NOVEMBER, 1934

Radio Engineering

DESIGN • PRODUCTION • ENGINEERING

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- Auto-Radio Receivers
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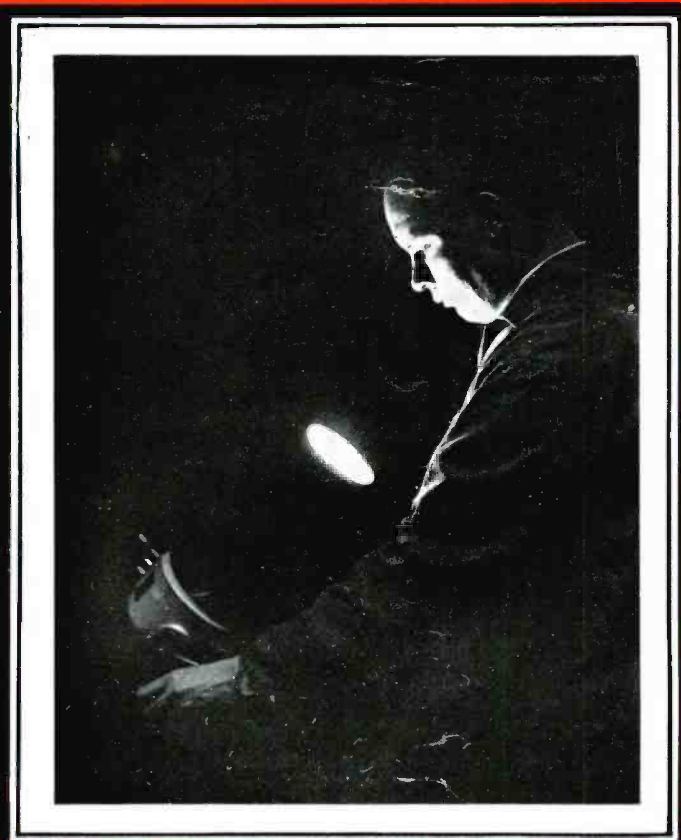

VOL. XIV NO. 11

The Journal of the Radio and Allied Industries

UNITED STATES RUBBER COMPANY

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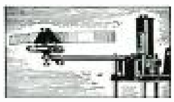
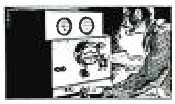


INSULATION RESISTANCE
K=54000 in formula
$R = K \log_{10} \frac{D}{d}$



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By change Specific Inductive Capacity method. • Specific Inductive Capacity after one day in water, not to exceed 4.0. • Increase in Specific Inductive Capacity at the end of 1st to 14th day, not to exceed 10.0%. • Increase in Specific Inductive Capacity at the end of 7th to 14th day, not to exceed 4.0%.

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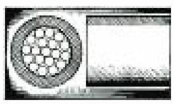
¼ inch set in 2 inches stretched to 10 inches; release; one minute interval prior to measurement



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AN OPEN LETTER TO THE RADIO INDUSTRY

INDUSTRIAL concerns, eligible to borrow funds from the Reconstruction Finance Corporation for the purpose of maintaining and increasing employment, have not yet taken full advantage of the assistance which the Corporation is prepared to extend.

Congress provided that such loans might be made to industrial and commercial businesses subject to the following requirements:

(1) That the business must have been established prior to January 1, 1934.

(2) That such loans be adequately secured.

(3) That maturity of loan must not exceed five years.

(4) That borrower must be solvent at the time of disbursement of the loan.

(5) That credit at prevailing bank rates for loans of the character applied for not be available at banks.

(6) That reasonable assurance of increased or continued employment of labor be given.

(7) That the aggregate of such loans to any one borrower made directly or indirectly shall not exceed $500,000.

(8) That such other provisions as the Reconstruction Finance Corporation may impose be complied with.

The Directors of the Reconstruction Finance Corporation feel that these loans should be made in such a way that the available funds can be utilized as fully as possible for the advance of permanent business recovery. This objective can be accomplished best if the moneys loaned by the Corporation are used principally to supply funds for the payment of labor and the purchase of materials incident to the normal operation of the business, rather than for the payment of existing indebtedness, though in exceptional cases a small part of the loan may be used for payment of existing debts or for the financing of construction, improvements and/or repairs that do not materially increase capacity. When a loan is to be used primarily for labor and materials, a small portion of the loan may be applied to these latter purposes when necessary to assure ordinary and efficient operation.

The Corporation will make loans in cooperation with banks, or by the purchase of participations in loans made by banks. In cases of national banks, only the bank's participation in such loans, rather than the full amount of the loan, must be within the legal limit which may be loaned to any one customer, and accordingly this plan will allow substantially greater credit to be extended through such channels to borrowers who are already borrowing up to their legal limit.

The depression years have left many enterprises in very much involved and weakened positions, but our experience has led us to believe that where present creditors are willing to cooperate by a proper adjustment of existing debt structure, many such enterprises may be safely supplied with additional funds that will enable continuing operations on a sound basis.

Accordingly, we suggest to industrial concerns, to which credit at prevailing bank rates for loans of such character is not available but which can offer adequate security (even though such security may be frozen and therefore not generally acceptable to banks) and which can profitably use additional funds for labor and materials, that they communicate with the local loan agency of this Corporation serving the territory in which such concerns are located.

Each Loan Agency of the Corporation will, when requested, assist and advise with applicants in determining their eligibility and in the preparation of applications.

JESSE H. JONES, *Chairman*
Reconstruction Finance Corporation
Washington, D. C.

RADIO ENGINEERING

Reg. U. S. Patent Office

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Associate Editor

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USING CATHODE-RAY OSCILLOGRAPH TUBE FOR CRITICAL STUDY OF TUBE NOISES
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DEPARTMENTS

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BUILT-IN PROTECTION

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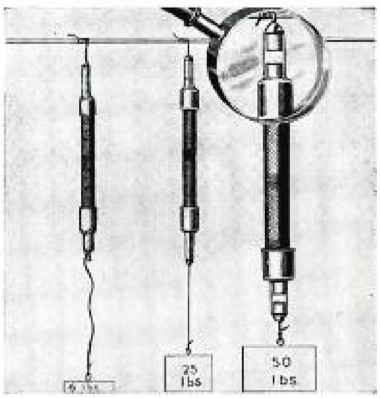
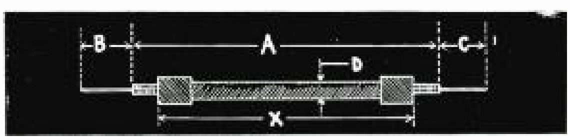


Left, above—Competitive make flexible resistor.
Center, above—Old type Clarostat flexible resistor.
Right, above—New "Clinch-Grip" flexible resistor.

Clarostat "Clinch-Grip" flexible resistors are a new series of units made and sold exclusively by us . . . superior in quality . . . yet priced competitively with carbon resistors.



"X" Directly proportional to watt dissipation.
Type "FX"—Watts per inch = one-half. "D" = 1/8 inch.
Type "FY"—Watts per inch = one. "D" = 1/4 inch.
"A" = "X" + 1/2 inch.
"B" = "C" = 2 inches. (Std.)
All linear dimensions ± 1/8 inch.

RESISTANCE TOLERANCE: ± 10% and not more than 1% change of original value when entire resistor is wound upon a 3/8 inch diameter arbor.

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TERMINALS: No. 24 B & S tin-coated copper wire.

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STANDARD STOCK:
All popular resistance values and sizes "FX."

In design "Clinch-Grip" flexible resistors are trim. In accuracy, the commercial tolerance is maintained at ±10%. In ruggedness and tensile strength, their new design permits them to exceed manufacturers requirements from 250% to 500%. The R.M.A. color code for resistance values is used throughout. Production facilities permit unlimited quantities on short notice.

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EDITORIAL

MIDGETS AND CABINETS

THE INTRODUCTION OF high-gain tubes and multi-purpose tubes made possible the development of receivers of small dimensions. Subsequent refinements in tubes, components and circuits have served to lift the midget set out of the novelty class and place it in line with the larger and more expensive receivers for home use.

The margin of profit on a midget receiver has been necessarily small. In many cases there has been no profit at all. Nevertheless, it cannot be denied that were it not for the midget receiver the present-day radio audience would be smaller by millions.

The midget receiver is the best radio salesman this industry ever had. The small set has brought radio to millions of people who could not have afforded it in any other way. It has done what we could not have done in any other conceivable manner—made radio one of the *necessities* in practically every home in the land. It has therefore developed a huge, potential market for new and better receivers and, if handled properly, a market which may never again become completely saturated.

The midget receiver has paved the way for the all-wave receiver, the auto-radio receiver and the high-fidelity receiver. It has also paved the way for *more expensive midget receivers* having sensitivity, selectivity and tonal characteristics equal to the console set.

A well-conducted survey of homes should lead to some very interesting results. We suspect it would be found that most women and some men prefer a good midget receiver, even though its price may approach that of a console receiver. We also suspect the reason to be that the average purchaser wishes the radio to be unobtrusive in the general scheme of room furnishing, not necessarily because the radio is unsightly, but because it is next to impossible to procure a console receiver with a cabinet designed to match the plan of the room in which it is to be placed. The upshot is that a midget receiver is purchased.

Some receiver manufacturers have attempted to get around this objection by the design of console cabinets that are heterogeneous in form, being neither this nor that. The result in many cases is a cabinet having no particular character and therefore even more objectionable than one of definite stamp.

It is a pity that radio manufacturers are incapable of offering the potential purchaser some choice in console cabinets for each model receiver. So far as we are able to learn, such a plan is economically impractical. If this be the case, there is still the opportunity of applying the same scheme to the higher-priced midget receiver for which there is an ever-growing demand. It would not be necessary that the cabinets be rigid examples of period design; it would be sufficient that a single, simple design be offered in maple, mahogany, walnut, etc.

We can hear possible objections to such a plan on the grounds that; first, the manufacturer is again open to the small-margin-of-profit curse; second, that really fine tone quality cannot be obtained with small baffle areas; third, that small receivers are inimical to efficient all-wave circuit design: fourth, that it would retard the growth of high-fidelity reception. Our answers to such objections would be about as follows: The midget receiver is getting too large for its pants. It is growing into a slightly larger, well-made, higher-priced unit, with a sufficient margin of profit. Tone quality can be obtained without the use of any baffles whatsoever, as evidenced by some recent developments. The larger type midget, using the new tubes of reduced dimensions, is not too small to reduce the efficiency of the all-wave circuit design. As for high-fidelity, we have just scratched the surface. There is no reason to believe that it cannot be adapted to a receiver of small dimensions.

RADIO ENGINEERING

FOR NOVEMBER, 1934

EXTENDING VOLUME RANGE

Methods for the Extension of the Volume Range of Broadcast Programs and Proposals Relative to Their Use at the Transmitter and Receiver

THE BROADCAST LISTENER is entitled to hear the program from his loudspeaker exactly as he would hear it were he in the broadcast studio. Naturalness involves faithful reproduction of all notes with equally relative intensities, without any additions or subtractions and with proper directional effects. That is to say, there are four requirements for any high-fidelity system designed for the transmission and reception of entertainment, and these requirements may be stated as follows:

1. A wide frequency range
2. A wide volume range
3. There must be nothing added and nothing subtracted
4. Auditory perspective.

Anyone who has had the privilege of studying, working with, or listening in on our present-day high-fidelity radio receivers realizes that there is still something to be desired for full program appreciation. A great deal has been heard about wide frequency ranges, and acoustics, but little has been written on the second high-fidelity requirement mentioned above; namely, wide volume range. Certainly part of what is lacking in our present high-fidelity reception can be traced to an insufficient volume range; and it is equally as important as any one of the others mentioned. The purpose of this article is to point out the importance of and to give a brief description of a few wide-volume-range systems that have been developed.

VOLUME-RANGE LIMITS

Briefly, it appears to the listener that loud passages of music never quite attain the volume they should, and it is also quite obvious that in most cases the low passages have had their volume increased. In other words, there seems to be an unnatural effect to the program caused by the volume of the loud passages being lowered and the volume of the soft passages being increased. This is exactly what is done in broadcast programs by the monitoring operator. Under present conditions it is necessary to change the volume of programs, but let us see why.

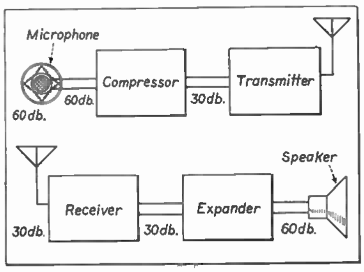

Fig. 1. Block diagrams of compressor-expander system.

With the present set-up there are certain factors that limit the volume range than can be broadcast. These limits are set on one hand by noise and on the other by distortion.

There is a certain amount of hum and hiss in transmitters and associated apparatus, which is carried along by the carrier wave, and which will appear in the loudspeaker as background noise. There is also a certain amount of noise in the ether. This interference is at times quite severe, and it also appears in the loudspeaker as background noise. In addition, there is a certain amount of noise in the receiver itself, though this noise may, in general, be pretty well covered up. All of these forms of interference contribute to the background noise that appears in the loudspeaker, and may, if it is attempted to broadcast too wide a volume range, obliterate the low passages entirely.

Distortion is, in general, caused by overloading. This factor sets the upper level in a similar manner to which the background noise sets the lower limit for the volume range that can be broadcast. The result is that all programs are to some extent "doctored" by the monitoring operator before they are put on the air. That is, variations in loudness are made at the transmitter by varying the depth of the modulation of the carrier, the degree of modulation being proportional to the volume. This means that a carrier modulated 100 percent contains a lot more energy than does one modulated, say, 50 percent, and so if the carrier is not sufficiently

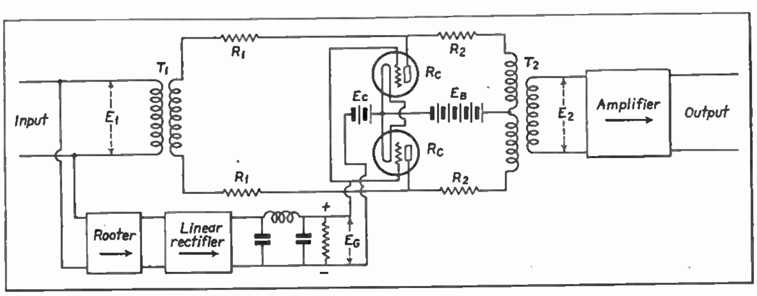

Fig. 2. Compressor circuit employed on long-wave radio-telephone system, controlled from the input.

modulated the accompanying noise will appear at the loudspeaker. Consequently, there must be sufficient modulation to give an adequate signal-to-noise ratio.

COMPRESSOR-EXPANDER SET-UP

Between the limits of noise and overloading we have left only a range of 30 or 40 db. This, then, is the range that is in use at present at both ends of the broadcast system; namely, receiver and transmitter. Comparing the 30- or 40-db range broadcast with a range of 70 db for a symphony orchestra, it is readily seen why there is considerable room for improvement in this respect. One method of overcoming this difficulty lies in fully modulating the carrier and then by some means compressing the 70-db range to a suitable value before transmitting, expanding again at the receiver end. Such methods can be worked out, and in fact there are already a number of systems in use for expanding and contracting, or compressing, volume ranges.

