Vol-11 283
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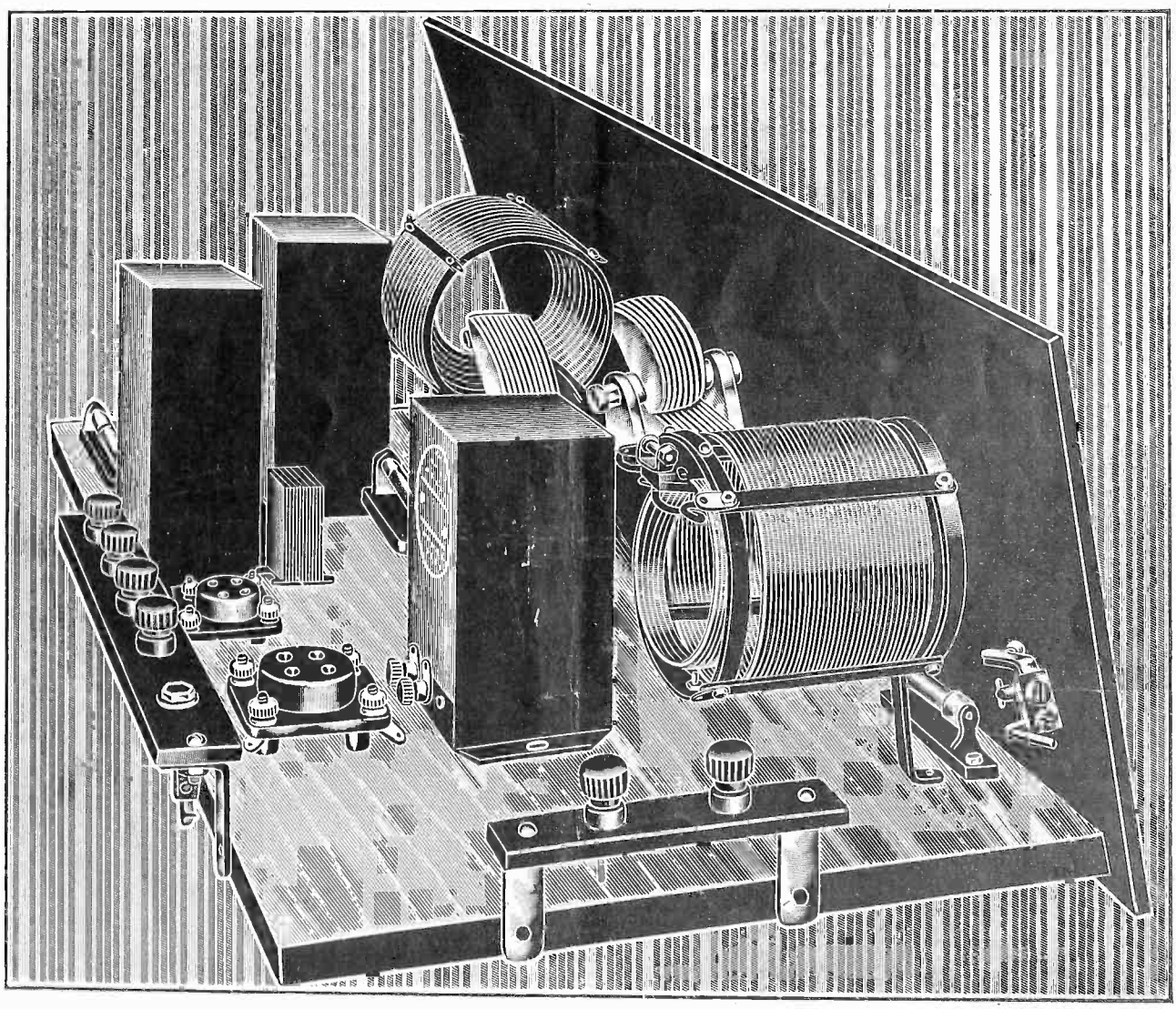

One Dial, One Switch, One Volume Control, but a Double Condenser and Double Impedance Audio Are Used in This Attractive Receiver. See page 3.

