

PERHAPS one of the most unique additions to loudspeaker communications equipment in he last few years has been the elec- ic megaphone. The potential use- ılness of such equipment had been ecognized by many, but practical de- gn problems were numerous. Thanks) the recent advancements in the coustic and electronic art, it was ossible to overcome these problems. In the original developmental plans roposed by the writer, the electric negaphone design called for a portable nit which could be used in the same ıanner, 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 megaphone. 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-





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.

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.

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. Widespread use of these electric megaphone showed the limitations of this equip ment, and a demand arose for an elec tric megaphone system which woul amplify the talker's voice to a muc greater volume. It was the consensu that the size and weight of the equip ment, particularly the megaphone it self, could be increased very little. T understand what was required of suc an improved system, let us review son of the technicalities of the origina system.

It might be well to digress at thi point to discuss the question whic arose so often when the electric mega phone was first introduced: "How the electric megaphone better than a ordinary megaphone?" Many person believed an electric megaphone to b no louder and intelligible than the or dinary shipboard megaphone, unt demonstrated under adverse condition Actually, the acoustic output of a prop erly designed electric megaphone sys tem is far greater than that produce by a megaphone, and the intelligibilit is far better. In the first place, a con cal megaphone amplifies only to th extent that it concentrates the talker voice chiefly in a conical beam, th concentration of which is a direc function of the size of the megaphon its proportions, and the frequenc transmitted. It is true that if the mega phone is made extremely long with small angle of taper, a large effectiv amplification can be obtained, but prac tical megaphones average between and 3′ in length. A short conical hor of this order has a relatively low effec tive amplification, particularly sinc this occurs mainly at resonance peak of the fundamental resonance fre quency and harmonics of the conica pipe. The ratio of these peaks to th dips between is so great, that the am

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

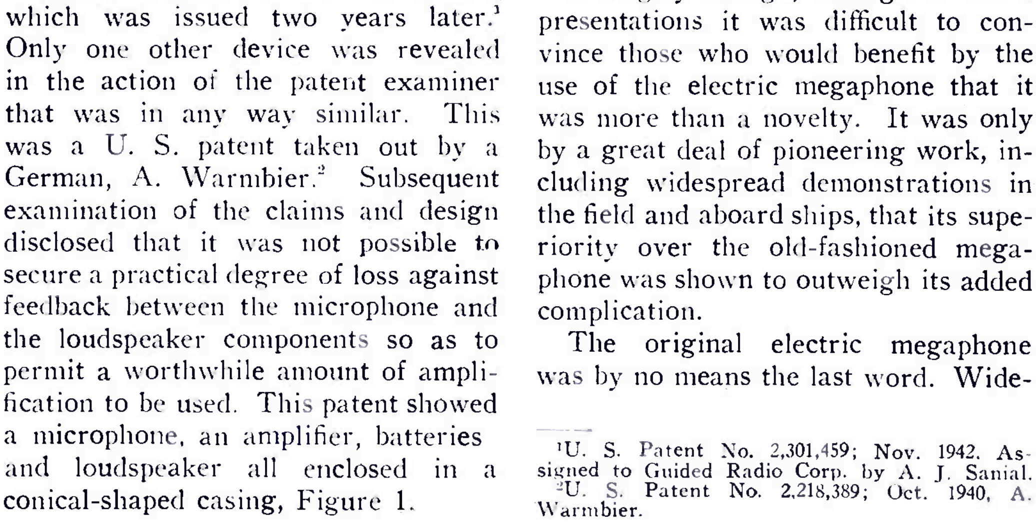


Figure 3
Setup used to test electric megaphones. Artificial mouth is driven by a warble tone of fro 1250 to 1750 cycles.

fication at the dips is practically o, particularly at lower frequencies. stortion of the voice is, therefore, gh, and therefore intelligibility is nsiderably marred. The intensity plification versus frequency of a pical finite conical megaphone is own in Figure 2.[3] Here we see the de variations in output from a source constant power.

From a quantitative standpoint it ght be estimated that an ordinary ort megaphone would give an amplication, at the resonant peaks, of the der of 10 db. The average gain is ich lower. In a well designed elecc megaphone system, the voice may amplified relatively uniformly in the eech band selected as adequate, just in any loudspeaker system designed a given application. The amplifition of the talker's voice does not pend solely on the horn but chiefly the gain and power output of the ctronic system.

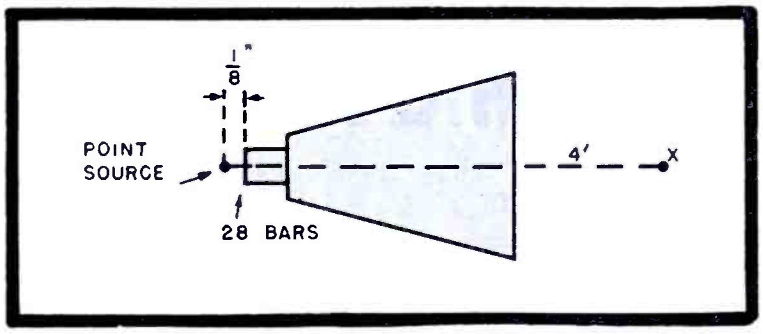
The original electric megaphone sysn was intended to produce 10 dynes r square cm at a point 4′ directly in nt of the megaphone, under standard asuring conditions. In making these ts the megaphone is first set up in acoustically treated sound room ving fairly high absorption in the eech frequency spectrum. Then an ificial mouth is placed directly opsite the microphone opening of the gaphone, and spaced so that when mouth is operating, a known sound essure is produced at a fixed distance m the plane of the microphone openg. The artificial mouth is driven by audio-frequency warble tone, usuy produced by varying a portion of ariable capacitor of a beat-frequency cillator at a constant rate. The war tone usually used is 1,250 to 1,750 cles; these frequencies affording the sults by which performance on voice y be gauged. The output of the gaphone is measured by a laborary standard microphone and amplir whose output is calibrated in terms the pressure in bars at this microone. The latter is placed 4′ in front the horn of the megaphone, and on axis. The setup is shown in Fige 3.

It is possible to secure a reading of e effective amplification the pressure 10 bars represents. It is necessary assume a point source, quite unlike tual conditions, but justified for comrative purposes providing conditions the input end are unchanged. Rering to Figure 4 let us assume 28 rs are produced ⅛″ from a point urce, and that this pressure exists at

[3] Stewart and Lindsay, *Acoustics*, D. Van Nosnd.

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

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

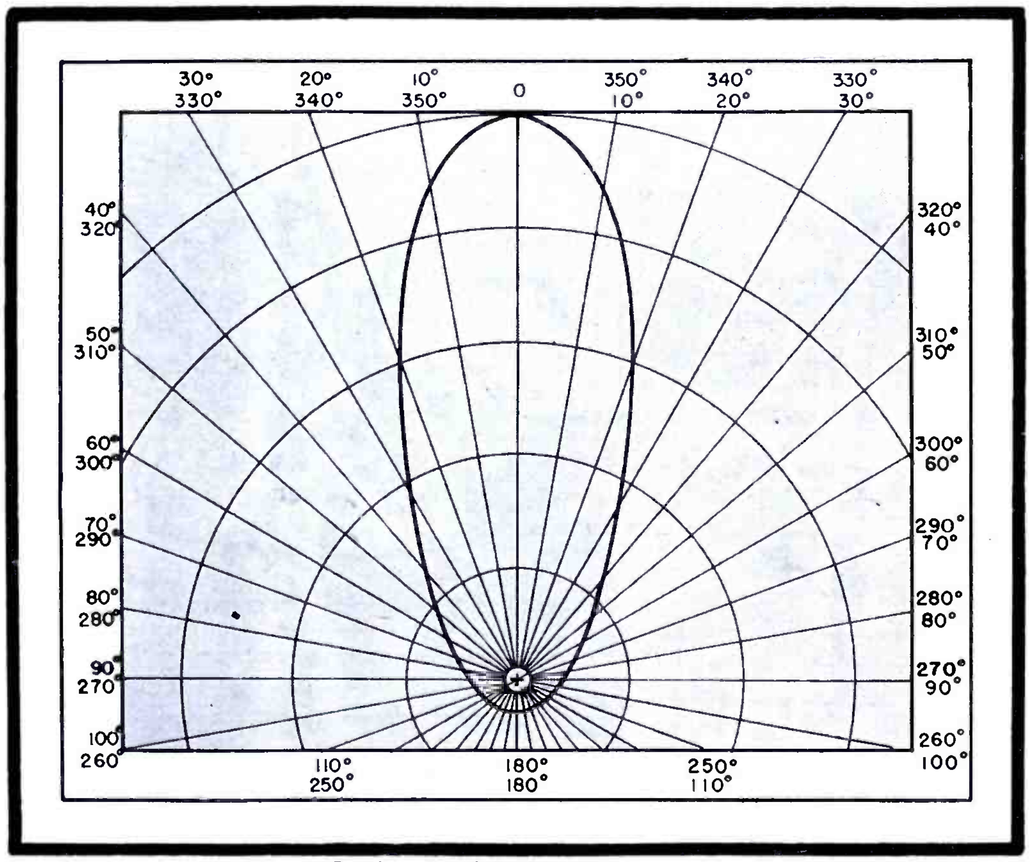
The increase of sound pressure of the voice is then in the ratio of

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

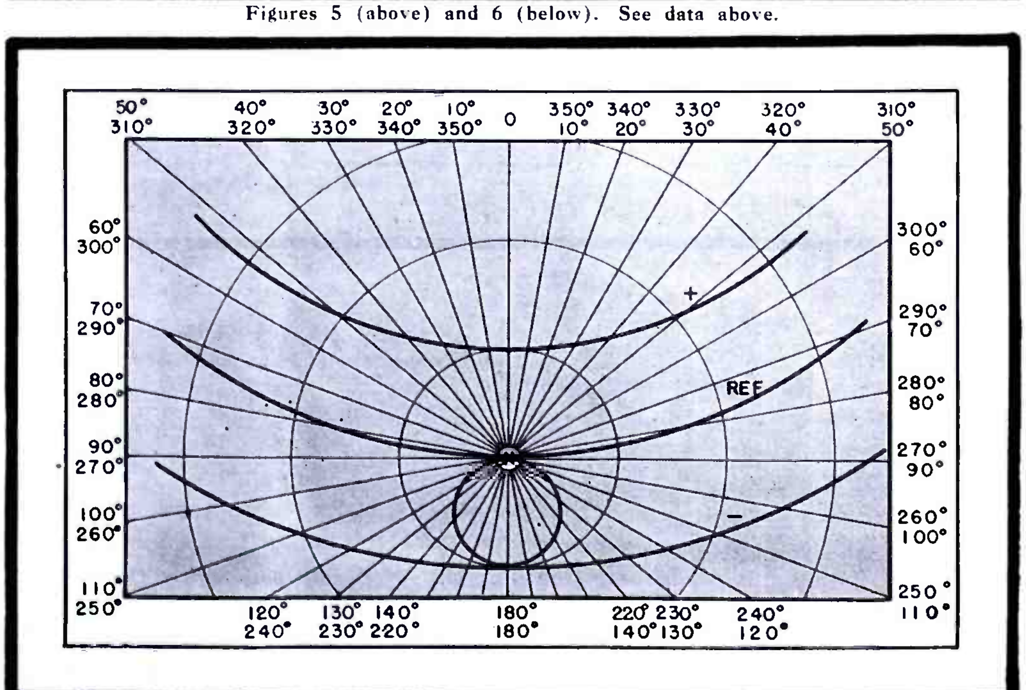
This is a considerable increase.

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.



COMMUNICATIONS SYSTEM

by RALPH G. PETERS

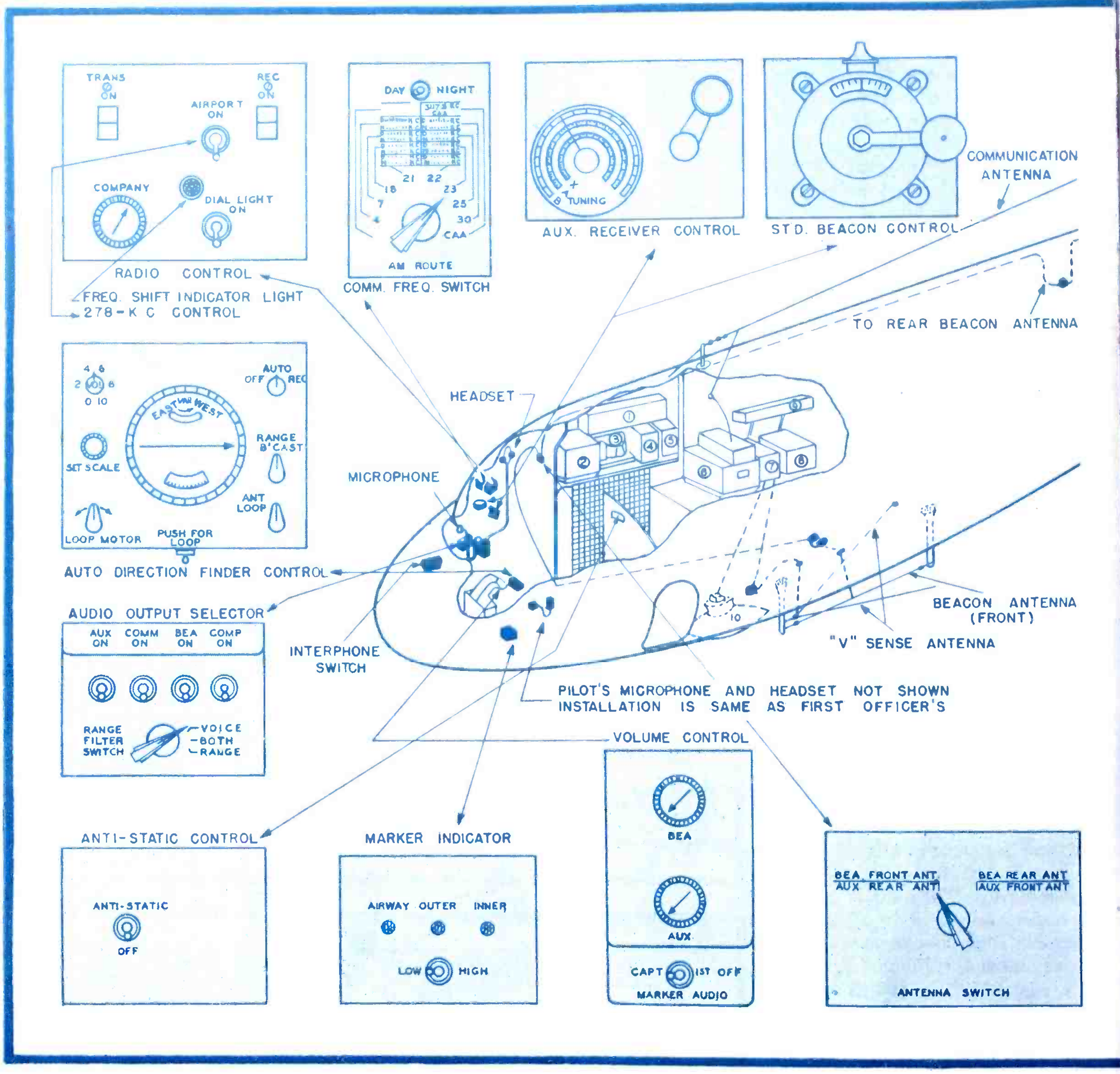


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Figure 1

DC-3 communications-equipment location diagram.

•

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; vibrators, 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. Oscillator 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-

BOARD DC-3 AIRCRAFT

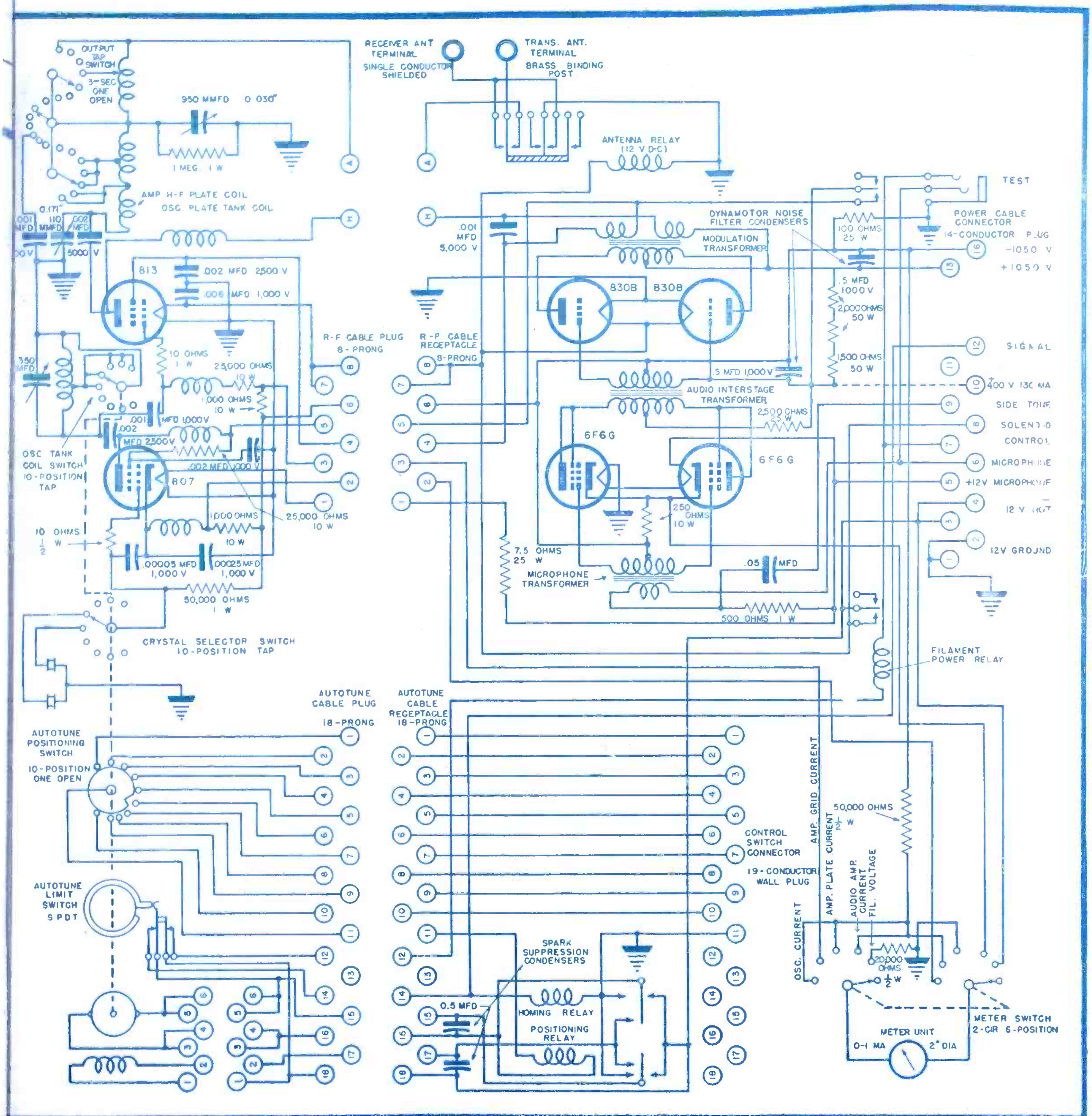
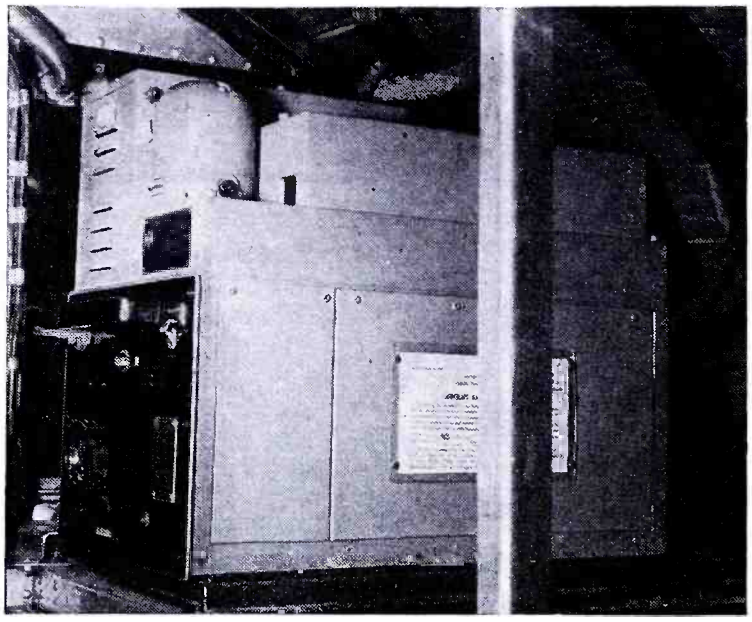


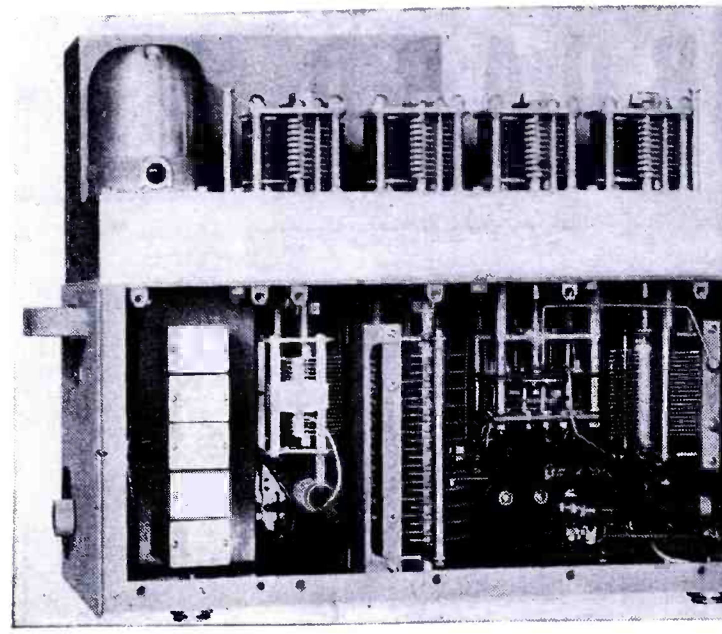
Figure 2
Schematic of Collins 17F-5 transmitter used aboard the DC-3 transports.

ı Electric, type 14B, and covers the)-400 kc band. It is used for recep-n of radio range, weather broad-sts and airport control stations. An CA, AVR7H, 3-band receiver is ed as an auxiliary unit to supple-ent the communications or beacon ceivers. Its third band covers the oadcast frequencies. This receiver s an average r-f sensitivity (aver-e with antenna), for 10 milliwatt tput on all bands, of 3 microvolts. s r-f selectivity (kc off resonance 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, positive 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





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.

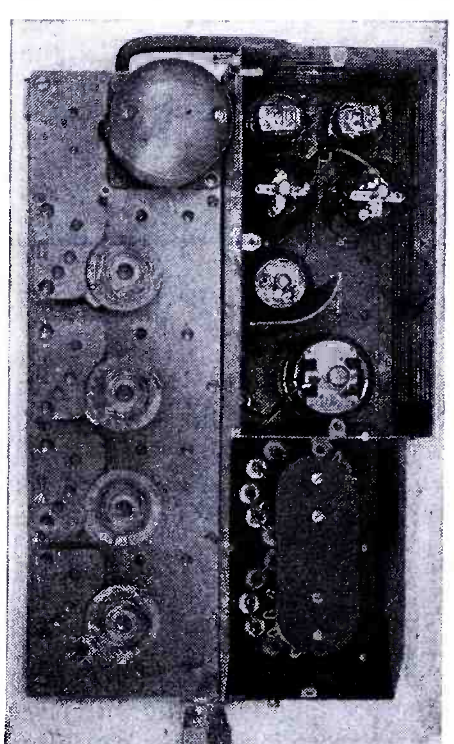


Figure 4
Top view of transmiter. At left, top to bottom, are autotune controls for exciter tuning, amplifier tuning, band switching and power-amplifier loading.

