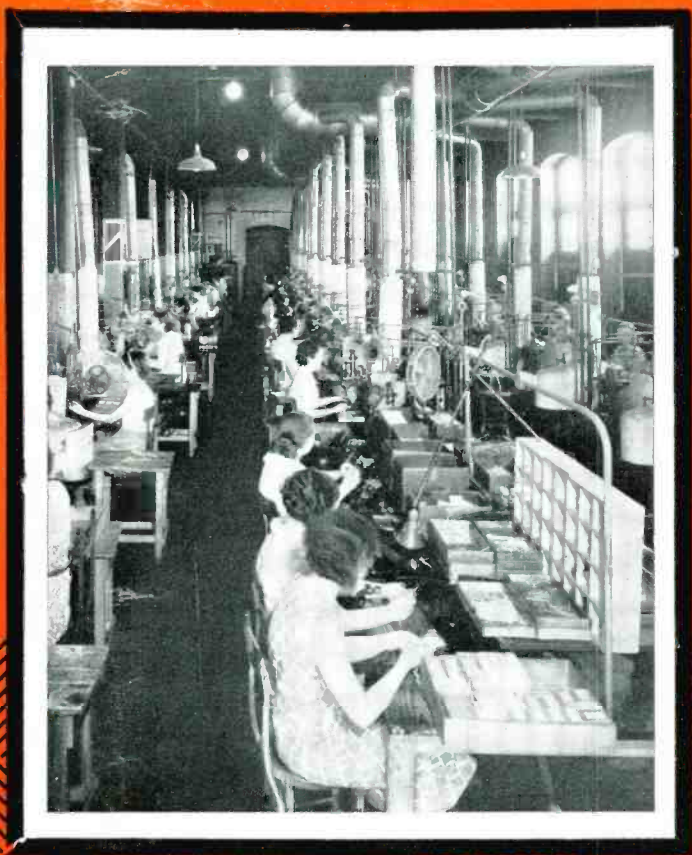
OCTOBER, 1935

Radio Engineering

DESIGN • PRODUCTION • ENGINEERING

- Broadcast Receivers
- Auto-Radio Receivers
- Electric Phonographs
- Sound Recorders
- Sound Projectors
- Audio Amplifiers
- P-A Equipment
- Electronic Control Devices
- Testing and Measuring Equipment
- Television Apparatus
- Loudspeakers
- Components
- Tubes
- Photocells



The Journal of the Radio and Allied Industries

VOL. XV NO. 10

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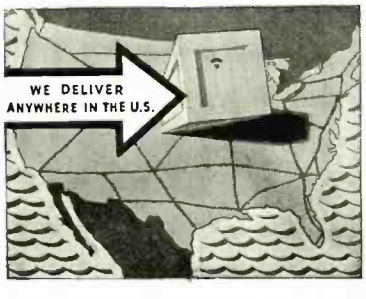

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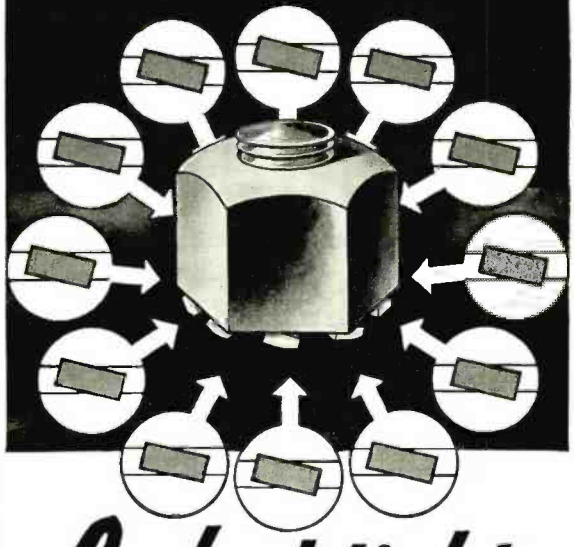

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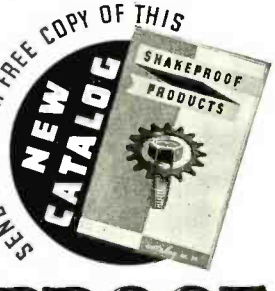

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RADIO ENGINEERING

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M. L. MUHLEMAN
Editor

RAY D. RETTENMEYER
Associate Editor

CONTENTS FOR OCTOBER

COVER ILLUSTRATION

METAL TUBE PRODUCTION LINE IN RAYTHEON FACTORY

FEATURES

DEPARTMENTS

VOL. XV NO. 10

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JAS. A. WALKER
Secretary

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EDITORIAL

BUILT-IN RADIOS

THE FEDERAL HOUSING Adminstration has made eligible for financing under its Modernization Credit Plan, public-address systems of a permanent character for apartment buildings, hotels, office and other commercial buildings, hospitals, orphanages, colleges, factories and schools. Built-in radio receivers for private residences have also been made eligible, the only requirement being that they become in some manner an integral part of the house.

Built-in radio equipment is not generally available. The systems which may be purchased are intended primarily for the large residence, and include automatic control and multiple speakers.

The small-home owner has been neglected. With the FHA backing up loans on built-in radio equipment, there is the possibility that a demand will arise.

No manufacturer need go out of his way to supply equipment meeting the FHA requirements. The stock chassis and speaker will suffice. Add to these two wall inserts, cable connections and an antenna inlet, and you have a complete, inexpensive built-in system within the reach of the average house owner.

There is a mild small-house building boom in the east. G. E. is behind a national home-building campaign. Certainly from this there should arise at least a moderate demand for built-in radio equipment.

The idea is worth a fling. We will be pleased to compile data on the condition of the eastern housing market for any manufacturer who may wish to institute test sales in the active building areas.

• • •

SILENCE

RADIO RECEIVERS need to be silenced. The majority of receivers have automatic volume control without benefit of squelching. The result is ear splitting. It takes every bit of the thrill and enjoyment out of the search for distant stations in the short-wave bands.

We have questioned a group of "all-wave listeners" with regard to this and each one stated that the noise brings on fatigue after a comparatively short period of tuning.

All-wave listeners are on the increase. For this reason the objection should be removed. Silent tuning is a necessity and nothing short of complete silence between stations is going to satisfy the public.

There are inexpensive ways of obtaining silence. We shall publish notes on one or two systems in the November issue.

WAVEBAND EXTENSION?

A NUMBER OF receiver models in the 1935-36 line have waveband ranges running as high as 60 megacycles. Is this worth the additional expense? Let's see:

The bands from 30 to 60 megacycles are slowly filling up. Two-way police radio systems are on the increase; there are straight and pick-up broadcasts to be heard; amateurs are flocking to the 5-meter band.

The 5-meter band is very much alive today in most cities. In New York, for instance, 200 amateurs operating in the 5-meter band have been logged at one receiving point.

These ultra-short-wave bands are clean, comparatively quiet in so far as noise is concerned, and represent one more spectrum that has become sufficiently active to make it of general interest.

• • •

METAL TUBE SOCKETS

OMITTING HOLES IN octal tube sockets may prevent the set owner from inserting a tube in the wrong socket, but it will place a heavy burden on the Radio Service Man.

It would be more to the point to predicate the design of a radio chassis on the assumption that, when anything goes wrong with a set, the owner fiddles at his own risk. It would be more to the point if the radio manufacturer were to support the men who repair the nation's receivers rather than to change socket design almost overnight and thereby make it almost imperative that these men purchase a large group of adapters for testing purposes.

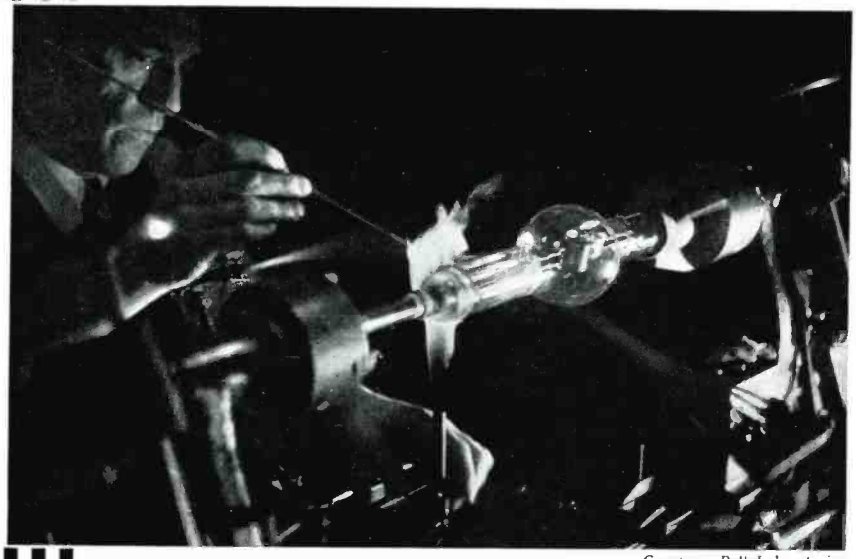
Frankly, we don't believe a redesign of the standardized octal socket will benefit anyone. Someone must have a case of the fidgets.

• • •

TWO-RADIO FAMILIES

IT IS REPORTED that there are over two million families in the United States with two or more radio receivers.

Radio advertising never suggests or implies two-radio ownership. A small corner of an advertisement could be effectively used to drive home the idea: A radio in the maid's room; midget receivers for guests so they may listen to the news reports in their own rooms; a radio for father's den; an extra radio for the rumpus room; a spare radio to fill in when the living-room set fails.



Courtesy, Bell Laboratories

The hand seeks perfection . . . the hand sets the pace

ILLUSTRATION: SEALING-IN AN EXPERIMENTAL VACUUM TUBE

RADIO ENGINEERING

FOR OCTOBER, 1935

WHAT FREQUENCY?

A NEW AND ORIGINAL METHOD FOR LOCATING THE FREQUENCY OF ANY RECEIVER BELOW 200 METERS

By CHARLES H. ROOF
Plant Department
PACIFIC TEL. & TEL. CO. (W6KTC)

THE QUESTION, "To what frequency is a receiver *actually* tuned?" is not an easy one to answer. Any operator who has set out to discover the answer by a "Tune and Guess" method has in all probability encountered many difficulties.

It is generally agreed that a calibrated oscillator, with its family of harmonics, is capable of rendering valuable assistance. However, the writer asks, "How many agree regarding *which harmonic* is *actually* being received, especially when the receiver is tuned to frequencies close to, or within, that band known as ultra-high?"

Of course, a satisfactory answer to that question can easily be obtained by using the formula:

$$F_x = \frac{F_1 F_2}{F_1 - F_2}$$

where F_x is the unknown frequency to which a receiver happens to be tuned and where F_1 and F_2 are frequencies corresponding to the two adjacent settings of a calibrated oscillator, both of which settings give beat notes with the receiver at its particular setting.

(e.g.) Let $F_1 = 25$ kc and let $F_2 = 20$ kc, and let it be required to find F_x.

$$F_x = \frac{F_1 F_2}{F_1 - F_2} = \frac{25 \times 20}{(25 - 20)} = 100 \text{ kc.}$$

This example, while serving its purpose as an illustration, is hardly sufficient to indicate the complications which are likely to be encountered when substitutions are made with figures obtained in actual practice. Moreover, if it is desired to set a receiver to some particular frequency other than F_x but close to it, one must proceed to divide F_x by either F_1 or F_2 in order to determine *which* harmonic is being used so that the necessary computations may be made.

The sum total of work involved when one attempts to solve this expression with pencil and paper is closely akin to manual labor. It is, therefore, at this point that further light on the subject is welcome.

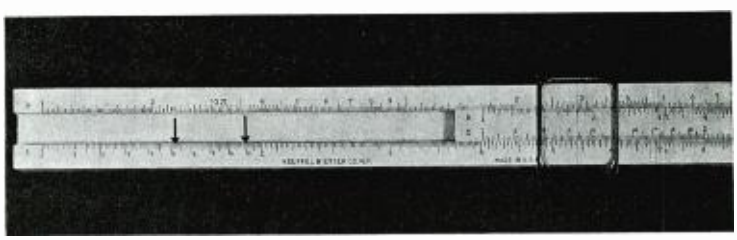


Fig. 1. On an oscillator calibrated to read directly from 1200 kc to 2200 kc, two readings, one of 1520 kc and one of 1900 kc, have been obtained. Note their location on the D-scale of an ordinary slide rule.

THE SLIDE RULE

The slide rule, that invaluable mathematical assistant, is capable of giving that light and, while it is true that the operations could be performed step by step as before by means of this instrument, there is still an inherent function of the rule which makes the calculation virtually *automatic!*

To start the explanation, let it be agreed that we are using an oscillator with maximum dial spread for frequencies included between approximately 1,200 kc and 2200 kc. This particular band is chosen for several reasons (viz.)

1. Such an oscillator possesses a fair degree of stability.

2. It is extremely easy to calibrate both by means of harmonics carried down from the broadcast band and from its own harmonics which beat with other stations of known frequency.

3. An oscillator with this approximate fundamental range, together with its harmonics, will cover practically every frequency from 200 meters to below 5 meters (only 200 kc in the neighborhood of 2300 kc being "uncovered.")

4. The slide rule, being so constructed that at points corresponding to similar frequencies it has one division on its scale for 10 kc, lends itself very well to the idea of using a knob with a pointer for the oscillator control and marking a cardboard scale behind the pointer directly in kilocycles (10 kc per division), thus eliminating the use of a calibration curve in transferring readings from the oscillator to the slide rule.

Assuming that we have an oscillator of the type described and a rule, we may proceed to tune our receiver to any frequency below 200 meters. We then vary the oscillator tuning until a beat note from one of its harmonics is heard in the receiver, and the fundamental frequency of the oscillator, as read under the pointer, is noted.

Next, we slowly turn the oscillator condenser in either direction until the *next* beat note is heard and this fundamental frequency is noted. Let us assume that the two frequencies as indicated are 1520 kc and 1900 kc. These two values are then located on the "D" scale of our slide rule as in Fig. 1.

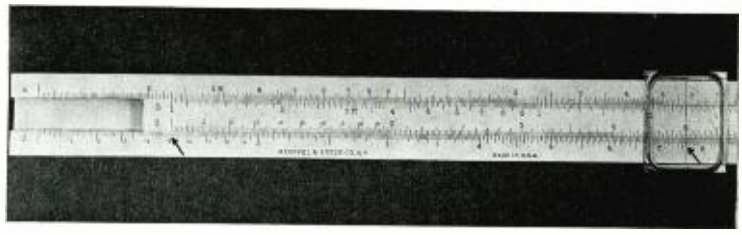


Fig. 3. Since the object is to *multiply the lower frequency by the higher harmonic,* we next place the left index (numeral 1) of the C-scale over the known lower frequency (1520). Then by moving the runner until its hairline is directly over 5 on the C-scale (which is the higher harmonic) the exact frequency to which the receiver is tuned is indicated directly beneath on the D-scale, 7600 kc. (A simple multiplication!)

The next step consists in finding two *consecutive whole* numbers on the "C" scale which are separated by *exactly the same distance* as are 1520 and 1900. Referring to Fig. 2 (a) we see that the spacing between 3 and 4 on the "C" scale is too great. By a similar observance we see that the spacing between 6 and 7 on the same scale is too small, Fig. 2 (b). But, upon further trial, it is determined that the spacing between 4 and 5 coincides *exactly,* Fig. 2 (c), and it is evident that these are the two *consecutive whole* numbers which we were seeking.

Having found them we know, without further calculation, that the receiver is tuned to the *fifth* harmonic of 1520 kc, and to the *fourth* harmonic of 1900 kc. *Multiplying the lower frequency by the higher harmonic, or vice versa,* we see that the rule indicates 7600 kc, which is the value for F_x in this particular case. See Fig. 3.

Let us further suppose that we desired to set our receiver at some particular frequency (e.g.) 7120 kc. Since 7120 kc is lower in frequency than 7600 kc there will be two points on our oscillator respectively lower in frequency than 1520 kc and 1900 kc, and which will have their fourth and fifth harmonics located at 7120 kc. Dividing 7120 kc on the slide rule by either 4 or 5, whichever we choose, we see that the answers are 1780 kc and 1424 kc. This means that we may slowly tune the oscillator either from 1900 kc to 1780 kc, or from 1520 kc to 1424 kc, at the same time following along with the receiver which will be tuned to 7120 kc when we have finished the operation. After some practice *this entire procedure should not occupy more than about one and one-half minutes!*

There are several other points which are worth mentioning. For example:

To avoid making mistakes it should be constantly borne in mind that, having found two harmonics on the "C" scale,

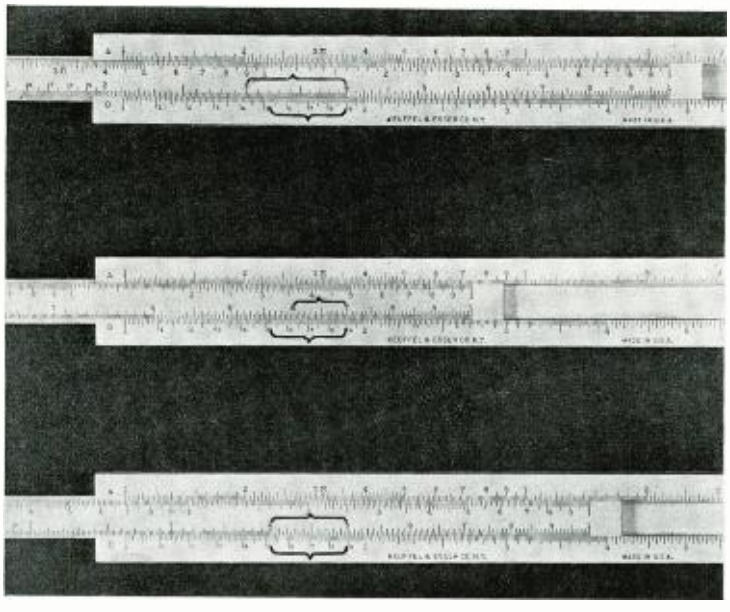


Fig. 2A (Top). The object being to find two *consecutive whole* numbers on the C-scale which *coincide exactly* with the two known frequencies shown in Fig. 1, it will be noted that 3 and 4 on the C-scale are too far apart. Fig. 2B (Center). Likewise it is noted that 6 and 7 on the C-scale are too close together. Fig. 2C (Bottom). This is correct. Observe that 4 and 5 on the C-scale correspond precisely with 1520 and 1900 on the D-scale. Thus we learn that our receiver is tuned to the *4th harmonic of the higher frequency* (1900 kc) and the *5th harmonic of the lower frequency* (1520 kc).

it is *the lower frequency which is multiplied by the higher order of harmonic, or vice versa.*

It should also be understood that in practicing this method without an oscillator actually in use, one must *first* select an arbitrary value for F_x and then work the problem backwards to determine F_1 and F_2 as it is seldom that frequencies for these expressions can be picked at random on the "D" scale and the method made to work.

