COMMUNICATION & BROADCAST ENGINEERING

4/5

MAY 1937

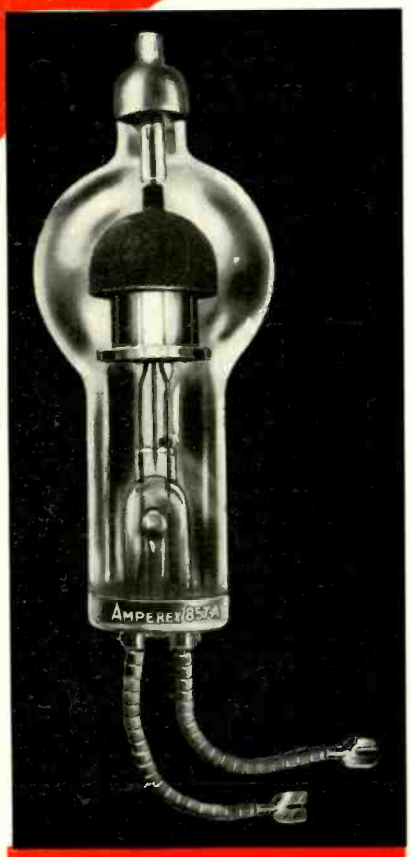
ANOTHER NEW AMPEREX MERCURY VAPOR RECTIFIER

857A

Emitting area and filament emissivity are the dominant factors in determining the merit of mercury vapor rectifiers.

The high emission efficiency of Amperex filaments, the cause of its special core material, permits the employment of greater areas and the operation of the filament at lower than usual temperatures and consequently at lower current densities per unit area.

In addition, the pumping and processing of these tubes is carried to a point where they are highly efficient thermionic rectifiers before mercury is distilled into them. All these factors result in tubes of unusual efficacy and extraordinary long life.



Filament Voltage	5 Volts
Filament Amperes	40 Amperes
Peak Inverse Voltage	22,000 Volts
Peak Plate Current	40 Amperes
Average Plate Current	10 Amperes

$270

$140

869

Filament Voltage	5 Volts
Filament Current	20 Amperes
Peak Inverse Voltage	20,000 Volts
Peak Plate Current	10 Amperes
Average Plate Current	2.5 Amperes

$35

575A

Filament Voltage	5 Volts
Filament Current	10 Amperes
Peak Inverse Voltage	15,000 Volts
Peak Plate Current	6 Amperes
Average Plate Current	1.5 Amperes

$16.50

872A

Filament Voltage	5 Volts
Filament Current	7.5 Amperes
Peak Inverse Voltage	10,000 Volts
Peak Plate Current	5 Amperes
Average Plate Current	1.25 Amperes

$4.00

866A

Filament Voltage	2½ Volts
Filament Current	5 Amperes
Peak Inverse Voltage	10,000 Volts
Peak Plate Current	1.4 Amperes
Average Plate Current	.35 Amperes

AMPEREX ELECTRONIC PRODUCTS, Inc.

79 WASHINGTON STREET BROOKLYN, NEW YORK

DIVISION DE EXPORTACION: 100 VARICK STREET, NEW YORK, E. U. A. CABLEGRAMAS: "ARLAB".

COMMUNICATION & BROADCAST ENGINEERING

Registered U. S. Patent Office
Member of Audit Bureau of Circulations

RAY D. RETTENMEYER
Editor

F. WALEN
Associate Editor

VOLUME 4 | MAY, 1937 | NUMBER 5

Broadcast Transmission
●
Recording
●
Sound Projection
●
Television
●
Facsimile
●
Aeronautical Radio
●
Police Radio
●
Marine Radio
●
Carrier Transmission
●
Beam Transmission
●
Radio Telegraphy
●
Radio Telephony

CONTENTS

Cover Illustration: Workmen connecting a new underground, 50-pair emergency telephone cable for KDKA, Pittsburgh. This cable connects the Grant Building studios of NBC and the Grant exchange board of the telephone company. Westinghouse photo.

Published Monthly by the
BRYAN DAVIS PUBLISHING CO., INC.
19 East 47th Street
New York City
New York Telephone: PLaza 3-0483

BRYAN S. DAVIS
President

JAMES A. WALKER
Secretary

PAUL S. WEIL
Advertising Manager

A. B. CARLSEN
Circulation Manager

Chicago Office—608 S. Dearborn St.—C. O. Stimpson, Mgr.
Telephone: Wabash 1903.

Cleveland Office—10515 Wilbur Ave.—J. C. Munn, Mgr.
Telephone: Republic 0905-J.

Wellington, New Zealand—Te Aro Book Depot.

Melbourne, Australia—McGill's Agency.

Entered as second class matter October 17, 1934, at the Post Office at New York, N. Y., under the act of March 3, 1879. Yearly subscription rate: $2.00 in the United States and Canada, $3.00 in foreign countries. Single copies: twenty-five cents in United States and Canada, thirty-five cents in foreign countries.

EDITORIAL

CONFERENCES

THE PRELIMINARY radio conference, which was held at Havana, Cuba, from March 15 through March 29, was participated in by representatives from Cuba, Mexico, Canada and the United States, and it is understood that plans for a more detailed gathering are now under way. This latter meeting is also to be held in Havana, probably during November.

While no official statement has as yet been made public, according to the NAB Reports, Commander T. A. M. Craven, the FCC's chief engineer and chairman of the American delegation at the conference, made the following statement at the close of the meeting:

"The accomplishments to date at this preliminary conference have been outstanding in that for the first time in the history of their radio relations, a common understanding has been reached by the countries represented on the technical principles that are basic, adoption of which is deemed essential if coordination is to be accomplished.

"We have also paved the way for study of the facts and conditions that exist today in the chaotic and unsatisfactory situation in short-wave communications in this hemisphere with the view that, at the approaching November conference, all the American nations will be in far better positions to suggest effective means for meeting this situation.

"The specific recommendations of the conference include an increase in the regular broadcast band used for the national broadcasting services from 550-1500 kc to 540-1600 kc, thus increasing the available channels from 96 to 107.

"Fifty-eight of these would be set aside as clear channels to be used by high-power stations in each nation, to render service over wide areas. The remaining forty-nine channels would be assigned for use by regional and local stations providing, through engineering principles and location of stations, against the present objectionable interference, on which the delegates have reached a common definition for the first time.

"There is also a recommendation for a change in the existing amateur band from 1750-2050 kc to 1715-2000 kc and for extension of existing bands allocated to State or Provincial police.

"A study looking toward elimination of interference by radio therapeutic machines and other apparatus will be made by all the attending countries and an international plan will be drawn up to provide for emergency communications in the event of disruption of normal channels of communications by hurricanes, earthquakes, and other disasters.

"Likewise, study will be given to adoption of suitable regulations with respect to frequency bands above 1600 kc that might permit interchange of international police communications. . . ."

ALSO, according to the Department of State, the President has approved the following delegation for the fourth International Radio Consulting Committee's meeting which will be held at Bucharest, Rumania, on May 21: Dr. J. H. Dellinger, chairman, Bureau of Standards, Department of Commerce; Captain Stanford C. Hooper, vice-chairman, U. S. Navy; E. K. Jett, FCC; Gerald C. Gross, FCC; Francis Colt de Wolf, Department of State; Lieutenant-Colonel D. M. Crawford, U. S. Army; Colonel J. Carroll Cone, Department of Commerce; William Walter Schott, American Legation, Budapest, Hungary.

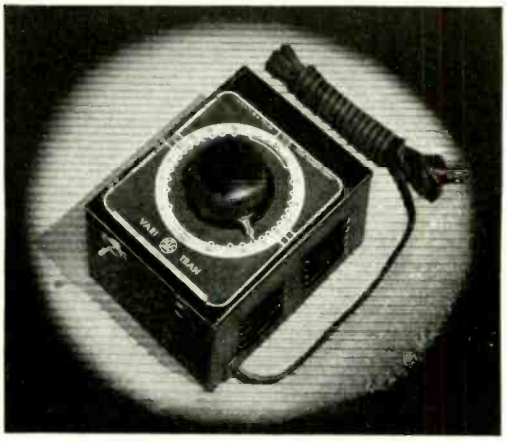
IRE CONVENTION

THE IRE celebrated their twenty-fifth anniversary by holding one of the biggest and best spring conventions in the history of the organization. This was especially true of the technical sessions which included papers on such subjects as television, vacuum tubes, antennas, measurements, auto radio, transmission phenomena, broadcasting, radio meterographs, blind-landing systems for aircraft, radio telephony, radio telegraphy, and the like. For those unable to attend, a report of the papers presented at this meeting will be found on following pages.

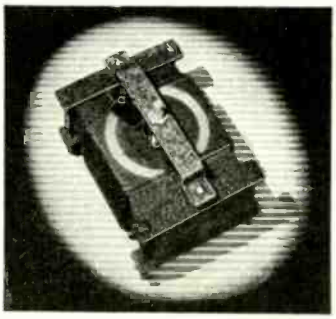
New VARI PATENT TRAN PENDING UNITS

FOR CONTINUOUSLY VARIABLE VOLTAGE CONTROL

The UTC VARITRAN is an ideal voltage control unit of the type employing a sliding contact riding over the transformer turns. Using a newly developed method of construction the UTC VARITRAN has been made very compact, simple, rugged and inexpensive.



The V-1 unit illustrated has stepless voltage control from 0 to 130 volts and is designed to control the voltage to any load which draws a maximum of 5 amps. at 115 volts.



MODEL V-1—VARITRAN 570 watts, maximum rating, 115 volts 50/60 cycles input. Output 0 to 130 volts, complete with cord, plug and switch as illustrated **$10**

MODEL V-2—Same rating as VA-1 but uncased with terminal strip for rack mounting, etc. **$9**

OTHER VARITRAN MODELS

The standard Varitran is available in ratings of 250, 500, 850, 1250, 2000 watts.

UTC also manufactures an **Automatic** type of VARITRAN control designed to correct automatically line voltage varying plus or minus 25% to plus or minus 2%. These units are ideal for broadcast and laboratory service. Designs are available in ratings of .5, 1, 2, 5, 7.5, 10, 15, 25 KVA. Other sizes on request.

VARIPOWER AUTOFORMERS

The UTC Varipower autoformer is a universal voltage control device suitable for every purpose where a step type voltage control is satisfactory. These autoformers are being put to new uses daily, some of the commercial uses being:

- Adjustment of voltages for testing refrigerators, radio sets, neon signs, insulation strength, etc.
- Measuring power consumption and other operating characteristics of electrical appliances where input voltage must be controlled.
- Control of soldering iron temperatures, temperature control of heating pots and electric furnaces.
- Dimmer control for theatre lighting.
- Stand-in and light adjusting control for photographic purposes.
- Motor speed control.
- Welding current control for spot welders.

They are designed to effect reduced power for transmitter operation, and they are so arranged that simultaneously with line voltage correction any output voltage from 0 to 130 volts can be obtained in five volt steps. The Varipower Autoformer thus permits control of filament voltage AT THE TUBE SOCKET to within 2½% of any desired value simultaneously with the line voltage and plate voltage control. These Varipower units may also be used to reduce or increase voltages on filament transformers. Thus an 872 filament transformer can be used for 866 tubes. A 203A unit may be used to supply the filaments of 800's, 801's, 807's, etc. No power or filament equipment becomes obsolete with a Varipower Autoformer. The Varipower Autoformer has taps at 55, 75, 95, 100, 105, 110, 115, 120, 125 volts.

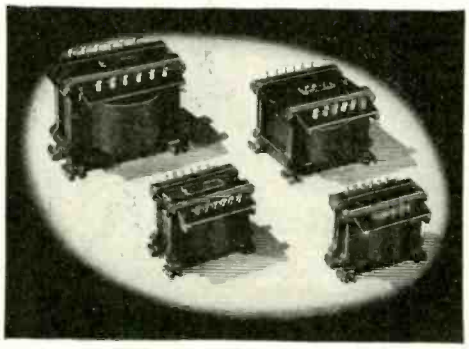
VA-1—150 watt output rating, net 3.60

VA-2—250 watt output rating, net 4.50

VA-3—500 watt output rating, net 6.00

VA-4—1000 watt output rating, net 9.00

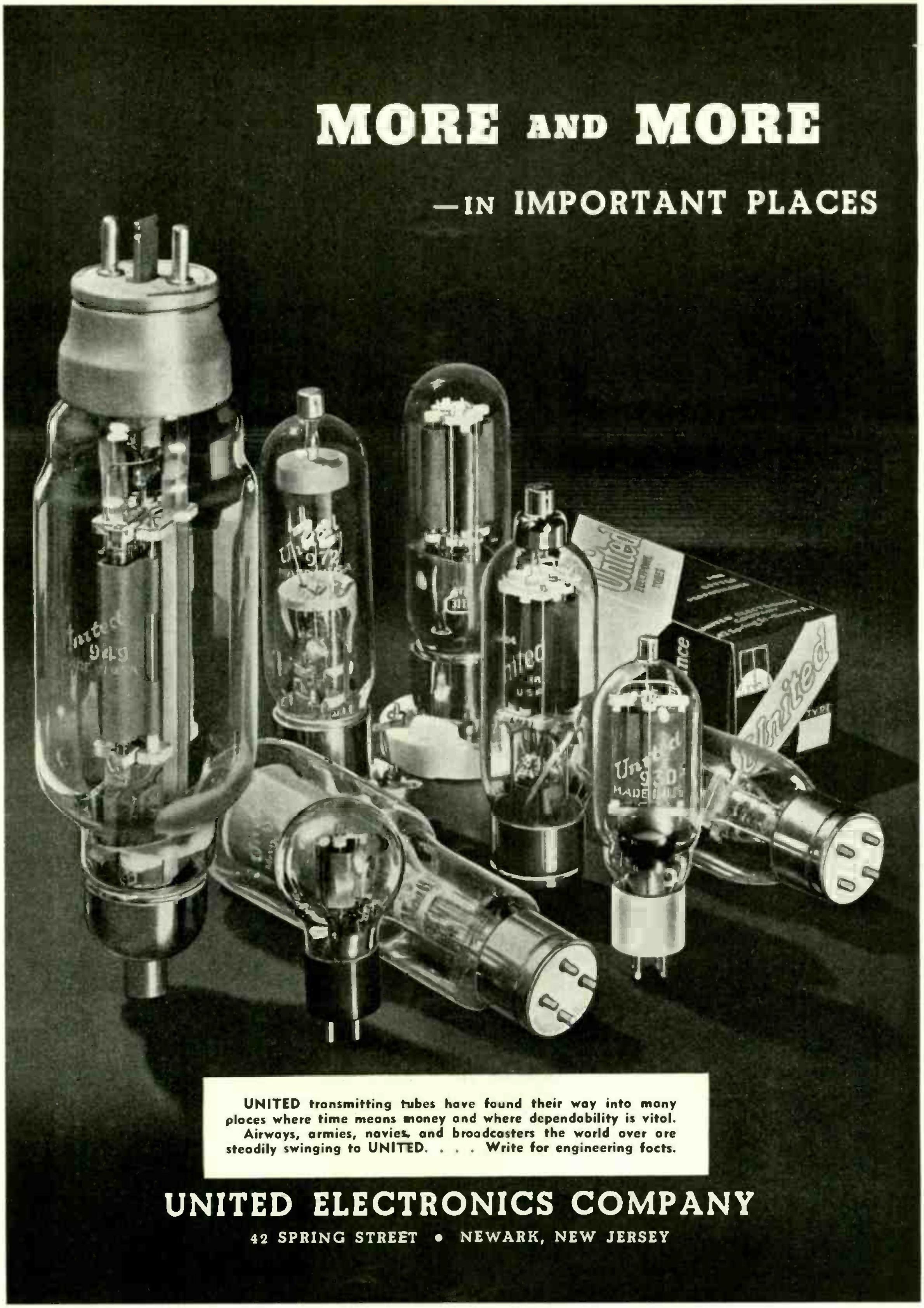
VA-5—2000 watt output rating, net 12.00



UNITED TRANSFORMER CORP.

72 SPRING STREET • NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK STREET NEW YORK, N.Y. CABLES: "ARLAB"



COMMUNICATION & BROADCAST ENGINEERING

FOR MAY, 1937

WNYC's 100-WATT P-A TRUCK

By AARON NADELL

THE 100-watt sound truck of the City of New York, shown in an accompanying illustration, serves outdoor municipal functions of all kinds such as park concerts, parades and public celebrations. Its first use was in connection with the formal opening of the west side elevated highway for automobile traffic. The truck's microphones and loudspeakers reinforced the speeches of the city officials. Afterward it participated in the parade of vehicles that followed the cutting of the ribbon stretched across the new roadway.

Among other services performed that day, the truck, through its remote equipment, relayed the ceremonies to the municipal broadcasting station WNYC, of which it is officially a part. Commissioner of Plants and Structures F. J. H. Kracke, in charge of the station, laid down the requirements the truck would have to meet, and the details of its design were worked out by the station staff, including Chief Engineer I. Brimberg, P-A Operator W. H. Pitkin and Control Operator M. G. Suffern.

The general layout is shown by the block schematic, Fig. 1, and the interior photograph, Fig. 2. The amplifiers, tuners, loudspeakers, microphones and gasoline-driven 2-kw generator are standard commercial equipment. The interstage controls and power distribution panels were built by the station staff.

Flexibility of operation, to meet the varied requirements of the municipal authorities, constituted one important feature of the design. Another is duplication of equipment to avoid any possibility of an embarrassing breakdown during some conspicuously public occasion.

The truck itself is a 1937 Chevrolet, streamlined, and finished in aluminum with fenders and wheels of ultramarine blue. Fig. 3 shows the general appearance but fails to reveal the modernistic design of the two-tone lettering. The flag of the city flies from the central staff. The number 810 at the rear of the body shows the frequency of station WNYC. The circle on the driver's door is the municipal seal. The occasional necessity for climbing among the loudspeakers to repoint them, in accordance with the requirements of an individual operation, made the false roof desirable as a protection to the appearance of the real roof. The false roof also provides protection for the two radio antennas with which the truck is equipped.

One of these antennas, of which the mast forms a part, is diagrammed at the extreme left of Fig. 1. It can be switched either to the short-wave converter shown just below it, or to either of the two tuner-mixer-amplifier panels shown to the right of the four microphones. This antenna constitutes one

FIG. 2. INSIDE VIEW OF THE 100-WATT P-A TRUCK.

