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RADIO ENGINEERING

Vol. VII APRIL 1927 Number 4

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Introducing Our New Editor

It is with pleasure that RADIO ENGINEERING introduces to its readers the new editor, Mr. M. L. Muhleman.

Mr. Muhleman, formerly the associate editor of RADIO NEWS, brings to RADIO ENGINEERING years of publishing experience, a keenly analytical sense of editorial and merchandising values together with a broad experience and wide reputation in technical and engineering circles. In his recent connections he was responsible for a great many progressively radical improvements in the design of radio apparatus and the promotion of cooperative merchandising plans.

He has been associated with various phases of radio for the past twelve years. His activities have covered the supervision of commercial stations, research and developmental work and the actual business of radio manufacturing.

It has been said about Mr. Muhleman that if it were not for his inherent desire for viewing the parade from the grandstand instead of marching along with the rest he could be one of the greatest merchandising men in the industry today. Rather than to find an outlet for his energies along the lines of actual engineering and sales development, he hides himself behind an editorial desk and promotes ideas that manufacturers find it wise to follow.

Mr. Muhleman could well be called an Editor-Engineer for his experience and knowledge are by no means limited to publishing and merchandising. He is the author of numerous booklets covering the technical side of radio and besides has contributed much to the radio engineering field itself. His knowledge of the editorial, the merchandising and the engineering field provide him with an enviable background.

Unquestionably, RADIO ENGINEERING is fortunate in securing the services of Mr. Muhleman. He has very definite views about a broader editorial policy for the magazine. Lack of space prevents us from giving the details of his plans, but we are sure that the editorial pages of the forthcoming issues will reflect his ability and personality.

RADIO ENGINEERING

The Technical Magazine of the Radio Industry

Edited by M. L. MUHLEMAN

Managing Editor, HOLLIS de NEEFE

Vol. VIII. **APRIL 1927** **No. 4**

Seventh Year of Publication

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RADIO ENGINEERING

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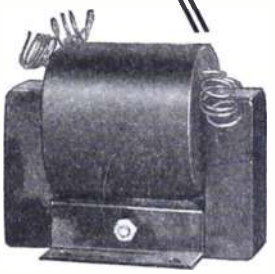

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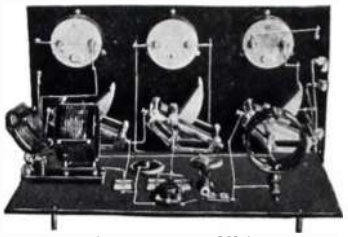
FRONT PANEL VIEW



REAR PANEL VIEW

Here's a new transmitter that is sure to appeal to every true amateur! Compact and pleasing in appearance, it has a really remarkable range on low power. Embraces flexibility to a heretofore impossible degree, because it is built around the famous AERO plug-in coils. Two pairs of AERO coils cover the entire band, 16.5 to 90 meters, without gaps, and are instantly interchangeable. These coils operate perfectly on low power, yet handle in excess of 1000 volts just as efficiently. Read the description of this wonderful transmitter elsewhere in this issue. Then plan to change over to this set. It's really very inexpensive, considering its great range on low power. Here are the AERO Kits you should use, tuning either kit with three good .0005 variable condensers:

KEY 2040 KIT **Price $12.00**

Kit contains 2 AERO Coils, 17 to 50 meters each, 1 AERO Antenna Coil Mounting Base, 1 AERO Grid Coil Mounting Base, 2 AERO Essential Choke Coils.

If you desire to have this set tune to 90 meters, simply buy two AERO 40 to 80 meter transmitting coils, which plug in the same mounting bases, and work efficiently with the above items.

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Kit contains 2 AERO Coils, 36 to 90 meters each, 1 AERO Antenna Coil Mounting Base, 1 AERO Grid Coil Mounting Base, 2 AERO Essential Choke Coils.

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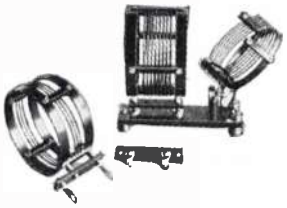

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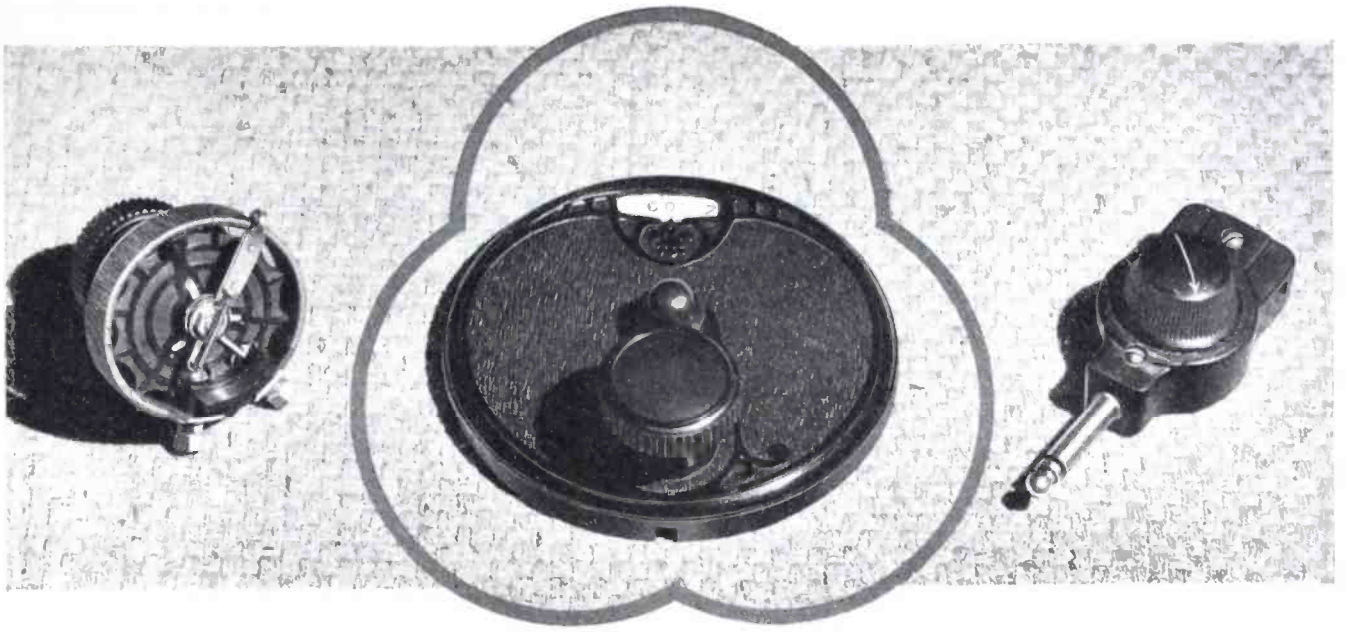

Marco rheostat, Centralab Modu-Plug and Eby dial, all of Bakelite Molded and made by the Martin-Copeland Co., Providence, R. I.

Refinement of design is practical *with Bakelite Molded*

THERE is a very definite trend toward refinement in design and beauty of finish in the making of radio parts. The fact that Bakelite Molded lends itself to the accurate reproduction of every kind of intricate design accounts, in part, for its wide use by the radio industry.

The parts pictured above are excellent examples of the possibilities of Bakelite Molded. The Bakelite insulation piece of the Marco air-cooled rheostat is molded with a "linen-finish" for the flat surface and a high lustre on the raised surfaces. The Centralab Modu-Plug has a uniformly lustrous surface throughout. The Eby dial, with its attractive ornamentation, is molded of Bakelite in a single operation.

Radio engineers and manufacturers will find that Bakelite Molded is well suited to the making of parts that require the utmost refinement of detail. In carrying out their ideas, they may also find the cooperation of Bakelite engineers and research laboratories of value.

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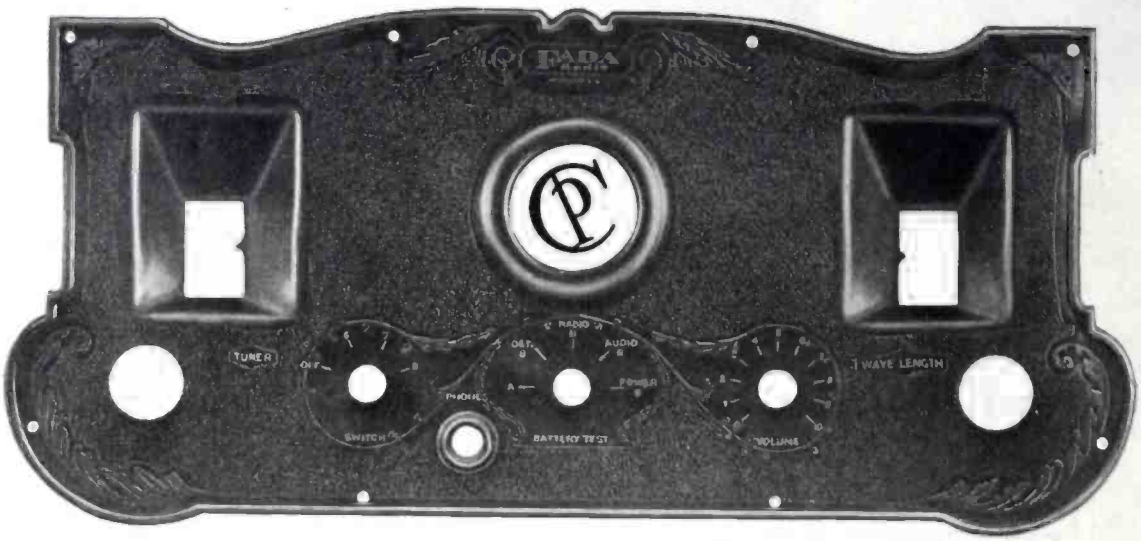

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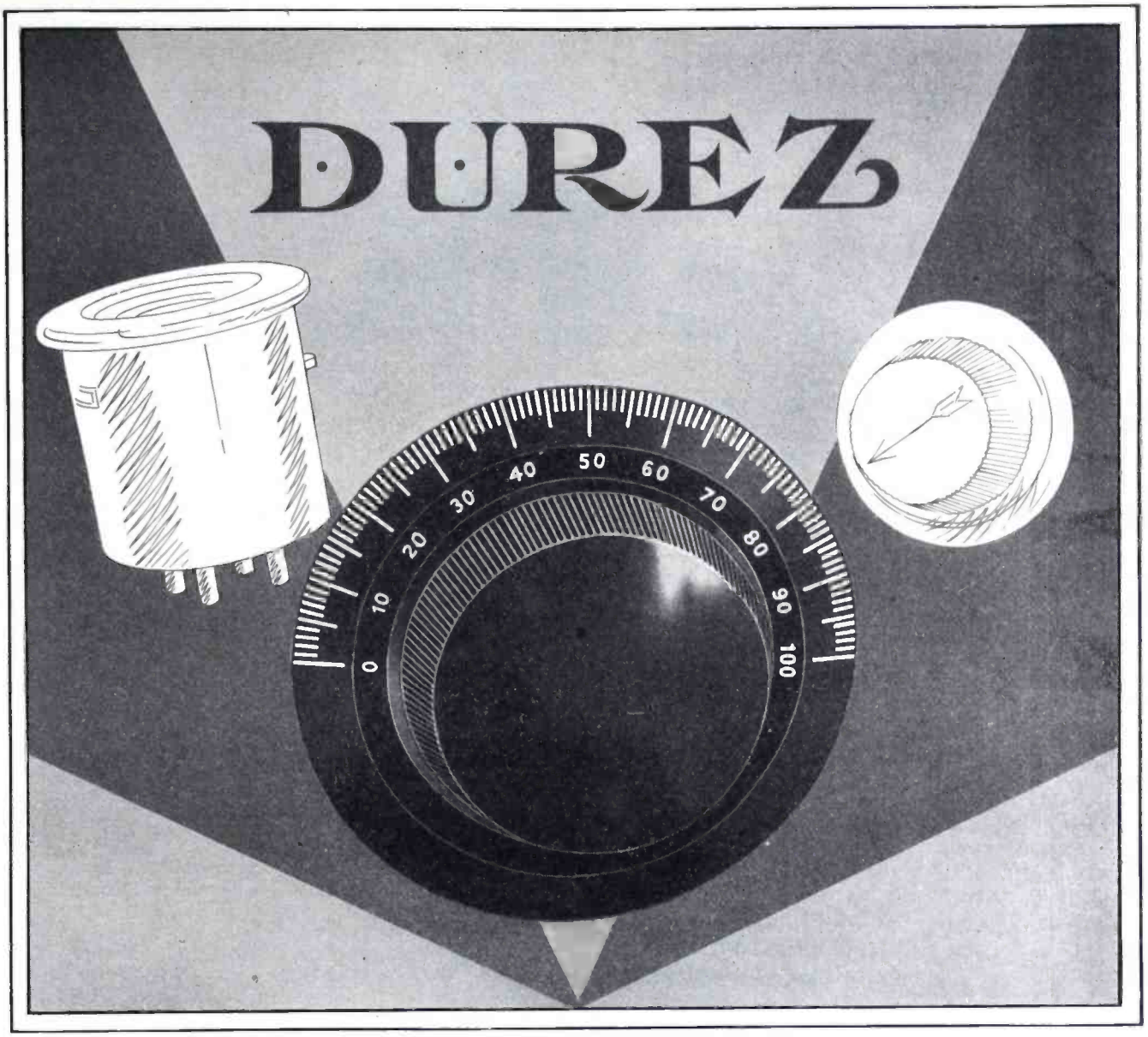

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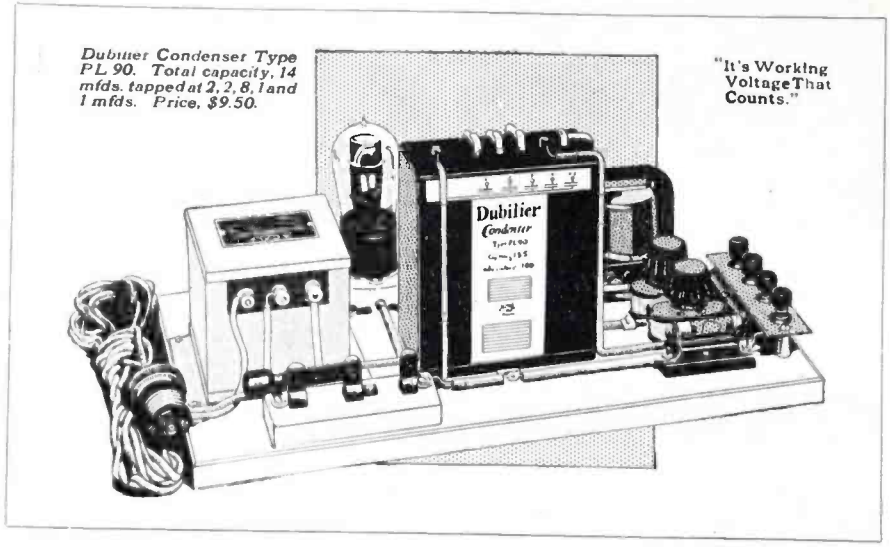

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* *Working voltage means more than "test voltage." It is the voltage at which a condenser may be safely used in continuous operation.*

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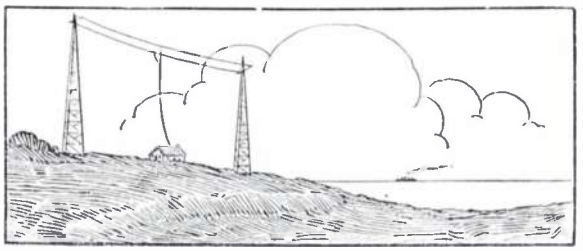


The Theory and Application of Tuned Audio Frequency Amplification

A description of the new tuned double impedance audio frequency amplifier—

*By E. E. Hiler**

This is the first of a series of articles by Mr. Hiler on his new tuned double impedance amplifier. The system has a number of advantages over present forms of audio frequency amplification which will appeal particularly to set and parts manufacturers. This new system is bound to occupy an important place in the industry.—The Editor.

FURTHER applications of the double impedance audio frequency amplifier, employing three stages, have proven conclusively that a great deal can be accomplished by the tuning or adjustment of each stage to obtain a resultant frequency characteristic curve to conform with that of a loud speaker. As a matter of fact the system is plastic in nature and can be so tuned as to obtain frequency characteristics to suit any condition.

It is interesting to observe that the mathematics of tuned radio frequency amplifier systems applies equally well to audio frequency systems which are tuned in one manner or another and that, fortunately, while the values can be determined experimentally, the present system lends itself to quick and accurate mathematical calculation.

In the present article I intend to cover only the theory and application of the tuned double impedance amplifier and cover the more specific subjects relative to commercial adaption, etc., later on.

Theory

Conventional audio frequency amplifiers are admittedly deficient at low frequencies, tho it is usual to excuse this failure on the grounds that the development of loudspeakers has lagged behind improvements in amplifying methods.

There is a serious fallacy in this argument. The failure of one part does not justify failure in another. In fact, the loudspeaker is deficient only because it requires greater energy to operate it at low frequencies than the ordinary amplifier is able to deliver.

If the energy is available, the loudspeaker can be actuated at low frequencies as well as at the upper end of the register.

There is the story of the tuned double impedance amplifier. Incidentally, this method of proportioning amplification to the energy requirements of the loudspeaker brings about other important effects.

It maintains a steady average grid potential.

It eliminates motorboating without requiring any auxiliary apparatus.

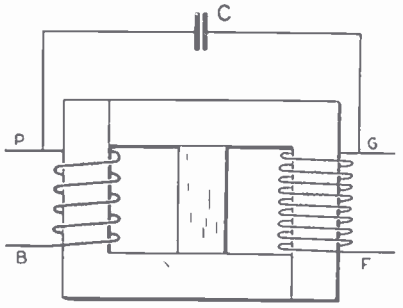


FIG. 1

Details of the double impedance unit

It provides complete magnetic shielding, so that radio frequency currents are eliminated from the audio circuits.

Double Impedance Unit and Circuit

The double impedance unit consists of a laminated figure-8 core, carrying one coil on each outer leg. The effect of this mechanical design is to almost isolate the windings magnetically. A fixed condenser is also contained in the case which houses the coils.

Fig. 1 and Fig. 3B gives the details and elements of the circuit. L1 and L2 are the windings, and C a condenser put across the plate and grid. A variable resistance of 0 to 50,000 ohms, indicated by X in series with the impedance in the grid circuit is used only in the first stage or in the second stage to adjust the resonance peak, as will be explained later. It is customary to use three stages of double impedance amplification.

The Formula

For the most perfect results obtainable from tuned A. F. amplification, the three stages of double impedance

* Hiler Audio Corporation.

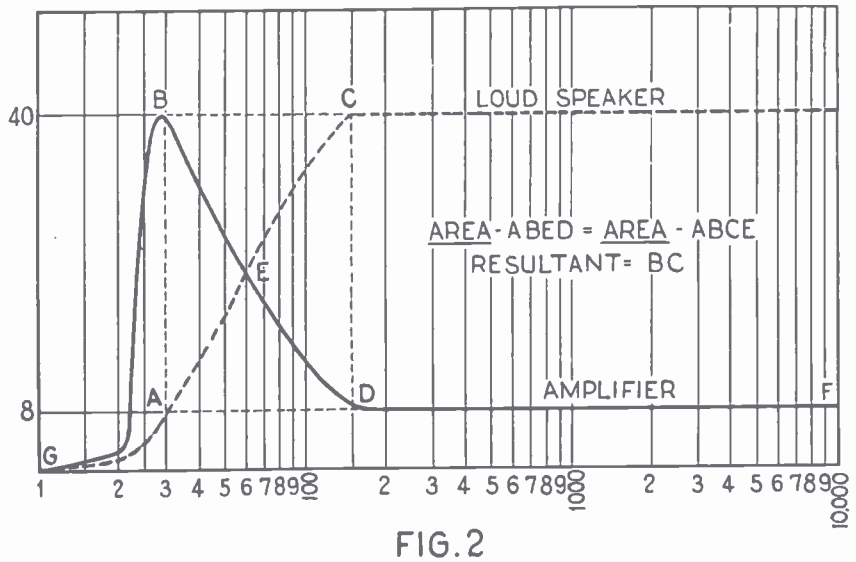
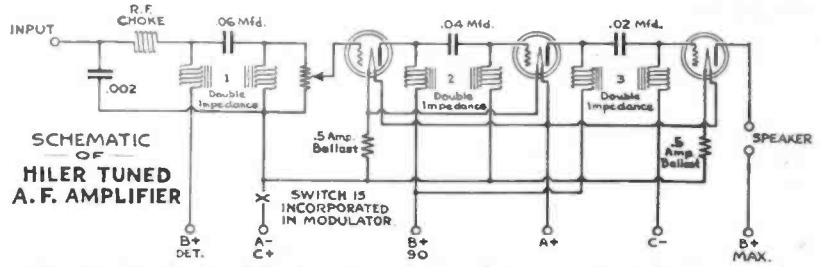


FIG. 2

The frequency characteristics of the general type loud speaker plotted against the curve of a tuned double impedance amplifier. BC is the resultant



The general circuit of the tuned double impedance amplifier. Variations of this circuit are covered in the article

should be designed to compensate for the response curve of the particular type of loudspeaker to be employed. While the values can be determined experimentally, this system lends itself to quick and accurate mathematical calculation.