It will be noted that an idea of the location of the receiver setting in kilocycles may be had by counting the number of beats heard when the oscillator is swung over its complete range. That is, if there are from 2 to 4 beats the receiver is set somewhere between 3500 kc and 9000 kc. If the beats heard number between 6 and 10 the receiver is between 15,000 kc and 30,000 kc. At 56 mc the number of beats heard should be about 21.

Since there is only a very slight difference in the spacing of the whole numbers on the "C" scale which would correspond to the order of harmonics giving beat notes at or near 56 mc, it is suggested that an additional coil for the oscillator be calibrated to cover about 3000 to 4000 kc, which will cut the order of harmonics in half, thereby increasing the spacing and allowing these values to be more accurately determined.

Any one of several varieties of oscillators will do provided the oscillator is calibrated as suggested.

Where a "super" is employed as the receiver, a beat oscillator must also be used or else a modulated type of oscillator for frequency locating.

The practicability of this system has, for several months, been in the process of demonstration at the homes of two short-wave experimenters, neither of whom had had previous experience with either an oscillator or a slide rule. Each of them after four hours of instruction and practice were able to determine the receiver setting to within from 7 kc to 20 kc. Also, they were able to set the receiver with the same precision, to any desired frequency below 200 meters. It is hoped that others may benefit to a similar or greater degree.

I.R.E. ROCHESTER FALL MEETING

NOVEMBER 18-19-20

THE ROCHESTER Fall Meeting of the Institute of Radio Engineers is to be held November 18, 19, 20, 1935, at the Sagamore Hotel, Rochester, N. Y. The complete program follows:

MONDAY, NOVEMBER 18

9:00 A.M. Registration
Opening of Exhibits

10:00 A.M. Technical Session
SUPERHETERODYNE OSCILLATOR DESIGN CONSIDERATION
W. A. Harris, RCA Manufacturing Company, Radiotron Division
ELECTRICAL QUALITY OF RADIO COMPONENTS
C. J. Franks, Boonton Radio Corporation

12:30 P.M. Group Luncheon

2:00 P.M. Technical Session
NEW PROBLEMS IN METAL TUBES
Roger M. Wise, Hygrade-Sylvania Corporation
LATEST DEVELOPMENTS IN ELECTRON OPTICS (WITH DEMONSTRATION)
W. H. Kohl, Rogers Radio Tubes Company, Ltd.

4:00 P.M. Inspection of Exhibits
Meeting RMA Committee on Television
Meeting RMA Committee on Sound Equipment

6:30 P.M. Group Dinner

8:00 P.M. Joint Technical Session with Radio Club of America
ELECTRON MULTIPLIERS AND NEW ELECTRON TECHNIQUE (WITH DEMONSTRATION)
V. K. Zworykin, RCA Manufacturing Company, Victor Division

TUESDAY, NOVEMBER 19

9:00 A.M. Registration
Opening of Exhibits

9:30 A.M. Joint Technical Session with RMA Engineering Division
A TRAGEDY IN SPECIFICATIONS
L. C. F. Horle, Consulting Engineer
MANAGEMENT'S STAKE IN STANDARDS
P. G. Agnew, American Standards Association

12:30 P.M. Group Luncheon

2:00 P.M. Technical Session
THE STATUS OF THE RADIO SPECTRUM
C. B. Jolliffe, Federal Communications Commission

3:00 P.M. Inspection of Exhibits
Meeting RMA General Standards Committee

6:30 P.M. Stag Banquet (Informal)
Toastmaster, A. F. Van Dyck
EUROPEAN EXPERIENCES IN RADIO
L. M. Clement, RCA Manufacturing Company, Victor Division
SPEECH WITH SOUND EFFECTS
David Grimes, Philco Radio & Television Corp.

WEDNESDAY, NOVEMBER 20

9:00 A.M. Opening of Exhibits

9:30 A.M. Technical Session
INSTANTANEOUS TRACING OF TUBE CHARACTERISTICS
Otto Schade, RCA Manufacturing Company, Radiotron Division
QUANTITATIVE INFLUENCE OF TUBE AND CIRCUIT PROPERTIES ON RANDOM ELECTRON NOISE
S. W. Seeley and W. A. Barden, RCA License Laboratory

12:30 P.M. Group Luncheon

2:00 P.M. Technical Session
DESIGN OF DOUBLET ANTENNA SYSTEMS
H. A. Wheeler, Hazeltine Service Corporation
IRON CORE ANTENNA COIL DESIGN
George H. Timmings, Meissner Mfg. Company

4:00 P.M. Exhibits Close
Meeting of RMA Committee on Broadcast Receivers
Meeting of RMA Committee on Vacuum Tubes

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RADIO RECEPTION AND SALES IN BRITISH WEST INDIES

LOCAL DEALERS report that they have been handicapped in the sale of American radios this year by the lack of daytime programs from the United States. All during last year one of the American radio stations sent out short-wave programs daily from 10:00 a.m. to 3:00 p.m. in sufficient volume to be clearly received. This program has been discontinued. The British Broadcasting Company sends out a strong program in the morning up until 8:00 a.m., which is well received, but from that time on until 4 o'clock in the afternoon no program comes through with sufficient strength to be picked up by 6 and 8 tube sets.

Night-time reception on both 6 and 8 tube sets is very good. (Consul Perry N. Jester, Barbados, in *Electrical Foreign Trade Notes.*)

English Receiver Design

BY ANDREW W. CRUSE
Chief, Electrical Division
U. S. DEPARTMENT OF COMMERCE

● **EXTRACTED FROM AN ARTICLE IN THE ELECTRICAL REVIEW (LONDON), THIS DESCRIPTION OF THE EXHIBITIONS AT THE OLYMPIA SHOW INDICATES A PARALLELISM BETWEEN AMERICAN AND BRITISH RECEIVER DESIGN.**

THE 1935 BRITISH Radio Exposition was held from August 14 to 24, at Olympia, according to a report published by the *Electrical Review* (London). The Grand Hall and its gallery were filled with trade exhibits, while adjacent to the Grand Hall there was an extensive post office exhibit, with a Broadcasting Theatre. The exhibitors numbered nearly 170. No television receivers were permitted to be shown, since the organizers did not feel justified in admitting this type of apparatus until a public service of high-definition television becomes available.

The article continues: The presentation of the exhibition this year is extremely attractive, with changing color illuminations of the large cycloramic display at the west end of the Grand Hall. A summary of the main features of 1935-6 radio receiver design as revealed by the show, follows:

RECEIVER FEATURES

As might be expected, the superheterodyne circuit is still the most popular one among set manufacturers, and there are very few exhibits of receivers which do not consist mainly of sets of this type. Many of these are of the 3- to 4-tube (plus tube rectifier) class, making use of multi-stage tubes in certain positions. On the other hand, receivers and phonograph combinations with up to 15 tubes are to be seen; these, of course, falling in the higher priced class. Generally speaking, the price levels have changed very little since last year, and the popular type of table superhet is usually listed at from 11 to 14 guineas. Lower priced sets are generally of the simple tuned-radio-frequency type.

Most of the receivers this year are fitted with some form of automatic volume control. In some cases, ordinary delayed avc is employed, but in the slightly higher priced class, there is a tendency to standardize "quiet" and amplified avc. Another feature of many of the modern superhets is automatic tone compensation, which operates in conjunction with the volume control, and increases the bass response at low volume levels.

For the first time, variable selectivity for superhets is featured by a number of manufacturers. The object, of course, is to provide a higher degree of fidelity of reproduction with moderate selectivity for local station reception, combined with high selectivity, and a sacrifice of the upper register, when receiving distant stations free from interference due to adjacent transmissions.

"High Fidelity" is undoubtedly the slogan of many firms this year. In most cases, this is justified, but in others there seems to have been very little attempt to improve on last year's models, except, perhaps, to incorporate a somewhat larger speaker.

Apart from the followers of the superhet circuit, there is a small, but none the less important, band of manufacturers of high-fidelity apparatus who pin their faith to "straight" receivers with tuned-radio-frequency stages. Since the products of the firms are largely individually built, the prices are necessarily a little above the average.

For some time it has been apparent that designers have been handicapped by the necessity of including the loudspeaker in the cabinet with the receiver. There is no real reason for this, except convention, and this year several firms supply receivers with no self-contained speaker. The breakaway is by no means general, however. In other cases, improvement in reproduction has been sought by the use of special output stages, twin, triple, or even quadruple speaker, and special cabinet design.

ALL-WAVE SETS

Another tendency this year is for manufacturers to show one or more so-called "all-wave" models, to cater for the interest in short-wave reception. In most cases the extra wavebands go down to 10 or 15 meters, but in no case is the complete waveband up to 2,000 meters covered without breaks. Generally one or two extra wavebands are included in more or less standard receivers, to cover up to 50 or 80 meters.

A careful survey of the exhibition fails to reveal any d-c receivers this year. In practically all cases manufacturers show a-c, d-c models. They employ the special universal type of tube, with series connected heaters and (barretters). Battery receivers are still prominent, many of them having Class B (or "q.p.p.") output stages for high outputs with battery economy. In many cases their performance is comparable with that of corresponding socket power models. On one or two stands midget battery sets are on view employing specially small tubes. One firm at least is showing a crystal receiver.

TUNING SCALE FASHIONS

Many and ingenious are the arrangements designed to provide easy tuning in modern receivers. Dials are mainly of the "full-vision" type, with a pointer, band or spot of light moving over the scale, which is calibrated in wavelengths and marked with station positions. The "All-in" dial is an interesting one, since not only is there the usual tuning calibration, but the positions of

(*Continued on page* 15)

cycle later, when the alternating force begins to oppose the constant force.

In the first case, the alternating force increases in intensity as the electron moves along, then decreases to zero, then reverses and opposes the motion, and finally completes the cycle by becoming positive again. If the electron passes through the grid mesh just before the alternating force returns to its first zero value, the action of the force upon it is as shown in Fig. 3. At the instant the electron passes through the grid, of course, the direction of the force acting on the electron reverses, not because of any abrupt change in the grid potential, but because the grid is now located behind the electron instead of ahead of it. As the electron moves on toward the plate, however, the alternating force decreases to zero and then reverses. Thus during both halves of the cycle the force acts in the same direction as the electron is moving, and delivers energy to it, as can be checked by reference to the area under the curve in Fig. 3. In other words, the transient in the external circuit has done work on this particular electron, and the electron, by taking energy away from the circuit, has produced a tendency for the transient to die out.

There is nothing in this behavior that gives encouragement to the maintenance of oscillations. The only consolation comes from noting that the electron is moving faster when it approaches the plate than it would if no alternating forces had acted on it, and consequently it will hit the plate even though the latter be at a slightly negative potential. Thus this useless, and in fact harmful, electron is at least prevented from doing still further harm by being removed through the plate from the scene of action.

Fortunately the other electron, that leaves a half cycle later than the worthless one just dismissed, is more useful. From the very start the alternating force opposes the motion of the new electron, but cannot stop it because the alternating force is never larger than the constant force of Fig. 2. The electron is therefore doing work against

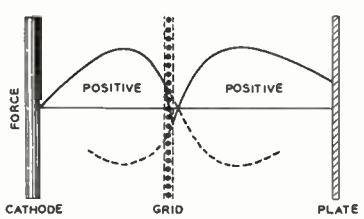

Fig. 3. Because the work done on an electron of the useless type by an alternating force is positive, the electron abstracts energy from the alternating-current transient.

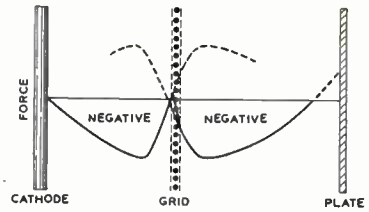

Fig. 4. With an alternating force, an electron of the useful type delivers energy to the transient, at the expense of the battery producing the constant force.

the alternating force, delivering energy to the transient in the external circuit. As the electron progresses, the phase of the force changes as shown in Fig. 4. Unlike Fig. 3, the reversal in direction occurs before the electron has reached the grid, because the force opposing the motion has decreased the speed. When passage through the grid mesh again reverses the direction of the force, the agreeable electron continues to deliver energy to the circuit transient, as it approaches the plate. Having lost much of its velocity in transferring its energy to the circuit, the electron comes to rest before hitting the plate, and then, urged by the constant force of Fig. 2, starts on its return journey toward the grid. At about the same time, the phase of the alternating force again reverses and again opposes the motion, so that the hapless electron must give up still more of its energy to the growing transient.

Another passage through the grid follows, accompanied by another reversal in the phase of the alternating force, and the tormented electron must again yield energy acquired from the constant force to the hungry transient. The energy loss brings the electron to a halt before it reaches the cathode, the phases again reverse, and the cycle starts over again.

In its round trip, the useful electron of Fig. 4 supplies to the transient nearly twice as much energy as the useless one of Fig. 3 abstracted in its one-way trip. Moreover, the useful electron reaches the cathode again at just the right time to join with other electrons of the useful type and augment their relative number. The action is consequently progressive, building up more and more useful electrons.

In practice, operating conditions modify somewhat the mechanism described. For example, space charge near the cathode produces more harmful electrons than useful ones and is to be avoided. Space charge near the plate causes a shift between the phase of the grid voltage and the force acting on the electrons, which in general tends to raise the frequency of oscillation. On the other hand, space charge in general makes the electrons move slower. Since the slower motion tends to decrease the frequency, the net result of space charge near the plate is only a small decrease in frequency. The tuning of the external circuit can also modify the frequency by about thirty percent, but for fixed values of plate, grid, and filament battery voltage, there is a particular tuning adjustment which gives maximum output.

There is a simple approximate expression for determining the proper grid voltage and size of vacuum tube to produce oscillations of a given wavelength. For example, a tube with a plate diameter of one centimeter, and with 100 volts applied to the grid, will produce oscillations with a wavelength somewhere between 100 and 50 centimeters, corresponding to a frequency between 300 and 600 megacycles, depending on the circuit adjustments.

It is interesting to note that the same kind of analysis here used to illustrate the workings of the Barkhausen oscillator can be applied to the well-known feedback oscillators operating with negative grid and positive plate, and shows that the two are not very different from each other after all. The Barkhausen oscillator will probably prove very useful in the fields of ultra-short-wave transmission, which are rapidly coming into commercial application.

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RESEARCH PAPER RP780

RESEARCH PAPER RP780, "Recent Studies of the Ionosphere," by Samuel S. Kirby and Elbert B. Judson, has just been issued by the National Bureau of Standards, U. S. Department of Commerce.

Results of ionosphere measurements utilizing transmissions at vertical incidence and made weekly over a period of 18 months are discussed. Typical graphs of diurnal variations of the E layer critical frequency and its relation to the ionizing force of the sun are shown for three seasons. Similar graphs for the F_2 layer are included as well as a seasonal curve of midday, and maximum critical frequencies of this layer. The absence of midday F_2 critical frequencies during the summer is pronounced.

A sporadic E layer appearing at the same virtual height as the normal E, and after the normal E has reached its critical penetration frequency, is discussed. A comparison of its appearance with local thunderstorms is tabulated. The presence of a tentatively named G layer is also indicated.

Research Paper RP780 may be obtained from the Superintendent of Documents, Washington, D. C. The price is five cents per copy.

CORES—

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PART I

● SELECTION OF MAGNETIC CORE MATERIALS FOR RADIO RECEIVER CONSTRUCTION

THE CORE MATERIALS employed in radio-receiver construction operate on widely varying magnetic circuit conditions, and for that reason the basis of selection must be suited to each particular unit. Materials excellently suited to the economical construction of the output audio transformer are rather too expensive for use in the filter reactor or power-transformer unit.

POWER TRANSFORMERS

The selection of material used in the cores of power transformers supplying energy for plate and filament circuits, is identical with the selection of core material for any power transformer, and is made upon a standard watt-loss specification. This information is reliably supplied by the manufacturers of such core materials, and there is little need for the user duplicating this expensive form of checking and testing. Loss tests on complete transformer units readily determine the suitability of various grades under consideration. The mechanical properties of the electrical sheet so selected must be carefully considered in discriminating between various makes of the same watt-loss specification. Quite often poor mechanical properties by causing injury to or premature loss of a die will tie up seriously the radio manufacturer's production program at the height of the season. Again, wavy irregular sheets, necessitating the scrapping of wide strips from both sides of the sheet, introduce an unexpected cost of much greater magnitude than would be involved in the selection of a sightly more expensive but superior grade from a mechanical performance standard.