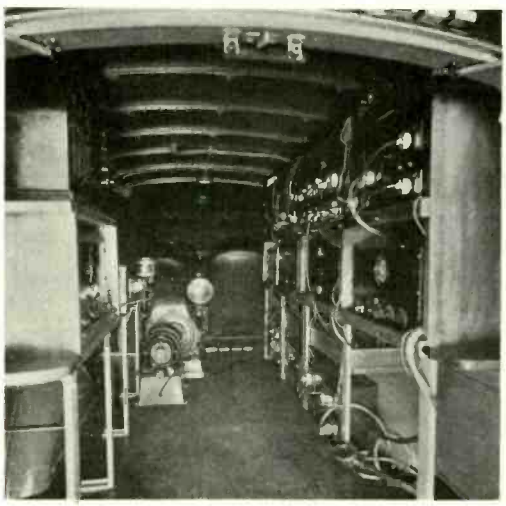
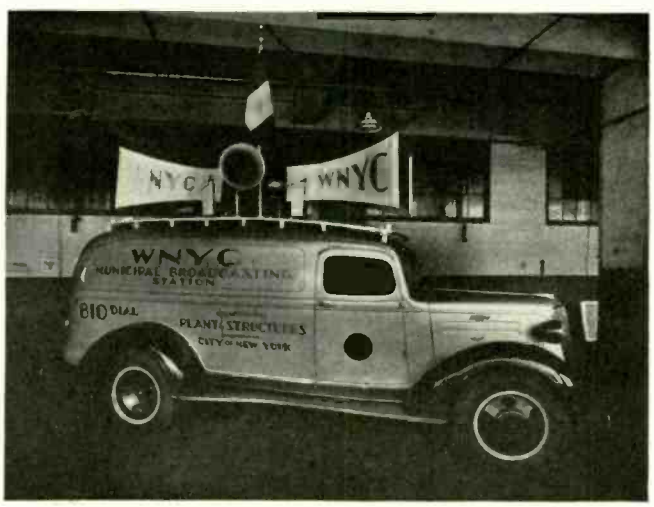


FIG. 3. OUTSIDE VIEW OF WNYC's P-A TRUCK.



of three sources of sound input. Another consists of the phonograph turntable shown just below it, and a third of the four dynamic microphones.

Either of the two mixer-tuner-amplifiers may be operated at any given time, the other serving as a spare for emergencies. The output, at 20 watts, runs to an "interstage control panel," shown just to the right of No. 1 amplifier. From this panel one line runs to the monitor speaker mounted in the truck. Another can be traced down and right, feeding a telephone line to radio station WNYC. Two others run right to the two 100-watt output amplifiers, which again are operated with one in use and the other serving as a spare.

To the right of these amplifiers is shown the speaker distribution panels, from which lines run to the six speakers at the top of the drawing. Of these, four are permanently mounted on the truck, as illustrated in Fig. 3. Two of the 10-watt units, equipped with suitable stanchions, are left availble for placement elsewhere as required.

The lower left of the block schematic shows the 2-kw gasoline-driven generator and its control panel, starting panel and starting batteries. To the right of this again, and just under the No. 2 20-watt amplifier, is the power distribution panel through which 110-volt a-c is patched to the amplifiers and speaker field supply units.

A standard automobile receiver, equipped with its own antenna, can be seen at the extreme lower right. It is used to monitor the broadcasts from WNYC. It draws its operating power from the car battery, and not from the 110-volt distribution panel.

As has been said, all of this equipment, except the control, station feeder and distribution panels, is standard commercial apparatus.

The short-wave converter shown just under and to the left of the mast covers 12-200 meters, using r-f on all bands. The bands (each having an individual set of coils) are: 1430 to 4200 kc, 3700 to 10,500 kc and 9000 to 25,000 kc. Tubes are: one 6D6 r-f amplifier, one 6A7 modulator, one 76 oscillator and an 84 rectifier.

One of the tuner-mixer-amplifiers is diagrammed in Fig. 4. The audio input is shown at the upper left of that drawing and consists of two high-impedance chanels mixed by the two 57 tubes.

The tuner circuit is shown in the lower half of Fig. 4. It is high-fidelity r-f, using two 58's as amplifiers and a 55 as diode detector. Its output is fed tc the left-hand grid of the 53, while the right-hand grid takes the output from the two 57's. The 53 is therefore used as a mixer to blend tuner reception with microphone or record sound. From this point on the circuit is conventional. Output power is 20 watts at 5 percent harmonic content, and frequency response of the audio section is within 3 db between 50 and 12,000 cycles.

The two power amplifiers use eight 46s in a push-pull parallel stage. Two 83s serve as rectifiers. Twelve watts are required to drive this amplifier, leaving the balance of the output of the tuner-mixer-amplifier to operate the remote line and the monitor. Suitable distribution of the power is made through the interstage control panel.

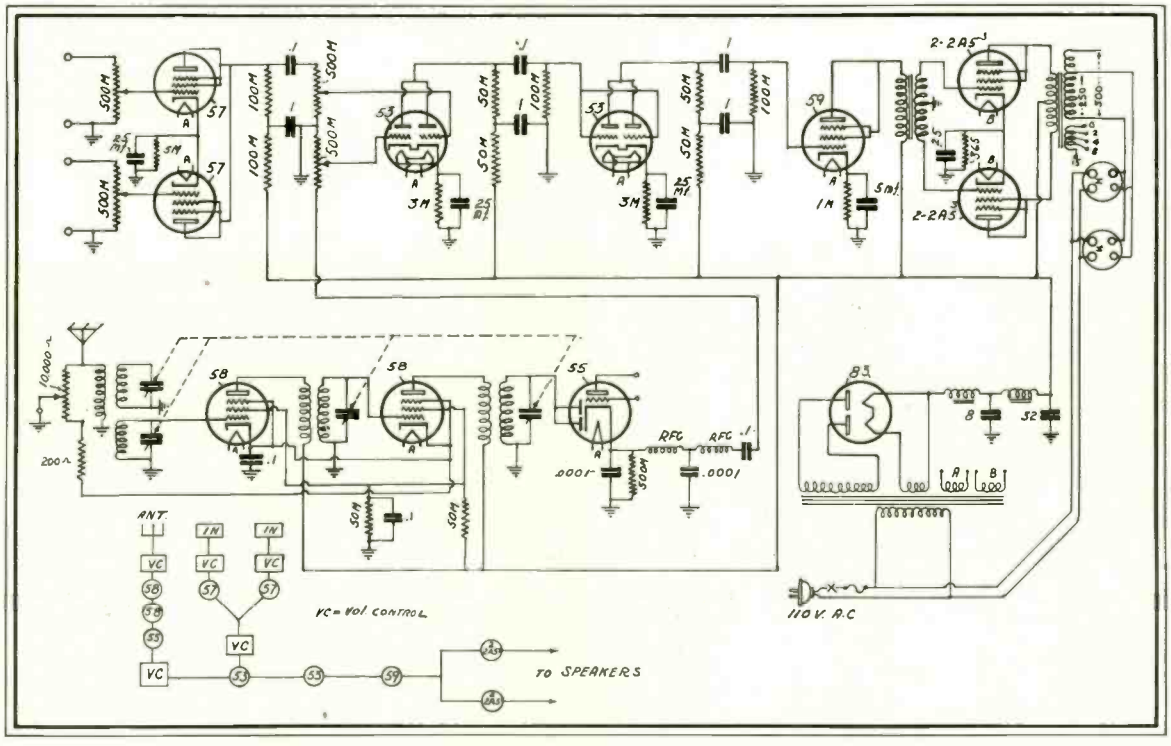
Power output is 100 watts to 500 ohms, and 1½ percent harmonic distortion is added by the power amplifier. Proper impedance match to the speaker lines is effected through the speaker distribution panels shown at the right of Fig. 1.

The large speakers, which Fig. 1 designates as projectors Nos. 1 and 2, are 12-inch models, the 20-watt rating of which is conservative. They are mounted in special Navy type weatherproof trumpets. The four smaller speakers are rated at 10 watts each.

Fig. 1, as already stated, does not show the speaker field supply rectifiers, which derive their operating power from the distributor panel diagrammed next to the generator, and are patched to the speaker fields as conditions of operation require.

Fig. 2 shows the gasoline-driven generator just behind the driver's seat. The monitor speaker is in the upper left-

FIG. 4. CIRCUIT DIAGRAM OF ONE OF THE TUNER-MIXER-AMPLIFIERS.



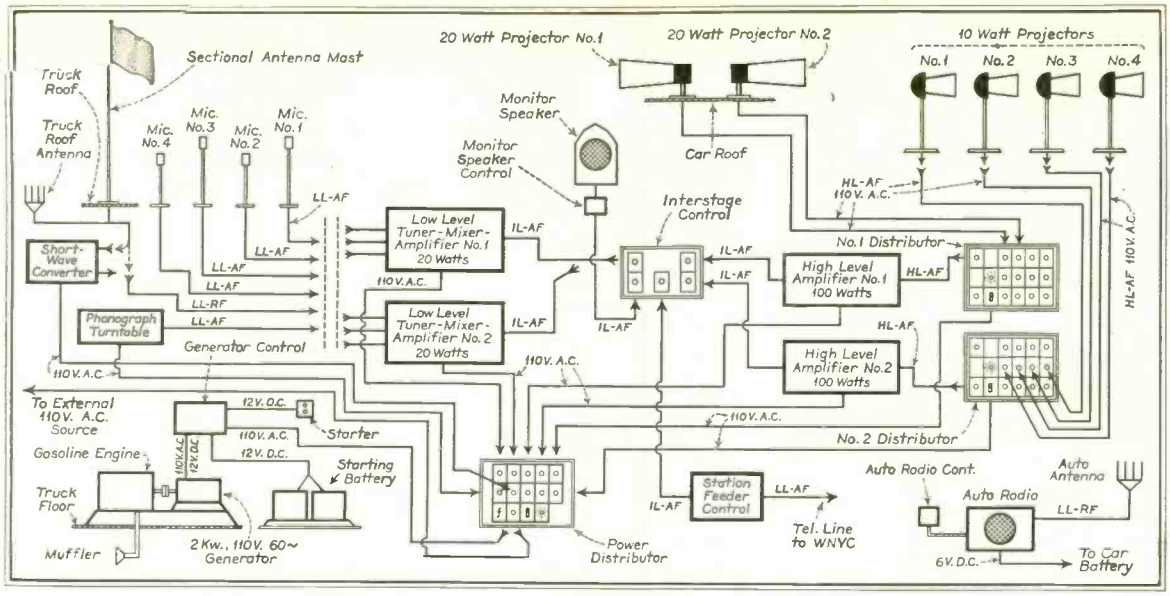


FIG. 1. SCHEMATIC DIAGRAM OF THE 100-WATT SOUND TRUCK.

hand corner, while just to the right of it, and on the same shelf, is the short-wave converter.

One of the two mixer-tuner-amplifiers is located in the recess directly below the monitor. Beyond it, toward the driver's seat, is one of the distribution panels, the physical arrangement of which is less compact, and more flexible, than shown in Fig. 1.

On the very top shelf on the right side of the truck, as illustrated in Fig. 2, is a standard volume indicator. The next shelf below is entirely occupied by distribution and patching panels. The third shelf shows, in the right-hand recess, the second mixer-tuner-amplifier. Beyond this, toward the driver, are the two 100-watt amplifiers.

Patching equipment and the generator control panel are shown on the floor at the right, and in the right foreground, one of the dynamic microphones. The monitor receiver is on the dashboard, and not visible in the picture.

It will be noted that none of the equipment is in any way overloaded, but that ample reserves of speech and operating power are maintained throughout. The two 100-watt amplifiers require 300 line watts apiece, and together with the two tuner-mixer-amplifiers impose a line drain of approximately 900 watts. The speaker field units need something less than 250 watts. Allowing 300 watts for the phonograph, short-wave converter, signal lamps and interior lighting, the maximum requirements of this truck, with all apparatus in simultaneous operation, would still be less than 75 percent of the rated output of the generator.

Sound power reserves are similarly conservative. The speakers used will, in fact, handle without overloading 50 percent more power than that indicated in Fig. 1. The full output of the 100-watt amplifier cannot overload them, but the ratings shown in the diagram also indicate that the amplifier itself is not overloaded in practice.

RCA TELEVISION FIELD TESTS

FIELD TESTS of RCA experimental television with the new 441-line definition have been resumed by the National Broadcasting Company on the largest scale ever undertaken in the United States.

Test programs will be televised daily from the NBC transmitter in the Empire State Tower. NBC has been on the air with television since 1931, and has had the only television station in operation in New York City for the last four years. Quality of reception will be checked by NBC engineers on more than 75 receivers placed at selected points throughout metropolitan area.

O. B. Hanson, NBC chief engineer, said the object of the new tests, which represent their latest development, is to determine the home program potentialities of high-definition television. RCA television of 441-line definition has been in operation in the laboratory since last December, but this will be the first test under practical field conditions.

In similar field tests of 343-line pictures held as early as last summer, NBC engineers received satisfactory pictures as far distant as 45 miles from the Empire State transmitter. Last December tests on this basis were discontinued to allow for necessary alterations to change the equipment over to the finer definition 441-line system.

The NBC engineers state that there are still many major problems to be solved in the televising of different colors, scenes and types of performance. A tentative schedule is under consideration which would provide for four evenings a week on alternate weeks. A complete technical staff will be on duty in the television studio to assist the program and production men. Leaders in stage design, textiles, decoration and fashion will be invited to cooperate in solving the many problems of television staging.

REPORT ON THE

MELVILLE EASTHAM, GENERAL RADIO CO.

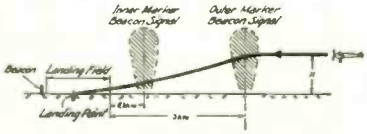
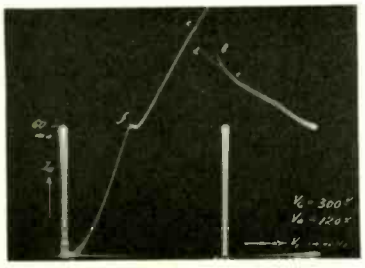


FIG. 2. SCHEMATIC ARRARGEMENTS OF LANDING METHOD.

FIG. 13. RELATION BETWEEN ANODE CURRENT AND CONTROL-GRID BIAS.



IN COMMEMORATION of their Silver Anniversary, the Institute of Radio Engineers this year held their annual convention in New York City. This meeting was held at the Hotel Pennsylvania on May 10, 11 and 12.

The attendance was well in excess of 1000, making this one of the largest gatherings in the history of the Institute. It was outstanding as well in the large number of localities represented and in the enthusiasm displayed. In addition to the technical sessions and a number of interesting tours, the IRE members were fortunate in being able to attend a 441-line television demonstration staged by NBC.

The Institute Medal of Honor was presented to Melville Eastham for his pioneering work in the field of radio measurements and his constructive influence on laboratory practice in communication engineering. The Morris Liebmann Memorial Prize was presented to W. H. Doherty for his improvement in the efficiency of radio-frequency power amplifiers.[1]

AERONAUTICAL RADIO

Among the interesting papers presented during the technical sessions was that of Walter M. Hahnemann, of C. Lorenz, A. G., Berlin, on *The Ultra-Short-Wave Beacon and Its Field of Application*. The favorable results obtained with this system have led to studying the possibility of using these ultra-short-wave beacons for other purposes of air navigation.[2] Instrument landing with this system is accomplished as follows: the aircraft approaches the airport in the vertical plane of the guide beam and a short distance from the airport it is directed by an outer distance marker to descend, while closer to the airport it is directed by an inner marker to land. The complete arrangement is illustrated in Figs. 1 and 2.

The conditions of the propagation of ultra-short waves were discussed on the basis of the theory of combining reflection and diffraction on the earth. Finally a new example of applying ultra-short-wave beacons for the further development of commercial air-navigation systems of a country were shown.

In the paper *"Radio Methods for the Investigation of Upper-Air Phenomena with Unmanned Balloons,"* H. Diamond, W. S. Hinman, Jr., and F. W. Dunmore, National Bureau of Standards, pointed out that experimental work conducted for the U. S. Navy Department on the development of a radio meteorograph for sending down from unmanned balloons information on upper air pressures, temperatures, humidities, and wind conditions had led to radio methods applicable to the study of a large class of upper-air phenomena. The miniature transmitter sent aloft on the small balloon employs an ultra-high-frequency oscillator and a modulating oscillator; the frequency of the latter is controlled by resistors connected in its grid circuit. These may be ordinary resistors mechanically varied by instruments responding to the phenomena being investigated, or special devices the elec-

1 "A New Power Amplifier of High Efficiency," by W. H. Doherty, COMMUNICATION AND BROADCAST ENGINEERING, page 7, Vol. 3, No. 5, May, 1936.

2 "Ultra-Short-Wave Radio Landing Beam," by R. Elsner and E. Kramar, COMMUNICATION AND BROADCAST ENGINEERING, page 12, Vol. 4, No. 3, March, 1937.

FIG. 11. SHOWING THE BRIGHTNESS OF OUTDOOR SCENES.

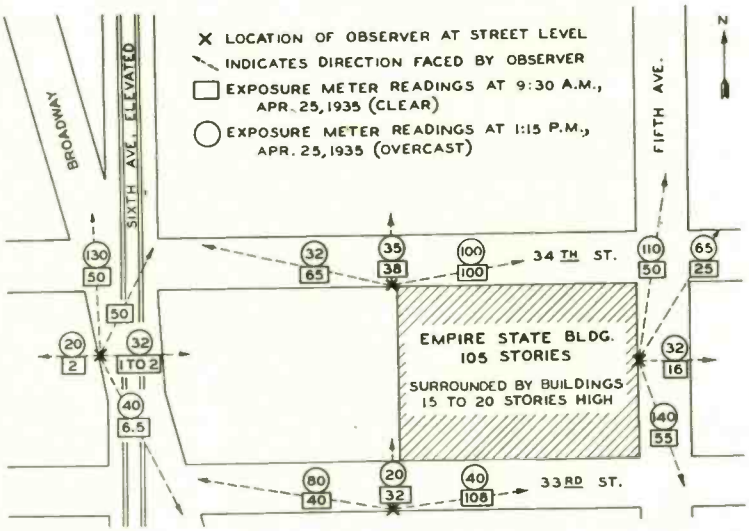
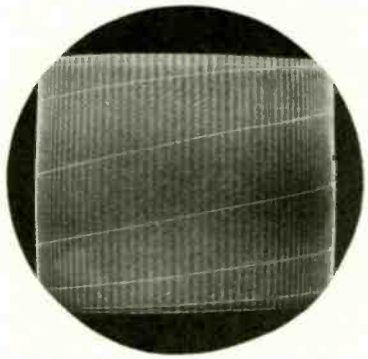


FIG. 9. A RESOLUTION PATTERN.



trical resistances of which vary with the phenomena. The modulation frequency is thus a measure of the phenomenon studied. Several phenomena may be measured successively, the corresponding resistors being switched into circuit in sequence by an air-pressure-driven switching unit. This unit also serves for indicating the balloon altitude. At the ground receiving station, a graphical frequency recorder, connected in the receiving set output, provides an automatic chart of the variation of the phenomena with altitude. Special direction-finding methods were described for determining the azimuthal direction of the balloon and its distance from the ground station, data required in measuring upper-air wind conditions.