Ordinarily, a standard winding is used for both coils and a standard core in all stages. The units are

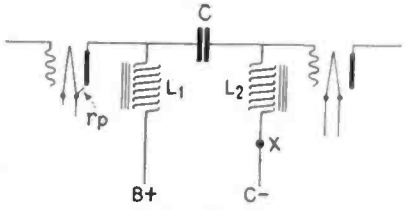


FIG. 3A

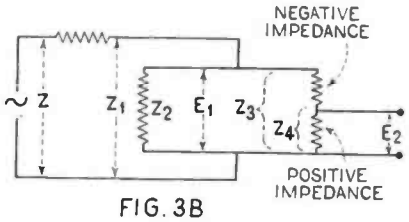


FIG. 3B

The resonance peak can be raised or lowered by adding resistance at point X in Fig. 3A. The unmarked resistance in Fig. 3B is rp

matched to the loudspeaker by the selection of coupling condensers and by the introduction of resistance, if required, in one or two stages, in series with the grid impedance.

The voltage step-up in one stage is determined by the relation between the internal and external impedances, and by the relation between the positive and negative reactances in the grid circuit.

The internal impedance is the effective resistance between plate and filament, indicated as rp in Fig. 3B. The external impedance is represented as Z_1. It consists of the parallel combination of the plate coil, the grid coil, and the coupling condenser. The coupling condenser is, in effect, in series, as shown in Fig. 4.

The ratio of the voltage across the external impedance to the applied voltage is

$$\frac{E_1}{E} = \frac{Z_1}{Z} \qquad (1)$$

The ratio of the voltage applied across the grid and filament of the succeeding tube to the voltage across the external impedance is

$$\frac{E_2}{E_1} = \frac{Z_4}{Z_3} \qquad (2$$

It is due to this last ratio the rising characteristic at low frequencies is obtained.

To get the complete voltage amplification ratio or response for one stage at a given frequency, multiply ratio (1) by ratio (2), and multiply the product by the mu of the tubes. That is,

Voltage amplification

$$= \frac{Z_1}{Z} \times \frac{Z_4}{Z_3} \times \text{mu} \qquad (3)$$

To determine the impedance values,

$$Z_4 = r_3 + jX_L \qquad (4)$$

$$Z_3 = r_3 + j(X_L - X_c) \qquad (5)$$

$$Z_2 = r_2 + jX \qquad (6)$$

$$Z_1 = \frac{Z_2 Z_3^2}{Z_2 + Z_3} \qquad (7)$$

In solving (7) the complex number values of Z_2 and Z_3 must be used. This is given by

$$Z_1 = \frac{r_2^2 r_3 + r_3^2 r_2 + X_2^2 r_3 + X_3^2 r_2}{(r_2+r_3)^2 + (X_2+X_3)^2} + j\frac{r_2^2 X_3 + r_3^2 X_2 + X_2^2 X_3 + X_3^2 X_2}{(r_2+r_3)^2 + (X_2+X_3)^2} \qquad (8)$$

The first fraction indicates the resistance component of Z_1, the total external impedance. The second fraction represents the reactance component of Z_1.

Z represents the total impedance of the circuit, as it appears in Fig. 4. It is given by the equation

$$Z = r_p + \frac{r_2^2 r_3 + r_3^2 r_2 + X_2^2 r_3 + X_3^2 r_2}{(r_2+r_3)^2 + (X_2+X_3)_2} + j\frac{r_2^2 X_3 + r_3^2 X_2 + X_2^2 X_3 + X_3^2 X_2}{(r_2+r_3)^2 + (X_2+X_3)^2} \qquad (9)$$

The inductive reactances can be determined by the following:

$$X_L = 2\pi f L_2 \qquad (10)$$

$$X_2 = 2\pi f L_1 \qquad (11)$$

$$X_c = \frac{10^6}{2\pi f\, C_{\text{mfd.}}} \qquad (12)$$

$$X_3 = X_L - X_c \qquad (13)$$

In these formulae, it is necessary to use *effective* inductance values, and not the *apparent* values. Effective values take into consideration hysteresis and eddy current losses.[1]

To determine the resonant frequency, or maximum voltage amplification frequency,

$$F_r = \frac{1{,}000}{2\pi\sqrt{L_2 C_{\text{mfd.}}}} \qquad (14)$$

The higher the phase angle of the grid coil—i. e. the lower the effective resistance—the higher the voltage amplification at the resonant frequency.

The ratio of Z_1 to Z_3 *above* the resonant frequency is always greater than 1 and approaches 1 as a limit on the frequency is increased, because the negative reactance of the condenser, subtracted from the positive reactance of the coil, makes impedance Z_3 less than impedance Z_4. Consequently, the voltage across Z_4 is greater than the applied voltage across Z_3.

It may be pointed out that in the series circuit Z_3 the current is same throughout, and the voltage is therefore proportional to the impedance.

Below the resonance point, the negative reactance of the condenser increases to a point where its reactance is twice the positive reactance of the coil. At this point the ratio

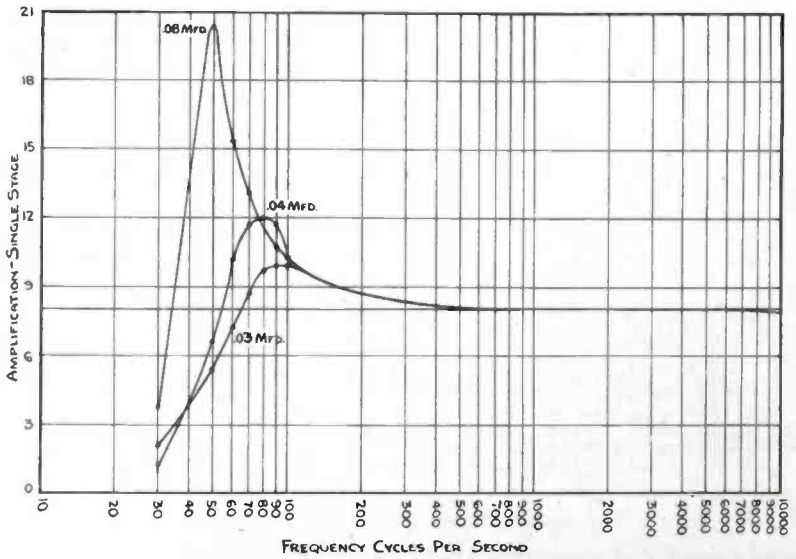


Fig. 5. The plotted curves of three stages of tuned double impedance amplification using different values of coupling capacities

* Irvington Varnish & Insulator Co.

[1] See Principles of Radio Communication, Prof. J. H. Morecroft, Chap. II, page 134.

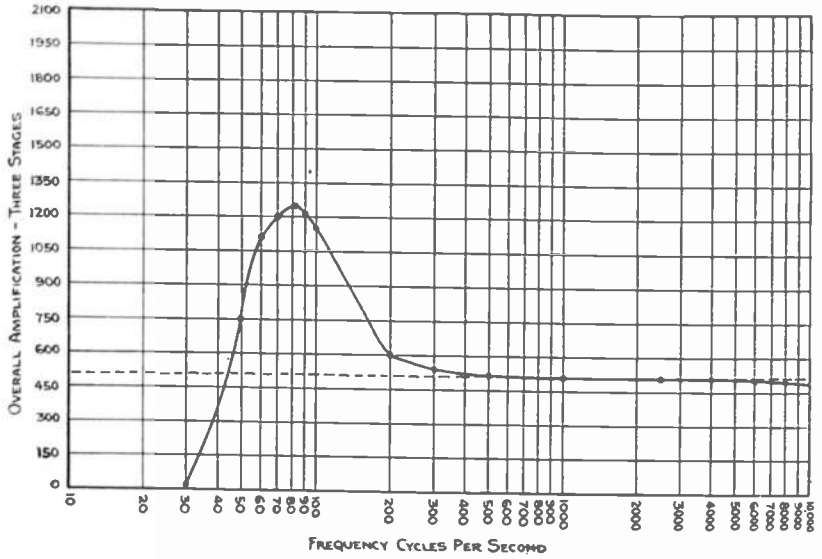


Fig. 6. The frequency characteristic curve of a three stage tuned double impedance amplifier. This will illustrate the rising characteristics of the amplifier at low frequencies

of Z_4 to Z_3 is 1. Reducing the frequency further, the ratio approaches zero as a limit.

The ratio Z_1 to Z is always less than 1, and approaches 1 as a limit as the frequency is increased.

As a result of the operation of these two ratios, Z_4 to Z_3, and Z_1 to Z, with the coils designed for this system, the amplification from 200 to 10,000 is a straight line. That is because the difference between 1 and either of these ratios is infinitesimal. Therefore, the amplification per stage is the mu of the tube.

The response curves of the best cone speaker start to drop steeply at 200 cycles. Thus the problem of producing perfect reproduction is in building up the response below 200 cycles, as far down as 40 cycles—and without altering the response curve from 200 cycles up, as would be the case if a large by-pass condenser were connected across the plate and filament of the detector tube.

In the double impedance amplifying system, the desired effect is achieved thru staggering the resonance peaks of the stages by using different values of coupling condensers.

To take a practical example:

Using standard coils, and coupling condensers in the first, second and third stage of .08 mfd., .04 mfd., and .03 mfd. respectively, the resonance peaks are at 50, 70.7, and 81.6 cycles.

The frequency below resonance at which the ratio Z_4 to Z_3 of each stage falls to unity is given by:

$$f = \frac{1{,}000}{2\pi\sqrt{2L_{\text{eff. henries}}\,C_{\text{mfd.}}}} \qquad (15)$$

With the values given above, this frequency is 35.4, 50, 57.7 cycles. This is approximately the point below resonance at which the voltage amplification is equal to the mu of the tube.

This shows that the curve of each stage falls much more steeply below resonance than above it. Fig. 5 shows the calculated curves of three staggered stages, and Fig. 6 the resulting

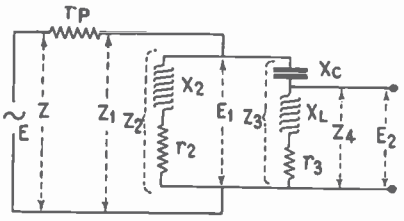


FIG. 4

Illustrating the electrical properties of a single stage tuned double impedance amplifier

overall amplification. Actual precision measurements show that these curves represent accurately the characteristics of this amplifier system.

Motor Boating

Transformers capable of amplifying frequencies as low as 30 cycles, or the conventional resistance coupled amplifiers, cause trouble from motor boating because the amplification does not cut off sharply slightly above 30 cycles. Motor boating occurs between 0 and a maximum higher value of 30 cycles. This is because the filter systems used in B eliminators are resonant between o and 30 cycles. To eliminate motor boating without external apparatus, the total overall amplification must not exceed approximately 20, with varying values.

A well-designed resistance amplifier of three stages gives an amplification of 40 to 50 at 30 cycles. Hence the motor boating.

In contrast to this, the tuned double impedance amplifier of three stages give only 11.8 at 30 cycles. Consequently, motor boating is automatically eliminated.

Heights of Resonance Peaks Adjustable

In Fig. 5, the heights of the second and third stage resonance peaks have been adjusted by resistances in series in the grid coils in the second and third stages. This is done to produce a uniformly rising overall amplification curve from 200 cycles to the cut-off frequency. The resistance so introduced is added to r^2 in Fig. 4.

This effect is to broaden the tuning by bringing the ratio Z_4 to Z_3 somewhat closer to unity at the resonance frequency.

When expressed vectorilly, the effect of the added resistance is to reduce the phase angle of the grid coil.

The phase angle of the grid coil is given by

$$\frac{X_L}{r_3} = \tan\phi \qquad (16)$$

It might appear from this frequency that it is necessary to use high phase angle coils, but overall audio frequency regeneration[2] raises the phase angle of standard coils used. Regeneration in the double impedance system is, therefore, an advantage because the resonance peaks are at low frequencies, whereas with transformers the resonance peaks occur between 3.000 and 10,000 cycles, thus altering entirely the normal characteristic curve of the transformers when used in conventional circuits.

[2] A. F. regeneration will be discussed fully by Mr. Hiler in the May issue of Radio Engineering.

Summary of Points on Curves

Frequency	08. mfd.	.04 mfd. with 25,000 ohms	03. mfd. with 50,000 ohms	Product overall amplification
30	3.98	1.30	2.28	11.80
50	20.40	6.80	5.40	750.00
60	15.25	10.20	7.15	1110.00
70.7	12.03	11.75	8.45	1195.00
81.6	10.75	11.90	9.75	1250.00
90	10.50	11.40	10.10	1210.00
100	10.40	10.90	10.10	1148.00
	1st stage	2nd stage	3rd stage	3 stages

S. W. Coil Resistance

Results of tests on standard coils and recommendations for best designs—By L. B. Root

WHEN the amateur builds a short wave receiver or wavemeter, he demands the lowest loss coil that it is possible to make. There are many good coils now available, with various details of construction, but most of them fall in the classification of an "air wound" coil which is nearly self-supporting. There is no question but that this is a good type, when properly proportioned, but it has the disadvantage of being more fragile than a form wound coil and is less adaptable to that very convenient plug-in system of changing from one wave band to another. This brings the experimenter to the question of which he shall choose—lowest loss or merely low loss, and good mechanical construction. The following measure-

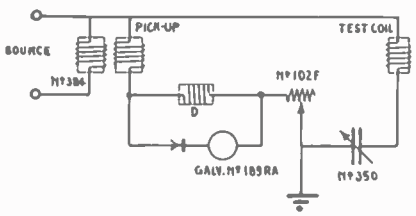


Fig. 1. Circuit diagram of the apparatus used to measure resistance of S. W. Coils

ments at 40 meters indicate some of the causes of losses in coils, and show that their source is frequently other than is supposed.

The diagram in Fig. 1 shows the method of measurement used in these tests. This is the General Radio type 353 Radio Frequency Measuring Set.

The pickup coil consists of only a few turns of wire to absorb energy from the source and feed the balance of the circuit. The coil "D" is a drop coil to by-pass the radio frequency around the high impedance of the crystal detector and galvanometer circuit, and provide a voltage drop to operate the galvanometer.

In operation the circuit is tuned to resonance with the resistance box set at zero, carefully noting the maximum galvanometer reading. Then the test coil is short-circuited and the circuit reset to resonance by increasing the capacitance of the standard condenser. The galvanometer deflection is then much greater than before, because the resistance of the test coil has been removed. Therefore, resistance is added to the circuit until the deflection at resonance is the same as before. This resistance is equal to that of the coil at the frequency of measurement.

The assumption of this method is that the resistance of the standard condenser does not change with setting. Obviously, this is not true, for it is known to decrease as the capacitance is increased. The condenser used is especially designed for this work, with the smallest possible amount of insulation, and that is placed in a weak electrostatic field. The conduction losses are very low. The circuit is sensitive enough to detect a change of 1/50 of an ohm, but when two of these condensers are connected in parallel, no change of resistance can be noted. It is, therefore, safe to neglect the resistance of the condenser, and assume that there is no change with setting.

In order to determine the proper size of wire to use for 40 meters a single Type 277 moulded bakelite form was wound with various sizes of wire from No. 8 to No. 26. Each winding consisted of ten turns, and as the length and diameter were constant, they were of essentially the same inductance. Length of coil, 1⅞"; diameter 2¾". This was chosen as a typical coil, for it had an inductance of about 7 microhenries, and required about 50 mmf to tune to 40 meters, a very usual condition in a receiver.

Measurements of this series of coils gave the curve shown in Fig. 2.

It is evident from this curve that there is an optimum size of wire which is not critical, but should be approached for minimum resistance. Curves taken similarly at other frequencies indicate that there is an optimum size for each wavelength band, and that the lower the frequency, the smaller the wire.

The use of collodion, shellac, or

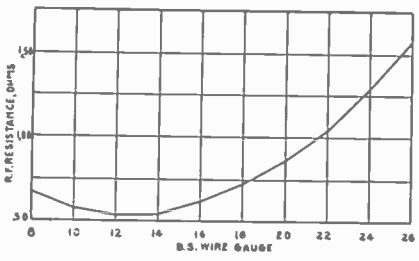


Fig. 2 A curve showing the optimum size of wire for least resistance

other good binders had no appreciable effect.

In order to test the effect of coil for a coil form was wound in the usual manner and a strip of bond paper cemented to the circumference of the wire with collodion. When dry, it was possible to slip out the form without disturbing the wire. Measurements on this coil gave the following: Resistance of coil with form .8 ohms Resistance of coil without form .6 ohms

Gain 25%
Inductance..... 7.5 microhenries

But it is efficiency in which we are interested, and a reduction of resistance is not indicative of the true gain. It is power factor which is to be considered.

Reactance=2—fL=6.28 x 7.5 x 10^6 x 7.5 x 10^6=353 ohms.

$$\text{Power factor} = \frac{R}{X} = \frac{.8}{353} = 23\%$$

with form,

$$\text{Power factor} = \frac{.6}{353} = .17\%$$ without form.

From this it is evident that the power factors differ by about .06%, a very doubtful gain when elimination of the form means a less rugged coil, more difficult to construct. The change of distributed capacity was too small to measure.

Some rather surprising results were obtained by placing metal in the field of the coil. The same coil was used in all the tests, having a resistance of .7 ohms, and an inductance of 7.5 microhenries. P.F. was .2%.

A strip of .010" x 1½" copper 4" long was placed along the axis and in-

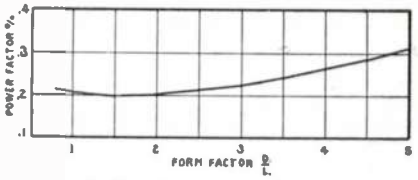


Fig. 3. Showing the desirability of keeping the form factor about 1 to 2.5

side of the coil. Power factor rose to .23%, an increase of .03%.

A sheet of ¼" aluminum placed successively nearer the side of the coil had no readable effect until it actually touched the insulation, when the power factor became .21%. When placed flat against the end of the coil the change was very slight.

A strip of .010" x 1¼" copper was placed around the circumference of the coil, with about ½" air space. When the loop was not closed to make a short-circuited turn, the power factor was .22%, but when closed it became .26%.

As an extreme case, a copper can was made to enclose the coil entirely leaving about ½" air space all around. The power factor went up to .27% in this case.

Power factor is mentioned in all of these tests rather than resistance, as a true indication of the change. In most instances, the inductance of the coil was reduced somewhat, accompanied by an increase of radio frequency resistance.

Six different coils were wound to practically the same inductance, on the same diameter form, but with the different winding lengths, and consequently some variations in the number of turns. Inductances averaged 7 microhenries. The curve of Fig. 3 shows the results.

The object of these experiments was not to prove that bad coils are good, nor to discourage the construction of really low loss coils, but to find the causes of inefficiency, and what practical means could be taken to avoid them.

It is very evident that most of the losses come from the conductor itself, and while form and nearby metal objects do contribute, their effect is relatively small, and if something else must be sacrificed, the gain may not be worth while.

Finally, it may be summed up that in designing a coil of a given inductance for the forty meter band, it is well to

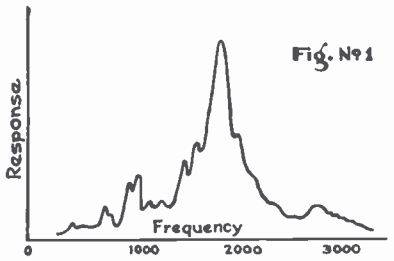
1. Use about No. 12 to No. 14 wire.
2. Keep the form factor $\frac{\text{(diam.)}}{\text{(length)}}$ around 1 to 2.5.
3. Use a form if desired.
4. Use plugs and jacks if desired.
5. Use any good "dope" as a binder.
6. Use any reasonable amount of shielding where advantageous.

For all practical purposes the coil will be of low losses, mechanically strong, convenient to use, and, if wound on a good form, will retain its calibration indefinitely. And these advantages are obtained with but slight and immaterial sacrifice of efficiency.

Sound Reproduction

*A discussion of the characteristics of present day amplifiers and speakers—By Paul G. Andres**

THE subject of audio amplification and sound reproduction has been a major problem with engineers since the invention of the telephone. The experiments with magnetic amplifiers and the results obtained with loud speaking equipment used as late as a decade ago, were such that very little enthusiasm could be aroused over their performance. It was only with the introduction of the vacuum tube that this problem neared a definite solution. The tube supplied not alone the means for obtaining the much needed amplification, but also gave the scientists a new tool by means of which speech and musical sound could be more accurately analyzed than ever before and the requirements for high quality reproduction definitely established.



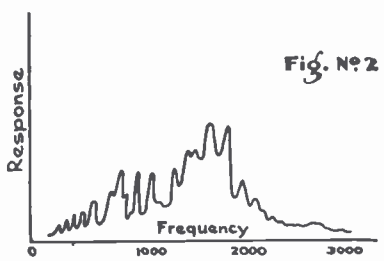
The effect of a combination of the early transformers and horn type speakers

It is interesting to note that the recently developed high quality mechanical phonograph was the result of development work based on accurate knowledge of the necessary acoustical principles and data. The application of devices which pass all essential audio frequencies in a radio set allowed radio reproduction to surpass the marvelous improvements which have been made in the phonograph but with the result that the phonograph designer and manufacturer introduced the desirable flexibility by the use of electrical equipment and in turn is able to reproduce music and speech with the same fidelity accomplished in radio reproduction.

