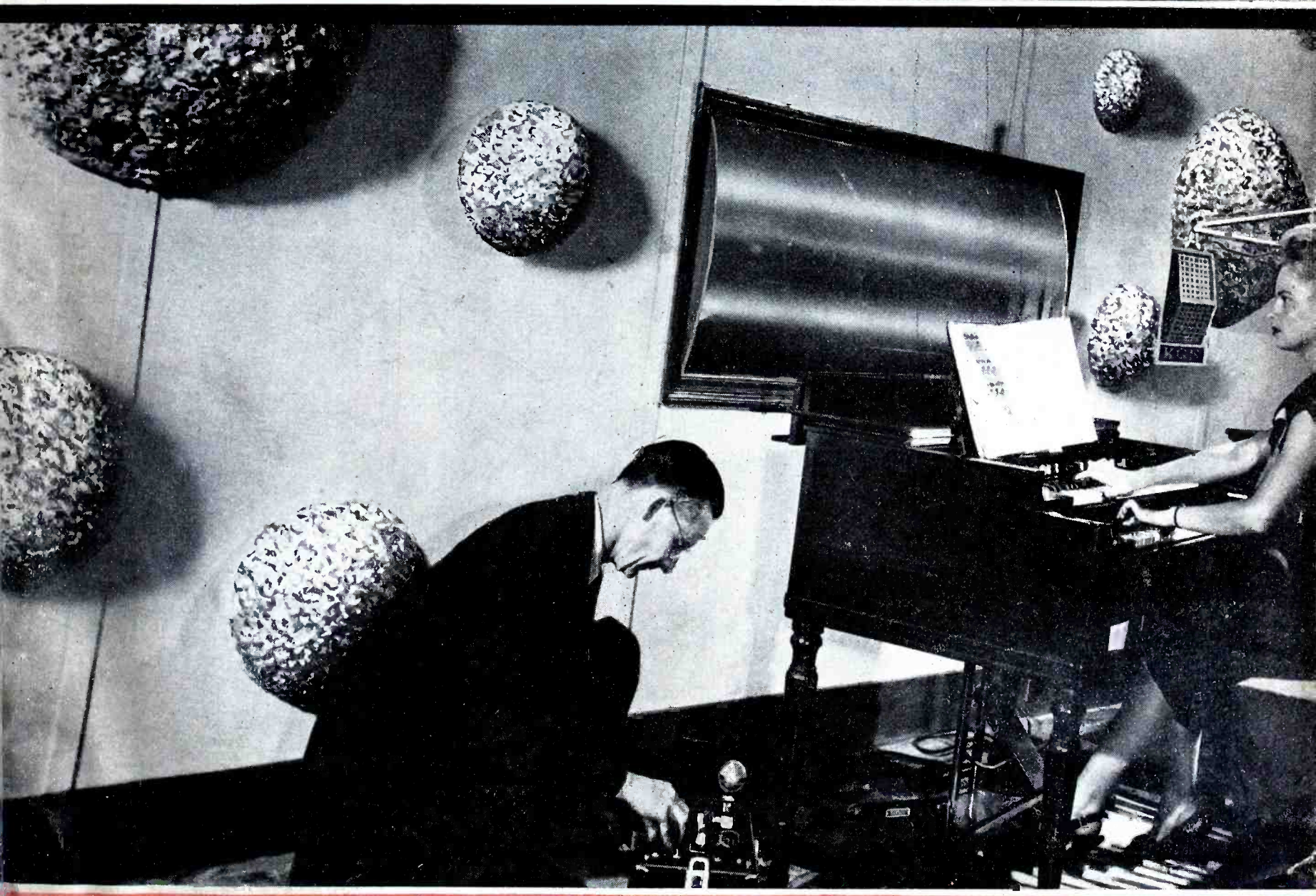
COMMUNICATIONS

INCLUDING "RADIO ENGINEERING" AND "TELEVISION ENGINEERING"



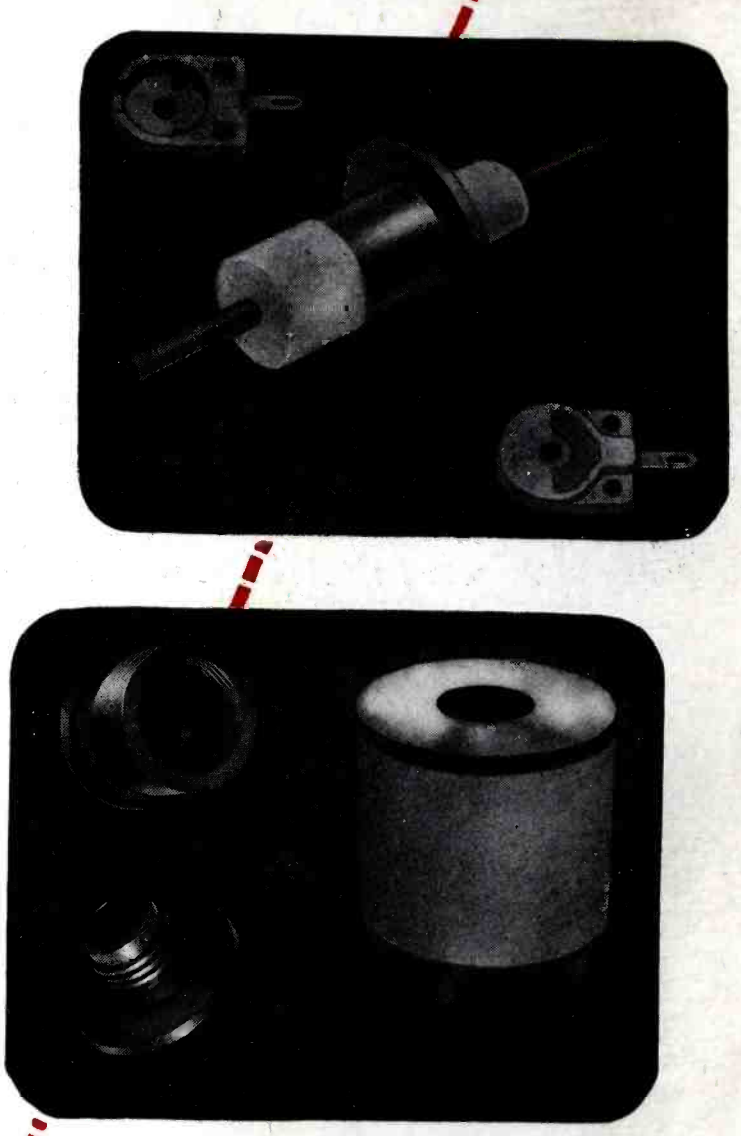
OCTOBER 1946

★ SPEECH CLIPPERS

★ SOUTHERN CALIFORNIA TELEVISION LINK TESTS

★ DETERMINING ABSOLUTE MAGNITUDE OF SOUND PRESSURE FIELDS

Here's why MYCALEX 410 ... is the "Last Word" in low loss insulation

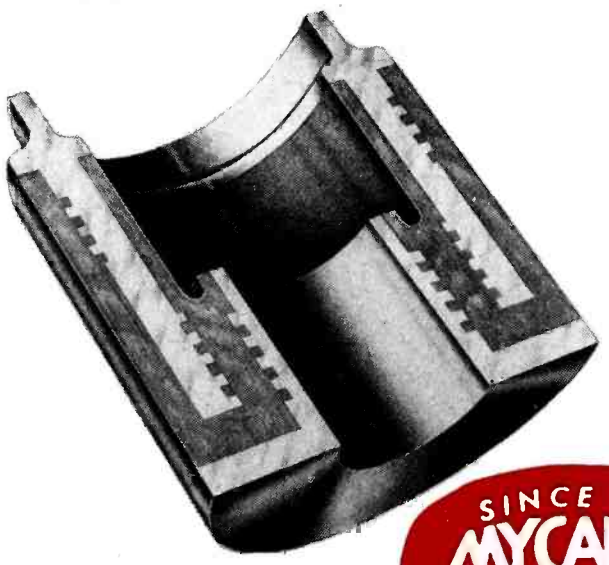


For more than 27 years MYCALEX has consistently demonstrated its superiority as an insulating material — supplanting one old-fashioned material after another as electronic advancements have made insulating needs more exacting.

MYCALEX excels wherever high dielectric strength and extremely low loss factor are important . . . where resistance to arcing and high temperature is desired . . . where imperviousness to oil and water must be virtually 100%.

Latest and greatest of MYCALEX advancement is MYCALEX 410 (Molded Mycalex). This highly perfected insulation, together with our exclusive injection-molding techniques, now makes available a wide variety of unusual or intricate shapes . . . especially with metal inserts or electrodes molded in to form a perfect bond or hermetic seal.

Our engineers invite your inquiries on all insulating problems.



SINCE 1919
MYCALEX
THE INSULATOR
TRADE MARK REG. U. S. PAT. OFF.

SOME PROPERTIES OF MYCALEX 410

Electrical Properties	
Power factor, 1 megacycle, dry	0.0015
Dielectric constant, 1 megacycle	8.3
Volume resistivity, ohm-cm	6.0×10^{17}
Arc resistance, ASTM seconds	250
Dielectric strength, volts/mil	400
Mechanical Properties	
Flexural strength, psi	13,000
Tensile strength, psi	6,000
Compressive strength, psi	20,000
Hardness, Brinell	150
Modulus of elasticity, psi	8×10^6
Maximum safe operating temperature, °C	400
Density, lb./cu. in.	0.136
Specific gravity	3.8

MYCALEX CORPORATION OF AMERICA

"Owners of 'MYCALEX' Patents"

Plant and General Offices CLIFTON, N. J. *Executive Offices,* 30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.

LEWIS WINNER, Editor

F. WALEN, Assistant Editor

We See...

NEW BRIGHT CHAPTERS IN THE ACTIVE HISTORY of radio communications were written during the crowded engineering conference days of October . . . in Chicago at the National Electronics Conference and at the meeting of the NAB, in New York at the TBA Conference, in Hollywood at the SMPE meeting and in Buffalo at the APCO Convention. Communications engineers, offering their first comprehensive report since VJ Day on their research and development work, disclosed a monumental parade of progress, a record of achievement of which the industry should be very proud.

Microwaves, antennas, television, frequency modulation, radio relays, air navigation, recording and facsimile . . . all were well represented in the advancement reports of the engineers.

In reports on microwave generation, the industry learned of important contributions to microwave frequency stability and the use of such new developments as all-metal tunable squirrel-cage magnetrons, wide-range coaxial-cavity oscillators using flexible klystron tubes, and a beam-switching tube, the cyclophon . . . generating devices that will permit transmission of extremely high powers at superhigh frequencies for pulse-time modulation, relay work, multiplex operation and other communications service.

Wide-band high-power antennas operating at 500 megacycles and beyond with a variety of radiation control features were also discussed.

The outstanding television development of the year, the image orthicon, was also discussed at the various meetings. Incidentally, the three men responsible for this outstanding technical contribution . . . Dr. Albert Rose, Dr. Harold Bell Law and Dr. Paul Kessler Weimer . . . received an award of merit for their work at the TBA Conference. Other important television developments discussed included an electrostatic image dissector, which achieves scanning by electrostatic rather than magnetic deflection, using scanning generators of the *bootstrap* type. The application of powdered iron in television deflection circuits was also discussed at the meetings. We learned of the development of low-loss powdered iron materials with a-c permeabilities of between 40 and 250.

In discussing microwave television relaying engineers reported that equipment producing an f-m signal with approximately 100 milliwatts of power for the picture carrier was now available. Operating in the 6500 to 7050-mc band, the system uses a highly directional parabolic antenna providing a signal gain of about 5000 times with a 4′ reflector or 11,500 times with a 6′ reflector. Discussing coaxial cable installations, telephone engineers disclosed that 2700 miles of coaxial cable has already been placed in service, and before the year is out coaxial lines will connect New York to Charlotte, North Carolina; Terre Haute to St. Louis; Jacksonville, Florida to El Paso, Texas; Miami to West Palm Beach, Florida; Buffalo to Cleveland; Minneapolis to Stevens Point, Wisconsin; and Marysville to Sacramento, Calif.

As the men and women in the laboratory, field and plant have said . . . it's only the beginning, only the beginning!—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.

OCTOBER, 1946 VOLUME 26 NUMBER 10

COVER ILLUSTRATION

Recording studio of Kasper-Gordon with acoustical-correction diffusers arranged in random pattern on one wall. (*See page 36 for further details*). (*Fay Photos, Boston*)

TELEVISION ENGINEERING

SOUND ENGINEERING

TRANSMITTER DESIGN

CIRCUIT ANALYSIS

F-M BROADCASTING

BROADCAST STATION MAINTENANCE

MONTHLY FEATURES

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.**

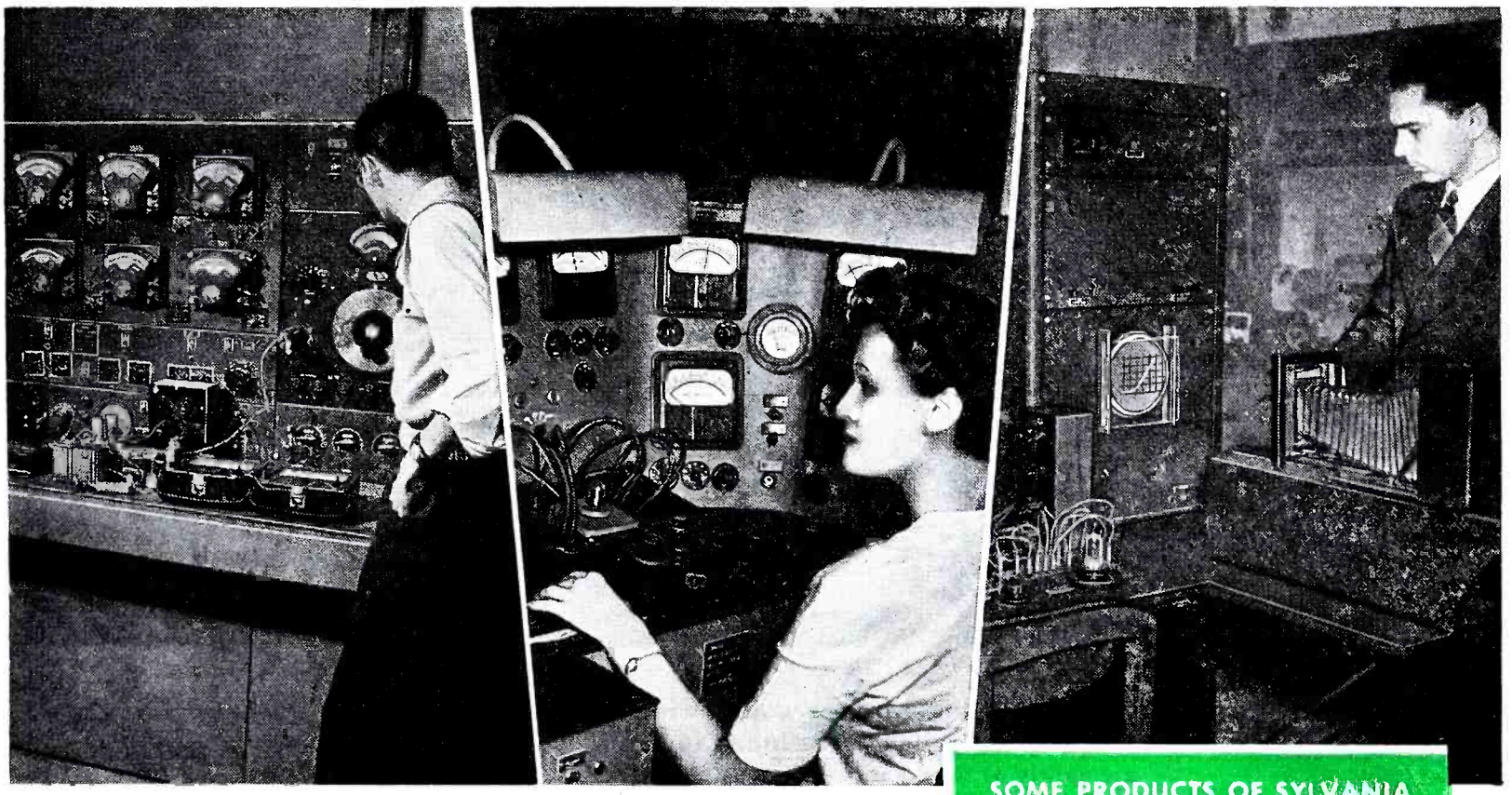
Advertising and Editorial offices, 52 Vanderbilt Ave., New York 17, N. Y. Telephone, MUrray Hill 4-0170. Cleveland Representative: James C. Munn, 2656 E. 126th St., Cleveland 20, Ohio; Telephone CEdar 7783. Chicago Representative: Lawrence Wehrheim, 5510 W. Lemoyne Ave., Chicago, Ill.; Telephone MERrimac 7919. Pacific Coast Representative: Brand & Brand, 1052 W. Sixth St., Los Angeles 14, Calif.; Telephone, Michigan 1732. Brand & Brand, 1085 Monadnock Building, San Francisco 5, Calif.; Telephone, Douglas 4475. 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 U. S. 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

CIRCUIT ENGINEERING EDITION

OCT. *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1946

SYLVANIA COMMERCIAL ENGINEERING DIVISION AIDS IN PRODUCING EFFICIENT SET CIRCUITS



Views of Sylvania Electric's renowned Commercial Engineering Department. Here, new discoveries from Sylvania's laboratories are built into the latest products.

Helping to engineer the best possible radio circuits for many set manufacturers is one of the numerous achievements of Sylvania's famous Commercial Engineering Department.

Time and again circuits found to be unnecessarily complicated were simplified and made even *more efficient* through the work carried on here.

For nearly twenty years Sylvania's Commercial Engineering Department has contributed to the advancement of circuit design as well as to the development of a great variety of electronic and lighting products.

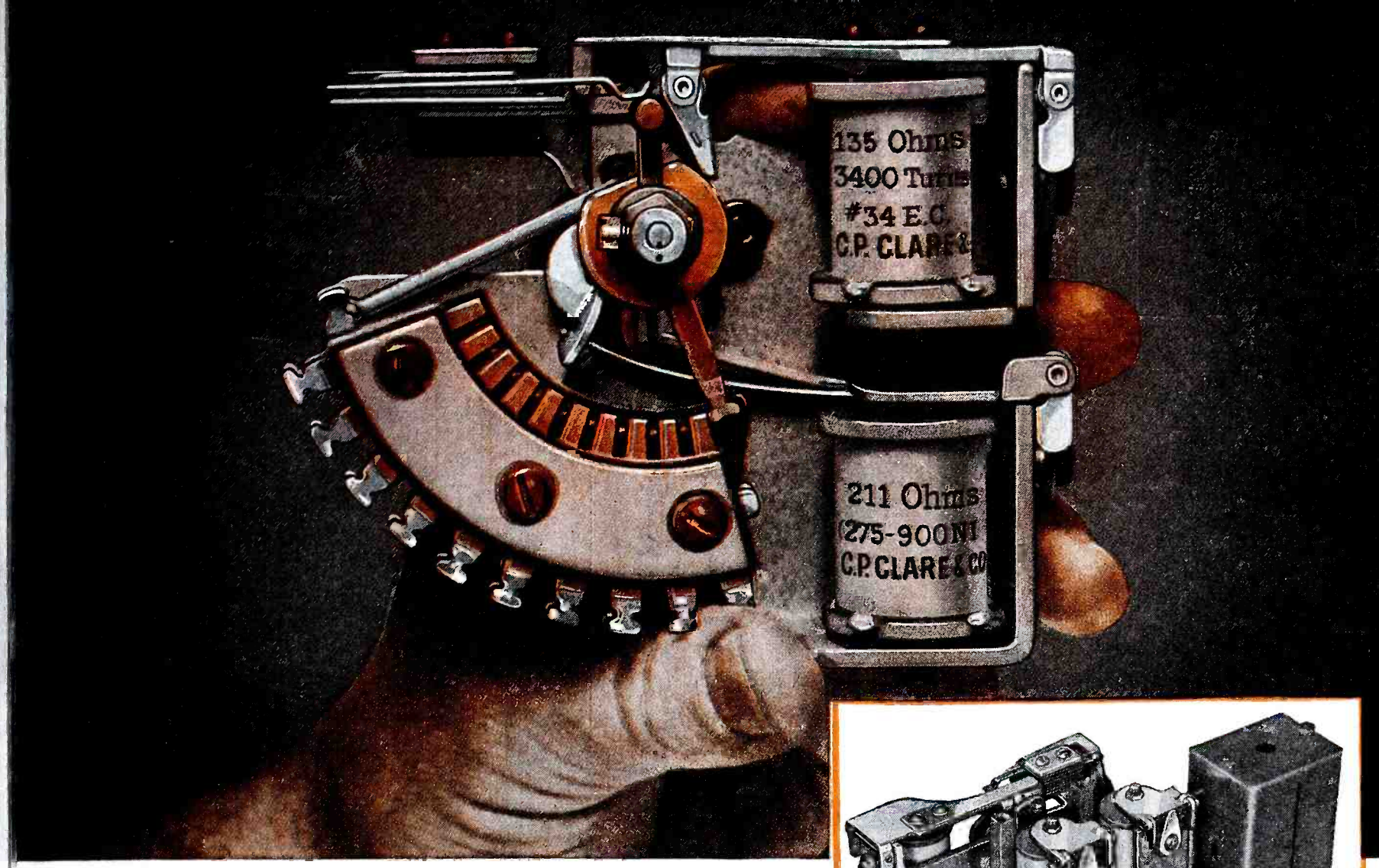
SOME PRODUCTS OF SYLVANIA ENGINEERING RESEARCH

Radio receiving tubes, such as the famous Lock-In.
Miniature radio receiving tubes, including the tiny T-3.
1.4 volt battery tubes.
150 ma. line of 6.3 volt tubes.
Radio transmitting tubes.
Cathode ray tubes.
Pirani tubes.
Silicon Crystal Diodes.
1N34 and 1N35 Germanium Crystals.
Electroflash Tubes and Units.
Radio tube parts.
Fluorescent lamps.

SYLVANIA ELECTRIC

Emporium, Pa.

MAKER'S OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS



Clare Stepping Switch Dials Radio Telephone Call in 3½ Seconds

● All or any one of 84 mobile units can be signalled in 3½ seconds from the master station of "Fleet Control," the new radio dial telephone system of the Hammarlund Manufacturing Company of New York.

This attachment, or addition, to a standard two-way radio system, employs a Clare Direct Drive Stepping Switch to provide the selective calling of trucks, taxicabs, busses, maintenance trucks, or any mobile units with which communication is desirable.

Calls are initiated by energizing the rotary stepping magnet of the Clare Stepping Switch which causes it to notch up the number of points called for by the digit dialed. It remains at this point to receive the impulses caused by dialing the second code number digit. Dialing of the four-digit code number, which must add up to 10, thus causes a succession of stepping operations which bring the rotary arm to Point 10.

The only unit that will step up to Point 10 on the Clare Stepping Switch will be the one with the code identical to the four digit order of the number dialed. Unwanted units are not bothered with calls for other stations.

Two Type "C" Clare Relays with pivot damping springs are also included in the Hammarlund "Fleet Control." These Relays and the Clare Direct Drive Stepping Switch were selected for this service because of their maximum reliability under the severe shock and vibration encountered in mobile operation.

Experienced Clare engineers are located in principal cities to assist in your relay or stepping switch problems. Look them up in your classified telephone directory or write: C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. Cable address: CLARELAY. *In Canada: Canadian Line Material Ltd., Toronto 13.*

CLARE RELAYS

"Custom-Built" Multiple Contact Relays for Electrical and Industrial Use

Outside view of HAMMARLUND "Fleet Control" master station

CLARE RELAYS AND STEPPING SWITCH MOUNTED IN "FLEET CONTROL."

This view of the sub assembly of the Hammarlund "Fleet Control" shows the location of the two Clare Relays and the Clare Direct Drive Stepping Switch.

Use of these Clare products makes possible the signalling of 84 mobile units with a four digit calling number . . . 126 mobile units with a five digit number.

Other features of this Clare equipped unit give:

1. Calls made and message started in 3 to 3½ seconds.
2. System returned from "in use" condition to normal standby in less than 0.6 seconds.
3. Unwanted units not affected by calls for other stations.
4. Other units unable to break in during transmission.
5. Any unit can call central station during standby.
6. Any number of units can be coded identically for simultaneous calls.
7. All units can be called simultaneously or selected groups may be called.

Specifications of Clare Ten-Point Direct Drive Stepping Switch

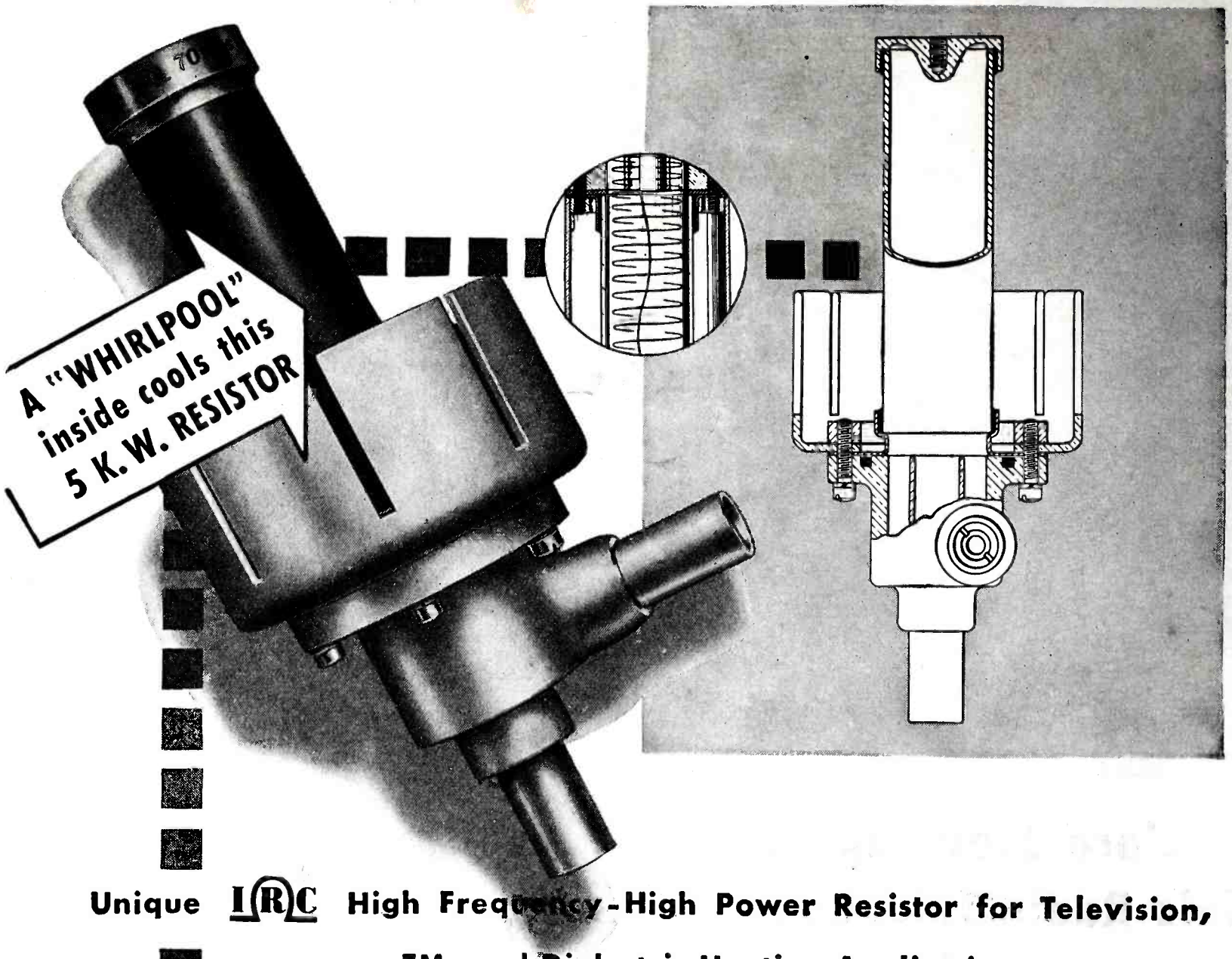
Bank Levels . . . One, two or three.

Operating Voltage . . . Nominal: 6, 12, 24, 48—Maximum: 8, 16, 32, 58.

Standard Test Voltage . . . 1000 volts.

Maximum Operating Speed . . . 35 steps per second on 48 volt switch under ideal conditions. Lower maximum on lower voltages.

Release Time . . . 0.030 second.



Unique IRC High Frequency-High Power Resistor for Television, FM, and Dielectric Heating Applications

Inside IRC's new Type LP resistor a high velocity stream of water flows in a spiral path against the *metallized* resistance film and, through centrifugal force, maintains intimate thermal contact with the entire surface. Interchangeable intake nozzles permit adjusting the rate of water flow and therefore the cooling action to suit local water pressure and power dissipation up to 5 K.W.

A resistance film less than 0.001" thick, with an active length considerably less than ¼ wave length at FM and television frequencies, gives good inherent frequency characteristics.

The mechanical design permits direct mounting on the end of a coaxial line with both water intake and outlet connections at R.F. ground potential. Resistor elements are interchangeable. Different values or service replacements can be readily installed in the field.

The IRC Type LP Liquid Cooled High Frequency High Power Unit is the latest in IRC's continuing development of resistors. It is available in resistance values of 35 ohms to 1500 ohms: Resistance tolerance: ±15% standard. Tolerances of ±10% and ±5% can be supplied at increased cost.

For specific engineering information contact your IRC Sales Engineer or write Dept. 8.