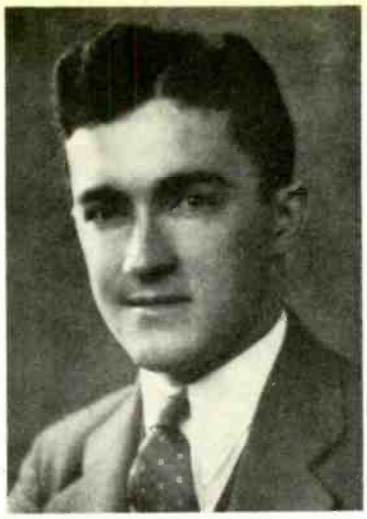
ANTENNAS

The theoretical considerations concerning losses in ground systems were advanced in the paper prepared by G. H. Brown, R. F. Lewis and J. Epstein, RCA Manufacturing Co., entitled *Ground Systems as a Factor in Antenna Efficiency*. These considerations indicate the feasibility of antennas much less than a quarter wavelength tall, for low-power broadcast use. The desirability of large ground systems was also indicated.

Experimental data are given which show that an eighth-wave antenna is practically as efficient as a quarter-wave antenna. It was also shown that a ground system consisting of 120 buried radial wires, each one-half wave long, is desirable. Tests of ground screens show them to be of no importance when adequate ground systems are used.

A Multiple Unit Steerable Antenna for Short-Wave Reception, by H. T. Friis and C. B. Feldman, Bell Telephone Laboratories, discussed a receiving system employing sharp vertical plane directivity, capable of being steered to meet the varying angles at which short radio waves arrive at a receiving location. The system is the culmination of some four years' effort to determine the degree to which receiving-antenna directivity may be carried to increase the reliability of short-wave transatlantic telephone circuits. The system consists of an end-on array of antennas, of fixed directivity, whose outputs are combined in phase for the desired angle. The antenna outputs are conducted over coaxial transmission lines to the receiving building where the phasing is accomplished by means of rotatable phase shifters operating at intermediate frequency. These phase shifters, one for each antenna, are geared together, and the favored direction in the vertical plane may be steered by rotating the assembly.

The paper by John F. Morrison, Bell Telephone Laboratories, on *Simple Method for Observing Current Amplitude and Phase Relations in Antenna Arrays* described a simple apparatus arrangement for observing the relative amplitudes and phases of the currents in the elements of a multi-element radiating system. The process of adjusting the array is greatly facilitated, much less time and skill being required than when each step in the process is checked by field-intensity measurements. Using the method described, these measurements need only be used as a final verification of the adjustment. Field experience with a commercial application was described.



W. H. DOHERTY, BELL TELEPHONE LABS.

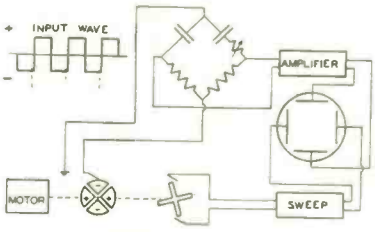


FIG. 7. A CIRCUIT FOR MEASURING CONDENSER CHARACTERISTICS.

FIG. 12. RELATION BETWEEN ANODE CURRENT AND ANODE VOLTAGE.

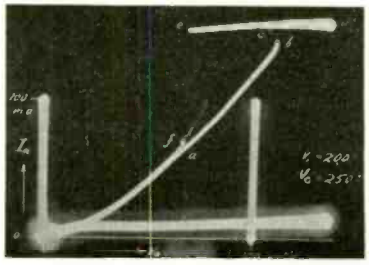
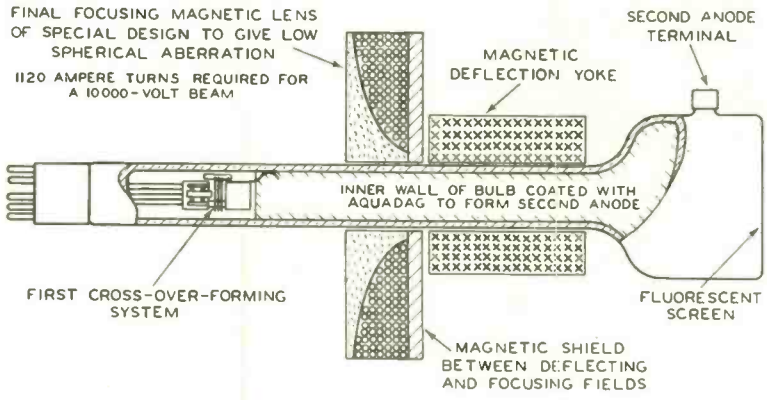
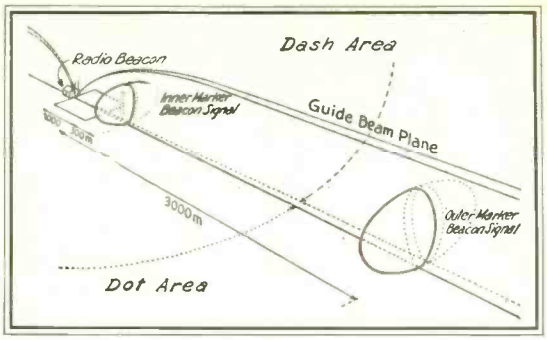


FIG. 8. AN EXPERIMENTAL PROJECTION "KINESCOPE."

GENERAL ASSEMBLY EXPERIMENTAL PROJECTION "KINESCOPE"

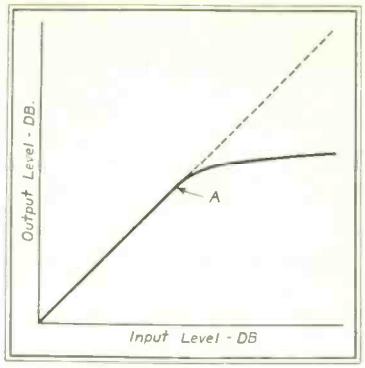
FIG. 10. ANOTHER RESOLUTION PATTERN.





LEFT: FIG. 1. GUIDE BEAM LANDING RADIO BEACON IN THE LORENZ SYSTEM.

RIGHT: FIG. 3. ILLUSTRATING THE ACTION OF THE AUTOMATIC VOLUME LIMITER.



BROADCASTING

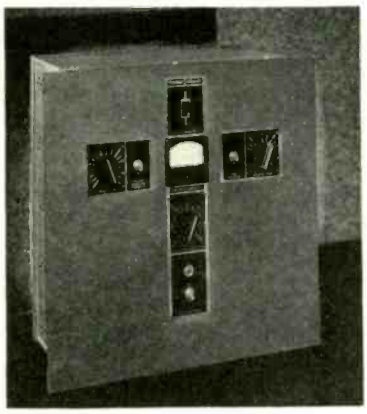
Radio circuits as extensions of wire-line facilities to permit presentation of programs from points not otherwise accessible have now become an integral part of broadcasting, according to W. A. R. Brown and G. O. Milne of the National Broadcasting Co. Some of the more important problems involved in relay broadcasting and brief descriptions of the equipment developed for this service as well as its operation under field conditions were given in their paper *Ultra-High-Frequency Relay Broadcasting*. Portable relay broadcast transmitters of various powers and frequencies and their associated receivers were demonstrated.

Higher Program Level Without Circuit Overloading, by O. M. Hovgaard and S. Doba, Bell Telephone Laboratories, described a device designed to enable broadcast stations to increase their effective signal level without raising their input power or increasing their licensed carrier power.

The program amplifier incorporates a circuit which normally amplifies the program to a predetermined level. However, when the input increases above a preselected level, the speech or music energy operates a volume control network in such a manner that the amplification is reduced, thus automatically compensating for the excessive rise. The result is that the product at the output of the amplifier is held within the desired limit, and the device may be adjusted so that program peaks will rarely cause modulation of the transmitter in excess of 100 percent.

The basis of this device is a variable loss network which is inserted as a part of the program circuit, and the loss which it inserts is directly controlled by the instantaneous program level. A characteristic of such a network is shown on Fig. 3 which depicts the relationship between the output and input levels for a steady-state single frequency. It will be seen that up to the level marked *A* the relationship is linear. For input levels less than *A* the network acts as though it were a small fixed loss and hence will not affect the character of the program. When the level *A* is exceeded the network inserts additional loss in an amount dependent upon the increase in program level, and the volume range beyond the level *A* will therefore be compressed.

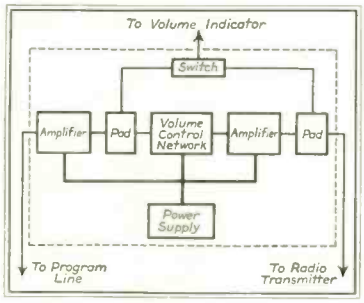
FIG. 4. FRONT VIEW OF THE PROGRAM AMPLIFIER.



MEASUREMENTS

A New Method of Measurement of Ultra-High-Frequency Impedance, by S. W. Seeley and W. S. Barden, RCA License Lab., dealt with a new and simple method for measurement of resistance and reactance at frequencies in the neighborhood of 100 mc. The method described provides a degree of accuracy higher than that obtained by previous and more complicated systems. It uses the incremental capacitance of a very small condenser as a standard. The absolute capacitance of this element need not be known. The indicating device is a vacuum-tube voltmeter whose deflection law (but not absolute calibration) must be known.

FIG. 5. BLOCK DIAGRAM OF THE AUTOMATIC VOLUME LIMITER.



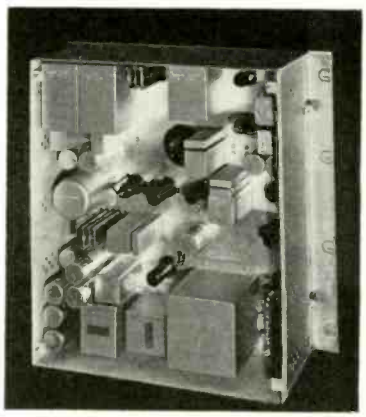
A Wide-Range Beat-Frequency Oscillator, by J. M. Brumbaugh, RCA Manufacturing Company, is concerned with the development and operation of an instrument having output ranges of 20 to 3,000,000 cycles (logarithmic scale), and .0004 to 45 volts, with automatic output-level control. A description was presented of the oscillator, r-f amplifier, detector, video amplifier, "AVC," and control circuits, with remarks on the attainment of stability. Design of the incorporated wide-range tube voltmeter, semi-automatic curve recorder, and oscilloscope, was discussed.

Wherever condensers and resistors must be of very high quality there is justification for measuring their characteristics with a degree of accuracy which does not obtain for ordinary audio- and radio-frequency work, according to W. D. Buckingham, Western Union Telegraph Co., in *Measurement of Condenser Characteristics at Low Frequencies.* It is known that the capacitance of a condenser may change with temperature, time, air pressure, voltage, frequency.

A condenser with absorption is

(*Continued on page* 28)

FIG. 6. INSIDE VIEW OF PROGRAM AMPLIFIER.



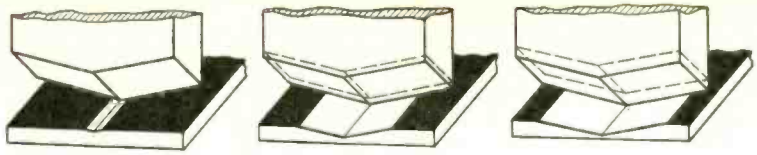


FIG. 2

THE PHILIPS-MILLER RECORDING SYSTEM

THE FIRST authoritative descriptions of the much discussed Philips-Miller system of sound recording have appeared in recent issues of the *Philips Technical Review*, the house organ of the Philips Research Laboratory of Holland. In this publication the main principles of this new method for recording sound are set forth.

In the Philips-Miller method as in the photographic sound-film process a sound track is recorded on a strip of film. However, the recording is accomplished by mechanical rather than optical means.

The film material ("Philimil" tape) consists of a celluloid base which, in place of the usual photographic emulsion, is coated with an ordinary translucent layer of gelatin about 60 μ in thickness. In turn, the gelatin is coated with a very thin opaque surface layer about 3 μ in thickness.

Recording is accomplished by means of a stylus shaped like an obtuse wedge (see Fig. 1). The cutter, which sets perpendicular to the tape and moves in synchronism with the sound vibrations to be recorded, removes a shaving from the gelatin layer which is displaced below it at a uniform speed.

When not actuated by sound, the cutter produces a groove of uniform width 2b in the film. Along this groove the thin top coating (and a part of the gelatin layer) is removed, so that a transparent trace on an opaque background is obtained. If the cutter is brought deeper into the film by a distance Δ h, the groove cut will become wider by a small amount 2 Δ b (Fig. 2) and if α is half the apical angle of the wedge (Fig. 1) the following relation-

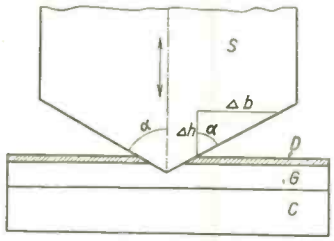
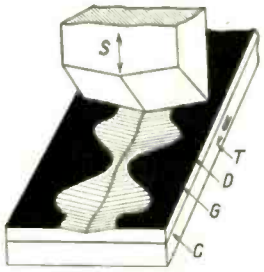


FIG. 1. ILLUSTRATING THE WEDGE-SHAPED CUTTER AND THE "PHILIMIL" TAPE.

FIG. 3. THE CUTTER S MOVES UP AND DOWN IN SYNCHRONISM WITH THE SOUND VIBRATIONS TO BE RECORDED.



ship will apply:

$$2\,\Delta b = \Delta h\,(2 \tan \alpha)$$

At $\alpha = 90°$, $\tan \alpha$ will be infinite. Hence, it is obvious that if α is nearly 90° a slight displacement Δ h of the cutter will produce a marked alteration 2 Δ b in the width of the recorded trace. At 87°, the wedge angle used in practice, the amount of magnification obtainable will be

$$\frac{2\,\Delta b}{\Delta h} = 2 \tan 87°$$

or about 40.

In recording, the cutter moves up and down in synchronism with the sound vibrations, thus producing on the moving tape a track whose width will vary with the sound (Fig. 3). To obtain a maximum trace width of $2b = 2$ mm, as commonly used in sound-film recording practice, the displacement of the cutter need only have a double amplitude Δ h of $2000/40 = 50\,\mu$.

The recorded sound is reproduced by the usual method employed in optical sound-film technology. The film carrying the sound track is moved between a photoelectric cell and a small, brightly illuminated slit (transversal to the direction of motion of the film). The intensity of the light falling on the photoelectric cell thus varies with the variable width of the sound track, and the resulting current fluctuations in the photoelectric cell are amplified and passed to a loudspeaker.

In the sound recorder, an electromagnetic driving system has been used.

FIG. 8. THE CHARACTERISTIC OF THE SOUND RECORDER IS GIVEN BY THE FULL LINE. WHILE THE OVERALL RESPONSE OF THE RECORDING AND REPRODUCING APPARATUS IS REPRESENTED BY THE BROKEN CURVE.

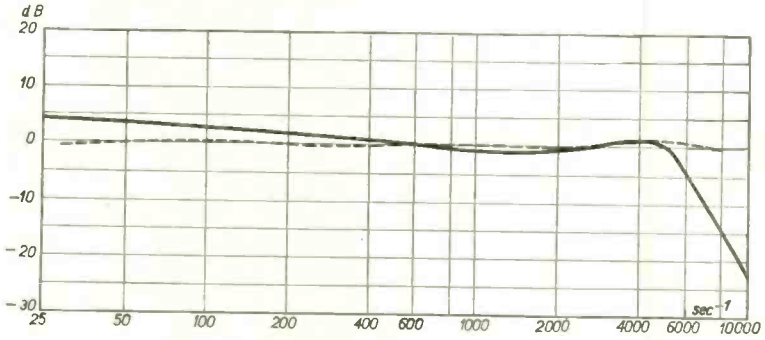
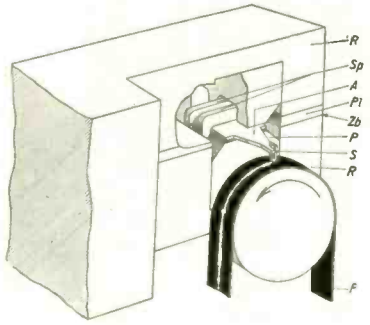


FIG. 5. A DIAGRAMMATIC SKETCH OF THE INTERIOR OF THE DRIVING SYSTEM OF THE PHILIPS-MILLER RECORDER.



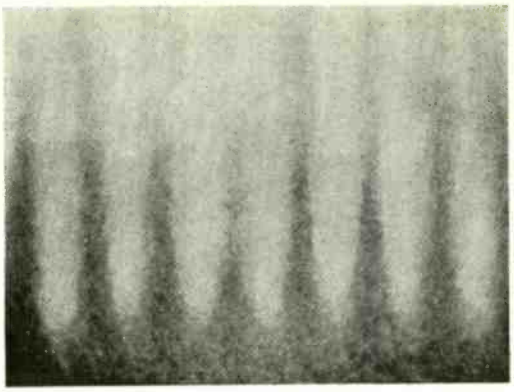
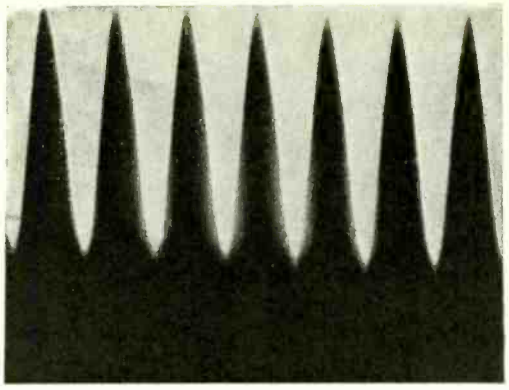


FIG. 11. LEFT: MICROPHOTOGRAPH (X100) OF A 5000-CYCLE NOTE RECORDED BY THE PHOTOGRAPHIC PROCESS. RIGHT: MICROPHOTOGRAPH OF THE SAME FREQUENCY RECORDED BY THE PHILIPS-MILLER PROCESS.