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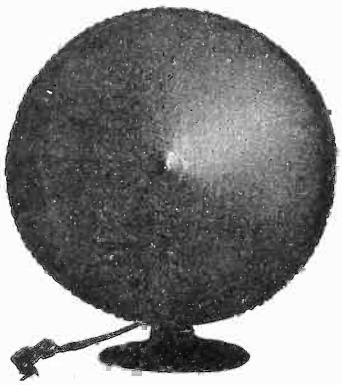

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SIXTH YEAR

RADIO WORLD

REG. U.S. PAT. OFF.

Vol. XI
No. 23

Whole No. 283
August 27, 1927

15c per Copy. $6.00 per Year

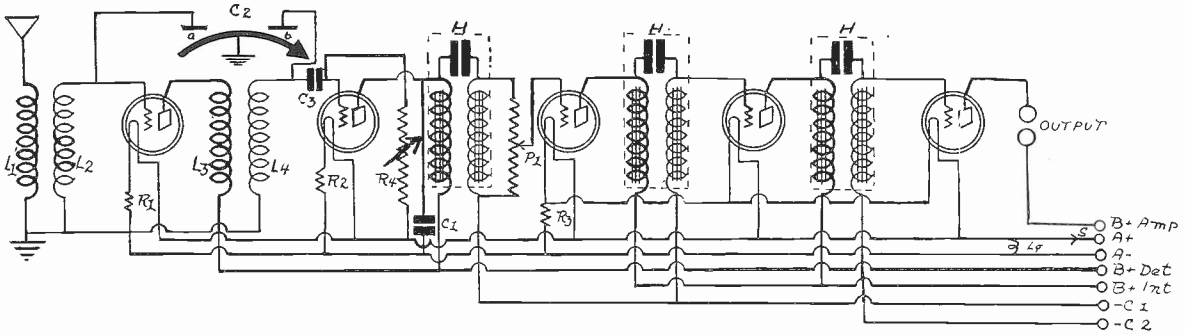
A Weekly Paper Published by Hennessy Radio Publications Corporation from Publication Office, 145 W. 45th Street, New York, N. Y.

Phones: BRYant 0558 and 0559

[Entered as second-class matter, March, 1922, at the post office at New York, N. Y., under Act of March, 1897]

The One-Dial Witz

By A. Irving Witz



THE circuit diagram of the One-Dial Witz Receiver, employing the double impedance system of audio amplification. It also employs a double condenser for simplified tuning. The pilot light is a part of the National dial.

PART I

WHAT are some of the advantages of the double impedance system of audio amplification which in a comparatively short time has succeeded in capturing the interest of the engineers and the fans alike? Surely the advantages are real and not fancied, or the engineers would have discovered the flaw and the rapidly increasing number of fans would not continue to be satisfied with their double impedance receivers.

Let us attempt to answer the question before we take up the description of a receiver in which the system is incorporated.

One of the obvious advantages of the system is the high degree of amplification of which it is capable. The plate coupling coil has a very high inductance, which is equivalent to a high impedance at any one frequency. Since the tube works into a very high impedance, nearly the entire voltage available in the plate circuit of the tube is transferred to the next tube. If the amplification constant of the tube is 30, the step-up per stage at 1,000 cycles per second is about 29. With certain resistance coupled amplifiers this would not have been more than 20, or two-thirds the mu of the tube.

Hence the gain in amplification is considerable in a circuit having three double impedance couplers.

Works on Low Plate Voltage

Another advantage is the low voltage requirements for the plate circuits. The choke coil through which the plate current flows has a comparatively low resistance. Hence the voltage drop in the coil will be negligible. This makes it practicable to work the amplifier with applied voltages as low as 45 volts, whereas in a resistance coupled amplifier voltages as high as 180 volts are desirable.

The low voltage requirement is an advantage especially when dry cell batteries are used to activate the set.

Again it will be recalled that when the load impedance on a tube is very high the amount of harmonic which is introduced into the signal is negligible. Thus in this system the wave form of the signal will remain pure.

These are considerable advantages yet they are of less importance than the advantages the system offers on the grid side of the couplers. One of the greatest of disadvantages of ordinary direct coupled circuits is the effect of the grid current which flows when the grid becomes positive. When the resistance of the device delivering voltage to the grid is high there will be a considerable voltage drop in it, and the effective voltage on the grid becomes less. Amplification drops. In fact there is practically no amplification while the grid is positive. If the input voltage swings positive during part of the cycle the positive peaks of the wave will be cut off. This represents harmonic or wave form distortion.