The properties to be considered in the selection of core material for the power transformers of a radio receiver are (1) standard watt-loss specification, and (2) mechanical properties affecting the economical use of the material and the mechanical production facilities available for the fabrication of the material.

Where limited space or weight requirements make necessary the use of flux densities of 14,000 Gausses or higher (this being particularly frequent in the design of 25-cycle radio transformer units), high permeability of the core material also becomes of importance. Low permeability core material in such designs results in high exciting current copper losses and poor voltage regulation in the transformer output.

AUDIO TRANSFORMERS AND CHOKES

The core materials used in smoothing reactors (chokes) of the plate supply unit, and in the audio transformers, must be selected on a permeability basis. The permeability on which the selection is to be made, must be a "working permeability" or "apparent a-c permeability" as established by the working inductance of some definite design of choke or transformer, and not the theoretical "permeability" disclosed in the usual so-called "saturation curve" (B-H) or "permeability flux density" curve (U-B). The values given in such curves are not directly usable in the design of transformers or reactors in which the core material is polarized by a relatively heavy unidirectional magnetizing force, which condition results from the nature of the electric circuits of which vacuum tubes form a part as in the radio receiver.

PERMEABILITY FROM INDUCTANCE MEASUREMENTS

The basis of selection of core materials for audio transformers and chokes should be solely on the basis of what is known as the "incremental" permeability, and the value of the permeability is determinable directly from the inductance of any definite design. The apparent inductance of an iron-cored reactor, or primary winding of a transformer with no load on the secondary, is given by the formula

$$L_a = \frac{1.256\ A\ K_1\ N^2\ \mu_a\ 10^{-8}}{L} \text{ henrys}$$

where L_a is the apparent inductance in henrys
- A is the cross-sectional area of the core in square centimeters
- K_1 is the core stacking factor (value largely determined by the mechanical properties of the core material)
- N is the number of turns in the winding
- μ_a is the apparent a-c permeability
- L is the length of the magnetic path in centimeters.

Rearrangement of the above formula gives an expression from which the value of the apparent permeability may be derived from the value of the inductance.

$$\mu_a = \frac{L_a\ L\ 10^8}{1.256\ A\ K_1\ N^2} = \frac{L\ 10^8}{1.256\ A\ N^2} \times \frac{L_a}{K_1}$$

STACKING FACTOR AND PUNCHING CHARACTERISTICS

The quantity $\left(\frac{L\,10^8}{A\,N^2}\right)$ is a constant, the value of which is determined by the physical dimensions of the core and the number of turns in the coil, with which the tests are to be made. The quantity $\left(\frac{L_a}{K_1}\right)$ indicates the way in which the "stacking factor" as affected by the punching characteristics enters into the determination of the permeability. A poorly mechanically performing material will result in burred edges on the punchings, resulting in reduced number of pieces in a given design, which will give reduced inductance. This will not, however, affect the permeability determination.

The value of the "stacking factor" for any design is given by dividing the product of the core volume (in cubic centimeters) and the specific gravity of the core material into the actual measured weight of the core material in grams.

$$K_1 = \frac{W}{V\,g}$$

where W is the weight of the core in grams
V is the volume of the core in cubic centimeters
g is the specific gravity of the core material.

In this connection the following specific gravity figures will be of value:

Silicon steel with silicon content of 2% or less	7.7*
Silicon steel with silicon content of more than 2%	7.5*
Allegheny Electric Metal	8.3

INDUCTANCE MEASUREMENTS

The performance of magnetic core materials in audio transformers and impedance units is most important at the lowest audible frequencies. Similarly, the performance of filter smoothing reactors (chokes) is most important at the lowest frequencies. The greatest discrimination between various core materials is therefore in the range of the commercial power frequencies of 25 to 60 cycles. This frequency range is conveniently available for measurements, and since the permeability does not change appreciably for frequencies up to 500 cycles, the effect of the presence of the usual percentage of harmonics in the inductance measurement by the method followed hereafter is not serious.

*See standard specification of A.S.T.M. for basis of the above figures.

DIFFICULTIES OF BRIDGE OR "NULL" METHODS OF INDUCTANCE MEASUREMENT

There are several bridge methods for inductance measurements, which are generally difficult to balance by telephone because of the low sensibility of the ear to low frequencies around 60 cycles or lower. The use of higher frequencies from 250 to 500 cycles has several disadvantages, notably (1) the effect of coil capacitances necessitates careful corrections to all determinations, and (2) the lack of linearity in the magnetization curve of iron and its alloys introduces harmonics rendering almost impossible an accurate balance of either two iron-cored inductances or between an iron-cored and an air-cored inductance. These difficulties also apply to the use of the thermocouple, which is incidentally much less sensitive than the telephone for bridge-null measurements.

IMPEDANCE AND REACTANCE DETERMINATIONS INDICATE INDUCTANCE VALUES

The measurement of the impedance of a transformer primary or choke coil is rather simple, and in the usual design the reactance is very closely the value of the impedance, the resistance of the winding being very small in comparison with either the impedance or reactance. From the reactance, at a known frequency, the apparent inductance can be quickly computed. The following relations are of importance in this connection:

$$Z = \sqrt{X^2 + M^2}$$

where Z is the impedance in ohms
M is the apparent resistance in ohms
X is the reactance in ohms

If M is negligible compared with X, then $Z = X = 2\pi f L_a$

where f is the freqency in cycles per second
L_a is the apparent inductance.

The value of "M" includes "r" the resistance of the copper winding plus a quantity representing the hysteresis and eddy current losses in the core material. In audio-frequency transformers and impedances, and in filter smoothing reactors (chokes) these are both negligible.

The problem is then that of measuring the impedance of a choke or transformer primary winding without any load on the secondary winding, at a commercial frequency of 60 cycles, the voltage being that of a usual service condition, as for example 1 volt rms, and sufficient direct current being introduced into the winding to simulate average working conditions of the same transformer. In the average interstage audio transformer, the direct current would be about 3 milliamperes, and in the average filter reactor, the value would be anywhere from 20 to 125 milliamperes. The heavier direct current values of the filter choke necessitate a slight variation in method of measurement, that can be easily handled and will be discussed in the forthcoming article.

ENGLISH RECEIVER DESIGN

(*Continued from page* 10)

the volume, tone and waveband controls are also shown on the dial by means of a number of pointers, while a tuning indicator, showing when the set is correctly in tune, is fitted. The so-called "Airplane" dial is favored by many this year, and is of the circular type, with a dual pointer.

Tuning indicators are again fitted by many firms. These are generally small moving-iron milliammeters or arrangements whereby a band of light on a scale is caused to contract or expand as the carrier wave is accurately tuned. Special small neon tubes, made by Cossor and the G. E. C., are also largely used.

SPECIAL RECEIVERS AND AMPLIFIERS

Car radio receivers are now produced by a number of companies. In most cases these employ the universal type of tube, with paralleled heaters, to run from the 12-volt car storage battery; "B"-supply is from a separate or built-in rotary transformer or a vibrator unit. Some models are interesting in that they are transportable and a simple plug arrangement enables them to be used in the car from the 12-volt supply, or in the home from the usual a-c supply.

Many firms at Olympia specialize in public-address apparatus, radio relay amplifiers, and similar equipment.

In summing up one's impressions of the receivers and similar equipment on show, it is safe to say that there seems to be a notable tendency for the manufacturers to aim at reliability of their products, rather than at extremely low prices. This policy must react favorably upon the public during the coming season, while the dealer should find his service problems eased to a considerable extent.

WWV EMISSIONS

Standard Frequency Service Broadcast by National Bureau of Standards

THE NATIONAL Bureau of Standards provides a standard frequency service which is broadcast by radio. Beginning Oct. 1, 1935, this service is given on three days each week, from the Bureau's station WWV, Beltsville, Md., near Washington, D. C. These radio emissions provide a standard for scientific or other measurements requiring an accurate radio or audio frequency or time rate, and are useful to radio transmitting stations for adjusting their transmitters to exact frequency, and to the public generally for calibrating frequency standards.

On each Tuesday and Friday the emissions are continuous unmodulated waves (cw); and on each Wednesday they are modulated by an audio frequency. The audio frequency is in general 1,000 cycles per second. (There are no emissions on legal holidays).

On all emissions three radio carrier frequencies are transmitted as follows: Noon to 1 P.M., Eastern Standard Time, 15,000 kc; 1:15 to 2:15 P.M., 10,000 kc; 2:30 to 3:30 P.M., 5,000 kc.

The emissions on 5,000 kc are particularly useful at distances within a few hundred miles from Washington, those on 10,000 kc are useful for the rest of the United States, and those on 15,000 kc are useful in the western half of the United States and to some extent in other parts of the world.

FREQUENCY ANNOUNCEMENTS

During the first five minutes of the one-hour emission on each carrier frequency, announcements are given. For the cw emissions, the announcements are made by telegraphic keying and consist of the station call letters (WWV) and a statement of the frequency; this announcement is repeated every ten minutes. For the modulated emissions, the announcements are given only at the beginning of the hour; they are given by voice and include the station call letters and a statement of the carrier frequency and the audio modulation frequency.

Except during the announcements, the cw emissions consist of continuous, unkeyed carrier frequency, giving a continuous beat note in the telephone receiver in heterodyne reception. The radiated power in the cw emissions is 20 kilowatts.

The modulated emissions, except during the voice announcements at the beginning of the hour, consist of an uninterrupted audio frequency superposed on the carrier frequency. The radiated power is only one kilowatt; reception is therefore not as reliable as for the cw emissions of Tuesdays and Fridays; it is hoped to increase the power later. The modulated emissions are somewhat experimental, and for this reason an audio frequency other than 1,000 cycles per second may be used on some occasions. The presence of the audio modulation frequency does not impair the use of the carrier frequency as a standard to the same high accuracy as in the cw emissions.

ACCURACY OF TRANSMISSIONS

The accuracy of the frequencies as sent out from the transmitting station is at all times better than a part in five million. Transmission effects in the medium (Doppler effect, fading, etc.) sometimes result in slight fluctuations in the frequency as received at a particular place. However, these practically never impair the reception of the carrier frequency to the accuracy stated. Under some conditions, momentary fluctuations as great as 1 cycle per second may occur in the modulation frequency. It is generally possible, however, to use the modulation frequency with an accuracy better than a part in a million by selecting that one of the three carrier frequencies which has the least fading. It is helpful to use automatic volume control on the audio frequency.

PAMPHLET OBTAINABLE

Information on how to receive and utilize the standard frequency service is given in a pamphlet obtainable on requests addressed to the National Bureau of Standards, Washington, D. C. From any single frequency, using harmonic methods, any frequency may be checked.

The Bureau welcomes reports of use and comments upon the standard frequency service. As the modulated emissions are somewhat experimental it is particularly desired that users report to the Bureau their experience in using them, including: Description of method of use; statement of relative fading, intensity, etc.. on the three carrier frequencies; and preference as to audio frequency to be furnished. Correspondence should be addressed National Bureau of Standards, Washington, D. C.

NEW PARIS STATION

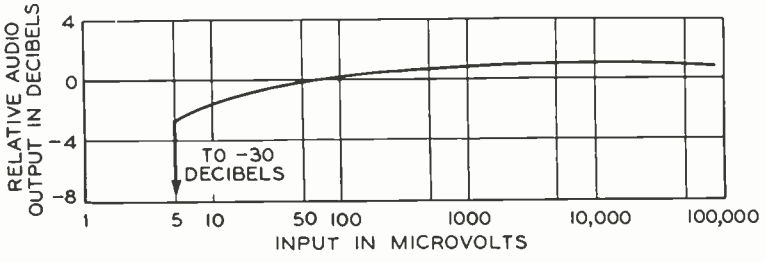
A NEW 120,000-watt broadcast transmitter will soon be put into regular service by the Paris "P. T. T." The station is situated at Villebon-sur-Yvette, 12 miles from Paris, and has been conducting experimental broadcasts with limited power since August 25. (*Assistant Trade Commissioner Lestrade Brown, Paris.*)

Lorenz television equipment exhibited at the recent German Radio Exposition in Berlin. Lorenz and Tefag companies are part of the International Standard Electric Group.

"CODAN"

A CARRIER-OPERATED ANTI-NOISE DEVICE

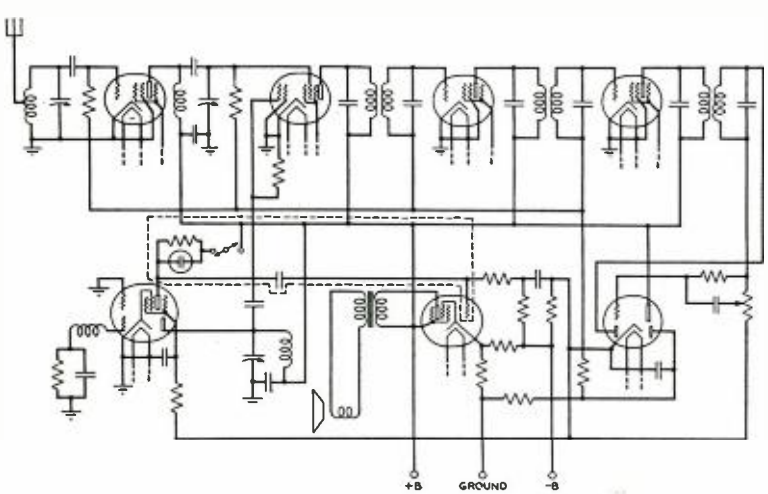
ULTRA-HIGH-FREQUENCY radio transmitters, such as are used in the Western Electric Police Systems at Newark, New Rochelle, and other cities of the country, are so arranged that carrier power is radiated from the antenna only while announcements are being made. This provision considerably reduces the operating costs both by prolonging the life of the tubes and decreasing the daily power consumption. The radio receivers used with the ultra-high-frequency system, on the other hand, are equipped with automatic volume control, which maintains a constant output from the loudspeaker regardless of the strength of signal picked up. When the carrier is on, the signal strength is considerably higher than noise arising from ignition systems and other sources, and as a result the noise is not normally objectionable. When the carrier is off, however, the noise, even though weak, would be amplified to the full output of the receiver by action of the automatic volume control and would be very objectionable if precautionary steps were not taken.



Output level of ultra-high-frequency receiver for police cars, showing the effect of codan and automatic volume control.

The possibility of noise when the carrier is off is eliminated in these radio receivers by a device called a codan. This word is constructed from the initial letters of the phrase "carrier-operated device, anti-noise," which describes its function. It is not a single piece of apparatus, but a circuit intimately associated with various parts of the receiver.

Its major element, however, and one employed only for the codan, is a small neon tube. The important characteristic of this tube is that it acts as a very high impedance to all voltages up to some critical value. At voltages above this critical value, however, a discharge occurs across the electrodes of the tube and the impedance drops to so low a value as to act as a short-circuiting path. This tube is so connected in the circuit that when the carrier is off, a high voltage is impressed across it which causes the tube to discharge. Under these conditions the tube is conducting, and forms a short-circuiting path that kills the output of the audio-frequency amplifier, and the loudspeaker remains silent. With the neon tube in a non-conducting state, the receiver acts normally.



Simplified schematic of ultra-high-frequency radio receiver for police cars. The codan circuits are within the dotted lines.

The voltage across the neon tube depends upon the average level of the received signal. When the carrier is on, this average level is high enough to keep the neon tube non-conducting, and the set operates. When the carrier is off, however, the average signal strength is low enough to make the tube conducting, and the loudspeaker remains silent. The noise impulses themselves may be quite high in intensity, but they are of extremely short duration so that their average value is too low to operate the codan.

With these codan-equipped receivers, therefore, the loudspeakers are silent as long as the transmitter at headquarters is off the air. As soon as it comes on, however, the codan operates, and the announcement comes in on the loudspeaker.

THE 6F5 AS A HIGH-GAIN A-F AMPLIFIER

MANY MODERN broadcast receivers require at least two stages of audio amplification in order to obtain rated power output. The gain necessary in the first stage depends upon the a-f voltage developed by the detector, which is usually a diode, and the input-voltage requirements of the second audio stage. When the number of tubes in the audio amplifier is restricted to two, it may be necessary to use a high-gain first-stage tube in order to meet the input-voltage requirements of the output stage, especially when a low-percentage modulated carrier is to be received. The 6F5, the all-metal high-mu triode intended for use in high-gain resistance-coupled amplifier circuits, can be used to advantage in this case, as evidenced by the following data provided by the Research Laboratories of RCA Radiotron.

The 6F5 may also be used to advantage in receivers having more than two a-f amplifier stages. For example, the high gain obtainable through the use of a 6F5 in the first stage of a three-stage amplifier makes it possible to feed to the first a-f tube only a part of the total audio voltage developed by the detector.

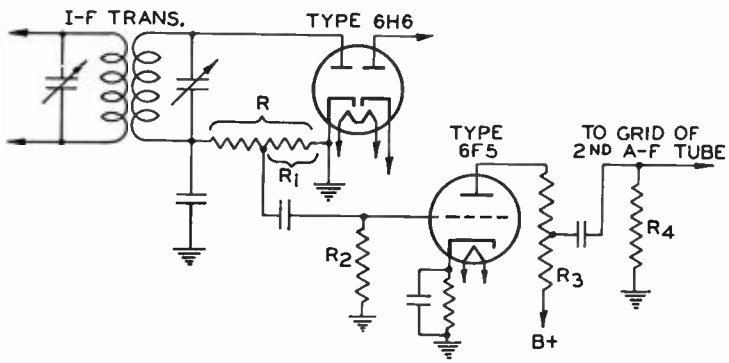


Fig. 2. Low distortion circuit using the 6F5 as a high-gain amplifier.