The sound emitted by the loud speaker or reproducer is the contact the "Consumer" has with the device whether radio or phonograph and because of its importance can well be studied and analyzed to advantage.

The Loud Speaker or Reproducer

The very early radio installations, after the headset days, were made incorporating a conventional type headset or telephone unit coupled to a small horn often only a foot long and generally conical in design. The unit from its previous telephone history had been designed to operate most efficiently around one thousand cycles or higher in order to reproduce the required intelligibility in speech and when these two devices were coupled together to a loud speaker the result was far from perfect, particularly in the case of reproducing the lower musical tones. It may be remembered that when complete table sets were first introduced, the set and cabinet designers often housed the set in its proper space and then allowed a few square inches at one end for a horn bell opening and a small space back of this for the tone arm. Obviously, this procedure did not tend toward improvement in the quality of reproduction but resulted in much volume of middle and high frequencies, since the horn and unit were operating at approximately the same resonance points. Fig. 1.

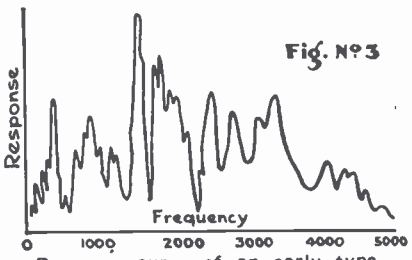


A reduction of the resonance peak by the development of the "goose-neck" speaker

The early audio frequency transformers, as will be mentioned under amplifiers, exaggerated this condition still more. The most casual comparison between the original and the reproduction from a radio set showed that considerable improvement should be made in the loud speaker.

The loud speaker of the horn type employs a unit which actuates a diaphragm. This diaphragm when clamped around the periphery has a number of resonance points in the audible frequency range depending on its diameter, thickness, material, clamping, corrugations, etc. The actuating mechanism of the diaphragm is either direct by magnetic action as in the case of the telephone unit, or by link arrangement from an auxiliary armature employed in the case of the floating armature type unit.

Improvements were made in both types of units whereby the proportionality between currents and diaphragms displacement became more nearly linear and the frequency range was extended down to greater response at the lower frequencies. While units have been made where the diaphragm resonances are either below or above the audible frequency range, such units in general lose much of their sensitivity.



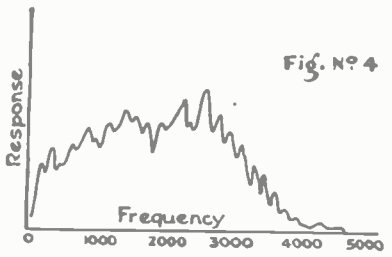
Response curve of an early type of cone speaker

The horn manufacturer next began to study his product in the light of the available units and found that considerable improvements in performance were obtained by so designing the short horn that the resonances of the horn were removed in the frequency scale from those of the unit and that the introduction of sound absorption by suitable choice of horn material and wall construction prevented undue resonances or blasting. Inter. No. 1. The outcome of this development was the common and still popular "morning glory" or "gooseneck" type of speaker. Fig. 2.

Along with this development the cone or large diaphragm type of speaker, previously developed for phonograph use, was applied as a radio loud speaker. The actuating mechanism was of the familiar floating

* Chief Engineer, Newcombe-Hawley, Inc.

armature, solenoid or direct acting types. The high and middle range frequencies were reproduced very well because of the greater grip the diaphragm had on the surrounding air while the lower frequencies were obtained by moving the entire diaphragm as a plunger, surrounding it with a baffle to prevent circulating sound waves and the introduction of low frequency resonant chambers in the back of the cone. The frequency response of such a speaker covered the frequency range decidedly better than the small horn type referred to above, but in general the resonance points of the unit and diaphragm were very sharp and with a decided tendency to favor the high frequency except in those cases where the resonant chamber introduced decided low frequency



Showing the favorable response of a horn using an air chamber longer than 60 inches

resonances, resulting in a muffled response. Fig. 3.

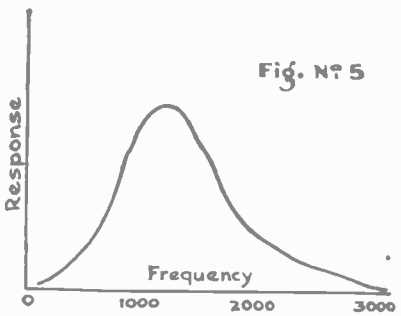
Improvements were made such as using units employing two separate armatures actuating the diaphragm, careful design of the diaphragm with regard to density, material, method of fastening, included angle or pitch and so forth. Filters were devised to operate between the speaker and the set to reduce the response at the extreme high frequencies. The use of the power tube aided materially in supplying the proper power to operate the speaker. The solenoid type of cone speaker when operated under proper conditions yields excellent results regarding frequency response, but requires auxiliary apparatus which makes it somewhat expensive. It is to be noted, however, that the cone speaker as such has definite peaks and valleys in its response characteristics.

In the meantime, the horn designer realized that the low frequency response obtained in the cone speaker could not be reproduced satisfactorily with a short horn and therefore designed longer conical horns. Experiments indicated that horns with exponential contours had a considerably greater low frequency response than conical ones and cabinet horns having exponential rates of expansion and lengths from 48 to 60 inches found application. Along with this, experiments on horn wall construction indicated that these longer tone chambers require rigidity and close attention to manufacturing tolerances of the air column. The success of such exponential horns, however, has led the set manufacturer to the conclusion that such a designed horn was ideal. There is no magic quality in the word "exponential" and serious doubts are being entertained in the minds of investigators and horn designers since theory and experiment again point to the fact that superior results can be obtained from horns designed with other than exponential or logarithmic equation.

The advent of the console type of radio set made possible the use of longer tone chambers than 60 inches and when arranged so that a sufficient bell area is used, very satisfactory results are possible. Fig. 4. As in the small horn and cone, the long horn type reproducer still retains its definite resonance response characteristic.

Experimental tone chambers with length from 15 to 18 or 20 feet have been developed in laboratories. Such extremely long horns have resonance points near the very lower edge of the frequency scale and yield remarkable results, but because of the limited space required in connection with the radio set such horns at the present time have not found extensive application.

No loud speaker with a perfectly flat response output characteristic has come to the writer's attention either in the laboratory or commercial application. When it is realized that the efficiency of a complete speaker is only a few per cent at best, it requires but little thought to realize that much improvement is possible. But as long as loud speakers operate with resonant characteristics, the frequency response consists of a series of valleys and peaks, smoothed out as much as possible and perhaps not obviously apparent to the average listener but nevertheless far from flat.

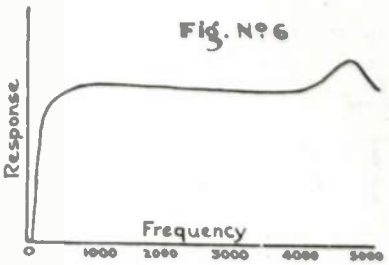


Curve of an early audio transformer, designed for code work in radio telegraph

The Audio Frequency Amplifier

The early interstage coupling transformers, made to operate efficiently on code work in radio telegraphy, had a decided medium and high frequency response characteristic. Having been designed to peak at 800 or 1000 cycles, they were essentially resonant devices with high transformation ratios and therefore passed but little low frequencies. Fig. 5. The resistance coupled amplifier used in laboratories in connection with measurement devices was then commercially developed, but because of the lack of high mu tubes, the instability of high resistances at that time and the high plate voltage requirements, it was used in a limited way but because of the superior results obtained pointed toward improvement in coupling devices. The obstacles to the resistance coupled amplifier have been overcome in a large measure and this type of coupling is finding wider application, primarily because of its flat output characteristics.

The impedance coupled amplifier, as in the previous case, introduces no step up ratio in the coupling device but allows the use of lower plate voltages. The modification incorporating dual impedances allows a definite design with respect to the grid to filament resistance and the coupling condenser resulting in less tendency to block. The



Curve of an improved audio frequency transformer. Low frequency response is lacking and the unit peaks at a high frequency

output characteristic of the impedance amplifier closely approaches a straight line particularly when the plate impedance is sufficiently large.

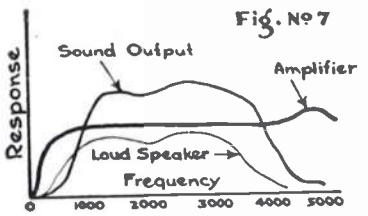
During this development transformer designers began a study of coupling transformers with the result that by the use of larger cores made with high permeable core material and minimum losses, lower transformation ratios and due regard for distributed capacity in the secondary, they were able to produce designs giving a nearly flat frequency characteristic with the additional feature of a voltage step up in the coupling device. In general, such designs fall off somewhat at the very low frequencies and a tendency toward a peak exists at the very high frequencies. Fig. 6.

The application of such high quality transformers yielded excellent results regarding reproduction over the previous designs but interstage reaction and regeneration at audio frequencies led toward modification and the determination of overall characteristics of the complete amplifier. As a final result transformer coupled amplifiers yield a practically flat frequency output from the last audio tube.

The Immediate Audio Problem and a Possible Solution

As outlined above, the loud speaker in its present form has a characteristic of irregular shape; that is, the low frequency response is poor; the medium response, good; and the high frequency response is exaggerated in

the cone type speaker and somewhat deficient in the long horn type speaker, particularly when the tonearm is coiled to conserve space. The amplifier, on the other hand, has been designed to have a nearly flat frequency output characteristic. It is apparent that when such an amplifier is connected to a certain loud speaker, the net result is an amplified response of the loud speaker characteristic. Fig. 7. But what is the problem in audio frequency amplification and sound reproduction? It is the equal reproduction of all frequencies for a definite voltage input; in other words, uniform sound output from the loud speaker is the desired performance. Since the loud speaker through its many years of development still insists on retaining definite limitations, it appears that the proper correlation between a definite loud speaker and the audio frequency amplifier may offer possibilities. In the design of such a combination, paramount importance must be placed on the selection of a loud speaker and definite knowledge and data regarding its performance must be obtained. A flat frequency response amplifier is invaluable in determining these factors; that is, it discloses whether the loud speaker responds to all essential frequencies and the magnitude of that response. Loud speaker manufacturers have gone into the problem extensively and through elaborate investigation have obtained data as to the relative performance of various loud speakers tested under conditions of constant voltage input to the grid of the last audio tube, and sound output under such conditions, such as short distances from the front of the loud speaker, in soundproof rooms, in normal furnished rooms, and so forth. The Standard Committee of the Engineering Society and Radio Manufacturers' Association can contribute very materially in analyzing the problem of obtaining loud speaker characteristics and adopting definite standards and testing means.

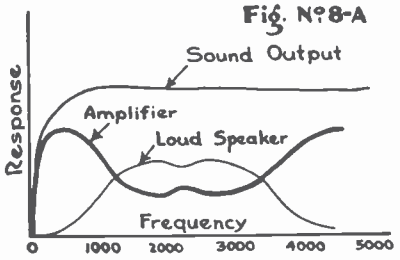


Showing that a straight line amplifier intensifies the loud speaker characteristics

With the performance characteristics of a given loud speaker thus determined, the audio frequency amplifier can then be designed to supplement the loud speaker on frequencies where modifications must be made; that is, on certain frequencies where the loud speaker is deficient, the amplifier should augment the response and conversely, where the response is more than normal, the amplifier should be arranged to reduce the response. Transformer coupling lends itself nicely to this procedure since the response characteristic of the transformer can be modified in a measure to achieve the desired results.

Taking the long horn type speaker as an example, a certain response curve shows that the extremely low notes are weak, the middle frequencies normal and the high tone weak. Obviously, the amplifier should be designed to exaggerate the low and the high tone and give a relatively lower output in the middle register. Fig. 8a.

In the case of a certain cone speaker, the amplifier characteristics can well



How the amplifier should be designed to compensate for the short comings of the long horn type of speaker

be chosen to exaggerate the low and with less response on the middle and still less on the high frequencies. Fig. 8b.

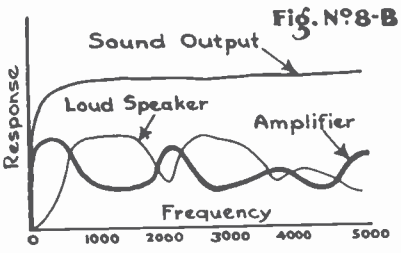
The desired characteristic can be obtained in such an amplifier by suitable design in the inherent resonant circuits, band filter suppression of certain frequencies, audio frequency regeneration either positive or negative at certain definite frequencies, by the use of two channel amplifiers, and so forth.

Output transformers have appeared on the market designed to exaggerate the low, give normal response in the middle, little response at the high frequencies and a definite cut-off point around 500 cycles. Such transformers are definite designs which operate satisfactorily with one definite make or design of loud speaker and as such should be so labeled since any set equipped with such an output transformer can only operate satisfactorily into that loud speaker. Substitution of another type or make of loud speaker can yield only mediocre results and conclusions drawn from the comparison of two speakers on such a device may point to the superiority of one when in reality the other speaker under its proper output transformer condition is the better.

The increasing popularity of the console type of radio receiving set with its built-in speaker and the improved electrical phonograph consisting of a complete entity of amplier and speaker, allow the incorporation of the principles outlined above. Then too, the specific recommendation of the set manufacturer regarding a definite make or type of loud speaker will allow the required modification to insure uniform sound output from the loud speaker.

The idea of placing the loud speaker divorced from the radio set in its proper acoustical position for best reproduction in the room, is meeting with favor and accordingly also requires definite matching between the set and the speaker.

In general, this problem of designing the audio amplifier, in conjunction with the loud speaker, may be compared to the electric starting system on an automobile. The starting motor is designed to turn a specific engine. The size and current required in turn determine the size of the storage battery and its characteristics. The generator in turn depends on the size of the battery. Obviously, one such system is not applicable to all makes of cars. It may perform ideally in one case and be a complete failure in another. Similar reasoning may be applied in the audio system and loud speaker. A flat response characteristic of all the component parts is ideally the best but until the limitations of any one part has been completely eliminated, the proper correlation between the speaker and the audio system is inevitable. By intelligent and careful design such a system is capable of reproducing music and speech with a more nearly flat sound output than is possible with the method of designing a flat frequency characteristic amplifier and then choosing the speaker which gives the best results.



Desirable characteristics of an amplifier to work in conjunction with a cone loudspeaker

The average layman is fast realizing that quality of musical reproduction is one of the major requirements of a radio receiving set and will therefore insist on reproduction closely approximating that of the original. A plan such as the one outlined above will help to realize this result and contribute toward satisfied radio listeners besides stimulating the demand for radio installation.

Obviously, the present systems of flat frequency characteristic amplifiers can not give the splendid results of which they are capable unless the loudspeaker also possesses a flat frequency characteristic. Since this last named requirement seems a most difficult one to satisfy commercially, it would seem that a logical solution is to effect a balance between the amplifier and the speaker, so that the net result is the same as though both were perfect. This will be effected more easily when our widely heralded standardization actually comes into effect.

Big Advances Due this Fall

A summary of improvements already in sight for sets to appear soon—By John Grabar

THERE are more improvements in radio equipment definitely in sight for the 1928 season, even this early, than any previous year.

The prospect of improved air conditions is a tremendous incentive, for manufacturers can feel confident that it will be possible for the public to appreciate the efforts which are being made in their behalf.

As for circuits themselves, few changes will be found. In fact, the tuned R. F., regenerative, and super heterodyne circuits are becoming as basic as the types of gasoline motors.

Tuned Audio Amplifiers

However, there is much to be done, working with any of these circuits as a starting point.

Tuned audio frequency amplification will be widely used this fall to compensate for the short-comings of loud speakers at low frequencies. This method for supplying comparatively high power for low notes certainly appears reasonable. When we know that the original production of audible sounds at low frequencies requires much energy, it seems logical that true reproduction must require correspondingly high amplification. So much for quality to overcome the criticisms of those who have rejected radio as unmusical.

More Shielding to Be Used

Greater R. F. Selectivity will be available in sets of lower price. Metal shielding in many sets will constitute the cabinet as well. We have learned much, altho there is much to be learned, about shielding. Unquestionably it offers advantages in sharpening tuning without sacrificing sidebands, and serves to reduce noises which originate within or without the set. We do know that metal sheets do not introduce the losses formerly attributed to their use.

A.C. Tubes Versus Eliminators

Whatever the reason for the statement made by Major Frost concerning tubes to use raw A. C. on the filaments, manufacturers of eliminators and rectifier tubes now feel confident of their market in 1928. It appears that, all things considered, it would be better to filter separately the output of two 150-mil tubes, and combine the rectified current in a parallel circuit, rather than attempt to handle 300 or 400 mils in a single tube. However, that can be judged best after the tubes are in use.

Condensers and Resistances

Tremendous advances have been made in the design of high-capacity, high-voltage condensers, and variable resistance for heavy currents. Transients have not been accorded the serious consideration that this chief source of eliminator break-downs deserves. It is not intelligent to meet this problem merely with increased insulation, for the effect of high-voltage strains is cumulative, comparable to the results of insufficient lubrication. However, practice has led theory in almost every step of the art.

Socket Power Sets

The radio music box will be available in a variety of forms this fall, meeting the previously unfilled demand for sets free of all attention beyond tube renewals. These can be divided into two classes—sets using 0.06-ampere tubes, and those with 0.25-ampere tubes. Both will have 171 or 210 power tubes with raw A. C. filament supply. They can be divided again into loop sets and antenna sets.

It may be possible to use perhaps four 199's in series, followed by a power tube. Whether the 199 will stand up or not is partly concerned with the plate voltage, but more particularly with the addition of the plate current to the filament current.

Keeping down the plate voltage to 60 or so will lengthen the life of 199's connected in parallel. This helps little with series filaments unless special means are used to relieve the filaments of the plate current added by each tube. We have learned that one 85-mil rectifier tube is enough to supply A, B, and C to 199 sets. Sometimes two tubes are used for this purpose, but still that does not solve the problem of keeping the plate currents out of the filament circuit.

Whether the savings effected by the use of 199's compensates for the cost of filament resistance shunts and bypass condensers we have yet to learn. Certainly it is unwise to use 199's without adequate relief for the filaments.

It is likely that 201-A's can be used as cheaply, and with greater assurance of customer satisfaction. For this purpose, four 65-mil rectifying tubes can be used. This statement is open to question, tho it may be pointed out that 201-A's can be operated with full efficiency at 235 mils on the filaments, leaving 25 mils for the plates. Moreover, the filament type rectifier tubes can be run at full load without affecting their rectifying characteristics.

On the other hand, many designers will prefer the 85-mil tubes allowing, on the basis of their rated output, 90-mils margin over the maximum requirements of the 201-A filaments.

These tubes and the associated apparatus we can count upon definitely for use this fall. They will be used in groups of two, with twin sets of step-up transformers and filters, the outputs being connected in parallel.

Heavy Current Rectifiers

As usual, when special developments are introduced, set manufacturers are waiting for the verdict of the experimenters before committing themselves to the use of the 300-mil and 400-mil rectifier tubes. It is still to early to know if they are or are not to be used in sets for this fall, altho a number of set companies are using these tubes for experimental models.

Detection Methods

Detector plate rectification will replace the grid condenser and grid leak in many sets. The effect of even a slight positive bias on the detector is equivalent to very faulty insulation on the tuning condenser in the grid circuit of the detector. Recent investigation has shown that unaccountable broadness of the detector tuning was eliminated by plate rectification. Just by removing the grid leak and condenser, and putting a small negative bias on the grid, the tuning was sharpened greatly, and the quality improved.[1]

More Loop Sets

Loop antennas, at one time rejected as failing to meet local conditions at many places where they were used, are coming back to great popularity. This is probably due to the increased efficiency of modern R. F. amplifier circuits. Shielded neutrodyne sets, introduced last year, are largely responsible for this, for they demonstrated the practicability of isolating the loop from the fields of the R. F. transformers, combined with highly efficient R. F. circuits.

Neutrodyne and Regenerative Circuits

Frequently we hear the question, "What will the Neutrodyne licensees do this fall?" A neutrodyne license is no more of a guarantee of commercial success than a regenerative license. Nearly all the regenerative licensees are out of business. Those that remain are highly successful. The same thing is true of the Neutrodyne group, except that the percentage of successes is higher.

Still more often we are asked about the regenerative situation. It appears to be no further advanced toward final settlement. Editorial comment is therefore withheld until such time as an official statement can be presented.

[1] This is explained in a very interesting way by A. H. Ghirardi in Radio Mechanics, April, 1927.

Kit Design Entirely Revised

Construction kits being worked out for this fall will surpass anything previously offered in the completeness of their design. Two price classes are becoming defined, one ranging from $15 to $25, and another from $50 to $70. The former will be sold with the parts completely contained in one box, while the latter will include chiefly manufacturer combinations typified by group advertising to promote the sale of individual parts and a foundation unit.

Syndicate Store Sales Increasing

Sales of low-price parts thru syndicate stores are increasing steadily. Reports show a large drop in parts sales during the 1927 season, but they do not present the true state of affairs because such reports do not include sales by syndicate stores. This channel of distribution handled a volume of business on parts, hardware, panels, and wire running into many millions of dollars last season.

The average radio manufacturer, totally unfamiliar with this outlet, has failed to realize that his dwindling sales is not a loss to the industry, but largely a loss to the jobber-dealer channel of distribution. Many a man has been amazed to discover the quality of the parts sold by syndicate stores at less than half the price at which equivalent apparatus is sold by radio dealers. Considering that there are over 1,000 syndicate stores carrying parts up to $4.99, and more than that which go up to $25 it is easy to understand the loss of business by radio dealers.