Effect of a Coil

When an inductance coil is used in place of a high resistance the voltage drop in the device is negligible even when considerable grid current flows, and there is no appreciable diminution in the amplification on the positive peaks. It is possible to leave the grid bias zero and let the voltage swing just as much positive as negative without introducing wave form distortion. Hence it is possible to put much higher signal voltages on the tube than would be possible with a resistance grid leak. The output also would be much greater.

With a low resistance in the grid circuit there is no tendency for the tube to choke due to the accumulation of a negative charge on the grid and stopping condenser. This trouble is one of the most exasperating in ordinary direct coupled circuits.

When hooking up a double receiver with a B eliminator one is at once struck by the absence of low frequency oscillation which is common in many other types of receivers. That is, the receiver does not motorboat. Naturally, that is a great advantage, because if a circuit motorboats it is of no value no matter how well it has been designed otherwise.

The reason for the absence of motorboating may be found partly in the phase relations in the circuit and partly in the amplification at the extremely low notes.

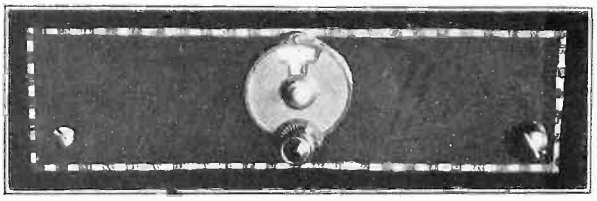
Amplification Analyzed

Each coil in the circuit introduces a certain change of phase in the signal. The condenser also introduces a change of phase. A complete coupler comprising the plate coil, the condenser and the grid coil, introduces a definite phase shift at any given frequency. This shift will throw the currents in the eliminator out of phase with each other so that they cannot produce motorboating. Particularly, the current through the loudspeaker is out of phase with the current through the first plate coupling impedance. When these two are opposite in phase, or if they are out of phase more than 90 degrees, the circuit is stable and will not oscillate.

The amplification at the sub-audible frequencies is low in this amplifier for two reasons. The first is that a finite stopping condenser is used and the second is that the various choke coils are not effective at these very low frequencies. This fact prevents the circuit from motorboating at the low frequencies, but it does not prevent the amplification of the audible frequencies. The capacity of the stopping condenser and the inductances of the two chokes in each coupler have been chosen so that the amplification is satisfactory down to the lower limit of audibility, while the amplification is very low below that limit. The low amplification at the sub-audible frequencies prevent very slow motorboating or fluttering.

The Inverse Proportion

An objection may be raised against the claim of sharp demarcation between the transmitted and the suppressed frequencies on the ground that the impedance of the stopping condenser is inversely proportional to the frequency and that the impedance of the choke coils is directly proportional. These facts would tend to make the transition from high to low amplification very gradual. And would, if either the chokes or the condenser alone were effective. When both inductance and capacity enter, the phenomenon



VIEW of the front panel of the one-dial set. The volume control, an Electrad type E Royalty, is at right, the switch at left. The National type C dial is used on the Lignole panel.

LIST OF PARTS

C2—One double section, .00035 mfd. Continental die-cast condenser.
C3—One Electrad .00025 mfd. grid condenser.
C1—One Electrad .0005 mfd. condenser.
R4—One Turnit grid leak, .5 to 12.5 megohms.
R1, R2—Two No. 1A Amperites.
R3—One No. 4A Amperite.
P1—One Electrad .5 megohm potentiometer (Royalty, Type E).
L1L2, L3L4—Two radio frequecy transformers for .00035 mfd. condensers.
HHH—Three F.M.C. double impedance couplers.
Lg—One six-volt pilot light.
S—One switch.
Nine binding posts.
One standard battery cable.
Five UX sockets.
One National Type C vernier dial.
One 7x21 inch Lignole inlaid two-tone panel.
One 7x20-inch wooden baseboard.

of resonance also enters, and where that occurs the amplification will be very high.

Now, it is possible to choose the values of the inductances and the capacity so that the resonance occurs rather low in the scale. This will keep up the amplification of all frequencies above the resonance frequency. The change in the amplification below the resonance point will be very rapid. This accounts for sharp cut-off. If it is desired to amplify all notes evenly down to 50 cycles per second the resonance point might be placed between 75 and 100 cycles. If it is desired to go down to 16, the resonance might be placed between 24 and 32 cycles. In this coupler the amplification is uniform down to about 30 cycles per second.