Now, in Fig. 1 is shown a block diagram which illustrates the idea of a compressor-expander set-up. For convenience, we shall assume that the desired volume range is 60 db. The system shown consists of a mike which picks up a program having a 60-db range, followed by a piece of apparatus known as a compressor. This latter piece of apparatus is generally a simple vacuum-tube circuit that performs the function of compressing the volume range, and in one system is known as a square rooter, or more often, simply as "rooter," performing in this system the function of taking the square root of the volume range, which amounts to nothing more than halving the db. As shown in the diagram, the db volume range is halved in the compressor, being contracted to 30 db at the point of entering the transmitter. The signal picked up at the receiver still, of course, has only a 30-db range but in the expander circuit, which is inserted between the receiver and the speaker, it is doubled so that we have a 60-db range delivered to the speaker. The expander performs exactly the inverse function of the compressor and hence is very similar in design.

EXTRANEOUS ROOTS

From the above description and diagram the whole idea appears quite simple and in reality the apparatus is just that. It also appears that by similar apparatus we might compress the volume range to any desired amount and undo the whole procedure at the other end of the system. To a certain extent this is true, but we are also reminded of a certain problem in algebra which serves well to illustrate what may happen if the proper precautions are not taken.

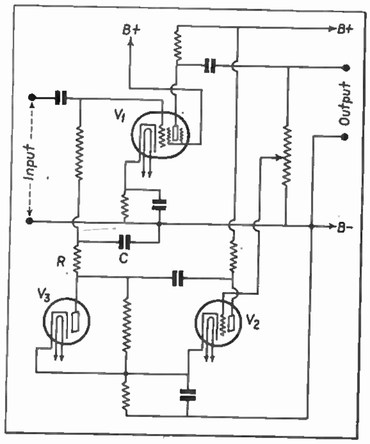

Fig. 4. Another compressor or contractor circuit. The degree of compression is adjustable by means of a potentiometer.

Let us say that

$$X = A.$$

Multiplying both sides by X gives

$$X^2 = AX$$

and if we subtract A^2 from both sides we have

$$X^2 - A^2 = AX - A^2.$$

Factoring results in

$$(X - A)\ (X + A) = A\ (X - A).$$

Dividing both sides by X — A leaves

$$X + A = A$$

which obviously does not satisfy the original equation.

Extraneous roots may in a like manner be introduced into expansion-contraction circuits if they are not properly designed. Obviously if such a thing happens our high-fidelity requirements as set up at the beginning are not followed, for something has been added. These extraneous roots appearing in the output may be of a number of forms, such as, harmonics, sum and difference frequencies, etc. It is necessary, then, to exercise a certain degree of care in the design of such circuits, if good results are to be expected from them.

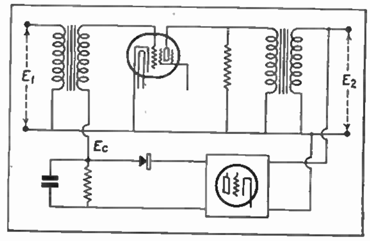

Fig. 5. A compressor somewhat similar to the one shown in Fig. 4. This circuit will handle a range of 70 db.

While improved results can be had from the use of only an expander at the receiver end of the circuit, the ideal condition is to have a complete compressor-expander system. So let us begin at the transmitter and consider a few compression circuits.

COMPRESSOR CIRCUITS

Now let us glance at the schematic of a circuit that is in use for compression purposes on a long-wave transatlantic radio-telephone system[1]. As we see in Fig. 2, the input feeds into a transformer T_1 from the input side of which voltage is tapped off and sent through a square-rooting device and then through a linear rectifier. The square rooter takes the square root of the voltage and the rectifier changes it to dc. This dc voltage, E_g, is poled to buck the voltage E_c which is applied to the grids of the two control tubes (R_c) connected in shunt to the circuit. The plate voltage is furnished by the battery which has a plate potential of E_b.

When a loud passage comes through, the voltage E_g becomes larger and reduces the grid voltage, since it is bucking E_c, and hence has the effect of decreasing the impedance looking out from the primary of transformer T_2. In other words, the two control tubes have a similar action to an automatically variable shunt across T_2, the internal impedance of the tubes being variable with their grid bias. This effectively decreased impedance across the circuit decreases the volume. For low passages,

[1] *Bell System Technical Journal*, July, 1934, "The Compandor—An Aid Against Static In Radio Telephony," by R. C. Mathes and S. B. Wright. *Communication and Broadcast Engineering*, November, 1934, "The Voice-Operated Compandor" by N. C. Norman.

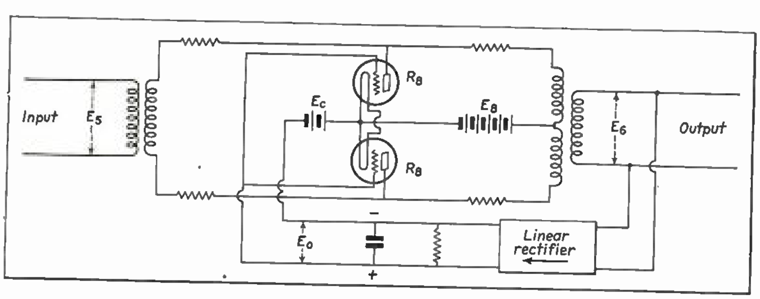

Fig. 3. A compressor circuit similar to the one shown in Fig. 2, but without a square rooter in the rectifier circuit. It is controlled from the output.

the voltage E_g is smaller, giving less bucking voltage, and resulting in more normal grid bias voltage. Effectively, this increases the impedance looking out from the primary of transformer T_2. That is, the loud passages are decreased in volume by the lower shunt impedance of the control tubes and the low passages increased giving a compression effect. In reality the center part of the circuit of Fig. 2 is similar in action to a variable pad.

Fig. 3 is the schematic of another form of compression circuit[1]. It will be noticed that no square rooter is used in the rectifier circuit. It will also be noticed that the rectified voltage, E_o, bucking the bias voltage, E_c, of the control tubes is taken from the output rather than the input. By the proper adjustment of circuit constants the control tubes have been made to perform the functions of a square rooter, which is equivalent to taking the voltage from the input and actually passing it through a square-rooting device. In its action this circuit is similar to that of the circuit shown in Fig. 2.

In Fig. 4 is shown still another form of contractor circuit[2]. In this circuit, the tube V_1 is connected in shortly after the microphone, so that all the modulating is done after the signal has passed through the circuit. Tube V_2, connected on the output side, acts like an amplifier to increase the signal voltage to such a point that it will operate V_3, the diode rectifier. This rectified voltage in turn is fed back to the grid of V_1. Adjustment of the input to V_2 controls the rectified voltage from V_3 and hence the bias voltage applied to V_1, and thus serves as a control device for the volume range by varying the amplification of the tube V_1. The degree of reduction of this volume range may be further changed, if the above system fails to provide sufficient compression, by connecting two or more tubes in cascade in the place of V_1. This contractor will handle a 70-db range.

Fig. 5 shows the schematic of yet another volume compressor circuit[3].

[2] *Wireless World*, August 24, 1934, Page 150, "Expanding the Music" by A. L. M. Sowerby, M.Sc.

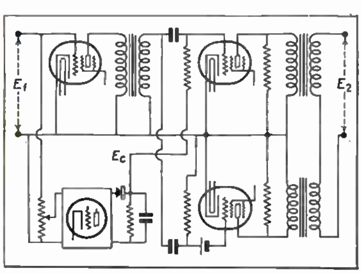

Fig. 7. Expander circuit capable of handling a 70-db range.

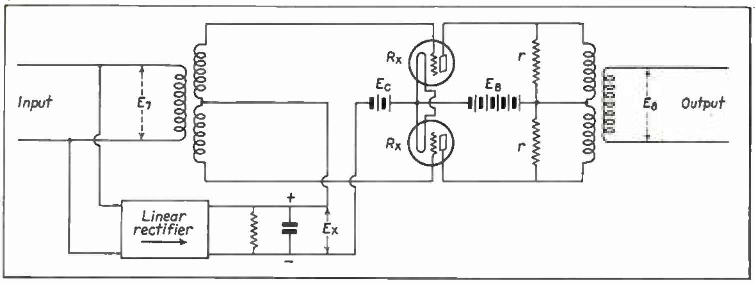

Fig. 8. Another push-pull expander circuit the operation of which is based on the relative plate impedances of the tubes as influenced by their grid bias.

Fundamentally this system is very similar to the one in Fig. 4. The input is taken from the output side, amplified, rectified, and placed on the grid of the control tube. As shown in the diagram, E_1 is the input voltage, E_2 the output voltage, and E_c the rectified voltage. This circuit will also handle a range of 70 db.

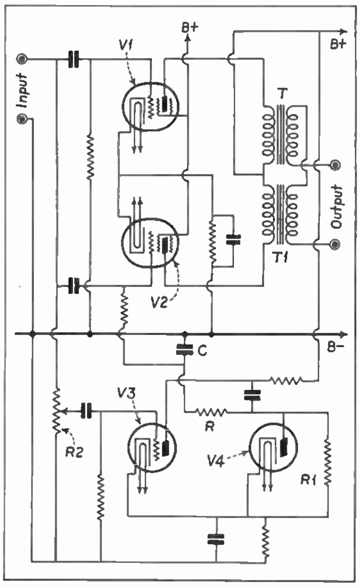

Fig. 6. Simple four-tube expander circuit. The range is controlled by the potentiometer R-2.

EXPANDER CIRCUITS

Now let us consider a few circuits of the inverse type, or expanders. These will also be found to be quite similar in fundamentals, differing for the most part in minor design characteristics. Fig. 6 shows a simple expander circuit[2] that uses four tubes of which V_1 and V_2 are audio amplifiers having separate output transformers. The secondaries of these transformers are connected series opposing. The bias voltages placed on these tubes are such as to give them unequal amplification. This makes the resultant voltage on the output the difference between the amplifications of the tubes V_1 and V_2. Now by adjusting the difference in amplification so that the output signal is equal to the input signal, the signals will be passed with no increase in volume.

A brief study of the circuit will indicate that a portion of the input signal is picked off and sent through V_3, where it is amplified, and is then fed to the rectifier V_4. The dc voltage from V_4 is used to bias the grid of V_2. Hence if a strong signal is fed to the input of the amplifier, a large negative bias will be placed on V_2 from V_4. The result is, of course, a larger difference in the relative amplifications of V_1 and V_2, and this appears in the output. A weak signal will not produce an appreciable negative bias voltage across the diode load resistor R_1, because the diode is negatively biased by the drop in voltage across the resistor common to the cathodes of both V_3 and V_4. Therefore there is little if any diode current until the signal voltage is sufficient to overcome the diode bias. Small signals will not then be effected by tubes V_3 and V_4 but will pass directly through the system and consequently be almost balanced out.

Potentiometer R_2 in Fig. 6 controls the voltage picked off for V_3 and V_4 and hence may be used as a means of controlling the amount of volume expansion. This circuit is capable of expanding the volume range to at least 70 db.

The volume expander[3] shown in Fig. 7 is very similar in operation to that of Fig. 6. Here again the expansion method depends upon the difference in amplification of two tubes . . . the amplification being adjusted by the difference in grid biases. The secondaries of the output transformer have therefore been connected so as to be opposing. The overall result is that low passages will pass through the circuit with but little amplification, and the loud passages will be amplified to a considerable extent. This unit is capable of expanding to 70 db.

The third expander circuit[1] is shown in Fig. 8. Here the main part of the

(*Continued on page* 13)

[3] May, 1934, *Proceedings of The Institute of Radio Engineers*, "High Quality Radio Broadcast Transmission and Reception" by Stuart Ballantine, Page 614.

BOOK REVIEWS

ELECTROMAGNETISM, *by H. M. MacDonald, published by G. Bell & Sons, Ltd., London, England,* 178 *pages, cloth covers.*

To attempt to do justice to the subject of electromagnetism in less than 200 pages is indeed an ambitious undertaking. It follows that if the subject is to be treated without slighting many of its ramifications, it is necessary to make a selection of the particular problems to be treated. While this book is far from a complete compendium of information on the subject, it does treat many of the most important problems in considerable detail.

The author states at the beginning that his object is the development of a consistent scheme for the representation of electrical phenomena and the derivation of the more immediate consequences of the fundamental laws from the fundamentals of electromagnetism. The book includes a discussion of the general equations of electrodynamics, application to material media and to conducting media, diffraction, radiation, resonance, and moving electrical systems. The relations developed rest on the hypothesis that electrical effects in free space are propagated in accordance with the laws of Ampere, Fresnel and Faraday. The author starts by setting up the field equations for electric and magnetic force in free space as originated by Faraday and leads naturally to a mathematical representation of the results of the Fresnel-Arago experiment performed in 1816 which indicated that electromagnetic waves polarized in perpendicular directions did not interfere in free space. The analogue of Green's theorem that the potential at points outside a closed surface due to fields inside the surface can be expressed in terms of the electric and magnetic fields tangential to the surface is developed.

Such a treatise is necessarily highly mathematical, and while the author seldom departs from the standard methods of differential equations, the going does become heavy and somewhat involved in spots. However, for the reader who can "take his mathematics or leave it alone" this book should prove highly interesting. The author covers all the more important problems of electromagnetics in considerable detail and with admirable clarity, once the reader becomes familiar with his methods of analysis.

The chapter on radiation and resonance is of particular interest to the radio engineer. For example, the derivation of the resultant radiated field from a number of simple sources of like frequency and varying phases is the basis of most calculations of the resultant fields of synchronized radio transmitters. Most antenna problems could be solved by starting with the equations developed for the radiation from the ends of free and terminated conductors in which electrical oscillations exist.

The book is replete with references for the reader who desires to follow further some of the more detailed ramifications of electromagnetic theory. The book is intended for the advanced student and should be an excellent text. It can also be recommended to the physicist who is interested primarily in theoretical considerations rather than applications of the theory of electromagnetism.

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STANDARDS ON ELECTRICAL INSULATING MATERIALS

COMPRISING ALL OF the A.S.T.M. specifications and test methods covering electrical insulating materials, and the annual report of Committee D-9 on Electrical Insulating Materials, this compilation presents under a single cover standards that are in widespread use for testing and evaluating these materials.

The 1934 edition includes in their latest approved form 21 standardized methods of test and 12 specifications. The method of testing molding powder used in manufacturing molded electrical insulators has not been published heretofore. During 1934, revisions were made in a number of the test methods including those covering the following materials used for electrical insulation—varnishes, solid filling and treating compounds, untreated paper, sheet and plate materials, varnished cloths and cloth tapes, laminated tubes and round rods, and electrical porcelain.

Changes in conducting the following tests were also approved this year: Power factor and dielectric constant, resistance to impact, and thickness. Specifications which have been revised cover the following materials: black bias-cut varnished cloth tape, friction tape, rubber insulating tape, asbestos roving and asbestos yarns and tape.

The current report of Committee D-9, covering 28 pages, outlines the major points of interest in the extensive research and standardization work under way and includes a modified Baader saponification test for insulating oils. Also given are proposed specifications for rubber insulating blankets for use around electrical apparatus or circuits not exceeding 3,000 volts to ground.

In addition to materials and subjects mentioned in the preceding paragraphs, the following are covered by specifications or tests: flexible varnished tubing, rubber gloves, rubber matting, electrical cotton yarns, silk and cotton tapes, pasted mica and slate.

Copies of this publication aggregating 284 pages, in heavy paper cover, can be obtained from A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia, at $1.75 per copy. Special prices are in effect on orders for 10 or more copies.

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RCA HANDBOOK SERIES

THE RCA Handbook Series are divided into three parts namely, the HB-1, HB-2, and the HB-3.

The "All Types" RCA Tube Handbook, HB-3, combines in one volume the material of the RCA Receiving Tube Handbook (forming the first section) and the material of the RCA Transmitting Tube Handbook (forming the second section). Provision is made for the inclusion of a third section to contain data on cathode-ray tubes and other miscellaneous special-purpose types. Sheets for this miscellaneous section will be issued in the near future.