Meeting Syndicate Competition

To meet this increasing competition, many parts manufacturers are changing entirely their sales promotion plans for next fall. Heretofore they have advertised almost exclusively in radio magazines, presenting their goods largely on the basis of their scientific merits, selling by technical arguments.

Last winter it became apparent, however, that the experienced set builders have learned enough now to select equivalent apparatus from the syndicate stores, where their money goes twice as far. By advertising in radio magazines they have educated their prospects and then lost their trade.

Accordingly, kit designs are being entirely revamped to suit an entirely new course of sales effort. The experienced set builder, familiar with the technicalities of radio, will receive little attention. Instead, kits will be designed for the absolute novice, and sales effort directed accordingly to putting across the fun of radio as a hobby.

Just as the elimination of storage batteries and the prospective clearing up of interference has opened a new and tremendous field for set sales, so has the simplification and improvement of designs opened the great hobby eld for kits. This has come about since manufacturers have applied their parts to standard set designs, maintained mechanical dimensions to assure the accurate fitting to standardized designs, and have maintained dimensions long enough to justify the us of accurate jigs and dies for panels.

An important innovation this fall will be metal base panels with etched markings to indicate the positions of the parts and the wiring. This fall, for the first time, experience with kits and their past failures is sufficient to make practical and possible their successful sale to men and boys, entirely ignorant of radio, who would enjoy the fun of making their own sets. This is unquestionably the correct answer to the lost business of the experienced set builders who have enough skill to select cheap equivalents from the chain stores.

It is also a clever way of taking advantage of the fact that goods in syndicate stores are bought, and not sold, with the result that their trade must necessarily be drawn from those who know enough about radio to buy what they want without having to be sold.

Detector Tube Development

Suggestions for obtaining the best results from special detector tubes*

THE economic growth of the radio industry during the past few years has caused a most intensive development and refinement of both the radio and audio frequency amplifying systems of a radio broadcast receiver.

Unfortunately the underlying principles of the detector have received little or no consideration from a commercial standpoint.

Due to the close relationship between both the audio and radio amplifiers and the detector, concentrated work was necessary to bring the detector up to the stage of development occupied by its associated circuits.

A complete survey of the technical literature gave meager assistance in formulating the method by which this problem should be attacked.

The Past History

In the early days of radio, detectors were simply tubes rejected as amplifiers on account of a residual amount of gas remaining in the bulb after the exhausting process had been completed.

Thousands of observations conducted immediately after exhausting invariably gave a definite sequence of characteristics with age.

If too much gas is left in the tube a very low detector efficiency results. However, a tungsten filament has a "clean-up" effect, that is, the gas present gradually combines with the tungsten and produces a practically non-volatile compound. Thus as the tube is operated, the gas pressure is gradually reduced.

At first the tube having an excessive amount of gas will not perform at all as a detector. The gradual reduction in gas pressure reaches a state where the tube will become a very noisy detector.

At a certain critical pressure, this tube will serve as a wonderfully efficient detector, but would only operate in this manner for a few minutes, as the tungsten in combining with the gas reduced the vapor pressure below the optimum value.

Tubes of this general type were placed on the market during the pioneer days of radio and each would be converted with use into an amplifying tube, due to vacuum improving action of the filament itself. When the amplification of the tube reached its most ideal value the tube no longer possessed the original efficient detector action.

These observations led many engineers to draw the conclusion that if a tube could be produced with a vapor whose pressure always remained constant and at the proper value the ideal condition for a detector would be obtained.

The Problem

The problem of developing a detector in keeping with audio and radio amplifying tubes resolved itself into:

A. A search of the Periodic Chart of the Atoms to locate an element whose vapor pressure coincided with the pressure which had been observed to produce this unusual detecting quality.

B. The provision of a scientific and reliable method of properly investigating its electrical characteristics.

C. To produce on a commercial manufacturing basis this detector tube so that one of any number selected at random from a large stock would be consistent in performance.

D. To insure stable operation throughout its life so as to justify the production of a tube bearing the manufacturer's stamp of approval.

Early Attempts and Difficulties

Several attempts have been made to utilize caesium, sodium, potassium and certain other members of the alkali group. However, it is found that the

* A report from the research division of the Ken-Rad Corporation.

results obtained were extremely inconsistent and could not be relied upon in the commercial production of vacuum tubes.

In view of this erratic behavior endeavors were made to produce an efficient detector tube without the use of vapor by increasing its mutual conductance. Tubes of this design were unquestionably superior to the ordinary amplifying tube but were not to be compared with those having the correct and precise vapor pressure.

Early experiments were also made wherein a small metal cap was secured to the plate, holding a pellet of material capable of liberating gas by the application of heat. The next step was to incorporate several additional operations before the complete assembly was prepared for the exhausting process. These operations increased the time of exposure of the hygroscopic pellet to the atmosphere, thus destroying its purity.

This method of manufacture necessitated the vaporizing of the material pellet at the same time the metal elements were being denuded of undesirable gases thru the application of high temperatures. It was apparent that a tube produced in this manner would contain undesirable gases liberated from the elements of the tube, as well as the desired pure gas. This combination would result in the most erratic behavior.

Other unsuccessful attempts included perfect degasification of the elements and perfect exhausting, after which various vapors were admitted to the bulb directly before sealing off. This method in addition to being extremely expensive from a commercial standpoint did not insure an equal amount of vapor being admitted to the tube.

A large percentage of the promising materials were found to be extremely hygroscopic hence it was impossible to make use of this group in its pure state due to combination with moisture and oxygen from the atmosphere.

In the usual process of manufacturing tubes it is necessary that quite an appreciable time element occur between various operations which militate against the use of this material having a high affinity for moisture and other foreign matter. Therefore the idea was conceived of producing the desired chemical inside the tube after the tube elements were thoroughly denuded of gases the bulb completely evacuated and hermetically sealed from the exhausting equipment.

A Successful Method

The Archatron method of producing a detector tube is to manufacture the entire stem, filament, grid, plate and arch assembly first. At this point of the manufacture the carefully selected vapor producing substance, in the form of a salt, together with another active chemical is placed in a small cup on the arch.

These highly active chemicals do not react with each other except when raised to a high temperature but combine readily with moisture and oxygen from the atmosphere. Immediately after placing these materials in the cup the tube assembly is sealed into the bulb placed on the vacuum pump and the elements denuded of gas by the application of a high temperature without causing the active materials in the cup to be under the influence of this heat. At this time the bulb is hermetically sealed from the exhausting equipment and based.

The climax of this manufacturing process now occurs. The electrical position of the arch and the little cap in the Archatron detector permits its being heated to an extremely high temperature. This heating process causes a violent chemical action inside the little cap wherein the active chemical robs the salt of the material not needed for-producing the desired vapor. The pure element which has been found to have the optimum vapor pressure necessary for a perfect detector tube is now free inside the tube.

Not only does this process enable the production of an extremely sensitive detector tube but the vapor pressure is maintained at a constant value in all of the tubes manufactured.

It is a known fact that different materials have different vapor pressures and even when part of the vapor is removed the material itself will immediately give up more vapor in order to maintain this inherent physical property.

Summary

In summation the data gained from this study has enabled the commercial production of:

(1) A stable, pure, vapor filled detector tube.

(2) An extremely sensitive detector.

(3) A detector having a practically uniform characteristic throughout its life.

(4) Unlimited guarantees of detector tubes having unusually uniform performance.

Proper Operation

The new vapor filled detectors, of the 200-A type now on the market, have given freakish results according to information received from numerous users. Some fans swear that they give an increased volume equal to an extra stage of amplification, others claim that the volume is no greater than that obtained when a regular 201-A tube is used for a detector, others claim that the volume decreases to practically nothing when the new tube is used and still others claim they are noisy.

Purpose

It is the purpose of this bulletin to explain why various users of these tubes obtain such wide varying results. Certainly the users when making reports such as those already referred to must be given credit for telling the truth in regard to the matter. One may, however, tell the truth and convey an impression which is erroneous.

Operating Temperature

Vapor filled detector tubes must have a certain critical pressure in order that they function at their best. If the pressure is slightly too high, noise will be the predominating sound emitted from the loud speaker which is connected to the set. If this pressure is too low the detector loses its sensitivity. Since the pressure inside the tube is determined by the vapor pressure of the material used in that tube, and since vapor pressure of a material depends on the temperature of that material, it is evident that the temperature must be correct before the correct internal pressure is obtained.

With the above information it is evident that in order to obtain proper operation when using a vapor filled detector it must be placed on the set and left there for a sufficient length of time to reach a condition of equilibrium until its ultimate temperature has been reached. If an attempt is made to use it before this temperature has been reached hissing sounds and distortion of all sorts impossible to rescribe will be admitted from the loud speaker.

Adaptability for Weak Signals

In order to obtain the benefits derived from the use of the vapor filled detector tube extremely weak signals must be made use of. With a strong signal the new tube is no better than a standard 201-A tube. Some users, after reading information regarding the tube, are of the opinion that replacing the regular 201-A detector tube with a new vapor filled detector tube is equivalent to adding an extra stage of amplification. This is true providing the signal received is from a distant station and very weak. It is not true if a strong signal is received from a nearby station. In the latter case no benefit whatsoever is obtained by using the new detector tube.

Tuning the Set

Since the electrical characteristics of this new tube, including its inter-element capacity, are different from those of a 201-A type tube it is also necessary, if tubes are interchanged, to retune the set to take care of this slightly different characteristic. Interchanging tubes without retuning is no test whatsoever on the good or bad qualities of the new tube.

Critical Filament Voltage

In order to obtain maximum efficiency when using this tube it is necessary that the filament voltage be adjusted to a certain critical value. This probably is not due to filament emission but due to the biasing action of the grid. On sets which make use of a fixed resistance in place of a rheostat greater difficulty may be encountered in getting satisfactory results. In such cases an accurate adjustment of grid biasing should be made use of.

The A.C. Super Revised

Mechanical and circuit refinements greatly improve the appearance and operation of this unusual receiver

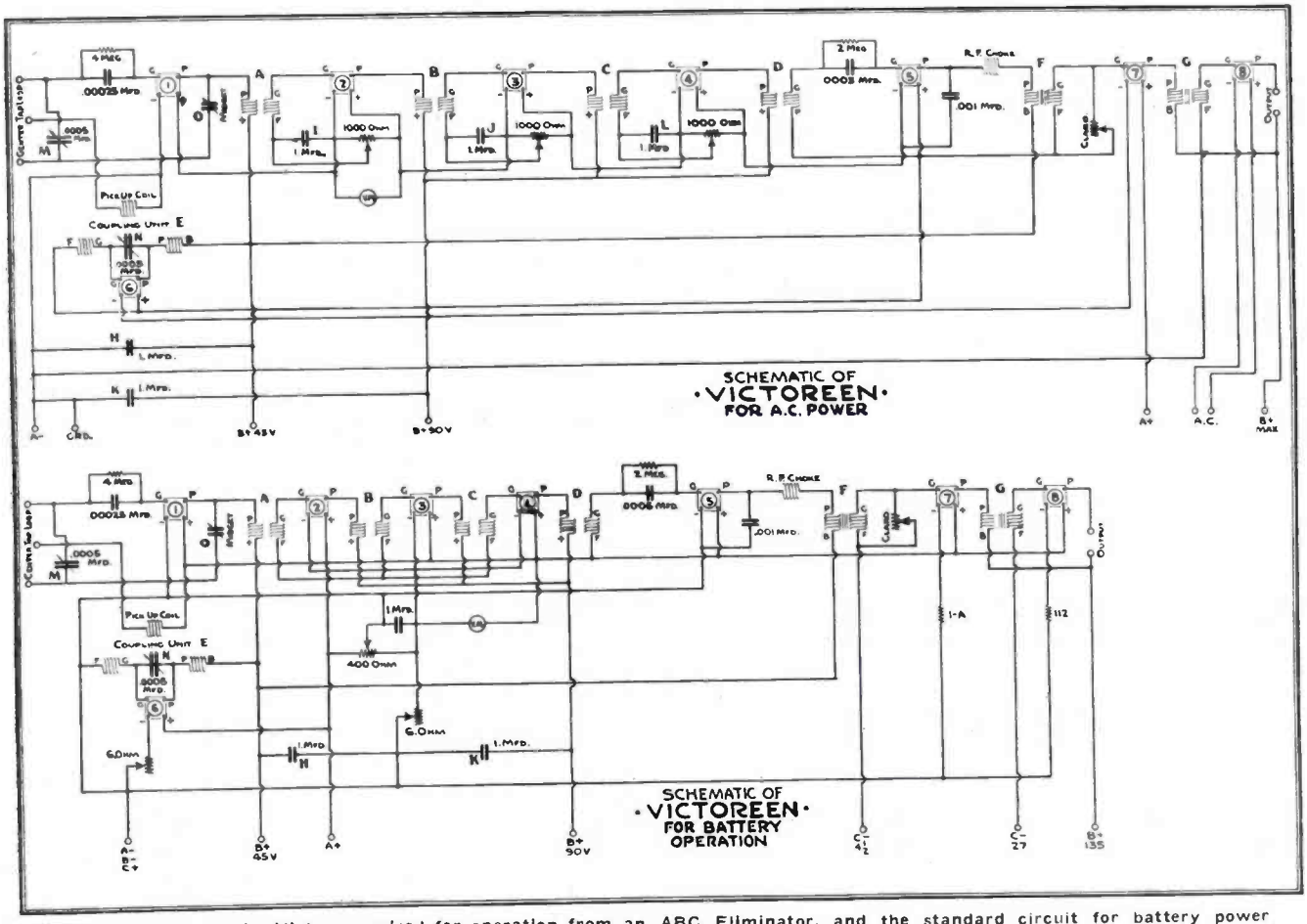
THE Victoreen Socket-Power Super described in Radio Engineering for February and March is unquestionably one of the most thoroughly satisfactory designs ever presented. The performance of the revised laboratory model, shown here in the accompanying photographs, has been nothing short of phenomenal. Using only a loop for the pickup medium, it was found possible to receive signals at full loudspeaker volume which were totally inaudible on an excellent four tube, tuned R. F. regenerative detector set tried in the same location, and using a good outside antenna.

The fact that this receiver operates without batteries of any kind is in itself a feature worthy of mention. It is very difficult to describe the immeasurable feeling of satisfaction experienced by the operator of such a set. There is no part of the 01-ABC Eliminator which requires attention after the preliminary adjustments have been made. The original model of the 01-ABC, developed in the laboratory of Radio Engineering, has now been in operation an average of four hours daily over a period of several months. During this period, no replacements have been made of any parts, and the unit continues to operate efficiently and in a thoroughly satisfactory manner with the original set of rectifying tubes. This thoroughly demonstrates the practicability of the outfit, particularly when it is known that a super-heterodyne similar to the one described here was the receiver operated by the 01-ABC.

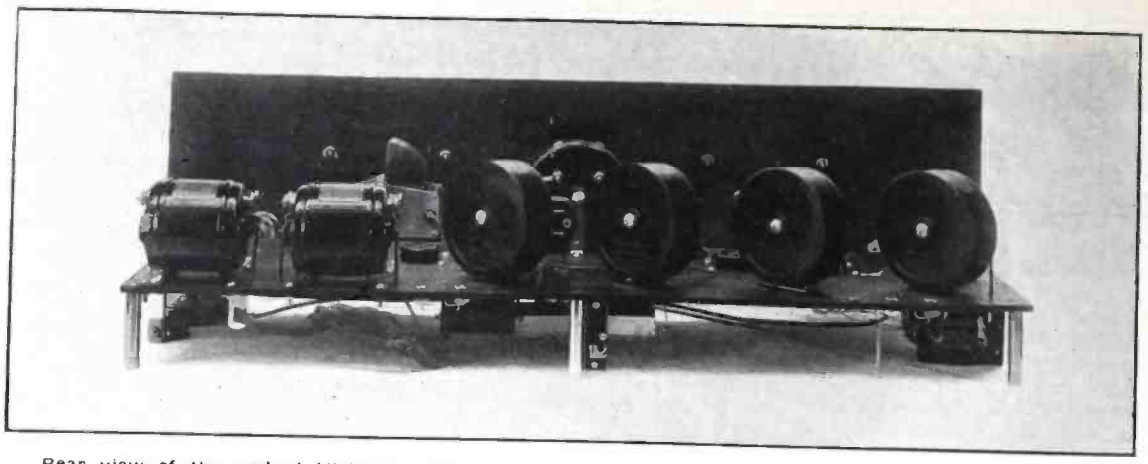
By referring to the schematic, it will be noticed that slightly different B voltages are employed than are customary in sets of this character. It is common in practice to furnish about 45 volts to the plates of all tubes up to the first audio. However, with the parts used, laboratory tests disclosed the interesting fact that a remarkable gain in sensitivity and volume was realized through the use of a higher voltage on the intermediate tubes. Accordingly, a separate lead was run to furnish B potential to the oscillator and the two detectors. The value of voltage applied at this point should be carefully adjusted for best results. The least interference from harmonic annoyance will be experienced with 22½ volts, altho there is a considerable gain in signal strength when a higher value is used.

On the intermediate tubes, 90 volts gives excellent results. It is recommended that this value be applied to the first audio tube also, in cases where higher than 135 volts are used on the power tube. It is obvious that, if 180 volts are applied to the 171, this amount is far too high to be used on the 201-A in the first stage, and the life of this tube would be very short.

For the convenience of those who do not wish to use the receiver with the 01-ABC eliminator, a schematic of the circuit wired for storage battery operation is shown. Exactly the same mechanical layout can be used, and is recommended, for nothing will be gained by a re-arrangement of parts. The two 1,000-Ohm potentiometers mounted on the sub panel, and which are used to obtain the correct value of grid bias on the intermediate stages, can be replaced by two 6-Ohm rheostats. One of these is used in the filament circuit of the two detectors and the oscillator, and the other controls the filaments of the three intermediate tubes. Front panel mounting of these units is unnecessary, for their adjustment is not critical and need be made only once.



Circuit diagram of the Victoreen wired for operation from an ABC Eliminator, and the standard circuit for battery power



Rear view of the revised Victoreen. The oscillator coupler is mounted in the exact center. All of the bypass condensers are fastened under the sub-panel, and are grounded to the brackets, which are in turn grounded to the minus A.

The 1,000-Ohm potentiomenter used on the A.C. model is replaced with one of about 400 Ohms maximum resistance. This lower value will give a somewhat finer adjustment, although the 1,000-Ohm resistance is satisfactory. The reason for using high resistance potentiometers in the A.C. set was the fact that those of lower values would bypass considerable filament current around each of the intermediate tubes, and consequently might impair somewhat the efficiency of the outfit. Of course, only one potentiometer is needed in the battery circuit, for the filaments of the intermediates are all at the same potential.

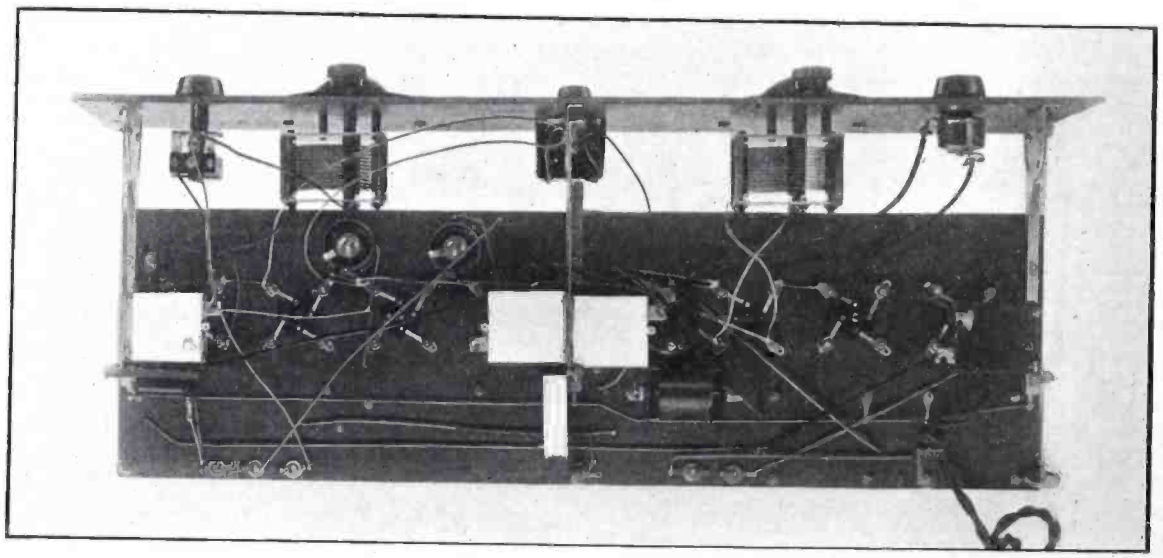
The speaker coupling device has been omitted, assuming the use of a 112 or 171 tube with not over 135 volts on the plate. Naturally, a protective unit, consisting of a choke coil and condenser or output transformer must be used between the power tube and speaker if more than 135 volts are available for the 171 tube.

For adequate control of the output, a Clarostat is shunted across the secondary of the first audio transformer. Whether the A.C. or the battery model is built, it is advisable to use this device, for the output of the receiver is so great that it can not be reduced sufficiently by the potentiometer when a strong signal is tuned in. With the Clarostat, any desired degree of volume can be instantly regulated from a mere whisper to full blast.