The smaller the fraction of the total detector output voltage that is fed to the first a-f tube, the larger the percent modulation that can be handled with small distortion. The utilization of less than maximum a-f voltage is not serious in a high-gain amplifier.

To understand why utilizing a part of the diode voltage is desirable, let us consider that the characteristics of a certain diode are as shown in Fig. 1. For a given carrier voltage (E_1, or E_2, — E_{15}) at the detector, the ordinate and abscissa indicate, respectively, the d-c current through and the d-c voltage across a suitably bypassed resistance (R) connected in series with the diode; the ratio of the d-c voltage across R to the d-c current through R equals the resistance of R. Hence, the intersection of a load line (whose cotangent is R) with any single carrier-voltage curve determines the value of the d-c current flowing in the circuit. Thus, if an unmodulated carrier voltage having a value E_0 is impressed across the input of the circuit consisting of R, suitably bypassed and the diode in series, a d-c voltage (E_c) will be developed across R and a d-c current (I_c) will flow in the circuit.

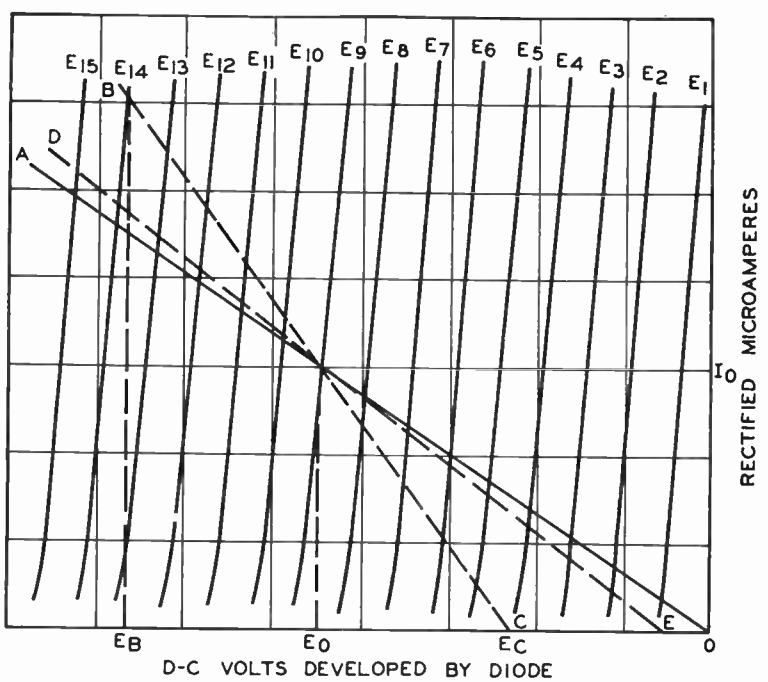


Fig. 1. Diode characteristics showing diode distortion of a high-percentage modulated carrier.

The audio voltage appearing across R is usually fed to the grid of the first a-f tube through a coupling condenser; the grid of this a-f tube is grounded through a high resistance (R_g). When the carrier is modulated, the diode load (R_d) is then essentially $R_d = R \times R_g/(R + R_g)$. The reciprocal of the slope of the line (BC) equals R_d; BC passes through point (E_c, I_c). If the percent modulation is such that the minimum amplitude of the carrier is less than E_4, small carrier amplitudes will be cut off. Therefore, the maximum percent modulation that can be handled by this circuit is $(E_0 - E_4)/E_0$. On the other hand, if R_g is connected to only a portion of R, then the load line for a modulated signal may be represented by DE. Thus, signals that are modulated up to approximately $(E_0 - E_1)/E_0$ percent can be rectified with little distortion. In other words, as the fraction of the total diode voltage (R_1/R in Fig. 2) coupled to the first a-f tube becomes smaller, the slope of the operating line approaches that determined by the unmodulated carrier. Hence, the percent modulation of the signal can be increased before diode-

current cut-off occurs. If the change in the slope of the operating line is small, nearly 100 percent modulation can be handled without distortion due to diode-current cut-off.

Diode biasing of the grid of the 6F5 does not produce this type of distortion, but is not generally suitable because of the probability of plate-current cut-off, even with relatively small signal voltages applied to the diode circuit. The use of a 6F5 in the first a-f stage of a high-gain amplifier, connected as in Fig. 2, permits the detection of highly modulated signals with little distortion.

The design of a receiver may be such that, even though a part of the audio voltage developed by the diode is applied to the grid of the 6F5, the signal voltage at the grid of the second a-f tube may be more than necessary. Under these conditions, the plate resistor of the 6F5 may be tapped, so that only a fraction of the voltage developed across this resistor is applied to the grid of the second a-f tube. This circuit will tend to minimize plate-circuit distortion in the 6F5, caused by plate-current cut-off during the negative voltage excursions of the signal. Fig. 2 shows a circuit that permits the rectification of highly modulated carriers with little distortion and also tends to minimize any plate-circuit distortion.

When the 6F5 is used in conjunction with a 6H6, the all-metal twin diode, the combination may be used as a detector, avc tube, and first a-f amplifier. A variety of circuits are possible with this combination, because each of the two diodes in the 6H6 has its own cathode and corresponding base pin.

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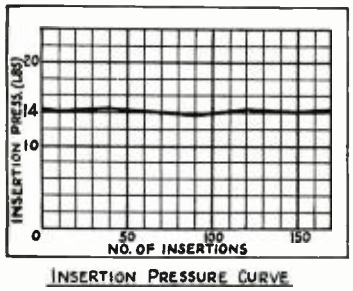
METAL-TUBE SOCKET DESIGN

THE TYPE 39 socket was developed as a result of the experience and knowledge gained from the limitations of previously designed sockets for the new metal tubes. Some of the design considerations incorporated in this socket follow:

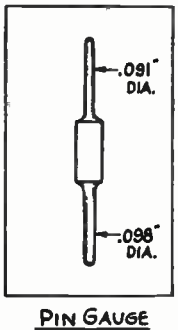
1. *Bow action spring contact*
   (a) Special spring bronze alloy.
   (b) Straight-line wiping surface.
   (c) Low electrical contact resistance.
   (d) Uniform insertion pressure.
   (e) Long soldering lug.
   (f) Double plated-electro-tinned plus cadmium.
2. *High quality bakelite*
   (a) Low moisture absorption.
   (b) High voltage breakdown.
   (c) High leakage resistance.

In order to ascertain the resilient quality of the Type 39 contact, a test was devised and made on a number of sockets. The curve of Fig. 1 corroborates the basic design. Notice that after 150 insertions the contact pressure remains practically uniform. The insertion pressure was kept at 14 pounds (total 8 prongs, or 1.75 pounds per contact), since it was found that this pressure was sufficient to hold the tube securely in position and that any additional pressure merely made it difficult to insert and withdraw the tube. The electrical contact resistance before and after this test maintained a value of 0.00438 ohm.



INSERTION PRESSURE CURVE

Fig. 1. Curve resulting from tests on socket contacts.



PIN GAUGE

Fig. 2. Details of pin used in the contact-pressure tests.

To prove the effectiveness of the socket to maintain good electrical and mechanical contact under conditions of varying prong diameter, the steel pin shown in Fig. 2 was constructed. After the 0.098-inch diameter pin was inserted to spread the contact, the 0.091-inch diameter pin was inserted, and it was found that the resiliency of the spring was such as to still maintain pressure on the pin. A contact that remains set after being spread with a 0.098-inch pin is certain to result in a poor contact and develop trouble in a receiver when used with tubes of varying prong diameters.—*Engineering Department, Albert W. Franklin Mfg. Corp.*

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AWARD FOR PRODUCT DESIGN GOES TO RADIO ENGINEER

TAKING PRECEDENCE over air-conditioning units, electric broilers, and other electrical equipment, a modern tester for radio tubes has received first award in the recent product design contest conducted by *Electrical Manufacturing*. The prize for the outstanding example of product design among all types of electrical equipment went to O. J. Morelock, Jr., assistant radio engineer of the Weston Electrical Instrument Corporation for his article, "Modern Tube-Tester for Radio Servicing."

Mr. Morelock is well-known in the radio field, particularly for his work in developing new and improved equipment for testing and servicing. He is a member of the Institute of Radio Engineers, the Institute of Radio Service Men, and the Radio Club of America.

As indicated in Mr. Morelock's account of the work in designing this equipment, tube-testing equipment must be regarded both as a test instrument for servicing and a merchandising instrument for selling tubes. Consequently, the external appearance of the unit was determined with the same care as were the internal electrical characteristics. In addition, the prize-winning design involved considerable effort to provide complete flexibility and protection against obsolescence in testing the ever-increasing number of tube types.

Utilization of three separate "loads," or values of resistance in the measuring circuit, for applying the total emission method of testing to different types of tubes gave the tester added interest from the electrical standpoint.

Ingenuity in correlating design factors to economical production operations was also a factor which brought the tube-tester design its award, as well as the methods of case construction and assembly to provide protection for the unit.

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NEW COLOMBIAN SHORT-WAVE BROADCASTER

The Ministry of Posts and Telegraphs has authorized the Municipality of Medellin, Colombia, to install a commercial short-wave radio broadcasting station with a power up to 300 watts in the antenna circuit. The station will operate on a frequency of 49.50 meters and will be identified by the call letters HJ4-ABD. (*Commercial Attache Clarence C. Brooks, Bogota, May* 17, 1935.)

· RMA NEWS ·

U. S. FINANCING FOR P-A EQUIPMENT

THE RMA HAS secured a ruling from the Federal Housing Administration at Washington that public-address systems of a permanent character are eligible for FHA financing under its modernization credit plan. The decision and the federal financing made available should open a wide field of business for radio manufacturers in the public-address field. It will permit FHA financing for public-address equipment in apartment houses, hotels, office and other commercial buildings, hospitals, orphanages, colleges, factories and especially in schools. The latter market is especially important in view of the Public Works Administration development of and expenditure in school structures.

Availability of FHA financing is made under revised regulations of the federal agency. The specific ruling received by RMA states that "public-address systems which are actually built into a Class A structure so as to become a part of the realty may qualify under the Modernization Credit Plan, provided all stipulations of the regulations are met." The Class A structures referred to include almost every type except private dwellings and in the latter built-in radio is also eligible for FHA financing. Details of the favorable ruling on public-address equipment financing have been sent to all members of the RMA Amplifier and Sound Equipment Division.

BROADCASTERS AND RMA PLAN RADIO INDUSTRY AWARDS

Committees of the National Association of Broadcasters and the Radio Manufacturers' Association will meet soon to make definite plans for annual radio industry awards similar to the Pulitzer prizes of the newspaper publishing industry. Establishment of a "Radio Industry Foundation" by the representatives of the broadcasters and manufacturers is contemplated. It is proposed to make annual awards for outstanding achievements in broadcasting, including chain, regional and local stations and their personnel, advertising agencies and program sponsors. Lambdin Kay, of Station WSB of Atlanta, Georgia, is chairman of the NAB Committee and Powel Crosley of Cincinnati, is chairman of the RMA Committee. The two committees will meet soon, in New York, to plan inauguration of the radio industry awards in 1936.

GREAT PUBLIC DEMAND FOR SHORT-WAVE PROGRAMS

Public interest in short-wave radio and its rapidly expanding use are evidenced by the demand, from newspapers as well as the public, of foreign short-wave programs. One hundred newspapers have been added during the last month to those receiving weekly foreign short-wave programs from the Service Bureau of the RMA. With the additions, there are now over 700 newspapers receiving the weekly short-wave programs and news. In Canada as well as the States there is a widely growing interest in short-wave reception and many Canadian papers have recently subscribed to the RMA program service.

The foreign programs and news also are growing in popularity as a feature of newspapers. Scores of voluntary letters commending the short-wave program service furnished to the press by RMA have been received, especially as the short-wave program service is confined to programs and news and devoid of advertising or sponsorship. The RMA short-wave program service is furnished without charge to newspapers as a new and popular feature for the radio listening public which has so emphatically evidenced its permanent interest in short-wave broadcasting.

RMA BOARD CONSIDERS TRADE PRACTICE RULES

With President Leslie F. Muter presiding, the RMA Board of Directors met at New York September 25 and considered the proposed trade practice rules for set manufacturers which are in discussion with the Federal Trade Commission. An RMA Committee was appointed to confer further with the Commission at Washington. There will be no labor provisions in any agreement which may be reached with the Commission as the set manufacturers' proceeding is under the long-established procedure of the Federal Trade Commission and not connected with NRA. Conferences at Washington are continuing.

39 PERCENT INCREASE IN EXCISE RADIO TAXES

Improvement in the radio industry was recorded in the last report of the U. S. Bureau of Internal Revenue of the 5% excise tax collections on radio and phonograph apparatus in August. An increase of 39% in tax collections over August, 1934, was reported. The 5% tax collections last August were $319,331.10 as against $229,681.76 in August, 1934. Excise tax collections in August, 1935, on mechanical refrigerators were $629,921.64 compared with $492,714.54 during August, 1934.

RADIO LABOR STANDARDS UPHELD SINCE NRA CODE

The last report, to July 15, 1935, of the U. S. Department of Labor, Bureau of Labor Statistics, on radio factory employment, gives further evidence that the radio industry has maintained labor standards generally since termination last May of the NRA codes. The federal report for July shows continued increases, over May and also June, 1935, in employment, payrolls and per capita weekly earnings of employees, together with slight increase in average hours worked by employees.

For the month ending July 15, 1935, fifty-four radio and phonograph establishments reported employment of 33,874 employees, compared with 27,954 employees reported by forty-eight companies during the previous month of June, 1935.

Radio factory employment in July, 1935, showed an increase of 11.8 percent over the previous month of June, but was 9.8 percent less than July, 1934. Employment was 85 percent above the official comparative three-year average of 1923-25.

Radio industry payrolls during July, 1935, increased 11.9 percent over the previous month of June, but were 1.3 percent less than July, 1934. However, payrolls were 12.9 percent above the three-year average of 1923-25. Per capita weekly earnings in radio factories reported for July, 1935, were $18.96, an increase reported of .2 percent over June, 1935, and 9.5 percent over July, 1934.

Average hours worked per week in radio establishments during July, 1935, were thirty-five hours, an increase of 3.2 percent over the previous month and 9.9 percent more than July, 1934.

Average hourly earnings of radio factory employees during July, 1935, were 54.4 cents, a decrease of 3 percent from June, 1935, and 1.7 percent less than July, 1934.

AUGUST EXPORTS INCREASE

American radio exports during August, 1935, increased sharply over recent months and for the first time since last March passed a total of two million dollars. The increased exports were principally in sets and parts, but American tube sales continue to show a loss in the foreign field as compared with 1934.

The August, 1935, report of the U. S. Bureau of Foreign and Domestic Commerce reported total radio exports of $2,051,579, compared with $2,040,412 in August, 1934.

During August, 1935, there were exported 44,896 receiving sets, valued at $1,167,141, as compared with 41,067 sets, valued at $1,096,674 in August, 1934.

Exports of receiving tubes during August, 1935, were 515,653, valued at $223,010, as against 625,719 tubes, valued at $306,865 in August, 1934.

Exports of receiving set components during August, 1935, were $449,990, compared with $422,901 in August, 1934.

There were 12,511 loudspeakers valued at $34,349 exported in August, 1935, compared with 7,968 valued at $22,751 in August, 1934.

August exports of other radio accessories were $37,319 against 64,982 in August, 1934, and there were exports in August, 1935, of $139,770 in transmitting apparatus against $126,239 in August, 1934.

RADIO SCARCE ON FARMS

The farm market for radio is graphically illustrated in a new pamphlet issued by the Rural Electrification Administration. Only 20 percent of farms have receiving sets, according to an illustrated chart of REA entitled "Too Many Farms Are Behind the Times." The REA pamphlet is issued to promote rural sales of electrical equipment.

IRE MEETING NOV. 18-20

Leaders of the American and Canadian radio industries will exchange engineering and promotion ideas during the fall meeting of the Institute of Radio Engineers at Rochester, New York, November 18 to 20. The IRE Board of Directors will be host at luncheon on November 19 to the presidents and directors of the RMA and the Canadian RMA. President Muter of the RMA and President Edgar of the Cana-

(*Continued on page 22*)

NEWS OF THE INDUSTRY

DRY ELECTROLYTIC CONDENSER PATENTS

According to a release received from P. R. Mallory and Co., Inc., the Ruben dry electrolytic condenser patents Nos. 1,710,073 and 1,714,191 have been upheld by the United States District Court for the Eastern District of New York.

"In an opinion by Judge Marcus B. Campbell in the case of Ruben Condenser Company and P. R. Mallory and Co., Inc., against Copeland Refrigerator Corporation the Court declared both patents valid, and also held them infringed by dry electrolytic condensers made by Delco Products Corporation and supplied to Copeland in conjunction with electric motors. The decision directs the entry of a decree for injunction against future infringement.

"Dry electrolytic condensers, extensively used in radio sets and as starting condensers for small a-c motors, particularly in electric refrigerators, were originated and perfected by Samuel Ruben and the patents involved in the suit are the fundamental patents under which the licensed dry electrolytic condenser industry operates. . . .