The respective sheets show not only the main use for which the particular type was designed, but also its rating, typical operating conditions, characteristics, interelectrode capacities, base connections and overall mechanical dimensions. In addition, full size sheets showing the more commonly used families of static and dynamic characteristics curves have been included. All curves have been plotted to easily readable scales and are sufficiently large to be useful for engineering design purposes.

The Transmitting Tube Handbook (HB-2) consists of the second section of HB-3, while the RCA Receiving Tube Handbook (HB-1) is made up of the first section of HB-3.

The handbooks have been placed on a subscription basis to partially cover costs and to limit its distribution to those who have real need for the data it contains.

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PHOTOELECTRIC CELLS, *by N. R. Campbell and D. Ritchie, published by Sir Isaac Pitman & Sons, Ltd., London, England (U. S. Representative, Pitman Publishing Corp., N. Y.), third edition,* 223 *pages, cloth covers, list price* $3.75.

Many readers will remember the first and second editions of this book, it being

(Continued on page 22)

I.R.E. ROCHESTER FALL MEETING

THE ROCHESTER FALL MEETING OF THE INSTITUTE OF RADIO ENGINEERS WAS A PRONOUNCED SUCCESS. OPTIMISM PREVAILED ON ALL SIDES. THE COMING YEAR SEEMS BRIGHT TO BOTH THE ENGINEERS AND THE MANUFACTURERS, WITH FULL PRODUCTION SCHEDULES LINED UP. THE I.R.E. ELECTED FOR ITS NEW PRESIDENT, STUART BALLANTINE, OF THE RADIO FREQUENCY LABORATORIES. TECHNICAL PAPERS DELIVERED WERE INDICATIVE OF THE RAPID PROGRESS BEING MADE IN ALL BRANCHES OF THE FIELD.

SPECIAL DISTRICT meetings of the Institute of Radio Engineers have for the past several years been held in Rochester, New York, and as a result are now known as the Rochester Fall Meetings. The 1934 Fall Meeting was held on November 12, 13 and 14, the place being the Hotel Sagamore in Rochester. This meeting should be considered as a joint meeting of the Institute of Radio Engineers, the Radio Club of America, and the Radio Manufacturers' Association.

ATTENDANCE

The attendance was, as was nearly everything that was at all connected with the meeting, unusual. With the surprising number of some 250 being registered by Monday night and the figure probably running well over 300 before the conclusion of the program, the meeting may well be said to have been a distinct success. Congratulations are due Mr. Virgil M. Graham, Executive Chairman, for the splendid way in which the entire program was handled.

TECHNICAL SESSIONS

The technical sessions, which were held in a special meeting room on the roof of the hotel, featured such timely subjects as Iron-Core Tuning Systems, Automatic Reactance Control Systems, High-Fidelity Reproducers, Detector Distortion, Diode-Coupling Considerations, Cathode-Ray Tubes, Centimeter Waves, Ultra-High Frequencies, Converter Tubes, High-Frequency Input Losses in Vacuum Tubes, New Equipment for the Radio Designer and Engineer, and Radio Interference.

The entire day of the fourteenth was devoted to the subject of radio interference with reference to the desirability of reduction of interference from the viewpoint of the consumer, the public utilities, the radio manufacturer, the radio dealer, and the Federal Communications Commission. Following this, two papers were presented. The first paper was by H. O. Merriman, Radio Branch, Department of Marine, Canada, and the second was by J. H. Dellinger, United States Bureau of Standards, the subjects being *Investigation and Suppression of Inductive Interference* and *Radio Interference Work of the Lisbon Conference* respectively. Lastly there was a discussion by interested organizations on promotion of interference reduction. This technical session was a joint affair of the Institute of Radio Engineers and the Radio Manufacturers' Association.

Of outstanding interest, to this reviewer at least, was the paper on *Putting the Ultra-High Frequencies to Work,* by L. C. F. Horle, Consulting Engineer, and C. J. Franks of the Radio Frequency Laboratories. Mr. Horle pointed out the desirability of the use of ultra-high frequencies from the viewpoint of economics in the actual construction costs, power required, and interference, and discussed the findings of the experimental setup on which he has recently been engaged. The demonstration which followed the presentation of this paper was very interesting and well conducted.

Two other papers received considerable comment. The paper, entitled *Transmission and Reception of Centimeter Waves,* was presented at a joint session with the Radio Club of America; and had its accompanying demonstration of centimeter waves. This demonstration probably caused more favorable comment than any other one, and credit should be given to I. Wolff, E. G. Linder, and R. A. Braden of the RCA Victor Company. The second paper, entitled *New Equipment for the Radio Designer and Engineer,* was given by C. J. Franks of the Radio Frequency Laboratories.

That intensive interest in these subjects exists was clearly shown by the size of the groups that attended the technical sessions and by the criticalness of this audience.

ENTERTAINMENT

While group luncheons were held on Monday, Tuesday, and Wednesday and a group dinner on Monday night, the outstanding feature in the entertainment program was the informal stag banquet held Tuesday night, this banquet being attended by a group of approximately 220. The toastmaster for the evening was W. E. Davison, of Canada, and the feature speaker was Judge John W. Van Allan. Judge Van Allan cited the friendliness and cooperation that had always been present between the United States and Canada in the radio field, and sent back greetings with those Canadians present at the meeting.

President C. M. Jansky announced the results of the Institute of Radio Engineers' election of new officers . . . the body has as its new President, Stuart Ballantine.

The RCA Victor 16mm. sound film was demonstrated and served to carry the greetings to and from the Australian members of the Institute of Radio Engineers by means of a mutual exchange of films. The demonstration was well received.

EXHIBITORS

The exhibition of component parts, manufacturing aids, measuring devices, and the like also attracted considerable interest and brought to the attention of those present the numerous new products that have recently been placed or will be placed on the market. There were in all some 35 companies represented.

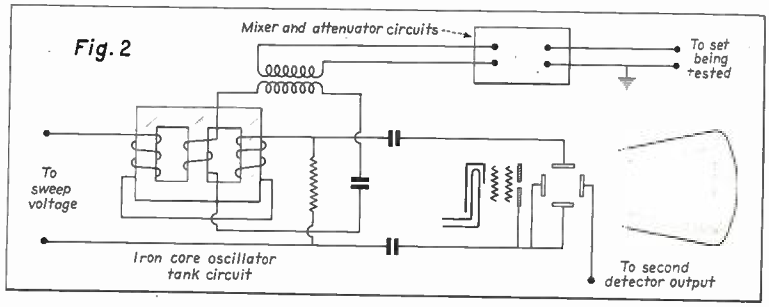
CONCLUSION

All in all, the Rochester Fall Meeting of the Institute of Radio Engineers was a very pronounced success. A general feeling of optimism seemed to prevail, and talks with engineers and personnel of the different organizations brought to light the fact that most of these companies have a full production schedule ahead of them. The radio industry and its allied fields seem to have progressed far towards complete recovery.

Receiver Production Tests

By S. BAGNO and J. SADOWSKY
EGERT ENGINEERING, INC.

THE MOST UNIVERSALLY useful piece of test apparatus in existence is the cathode-ray tube. Hitherto, widespread use of this device has been largely restricted by its high cost and the complexity of the associated equipment. Recently, certain new designs have overcome these objections, and there has been made available for the general market a number of compact, self-contained oscilloscope units built around the cathode-ray tube. With most of these units it is possible to run any desired tests for power factor, modulation percentage, resonance and band-pass characteristics.



Electrical cathode-ray resonance indicator, using the saturation characteristics of an iron-core oscillator for providing the sweep.

Essentially, the cathode-ray tube is simply a voltmeter that can respond to an instantaneous change in voltage because its pointer, being an electron stream, has practically no inertia. Also. the deflection can be anywhere in a plane depending on the magnitude of two voltages at right angles, instead of a straight line response as we get on the ordinary voltmeter. By displacing the electron stream horizontally as a direct function of time or frequency, or any other ordinate, and displacing the other voltage directly as the resultant of that ordinate, we can obtain any desired characteristic curve on the screen of the oscilloscope.

RECEIVER TEST APPLICATIONS

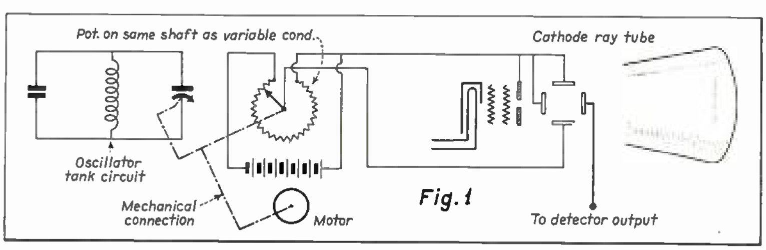
There are three applications that are of special importance in radio test work, and these three applications are the essence of this article. The most important of these applications is checking the response characteristics of tuned circuits. These characteristics are especially important since they control both the selectivity and the fidelity of a receiver.

Since a broadcast station transmits a carrier and a great many sidebands, it is obvious that these sidebands must not be attenuated, for if they are, part of the intelligence transmitted is attenuated with them. The ideal selectivity curve for a selective input system in a radio receiver is therefore a flat-topped one with perpendicular sides.

POWER FACTOR

In order to have maximum energy transfer from one tuned circuit to the next, while retaining the desired over-all band-pass characteristics, it becomes necessary to control the power factor of the inductors and capacitors that make up these tuned circuits. This power factor can be measured by means of a dynamometer instrument, preferably consisting of a beat-note arrangement where the current and the voltage are separately fed through an amplifying system and beat with an external oscillator in order to obtain a low enough frequency to actuate a wattmeter. This method and many others like it are too complicated for ordinary production test work, and besides, they measure only one of the factors that determine the result that interests us, which is the resonance curve of the circuit section under test.

This resonance curve can be shown on the oscilloscope. By making the horizontal deflecting voltage vary directly as the frequency, the output voltage from the resonance selector system can be made to feed the vertical deflecting plates of the oscilloscope, and the resultant image, if the frequency has been swept through a sufficiently wide range, is the selectivity curve of the tuned circuit. There are several ways of obtaining this frequency modulated sweep and making the horizontal deflecting plates deflect the beam directly as the frequency.



Circuit of mechanical cathode-ray resonance indicator, using a motor coupled to a variable condenser and potentiometer for providing the sweep.

The most common (although not the most flexible) method is the use of a motor-driven trimmer condenser. Mounted on the same shaft as the condenser is a potentiometer, the voltage of which controls the horizontal sweep of the cathode-ray tube. This is shown in Fig. 1. As the frequency varies due to the rotation of the condenser, the potential that deflects the electron stream varies as the output voltage from the potentiometer. This sweeps the beam across the tube as a direct function of the frequency.

ELECTRICAL SWEEP CIRCUIT

A new and better arrangement has been designed which is entirely electrical and which does away with motor-driven devices. This is shown in Fig. 2. In this system, by utilizing the saturation characteristics of an iron core, a fixed-frequency oscillator is frequency modulated from the source of the horizontal sweep voltage, and its output is mixed with the output of a variable signal generator to provide a frequency modulated beat having any chosen fixed sweep width over the entire frequency range of 100 kc to 22 mc. This voltage is fed into the tuned circuits under investigation, and the output after rectification is applied to the vertical deflectors. A clear and accurate selectivity curve is thus obtained, whose shape shows us not any one individual characteristic of the tuned circuit, but the overall result, which is what we want.

COIL AND CONDENSER CHECKING

Probably the most important application of the oscilloscope in the testing of parts before a set is assembled is checking the accuracy of coils and condensers separately, and of combinations of the two. The position of the peak of the resonance curve obtained when a standard condenser is used and a test coil plugged in, gives a direct indication of how far off the coil is from a standard inductance. (Fig. 3.) The width of the curve or the area under it, as well as the height of the peak, is a true indication of the power factor of the coil. In a similar manner, it is possible to check both fixed and variable condensers. The power factor of fixed mica condensers is very important especially in all-wave sets, where a poor condenser can prove particularly troublesome. Likewise, transformers and other inductors can be examined and their characteristics studied.

The transformer presents a very interesting case. By putting the input voltage from the primary into the horizontal deflector plates of the cathode-ray tube and permitting the secondary voltage to do the vertical deflecting, a curve is obtained on the cathode-ray tube which is a combination of the hysteresis and leakage reactance characteristics of the transformer. The loop is shown in Fig. 4. If the leakage reactance is negligible as in the case of most well-designed transformers, the area within this loop is the energy consumed per cycle by the hysteresis of the iron. A shorted turn has the effect of altering the phase angle between the primary and secondary voltages and thereby broadening the area of the curve without effecting its departure from a pure ellipse as is the case with hysteresis.

DISTORTION CHECK

A similar method can also be used for checking the amount of distortion present in any amplifying system. If a sine wave is put into the input of the amplifier, a resulting sine wave without any phase displacement in the amplifier will show a straight line. The slope of this line depends on the ratio of amplitudes of input and output voltage. If the line is ragged or consists of several loops, it indicates the presence of distortion. If there is a phase displacement between the input and output and no distortion, the result will be a pure ellipse. Distortion will introduce ragged edges with possibly bumps and peaks to mar the shape of the ellipse. In conjunction with a beat-note oscillator, this arrangement makes an ideal method for checking the overall frequency response and at the same time the distortion and phase displacement introduced in an amplifier or amplifier transformer.

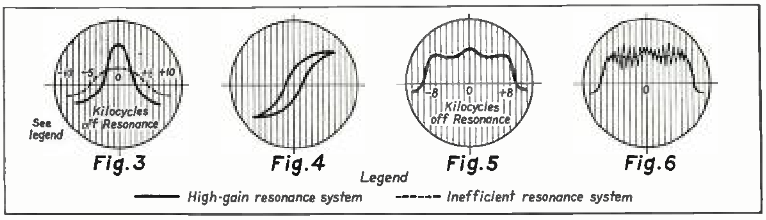


Fig. 3 shows resonance curve of a simple tuned circuit. Fig. 4 shows hysteresis loop of a transformer. Fig. 5 illustrates an ideal overall resonance curve for high-fidelity reception. Fig. 6 is a resonance curve superimposed with audio fidelity envelope.

"LINE-UP WORK"

After these various parts are assembled in a complete radio set, the set must be lined up so that all these instruments operate together for maximum efficiency. This "lining up" entails the adjustment of various resonant circuits so as to give the desired selectivity to avoid adjacent channel interference, the desired band widths to carry the full intelligence transmitted by the broadcast station, and the desired sensitivity. For this operation, the cathode-ray visual resonance curve indicator of the type shown in Figs. 1 or 2 is a necessity, since it shows the operating conditions of the receiver at any instant as each adjustment is made.

SELECTIVITY CHECKS

A complete check which can be shown instantly by visual methods is the discrimination of a receiver against a signal of 60 or more decibels above the level at which the set is operating. In other words, if the set is adjusted to its greatest sensitivity so as to receive distant stations, the effect of a local station in an adjacent channel can be visually observed. As was mentioned before, the ideal condition is a flat-topped selectivity curve with perpendicular sides. Although this condition is never obtained in practice, we can approximate it very closely. A practical resonance curve that approximates this is shown in Fig. 5. If the curve is asymmetrical about the carrier (such as a saw-tooth shaped selectivity curve), and linear detection is used, the result will be distortion. The percentage distortion varies with percentage modulation, reaching 100% for 100% modulation. Such a saw-tooth shaped curve is very often obtained when a receiver is lined up by means of a maximum output indication on an output meter.