Considerably more flexibility is afforded in the new receiver through the use of two tuning controls. This change facilitates the tuning of the oscillator to either of the repeat points at will. Such a procedure is often helpful, particularly in congested districts where a number of powerful locals blanket the reception of distant stations on a single control super.

The list of parts, as used in the laboratory model of the revised receiver, is as follows:

1 Victoreen No. 150 coupling unit.
4 Victoreen No. 170 R. F. transformers.
2 Victoreen .0005 mfd. variable condensers.
1 Bodine DeLuxe loop.
8 Benjamin spring sockets for sub panel mounting.
2 Karas Harmonik audio transformers.
1 Hammarlund 11 plate midget variable condenser.
5 Tobe 1. mfd. bypass condensers.
2 Sangamo .00025 mfd. grid condensers, with clips.
1 Sangamo .001 mfd. fixed condenser.
2 Electrad gridleaks, 2 megohms.
2 Kurz-Kasch Aristocrat vernier port dials, walnut.
1 Clarostat.
3 Carter 1,000 ohm potentiometers.
5 Union phone tip jacks.
1 Samson No. 125 R. F. choke.
1 Acme Celatsite battery cable.
50 ft. Acme Celatsite wire.



Bottom view of the new Victoreen. The potentiometers controlling the second and third intermediate tubes are mounted on the sub-panel, as shown. Flexible connections are made between the front panel apparatus and the sub-panel units and, since the mounting brackets are adjustable, a sloping front cabinet can be used, if desired

1 7 x 26 Lignole front panel, inlaid walnut.
1 7 x 24 Lignole sub panel.
1, Westinghouse Voltmeter, style No. 492418.
4 Benjamin adjustable sub panel mounting brackets.
1 Corbett type C cabinet.

Tuned R.F. on A.C.

Circuit changes in the popular variety of T.R.F. set for full A.C. operation—By Hollis De Neefe

WIDESPREAD interest in A.C. operation of 201-A tube sets followed the introduction, in Radio Engineering for December, 1926, of the 01-ABC Eliminator. This power plant was the first outfit, built throughout of standard parts, to eliminate all batteries on receivers using quarter ampere tubes up to the output stage and a half ampere power tube. The use of the 01-ABC necessitates the wiring of the filaments in series, but this is an advantage rather than a drawback, as will appear later in this article.

It is unfortunate, however, that in the mind of the layman some confusion exists about series filament wiring. This is undoubtedly due to the fact that but little space in current publications has been devoted to its analysis and description, whereas, on the other hand, the usual parallel method has been discussed many times.

As a matter of fact, series filament wiring is much more simple than the parallel circuit. No practical difficulties are encountered in its application to any standard receiver, and it offers the utmost flexibility in the matter of obtaining correct grid biasing voltages for the various tubes. Radio Engineering has presented data on the TC on AC, and the Victoreen Socket-Power Super.

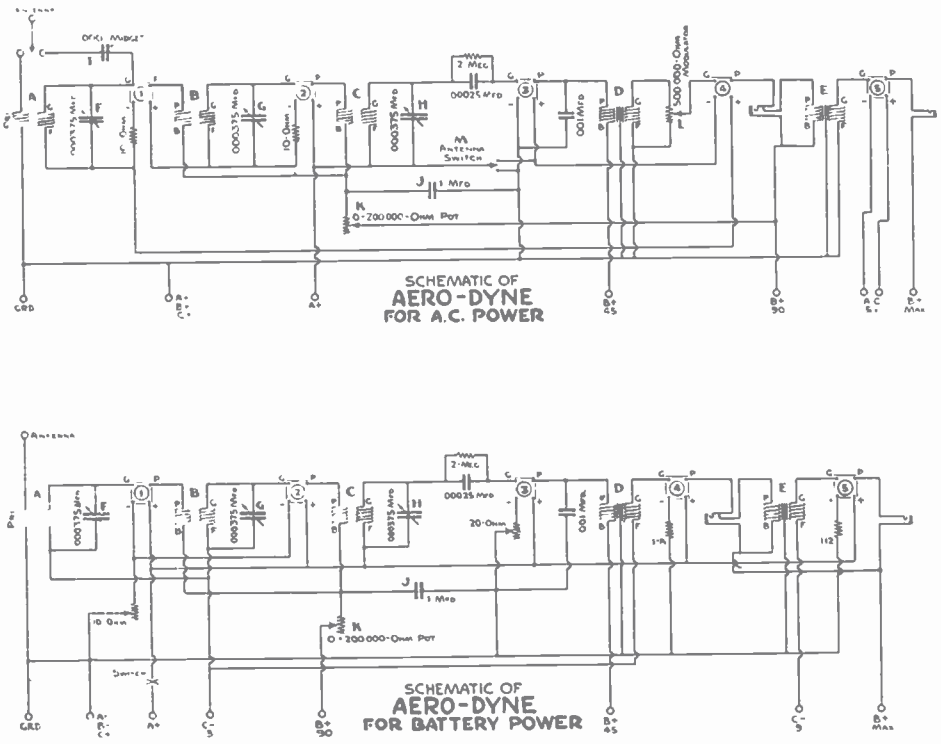
The first of the circuits named, the TC set, is a combination of tuned, neutralized radio frequency and a regenerative detector, followed, in this case, by two stages of transformer coupled audio. The wiring of this circuit was very simple, for only three tubes are used in the series line.

The Victoreen employs eight tubes, seven of which are in the series line. Here again no difficulty is encountered. The first audio tube grid is biased 5 volts negative by the drop across the filament of the preceding tube. The other tubes in the train have the grid returns made to their respective positive or negative filaments, with the exception of the intermediates which require a potentiometer in the grid returns for oscillation control.

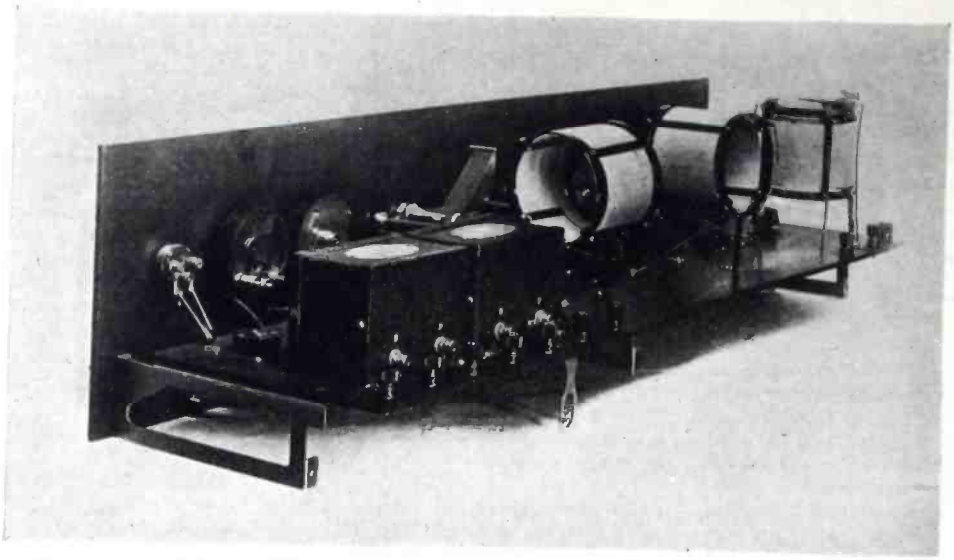
In the tuned R. F. set described here, a number of circuit kinks have been incorporated. First, the characteristics of the coils employed render inadvisable the use of a 5 volt negative bias on the R. F. tubes. It is obvious that this amount is the only value available in the conventional series circuit and that some arrangement other than the drop across one filament must be used.

Applying Ohm's law, we find that, since $R = \frac{E}{I}$, or $R = \frac{5}{.25}$, that the resistance of a 201-A filament is 20 ohms, and the drop across its filament is 5 volts. Assuming that $2\frac{1}{2}$ volts of C bias are desired, this value can be obtained by the insertion of 10 ohm fixed resistances in series with the negative lead of each R. F. tube, and by the connection of the grid return between this resistance and the preceding tube. These connections are shown clearly in the schematic.

The first audio tube operates at a plate potential of approximately 100 volts, and its grid is therefore negatively biased 5 volts by the drop across the filament of the tube immediately preceding it in the negative line from the rectifier output.



Shown here is the T.R.F. set under discussion. Schematics for series and parallel wiring are given, so that the differences in the two systems are apparent at a glance



Rear view of the A. C. Aerodyne. The switch at the extreme left end of the panel is in the grid return lead of the detector, and changes this connection from negative to positive, according to the detector used

The second audio tubes grid return is connected directly to A-, for the correct grid bias for this tube is taken care of in the 01-ABC Eliminator by a series resistance between the center of the filament lighting source and the minus of the rectifier system.

Oscillation in the R. F. stages is controlled by a variable high resistance in the plate circuit of the R. F. tubes. This resistance permits the use of a certain amount of controlled regeneration in the R. F. end, and consequently increases the distance reach and sharpens the tuning. This resistance is bypassed to ground by a 1. mfd. condenser, which removes the ill effect of a high resistance in the R. F. circuits.

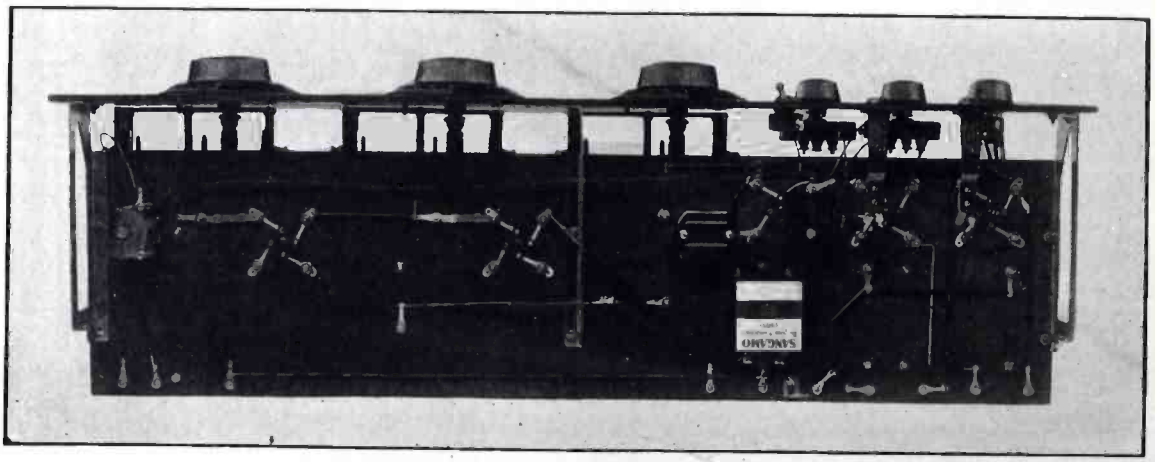
Another feature worthy of mention is the switch in the grid return circuit of the detector. This switch instantly changes the grid return from negative to positive, or vice versa, so that any type of detector tube can be used without circuit changes. Greatest distance will be achieved with the 300-A type, of course, but maximum selectivity will be had with the 301-A.

Two forms of antenna coupling are provided. One is through the primary coil ordinarily used, and the other is capacitative coupling direct to the grid through a .0001 mfd. variable midget condenser. The best signal strength will be found when using the capacitative coupling and with the midget condenser at maximum capacity. On the other hand, selectivity is greatest when the coupling medium is the primary coil, or when the capacity of the midget condenser is reduced.

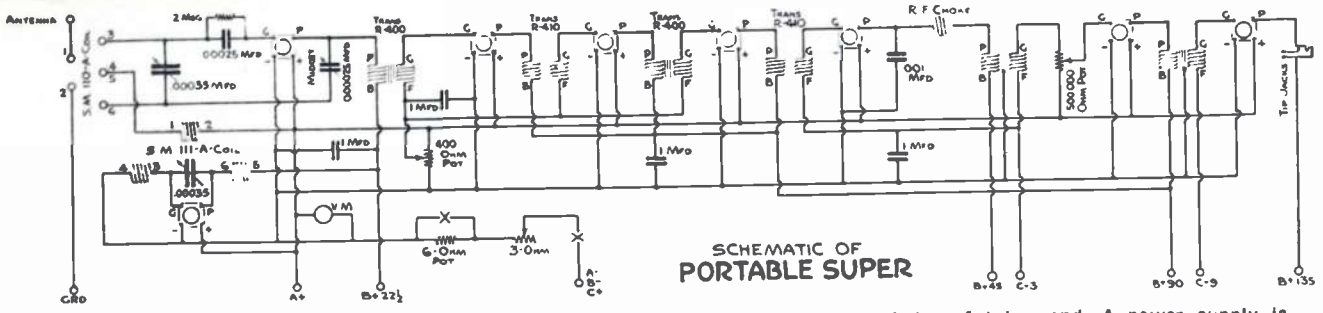
No special precautions need be observed in the wiring of this circuit, for the layout is the same as that used in the battery operated model of the same set. The audio transformer cases and all mounting brackets are grounded, to prevent possible inductive pickup from this source. It is important also, that the coils be spaced correctly, and at the angle recommended by the manufacturer.

The parts used in the original model, built in the Radio Engineering Laboratory, are as follows:

1 Set Aero tuned R. F. coils, TRF-120.
1 7x28 Formica front panel, drilled and engraved.
1 7x27 Formica sub base.
5 Benjamin spring sockets, sub panel mounting.
3 Benjamin mounting brackets.
1 Pair Jefferson Concertone audio transformers.
1 Yaxley No. 2-A, two circuit jack.
1 Yaxley No. 1, open circuit jack.
1 Carter antenna switch.
2 Carter 10 ohm fixed resistances.
1 Saturn power toggle switch.
3 Karas Orthometric .00037 mfd. variable condensers.
1 Centralab 500,000 ohm modulator.
1 Centralab 0-200,000 ohm variable resistance.
1 Sangamo 1. mfd. bypass condenser.
1 Sangamo .001 mfd. fixed condenser.
1 Sangamo .00025 mfd. grid condenser with clips.
1 Precise .0001 mfd. Microdenser.
10 Eby binding posts.



Underneath the sub-panel of the A. C. operated T.R.F. set. Note the fixed resistances, connected to the filament posts of the R.F. sockets, and which are used to provide a negative bias on the R.F. tubes



Circuit diagram of the Portable super-heterodyne. Extreme flexibility in the choice of tubes and A power supply is afforded by the fixed resistance and short-circuiting switch. A jack is provided for an external speaker

Portable Super-Heterodyne

A sensitive and powerful receiver which combines compactness and efficiency—By H. F. Van Holm

DURING recent years, many so called portable sets have been offered to the public. Many of these have sacrificed efficiency in order to gain compactness, or important accessories in order to save weight. Such economy is undesirable if a full measure of satisfaction is to be derived from a receiver of this type.

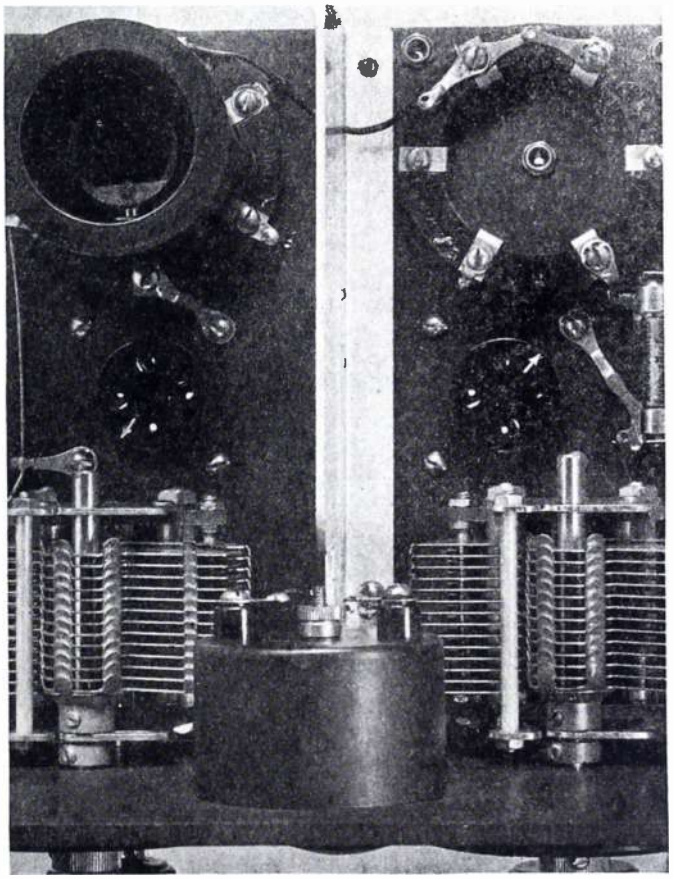
It is generally acknowledged that a super-heterodyne possesses most of the attributes desirable in a portable receiver. It is very sensitive, so that a small loop or short antenna provides ample pickup and, well designed, it affords a degree of selectivity that cannot be approached by other circuits.

The chief drawback associated with a super-heterodyne for portable use is its weight, on account of the multiplicity of tubes and the necessary associated equipment. The main item contributing to the weight is, naturally, the battery equipment. However, it is safe to say that, in the majority of cases, a portable receiver is used in conjunction with an automobile. Working on this assumption, we can figure on the storage battery of the car to supply the necessary A potential, and the power requirements are then reduced to the necessary B and C batteries.

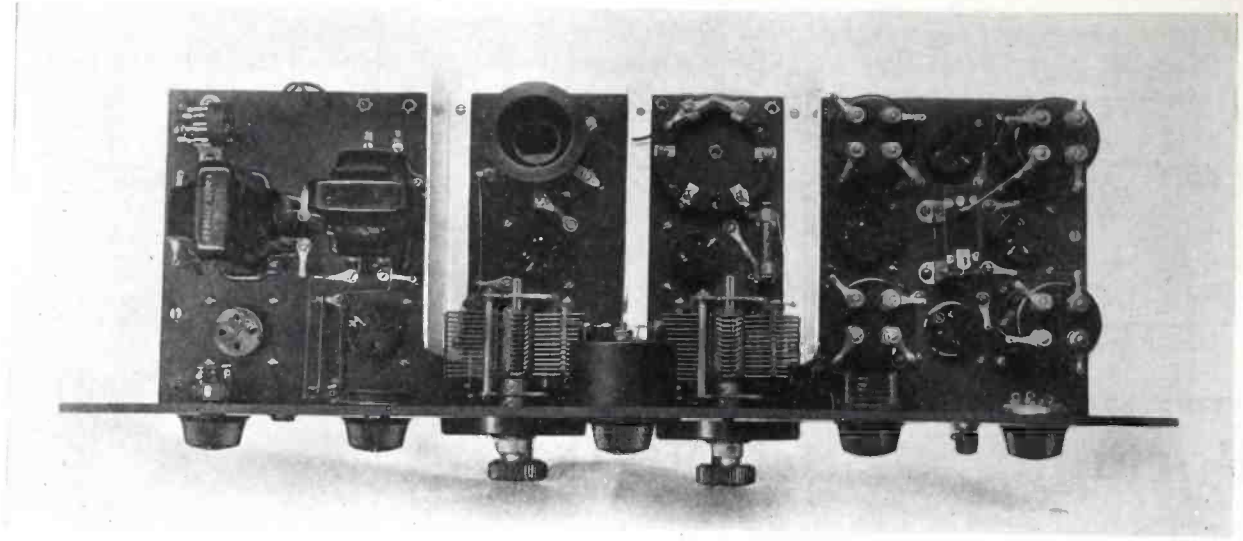
The portable super-heterodyne described here has therefore been designed to draw A power from the car storage battery. However, there are undoubtedly many who will desire to use small tubes and dry battery equipment. In order to make the receiver adaptable to any conditions, several features are incorporated in the filament circuit. A three ohm rheostat is used to control the filaments of all of the tubes, and this value will be found satisfactory when storage battery tubes are employed. In series with this three ohm rheostat is a six ohm fixed resistance, which reduces the voltage of the storage battery, if used, sufficiently for the safe operation of 199s.

On the other hand, banks of dry cells in series parallel may be used for the A battery for 199s, or 201-As may be run from a storage battery. To facilitate a change from one type of tube to another or in the source of A power, a switch is provided which short circuits the fixed resistance in one position and, when thrown the other way, leaves it in the circuit. This feature makes the outfit so adaptable that a 12 volt storage battery, with which some cars are equipped, can be used to supply the filaments of 201-As without wiring or circuit changes. The voltmeter provided on the front panel gives an accurate check on the filament voltage at all times.

The circuit is a standard super-heterodyne layout, with nothing essentially new about it. It is merely the application of well tried and proven principles so as to gain the utmost from the outfit. Plug-in coils are used



Details of the antenna and oscillator coil mountings, and the interstage shielding. The center shield is cut away slightly to accommodate the voltmeter



Bird's eye view of the Portable Super, completely wired and ready for installation in its carrying case. Practically every available inch of space is occupied by an efficient and compact grouping of apparatus

for the antenna and oscillator inductances. With the type numbers specified, the broadcast band is covered, and other coils can be obtained which will permit a wider wave band to be received.