PREFERRED FOR PERFORMANCE · IRC · FIXED & VARIABLE RESISTORS

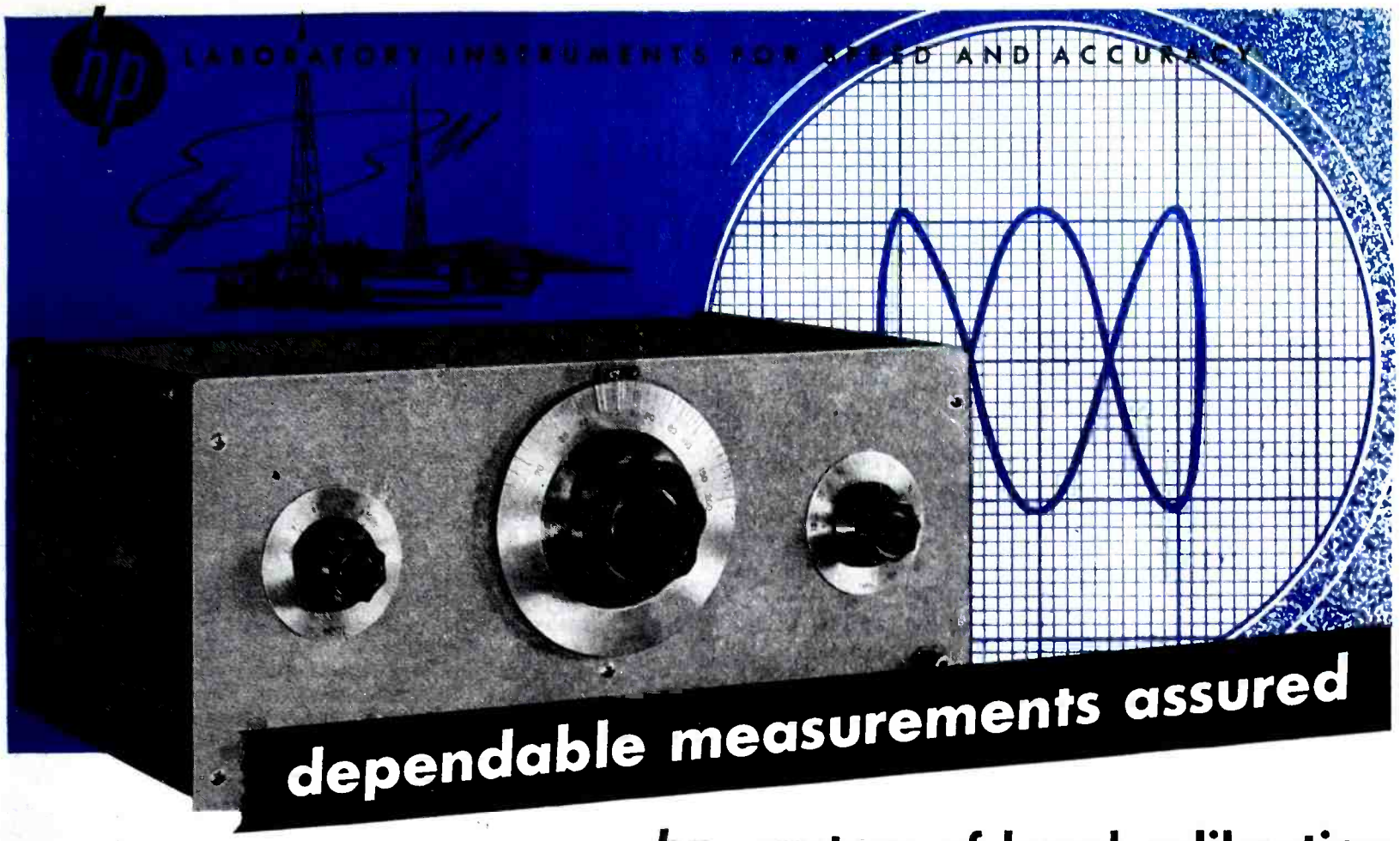
SHORT DELIVERY CYCLE

Fittings are now carried in stock. Resistance elements are made to order for range and tolerance.

INTERNATIONAL RESISTANCE CO.

401 N. BROAD ST., PHILADELPHIA 8, PA.

In Canada: International Resistance Co., Ltd., Toronto, Licensee



-*hp*- system of hand calibration guarantees accuracy of AF oscillators

The calibration of every -*hp*- Resistance Tuned Oscillator is guaranteed accurate to within 2%—a guarantee that is possible only because of the high inherent stability of these instruments. To exploit this stability to the utmost, each -*hp*- oscillator is hand-calibrated using an extremely accurate technique.

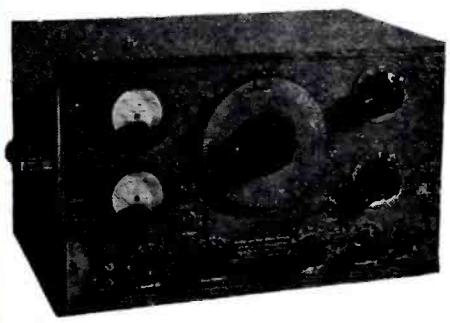
The frequency source used in this procedure is the Model 100B Secondary Frequency Standard. This provides frequencies of 100 cps, 1000 cps, and 10,000 cps, accurate to within 0.001%. By frequent comparison with U. S. Bureau of Standards Station WWV this accuracy is increased to within 0.0002%.

The output of the oscillator under test is compared with these standard frequencies by means of a cathode-ray oscilloscope. Using Lissajous figures of high order a large number of calibration points are established over the entire frequency range; the Model 200I Spread-Scale Audio Oscillator, for example, has a total of 277 calibration points.

Individual hand-calibration is but one of the many precautions taken to insure the dependability and accuracy of -*hp*- oscillators. Rugged mechanical design maintains the calibration. Careful layout minimizes temperature effects. Unique circuit arrangements assure high stability.

Ten models are available, covering the frequency-range from 2 cps to 200 kc, and with various power outputs and impedance terminations. Write today for full technical information.

OTHER OUTSTANDING -*hp*- INSTRUMENTS



-*hp*- MODEL 205AG
AUDIO SIGNAL GENERATOR

Frequency range—20 cps to 20 kc
Power output—5 watts
Output impedance—50, 200, 500, and 5000 ohms, all ct

-*hp*- MODEL 200I
SPREAD SCALE AUDIO OSCILLATOR

Frequency range—6 cps to 6 kc
Hair-line tuning, no parallax
Effective scale length nearly eight feet

HEWLETT-PACKARD COMPANY
1200E PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

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

FOR
HEARING AIDS
VEST POCKET RADIOS
AIR BORNE DEVICES

UTC
SUB-OUNCER SERIES

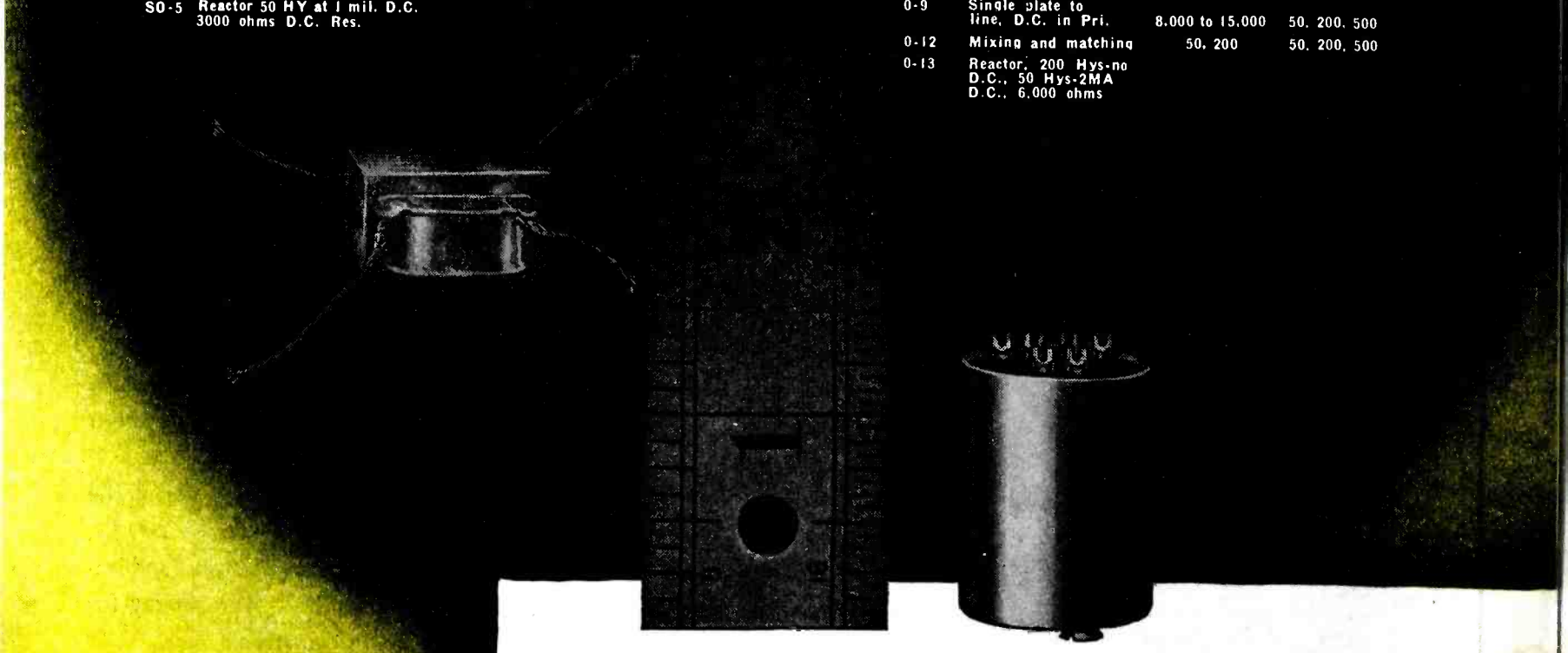
UTC Sub-Ouncer units are 9/16" x 5/8" x 7/8" and weigh only 1/3 ounce. Through unique construction, however, these miniature units have performance and dependability characteristics far superior to any other comparable items. The coil is uniform layer wound of Formex wire . . . On a molded nylon bobbin . . . insulation is of cellulose acetate . . . leads mechanically anchored (no tape) . . . core material Hiperm-alloy . . . entire unit triple (waterproof) sealed. The frequency response of these standard items is ± 3 DB from 200 to 5,000 cycles.

Type	Application	Level	Pri. Imp.	D.C. in Pri.	Sec. Imp.
SO-1	Input	+ 4 V.U.	200 50	0	250,000 62,500
SO-2	Interstage/3:1	+ 4 V.U.	10,000	0	90,000
SO-3	Plate to Line	+ 23 V.U.	10,000 25,000	3/1.5 mil.	200 500
SO-4	Output	+ 20 V.U.	30,000	1.0 mil.	50
SO-5	Reactor 50 HY at 1 mil. D.C. 3000 ohms D.C. Res.				

UTC
OUNCER SERIES

The standard of the industry for seven years. The overall dimensions are 7/8" diameter by 1-3/16" height including lugs. Mounting is effected by two screws, opposite the terminal board side, spaced 11/16". Weight approximately one ounce. Units not carrying D.C. have high fidelity characteristics being uniform from 40 to 15,000 cycles. Items with D.C. in pri. are for voice frequencies from 150 to 8000 cycles.

Type	Application	Pri. Imp.	Sec. Imp.
O-1	Mike pickup or line to 1 grid	50, 200, 500	50,000
O-4	Single plate to 1 grid	8,000 to 15,000	60,000
O-5	Single plate to 1 grid, D.C. in Pri.	8,000 to 15,000	60,000
O-6	Single plate to 2 grids	8,000 to 15,000	95,000
O-8	Single plate to line	8,000 to 15,000	50, 200, 500
O-9	Single plate to line, D.C. in Pri.	8,000 to 15,000	50, 200, 500
O-12	Mixing and matching	50, 200	50, 200, 500
O-13	Reactor, 200 Hys-no D.C., 50 Hys-2MA D.C., 6,000 ohms		



Manufacturers: Our experience in building hundreds of thousands of ouncers and sub-ouncers is yours for the asking. Special types, and mountings are readily available. U.T.C. engineers can help you save weight and space in the design of miniature equipment.

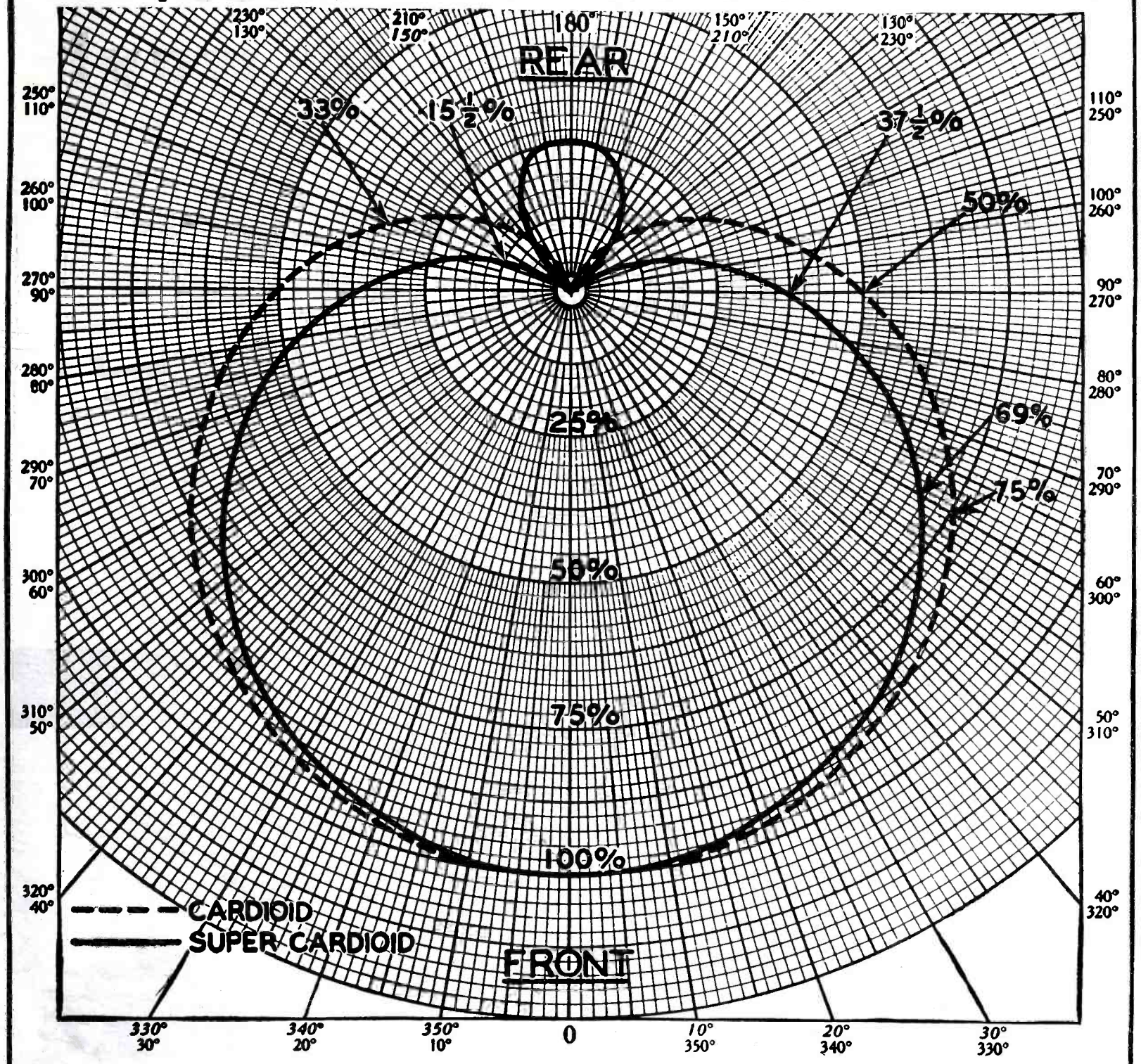
ARMY E NAVY

United Transformer Corp.

150 VARICK STREET • NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

. . . Comparative Graph Proves SHURE Super-Cardioid Microphone twice as unidirectional as Cardioid . . .



Here is the difference in pickup patterns between the Cardioid and the Shure Super-Cardioid Microphone. Maximum sensitivity (100%) is achieved by sound approaching the Microphone, directly at the front. At 60° off the front axis sensitivity of the Super-Cardioid is only slightly less than the sensitivity of the Cardioid (69% against 75%). The Super-Cardioid insures, therefore, a wide range pickup at the front. Beyond the 60° angle, the sensitivity of the Super-Cardioid decreases rapidly. At 90°, the sensitivity of the Cardioid is 50%; the sensitivity of the Super-Cardioid 37½%; 12½% less. For sounds approaching at a wide angle at the back (110° to 250°) the sensitivity of the Cardioid is 33%; the Super-Cardioid 15½% or 17½% less. It has been proved mathematically that the ratio of front to rear pickup of random sound energy is; *Cardioid 7:1; Super-Cardioid 14:1.*

This additional directional quality is important in critical acoustic work. The Shure Super-Cardioid, employing the exclusive "uniphase" principle, gives such performance in a single, compact rugged unit.

SHURE BROTHERS, Inc.

Microphones and Acoustic Devices

225 W. Huron St., Chicago 10, Illinois • Cable Address: SHUREMICRO

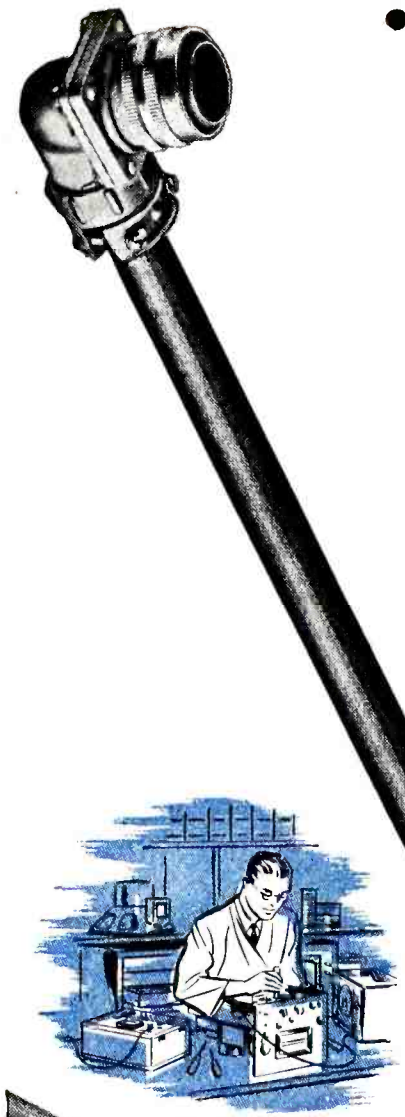
SHURE

• • • it's Amphenol all the way!

Amphenol components are in use in every branch of the electronics industries. In radio and in mobile communications such as Police, Railroads, Buses, Marine, Aviation, and Military equipment; in broadcasting stations, FM and Television studios; in projection and sound devices; in testing and experimental laboratories; in Industry where electronically operated or controlled devices are used. Whatever the need may be—for whatever type of installation—for any and all operating frequencies—there is an Amphenol component to fill a vital need.

The list of Amphenol products includes more than 8,000 *different* items—the most complete line of cables, plugs, connectors, fittings, sockets, antennas and plastic components available from any one source in the world today.

AMERICAN PHENOLIC CORPORATION CHICAGO 50, ILLINOIS
In Canada: Amphenol Limited · Toronto



COAXIAL CABLES AND CONNECTORS · INDUSTRIAL CONNECTORS, · FITTINGS AND CONDUIT · ANTENNAS · RADIO · COMPONENTS · PLASTICS FOR ELECTRONICS

Jensen Speech Master REPRODUCERS

...for clear, crisp, intelligible Speech* Reproduction

Designed especially for speech reproduction in intercommunication and public address applications, this Speech Master family of JENSEN Reproducers, delivers clean, sharp, understandable announcements and orders. Like all JENSEN products, these Speech Masters were completely engineered to do their job efficiently and well.

MODEL NJ-300 SPEECH MASTER (Railroad Type). PM design. Widely used in railroad intercommunication in locomotives, cabooses, signal towers and yards. Rugged case protects against shock and vibration; withstands dust, smoke and the elements. Voice coil impedance 12 ohms; power rating, 10 watts. Space provided inside case for 500-ohm impedance transformer. Overall height 11-3/4"; width 6-25/32"; depth 4-13/16". Holes provided in base for mounting in any position.

MODEL AR-10 SPEECH MASTER *ALNICO 5* design. Specially constructed reflex horn increases efficiency in mid-frequency range, giving added effectiveness and "punch" to speech quality; prevents direct access of rain and snow to speaker diaphragm. Voice coil impedance, 4 ohms and 45 ohms; power rating, 6 watts. Space provided inside for ½" x ½" transformer. Overall diameter 10"; depth 8". Complete with mounting bracket.

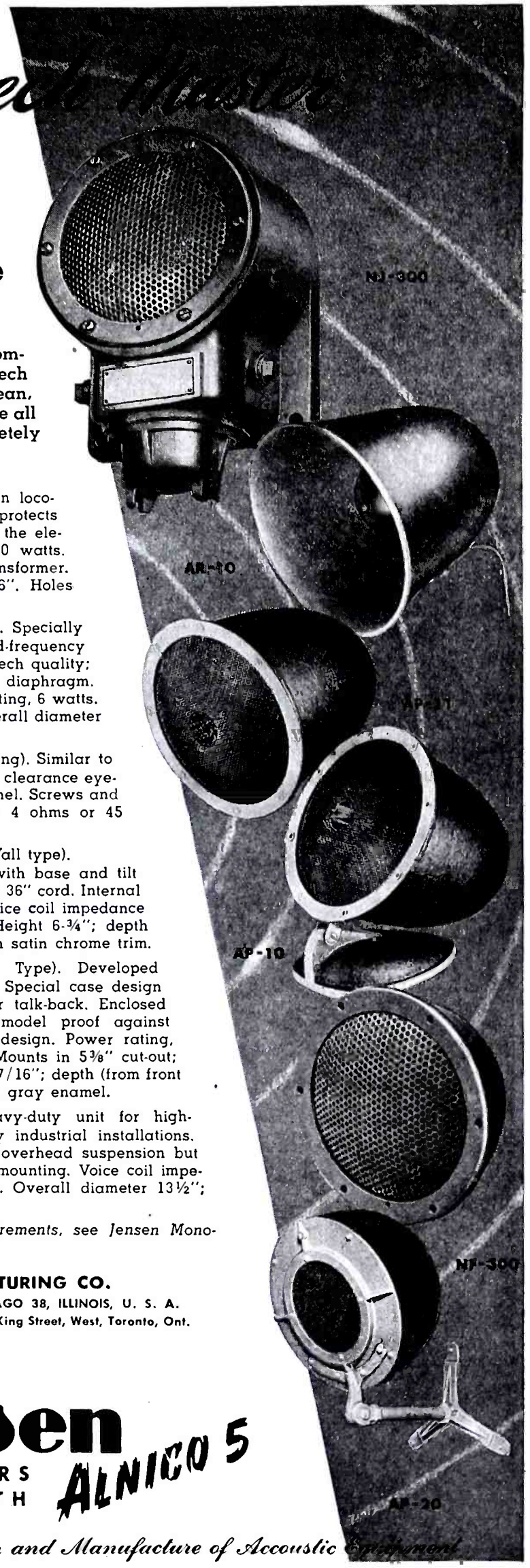
MODEL AP-11 SPEECH MASTER (Panel mounting). Similar to AP-10 but without base. Mounts in 4-27/64" cut-out; clearance eyelets for mounting screws. Depth 4½" from front panel. Screws and drilling template included. Voice coil impedance 4 ohms or 45 ohms; power rating, 5 watts.

MODEL AP-10 SPEECH MASTER (Desk or Wall type). PM design, desk or wall mounting. Complete with base and tilt adjustment. Double dustproofed. Rubber covered 36" cord. Internal mounting bracket for ½" x ½" transformer. Voice coil impedance 4 ohms or 45 ohms; power rating, 5 watts. Height 6-¾"; depth 5⅛"; diameter 5". Finish hammered gray with satin chrome trim.

MODEL NF-300 SPEECH MASTER (Navy Type). Developed for use as a loud speaker and microphone. Special case design over-rides wind and background noises for talk-back. Enclosed case and protective screen render this model proof against weather, dust and moisture *ALNICO 5* PM design. Power rating, 10 watts; voice coil impedance 12 ohms. Mounts in 5⅜" cut-out; six screw holes in rim. Overall diameter 6-7/16"; depth (from front of panel) 2-9/64". Finished in Munsel N4-5 gray enamel.

MODEL AP-20 SPEECH MASTER Heavy-duty unit for high-level paging and call systems in noisy industrial installations. PM design. Furnished with eyebolt for overhead suspension but available with stand for wall or table mounting. Voice coil impedance 8 ohms; power rating, 25 watts. Overall diameter 13½"; depth 9"

**For full discussion of Speech requirements, see Jensen Monograph No. 4.*



JENSEN MANUFACTURING CO.
6603 S. LARAMIE AVENUE, CHICAGO 38, ILLINOIS, U. S. A.
In Canada: J. R. Longstaffe, Ltd., 11 King Street, West, Toronto, Ont.

Jensen SPEAKERS WITH ALNICO 5

Specialists in Design and Manufacture of Acoustic Equipment

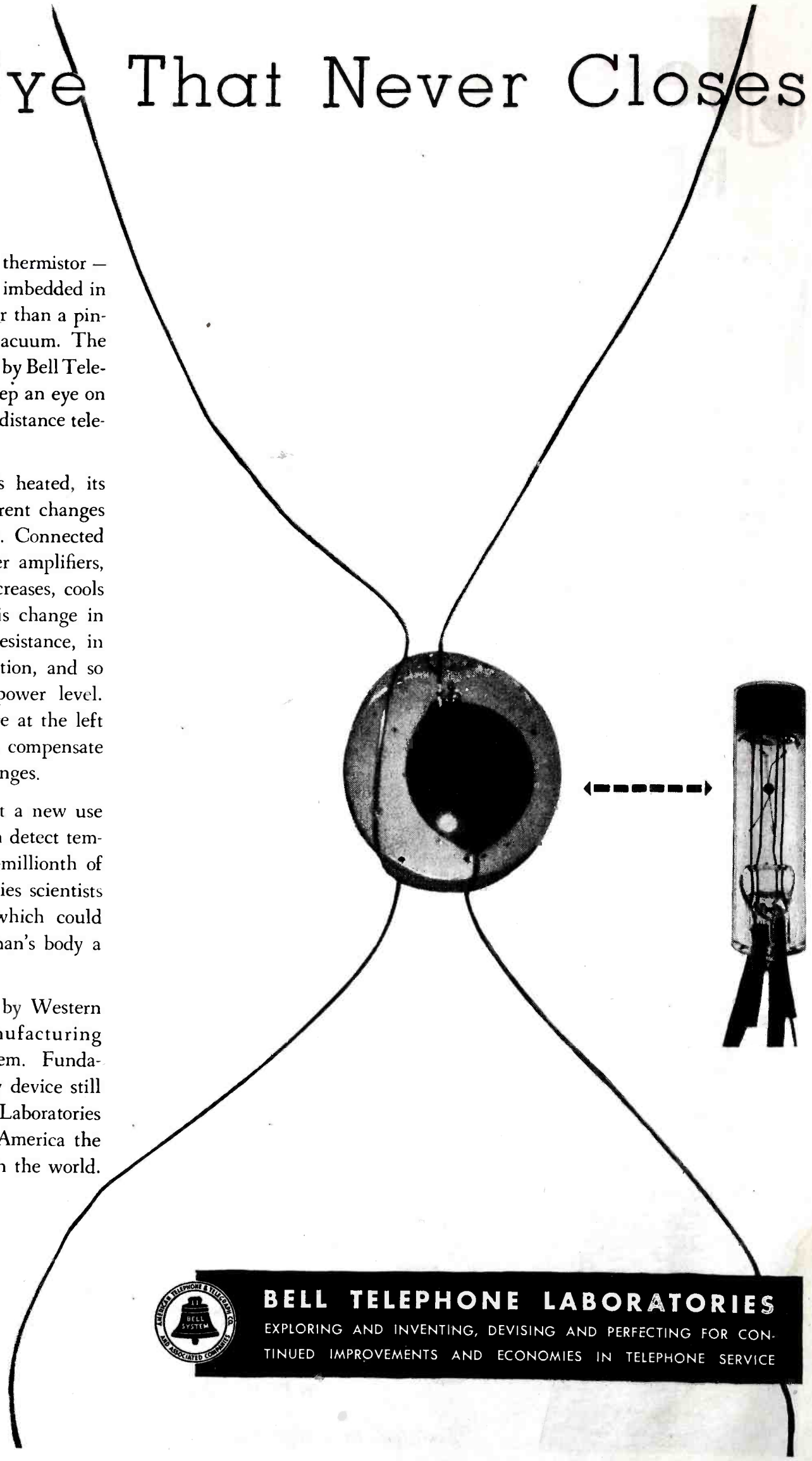
The Eye That Never Closes

You are looking at a thermistor — a speck of metallic oxide imbedded in a glass bead hardly larger than a pinhead and mounted in a vacuum. The thermistor was developed by Bell Telephone Laboratories to keep an eye on the amplification in long-distance telephone circuits.

When a thermistor is heated, its resistance to electric current changes rapidly. That is its secret. Connected in the output of repeater amplifiers, it heats up as power increases, cools as power decreases. This change in temperature alters the resistance, in turn alters the amplification, and so maintains the desired power level. Current through the wire at the left provides a little heat to compensate for local temperature changes.

Wartime need brought a new use for this device which can detect temperature changes of one-millionth of a degree. Bell Laboratories scientists produced a thermistor which could "see" the warmth of a man's body a quarter of a mile away.