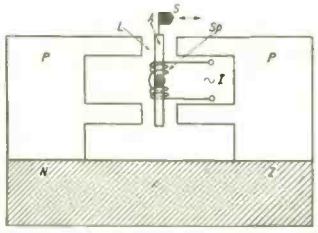


FIG. 4. THE ELECTROMAGNETIC DRIVE USED IN THE RECORDER.

This is shown diagrammatically in Fig. 4. Contrary to an electrodynamic system, the attainable amplitude with an electromagnetic system is determined by the dimensions of the system. The amplitude is found to be

$$a = k \frac{H_0 \Delta H}{\rho \omega^2}$$

where ΔH is the alternating field in the armature A and H_0 the field in the air gap L due to the permanent magnet P; k is a factor of the dimension of a reciprocal length and is inversely proportional to the dimensions of the system. By reducing the size of the recorder, its amplitude can be increased, although there is a limit to this increase.

The interior of the sound recorder is shown in Fig. 5, while the armature components are shown separately in Fig. 6. In Fig. 7 the sound recorded is depicted; in Fig. 8 the frequency characteristic.

The armature is connected with the two clamping plates P1 by a pair of

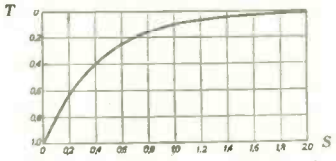


FIG. 10.

short bridge stays T which provide a torsion axis. In designing the sound recorder, the first requirement to be met was that the air gap in which the armature moves must be made large compared with the armature amplitude, as otherwise the displacement of the armature would not be proportional to the force. On the other hand the air gap must be kept small in order that the resistance of the magnetic circuit does not become too large. The air gap is 0.12 mm. To obtain accurate adjustment to this value, the armature is made in one piece with the clamping plates P1 and the torsion stays, and is ground quite flat. Similarly the upper pole-piece together with the top part of the brass frame R in which it is countersunk, and the lower pole-piece with the lower section of the frame, are also ground flat on the front surface.

When clamping the armature, thin spacing sheets Zb (Fig. 5) exactly 0.12 mm in thickness, are inserted between the end surfaces of the frame and the clamping plates P1. This arrangement

(*Continued on page 27*)

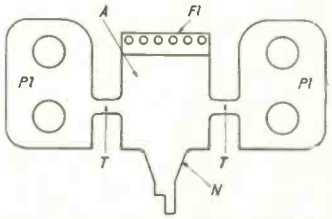


FIG. 6. THE FLAT ARMATURE COMPONENT IN THE SOUND RECORDER.

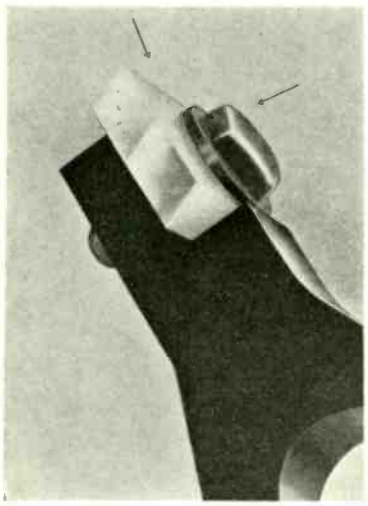


FIG. 7. THE SOUND RECORDER MOUNTED ON THE DESK OF A RECORDING MACHINE.

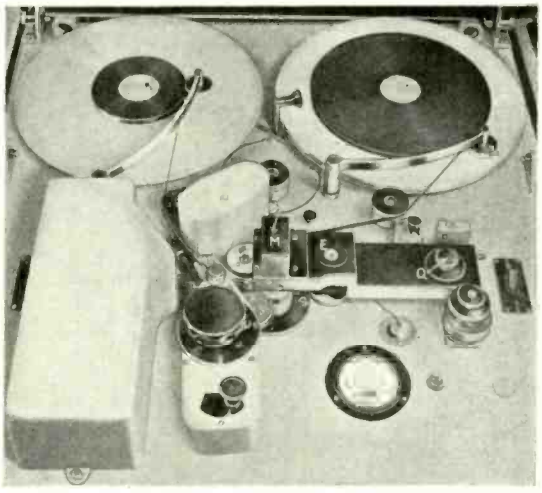


FIG. 9. AN ENLARGED VIEW OF THE CUTTER SHOWING THE METHOD OF MOUNTING.

FIG. 3. ONE OF THE MAINLINERS IN FLIGHT.

RADIO EQUIPMENT ON NEW TRANSPORTS

IN PLACING its new $3,000,000 fleet of Mainliner transports in service, the communications department of United Air Lines has spent many months in research work to perfect the multiple radio equipment to be found aboard each ship. These twelve-ton, three-mile-a-minute planes have just been placed in non-stop service between New York and Chicago and will shortly be used on the overnight coast-to-coast schedules.

A large radio bench has been installed on the Mainliners just aft of the pilots' cockpit and forward of the passenger cabin (Fig. 1). On this has been mounted the principal radio units, with all controls for these being located in the pilots' cockpit. The radio installation was completed to specifications at the Douglas Aircraft factory on the Pacific Coast where the Mainliners were constructed. All radio equipment is Western Electric. One of the important units on the bench is the short-wave or company receiver, used for listening to the ground stations of United Air Lines. It may be operated on either the daytime or the nighttime frequency, selection of "day" and "night" being made by means of the frequency-shift control. The volume is adjusted by a rheostat located on the control column pedestal (see Fig. 2).

The transmitter of each Mainliner, also located on the bench adjacent to the short-wave receiver, is used to communicate with United ground stations as well as the Department of Commerce radio stations. It is equipped to transmit on the same frequencies as the short-wave receivers by the same frequency-shift control. The transmitter is operated by turning the transmit-receive switch on the main radio control panel to the transmit position and pressing the push-button on the microphone of the pilot's telephone set.

The second receiver is the long-wave or beacon receiver which is used for receiving weather broadcasts and radio range signals in the 200-400 kilocycle band. This receiver is tuned over this band by means of the "coffee-grinder" type control, this being located above the pilot's head and near the magnetic compass. Volume is also adjusted by a rheostat control on the control column. The receiver may be instantly placed in operation on 278 kilocycles for reception of marker beacons and airport control towers by throwing the toggle

(*Continued on page* 19)

FIG. 1. SHOWING LOCATION OF THE RADIO APPARATUS.

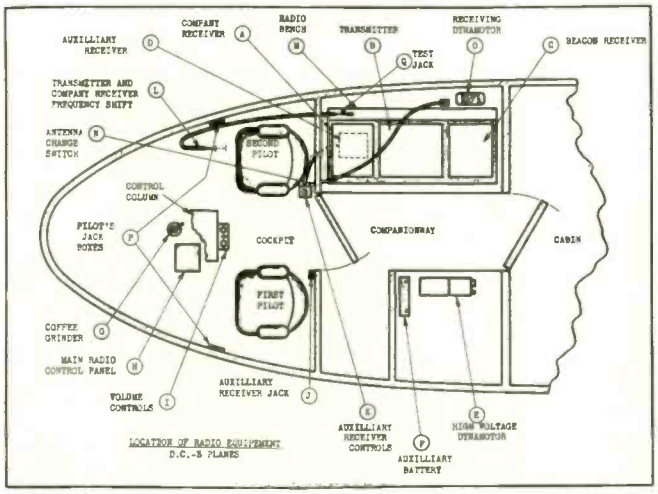
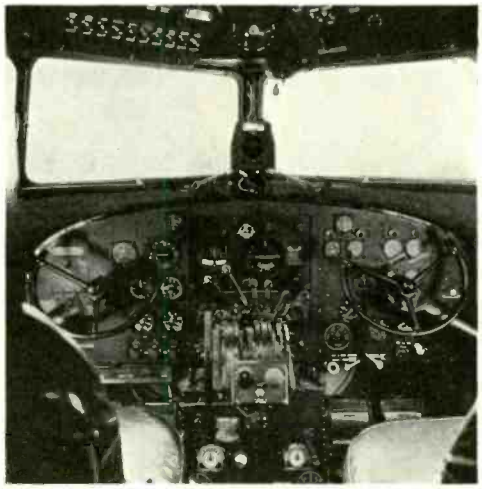


FIG. 2. THE COCKPIT ON ONE OF THE MAINLINERS.



TELEVISION STUDIO CONSIDERATIONS

PART II

By W. C. EDDY, Lieut. U. S. N. Ret.
Studio Director
FARNSWORTH TELEVISION, INC.

IN THE FIRST article of this series we have considered, among other things, the psychological effects of arrangement in subject matter, backgrounds and tonal qualities in a television picture. For the sake of clarity it might be wise to review briefly the more dominant features of such emphasis in composition in order that certain basic assumptions already established can be further modified. By diagram and subject matter we have pointed out that certain arrangements held more emphasis than others, that simplicity was stressed when grouped amid complexity; that severe geometric lines were emphatic among elaborate irregular shapes. In all we attempted to point out that interest bestowed on any character, subject or color was based directly on its uniqueness or in its antithesis, the lack of individuality of its supporting background.

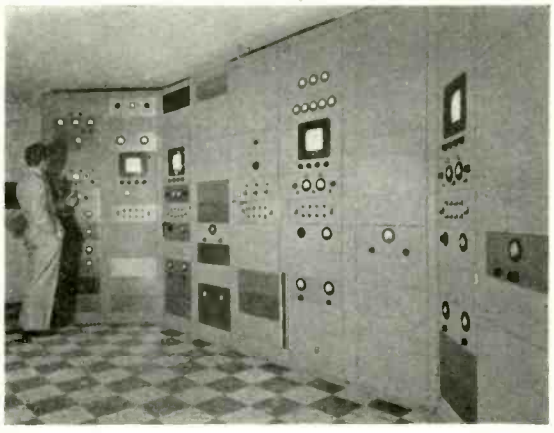
Possibly this definition might bear further explanation. Take for example our reference to the seventh rule of emphasis: that between two objects, one in motion and one static, interest is centered in the more active subject. This is quite true when we consider two like objects of similar shape, color, and size. On the other hand, consider this seventh rule where the static object is alone in a group of moving figures. Here we find the uniqueness of motion completely subordinated by successive repetition of the animate, the static character taking on emphasis by reason of its definite dissimilarity. In other words, this originally strong subject has been relegated to second place by a weaker figure that holds it position of prominence only by reason of the fact that it remains unique in number as well as movement. If, for instance, we should place one singer on a television stage, necessarily all interest would be focused on her. If two similarly costumed singers were working in the same acting area, emphasis would be directed to the figure which implied the greatest motion. Now if we should duplicate this moving figure many times, as in a ballet or chorus, the predominating interest shifts from the active to the inactive because of its dissemblance to the rest of the picture. The inactive singer is dissimilar in two ways. She remains static before a moving background and unique because of her isolation, thereby drawing attention from the more complicated subject matter of the chorus to herself as the predominating figure. We have, however, done more to accentuate the static singer's importance than merely isolating her from the line of the chorus. By repetition of the one moving character in costume, movement and size we have decreased the interest in any one person and conversely have added interest to the isolated and unimitated actress. This so-called depreciation in emphasis is employed in fields far removed from the stage or studio. A transmitter panel produced by one of our better known manufacturers illustrates an application of these principles. In this particular unit, designed for specialized service, the antenna-current meter was indicative of its operating efficiency. Rather than relying on the operator to instantly isolate this meter from the numerous plate and grid meters on the panel, the designers have given it particular emphasis by changing its size and shape as well as its position, thereby making it unique in three respects over the multiple grouping of the others. In addition, the relatively unimportant meters are depreciated in interest because of the duplication in size, shape, and arrangement.

In order to limit the wordage as well as to get further into the field of actual studio practice, let us recapitulate the two major principles of emphasis before leaving.

(1) Uniqueness governs the emphasis placed on any subject . . . the more unique, the more it is emphatic.

(2) Duplication or repetition of any

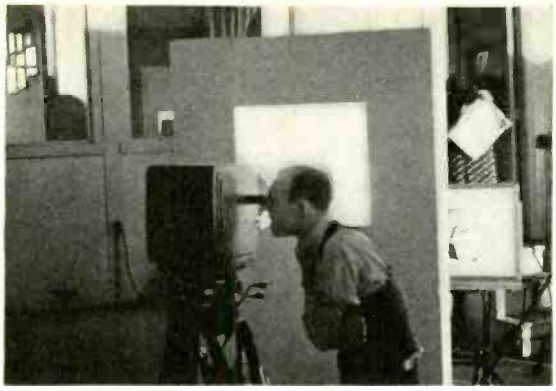
THE CONTROL BOARD. SOUND AND CAMERA CHANNELS TERMINATE AT THIS POSITION FOR PROGRAM MIXING, COMPOSITION AND CORRECTION.



CHECKING ROUTINE AGAINST TIME. MISS PATTY LAVERNE MAKING TIME CHECK ON A NEW ROUTINE DURING REHEARSAL.

© Farnsworth Television, Inc.

MISS VERA BUKER REPAIRING THE SIGNATURE MINIATURE USED IN THE OPENING AND CLOSING OF PROGRAMS.



© Farnsworth Television, Inc.

CAMERAMAN JAMES COOK CHECKING FINAL FOCUS ON NO. 2 MINIATURE STAGE WHILE WAITING FOR READY LIGHTS.

object depreciates its interest and this loss is the unique object's gain.

These two laws find everyday application in all fields of endeavor. In music the theme is accentuated by reason of the repetition and mono-chromatic characteristics of the accompaniment. A picture in our room attracts our attention because of subordinating similarity in the design of the wallpaper. The brightness of a television picture is stressed by the somberness of the cabinet design and the diffused surroundings. In every place we care to look we find these two principles of emphasis have been employed, some knowingly and others because our subconscious mind has given us a "nudge."

Sound reproduction must also be taken into serious consideration by the studio engineer. Broadcasting has developed this art to the point where we can add nothing. Our main problem then resolves itself into a judicious application of good sound engineering to television. If our picture portrays a close-up of an announcer, let us have the sound come from her lips rather than appearing to have been scattered at will throughout the studio and collected at random for transmission. On the long shots, it is not only good technique but good engineering to employ methods that will make the sound appear as if it originated at a distance rather than booming out at close-up volume. In the Farnsworth studios we encompass these two points with comparatively simple apparatus. Both announcers' desks are equipped with high-fidelity mikes installed in such a position that the speaker must necessarily cooperate in producing "close-up sound." On the main set, however, where the long and intermediate shots are made, we use a semi-parabolic reflector in the ceiling flat which enables us to pick up reflected sound from the set without consideration of the position of the actors on the stage. We find that such an arrangement allows us to duplicate the televised action with variations in pick up and create an artificial dimensional effect on the sound channel.

In our studio we make a practice of carrying the sound with the picture rather than relying on a duplication of centrally placed microphones to cover the action. It is our practice to cut in different mike positions as the scene is switched from one stage to another. Fading and blending of this sound track is accomplished at the control board in unison with picture laps and fades, all of which helps to carry out the impression of realism in the final result.

To coordinate the various functions that enter into a television program we utilize what we term a "master script" system. On this sheet all details of the program are cued in from the opening flare to the final black-out. Microphone levels, light changes, scene shifts, as well as camera transfers are outlined against the cue lines of the action in work. This master script, however, finds application only in the director's hands and at the control board. All details relating to camera work are drafted on a separate copy called the "camera script," while sound, lights, and stage staffs each have their own particular resume of the program. This allows the major part of the program to be fabricated in the production room rather than in the rehearsal studio.

After some practice we have found it fairly simple to visualize the necessary functions that will enter into a particular continuity and from this experience to create a usable "master." The breaking down of this draft into the detailed outlines can be accomplished in short order by the secretarial staff. With such a system it is entirely possible for a trained studio group to produce the continuous program that has long been considered the goal of this new art. Long and necessarily tedious rehearsals give way to a short discussion of the subject matter and a rechecking of the cues in the production office. This leaves the studio clear for final engineering checks and such other preparations as might normally precede the program.

As a means of coordinating this script among the various activities, we use a simplified light system actuated from the control board where actual sound and picture mixing and control are accomplished. Stand-by lights on cameras, acting areas, and music signal a change in set up while action lights indicate the equipment in use. Such an arrangement allows for quick changes in continuity to take care of emergencies that may arise.

As a result of our investigations into staging procedures that were available for adaptation in television work, we have come to the conclusion that the "movie lot" type of studio offers the most in flexibility of equipment and utilization of space. In the Farnsworth studios we attempt to maintain portability rather than stress permanency. Experimental work conducted during the first year convinced us that smooth continuity in program work required multiple stages and multiple shots, the technique of fading and lapping as employed in the movies, enabling us to blend the whole into a smooth interesting production. We further determined that in order to hold the audience for any lengthy sequence, the action had to be broken up into close, intermediate and long shots, taking care that such dissection of the material did not distract from the story at hand. This, then, meant that the script for television production had to be written to take into account specific camera work rather than allowing the camera men to shift focus at will. Normal stage and movie practice dictate a useable scheme and a modification of this policy was adopted.