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 design particularly adapted to high-po[wer] aircraft use. The input transfor[m]er which couples a 75-ohm micropho[ne] 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 modulati[on] transformer provides proper modu[la]tion and impedance match to complet[e]ly modulate both the screen and t[he] plate of the 813 amplifier. For t[he] convenience of the operator, a sic[le]tone circuit is provided in the spee[ch] amplifier stage so that the transmissi[on] may be monitored in the telephone receiver circuits of the plane.

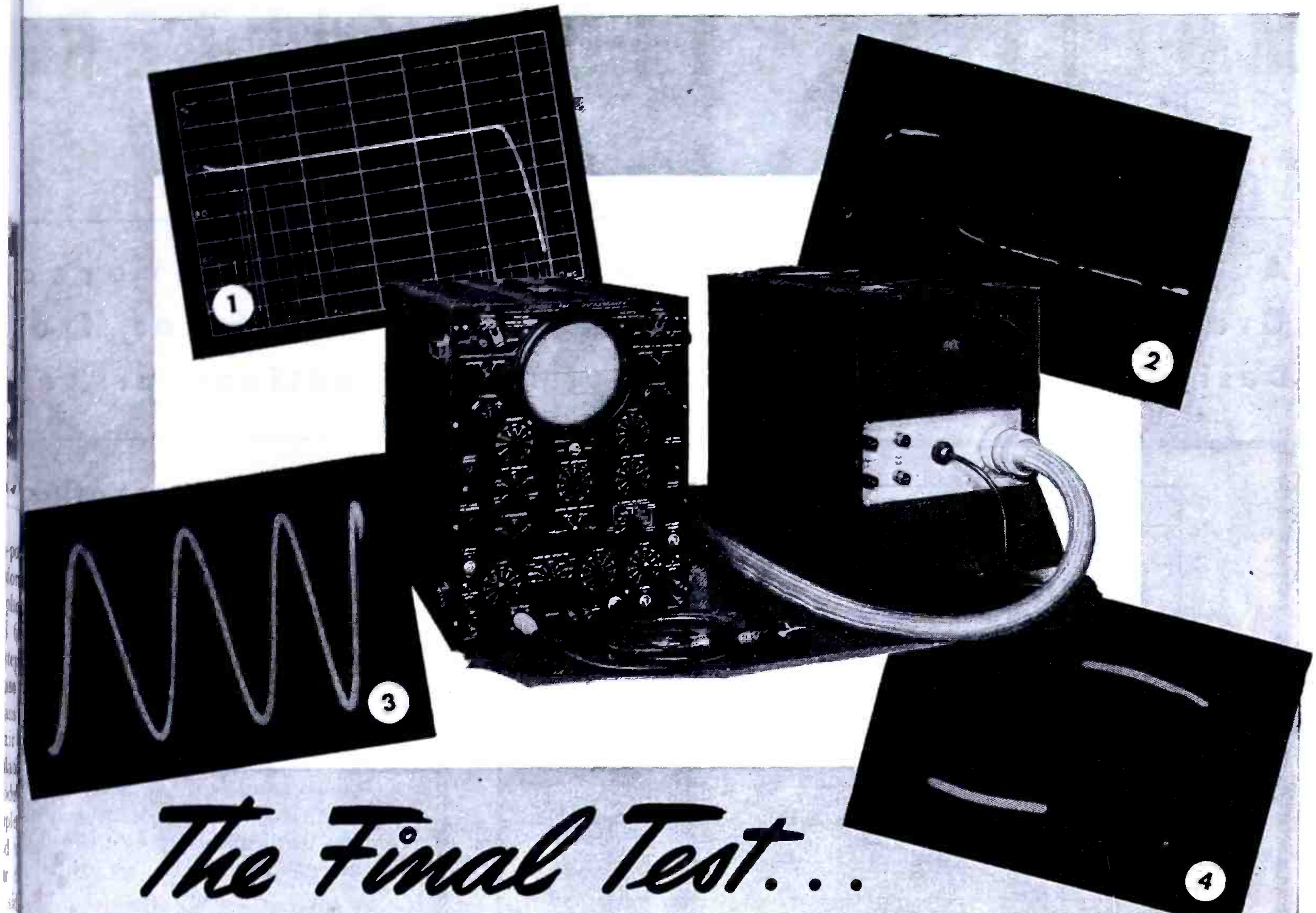
The audio system is designed f[or] use with any ship's convention[al] microphone and inter-phone system [...] a conventional single button micr[o]phone and provides complete high le[v]el modulation of the carrier. The fr[e]quency response of the system has [a] sharp cut-off below 200 cycles to e[x]clude motor noise and vibration. T[he] frequency response above 500 cycles [is] essentially flat throughout the voi[ce] range.

A pi-section output network is a[n]other transmitter feature. This is a[r]ranged so that it will tune to either [a] fixed or trailing antenna, or to a co[n]centric transmission line. Addition[al] loading inductance is provided so th[at] the capacity reactance of short ante[n]nas may be tuned out.

Output Circuit Tuning

The output circuit may first [be] tuned approximately for each freque[n]cy with the antenna disconnected, tu[rn]ing the amplifier tuning condenser f[or] resonance as indicated by a minimu[m] reading of plate current. When th[e] antenna is connected, and for a give[n] frequency (ordinarily frequencies low[er] than 4 mc) the tap on the antenn[a] loading coil is varied until a rise i[n]

(*Continued on page* 85)



The Final Test...

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

This is the DuMont Type 248 Oscil-
raph. As is true of all other preci-
n instruments, it must stand or fall
its performance. Because written
ecifications often give little indica-
n of how well an oscillograph meets
day's critical requirements, we be-
ve the accompanying *unretouched*
otos cover points of particular inter-
to those who work with modern
ctronic circuits. To wit:

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

2 The excellent transient response of this
trument is shown by absence of over-
oot 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.

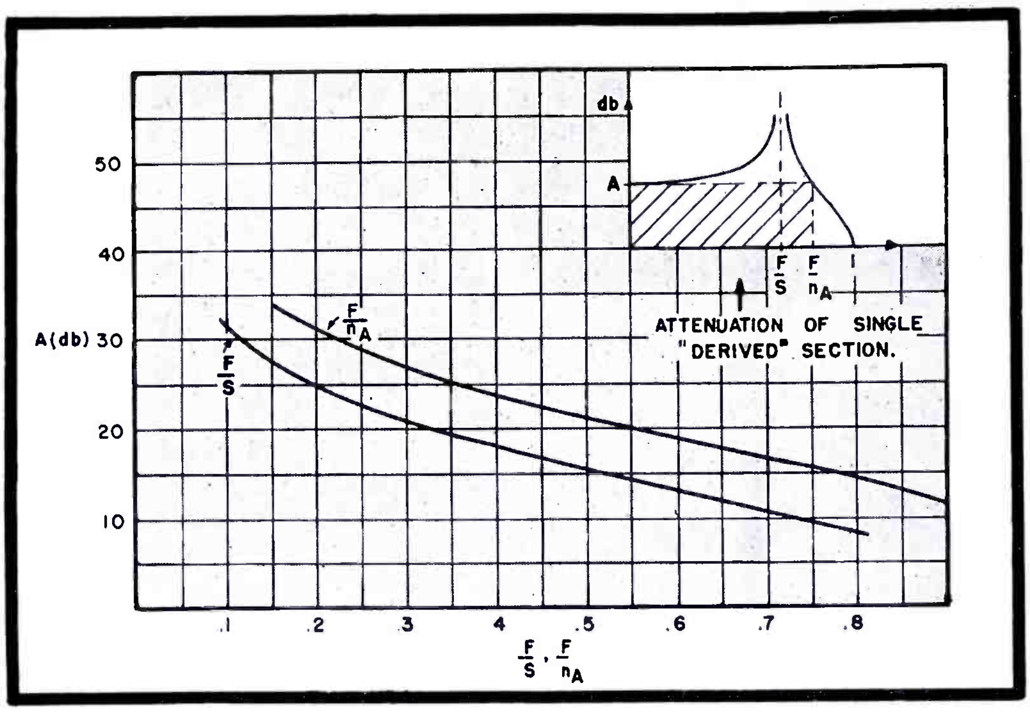
Write for Literature . . .

DUMONT *Precision Electronics & Television*

ALLEN B. DU MONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: WESPEXLIN, NEW YORK

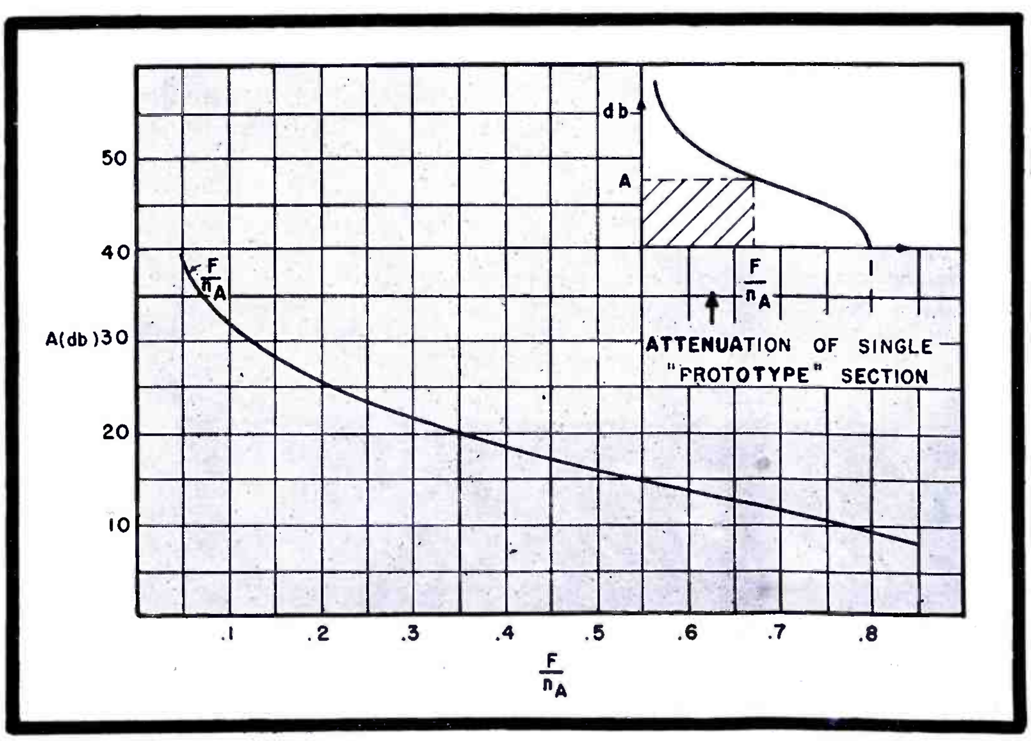
MULTI-SECTION FILTER

A Step-by-Step Procedure, Using Universa Grouping Charts, Eliminating Trial and Error fro Design of Filters Composed of Three Sections or Les



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.



by PAUL SELGIN

Senior Electronic Engineer
Halstead Traffic Communications Co

THE synthesis of filter netwo has received much attent from the literature, and substa tial progress has been recorded sin what is known as *classical* filter th ory was first introduced.

It must be recognized, however, th the more recent methods of synthe present mathematical difficulties whi preclude their use in many situatio

Classical Method

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

Six-Step Method

The method presented here, invol ing six steps, seeks to overcome bo these difficulties and remove all nece sity for guesswork.

Requirements

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

In the second step, the frequenc

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

Frequency Number

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

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

$$= j\,\omega\,L + \frac{1}{j\,\omega\,C} \qquad (1)$$

w if we let

$$W = f/f_o - f_o/f$$

ere

$$2\,\pi\,f_o = \frac{1}{\sqrt{LC}}$$

uation *1* may be written

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

ich is a much simpler and more nageable form than *1*. The admit-nce of a parallel $L-C$ combination an equally simple function of W. e use of W in place of frequency o simplifies the expressions for the age impedance and transfer constant symmetrical band-pass filters; in s case, f_o is the *midband* frequency the filter. In the following design thod, the square of W has been used, it eliminates confusion, having the me value for both cut-off frequencies d for both frequencies of peak at-uation of each derived section. is function is the *frequency number* the band-pass filters. The fre-ency numbers for high and low-pass ers are also indicated in step *2*.

ter and Section Numbers

The third step of the design pro-dure is aimed at determining the toff frequencies of the filter (com-on to all sections) and the peak at-uation frequencies of each derived ction, so as to obtain the specified ss *A* while keeping the loss within e transmitted band as low as pos-le.

In Figures 1 to 7 are offered *ouping charts* to serve this purpose. ese charts have been prepared for e six possible combinations of no

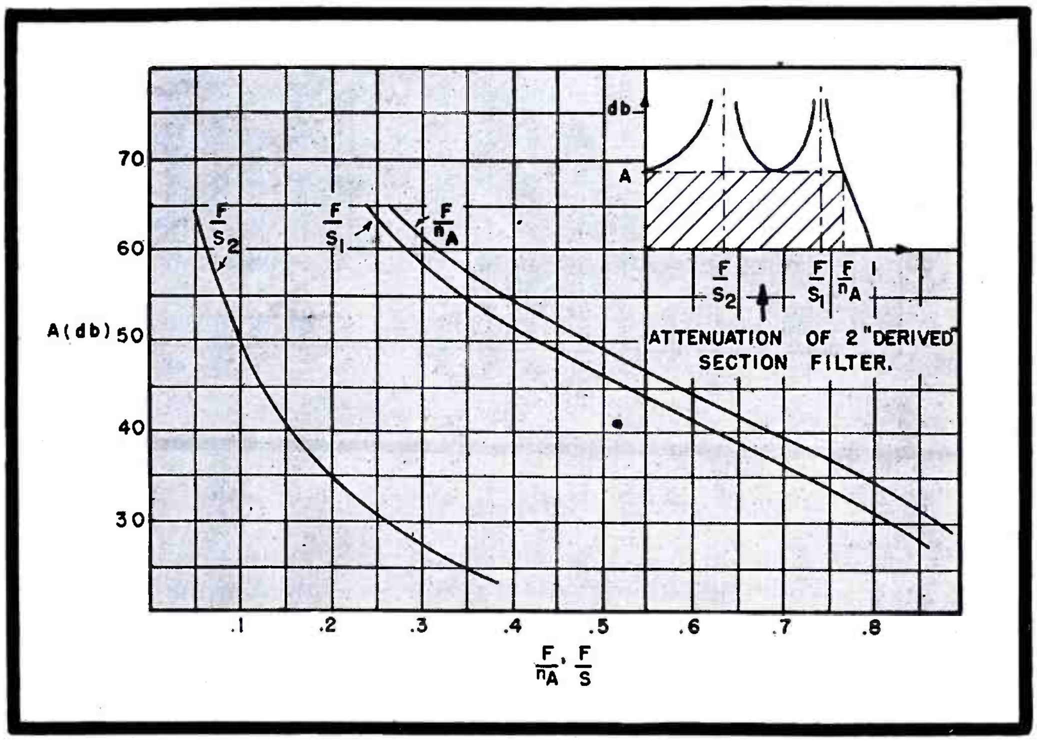
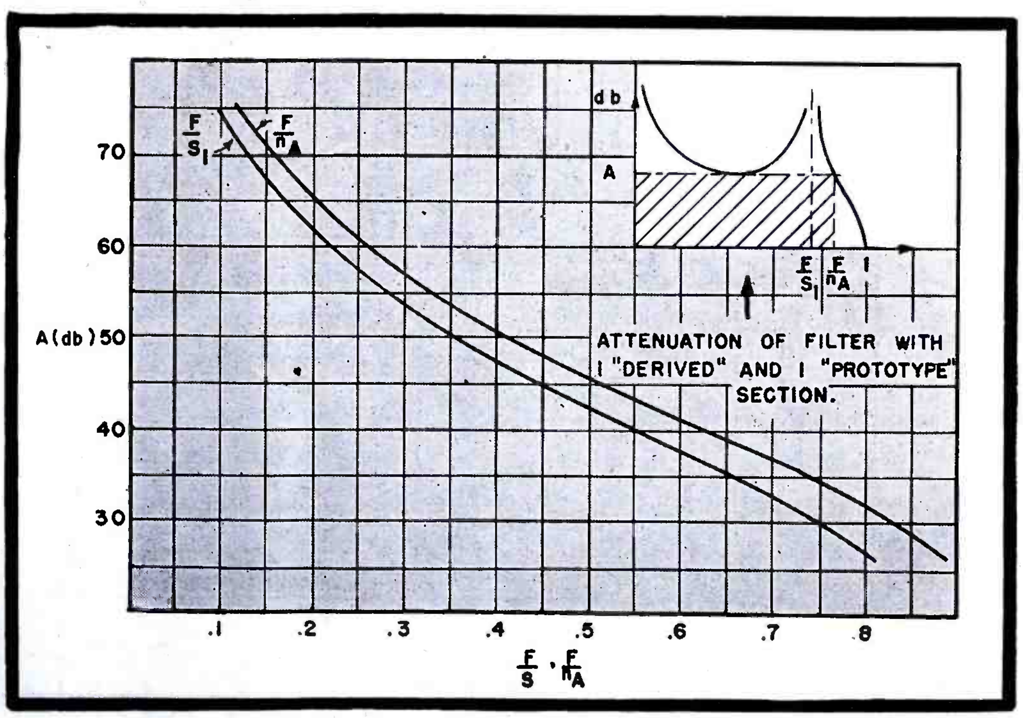


Figure 3 (above) and 4 (below)

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 . . . the section numbers (frequency numbers of the frequencies of peak attenuation for the various derived sections). For prototype sections, $S = O$. 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.



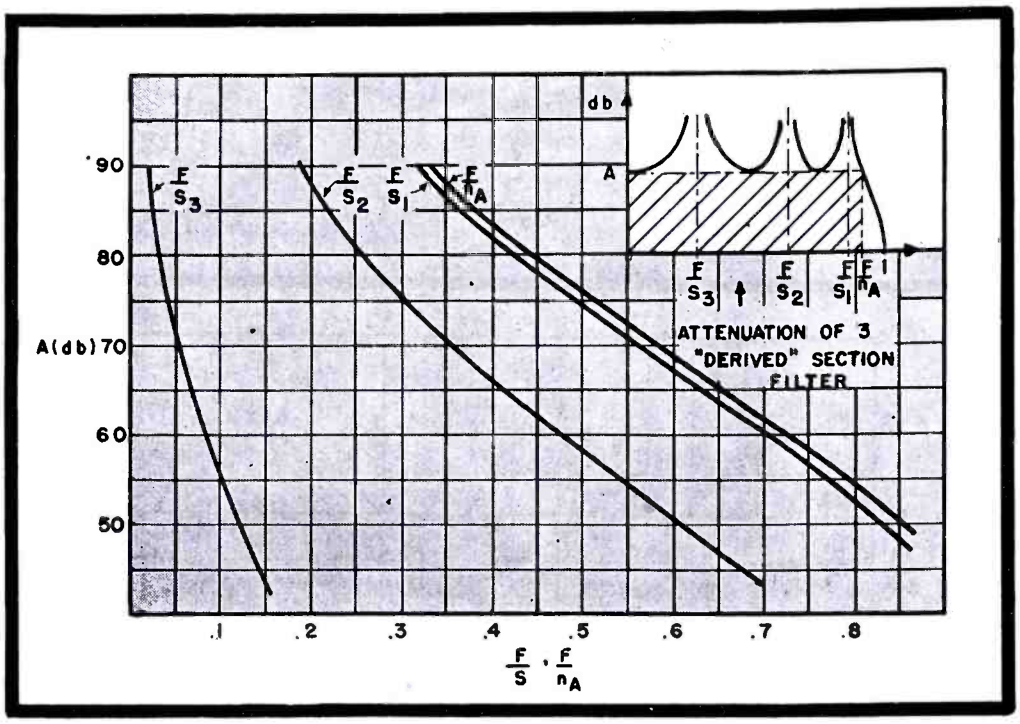


Figure 5

Grouping chart *No. 5* for ***three-derived*** sect
Shaded areas show typical attenuation req
ment.

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 . . . , the *section numbers* (frequency numbers of the frequencies of peak attenuation for the various derived sections). For prototype sections, $S = O$. 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_o, 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_L is considered to be a constant resistance in accordance with telephone practice. The choice of the proper value for R_o is carried out by means of the impedance matching chart, Figure 7.

The designer now has at his disposal all the numerical paramet
upon which to base the computat
of the actual filter elements.

Computation of Filter Element Val

To eliminate ambiguity aris
from the factor *2* which enters i
the evaluation of *T* and *π* section e
ments, the present method consid
half sections, or *L* sections, as
component parts of the filter. Val
for the half sections are given in ter
of F, R_o and S_1, S_2, in step *5*. I
L – C combinations (parallel
series), instead of expressing *L* a
C, it has been found more conveni
at this point to express $r = \sqrt{L}$
(for series combinations)
$g = \sqrt{C/L}$ (for parallel combi
tions), and $w = 1/\sqrt{LC}$ (in b
cases). This facilitates the task
merging together adjoining half s
tions, whether part of the same s
tion or of different ones. This ope
tion, leading to the final values for t
assembled filter, is the object of s
6. The design of a 3-section ba
pass filter is carried through all
steps by way of example. The compl
design presented in this paper to
less than one hour, which is very lit
compared to the time normally
quired for such work.

Effect of Dissipation

The design problem is not fu
solved by specifying inductances a
capacitances. Dissipation cannot
ways be ignored, and the degree
which it may be tolerated depends
the data of the problem, particula
the pass-band loss *a* (step *1*).

In another paper on this subje
scheduled for early publication, t
determination of the lowest perm
sible value of *Q* for the filter co
will be discussed. This is the seven
and final step of the design procedu
In many cases this additional step m
be omitted; unless the requiremen
are unusually strict, they will be m

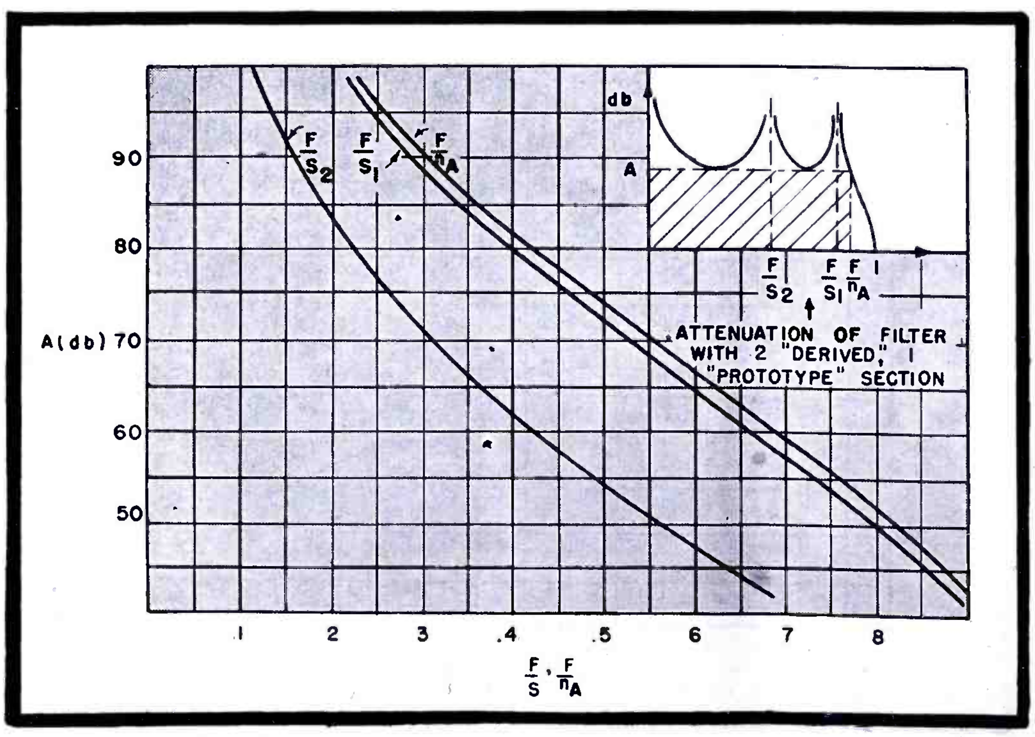


Figure 6

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

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HIGH on the list of important recent electron tube developments in the National Union Research Laboratories is this ultra sensitive N. U. Ionization Gauge.