OVERALL FIDELITY

After the receiver is lined up to approximate the ideal conditions, we are ready to check the overall audio fidelity. This can be accomplished in several ways. Probably the simplest is to beat a pure continuous-wave signal, tuned exactly to the frequency of the desired carrier, against the frequency modulated oscillator. The result will be a selectivity curve on which is superimposed an envelope of beats (Fig. 6), and the shape of this envelope will describe the overall audio response of the receiver up to the loudspeaker. If we wish to include the speaker in these measurements, the test can be made with a condenser or velocity type microphone situated directly in front of the speaker. In this latter case, reverberations will produce errors such as sudden peaks and dead spots. However, the mean envelope of the area covered by these beat frequencies as we sweep through resonance, will show us what the set is really doing.

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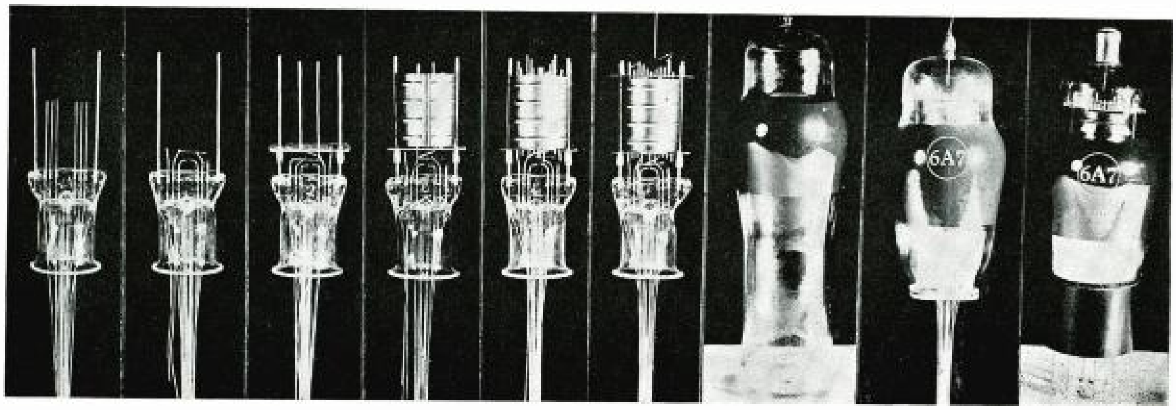
EXTENDING VOLUME RANGE

(Continued from page 9)

circuit might be said to be nothing more than an amplifier with a push-pull connection. A portion of the input signal voltage is picked off and put through a linear rectifier to obtain the dc voltage E_x which bucks E_c. Plate voltage is supplied by E_b. As has been the case in the other two expander circuits the loud passages will be amplified to a considerable extent, but the soft passages will pass through with but little amplification. However, this circuit differs from the other expander circuits in that it does not depend upon the relative amplification difference of the two control tubes but depends entirely upon the amount of the impedance in the plate circuit of the tubes as influenced by their grid bias.

CONCLUSION

As has been stated, most satisfactory results will be obtained from a system employing a compressor at the transmitter and an expander at the receiver. However, whether or not a compressor at the transmitter end of the system is employed, reception will be appreciably improved by the use of an expander directly ahead of the loudspeaker.



(*Photo. by Austin C. Lescarboura*)

The evolution of a modern multi-element tube, starting with the press and ending with the based bulb.

Better Tubes for Better Sets

BY AUSTIN C. LESCARBOURA

Mem. I. R. E., Mem. A. I. E. E.

THERE ARE YEARLY models in radio tubes, too. Make no mistake about it. Hardly official, of course, for tube manufacturers, for reasons best known to themselves, rarely announce specific improvements and refinements. Rather they prefer to appeal to public and trade with generalities, and this habit may in some cases mislead the set manufacturer who, more than anyone else, should exercise care in the selection of tubes.

TUBE QUALITY

The real trouble lies in the similarity of tubes—externally speaking. Good tubes and bad tubes look pretty much alike. Also this year's tubes and last. Only when autopsies are performed on tubes are their virtues and sins fully revealed. And unfortunately, such practice seems confined to tube manufacturers constantly checking up on the other fellow's products. The findings are kept a state secret.

The simplest check on tube quality is the engineering activity, production setup, and the reputation to be maintained by the tube manufacturer. What such a check-up reveals, briefly, is the purpose of the following in which no names are mentioned for greater freedom of speech.

Although any established radio tube type might be considered pretty much a stabilized product, such is not the case with the enterprising manufacturer. Nor does the successful manufacturer today sit on the doorstep of the leader of the industry, waiting for tube types and designs to appear in order that Chinese copies may be made. It is true, however, that standard types are established as a rule by two or three of the largest manufacturers; but equally true, too, that almost every sizable tube manufacturer has his own idea as to how to obtain the standard characteristics. There are almost as many versions of any standard type as there are sizable tube manufacturers.

ENGINEERING STAFFS

All of which points to an ambitious engineering staff. Indeed, it is doubtful if any other major branch of the radio industry can boast of as large a proportion of engineers to production force. Certain leading tube organizations have dozens upon dozens of engineers. One manufacturer has about 150 graduate engineers working on tube research, design and production problems.

Until the present year, tube engineers have been pretty much tied up with designing and production of new tube types. The record indicates that while there were only five types called for as original equipment in 1924, the growing multiplicity of types began in earnest in 1931 with 10 types that year, 32 in 1932 and 15 in 1933. During 1934 the new types will be less in number, for the radio industry now has an ample variety to choose from for some time to come.

These new types have kept engineers and production men busy. With a lull in the variety race, however, engineers have more recently turned their efforts to each established type in turn seeking improvements and refinements.

By far the outstanding and likewise the obvious improvement is the dome-shaped bulb introduced generally in 1931. From an appearance standpoint, the dome has served to reduce the apparent bulk of the glass envelope for a more pleasing effect. A more substantial gain, however, has been in the growing rigidity of internal details. The dome has served as a top or second support for tube structure or mount, providing a firm anchorage at the top just as the press supplies the anchorage at the bottom.

"RIGID TUBES"

Using a circular or cruciform mica spacer with toothed edges contacting the inside walls of the dome, tube elements have been adequately positioned at the top. It seems simple enough. Yet the fact that the inside dome diameter is not always true round has caused plenty of complications for the tube manufacturer. Tube designers have had their hands full trying to make a snug fit between mica spacer and dome inside. Adding insult to injury, tube users have become increasingly critical of rattles and mechanical noises in present tubes. Tubes are often slapped and held to the ear. The slightest rattle bars the tube from use. And yet the same users, only a few years ago, were satisfied with tubes that came in cotton wadding, often with obviously cock-eyed mounts!

The snug fit between top spacer and

Constant improvement and refinement made by tube manufacturers may too often pass unnoticed.

bulb dome has challenged ingenuity. Various shapes of spacers have been essayed. Large and small teeth and various combinations have been tried. In the past year the trend has been towards mica pads or members placed at right angles to the plane of top spacer or metal cage. These resilient pads press against dome walls and provide a snug, lasting fit. There are no teeth to become broken. A still more recent refinement is the spring wire clip—a bit of resilient wire held in mica spacer or metal cage, and pressing against dome walls.

High-gain receivers for home use on the one hand, and auto-radio sets on the other, have made rigid tubes imperative. The slightest displacement of elements or insecure contact between members may introduce serious noises or distortion in home or auto receiver. After rigidly anchoring the mount at top by suitable means, tube engineers, rattle-minded—no, not rattle brained! —have turned to individual elements and welds.

FILAMENT CONSTRUCTION

The filament wire has received full consideration in the filament tubes. Tungsten filament if stretched tightly tends to vibrate like the string of a violin. If left loose, it whips around under any slight mechanical shock. Either of these effects cause variation in tube characteristics, resulting in plate-current pulsations and extraneous noises or distortion in the loudspeaker rendition. Certain forms of filament vibration act as a delicate microphone, and result in loudspeaker howls at certain frequencies, called "microphonism" by tube engineers.

New filament materials have been developed. Straight filaments have in some tubes replaced hairpin filaments, using oxide-coated wire instead of the former thoriated tungsten. Where the hairpin has persisted in excessive vibration, side hooks or filament damping anchors have been introduced. Ceramic coated or insulated where they contact the legs of the hairpin filament, these side hooks can be welded or fastened to side supports of surrounding grid. Such construction applies just the right tension on filament legs to dampen troublesome vibrations.

Other elements have been more rigidly positioned not only by using heavier support members but also by better structural design. The dome bulb has made possible the shipment of the tube complement in the sockets of the radio set, ready for instant operation when unpacked.

WELDING ELEMENTS

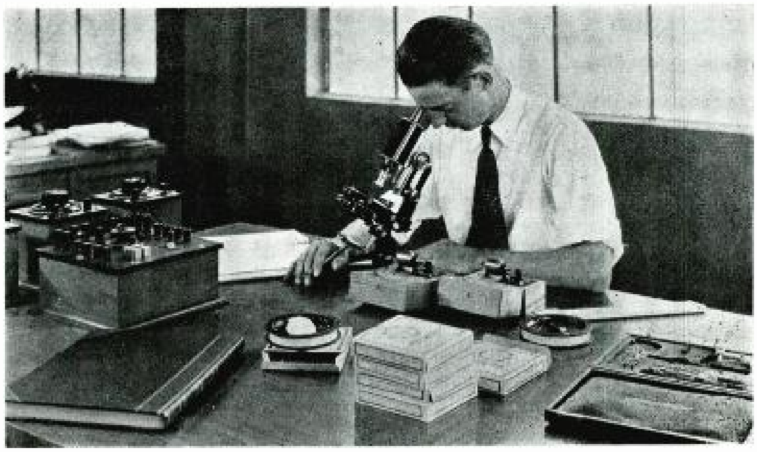
The spot welding of the metal parts has also been subjected to considerable engineering study and action. The usual practice is to weld contacting members together by a heavy current passing through electrodes that pinch the parts together. The girl operator who assembles the members of the tube mount and welds them together, can usually vary the pressure brought to bear on the electrodes, and also the welding time. Heretofore the welds have varied all over the map. Sometimes they might be insufficient, causing a weak, insecure weld. Other times they might be too long, causing the metal beyond the actual welding area to become badly burnt or weakened. Of late certain tube manufacturers have been installing automatic welders whereby pressure is positively predetermined and maintained, and timing is cut down from several seconds to a fraction of a second. The timing is quite outside the girl operator's jurisdiction, and is automatically achieved by suitable electrical means. The result of automatic welding is a cleaner weld, a more uniform weld, and no burnt or weakened metal.

SPECIAL TUBE TESTS

Loose elements or element displacement simply cannot be tolerated in 1934 tubes and receivers. One manufacturer considers this matter so seriously that his engineers have developed a special means of detecting vibration or element displacement, giving rise to microphonism and tone distortion. Sample tubes are employed as microphones and subjected to the entire range of audio frequencies striking the glass bulb. Each tube has cathode and plate or grids connected to a high-gain amplifier and output meter. The tube is mounted in a socket that can be rotated 180 degrees. It is placed at the concentrated opening of a cone speaker driven by a beat-frequency oscillator and power amplifier. To obtain the microphonic characteristics of the tube, the beat frequency is operated over the entire range of audio frequencies of present-day radio sets so that readings may be taken for a microphonic curve. The curve indicates to tube designers what must be changed so as to avoid those howls and rattles that mar some radio reception.

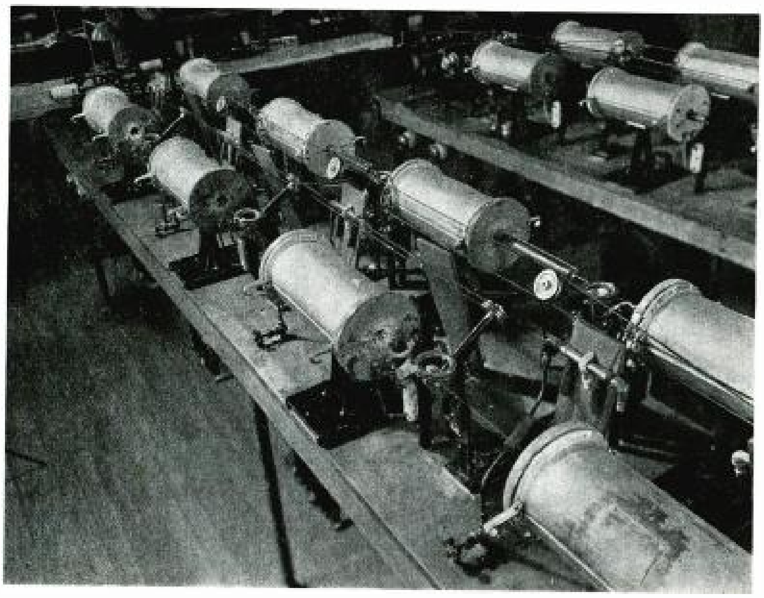
Also, tubes are taken for a ride. Mounted in a vibrating socket driven by a motor at different rates of speed, a tube is subjected to as much vibration as it may receive in thousands of miles of travel in the auto-radio set. The prime purpose is to discover structural weaknesses. However, if the tube elements are connected during the actual vibration, other factors may be determined, such as whether the operators assembling the mounts are careless and permit lint to stay in the tube. The lint is attracted to the high-potential elements and, bridging live members, burns with a yellow glow indicating its presence.

Noises are certainly the bane of the



(Photo. courtesy Hygrade Sylvania Corp.)

Every bit of wire used for the filaments or heaters of tubes is subjected to a rigid inspection in this materials-testing department before it is accepted for production.



(*Photo. courtesy Hygrade Sylvania Corp.*)

Filament coating department, showing the ovens which bake the successive coatings on wire or ribbon.

tube manufacturer's existence these days. Some tube plants hammer the poor tubes as part of the routine tests. Rubber hammers and loudspeakers soon detect any loose elements. One step further is the neon-lamp indicator, which is more sensitive to tube irregularities than the loudspeaker test. Tube testers employing neon glow tubes for various circuits, are used in some plants on routine tests of all tubes produced.

EMISSION STUDIES

As the heart of the tube, emission is carefully studied and watched by tube engineers. It is here mainly that tube chemistry comes into play. Leading tube manufacturers have elaborate chemical facilities not only for testing every batch of raw material that enters into tube production, but also for working out filament and cathode coatings, the graphiting of bulbs and parts, the hydrogen treatment of components, etc. The tube chemist works side by side with the electrical engineer, for the proper functioning of any tube is as much a chemical matter as it is electrical and radio.

Different alloys are being tried for filament supports. Also for other metal members. The emitting coatings are constantly being watched. There was a time when tube manufacturers bought coated filaments from outside sources, but practically every sizable manufacturer today maintains his own filament-coating department. Likewise with cathode heaters. The troubles with earlier indirect heaters or cathode heaters have been eliminated. Where cathode insulators are still employed, the material is such as to cause no troublesome interaction chemically or abrasively with the filament wire. In other cathode heaters the insulator is dispensed with, and either a double or reverse spiral coil or a folded filament with ceramic coating, is employed. The heating time, once the subject of a race among some tube manufacturers, is no longer considered a prime matter. Tubes can heat to full operation anywhere from 10 to 30 seconds, and no one minds the difference.

GRAPHITING BULBS

The graphiting of certain bulbs is another interesting development. The exact reason for this black coating is usually evaded by the questioned radio tube engineer. But we may draw our own conclusions. For one thing, the carbon coating perhaps serves to reduce the water vapor during pumping operations. For another, it distributes any bombardment of the inside glass wall by stray electrons not stopped by a cage, thereby preventing the concentration of such bombardment at any one point and avoiding the excessive heating and perhaps the puncturing of the glass bulb.