Thermistors are made by Western Electric Company, manufacturing branch of the Bell System. Fundamental work on this tiny device still continues as part of the Laboratories program to keep giving America the finest telephone service in the world.



BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

The Collins 75A...A new standard for amateur receivers

The Collins 75A is a hot new amateur receiver with all the distinctive features that hams have read about, talked about, and dreamed about. It features accuracy of calibration, stability of operation, double conversion (triple detection), pinpoint selectivity, effective automatic noise limiter, positive image rejection.

The smart new dial is accurate to within one kilocycle (2 kc on ten and eleven meters). The smooth action of the crystal selectivity circuit provides a bandwidth that is variable from 200 cps to 4 kc. Proper design of the selectivity circuit and precise control of the crystal frequency assure no detuning effects.

Image rejection is more than 50 db, even on 10 meters. Signal to noise ratio is approximately 10 db with a 1 microvolt r-f signal and normal audio output. Six amateur bands—80, 40, 20, 15, 11, 10—are completely covered. A speaker is available in a matching cabinet.

Step up your QSO's with the new Collins 75A receiver. Write us for detailed information.

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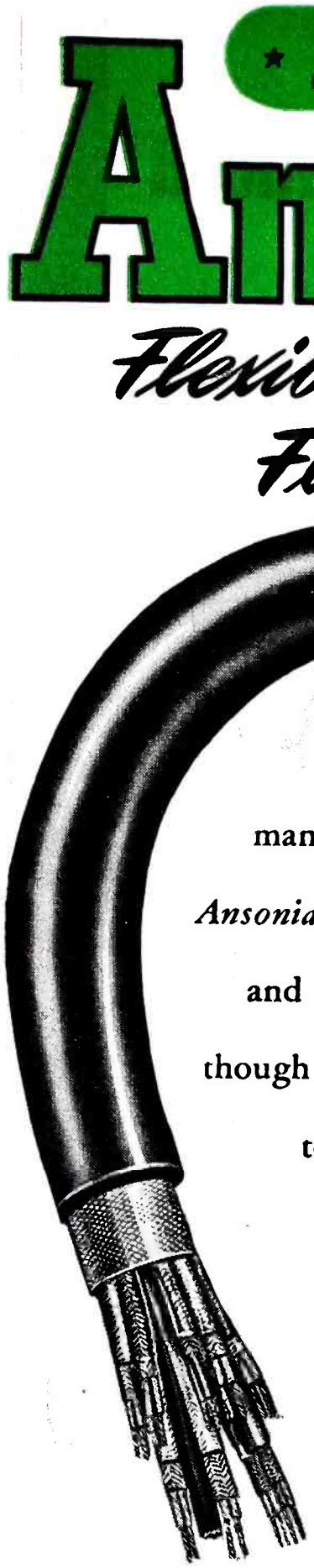

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COMMUNICATIONS

LEWIS WINNER, Editor

* * OCTOBER, 1946 * *

TELEVISION LINK TESTS In Southern California

Programs Sent To and From Mt. Wilson in 4000-mc Band Via Metallic Lens Circuit To and From Los Angeles and Hollywood.

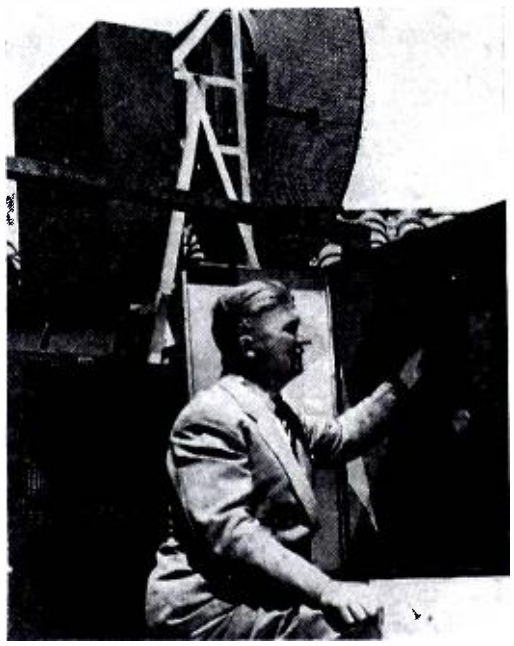


Figure 1 (above)
E. H. Schreiber, engineer of Southern California Telephone Company, checking the transmitting frequency of microwave television video system located on the roof of the Hollywood Telephone Building. Images were beamed from this location to a receiver on Mt. Wilson and beamed back again to other receiving equipment.

by PAUL B. WRIGHT

To STUDY THE practicability of transmitting and receiving television signals between telephone company central offices and selected mountain-peak sites over line-of-sight paths the first of a series of tests was recently conducted between Mt. Wilson and the metropolitan areas of Hollywood and Los Angeles. Television Productions,[1] now telecasting from the top of Mt. Wilson, supplied the mountain-top signals, test patterns, slides, live talent, and 20″ television monitor.[2]

The total cable length between pickup camera and the transmitter location at Hollywood was 1.5 miles. An intermediate amplifier was inserted 0.6 mile from the transmitter to compensate for the losses occasioned by the cable. Associated with the amplifiers were gain and phase equalizers. The cable loop with its associated equipment was equalized to give a uniform frequency response within about ½ db over the video range to 4.0 mc. Predistortion was used to give an improved signal-to-noise ratio response at the levels used.

In the transmitter were a video amplifier with a clamp circuit, whose function in part was to suppress the low-frequency noise components during the time of transmission of the synchronizing pulse, and a klystron oscillator operating at 4380 mc in one direction and 4220 mc in the other direction of transmission at the synchronizing pulse level. The output of the oscillator (0.4 watt) was fed into a waveguide and then to an antenna system. At the Hollywood end a *metallic lens*[3] was used to transmit the microwave beam to a similar lens at

(*Continued on page* 55)

[1]Paramount Pictures subsidiary.
[2]DuMont.

Figure 3
Arrangement of equipment for the television tests between Hollywood and Mt. Wilson.

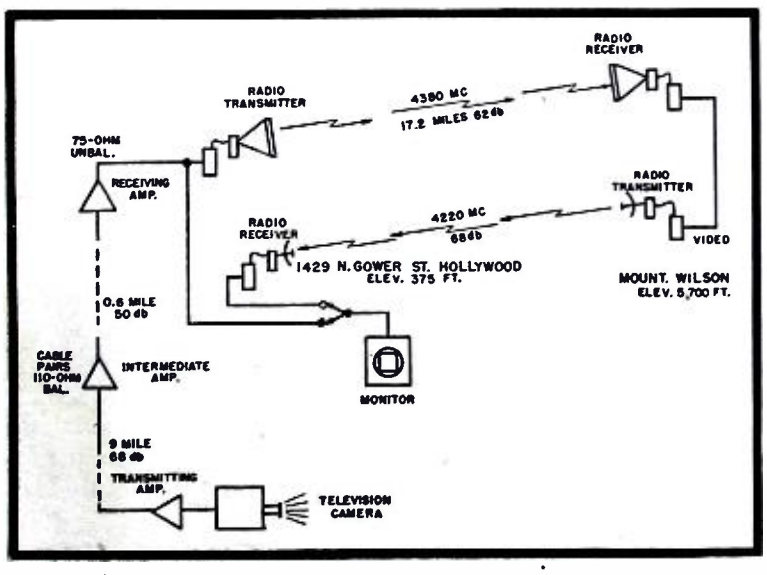
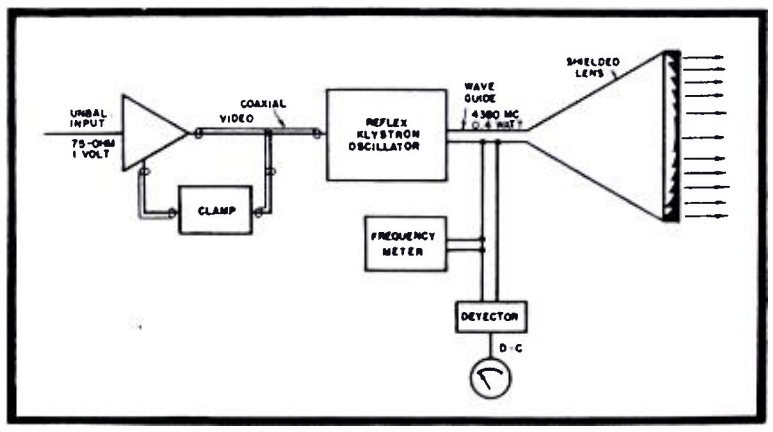


Figure 2 (below)
Block diagram of the transmitter setup illustrating how the metallic lens was connected to the transmitter.



A New

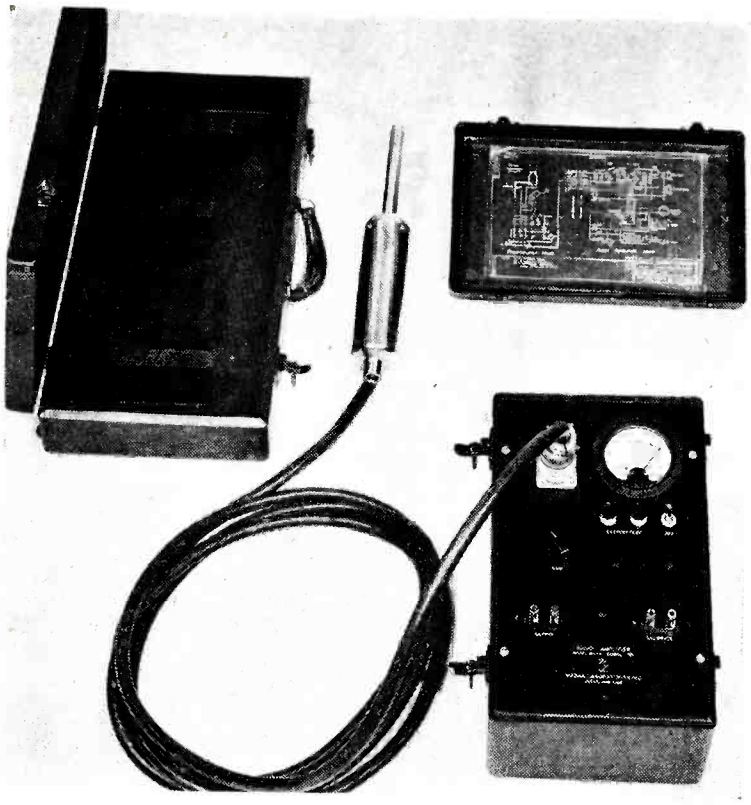


Figure 1
Complete sound pressure measurement system.

THE PROBLEM OF MAKING absolute sound pressure measurements has always been one in which the effect of the microphone in disturbing the sound field has offered serious obstacles to the realization of accuracy and ease of measurement, especially at the higher audio frequencies. Other difficulties that have limited the utility of the generally available means for making acoustic measurements have been the lack of long-time stability of the standard microphone, the limitation in frequency range and dynamic range of the instrument, and the relatively low acoustic impedance of the sound-pressure measurement unit especially at the upper portion of the audible range.

To overcome these limitations, a three-unit system consisting of a microphone standard, preamplifier and auxiliary amplifier has been developed. The system is linear to the direct measurement of sound pressures up to 20,000 dynes/cm^2. For higher pressures, up to several million dynes/cm^2, a non-frequency discriminating multiplier can be provided for insertion between the microphone and the preamplifier socket so that sound pressures as high as desired, including gun blast, may be measured without making any internal amplifier changes.

The equipment includes self-contained batteries as well as a built-in calibration circuit providing portability and permitting acoustic measurements to be made in the field as well as in the laboratory.

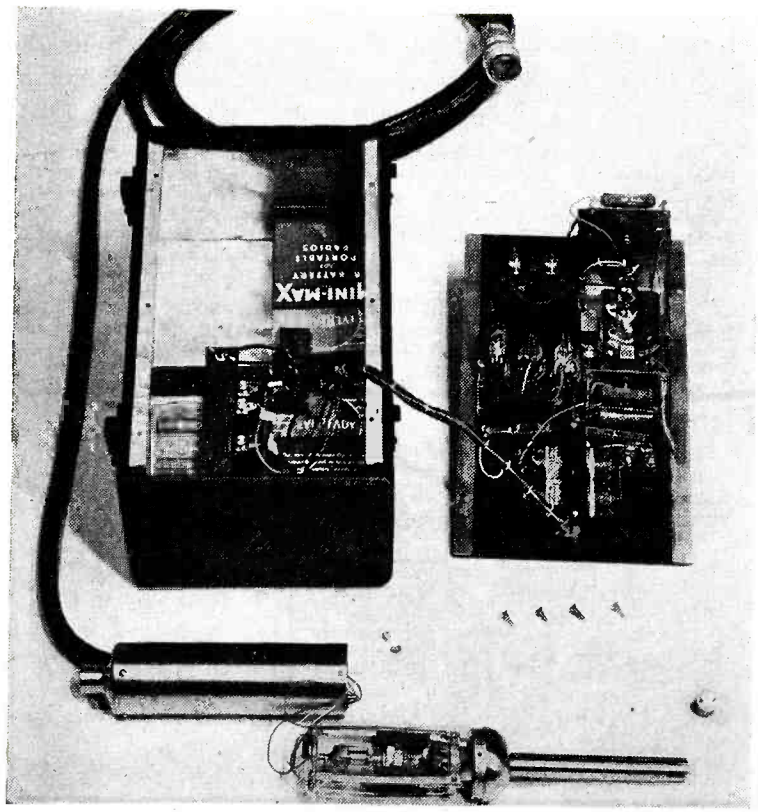


Figure 2
Internal view of equipment.

General Design of the System

Two factors which were considered most important in the design of the system were assured accuracy of measurements on an absolute basis, and simplicity of operation, so that absolute sound pressure measurements could be made easily by any laboratory assistant.

As mentioned previously the entire system consists of three basic units: a small microphone standard, a preamplifier, and an auxiliary amplifier shown in the assembled photograph of Figure 1 and in the *exploded* view of Figure 2. The preamplifier includes a shock-mounted vacuum-tube stage and an extension microphone socket which locates the small standard microphone. Thus the microphone is removed from the main body of the preamplifier minimizing the obstruction which would have been offered to the sound field if the microphone were attached directly to the main body of the housing. The extension socket is isolated from the housing by flexible shock mounts so that it is possible to hold the preamplifier housing in the hand and use the microphone as a probe for the investigation of sound fields without having disturbing vibrations transmitted to the microphone element. This mounting also reduces floor vibration pickup by the microphone, when the preamplifier is attached to a conventional microphone stand for the measurement of free field-sound pressures in the laboratory.

The schematic wiring diagram of the

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by FRANK MASSA

Director
Massa Laboratories, Inc.

complete system is shown in Figure 3. A calibrating circuit, built into the system, permits setting the absolute level of the instrument so that exact sound pressure measurements may be easily made at any time on an absolute basis. The auxiliary amplifier has sufficient gain to permit its adjustment so that exactly 1 millivolt is produced across the output terminals per dyne/cm^2 sound pressure, which makes it extremely convenient to employ a conventional electronic voltmeter across the output terminals in which the reading in millivolts is numerically equal to sound pressure in dynes/cm^2.

Design of the Standard Microphone

The most important element of the system is the microphone standard which converts sound pressures to alternating voltages. Simply stated, the basic requirement of a good working standard of sound pressure measurement is that it shall give an exact quantitative reproduction of the sound pressure wave as it existed at a point, before the microphone was introduced.

Some of the more important specific requirements that must be met by a microphone so that it can be accepted as a good working standard are:

1. *Uniform response characteristic throughout the complete audible frequency range.* It is practically self-evident that this requirement results in a microphone which offers great convenience in its use. Although variations from flat response may be generally tolerated in the acoustic laboratory, even though considerable time may be spent in correcting for microphone variations over the frequency range, there are certain types of measurements that cannot be made when such variations exist. For example, if distortion measurements were attempted, the apparent harmonic content would be very greatly dependent on the degree of variation from flatness of the microphone characteristic.

2. *Wide dynamic range.* For greatest utility, the electrical output of the measurement standard should be linear with respect to the sound pressure over wide ranges of magnitude, so that it may be employed for the calibration of intense sound fields such as are realized in gun blast waves, engine exhausts, inside muffler sections, horn loudspeakers, etc.

3. *Small physical size.* This requirement is essential if minimum diffraction error is to be introduced by the presence of the microphone in a free sound field. It is also important that the structure be small if measurements are to be made inside small enclosures or in restricted spaces such as conduits or acoustic filters in order that the volume of the test chamber is not appreciably altered by the presence of the microphone.

4. *High acoustic impedance.* This is one of the most important requirements of a good sound pressure measurement standard. If the acoustic impedance of the standard is not very much greater than that of the surrounding environment in which it is used, the insertion of the microphone may greatly disturb the sound field which existed before the microphone was introduced and the measurement

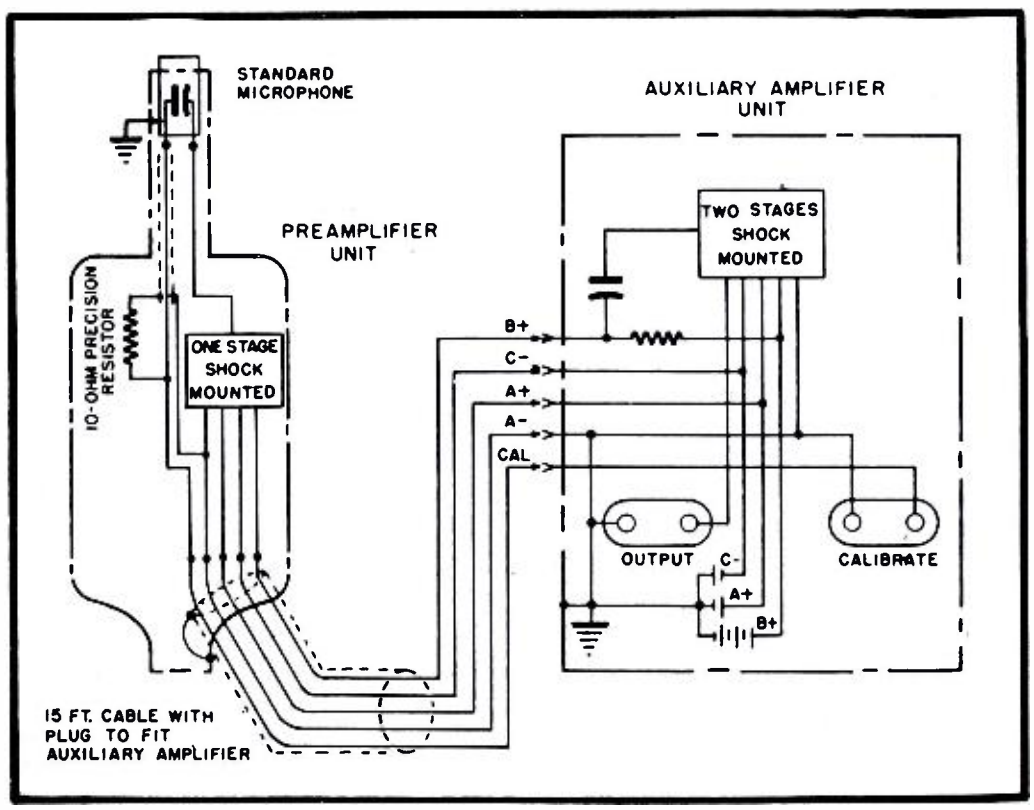
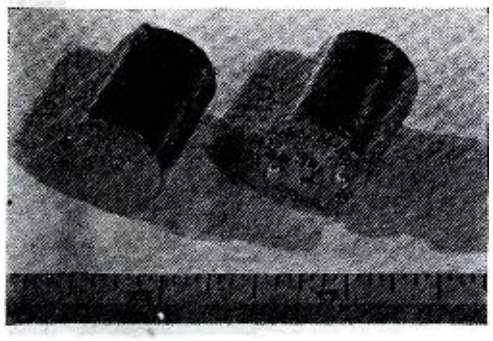
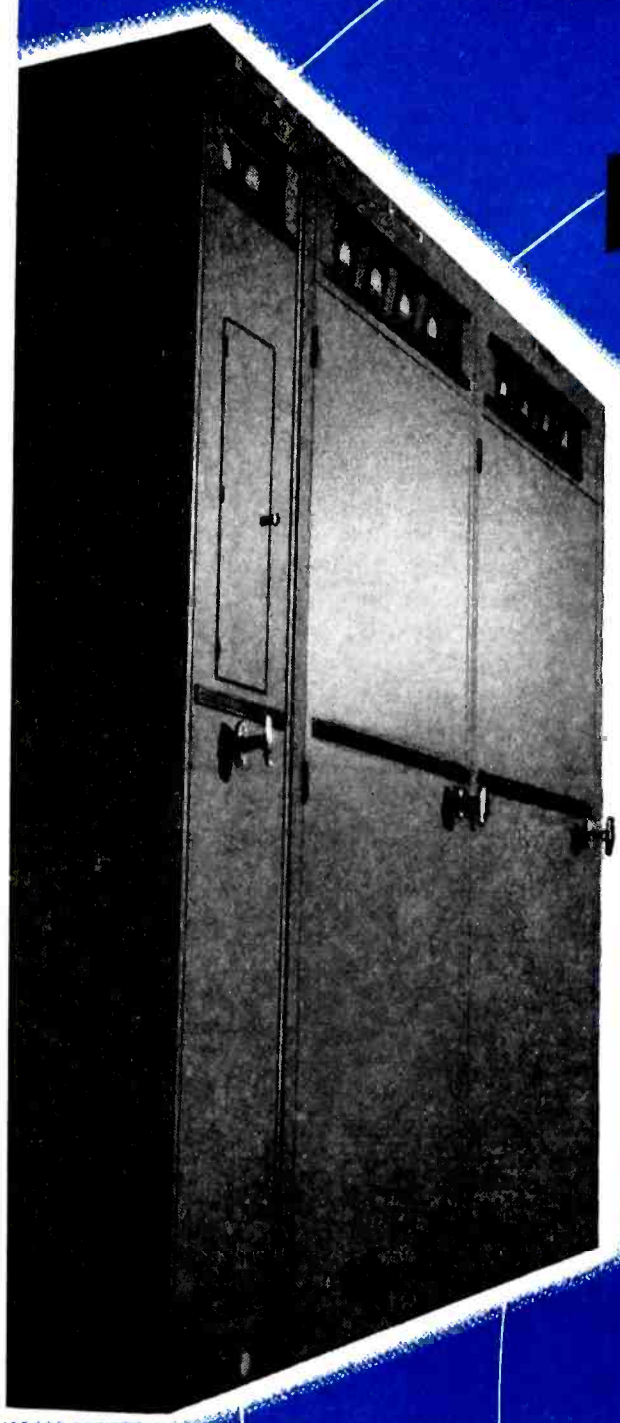


Figure 3
Schematic diagram of the complete system.

Figure 4
View of the standard microphone unit.





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obtained would be in considerable error.

5. *Smooth electrical impedance characteristic.* If this requirement is met, the microphone will lend itself to the use of electronic circuits with greater ease than would be the case if the impedance characteristic varied violently with frequency, such as would result in a system having a resonance within the audible range. A desirable impedance characteristic is that represented by a single electrical circuit element over the entire audible frequency range which will permit its easy adaptation to a variety of special circuit connections.

6. *Rugged construction.* The advantage of this requirement is, of course, to permit the use of the standard as an every-day working apparatus instead of a delicate piece of laboratory equipment that can be handled only by specially-trained personnel.

7. *Dependability and constancy of calibration.* This requirement is necessary for a good working standard so that readings may be made on an absolute basis over long periods of time and under varying conditions of temperature and pressure without resorting to correction curves or frequency recalibrations to be assured of accurate data.

The measurement standard used in the new system consists of a rigid cylindrical structure, ½" diameter by approximately 1" long; Figure 4. In the microphone are an assembly of piezo-electric crystal plates that have been designed to result in a stiffness-controlled vibrating mechanical system up to a frequency of 45 kc. A stiffness-controlled vibrating system is one of the best means for achieving the important requirement of high acoustic impedance[1] and a quantitative indication of the deviation from stiffness control of a vibrating system may be learned from the change in phase angle of the mechanical impedance of the system with frequency. An ideal stiffness-controlled mechanical system will show a phase shift of –90° over the entire audible range. Figure 5 shows the phase shift of the new microphone (solid line) as compared with the phase shift of a miniature highly-stretched diaphragm (dotted line) indicating the superiority of the present unit in the frequency region above 5,000 cycles.

The actual magnitude of the acoustic impedance of the new microphone as a function of frequency is shown in Figure 6. For comparative purposes, the

[1] For a more complete discussion of the fundamental factors concerning the sound pressure measurement standard, see Frank Massa, *A Working Standard for Sound Pressure Measurements*, Jour. Acous. Soc. of Amer.; July, 1945.

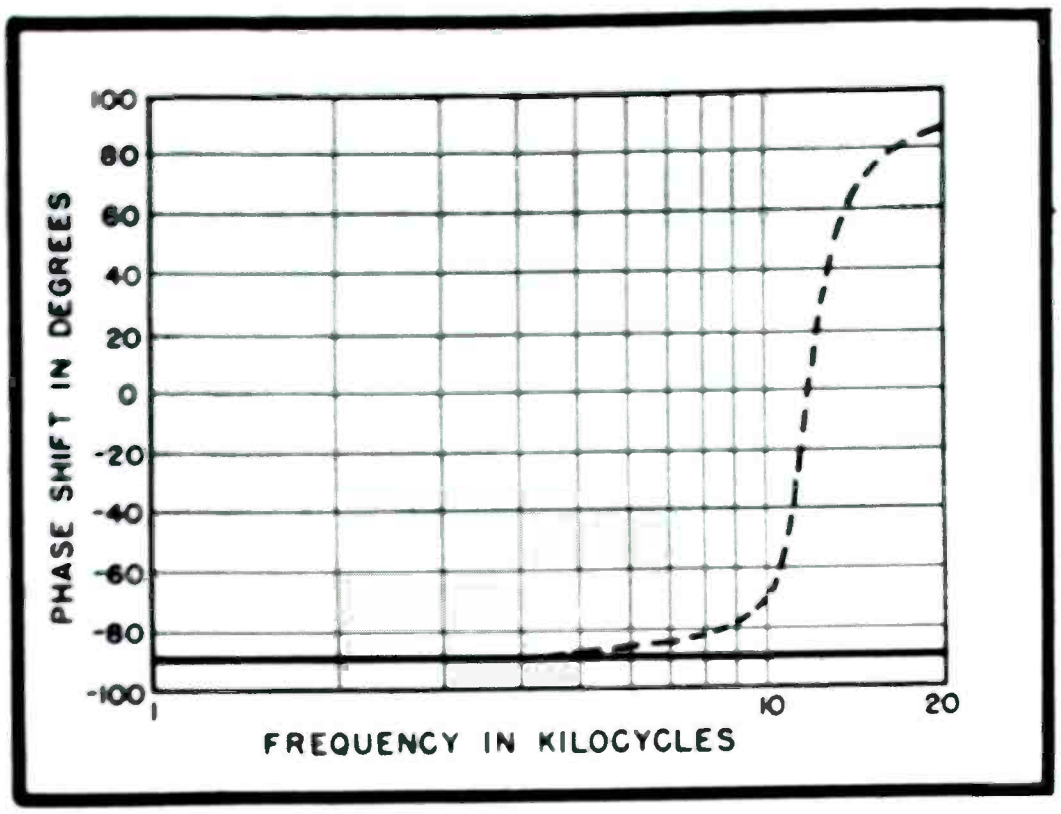


Figure 5

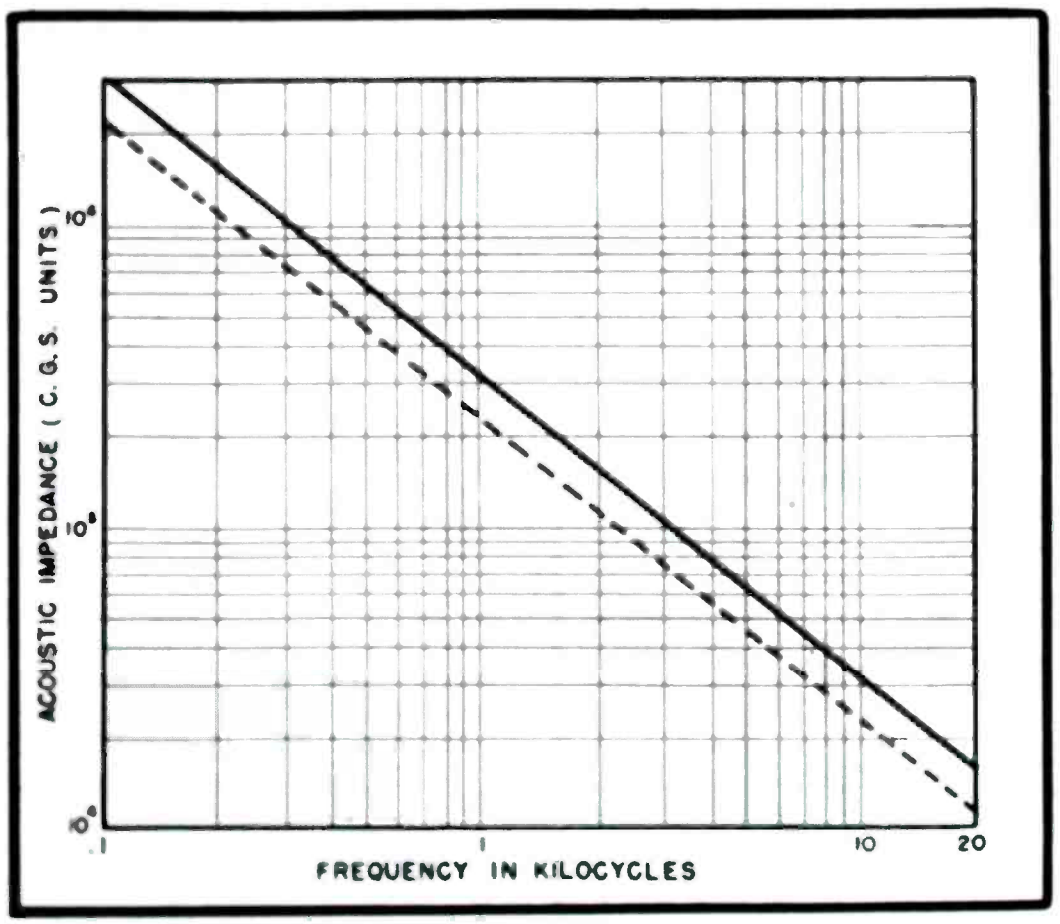
Solid line shows phase angle of the mechanical impedance of the vibrating system employed in the measurement standard. Dotted curve shows the phase angle of the impedance of a small, highly-stretched, thin diaphragm.

dotted line shows the acoustic impedance of .001 cc of air indicating that the new unit has a higher acoustic impedance than is presented by .001 cc of air. In the way of further comparison, it may be stated that the acoustic impedance of a highly-stretched thin diaphragm having the same diameter as this new standard would have an acoustic impedance more than one hundred times lower than shown by the data in Figure 6, which means that the new unit would cause less than 1% as much error as would be caused by a small standard employing a stretched

(*Continued on page* 50)

Figure 6

Acoustic impedance of the new standard microphone (solid line). Dotted curve shows comparative impedance of .001 cc of air.