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Typical Operation

- Filament voltage—3.0 volts
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- Electron current—20 Ma.
- Ion collector voltage—200 volts
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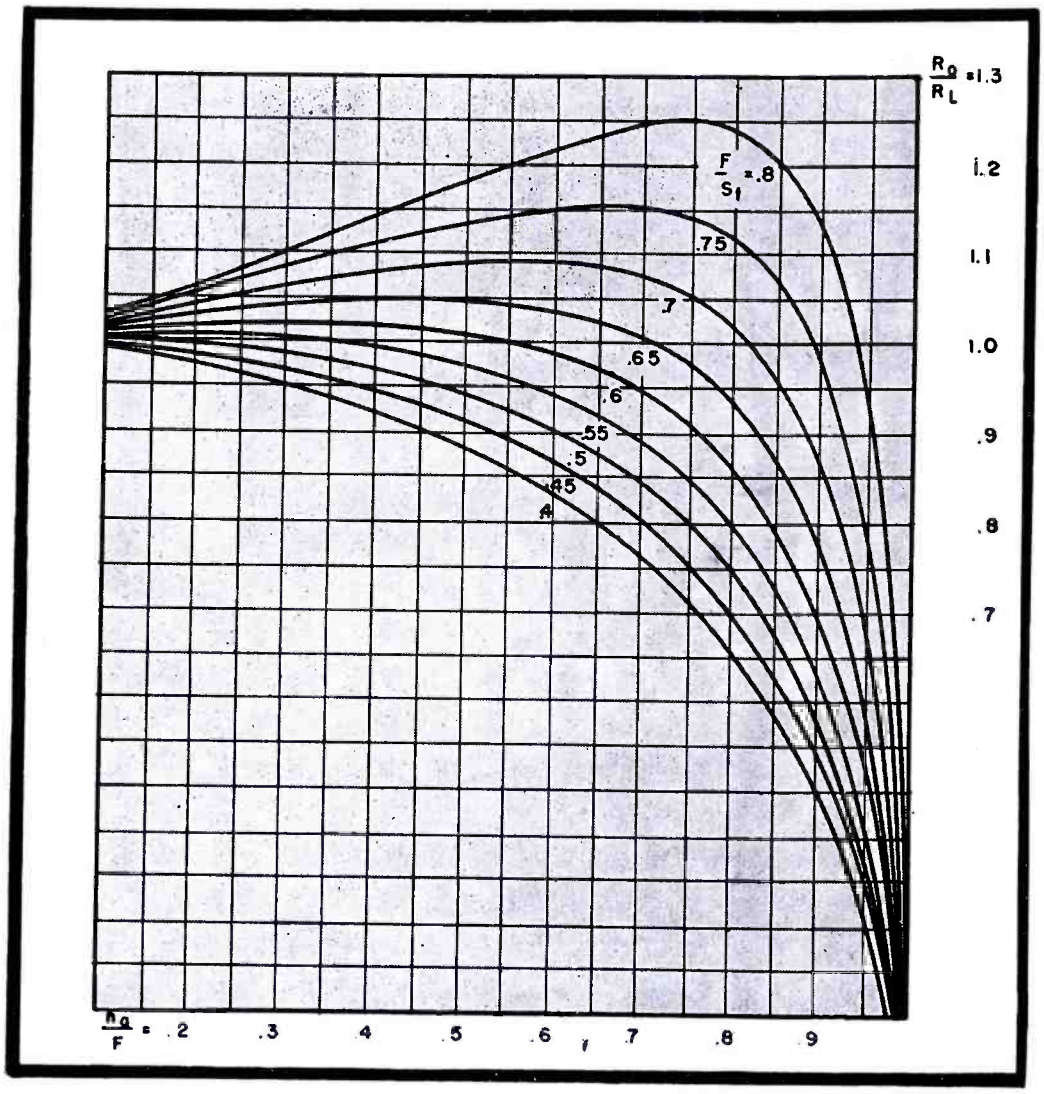

Figure 7
Impedance matching chart. See design proce[dure] step 4.

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 = 2db; $f_A = 4.5$ 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 μfd, resistances should be given in KΩ.

2. Conversion of Specified Frequences Into Frequency Numbers

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

3. Determination of Filter Num[ber] and Section Numbers from Grou[ping] Charts

From grouping charts, we find va[lues] of F/n_a, F/S_1, F/S_2, for given *A* [...] better results, select composition of f[ilter] so that values range between 0.2 and ([...] Then we obtain *filter number* F ([fre-] quency number of cut-off frequency) [...] *section numbers* S_1, S_2 (frequency n[um-] bers of peak attenuation frequenc[ies]

$$F = (F/n_A)n_A; \quad S_1 = \frac{F}{(F/S_1)}; \text{ in g[en-]}$$

eral, $S_j = \frac{F}{(F/S_j)}$

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

Example:

$F/n_A = 0.55$; $F/S_t = 0.525$;
$F/S_1 = 0.31$ (see Figure 14)
$F = 0.55 \times 0.341 = 0.1875$;
$S_t = 0.1875/0.525 = 0.358$
$S_1 = 0.1875/0.31 = 0.605$

4. Determination of Nominal Fil[ter] Impedance R_o (From Figure 7)

We first compute n_a/F (see *2* and [...] Then we select from Figure 7 a cu[rve] corresponding to correct value of F/[...] On this curve we obtain the value [of] R_o/R_L. Multiply by R_L, terminati[ng] impedance (see *1*) to obtain R_o.

Example:

$n_a/F = 0.134/0.1875 = 0.714$;
$R_o/R_L = 0.86$
$R_L = 600$ ohms (given)
$R_o = 0.86 \times 600 = 516$ ohms

(*Continued on page* 70)

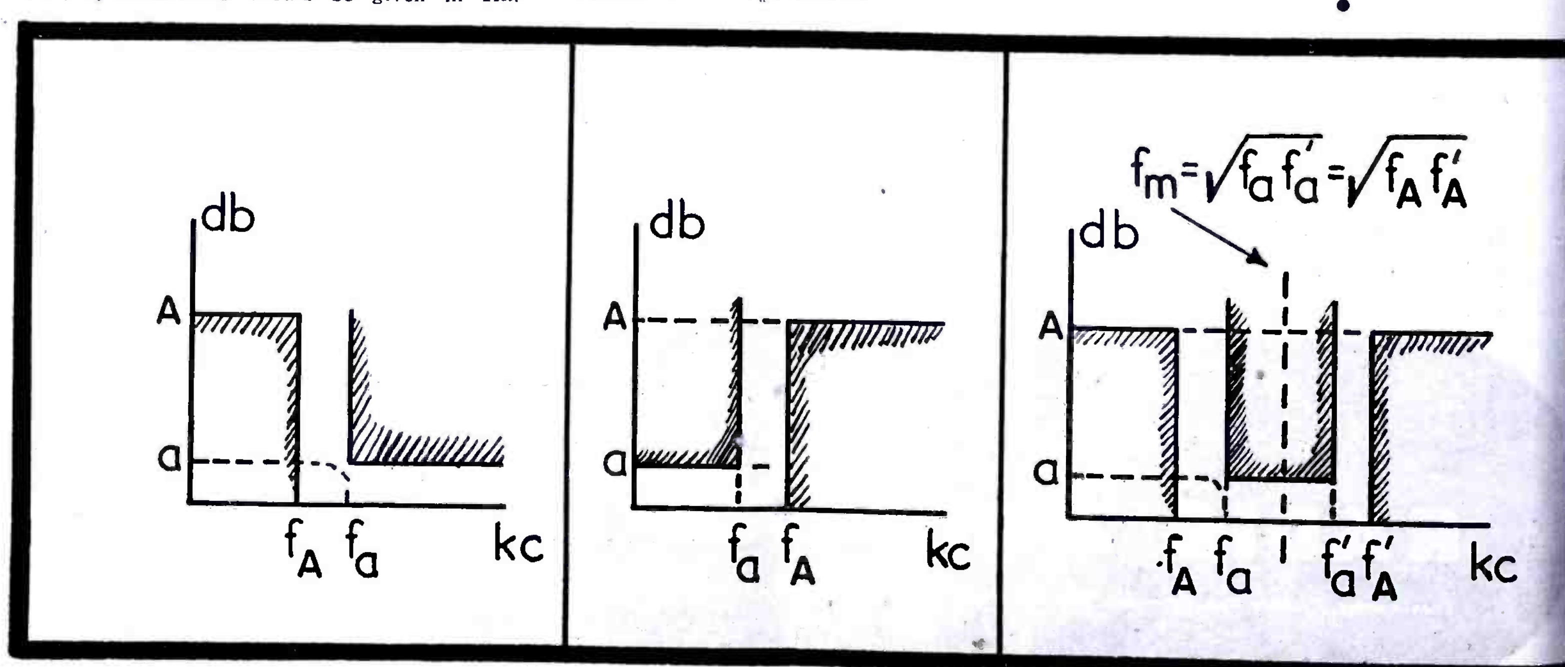

Figure 8
Attenuation characteristics of high-pass filt[ers] (left, below), low-pass filters (center, belo[w]) and band-pass filters (right, below).

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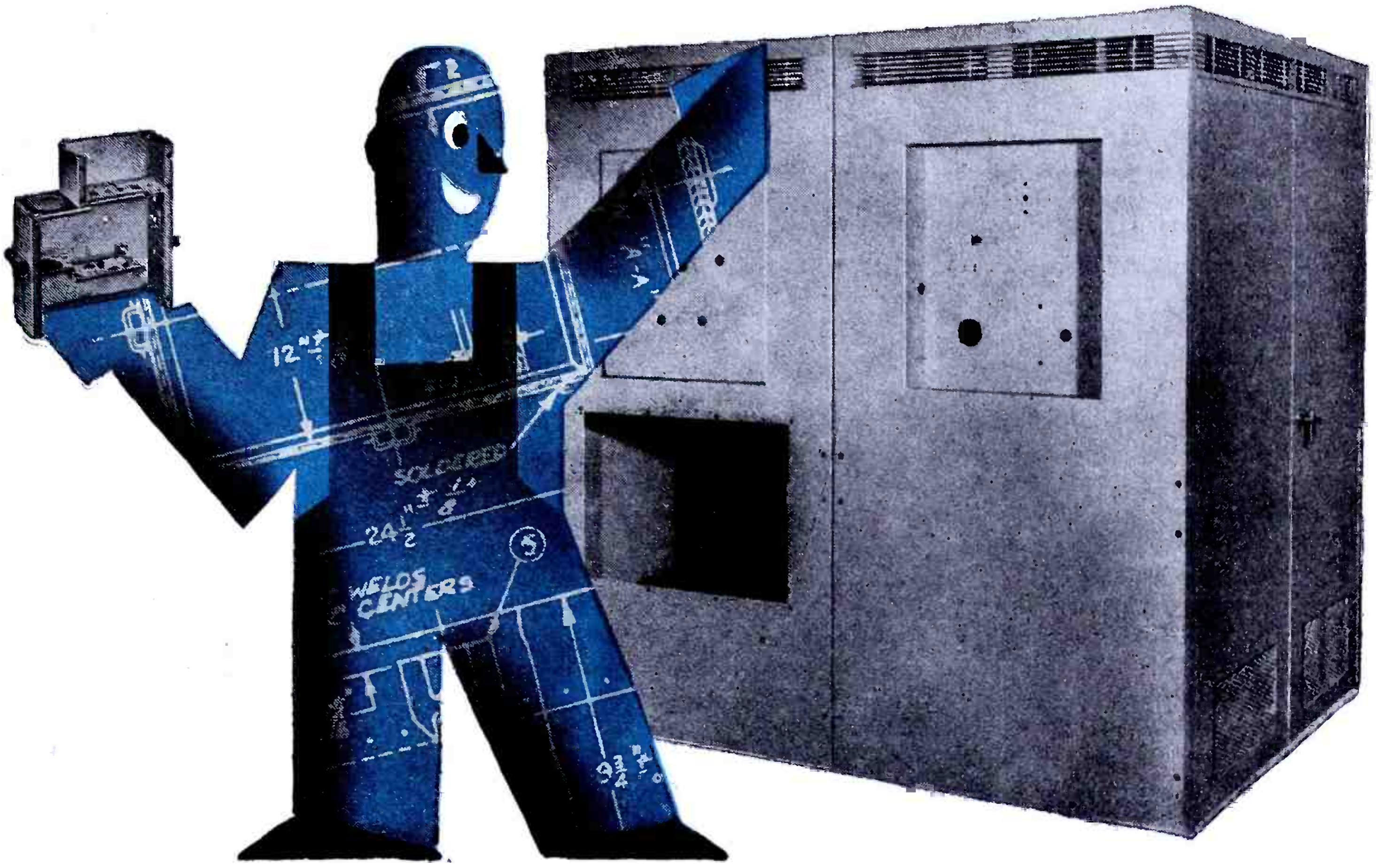

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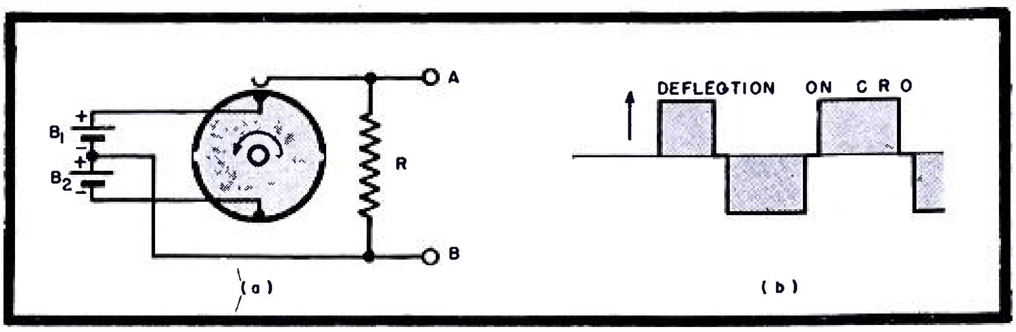


Figure 1

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-hydrogene*** 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-sinusoidal 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

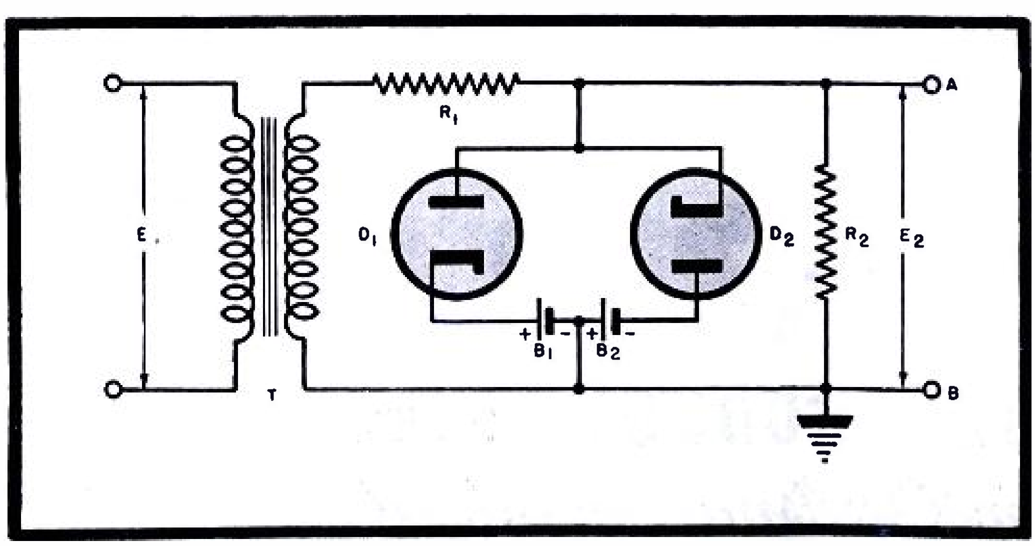
In the circuit, E_1 is the line voltage and E_2 the desired calibration voltage. *T* is a line transformer, and D_1 D_2 a double diode of a commercially available type, such as 6H6. The batteries B_1 and B_2 are bias sources, and R_1 and R_2 are fixed resistors. If R_2 were infinitely large, the voltage 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

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.



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

[2]The curve in Figure 1 is the square-wave curve plotted from the screen of the cro 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*.

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.

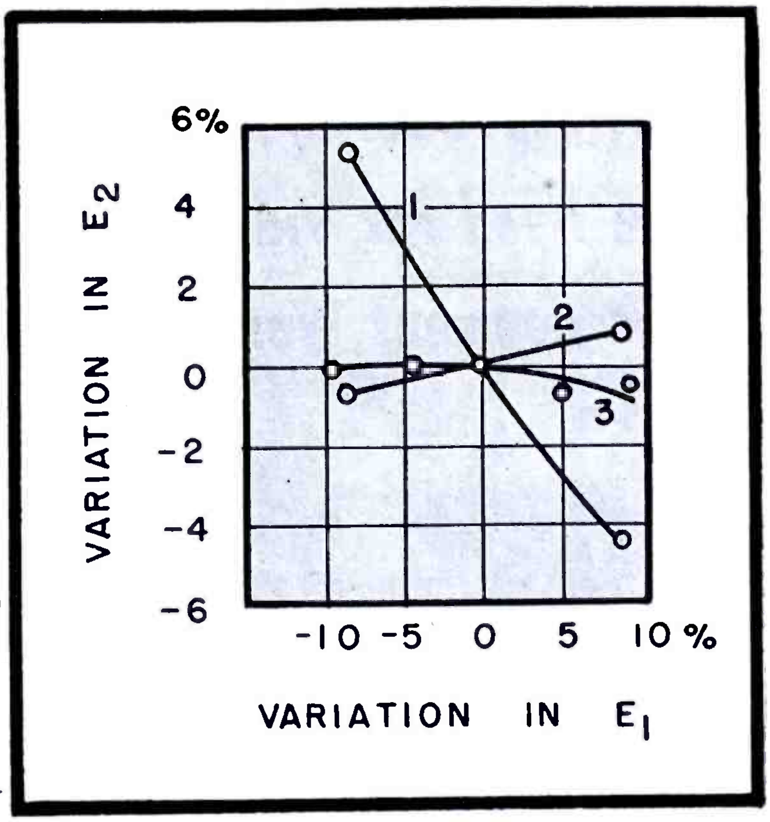


Figure 3

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* 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 . . . D_1, D_2, and the linear potentiometer R_1 . . . R_2, in combination, would give an essentially sinusoidal waveform and a calibration 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 manufacturer. 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.

[3]It 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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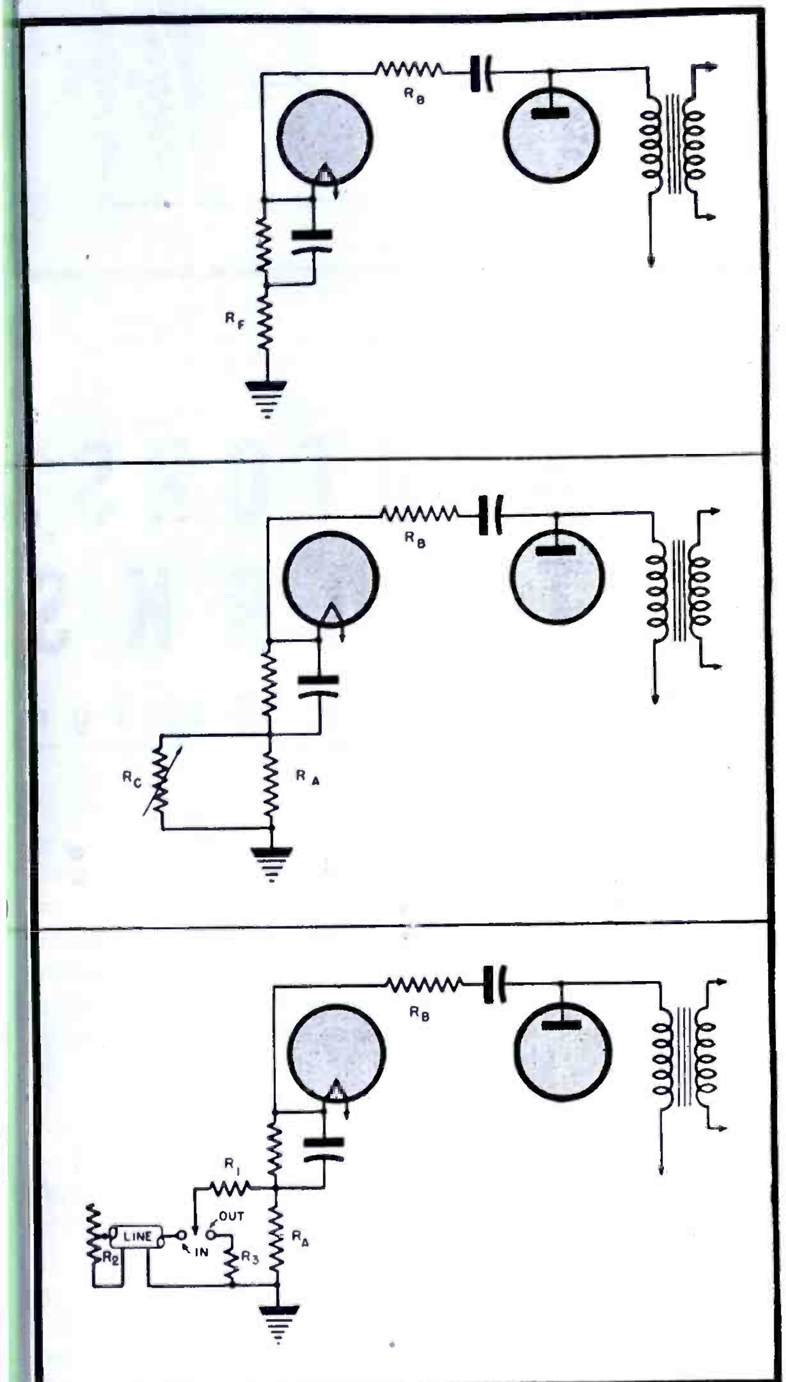

Figure 1

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.