Two identical radio frequency transformers L1L2 and L3L4 are used in the receiver. The two secondaries L2 and L4 of these are tuned with a double Continental Die Cast condenser C2 of .00035 mfd. capacity per section. Careful adjustment of the inductances and the distributed capacities in the two tuned circuits is necessary to get the greatest selectivity and sensitivity out of this arrangement. But it is only necessary to make this adjustment once. To facilitate the adjustment of the distributed capacity, the rotor plates of one of the sectional condensers are shifted, if necessary. Small adjustments of capacity can be effected when tubes are changed, as different tubes have different capacities. The capacity difference thus established for equalization varies at the same rate as the condenser in rotation, a good point.

Discussion of Constants

A grid condenser C3 of .00025 mfd. capacity is connected in the grid circuit of the detector tube. The grid leak resistance R1 is variable and it is connected between the grid and the positive side of the filament. It is variable so that the detector circuit can be adjusted for optimum sensitivity for any given signal strength. It is connected in parallel with the tuned circuit so that the positive grid return can be used when the tuning coil returns to the negative or ground. The coil is thus returned because the rotor side of the double condenser is grounded.

To provide a low impedance load on the detector for the radio frequencies, a by-pass condenser C1 is connected across the first plate coupling choke, or rather from the plate to ground. This also by-passes the batteries. The condenser should be of .0005 mfd. capacity.

For controlling the volume in the set a high resistance potentiometer P1 is connected across the first grid choke coil. This instrument should have a resistance of 500,000 ohms. By means of this the volume can be varied from almost zero to the full output of the circuit.

There are three double impedance couplers H in the circuit. The symbols inside the dotted lines indicate just what is an integral part of each coupler.

Plate and Grid Voltages

The plate voltage on the detector and the radio frequency tube is 45 volts, obtained from the B plus Det. bus wire. The plate voltage applied to the intermediate audio amplifiers is 90 volt, obtained from the B plus Int. bus wire. The voltage applied to the last tube is 180 volts.

The grid voltage on the RF tube is obtained from the drop in the Amperite R1. The normal drop in this ballast is one volt.

While a grid bias is not necessary on the intermediate tubes with the double impedance coupling system, bias voltages can be used if desired. When a bias is used the value depends on the type of tube that is used. Since the load impedances in these tubes is very great, high mu tubes like the CX-340 can be used to advantage. Fine results are obtained with —01A tubes. The grid voltages for these tubes with 90 volts on the plates are as follows: CX340, 1½, and —01A, 4½ to 6 volts.

The last tube should be a —71 type power tube. Since the applied plate voltage on this tube is 180 the grid voltage should be 40½ volts. The small battery E gives this bias. By tapping suitably it will also give the bias for the other tubes if a bias is desired.

[*Part II Mr. Witz's interesting article will be published next week, issue of September 3. Constructional data will be completed then. In the two succeeding issues other important aspects of the circuit will be discussed.*]