When a character enters the set, the action is normally covered with the long-range camera because we must necessarily show the full stage in order

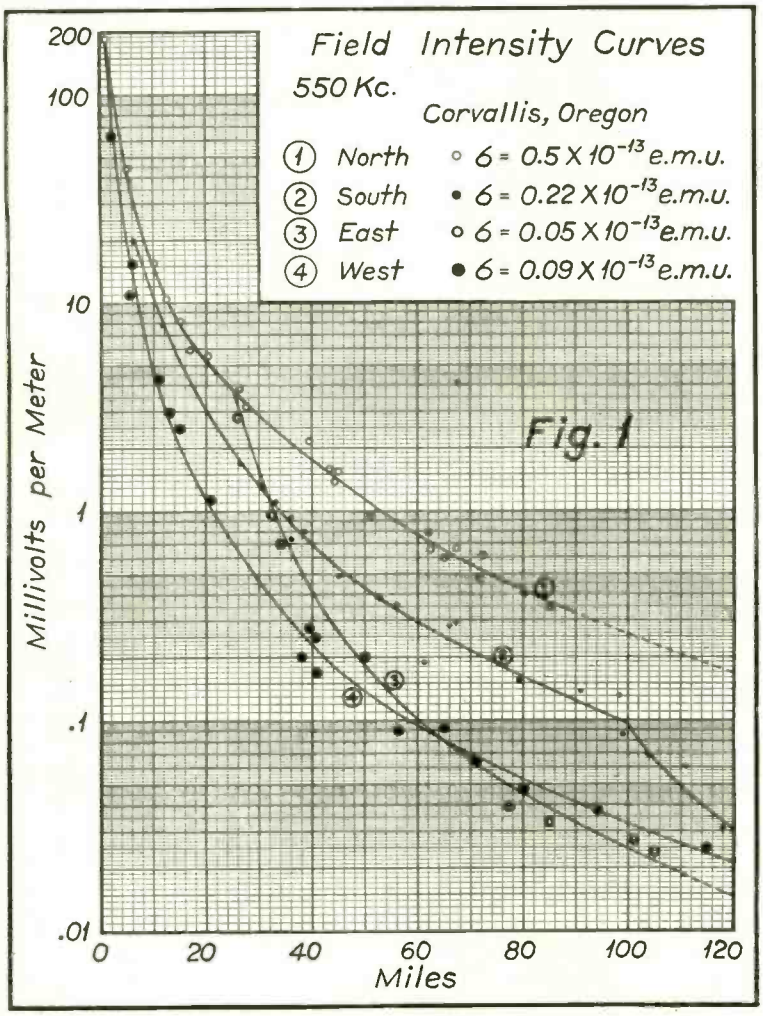
(*Continued on page 27*)

GROUND-WAVE ATTENUATION

By OLIVER D. PERKINS

DURING RECENT YEARS there has been a continued increase in the use of field-intensity measuring equipment, especially in the determination of radio broadcast station coverage. With the recent advances in technical requirements it has become necessary for the radio engineer to become cognizant of the factors affecting radio transmission, especially those over which he can exercise but little control; namely, earth conductivity and frequency.

With this in mind, the author has prepared the following paper, briefly discussing the Sommerfeld formula, and considering the results of some of the field-intensity measurements made in Oregon during the past three years.



THE SOMMERFELD FORMULA

The original Sommerfeld formula derived in 1909 included three variable factors depending upon the transmitting surface; namely, the conductivity, the dielectric constant, and the permeability. In the application of the formula to the earth's surface, the effect of permeability is negligible and may be neglected. The dielectric constant has no appreciable effect upon transmission at frequencies below 1500 kc. Errors due to the neglect of this factor at broadcast frequencies are likely to occur only when a high dielectric constant and a low conductivity exist together, a condition which probably cannot be encountered in practice, since a high dielectric constant indicates a wet earth which has a high conductivity.

The simplified Sommerfeld formula for ground-wave transmission is given as:

$$e = A\,E/d \quad \text{millivolts per meter} \qquad (1)$$

in which E represents the unattenuated field intensity at one mile, A is the attenuation factor which accounts for the effect of the earth conductivity, and d is the distance in miles from the antenna.

The relation between the factor A and a "numerical distance" d_n may be expressed by the empirical formula of Dr. Van der Pol:

$$A = \frac{2 + 0.3\,d_n}{2 + d_n + 0.6\,d_n^2} \qquad (2)$$

A curve showing this relation may be prepared in a few minutes.

The numerical distance is expressed as the relation:

$$d_n = \frac{(0.936 \times 10^{-6} \times d \times f^2)}{\sigma} \qquad (3)$$

in which f is the frequency in kilocycles

AT BROADCAST FREQUENCIES

ENGINEER

per second; *d*, the distance in miles; and σ, the conductivity in electromagnetic units.

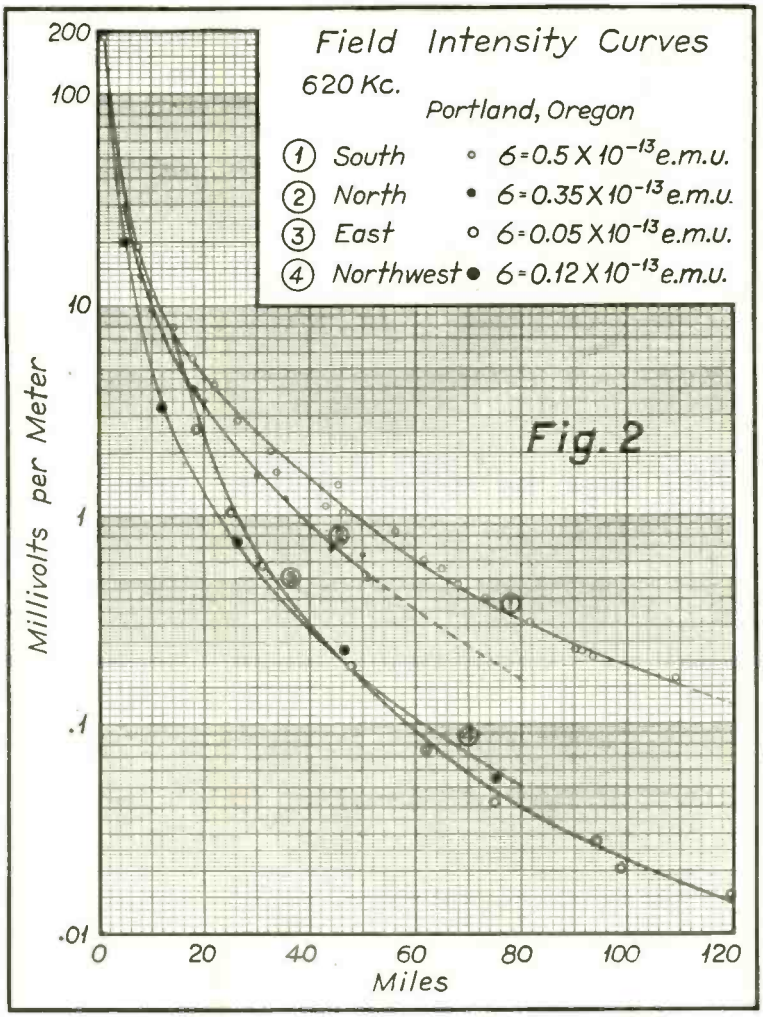
In order to calculate the value of the earth conductivity over any particular route or area by this method, it is necessary to know only the unattenuated field intensity at one mile and the field intensities at various distances.

EARTH CONDUCTIVITY VALUES FOR OREGON

The accompanying curves show the attenuation encountered in western Oregon over the various types of terrain. All measurements have been corrected to correspond to an unattenuated field intensity of 186 millivolts per meter at one mile, which represents closely a radiated power of one kilowatt from a quarter-wave vertical antenna.

The curves of Fig. 1 depict the field attenuation in four directions from Corvallis, Oregon, on 550 kilocycles. The conductivity of the Willamette valley on the north radial is indicated to be 0.5 x 10^{-13} emu. This land is very fertile, moist, and relatively flat, varying in elevation gradually from 100 to 200 feet above sea level; it is representative of the best transmission path in Oregon. South of Corvallis, the terrain is for the most part quite hilly and rolling. The average elevation of cities and towns is about 500 feet, while the hills attain heights of 1000 feet. Because of this, the conductivity is lower than that of the Willamette valley and is determined to be 0.22 x 10^{-13} emu. South of Roseburg, continuing on the same radial, the terrain becomes more rugged with the elevation of the towns approaching 1000 feet and the mountain peaks several thousand feet, and the curve changes slope to indicate a correspondingly decreased conductivity. If data for the Siskiyou mountains, not shown, are included, the average conductivity appears to be about 0.04 x 10^{-13} emu. Data for the Coast range west of Corvallis include all directions between northwest and southwest and indicate a conductivity of 0.09 x 10^{-13} emu. The elevation of this range varies between 1000 and 1500 feet with some towns as low as 150 feet. East of Corvallis, transmission is over the Willamette valley for 25 miles before the Cascade range is reached. Accordingly, the attenuation curve coincides in part with that for the northern radial and then drops off to indicate a value of 0.05 x 10^{-13} emu for the mountains. The elevation of this range varies from 5000 feet at the passes to over 10,000 feet at the peaks.

The calculation of the conductivity



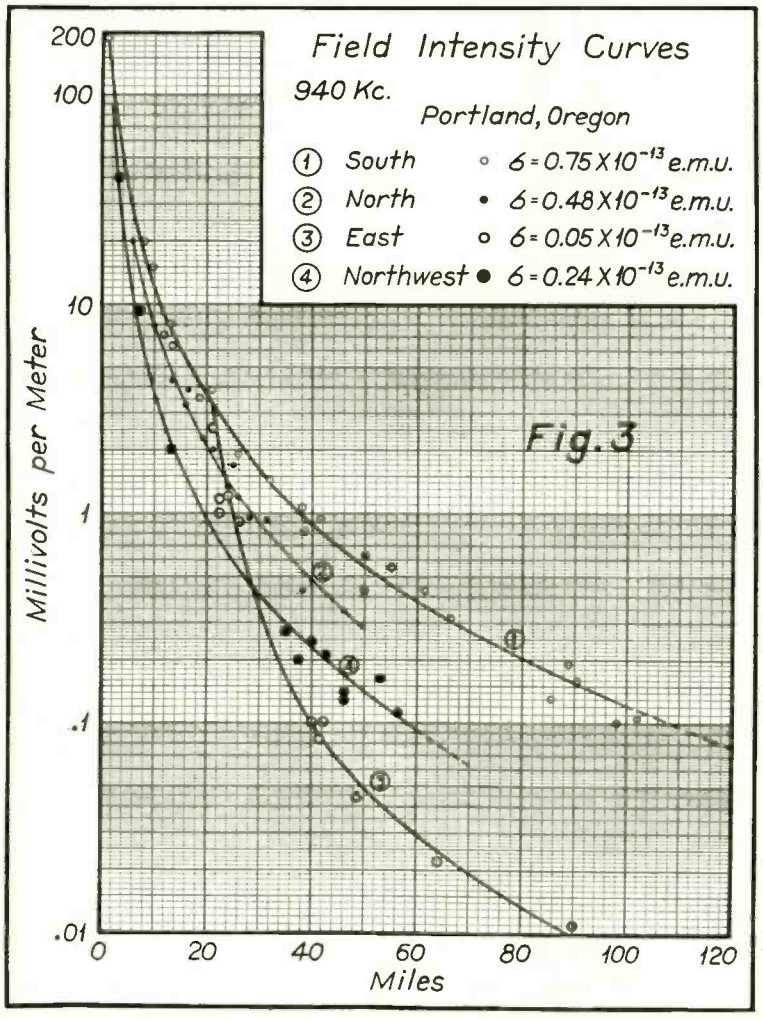
from a curve which has changed its slope is somewhat involved. A simple and sufficiently accurate method is to compare graphically the slope of the curve with slopes of a family of calculated curves for various conductivities at the same frequency. For further information on this subject, reference is made to the discussion by P. P. Eckersley in the July, 1930, *IRE Proceedings*.

The curves of Fig. 2 indicate the normal attenuation encountered in transmission from Portland, on 620 kc. The conductivity indicated for the southern radial in the Willamette valley is 0.5 x 10^{-13} emu which is identical with results on 550 kc. Over the north radial, following the Columbia river and including country in Oregon and Washington on each side of the river, the conductivity is 0.35 x 10^{-13} emu. This appears low for a water route, but is explained by the fact that the path included considerable hilly terrain. The curve for the Cascade range east from Portland indicates a value of 0.05 x 10^{-13} emu identical with results on 550 kc. Northwest from Portland, toward Astoria, a conductivity of 0.12 x 10^{-13} emu is found. This is somewhat better than for the Coast range further south and is due no doubt to the fact that the country is less rugged and lower in altitude with considerable flat agricultural land between the hills.

TABULATION

Earth Conductivity Values for Oregon

Willamette valley	0.5 x 10^{-13} emu
Grande Ronde valley (limited in area) (estimated)	0.5 x 10^{-13} emu
Between Corvallis and Roseburg including Siuslaw and Umpqua River valleys	0.22 x 10^{-13} emu
South of Roseburg to California State line including Siskiyou range	0.04 x 10^{-13} emu
Coast range	0.09 x 10^{-13} emu
Cascade range	0.05 x 10^{-13} emu
Between Portland and Astoria	0.12 x 10^{-13} emu
Blue Mountains and Wallowa Mountains (estimated)	0.05 x 10^{-13} emu
Central and Southeastern Oregon (estimated)	0.3 x 10^{-13} emu



Since the Blue Mountain and Wallowa ranges are comparable in ruggedness and altitude to the Cascade range, it may be estimated safely that the conductivity of that part of the state is close to 0.05 x 10^{-13} emu. A similar analogy would indicate the Grand Ronde valley to have the same conductivity as the Willamette valley. An estimate of the possible value of conductivity for the sandy semi-desert regions of central and southeastern Oregon is 0.3 x 10^{-13} emu.

An interesting and possibly controversial feature is indicated by the curves of Fig. 3 for Portland, on 940 kc. The transmitter location is at an elevation of 1050 feet above sea level, some 900 feet above other transmitter sites. The apparent conductivity south is 0.75 x 10^{-13} emu; north, 0.48 x 10^{-13} emu; northwest, 0.24 x 10^{-13} emu. Eastward there is no appreciable difference, probably because the Cascade range is considerably higher than the transmitter location. It appears from these data that the elevation of the transmitter site is responsible for an appreciable increase in the service area of this site over normally predicted area. Measurements made at other Portland locations at higher frequencies, have given results identical with those on 550 and 620 kc, so that it does not seem reasonable to attribute the results on 940 kc to some cause other than elevation.

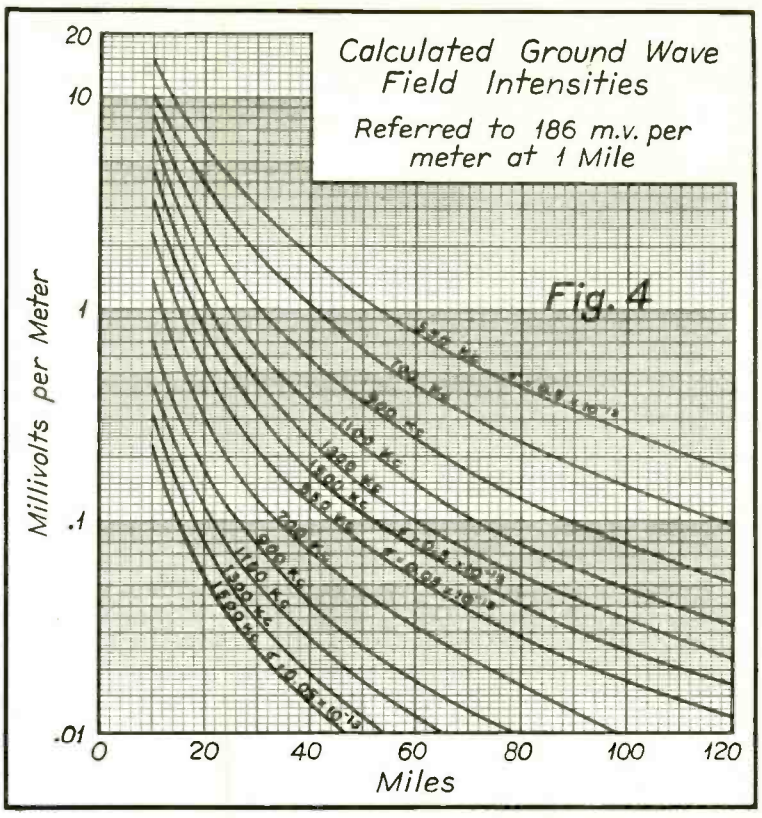
THE EFFECT OF FREQUENCY

It is becoming quite widely known that the use of a high frequency results in a very marked decrease in the service radius of the ground wave. An examination of the foregoing curves will reveal that an increase in frequency from 550 kc to 620 kc will result in a decrease in field intensity of 20 percent and more.

The curves of Fig. 4 show values of ground-wave field intensity for distances up to 120 miles and for frequencies

throughout the broadcast band calculated by means of the Sommerfeld formula for the two extreme values of earth conductivity typical of Oregon: 0.5×10^{-13} emu and 0.05×10^{-13} emu. It is apparent from these data that effective transmission over regions of low conductivity requires a low frequency. Fortunately there are few instances of an appreciable population in regions of very low conductivity so that actual service is not seriously affected from the standpoint of number of listeners.

From equation (3) it is obvious that the numerical distance, for a given transmitting distance, is proportional to f^2/σ. Therefore the same attenuation curve applies to all frequencies provided f^2/σ is constant. For instance, the curve for 1500 kc and a conductivity of 0.5×10^{-13} emu is identical with that for 475 kc and a conductivity of 0.05×10^{-13} emu. This relation may be employed with a set of standard curves such as those of Fig. 4 to predict the attenuation at any frequency and any value of conductivity. An equivalent frequency is determined, for the standard value of conductivity, corresponding to the frequency and conductivity in question. The desired attenuation curve then is that corresponding to the equivalent frequency.



RADIO EQUIPMENT ON NEW TRANSPORTS

(*Continued from page* 13)

switch, located between the volume controls, to the fixed longwave position.

As an additional safety unit, an auxiliary or emergency receiver has been installed aboard each ship. It is located in the forward baggage compartment on the starboard side and is suspended from the ceiling of the compartment directly beneath the short-wave receiver. This emergency receiver may be used to listen to Department of Commerce radio range stations by throwing the band-change knob on the control unit to the "beacon in" position. It may also be used to receive United or any other airline ground stations or planes by leaving the band-change switch in the "out" position. To simplify use of the emergency receiver a list of approximate dial settings has been listed on a frequency chart which is located in an accessible compartment in the pilots' cockpit.

The auxiliary battery for the emergency receiver, located on the port side of the forward baggage compartment and directly opposite the radio bench, is intended for operating the receiver only in case of storage battery failure. Normally, the auxiliary receiver is operated from the plane's storage-battery supply, but should that fail, the battery changeover switch may be thrown to the emergency battery position by breaking the seal on the switch. The auxiliary battery will operate the receiver for approximately four hours. This being a short-life battery a notation is made in the plane's log book if it has been necessary to use this battery. Once the switch seal is broken, the emergency battery is changed at the next ground station regardless of the amount of time it was in use.