SPEECH CLIPPERS For More Effective Modulation

Analysis of Methods Used in Clipping of Peaks Which Provide Increase in Power of Consonant Sounds, Increase in Mean Audio Power, Increase in Average Modulation Level and Maximum Use of the Carrier.

by JOHN W. SMITH and N. H. HALE

Collins Radio Company

IN AMPLITUDE-MODULATED transmission it is necessary to modulate the carrier 100% in order to realize its maximum usefulness. This condition can be obtained when the carrier is modulated by a continuous tone. In voice transmission, however, when the voice peaks modulate the carrier 100%, the average or effective modulation is only about 30%. This means that the average sideband power is 10.5 db below the 100% modulation level. Therefore, only about one-tenth of the maximum carrier usefulness is being realized.

If a circuit were incorporated into the speech amplifier equipment that would attenuate the voice peaks, but not affect the lower level voice components, it would be possible to increase the average level of modulation and thereby realize a greater usefulness of the carrier power. If the voice peaks could be attenuated 10.5 db, and the overall gain of the audio equipment increased 10.5 db, an average modulation level approaching 100% would be realized, resulting in the best possible carrier effectiveness.

Harmonic Distortion Tests

In tests conducted to determine the effects of harmonic distortion upon the intelligibility of speech, it has been established that the vowel sounds contain the major portion of speech power. However, these same vowel sounds contribute very little to intelligibility. On the other hand, consonant sounds (t, k, p, v, b, etc.) have little power but are the principal means of conveying intelligence. Therefore, it should be possible to change or distort the wave shape of the vowel sounds (the voice peaks) without affecting the speech intelligibility.

Extensive tests to determine the degree to which voice peaks can be distorted without adversely affecting intelligibility show that 6 db of peak clipping is barely noticeable, 12 db of peak clipping does not affect intelligibility, and 24 db of clipping can be tolerated. By the use of peak clipping, and with an overall increase in amplifier gain, (*1*) the effective power in the consonant sounds is increased, (*2*) the mean audio power is increased, (*3*) the average modulation level is increased, and (*4*) the carrier is utilized to the maximum.

Volume compressors have been advocated for effecting a higher modulation level. They do so, and without introducing appreciable distortion. This type of equipment is used in broadcasting where distortion cannot be tolerated. However, the low level consonant sounds immediately following a high level vowel sound will be attenuated in the same proportion.

The basic difference between peak clippers and volume compressors is that a peak clipper is an instantaneous device while a volume compressor functions on a voltage depending upon the average signal. The peak clipper sits idly by and waits for the instantaneous voltage of the signal to reach a predetermined level, then bypasses everything above that level. As soon as the signal voltage drops below this limit the peak clipper ceases to operate. On the other hand the volume compressor attacks very shortly after the instantaneous signal voltage reaches a predetermined level, lowering the overall gain of the system and thus attenuating low-level components as well as high-level components. Some time after the surge has passed, the compressor gradually releases, returning the system to normal amplification.

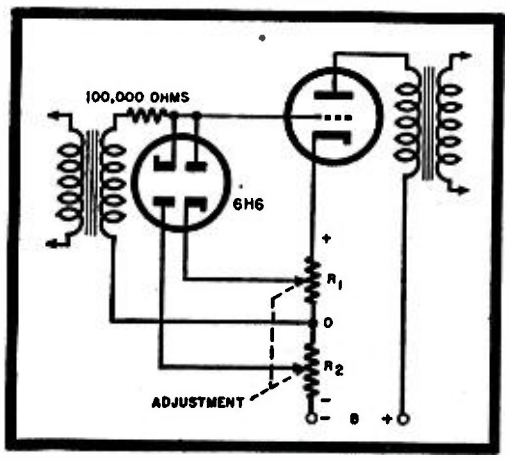


Figure 1
A simple peak limiter for a low-level class *A* amplifier.

Circuit Considerations

There are several ways in which peak clipping can be accomplished. One method would be to design the class *B* modulator so that at 100% modulation the minimum instantaneous plate voltage equals the maximum instantaneous grid voltage. With this design any further increase in instantaneous signal voltage will clip the signal peaks in both the grid and plate circuits. This method of design produces high distortion of both consonant and vowel sounds which result in a minimum plate voltage less than three times as large as the maximum grid voltage, i. e.,

$$\frac{e_p \text{ min}}{e_g \text{ max}} < 3$$

It would also result in a high power demand from the driver stage, present a problem of eliminating the high harmonics introduced by peak clipping, and would vary with the plate loading of the class *B* stage.

A second method of approach would be to use a high-impedance driver de-

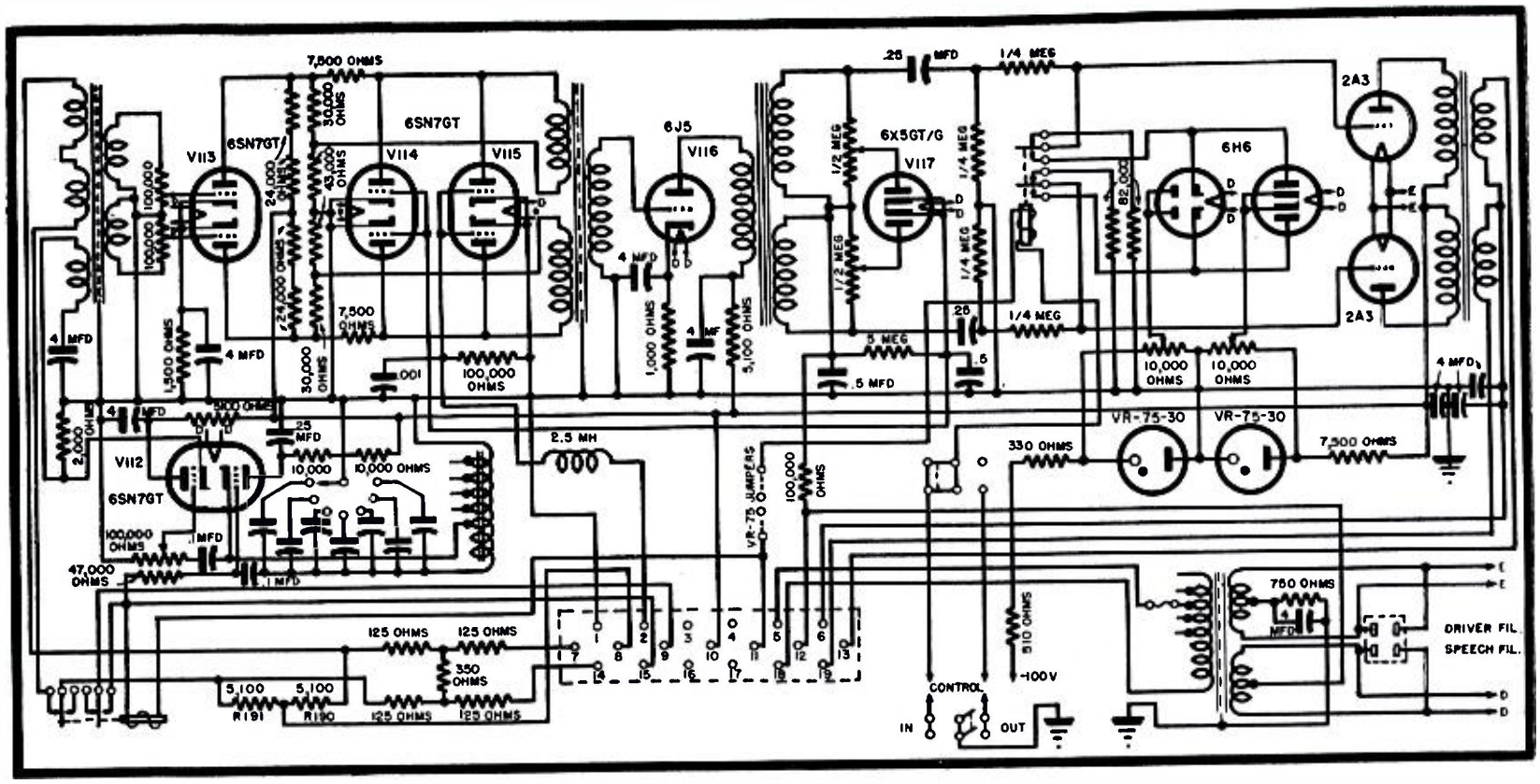


Figure 2
Speech amplifier employing a peak-clipper system

signed so that when the load presented by the class *B* stage reaches a certain value, the driver will not deliver any more voltage swing. This approach requires the grid characteristic of the class *B* stage to be in the correct proportion to the driver plate characteristic and the driver transformer must be designed for the particular application. Peak limiting at such a high level would, again, present a problem of eliminating the high harmonics introduced. Filter components would necessarily be large and cumbersome as well as expensive.

A third approach would be to limit the peaks in a low-level stage of the speech equipment, thus simplifying most of the problems. This is a practical method. The peak clipper requires very little power when incorporated in low-level circuits. It is a fairly simple matter to incorporate a low-pass filter in low-level stages, and the amount of peak clipping can be controlled easily.

Shunt Peak Clipper

In Figure *1* appears a schematic of a simple peak clipper for low-level class *A* amplifier application. The two resistors R_1 and R_2 are of equal value and each is equal to the normal cathode bias resistance for the particular tube. The grid return is to the center of the two resistors, thus providing normal grid bias. The adjustments on R_1 and R_2 provide bias to the clipper diodes. The amount of diode bias determines the signal amplitude at which clipping will start. The 100,000-ohm resistor provides a high impedance signal source so that the 6H6 can control the peak amplitude of the signal. This circuit is a simple shunt-peak clipper; a series circuit would produce the same result.

A series-type clipper has a theoretical advantage over the shunt type, in that it is more effective in preventing overmodulation. The shunt type has the impedance of the diode in parallel with the circuit impedance, and does not offer an absolute short circuit to the clipped portion of the speech. Therefore, the shunt type theoretically can allow a certain amount of overmodulation. In practice, however, the circuit impedance is relatively high compared to the diode impedance. In Figure 1, the circuit impedance is of the order of 100,000 ohms, while the 6H6 impedance is less than 1,000 ohms during clipping. In Figure 4 the lack of leak through is illustrated. Shunt clipping is simpler in operation than series, and requires considerably fewer components.

If the average signal level at the input of the clipper can be maintained constant, there will be a definite amount of vowel clipping, and the ratio of clipped vowel sound peaks to consonant sound peaks will remain essentially constant. Any audio level indicating device or average level compression circuit must be ahead of the peak clipper. An average level compression circuit is the most desirable means of maintaining the average peak clipper input level constant. Each equipment application will impose certain restrictions of cost, space and weight that will dictate the circuit best suited to the equipment.

Experimental Results

To determine experimentally the value of peak clipping as a means of increasing average sideband power,

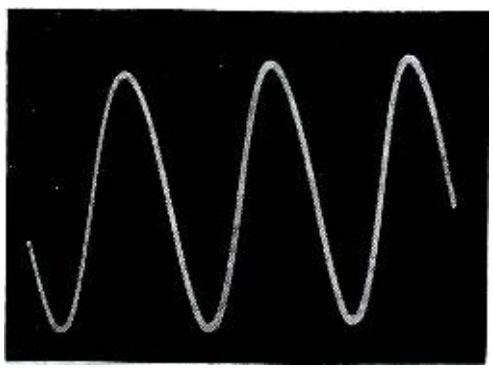


Figure 3 (left)
Output of an amplifier with no clipping.

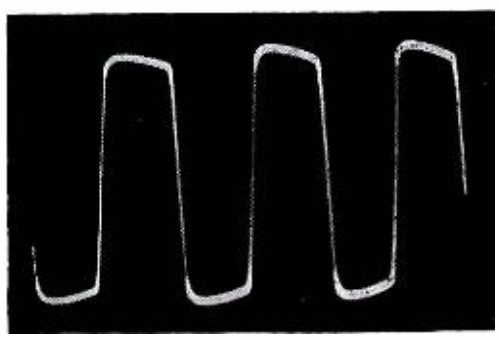


Figure 4
Amplifier output with 10.4-db clipping.

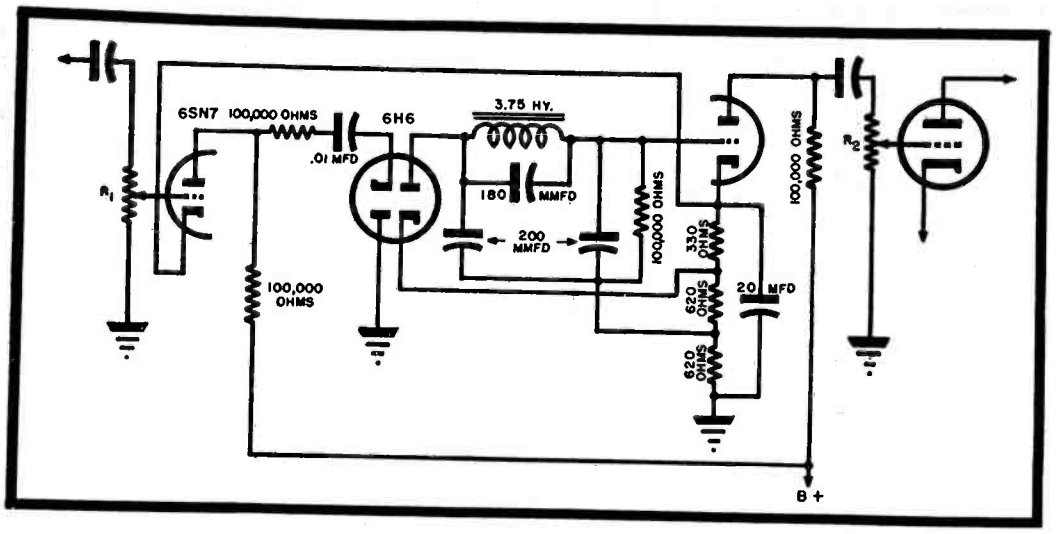


Figure 5
Clipper circuit for a ham transmitter

speech equipment for a 300-watt transmitter[1] was designed, incorporating a clipper circuit. The schematic is shown in Figure 2.

The circuit uses a 500-ohm input, V113 preamplifier, V112 m-c-w oscillator and cathode follower to a 75-ohm preamp input. R_{190} and R_{191} provide for simplex controlled remote indication of carrier frequency channel. V114 is a compressor; V115, a carrier control audio squelch; V116, a straight amplifier, and V117, compressor rectifier. The peak clipper circuit consists of the two 6H6's. Both positive and negative peaks were clipped in the push-pull circuit. The VR tubes provided bias for the clipper tubes. Operation of the relay in this circuit activates the clipper. A filter following the clipper was unnecessary due to the frequency response of the modulation transformer, which dropped off sharply above 3,500 cps.

Preliminary articulation tests, using the 300-watt transmitter and a standard communications receiver showed that on a clear channel little or no improvement or deterioration in intelligence is experienced. But, when there was considerable atmospheric noise, an intelligence improvement of 40% to 125% (varying inversely with the signal-to-noise ratio) was achieved. Assuming that intelligence is proportional to sideband power, then the average sideband power has increased about 8 db or the average modulation is now approximately 75%.

In Figure 3 appears a photograph of the output oscilloscope pattern of the special speech amplifier without clipping, and Figure 4 shows the output of the same unit with 10.4 db of peak clipping. In designing class-*B* modulator stages, it must be remembered that the wave shape shown in Figure 4 represents considerably more power for the same peak value than that of the sine wave shown in Figure 3. The ratio of rms to peak of Figure 4 is 0.9+, which is considerably better than the 0.707 of the sine wave.

Practical Circuits and Considerations

Figure 5 shows a clipper circuit used in a transmitter[2] designed for amateurs. The bias for the clipper is obtained from the 6SN7 cathode resistors. The 620-ohm resistors are not critical in value, but they must both be of the same resistance. With the values shown, clipping begins at about 3 volts. Changing the resistors will, of course, alter the clipping threshold. The filter action begins at about 4,000 cps. Figure 6 shows its effectiveness.

The amount of clipping is determined by the voltage available at R_1 and by the amount of audio amplification following R_2. Some method of checking overmodulation is necessary, R_2 is set to obtain 100% modulation with R_1 advanced about half way. R_2 should preferably have a screwdriver adjustment so that it will not be disturbed after having been set. R_1 will then regulate the clipping. A listening test is the most practical means of ascertaining the desired clipping level.

It is important that the choke in the filter has good quality. Some chokes lose their performance at higher audio frequencies, depending on capacity between turns, etc. The filter used in this transmitter has a characteristic impedance of 100,000 ohms, which is a good practical value.

Phase shift in transformers can tilt the clipped wave, and cause overmodulation. By observing the modulator output on an oscilloscope, phase shift can be detected. A variable frequency audio oscillator is necessary if thorough testing is to be accomplished. Attenuation of the low frequencies

(*Continued on page* 24)

[1]Collins 16-F.
[2]Collins 30K.

Figure 6
Frequency response of amateur-type transmitter with 100% modulation at 1000 cps.

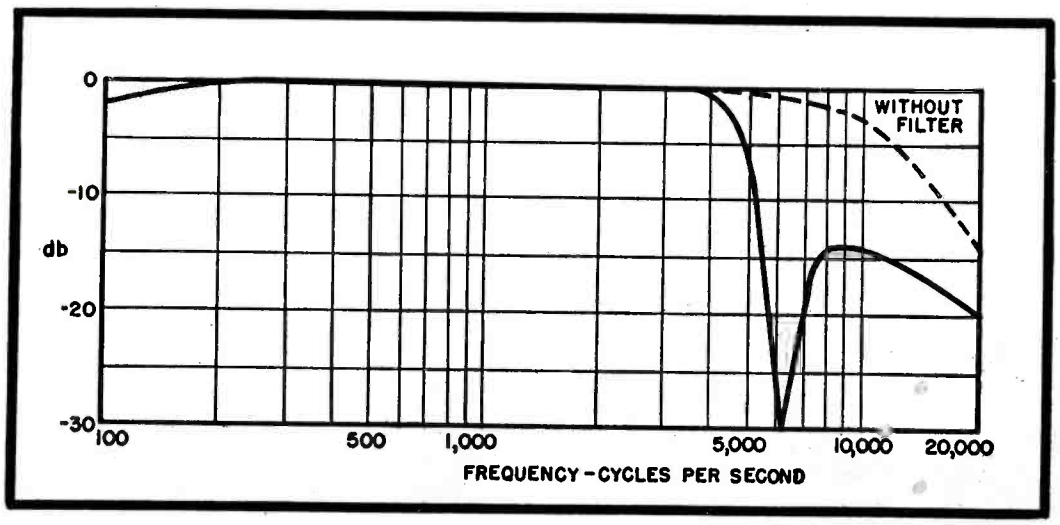
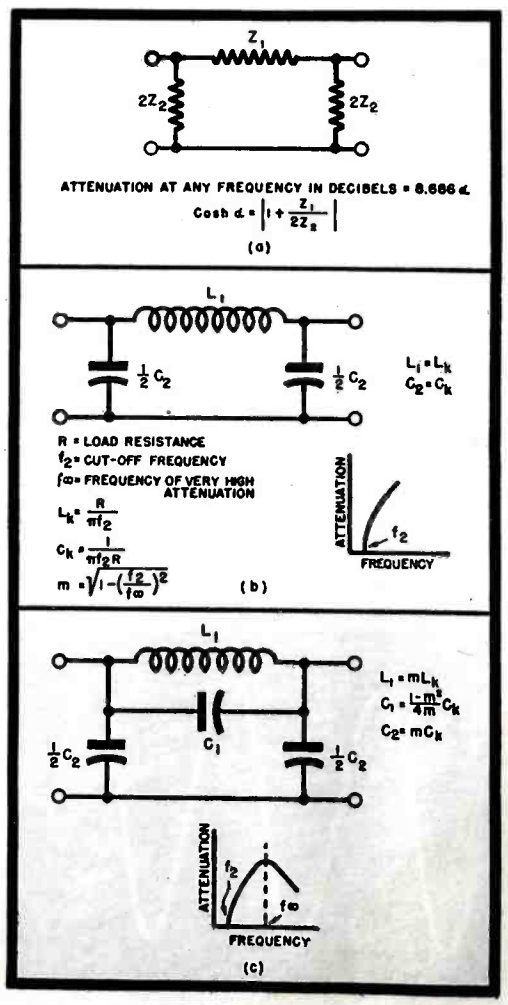


Figure 7
Filter design data.



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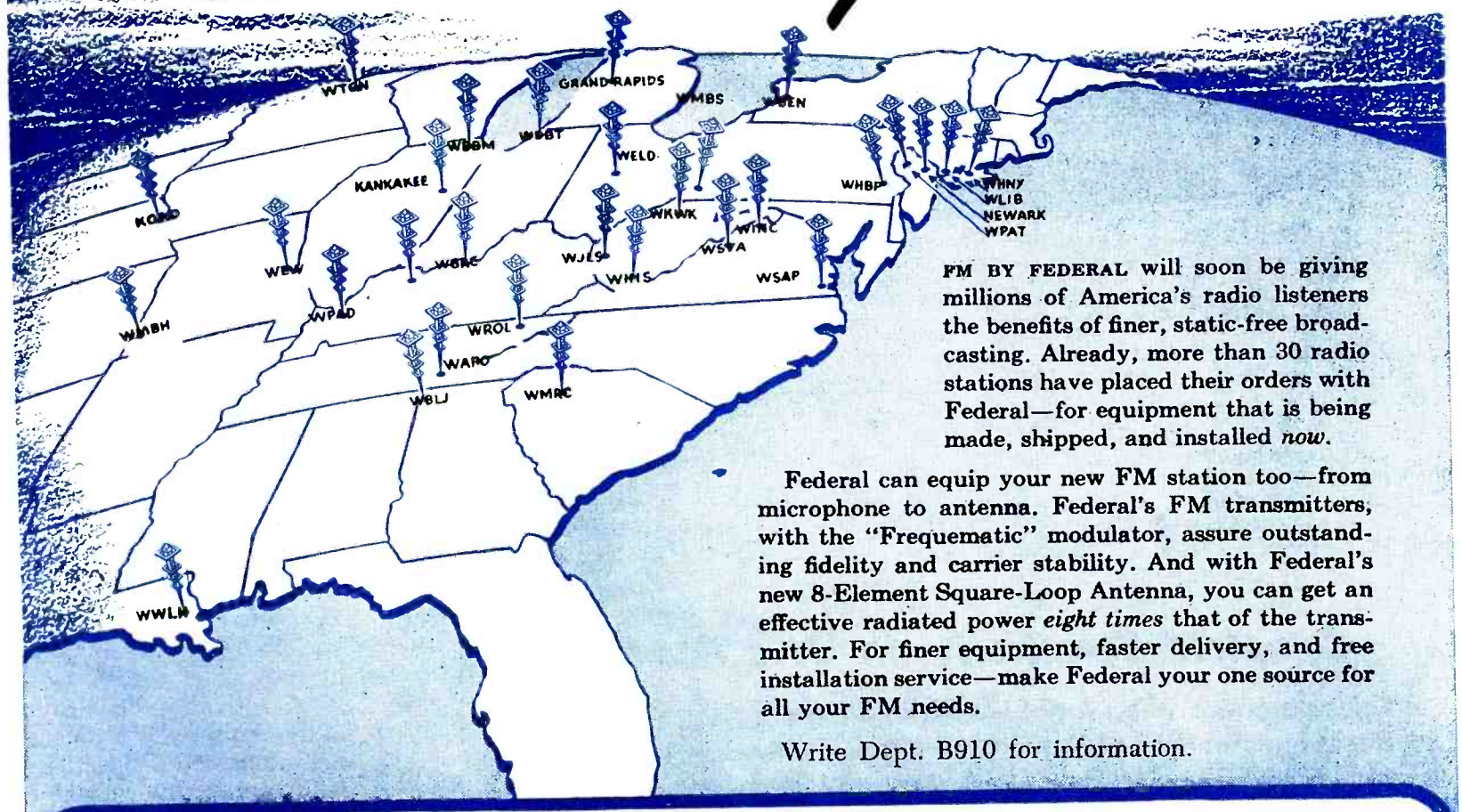

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Federal can equip your new FM station too—from microphone to antenna. Federal's FM transmitters, with the "Frequematic" modulator, assure outstanding fidelity and carrier stability. And with Federal's new 8-Element Square-Loop Antenna, you can get an effective radiated power *eight times* that of the transmitter. For finer equipment, faster delivery, and free installation service—make Federal your one source for all your FM needs.

Write Dept. B910 for information.

Here Are The First 30 Orders for FM by Federal

WSVA	Harrisonburg, Va. 10-Kw Transmitter 5-Kw Transmitter Associated Equip.
WPAT	Paterson, N. J. 10-Kw Transmitter
WGRC	Louisville, Ky. 10-Kw Transmitter
WMBH	Joplin, Missouri 3-Kw Transmitter
WBEN	Buffalo, New York 3-Kw Transmitter 2-Element Square-Loop Antenna Associated Equip.
WMRC	Greenville, S. C. 10-Kw Transmitter 8-Element Square-Loop Antenna Associated Equip.
WHBP	Reading, Pa. 3-Kw Transmitter Associated Equip.
WHNY	Hempstead, N. Y. 1-Kw Transmitter
WINC	Winchester, Va. 3-Kw Transmitter 6-Element Square-Loop Antenna
WLIB	Brooklyn, New York 10-Kw Transmitter Antenna Associated Equip.
WBLJ	Dalton, Georgia 3-Kw Transmitter Associated Equip.
WELD	Columbus, Ohio 10-Kw Transmitter Antenna Associated Equip.
KOAD	Omaha, Nebraska 1-Kw Transmitter 8-Element Square-Loop Antenna Associated Equip.
WEW	St. Louis, Missouri 10-Kw Transmitter 8-Element Square-Loop Antenna Associated Equip.
WSAP	Portsmouth, Va. 3-Kw Transmitter Associated Equip.
WTCN	Minneapolis, Minn. 3-Kw Transmitter 8-Element Square-Loop Antenna Associated Equip.
WWLH	New Orleans, La. 3-Kw Transmitter Antenna Associated Equip.
WAPO	Chattanooga, Tenn. 250-Watt Transmit.
WROL	Knoxville, Tenn. 8-Element Square-Loop Antenna Associated Equip.
WBBM	Chicago, Illinois 3-Kw RF Amplifier
WKWK	Wheeling, W. Va. 3-Kw Transmitter Associated Equip.
WPAD	Paducah, Kentucky 3-Kw Transmitter Associated Equip.
WMBS	Uniontown, Pa. 1-Kw Transmitter Associated Equip.
WSBT	South Bend, Indiana 10-Kw Transmitter 8-Element Square-Loop Antenna Associated Equip.
WHIS	Bluefield, W. Va. 20-Kw Transmitter 12-Element Square-Loop Antenna
WCIL	Carbondale, Ill. 1-Kw Transmitter Associated Equip.
WJLS	Beckley, W. Va. 3-Kw Transmitter 8-Element Square-Loop Antenna Associated Equip.
#	North Jersey Radio, Inc. Newark, New Jersey 3-Kw Transmitter Antenna Associated Equip.
#	Grand Rapids, Mich. 3-Kw Transmitter Associated Equip.
#	Kankakee, Illinois 10-Kw Transmitter Associated Equip.

#Call letters not yet assigned.

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SPEECH CLIPPERS

(Continued from page 22)

(below 150 or 200 cps) is desirable in communications equipment. A simple *RC* filter is satisfactory. A rising frequency response will result, and low frequencies will not be bothersome.

The filter action should begin at about 3,500 cps. Higher frequencies contribute nothing to communication, and cause signals to be broader than necessary. It is interesting to note that the odd harmonics are prevalent to a large degree in a clipped wave and are a part of the modulation. A filter cutting off at 3,500 cps will not pass the third harmonic of a 1,500-cps tone, and smoothes the wave back into something approaching its original form. However, the peak voltage is still at the predetermined level.

Two common types of π filters[3, 4] are shown in Figure 7, together with their attenuation characteristics. In *a* appears the prototype, and *b* the composite or *m-derived* filter. The composite filter with a value of 0.6 for m will have a practically constant impedance over the voice frequency range, and therefore several sections can be used in tandem without mismatch. The different sections can be assigned various frequencies of high or *infinite* attenuation and a really formidable filter will result. Terminating *half-sections* are utilized in a complete filter design. The total attenuation in decibels is, of course, the sum of the attenuations in all sections. The equation for attenuation assumes that there is no dissipation in the filter.