"P. R. Mallory and Company, Inc., Indianapolis, is the exclusive licensee under patents 1,710,073 and 1,714,191 as well as other Ruben patents relating to dry electrolytic condensers. Sub-licenses are held by The Magnavox Company, Sprague Specialties Company, Cornell-Dubilier Corporation, Condenser Corporation of America and the Aerovox Corporation."

Copies of Judge Campbell's opinion will be furnished to interested parties upon request to P. R. Mallory and Co., Inc.

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WHOLESALE INCREASES ADVERTISING STAFF

Two additions to the advertising staff of Wholesale Radio Service Company, Inc., 100 Sixth Avenue, New York, N. Y., are announced by Robert Hertzberg, Advertising Manager. H. M. Bayer, a graduate of Pratt Institute and at one time technical editor of "Radio News," has been engaged as technical consultant and copywriter. Sidney Dru, well-known commercial artist, has been placed in charge of the art department.

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OHMITE MOVES TO LARGER PLANT

D. T. Siegel, General Manager, Ohmite Manufacturing Company, Chicago, Illinois, announced that this company would be located in its new and larger plant at 4835 Flournoy Street after October first. The need for additional factory space became increasingly necessary during the past year, and the new building was started the first of August. The new factory, which has more than twice the area of the old one, has been designed to furnish the utmost in shop convenience for the production of quality resistors and rheostats. Responsibility to its customers has been kept foremost in mind in providing for a fireproof tool vault in addition to the standard sprinkler method of fire protection.

VIRGIL M. GRAHAM HEADS SYLVANIA APPLICATION LABORATORY

Hygrade Sylvania Corporation announces the appointment of Virgil M. Graham as head of the Sylvania Application Laboratory at Emporium, Pa. He will act as consultant to radio manufacturers and engineers, a position for which he is eminently fitted both through his radio engineering experience and his wide acquaintance in the industry. Mr. Graham will be assisted by Dr. Ben Kievit, Jr., who will continue in his present capacity as direct supervisor of the work conducted in the laboratory.

Since 1923, and until his acceptance of

VIRGIL M. GRAHAM

the Sylvania appointment, Mr. Graham has been Radio Engineer for Stromberg-Carlson, and assisted in the development of the first Stromberg-Carlson radio receiver to be put on the market.

He is also well known through his active leadership in technical committee work, having made important contributions to the improvement and advancement of radio standards. He edited the early NEMA handbooks of Radio Standards. Since 1931, he has been Chairman of the Standards Section of the RMA Engineering Division, was Chairman of the joint SEA-RMA Committee on Automotive Radio 1932-34, and RMA Chairman of the Joint Coordination Committee of EEI, NEMA, and RMA on Radio Reception since 1933.

He is Fellow of the Institute of Radio Engineers, and a member of the IRE Board of Directors, and has been very active in IRE affairs in the Rochester Section.

Before leaving to take up his duties at the Sylvania plant, his associates at Stromberg-Carlson gave a farewell dinner in his honor, at which he was presented with a Ciné kodak and projector in appreciation of his long service and as a token of personal friendship.

CALLITE INCREASES FACILITIES

Callite Products Co., 549 39th St., Union City, N. J., has recently added new equipment and enlarged their facilities for the production of Tungsten and Molybdenum products to take care of the increased demands of the radio tube industry.

New control and testing equipment has been added to assure uniformity and unvarying quality.

A special department has been added to manufacture the newly developed Kulgrid Moly which is an improved carbonized Moly grid wire having greater heat radiation properties. It has been adopted as a standard grid wire in some of the special multi-grid tubes where grid emission has been a problem. The use of Kulgrid Moly tends definitely to lower this grid emission to a negligible quantity, it is said.

Automatic control equipment has been added to the Kulgrid "C"—Tungsten weld department for the exact control of all types of special Tungsten welds used as lead-in wire through hard glass.

These enlarged facilities will more adequately serve the Radio Industry.

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WOOD CABINETS

The Excel Woodcraft Corporation, Columbus Road at Leonard Street, Cleveland, Ohio, has succeeded the Soros Woodturning and Cabinet Company, Cleveland, in the manufacture of wood cabinets and wood parts for the radio and allied industries.

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SUMMERILL ELECTS OFFICERS

At the last meeting of the Board of Directors the officers mentioned below were elected.

Mr. E. L. Parker continues as President, which position he also holds with the Columbia Steel and Shafting Company and its subsidiary, the Edgar T. Ward's Sons Company of Pittsburgh, Pa.

Mr. J. P. Boore, who has been acting as Assistant to the President for the past two years, was elected Vice-President and is moving from Pittsburgh to Bridgeport to devote all of his time to Summerill.

Mr. George P. Kraemer was elected Secretary and Treasurer. Mr. Kraemer will continue his connection as Assistant Manager of the Philadelphia Branch of Edgar T. Ward's Sons Company and devote a part of his time to the Summerill interests.

Mr. N. H. Wolf, located at Bridgeport, continues as General Manager, which position he has occupied for many years.

Mr. H. M. Brightman, located at Pittsburgh, will continue as Assistant to the President, and devote most of his time to research and other engineering problems.

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BULLETIN ON TIME SWITCHES

This is an 8-page bulletin covering the Type T-17 and Type T-27 general-purpose automatic time switches. Complete descriptions are given. Write to the General Electric Company, Schenectady, New York, for Bulletin GEA-1427D.

LAMINATED BAKELITE BULLETIN

The Synthane Corporation, Oaks, Pa., has issued a new folder, "Synthane Laminated Bakelite for Mechanical Applications." This folder contains the essential physical, electrical, chemical and mechanical properties of Synthane, some of the more important material strength values, representative uses, machinability, types of stock, shapes and colors. One section of the folder deals with Synthane silent stabilized gear material and methods of gear cutting.

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S. S. WHITE MOVES OFFICES

The Industrial Division of the S. S. White Dental Mfg. Co., which handles all of the industrial products manufactured by the company, including flexible shafts, flexible shaft driven machines, small cutting and grinding tools, molded resistors, etc., has moved its offices to new and larger quarters on the 23rd floor at 10 East 40th Street, New York City. Mr. George T. Latimer is manager of the division.

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"DILECTO"

"Dilecto" is the title of a very interesting and informative 46-page booklet. The purpose of this booklet is to acquaint engineers and designers with the properties of Dilecto (a laminated phenolic material), its manufacture and its uses. It may be obtained from the Continental-Diamond Fibre Company, Newark, Delaware.

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"ELASTIC STOP"

"Elastic Stop" is the title of a 15-page booklet covering applications of and giving design information on the use of elastic stop nuts. The price lists and dimension tables include sizes usually carried in stock. Those interested should write to the Elastic Stop Nut Corporation, P. O. Box 38, Elizabeth, N. J.

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RADIO COMPONENTS CATALOG

A well-illustrated 72-page catalog of radio components has recently been made available. This catalog covers dials, grilles, name plates, escutcheons, tuning controls, metal cabinets for 1936 receivers, etc. Write to the Crowe Name Plate and Manufacturing Company, 1749 Grace Street, Chicago, Illinois, for Catalog No. 70.

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BUYER'S GUIDE CORRECTION, ADDITIONS

On page 30 of September, 1935, RADIO ENGINEERING, the Albert W. Franklin Manufacturing Corp., 137 Varick Street, New York City, are incorrectly listed under *Speakers and Headphones*. This organization manufacture Sockets for all types of tubes, Switches, Terminal Insulation Strips, etc., and should have been listed under the preceding heading, namely, *Sockets, Dials, Switches, . . . etc.*

The C. O. Jelliff Mfg. Corp., Southport, Connecticut, manufacturers of Bronze, Copper and "Inconel" Screen Cloth, and Nickel Alloy Wires for Electrical and Chemical uses, were inadvertently omitted from the Buyer's Guide. Amperex Electronic Products, Inc., 79 Washington Street, Brooklyn, N. Y., were also omitted. This latter organization manufacture Sound, Transmitting, Industrial, Television and Radio Electron Tubes.

A.S.T.M. STANDARDS ON ELECTRICAL INSULATING MATERIALS

This compilation presents under a single cover A.S.T.M. standards that are in widespread use for testing and evaluating electrical insulating materials. The 1935 edition, 311 pages, gives 25 standardized methods of test and ten specifications. The method of testing shellac has not been published heretofore. During 1935, revisions were made in a number of the test methods including those covering the following: Varnishes, solid filling and treating compounds, molding powders, sheet and plate materials, laminated tubes and round rods, natural mica and flexible varnished tubing.

Specifications which have been revised cover the following materials: Friction tape, rubber insulating tape and flexible varnished tubing.

The current report of Committee D-9 outlines the extensive research and standardization work under way, gives a modified Baader saponification test for insulating oils and proposed requirements for rubber insulating blankets.

The following materials are also covered by specifications or tests given in the book: Rubber gloves, rubber matting, electrical cotton yarns, silk and cotton tapes, pasted mica, and slate; also, black bias cut varnished tape; asbestos yarns, tape and roving; untreated paper; electrical porcelain; insulating oils. Other tests which are included cover procedures for thickness testing, impact, thermal conductivity, resistivity.

Copies, bound in heavy paper cover, can be obtained from A.S.T.M. Headquarters, 260 S. Broad Street, Philadelphia, at $1.75 per copy. Special prices are in effect on orders for ten or more copies.

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BARBER ENLARGES LABORATORY

Alfred W. Barber, consulting engineer, formerly connected with John V. L. Hogan, has enlarged his laboratory at 146-24 Queens Ave., Flushing, New York.

Mr. Barber's laboratory is equipped for the solution of problems in the fields of radio, television and general electronics. Cathode-ray tubes and wide-range measurement apparatus characterize the new setup.

Mr. Barber would be pleased to contact firms having unsolved problems in the fields mentioned.

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RADIO PARTS BULLETIN 43-J

Radio Parts Bulletin 43-J is entitled "Amphenol" and covers various Amphenol products, including microphone connectors, steatite sockets, plugs, cable connectors, cable connector covers, socket accessories, etc. Bulletin 43-J may be obtained by writing to the American Phenolic Corporation, 500 South Throop Street, Chicago.

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RMA NEWS

(*Continued from page 20*)

dian RMA have accepted invitations from the IRE governing board. It is possible that the RMA will hold a business meeting of its Board of Directors during the Rochester meeting.

CREDIT COMMITTEE MEETING OCT. 29

The regular monthly meeting of the RMA Eastern Credit Committee will be held at noon, Tuesday, October 29, at the Hotel New Yorker in New York City, with the customary cooperation of the National Credit Office, the RMA official credit information agency. All RMA members are invited to have representatives in attendance. Vice-Chairman Edward Metzger of the Eastern RMA Committee and Ken W. Tibbitts of NCO will be in charge of the October 29 luncheon meeting.

ENGINEERING MEETINGS

Tube standards will be considered further by the RMA Tube Committee, of which Roger M. Wise of Emporium, Pa., is chairman, at a meeting called for October 24 at the Hotel New Yorker in New York. Interference problems of automotive radio were considered at a meeting of the Joint SAE-RMA Committee on September 30 at Buffalo.

SERVICE MEN MEET OCT. 27

The annual New York convention and radio parts show of the Institute of Radio Service Men will be held October 25-27 at the Hotel Pennsylvania in New York City. A representative display of exhibits and a large attendance is promised. During the Service Men's convention, on October 26, there will be a meeting of the RMA Service Section of which F. B. Ostman of Camden, New Jersey, is chairman.

CANADIAN SALES

Canadian manufacturers during August, 1935, according to information received by the RMA through cooperation with the Canadian RMA, sold 15,024 sets, valued at $1,438,283. Canadian sales included 9,925 a-c sets, valued at $998,312; 4,376 battery sets valued at $392,754, and 723 automotive sets, valued at $27,217.

Canadian inventories as of August 31, 1935, were 24,973 a-c sets; 14,220 battery sets and 1,322 automotive sets, while projected production of Canadian manufacturers for the month of September was 32,603 sets, including 27,365 a-c sets, 5,111 battery sets, and 121 automobile set chassis.

"LES" MUTER DAY CELEBRATED

A gala climax of the season for radio golfers of Chicago was "Les" Muter Day on October 3 at the Calumet Country Club. The popular president of RMA, who is also president of the Calumet Club, was the honored guest at the final golf tournament of the Chicago Radio Industries Golf Club. About a hundred radio golfers attended and about everyone won a prize. Plans for 1936 for the Chicago golfers were made.

U. S. CENSUS BUREAU AND RMA COOPERATE ON NEW RADIO CENSUS

In preparation for the U. S. biennial census of manufactures in 1935, officers of the Census Bureau and the RMA are cooperating to develop more detailed statistics on the radio industry and its operations. New census forms for the reports of individual radio companies are being prepared by the Government and RMA representatives, to develop details of radio manufacturing operations. The classifications of products, especially of receiving sets, are being extended to cover late changes in styles and types of modern sets, including those having various frequencies beyond the standard broadcast band. Reports on the manufacture of the new metal tubes as well as glass types also are being arranged, and the new manufacturers' census is expected to compile the best radio industry data which has yet been developed.

NEW PRODUCTS

TECH LABS PRODUCTS

Tech Laboratories, with a factory located at 703 Newark Avenue, Jersey City, N. J., is now engaged in manufacturing a line of standard and special precision resistance instruments and allied products, for industrial and laboratory use.

The standard line includes—Attenuators, Potentiometers, L- Pads, T- Pads, H- Pads and other impedance-matching networks, Line Equalizers, Sound Level Indicators, Tap Switches, Precision Wire-Wound Resistors and Geophysical Instruments.

For attenuators and potentiometers impedance values range from one to a million ohms. Standard accuracies: two percent. Special accuracies: down to one-tenth of one percent. Steps: from one to sixty, any circuit, any loss per step.

These units are compact in mechanical design. They are entirely noiseless, and frequency characteristics are flat from zero to 50,000 cycles, it is said.

The first of a series of bulletins on this type of equipment and its application is now available.

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METAL SHIELDED FUSE MOUNTING

Littelfuse Laboratories, 4238 Lincoln Ave., Chicago, announces a new metal-shielded fuse mounting designed for use on the new metal-tube radio sets.

This mounting (No. 1126) takes standard 3 AG radio fuses, has cadmium-plated metal parts, meets Underwriters' Laboratories requirements, in that a tool is required to remove the cover, measures only 2½ x ⅞ inches overall, and is priced for volume production. Underwriters approved fuses are available for this mounting.

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SPACE-SAVER DRY ELECTROLYTIC CONDENSERS

Without sacrificing working voltage, full capacity value or service life, yet taking full advantage of a new development in the treatment of the aluminum foil, Aerovox engineers announce a reduction in the bulk of dry electrolytic condensers. Known as "Midget" electrolytics, these units are available in 200-volt and 450-volt ratings, and in capacities of 2 to 16 mfd. They average approximately half the bulk of the ultra-compact units heretofore available, it is said. The 8-mfd, 450-volt unit, for example, measures but 2 7/16 x 1⅛ x 11/16 inches.

These units are proving popular in new assemblies where space is at a premium, and again in the replacing of wornout condensers with units of greater capacity or higher working voltage.

Midget electrolytics are described and listed in a bulletin dealing with a number of recently added items, available to anyone addressing Aerovox Corporation, Brooklyn, N. Y.

NEW ROLA SPEAKERS

The Rola Company, 2530-70 Superior Avenue, Cleveland, Ohio, have recently introduced new 8- and 10-inch speakers. These new models are said to emphasize the ability of fine engineering and manufacturing equipment to produce superior speakers. The accompanying illustrations show these models.

The Model K-8 has an overall diameter

of 8 3/32 inches, and an overall depth of 4 7/16 inches. The recommended baffle opening is 7 inches maximum inside diameter.

The Model K-10 has an overall diameter

of 10 3/32 inches, and the overall depth is 5¼ inches. The recommended baffle opening for this model is 9 1/16 inches maximum inside diameter.

These units are available in dustproof and non-dustproof models. Curved or straight design cones are optional, as are field coil and transformer specifications.

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NEW HIGH-LEVEL VELOCITY MIKE

Amperite announces a new high-level velocity microphone that is said to have unusual brilliancy on the higher frequencies. It is not boomy on close talking, it is further stated. Its output impedance of 2,000 ohms permits operating directly into the grid—eliminating the input transformer. Requires 15 db less amplification than the lower impedance velocity mikes, making it possible to build simple and compact amplifiers. It is said to be excellent for both studio and remote work.

The limitation of the 2,000-ohm impedance velocity microphone is in cable length. With 60 feet of ordinary ⅜-inch cable, the high-frequency response is still superior to the low-impedance type, it is stated. For longer cable lengths, low-capacity r-f cable can be used.

NEW BRASS DIE CASTING ALLOY

Doehler Die Casting Co., 386 Fourth Ave., New York City, announce a new brass die casting alloy under the trade name "Doler-Brass."

This new alloy, containing copper, zinc and silicon, is said to be especially adapted to the die casting process and results in a fine finish when cast. It has the following physical properties:

Tensile Strength..65,000-75,000 lbs./sq. in.
Yield Point.....30,000-40,000 lbs./sq. in.
Elongation .....20-25% in 2"
Reduction Area...20-25%
Brinell Hardness..110-120 (500 kg.)
Impact Strength..30-36 ft. lbs.
Color .....Light Yellow

The addition of "Doler-Brass" to its other trade marked alloys "Brastil" and "Doler-Niklbrass," both previously announced, bring a wide range of copper base alloys in die cast form to the design engineer.

Descriptive booklets will be sent upon request.