The main radio control panel is located on the ceiling of the cockpit and contains switches and fuses for all the Mainliner's radio equipment with the exception of the auxiliary receiver and the 1000-volt dynamotor. There are three switches on this panel that must be in "on" position in order to operate the radio equipment. One is for the short-wave and beacon receiver filaments, one for the receiving dynamotor, and the third for the heater circuits for the crystals in the transmitter and short-wave receiver. Another switch on this panel is the transmit-receiver switch which turns on the transmitter filaments and supplies power to the transmitting dynamotor. Unless the transmitter is in use, this switch is left in the receive position to conserve power.

There are two antennae on each Mainliner. They are utilized by an antenna change switch which connects the beacon receiver to either the regular beacon antenna on the belly of the airplane or to the short-wave antenna on top of the ship (see Fig. 3). For normal operation with the receiver connected to the belly antenna the knob switch is pushed in. To increase the range of the beacon receiver, this knob is pulled to out position. Under these conditions it is not possible for the pilots to utilize the continuous range feature of the pilot's jack boxes, i.e., when using the beacon receiver on the top antenna, range signals are interrupted whenever the transmitter is used.

BROADCAST RELAY TRANSMITTER

FIG. 2. FRONT VIEW OF TRANSMITTER.

THE TWO-WAY airplane rebroadcast between the airplane flown by Bill Lear and radio station WOR, at the time of the arrival of the *Queen Mary*, attracted considerable attention. The same airplane transmitter that was used from the airplane over the *Queen Mary* was also used with an equal degree of success at the Poughkeepsie Boating Meet and on other occasions.

However, since this unit was a more or less temporary apparatus, and since it was principally designed as an airplane equipment, a transmitter particularly designed for broadcast relay work was developed. A rear view of this unit is shown in Fig. 1. This rear view shows the arrangement of tubes, antenna pi network, modulation units and, on the lower shelf, the 12-volt input, 500-volt output dynamotor with its control relay.

The front view (Fig. 2) shows the controls and the shockproof mounting arrangement. By removing four thumbscrews, the whole chassis unit slides out for inspection or service. The little trap door on the top makes it possible to adjust the antenna loading coil.

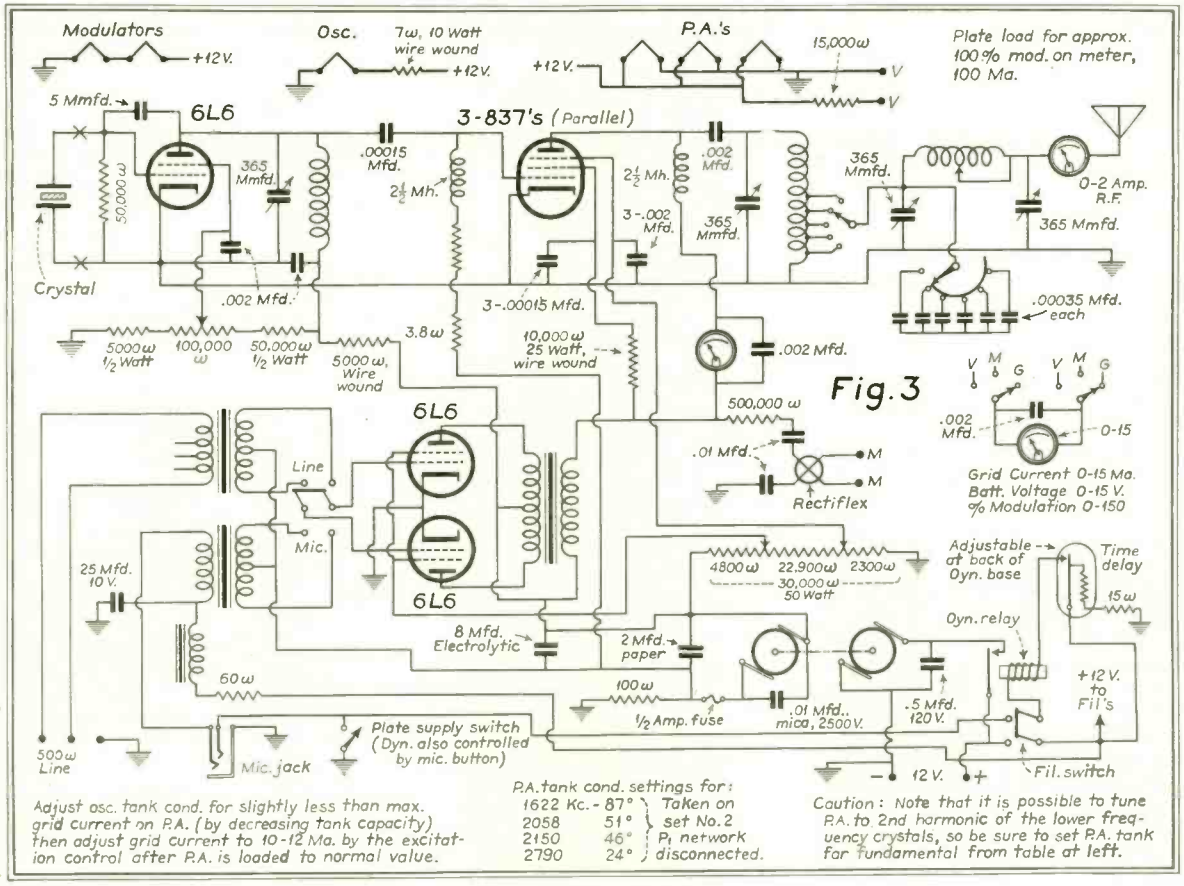
The circuit arrangement is shown in Fig. 3. It will be noticed that three 837 tubes are used in parallel and modulated by two 6L6Gs with a 6L6G as a master oscillator crystal control to drive the three 837 power amplifiers.

The crystal is plugged in on the front of the panel and the tank circuit of the crystal oscillator is tuned by the control directly above it. The left-hand meter reads either grid current in the

FIG. 1. REAR VIEW OF TRANSMITTER.

power-amplifier tube, percentage modulation, or filament voltage. Below and between this meter and the power-amplifier plate-current meter is the power-amplifier plate-tuning condenser. The two controls to the right tune the pi network. The antenna post is in the upper right-hand corner, with the ground post directly below it.

The whole unit is operated from a 12-volt storage battery.

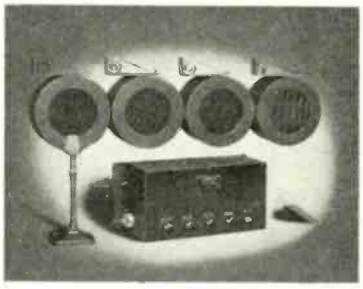


THE MARKET PLACE

NEW PRODUCTS FOR THE COMMUNICATION AND BROADCAST FIELDS

PAGING SYSTEM

The Operadio Model 111 Paging System is suitable for factories, hotels, public build-



ings, theatre dressing rooms and other similar places. The system is supplied complete with contact type crystal microphone mounted on a stand; a special amplifier with its tubes which mounts on the wall at some convenient place near the microphone; a foot switch for use when talking; and a complement of permanent magnet dynamic speakers in attractive steel wall cabinets. Speakers are connected in parallel through a two wire system. Microphone and speaker connections to the amplifier are most simple and require no engineering on the part of the installer. The basic Model 111 Amplifier Paging System comes with four speakers, but additional speakers may be added to this basic system at slight additional cost.

Specifications and further details may be had by writing Operadio Manufacturing Company, St. Charles, Illinois for Catalog 10-A.

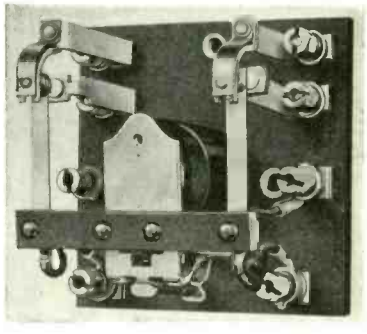
WARD LEONARD RELAYS

Ward Leonard radio-frequency relays are available in two sizes: 15-ampere capacity and 4-ampere capacity.

The midget type with 4-ampere contacts arranged for double-pole, double-throw is available for operation on 6- to 8-volt d-c and 110-volt a-c circuits.

A micalex insulating base and cross arm and 2-in spacing of contact arms insures against leakage of radio-frequency currents.

These radio-frequency relays are designed for antenna change over and for switching directional antennae. The midget size, 3-inch square base, is adapted for mobile installations such as police or aircraft transmitters. They are also suitable for other high-frequency applications.



MINIATURE PANEL INSTRUMENTS

A new line of round and rectangular-design miniature instruments available in alternating-current, direct-current, rectox and radio-frequency types has been announced by the Westinghouse Electric and Manufacturing Company. For use as ammeters, milliammeters, microammeters, voltmeters, millivoltmeters, power-level meters and volt-ohmmeters this line of Type 35 miniature meters are said to be accurate, durable and easily read.

DYNAMIC PICKUP

The Sound Apparatus Co., 150 W. 46th St., New York City, have developed a dynamic pickup to playback lateral cut records. The unit is said to be free from distortion and its constant impedance allows it to be matched to the amplifier at all frequencies instead of a single frequency. The impedance characteristic of the Neumann electrodynamic phonograph reproducer permits sharp cut-off band controlling filters to be used between the reproducer and the amplifier input without any effects on the filter characteristic. The response curve is said to be practically flat from 40 to 8000 cycles.

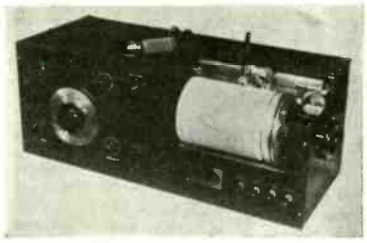
SUPER-UNIMETER

In addition to offering a complete array of a-c and d-c voltage ranges, the new Clough-Brengle Model 95 Super-Unimeter has direct-reading capacity scales to cover all values from 0.00025 to 16 mfd. The resistance ranges allow measurement of values from ½ ohm to 20 megohms.

A complete listing of the voltage and current ranges, as furnished by the manufacturer, The Clough-Brengle Co., of 2815 W. 19th St., Chicago, Ill., is as follows: d-c volts, 0-5-50-500-1000; d-c ma, 0-50-500; a-c volts, 0-8-40-160-400-800; plus five resistance ranges and three capacity ranges.

AUTOMATIC RECORDER

A wholly self-contained a-c operated instrument for producing automatically a



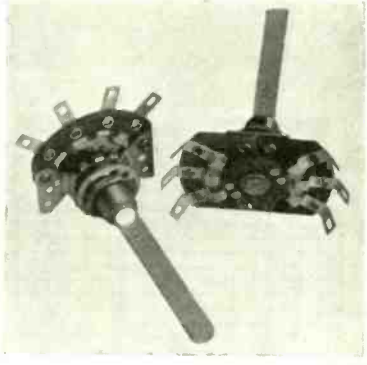
graphic record of the audio-frequency characteristics of a radio receiver, audio-frequency amplifier, audio filter, loudspeaker, transformer, microphone or audio pickup device, has recently been developed by the Tobe Deutschmann Corporation, Canton, Mass.

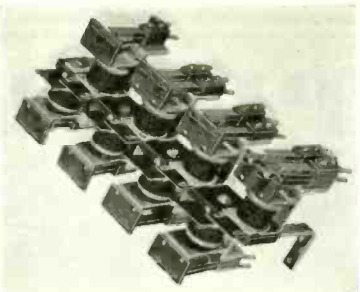
This new instrument, the "Audi-O-Graph," has been designed with a view to meeting the need for practical equipment which will give the design engineer essential information about loudspeaker or microphone performance.

TONE SWITCH

Centralab, 900 E. Keefe Ave., Milwaukee, Wis., have announced a new tone switch shown in the accompanying illustration. It is available in three types: 1-pole 2 positions, 1-pole 3 positions, 2-pole 2 positions. The latter two are illustrated. The common terminal is insulated from the shaft and bushing in all types.

The small size makes the tone switch particularly useful where space is limited. As the name indicates, it is used as a step-type tone control in radio receivers, phonograph switch, sensitivity control, simple selector switch, public-address channel selector, meter-reversing switch, wave-band changing, intercommunicator talk-back, or in new midget oscilloscope circuits.





D-C RELAY

The d-c relays shown in the accompanying illustration are products of the Guardian Electric Manufacturing Co., 1621-27 W. Walnut St., Chicago. The d-c 115 series relay has such features as full-floating permanently-locked armature, ability to remain in operation without heating or sticking, and adjustable air gap with a permanent setting. Standard operating characteristics of the 115 are: 3 watts draw at 110 volts with a 3600-ohm coil. It can be supplied to operate on as low as 1.5 watts.

Complete information may be secured from the manufacturer.

PANEL INSTRUMENTS

A line of low-priced panel instruments with bridge type construction and soft iron pole-pieces has been announced by the Simpson Electric Company, 5216 Kinsie Street, Chicago. This type of construction, states the Simpson organization, has only been available in instruments selling at considerably higher prices. Increased initial accuracy and lasting accuracy over a period of years are the advantages claimed for this construction.

AMERICAN MICROPHONE

The American Microphone Co., 1915 South Western Ave., Los Angeles, Calif., have just announced a multi-purpose, moving-coil, permanent-magnet microphone which is semi-directional in nature. The Model D-5-T is designed for high-impedance input (10,000 ohms). A high-permeability nickel alloy transformer is enclosed in the microphone case. Up to fifty feet of cable may be used with this instrument without frequency discrimination, it is stated.

The Model D-5 has been designed for low-level mixing and for use on long lines. The standard output (50 ohms) will work into any conventional dynamic microphone circuit or input transformer 30-50 ohms to grid.

SKIFTER PADS, RESISTORS

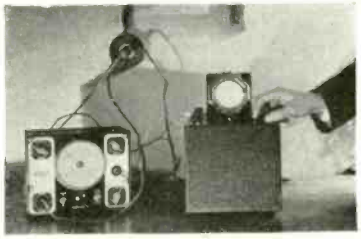
Two new pads for general use in audio circuits and four types of precision resistors have been announced by Hector R. Skifter, St. Paul, Minnesota.

The type P4 pad is designed to plug into a 4-prong tube socket and is 2¾ inches high and 1½ inches in diameter. The type W4 is made in a fibre tube 2 inches long and 1 inch in diameter and is furnished with flexible leads. Accurate wire-wound non-inductive resistors, impregnated in wax, are used and both types may be had in any value of attenuation and impedance.

The precision resistors are made in four types, all are non-inductive and have an accuracy of ½ of 1 percent, and may be had with an accuracy up to 1/100 of 1 percent. The card type is available in any resistance up to 100,000 ohms, and the other types in all values up to 10,000 ohms.

SINE-WAVE GENERATOR

A unit of considerable value around a broadcast station is a source of pure alternating current which may be used to check amplifier distortion on a cathode-ray oscillograph.



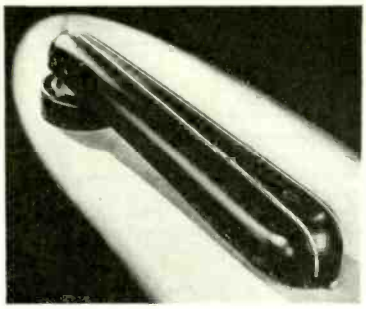
The new Triumph Model 120A signal generator delivers both r-f and a-f or r-f modulated with the a-f in a sine-wave pattern. The generator covers a frequency band of 100 kc to 75 mc and the audio modulation is a tone of 380 cycles.

A calibrated attenuator on the signal generator provides for accurate attenuation of the r-f output from 0 to 50,000 microvolts. The oscillograph in the illustration is a standard Triumph Model 800 3-inch combination oscillograph and linear sweep.

Further information may be obtained from the Triumph Manufacturing Co., 4017-19 West Lake St., Chicago.

WEBSTER ELECTRIC PICKUP

The Webster Electric Co., Racine, Wis., have just introduced their Model 40A-5 magnetic pickup, shown in the accompanying illustration. This unit is said to incorporate the following design features: critically damped armature to eliminate resonance peaks and transient response, coordinated bearing and arm design to maintain compensated bass response and smooth tracking, light construction, vibration-free bearings, vertical and lateral stops, 80° pivoting of vertical bearing to make needle changing easy.



DU MONT CATHODE-RAY TUBE

This tube is of the high-vacuum type with four electrostatic deflection plates, two common, mounted in a glass envelope having a full two-inch fluorescent screen. It is 7⅝ inch overall in length and a large octal base is used. The heater voltage a-c or d-c is 6.3 volts. From 300 to 600 volts may be used on the second anode. The 24-XH is a practical tube for all routine operations where economy and compactness is essential without sacrificing screen area. Full information may be obtained from Allen B. Du Mont Laboratories, Inc., Upper Montclair, New Jersey.

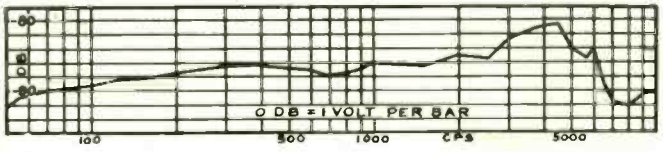
GATES DYNAMOTE

The Gates Dynamote, a remote amplifier for use with dynamic microphones, is shown in an accompanying illustration. This unit, while developed specifically for use with dynamic and inductor microphones, may be used with any type of low-level mike except the crystal.

This unit is built into a light steel cabinet 14 inches wide, 7 inches high and 8 inches deep. Amplifier, mixer and all equipment except output meters are built into a steel frame which fits into the cabinet as one piece.

The amplifier has 4 high-gain stages using glass-metal tubes. Type 6C5 tubes are used in the first 3 stages and type 6F6 tubes in the output. The gain of the amplifier is 95 db including mixer loss. It may be operated from 6 to 180 volts of battery or from a Gates P-3 power supply which uses 84 rectifier and supplies all filament and plate current. Output impedance is 500 ohms.

Complete information may be secured from the Gates Radio & Supply Co., Quincy, Illinois.



FREQUENCY RESPONSE OF THE AMERICAN MICROPHONE

"The Standard by Which Others Are Judged and Valued"

HERE is recording-microphone fidelity, right down to the finest detail. Not since the advent of the pick-up in 1926 has there been a development so important to recorded music. Now . . . listen to absolute *facsimile* reproduction . . . delightful to engineers and laymen alike . . . a real wide-range pick-up performance that has made skeptical technicians say, "That's THE answer to the problem!"

In addition to the remarkable performance of MICRODYNE, it embodies features which, without doubt, will in time be adopted by others. For example, needle insertion is at last made convenient by MICRODYNE—feeding from the top and automatically holding the needle. While a minor matter in itself, this is one of many features which places MICRODYNE in a class by itself. Only 1½ oz. weight on record.