REJECTS

There are many other refinements that have been made in tubes and that can be checked by a critical comparison of tubes of today and one or more years ago. But after all, the main difference in good tubes and poor tubes may not be so much in noticeable refinements and improvements as in meticulous care given to the production details. The manufacturer of good tubes permits none but standard quality tubes to be passed for shipment. Outside his plant you may see a rising pile of broken glass —tubes that did not pass muster. Only the bakelite bases are salvaged. When that glass pile is small, you may be reasonably sure that the manufacturer is not so fussy and is permitting many tubes to pass through so as not to have the added item of high shrinkage. Good production equipment and properly trained personnel also help to keep down legitimate shrinkage, but there will always be a certain amount of shrinkage if high standards are to be maintained.

NOISE DIAGNOSIS

RECENTLY A DIAGNOSIS was made of the noise of an airplane in flight, speeding trains, street cars and buses. Although airliners, railroad coaches and Pullmans have often been tested for loudness or total noise, this time these noises were analyzed to find out what percentage of the noise was in the low-frequency band, how much was in the high-frequency band, and at what frequencies peaks of noise occurred.

In making the tests, total noise readings and analysis readings were taken for various rates of speed and for various conditions. The total loudness readings checked the findings of other investigators who had studied noise from that standpoint. Stated in decibels, the standard unit of sound, results found by use of a portable noise analyzer developed in the Westinghouse Research Laboratories were:

Media	*Speed in Mph*	*Loudness in Decibels Min.*	*Max.*
Railroad Pullman	45	68	74
DeLuxe Transcontinental Bus	40	74	79
Railroad Coach	35	75	80
Transport Airliner	190	77	81
City Bus	30	78	84
Street Car, special gears	35	81	83
Street Car, conventional type	35	85	88

It was found in each of the four vehicles that the low-frequency sources of noise are much more intense than the high-frequency sources. In the case of the airliner and the Pullman the high-frequency noises dropped below 25 decibels.

(*Continued on page 22*)

IRON-CORE
High-Frequency Transformers

By HARRY A. FORD

President

FERROCART CORP. of AMERICA

THE USE OF SPECIALLY MADE IRON CORES FOR R-F AND I-F TRANSFORMERS PERMITS CONSIDERABLE IMPROVEMENT IN THE GAIN AND SELECTIVITY OF BROADCAST RECEIVERS.

A COMMERCIALLY PRACTICAL way has been found of using iron core r-f and i-f transformers of a high performance which has been definitely confirmed and re-confirmed by the Radio Frequency Laboratories and other leading radio engineers. This invention originated with Hans Vogt, a European scientist of first rank.

CHARACTERISTICS

In the broadcast receiver, the use of one or more iron cores in the i-f transformers brings about a marked increase in gain which may be capitalized upon to obtain a much greater selectivity and sensitivity. The curve of Fig. 1 shows the resultant selectivity of a typical i-f

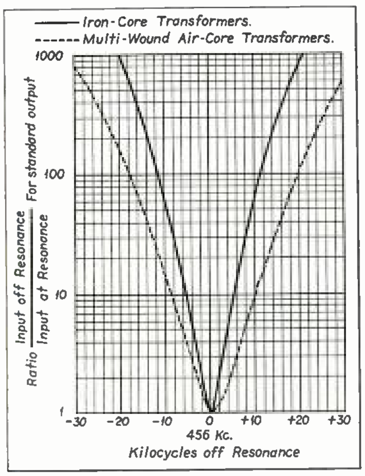


Fig. 1. Selectivity curves providing a comparison of iron-core and air-core i-f transformers used in a typical intermediate-frequency amplifier feeding a diode detector.

amplifier, the solid lines indicating the iron-core transformers and the dashed lines showing the optimum performance in most cases of a multi-wound commercial air-core unit. The selectivity was measured at the top of the 6A7 oscillator-detector tube. The i-f amplifier consisted of a 6D6 transformer connected into a typical diode.

For high-fidelity receivers, where the requirements call for a 10-kilocycle band, the iron-core i-f transformers may be adapted to the necessary variable bandwidth conditions by any arrangement permitting a change in the degree of transformer coupling.

CHARACTERISTICS OF MATERIAL

The core material, which may be made in either laminated or molded form, and in any desired shape, is capable of machining and is mechanically solid and thermally stable up to 150 degrees centigrade.

Paired with sufficiently high usable permeability, this material has proven in its extensive use in Europe, as being uniform in regard to permeability losses and physical dimensions, and its strikingly low eddy current and hysteresis losses, enabling the material to be used at practically all radio frequencies. Its use also permits a reduction in the size of the transformer coils.

The molded or laminated cores are made in various shapes, although American users have agreed upon the use of a plug core one-half inch long, ⅜-inch in diameter, with a 1/8-inch hole through the center, having an effective permeability of 2.0, with a 1.5 mh coil at 456 kc. The Q of such transformers at 456 kc is in the neighborhood of 180.

Fig. 2 is the illustration of a typical iron-core i-f transformer, "broken open" to show one of the plug cores with a hole through the center. There are two cores in each transformer, these being inserted inside the coil-support tubing and placed in conjunction with the plane of each coil.

Center holes are taken care of in the pressing process, making the cores adaptable for winding jigs, in which case they merely replace the wooden dowel or the tubing ordinarily used. These holes may also be used for the final mounting of the coils and cores in transformers, a wooden dowel of the diameter of the hole being used with a spacer between the two coils for coaxial mountings.

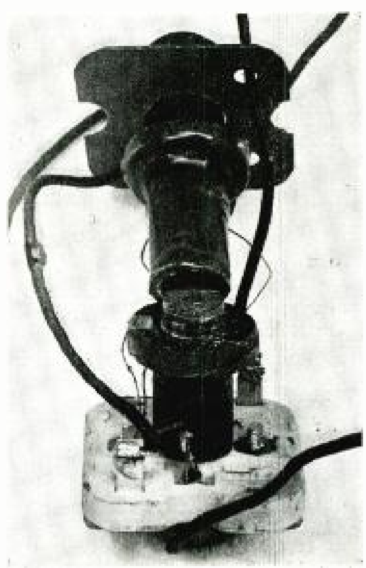


Fig. 2. Intermediate-frequency transformer broken open to show the character and position of one of the iron plug cores. A similar core is inside the upper part of the tubing. The coils may be wound directly on the plug cores, if desired.

(Patents pending.)

THE COLD CATHODE TUBE

Technical description of the latest Farnsworth cold cathode multiplier and oscillator tubes. Both have decidedly unique characteristics and may be applied to a wide variety of uses.

By D. K. LIPPINCOTT and H. E. METCALF*

A COLD CATHODE, gridless and high-vacuum oscillator tube at last! One can almost hear the combined sighs of relief breathed by thousands of research men, inventors and "wishers." No longer would that problem disturb their restless slumbers.

Furthermore, the tube is not just a laboratory experiment, for on September 13, 1934, one was used in a commercial telegraph channel of the Globe Wireless Company of San Francisco, and messages were sent from the laboratories of Heintz & Kaufman, Ltd., Research Engineers for Globe, to Honolulu, Manila, New York and other points throughout the world and were picked up by Sir Hubert Wilkins at Dunedin, New Zealand. A notable group of Army and Navy officials, scientists and newspaper men witnessed the inauguration of the service and the baptism of a new commercial radio device.

Philo T. Farnsworth, of television fame, is the creator. As is often the case, the invention was the direct result of a need. In Farnsworth's electron beam dissector tubes used for television pickup, the output currents were exceedingly small and large external amplification was necessary before they could be transmitted. He decided to multiply the output within the dissector tube, and invented the electron multiplier for that purpose. Later he found that it would also self-oscillate, detect, amplify, and that it could be easily modulated.

THE MULTIPLIER

The complete device, whether it is to be used as a multiplier or as an oscillator, is extremely simple in construction. It comprises two facing cathode plates with an anode ring positioned approximately midway between the plates. The two cathode plates are usually treated to have a low work function and thus be able to emit copious secondary electrons when bombarded by primaries traveling at a sufficiently high velocity. It is possible to so process the two plates that they will emit secondaries upon impact of an electron falling through a potential of ten electron volts, and when bombarded with higher voltages, to emit as many as six secondaries when hit by one primary. The anode is untreated and may be of nickel, tungsten or other suitable material.

Fig. 1 is a diagram showing the multiplier and its circuit when used to multiply electrons in a beam entering the multiplier chamber along a line indicated by the arrow A. Usually there is provided a small hole in one of the cathodes through which these electrons may reach the space between the two cathodes. In other cases the electrons which it is desired to multiply may be liberated within the space itself, an example of this type of operation being where the cathodes themselves are photo-electric, and it is desired to use the device as a photo-cell. The two cathodes are connected together with an inductance B which is fed by an oscillator C. The center tap of the inductance B is attached to the anode through a battery or other source D and an output resistor E, across which the output leads F are connected. A guiding field is provided by means of a solenoid G supplied by a source H.

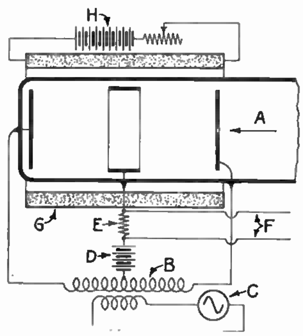


Fig. 1. Diagram showing the multiplier and its circuit when used to multiply electrons in a beam entering the multiplier chamber along a line indicated by the arrow A.

Applying, say, 50 volts at a frequency of 10 to 100 megacycles between the cathodes and gradually increasing the potential applied to the anode, currents will be produced in the anode circuit as shown by the graph in Fig. 2. Up to a certain minimum voltage which depends primarily on the distance between the cathodes, no measurable current will flow; beyond this point the current increases with voltage up to a definite point, while beyond this point it decreases again to zero. Further increase of voltage gives another definite point where current starts to flow, giving a second curve of the same general form as the first; while still further increase will show a second repetition of the effect, usually of greater magnitude. Cutting off the guiding field stops the flow immediately. Increasing the oscillating potential on the cathodes broadens the range wherein current flow occurs, eventually causing the curves to merge into a single continuous one having either multiple peaks or mere changes of slope indicating their position.

FUNCTIONING OF TUBE

Explanation of these properties is simple in general, although the detailed analysis presents certain obscurities which render its presentation here undesirable. An electron, either a photo-electron or an electron from the stream A in Fig. 1, liberated at one of the cathodes, is accelerated toward the other cathode by the anode voltage, and is prevented from striking the anode by the magnetic field which converts the transverse component of the electron's motion into an arcuate one. Its time of flight is determined by the distance between the plates and the velocity imparted to it by the anode potential plus the integrated effect of the potential between the cathodes. The latter factor determines whether (1) it will strike the other cathode with sufficient velocity to cause emission of secondary electrons, (2) strike with a lesser velocity, or (3) fail

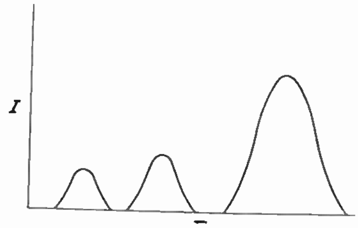


Fig. 2. Currents produced in the anode circuit through application of oscillating voltage to the cathodes.

*Lippincott & Metcalf, Patent Attorneys, 57 Post Street, San Francisco, Calif.

to strike at all. Where the first condition obtains the emitted secondaries are accelerated in the opposite direction to generate new secondaries at the cathode where the first electron started, and if the ratio of secondary emission be greater than unity, a multiplication will occur at each impact. Under the second and third conditions, no multiplication will occur.

Although the collection of any individual electron by the anode is improbable, owing to the shape and position of the latter and to the presence of a guiding field, a certain proportion of the total electrons will be collected. This proportion will depend upon the portion of the cathodes which are emitting secondaries and upon the transverse component of the electrostatic field within the chamber, as determined by the space charge, the curvature of the lines of force between cathode and anode, and upon any bias which may be applied within the tube.

Eventually, however, a point will be reached where the number of new secondaries emitted is equal to the number collected at each impact, and the current in the anode circuit becomes constant.

The peaks in the curve occur where the average time of flight is an odd number of half cycles of the oscillating potential on the cathodes, the three peaks shown in Fig. 2 representing 5, 3, and 1 half-cycles respectively. With a given tube and source of oscillations and range of anode voltage, it may only be possible to show one or two of the peaks. Under other circumstances, still other peaks will be shown, e. g., the 7 or 9 half-cycle peaks. The higher the anode potential the smaller is the time of flight, and hence the peak of output current corresponding to the highest voltage represents a time of flight of one half-cycle.

Uses of the device may readily be deduced from the characteristic curve which shows alternate regions of positive and negative resistance. These regions obviously permit the modulation of the output by variation of anode potential. Rectification and frequency doubling both occur in the anode branch of the circuit and may be put to their usual uses. Operation in the negative resistance regions permits use as a generator of oscillations of any frequency, as in the case of any of the well known negative resistance devices.

THE OSCILLATOR

A fundamental circuit of the device, when used as an oscillator, is shown in Fig. 3.

Connected between the two cathodes is an oscillating circuit 1. A central tap 1 on the inductance connects through a potential source 2 to the anode, preferably through radio-frequency chokes 3, although these are not strictly necessary but improve the performance. An output coil 4 is coupled to the inductance and used to withdraw power from the circuit. Surrounding the tube is the solenoid 5 used for generating the guiding field.

Consider the circuit in the non-oscillatory condition, and that electrons are released from approximately the center of one cathode with zero velocity. These electrons may be photo-electrons liberated by the use of light, and usually the ordinary room light is sufficient to start oscillations. Such electrons will be accelerated toward the anode and in the absence of the guiding field would probably strike the anode and be collected. If, however, the guiding field be of proper value, the electrons will pass the anode and approach the opposite cathode. During their flight they are accelerating up to the time they reach the median plane of the anode, while from this point on they are decelerated by the electrostatic field supplied by the anode source, and under the conditions mentioned, and arrive at the opposite cathode with zero velocity, having occupied in flight a time determined by the anode potential and the distance between the two cathodes.

If, however, the resonant circuit be tuned to a frequency whose one-half period is approximately equal to the time of flight of the electrons, the original liberation of the electrons from the first cathode will cause a current to flow from the source through one-half of the inductance to the first cathode. This provides a potential drop which appears on the two cathodes in such phase as to accelerate the flight of electrons, causing them to impact the second cathode with a finite velocity. If this velocity be sufficient to release electrons from the second cathode at a ratio greater than unity, the difference between the number of impacting primary electrons and emitted secondary electrons forms a current which is supplied to the other branch of the inductance, causing a voltage drop in opposite phase which accelerates the space current through the tube in the opposite direction. The secondary electrons emitted, therefore, impact the first cathode in increased numbers and with increased velocity, and the oscillation quickly builds up to a point where it is limited either by space charge effects within the tube, by loss of energy through the output circuit, or by some other extraneously introduced factor.

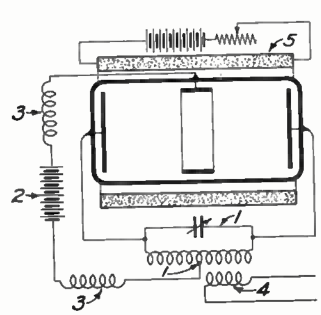


Fig. 3. Diagram showing the oscillator and its circuit.

CHARACTERISTICS OF OSCILLATOR

It is not possible in an article of this scope to go into the effect of the guiding field, the effect of the materials of the cathodes, or the effect of slight changes in electrode shape and position. Suffice it to say, however, that tubes of this sort will operate not only upon the time of flight principle above described, but have been made to oscillate grossly at frequencies varying down to audibility.