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CROSS-PLY CORRUGATED BOARD

David Weber and Company, 3500 Richmond Street, Philadelphia, Pennsylvania, who have been pioneering since 1893 in corrugated fibre products, recently announced a new development, known as the Weber Cross-Ply Corrugated. This board offers high compressive strength, uniform in all directions. Weber Cross-Ply Corrugated is manufactured exclusively by David Weber and Company.

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"NOISE-MASTER" NOW AUTOMATIC

"Noise-Master" Antenna, which was successfully introduced by Cornish Wire Co., several months ago, now features automatic operation. Quoting from the latest literature of this manufacturer: "after 'Noise-Master' is properly installed . . . no adjustment is necessary and no manual operation is required, because this antenna is fully automatic electrically."

The literature referred to above is understood to contain schematic and construction details of the "Noise-Master" unit, also of other Corwico kits.

This manufacturer is also distributing a treatise on "All-Wave Antenna," and folders in color for the set-owner may be had

without charge by dealers for distribution to their prospects. Address the Cornish Wire Co., 30 Church Street, New York City.

NEW LAPEL MICROPHONE

The Shure Brothers Company, 215 West Huron Street, Chicago, Illinois, recently announced a new crystal lapel microphone, the Model 73A.

Despite its small size, the Model 73A is said to be highly efficient due to its specially shaped diaphragm and improved mechanical coupling system. The Bimorph crystal element used in this microphone is insensitive to mechanically transmitted shock, thus rendering the unit immune to "frictional" noises.

The Model 73A is small and unobtrusive. It is only 2 inches in diameter and weighs only 1½ ounces exclusive of the connecting cord. It is equipped with a spring clip which snaps over the lower notch of the speaker's lapel. Twenty-five feet of shielded cord is furnished with the unit.

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ELECTRAD VITREOUS POWER RHEOSTATS

Electrad, Inc., 175 Varick St., New York, N. Y., has introduced a new line of Vitreous Enameled Power Rheostats, known as the Type 2X.

These rheostats are arranged for single-hole mounting with provision for anchoring against rotation of the base. The shaft and bushings are insulated from the contact arm; this allows for mounting on a metal panel without the necessity of insulating washers. The contact shoe, of

special metal graphite composition, contacts the wire-wound element on the outside surface. This insures smooth, noiseless action and long life, it is stated. The wire winding is rigidly held in place by vitreous enamel which also covers the refractory base.

These rheostats are applicable as speed controls for small motors; temperature controls for vacuum tube filaments or small heating devices; and as general voltage or current regulators in laboratory or shop.

The Type 2X has a 25-watt rating. It may be obtained in resistance values from one to 2000 ohms. The standard tolerance is ± 10 percent.

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MINIATURE AUDIO TRANSFORMERS

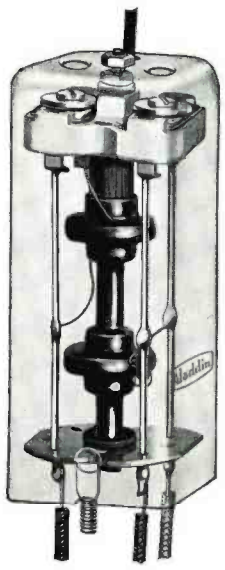
The Alloy Transformer Company, 135 Liberty Street, New York City, New York, have a miniature line of audio transformers. These units, which are said to have a frequency response uniform within 1 db from 30 to 15,000 cycles, are of the "Permalloy type" with lap-jointed laminations.

These units are housed in humproof high-permeability "Alloy" castings and are fully shielded electromagnetically and electrostatically, it is stated. These transformers are completely sealed and 1000-volt insulation is used throughout.

Information is available from the Alloy Transformer Company.

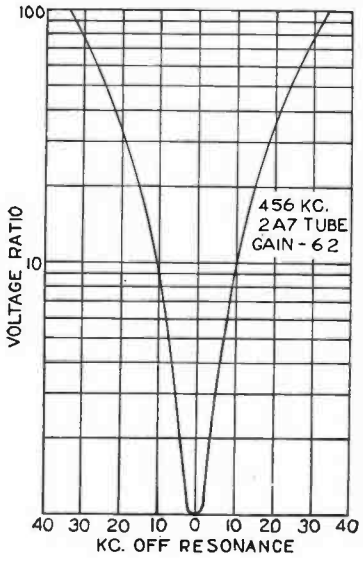
NEW ALADDIN TRANSFORMERS

The trend in intermediate-frequency transformer design is towards the use of iron in the higher intermediate frequencies. To meet the need for intermediate-frequency transformers at 456 kc, which is the popular choice, particularly in all-wave



receivers, the Aladdin Radio Industries announce a compact unit, type B-101 substantially lower in price than their last year's line which makes available these products to set manufacturers for use even in popular priced receivers.

The first of these in production is their type B-101 contained in a shield 1⅜ inches square and 3½ inches long. The Litz coils



wound on Polyiron cores are tuned with a conventional mica compression type condenser, the adjusting screws of which are accessible through the top of the shield. Uniformity of performance can be held to any reasonable tolerance with the use of cathode-ray ocsilloscopes which are standard production equipment in the Aladdin plant. In addition the production run is said to be spot-checked in the laboratory under actual operating conditions with precision equipment.

The type B-101 transformer mentioned above is designed for use with the 2A7 tube with which it has a gain of 62 and band widths of 21 kc, at ten times normal input and 67.5 kc at one hundred times normal input.

The accompanying curve shows the complete data obtained with the Aladdin Polyiron Type B-101 transformer illustrated. The symmetry of the curve is indicative of the efficiency of the design.

The transformer is complete with leads arranged in such positions as to permit short connections to the tubes. Other means are also provided to keep the coil leads fixed in such a position that any stray coupling remains constant.

The general design is said to be extremely flexible and with slight adjustments the individual requirements for any receiver can be met.

•

ALLOY CORES FOR I-F, R-F TRANSFORMERS

Marked gains in i-f and r-f transformer and coil performance is claimed for a new core material recently released by Henry L. Crowley and Co., West Orange, N. J. Known as Crolite Magicore, this material is said to increase selectivity 2¼ times over air-core coils, double the gain and cut the power factor in half (doubling the Q). The material is highly satisfactory in the broadcast and short-wave ranges, it is said.

Magicore differs from other metallic i-f and r-f coil cores in that it is a magnesium alloy imbedded in a ceramic body, rather than a finely divided iron held in a binder mass. The new material is extruded and fired at high temperatures, in accordance with ceramic practice. Precise control over raw materials and processing makes for maximum uniformity of finished cores, while the entirely domestic nature of the raw materials and production makes for prompt delivery at all times. The standard magicore is ½ inch long by ⅜ inch diameter, with a ⅛ inch center hole. Other dimensions can be met. Each piece has a smooth, shiny, metallic finish, and clean-cut ends and edges. It does not rust or corrode, nor otherwise alter its initial characteristics during use, it is said.

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MILLISECOND MEASUREMENTS

General Electric has announced an electronic timer for quickly and conveniently giving direct readings in terms of thousandths of a second. The method of determining time is to charge a condenser at a known rate during the interval, and then measure the voltage built up on the condenser. To eliminate, in so far as possible, errors of mechanical devices, the charging of the condenser is controlled by two Thyratron tubes, one to start and the other to stop the current flow. The condenser voltage is measured by a vacuum-tube voltmeter arrangement, using a bridge circuit, so that the condenser charge is maintained during the reading period.

A compact box contains all the necessary equipment with terminals for connecting to the power supply (115 volts, 60 cycles; and 125 volts direct current) to the device under test. Readings can be taken quickly, as the time values are obtained by a simple conversion of the voltmeter reading.

NEW PRESTO DISCS

The Presto Recording Corporation, 139 West 19th Street, New York City, have announced their improved, chemically-coated acetate disc for instantaneous recording. Improvements in the coating material and manufacturing methods have been made, and this has resulted in an extremely efficient recording disc, it is said. Instantaneous recording requires that the disc be soft enough to be cut and at the same time hard enough to be reproduced a reasonable number of times with steel needles. The new Presto disc is said to meet these requirements, the texture and hardness of the coating used on this record being such that frequencies up to 6,500 cycles have been recorded using lateral cutters—with vertical or "hill and dale" cutters, frequencies up to 9,000 cycles have been recorded.

These discs are said to be absolutely free from dirt, air bubbles, craters, and any foreign material, and they have a very heavy aluminum base so that the record lies flat on the recording table. The thickness is uniform over the entire surface.

For instantaneous recording these discs are available in the following sizes: 6, 8, 10, 12, 13¼ and 16 inches.

For processing, where over-sized discs are required, the following sizes are available: 17¼-inch discs for 16-inch pressings, 13¼-inch discs for 12-inch pressings and 11½-inch discs for 10-inch pressings.

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NEW G-M LAMP SOCKET

G-M Laboratories, Inc., 1735 Belmont Avenue, Chicago, announce an improved bayonet type single contact lamp socket for all standard automobile lamps and special service lamps having this style of base. This socket is suitable for use in scientific and industrial instruments, or in any other device in which a high quality socket of long life is required. It is said to be especially suitable for high wattage lamps which are mounted in a confined space where the temperature rise is great.

All insulating parts are of bakelite in the place of the usual hard rubber insert. The contact pressure is produced by a helical spring of large size which remains constant under all operating conditions. Con-

nection to the center contact is made by means of a convenient spring clip which is cadmium plated and can be readily soldered if desired. Because of the positive and permanent contact pressure, low contact resistance is said to be maintained at the center contact, which prevents melting of the soldered connection on the lamp base. This socket is made to close specifications on the inside diameter insuring accurate alignment of the lamp.

NEW SKILSAW DRILL MODELS

New additions to the line of Skilsaw ball-bearing electric drills are being announced by the manufacturer. Two small drills and three new large heavy-duty models, help to round out this line.

The new 3/16 inch and ¼ inch high production Skilsaw drills have been designed particularly for assembly line work in the airplane, automobile, radio and refrigerator fields and in all other industries where fast drilling of holes up to ¼ inch in diameter is required. Both models are 7½ inches long by 3 3/16 inches in diameter, with a die-cast aluminum alloy body that reduces weight, yet which is said to add strength and durability. A feature is the design of the handle which has been centered below the body of the tool, balanced to give the operator convenience and freedom from strain. The handle is closer to the chuck and permits better pressure with a minimum of effort. Smoothness and reliability in operation are assured by ball bearings, placed on armature, intermediate gear and spindle, it is said. The two-pole switch is enclosed in bakelite. Both drills are available in speeds of 2,000, 2,500, 3,000 and 3,700 r.p.m.

At the other end of the scale, are the three new giants of the drill field—⅝ inch, ¾ inch, and ⅞ inch Skilsaw heavy duty drills. These three models represent a fresh achievement in drill construction, with engineering improvements and refinements in every detail, it is stated, delivering more power under load than is usual in tools of this type. Ball-bearing construction brings smooth, vibration-free operation; there are two bearings on this armature, two on the intermediate gear and three on the spindle. This represents a departure from conventional construction and is said to assure a perfect concentricity of spindle and bearings, compensating for both radial and thrust loads. Helical-cut gears bring quiet operation. Housings are of die-cast aluminum alloy. On the ⅝ inch and ¾ inch models, a three-jaw geared chuck is furnished. The ⅞ inch model is equipped with a No. 2 Morse taper socket.

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NEW REMLER PUBLIC-ADDRESS SYSTEM

The new APS-57 public-address system has been produced for non-technical operators who demand foolproof simplicity and professional high-fidelity tone quality, it is said. Absolutely no technical or engineering knowledge is necessary to install or to operate, complete instructions being provided.

The APS-57 is said to be highly desirable for night clubs, dance halls, cafes, mortuaries, orchestras, churches, club and banquet rooms, restaurants, auditoriums, lodge halls and other installations where high-fidelity performance is paramount. The wide application and sturdy construction of the Remler APS-57 makes it adaptable for radio and public-address dealers for rental purposes.

The amplifier supplies current to the microphone and to both speakers; it has a three-stage, resistance-coupled, push-pull circuit, using two type 6A6 dual triode tubes, two type 42 tubes and one type 82 tube. The first 6A6 is used as a voltage amplifier and phase inverter, supplying equal voltages of opposite phase to the grids of the following 6A6 tube. The second 6A6 is operated as a resistance-coupled driver stage into two type 42 push-pull power tubes. The use of balanced push-pull in all stages and resistance-coupling throughout greatly reduces hum pick-up and harmonic distortion.

The volume control is located in the microphone input circuit. A special low-impedance input is provided for operation from auxiliary apparatus.

The Remler APS-57 includes a condenser microphone and two Type AD102 speakers, all necessary plugs, tubes and cable ready to plug into any standard 110/120-volt power lines for immediate use. For further information address the Remler Company, Ltd., 2101 Bryant St., San Francisco, Calif.

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NEW 30-WATT P-A SYSTEM

The Bell Sound Systems, Inc., of Columbus, Ohio, has just announced the addition of a 30-watt P-A System, known as the Model P. A. 5C, to their already extensive line. The new model is a powerful, easily operated, complete system, arranged for transporting in three compact, Kerotal covered carrying cases. Though standard equipment includes two high-fidelity, heavy-duty G-12 speakers, the unit has facilities for utilizing six speakers. By a series arrangement of transmission lines it is possible to use as many as 12 to 15 peakers, it is stated.

The microphone is of the new crystal type, affording freedom from frequent re-

packing and overhauling, and eliminating hiss and background noise when the instrument is jarred or moved. Two separate input channels permit the simultaneous use of two microphones or a microphone and phono pickup. Controls consist of two volume controls, tone control, selector switches and a-c on-off switch.

The Model P. A. 5C is said to have a frequency response within plus or minus 2 db from 35 to 10,000 cycles. The circuit is the 5-stage, Class A type, resistance and impedance coupled, with all filter components built into the chassis.

It is said that this is an exceptionally practical and economical system for any place calling for sound amplification over extremely large areas. For complete details on this, or other Bell Systems, write direct to the manufacturer: Bell Sound Systems, Inc., 61 East Goodale St. Columbus, Ohio.

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THE FILTERAD

The Filterad, a new device for eliminating radio interference at its source, has just been announced by the Automatic Electrical Devices Co., of Cincinnati. The unit is simple plug-in device that attaches directly between the supply circuit and the offending switch, motor or other unit. It is said that the Filterad uses an entirely new idea and circuit in filtering out the interfering radiations, and, unlike previous units marketed for the same purpose, has nothing that can break or wear out. Exhaustive tests have proved its effectiveness on power motors, generators, motor-driven appliances, circuit control devices and even on such offenders as battery chargers, neon signs, X-ray and violet-ray machines.

GENERAL RADIO TYPE 713-A BEAT-FREQUENCY OSCILLATOR

The General Radio Company, 30 State St., Cambridge A, Mass., has announced a newly designed a-c operated beat-frequency oscillator, having as its outstanding features high power output, excellent waveform, constant output, and wide frequency range. This oscillator, listed as type 713-A, replaces the Type 513 unit.

In the Type 713-A Beat-Frequency Oscillator, a high degree of frequency stability has been introduced through the use of a pentode oscillator circuit. To reduce temperature variation, the two tuned circuits have been symmetrically placed and mounted on a heavy aluminum slab which is thermally insulated from all heated portions of the circuit, including the oscillator tubes themselves, reducing the temperature variations due to heating within the oscillator to a somewhat lower order than normal room temperature fluctuations.

Good waveform is obtained by the use of a balanced push-pull detector circuit which eliminates the second harmonic. The amplifier, filter and transformer design is such as to provide substantially uniform gain from 10 to 20,000 cycles. It was found impossible to pass the full 10-cycle output of 2 watts—the undistorted output of the oscillator—through any transformer of practical size without serious distortion. Therefore a switch has been provided so that the input to the detector can be reduced and with it the level throughout the instrument. At the reduced output level, the distortion remains at less than 1% down to 10 cycles.

An "incremental pitch" condenser, with direct-reading scale of ± 50 cycles, has been included in the Type 713-A Oscillator. This dial permits resonance curves to be taken as well as permitting the auditory tests. The use of this dial has been enhanced by engraving a line at least every 100 cycles on the main scale, thereby effectively providing a calibration point for every cycle throughout the scale.

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AUTO-RADIO POWER UNIT

A new 6-volt, 6-ampere automobile-radio battery eliminator is being offered by the Schauer Machine Company, 905 Broadway, Cincinnati, Ohio. This Type AR 6006 Eliminator is designed especially to serve as a power-supply unit for demonstrating automobile-radio sets in dealers' display rooms. The device is operated from 110-volt, 60-cycle house or store lighting system. The direct-current output is thoroughly filtered and it is claimed that it will operate, without hum, any of the standard makes of auto-radio receivers.

The assembly consists of a rectifying element of the copper-oxide type, a transformer with insulated primary and secondary windings, the latter with taps connected to a multi-point switch for varying the d-c output. A pilot lamp is also provided to indicate when current is on.

The entire assembly is housed in an attractive black crystalline finish metal case, size 10" x 10" x 8" arranged for wall or shelf mounting. The eliminator may be used continuously or may remain connected to the line indefinitely at no load without damage. The energy consumption at maximum load is said to be less than 75 watts.

•

"RESISTUBE"

A device specially designed to replace the ballast tube used in the 2-volt air-cell battery-operated sets common in many rural districts is now being manufactured by the Ohio Carbon Company, 12508 Berea Road, Lakewood, Ohio. It is known as the "Ohiohm Resistube" conversion plug, and consists of an enclosed moisture-proof carbon resistance mounted on a regular radio-tube base. In cases where age has impaired the usefulness of the ballast tube so that it interferes with the proper operation of the set, the change can be made readily. The manufacturers state that the "Resistube" retains its resistivity value almost indefinitely.