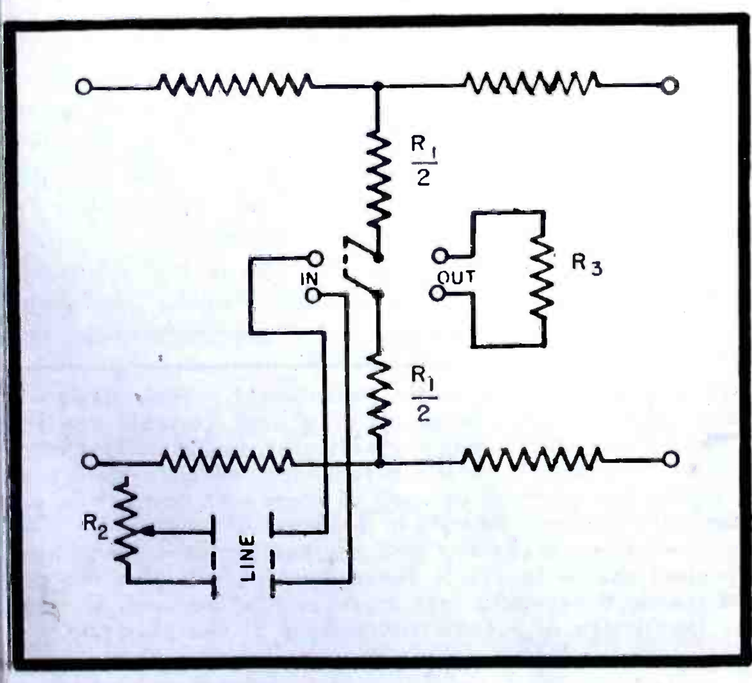

Figure 2

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.

Two methods provide effective dynamic-range control

by RAYMOND P. AYLOR, JR.

Formerly Chief Eng., WGH

Now with Maritime Commission

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)

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.

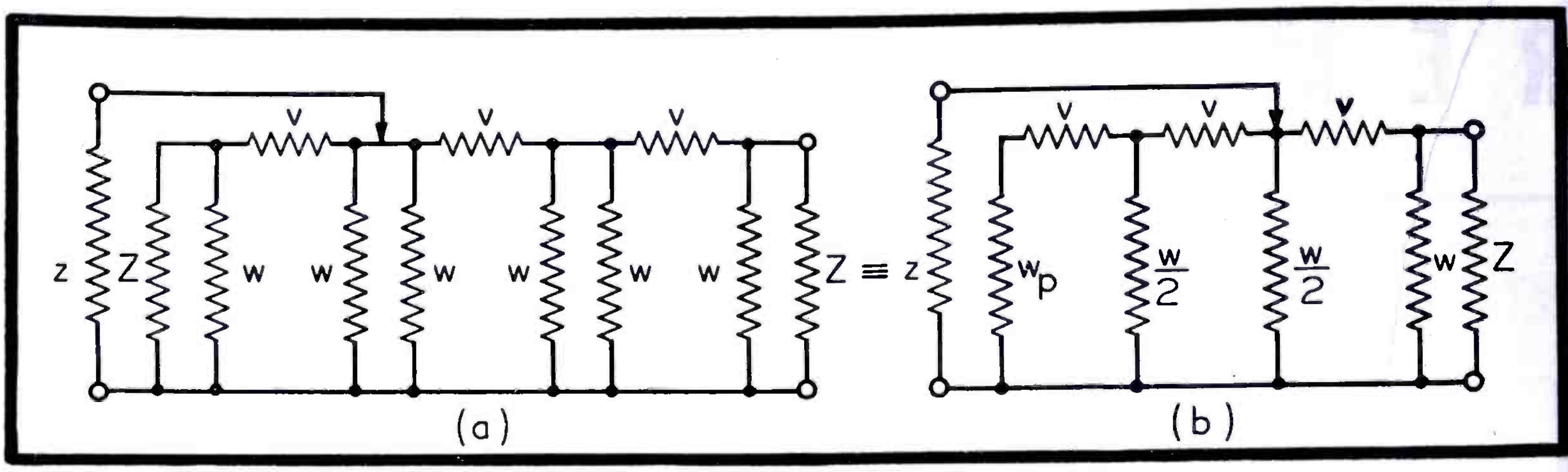

Figure 1

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* networks 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 series[1] 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 junction 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.

[1]May, 1945; COMMUNICATIONS.

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

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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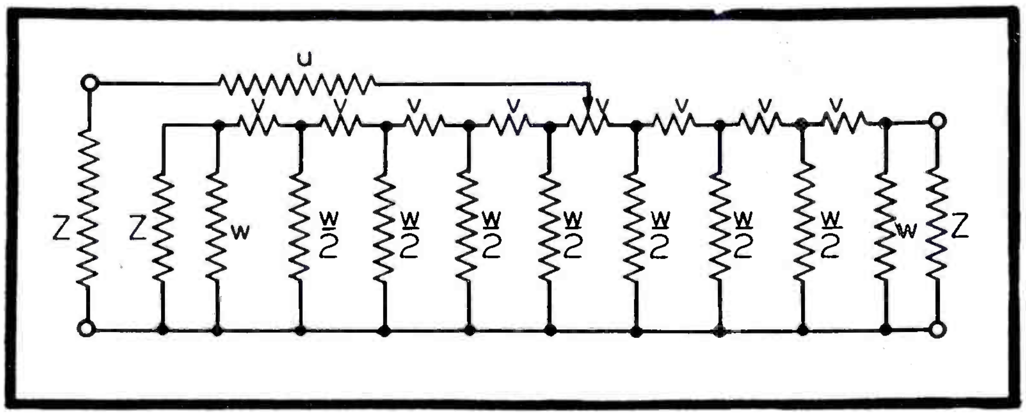


Figure 2
A ladder network composed of a tapped slid[e]
wire; u = Z/2.

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.

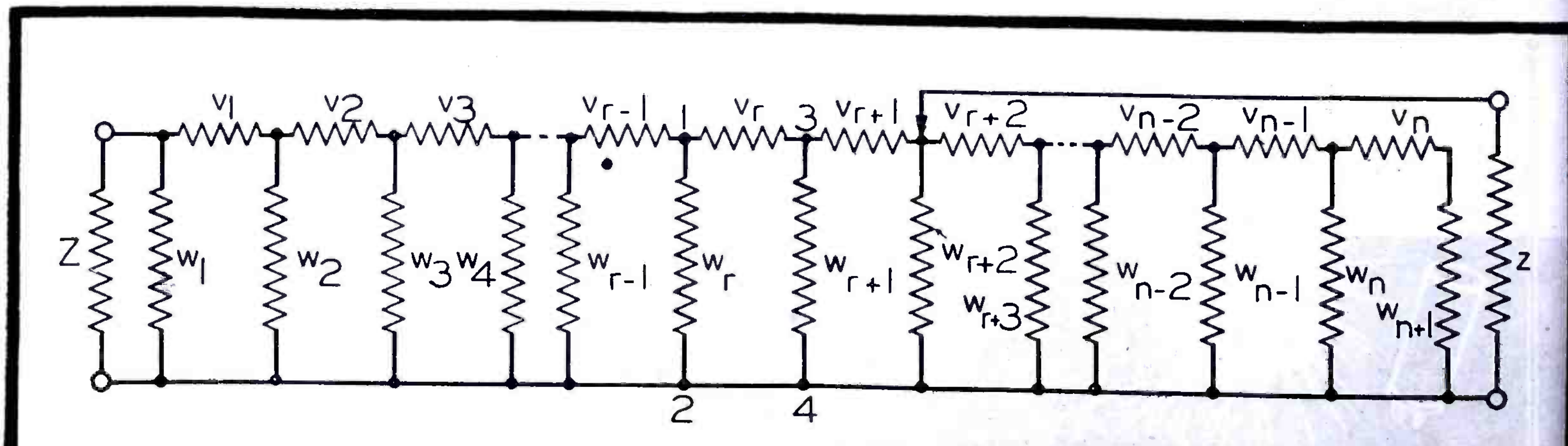
Advantages and Disadvantages of Ladder

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 preference 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 inser[-]tion loss which these attenuators nor[-]mally provide. Hence, we must stud[y] carefully the selections of attenuator[s] for pick-up program service. One fur[-]ther item should be considered. Tha[t] is the ultimate or overall effect upo[n] the signal-to-noise ratio. If sufficien[t] gain is not available to maintain th[e] proper operating level in spite of th[e] insertion losses of the mixer controls then either a choice of a different at[-]tenuator or some additional gain i[s] indicated.

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.

Network Ratios

To avoid the variety of impedance[s] which it would be possible to have b[y] design of these networks, manufactur[-]ers have selected those which cove[r] most of the ranges of impedances nor[-]mally used in practice and are usuall[y] offered in ratios of either 1:1 or 1:2[.] Other ratios may be obtained by spe[-]cial 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 varia[-]tions from these limits may be had by choosing a network meeting the re[-]quirements for the application in which it is to be used. A good general cri[-]terion to use in judging how far one may go in matching impedances, in[-]volving 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 × no. (db). The minimum loss pos[-]sible 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 symboli[-]cal notation used for the function it[-]self. These were given in the second



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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.

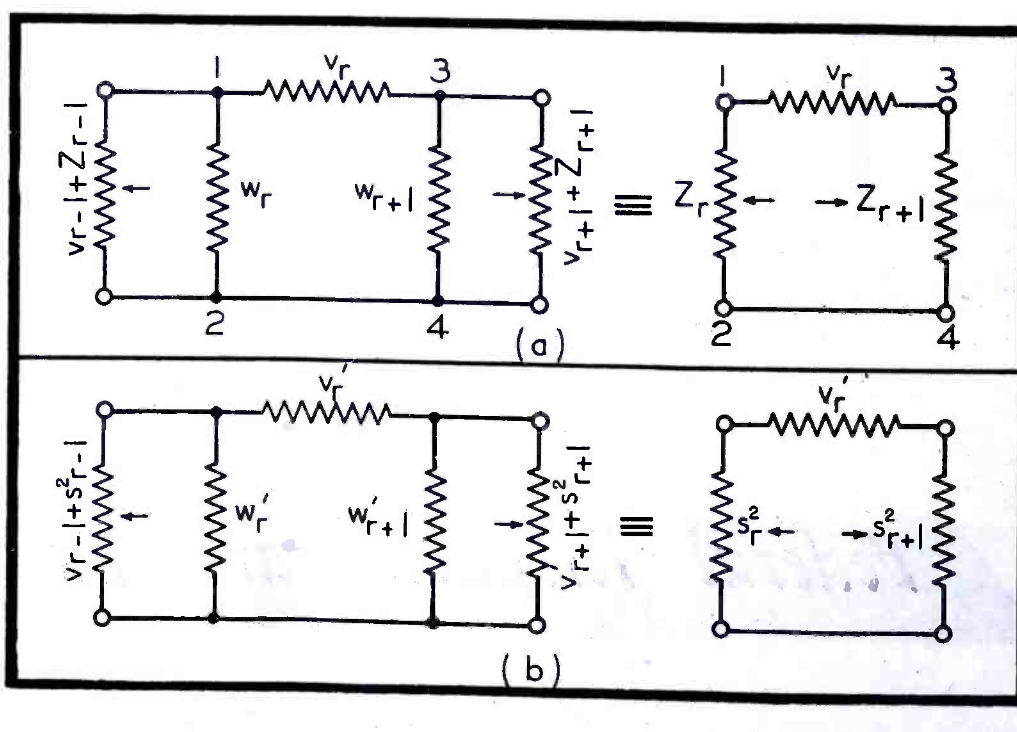
Design of Ladder Attenuators

The standard network most commonly used for design purposes is the π type. If the ladder is to balanced, the π will become the *0* 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*)

[2]Oct. 1944; COMMUNICATIONS
[3]August, 1944; COMMUNCATIONS.
[4]October, 1944; COMMUNCATIONS.



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.

INTERPLANT R. R. RADIO SYSTEM

•

Above, calling the Westinghouse yard office via the interworks f-m communications system, recently installed at East Pittsburgh. System covers 25 miles of Westinghouse switch track. Below, checking up main train-radio transmitter. Five locomotives, radio equipped, maintain constant contact with the yard office through this central link.

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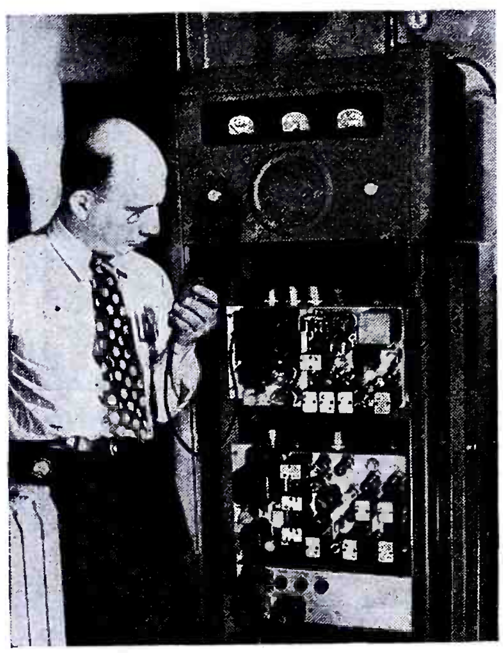

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Below, dispatching switching orders via the f-m system. Incidentally the main transmitter is located in the famous "K" building, from which the first regularly scheduled broadcast was made in 1920; Harding-Cox presidential election returns.

•

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

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

and

$$v' = A \quad (2)$$

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 1*a* and 1*b*. 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 8*a*, *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 5*a* and 5*b*, 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

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

$$\text{where: } \Delta = s^2_r + s^2_{r+1} + v'_r \text{ or } s^2_r = s^2_{r+1} \quad (4)$$

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

[2]October, 1944 COMMUNCATIONS.
[5]January, 1945 COMMUNICATIONS.

No. db per Section	v'	w'	1/w'
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	.852825
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

$$k^2_r = \frac{E^2_r/s_r^2}{E^2_{r+1}/s_{r+1}} = \frac{E^2_r}{E^2_{r+1}}\cdot\frac{s^2_{r+1}}{s^2_r} \quad (5)$$

but $s^2_{r+1} = s^2_r$; hence, taking the positive square root, for $k_r \geqq 1$.

$$k_r = \frac{E^2_r}{E^2_{r+1}} = \frac{E^2_r}{E^2_r\left(\dfrac{s^2_{r+1}}{s^2_{r+1} + v'_r}\right)}$$

$$= 1 + \frac{v'_r}{s^2_{r+1}} \quad (6)$$

The series element of the network is therefore

$$v'_r = s^2_{r+1}\,(k_r - 1) = s^2_r\,(k_r - 1) \quad (7)$$

From equations *3* and *7*, we find that

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

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

Using *8* in *7* to eliminate s^2_r.

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

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

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

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

$$w'_r = \frac{s^2_r\,(v'_{r-1} + s^2_{r-1})}{v'_{r-1} + s^2_{r-1} + s^2_r}$$

$$= \frac{(1 + r_r)\,(1 + r_{r-1} + 2A_{r-1})}{r_{r-1} - r_r + 2A_{r-1}} \quad (11)$$

Equations *8* and *9* may be obtained directly from the tables given in *Part 1*[3] and *Part 2*[2] 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

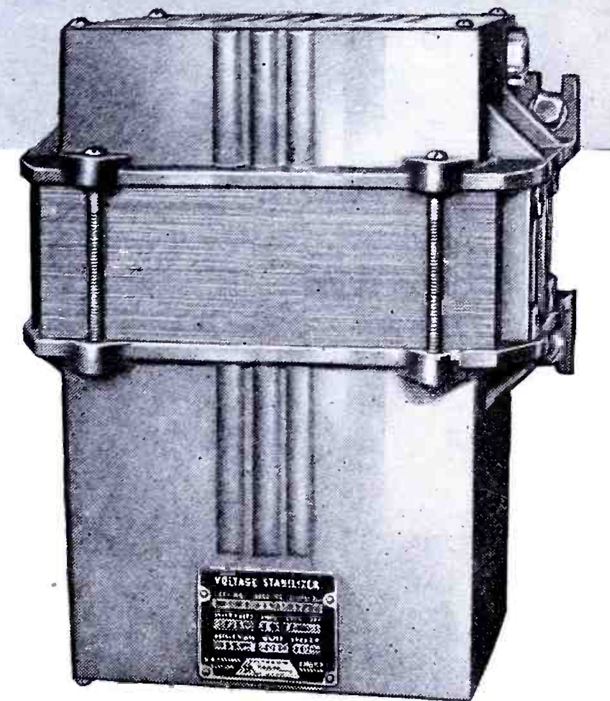
(*Continued on page* 60)

RESISTIVE NETWORKS

RAYTHEON VOLTAGE STABILIZERS

Keep Varying Input Voltages Uniform

at ±½% of 1%



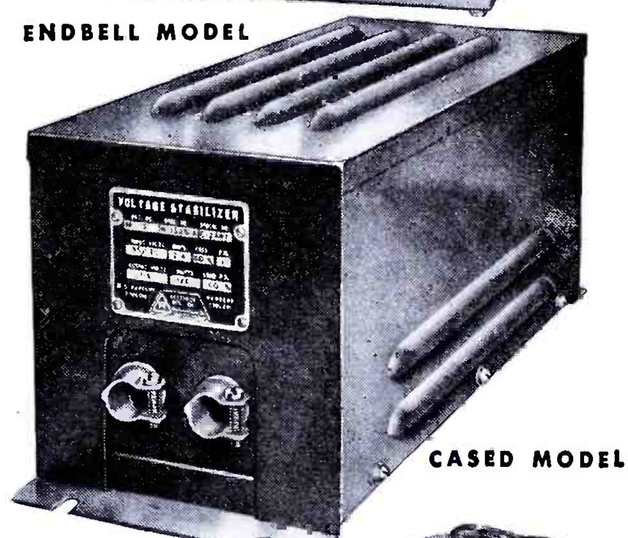
ENDBELL MODEL

Built into new equipment or incorporated into equipment already in use, Raytheon Voltage Stabilizers improve the operation of electrical equipment by stabilizing varying input voltages to ±½% of 1% within 2 cycles.

Because they have no moving parts . . . nothing that wears out, they require no adjustments or maintenance. Simply hook them up and Raytheon Voltage Stabilizers will give years of trouble-free service.

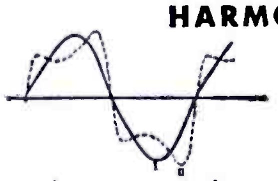
Many models and ratings are available for practically every application requiring uniform voltage. All stabilize voltages at any load within ratings to ±½%.

Standard Raytheon Voltage Stabilizers may be had for controlling A. C. input variation of 95 to 130 volts or 190 to 260 volts. Write for bulletin DL48-537. It gives dimensions, operating characteristics and other important data.



CASED MODEL

HARMONIC CONTENT

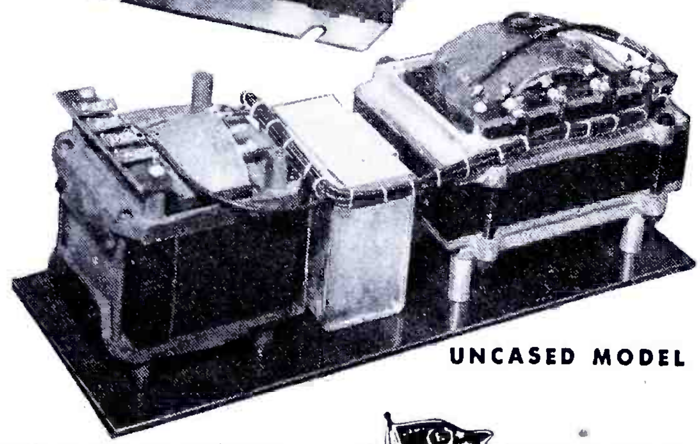


The high magnetic density in one of the transformers introduces harmonics in the output voltage wave. The actual harmonic content is usually unimportant except when instruments are being calibrated.

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



UNCASED MODEL

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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

$$db = 10 \log_{10} \frac{\frac{E^2_2}{R^2}}{\frac{E^2_1}{R_1}} \quad (3)$$

$$db = 10 \log_{10} \frac{E^2_2}{E^2_1} - 10 \log_{10} \frac{R_2}{R_1} \quad (4)$$

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

$$E^2_1 = P_1 R_1 \text{ (zero level values)}$$
$$E^2_1 = 0.001 \times 600 = 0.6 \text{ volt}$$

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

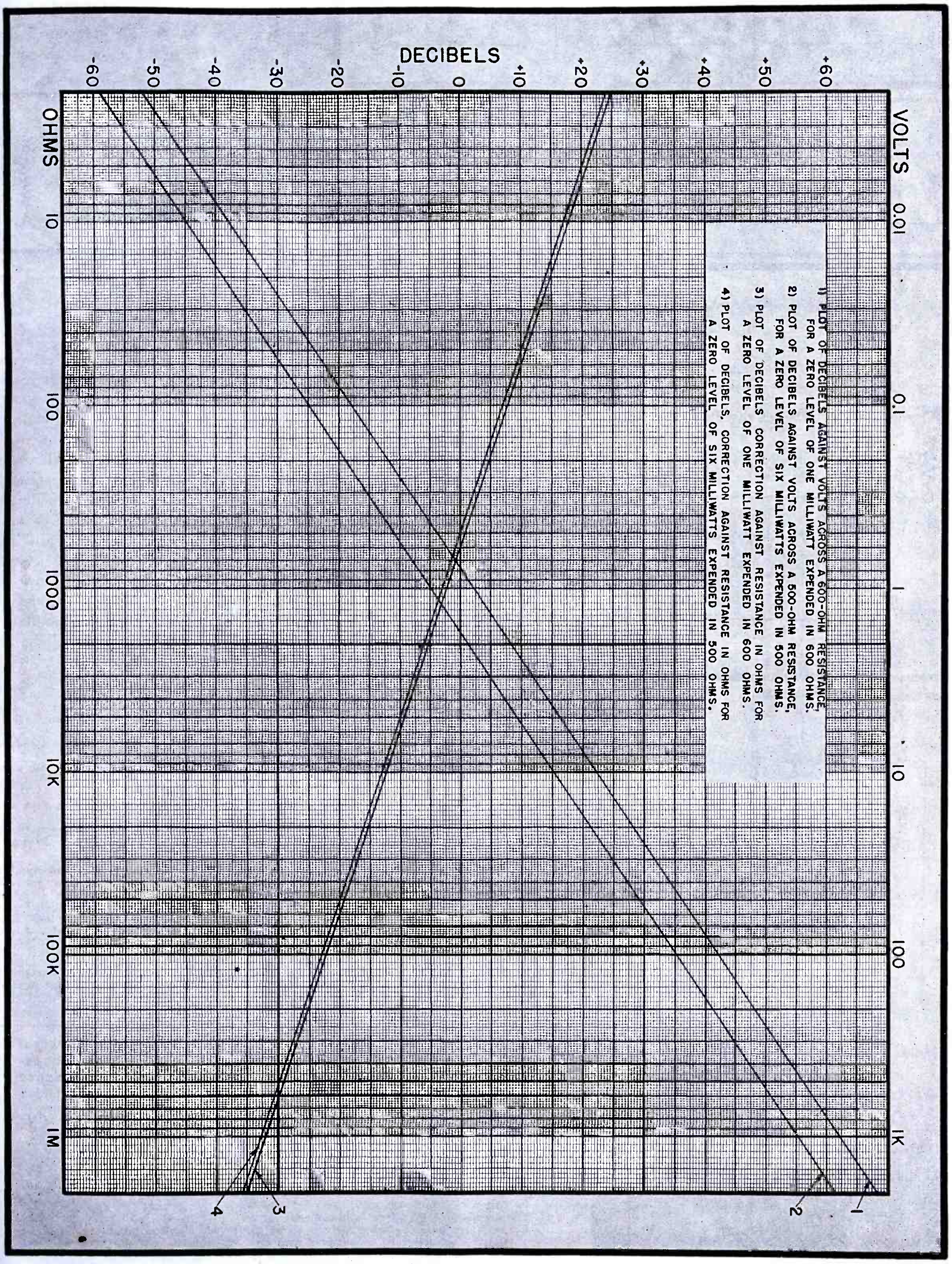
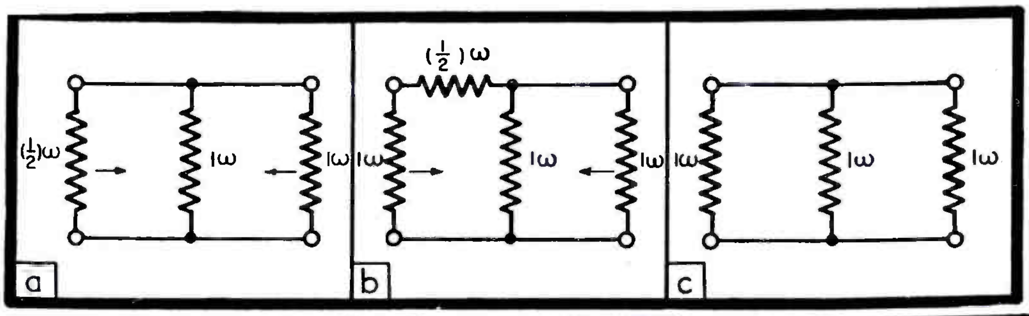


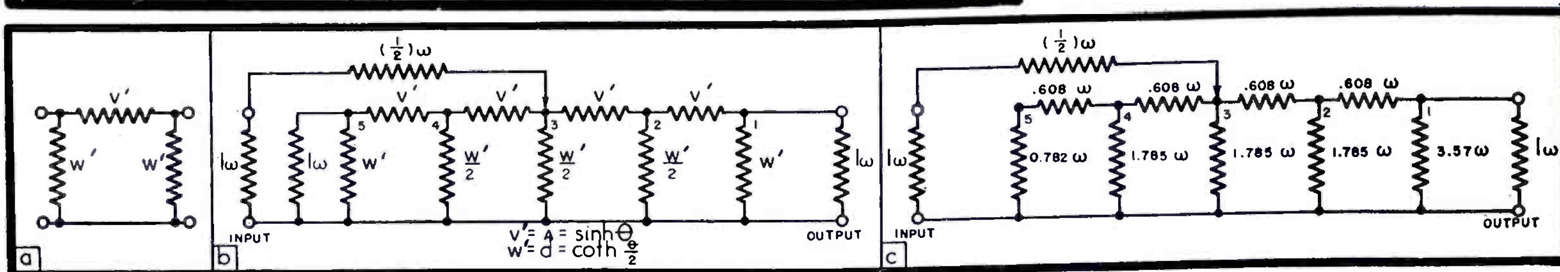
Chart with combined plots of decibels-volts and decibels-ohms. The db-volt scales are for use with curves *1* and *2*; db-ohm scales are for use with curves *3* and *4*. Plot data may be combined to provide a corrected meter reading, as indicated by examples in the paper.