To give some actual values, and thus indicate the order of magnitude of the circuit constants involved, a tube of the character described, having a spacing of 5-5/10 centimetres between the cathodes, was operated at frequencies varying between 30 megacycles and something over 100 megacycles. The corresponding voltages of the dc source required to give the necessary corresponding times of flight, varied between 350 volts for the lower frequency and 800 volts for the higher one. The tube used in the Heintz & Kaufman demonstration was supplied with approximately 33 watts of power and gave an oscillating output of approximately 20 watts. By the use of higher Q circuits and the use of permanent-magnet guiding field sources, or by the use of an electrostatic guiding field created by the electrodes themselves, efficiencies can be made much higher. In normal operation the tubes run cold and apparently will have an exceedingly long, useful life.

HIGH STABILITY

Furthermore, the device is inherently stable . . . surprisingly so, in fact. Measurements have shown that a 50% variation in the voltage applied to the guiding field solenoid gives a frequency variation of only 0.1%, and that a variation in anode voltage produces a frequency variation of only 0.5% when the tube is operating under certain preferred conditions. The two variations are opposite in character so that a 50% change in supply voltage will produce a net change of only 0.4%.

Ordinary line voltage changes therefore do not greatly disturb frequency and the stability, in proper circuits without crystal control, is considerably better than required by Federal regulations.

All in all, it appears that there has been an exceptionally valuable contribution to the radio art made by Mr. Farnsworth.

"VISUAL" PRODUCTION ALIGNMENT

"VISUALS" OR CURVE-TRACING devices for showing the resonance curves of the intermediate- or radio-frequency stages of broadcast receivers have been in use for some time. Some manufacturers have installed enough "Visuals" to align their entire production. Others have installed one or more for aligning part of the production and for checking the work of aligners equipped with meter indicators.

ADVANTAGES OF "VISUAL"

The "Visual" is particularly useful where coupling is such that a double-peaked resonance curve is obtained, since the depth of the valley between the peaks is difficult to determine unless a plot of the curve can be examined.

In contrast to high-priced apparatus employing the string galvanometer, cathode-ray apparatus is comparatively inexpensive and will give better results. Some of the advantages of a cathode-ray "Visual" over the string-galvanometer type are:

(1). The trace is more brilliant and does not require an awkward hood for observations in daylight.

(2). Overload does not damage the apparatus but merely causes the beam to deflect off the screen.

(3). The apparatus can be made portable.

(4). The cost of the apparatus is low.

DETAILS OF OSCILLOGRAPH

A resonance curve tracer employing the type 906 cathode-ray tube has been set up and operated in the laboratory of the *RCA Radiotron Co.* This device is designed to cover a range of intermediate frequencies of 100 kc to 500 kc and has an amplifier-detector section which is practically flat over the entire range. Since it is believed that a "Visual" of this type will be of distinct value to many laboratories as well as to manufacturers and service men who desire to improve their testing facilities, a detailed description of the instrument is given in this article. Fig. 1 is the schematic circuit diagram while Fig. 2 shows the functional layout and a suggested arrangement for a portable resonance curve tracer. It should be borne in mind that the principles and methods involved in this application can be applied to obtain the curves of any form of tuned circuit and that the frequency range is not limited to the 100-500 kc of the apparatus illustrated.

REQUIREMENTS

A resonance curve is a plot of the voltage output of a tuned stage for a given frequency band. To obtain this curve, it is necessary to have a voltage source, which in this instance is the oscillator T_2 of Fig. 1, and to have a source of variable frequency covering a range which extends above and below the resonant frequency. The frequency variation to sweep across the frequency range of the tuned circuit can be accomplished manually by hand manipulation of a condenser or it can be speeded up to thirty times a second as is done in this case by means of an 1800-rpm motor. The fluctuating output voltage of the stage is then amplified, rectified, and again amplified, and finally applied to one set of the deflecting plates of a cathode-ray tube. The other set of deflecting plates is supplied with the sweep-frequency voltage.

The frequency sweep is produced by a motor of about 1/20 hp or more driving a rotating condenser C_2 of maximum capacitance of 0.00035 mfd. A range switch S_2 connects different values of capacitance C_3, C_4, C_5, etc., in series with C_2 to adjust the sweep for different frequency ranges. The oscillator is tuned by adjusting C_1.

A contactor on the motor shaft controls the linear-sweep voltage by periodically short-circuiting condenser C_7. Condenser C_7 charges linearly with time during the half revolution that condenser C_2 sweeps the frequency. During the remaining half revolution, condenser C_7 is short-circuited and C_2 returns to the initial position.

CONTROLLING THE SWEEP

The rheostat P_3 in the cathode circuit

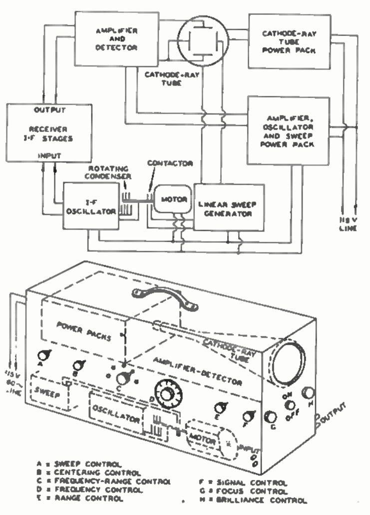


Fig. 2. Set-up of equipment.

of tube T_1 controls the rate of charge of condenser C_7. When P_3 is properly adjusted, the contactor on the motor causes the voltage of condenser C_7 to return to zero somewhat before the condenser becomes fully charged. When P_3 is adjusted for too slow a charging rate, the sweep, as viewed on the screen of the cathode-ray tube, returns to zero before the full width of the screen has been traversed. On the other hand, if P_3 is adjusted so that the charging rate is too high, the sweep terminates with the condenser fully charged before the contactor has returned it to zero. Considerable distortion of the resonance curve traced on the screen results from this latter adjustment due to non-linearity at the end of the sweep.

The proper adjustment of P_3 causes a full sweep across the screen without any bright spot occurring at the end of the sweep. The appearance of a bright spot is due to the beam remaining in one position for a greater length of time than in other positions. A bright spot should appear at the beginning of the sweep since the beam remains there for one-half of the cycle. At the end of the sweep, no spot should appear when P_3 is properly adjusted.

The centering of the pattern on the screen is accomplished by adjusting the knob of potentiometer P_4.

The frequency-range switch S_2 and the tuning condenser C_1 should be adjusted so that the resonance characteristic appears in the center of the sweep on the screen. As condenser C_1 is varied, the resonance characteristic is shifted along the sweep axis. The best value of C_1 is that which centers the resonance curve on the sweep range.

The input to the grid of the i-f stage to be tested is connected to the contact terminal of potentiometer P_5. The test signal can be adjusted by means of P_5 to give a suitable height of resonance curve. The range switch S_3 reduces the signal when an overall test of two or more i-f stages is made.

ALIGNING I-F STAGES

When intermediates are to be aligned, the output voltage from the plate of the tube following the i-f stage is connected through a blocking condenser in series with a low resistance of approximately 1,000 ohms to the amplifier circuit as shown in Fig. 2. When the tube following the i-f stage is a diode detector, the resistance can be eliminated. In this case, the input lead is connected to the high-potential end of the diode load resistance. Sufficient i-f voltage is generally present across the by-pass condenser of the diode load resistor to

COMMENT . . *Production*

give a deflection on the cathode-ray tube. Since the diode load is by-passed, there is no capacity effect from the connecting leads and the resonance adjustment does not change with their removal. The resonance curve obtained on the screen of the cathode-ray tube represents audio frequency and, hence, appears not as a modulation envelope but as a single-line curve above the zero axis.

OSCILLATOR CONSTANTS

The constants of the oscillator circuit will depend somewhat upon the arrangement of the wiring, distributed capacitance, etc. In order to realize the full operating range of frequencies from 100 kc to 500 kc, it is important to have tuning condensers with low minimum capacitances and to keep wiring capacitances at a minimum. The exact values for the constants of the oscillator circuit are best determined by actual test after the apparatus is in operation. Suggested values for these constants are as follows:

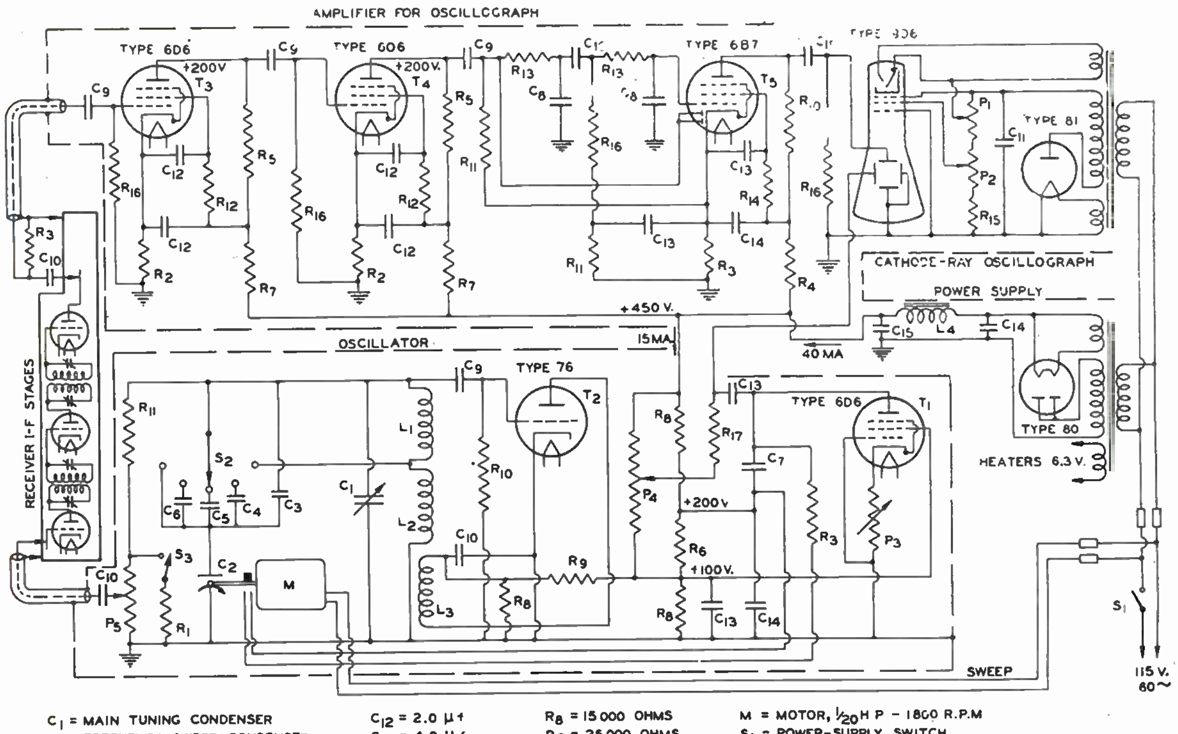
C_1=150 mmfd maximum
C_2=350 *mmfd maximum
C_3=0.00005 mfd
C_4=0.00005 mfd
C_5=0.0001 mfd
C_6=0.00035 mfd
L_1=2.0 millihenries
L_2=2.0 millihenries
L_3=5.0 millihenries

*Ball-bearing type.

The inductances are closely coupled.

Desirable characteristics for the oscillator are uniform voltage output especially throughout the sweep range, and frequency change proportional to the angular rotation of the frequency-sweep condenser C_2. This condenser should preferably be one of the straight line-frequency type, although an ordinary semi-circular plate condenser is easier to balance mechanically in order to avoid vibration. The latter, however, is satisfactory for the usual alignment purposes; that is, with it no distortion of the resonance curve is noticeable to the eye, although it could not be depended upon for precise measurements.

Care should be taken to select a variable condenser that is rugged in construction and revolves on ball bearings. Contact with the rotor can be made by means of a brush or other smooth-riding pressure contact on the condenser shaft. The short-circuiting contactor is a standard automotive ignition breaker. It is operated by a cam on the motor shaft. A bakelite drum having a metal insert in its periphery can be used as a shorting device, if it is desired.



C_1 = MAIN TUNING CONDENSER
C_2 = FREQUENCY-SWEEP CONDENSER
C_3, C_4, C_5, C_6 = FREQUENCY-RANGE CONDENSERS
C_7 = 0.5 μf
C_8 = .0001 μf
C_9 = .0002 μf
C_{10} = 0.1 μf
C_{11} = 1.0 μf
C_{12} = 2.0 μf
C_{13} = 4.0 μf
C_{14} = 8.0 μf
C_{15} = 16.0 μf
R_1 = 50 OHMS
R_2 = 300 OHMS
R_3 = 1000 OHMS
R_4 = 5000 OHMS
R_5 = 10 000 OHMS
R_6 = 11 000 OHMS
R_7 = 14 000 OHMS
R_8 = 15 000 OHMS
R_9 = 25 000 OHMS
R_{10} = 50 000 OHMS
R_{11} = 100 000 OHMS
R_{12} = 120 000 OHMS
R_{13} = 200 000 OHMS
R_{14} = 300 000 OHMS
R_{15} = 500 000 OHMS
R_{16} = 1 MEGOHM
R_{17} = 5 MEGOHMS
L_4 = 40 HENRIES
M = MOTOR, 1/20 H P - 1800 R.P.M
S_1 = POWER-SUPPLY SWITCH
S_2 = FREQUENCY-RANGE SWITCH
S_3 = TEST-SIGNAL-RANGE SWITCH
P_1 = 50 000 OHMS, BRILLIANCE-CONTROL POTENTIOMETER
P_2 = 200 000 OHMS, FOCUSSING-CONTROL POTENTIOMETER
P_3 = 50 000 OHMS, TIME-SWEEP-CONTROL POTENTIOMETER
P_4 = 200 000 OHMS, CENTERING-CONTROL POTENTIOMETER
P_5 = 400 OHMS, TEST-SIGNAL-CONTROL POTENTIOMETER

Fig. 1. Circuit of the cathode-ray oscillograph apparatus designed for the alignment of tuned circuits.

BOOK REVIEWS

(*Continued from page* 10)

one of a very few texts on this subject which was then sadly lacking in literature. Since the first edition was published in 1929, there have been a number of excellent books both on the theory and applications of photoelectric cells as well as a great many excellent articles on various phases of the subject. The authors are to be commended on their frank recognition of this fact and their consequent complete revision of the original text. This book is therefore much more than an attempt to bring the earlier editions up to date, it is essentially a new book. As the authors state in their preface, the gap that the first and second editions were intended to fill no longer exists. Whereas the original editions emphasized practice instead of theory, this edition reverses the process. While there are a number of excellent books available on the subject of photoelectric cells, none of them that have come to this reviewer's attention have been concerned primarily with the principles of operation as subsidiary to operating practices and applications. It would, therefore, appear that this book fills a distinct need in this field.

This book contains 13 chapters dealing with such concepts as Colorimetry, Photometry, Valve Amplification, as well as a complete discussion of vacuum, gas filled, rectifier and conductivity cells. The book is divided into three sections. The first is entitled Properties of Photoelectric Cells; the second, Use of Photoelectric Cells; and the third, Some Applications of Photoelectric Cells. On the whole, the book is readable even for the non-mathematical reader. While mathematics is not dispensed with, where it can serve a useful purpose, the arrangement is such that the results of each analysis can be visualized without following through the mathematics. The reader may in some cases be confused by the fact that the authors deliberately ignore the distinction between emf and potential difference and by such statements as $\frac{dx}{dy}$ as positive instead of x increases with y. However, this will present no difficulty to the careful reader since the authors state their position at the beginning and follow it rigorously throughout the book. The authors are especially to be commended on the inclusion of a wholly adequate discussion of the little used and nearly forgotten conductivity cells. It appears to this reviewer that no text on this subject would be complete without at least a mention of this type of cell which has played so important a part in the early development of photoelectricity.