It will be noted that the clipper used with the 300-watt transmitter in the experiments would prevent overmodulation. There the clipping level was at a voltage calculated to produce 100% modulation, and the audio gain control was ahead of the clipper. The circuit of the clipper in the amateur transmitter is simpler, but the gain control follows the clipper and overmodulation could occur under careless operating practices.

Since the effective microphone sensitivity is extremely high in a clipper amplifier, a noisy operating location should be avoided. Close talking microphones and noise-cancelling microphones are helpful if the noise cannot be avoided. An alternative is to reduce the gain preceding the clipper and talk in a loud voice.

Peak clipping for receivers has also been considered. Transmitters can utilize clipping to put more power in their sidebands and thus compete with atmospheric static or higher-powered transmitters. However, a receiver is

impartial; peak clipping there would benefit all signals, with special advantage for none. Experiments have confirmed this reasoning.

Conclusions

The clipper results in a high average modulation, and improves intelligibility when reception is hampered by static or when frequencies are congested. The advantages of clipping rise in proportion to the interference. It also prevents overmodulation and, in conjunction with a filter, contributes to a clean, sharp signal with no *splatter*. The carrier is fully utilized.

Credits

The clipper circuit of the amateur transmitter was originally developed by P. G. Wulfsberg for use in airborne transmitters. W. B. Bruene designed this transmitter and supplied test results.

Bibliography

[3]W. L. Everitt, *Radio Communication.*

[4]F. E. Terman, *Radio Engineers' Handbook.*

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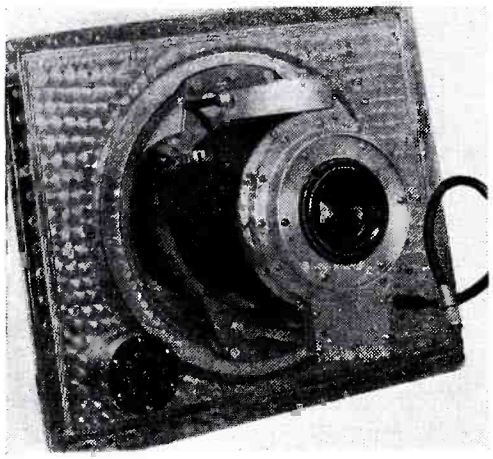
TELEVISION TELEMETERING

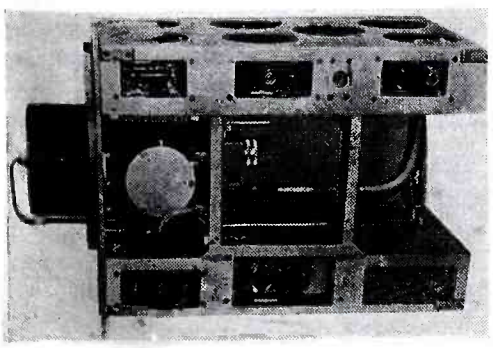


Television-telemetering equipment developed by Farnsworth in cooperation with Curtiss-Wright and the Navy, which permits observers at a ground station to see by television all instrument recordings and indicators of pressures, strains and structural failures of a test plane in the air.

An instrument panel, strongly lighted, faces a 23-tube television camera-transmitter in plane.

View above shows television-telemetering electric eye assembly, in which a fast lens focuses the image on an image dissector.

Below, an open top view of the conversion-modulator transmitter system.



Conditions for TRANSFER OF MAXIMUM POWER

Discussion of Procedures Used to Secure Maximum Power in Circuits. Plots Offered May Be Applied to Antenna, Cable, Acoustical Device Systems, etc., When Considering the Problem as a Source of Voltage in Series with a Linear Impedance.

by H. E. ELLITHORN

Associate Professor of Electrical Engineering, University of Notre Dame
Engineering Consultant, Electro-Voice, Inc.

THE DESIRE AND DEMAND for good efficiency often over-shadows the requirements for the transfer of maximum power across a junction point to a load in low-frequency power transmission. The communications engineer is, however, faced with the task of preserving and using to a maximum the small amounts of power that he has available, which in general comes from the voice or musical instruments. As a result, engineers involved in communications are much more concerned with obtaining maximum power at reasonable distortion from their devices rather than the maximum efficiency. The simplest case is that of obtaining maximum power from a d-c source which has an internal resistance r. The problem is usually formulated as shown in Figure 1.

In this problem, it is necessary to find the value of the load resistor R so that maximum power is obtained from the source.

The power developed in R can be expressed as

$$P = R\left(\frac{E}{r+R}\right)^2 \qquad (1)$$

which when differentiated with respect to R and set equal to zero gives a maximum of power, when

$$R = r \qquad (2)$$

Under the requirements imposed by equation (2) the maximum power obtainable from a source is

$$P_{max} = \frac{E^2}{4r} \qquad (3)$$

Equation (3) gives the maximum power obtainable from a source having an internal resistance r.

It will be noticed that for equation (3) to hold it is necessary that the resistance in each direction at points *1* and *2* must be equal or matched.

The efficiency of the circuit of Figure 1 may be written as follows: Since total power from the emf source is $E \cdot I$ or $E \cdot \frac{E}{r+R}$, the power delivered to the load is

$$\left(\frac{E}{r+R}\right)^2 \cdot R.$$

Therefore

$$\text{eff.} = \frac{\text{power out}}{\text{total power in}} = \frac{R}{r+R} \times 100\% \qquad (4)$$

If the condition of equation (2) is satisfied, the efficiency is 50%.

While equations (3) and (4) give expressions for power delivered and efficiency under the optimum conditions when $R = r$, it is of great interest to see what percentage of the maximum power or how many db below maximum power and at what efficiency the circuit is operating when R is some multiple of the internal resistance r. By dividing equation (3) by (1) we have

Figure 1
Representation of a simple case of obtaining maximum power from a d-c source which has an internal resistance, r.

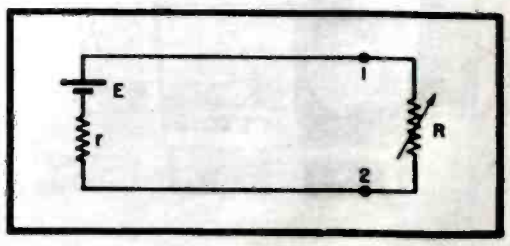
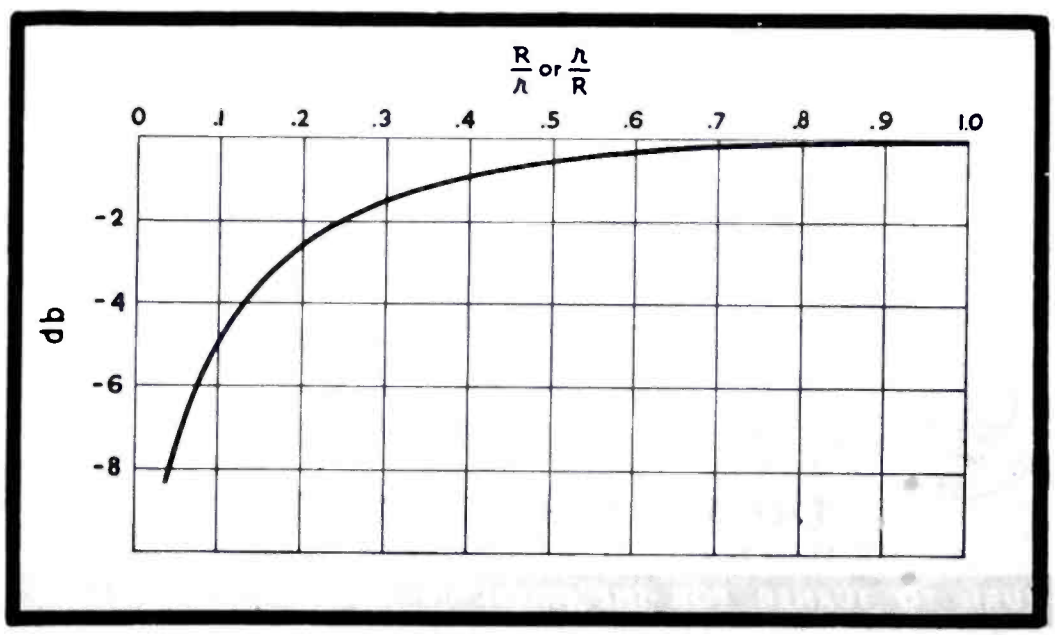


Figure 2
Per cent of maximum power delivered when the load resistance does not match the source resistance.



$$\frac{P_{max}}{P} = \frac{\frac{E^2}{4r}}{\left(\frac{E}{r+R}\right)^2 R} \quad \text{or}$$

$$\frac{P}{P_{max}} = \frac{4rR}{(r+R)^2} \qquad (5)$$

By giving R various values in terms of r, it is possible to find the fraction of power delivered as compared with the maximum power. These results are plotted in Figure 2.

By taking 10 $\log\left(\frac{P}{P_{max}}\right)$ we get db as

$$db = 10 \log\left[\frac{4rR}{(r+R)^2}\right] \qquad (6)$$

Equation (*6*) is plotted in Figure 3 while equation (*4*) is plotted in Figure 4.

As an example of the use of the curves, let us assume that the source has a 72-ohm internal resistance and a load of 144 ohms is connected to the source. With these values $r = 72$ and $R = 144$, so $R = 2r$. Since the multiple that R is of r only covers values between zero and one, we take the reciprocal r/R or .5.

From Figures 2, 3, 4 we find that 89% of maximum power is transmitted or is down .5 db and the efficiency is 66.7%. If values of r and R are interchanged so that $R = .5\,r$ the values become 89% of maximum power transmitted or down .5 db but at an efficiency of 33.3%.

When a source with internal resistance, r, is connected to a load resistor, R, by a network of resistors, the intervening network, provided it contains no other sources of emf, may be replaced by an equivalent T or π network[1]; Figure 5.

In general the values of A, B and C will all differ from each other, but A may equal B if the network is symmetrical.

The network of Figure 5 may be considered in two ways. The first is by considering the elements to the right of terminals *1* and *2* as constituting a load on the source to the left of terminals *1* and *2*.[2] Thus for maximum power transfer across the terminals *1* and *2* the impedance must be matched at the junction. This means that

$$A + \frac{(B+R)C}{B+R+C} = r \qquad (7)$$

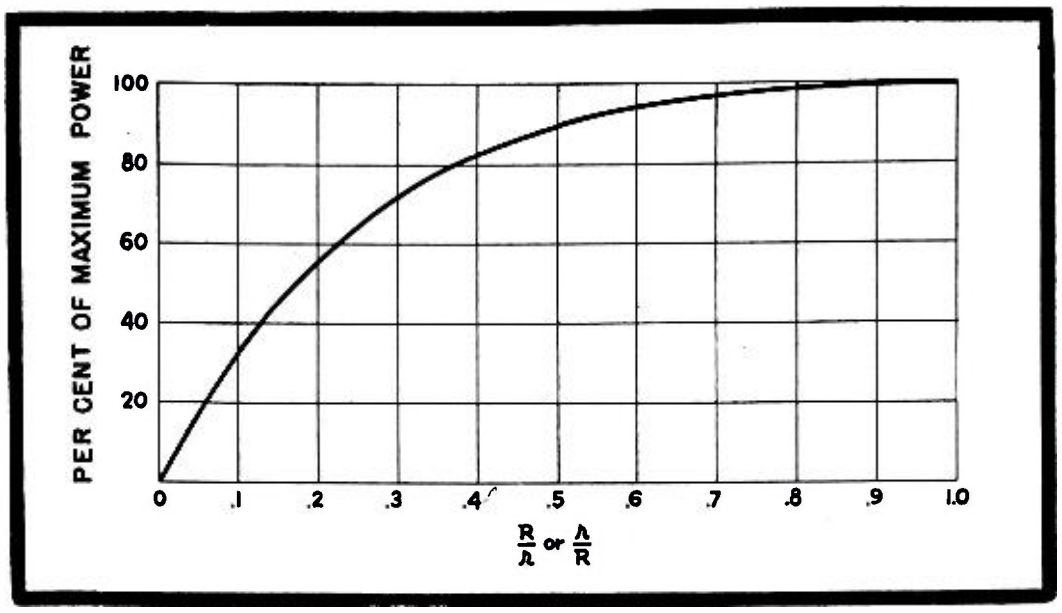


Figure 3
Plot showing how decibels may fall below maximum power.

Or solving for R, which is considered as a variable, we have

$$R = \frac{(r-A)(B+C) - BC}{A+C-r} \qquad (8)$$

It is to be noted from equation (*8*) that if $A \geqq r$, then there is no physically realizable value of R which will cause maximum power to be transferred across points *1* and *2*.

The second way of looking at the circuit of Figure 5 is by use of *Thevenin's Theorem*[3] at terminals *3* and *4*. This simply requires the impedances to match at terminals *3* and *4*, resulting in

$$B + \frac{(r+A)C}{r+A+R} = R \qquad (9)$$

$$R = \frac{(r+A)(B+C) + BC}{r+A+C} \qquad (10)$$

In contrast to equation (*8*), equation (*10*) always gives a physically realizable value of R. This means that it is always possible to maximize the power into the load while it may not be possible to maximize the power input to the connecting circuit.

To find the overall efficiency for the circuit of Figure 5, we state that

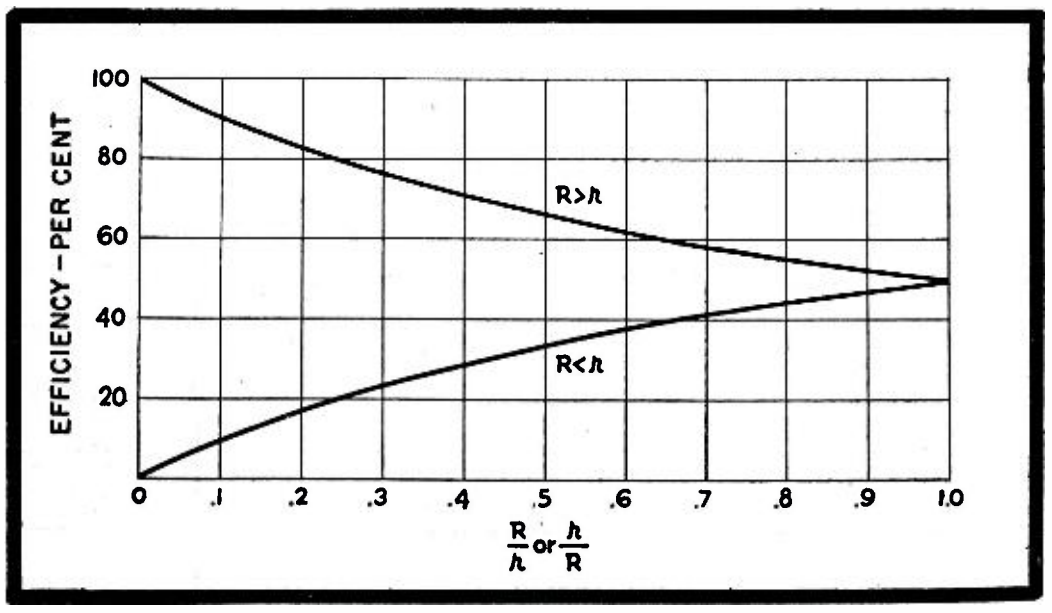
$$\text{eff.} = \frac{P_R}{E \cdot I}.$$

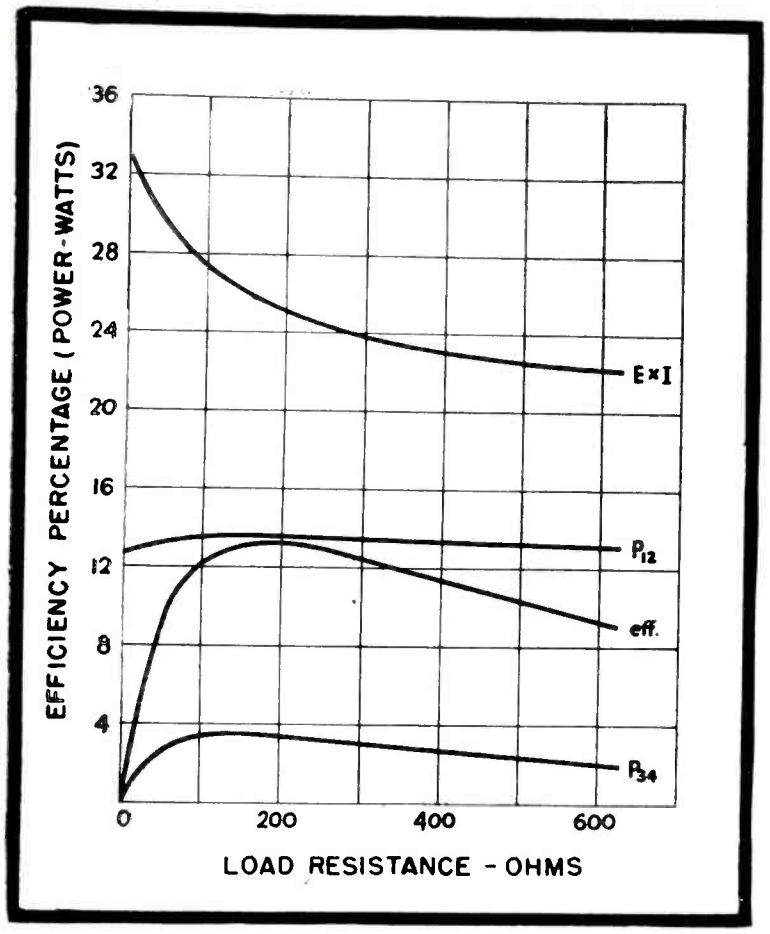
When P_R, the power in the load R, is expressed in general terms as well as I, and mathematical simplifications made, we have

$$\text{eff.} = \frac{C^2 R}{(B+C+R)\{(r+A)(B+C+R)+C(B+R)\}} \qquad (11)$$

Differentiating equation (*11*) with respect to R and setting the differential equal to zero, to find a maximum, we have

Figure 4
The per cent efficiency when the load is not matched to the source resistance.





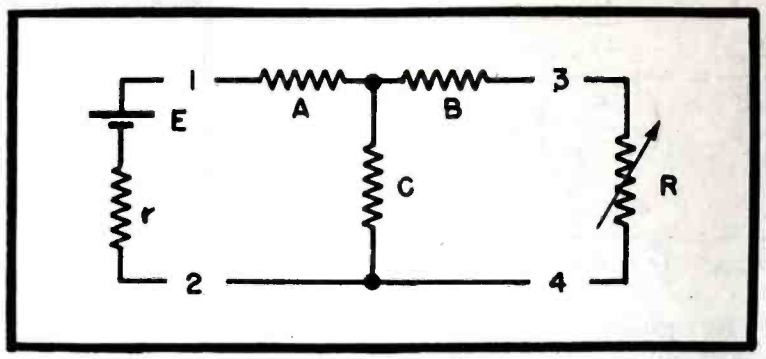


Figure 5

Circuit illustrating how an intervening network may be replaced by an equivalent T or π network; the internal resistance source, r, is connected to a load resistance, R, by a network of resistance.

Figure 6

Performance of the T network shown in Figure 7.

$$R^2 = B^2 \frac{(r+A+C)+BC(2r+2A+C)+C^2(r+A)}{r+A+C} \qquad (12)$$

Equation (*12*) thus gives the value of R for maximum overall efficiency. Figure 6 shows the experimental results for the circuit shown in Figure *7*.

The calculated values of R from equation (*8*), (*10*) and (*12*) result in values of R as *127*, *138* and *177* ohms, as compared with experimental values of 125, 140, 180 ohms.

While the derivations have been given for d-c sources, the results are equally valid for a-c supplies having a pure resistance internal impedance and working into a pure resistive load.

To complete the study of impedance matching, we can consider the general a-c case shown in Figure 8.

The impedances Z_s and Z_R written in polar form become $|Z_s| \angle\theta$ and $|Z_R| \angle\varphi$. Now $|Z_s|$ many be written as $|Z|$ and $|Z_R|$ as $k|Z|$ where k is a pure positive number. Using this notation, the magnitude of the current squared is

$$|I|^2 = \frac{|E|^2}{[Z(\cos\theta + k\cos\varphi)]^2 + [Z(\sin\theta + k\sin\varphi)]^2} \qquad (13)$$

Since the power delivered to the load is

$$P = |I|^2 k Z \cos\varphi$$

$$P = \frac{E^2 k Z \cos\varphi}{Z^2[1+k^2+2k(\cos\theta\cos\varphi + \sin\theta\sin\varphi)]} \qquad (14)$$

By simplification, equation (*14*) becomes

$$P = \frac{E^2 k \cos\varphi}{Z[1+k^2+2k\cos(\theta-\varphi)]} \qquad (15)$$

Since the maximum power delivered to a load in an alternating-current circuit is when the impedances in opposite directions from the junction points are complex conjugates, we have the maximum power given by

$$P_{max} = \frac{E^2}{4Z\cos\theta} \qquad (16)$$

For any values of Z, k, φ and θ it is now possible to find the percentage of maximum power transmitted across the junction points by dividing equation (*15*) by equation (*16*), which after simplification becomes

$$\%P = \frac{4\cos\varphi\cos\theta}{\frac{1+k^2}{k} + 2\cos(\theta-\varphi)} \times 100 \qquad (17)$$

If the quantities φ and θ of equation (*17*) are known so that they be-

(*Continued on page 34*)

Figure 7

Circuit used to plot curves of Figure 6.

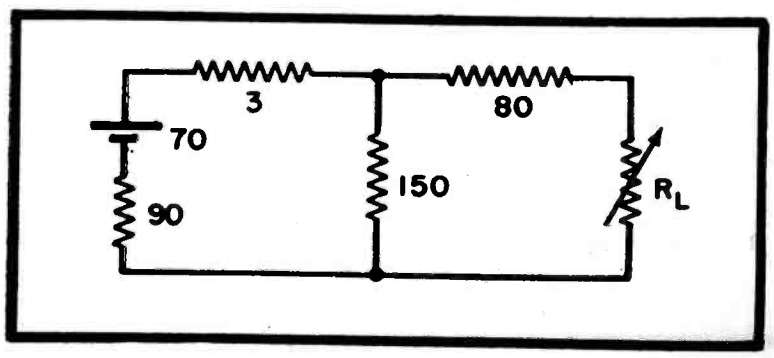
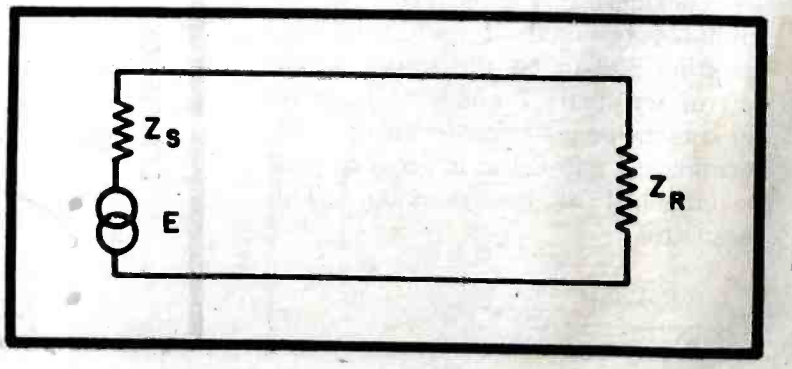


Figure 8

General a-c case considered in study of impedance matching.



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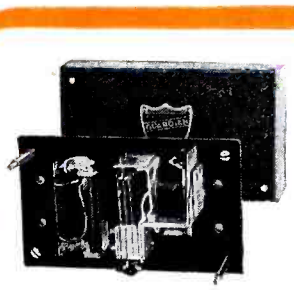
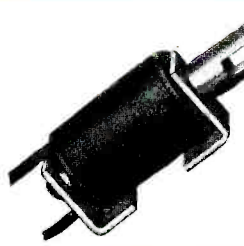
Series 40 A. C. Laminated Relay

This laminated relay is designed to produce maximum output with minimum current input. Typical uses include control of call system bells; auxiliary for automatic radio tuning; remote control of fractional motors; safety devices; instruments; sound movie auxiliaries.



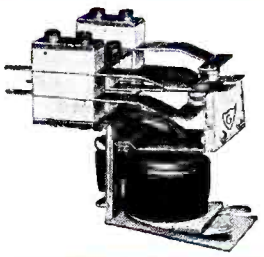
Series T-110 Time Delay Relay

This relay employs a resistance wound bimetal strip to achieve a delayed operation from 10 to 60 seconds. Current flows through the windings generating heat, causing the bimetal strip to bend, closing a contact after the required time delay.



Series 1-A Solenoid

The series 1-A Solenoid by Guardian is one of numerous types for intermittent and continuous duty. Applications include valve control and operation; electrical locking; clutch and brake operation; material ejector; spray gun operation among others.

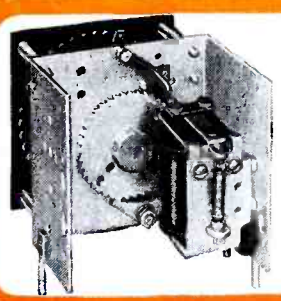


Series A-100 High Frequency

This A1SiMag insulated relay is compact, convenient, low in cost. In radio applications it is used for antenna changeover, break-in, high voltage keying, grid controlled rectifier keying, remote control of receiver and transmitter, and other high frequency applications.

Series 120

The Series 120 is a small, compact relay. It is an economical unit designed for control needs which do not exceed single pole, double throw combination. Economy and simplicity of construction make it possible to offer the Series 120 at a low price compared with its high quality performance.



Series R Stepper

This Relay is built in three basic types for A.C. and D.C. operation: (1) Continuous rotation, (2) Electrical reset, (3) Add and subtract. Its principle application is automatic circuit selection including automatic sequence, automatic wave changing on short wave transmitters, automatic business machines, totalizing units, conveyer control.

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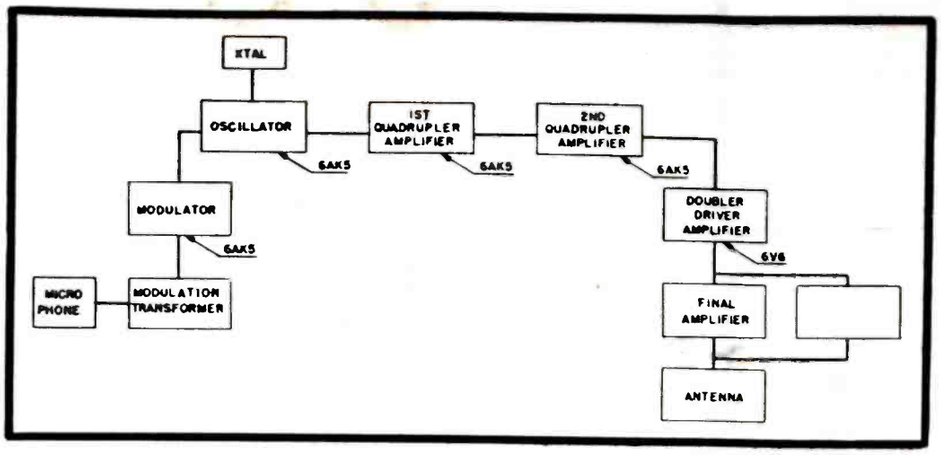

Figure 1
Block diagram of a 25/50-watt mobile transmitter. When only one 4381A tube is employed in the final p-a, the output power is 25 watts. Using two 4381As results in an output power of 50 watts. (*Courtesy FTR*)

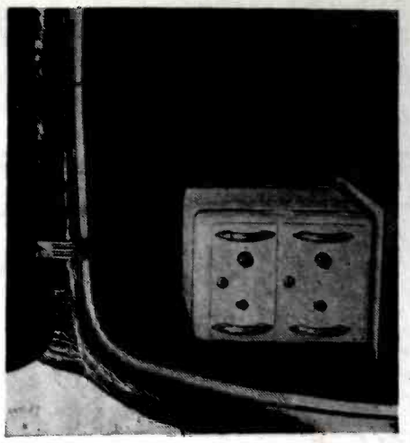

Figure 2
Complete transmitter-receiver unit installed in the trunk of a passenger vehicle.
(*Courtesy FTR*)

MOBILE F-M TRANSMITTERS

Part X of Analyses of F-M Transmitters Covers F-M Mobile Communications Systems.

by N. MARCHAND*

Consulting Engineer
Lowenherz Development Company

ONE OF THE OUTSTANDING ADVANTAGES of f-m is its ability to improve the signal-to-noise ratio in a receiver, affording a quieter and clearer signal. Of course high fidelity is not required for a communications system so that the frequency response may be limited to 300 to 3,000 cycles. Similarly the frequency deviation is reduced to ±15 kc which has been found quite satisfactory for noise reduction to eliminate many of the blind spots usually encountered when a-m is employed.

Another property of the f-m wave which makes it peculiarly adaptable to mobile work, is its ability to suppress the signal from an adjacent carrier or a signal on the same carrier frequency. If the mobile system is to work properly it is important that the strength of the received signal from other stations on the same frequency be reduced in volume so that no heterodyne or interfering signal is heard. The ratio of the desired to the undesired signal in a-m has to be in the neighborhood of 100 to 1 so that no interference will be encountered. In f-m, on the other hand, a signal ratio of only 2 to 1 is necessary for suppression of the unwanted signal.

One of the major difficulties encountered with a-m is skywave interference at night. Thus a-m stations must be separated sufficiently in either frequency or distance so that no interference is encountered when the skywave is present. In many cases it is therefore necessary to reduce radiation by either a reduction in power or the use of a directional antenna reducing the primary coverage of the station.

By using an f-m transmitter in the very high frequency band, this type of interference is practically eliminated and no precautions need be taken. Thus, many more stations may be employed and the coverage of each one may remain the same for night as for daylight operation.