RESISTIVE NETWORKS

(*Continued from page* 56)

total loss of 20 db in 5 steps of 5 db per step. Figure 12 shows the com-

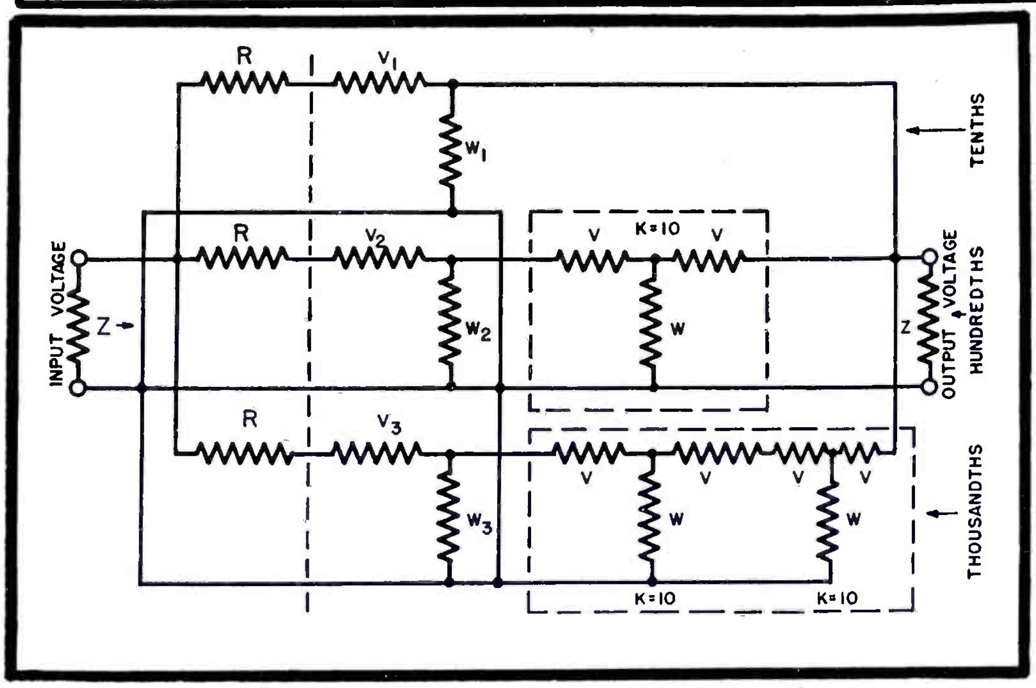


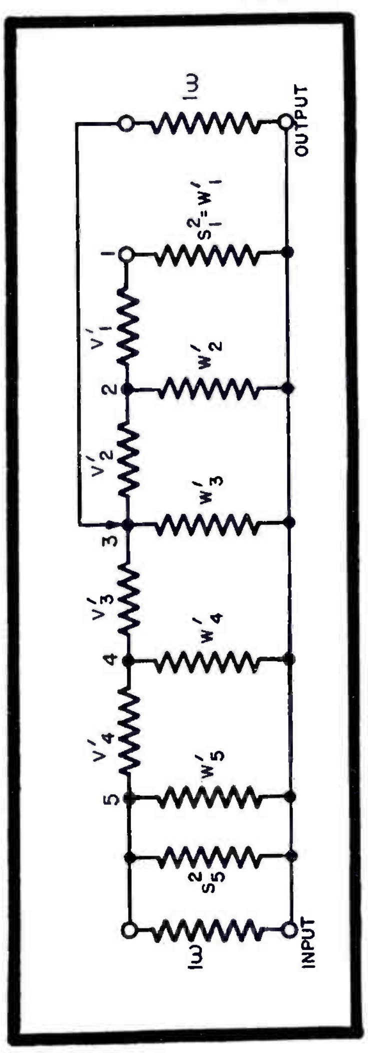
pleted form of the attenuator design given by Figures 10 and 11.

Decimal Attenuators

The decimal attenuator is really a system of attenuators arranged as shown in Figure 9. Similar *L taper* attenuators of the *type III* shown in Figure 11 of *Part 2*[2] are combined in multiple on their input ends through building out impedances or resistances to give the proper image impedance match between the voltage source and the decimal network system, and on their output ends by adding additional standard network configurations to give the desired decimal variations of voltage as read at the output terminals. Under this condition, there will be an

(*Continued on page* 73)





Figures 7, 8, 9 and 10 (top to bottom)

Figure 7*a*. The maximum insertion loss of a standard 1:2 impedance ratio ladder network may be represented as shown here when set in its zero reference loss position. The insertion loss is then db $= 20 \text{ Log}_{10}\left(1 + \frac{s^2}{s^2+1}\right) = 20 \text{ Log}_{10}\, 1.667 = 4.4$ db. Figure 7*b*. The standard 1:1 impedance ratio ladder network may be represented as shown, when set in its zero reference position of minimum attenuation. The insertion loss is then db $= 20 \text{ Log}_{10}\left(1 + \frac{(1/2)}{2} + \frac{(1/2)+1}{2}\right) = 20 \text{ Log}_{10}\, 2 = 6.02$. Figure 7*c*. The alternative method described in the text shows that it may be represented as a 1:1 impedance ratio ladder network having the simplified structure given by this figure and having an insertion loss of $20 \text{ Log}_{10} (1 + 1/2) = 3.46$ db for an average loss structure such as that of Figure 10.

Figure 8*a*. A single section π network having *n* db loss. By combining any required number of such sections in tandem having either equal or unequal losses per section, a ladder network results. Figure 8*b*. An illustration of the development of the network of Figure 1*b* arranged for a 1:1 ratio of input to output impedances. Figure 8*c*. This figure illustrates the design of a 20-db ladder network on a unit basis having an insertion loss of 6.02 db on step *1* and four additional steps of 5 db each. The input impedance is constant on each step, but the output network impedance varies from 0.6 ω on step *1* to 0.976 ω for the tap on step *5*.

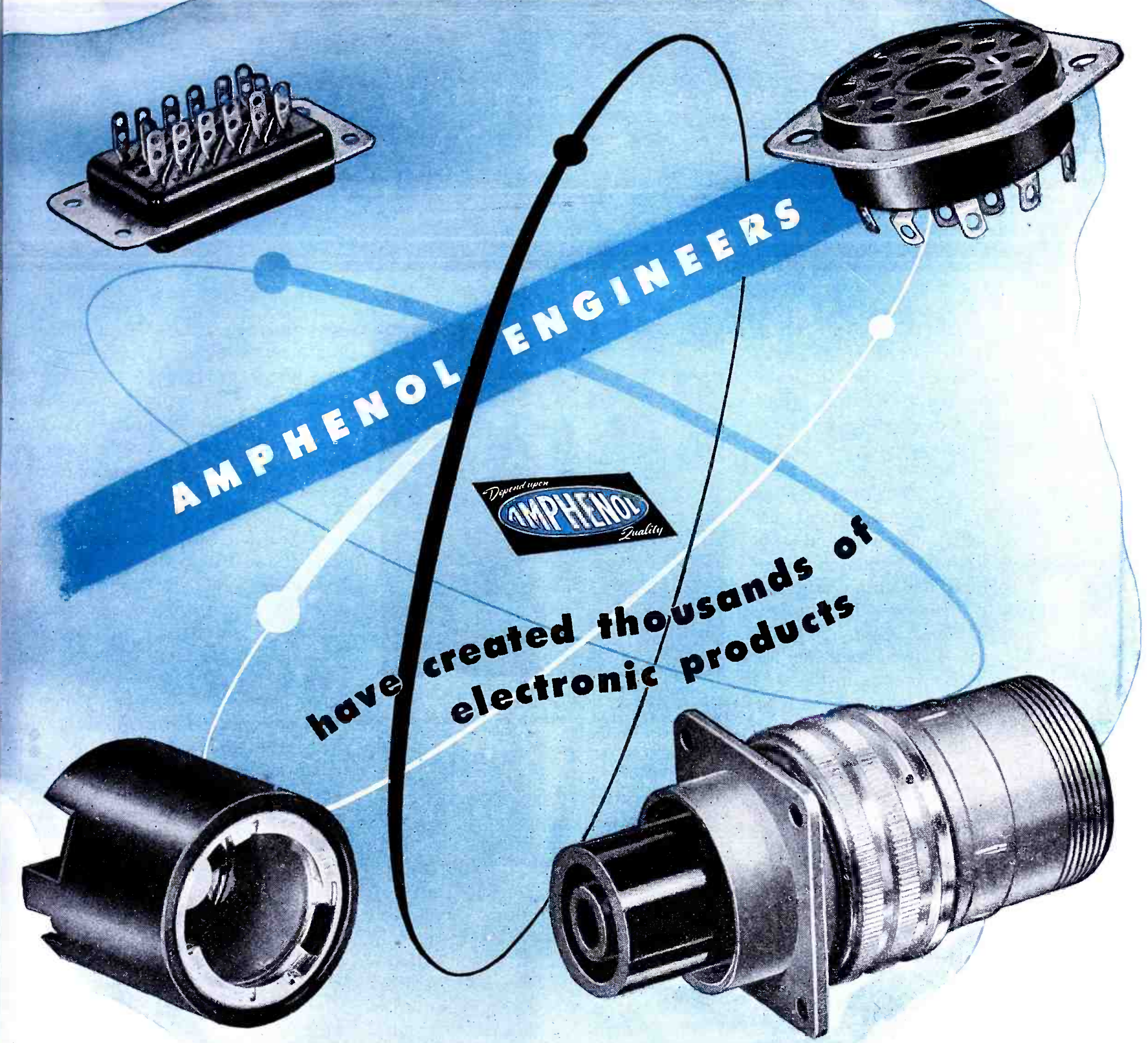
Figure 9. A decimal type of attenuator by means of which the output voltage may be regulated by incremental changes in steps of 0.001 of the input voltage. Figure 10. The alternative method of designing ladder type networks results in a structure as shown, for a *5*-step attenuator. The symbols shown are the normalized or unit basis impedances of the network.

Step No.	r_r	$\frac{s^2_r}{1 + r_r}$	$\frac{v'_r}{2A_r}$	$v'_{r-1} + s_{r-1}$	$v'_{r-1} + r_{r-1} - r_r$	w'_r	Input Impedance Ohms	Output Impedance Ohms
1..........	0.10000	1.10000	9.90000	......	......	1.10000	1.000	1.000
2..........	.17783	1.17783	5.44556	11.00000	9.82217	1.31907	.999	.999
3..........	.31623	1.31623	2.84606	6.62339	5.30716	1.64267	.984	.984
4..........	.56234	1.56234	1.21594	4.16229	2.59995	2.50117	.842	.842
5..........	1.00000	2.00000	0.00000	2.77828	0.77828	7.13954	.500	.500

where: $r_r = \epsilon^{-\theta}$, $\theta = 0.115129 \times$ No(db).
v'_r = unit series impedance in the $r-th$ section.
w'_r = unit shunt impedance in the $r-th$ section.
s^2_r = unit junction impedance as viewed at the $r-th$ junction including all of the network to the right terminated in a unit impedance.
To raise to any given impedance level, multiply all figures given in the table by that value of impedance.

Figure 12

This table gives the design details necessary to obtain Figure 12 from the structure of Figure 10 and given design data; in this case, we have a 20-db ladder network having a total of 5 steps, with 4 steps of 5 db each and the fifth step being the zero reference step having an insertion loss of 3.46 db, and operating between equal impedances.



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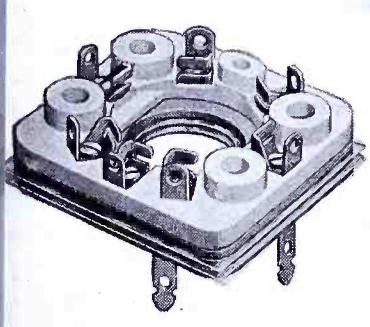

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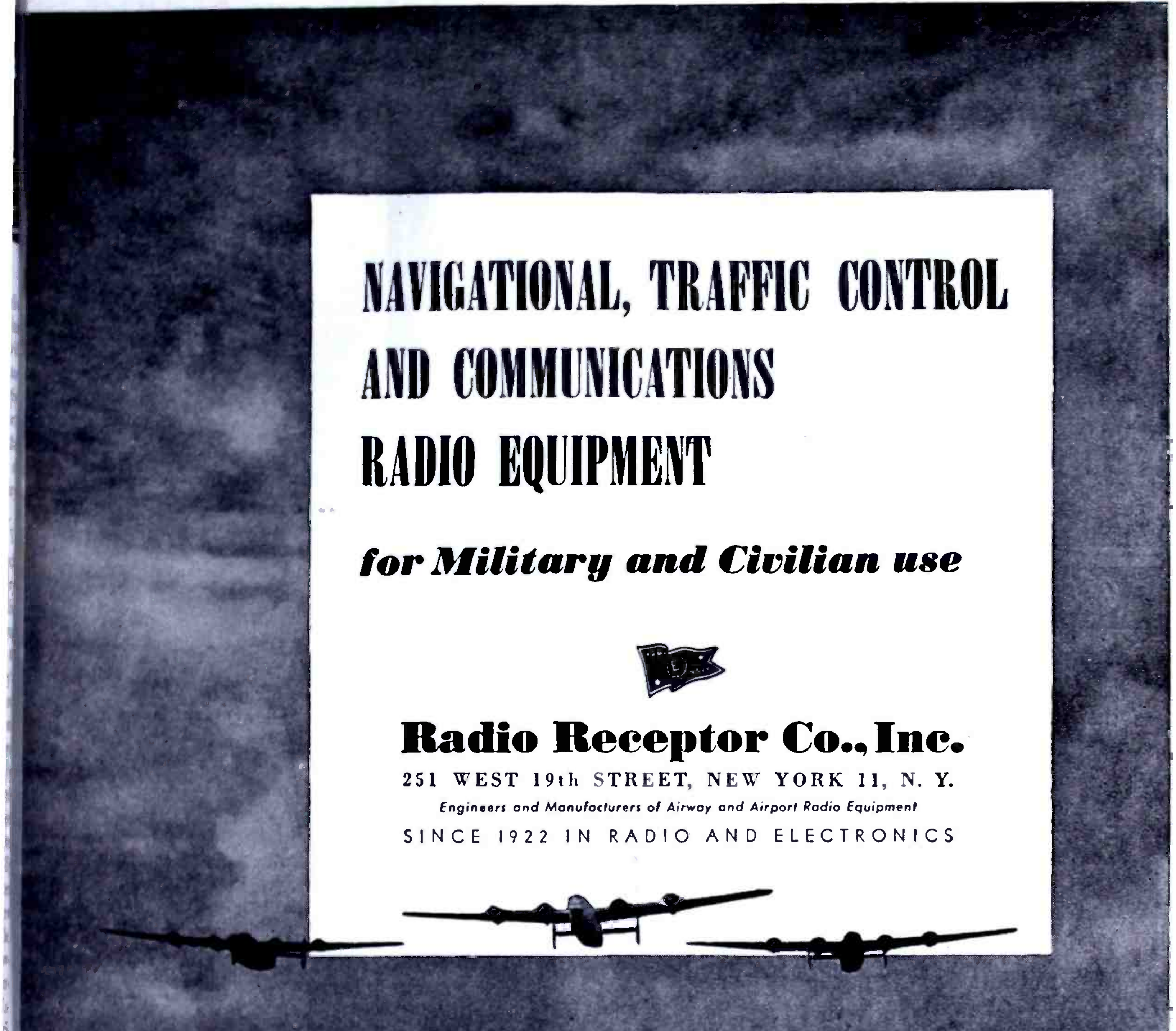
VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President RCA BUILDING, 30 Rockefeller Plaza, New York, N. Y. 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 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.

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



THE ADMINISTRATION BUILDING AT JACKSONVILLE MUNICIPAL AIRPORT No. 1, SHOWING THREE NAVY LIBERATOR PATROL-BOMBERS FLYING OVER THE TOWER IN FORMATION.

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 appreciable 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 amplifier power with increased amplification. The latter immediately would require that the discrimination against acoustics 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 permissable 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

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

ors in *emphasized* loudspeaking ems (i.e. with a markedly rising ponse) and the advantages accru-, 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 lligibility too greatly. This is nec- 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 ve, 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- igibility or loudness is effected even he response were cut off sharply at point (this is seldom the case un- a high-Q high-pass filter is inten- ally added to the transmission uit.)

ustic Feedback Margin

n trying to improve the acoustic lback margin (which is the main blem) in this type of system, it is l to consider what had been accom- hed before. It is evident that one the most important factors is the unate operating requirement that microphone be located behind the e of the reproducer mouth, and ng in the opposite direction. The aration distance is important, but ctical considerations require it to s little as possible. At these short aration distances (of the order of other effects (due apparently to ial distances between reproducer ith and microphone, being of the er of wavelength multiples of par- lar frequencies transmitted, such tanding waves, Fresnel effects, and like), indicate that increase in feed- k margin is not necessarily propor- al to increase in separation dis- e. Experiments have shown that ome cases an actual decrease in the cing between microphone and re- ducer mouth has reduced the feed- k somewhat. For some designs, it ossible to find a *best* separation dis- e within the limitations, although usually indicates an unstable sys-

(*Continued on page* 68)

[5] *he Effective Reproduction of Speech,* Jensen nical Monograph 4; 1944.

V-H-F TRANSMISSION-LINE ELEMENT CHART

by FREDERICK C. EVERETT
Engineer, Radio Facilities Group, NBC

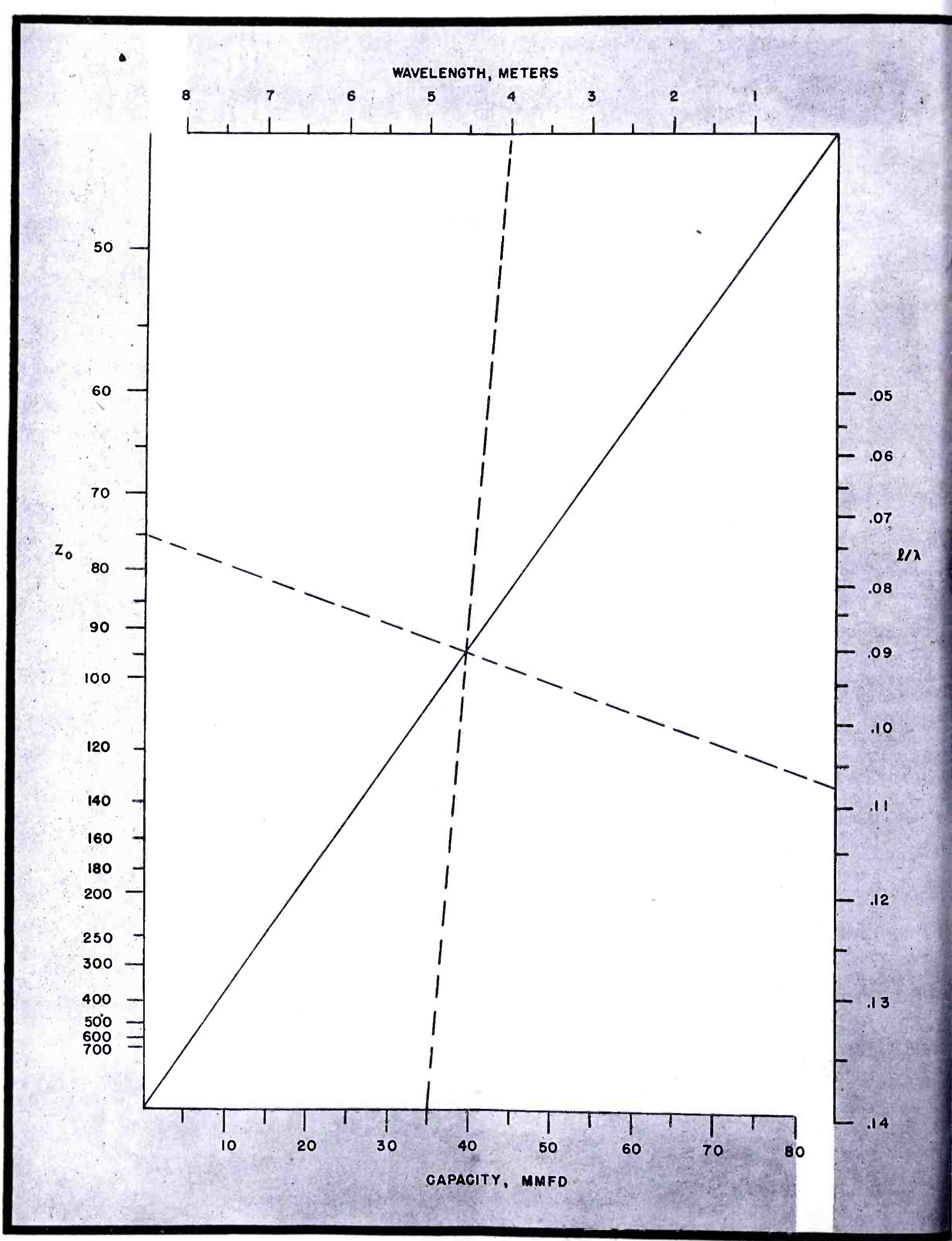


Figure 1

AT high frequencies the shorted transmission line is used considerably as a tuning element in-
..d of a coil. If used alone, its length ..ld be $\lambda/4$, but as a tuned circuit it .. a variable condenser and tube ca-..itance shunted across the open end. ..ther, the line length at the longer ..elengths would be too long for ..venience. This means that the line ..th is considerably fore-shortened; ..narily to something of the order ..$/8$.