The book is thoroughly up to date, the main body of the material dealing largely with information which has come to light within the past few years. It is replete with references, over 100 separate citations being given. The typography and illustrations are of a high class and, so far as this reviewer could determine, very few errors are present.

While this book is intended primarily as a text for the student of photoelectricity, it appears that it is likely to be even more valuable as a handy reference volume both for the worker in the field of photoelectricity and for the engineer who has occasion to refer to standard texts on the subject in connection with the design and operation of photoelectric and allied apparatus. To this field, this book is highly recommended.

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GATEWAY TO RADIO, by Major Ivan Firth and Gladys Shaw Erskine, published by The Macaulay Company, New York City, 319 *pages, cloth covers. List price,* $2.50.

A book for the person interested in radio program technique and "how to write for radio." It points out the difficulties one encounters in attempts to amuse the great unwashed. Examples of program material are given. They are very discouraging.

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KRUSE'S RADIOPHONE GUIDE (2nd Edition), by R. S. Kruse, published by Robert S. Kruse, Guilford, Conn., 82 *pages, well illustrated, paper cover. Price,* 50 *cents.*

The latest edition of "Kruse's Radiophone Guide" contains a group of "Radiographs" worked up by Ralph Batcher, covering the determination of pad design, resultant values of equal and unequal resistors in parallel, condensers of unequal value in series, etc. There are also graphs dealing with coil calculations for wavelengths below 200 meters, with Ohm's law, and two charts relative to wire weight and wire winding.

The book opens with an article on the use of the cathode-ray tube in the testing of radiophone transmitters. This is followed by data on tank circuits, the construction of an inexpensive oscilloscope, pre-amplifiers and modulators, means of checking plate modulation without an oscilloscope, precision frequency meters, grid modulators, a chart on the operation of tubes in Class C modulated r-f amplifiers using grid leak bias, etc.

Though the book is written principally for the amateur, it should be of interest to engineers concerned with low-power transmitter design.

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EARTH, RADIO AND THE STARS, by Harlan T. Stetson, Ph.D., Research Associate in Geophysics, Harvard University, published by McGraw-Hill Book Company, Inc., New York City, 336 *pages, cloth covers. List price,* $3.00.

This book brings together the results of recent scientific research in the fields of astronomy, geology and radio engineering which the author believes synthesize into a new field of science—the study of the earth and its cosmic environment, or *cosmecology,* as the author suggests it be called.

A listing of a few of the chapter heads will indicate the general contents: Ocean Tides, Earth Tides, The Earth from the Inside, Sun-spots and Radio Reception, The Moon and Radio, Transatlantic Radio Transmission, Cosmic Clouds.

The material in the book is very well knitted together. It should prove of considerable interest and value to the engineer concerned with long-distance radio transmission, long-range weather forcasting, aviation radio, and radio phenomena in general.

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NOISE DIAGNOSIS

(*Continued from page* 16)

In the cases of the street car and bus, the intensity curves, although higher in value, follow a pattern similar to those of the airliner and Pullman with a downward slope through the low and medium frequencies; but where the curves for the latter two continue to decline in the high-frequency band (about 1,500 cycles), the street car and bus curves flatten out. This fact is attributed to the presence of high-frequency gear noises in the street car and to window rattle and similar impact noises in the bus.

Numerous sharp peaks occur in the curves indicating sources of loud noises at frequencies corresponding to the peaks. By tracing the causes of such noise sources and eliminating as much as possible of the causes, engineers may be able to do considerable towards quieting the total noise.

NEWS OF THE INDUSTRY

SOUND SYSTEMS APPOINTS DISTRICT SALES MANAGER

Sound Systems, Inc., with offices at 1311 Terminal Tower, Cleveland, Ohio, announces the appointment of Mr. James Sturtevant, formerly of the Cleveland Graybar organization, as its Cleveland and Ohio District Sales Manager. Mr. Sturtevant will serve the territory in a sales and engineering capacity.

Mr. Sturtevant was associated with Westinghouse Supply Company for a number of years and during the past four years has been with Graybar Electric Company in charge of Graybar's Research Products Department in northern Ohio.

He has had a wide experience in the application of amplifying equipment with the Graybar organization, handling Western Electric equipment, and will now serve his territory with a wide line of amplifiers and public-address systems, studio control and speech-input equipment.

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NEW WESTON BULLETIN

"Weston Relays" is the title of a new, twelve-page bulletin now being distributed by the Weston Electrical Instrument Corporation of Newark, N. J.

On its pages are grouped comprehensive lines of sensitive, toggle, polarized, power and time-delay relays. The bulletin might well be termed a complete summary of over thirty years' experience in the development and manufacture of relays.

Copies are available by writing the Weston Corporation at Newark, N. J.

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G-E RADIO MANUFACTURE AT BRIDGEPORT

Final arrangements have been made by the General Electric Company to inaugurate the manufacture of radio receivers at its Bridgeport, Conn., works.

Since September 1 the radio engineering force has been located at Bridgeport, and the radio sales organization has been there a number of years. Preparations are now going forward for the completion of designs, tools and manufacturing equipment; and manufacturing space is being provided and equipped on several floors of the huge main building of the works.

F. J. Healy, Manufacturing Manager of Receiving Tubes—Hygrade Sylvania plant at Salem, Mass.

ZIMMER APPOINTED MANUFACTURING MANAGER FOR SYLVANIA TUBES

Hygrade Sylvania Corporation announces the appointment of H. W. Zimmer as Manufacturing Manager of the Sylvania Tube plant at Emporium, Pa. This position was formerly held by R. W. Roloff, who in January, 1934, was appointed General Manufacturing Manager of Sylvania Receiving Tubes for both the Salem, Mass., and the Emporium plants.

During 1934, until the appointment of Mr. Zimmer, Mr. Roloff has also continued to act as Manufacturing Manager at the Emporium plant. Relief from these duties will permit him to give his entire attention to supervision of receiving tube production in Salem and Emporium.

H. W. Zimmer, Manufacturing Manager for Sylvania Tubes at Emporium (Pa.) plant.

F. J. Healy remains Manufacturing Manager of receiving tubes at the Salem plant.

All three have had a long connection with the company. Mr. Zimmer was formerly General Purchasing Agent at Emporium and has recently been acting as General Manager of the Hygrade Sylvania Electronics Department plant at Clifton, N. J.

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PERFEX PURCHASES CENTRALAB

The Perfex Controls Company of Beloit, Wisconsin, a wholely owned subsidiary of the Perfex Radiator Corporation of Milwaukee, Wisconsin, announce the purchase of the Central Radio Corporation of Beloit, Wisconsin, manufacturers of automobile "B" battery eliminators, radio tube sockets and range switches for all-wave radio receivers.

Mr. J. K. Luthe, President of the new organization, formerly was Vice-President of the Minneapolis-Honeywell Regulator Company, and previous to that, President of the Time-O-Stat Controls Company, and has long been a prominent figure in the automatic switch controls industry.

Heading the engineering department of the Radio Division, is Mr. Stephen R. James, who has been associated with the engineering departments of Howard Radio Company, Grigsby-Grunow Company, and others. The Perfex Controls Company is the exclusive licensee of all James' patents and applications. The company will carry on an extensive development program.

Mr. E. W. Patterson, formerly Vice-President of the Oak Manufacturing Company, and also Vice-President of the Central Radio Corporation, will continue with the Perfex Controls Company as Manager of the Radio Division, with offices at Suite 1222-205 West Wacker Drive, Engineering Building, Chicago, Illinois.

The New York office will continue under the direction of Mr. Wesley S. Block, New York City.

The new company will proceed with the manufacture of all items produced by the Central Radio Corporation, and plans to add other products adapted to the Radio trade.

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TUNGSTEN PRODUCTS

The Cleveland Tungsten Manufacturing Company, Cleveland, Ohio, are exclusively manufacturers of tungsten products. Among their products are the following items: Tungsten carbides, powder, rod, wire, ribbons for heating elements and high-temperature, protected atmosphere furnaces.

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CUTTING MANUFACTURING COSTS

The ease with which the production manager may often pave the way to substantial manufacturing economies finds apt illustration in the wire-stripping practice of Fansteel Products, Incorporated, North Chicago, Illinois, it is stated.

At this plant, five machines equipped with motor-driven cutting knives strip the insulation from the wires used in production, maintaining at the same time the tightly twisted condition of wire strands and making a clean polished exposure.

The machines, manufactured by The France Manufacturing Co., 10325 Berea Road, Cleveland, Ohio, are easily adjusted to strip the various sizes and types of wires with their different forms of insulation. A wing-nut adjustment sets the revolving knives accurately to the wire diameter. Length of stripping is regulated and made uniform by another quick adjustment.

R. W. Roloff, General Manufacturing Manager of Sylvania Receiving Tubes, Salem and Emporium plants.

NEW ARMCO SALES OFFICE

The American Rolling Mill Company has established a new sales office in Atlanta, Georgia. The office will be located in Room 1437, Citizens and Southern National Bank Building.

C. M. Broome, Jr., Assistant District Manager, will be in charge of the office. Broome is well known in the South where he has visited the iron and steel trade for many years.

The new Armco sales office will serve the States of Florida, South Carolina, Alabama, Georgia, and parts of Tennessee and North Carolina, which territory was formerly covered by the Middletown District Office.

Though recognized for many years as one of the outstanding merchandizers in the iron and steel business, ARMCO believes that its broader sales activities will insure even better service to its customers.

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WESTINGHOUSE ENGINEER TRANSFERRED

W. K. Greis, Radio Engineer of the Chicopee Falls Plant of Westinghouse, has been transferred to the Westinghouse Electric Supply Company, 150 Varick Street, New York City, to aid in marketing the new Westinghouse radio receivers. His recent study and survey of receiver designs places him in an excellent position for this new task.

Mr. Greis has specialized in engineering of radio receivers and has been with Westinghouse as an engineer in that capacity since 1925. For the past few years, he has devoted his time to the development of receivers for commercial application including both Government and Aircraft Service.

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U. S. S. R. PATENTS AND TRADE MARKS

The October 1, 1934, issue of *Exporters' Digest,* issued by the American Foreign Credit Underwriters Corporation, 381 Fourth Ave., New York, N. Y., contains a very interesting article on "Patents and Trade Marks in the U. S. S. R.," written by Victor G. Olkhovsky.

The American Foreign Credit Underwriters Corporation state that it has been extremely difficult to obtain really authentic information on this subject, and that they are fortunate in having been able to secure the services of Mr. Victor G. Olkhovsky, who will cooperate with their Soviet Trade Division in handling inquiries from those who desire to protect their rights in the Soviet Union, or who are interested in further information.

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HORN JOINS WHEELER CO.

Mr. George B. Horn has become associated with The Wheeler Insulated Wire Company in the capacity of General Superintendent and Chief Engineer.

He comes to the Wheeler Insulated Wire Company from the General Cable Corporation where from 1927 to date he served as Chief Engineer in charge of their Engineering as well as their Coil and Magnet Wire Inspection departments.

Mr. Horn attended both Indiana University and Purdue and graduated from the latter in 1914. After spending one year taking the General Electric Engineering Course at their Fort Wayne plant, he entered the employ of Dudlot Manufacturing Company with which company he was still associated when it became part of the General Cable Corporation in 1927.

During the war, Mr. Horn served in both the Signal Corps and Air Service.

MANUFACTURERS TAKE NOTE

Editor, Radio Engineering:

We are looking for representations of well-known American radio and electrical products which are not at the present time represented in Argentina, Uruguay and Paraguay.

Our firm has been established in the radio business for a number of years, and we are exclusive representatives of Crosley radios and refrigerators, as well as Magnavox loudspeakers. We have also been manufacturing radios in this country, and are very well known in the trade. However, due to the decreased activity in business in the last year or so, we will have time to devote to other activities, and we intend opening a department in our firm which will handle representations of foreign products only.

In view of the above, we would appreciate contact with manufacturers of American radio products, as well as electrical products and appliances, who would like to enter this market. We would also like contact with American manufacturers of dials who could make us a special dial for long- and short-wave reception . . . a dial which we should like to adopt in all of our 1935 all-wave models.

With reference again to representations, we are not interested in selling completely manufactured imported radios, as present conditions make the sale of such equipment practically impossible. What we do wish to market are radio parts of various types, such as, variable condensers, fixed resistances, fixed condensers, etc.

Due to our connections in radio and electrical lines, we are in a very good position to sell imported products, and any manufacturer whom we can represent can rest assured that we will properly handle their interests.

Chilibroste Y Co.,
Misiones 48,
Buenos Aires, Argentina.

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SOUND ENGINEERING BULLETIN

A new bulletin has just been released by Sound Engineering Corporation, 412 North Leavitt Street, Chicago, Ill., featuring Insulation Testing Equipment.

This 12-page bulletin illustrates and describes (giving considerable information) such instruments as Dielectric Strength Test Sets, Insulation Resistance Meters, and Humidity and Temperature Control Apparatus. Discussed are such subjects as insulation, dielectric strength, resistivity, and dielectric constant and power factor.

This bulletin is designated as 934.

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SYLVANIA TUBE PARTS FACTORY COMPLETED

Machinery is rapidly being installed in Hygrade Sylvania Corporation's new Tube Parts Factory at Emporium, Pa. The Tube Parts Department will be completely transferred from outgrown quarters in the Sylvania Tube Factory. Started in 1932 for the purpose of controlling quality and costs in the manufacture of small parts for Sylvania Receiving Tubes, the Sylvania Parts Department operates as a "factory within a factory" under the management of C. R. Razey. From a modest beginning, it reached, during the summer of 1934, a peak production of approximately 25,000,000 parts per month. Parts are fabricated for both the Emporium and the Salem plants of the corporation.

The new Parts Factory provides 12,000 square feet of manufacturing space with a wing twenty by sixty feet for offices and administrative departments. It is the last word in factory construction, being built without supporting posts on the interior, so that machinery can be placed for maximum operating efficiency. Specially designed lighting fixtures, installed under the supervision of Hygrade Sylvania lighting engineers, provide the most approved type of industrial lighting. A glass enclosed monitor top provides additional natural light as well as ventilation. All windows are fitted with glass of the type which admits ultra-violet rays.

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ALLEN-BRADLEY ADDS SALES ENGINEER TO NEW YORK OFFICE

Mr. Frank J. Connolly was recently appointed as sales engineer for the New York office of the Allen-Bradley Company located at 50 Church Street, New York, New York.

Mr. Connolly received his technical training at Tufts College and Massachusetts Institute of Technology. He has had wide experience in the application of electric motor and control equipment, and will be in charge of sales engineering in Manhattan and the Bronx territories.

Mr. C. N. Calkins is district manager.

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GILBY INSTITUTES FRENCH SUBSIDIARY

Mr. Wilbur B. Driver, President of Gilby Wire Company, Newark, New Jersey, announced, upon his return from Europe, the establishment of a new French company to take over the European business of the Newark company.

The new company, known as Gilby Wire Société Anonyme, with the main office at 11 bis Rue d'Aguesseau, Paris, and plant at 76 Boulevard Richard Wallace, Puteau, France, commenced business on September 1, 1934. Mr. Gabriel Fodor, formerly European Manager of the Gilby Wire Company, Newark, will direct the affairs of the new company.

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PURCHASING GUIDE ADDITION

Inadvertently the Brush Development Company, Perkins Avenue and East 40 Street, Cleveland, Ohio, failed to receive a proper listing in the Purchasing Guide Section of the September issue of Radio Engineering. The listing follows:

The Brush Development Company are manufacturers of Brush Sound Cell Grille-Type Microphones for Broadcast Stations, Theatre Stage, Public Address, and other uses. They also manufacture Crystal Speakers and Tweeters.