The easy removal of the antenna coil facilitates the use of a loop. Tip jacks are provided for the loop terminals, so that the change from one pickup device to the other can be made with a minimum of trouble. The speaker used delivers remarkable volume, and is of such small size that it fits into the space provided for it in the portable case very nicely. The connections to this speaker are also made through tip jacks, which in turn are led to a jack mounted on the front panel so that a large external-speaker can be plugged in when the set is used at home.

The audio channel consists of two transformer coupled stages, using high quality transformers. The first stage is a 1-2, and the second stage is a 1-6, which combination delivers ample volume and compensates for the low mu of power tubes of the 120 and 171 type. A high resistance potentiometer of 500,000 ohms maximum is shunted across the secondary of the first audio transformer and provides adequate control of the output without altering any characteristics of the signals.

1. mfd bypass condensers are used at all the important points, and prevent stray R. F. from coursing through the batteries and broadening the tuning. All battery connections, with the exception of the two C battery leads, are made through a multiple plug. As a measure of precaution, this plug can be disconnected before the set is transported and the tubes and batteries safe-guarded thereby.

The intermediate stages are coupled by two air core and two iron core transformers, which are carefully peaked and matched. This combination affords high amplification and most unusual selectivity. During tests made on the outfit, no difficulty was experienced in working through local interference.

Aluminum shielding strips are used which effectually segregate the intermediates, the first detector, the oscillator and the audio end. The layout is such that very short leads are run throughout, and the partial shielding prevents any ill effects which possibly might be occasioned by the close grouping of apparatus.

The entire assembly has been designed to maintain the utmost strength and rigidity. Four sub panel mounting brackets are used, and the variable condensers, bolted to both front and sub panels, assist materially in strenghtening the outfit. Lock washers are used under every nut, and are an important factor in this type of receiver, for they prevent the loose connections that will surely result if they are omitted.

The list of parts used to construct the portable-super described are as follows:

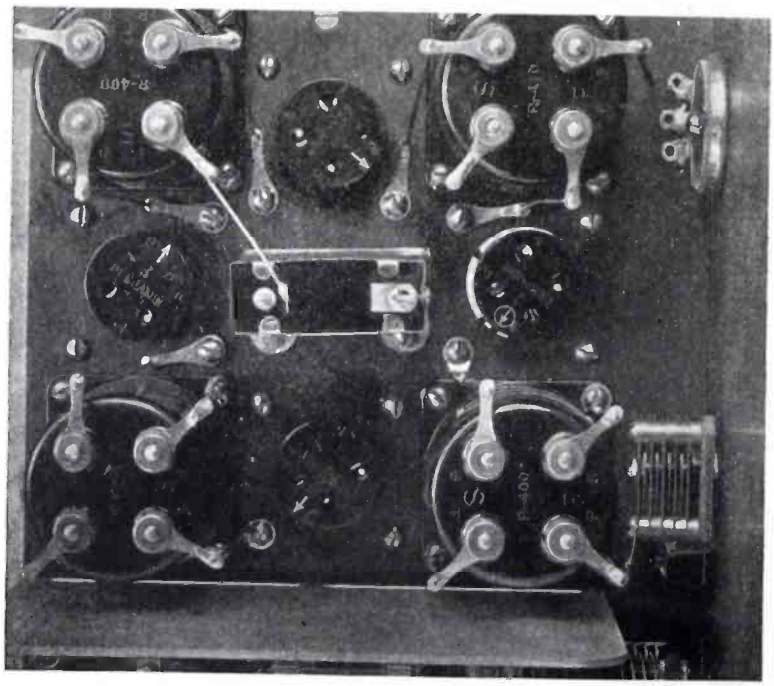
List of Parts for Portable Super.

1 Barawik portable case.

1 Utah Superflex Speaker.

1 Bakelite or hard rubber front panel, 7x21.

1 Bakelite or hard rubber sub panel, 7x20.



Details of the mounting and connections of the intermediate amplifier. Very short leads are used for all high potential wiring

Complete set up of the Portable Super. The design of this receiver has been so worked out that it is adaptable to practically any installation requirements. Sufficient space is available in the cabinet for dry batteries, so that the outfit can moved easily.

8 Benjamin spring sockets for sub panel mounting.
4 Silver-Marshall No. 540 mounting brackets.
2 Silver-Marshall No. 316b condensers.
2 Silver-Marshall No. 515 coil sockets.
1 Silver-Marshall No. 340 midget condenser.
1 Silver-Marshall No. 110-A antenna coil.
1 Silver-Marshall No. 111-A oscillator coil.
1 Silver-Marshall No. 276 long wave choke.
4 Electrad 1. mfd. bypass condensers.
2 Selectone transformers, type R-400
2 Selectone transformers, type R-410.
1 General Radio type 285 audio transformer, 1 to 6.
1 General Radio type 285-L audio transformer. 1 to 2.
1 Jones Multi-plug and cable.
1 Carter Midget rheostat. 3 ohms.
1 Carter Hi-pot, 500,000 ohms.
1 Carter Midget potentiometer, 400 ohms.
1 Carter Short jack, closed circuit.
1 Carter fixed resistance. 6 ohms.
2 Carter filament switches.
5 Carter tip jacks.
1 Sangamo .001 mfd. fixed condenser.
1 Sangamo .00025 mfd. fixed condenser.
3 Aluminum Co. of America aluminum shields.
1 Jewell pattern 135 voltmeter, 0-8 volts.
2 Marco 3 inch vernier dials.
5 dozen Shakeproof soldering lugs.
10 Dozen Shakeproof lock washers.
50 feet Acme flexible Celatsite.

Steel Stamping List for Radio

*Contrary to accepted practice, steel can be used without loss of efficiency in radio sets—By Frank N. Jones**

IT was quite a concession on the part of radio engineers to investigate and finally approve the use of metal sheets for shielding, panels, and sub-panels. It has been considered until lately, however, that only non-magnetic metal can be used without introducing serious losses.

Applying the tests of practical results first, as is usual in radio exxperiments, it has now been demonstrated that steel parts can be used, if they are used correctly, without affecting the efficiency of radio circuits, thereby contributing greatly to the reduction of costs.

To be specific, sets equipped with steel front and sub panels have been marketed successfully, and other sets ready for production are also using steel stage shields, and steel cabinets.

This latter is an adaptation of steel furniture manufacturing methods to radio cabinets, and promises some highly successful merchandising possibilities, particularly if a number of manufacturers build kits using the same size front panels, so that any one of a number of kits can be fitted into a standard steel cabinet.

Special Steel for Radio Use

A special grade of steel has been developed for radio requirements. It is a patent levelled, cold-rolled sheet, of low carbon content, with a surface so smooth and workable that it is perfectly suited for the application of various kinds of finishing. Steel has the advantage of taking heat well, it can be welded and worked in every manner. There is no tendency for the surface to chip.

Steel is, of course, the most economical metal to use because of the low price. There is also the advantage that it can be procured in very large quantities, an important factor in an industry where manufacturers want their orders delivered almost before they are placed. No. 20 gauge steel is the standard thickness. It has the rigidity and tensile strength of No. 16 in other metals.

Steel Panels Offer Many Possibilities

Finished steel panels are obtainable in any size. Demands of radio manufacturers have created the standard sizes of 7 by 18, 21, 24, 26, 28, and 30 ins. Specifications for 1928 equipment indicate a tendency toward shorter panels, few exceeding a length of 21 ins.

Practically any ground finish can be applied to steel panels, matching effectively the tones of any cabinet, with walnut or mahogany grain. The grain is reproduced perfectly, for a photographic process is employed. The very finest woods are used for the originals.

There is an innumerable variety of novel effects which can be used, as well as various duo-tone finishes.

A number of colors can be used for border or scroll effects, calibrations and escutcheon plates.

Designers who are not experienced in using steel may be surprised at the possibilities of steel panels, not realizing that it is really possible to put a perfect finish on steel as well as on any other metal.

In addition to the design work on the panels, holes are also drilled to specification, and fiber bushings supplied to shaft dimensions. Hard rubber can be used for insulation, too, and is often specified where insulation is important.

Chassis Designs to Simplify Assembly

Most specifications for steel sub panels call for a one piece base, with the sides bent down and corners matched, to raise the panel itself from the bottom of the cabinet. This is more attractive in appearance than the plain flat set and also provides firm support for the panel where it must be raised to permit by-pass condensers and other things to be mounted underneath.

The corner seams are usually welded. A novel idea which contributes greatly to the ease of assembly is the etched instructions, either in gold or various colors on the top and under side of the subpanel. On the top, light outlines of the instruments to be mounted indicate the exact positions of the parts. Wiring can be indicated on the top and underneath as well, if wiring is planned that way. Bushings can be used to take the wires if they are necessary. The binding post strip is generally mounted over a slot cut in the sub panel, leaving the connections free and clear underneath.

Application of Steel to Shielding

Special designs have been developed for total shielding for the whole set, or individual stage shields in accordance with the most satisfactory and economical manufacturing methods.

Usually a cadmium plate is put on the steel which gives efficiency curves, in the matter of R. F. losses, practically identical to any other metal.

In the past, the folded or crimped assembly has been employed. But designers are turning toward deep-drawn or spun shields. These are a little more expensive, but are considered more satisfactory.

It would be advantageous if some standards could be set for shielding. So far, every engineer insists upon his own ideas as to sizes and shapes. Fortunately, the preparation is not expensive, although an appreciable saving could be made through standardization.

The one-piece shield is best for manufactured sets and is coming to be accepted for kits, although some knocked-down shields are still specified.

All-Metal Cabinet for Economy

Plans are under way to standardize on an all-metal cabinet to take a panel 7 by 18 ins. That makes a highly satisfactory cabinet, decidedly economical in price, and most attractive in appearance, for the finest wood-grain finishes can be applied.

There is an advantage in the metal cabinet where individual stage shields are not employed. This will be appreciated by those who have operated shielded sets in the larger cities, where the pick-up on the coils themselves is an important factor in tuning.

With welded joints and the strength of sheet steel, the all-metal cabinet simplifies packing problems considerably, for it affords adequate protection in shipping. In this way, the expense of damaged cabinets, on which the top or joints are split, is eliminated.

*Van Doorn Company, Chicago.

New Ceco R. F. Tube

It has been the custom for the past few years to design a Radio Amplifying Tube with regard to its use as an A. F. Amplifier, and to then expect the Radio Engineer to design his R. F. Transformer to work with such a tube. It is astonishing that he has been able to develop such a good R. F. Transformer, as we find in the majority of sets today.

However, realizing that such a method of designing R. F. Transformers was not fundamentally correct, the C. E. Mfg. Co., of Providence, R. I. has developed a tube, which is specially designed to be used as a Radio Frequency Amplifier. The characteristics of this tube are as follows:

If	Ip	Mu	Rp	Gm	Mu^2/Rp
.250	2.6	120	13,000	924	11.1

It will be noted that the characteristic Mu^2/Rp equals 11.1. It is well known that the gain as far as the tube is concerned in a Radio Frequency Amplifier is proportional to this factor, and it will also be noted that a tube with the highest value of mutual conductance is not always the tube most suited for the radio frequency stage.

In the case of the ordinary 201A type of tube, the amplification factor is about 8. In the new tube, which has been developed, the above figure has been raised to 12, with a consequent increase of efficiency.

Reports from the R. M. A.

An attempt to standardize Vacuum Tube Nomenclature

DIRECTLY after the first meeting of the Vacuum Tube Committee held at Atlantic City, your chairman received from several members the suggestion that your committee give consideration to the subject of vacuum tube nomenclature in general and particularly that phase relating to the possibilities of developing a system of identification that may receive international standardization.

The vacuum tube was first introduced in radio receiving circuits as a detector, subsequent progress in the art applied this tube as a radio and audio frequency amplifier.

As the radio industry developed, it was found that the efficient operation of circuits was somewhat limited by the characteristics of this general purpose tube, hence the design of various types of power amplifiers, resistance coupled amplifier, radio frequency amplifier and vapor-filled detector tubes, followed.

Today some twenty radically different tubes are being utilized in radio receiving equipment and this season will no doubt contribute several new models.

It is unnecessary to comment upon the untold confusion imposed upon the unskilled radio listener by the technical names and meaningless type numbers assigned to this multitude of different tubes.

In the older and parallel branches of the electrical industry, this confusion does not exist. As an example, incandescent lamps are not specified by a code number having no bearing upon the electrical consumption or operating potential of the lamp. A most logical system of international scope has been introduced—an electrical fuse is purchased in all parts of the world by specifying its electric current rating and not by type number.

In connection with vacuum tubes, a search of the foreign literature does not give relief. However, our foreign colleagues have, from time to time, pointed out the wisdom of introducing a more logical and simplified system of tube type numbering.

What the British Say—

In a paper, "The Testing and Measurement of Wireless Components," read before the Radio Society at the Institute of Electrical Engineers, March 25th, 1925, Mr. P. K. Turner refers to the subject of classification of vacuum tubes as:

"I will give a few typical results. These are mostly the averages obtained from a number of observations. The first column is a little personal fad of my own, namely a class number for a valve. Different makers have initials for different types of valves and they also have numbers.

"One maker calls a given type of valve one thing, another maker another and another maker, another, and so forth, and one gets them badly mixed up.

"I propose to give all valves of a certain description a number, of which the first figure gives the approximate rating of the filament volts and the others the approximate rated filament amperes."

See table No. 1 for Mr. Turner's arrangement.

Again reference is made in the British technical press to the subject of valve types, in an editorial, Experimental Wireless and The Wireless Engineer, Vol. II, No. 25, November, 1925, p. 863, as:

Valves and Their Names

"We do not as a general rule, like to repeat ourselves, but for once we propose to do so, in the effort to call attention again to the question of valve nomenclature.

"At the moment of writing, we have no access to our records, but even speaking from memory, we can give sufficient examples to show the absurdity of the present position.

"For example, Marconi-Osram valves in common use comprise 'L. S.' Nos. 1 to 5, and 'D. E.' 2 to 8—perhaps now the Marconi and Osram are separating one of them and will rename them!

"Among Mullard valves are a '.3' and a '.06' series, and 'S' series, and a 'D. F. A.' series, and a new valve called the 'PM4.'

"Many of them are identical with the M-O types but neither the letters nor the figures have any correspondence with one another nor the purpose of the valve.

"BT-H have a 'B' series, and Ediswan 'ARDE', 'ARO6,' and 'PVDE' series, and the same remarks apply.

"Cossor valves have their own keys, and so have all the other makers. In spite of the fact that most of these firms work together, and that a definite nomenclature has been suggested.

"We are glad to see that the new Burndept valves are actually marked according to our suggested scheme, a considerable improvement in it having been made by them.

"What we now suggest is that, since other valve makers are apparently too indifferent to users' convenience to make any step, our readers should consistently use the new nomenclature, order valves accordingly, and so gradually force a reasonable scheme on the makers.

"As a reminder, the scheme suggested is as follows: Every type of valve has a three figure number, of which the first figure is the filament volts, and the last two, rated filament current. Thus the popular '60-milliamp' type is a—306—, and the old 'R' a—465—.

"In our original scheme we used small letters 'a' and 'b' to indicate the valves of exceptionally low or high Mu. But we now suggest a slight elaboration of the Burndept scheme, for *use when desired*.

"According to this, letters before the numbers denote the magnification, as follows:

HH: extra high; for Mu or thereabouts.
H: high; for Mu of 9-14.
HL: medium; for Mu 6-9.
L: low; for Mu 4-6.
LL: extra low; for Mu of 2 or thereabouts.

"These letters also correspond to the present popular habit of recommending Hi-Mu valves for H. F. and low Mu for L. F. amplification.

"Thus the valve sold by M-O as D. E. 5-b, and by Millard as D. F. A-4 should be called in either case HH625 if we wish to note its Mu; otherwise as 625 type.

"Perhaps if readers help, we can in time put an end to the ridiculous situation under which the same valve, according to the firm who sells it, is called a D. E. 5, a DFA1, a B4 or a PV5D.E."

A Proposed Alteration—

From all available information the British method embodies certain fundamentals that should make it possible to propose this system for international standardization.

There are, however, several minor alterations that may be included, as:

1. To eliminate confusion by a series of numerals the letter designating the amplification factor is interposed between the filament potential and current.

2-a. With a view to avoiding unfavorable international comment, it is suggested that the letters H and L, representing "high" and "low" be altered to "A" and "Z." "A" being the first or highest letter in the alphabet and more nearly in accord with the internationally accepted word "Alta" and "Z", the most distant letter, representing "low".

2-b. *Alternative Proposal*—As the amplification factors may in the near future greatly exceed those in common practice at present, it may be well to consider a method of using the nearest Roman numeral of two letters.

3. The current values are entered in units of ten milliampere values, it being assumed that currents greater than nine amperes will not be encountered, in practice, whenever currents of greater magnitude are presented, the value is of such proportions as to accommodate a name-plate containing more detailed information regarding the electrical characteristics.

4. Values of potentials and current are entered as whole numbers, the use of decimal parts should be discouraged.

5. In special purpose tubes such as power rectifiers, ballast and protective devices, in which it is impossible to assign an amplification factor, the following designations are recommended:

R—Rectifier.
B—Ballast.
P—Protective.
C—Controller.

Here the nomenclature is exactly the same as utilized in regular tubes where the potential and currents are specified in conjunction with the designation letters.

6. Devices operating upon direct current sources should be designated by small designation letters and those operating upon alternating current sources, by large or capital designation letters.

To permit a more comprehensive view of the various system, the Table No. 2 Appendix, illustrates the revised plan contrasted with the present American practice.

American Support—

Should this subject receive a favorable report from the vacuum tube committee and a practical solution proposed, it is recommended that the tentative plan, or agenda, be submitted to other associations and engineering groups of our industry, requesting their constructive criticism of the plan and support in the direction of international standardization of this particular section of vacuum tube nomenclature.

Foreign Co-operation—

Your committee has developed a co-operative spirit with a number of scientists of outstanding reputation in the radio art of England, Germany and France. These gentlemen have indicated their desire to join forces in activities tending to simplify radio practices.

At the same time the various American units of our industry are approached to review the agenda, it is recommended that our foreign colleagues be provided with sufficient copies of the proposal for distribution in their respective countries.

The First Foreign Letter

Previous correspondence passing between us described among other activities of the Vacuum Tube Committee of the Radio Manufacturers Association our desire to introduce certain suggestions regarding vacuum tube nomenclature, which we hoped would somewhat simplify the present identification system.

In proposing a system, it is our desire to arrange the details with sufficienty flexibility to permit alterations where necessary for international acceptance.

It is with pleasure that I attach hereto a copy of the first draft or agenda relating to this subject, which is transmitted this date to the membership of the Radio Manufacturers Association.

Will you be so kind as to give us your views regarding the manner in which this subject should be officially acted upon in your country, that is, should the Radio Manufacturers Association address any particular body of scientists or radio association, or could you transmit the document together with your comments.

Your kind assistance in this important work is deeply appreciated and we only trust that the occasion will be presented wherein the members of the Vacuum Tube Committee and the Radio Manufacturers Association at large can reciprocate.

Final Disposition

After a general agreement has been reached by the more important units of our industry the plan should be referred to the American Standards Committee for action teuding to establish an American standard.

Simultaneously with this dispatch to the American Standards Committee, the foreign groups assisting in this work should be requested to take like action in their respective countries, thus permitting the International Electro-Technical Commission to review the plan at their next annual meeting.

I am, Sir, you most obedient servant.

GEORGE LEWIS, Chairman,
Vacuum Tube Committee, R. M. A.

TABLE No. 1

Class No.	Description	(1)	(2)	(3)	(4)	(5)
460	"R"	8	25,000	7.0	2.0	3.0
460	New Bright General Purpose	15	20,000	7.0	2.5	6.0
306	.06 Tube	7.6				
		76	18,000	7.0	3.0	30.0
255	Dull-semi	15	18,000	7.0	3.0	15.0
245	2-volt power	25	15,000	5.5	2.0	26.0
606	.06-power	40	7,000	8.0	9.0	60.0
625	Power	50	5,000	7.0	10.0	30.0

(1)—Saturation current—Is—Milli-amperes.
(2)—Anode Impedance—Ra—ohms.
(3)—Voltage Amplification—Mu.
(4)—Power Amplification—1000 Mu^2 Ra.
(5)—Filament Efficiency—Is (Ma)/ P (Watts).

TABLE No. 2

Present American Plan	British Plan	Revised Plan	Description
UX-199	L-306	3V106	Dull Emitter—General Purpose
UX-120	LL-312	3₁V12	Dull Emitter—Power Amplifier.
UX-201-A	HL-525	5IX25	Five Volt—General Purpose.
UX-112	HL-550	5IX50	Five Volt Power—Rp=6,000.
UX-171	LL-550	5IV50	Five Volt Power—Rp=2,500.
UX-210	L-7125	7IX125	Seven Volt—Rp=6,000.
UX-216-B	N-7125	7R125	Half Wave Rectifier.
UX-213	N-5200	5R200 / 5R200	Full Wave Rectifier.
UX-176	———	50B170	Ballast Tube.
UX-174	———	90C50	Protective Tube.
UX-200-A	HH-525	5D25	Detector (Vapor-Filled).
UX-277	———	5P20 / 3P90	Protective Tube.

A High Speed Tube Tester

A machine which tests radio tubes many times more rapidly than the most expert human operator and does its work almost perfectly, has been installed at the radio tube factory of the Westinghouse Lamp Company at Bloomfield, N. J.