..he general equation for the sending .. impedance Z_s of a transmission .. of length x with characteristic im-..ance Z_o and terminated in impe-..ce Z_r is

$$Z_s = Z_o \left[\frac{Z_r \cosh x\sqrt{ZY} + Z_o \sinh x\sqrt{ZY}}{Z_o \cosh x\sqrt{ZY} + Z_r \sinh x\sqrt{ZY}}\right]$$

$$Z_s = Z_o \left[\frac{Z_r \cosh (a + j\,b) + Z_o \sinh (a + j\,b)}{Z_o \cosh (a + j\,b) + Z_r \sinh (a + j\,b)}\right]$$

..or a low-loss line, if α is nearly ..o, then if

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

$$Z_s = Z_o \left[\frac{Z_r \cosh j\,2\pi\, l/\lambda + Z_o \sinh j\,2\pi\, l/\lambda}{Z_o \cosh j\,2\pi\, l/\lambda + Z_r \sinh j\,2\pi\, l/\lambda}\right]$$

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

..f the line short is circuited $Z_r = 0$

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

$$Z_s = Z_o\, j \tan 2\pi\, l/\lambda$$

$\sqrt{ZY}$ = propagation constant (complex) $= a + j\,\beta$)

..or a 2-wire line*

$$Z_o = 276 \log \frac{s}{r}$$

..or a concentric line*

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

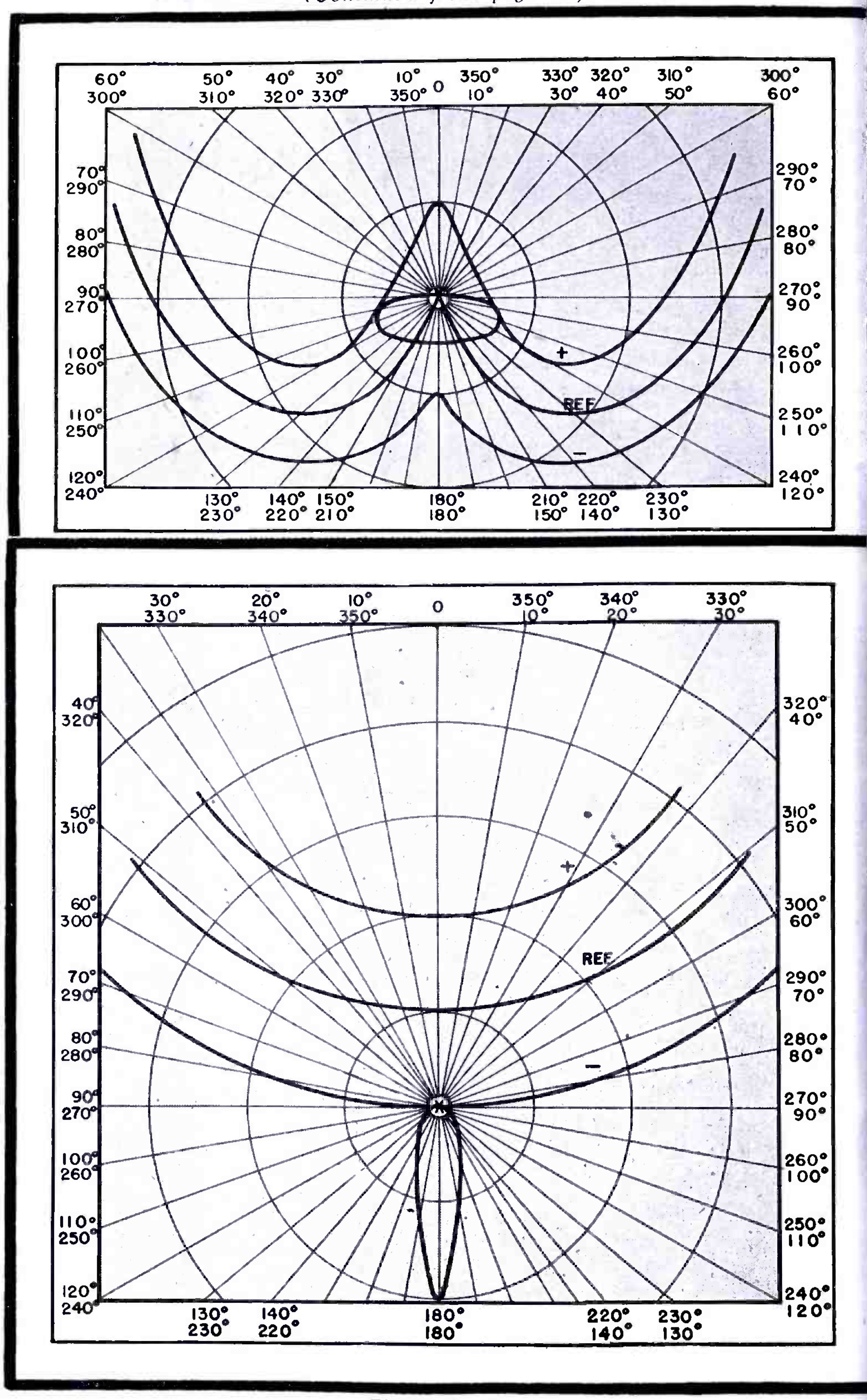
..or resonance this must equal the ..acitive reactance of the condenser ..oss it, which is $1/2\ (\pi\, f\, C)$.

..aving selected a tuning capaci-..ce, and added to it the tube capaci-..ce and a characteristic impedance .. the line, it is possible to determine .. tuning range and length of line ..m a chart, Figure 1, page 66. Con-..sely we can use such a chart to de-..mine the capacitance and the length .. line necessary for a given wave-..gth.

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

ELECTRIC MEGAPHONES

(*Continued from page 65*)



Figures 7 and 8

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

ECTRIC MEGAPHONES

(*Continued from page* 68)

which will feed back if the megane is moved with respect to objects, aces, etc., which may be in the r vicinity.

directional Sensitivity Patterns

n addition to the separation factor, reasing the acoustic feedback in the gn of the megaphone proper cons in reducing both back radiation sound from horn mouth to the atest degree, and ability of microne to respond to sound other than originating at mouth of talker. To strate the importance of approach- undirectional sensitivity patterns both components let us consider e possible cases, simplified for clar- Suppose that we represent the ectivity patterns in a manner sim- to a field strength plot, in which h contour line represents a definite nd pressure from the loudspeaker, point on the line being directly portional to the distance from the rce. Similarly, the lines about the rophone represent contours of equal sitivity in space. Let Figure 5 be idealized directivity pattern of a dspeaker; for our purpose only the r portion will be used. In Figure 6 point x indicates the center of the rophone diaphragm, assuming it to the point of maximum sensitivity. the small circle be the contour of arbitrary lower sensitivity. If the dspeaker isobar passing through x called the reference pressure, the ar marked + represents a higher nd pressure and that marked — a er sound pressure. It can be seen the acoustic feedback between the dspeaker and the microphone can computed if this reference sound ssure and the microphone sensitiv- and effective amplification are wn. If, for instance, with a given blification between microphone and dspeaker in the transmission circuit, ource of 50 bars, at a known fre- ncy, at x produce 45 bars in the rence isobar, howling or singing not occur. If the amplifier gain is eased so that only 45 bars or less x are required to produce 45 bars greater) in the reference isobar, ustic feedback will start. In the ve figure, contours representing er microphone sensitivity, due to points on them being farther away n the microphone diaphragm, cross aker isobars of lower pressure, a dition representing less tendency to dback.

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

(*Continued on page* 76)

MULTI-SECTION FILTER DESIGN PROCEDURE

(Continued from page 44)

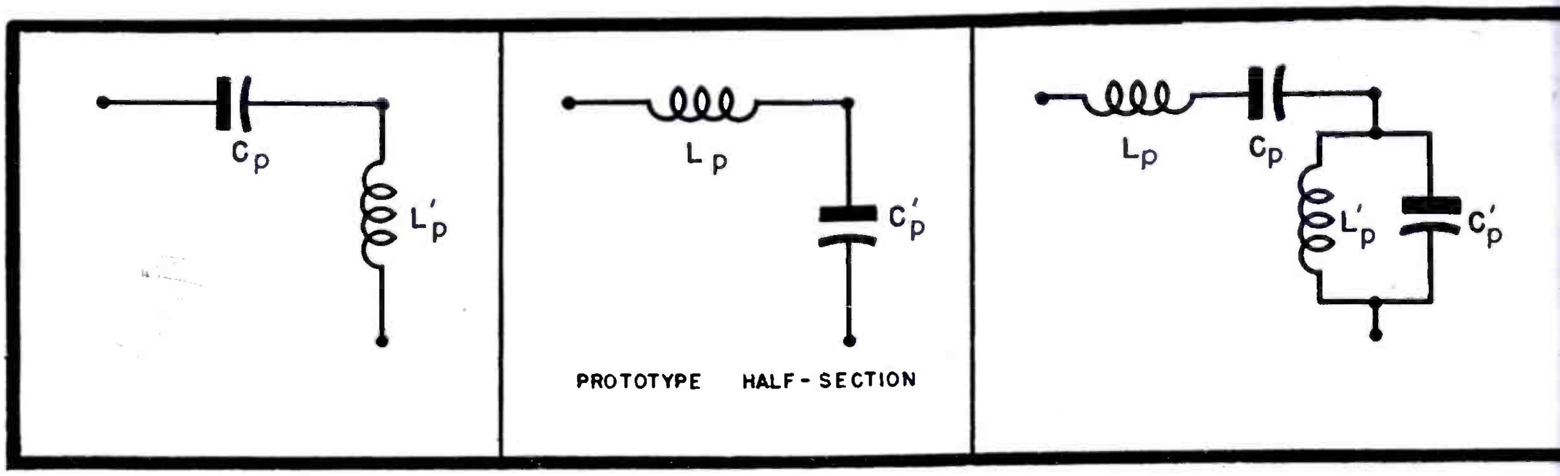


Figure 9

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).

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),

$$r_p = \sqrt{\frac{L_p}{C_p}} = \frac{R_o}{\sqrt{F}};$$

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

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

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

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

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

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

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

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),

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

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

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

$$= R_o\sqrt{\frac{F(S_j + 4)}{S_j}}$$

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

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

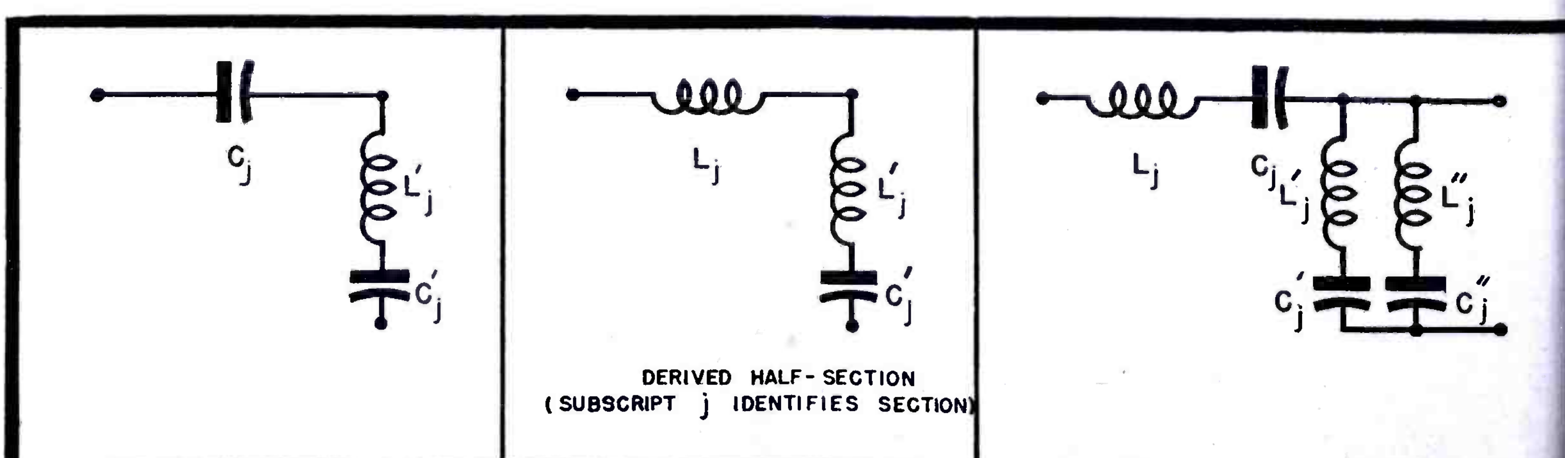


Figure 10

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

mples

rototype section:

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

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

$$w'_p = 37.7$$

rived section (1):

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

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

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

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

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

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

erived section (t) (terminal):

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

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

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

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

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

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

Values of Assembled Filter

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

mple (values in μfd and mh)

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

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

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

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

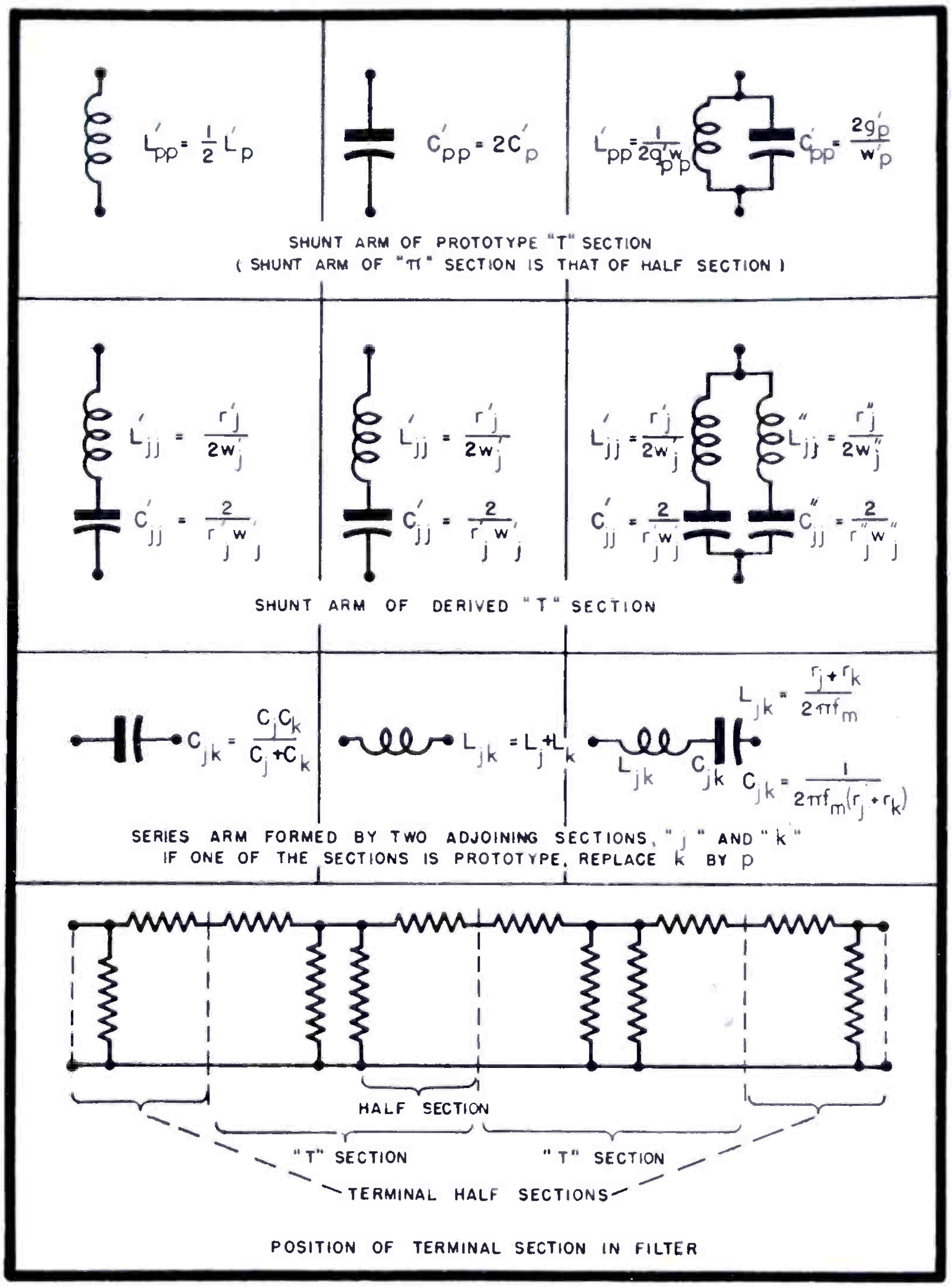
$$= \frac{r_t + r_p}{2\pi f_m} = \frac{822 + 1190}{37.7} = \frac{2012}{37.7} = 53.3 \text{ mh};$$

* See note, page 72.

(*Continued on page* 72)

MULTI-SECTION FILTER DESIGN PROCEDURE

(Continued from page 71)



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

$$L'_{pp} = \frac{1}{2\,g'_p w'_p} = \frac{10^3}{2 \times 4.47 \times 37.7} = 2.97$$

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

$$L_{p1} = \frac{r_p + r_1}{2\pi f_m} = \frac{1190 + 990}{37.7} = 57.8\ \text{mh}$$

$$C_{p1} = \frac{1}{2\pi f_m (r_p + r_1)} = \frac{1}{37.7 \times 2.18} = 0.01218\ \mu$$

$$L'_{11} = \frac{r'_1}{2\,w'_1} = \frac{618}{2 \times 25.95} = 11.9\ \text{mh}$$

$$C'_{11} = \frac{2}{r'_1 w'_1} = \frac{2}{0.618 \times 25.95}\ 0.1247\ \mu\text{fd}$$

$$L''_{11} = \frac{r''_1}{2\,w''_1} = \frac{618}{2 \times 55.2} = 5.6\ \text{mh}$$

$$C''_{11} = \frac{2}{r''_1 w''_1} = \frac{2}{0.618 \times 55.2} = 0.0586\ \mu$$

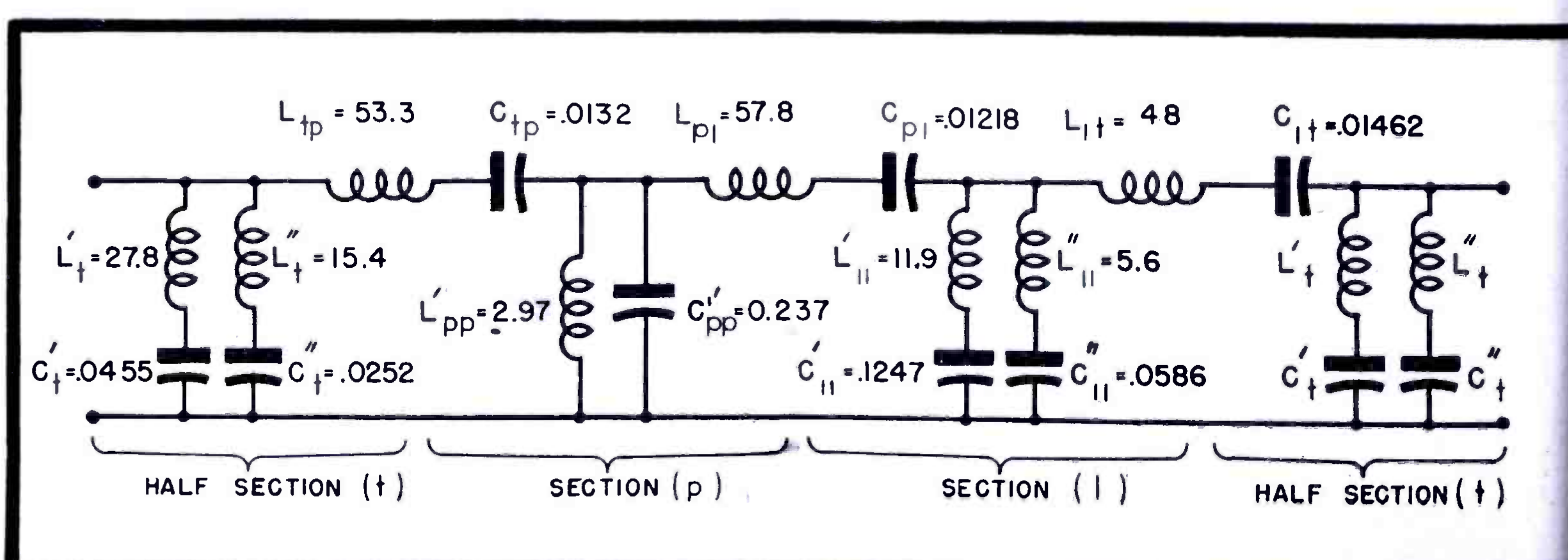
$$L_{1t} = \frac{r_1 + r_t}{2\pi f_m} = \frac{990 + 822}{37.7} = 48\ \text{mh}$$

$$C_{1t} = \frac{1}{2\pi f_m (r_1 + r_t)} = \frac{1}{3.37 \times 1.812} = 0.01462\ \mu$$

(Continued on page 74)

*Resistance r'_t is expressed in KΩ (0.782 K 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.

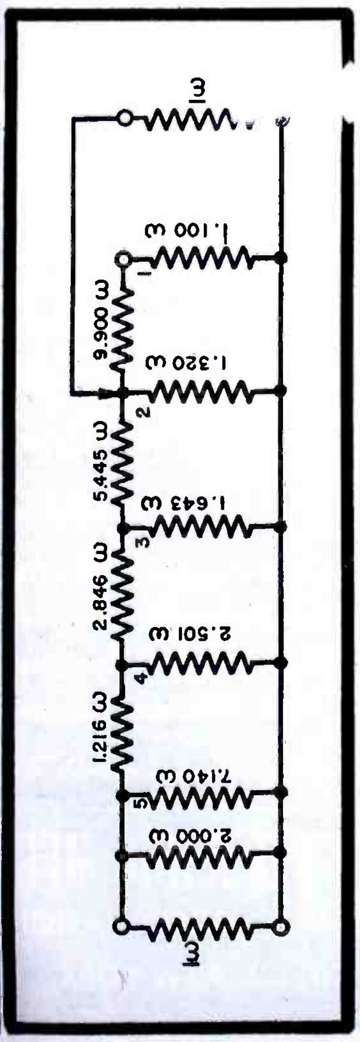


ESISTIVE NETWORKS

(*Continued from page 60*)

edance mismatch at the output terals of the network system. No corion is necessary because of this ever, since all output voltages are nged by the same percentage withcausing any deviation in the relavalues of them for the different nuator settings. The input impece of the network is normally ched to the voltage source impece, but the output impedance of network as seen from the load side qual to the quotient of the nominal gn value of the equal image imnces of the individual section outand the number of outputs it is red to use. If, for example, the ber of branches were three and the etworks were designed to have an put impedance of 225 ohms, the plete attenuator output impedance be 225/3 = 75 ohms. Such sys are very useful for the testing of xial and cable feeder units by means microvolter signal generator, as as for general test purposes where desired to regulate the output in s of relative voltage instead of bels.