A 25/50-Watt Transmitter[1]

In Figure 1 we have the block diagram of a 25- or 50-watt mobile 30 to 44-mc f-m transmitter, with a 6AK5 modulator modulating a 6AK5 oscillator. Two 6AK5 tubes in cascade multiply the output frequency of the modulated oscillator by sixteen. The signal is then fed into a 6V6 doubler-driver amplifier. This tube delivers sufficient power to drive either a single 4381A tube for 25 watts output power or two 4381As for 50 watts of output power.

The 6AK5 tubes are of the miniature type so that the power consumption in the standby position is very small. The stages are all class *C* amplifiers and are driven well beyond their saturation so that changes in tube characteristics or slight changes in emission should have no effect on the operation of the transmitter.

The output from the power amplifier is fed into a matching network which couples to a 34-ohm antenna. A 0-50 microampere meter is employed with a switch so that the grid currents of the multipliers and the power amplifier can be read.

Squelch Circuits

The f-m mobile receiver used for police, fire, and other similar emergency applications, is usually on as long as the vehicle is in service, while the transmitter at the home station may be on only a few times a day, usually for the duration of the broadcast. Since the receivers are very sensitive, we have an in-between-signal noise problem; a blast of noise heard when there is no quieting signal from the transmitter. Therefore every receiver employs some type of squelching circuit to mute the output when there is no transmission.

*Instructor in Graduate Electrical Engineering courses, Columbia University.

[1]Federal Telephone and Radio Corp.

[To Be Continued]

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ELECTRICAL CHARACTERISTICS—EIMAC 4-250A

Filament: Thoriated Tungsten	
Voltage	5.0 volts
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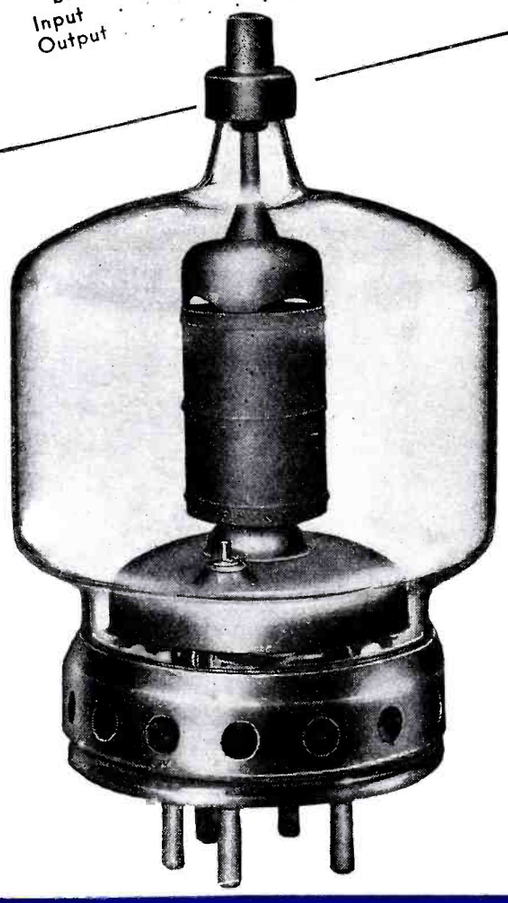
Direct Interelectrode Capacitances: (Average)	
Grid-Plate (Without shielding, base grounded)	0.12 *uufd*
Input	12.7 *uufd*
Output	4.5 *uufd*



Proven performance is the reason why the EIMAC 4-250A tetrode is the logical choice when a dependable power-amplifier tube is needed. Below are listed characteristics and design features of the EIMAC 4-250A which explain why this tetrode is *picked for power.*

HIGH POWER—LOW DRIVE:

At frequencies up to 70 Mc. the EIMAC 4-250A develops a power output of 750 watts with a drive of less than 6 watts.

LOW PLATE—GRID CAPACITANCE:

Extremely low plate to grid capacitance, only 0.12 *uufd*, permits operating without neutralization in many cases—simplifies neutralization in others.

OPERATIONAL STABILITY:

The unique arrangement of low inductance leads, plus especially treated grids insures exceptionally stable operation.

COMPACT—RUGGED:

Approximately 3½ x 6½ inches in size, the 4-250A has been constructed to withstand abnormal abuse —and give extra long life.

The 4-250A is just one of a host of EIMAC tubes designed for long-life and trouble-free operation. Investigate the possibilities of their use in your transmitters today. Contact your nearest EIMAC representative, or write direct for full technical information.

EITEL-McCULLOUGH, INC., 1265F San Mateo Ave., San Bruno, Calif.
Export Agents: Frazar and Hansen, 301 Clay St., San Francisco 11, Calif., U.S.A.

CALL IN AN EIMAC REPRESENTATIVE FOR INFORMATION

Follow the Leaders to

Eimac REG. U.S. PAT. OFF. TUBES

THE COUNTERSIGN OF DEPENDABILITY IN ANY ELECTRONIC EQUIPMENT

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President — RCA BUILDING 30 Rockefeller Plaza, New York N. Y. — GEORGE H CLARK, Secretary

Personals

IT IS NOW LT. COL. Manuel Fernandez, chief of communications of the Army Transport Command, with headquarters at Memphis, Tenn. . . . Paul W. Newman, a former Chief Radioman in the United States Coast Guard is now with Tropical Radio at Hialeah, Fla. . . . Guy Entwistle, formerly chairman of our Boston chapter and president of the Massachusetts Radio School, has moved his school quarters to 271 Huntington Avenue, Boston. He reports a record enrollment. . . . We have some interesting notes about a new member, Charles E. Williams of Seattle, Wash., who first went to sea in 1915. He has seen service aboard numerous ships including the S. S. Admiral Schley and at the Puget Sound Navy Yard from 1917 through 1946. . . . H. P. Schueler, who hails from Pittsburgh has been commercially active since 1930, with the United Fruit Company, TWA, Eastern Airlines and Keystone Radio School as an instructor. He is now broadcast engineer at WJAS. . . . C. W. Phillips in commercial radio since 1917, served aboard the old U.S.S. South Carolina, a veteran Navy vessel. He then went to Tropical Radio and today he is manager of Cia. Radiografica Internationale de Costa Rica, San Jose, Costa Rica. . . . Veteran member O. J. Cain, a commercial wireless operator since 1925, recently sales manager of the Radiomarine Corporation of America, is now president of the Industrial Radio Corporation, Norfolk, Virginia. . . . E. W. Mayer, commercially active since 1919, who served at WPR, San Juan, Puerto Rico, and then the FCC is now with CAA in San Juan. . . . Tropical Radio Telegraph Company has given up its New York office. Our own treasurer and executive secretary, "Bill" Simon, will continue to serve Tropical as general manager with headquarters at Pier 7, North River, N.Y.C. . . . Our congratulations to Commodore E. M. Webster, honorary member and former Chief of Communications of the United States Coast Guard, who has been appointed chief advisor to the American Shipping Association. . . . Veteran member L. R. Dawson continues active in VWOA affairs out Honolulu way. . . . W. A. Breniman, a World War I veteran operator, who served aboard ship for eight years obtaining his first class commercial license in 1919, is now chief of the commercial operations division of CAA.

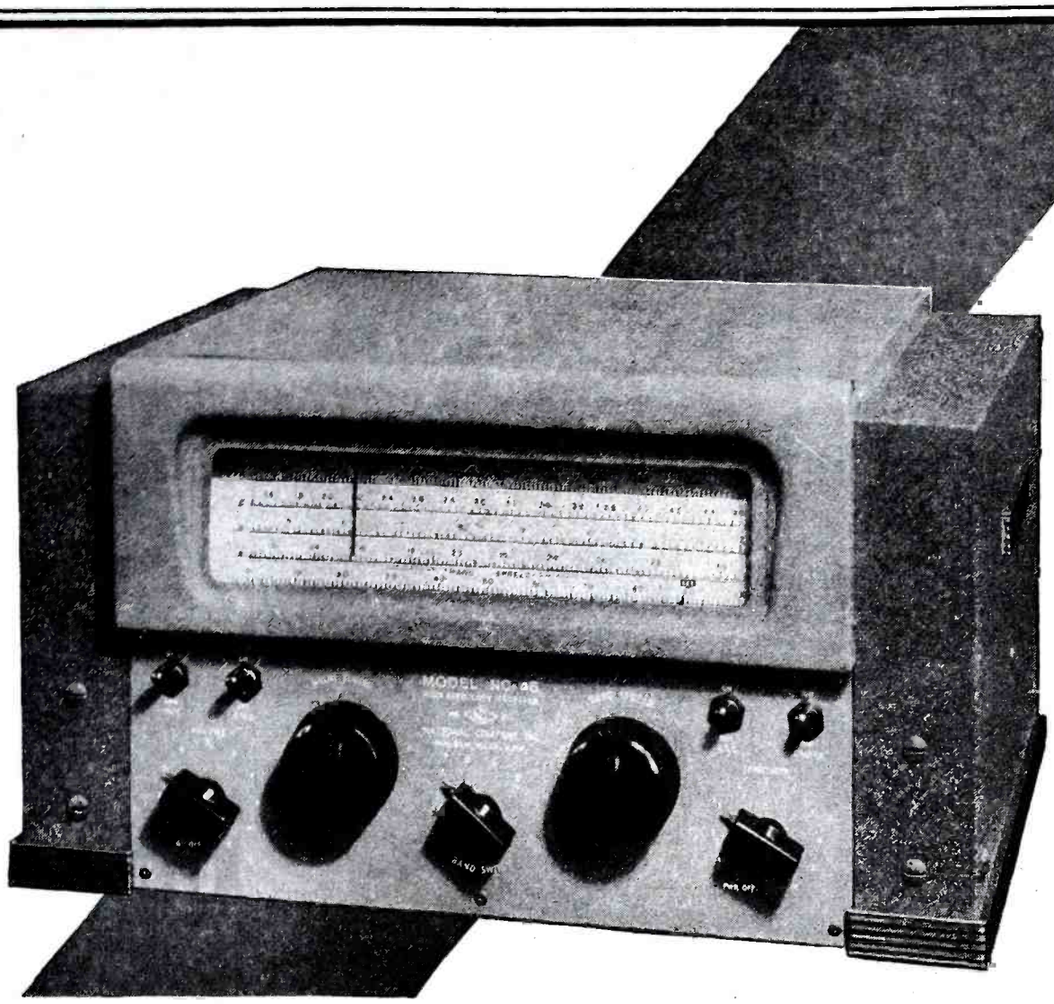
Jack Poppele, VWOA life member, vice president and chief engineer of WOR, who as president of the Television Broadcasters Association directed the very successful second TBA conference and exhibit at the Waldorf Astoria in New York City recently.

Fortieth Anniversary

OUR SINCERE CONGRATULATIONS to General "Dave" Sarnoff, first VWOA life member, upon the completion of forty years of outstanding service to the advancement of the radio art, a service which industry applauded at an anniversary dinner at the Waldorf Astoria in N. Y. City on September 30. . . . A boy of nine, DS came to this country lacking a knowledge of the language. In 1906 he became a wireless messenger, learned the art of telegraphy and in 1908 he became an operator at Siasconsett, the pioneer wireless station. Then in 1911 he became an operator aboard the S. S. Harvard. Later that year he went into the Arctic ice fields as a wirelessman aboard the S. S. Beothic. Attended Pratt Institute in 1912, while serving at the Wanamaker station in New York, during which period he received the ill-fated Titanic messages. As chief radio inspector for the Marconi Company in 1913 he made the first tests of radio equipment aboard a D. L. & W. train. In 1919 DS became commercial manager of the newly formed Radio Corporation of America, and in 1930 was elected president of RCA. DS received the first VWOA Marconi Memorial Medal of Achievement. Always a staunch supporter of veteran wireless affairs, General "Dave" Sarnoff is general chairman of our Marconi Memorial Fund.

75th Birthday

WE CONGRATULATE ONE OF OUR first honorary members, 75 years young G. Harold Porter, who was born in Carbondale, Pa., in 1871. He began his career, at the age of nine, with the mining department of the Delaware and Hudson Railroad as a breaker boy. He later became a messenger boy with the same company, studied telegraphy and at twelve was a telegraph operator. Joined the Kings County Elevated Railway Company and then was appointed division operator in charge of the New York Division of the Baltimore and Ohio. In '98 he was named chief clerk of B&O, leaving in '06 to become traffic manager of the Tyler Lumber company and a year later secretary. Entering wireless in 1913 with the Marconi Company, GHP directed purchasing of equipment for the high power stations in New Jersey, Massachusetts, California, Alaska and Hawaii. In '17 he became assistant commercial manager of the Marconi Company. He went to San Francisco in 1925 as manager of the Pacific division of RCA and in 1930 he was elected vice president of RCA in charge of Pacific coast activities. Following retirement in 1936, he associated himself with the Preferred Accident Insurance Company, as a special representative, a connection he still retains.



NC-46

Clean modern styling combines with advanced electrical design to make the NC-46 an outstanding choice for the amateur. Workmanship is of traditional National quality in spite of moderate price. Features of the NC-46 include a series valve noise limiter with automatic threshold control, CW oscillator, separate RF and AF gain controls, and amplified and delayed AVC. Four coil ranges cover from 550 Kc. to 30 Mc. A straight-line-frequency condenser is used in combination with a separate bandspread condenser. Look over an NC-46 at your dealer's, study it inside and out. It's a lot of receiver for your money.

NATIONAL COMPANY, INC. NC **MALDEN, MASSACHUSETTS**

POWER TRANSFER

(*Continued from page 28*)

come constants, it is possible to differentiate equation (*17*) with respect to k and find value of k for which the per cent of power is a maximum. This results in

$$\frac{\partial P}{\partial k} = -4 \cos\phi \cos\Theta \left(1 - \frac{1}{k^2}\right) = 0 \quad \text{or}$$

$$4 \cos\varphi \cos\Theta \left(1 - \frac{1}{k^2}\right) = 0 \qquad (18)$$

There are three possible solutions for equation (*18*), namely: $\cos\varphi = 0$; $\cos\Theta = 0$;

$$\text{or} \qquad \left(1 - \frac{1}{k^2}\right) = 0$$

If $\cos\varphi = 0$ then $\varphi = 90°$ or the load is all reactance and thus it can absorb no power, resulting in a minimum. If $\cos\Theta = 0$, then $\Theta = 90°$ and thus the internal impedance of the generator is all reactance and by the preceeding work, it will be also necessary that the load be a reactance to match. However, a pure reactance load absorbs no power. The third case, $1 - \frac{1}{k^2} = 0$, results in $k^2 = 1$ or $k = +1$ or -1. By our definition of k, we are inherently restricted to positive values so the -1 value is ruled out. We are led to the conclusion that if Θ and φ are specified, the maximum fraction of the possible power available from the source is obtained when the magnitudes of the generator and load impedances are equal.

Further, if the ratio of impedance magnitudes is known and the angle Θ of the generator impedance also known, the maximum fraction of power is obtained by again differentiating equation (*17*), but with respect to φ instead of k resulting in

$$\frac{\partial P}{\partial \phi} = -4\left(\frac{1+k^2}{k}\right) \sin\phi - 8 \sin\Theta = 0 \quad \text{or}$$

$$\sin\varphi = -\frac{2k \sin\Theta}{1+k^2} \qquad (19)$$

Equation (*19*) gives the sine of the angle that the load impedance should have to obtain maximum power for given values of k and Θ.

By similar work, if the angle of the

generator impedance is controllable, then for maximum fraction of total possible power

$$\text{sine } \Theta = -\frac{2k \text{ sine } \varphi}{1 + k^2} \qquad (20)$$

As an example of the use of the equations, the following values are assumed:

$$Z_s = 100 \angle 45 \quad \text{and} \quad Z_R = 20 \angle 30.$$

From equation (*17*) the per cent of maximum possible power delivered is since $k = .2$

$$\%P = \frac{4 \cos 30 \cos 45}{\frac{1 + .04}{.2} + 2 \cos (45 - 30)} \times 100 = 34.3\%$$

If $Z_s = 100 \angle 45$ and $R_R = 20 \angle ?$, then by equation (*19*)

$$\text{sine } \varphi = -\frac{2 (.2) \text{ sine } 45}{1 + .04} = -.272$$

or

$$\varphi = -15^\circ 50'$$

If this value of φ is used, the per cent power becomes, from equation (*17*),

$$\%P = \frac{4 \cos -15^\circ 50' \cos 45}{\frac{1.0 + .04}{.2} + 2 \cos (45 + 15^\circ 50')} = 44.0\%$$

While the foregoing developments have been made using the more familiar electrical impedance symbols, the results are applicable to all impedance circuits. As a result, equation (*17*) will hold for mechanical, acoustical or electrical impedance conditions. The curves of Figures 2, 3, 4 many be used for antennas, cables, amplifiers, as well as acoustical devices, if they may be considered in the problem as a source of voltage in series with a linear impedance.

References

[1]Everitt, *Communication Engineering*, pp. 28-30; First Edition, McGraw-Hill.

[2]Reference 1, p. 38.

[3]Reference 1, p. 36.

[4]P. K. McElroy, *Proceedings IRE;* March, 1935.

[5]Shea, *Transmission Networks and Wave Filters*, chapter IV; D. Van Nostrand Co. Ware and Reed, *Communication Circuits*, chapter XI, 2nd Edition; J. Wiley.

ACOUSTICAL CORRECTION BY SOUND DIFFUSION

[*See Front Cover*]

by FORREST L. BISHOP

Chief Engineer
Kasper-Gordon, Inc.

Semi-Spherical 12" to 36" Diffusers Arranged in Random Pattern on One Wall Used to Improve Acoustical Properties of Recording Studio.

WITH HIGH-FIDELITY reproduction a must characteristic of all types of recording today, the studio has become a major fidelity factor. For it is in the studio that many basic problems can originate. It has thus become necessary to develop or redesign studios that have a minimum of acoustical faults.

In our Boston studios we were faced with a problem of boominess resulting from phase distortion and reverberation. By carefully placing the microphones, this could be modified, but critical placement was an expensive time-consumer. And from a technical standpoint, it was a nuisance.

Our early analysis of the acoustical properties of the studio indicated that two major factors contributed to the defect, the most obvious of which were the room dimensions, 28′ × 12′ 10″ with a height of 10′ 6″. This is hardly the ideal as derived from the ratio of the $3\sqrt{2}$. Another, and, as it now appears, the principal cause of distortion, was the construction of two walls, a long wall on the control-room side and a short wall meeting the long one at right angles, both of which were surfaced with painted wallboard. Another long wall and ceiling were treated with panels of acoustical cane. The remaining short wall, almost completely filled with long windows, was draped.

A series of test recordings were made and measurements were taken at various positions in the room with a sound level meter[1] at frequencies from 30 to 10,000 cycles. In all measurements, high peaks appeared in varying degrees within the range of 100 to 150 cycles together with long hangovers of reverberation. We were thus reasonably sure that the painted walls were resonating within the indicated range.

The construction of the building in which the studio was located did not permit any change in the room dimensions. Consequently, our corrective experiments were concentrated on the resonating walls.

Heavy drapery was not the answer. This resulted in complete deadening which removed all life and sparkle from the test recordings.

Since absorption proved a failure, we believed that diffusion might bring about the desired effect. The conventional treatment would have been polycylindrical, but we decided to use semi-spherical diffusers.[2] We believed that we would have greater control over the amount and quality of diffusion by the addition, subtraction and placement of the diffusing semi-spheres.

The spheres were made from a cement and cellulose mixture, easily molded to the desired size and shape. When set they become rigid, slightly porous and very rough surfaced.

The semi-spherical sections ranged in size from twelve to thirty-six inches

[1]General Radio.
[2]Kasper-Gordon design.

across. When permanently attached, they were bolted to the walls by special steel brackets.

Diffuser Placement

In determining the position of the diffusers, they were arranged in a random pattern, more diffusers being used at the end of the studio where less life was desired. To carry out the principle of diffussion still further, a convex pane of plexiglass was installed in the control-room window.

The resulting acoustical improvement was evident immediately. Those familiar with the studio recognized it by ear alone. The series of test recordings and measurements which followed proved that all boominess had been eliminated. Microphone placement was no longer critical. Both speech and music were recorded with high-fidelity quality. Piano recordings, which formerly were made with great difficulty, could be cut with fidelity at all instrumental amplitudes. A recent choral-group transcription proved the effectiveness of this acoustical treatment. A chorus of sixty recorded in our small studio, a procedure that would have been impossible in the old studio. And the disc reproduction was excellent.

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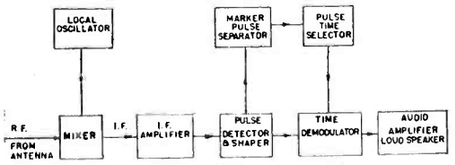
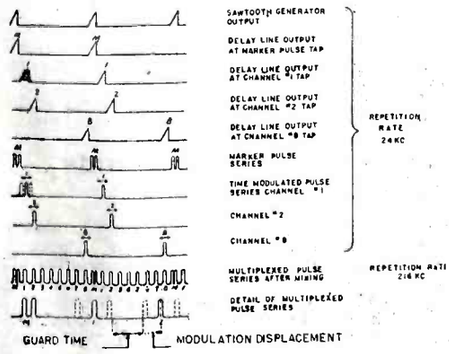
PULSE TIME MODULATION



Above, block diagram of the pulse time modulation receiver used in the multiplex broadcasting system developed by the laboratories of I.T.&T. Below, diagram showing the evolution of pulses from their generation to the final interleaved time-modulated multiplex pulse sequence.



NEWS BRIEFS

ROCHESTER FALL MEETING PROGRAM
[RMA Eng. Dept. and the IRE]

The Sheraton Hotel
Rochester, N. Y.
November 11, 12, 13, 1946

MONDAY, NOVEMBER 11

9:30 A.M. Technical Session
Electronic Transducers; H. F. Olson, RCA Laboratories
Some Canadian Television Aspects; Gordon W. Olive, Canadian Broadcasting Corporation
Television at Bikini; Donald G. Fink, McGraw-Hill Publishing Company, and Captain Christian L. Engleman, Electronics Coordinating Officer, Operation Crossroads

2:00 P.M. Technical Session
Television Broadcasting as a Public Service; Raymond F. Guy, National Broadcasting Company
Color Television; Paul H. Reedy; Columbia Broadcasting System
Measurement Methods for Ferromagnetic Materials; Horatio W. Lamson, General Radio Company

8:00 P.M. General Session
Death Rays — Are There Such Things?; A. F. Murray, Consulting Engineer

TUESDAY, NOVEMBER 12

9:30 A.M. Technical Session
Television Sound Channel; R. B. Dome, General Electric Company
Report of RMA Data Bureau; L. C. F. Horle, RMA Data Bureau
Some New Tube Developments; F. E. Gehrke, Sylvania Laboratories
Wide Band I-F Amplifiers Above 150 Mc; Matthew T. Lebenbaum, Airborne Instruments Laboratory, Inc.

2:00 P.M. Technical Session
A New Frequency Modulated Signal Generator; D. M. Hill, Boonton Radio Corporation
A Comparison of A-M with F-M in Broadcasting; M. G. Nicholson, Colonial Radio Corporation

WEDNESDAY, NOVEMBER 13

9:30 A.M. Technical Session
Application of Selenium Rectifiers to Receiver Designs; Harold Heins and T. M. Liimatainen, Sylvania Electric Products, Inc.
Report on Television Standards; D. B. Smith, Philco Corporation
Recent Improvements in Television Equipment (With Demonstration), G. L. Beers, RCA Victor Division

2:00 P.M. Technical Session
Production Design of Magnetic Wire Recorders (With Demonstration); Roy S. Anderson and George W. Carlson, Stromberg-Carlson Company
High Frequency A-M Broadcasting Designed for Small Community Use; Sarkes Tarizan, A. Valdettaro, and M. Weijdel, Consulting Engineers

8:00 P.M. Photographic Session
Recent Developments in Color Photography; A. L. TerLouw, Eastman Kodak Company

* * *

FRANKART BECOMES LEAR SENIOR PROJECT ENGINEER

William F. Frankart has been named senior radio project engineer for Lear, Inc., Grand Rapids, Michigan.

Mr. Frankart was formerly chief radio engineer for Precision Specialties, Inc., Los Angeles.

* * *

LAIRD NOW PARTS ASSOCIATION CHAIRMAN

Roy S. Laird, vice president and sales manager of Ohmite Manufacturing Company, Chicago, has been elected chairman of the Association of Electronic Parts and Equipment Manufacturers, to succeed J. A. Berman of Shure Bros.

Les Thayer, Belden Manufacturing Company, was elected vice chairman; Miss H. A. Stani-

land, Quam-Nichols, was reelected treasurer; and Ken C. Prince was reelected executive secretary.

Roy S. Laird

* * *

DeNIKE JOINS MORRIS F. TAYLOR CO.

G. E. DeNike has been named vice president of the Morris F. Taylor Company, 8416 Georgia Avenue, Silver Spring, Maryland, manufacturers' representatives.

Mr. DeNike was formerly director of public relations and sales manager of the distributor division of National Union Radio Corp.

* * *

CANNON ELECTRIC WATERPROOF CONNECTOR BULLETIN

A 4-page bulletin describing waterproof connectors, type W, designed specifically for submarine geophysical exploration, has been published by the Cannon Electric Development Company, 3209 Humboldt Street, Los Angeles 31, Calif.

Watertight coupling between the connectors is said to be effected by the use of Acme threads on coupling nut and shell, together with a special rubber ring. The cable entry of the plug is sealed with a threaded gland nut, having a rubber packing bushing.

* * *

GOVERNMENT OFFICIALS ATTEND FARNSWORTH R.R. RADIO TEST

Members of the FCC, ICC and officers of the Army Transportation Corps, recently attended a Farnsworth demonstration of railroad radio at the Potomac Yards in Fort Wayne, Ind.

Tests were conducted over a 10-mile trip, using five fixed stations and with a second locomotive equipped with mobile radiotelephone equipment.

* * *

DUDLEY GRAY FORMS MANUFACTURING COMPANY

Dudley Gray has resigned as vice president, general manager and chief engineer of Doolittle Radio Co., Inc., to form his own company, the Dudley Gray Manufacturing Co., 612 N. Michigan Ave., Chicago 11, Ill.

* * *

COLLINS RADIO APPOINTMENTS

L. E. Bessemer has been appointed general manager of the manufacturing division of the Collins Radio Company, Cedar Rapids, Iowa. He was formerly chief production engineer.

L. Morgan Craft has been named vice president in charge of engineering and manufacturing. He was formerly general manager of the manufacturing division.

Captain Willis E. Cleaves, U.S.N., has been appointed manager of the aviation sales department of Collins.

L. M. Craft

L. E. Bessemer

* * *

CLAROSTAT ACQUIRES KURMAN

Kurman Electronics Corporation, Long Island City, N. Y., has been bought by Clarostat Mfg. Co., Inc., of Brooklyn, N. Y.

The new officers of Kurman Electronics, which will operate as a Clarostat subsidiary,

(*Continued on page* 40)

NEWS BRIEFS

(Continued from page 39)

are: Victor Mucher, president; George Mucher, executive vice president; Nathan Kurman, vice president in charge of research; William Mucher, treasurer; and Charles H. Burnell, secretary.

* * *

S. J. McDONALD, JR., JOINS SYLVANIA SALES STAFF

Samuel J. McDonald, Jr., has been appointed to the sales staff of the radio tube division of Sylvania Electric.

* * *

G.E. TRANSMITTING TUBE MANUAL

A 600-page technical manual on transmitting tubes has been prepared by General Electric Company's tube division.

The manual, which sells for two dollars, contains photographs, outline drawings, ratings, performance curves, and application data on 94 tube types.

* * *

SCHULTZ, JR., JOINS COOK RESEARCH

Edward E. Schultz has joined the engineering staff of the Cook Research Laboratories, of the Cook Electric Company, Chicago 14, Ill.

Mr. Schultz was formerly chief engineer of Press Wireless.

* * *

WABC CALL LETTERS CHANGED TO WCBS

The call letters of WABC will be WCBS, after November 1.

WABC-FM will become WCBS-FM and WCBW will be changed to WCBS-TV.

* * *

INDIANA STEEL EXPANDS

Indiana Steel Products, Valparaiso, Ind., will soon build a plant in Greenburgh, Westchester County, New York.

The Cinaudagraph Corporation, Stamford, Connecticut, was recently purchased by Indiana Steel.

* * *

PREMIER METAL ETCHING BOOKLET

An 8-page booklet describing etched and lithographed metal instrument dials, panels, plates, scales and gauges, has been released by the Premier Metal Etching Company, 21-23 44th Ave., Long Island City 1, N. Y.

* * *

BARKER & WILLIAMSON ACQUIRE NEW FACTORY

Barker & Williamson have leased a factory building in Bristol, Pa. The present main plant of the company at 237 Fairfield Avenue, Upper Darby, Pa., will be retained.

* * *

CAPTAIN N. R. STILES BECOMES CHISHOLM-RYDER PRESIDENT

Captain Norman R. Stiles has been elected president and treasurer of Chisholm-Ryder Co., Inc., Niagara Falls, N. Y., to fill the vacancy caused by the recent death of Stephen Morse Ryder.

* * *

TRANSICOIL CORP. BULLETIN

A 2-page bulletin describing 60-cycle, 2-phase, low inertia servo-motors for remote control applications has been released by the Transicoil Corporation, 114 Worth Street, N. Y. 13.

* * *

KNOWLSON RECEIVES MEDAL FOR MERIT

The Medal for Merit was awarded recently to James S. Knowlson, chairman of the board and president of Stewart-Warner Corporation for his wartime services. The award was made by

Secretary of War Robert P. Patterson at a private ceremony held in the Mayflower Hotel, Washington.

* * *

CAHN JOINS INSULINE

Major Bernard L. Cahn has been named executive assistant in charge of sales and promotion activities of Insuline Corp.

* * *

SMITH NAMED G-S-M OF RCA ENGINEERING PRODUCTS DEPARTMENT

Theodore A. Smith has been appointed general sales manager of the engineering products department of RCA.