The above organization is represented by the following firms or persons:

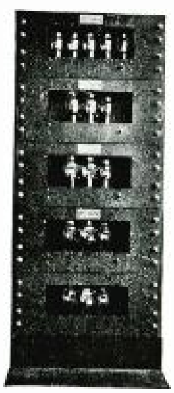
Arthur H. Baier, 2015 East 65 Street, Cleveland, Ohio.
C. C. Baines Sales Co., 4107 River Park Drive, Louisville, Ky.
Arthur F. Blinn, 1220 N. Sycamore Ave., Hollywood, Calif.
Robt. L. Cooper, 3917 Morrell Avenue, Kansas City, Mo.
Merton A. Dobbin, 407 Postal Building, Portland, Ore.
Foster Company, 601 Cedar Lake Road, Minneapolis, Minn.
General Engineers, 2201 Laws Street, Dallas, Tex.
Walter V. Gearhart Co., Volunteer Building, Atlanta, Ga.
King Sales Co., 2203 W. Clybourn Street, Milwaukee, Wis.
Westley S. Scharp, 67 West 44 Street, New York, N. Y.
James H. Southard, 420 Market Street, San Francisco, Calif.

New Products

NEW HIGH-FIDELITY AMPLIFIERS

Sound Systems, Inc., of Cleveland, Ohio, announces a new line of high-fidelity general-purpose amplifiers which are supplied with panels for rack mounting or without panels for other purposes.

The new Series S Amplifiers are constructed in a heavy sheet steel, one-piece case, with tubes mounted in a single row and completely protected. All audio- and power-transformer chokes and retards are sealed in heavy individual steel cases. These cases are securely mounted within the main amplifier case. Input and output terminals are conveniently located inside of the base of the amplifier with a removable cover



mounted in the back of the amplifier, giving easy access to these terminals; and knockouts are provided in the end of the amplifier to accommodate input and output lines. All metal parts are rustproof and have a black crystalline finish.

The Series S voltage amplifier is provided with a master gain control. Input impedances of all Series S amplifiers are as follows: 500 and 200 ohms center tapped 333, 235, and 50 ohms are also available. Output impedances: 500-ohm tapped at 250, 168, 125, 100 and 84 ohms, permitting the use of from one to six 500-ohm lines. There is also a separate 15-ohm monitor line. The PA-100 and combinations of the PA-100 and PA-101 give the desired output ratings, such as 4½, 10, 15, 39, 45, 60, 75 and 90 watts. The PA-100 is rated as a 4½-watt voltage amplifier and is also recommended as a driver or pre-amplifier by connecting its output to from one to six PA-101 output stages to obtain power output up to 90 watts. The hum level of the PA-100 is said to be approximately 60 db below signal level.

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SYLVANIA CATHODE-RAY TUBE

The H7-2 cathode-ray tube of the Hygrade Sylvania Corporation, Emporium, Pa., is a general-purpose oscillograph tube equipped with two sets of deflecting plates. It may be used for observation and photography of many transient and recurrent electrical phenomena.

The essential parts of the H7-2 are as follows: A substantial cathode, used as a source of electrons; a control electrode (grid), used for varying the intensity and size of the focused electron beam; two anodes, which accomplish the acceleration and focusing of the electron beam; a fluorescent viewing screen, three inches in diameter, upon which the electron beam is brought to a focus; and two sets of deflecting plates for deflecting the electron beam in two mutually perpendicular directions.

The high-voltage electrode (anode No. 2) voltage is designed for a maximum of 1,200 volts, and the maximum focusing electrode (anode No. 1) voltage is 250 volts. The grid voltage is never positive, the grid voltage for current cut-off with approximately 200 volts on anode No. 1 being nearly —35 volts. The H7-2 heater voltage (ac or dc) is 2.5 volts, while the heater current is 2.1 amperes. Heating time is around 0.5 minute.

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PERFEX VIBRATOR

The Perfex Controls Company of Beloit, Wisconsin, announce the new Perfex Vibrator for use in automobile radios.

This new device is manufactured under the James patents, incorporating the latest and most desirable features in vibrator construction, as well as many new developments as a result of exhaustive field and laboratory tests, it is said. It features a push-pull dual-magnet motor of new design.

The push-pull motor assures equalized wear on both sides of contacts, the contacts wearing almost completely to the vanishing point before becoming inoperative, thus insuring efficiency over a longer period of time than can be accomplished with other methods, it is stated.

The unit is obtainable in the plug-in or stationary mounting types, and is available in many voltage ranges to meet all engineering requirements.

•

NEW MIDGET EQUALIZING CONDENSERS

An unusually interesting and efficient midget equalizing condenser has just been developed in the Hammarlund laboratories, 424 West 33rd Street, New York City.

The size of the base is only ⅝" x ¾". It is so light in weight that it is self-supporting in the wiring of circuits. With its Iso-

lantite base, special mica dielectric, and phosphor bronze springplates, it may be used for trimming of r-f tuning coils, and other similar applications.

•

NEW "UNIVERSAL" RECORDS

"High-Fidelity Silveroid Records" becomes the trade name for a new development in cellulose coated aluminum discs to be put on the market early in December from the Inglewood, Cal., factory of the Universal Microphone Co.

The manufacturers' claim for the discs is that they have a lower background level than anything yet produced in the line of instantaneous recordings.

The records can be cut with the regular sapphire points exactly as in the usual wax transcription recording. They play back with any needle, though best results are said to result from the use of a trailing needle, known to the trade as a "phony." But any type of non-metallic needle now on the market can also be used.

In appearance the Hi-Fidelity Silveroid Records are of a brilliant silvery finish in 12-inch size.

The line has been on the market for use with air checks, program auditions, personal recordings and can also be used instead of electrical transcriptions when only a few discs of a single program are needed.

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MIDGET AIR TUNED PADDING CONDENSER

In the laboratories of the Hammarlund Manufacturing Company, 424 West 33rd Street, New York City, a true midget, space saving, Isolantite based, air padding and tuning condenser, particularly useful in marine, aircraft and police work, has just been evolved. The largest of the type, 100 mmfd, measures only 1 7/32" x 15/16" x ½".

Brass stator rotor and stator plates of

.015-inch thickness, spaced the same distance, are employed. A phosphor bronze spring plate affords perfect rigidity. Every other metal part is pure brass, for highest conductivity and lowest loss. Being of this air type construction, is provides absolute maintenance of constant capacity under any conditions of vibration, temperature, and humidity, it is said. It is applicable for short-wave or ultra short-wave work, or for tuning i-f transformers, trimming r-f coils and gang condensers, antenna tuning, fixed tuning of r-f coils or plug-in coils, and for padding purposes in general.

The approximate capacity per air gap is 4 mmfd.

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AC PRE-AMPLIFIER

The Bruno Laboratories, 20 W. 22nd St., New York City, announces an ac, dc-operated pre-amplifier having the same standards of quality and performance adhered to in their velocity microphones.

The pre-amplifier consists of a single unit employing two 77s and one 25Z5 tube, and is mounted in an iron case 7" x 12" x 5" finished in crystalline black.

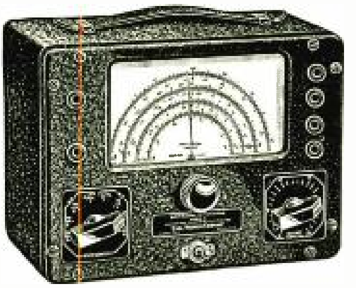
The "Bruno" Pre-Amplifier is adapted for remote pick-up and when used with Model RV-3 is capable of loading a telephone line with full gain on, it is stated. A switch regulates its output to a lower level if desired.

This Pre-Amplifier can be supplied for standard rack mounting or for portable use, both types being capable of operation from 115 volts, 60 cycles ac or from 115 volts dc.

NEW TEST OSCILLATOR

A brand new item of interest to every radio Service Man or service department manager is the recently announced Burton-Weber All-Wave Test Oscillator Model 10.

The new unit's full-visioned direct reading dial permits speedy, accurate settings without reference to graphs or tables, it is stated. Eight arcs provide a scale length of approximately 47 inches, covering from 90 kilocycles to 25 megacycles all on fundamental frequencies. Attenuation is of the ladder type with adjustable control on high, medium and low steps, permitting any signal voltage to be obtained from maximum to practically zero, and affording excellent attenuation on signals as high as 25 megacycles.



A 400-cycle note, approximately 35% modulated, is supplied by a separate modulator tube. The oscillator can be demodulated for adjusting radio receivers by the unmodulated method, and audio-frequency signal is available at panel jacks.

The new oscillator is manufactured and licensed under the approved circuits of the American Telephone & Telegraph Co., and each unit is carefully standardized with precision crystal-controlled frequency standards at 6 points on each band or arc, or at a total of 48 points, it is said.

Battery operated, this new testing device is fully portable. A one-piece aluminum case reduces leakage to a minimum, and the 6 to 1 vernier control aids in obtaining fine settings.

Full information may be had from the Earl Webber Company, Daily News Bldg., Chicago, Illinois, or from C. W. Burton, 755 Boylston St., Boston, Mass. Just ask for pamphlet No. RP11.

NEW PRECISION RESISTOR

The Precision Resistor Company, 334 Badger Ave., Newark, N. J., have recently announced their new Type M noninductive unit, shown in the illustration, which has been designed to meet the requirements of a resistor with soldering lug terminals and a unit that could be purchased rough wound to be calibrated to meet meter requirements.

This unit is manufactured as a complete unit of standard accuracy or may be purchased rough wound to an accuracy of approximately 3 percent of its rated resistance. The resistor is so constructed that the purchaser may calibrate it to his requirements and connect the wire to the terminal again without the use of insulating paper. Type M is a 1-watt unit having a resistance range from 0.25 to 500,000 ohms.

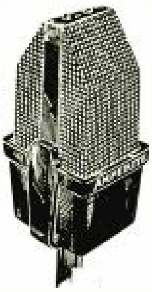
A copy of the new Precision Resistor catalog may be had on request.

CROWE REPLACEMENT COMPONENTS

The Crowe Name Plate and Manufacturing Company, 1749 Grace Street, Chicago, Illinois, manufacturers of tuning controls, remote controls, dials, grilles, metal cabinets, name plates, and escutcheons for all types of radio receivers, are featuring many of these numbers as replacements on a number of the well-known types of radio receivers. For further information see Crowe Bulletin No. 55, their complete catalog of radio components.

NEW VELOCITY MICROPHONE

A new Velocity Microphone, Model RAE, which is especially designed for small studio work is shown in the illustration. The open construction obtained with the perforated case is used to prevent high- or low-frequency cut-off. A nickel alloy (permalloy) core transformer preserves the flat characteristic of the hand-hammered duraluminum (.00015") ribbon, it is stated.



The microphone is of a rugged construction, not affected by temperature, humidity, or age. It can be used for both speech or music. One microphone is sufficient to "pick up" an entire orchestra.

The unit is a product of the Amperite Corporation, 561 Broadway, New York.

MORRILL PRECISION MULTIPLIER

The Morrill Six-Range Precision Multiplier, Model A, is a device which in connection with a suitable milliammeter provides a safe and convenient method of making accurate and dependable voltage measurements covering all values generally encountered in electronic work, it is stated.

When used with an 0-1 milliammeter the unit is capable of making voltage measurements from 0.1 volt to 1,000 volts, dc or ac, at 1,000 ohms per volt in six ranges, namely, 5-10-50-100-500-1,000 volts. The desired range is obtained by simply turning the selector switch to the proper setting, the accuracy of the multiplier being within plus or minus one percent.

This unit can also be used with 100, 200 and 500 microampere meters, the voltage ranges being 0.5-1-5-10-50-100, 1-2-10-20-100-200, and 2.5-5-25-50-250-500 volts, respectively.

As the multiplier is non-capacitative it is said to induce no appreciable error into ac voltage measurements up to 50,000 cycles. The unit is built into a sturdy, compact bakelite case measuring 3 inches by 4½ inches by 1½ inches. The manufacturers are Morrill and Morrill, 30 Church Street, New York, N. Y.

PRESTO RECORDING AMPLIFIER

The Presto Recording Corporation, 139 West 19th Street, New York, N. Y., have introduced a three-stage, resistance-coupled, triple push-pull recording amplifier that has an output of 10 watts and a gain of 92 db. The microphone supply is built in and is of the variable type, so that any carbon mike can be used and the current adjusted for maximum efficiency. The loudspeaker is also of the built-in dynamic type.

This amplifier uses the following tubes: Two 57s, two 56s, two 2A3s, and one 5Z3.

The motor used is of the 1/20 hp, 110-volt, 60-cycle, General Electric constant speed type. The speed is 78, or 78 and 33-1/3 rpm.

"SYNTHOGRAPHIC" PROCESS

Those interested in inexpensively marking panels or parts fabricated from sheet bakelite, fibre, hard rubber or similar materials will be interested in a new process developed by the Synthane Corporation, of Oaks, Penna.

The results obtained with the new synthographic process, as it is called, compare favorably with engraving in quality. The cost is said to be much lower than engraving.

By means of the synthographic process effects may be produced which are either impossible or impracticable by engraving, it is said. For example, one may choose certain colors or combination of colors. The intricacy of the ornament bears little relation to the time or cost of production. Properly applied, letters, symbols, trade marks or other designs readily resist wear.

NEW CATHODE-RAY TUBE

The Allen B. DuMont Laboratories of 542 Valley Road, Upper Monclair, New Jersey, announce a new cathode-ray tube known as the 54-8-C or 94-8-C, being made in two sizes, respectively, 5" and 9".

The type 54-8-C or 94-8-C is designed to eliminate a number of the defects which occur in the ordinary cathode-ray tubes. By a special design of the elements, the threshold effect is eliminated, a more uniform pattern is obtained and the tube has a constant and higher impedance across the deflection plates as the voltage supplied to them varies, it is stated.

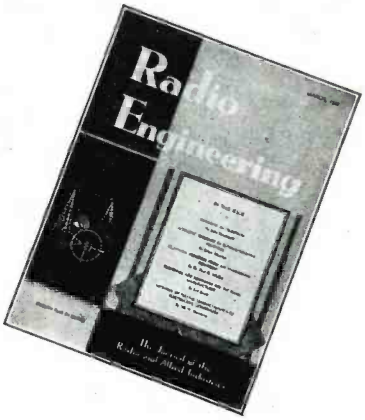
"TATTELITES"

The Littelfuse Laboratories, 1772 Wilson Ave., Chicago, Ill., have announced Tattelites, their addition.

Tattelites are a line of neon discharge tubes having breakdown potentials of 100, 250, 500, 1,000, and 2,000 volts. They are really voltage fuses, protecting equipment against excessive voltages, whereas regular fuses protect against excessive currents. They operate by shunting out the overload.

This line of fuses prevent insulation breakdowns; protect voltmeters, ammeters, transformers, condensers, and gaseous rectifiers against voltage surges; make radio lightning arresters, and leak off static charges from machinery; test for blown fuses, defective resistors, and condensers; indicate radio frequency, resonance peaks, high tension lines; and are used in making saw-tooth oscillators, trigger circuits, bleeders for dc power supplies and stroboscope effects.

Tattelites are described in the new Littelfuse Catalog No. 6, available upon request.



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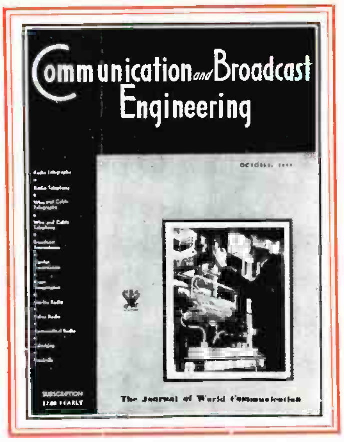

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