Figure 12
llustration of the application of the alter method given for the design of ladder rks. This network has a total loss of 20 ith 5 steps having 5-db per step for 4 and an insertion loss of 3.46 db on the fifth step.



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

$$\Theta = l\,n \frac{\sqrt{1+P}+\sqrt{P}}{\sqrt{1+P}-\sqrt{P}}$$

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

$$P = \frac{1-\frac{F}{S}}{\frac{F}{S}-\frac{F}{n}}$$

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 ıe resulting curve has equal minima. 'he grouping charts themselves are lots of this minimum value against ıe values of F/S for each of the variıs universal curves which have been dded together, and the value F/n_A hose significance is best explained by ıe explanatory diagrams inserted in igures 1 to 6.

auer Parameters

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

implified Method

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

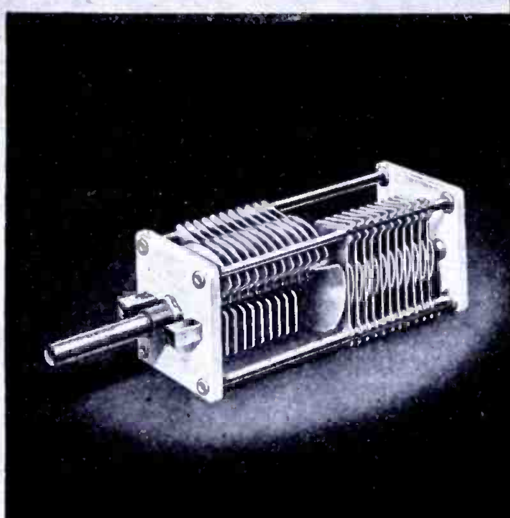
•

CBC INTERNATIONAL STATION

•

Above, checking instrument panels of master control board of new CBC 100-kw international h-f station at Sackville, Canada. Below, installing tube in water-cooled jacket of transmitter panel. Station beams programs over the Great Circle route to Europe.

•



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 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-

PROGRAM ANALYZER

CBS program analyzer designed to record large audience reaction. Instrument was originally designed by Frank Stanton, CBS vice-president and general manager and Dr. Paul Lazersfeld of Columbia University.

cal, from the user's standpoint, to ake this diameter greater than about ". An equivalent piston of this ameter radiates the greater propor- on of sound in a narrow cone about e axis, above 2,000 cycles. However, e directivity becomes relatively broad the frequency is reduced below 2,000 cles, so that considerable sound is diated between 90° and 270° from e forward axis at low frequencies. 500 cycles, for instance, the equiv- ent piston produces a pressure at 90° ly about 2 to 3 db down from axial essure, while at 2,000 cycles it is ap- oximately 22 to 23 db down. The lative pressure at 180° depends upon e configuration of the diffraction pat- rns existing around any given device, t even making the simple assumption at the same difference in loss exists 180° as at 90°, it can be seen that in system having an overall uniform re- onse, the loss against acoustic feed- ck is of the order of 20 db less at 0 cycles than at 2,000 cycles. This fference can be reduced considerably ing an *emphasized* system equalized give a rising response of between db and 10 db per octave.

coustic Feedback Loss Limits

To illustrate how the acoustic feed- ck loss limits the sound pressure nplification of a megaphone, let us ke a simplified example. Assume a egaphone 1' long connected to a suit- ble amplifier so that with 28 bars put at the microphone, 100 bars can produced by the horn at 4' on its xis, Figure 9 (page 78).

xamples

Assuming output power versus dis- nce follows the inverse square law, r purposes of illustration, the sound essure at 1' from the horn would be 00 bars. If the directivity loss at 180° a radius of 1' from the center of the orn mouth is 22 db down from the xial pressure, i.e. 400 bars, at this dius the pressure at the microphone aphragm P_M due to the horn pressure $_H$ 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 eing fed into the microphone, the sys-

(*Continued on page* 78)

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-

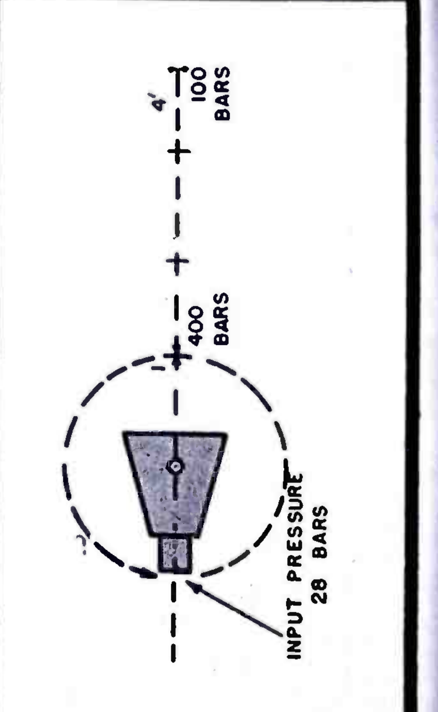


Figure 9
Illustrating how the acoustic feedback loss limits the sound pressure amplification of a megaphone.

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

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

, the ring is thin compared to its meter. Massa[9] and others have own the comparative increase in ectivity of ring radiators over cir- ar pistons. Taking the diameter of horn mouth as the diameter of the uivalent piston, when $D_M = \frac{\lambda}{2}$, the rease in directivity of a thin ring er a circular piston is shown to be out 4 db at 90° off the central radi- ing axis.

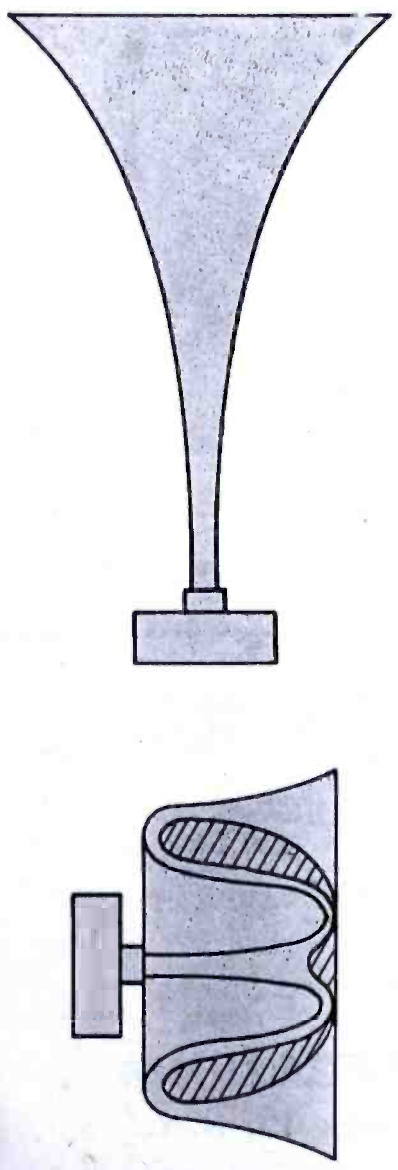
At higher frequencies where λ is s than 2 D_M, the increase in directiv- of the ring over the piston is eater, except where secondary or

(*Continued on page* 80)

[9]Frank Massa, *Acoustic Design Charts*, The akiston Co.

Figure 10

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

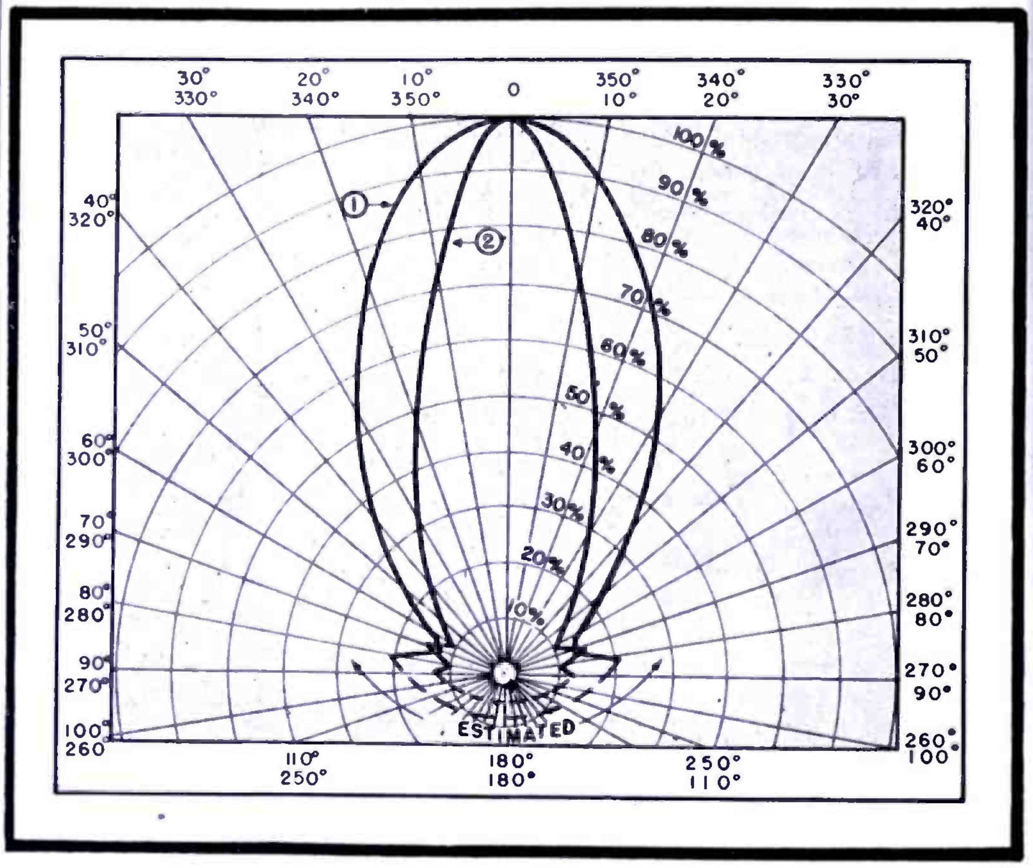


ELECTRIC MEGAPHONES

(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 sections 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.



ꞮEMOTE GAIN CONTROL

(*Continued from page* 49)

›sirable to run the risk of failure or
›osstalk from carrying all lines back
rough the control point. Stepping
lay systems, other than being com-
icated and expensive, require fre-
ıent service and are susceptible to
ouble. Two *direct-control* methods
ıve been found to solve the foregoing
oblems. These are the feedback-type
ontrol and variable-pad control.

eedback Type Control

If the output amplifier is of the volt-
ge feedback type, Figure 1, it is very
onvenient to use a feedback control.
his circuit has been used successfully
rough 40' of cable without frequency
stortion or otherwise noted discrep-
ıcies. It could probably be used over
reater distances with special design
onsiderations.

dequate DB Range

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

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

applied to the amplifier at normal
ain and at 1 db above and below nor-
al gain, to solve for three values
R_F.

ormal Gain With Feedback

For example, if the normal gain
ith feedback is to be 30 db, values of
$_F$ for gains of *29, 30,* and *31 db* will
required, R_F can either be made
riable or as a safety measure split
to two resistances, R_A and R_C, mak-
g one of these variable.[1] In making
the parallel circuit, it can be seen
at it is preferable to keep the vari-
ble portion of R_C small with respect
the lines' capacitive reactance.
therwise, the capacity in the line
ould tend to shunt out high-frequency
omponents of the feedback, giving the
nplifier a rising characteristic. The
ıe should be a low-capacity crystal-
icrophone cable or flexible concentric
ansmission line. After correct pro-
ortioning of R_A and R_C, R_A becomes

(*Continued on page* 82)

[1]Aylor, *Combining Components*, COMMUNICA-
ONS, March 1945.

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_2 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 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 rack 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 ± 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)

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 utilizng 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.

(*Continued from page* 38)

late current is noted. The tap is then ermanently attached to the turn of ie coil giving maximum plate cur-ent.

At the high-frequency end of the ansmitter's range (ordinarily fre-uencies higher than 4 mc), the an-nna reactance may be essentially zero r positive (inductive), when the load-ig coil should be shorted out.

peech Amplifier and Modulator

The gain of the speech amplifier is xed to provide full modulation under ormal close talking by the operator nto a W. E. single-button carbon nicrophone.

Another item of interest is the in-lusion of a complete metering system an integral part of the transmitter. he metering system consists of a sin-le 0-1 ma meter together with a suit-ble switch and multiplier resistors o read voltages across fixed resistors n various circuit branches. In this ystem of metering there are no closed ircuit metering jacks upon whose roper functioning the transmitter is ependent.

Relays in Transmitter

A total of only four relays is used n the transmitter. Two relays con-rol the autotune motor, one relay ap-lies filament power to modulator and inal amplifier tubes and the fourth re-ay switches the antenna from receiv-r to transmitter. Wiring of these elays is such as to provide complete nterlock of autotuning and operating equences.

Standard type relays perform the ntenna changeover function, bring he modulator and amplifier filaments ip to full voltage and apply plate pow-r by means of an external solenoid, vhen the microphone button is pressed y the operator. A connection is pro-ided through the autotune circuit to he control leads so that the circuit f the dynamotor-starting solenoid cir-uit is broken during the frequency hange cycle. Thus frequency change s never accomplished with plate pow-r applied to the transmitter.

Antenna

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

Credits

The author is grateful to Stan Er-vin of American Airlines for his kind ssistance in the compilation of this aper.

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.

Poblem 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

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

ytheon Manufacturing Company has received C authorization to construct five 100-watt perimental radio-relay stations (operating be-een 1,900 and 26,500 mc) to be installed at w York City, Lexington, Mass., Bristol and lland, Conn., and Webster, Mass. This New rk-to-Boston circuit is the first leg of ytheon's proposed nation-wide communica-ns system, which will follow the airline routes Cleveland, Detroit and Chicago to the Pa ic Coast.

Raytheon has also received FCC permission erect two developmental f-m stations in w York City on top of the 700' Lincoln ilding, using frequencies of 105 and 107 mc. he call letters of these stations are W2XRA d W2XRY. Transmissions from these sta-ns will be co-ordinated with the FCC f-m mmer tests.

One of the f-m stations will direct its ansmission southward on 105 mc, for observa-on by the Commission's field stations extend-g from Philadelphia to Atlanta. The second ansmitter will be directed on 107 mc toward hicago, for observation by western points.

* * *

EATCH NOW WASHINGTON RCA REQUENCY BUREAU MANAGER

mes P. Veatch, formerly with the FCC in arge of the Treaty Section of the Inter-ational Division, has been appointed manager the Washington office of the RCA Frequency ureau, 1625 K Street, N. W., Washington, . C.

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

* * *

IALLICRAFTERS APPOINTS HERWOOD S-M

. J. Sherwood has been named sales manager the Hallicrafters Company, Chicago.

Mr. Sherwood was formerly assistant to the resident of General Dry Battery, Inc., Cleve-nd.

* * *

EEGARDEN TO HEAD RCA CENTRALIZED TUBE DIVISION

new tube division providing for centralization tube equipment engineering, manufacturing, nd sales activities, with L. W. Teegarden s general manager, has been announced by CA.

Plans call for the transfer of the division's

(*Continued on page* 88)

•

MECK HANDIE-TALKIE

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

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 suceed 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 McCanne, 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.

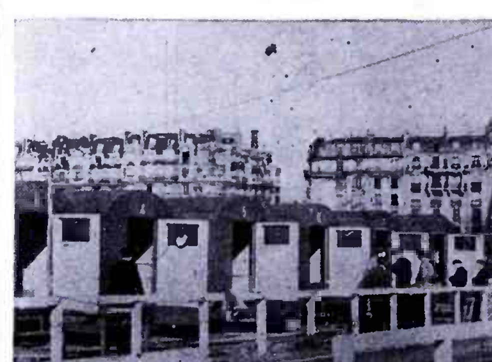
In attendance were Howard Thomas (Packard, Bell Co.), chairman of the council; Lew Howard (Peerless Electrical Products), vice chairman of the council and James L. Fouch (Universal Microphone Co.) treasurer of the council and of the association.

* * *

KOHLHAAS BECOMES ASS'T 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.

tional 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 CROSLEY

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

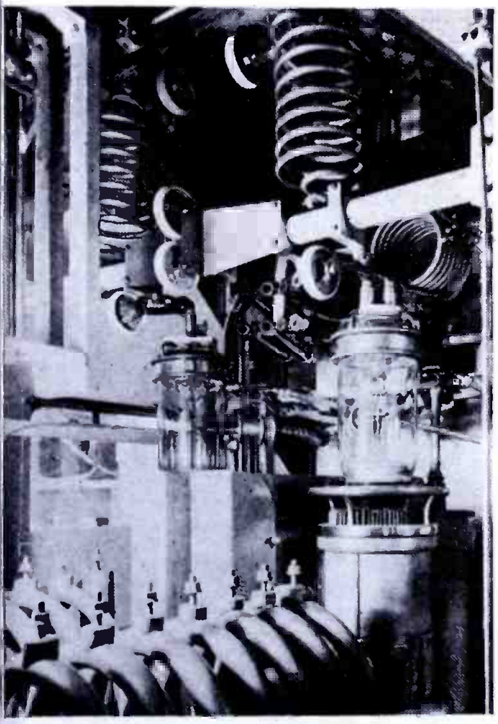
Mr. Crosley will now manufacture Crosley automobiles.

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.

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.

Canada and its allies $200,000,000 worth of dio equipment. The annual prewar producn rate was approximately $15,000,000.

* * *

PRAGUE PULSE SERVICE APACITOR NOMOGRAPH

pulse service capacitor nomograph, No. 11, s been prepared by the engineering departent of the Sprague Electric Company, North dams. Although the nomograph is primarily signed for determining the volt-amperes rough a capacitor used in rectangular pulse rvice, it first, as an intermediate step, finds e d-c (unit pulse) energy content which, in me cases, may be sufficient.

* * *

EVILLE MILLER NOW WITH RMY-NAVY LIQUIDATION OFFICE

eville Miller, former president of the National ssociation of Broadcasters, has joined the aff of the office of the Army-Navy Liquidan Commissioner.

He will serve as special assistatn to the Comssioner for surplus disposal activities of the med forces in the Mediterrancan Theater of peration, the African-Middle East Theater, e Persian Gulf Command and the Indiaurma Theater.

* * *

. G. ERSKINE DEAD

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

* * *

IEROVOX NAMES RANK L. MARSHALL ASS'T S-M

rank L. Marshall, former assistant sales manger of Bundy Tubing Company, Detroit, has ecome assistant sales manager at Aerovox orporation, New Bedford, Mass. He will andle sales to equipment manufacturers.

* * *

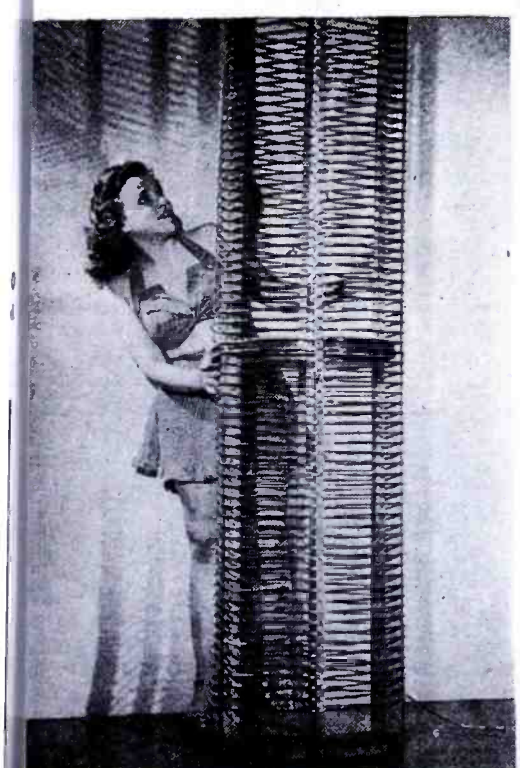
CA SOUND SYSTEM BROCHURE

ses of 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.

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 Fiberglas 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,

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STEEL-TO-GLASS METAL TUBE SEAL

Steel header insert of metal tube, using new steel-glass fusing process to provide airtight seal. *(Courtesy RCA)* a recent N. Y. IRE meeting.

Dr. DuMont said that direct-viewing cathode-
y tubes offer high-light brilliance, better
ntrast range, wide angle viewing, lower ac-
lerating voltage, longer life, better resolution,
ss alignment difficulty, and simplicity of the
cusing system. However, he said, the dis-
lvantage of the direct-viewing system is a
ight curvature of the screen and the need
r a special mounting arrangement to reduce
e depth of the television receiver in the
rger bulb sizes.

Continuing the analysis, Dr. DuMont said: "Taking up the various characteristics of rect-viewing, we find that the high-light ightness of the 20" tube is in the order of foot lamberts as compared with approx- nately 3.5 foot lamberts for the most efficient ojection system now in use. In both cases e size of the picture is considered to be ½ x 18".

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

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

"As to directivity (maximum viewing angle om the normal-angle at which the apparent ightness decreases to 50% of its value in ormal direction) we find that the 20" tube an be viewed from ±80° whereas the projec- on system screen can only be viewed from ±15°. It of course is possible to widen this ngle somewhat in the projection system but so doing the high-light brightness will de- rease from its already low value.

"In making these comparisons we have as- umed an accelerating voltage on the 20" tube f 15 kilovolts, and 30 kilovolts on the 5" at face tube of the projection system."

* * *

ROBINSON-HOUCHIN NAMES C. A. VOLF RESEARCH DIRECTOR

Dr. Christian A. Volf has been appointed di- ector of research in the electronic and acous- ic division of the Robinson-Houchin Optical Company Columbus, Ohio.

* * *

JAMAICA, L. I., TO HAVE EXPERI- MENTAL TELEVISION STATION SOON

W2XJT (600-watts peak video, 150-watts udio) being installed at 148-18 Jamaica Ave- ue. Jamaica, Long Island, by William B. till, is expected to be on the air soon on hannel 13, 230-236 megacycles.

Its facilities are expected to include studio or live broadcasts, motion picture film equip- nent, control room containing three video monitors, two turntables and audio and video onsoles.

* * *

BROPHY REELECTED CANADIAN RMA PRESIDENT

R. M. Brophy, president of Rogers Majestic Limited and Rogers Electronic Tubes Limited, has been reelected president of the Radio Man- facturers Association of Canada. S. L. Capell,

(*Continued on page* 94)

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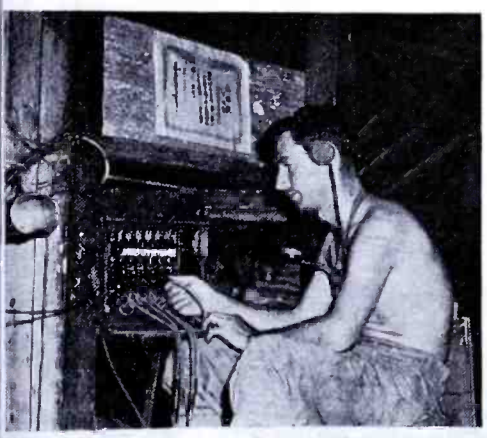
OKINAWA COMMUNICATIONS



Pvt. Earl G. Gleason, Ponca, Neb., operating communications unit in the 105th Infantry mes- sage 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.*)

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 ident in charge of the patent department RCA Laboratories.

r. Coe had been Commissioner of Patents e 1933. He had been appointed by the late sident Roosevelt.

* * *

AGUIRE BUYS MEISSNER, RROCART AND MICRO PRODUCTS

e Meissner Manufacturing Company, Mt. rmel, Ill., has been purchased by Maguire lustries, Inc.