Also available with "offset" head.

Other models for every purpose listing from $9.50 *to* $390.00

AUDAK COMPANY

500 Fifth Avenue New York, N. Y.

"Creators of High Grade Electrical and Acoustical Apparatus Since 1915"

Real

high fidelity

RECORDING

has now been

made possible

as a result

of the NEW

Professional

CUTTING HEAD . . .

pioneered,

as the sound

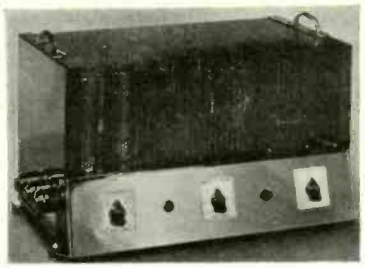
industry would

expect,

by

AUDAX

●



HIGH-GAIN AMPLIFIER

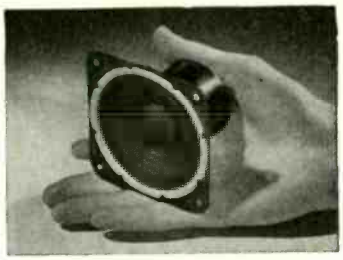
The new DeLuxe 35-watt amplifier marketed by the Radolek Company, 601 West Randolph Street, Chicago, is said to be well suited for all audio-frequency amplifying requirements of high quality.

There are two high-gain input channels designed for high-impedance devices such as crystal or velocity microphones, and one low-gain channel for phonograph pickup or similar device. There are two individual controls for the microphone circuits, one of these controls also varying the gain of the phono input.

The circuit employs the latest type tubes, with type 6L6's in the output, giving 130 db usable gain. The frequency-response characteristics are flat within 1 db from 40 to 9,000 cycles. The output impedance is tapped at 3, 6, 9, 15, 500 ohms with the values engraved on each binding post.

OXFORD SPEAKERS

A complete line of permanent-magnet speakers is announced by Oxford Tartak Radio Corporation, 915 W. Van Buren St., Chicago.



This line comprises speakers ranging in size from 3 inches in diameter to 14 inches. The 3-inch speaker is being featured as the world's smallest permanent-magnet dynamic speaker. Advance inquiries indicates that this speaker will be popular in small a-c, d-c sets and interoffice communicating systems.

In addition to the 3-inch Permag, Oxford has developed a trumpet-type permanent-magnet speaker with a 6-inch cone housing for use with an exponential horn. It is claimed that this job is superior to a dynamic unit with standard field-coil excitation.

Oxford states that a new spun aluminum exponential horn, Model XA22, is now available for use in connection with their Permag trumpet or standard dynamic trumpet. Detailed information will be furnished upon request.

SHURE STETHOPHONE

A new improved non-acoustic piezoelectric stethophone, Model 66A, is announced by Shure Brothers, 225 W. Huron St., Chicago. The new device is designed for pickup of heartbeats and chest sounds reproduction and recording.

Extremely faint noises can be clearly and fully with the stetho which would be difficult or impossi detect with the ordinary stethoscope stethophone is specially designed fo sensitivity to vibrations produced body and insensitive to "air-bor acoustic sounds. An outstanding fea this new model is the anti-feedback

which permits the stethophone to be used near loudspeakers without acoustic feedback.

SPEECH-INPUT ASSEMBLY

The Collins Radio Company, Cedar Rapids, Iowa, have just announced the 12H speech-input assembly shown in the accompanying illustration.

Briefly, the 12H will work properly with any type of microphone. Universal input

connectors are provided. The unit will handle 4 microphone inputs, 2 turntables and 6 incoming lines. The 6 mixing controls and 2 master gain controls regulate the level in the various circuits.

The 12H has 2 main amplifiers channels, one channel for the program and the other for monitoring, auditioning and talk-back. Finger-tip switching allows any desired combination of circuits to be set up. Auditioning with full talk-back may be carried on in one studio while another studio is on the air. Talk-back and cue signalling can be accomplished on any of the remote lines without the use of an order wire. A complete system of relay interlocks is provided for automatic control of studio speakers and warning lights. High-level mixing is employed.

Complete information may be secured from the above organization.

TRU-TAN MODEL B-16 PICKUP

The engineers of the Astatic Microphone Laboratory, Inc., of Youngstown, Ohio, have released their new Tru-Tan Model B-16 Pickup.

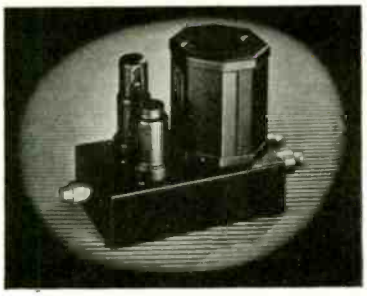
This instrument introduces to the professional field the Astatic Offset Head Design, a refined form of the offset principle which is the European practice.

MICROPHONE DESK STAND

The desk stand shown in the accompanying illustration has just been announced by the Amperite Company, 561 Broadway, New York City. By placing the microphone horizontally, the center of gravity is lowered, making the stand quite stable, and the leaf spring suspension acts as a shock absorber. The microphone can be rotated in practicalily any position, making it useful for pulpit, desk and footlight installations.

UTC PREAMPLIFIER

The United Transformer Corp., 72 Spring St., New York, N. Y., have just brought out a preamplifier which obtains its power supply directly from the main amplifier. It incorporates a 6F5 resistance coupled to a 6C5 providing 60 db of gain. The input is high impedance and the output provides universal line impedance. Filtering is provided in the preamplifier to assure low hum level. If desired, a separate power supply can also be obtained for this unit.



MOBILE TRANSMITTER

The Harvey Radio Laboratories, Inc., of Brookline, Massachusetts, have recently introduced a special transmitter for use in automobiles, trucks, or in other services where remote control is desired.

This unit, called Type UHX-10R, is compact and employs only four tubes. The r-f section employs two 6L6 tubes, one as a crystal oscillator and the other as a power amplifier. The input to the amplifier is 20 watts throughout the frequency range of the transmitter (1.5 to 60 mc). Two type 6N7 tubes comprise the audio system, one of which serves as a modulator and the other as a Class B driver.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGonigle, President, RCA Building, 30 Rockefeller Plaza, New York, N. Y.

MEMORIAL SERVICES

MEMORIAL SERVICES this year will be held at the Wireless Operators Monument which is located alongside the Barge office in Battery Park, New York City, at 1 p.m., Daylight Saving Time, on Saturday, May 29, 1937. The service will include the placing of a wreath by our president, an appropriate address by a prominent speaker and prayer by a local chaplain. We urge our membership and friends to attend these services and pay tribute to our deceased comrades who so gallantly gave their lives in the performance of their duty as wirelessmen aboard ships at sea, on land and in the air. It is believed that Saturday noontime will be more convenient than either Sunday or Monday for the majority of our members and friends.

At noon, E. S. T., on the East coast and, P. S. T., on the Pacific all ships and stations both commercial and government, including the Army and Navy, will observe a one-minute silent period on Memorial Day in reverence to the memory of our departed brethren. This silent-period observance has been sponsored by our Association for some years past and we earnestly request the cooperation of all concerned.

JUNE MEETING

THE JUNE MEETING of the Veteran Wireless Operators Association in New York will be held at Bonat's Restaurant, 330 West 31st Street, New York City, at 6 p.m. on Monday, June 7, 1937. An interesting program is being arranged, and we suggest that those of us who have not partaken of the hospitality of this exceedingly fine French restaurant do so this evening and at the same time enjoy the camaraderie which is ever present at our monthly meetings. A delicious dinner including a cocktail (liquor) is available for the nominal sum of seventy-five cents per person.

MIAMI

HEAR YE! HEAR YE! Brethren of the Dot-Dash Fraternity! The Miami Chapter of our Association will hold its next regular (and we mean "regular") Beer Party and Frolic at the very same congenial "Modern Bar," scene of many of our previous get-togethers, on the evening of May 28—and the first official toast will be imbibed at exactly 8 p.m. So prepare to take a bearing on the Western Union office (or find it with a pocket compass if you can—but however you find it—come) on 79th Street in Little River, Florida, but do not enter unless you wish to dispatch a wire—ascertain that you have found the proper W. U. office by observing that there is an establishment, next door, in which conviviality and good-fellowship are the order of the day (and evening, too) and enter there. You should find yourself in the presence of Messrs. Corrigan and Eberlin, chairman and secretary, respectively, of the Miami Chapter.

MEET A DADDY OPERATOR—On a recent visit to some of the ships along the Miami waterfront "Ebby" upon inquiring for the operator aboard the S/S *Youngstown* of the Lykes Brothers Steamship Company was surprised and delighted to meet Mr. Manning White who presently approaches the budding age of 65 summers and winters and who has been continuously employed as radio officer aboard the *Youngstown* since that day, seventeen years ago, when a spark transmitter was first installed. Mr. White has held first class licenses continuously and has been actively engaged in wireless telegraphy since 1913. "Ebby" believes Mr. White is probably the oldest operator (in age) actively engaged in our profession. We assure Mr. White that a hearty welcome awaits his application which he has promised to forward in the near future.

Wiley Paul is leaving for a few months' tour of the West and rumor has it that he will include a visit to Reno on his trip—not, however, for the purpose that people usually visit that fair city, tho. . . . C. J. Corrigan has been kept so busy attending to details of his contract for servicing Radiomarine ships in Miami that he neglected to provide his usual quota of provender (and a look at the dictionary gives a definition of that last word as "dry food for beasts, as hay, etc."—we're sure those "Bunny" chasers wouldn't care particularly for that type of "hamburger" but we'll have to let it go, now) for the spaniels at the Hialeah dog track. . . . Brother Baarslag, author of "S O S to the Rescue" and "Coast Guard to the Rescue," recently departed Miami for a year's cruise down Alaska way. We wonder whether Karl's prolific pen will set down as interesting a tome about Eskimo life as the aforementioned books during his sojourn among the interesting inhabitants of the Far North. We're looking forward to some notes from Karl while he is away. . . . David Harpley, formerly an operator for the Goodyear Company, is now flying down to Rio for Pan American Airways. Why not drop us a few notes for this page on things you see and do while flying over South America DH? . . . George Rogers, genial superintendent of the Hialeah and adjoining plants, is becoming a confirmed devotee of our meetings and appears to enjoy each and every one of our affairs. . . . "BL," otherwise known as "Ebby" and incidentally our ever-cooperative Miami correspondent-author of the Miami notes included in this page from time to time, has acquired a new Plymouth and with its array of ship decorations has brought his charming wife and daughter Gai Elli to the "big" city for several weeks' vacation during which we hope to see them often. So welcome, "Ebby" or "BL" as he likes to be known, and may your visit to New York be a very pleasant one.

CHAPTERS

HARVEY BUTT, chairman of our Chapters Committee, is about to launch an active campaign for the solidification of Chapters already formed and the establishment of new ones. Mr. Butt will appreciate reports from the various Chapter officers as to the progress made and the problems peculiar to this type of activity. In the very near future Mr. Butt will communicate with all of the chapter executives and impart to them his hopes and aspirations for the further development of active groups within our organization throughout the world. Veteran operators in sections where a chapter is not yet functioning and are desirous of seeing one established should communicate this information, including as much detail as is possible as to potential membership and other pertinent data, to Mr. Butt at the above address.

DUES

STATEMENTS for the current year's dues have been late getting to our membership. We appreciate the support of those members who, nevertheless, sent in their dues. Won't you please examine the contents of your wallets and see whether you have a 1937 membership card. If not, and you do not recollect sending in your dues, just drop us a note and two dollars and we will immediately forward a paid up card, or if our records show you have already paid a 1938 card will be sent you. Thank you.

PERSONALS

F. Wallis joins as a Veteran Member having started radio operating in 1918 and was with the Wireless Improvement Company, Electro Importing Company, Independent Wireless, Federal Telegraph Co., and the Mackay Company . . . Frank Rigby handled the details of the Boston Chapter cruise in grand style and deserves the highest commendation for his wholehearted cooperation in the absence of Harry Chetham, chapter secretary . . . Walter B. Rogers has found time to keep the New York office informed re developments in the Boston area . . . Johnny Walker of Mackay Radio has been very busy getting operators for the boats in the numerous ports around Boston . . . Sam Curtis is moving his school to a new central location near the new Boston Federal Building . . . Ted McElroy is keeping out of trouble and busier than the proverbial one-armed paperhanger completing a navy contract for his speed keys. We think that Ted has something else in mind with regard to the regular telegraph and radio operator's equipment . . . Lt. Waitt in charge of radio communications for Boston police radio, left by aeroplane to the stricken flood area with some fourteen radiomen and radio equipped cars and auxiliary equipment before the Mayor of Louisville sent out his plea for assistance.

THE PHILIPS-MILLER RECORDING SYSTEM

(*Continued from page* 12)

gives the required dimension for the air gap between the pole-pieces and the armature.

Fig. 9 shows the attachment of the sapphire cutter to the armature extension of the sound recorder. When inserting the cutter is pressed against the machined contact surfaces in the direction of the two arrows and is screwed tight by means of a small spanner.

It is naturally desired to obtain an adequate volume of sound from the sound track with a given amplification. The volume range is governed on the one hand by the ground noise, as the softest sounds must still be above the interference level, and on the other hand by the difference in transmission of light between the transparent and black portions of the sound track. For a given width of stationary track this difference in fact determines the maximum variation in the fluctuations of light intensity falling on the photoelectric cell. If T_H is the transmissibility for the bright portion of the strip and T_Z that of the black portion[1], then with 100 percent modulation the maximum amount of light falling on the photoelectric cell, and hence also the photoelectric current generated, is proportional to T_H, and the smallest amount of incident light proportional to T_Z so that the amplitude of luminous intensity is proportional to $T_H - T_Z$. The maximum value of $T_H - T_Z$ is unity, i.e., when the covering layer is completely opaque ($T_Z = 0$) and the transparent layer has nil absorption ($T_H = 1$).

In Fig. 10 the transparency is plotted logarithmically against the "blackening" S, the latter being defined in photography as $S = \log_{10} 1/T$ where T is the transparency. Fig. 10 thus gives directly the required thickness of the covering layer. Little is to be gained by making the blackening of the covering layer greater than $S = 1.4$ ($T = 0.04$) as measured with infra-red rays, which are used for the reproduction, since above $S = 1.4$ the transparency is no longer greatly reduced.

The covering layer of the Philimil strip consists of a black mercury sulphide sol which is easily prepared by chemical means and which, similar to other metallic sulphide sols and metal sols, possesses a high covering power. No granulation can be observed even under the microscope in the mercury-sulphide covering layer, if it is carefully prepared. A comparison under the microscope of a high-frequency registered by the Philips-Miller process with the same frequency registered photographically is given in Fig. 11.

The sound track on the Philimil tape has the same desirable characteristics as the ordinary film: a longer playing time (30 to 60 minutes), the possibility of cutting and splicing, and the production of copies photographically. In addition all operations with the film strip can be carried out in daylight, the sound track is more sharply recorded since no granulation and dispersion of light in the photographic emulsion occur, the ground noise is reduced and high frequencies are recorded with better fidelity. Perhaps the most striking advantage offered by this method, however, is that the sound-track can be reproduced immediately after the recording process has been completed.

[1]The transparency is $T = I_1/I_0$ where I_0 is the intensity of the incident light and I_1 the intensity of the transmitted light.

•

TELEVISION STUDIO CONSIDERATIONS

(*Continued from page* 15)

that the situation at the instant of entrance can be made apparent to the audience. The next question that is asked is, "Who is the person that has entered?" This calls for a close-up as a means of introduction. From this point on the camera can use either the long or intermediate shots for general action and the close-up or semi-close-up for details. In all of this we must gear the story to the camera or vice versa. It would be foolhardy to attempt to catch a close-up that was worthy of reproduction while the character is in full motion and conversely a long shot of a stationary figure would soon become a tiresome still on the receiver.

It will pay the studio engineer to consider his script from these angles and ascertain whether or not ample opportunity has been provided for proper camera employment.

These are a few of the considerations that confront the production staff in a television studio today. As program work develops, problems that for the time seemed extremely puzzling will find their answers and other more complicated situations will appear to take their place. Here the ingenuity of the engineering staff will find full play in devising new apparatus to satisfy these specifications or in applying time-tested devices to new usage.

Studio work still remains primarily an engineering job. A knowledge of art, optics, photography and lighting, however, contribute their appreciable share to a broader understanding and perhaps a more satisfactory solution of the studio production problem.

(*To be continued*)

IRE CONVENTION

(*Continued from page* 10)

equivalent to a pure capacitance shunted by other pure capacitances in series with resistances. Through the use of circuits and apparatus associated with the oscilloscope (see Fig. 7) the equivalent values of a condenser in direct and retarded capacitance, may be determined by a process similar to that used in balancing an artificial line. A bridge system is set up and the known condenser is balanced by a pure capacitance shunted by a number of branch circuits consistingo f capacitance and resistance in series.

RADIO TRANSMISSION

In their paper on *Characteristics of the Ionosphere and Their Application to Radio Transmission,* T. R. Gilliland, S. S. Kirby, N. Smith and S. E. Reymer, National Bureau of Standards, presented results of ionosphere measurements near Washington, D. C., made at normal incidence over the period May, 1934 to December, 1936 inclusive.

TELEVISION

High-Current Electron Gun for Projection "Kinescopes," by R. R. Law, pointed out that one of the problems in the art of reproducing a scene by television is to secure an image of adequate size. Because of this there has been considerable interest in projection systems where a small, high-intensity image reproduced on the face of a projection "Kinescope" is thrown onto a viewing screen of the desired size by a suitable optical system. The light output of these systems has been limited by the inability of the electron gun to provide a sufficiently large beam current in a small spot.

This paper described an electron gun giving large beam current in a small 13—Broadcasting—Poulis-105—May 17 spot. The design of this electron gun is based on the results of the present investigation which show that the ratio of the current in the first cross-over inside the radius r to the total space current is:

$$I/I_s = 1 - \varepsilon^{-ar^2E}$$

where E is the voltage applied to the first-cross-over-forming system and a is a constant for any given cathode temperature, potential distribution and geometry. Inasmuch as the total space current varies approximately as $E^{3/2}$, the concentration of current in the first cross-over increases very rapidly with voltage.