The capacity of this machine is 30,000 tubes a day, whereas the best human operator cannot test more than about 2,000 tubes in a ten-hour day. Furthermore, the human operator is bound to make occasional slips in her work, but the machine never makes any mistakes. For the period of several months during which it has been in service, its record for accuracy stands at 99.9 per cent, but the 0.1 per cent error is not chargeable to the machine, but to the accidental introduction of defective tubes into the good stock.

Though the electrical connections of

Here is a view of the high speed tube tester, an almost human machine which has a capacity of 30,000 tubes a day

this machine are a night-mare for everyone but its inventor. Allen B. Dumont, of the Westinghouse Lamp Company, its operation is very simple.

Tubes on Revolving Disk

It consists essentially of a revolving disk, about 3 feet in diameter, which carries sockets for tubes on one of its faces. As the disk revolves, the tubes are connected successively to connections which test them for the various characteristics; and if a tube is found wanting, it is kicked out of its socket by an electro magnetically acting plunger located in the rear of the machine.

Tubes that are hopelessly bad are unceremoniously shot into a "down-and-out" and laid in the scrap heap; but those which can be reclaimed are gently laid on to moving belts which convey them to operators for further treatment. Perfect tubes are also placed on a belt and are carried to the wrapping department.

The points for which tubes are tested are: Short circuits, broken filaments, emission, gassiness, and high and low plate current. Some of these tests involve the use of extremely small currents, and special sensitive relays are employed to operate the ejecting mechanism. Each test is a positive one, and each testing mechanism operates to eject tubes in case they should be damaged during the process of testing. Hence, when the machine okeh's a tube, that tube is a good one.

Job for Left-Handed Girl

The machine is arranged to be fed by two girls seated side by side. After it was placed in operation, the fact developed that one of the girls should be left-handed and one right-handed. A search soon disclosed a left-handed operator, who for once, at least, found advantage in her peculiarity. But, alas! She is destined to lose her job soon, because the machine is being arranged to be fed automatically in order to bring it up to its full productive capacity.

Apparatus Characteristics

Noting the trend toward more complete information given about the various products by manufacturers

IT is unfortunate that the majority of manufacturers are so backward about giving complete details regarding their various apparatus. It has come to be generally acknowledged that much better results will be obtained from parts when they are specially designed for a specific purpose. Particularly is it to be regretted that more manufacturers of reproducers do not give definite data on this equipment.

In order to achieve the best possible quality of reproduction, the impedance of the speaker must match the impedance of the tube which feeds it, or of the output coupling device used between the tube and speaker. These requirements are easily satisfied in an output transformer but, of course, this unit must be designed to work in conjunction with a certain tube and speaker combination.

Fortunately, tube manufacture are not so reticent about their products. We know the characteristics of the various tubes and, were information available concerning the speaker, it would insure better results from our present amplifying and reproducing equipment. The Amplion Corporation of America makes units of various impedances, which are therefore much better adapted to certain power tubes. Assuredly this is a step in the right direction.

The General Radio Company is now making an audio transformer with an unusually high primary impedance which is designed to match the higher plate impedance of the new UX-200-A, CX-300-A special detector tubes. A noticeable improvement in both volume and tone quality results from this closer matching of impedances.

As is well know, the impedance of the transformer varies with the frequency, but the tube impedance remains constant. Accordingly, the input to the transformer varies over the frequency range and distortion results. This condition, however, can be reduced by means of a high primary impedance, and is satisfied by special transformer designs.

Silver-Marshall quote figures on the primary impedance of their audio transformers at 30, 300, and 3,000 cycles. With these figures available, it is an easy matter to find what results may be expected from certain tube combinations, and to compare fairly accurately the advantages or disadvantages of this type of amplification with other varieties.

The Samson Electric Company is particularly to be commended for giving accurate data on the characteristics of the various products of its manufacture. In one of the booklets packed with each piece of apparatus is a table which gives the mechanical and electrical characteristics of all items. This should be of such general interest, and is so significicant a forerunner of a new trend, that the table of electrical characteristics is given here.

Electrical Characteristics

Type	A	B	C	D	E	F	G
Symphonic....	69	66	1080	830	8000	60	3 to 1
HW-A3 (6-1).	9	14	415	275	8000	95	6 to 1
HW-A3 (3-1).	18	32	1080	275	8000	60	3to 1
HW-A3 (2-1).	44	38	1610	250	7100	50	2 to 1
D.....	66	51	3700	...	....	30	.....
G.....	225	..	6400	...	....	..	....
O.....	12	12	500	...	....	90	....
P.....	175	170	3200	...	....	35	....
X.....	18	32	1080	275a	8000a	60	1.5-1
Z.....	18*	18*	650*	...	....	75	....

* Each half of winding.
a Entire winding.

A. Primary Inductance in Henrys with no Direct Current.

B. Primary Inductance in Henrys with 2.5MA. Direct Current.

C. Approximate D-C. Resistance of Primary in Ohms.

D. Secondary Inductance in Henrys (no D-C.)

E. Approximate D-C. Resistance of Secondary in Ohms.

F. Safe Current-Carrying Capacity in MA.

G. Turn Ratio.

The Measurements of inductance are at 60 c.p.s. with 1 volt (r.m.s.) impressed on the winding.

The Symphonic is the highest quality audio transformer made by this company. The H-W-A3 line consists of more moderately priced audio transformers of three different ratios. Type D is a dual impedance of Donle design. This unit is not recommended for use with high-mu tubes, for the values of inductance are not sufficiently high to ensure the best results. For high-mu tubes, the separate plate and grid impedances, types P and G respectively, are recommended.

Type O is an output impedance designed to be used in conjunction with a 2. to 4. mfd. condenser to protect the loud speaker against the heavy plate current of power tubes. This unit is provided with a tap, so that speakers of incorrect impedance can be coupled efficiently to the output tube. Its use does not in any way decrease the efficiency of the amplifier. Types X and Z are, respectively, input and output push-pull impedances. The use of these in place of transformers minimizes the tube distortion ordinarily introduced in every amplifier. These units are also made in the Symphonic type, at correspondingly higher prices.

When this system comes more into general use, it undoubtedly will do much toward establishing the merchandising of parts on a firmer foundation. The present system of purchasing "sight unseen" as it were, does not appeal to the average buyer, for he feels vaguely dissatisfied.

B Power Unit Assembly

A new idea in the assembly of B eliminators to facilitate replacement in case of breakdown

MOST of the modern manufactured B power units are very satisfactory and reliable pieces of apparatus. That this equipment has reached its present state of perfection is a decided tribute to improved manufacturing methods and careful testing at the factory.

However, regardless of the care exercised during manufacture, a certain percentage of the units sold is sure to prove defective in service, and the factory is consequently called upon for replacements. When the entire eliminator is built as one unit, it is often necessary to substitute a new eliminator, rather than a part, on account of the labor involved in dissembling and testing. Naturally, this proves to be an expensive procedure.

Unit Assembly Less Expensive

The Accurate Electric Company now sounds a new note in B eliminator designs. Each important part of this apparatus is built into a separate unit. The power transformer is built into one block, the filter chokes into another, and the rectifying tube socket and condenser bank into a third. Accurately spaced terminals are provided on each of these blocks, and the connections between them are very easily made by means of suitable lugs and nuts.

The advantages of the system are immediately apparent. In case of transformer burnout, it is only the work of a few minutes to replace the defective unit. The same applies to a shorted choke or blown filter condenser. Naturally, tests for defective apparatus are facilitated.

An Eliminator built of five separate units. The completed eliminator consists of five distinct units. The power transformer is in one case, upon which are mounted two insulated binding posts for connecting to the A. C. line. The outfit is designed to use a full-wave rectifier of the 213 type, and the transformer therefore has two secondary windings — one of 440 volts with center tap, and a center tapped 5-volt winding.

Unit No. 2 contains the condenser bank and rectifier socket. Two 4 mfd., two 2 mfd., and two 1 mfd. capacities are incorporated in the condenser block.

Unit No. 3 consists of two 30 Henry choke coils which, in combination with the condenser bank, provide adequate filtration. Each of these three units is provided with a ground terminal, which is finally connected to the metal case of the eliminator, which is in turn connected to the Gnd. binding post provided. The metal case is supplied with a cover of the same material suitably drilled with ventilating holes.

The front panel carries the two Resistograds which regulate the detector and intermediate voltage taps, and binding posts for the Gnd., B—, B+Det., B+Int., and B+Amp. connections.

One of the main reasons for the design of the outfit is that it is primarily intended to be sold in unit form. However, the system possesses many other advantages and it will be interesting to note whether the idea is not soon adopted by other manufacturers.

Connewey Electric Laboratories

The Connewey Electric Laboratories, manufacturers of the well known brand of MAGNATRON radio vacuum tubes, will shortly announce a line of special tubes containing an entirely new type of filament.

This new filament, developed exclusively in the Magnatron Laboratories, possesses all the advantages of the oxide coated platinum filament now used in the Magnatron power tubes, DC-112 and DC-171, and the Magnatron Super Rex rectifier tube. It operates at a very much lower temperature than tungsten, is considerably richer in electronic emission, has no critical temperature, withstands excess voltage better, and has very long life. Tubes with this filament have been in use for 10,000 hours without perceptible deterioration and are still going strong.

The new Magnatron filament, called Magnium, not only has the above characteristics, now present in their coated platinum, but has also the advantage of cheapness, greater tensile strength, ease of handling, and still higher electronic emission.

These latter characteristics make it possible to use this filament in such low priced tubes as the DC-201A and the DC-199. Such tubes thus become semi-power tubes and much more useful in receiving sets.

It is understood that the Connewey Electric Laboratories will supply, and co-operate with, a number of the most reputable tube manufacturers who desire to use this new filament in their product.

The Magnatron DC-216B, the DC-210 and the DC-213, are now regularly manufactured with this new Magnium filament. The DC-216B, and the DC-213, under identical electrical conditions, each have an output about 25% higher than usual, namely 80 milliamperes as against 65 milliamperes. The same is true of the DC-210, the difference here being apparent in milliwatt output power.

Benjamin Electric Co.

An improved small and rugged straight line frequency condenser which gives a wide separation of stations on the dial, especially on lower wave lengths, is announced by Benjamin Electric Manufacturing Company, 120 South Sangamon Street, Chicago.

The new condenser has a new straight line frequency curve and is the smallest size consistent with accuracy and ruggedness. Losses are reduced to the lowest degree. Insulation is provided by two especially prepared bakelite discs. Plates are brass, end plates being thicker and ribbed to gain strength. Wide spacing of plates insures accurate matching in multi-stage sets. Mounting plate is effective shield against any hand capacity. Plates will not grip or bind at any point. Ball bearings give smooth turning and positive control of rotor.

R. M. A. Activities

In accordance with a recent statement issued from our New York office, the Radio Manufacturers Association is now ready to announce the establishment of an Engineering Division, composed of nine member executives, with H. B. Richmond, of the General Radio Company of Cambridge, Mass., in charge.

The executive group will be divided into units of three members heading three sections, as follows:—

Standards Section
Safety Section
Technical Procedure Section

The Standards Section is already a going organization under the guidance of A. J. Carter of Chicago, who has been in charge of the development of the standard practice work which the R.M.A. has been engaged in for over a year. At a meeting of this section held in Chicago in February there were 105 companies represented by 205 men, who in several days' session worked out acceptable standards covering the following items.

1. Aerials and Arrestors
2. Condensers and Dials
3. Fixed Condensers
4. Loud Speakers
5. Panels
6. Plugs, Jacks and Switches
7. Power Equipment
8. Power Transformers
9. Receiving Sets (Circuits)
10. Rheostats
11. Resistance Units
12. Sockets
13. Test Instruments
14. Vacuum Tubes
15. Wiring Devices

In reviewing the work of this section at the Boston meeting of the Board of Directors of the R.M.A., it has been found that a major part of these standards are already in practice among the members, and therefore, although the complete list must await the June Convention for final ratification, the standards are, in effect, realities at this time. This is a most significant thing to both the trade and to the public, inasmuch as they may be assured that when they buy the products of the R.M.A. members, they are purchasing radio equipment which meets a high requirement.

Copies of the standards as announced by this section are on the press at this time, and will soon be made available.

The Safety Section is only beginning to get in operation, but within a short time will have a very important piece of work to accomplish with the advent of electrified sets, both from the shock and fire hazard viewpoints. The R.M.A. has been the first to recognize the need for work in this line, and I believe before many months have passed the work of the Safety Section will be one of the outstanding contributions of the Association to Radio.

The Technical Procedure Section aims to establish uniform methods of test and procedure in rating equipment.

RADIO MANUFACTURERS ASSOCIATION,
Engineering Division,
H. B. RICHMOND in charge.

Many Special Trains Bring Radio Show Visitors

Special trains from all over the United States will bring members of the radio industry to the annual radio trade show and convention of the Radio Manufacturers Association to be held in Chicago the week of June 13th, according to announcement by G. Clayton Irwin, Jr., general director of the trade show in reviewing the situation as regards transportation.

"A special train has been arranged by the New York Central railroad to run as a section of the Twentieth Century," Mr. Irwin said, "leaving New York City on Sunday, June 12th, and arriving in Chicago the morning of the 13th when the trade show will open. Several hundred dealers, jobbers and manufacturers will be aboard this train with everything possible done to make the excursion most attractive for those joining.

"Special cars will be added to the train at Albany where the Boston Delegation joins, and at Rochester where the Buffalo and Rochester dealers will have special Pullman cars outfitted for them.

"A committee of New York dealers, jobbers and manufacturers' agents under the direction of L. C. Welling and Dudley M. Cohen of the M. W. Radio Company will have full charge of the arrangements for the train, making this truly an excursion for the dealers and jobbers, although a number of manufacturers have already signified their intention of traveling with the New York delegation.

"On March 24th more than five cars in this train had been paid for, with reservations pouring in on the New York Central and the offices of the RW Radio Company at Park place that indicated that the capacity of the train would be sold out long before the show.

In the event the first train is filled a second train will be begun with standard equipment and as many special features as possible.

Special trains from the Northwest will bring members of the Northwestern radio trade association, while visitors from St. Louis will have a special section of one of the crack overnight trains to Chicago exclusively devoted to bringing the radio guests.

Philadelphia dealers and jobbers will split, half of them coming to New York to join the New York excursionists, the others traveling in special cars via the Pennsylvania railroad. Two special cars of Pittsburgh dealers and jobbers will join the Philadelphia crowd at that city. Cleveland jobbers and dealers as well as those in Detroit will travel in special cars and by motor, according to advices from those cities received by headquarters for the trade show in New York City. A number of music dealers from all over the country who will attend the annual convention of the Music Industries Chamber of Commerce and the various music associations will be in Chicago the week previous to the radio show many of them staying over the first part of the radio exhibition and the various dealers and jobbers meetings that will mark the convention period.

Efforts are being made by New Orleans dealers and jobbers to arrange for a special car from that city which will pick up the middle Illinois trade members as well as those from Memphis and other southern cities en route. More than three thousand members of the radio trade are expected to attend the convention and trade show.

Many of the special trains will be equipped with radio receiving sets, the New York train possibly may carry a portable broadcasting station if the necessary arrangement can be made and licenses secured. L. C. Welling, in charge of arrangements in New York, announced that already a piano, and saxaphone player had been discovered with every indication that the New York delegation will land in Chicago with their own orchestra in addition to a number of radio stars who will attend the convention, performing on the train for the entertainment of the visitors en route.

Metric Standardization

UNIFICATION of commercial standards of all the American republics will be the program of the 2nd Pan-American Standardization Conference, meeting in Washington, D. C., early in May. The sessions will immediately follow those of the Pan-American Commercial Conference, also meeting in Washington.

Advocates of the adoption of the metric weights and measures in the United States are pointing to the fact that the 1st Pan-American Standardization Conference, which met in Lima, Peru, in 1925, endorsed the principle of standardization on the world-uniform decimal metric basis, and that it actually began its work of unifying standards for all the American republics (including the United States) on the metric basis. The first industry for which the metric units were recommended was the petroleum industry.

WITH THE MANUFACTURERS

Dudlo Mfg. Corp.

Dudlo Manufacturing Corporation, Fort Wayne, Indiana, manufacturers of a wide variety of Magnet Wire and Coils, are adding new equipment.

The company is enjoying a large increase in business and it has been found necessary to build many new enamel and cotton insulating machines. Equipment is also being installed for producing square and rectangular wire and flexible copper cables. A new conveyor system is in operation to accelerate the handling of materials through the various departments.

The company recently completed a new wire mill devoted exclusively to the drawing and insulating of magnet wire.

The eastern office is now located at 56 Earl Street, Newark, N. J., where a branch factory for winding coils is now operating in conjunction with the warehouse stock of wire. This step was taken to give speedy service to the New England and Atlantic states on Dudlo products.

Sparks-Withington Appoint Detroit Agency

Capt. William Sparks, president and general manager of the Sparks-Withington Company, Jackson, Mich., announces the appointment of Brooke, Smith & French, Inc., Detroit national advertising agency, as advertising and merchandising counselors in the marketing of Sparton Radios and Sparton Motor Car Horns. It will be recalled that the company recently announced the purchase of the large Earl Motors plant, which provides 50% more manufacturing space than in the present factory.

Durham Resistor Data

The International Resistance Company, manufacturers of the Durham Metallized Resistors, have inaugurated a technical bulletin service which is supplied to the engineering department of their manufacturing accounts and to jobbers and dealers.

Three bulletins in 1927 have been issued as follows:

1. Design and Manufacture of Resistance Units
2. Resistors for Radio Circuits
3. The Manufacture of High Resistance Units for Radio Circuits.

The International Resistance Company will be very glad to forward copies of these bulletins to any individual or company requesting them.

National Sales Representation for Buckingham Radio

R. T. Anderson, Sales Manager, of the Buckingham Radio Corporation, Chicago, announces that the Buckingham Sales organization is virtually completed for the coming year and will give this company active representation and distribution over the entire United States. The Buckingham line featured by the new single dial control chassis will be sold and serviced through the following organizations:

MacNeil Electric Service Co., Boston, Mass.

F. A. Hudgin & Co., Buffalo & Syracuse, N. Y.

Manufacturers Sales Co., Metropolitan, N. Y.

Erlichman Brothers, Inc., Philadelphia, Hartford, Pittsburgh & Cleveland.

Gallinson & Company, Minneapolis, Minn.

Harris F. Holland, Indianapolis, Ind.

Franklin McDermott, St. Louis, Mo.

Barnes & Company, Atlanta, Ga.

American Sales Company, San Francisco, Calif.

Neutrowound Radio Mfg. Co.

For the 1927 season the Neutrowound Radio Manufacturing Company will continue its policy of selling exclusively through automotive jobbers and dealers and will announce early in the season a new series of models.

Silver-Marshall

Silver-Marshall, Inc., 844 W. Jackson Boulevard, Chicago, is now in production on a new output transformer, numbered 222. This transformer is identical to the No. 221 made by this company, but is now provided with tip jacks to receive the loud speaker cord, and a phone cord with which it is connected to the output of the receiver. This convenient feature makes the 222 easily adaptable to any set.

The 222 is made to be used between the power tube and loud speaker and, so used, it prevents the heavy plate current of 171 and 210 amplifiers from damaging the speaker windings. The 222 is designed to supply maximum energy to the speaker at 30 cycles, and delivers a gradual fall off of energy as the frequency increases, which compensates for speaker tendencies of the reverse order.

The impedance value of the 222 and 221 output transformer secondaries as approximately 1500 ohms at 30 cycles, which is the impedance of the average loud speaker at this frequency and which results in maximum energy transfer to the speaker. The impedance of the primary is such that maximum undistorted power is obtained from a UX-171 tube and, at the same time, satisfactory results are obtained from the UX-112, UX-210, or UX-201-A.

Manhattan Electrical Supply Co., Inc.

The Manhattan Electrical Supply Co., Inc. (St. Louis branch), is now located at 810–818 Clark Ave., St. Louis, Mo. Their former location (1106 Pine St.) was recently destroyed by fire.

Utah Radio Products Co.

Henry C. Forster announces the removal of the Utah Radio Products Co. to more commodious quarters at 1615 So. Michigan Ave., Chicago, Ill.

Radio Production Machinery Co.

The Radio Production Machinery Co. has just released new circulars of late developments in hand and power driven automatic coil winding machines and power driven condenser winding machines. The circulars contain full data and prices.

Federal Radio Corporation Produces Speaker Coupler

A new loud speaker coupler, known also as a power tube coupler, has been announced by the Federal Radio Corporation. This unit, which is housed in a neat, compact black metal housing, contains a condenser and choke arrangement which operates most efficiently to improve the tone quality of any receiver and speaker.

The Federal Ortho-sonic coupler is furnished complete with a silk-covered cord terminating in pin tips to be inserted in the loud speaker jacks of the receiver, and has similar jacks to receive the loud speaker lead. It is very neat in appearance and quite unobtrusive when installed. Its chief advantages are its ability to beautify the tone quality of any set or reproducer, and its capacity for handling heavy voltages in a manner to protect the speaker against all chance of distortion.

Modern Electric Mfg. Co.

The Modern Electric Mfg. Co., Toledo, Ohio, is working with many of the larger manufacturers on various shielded transformers, eliminators and special power supply equipment.