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PACENT HIGH-FIDELITY AMPLIFIER

The Pacent Engineering Corporation, of 79 Madison Avenue, New York City, N. Y., announces a new High-Gain High-Fidelity Amplifier. Although designed primarily for theatre use, it is suitable for public-address work and has many other special applications.

The overall dimensions are 20 inches long, 17 inches high and 6 inches deep. The heavy metal case of unique design is compact and intended for wall mounting. Shielding is complete, layout systematic and construction is of the latest unit type, with condensers and resistors grouped in units in separate shield cans and sealed with wax. Wiring is cabled and covered with black varnished cambric tubing. The amplifier will operate continuously in an ambient atmosphere of 120 degrees and a humidity of 98 percent, it is said. Auditorium resonance or other low-frequency difficulties may be reduced by opening several links in the circuit designed to reduce the bass response, a unique feature. Fader or volume control, range control, which adjusts both the high- and low-frequency response, magnetic pickup switch, line switch and pilot light are all located conveniently on the front panel.

Five standard tubes are used, and total output of amplifier is 23 watts, although manufacturer claims only 10 watts undistorted. The gain is 108 db, sufficient to operate directly from photocell or standard microphone. When operated with its associated speaker system, the overall response is said to be flat from 40 to 10,000 cycles.

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PORTABLE CATHODE-RAY OSCILLOGRAPH

A new portable cathode-ray oscillograph, Model 148, has recently been announced by the Allen B. Du Mont Laboratories, Upper Montclair, N. J. Many new features have been incorporated in this instrument widening its use and simplifying its operation.

This unit employs a basically new sweep circuit, having a range from 10 to 100,000 cycles per second, allowing r-f waves to be studied. Improved linearity is accomplished by the use of a current-limiting tube and a faster return trace is obtained by means of a mercury-vapor discharge tube.

The amplifiers are arranged so that they can be used singly or in cascade. When connected in cascade a signal of 0.2 volt gives a deflection of 1 inch.

A patented calibrated scale is provided with the 5-inch Du Mont type 54-H cathode-ray tube. All the controls and input posts are conveniently located on the front panel and a single knob controls all the necessary switching. Position controls are provided for the vertical and horizontal axes.

In addition to the cathode-ray tube there are two type 53 amplifier tubes, one type 57 current-limiting tube, one type 80 rectifier tube and one type 128 mercury-vapor discharge tube. The unit is completely self-contained and is operated from the 110-volt a-c mains.

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WESTON VACUUM TUBE VOLTMETER

A vacuum tube voltmeter for radio servicing has just been announced by the Weston Electrical Instrument Corporation, Newark, N. J. The new voltmeter, known as Model 669, augments the group of standardized servicing units previously available, operating directly from any 115-volt, 60-cycle, a-c line. Six full-scale ranges (1.2, 3, 6, 8, 12, 16 volts) permit measurements from 0.1 to 16 volts.

The instrument uses two tubes, a type 1V and a type 78. A neon regulator bulb keeps line fluctuations out of the meter and holds plate and grid potentials constant. This regulation is of extreme importance when making measurements below 1 volt. The input capacity of the voltmeter has been kept at a minimum by bringing the tube up through the top panel so that the grid lead is one inch or more from any grounded surface. In this way, very short leads can be run to the circuit to be measured, and the shunt capacity kept at a minimum.

In the new voltmeter, only the grid-to-cathode impedance of the tube is placed in the circuit to be measured. All ranges have an input impedance equal to that of the 78 tube itself, no resistance divider being used in the input circuit. This arrangement permits use of the unit to measure all avc circuits without placing any load on the circuit being tested, since in certain cases two or three megohms in an avc circuit may upset it by as much as 50 percent.

The new voltmeter is expected to meet the increasing need for an instrument of this type in connection with a test oscillator for measuring gain-per-stage; for checking the pre-selector or first i-f stage in superheterodynes; for measuring the r-f amplitude in the oscillator circuit of superheterodynes; for checking impedance of

chokes, condensers, etc., and other voltage measurements where the ordinary meter interferes with the characteristics of the circuit being tested. Dimensions of the meter are 8¼ in. x 5½ in. x 5¾ in., and the weight is 6½ pounds.

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF MARCH 3, 1933, OF RADIO ENGINEERING

Published monthly at New York, N. Y., for October 1, 1935.

State of New York, } ss.:
County of New York, }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared B. S. Davis, who, having been duly sworn according to law, deposes and says that he is the Business Manager of RADIO ENGINEERING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Bryan Davis Publishing Co., Inc., 19 East 47th Street, New York. Editor, M. L. Muhleman, Mt. Vernon, N. Y.; Managing Editor, Ray D. Rettenmeyer, Madison, N. J.; Business Manager, B. S. Davis, Scarsdale, N. Y. 2. That the owners are: Bryan Davis Pub. Co., Inc.; B. S. Davis, Scarsdale, N. Y.; Roy T. Atwood, Albany, N. Y.; G. R. Bacon, Douglaston, N. Y.; J. C. Munn, Union City, Pa.; J. A. Walker, Richmond Hill, N. Y.; A. B. Goodenough, New Rochelle, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1% or more of the total amount of bonds, mortgages, or other securities are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where a stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also, that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) B. S. DAVIS, Business Manager.

Sworn to and subscribed before me this 25th day of September, 1935.
(Seal) J. A. WALKER, Notary Public.
Queens Co. Clk's No. 3149, Reg. No. 7476.
New York Co. Clk's No. 831. Reg. No. 7-W-514.
Commission expires March 30, 1937.

INDEX TO ADVERTISERS

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DESIGN ENGINEERS • PRODUCTION ENGINEERS • PURCHASING AGENTS

A continuous, indexed recording of the reliable sources of supply of Materials, Parts and Equipment employed in the Design and Manufacture of Radio Receivers and Electronic Devices.

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Carter Radio Co.
Insuline Corp. of Amer., 25 Park Pl., N. Y. C.

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Callite Products Co., 542 39th St., Union City, N. J.
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Consolidated Wire Corp.
Driver Company, Wilbur B.
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Bakelite Corp.
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Isolantite, Inc., 233 Broadway, N. Y. C.

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American Brass Co., The, Waterbury, Conn.
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Alden Corp.
Excel Woodcraft Corp., The, Columbus Rd. at Leonard St., Cleveland, Ohio
Peerless Cabinet Co.
Superior Cabinet Corp.

CATHODES (See Tubing, Seamless Cathode)

CATHODE RAY—TUBES
Dumont Laboratories, Allen B., 542 Valley Rd., Upper Montclair, N. J.
General Electric Co.
Hygrade-Sylvania Corp., Clifton, N. J.
RCA Manufacturing Co., Inc., Camden, New Jersey
Western Elec. Co., 195 Broadway, N. Y. C.
Westinghouse Elec. & Mfg. Co.

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Radio Instruments Co., 22 Wooster St., N. Y. C.
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Continental Electric Co.
Eby, H. H., Mfg. Co.
General Electric Co.
G-M Laboratories
RCA Manufacturing Co., Inc., Camden, New Jersey
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instruments Corp., 612 Frelinghuysen Ave., Newark, N. J.

CERAMICS
American Lava Corp., Chattanooga, Tenn.
Colonial Insulator Co.
Crowley & Co., Henry L.
Dielectric Products Co.
Isolantite, Inc., 233 Broadway, N. Y. C.
Mycalex Corp. of Amer.
Stupakoff Laboratories, Inc., 6627 Hamilton Ave., Pitts, Pa.

CHOKES
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Alloy Transformer Company, 135 Liberty St., N. Y. C.
American Transformer Co., 175 Emmet St., Newark, N. J.
General Transformer Co.
Hammarlund Mfg. Co., 424-438 W. 33rd St., N. Y. C.
Kenyon Transformer Co., Inc., 840 Barry St., N. Y. C.
United Transformer Corp., 72-74 Spring Street, N. Y. C.

COIL MACHINERY
Universal Winding Co., Elmwood Ave., Providence, R. I.

COILS—POWER
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Acme Wire Company, 1255 Dixwell Avenue, New Haven, Conn.
American Enameled Magnet Wire Co.
Belden Manufacturing Co.
Coils, Incorporated
Electrical Winding Company
General Cable Corp.
General Electric Company, Schenectady, N. Y.
Roebling's Sons, John
Westinghouse Elec. & Mfg. Co.

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Automatic Winding Co.
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Tobe-Deutschmann Corp., Canton, Mass.

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Curtis Condenser Corp., 3088 W. 106th St., Cleveland, Ohio
Magnavox Co., Ltd.
Mallory & Co., P. R., Indianapolis, Indiana
Micamold Radio Corp.
Polymet Mfg. Co., Inc.
Solar Mfg. Corp., 599-601 Broadway, N. Y. C.
Sprague Specialties Co.

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DeJur-Amsco Corp.
Hammarlund Mfg. Co., 424 W. 33rd St., N. Y. C.
Meissner Mfg. Co.
Solar Mfg. Corp., 599-601 Broadway, N. Y. C.
Tobe-Deutschmann Corp., Canton, Mass.

CONDENSERS, VARIABLE
Cardwell Mfg. Co., Allen B., 81 Prospect St., Brooklyn, N. Y.
DeJur-Amsco Corp.
General Instrument Co.
General Radio Company, 30 State St., Cambridge, Mass.
Hammarlund Mfg. Co., 424 W. 33rd St., N. Y. C.
Oak Mfg. Co., 711 W. Lake Street, Chicago, Ill.
Precise Mfg. Co.
Radio Condenser Co.
Reliance Die & Stamping Co.
Scoville Mfg. Co.

CONTACTS, METAL
Baker & Co., Inc.
Callite Products Div., 542 39th St., Union City, N. J.
General Plate Co.
General Tungsten Mfg. Co.
Mallory & Co., P. R., Indianapolis, Indiana
Wilson Co., H. A.

CONTROLS (See Resistors, Variable)

CORD, FLEXIBLE (See Wire, Flexible)

CORES, RESISTANCE COIL
American Lava Corp., Chattanooga, Tenn.
Colonial Insulator Co.
Isolantite, Inc., 233 Broadway, N. Y. C.
Steward Mfg. Co.

CORES, TRANSFORMER
Thomas & Skinner Steel Prods. Co., 1100-1120 E. 23rd St., Indianapolis, Indiana

CRYSTALS, QUARTZ and ROCHELLE SALT
Bliley Electric Co., 237 Union Station Bldg., Erie, Pa.
Boonton Research Labs.
RCA Mfg. Company, Inc., Camden, N. J.
Brush Development Co., E. 40th St. & Perkins Ave., Cleveland, Ohio
Scientific Radio Service, University Pk, Hyattsville, Md.

DIALS, ESCUTCHEONS
Crowe Nameplate Co.

DIAPHRAGMS, SPEAKER
Hawley Products Co.
Masland Mfg. Corp.
United Pressed Products Co., 407 S. Aberdeen St., Chicago, Ill.

ELECTRODES, NEON
Callite Products Div., 542 39th St., Union City, N. J.
Eisler Electric Corp., Union City, N. J.
Eisler Engineering Co., Inc., 747 So. 13th St., Newark, N. J.
Kahle Engineering Corp., 330 Manhattan Ave., Union City, N. J.
Swedish Iron & Steel Corp., 17 Battery Pl., N. Y. C.

EYELETS
Platt Bros. & Co.
Waterbury Brass Goods Branch, Waterbury, Conn.

FIBRE, PHENOL and VULCANIZED
(sheet, rod, tube)
Bakelite Corp.
Brandywine Fibre Products Co.
Continental-Diamond Fibre Co.
Formica Insulation Co.
Franklin Fibre-Lamitex Corp.
General Electric Co.
Mica Insulator Co.
National Vulcanized Fibre Co.
Resinox Corporation
Synthane Corporation, Oakes, Penna.
Westinghouse Elec. & Mfg. Co.
Wilmington Fibre Co.

FILAMENT WIRE (See Wire, Filament)

FINISHES (See Lacquer, Paint, Varnish)

FLEXIBLE SHAFTING
Fischer Spring Company, Chas.
White Dental Mfg. Co., S. S.

FURNACES, ELECTRIC
General Electric Company, Schenectady, N. Y.
Lepel High Frequency Laboratories, Inc., 39 W. 60th St., N. Y. C.
Trent Co., Harold E.
White Dental Mfg. Co., S. S.

FUSES
Littlefuse Laboratories, 4238 Lincoln Ave., Chicago, Ill.

GENERATORS
Carter Motor Company
Columbia Elec. Mfg. Co.
Electronic Laboratories, Inc., 122 W. New York St., Indianapolis, Ind.
Mallory & Co., P. R., Indianapolis, Indiana
Onan & Sons, D. W., Minneapolis, Minn.
Pioneer Gene-Motor Corp., 466 W. Superior St., Chicago, Ill.

GETTERS (See Nickel Tube Parts)

GRAPHITE
Acheson Colloids Corp., Port Huron, Mich.

HORNS
Bud Radio, Inc., 1923 E. 55th St., Cleveland, Ohio
Hope Mfg. Co., 401 Broadway, N. Y. C.
Macy Engineering Co., 1452 39th St., Brooklyn, N. Y.
Racon Elec. Mfg. Co., 52 E. 19th St., N. Y. C.
Wright-Decoster, Inc., 2253 University Ave., St. Paul, Minn.

INSTRUMENTS (See Meters or Cathode Ray)

INSULATION, BEADS
American Lava Corp., Chattanooga, Tenn.
Dunn, Inc., Struthers
Isolantite, Inc., 233 Broadway, N. Y. C.
Steward Mfg. Co.
Stupakoff Laboratories, Inc., 6627 Hamilton Ave., Pitts, Pa.

INSULATION, CERAMICS (See Ceramics)

INSULATION COMPOUNDS
Candy & Co., Inc., 35th and Maplewood Ave., Chicago, Ill.
Dolph Co., John C.
Glenn & Co., J. J.
Mica Insulator Co.
Roebling's Sons Co., John A.
Zophar Mills, Inc., Court, Lorraine and Creamer St., Brooklyn, N. Y.

INSULATION, FIBRE (See Fibre)

INSULATION, MOLDED
American Insulator Corp.
American Phenolic Corp.
American Record Corp.
Bakelite Corp.
Chicago Molded Prods. Corp.
Formica Insulation Co.
General Electric Co.
General Plastics Co.
Kurz-Kasch Co.
Macallen Co.
Watertown Mfg. Co.
Westinghouse Elec. & Mfg. Co.

INSULATION, TUBING
Bentley Harris Mfg. Co., Conshohocken, Pa.
Brand & Co., Wm., 276 Fourth Ave., N. Y. C.
Glenn & Co., J. J.
Mica Insulator Co.

INSULATION, VARNISH (See Lacquer, Paint, Varnish)

INSULATION, WAX (See Insulation, Compounds)

IRON, SWEDISH (Tube Parts)
Swedish Iron & Steel Corp., 17 Battery Pl., N. Y. C.

KNOBS
Crowe Name Plate & Mfg. Co., 1749 Grace St., Chicago, Ill.
Kurz-Kasch Co.
Syracuse Ornamental Co.

LACQUER, PAINT, VARNISH
Acme Wire Company, 1255 Dixwell Ave., New Haven, Conn.
Doph & Co., John C.
Impervious Varnish Co.
Irvington Varnish Co.
Mass & Wallstein
Roxalin Flexible Lacquer Co., Inc.
Zapon Company, 60 E. 42nd St., N. Y. C.
Zophar Mills, Court, Lorraine and Creamer Sts., Brooklyn, N. Y.

LAMPS, GLOW
Blue Seal Sound Devices, Inc., 723 Seventh Ave., N. Y. C.
Braman, Verne E., Hotel President, N. Y. C.
Littlefuse Laboratories, 4238 Lincoln Ave., Chicago, Ill.

LUGS
Waterbury Brass Goods Branch, Waterbury, Conn.
Zierick Machine Works, F. R., 68 E. 131 St., N. Y. C.

MAGNETS
Thomas & Skinner Steel Prods. Co., 1100-1120 E. 23rd St., Indianapolis, Indiana

MELTING POTS
Dunn, Inc., Struther
Sta-Warm Electric Co., Ravenna, Ohio
Trent Co., Harold E.

METERS; TESTING INSTRUMENTS
Apparatus Design Co.
Boonton Radio Corp.
Burton-Rogers Co., 755 Boylston St., Boston, Mass.
Clough-Brengle Co., 1134 W. Austin Ave., Chicago, Ill.
Dumont Laboratories, Allen B.
Ferris Instru. Corp.
General Electric Co.
General Radio Company, 30 State St., Cambridge A, Mass.
Hickok Elec. Instru. Co., Cleveland, Ohio
Jackson Elec. Instru. Co., Dayton, Ohio
RCA Mfg. Co., Inc., Camden, N. J.
Radio City Products Co., 28 W. Broadway, N. Y. C.
Radio Instruments Co., 22 Wooster St., N. Y. C.
Radio Products Company, 145 Sunrise Pl., Dayton, Ohio
Rawson Elec. Instru. Co.
Readrite Meter Works, Bluffton, Ohio
Shallcross Mfg. Co.
Supreme Instruments Corp., Greenwood, Miss.
Triplett Elec. Instru. Co., Bluffton, Ohio
Triumph Mfg. Co., 4017 W. Lake St., Chicago, Ill.
Western Electric Co., 195 Broadway, N. Y. C.
Weston Elec. Instru. Corp., 614 Frelinghuysen Ave., Newark, N. J.
Westinghouse Elec. & Mfg. Co.