A description is given of an electron gun based on this theory. All available voltage is used to form a small intense first cross-over whose edges are sharply defined by a first-cross-over-defining aperture. A magnetic final focusing lens reimages this first cross-over on the fluorescent screen. This electron gun gives beam currents of 1.5 to 2 milliamperes at an operating potential of 10 kilovolts. This beam current may be readily concentrated into a 300-micron spot on the screen when the electron gun is spaced at such a distance from the screen as to give a 2.4 x 1.8-inch image. In conjunction with an f-1.4 lens having a focal length of 12 cm, this projection "Kinescope" has a light output sufficient to give an 18 x 24-inch picture having highlights with an apparent brightness of about 2.5 foot-lamberts when viewed on a 480% directional screen.

An Oscillograph for Television Development, by A. C. Stocker, RCA Manufacturing Co.: Development of high-fidelity television with its essentially transient signal wave shapes, demands an oscillograph with unusually good transient response. Frequency vs response characteristics have proven of small value in the development of such an instrument. An oscillograph having exceptionally accurate response to transient waves and sine-wave response flat from 20 cycles to 2000 kc was described in detail. Test methods using transients of known wave shape were described, and some comparative results given.

Development of the Projection "Kinescope," by V. K. Zworykin and W. H. Painter RCA Manufacturing Company, discussed the general requirements and design of "Kinescopes" for projecting television images. A picture 18" x 24" in size having a brightness in the highlights of 0.9 candles per square foot appears to be an acceptable minimum for home television reception. Several years of developmental work were required before the problems of designing a suitable projection system were clarified. This clarification led to a developmental "Kinescope" which approaches the minimum brightness requirements.

A paper that attracted considerable interest was *A Circuit For Studying "Kinescope" Resolution,* presented by C. E. Burnett, RCA Manufacturing Co. In this paper the problems of synchronization were discussed. It was necessary to produce synchronization practically free from periodic phase shift between frequencies varying from 30 cps to approximately 2 megacycles. The degree of stability which was obtained with the synchronizing circuits that were developed is illustrated by the fact that photographs can be made of the resolution patterns produced on the "Kinescope," by using a 15-second time exposure. Figs. 9 and 10 are typical examples of the results obtained.

Television Pickup Tubes with Cathode-Ray Beam Scanning by Harley Iams and Albert Rose, RCA Manufacturing Co.: A cathode-ray beam scanning a target will ordinarily generate video signals if the optical image projected on the target causes either a corresponding distribution of potentials over the target surface, or a corresponding variation of the secondary-emission properties of the target surface. A distribution of potentials may be effected by light in a variety of ways: by photoemission, photoconductivity, photovoltaic action, or thermoelectric action. A change of secondary-emission ratio with light is more difficult to obtain, and has been observed in only one tube using a caesium-sensitized silver-oxide photocathode as target. Tubes in which the target consisted of aluminum oxide or zirconium oxide treated with caesium, a thin layer of selenium, a thin layer of germanium, or a copper plate oxidized and treated with caesium have been found to operate by a distribution of potentials over the target surface caused by light.

It is not necessary that the light be focused upon the target which is scanned by the electron beam. In some tubes the light was thrown upon a photocathode, and the electron picture was focused upon the target by magnetic or electrostatic fields. The secondary emission resulting from the electron picture produced a distribution of potentials over the target surface sufficient to generate video signals during the scanning by the electron beam.

Each of the types described has certain characteristics which may, for certain applications, be desirable. The sensitivity is high in devices which project an electron picture upon an insulating target. A large amplitude of signal is obtained with some of the photoconductive materials. Thermoelectric materials should respond to radiation invisible to the eye.

The Brightness of Outdoor Scenes and its Relation to Television Transmission was the title of a paper by Harley Iams, R. B. Janes and W. H. Hickok, RCA Manufacturing Co. Until the last few years devices for the converting of light into television picture signals have required a very large amount of light to give a useful signal. Today, it is practical with such electronic devices as the "Iconoscope"* to transmit pictures of outdoor scenes, even on cloudy days.

In the transmission of outdoor scenes with an "Iconoscope" a lens is used to focus the picture on the "Iconoscope" mosaic. The intensity of illumination of the mosaic depends on the surface brightness of the object, irrespective of the object distance. Consequently sur-

*Reg. Trade Mark, RCA Mfg. Co. Inc.

face brightness, measured in candles per square foot, is used. The first part of the paper was concerned with the surface brightness of a variety of scenes and its variation with the weather and the time of day and year. The values of surface brightness that have actually been measured with a brightness meter for hundreds of typical scenes have been largely depended upon. Examples of these measurements picked particularly from those of low surface brightness were given. The effect of various weather conditions on the brightness of one scene was also given in graphical form. It was found that the brightness of different scenes varies from nearly 0 to over 1000 candles per square foot.

The second part of the paper dealt with the sensitivity of the "Iconoscope." A series of tests made about two years ago with one of the best "Iconoscopes" then available indicated that an average surface brightness of 50 candles per square foot was sufficient for a satisfactory picture if an f-4.5 lens was used. Today quite faithful reproductions of scenes with a surface brightness of 15 candles per square foot can be transmitted with an f-4.5 lens. Scenes having as low a surface brightness as 2.5 candles per square foot have been reproduced with an f-4.5 lens, but these pictures have little entertainment value.

TUBES

The *Effects of Space Charge in the Grid-Anode Region of Vacuum Tubes* was another interesting paper. It was presented by Bernard Salzberg and A. V. Haeff, RCA Manufacturing Co. According to the authors the main effects of the space charge are to introduce departures from the linear potential distribution of the electrostatic case; to set an upper limit to the current which can be collected at the anode, the value of this maximum current being a function of the grid-anode spacing and grid and anode voltages:

$$(I_a)_{max.} = 2.334 \times \frac{(V_g{}^{1/2} + V_a{}^{1/2})^3}{a^2} \times \text{Area (amp)};$$

to introduce instabilities and "hysteresis" phenomena in the behavior of the tube; and to increase the electron transit time in this region.

Figs. 12 and 13 are oscillograms taken on a tetrode used to verify theoretical results. These exhibit the instabilities and "hysteresis" phenomena which may occur due to the presence of space charge in the grid-anode region of vacuum tubes. Fig. 12 shows the relation between anode current and anode voltage, for fixed values of control-grid and screen-grid voltages. Fig. 13 shows the relation between anode current and control-grid bias, for fixed values of anode voltage and screen-grid voltage.

OVER THE TAPE...

NEWS OF THE RADIO, RECORDING AND SOUND INDUSTRIES

CUNNINGHAM RESIGNS FROM RCA

David Sarnoff, president of the Radio Corporation of America, has announced the resignation of E. T. Cunningham as president of the RCA Manufacturing Company, Inc. Mr. Cunningham continues as a member of the RCA Manufacturing Company Board of Directors, and has been retained as counsel on production, sales and trade relations.

LEAR BULLETIN

A new bulletin issued by Lear Developments, Inc., 121 W. 17th St., New York City, contains considerable information on the T-30, R-3 aircraft transmitter-receiver combination. This bulletin is available from the above organization.

INDUSTRIAL WIRING GUIDE

"Industrial Guide for the Proper Selection of Wire and Cable" is a 32-page publication designed to help clarify present-day practice involving the selection and application of wire and cable.

Factors affecting the selection of wire and cable and the importance of up-to-date wiring designs are discussed. Colored layouts illustrate typical power-supply circuits and tables covering practical limitations to be considered are included in these discussions.

Nine charts for recommending insulation and protective coverings to meet exposures and conditions of use are so arranged as to make for ease in selecting the wire or cable for different industrial circuits. For your copy, write to the Anaconda Wire and Cable Company, 25 Broadway, New York, N. Y.

KENYON CATALOG

Kenyon Transformer Co., Inc., 840 Barry St., New York, N. Y., have announced a newly revised edition of their T line catalog. The Kenyon T line is a medium priced line of audio and power components suitable for p-a and amateur applications. This 16-page catalog is illustrated with numerous schematic diagrams of audio amplifiers, modulators, call systems, electronic mixers, and a volume expander.

SOLAR CATALOG

"Solar Radio Capacitors" is the title of a new 28-page catalog issued by the Solar Manufacturing Co., 599-601 Broadway, New York, N. Y. Complete data is given on the Solar line of capacitors. Write for Catalog 8-S.

HARDWICK, HINDLE BULLETIN

Hardwick, Hindle, Inc., 40 Hermon St., Newark, N. J., have just announced Bulletin No. 237 which describes in detail their standard line of power rheostats. This bulletin supersedes all other literature pertaining to rheostats of their manufacture. It is available on request.

SMPE SPRING CONVENTION

The Spring Convention of the Society of Motion Picture Engineers will be held at the Hollywood-Roosevelt Hotel, Hollywood, California, from May 24th to 28th inclusive. While the schedule for the technical sessions has not yet been announced, it is anticipated that several sessions will be held in the evenings.

UNIVERSAL MICROPHONE BIRTHDAY

The modern, three-story factory building of the Universal Microphone Co., at Inglewood, California, is the outgrowth of a one-man business, and James R. Fouch, founder and president of the organization, will hold open house on May 5th when its ninth birthday is celebrated. During the early days of broadcasting, Mr. Fouch was the owner and operator of stations KMIC, Inglewood, and KFWC, Pomona.

COLOR CODE CHARTS

A convenient chart, of vest pocket size, illustrating the standard RMA mica capacity color code, has been made available by the Cornell-Dubilier Corporation, South Plainfield, N. J. The compactness of the modern mica capacitor has necessitated the substitution of a color code for the usual numeral capacity identification.

POLICE-RADIO BULLETIN

Bulletin GEA-2497, on police-radio equipment, has just been issued by the General Electric Company, Schenectady, N. Y. This bulletin describes GE's Type G-6, 50-watt ultra-high-frequency transmitter (30 to 42 mc) and accessories. This bulletin may be obtained from the radio department of the above organization.

DUMONT OSCILLOGRAPHER

The *Dumont Oscillographer* is a new publication issued monthly by the Allen B. DuMont Laboratories, 542 Valley Rd., Upper Montclair, N. J. This organ will be devoted to giving technical data on and applications of cathode-ray tubes and oscillographs. Those interested should write the above organization.

CATALOG ON GRAPHIC METERS

The Esterline-Angus Company, Indianapolis, has just issued a new 88-page catalog describing its complete line of graphic instruments. The book illustrates seven types of instrument cases, twenty-one different chart drives and twenty-four kinds of meter elements.

"THE GRAMOPHONE RECORD"

"The Gramophone Record," reviewed in the February, 1937, issue of COMMUNICATION AND BROADCAST ENGINEERING, is now available in this country through Van Nostrand Company, 250 Fourth Ave., New York City.

MECK PRESIDENT ELECTRONIC DESIGN CORPORATION

The board of directors of a newly-formed entry into the radio-electric field, the Electronic Design Corp., has just announced the appointment of John S. Meck as president and general sales manager. Factory and general offices are located at 164 North May St., Chicago, Illinois, where their Vocagraph sound equipment line is now in production. Plans call for manufacturing and merchandising through regular jobber channels of a complete array of sound amplifiers and accessory equipment.

REMCO BULLETIN

Bulletin SE-1 describes the Remco 95A sound effects reproducer for broadcast studio, recording and theatrical use. This reproducer is a product of the Radio Engineering and Manufacturing Co., 26 Journal Square, Jersey City, N. J. The bulletin may be obtained from them.

MAGNETIC RELAYS

Ward Leonard Electric Co., Mt. Vernon, N. Y., have just issued a bulletin on magnetic relays. Bulletin 131 lists more than 100 relays for heavy-duty (1 to 25 amperes) on d-c and a-c circuits. These relays are particularly adapted for transfer purposes.

The bulletin also gives valuable coil and contact data, contact arrangements, dimensions and enclosures.

USE CATALOG

The United Sound Engineering Co., 2233 University Ave., St. Paul, Minnesota, have just issued a 16-page bulletin covering their line of microphones, loudspeakers, and portable and permanent sound systems. This catalog will be sent free on request. Write for Catalog No. 107.

HAMMARLUND BULLETIN

A very attractive and complete bulletin has been released by The Hammarlund Manufacturing Co., 424-438 West 33rd St., New York, N. Y. This bulletin contains complete technical data on the new Model Super-Pro. It may be secured by writing to the above organization.

AEROVOX IN CANADA

The control of the Polymet Delta Company of Hamilton, Ontario, Canada, has been taken over by the Aerovox Corporation. Henceforth the Canadian plant will operate as Aerovox Canada Limited. It is reported that negotiations have been going on for over a year.

COAXIAL CABLE BULLETIN

Victor J. Andrew, 7221 South Francisco Ave., Chicago, Illinois, has just issued Bulletin 72 on coaxial cables. This bulletin will be sent free on request.

INDEX TO ADVERTISERS

You wouldn't send this lad on your sales errands....

. . . yet you are producing just as harmful an impression if your transmitter is putting out a poor signal . . . a signal which doesn't have a sales chance of being listened to alongside distortionless transmitters.

No matter how modern your transmitter, you cannot expect it to operate month after month with the same degree of fidelity as it did when originally installed and adjusted. Serious and unavoidable distortion may be introduced in *any* broadcast transmitter through changes in tube or circuit characteristics.

With the G-R Type 732-A Distortion & Noise Meter the total distortion can be checked in *10 seconds*. It's so simple that many stations using this instrument log the distortion regularly with other operating data.

This meter not only gives you a constant check on transmitter distortion but also on noise and hum throughout the entire system from audio line to antenna. Measurements can be made rapidly and accurately to isolate residual noise level, excessive hum, noisy tranmitter tubes, unbalanced rectifiers, noise in a-f amplifiers and studio or pick-up lines.

As a companion instrument the Type 733-A Oscillator is designed for use as a constant-frequency 400-cycle tone. Both the Type 732-A and Type 733-A instruments are completely self-contained, self-operated, relay-rack mounted, a-c operated and are furnished complete with tubes and all necessary accessories for immediate operation.

Type 732-A Distortion and Noise Meter **$220.00**

Type 733-A Oscillator **$62.00**

Write for Bulletin 121-K for complete data

GENERAL RADIO CO.
CAMBRIDGE, MASS.

MEET F.C.C. REQUIREMENTS

● Federal Communications Commission Rule 139, paragraph A, requires that no broadcast transmitter have more than a total of 10% combined audio harmonic when operated at a modulation level of at least 85 per cent. Systematic use of the Type 732-A Distortion and Noise Meter will tell you immediately whether or not this rule of the Commission is being complied with in your station.

AMPERITE VELOCITY MICROPHONES

Distinguished in Performance, Design, and Construction Used in Leading P.A. Systems.

Considered by P.A. Men As the Greatest Values in Microphones Available Today.

PERFORMANCE!
"A magnificent instrument. . . . Despite the climate here, results are marvelous and could not be bettered. I am sure." — D. Hopkins. Raffles Hotel, Singapore.

DESIGN!
"Your streamline mike is going over big with our trade. Congratulations on its fine design and performance." — R. Ruben Saugus, Mass.

CONSTRUCTION!
"We believe no other mike could take the punishment it has and still give such excellent reproduction." — Johnston P.A. Service, Oneonta, N. Y.

VALUE!
"The finest type microphone that I ever used. . . . Please duplicate my order." — Ridley's P.A. Systems, Inc., Tulsa, Okla.

FEATURES

The Amperite Velocity is compact, streamline, modern. Embodies the latest technique in microphone design, featuring . . .

1. Output increased 6 DB.
2. Triple Shielded—against all RF or magnetic fields, entirely eliminating hum pickup.
3. Eliminates feedback troubles.
4. Excellent for close talking and distant pickup.
5. Acoustically designed to eliminate any possibility of cavity resonance.

LEADING MODELS

MODELS RBHn (High Impedance); RBMn (200 ohms); with cable connector and switch,
$42.00 LIST
Chrome, or Egg Shell. . . . . $43.00 LIST

MODELS RBSn, RSHn, streamline design, slightly lower output than above, with switch only,
$32.00 LIST
With cable connector. . . . . $34.00 LIST

FINISHES: All microphones have the new standard gunmetal finish.

Chrome or Egg Shell,
extra $1.00 LIST

OTHER PASTEL SHADES
extra $2.00 LIST

A POPULAR AMPERITE VELOCITY . . . . . $22.00 LIST

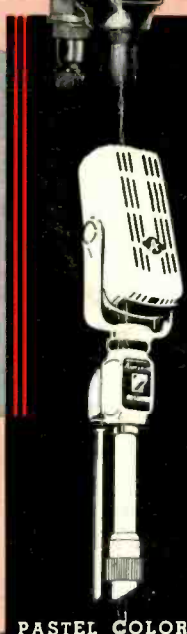
A Velocity Microphone of very high excellence. Built to Amperite standards. Used for both speech and music with great success. No peaks. Flat response over audible range. Output,- 68 db. Triple shielded. Fitted with shock absorber and swivel bracket. MODEL RAL (200 ohms) with 8 ft. of cable; MODEL RAH (2000 ohms) high impedance, with 12 ft. of cable.
$22.00 LIST
CHROME OR EGG SHELL. . . . . $23.00 LIST

FREE TRIAL OFFER TO STUDIOS

A Two Weeks' Trial Offer of the Amperite SR-80 Velocity is extended to broadcasting studios only. No deposit, obligation, or strings attached. Give the SR-80 an exhaustive two weeks' test. Then you may either return the microphone or keep it on our very attractive terms. Write, specifying either MODEL SR-80 (low impedance); or SR-80 H, high impedance. LIST $80.00, with New Special Discount to Studios.

AMPERITE JUNIOR

A "lapel" Velocity of surpassing quality. Size of a match box. Ideal for lectures and specialty acts. Can be hidden under coat. Output constant with any position of the head. Transformer included in microphone case. MODEL 7J (200 ohms); or MODEL 7J-H (2000 ohms) . . . $30.00 LIST



PASTEL COLORS on Microphones and Stands.

Amperite now furnishes microphones and stands in EGG SHELL or other pastel finishes to suit decorative schemes. The stands feature the patented positive, non-sliding clutch. Complete line of desk, banquet, floor and studio stands. Available in Chrome or Egg Shell at $1.00 LIST extra per stand.

Write for Bulletin ST-66

FREE: WINDOW DECAL

A striking window decal advertising your SOUND SERVICE. Size, 5¼x9¼, finished in 4 colors.

Free to Jobbers, Dealers, and Service Men. Write for it today.

AMPERITE Company 561 BROADWAY, N. Y. U.S.A. CABLE ADDRESS ALKEM, NEW YORK

VELOCITY **AMPERITE** MICROPHONES