NEWS OF THE INDUSTRY

Trade Literature

Acme

The Acme Apparatus Company, Cambridge, Mass., is publishing a booklet entitled "Power Supply for Radio Sets." This booklet is a treatise on the theory and practical application of rectifier and filter circuits. A, B, and C eliminators are discussed, and diagrams and working drawings are given to facilitate the construction of the units described.

All-American

E. N. Rauland, President of the All-American Radio Corporation, Chicago, has collaborated with Harry K. Randall on "The Radio Key Book." This booklet gives a very complete treatise on the theory of broadcast transmission and reception, and fully describes the use and function of each component part of a receiver. A glossary of circuits is included, and constants and makes of the necessary parts are given.

American Mechanical Labs

The American Mechanical Laboratories, 285 North Sixth St., Brooklyn, N. Y., has released a pamphlet, entitled "The Gateway to Better Radio." This booklet covers the care of a receiver and its equipment and suggests methods for obtaining the best results from a set.

The main part of the book is devoted to diagrams and descriptions, showing how the Clarostat, which is manufactured by this company, can be adapted to different circuits in receivers and eliminators.

Benjamin

The Benjamin Electric Manufacturing Company, 120 South Sangamon St., Chicago, publishes the "Radio Handbook." This handbook covers the installation and care of a receiver and its accessories, and contains a discussion on each component part of a radio set. Wiring diagrams for popular circuits are given, and a table of the formulae commonly used in radio. In addition, a selected list of radio books and periodicals is presented.

Dubilier

The Dubilier Condenser and Radio Corporation, 4377 Bronx Blvd., New York City, has a 32 page booklet entitled "Seventeen Ways to Improve Your Set." This booklet describes the many applications of fixed and bypass condensers so as to improve the operation of receivers.

Amertran

The American Transformer Company, 178 Emmet St., Newark, N. J., has an interesting booklet "Improving the Audio Amplifier." This booklet contains authentic information on the subject of audio frequency amplification, and is illustrated with diagrams. The characteristics of tubes are also noted.

The same company issues a pamphlet "The Audio Manual," which lists the correct answers to the questions most frequently asked about audio amplification.

Willard

The Willard Storage Battery Company, Cleveland, Ohio, issues a booklet "The ABC of Radio Batteries and Power Units." This pamphlet describes transmission and reception, and diagrams are given to show these processes in simple form. A description is given of the action of vacuum tubes, and the function of batteries and power supply devices.

Jewell

The Jewell Electrical Instrument Company, 1650 Walnut St., Chicago, issues a catalog of Jewell Radio Instruments. In this catalog are listed various meters, and suggestions are given as to the use of each.

Thordarson

The Thordarson Electric Manufacturing Company, 500 West Huron St., Chicago, is issuing booklets descriptive of their new B eliminator and power amplifier foundation units, the Power Compacts R-171 and R-210. In these booklets, diagrams are shown which illustrate the method of properly connecting these units into suitable circuits.

The booklet "Thordarson Power Compact R-171 describes the construction of an outfit using the Raytheon B H rectifier and the 171 power tube. The booklet "Thordarson Power Compact R-210" gives constructional details on a power pack using the 216-B rectifier and 210 power amplifier tubes.

Ceco

The C. E. Manufacturing Company, Providence, Rhode Island, issues a booklet "Ceco Radio Vacuum Tubes." In this booklet curves are given which show the characteristics of all types of Ceco tubes. Each type is discussed and recommended voltages for filament, grid, and plates are listed.

Radiall

The Radiall Company, 50 Franklin St., New York City, publishes "The Radiall Book," which is a guide for the experimentor, set builder, and radio engineer. This pamphlet contains discussions on tubes, the problem of A current, and amplifiers. In addition, a hook-up section is presented, which lists the ten most popular radio circuits of the year.

R. C. A.

The Radio Corporation of America, Woolworth Building, New York City, publishes individual booklets descriptive of the apparatus made by that company. Of interest to everyone is the booklet "R. C. A. Radiotron Vacuum Tubes," which lists the various tubes and their uses. In addition, a table of tube characteristics is given, which is very handy for the experimenter's information.

Samson

The Samson Electric Company, Canton, Massachusetts, has released a new book entitled "Audio Amplification." This booklet describes in detail the various audio coupling methods, and gives many diagrams of audio and receiver circuits. The advantages and disadvantages of each system are outlined, and an unbiased comparison is made between them.

Silver-Marshall

Silver-Marshall, Incorporated, 846 West Jackson Boulevard, Chicago, has a booklet entitled, "The Secret of Quality." In this booklet is presented a complete discussion on the various forms of audio amplifiers, and various B eliminator and power packs. The booklet is completely illustrated with photographs and diagrams, and all circuit constants are given.

Aluminum Co. of America

The Aluminum Company of America, Pittsburgh, issues a booklet "Aluminum for Radio." In this booklet are listed many diagrams, and the component parts of radio receivers are discussed. Of particular interest are the tables of information, which cover such subjects as "Relation of Wave Length, Frequency, and the Product of Inductance and Capacity in Tuned Circuits," "The Electrical Conductivity of Metals and Alloys," "The Dielectric Constants of Insulating Materials; Flash-over Voltage at Radio Frequencies of Some Electrical Insulating Materials," etc.

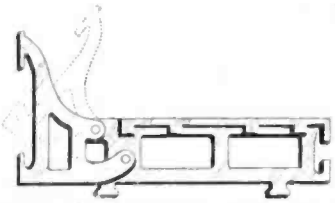
NEW PRODUCTS OF THE MONTH

Saturn Mfg. and Sales Co., Inc., 48 Beekman St., New York City, have announced a new socket for manufacturers. A small amount of metal is used. The molding is of Bakelite. It is furnished for one or two hole mounting.

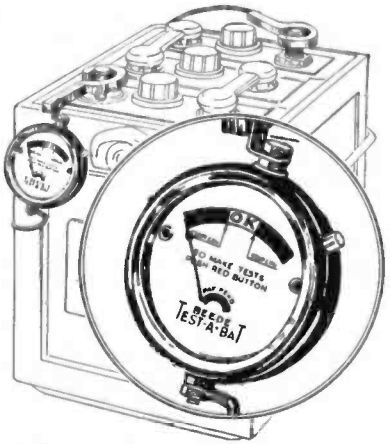
Saturn Mfg. and Sales Co., Inc., 48 Beekman St. New York City, is supplying a new power toggle switch to radio manufacturers and the trade for use in power sets, chargers and eliminators.

Sprague Specialties Co., Quincy, Mass., are in production on a new line of Midget condensers. Each condenser is tested at 1500 volts and is safe for continuous operation at 1000 volts. D. C. capacity is maintained constant by a special waterproofing process of triple impregnation. An asphalt and paraffin casing prevents short circuiting of leads. They are made from .0007 mfd. to 1. mfd.

The Klosner Radio Co., New York City, has announced a new line of rheostats and sockets particularly adapted to the requirements of manufacturers.



Bruno Radio Corpn., Long Is. Cy., N. Y. is in production on a new adjustable bracket. The adjustable feature allows the front panel to be sloped at any angle desired. The material used is die cast aluminum.



A battery tester which may be permanently attached to any storage battery and which is always ready for immediate action by simply pressing a little button has just been placed on the market by the Beede Instrument Company of Penacook, N. H. This new storage battery testing device is known as the Test-A-Bat.

It consists of a high resistance meter two inches in diameter, built in a nickel case and finished with two attachments which have universal polarities, either one of which may be attached to either pole of the battery. One of these attachments is fixed to the top of the meter with a swivel joint permitting the meter to be placed at any angle for convenient reading. The other terminal is attached to a rubber covered cord sufficiently long to reach the other connection on the battery. The terminals, which are of non-corrosive metal, are finished with set screws.

The dial reading is very simple. There are three divisions reading from left to right, red, white and green. The white is marked O. K. If on pressing the button the needle points to the red division the dial states "start charging." If at the green division, "stop charging." Merely pressing the button ascertains the condition of the battery.

The fact that this permanently attached battery tester eliminates the need of moving the battery to make tests should create a popular demand for for it regardless of season. It appeals very strongly to owners of console model receivers inasmuch as they need only open the door of the cabinet and press a button to ascertain the condition of the battery.

The Test-A-Bat may be placed at either end or side of the battery. It is being distributed through jobbers to retail at $1.75.

The C. E. Mountford Co., New York City, have announced the Mountford Tapohm. It is a tapped Kroblack wire wound resistance—designed especially for use in B Eliminators.

The Tapohm has a total resistance of approximately 30,000 ohms and when connected as shown in diagram will give nine variations in voltage.

The voltage range given by the Tapohm is regulated by two factors, namely: Total eliminator voltage (represented Vt) and the series fixed resistance.

With a voltage of 135 and A series resistor of 25,000 ohms the voltage delivered to the detector tube is as follows: 0-14-15-24-27-33-37-41-45-48. volts.

With 185 volts and 25,000 ohms, range is 0-20-22-33-36-43-47-52-57-60 volts.

If the eliminator voltage exceeds 200 volts the series resistor value should be 50,000 ohms.

(Laboratory date sheet
File No. 1920 date 3/8/27.)

C. E. MOUNTFORD,
New York, N. Y.

The Mayolian Corp., New York City, is in production on a complete line of eliminator parts for manufacturers and the trade, including the tone filter shown above.

Recent expansion will increase the output of this company measurably for the coming season.

Dongan

The Dongan Electric Manufacturing Company, Detroit, Michigan has announced an new B eliminator unit, the serial number of which is 3516.

New Products and Developments

X-L Radio Labs

The X-L Radio Laboratories, 2424 Lincoln Avenue, Chicago, manufacture binding posts known as the X-L Push-posts. These binding posts are equipped with soldering lugs and with name plates which describe the various connections in the circuit. The tops are non-removable, and the connections are made by pressing down on the heads of the posts, which opens a slot running through the center of the unit. The connecting wires are then inserted through the slot and when the pressure on the head of the post is released, a spring in the device holds the wire in a firm grip.

Zierick

The F. R. Zierick Machine Works, 6-8 Howard St., New York City, specializes in terminals, angles, dies, and shielding. This company makes metal stampings to order.

Apperson Plant Sold

The large and modern plant of the former Apperson Brothers Motor Car Co. at Kokomo, Indiana, has been recently purchased by the Wolf Manufacturing Industries of Quincy, Illinois. The plant has over 200,000 square feet in modern one story buildings with every manufacturing and shipping facility provided.

The Wolf Manufacturing Industries will occupy this plant at once, giving them the additional space needed for expansion. The re-location of this industry was effected by the Fantus Factory Locating Service of Chicago.

This is the second important Radio and Phonograph industry located in Kokomo within the past few months, the former being the Davis Industries of Chicago, who purchased the large Haynes Assembly Building with 300,000 square feet.

Klosner

The Klosner Radio Corporation, 1022 E. 178th St., New York City, is making a new Type T socket which is designed especially for sub panel wiring. It is not necessary to drill a large hole in the sub panel in order to mount this socket, since the terminals are so arranged that the regular screw holes will suffice. The list price of this socket is forty cents.

Showers Brothers Company

Showers Brothers Company, 914 S. Michigan Avenue, Chicago, is in production on the new Showers Laphonic Receiver. This model contains the regular 1927 chassis—one dial control, two stages tuned radio frequency, detector, and three stages of audio—and is manufactured under a license granted by the U. S. Navy Department.

The walnut cabinet is modeled around the phonographic style and a grill of gold cloth shields a Utah cone speaker.

Ford Methods in Radio

Mr. Fred Allison has resigned as Chief Electrical and Mechanical Engineer of the Ford Motor Company, and will now engage in Consulting Engineering work through H. R. Van Deventer Incorporated, 342 Madison Avenue, New York City.

Mr. Allison has been connected with Mr. Henry Ford for over twenty years and his activities have included all the diverse branches of the Ford Industries.

Some idea of the diversification of the engineering work handled by Mr. Allison will be apparent when it is considered he supervised the installation of the systems for the production of Ford cars, the building of electric locomotives for Ford's railroad, the building of turbines at the Ford plants which are among the largest in the country, installing plant for the production of over 10,000 storage batteries a day, installation of systems for the mass handling of lumber and ores in the forests and mines owned by the Ford interests, installing complete plant for producing small electrical motors used by Ford, together with conveyor equipment and equipment for the numerous electrical, mechanical, manufacturing and transportation groups that go to make up the Ford industry.

It is reported that not only will Mr. Allison's services be available to a limited number of manufacturers who wish to install the production methods originated by him but he is also in a position to grant licenses under many of his patents to manufacturers in a large number of industries to which these patents may apply.

The introduction of Mr. Allison's methods into other lines of industry, such as Radio, Iceless Refrigeration machines and other new devices adapted to mass production will be awaited with interest.

Fralick

S. R. Fralick and Company, 15 S. Clinton St., Chicago, are General Sales Agents for the line of Banner battery chargers, made by the Banner Radio Laboratories, of the same address. These chargers are the same as those formerly listed under the name Dynamik and are made in several types.

Plate Voltage Aplenty

for Big or Little Sets

TYPE 405
PLATE SUPPLY
Write for descriptive folder 405-M
GENERAL RADIO CO., Cambridge, Mass.

The Type 405 Plate Supply delivers ample plate power to permit its use with multi-tube sets where there is a heavy current drain as well as with receivers having small current demands.

The Type 405 Unit operates on 110-volt (60 cycle) A. C. and provides voltages of 45, 90, 130 and 200.

Voltages are readily adapted to plate requirements of amplifier tubes in popular use by means of fixed resistances. These resistances are tightly sealed from dust and moisture, thus eliminating bothersome and noisy tendencies of variable resistance voltage controls.

The Unit is contained in a metal case with attractive black crystalline finish and has a conveniently located A. C. switch.

Type 405 Plate Supply with Type BH Raytheon Tube $46

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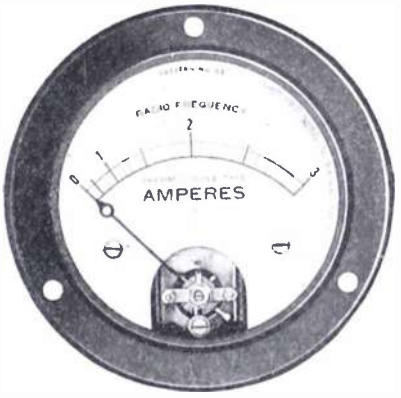
PARTS AND ACCESSORIES

The General Radio Company has endeavored to make it possible for the experimenter to obtain its products with minimum of effort. A careful selection of distributors and dealers has been made. They are best suited to serve you. If, however, you are unable to obtain our products in your particular locality, they will be delivered to you, post paid, direct from the factory upon receipt of list price.

JEWELL

MAKES--

Any Set Attractive



Pattern No. 135—Movement parts are all silvered and the scale is silver etched with black characters. The case diameter is two inches and can be furnished in any desired finish, standard being black enamel. It is equipped with zero adjuster, as are all Jewell moving coil instruments.

An instrument mounted in the panel of a radio set makes a very practical as well as attractive addition. It increases the sales value of any set many times in excess of the cost of the instrument itself.

Radio engineers working on new radio set designs for 1927 find in the Jewell Pattern 135 an ideal instrument for panel mounting, and many of the new fall sets will be so equipped.

It is a moving coil instrument of the highest grade, and is available in a large range of scale values including milliamperes as well as single and double voltage ranges suitable for A and B battery checking and filament regulation.

Write us about your set requirements

Jewell Electrical Instrument Co.

1650 *Walnut Street* -- *Chicago*

"27 Years Making Good Instruments"

RMA RADIO MANUFACTURERS ASSOCIATION MEMBER

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Readers interested in products not listed in these columns are invited to tell us of their wants, and we will inform the proper manufacturers. Address Readers' Information Bureau. Addresses of companies listed below, can be found in their advertisements—see index on page 598.

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Carter Radio Co.

AERIALS, LAMPSOCKET:
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COILS, TRANSFORMER
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Union Radio Co.

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Donle-Bristol Corp.
Equamatic System.
Karas Electric Co. (Equamatic)
United Scientific Laboratories. (Pierce-Aero)

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KITS, TRANSMITTING:
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Carter Radio Co.
Electrad, Inc.
International Resistance Corp.
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Federal Radio Corp.
International Resistance Corp.
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X-L Radio Laboratories.

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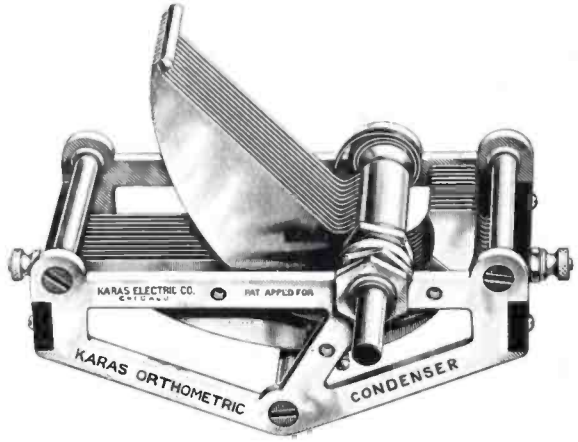

KARAS ORTHOMETRICS SPECIFIED FOR THE AERODYNE RECEIVER

THREE Karas .00037 Mfd. 17 Plate Orthometric Variable Condensers are specified by the Aero people for use in constructing the super-sensitive 5-Tube Aerodyne Receiver. This famous receiver has won a unique place for itself because of its remarkable performance and extreme selectivity under the most adverse conditions. Distant stations can be brought in through the heaviest kind of a local barrage, and tuning is remarkably sharp.

The Aerodyne not only is an easy receiver to build, but it also is extremely easy to tune. The wide, even separation of wavelengths afforded by Karas Orthometrics makes tuning a pleasure. These condensers actually eliminate crowding from every part of the dials. Every point on the dial from 1 to 100 thus becomes a separate broadcasting wavelength. For Orthometrics are strictly straight frequency line variable condensers. Each station is equally separated from its adjoining stations in both directions by 10 kilocycles, exactly as wavelengths are allocated by the Government.

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Orthometric Condensers have die-stamped solidly braced plates and frames of finest quality brass, and both rotor and stator plates are soldered at every contact point. Frame and rotor plates are grounded to eliminate body capacity. Rotor is held in cone bearings which permit easy, smooth action, yet with permanent alignment. Hard rubber dielectrics placed well outside of the effective electrostatic field eliminate absorption losses. Tests have shown that Orthometrics have no measurable losses—and resistance has been reduced to the absolute zero point within the limits of modern engineering.

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Your dealer carries Orthometrics or can get them for you. If you are in a hurry you may order direct from this advertisement by filling out and mailing the coupon. SEND NO MONEY. Merely hand the postman the price of the condensers plus a few cents postage. Start building your Aerodyne NOW.

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FOR the Victoreen A. C.-operated Super described in this issue of Radio Engineering two Karas Harmonik Audio Frequency Amplifying Transformers are specified. As is well known, the Victoreen is famous for the volume of highest quality tone it offers those who seek natural, pure, sweet reproduction of both voice and music. Harmoniks help to insure the marvelous reception you will enjoy when you build the Victoreen.

Natural Tone Through Scientific Design and Construction

The sweet, natural tone of the Victoreen or of any receiver employing Karas Harmoniks is due to the scientific design of these famous transformers. They actually deliver more total amplification of the vital harmonics than do other transformers lacking Karas features. For example, we build Harmoniks with large coils to give a very high inductance, and Harmoniks also are very high impedance transformers, with extremely low distributed capacity. This makes for full, rich, mellow, rounded tones, with no indistinct, blurred reproduction, whether you are working on DX or local stations.

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Order Harmoniks from your dealer today. If your dealer is out of stock and you are in a hurry you may order them direct from us by filling out and mailing coupon below. If you order from us SEND NO MONEY. Merely hand the postman the price of the two transformers plus a few cents postage, upon delivery. Build the Victoreen—send for your Karas Harmoniks NOW.

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1094 Association Bldg., CHICAGO

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Address.....
City.....State.....
(We prepay postage when cash accompanies order.)

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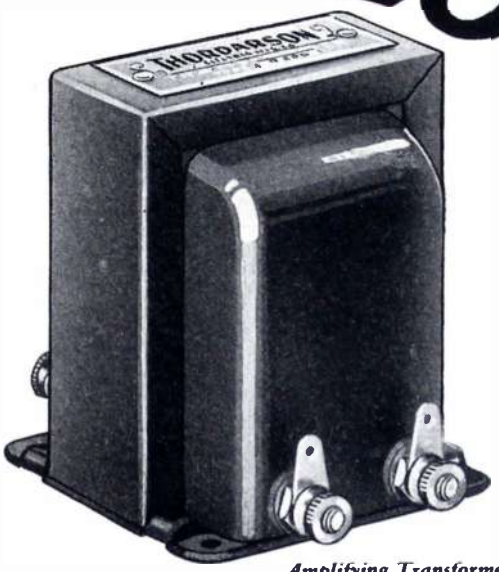

Amplifying Transformer Type R-200

Thordarson Amplification Reproduces Every Note

NO NOTE of any instrument — not even the faintest harmonic — can escape Thordarson Amplification.

Leading Radio set manufacturers know this secret of musical reproduction. That is why you find more Thordarson transformers in quality receivers than all competitive transformers combined.

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Stop overloading your last audio tube. A power amplifier and "B" eliminator built with the Thordarson Power Compact will give full reproduction to the deeper tones that the ordinary amplifying tubes cannot handle.

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Audio—Battery Eliminator—Power Amplifier Transformers and Chokes All Styles

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