Mr. Smith joined RCA in 1925 as a member of their technical and test laboratories at Van Cortlandt Park, New York.

* * *

RADIO RECEPTOR SELENIUM RECTIFIER DATA

An 8-page bulletin describing selenium rectifier equipments for direct-current requirements, has been released by the Selectron Division, Radio Receptor Co., Inc., 251 West 19th Street, New York 11, N. Y.

* * *

DR. W. N. TUTTLE RECEIVES MEDAL OF FREEDOM

The Medal of Freedom was presented recently to Dr. W. N. Tuttle of the General Radio Company by Major General Harold M. McClelland, formerly Air Communications Officer of the Army Air Forces and now commanding Army Air Forces Air Communications Service. The award was made "for exceptionally meritorious achievement which aided the United States in the prosecution of the war against the enemy in Continental Europe as head, radar subsection, Operational Analysis Section, Headquarters, Eighth Air Force, from 16 October 1942 to 3 October 1944."

* * *

ROY DALLY JOINS ELECTROVOX

Roy Dally has been appointed chief engineer in charge of phonograph needle and pickup design of Electrovox Company, Inc., 31 Fulton Street, Newark 2, New Jersey.

* * *

KAHN OF AEROVOX AWARDED ASA CERTIFICATE OF APPRECIATION

Louis Kahn, assistant chief engineer of Aerovox Corporation, has received the ASA Certification of Appreciation for his work on the war committee of the American Standards Association.

* * *

HENRY HUTCHINS FORMS OWN SALES COMPANY

Henry Hutchins has announced the formation of Hutchins Industries, 325 West Huron St.,

(*Continued on page 42*)

NEWS BRIEFS

(*Continued from page* 41)

Chicago 10, Ill., to specialize in the national distribution of radio and electronic products.

Recently Mr. Hutchins was president of the J.M.I. Sales Corp., which has been dissolved. He was formerly general sales manager of the National Union Radio Corp.

* * *

ELECTRIC SPECIALTY CATALOG

An 8-page catalog, No. 46-1, describing motors, generators, motor-generator units, converters, and other rotating electrical products has been published by the Electric Specialty Co., Stamford, Conn.

* * *

COLLINS TO PUBLISH TECHNICAL MAGAZINE

The Collins Radio Company will soon resume publication of "The Collins Signal," with articles on broadcast, aircraft and communications engineering. Magazine will be edited by Lew H. Morse. Copies of the magazine will be available upon request from Collins Radio Company, Main Plant, care of the Signal Office, Cedar Rapids, Iowa.

* * *

HEYMAN JOINS TOBE

Samuel Heyman has been named factory manager for the Tobe Deutschmann Corporation, Canton, Massachusetts. Mr. Heyman was formerly production manager for Aerovox Corporation.

* * *

S. M. FINLAYSON NOW CANADIAN MARCONI DIRECTOR

S. M. Finlayson, general manager of Canadian Marconi Company, has been elected a director.

* * *

REX MUNGER RESIGNS AS TAYLOR TUBE S-M

Rex L. Munger has resigned as sales manager of Taylor Tubes, Inc., 2312 Wabansia Avenue, Chicago, Ill.

* * *

REL F-M BROADCAST ENGINEERING CLINIC

A 3-day f-m engineering clinic devoted to the solution of problems facing f-m broadcast station engineers has been announced by Radio Engineering Laboratories, Inc., 35-54 36th St., Long Island City, N. Y.

The first session has been tentatively set for December 2, 1946. The program will consist of a review of f-m theory and fundamentals, and a study of f-m progress up to and including present equipment and operating techniques. Time will also be allowed for actual laboratory work and round table discussion.

The clinic will be headed by Frank A. Gunther, vice president, assisted by a group of REL engineers.

* * *

ELECTRO-VOICE MOVES

Electro-Voice, Inc., has moved to a new plant in Buchanan, Michigan. All of the facilities of the South Bend plant will be incorporated in the new plant.

* * *

G.R. VARIAC BULLETIN

An 8-page bulletin describing continuously-adjustable transformer, 200B Variac, has been published by the General Radio Company, Cambridge 39, Mass.

Presented are mechanical and electrical operating data and illustrations.

* * *

HATFIELD NAMED PRESS WIRELESS MFG. CORP. CHIEF ENGINEER

Lester N. Hatfield has been appointed chief engineer of Press Wireless Manufacturing Cor-

poration, 38-01 35th Avenue, Long Island City, N. Y.

* * *

DR. R. K. ABBOTT TO HEAD RIO DE JANEIRO G.E. LAB.

Dr. Royal K. Abbott has been appointed laboratory director for General Electric, S. A., Rio de Janeiro, Brazil.

* * *

AMERICAN CONDENSER CORP. CATALOG

A 16-page catalog describing tubular papers, hermetically-sealed dry electrolytics, midget papers, tubular plastics inverted electrolytics, and midget electrolytics, has been published by the American Condenser Corp., 4410 N. Ravenswood Avenue, Chicago 40, Ill.

* * *

YARDENY LAB. PULSING DRIVE DATA

A 6-page bulletin describing pulsing drives has been released by Yardeny Labs., Inc., 107 Chambers Street, New York 7, N. Y.

* * *

ANDREW COAXIAL TRANSMISSION LINE CATALOG

A 16-page catalog describing coaxial transmission lines for f-m and television has been published by Andrew Co., 363 E. 75th Street, Chicago 19, Ill.

* * *

COLLINS BUYS AIRPLANE FOR EQUIPMENT TESTS

A Beechcraft airplant, to be used for flight testing communications and navigation equipment, has been purchased by Collins Radio Company.

* * *

C. N. KIMBALL NOW CONSULTANT

Dr. C. N. Kimball has resigned as vice president and chief engineer of the Aireon Manufacturing Corporation, to become a consulting engineer. He will act as a consultant for the Railway Radiotelephone and Signals Company, Washington, who represent Aireon in railroad radio equipment sales.

* * *

K. F. KELLERMAN NOW WITH AIRCRAFT RADIO

Karl F. Kellerman, formerly Commander, U.S.N., has been appointed manager of commercial sales and advertising by Aircraft Radio Corporation, Boonton, N. J.

Mr. Kellerman served as head of the Electronics Coordination Section of the Bureau of Aeronuatics.

* * *

CONTINENTAL CARBON CATALOG

A 6-page bulletin presenting electrical and mechanical data on resistors, capacitors and filters has been released by Continental Carbon, Inc., 13900 Lorain Avenue, Cleveland 11, Ohio.

* * *

PRECISION METAL BULLETIN

A 4-page folder describing machine shop facilities has been released by the Precision Metal Turning Co., 534 W. Broadway, New York 12.

* * *

CHICAGO TAXIS INSTALL TWO-WAY SYSTEM

Two-way Motorola f-m units were recently installed in several Chicago taxicabs.

Both transmitter and receiver are crystal-controlled. Crystal is compensated for changes in temperature.

Dispatching station, W9XLD, transmits on a fixed frequency of 152.27 mc. The mobile units, W9XLE, transmit on a frequency of 157.53.

Calls for cabs are transmitted from the switchboard to the broadcasting studio by means of telautograph facsimile equipment. From here the dispatcher can use one of two methods: broadcast the address or zone of the call, wait for the reply of the nearest cab, and dispatch him to the spot; or call one particular cab which he knows to be heading in that direction from a previous assignment.

THE INDUSTRY OFFERS . . .

RCA PLUG-IN AMPLIFIERS

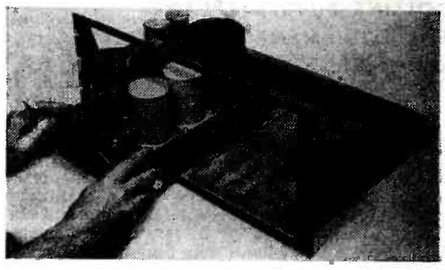
A line of *plug-in* amplifiers has been developed by the RCA engineering products department.

Designed for the plug-in amplifier is a shelf assembly for mounting in a standard rack. The brackets which hold rectangular sockets matching the plugs on the back of the amplifier are mounted on the back of the rack. Pulling a lever near the front of the amplifier will eject the unit from its socket and automatically detach it from the circuit connections.

Depending on the size of the unit, from one to two stainless steel ejector levers are supplied with each amplifier.

Amplifiers range in size from a small preamplifier to large monitoring amplifiers. They include the program amplifier, line amplifier, bridging amplifier, high level isolation amplifier, high fidelity monitoring amplifiers, and driver amplifiers.

All amplifier chassis are 11¾" long and 2½" high, with the exception of the preamplifier chassis, which is 1½" high. A single BR-2A shelf will carry six preamplifiers with ¼" clearance between them.



* * *

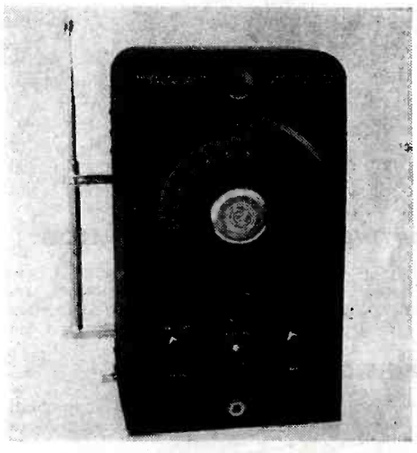
BROWNING FREQUENCY METER

A frequency meter (model S-4) for the 1.5 to 100-mc range has been developed by Browning Laboratories, Inc., Winchester, Mass.

A 100-kc crystal is used as a secondary standard. Its frequency may be checked against WWV, assuring an accuracy of 5 cycles in 10,000,000.

A machine cut dial with vernier is employed for tuning. Telescoping antenna provides for coupling to the transmitter.

Size, 13⅜" x 7⅝" x 6⅝".



* * *

RAYTHEON MONITORING AMPLIFIER

A 10-watt monitoring amplifier (RM-10) for a-m or f-m has been announced by Raytheon Manufacturing Company's broadcast equipment division of Chicago.

Designed for standard relay rack or cabinet mounting. Requires 10½" vertical panel space. The amplifier and heavy duty power supply are mounted on a common vertical chassis. Tubes and plug-in capacitors may be removed through the front panel.

Unit uses a four-stage amplifier consisting of a 6J7 pentode, 6J7 triode, 6SN7GT balanced phase inverter and 6L6G push-pull output stage. Feedback is used around the phase inverter and output stage to reduce distortion and noise.

At 5 watts output the harmonic distortion is

said to be less than 0.6 of 1% while at 10 watts it is approximately 1.2% from 50 to 10,000 cycles, and less than 2% at 15,000 cycles. Gain is said to be 102 db from 500-ohm source to 15-ohm load.

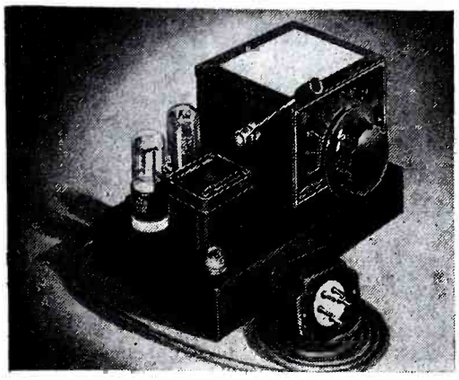
Gain adjustment is provided through the use of an interstage variable control on the front panel. A fixed 35-db plug-in H-pad of 10,000/500 ohms impedance is furnished for use on the input circuit.

* * *

MILLEN FREQUENCY SHIFTER

A frequency shifter, 09700, for use with a 50-watt transmitter-exciter is now being produced by James Millen Manufacturing Company, Inc., 150 Exchange St., Malden, Mass.

Plugs in, in place of crystal, for finger-tip control of carrier frequency. Has band spread and built-in power supply.

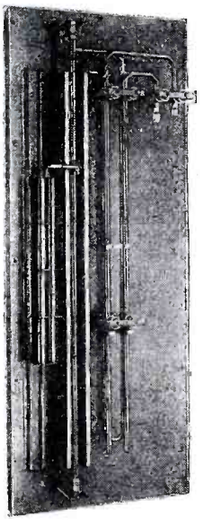


* * *

JOHNSON F-M ANTENNA COUPLER

Coupling equipment to isolate a-m and f-m systems and feed an f-m antenna across the base insulation of an a-m tower has been developed by the E. F. Johnson Company, Waseca, Minnesota.

Known as the f-m Antenna Iso-Coupler, it is rated up to and including 50 kw a-m, and 10 kw f-m. It will match 50-ohm lines from the f-m transmitter and is said not to disturb a-m tower impedance. Furnished in a 94" x 37" x 24" cabinet, finished for outdoor service, but may be mounted in an existing tuning house, or combined with Johnson a-m antenna coupling equipment.



* * *

SORENSEN D-C VOLTAGE-REGULATED POWER SUPPLY

D-c voltage-regulated power supply units that are said to maintain d-c output voltage with an accuracy of ±.5% have been announced by Sorensen & Company, Inc., 375 Fairfield Avenue, Stamford, Conn.

Units are available in 5, 10 and 15-ampere sizes at either 6 or 12 volts nominal output.

* * *

CONTINENTAL ELECTRIC COIL WINDER

A concentric coil winder has been developed by The Continental Electric Co., 650 N. Prairie Avenue, Hawthorne, California.

Winding head has nine pair segments, large to small sizes, eight of them adjustable by

(*Continued on page* 46)

THE INDUSTRY OFFERS . . . —

(Continued from page 45)

means of a screw. By referring to a chart operators can set the segments to the proper dimensions for windings.

Winder produces concentric coils for single phase motors; coils for 1/20th hp, 24-slot 6-pole stator to coils for 3 hp, 36-slot 2-pole stator, the latter 7 coils to a group.

* * *

G.E. AIR-COOLED TUBES

A forced-air-cooled transmitting tube, GL-5518, has been announced by the tube division of G.E.

Designed for use as a class *C* r-f amplifier and oscillator, the tube is well adapted for grounded-grid circuit applications.

Tests at 108-mc on a pair of tubes under class *C* grounded-grid conditions are said to show a useful power output of 12.9 kw at a d-c plate voltage of 6000.

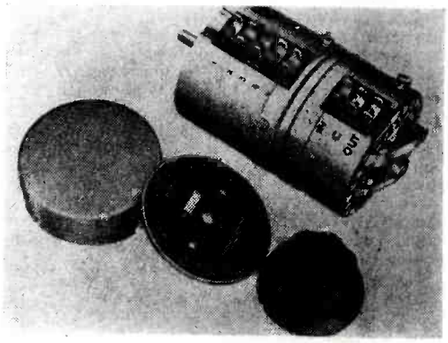
Under typical operating conditions of 600 volts d-c and 1.3 amperes, the total driving power per tube is 1400 watts.

* * *

DAVEN TONE COMPENSATING ATTENUATOR

A tone compensating attenuator, type LAC-720, essentially a ladder network, has been designed by the Daven Company, 191 Central Avenue, Newark, N. J.

Six attenuation versus frequency curves are said to be available, varying from the human-ear type of response to a flat frequency response. When the unit is wired for a flat frequency response it is said to function as a straight ladder of 2.5 db per step.

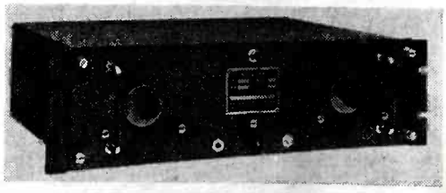


* * *

RADIO RECEPTOR V-H-F AIRLINE RECEIVER

A 100 to 162-mc crystal-controlled receiver (RV-1-B) has been announced by the communications division of the Radio Receptor Company, 251 West 19th Street, New York 11, N. Y. Undistorted audio output of 1 watt said to be available, with a signal-to-noise ratio of better than 2:1 for a 2-microvolt signal modulated 30%.

Amplified avc audio output said to change less than 4 db for signal inputs between 10 and 100,000 microvolts. Receiver also features a peak noise limiter and a *snap-action* circuit which opens the audio channel when receiving carriers of 2 microvolts or more.



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ALTEC LANSING 12" DIA-CONE

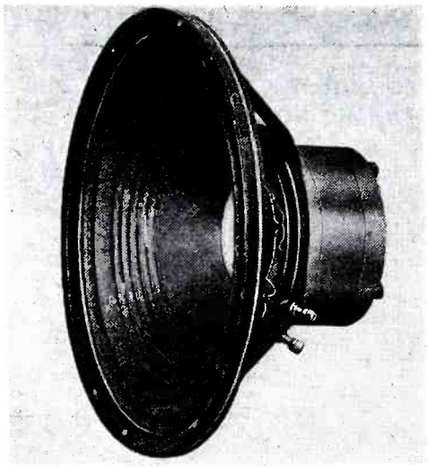
A Dia-Cone speaker (model 600) mounted in a 12" frame with a Alnico V permanent magnet and a 3" wound aluminum voice coil to which is mounted a domed aluminum alloy metal diaphragm and a seamless moulded cone has been annnounced by Altec Lansing Corporation, 1161 N. Vine St., Hollywood, Calif. Seamless moulded cone vibrates as a piston with the voice coil to reproduce all lower frequencies up to approximately 2,000 cycles.

The shape of the metal diaphragm is said to

provide a means of radiating the high frequencies over a wide area with a smooth distribution pattern eliminating the high-frequency beam.

Speaker said to deliver 89 db (ref. 10-16 dynes per sq cm) at 5' with an input of .1 watt.

Power rating, 18 watts; diameter, 12¼"; depth, 5¼"; voice-coil diameter, 3"; voice-coil impedance, 10 ohms.



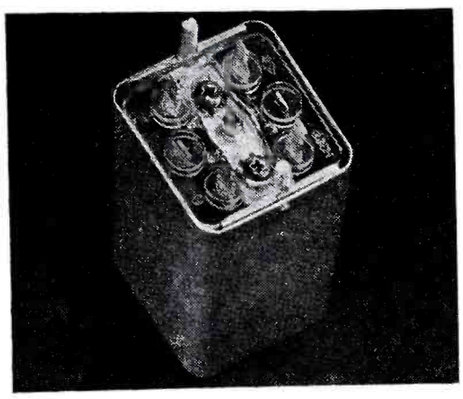
* * *

NATIONAL I-F TRANSFORMERS

I-f transformers for 10.7-mc have been developed by the National Company, Inc., Malden, Mass.

Iron core tuning is used. The discriminator output is said to be linear over the full 150-kc output and remaining symmetrical regardless of the position of the tuning cores.

Insulation is polystyrene. Transformer is 1⅜" square and stands 3⅛" above the chassis.

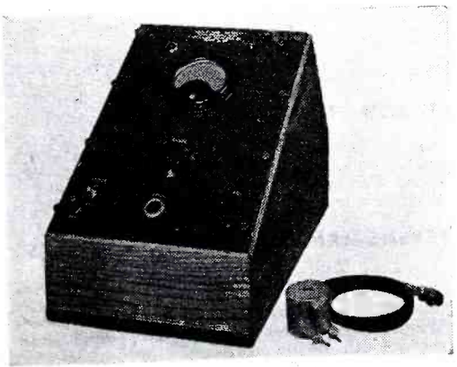


* * *

TELEVISO VACUUM-TUBE VOLTMETER

A vacuum-tube voltmeter (series 200A) that is said to have a full-scale sensitivity of .5 volt has been announced by Televiso Products Company, Chicago 34, Ill.

Has an external probe, to which connections can be soldered, and binding posts that can receive wires or banana plugs. Input tube is a plate-circuit rectifier type in which the input voltage is rectified under full-wave, square-law operating conditions, indicating rms values.



* * *

RCA PYLON F-M ANTENNA

A cylindrical single-element pylon type f-m

(*Continued on page* 48)

THE INDUSTRY OFFERS . . . —

(*Continued from page 47*)

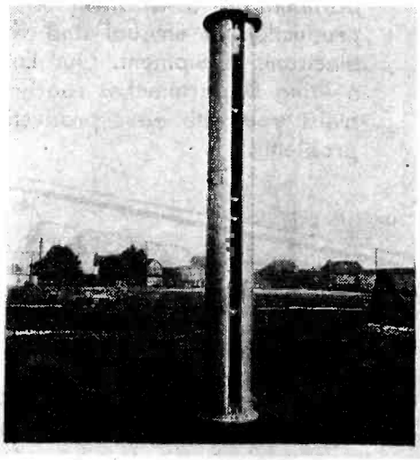
antenna has been developed by the RCA engineering products department.

Where high gain is needed for an f-m station, additional sections of the antenna can be stacked on top of each other by bolting together the end flanges of the antenna. Stacking four sections of the pylon is said to result in a power gain of six.

Pylon is a cylinder approximately 13' high and 19" in diameter, with a narrow slot cut from top to bottom. Cylindrical structure itself is the radiator. Feed line is a single transmission line running up the inside of the cylinder, along the slot.

The cylinder is rolled from a single sheet of metal and weighs approximately 350 pounds. It is capped on each end with a case base (flange).

Only one r-f feed point per section is required. When two sections are used, they may be joined on the ground, the interconnecting feed line mounted in place and the whole assembly raised together.



* * *

G.E. COMPOSITION RESISTORS

Composition resistors have been announced by the specialty division of G.E.

Resistors are said to be capable of being operated at full rating in ambient temperatures up to 70° (168° F). Available in standard RMA resistance values and in sizes of one-half, one and two watts.

* * *

TECHNOLOGY INSTRUMENT DYNAMIC NOISE SUPPRESSOR

A dynamic noise suppressor (type 910A) using a gate circuit to eliminate needle scratch noise and provide faithful transmission of the desired signal, has been announced by the Technology Instrument Corp., Waltham, Mass.

Suppressor, designed particularly for broadcast stations, may be inserted in practically any 600-ohm circuit over a wide range of volume levels. Input and output controls are provided so that the unit may provide gain or loss, or equal input and output levels if desired.

Single control for the gate circuits has five positions. Two positions have an effective range to 8000 cycles. These are intended, respectively, for shellac records and vinylite records. A third position, for old or extremely distorted or noisy records, has an effective range to 5000 cycles. The other two steps on the switch cut out the dynamic operation and provide straight-through operation with top frequency limits of 8000 and 20,000 cycles, respectively.

In tests of production samples, units provided:

Maximum suppression; high-frequency noise, 20 db; low-frequency noise, 15 db.

Normal input level, —30 to +10 vu; normal output level, —30 to +10 vu (operating levels may be lowered with corresponding increase in noise level).

At rated output level the total harmonic distortion was less than 0.3%; at a 10-db. higher level, distortion 0.5%. The maximum output level without noticeable distortion was 20 db above the normal operating level.

Hum level was 80 db below normal output level.

Uses one 6SL7; one 6SN7; one 6H6; two OD3; six 6SK7; one 6SJ7; and one 6X5.

* * *

Du MONT FERROGRAPH

A ferrograph for comparing ferrous materials as to both their chemical analysis and heat treatment has been developed by the Allen B. Du Mont Laboratories, Inc., Passaic, N. J.

This instrument based on the correlation between magnetic properties, particularly remanent magnetism which predominates at the low frequency (below 25 cps) and metallurgical properties, affords determination of composition and condition of ferromagnetic materials by magnetic testing, with a cathode-ray tube as an indicator.

* * *

HAYDON TIMING MOTOR

A timing motor (Circle B) that fits into a 2" diameter area, has been announced by the A. W. Haydon Company, Waterbury, Connecticut.

Motor made in 1 and 5 rpm speeds.

* * *

STEVENS-ARNOLD RESONANT RELAYS

A resonant relay (type 182) using a vibrating reed mechanism to respond to a narrow band of frequencies and to reject all others, has been developed by Stevens-Arnold Co., 22 Elkins Street, South Boston, Mass.

A small amount of energy received by the relay at its resonant frequency causes contacts to vibrate. These contacts, in turn, are connected in series between the power supply and the circuit to be controlled. When the relay operates, the current from the power supply is

delivered to the circuit to be controlled in pulses at the resonant frequency of the relay.

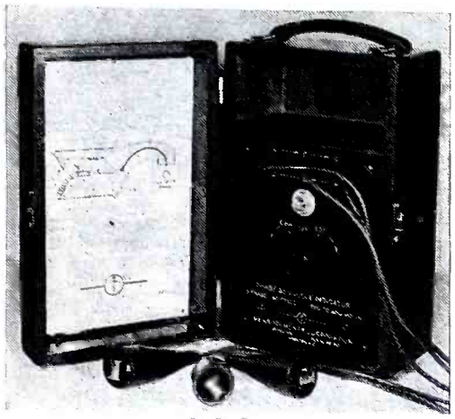
* * *

MEASUREMENTS CORP. PHASE-SEQUENCE INDICATOR

A phase-sequence indicator for determining the phase sequence of polyphase circuits has been developed by the Measurements Corporation, 116 Monroe Street, Boonton, N. J.

Used in connection with machine drives, compressors and blowers, and in determining the proper connections for paralleling generators, transformer banks and power buses. In measuring circuits, indicator can be used to determine the proper connections for watthour meters, reactive-component meters, power factor meters, etc.

Uses a Y-circuit; one leg being pure resistance with a gaseous discharge-type tube connected across it as a voltage indicator; other legs being capacitive and inductive.



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DIALCO LIGHT-SHIELD PILOT LIGHT ASSEMBLIES

Pilot light assemblies designed on the light-shield principle, to direct a beam of light within a rotation of 360°, have been developed by the Dial Light Co. of America, Inc., 900 Broadway, New York 3, N. Y.

Model 21408 has opening ½" wide x ½" long; 89408 opening 3/16" wide x 9/16" long; 90408 opening ½" wide x 3/16" long; 22408 opening ½" wide x 3/32" long. The overall size of the unit is approximately 2¼" x 1".

Provided with a built-in resistor for use in conjunction with the NE-51 neon lamps on 110 and 200-volt circuits.

* * *

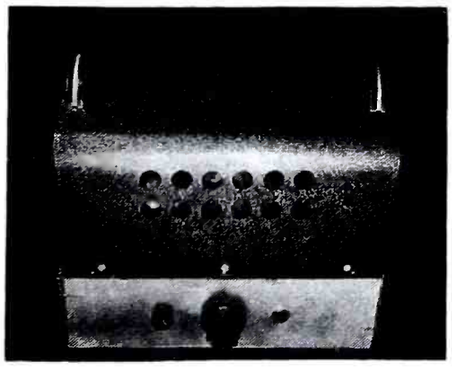
PAN-AMERICAN AMPLIFIERS

A two-stage medium gain, 15-watt power amplifier, PAB-1500, for use as a monitor amplifier, with speech input equipment, has been announced by Pan American Electric Company, Inc., 132 Front Street, New York 5.

Gain is said to be 50 dm, hum and noise 70 db down from +42 vu; frequency response ±1 db, 40 to 10,000 cps of 400 cps response.

Input impedance to match or bridge 500 to 600-ohm line (balanced or unbalanced). Bridging impedance 20,000 ohms.

Tubes, 5U4-G rectifier, 6L6-G PP output tubes, 6SL7-GT phase combiner and splitter, and 6SN7-GT driver.



* * *

LUMA RESISTANCE SOLDERING IRON

Resistance-type soldering tools have been announced by Luma Electric Equipment Company, Toledo 1, Ohio.

Four ranges of power units are offered: two single and two multi-stage. Single stage tools have a range of from 1050 to 1225 watts; multi-stage, from 1575 to 2500 watts. Multi-stage is equipped with a selector switch for temperature control at six settings.

SOUND MEASUREMENT SYSTEM

(*Continued from page* 19)

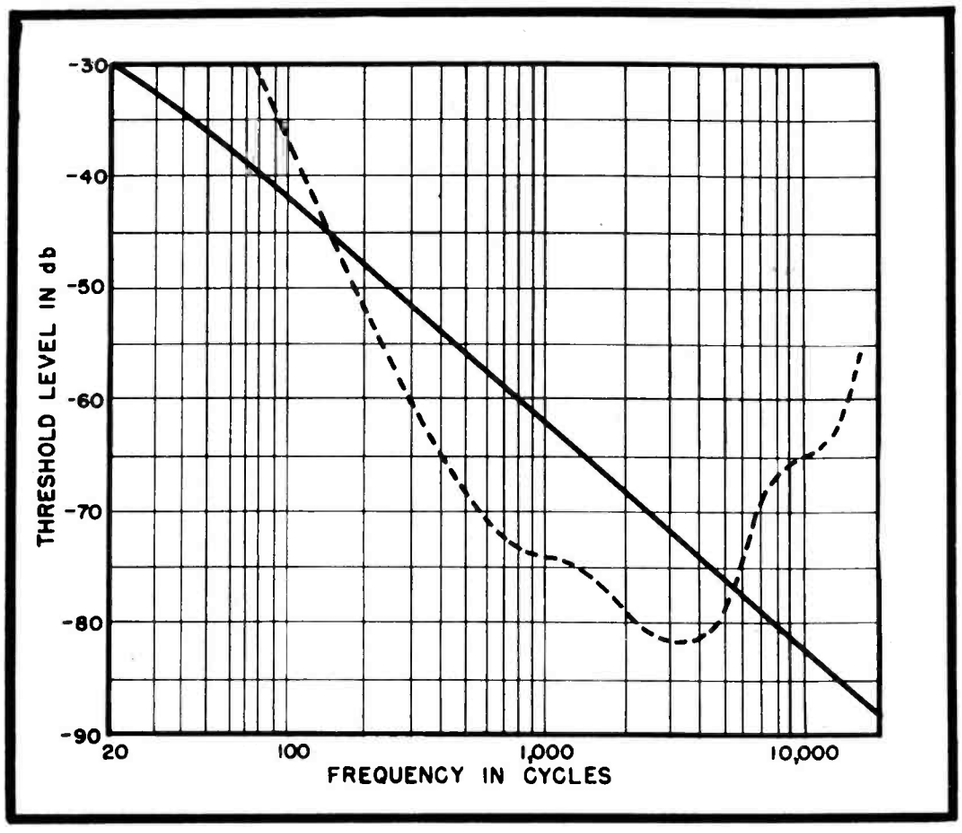


Figure 7

Threshold level of new microphone (solid curve), indicating sound pressure per one-cycle bandwidth which generates a microphone voltage equal to the thermal noise in a 100-megohm resistor; 0 db reference level = 1 dyne/cm². Dotted curve shows the minimum threshold of the average human ear (*Fletcher* and *Munson*).

diaphragm when placed in high-impedance environments such as small enclosures or coupling chambers.