Meissner will continue its operations as an lependent division of Maguire Industries. ames T. Watson and George V. Rockey, rmerly principal stockholders, will continue head the Meissner management and all ner key personnel will remain the same. r. Watson has been elected vice president. len F. Jester continues as sales manager the radio-phonograph division; Ray Hut-ker continues as Mr. Jester's assistant and dfrey Wetterlow as eastern sales manager.

The Ferrocart Corporation of America and e Micro Products Corporation have been erged into a new division of Maguire Indus-ies, the Micro-Ferrocart products division. Harry A. Ford, founder and president of the o firms, has become a vice president and neral manager of the new division.

Plant operations have been moved from astings-on-Hudson to one of the Maguire ants at 375 Fairfield Avenue, Stamford, Conn.

The Thordarson Electric Manufacturing ompany of Chicago, purchased by Maguire dustries a few months ago, has been con-lidated into a transformer manufacturing vision of Maguire Industries.

L. G. Winney, formerly first vice president d treasurer of Thordarson, has been elected vice president and will be general manager what will be known as the Thordarson Elec-ic Manufacturing division.

Harry Ford

* * *

ENERAL RADIO CELEBRATES 0TH YEAR

he 30th anniversary of the General Radio ompany, Cambridge 39, Massachusetts was lebrated recently. A special 30th anniversary sue of the "Experimenter" for June offers discussion of the G-R engineering depart-ent.

* * *

NDREW RHOMBIC TRANS-ORMER BULLETIN

rhombic antenna coupling transformer is scribed in bulletin 31 recently released by the ndrew Company, 363 East 75th Street, Chi-go 19, Illinois. Coaxial plugs and jacks e also described in the bulletin.

* * *

R. BURROWS JOINS CORNELL UNIV.

r. Charles Russell Burrows of Bell Tele-one Laboratories has ben appointed pro-ssor of electrical engineering and director the School of Electrical Engineering at ornell. He will assume his new duties about eptember 1.

* * *

ECHRAD LOW-RADIATION ECEIVER DATA

n 8-page folder describing a low-radiation pe receiver, LRR-5, has been prepared by echnical Radio Company, 275 Ninth Street, n Francisco, California.

* * *

AYLOR TUBE CATALOG

36-page tube catalog has been released by Taylor Tubes, Inc., 2312 Wabansia Avenue, Chicago.

Presented are data on 35 types of Taylor tubes. A chapter on tube and transmittter 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 transfer 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)

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 properties 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

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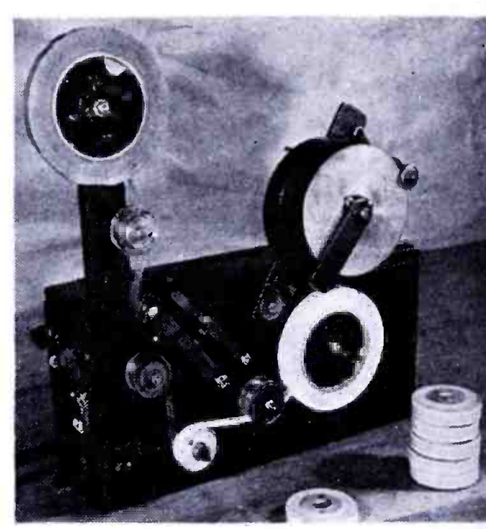
CELLOPHANE TAPE PRINTER



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 airdriven 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 micarda, one rubber, and one roller holding the interchangeable type.

F. Hirsch, Inc., New York, N. Y. The w unit, to be known as Solar Precision Castrs, Inc., will be headed by Edmund T. ice, president of Solar Aircraft. B. L. vinson, until now vice-president and genl manager of B. F. Hirsch will have the me posts in the new unit.

* * *

EDS & NORTHRUP RESISTANCE OCHURE

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

* * *

" AWARDS

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

he third white "E" flag star has been arded to the Bendix Radio division of Bendix iation Corporation.

he Cherry Rivet Company, 231 Winston reet, Los Angeles, Calif., has won an Armyvy "E".

* * *

NGDON JOINS SLER ENGINEERING

oward E. Kingdon has been named chief enneer and manager of the transformer dertment of the Eisler Engineering Company, wark, N. J.

* * *

OMMUTATORS AND SLIP RING DATA

catalog listing over 3,000 variations of mmutators and slip rings has been published the Toledo Standard Commutator Co., oledo, Ohio, and the Homer Commutator rp., Cleveland.

* * *

UGENE SYKES DEAD

ugene O. Sykes, member of the first Federal adio Commission, died recently.

* * *

EPS HOLD ANNUAL DINNER NEW YORK

e metropolitan chapter of the Representaes held their annual dinner in New York cently. Representatives of leading manucturers, distributors and the press attended. irty Camber, president of the Representaes, addressed the group.

* * *

ARION INSTRUMENT BOOKLET

12-page booklet describing the history, uses d advantages of glass-to-metal hermetically led electrical indicating instruments, has en released by the Marion Electrical Inrument Company, Manchester, New Hampire.

* * *

HERRY RIVET POCKET MANUAL

20-page pocket manual, D-45 describing basic pes of self-plugging and hollow rivets, inallation methods and applications, has been nounced by Cherry Rivet Company, 231 inston St., Los Angeles 13, Calif. Also scribed and illustrated are application guns 15RB pneumatic and the hand guns G-10, 25, G-35 and G-20, with angle adapters, t-face nippers and Cherry Rivet kits.

* * *

MPEREX RADIATOR PERORMANCE DATA

bulletin describing the radiator performance aracteristics of forced air-cooled copperode tubes has been released by the Amperex ectronic Corporation, 25 Washington Street, rooklyn 1, N. Y.

* * *

UARDIAN RELAY CATALOG

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

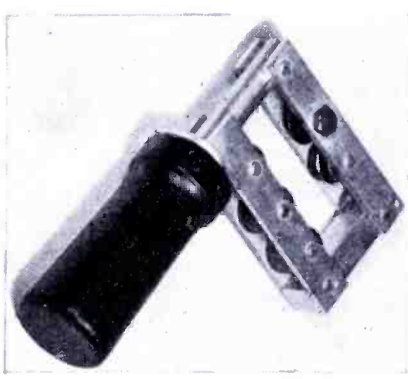
Discussing the two general types of blue screen materials used commercially for photographic work, the bulletin says that both had been designated as P5. It has now become apparent, however, that these materials, each offering distinct advantages in certain photographic applications, are sufficiently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

THE INDUSTRY OFFERS . . . —

ANDREW COAXIAL CABLE GROOVING TOOL

A grooving tool for soldering splices on ⅞" 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 1¾" x 1⅝" x 2$\frac{3}{16}$" to 5⅞" x 4¾" x 6-19/32"

* * *

UNIVERSITY DIRECTIONAL SPEAKERS

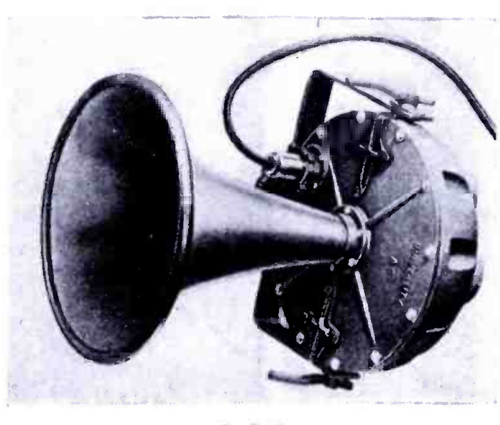
Directional loudspeakers, B-6, that are said to have a range of approximately one mile over open country and two miles over water, have been designed by University Laboratories, 225 Varick Street, New York 14, New York.

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 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.



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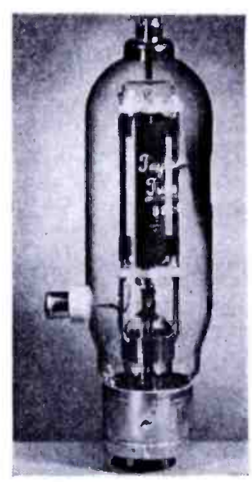
TAYLOR TUBE 822-S TRIODE

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 2⅝". Base, standard 50-watt.



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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 Fairoaks Avenue, South Pasedena, Calif. The sleeve is composed of three thin fingers with an inside taper extending approximately three-fourths of their 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 10 5/32", width 5 7/32". Maximum height, 6½" (5½" above, 1" below mounting chassis).

* * *

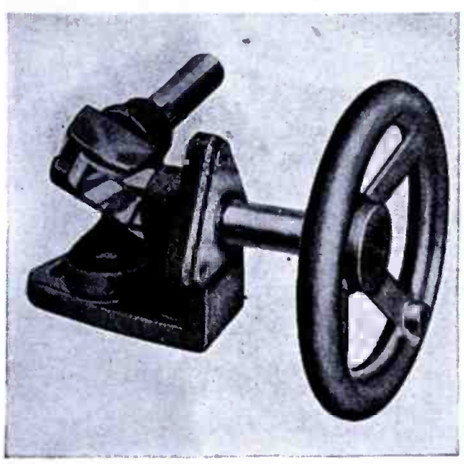
PIEZO UNIVERSAL LINK JOINT

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 adjustables 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.



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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.

* * *

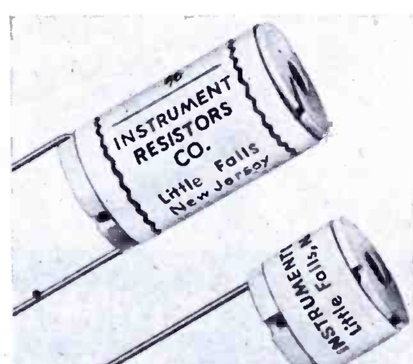
IN-RES-CO NON-INDUCTIVE RESISTORS

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%.



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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)

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

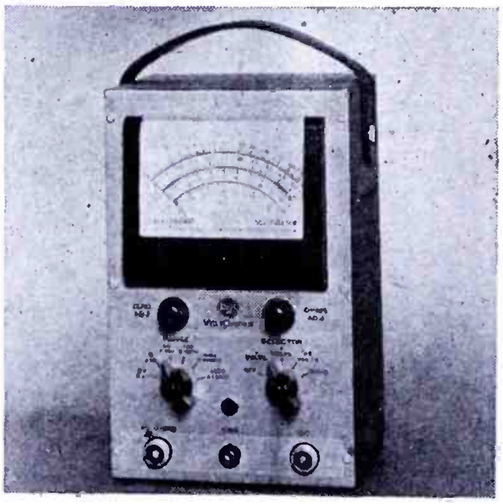
A liquid cold setting plastic, cardolite 5616, for filling of junction boxes, stuffing boxes, pot-heads and similar void spaces encountered in electrical work, has been developed by the Irvington Varnish & Insulator Company, Irvington 11, New Jersey. The liquid, mixed with Irvington 5612 setting agent, 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 alkalies. Although cardolite 5616 will adhere to metal, it can be stripped away.

* * *

RCA 6-WAY VOLTOHMYST

A test unit, 195-A voltohmyst, 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.



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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.

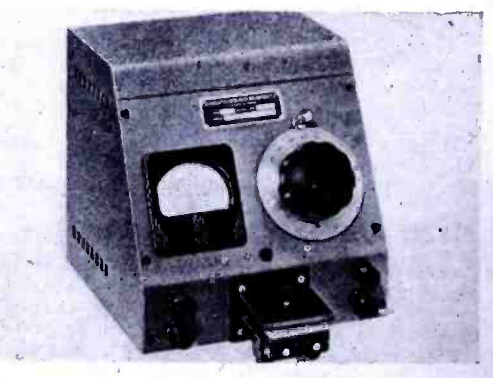
* * *

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 ¼ ohm to 10,000 ohms, with adjustable ratio arm, sensitivity control, production type test fixture with automatic on-off switch. Sensitivity control range is from ±¼% to ±10%. Indicator is a sensitive zero center galvanometer.

Battery-operated unit measures 8" x 8" x 12"; weight, 18 pounds.

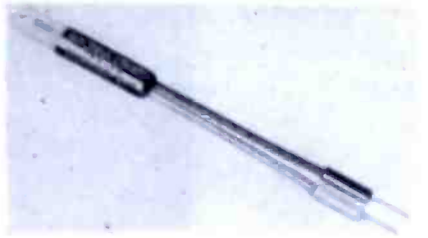


* * *

AMERLINE POCKET CIRCUIT TESTER

A vest-pocket all-purpose circuit tester has been produced by Amerline, 1753 North Honore

St., Chicago 22, 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.



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G. E. PORTABLE CURRENT TRANSFORMERS

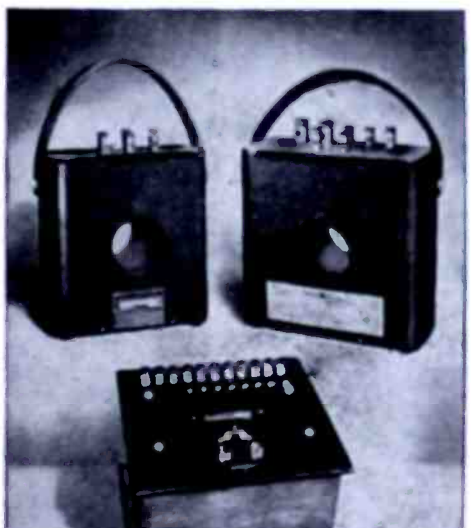
Portable current transformers, types JP-2, -3, and -4, has been announced by G. E.

The JP-2 and -3 units one said to meet the accuracy requirements of the ASA 0.3 accuracy class with Burdens B-0.1, -0.2, and 0.5 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 the 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 2500 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.



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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 flourescent equipment, and are said to provide an efficient source of near ultra-violet radiation for all applications requiring excitation of flourescent 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.

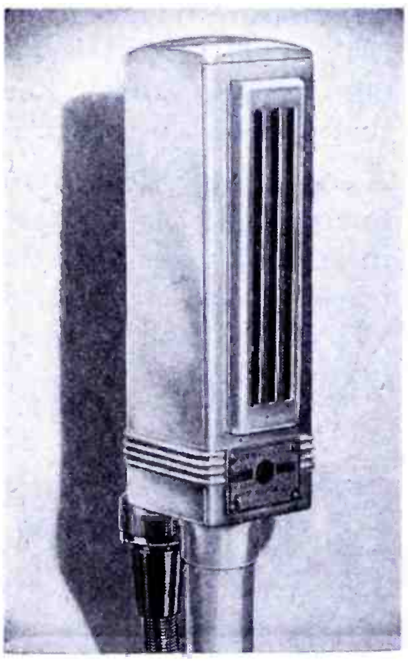
Has a 5 millimeter ribbon element.

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)

is available in only one high-impedance model.



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LANGEVIN AUTO TRANSFORMERS

Three types of continuous duty auto transformers, 800-A, 801-A, 802-A, have been announced

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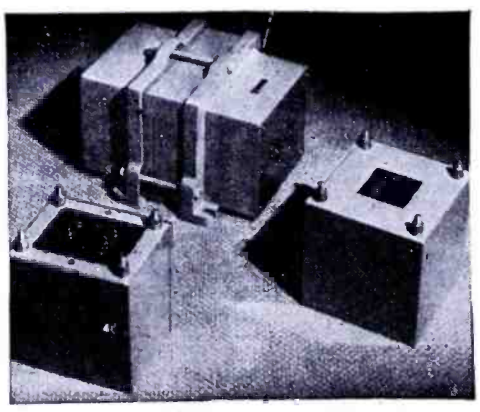
(*Continued from page* 101)

by the Langevin Company, Inc., 37 West 65th Street, New York, N. Y.

Type 800-A characteristics are: Primary 220 volts, 60 cycles; secondary 110 volts, 250 watts; 5AS case, length 4 5/16"; width 3 13/16"; height 5", weight 10 pounds. Type 801-A: Primary 220 volts, 60 cycles; secondary 110 volts, 500 watts; 6AS case, length 5 1/16", width 4 15/16", height 5"; weight 16 pounds. Type 802-A: Primary 220 volts, 60 cycles; secondary 110 volts, 1000 watts; housed in #6 casting poured with humidity-proof compound.



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BRUSH HUSHATONE

A miniature (bimorph crystal) molded plastic extension speaker, Hushatone, designed for private listening and consuming .01 watt, has been announced by the Brush Development Company, Cleveland, Ohio.

The Hushatone has a flat, disc shape, 4 3/16" x 1 1/16". It is hermetically sealed.

* * *

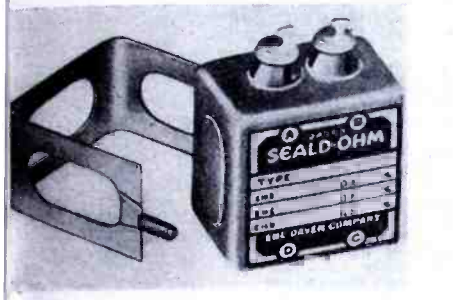
DAVEN WIRE-WOUND RESISTORS

Wire-wound "Seald-ohm" hermetically sealed precision resistors have been developed by the Daven Company, 191 Central Ave., Newark 4, N. J.

Resistor elements are mounted in a drawn brass case. Connections are brought out through fused glass seals, soldered in the case.

Mounting bracket permits vertical, inverted or horizontal mounting.

:esistor windings are spool, or mica-card depending upon engineering requirements; nductively wound. Any desired resistance : value may be had; maximum 1,600,000 depending upon the type of resistance employed.
uracy is said to be ±0.1% to ±10.0%. Re-s 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 s and accuracies.
nensions are: 1 9/16" wide, 1½" high, ⅞" add terminal height, 9/16"; studs on ting bracket, 1 11/16" between centers.



* * *

'HERINGTON SWITCHES

ches for both industrial and aircraft use total movement of 7/16", that are said e environment proof have been produced Robert Hetherington & Son, Inc., Sharon Pa. Two methods are used in the proof-process. One places a bellows on the ger end of the switch and the other is lace a rubber boot over the plunger.
temperatures down to 40° below zero, the er boot has been satisfactory under many itions. However, where hydraulic fluids gasoline or other solvents are present, or e the switch will meet extremes of heat cold, the metal bellows is recommended. l switches are sealed, back and front and made for a-c or d-c. Contacts are double k type, solid silver.

* * *

3E BROAD-BAND FILTERS

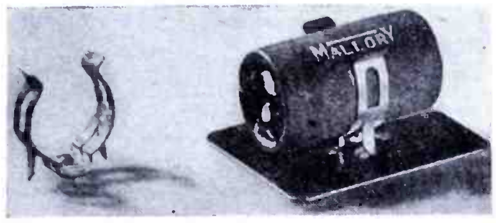
wer-line filter for use with screen-rooms that aid to prevent entrance of objectionable noise at all frequencies from 150 kilo-es to 400 megacycles, has been announced he Filterette division of the Tobe Deutsch-in Corporation, Canton, Massachusetts. is said to provide attentuation better than b over the entire band.
signed for continuous operation at 500 d-c or a-c at a full load current of 100 eres. Filter is available for installation wo-wire and three-wire circuits. The three-i filter is 23" long x 12" wide x 4⅛" deep; two-wire filter is 20" long x 8" wide x 4⅛" deep. Electrical connection is made to ⅜" 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 ⅝" to 1⅜". Catalog number is Mallory type TH or Prestole series 500.



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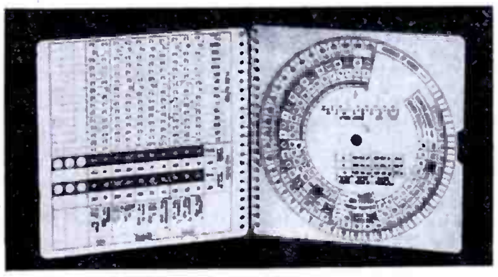
HOPP PHOTOGRAPHIC COMPUTER

A photographic computer 4" x 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.



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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.

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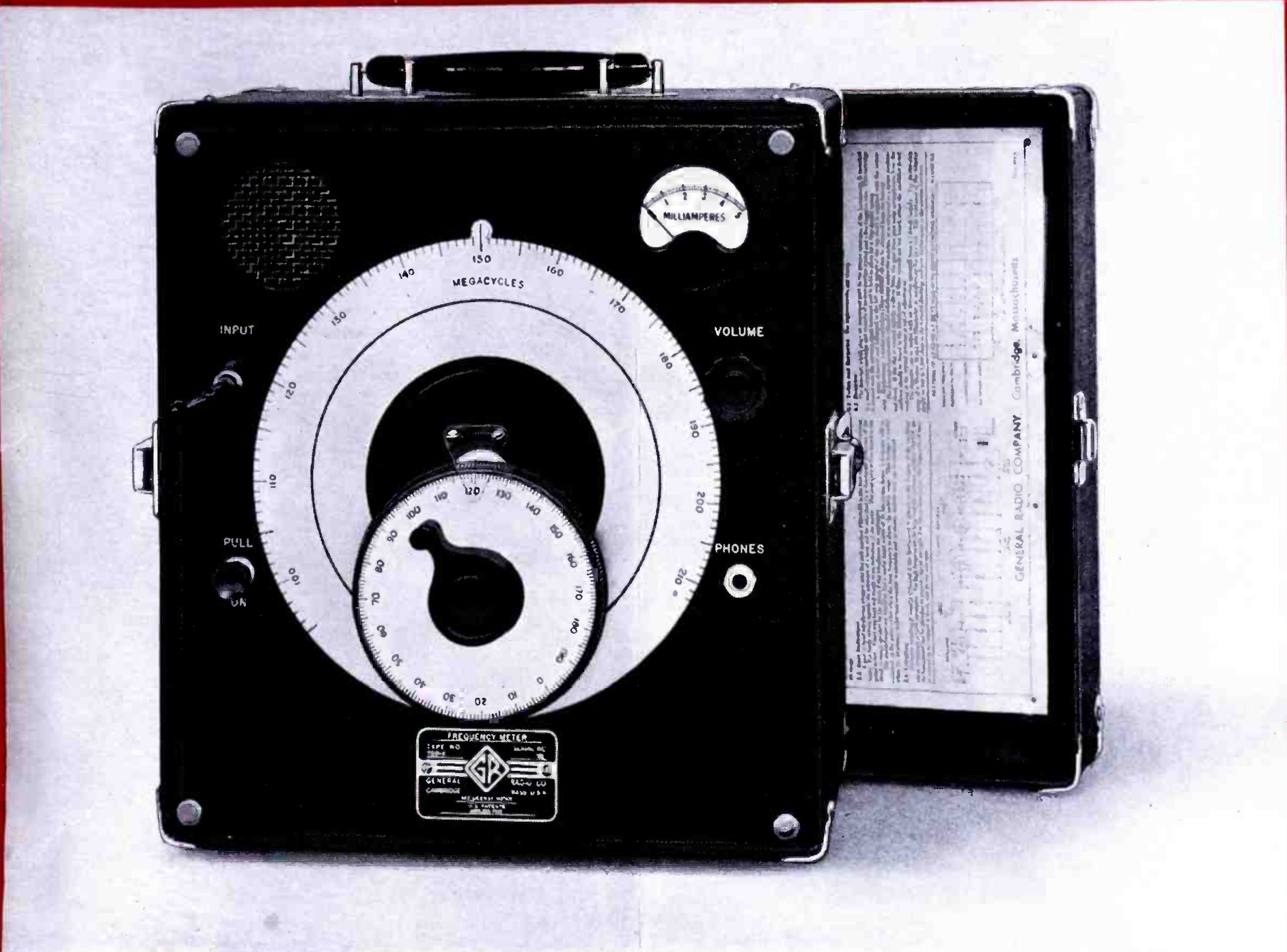

For Measuring Frequencies Between 30 and 3,000 Mc

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