MICA
Bakelite Corp.
Brand & Co., Wm. 276 Fourth Ave., N. Y. C.
Ford Radio Mica Co., Inc.
Macallen Co.
Mica Insulator Co.
New England Mica Co.

MICROPHONES
American Microphone Co., Los Angeles, Calif.
Amperite Corp., 561 Broadway, N. Y. C.
Astatic Microphone Lab., Inc., 40 Hubbard Road, Youngstown, Ohio
Beacon Microphone Co.
Bruno Laboratories, 20 West 22nd St., N. Y. C.
Brush Development Co., Cleveland, Ohio
Carrier Microphone Co.
Electro-Voice Mfg. Co., Inc., South Bend, Indiana
Radio Receptor Co., Inc., 106 Seventh Ave., N. Y. C.
RCA Mfg. Company, Inc., Camden, N. J.
Shure Bros. Co., 215 W. Huron St., Chicago, Ill.
Sound Systems, Inc., 1311 Terminal Bldg., Cleveland, Ohio
Turner Company
Universal Microphone Co., Ltd., Inglewood, Calif.
Western Electric Co., 195 Broadway, N. Y. C.

MOLDED INSULATION (See Insulation, Molded)

MOLYBDENUM
American Electro Metal Corp., Lewiston, Maine
Callite Products Div., 542 39th St., Union City, N. J.
Metallurgical Corp.

MONEL METAL
International Nickel Corp.

NICKEL, TUBE PARTS (Also see Iron)
(plates, grids, wire cloth, cathodes, getters, hooks, heaters, base-pins, welds)
American Brass Co., Waterbury, Conn.
American Electro Metal Corp., Lewiston, Maine
Callite Products Div., 542 39th St., Union City, N. J.
Cleveland Wire Cloth & Mfg. Co.
Driver Co., Wilbur B.
Driver-Harris Co.
General Plate Co.
Goat Radio Tube Parts, Inc., 314 Dean St., Brooklyn, N. Y.
Kemet Labs., Inc.
King Laboratories, Inc.
Newark Wire Cloth Company
Pequot Wire Cloth Company
Prentiss & Company, Geo. W.
Summerill Tubing Company, Bridgeport, Penna.
Superior Tube Company
Wizard Electric Company

PAPER, for CONDENSERS
Dexter & Sons Co., Inc., C. H.
Schweitzer, Inc., Peter J.
Strype, Fred. C.

PAPER TUBES
Chicago Paper Tube Co.
Cross Paper Products Co.
Paper Tube Company, The
Paramount Paper Tube Co.

PHOSPHOR BRONZE
Phosphor Bronze Smelting Co.
Riverside Metal Company
Scoville Mfg. Company
Seymour Mfg. Company
Waterbury Rolling Mills, Inc.

PHOTOELECTRIC CELLS (See Cells)

PICKUPS, TRANSCRIPTION
Astatic Microphone Lab., Inc., 40 Hubbard Road, Youngstown, Ohio
Audak Company, The, 500 Fifth Ave., N. Y. C.
Proctor & Company, B. A., 17 W. 60th St., N. Y. C.
RCA Mfg. Company, Inc., Camden, N. J.

PLASTICS (See Insulation, Molded)

POINTS, CONTACT
Baker & Company
Callite Products Div., 542 39th St., Union City, N. J.
Mallory & Co., Inc., P. R., Indianapolis, Indiana

RECTIFIERS
B-L Electric Mfg. Co.
General Electric Co., Bridgeport, Conn.
Mallory & Co., Inc., P. R., Indianapolis, Indiana
United Transformer Company, 72-74 Spring St., N. Y. C.
Westinghouse Elec. & Mfg. Co.

RELAYS
Allen-Bradley Co., 126 W. Greenfield Ave., Milwaukee, Wisc.
Automatic Electric Co.
Dunn, Inc., Struthers
General Electric Company, Schenectady, N. Y.
Kurman Elec. Co.
Mercoid Corporation
Ward-Leonard Elec. Co., 33 South St., Mt. Vernon, N. Y.
Weston Elec. Instru. Corp., 612 Frelinghuysen Ave., Newark, N. J.

RESISTORS, CARBON-COMPOSITION
Aerovox Corp., 90 Washington St., Brooklyn, N. Y.
Allen-Bradley Co., 126 W. Greenfield Ave., Milwaukee, Wisc.
Centralab, 900 E. Keefe Ave., Milwaukee, Wisc.
Chicago Tel. Supply Co.
Clarostat Mfg. Co., Inc., 287 N. 6th St., Brooklyn, N. Y.
Continental Carbon, Inc., 13902 Lorain Ave., Cleveland, Ohio
Electrad, Inc., 175 Varick St., N. Y. C.
Erie Resistor Corp., Erie, Penn.
Globar Corp.
International Resistance Co., 2100 Arch St., Phila., Pa.
Mallory & Co., Inc., P. R., Indianapolis, Indiana.
Micamold Radio Corp.
Ohio Carbon Co.
Ohmite Mfg. Company, 4827 Flournoy St., Chicago, Ill.
Speer Resistor Corp.
Stackpole Carbon Co.
Solar Mfg. Co., 599-601 Broadway, N. Y. C.
Tech Laboratories
Ward Leonard Elec. Co., 33 South St., Mt. Vernon, N.Y.
White Dental Mfg. Co., S. S.
Wirt Company, The

RESISTORS, WIRE WOUND
Atlas Resistor Co.
Clarostat Mfg. Co., Inc., 287 N. 6th St., Brooklyn, N.Y.
Daven Company
Electrad, Inc., 175 Varick St., N. Y. C.
Hardwick Hindle, Inc.
International Resistance Co., 2100 Arch St., Phila., Pa.
Mallory & Co., Inc., P. R., Indianapolis, Indiana
Muter Co., The, 1255 S. Michigan Ave., Chicago, Ill.
Ohmite Mfg. Company, 4827 Flournoy St., Chicago, Ill.
Precision Resistor Corp., 334 Badger Ave., Newark, N. J.
Shallcross Mfg. Co.
Ward Leonard Elec Co., 33 South St., Mt. Vernon, N.Y.

RHEOSTATS (See Resistors)

SCREWS, SELF LOCKING
Parker-Kalon Corp.
Shakeproof Lock Washer Co., 2501 N. Keeler Ave., Chicago, Ill.

STEEL
Allegheny Steel Co.
American Rolling Mill Co., Middletown, Ohio
American Steel & Wire Co.
Ryerson & Son, Inc.

SOCKETS
Cinch Mfg. Corp., 2335 W. Van Buren St., Chicago, Ill.
Eby Mfg. Co., H. H.
Franklin Mfg. Corp., Albert W., 137 Varick St., N.Y.C.

SOLDER
Dunton Co., M. W.
Gardiner Metal Co., 4820 S. Campbell Ave., Chicago,
Kester Solder Company
Ruby Chemicals Co.

SOLDERING IRONS
Electric Soldering Iron Co., 342 W. 14th St., N. Y. C.
Insuline Corp. of America, 25 Park Pl., N. Y. C.
Sta-Warm Electric Co., 508 N. Chestnut St., Ravenna, Ohio

SPEAKERS and SPEAKER UNITS
Best Mfg. Co.
Boudette & Co.
Jensen Radio Mfg. Co.
Magnavox Co., Ltd.
Operadio Mfg. Co., 13th and Indiana St., St. Charles, Ill.
Oxford Radio Corp., 350 W. Huron St., Chicago, Ill.
RCA Mfg. Company, Inc., Camden, N. J.
Racon Elec. Co., Inc. 52 E. 19th St. N. Y. C.
Rola Company, The
Utah Radio Products Co. 820 Orleans St., Chicago, Ill.
Victory Speakers, Inc.
Voice Of The Air Co.
Western Electric Co., 195 Broadway, N. Y. C.
Wright-De Coster, Inc., 2253 University St., St. Paul, Minn.

STRIPPERS, WIRE
Carlander, Henry
Wire Stripper Co., 1725 Eastham Ave., East Cleveland, Ohio

TAPE, VARNISHED FABRIC
Acme Wire Co., 1255 Dixwell Ave., New Haven, Conn,
Brand Co., William, 276 Fourth Ave., N. Y. C.

TRANSFORMERS (Also see Chokes)
Acme Elec. & Mfg. Co. The, 1440 Hamilton Ave., Cleveland, Ohio
Alloy Transformer Co., 135 Liberty St., N. Y. C.
American Transformer Co., 175 Emmet St., Newark, N. J.
Chicago Transformer Co.
Dongan Electric Mfg. Co.
General Transformer Corp., 5025 S. Throop St., Chicago, Ill.
Halldorson Company, The, 4500 Ravenswood Ave., Chicago, Ill.
Jefferson Electric Company, Bellwood, Miss.
Kenyon Transformer Co., Inc., 840 Barry St., N. Y. C.
RCA Mfg. Company, Inc., Camden, N. J.
Standard Transformer Corp., 866 Blackhawk St., Chicago, Ill.
Thordarson Elec. Mfg. Co., 500 W. Huron St., Chicago, Ill.
United Transformer Corp., 72-74 Spring St., N. Y. C.

TRANSPORTATION, EXPRESS
Railway Express Agency, Inc. Offices in all cities

TUBING, SEAMLESS CATHODE
General Plate Company
Summerill Tubing Company, Bridgeport, Pa.
Superior Tube Company, Norristown, Pa.

TUBING SPAGHETTI (See Insulation Tubing)

TUNGSTEN
Callite Products Div., 542 30th St., Union City, N. J.
Cleveland Tungsten Mfg. Co., Inc.

WASHERS INSULATING (See Fibre, Phenol and Vulcanized)

WASHERS, METAL
Shakeproof Lock Washer Co., 2501 N. Keeler Ave., Chicago, Ill.
Wrought Washer Manufacturing Co., 2203 S. Bay St., Milwaukee, Wis.

WAXES, CEMENTS, COMPOUNDS (See Insulation, Compounds)

WIRE, BARE (Also see Molybdenum and Tungsten)
Alpha Wire Co.
American Braiding Co.
American Steel & Wire Co.
Anaconda Wire & Cable Co., 25 Broadway, N. Y. C.
Belden Mfg. Co.
Callite Products Div., 542 39th St., Union City, N. J.
Cornish Wire Company, 30 Church St., N. Y. C.
Crescent Insulated Wire & Cable Co.
General Cable Corp.
Holyoke Company, Inc.
Hoskins Mfg. Co.
Phosphor Bronze Smelting Co.
Riverside Metal Co.
Roebling's Sons Co., John A.
Scovill Mfg. Co.

WIRE, BRAIDED
American Braiding Co.
Cornish Wire Company, 30 Church St., N. Y. C.
Holyoke Company, Inc.
Roebling's Sons Co., John A.

WIRE, COPPER CLAD
American Braiding Company
Callite Products Div., 542 39th St., Union City, N. J.

WIRE, FILAMENT and GRID
American Electro Metal Corp., Lewiston, Maine
Callite Products Div., 542 39th St., Union City, N. J.
Driver Co., Wilbur B.
Driver-Harris Co.
Jelliff Mfg. Corp.
Newark Wire Cloth Co.
Pequot Wire Cloth Co.
Prentiss & Co., Geo. W.
Swedish Iron & Steel Corp., 17 Battery Pl., N. Y. C.

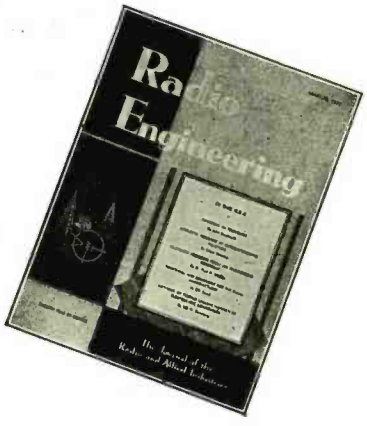
WIRE, INSULATED
Acme Wire Company, 1255 Dixwell Ave., New Haven, Conn.
American Braiding Company
American Enameled Magnet Wire Co.
American Steel & Wire Co.
Anaconda Wire & Cable Co., 25 Broadway, N. Y. C.
Belden Mfg. Co.
Cornish Wire Company, 30 Church St., N. Y. C.
General Cable Corp.
General Electric Company, Schenectady, N. Y.
Lenz Electric Mfg. Co., 1751-1757 N. Western Ave., Chicago, Ill.
Rockbestos Products Corp.
Roebling's Sons Co., John A.

WIRE, MAGNET
Acme Wire Company, 1255 Dixwell Ave., New Haven, Conn.
American Braiding Co.
American Enameled Magnet Wire Co.
American Steel & Wire Co.
Anaconda Wire & Cable Co., 25 Broadway, N. Y. C.
Belden Mfg. Co.
General Cable Corp.
General Electric Company, Schenectady, N. Y.
Roebling's Sons Co., John A.

WIRE, RESISTANCE
American Electro Metal Corp., Lewiston, Maine.
Callite Products Div., 549 39th St., Union City, N. J.
Driver Co., Wilbur B.
Driver-Harris Co.
Holyoke Company, Inc.
Hoskins, Mfg. Co.
Jelliff Mfg. Corp., C. O.
Prentiss & Co., Geo. W.
Swedish Iron & Steel Corp., 17 Battery Pl., N. Y. C.

WIRE STRIPPERS (See Strippers, Wire)

ZINC
New Jersey Zinc Co.
Platt Bros. & Co.



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.....sales afterwards

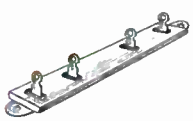
Some CLAROSTAT Products:

WIRE WOUND VOLUME CONTROLS

LINE BALLASTS

COMPOSITION VOLUME CONTROLS

FLEXIBLE RESISTORS



POWER RESISTORS and VOLTAGE DIVIDERS

All Clarostat Products Are Fully Covered by Patents

CLAROSTAT has been accused on occasion of being too conservative. CLAROSTAT has often lagged in offering so-called new developments to resistance buyers. Many large assemblers under sales pressure, have adopted devices which had progressed little beyond the "sample" stage, much to their dismay when production quantities were "rushed through."

CLAROSTAT has never used such sales pressure. It considers trial production runs as a necessary part of research.. It is not dominated by a sales department bloodthirsty for orders at the expense of proper tooling up.

While this policy may appear less glamorous . . . it is sounder . . . both for buyers and for CLAROSTAT. And . . . it has kept CLAROSTAT products in receivers SINCE RADIO FIRST BEGAN.

We solicit inquiries on mass production or special resistor problems, for radio, sound, communication or industrial application.

CLAROSTAT MFG. CO., Inc.

287 North 6th Street Brooklyn, N. Y.

When Better Radio Resistors Can Be Made ... Allen-Bradley Will Be First to Make Them!

Are you familiar with this Compact Volume Control? Its performance is unaffected by moisture or long service...

● Bradleyometer Types J and JS are so different from ordinary volume controls that every radio engineer should be familiar with their designs.

● For instance, the resistor is a solid-molded ring—not a film-type unit. The resistor material is varied, in longitudinal section, to provide any specified resistance-rotation curve.

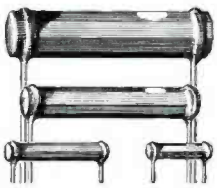
Type J Bradleyometer

● After molding, the unit cannot change; even severe service cannot alter its performance. Long wear does not deteriorate this unusual Allen-Bradley resistor. Even high humidity has no effect on Bradleyometer Types J and JS; they remain permanently quiet.

Type JS Bradleyometer

● These volume controls are only $1\frac{1}{16}$ in. in diameter. They are available with or without a built-in line switch actuated by the control knob. They are interchangeable with other units built to R. M. A. standards.

Allen-Bradley Co.
126 W. Greenfield Ave., Milwaukee, Wis.



SPECIFY BRADLEYUNITS IF YOU WANT QUIET, DEPENDABLE RESISTORS

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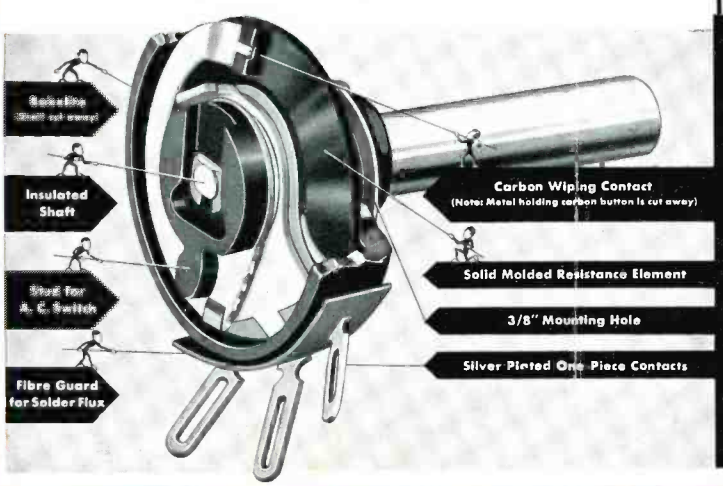
SUPPRESSORS THAT HAVE NO HIGH VOLTAGE CHARACTERISTICS

Allen-Bradley Suppressors do not "open circuit" in service; they do not "drop" in resistance and, therefore, fail as suppressors; they do not have a high voltage characteristic; they do not fail from exposure to oil and water; they do not break due to car or engine vibration. These resistors are enclosed in rugged, non-arcing bakelite casings.



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the Choice of the World's Largest Radio Manufacturers