From the results shown in Figures 5 and 6, it is evident that the *standard* microphone meets the high acoustic impedance requirements throughout the entire audible range to 20 kc. This insures true sound pressure measurements limited only by the diffraction caused by a ⅝" diameter rigid cylinder. The physical size of the structure was arbitrarily chosen as a ⅝" diameter cylinder to obtain a satisfactory compromise between electrical and mechanical characteristics over the audible frequency range. If the microphone were to be employed primarily in the frequency region above 10 kc, it might have been more desirable to make the structure still smaller to achieve a true point source for the unit so that there would be no diffraction effects in this high-frequency region. As it is, the standard microphone will display some directional effects in the vicinity of 10 kc, so that it will have to be employed with a particular orientation with reference to the direction of the sound wave for measurements that are to be considered absolute. With regard to pressure measurements in which pressures are developed normal to the diaphragm, such as may result inside small enclosures, the pressure response was found to be absolutely uniform throughout the audible range and beyond to about 45 kc.

The maximum pressure that can be measured without distortion in a stretched diaphragm type of microphone is limited by the deflection of the diaphragm in comparison with the fixed air gap spacing. For a typical miniature condenser microphone having a .002" air gap, distortion is evident at sound pressures having magnitudes of the order of 1,000 dynes/cm². The dynamic range for the new microphone is limited only by the linearity of the compliance of the crystal substance which obeys Hooke's law to pressures of thousands of psi, which means that there is no limitation to the measurement of sound pressures of millions of dynes/cm².

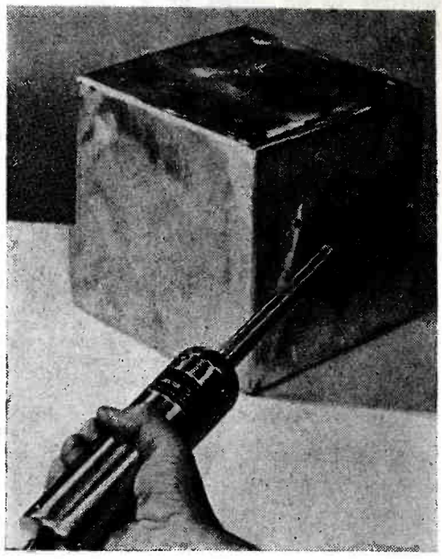


Figure 8

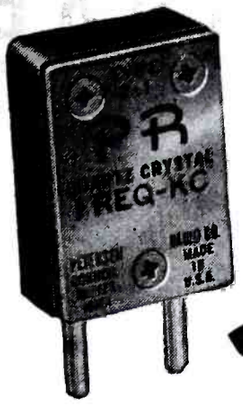
Sound pressure measurement equipment as an acoustic probe, for the determination of the energy distribution, in the vicinity of a small piston source.

The new microphone requires no polarizing voltage for its operation and develops about 23 microvolts/dyne/cm² across its terminals. Its electrical impedance is that of an electrical capacity equal to 100 mmfd over the entire audible range. The minimum sound pressure that can be measured by the microphone varies with frequency and is indicated by the threshold data presented in Figure 7; the threshold level of the microphone is defined as the sound pressure which generates the same voltage as is produced by the thermal noise in the grid resistor. The solid curve in Figure 7 shows the threshold of the new microphone when connected across a 100-megohm resistor. The dotted line shows the minimum threshold of the average human ear plotted to the same scale.

Applications

Some of uses to which the system can be applied include:

- Absolute free field sound pressure measurement.
- Sound pressure measurements inside small enclosures.
- Sound pressure measurements inside horns, conduits, and acoustic filters.
- Wave front determination in horns and other sound propagating apparatus.
- Pilot microphone for maintaining or controlling the intensity level of a sound field.
- Reference standard for calibrating other microphones.
- Measurement of loudspeaker response and distortion characteristics.
- Contact microphone for picking up vibrations in solids.
- Calibration of headphones with artificial ear couplers.
- Analysis of engine exhaust and propeller noise.
- Analysis of wave shape in transient and steady state sounds.



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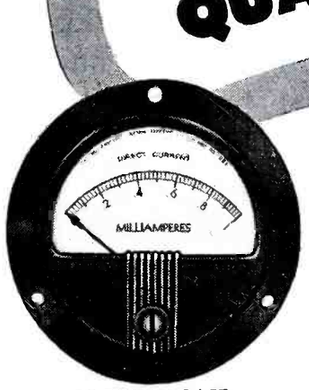
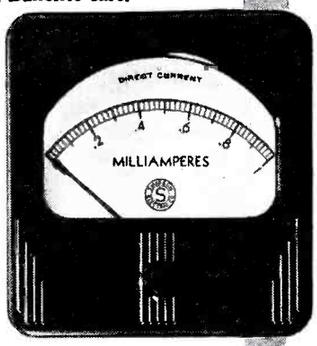


3" ROUND CASE
Shroud Style
Flange diameter, 3½"; body diameter, 2¾"; scale length, 2-9/16". Bakelite case.

2" ROUND CASE
Shroud Style
Flange diameter, 2¾"; depth overall, 2-5/16"; body diameter, 2-11/64"; scale length, 1⅞". Bakelite case.

3" ROUND CASE
Open Face Style
Flange diameter, 3½"; body diameter, 2¾"; scale length, 2-9/16". Bakelite case.

2" ROUND CASE
Open Face Style
Flange diameter, 2¾"; depth overall, 2-5/16"; body diameter, 2-11/64"; scale length, 1⅞". Bakelite case.



3" RECTANGULAR CASE
Width, 3"; height, 3⅛". Mounts in round hole. Body diameter, 2¾". Bakelite case.

2" RECTANGULAR CASE
2⅜" square. Mounts in round hole. Body diameter, 2-3/16". Bakelite case.

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INSTRUMENTS THAT STAY ACCURATE

PREVENTIVE MAINTENANCE for Broadcast Stations

Part V of Series Offers an Analysis of Preventive Maintenance Techniques Applied to Tube Envelopes, Seals, Grid or Plate Caps and Terminals, Base and Pins, and Sockets.

by CHARLES H. SINGER

Assistant Chief Engineer
WOR-WBAM

PREVENTIVE MAINTENANCE work on tubes includes feeling, inspection, tightening and cleaning of tubes, and adjusting of sockets, connections and mountings. Proper tube maintenance will prevent tube failures caused by loose or dirty connections and will keep the tubes in a clean and more satisfactory operating condition.

Maintenance procedures differ according to tube types. Certain maintenance operations that must be performed on transmitting type tubes may be omitted in the maintenance of receiving-type tubes. Tubes requiring the most frequent maintenance are those used in high-voltage circuits. Because of their high operating potentials, these tubes require more frequent cleaning and inspection than tubes used in low-voltage circuits.

Too frequent handling may result in damage to the tube terminals or connections. It is therefore *not* recommended that tubes be removed from their sockets unless an abnormal condition is indicated on an operating log check sheet or through other means. Incidentally it is quite important to remember that tube envelopes should not be touched with the bare hand immediately after shutdown for if they are too hot severe burns may result.

Tube Envelopes

(*1*)—*I*nspect:[1] The envelopes of the glass and metal tubes should be clean and bright. It is necessary to watch for tube envelopes which have broken away from the tube base.

(*2*)—*C*lean: A clean lint-free cloth should be used to remove dirt, dust or any foreign matter present on the tube envelopes.

Account must be taken of the type of tube. Tubes operated at high voltages and with exposed plate or grid connections must be kept free of dirt and dust because of possible leakage between grid and plate terminals. In contrast, tubes operating at low voltages and not having exposed grid or plate caps do not require frequent cleaning. Dirt should not be permitted to accumulate on low-voltage tubes, but the presence of dirt on them is far less important than it is on high-voltage tubes.

Tubes must not be removed from their sockets for cleaning of the envelopes. This calls for special care during work on tubes with exposed plate leads. The danger of breakage is great.

[1]See the *FITCALM* maintenance procedure discussed in Sept., 1946, COMMUNICATIONS.

A typical maintenance cleaning kit.

Tube Seals

(*1*)—*I*nspect: The exposed glass seals of the tubes must be checked for evidence of cracks. A tube with a cracked seal is likely to fail at any time during use and should be replaced.

Grid or Plate Caps and Terminals

(*1*)—*I*nspect: The connection at the top of the glass and metal tube terminals should be examined for cleanliness and for discoloration caused by overheating. The cap or connector should make a solid and firm connection. Plate caps must be secure to the tube envelope.

The spring clips and connectors which make contact with the tube caps or terminals must be examined for corrosion and for loss of tension with resulting looseness. Also, the condition of the wires soldered to the spring clips and connectors must be checked. The wires should be free of frayed insulation or broken strands. Extreme care must be applied when connecting clips from grid or plate caps or terminals, particularly if signs of corrosion exist. A clip should never be turned if it is on a loose cap; the result may be a broken seal.

(*2*)—*T*ighten: The top connector or clip should make a snug and tight connection to the top tube terminal or cap. If the connections are dirty or corroded, they should be cleaned before they are tightened.

(*3*)—*C*lean: If proper care is exercised, the grid and plate caps or terminals may be cleaned, when necessary, with a piece of No. 0000 sandpaper. The paper should be wrapped around the terminal and gently rubbed along the surface.

(*4*)—*A*djust: Grid or plate connector clips must not be flattened during adjustment. Flattened clips do not make adequate contact with the surface of the tube cap. If the cap is made of a thin metal, it can be adjusted by gently compressing it with the fingers. If it is made of heavy-gauge metal, suitable pressure can be applied with a pair of longnose pliers; adjust to obtain a good mechanical connection throughout the contact surface.

[See page 54 for typical operating log.]

[To Be Continued]

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MASTER OPERATING LOG

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Sig. of Person in Charge _____

NO.	ITEM	II OPTIMUM	III LOWER LIMIT	IV TOLERANCE	V UPPER LIMIT	VI UNIT	VII ENTRIES TO BE MADE IMMEDIATELY AFTER GOING ON AIR & THEREAFTER WITHIN PERIODS INDICATED										
							12M–2A	2A–4A	4A–6A	6A–8A	8A–10A	10A–12N	12N–2P	2P–4P	4P–6P	6P–8P	8P–10P	10P–12M
1	LOCAL STANDARD TIME	( )	[ ]	[ ]	[ ]	(EST–EDST)												
2	LOG STARTING TIME	( )	[ ]	[ ]	[ ]	(HR–MIN)												
3	OUTSIDE TEMPERATURE	( )	[ ]	[ ]	[ ]	(°F)												
4	WEATHER CONDITIONS	( )	[ ]	[ ]	[ ]	(SYMBOL)												
5	*TOWER AND BEACON LIGHTS*	( )	[ ]	[ ]	[ ]	(ON–OFF)												
6	**M. E. ROOM**—50 KW D. W. EXP. TANK LEVEL	( )	[0]	[4–6]	[22]	(INCHES)												
7	5 KW D. W. EXPAN. TANK LEVEL	( )	[0]	[1–3]	[11]	(INCHES)												
8	**CONTROL UNIT**—LINE VOLTAGE PHASE "A"	( )	[445]	[455–475]	[485]	(VOLTS)												
9	LINE VOLTAGE PHASE "B"	( )	[445]	[455–475]	[485]	(VOLTS)												
10	LINE VOLTAGE PHASE "C"	( )	[445]	[455–475]	[485]	(VOLTS)												
11	*DISTILLED WATER PRESSURE*	( )	[38]	[50–58]	[70]	(LBS)												
12	*DISTILLED WATER TEMPERATURE*	( )	[40]	[85–150]	[180]	(°F)												
13	*FILAMENT GENERATOR VOLTAGE*	( )	[19.5]	[20.0]	[20.5]	(VOLTS)												
14	*BIAS GENERATOR VOLTAGE*	(300)	[290]	[300]	[310]	(VOLTS)												
15	*RECTIFIER FILAMENT VOLTAGE*	(408)	[400]	[408]	[420]	(VOLTS)												
16	*1600 VOLT RECTIFIER VOLTAGE*	(1650)	[1625]	[1650]	[1750]	(VOLTS)												
17	*17 KV RECTIFIER VOLTAGE*	( )	[16.5]	[17.0–18.1]	[18.6]	(KVS)												
18	**17 KV. RECT. UNIT**—*17 KV. RECT. AIR BLAST TEMP.*	( )	[80]	[95–105]	[120]	(°F)												
19	**OSC. MOD. UNIT**—*XTAL OSC. SEL. SW. POS'N.*	( )	[ ]	[ ]	[ ]	(1–2)												
20	OSCILLATOR #1 GRID CURRENT	( )	[.25]	[.30–.40]	[.50]	(MILS)												
21	OSCILLATOR #2 GRID CURRENT	( )	[.25]	[.30–.40]	[.50]	(MILS)												
22	1–C FREQ. METER OSC. PLATE VOLTAGE	(130)	[ ]	[130]	[ ]	(VOLTS)												
23	1–C FREQ. METER OSC. GRID CURRENT	( )	[.05]	[.25–.45]	[.55]	(MILS)												
24	*FREQUENCY DEVIATION*	( )	[–20]	[±3]	[+20]	(CYCLES)												
25	**BUFFER AMP.** PLATE CURRENT	( )	[11]	[15–30]	[40]	(MILS)												
26	R. F. AMPLIFIER PLATE CURRENT	( )	[40]	[45–60]	[75]	(MILS)												
27	R. F. AMPLIFIER OUTPUT CURRENT	(210)	[175]	[210]	[250]	(MILS)												
28	MOD. AMP. PLATE CURRENT	( )	[65]	[70–85]	[90]	(MILS)												
29	MOD. AMP. OUTPUT CURRENT	( )	[350]	[390–475]	[500]	(MILS)												
30	*FEEDBACK CURRENT*	( )	[7.5]	[8.0–10.5]	[12.0]	(MILS)												
31	AUDIO INPUT AMP. PLATE CURRENT	( )	[20]	[25–35]	[60]	(MILS)												
32	AUDIO POWER AMP. PLATE CURRENT	( )	[85]	[90–115]	[130]	(MILS)												
33	1ST POWER AMP. INPUT DIVISIONS	( )	[28]	[30–40]	[60]	(DIVS)												
34	**1ST P.A. UNIT**—1ST P.A. FRONT TUBE PL. CUR.	( )	[75]	[90–140]	[160]	(MILS)												
35	1ST P. A. REAR TUBE PLATE CURRENT	( )	[75]	[90–140]	[160]	(MILS)												
36	1ST P. A. LOAD CURRENT	( )	[180]	[200–300]	[350]	(MILS)												
37	**2ND P. A. UNIT**—2ND P. A. FRONT TUBE PL. CUR.	( )	[300]	[400–700]	[800]	(MILS)												
38	2ND P. A. REAR TUBE PLATE CURRENT	( )	[300]	[400–700]	[800]	(MILS)												
39	2ND P. A. LOAD CURRENT	( )	[2700]	[3000–3700]	[4000]	(MILS)												
40	LEAKAGE CURRENT	( )	[0]	[1–15]	[25]	(MILS)												
41	**3RD P.A. UNIT**—3RD P.A. FRONT TUBE PL. CUR.	( )	[3.0]	[3.5–5.5]	[6.0]	(AMPS)												
42	3RD P. A. REAR TUBE PLATE CURRENT	( )	[3.0]	[3.5–5.5]	[6.0]	(AMPS)												
43	3RD P. A. LOAD CURRENT	( )	[20.0]	[22.0–25.0]	[26.0]	(AMPS)												
44	3RD P. A. TOTAL CURRENT	( )	[6.0]	[7.0–11.0]	[12.0]	(AMPS)												
45	*LIGHTNING PROTECTIVE DEVICE CUR.*	( )	[0]	[0–.2]	[.5]	(MILS)												
46	**ANT. COUP. RM.**—TR. LINES #1–#2 PRES.	( )	[0]	[10–30]	[30]	(LBS)												
47	TRANSMISSION LINE #1 CURRENT	( )	[15.8]	[16.5–17.2]	[17.5]	(AMPS)												
48	TRANSMISSION LINE #2 CURRENT	( )	[16.6]	[17.0–18.0]	[18.2]	(AMPS)												
49	CLOSED CIRCUIT INDUCT. CURRENT	( )	[34.0]	[35.0–37.0]	[38.0]	(AMPS)												
50	CLOSED CIRCUIT CAP. CURRENT	( )	[30.0]	[31.0–32.5]	[33.5]	(AMPS)												
51	*MAIN CONCENTRIC LINE #3 PRES.*	( )	[15]	[30–50]	[55]	(LBS)												
52	*MAIN CONCENTRIC LINE #3 INPUT CUR.*	(26.1)	[24.8]	[26.1]	[26.7]	(AMPS)												
53	**3RD P.A. TUNING UNIT**—*WEST ANT CURRENT*	( )	[17.2]	[17.8–18.5]	[19.1]	(AMPS)												
54	*CENTER ANTENNA CURRENT*	( )	[15.2]	[15.7–16.5]	[16.9]	(AMPS)												
55	*EAST ANTENNA CURRENT*	( )	[17.0]	[17.5–18.5]	[19.0]	(AMPS)												
56	**AUDIO FAC. CONT. RM.**—BUILDING TEMP.	( )	[65]	[75–100]	[105]	(°F)												
57	81A #1 AMP PLATE CURRENTS	( )	[ ]	[OPR.COND.]	[ ]	(OK–N*)												
58	82A #1 AMP PLATE CURRENTS	( )	[ ]	[OPR.COND.]	[ ]	(OK–N*)												
59	82A #4 AMP PLATE CURRENTS	( )	[ ]	[OPR.COND.]	[ ]	(OK–N*)												
60	1126A AMP COMPRESSION	( )	[0]	[0–5]	[7]	(DB)												
61	1126A PLATE CURRENTS	( )	[ ]	[OPR.COND.]	[ ]	(OK–N*)												
62	82A #2 AMP PLATE CURRENTS	( )	[ ]	[OPR.COND.]	[ ]	(OK–N*)												
63	82A #3 AMP. PLATE CURRENTS	( )	[ ]	[OPR.COND.]	[ ]	(OK–N*)												
64	PROG. PHASED DURING THIS PERIOD	( )	[ ]	[OPR.COND.]	[ ]	(OK–N*)												
65	**M. E. ROOM**—AVERAGE % MOD. (731A)	( )	[50]	[85–100]	[100]	(%)												
66	**5 KW OSC. MOD. UNIT**—5 KW XTAL #1 TEMP.	( )	[56.5]	[56.8–57.2]	[57.5]	(°C)												
67	5 KW XTAL #2 TEMP.	( )	[58.0]	[58.2–58.8]	[59.0]	(°C)												
68	**BASEMENT**—SWITCH ROOM INSPECTION	( )	[ ]	[OPR.COND.]	[ ]	(OK–N*)												
69	DIP OIL CIRCUIT BREAKER TEMP	( )	[10]	[20–45]	[60]	(°C)												
70	DIST. WATER PUMP OUTPUT PRES.	( )	[85]	[90–100]	[110]	(LBS)												
71	POND WATER PUMP OUTPUT PRES.	( )	[1]	[2–20]	[24]	(LBS)												
72	P. W. INTERCOOLER OUTPUT PRES.	( )	[1]	[2–20]	[24]	(LBS)												
73	POND WATER INTERCOOLER TEMP.	( )	[32]	[40–100]	[120]	(°F)												
74	DIST WATER INTER TEMP. IN–OUT	( )	[40]	[85–150]	[160]	(°F)												
75	COND. OF MOTORS–GENS.–PUMPS	( )	[ ]	[OPR.COND.]	[ ]	(OK–N*)												
76	PUMP BEARINGS–GLANDS TEMP.	( )	[ ]	[OPR.COND.]	[ ]	(OK–N*)												
77	FIL. MOTOR GENERATOR TEMP.	( )	[30]	[40–60]	[65]	(°C)												
78	BIAS MOTOR GENERATOR TEMP.	( )	[30]	[40–60]	[65]	(°C)												
79	CIRCULATE VENT MOTOR #1 TEMP.	( )	[25]	[30–60]	[65]	(°C)												
80	EXHAUST VENT. MOTOR #2 TEMP.	( )	[25]	[30–60]	[65]	(°C)												
81	PIP–H. V. PROTECTIVE UNIT TEMP.	( )	[30]	[40–105]	[120]	(°F)												
82	TRANSF. VAULT VENT. FAN.	( )	[ ]	[OPR.COND.]	[ ]	(OK–N*)												
83		( )	[ ]	[ ]	[ ]	( )												
84		( )	[ ]	[ ]	[ ]	( )												
85	**E. D. G. ROOM**—DRYAIRE DEHYDRATOR	( )	[28]	[32–40]	[45]	(LBS)												
86	DRYAIRE DEHYDRATOR COLOR	(BLUE)	[P]	[P–B]	[B]	(COLOR)												
87	**5 KW TRANS.**—DEHYDRATOR COLOR	(BLUE)	[P]	[P–B]	[B]	(COLOR)												
88		( )	[ ]	[ ]	[ ]	( )												
89		( )	[ ]	[ ]	[ ]	( )												
90	LOG FINISHING TIME	( )	[ ]	[ ]	[ ]	(HR-MIN)												

		ON	OFF			ON	OFF			ON	OFF
91	SIGNATURE OF TECHNICIAN			94	SIGNATURE OF TECHNICIAN			97	SIGNATURE OF TECHNICIAN		
92				95				98			
93				96				99			

MAKE ENTRIES IN INK. PLACE AN ASTERISK (*) AFTER AN ABNORMAL ENTRY, CORRECT SAME WHERE AN ADJUSTMENT IS POSSIBLE

100 SHEET NO. _____

Figure 1
Master operating log for the 50-kw transmitter at WOR. [*See page 52 for preventive maintenance discussion.*]

TELEVISION TESTS

(*Continued from page 15*)

the Mt. Wilson end of the circuit. The return circuit utilized a *parabolic* reflector antenna system for transmission and reception. A 5′ × 7½′ lens was used for the tests. The power gain obtained was about 35 db per lens. This was about 3 to 4 db greater than that obtained from a 57″ parabolic reflector type radiator. The power gain of 35 db gave an effective directed power of approximately 1,200 watts per lens over that of a point source having the same power radiating in all directions through a spherical area. This ratio gave a substantial margin over that which would be required to give a satisfactory signal-to-noise ratio. Thus even with severe fading conditions, there would still be sufficient margin over the required power.

At the Mt. Wilson end of the circuit, the video output of the receiver was fed to a transmitter operating at 4,220 mc. The beam from the parabolic reflector used with this transmitter was directed at Hollywood and received with a similar reflector unit only a few feet from the metallic lens which projected the original wave to Mt. Wilson.

Except for the difference in the frequencies used for transmission and reception in the two directions the receivers at both ends of the circuit were identical. The frequency bands utilized for transmission in the two directions were 4,380 to 4376 and 4420 to 4416 mc, respectively. A beat-frequency oscillator was used in conjunction with a converter to translate the frequency-modulated wave into the 65-mc region for amplification by the i-f amplifier. This amplifier was designed to pass a bandwidth of 14 mc to include the important side current pairs lying on each side of the center or mid-band frequency region.

Automatic gain and frequency controls were incorporated for stability purposes. The deviation ratio was 0.5 for the maximum modulating frequency excursions. A limiter and a discriminator with an associated detector passed the video signal to a video amplifier where it was fed into a coaxial cable and a television monitor.

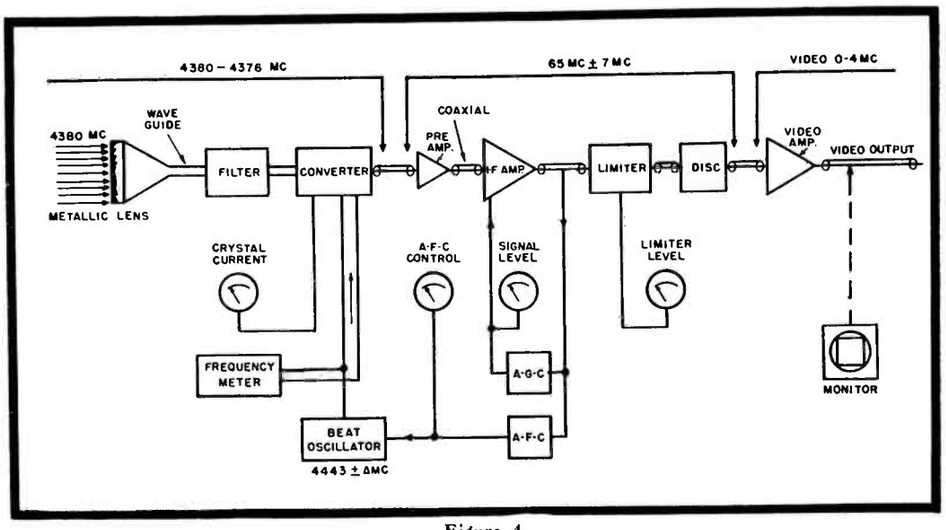

Figure 4
Block diagram of the receiver used in the tests showing the arrangements used to control the converter frequency modulator carrier about the i-f midband region.

[3]IRE Winter Meeting Report, February 1946, COMMUNICATIONS.

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COMMUNICATIONS—OCTOBER, 1946

A NEW

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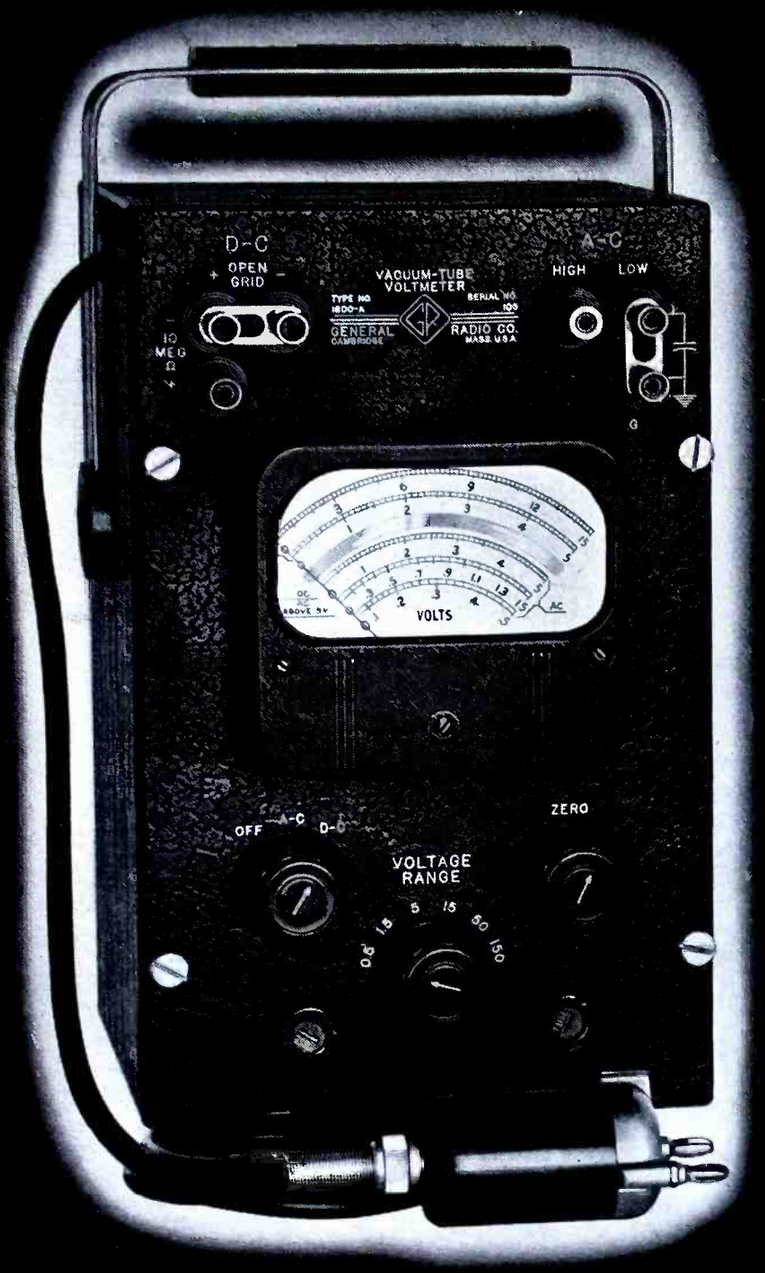

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- CALIBRATED FOR DC AS WELL AS AC
- WIDER VOLTAGE RANGES — 0.1 to 150 volts for ac; 0.01 to 150 volts for dc; both in six ranges
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- IMPROVED PROBE — much smaller — natural frequency increased to 1050 Mc — much better shielding — can be used with a variety of standard probe fittings, three of which are supplied
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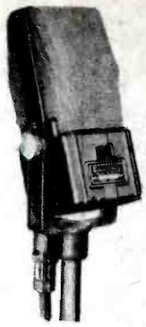

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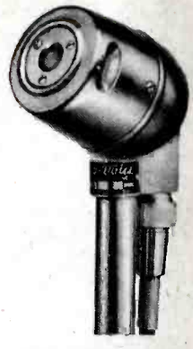

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*Patents Pending †Patent No. 2,350,010
Crystal Microphones Licensed under Brush patents.

Hand-Held Dynamic Model 600-D
Differential Dynamic Model 602

Versatile Dynamic
Model 640

General-Purpose Dynamic
Model 605

Differential Handset
Model 260 Carbon, Model 660 Dynamic

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