WIZARD SPEAKS

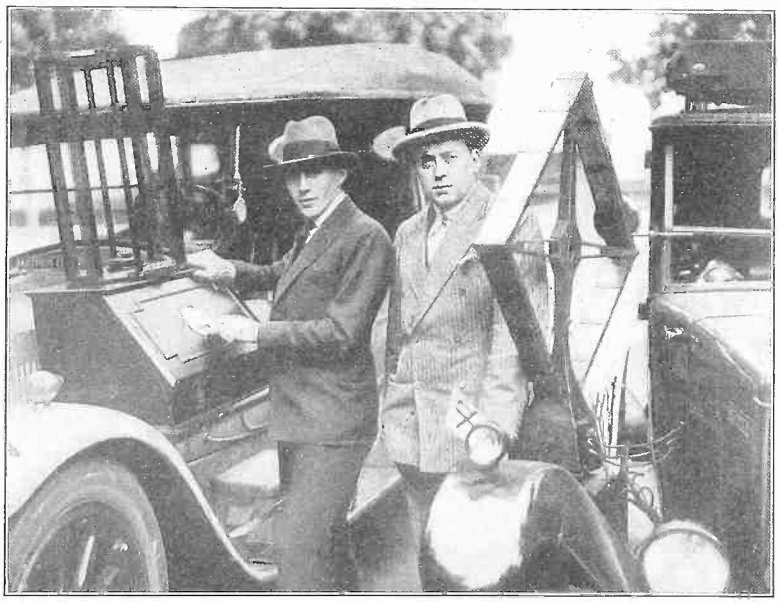
THOMAS A. EDISON RECITING

On the fiftieth anniversary of the invention of the phonograph a reception was given in honor of Thomas A. Edison, the inventor, by his friends and business associates. Mr. Edison was induced to make a speech. It was one of the few times that the inventor had ever made a public address, and had spoken into a broadcast microphone.

The subject of his address was "Mary Had A Little Lamb." He recited the well-known ditty because this was the first thing that came to the inventor's mind fifty years ago when he was about to record his first record in the laboratory.

The photograph shows Mr. Edison telling the radio listeners about the faithfulness of Mary's little lamb.

"DON'T WRITE—"



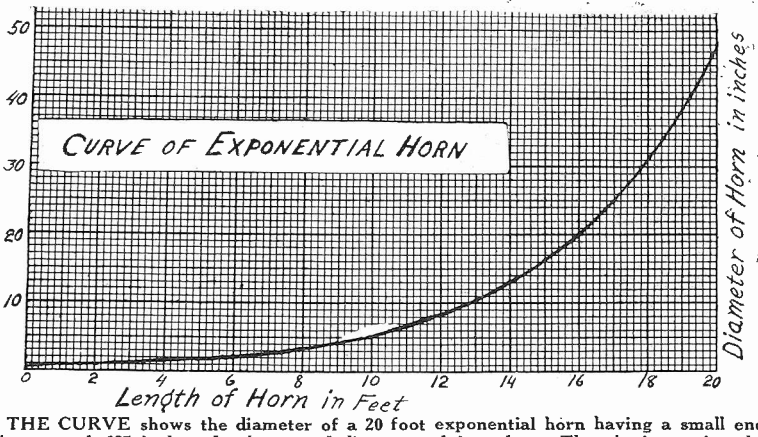
(Herbert Photos)

CAPTAIN L. F. PLUGGE (right) and Horace Connell (left) with their radio equipped cars. These well-known Europeans will attempt to keep in constant communication with each other while touring about 500 miles apart on a trip through southern Europe.

What Is the Exponential Horn?

By H. B. Herman

Acoustical Expert



THE CURVE shows the diameter of a 20 foot exponential horn having a small end diameter of .625 inch and a large end diameter of four feet. The abscissas give the length of the horn in feet and the ordinates the diameter in inches.

In the constant quest for better reproduction of radio broadcasts many types of loud-speakers have been made and marketed. At first we had the horn in its devious forms. We had straight horns, bent horns, coiled horns, reflex horns. We had horns of circular cross-section, of elliptical cross-section, of square section, of hap-hazard cross-section. We had horns of pyramidal and conical lines and we had horns with graceful curved lines. We heard about exponential horns but we did not see any, not in the radio field. Following the era of horns we entered the era of cones, discs, and other large diaphragms. We also entered the era of better reproduction and of a greater demand for still better reproduction. Then in the midst of popular acclaim for the cone a couple of engineers had the audacity to bring out another horn, this time an exponential horn in fact. And they claimed for it uniform reproduction over the entire audible range of frequencies and great volume as well. One of these exponential horns was used at the Westinghouse plant in Pittsburgh for projecting the human voice over a distance of three-quarter of a mile. The voice was clear and easily intelligible. Again horns of the same type were used to inform the New York crowds of the progress of the welcoming ceremonies in honor of Com. Richard E. Byrd and his crew and Clarence Chamberlin. The voice of the announcer was clearly heard over the din of the street.

ACOUSTICAL engineers are agreed that the exponential horn is the most uniform sound radiator. They have proved mathematically that it is so, and they have corroborated their deductions by experimental evidence. What is meant by "the most uniform sound radiator" and of what practical interest is such a radiator?

The uniform sound radiator radiates sound energy at the same rate at all frequencies. It does not favor the very low notes, nor the very high, nor the medium, nor any other notes. It is as impartial as a judge is supposed to be. It has no resonance peaks.

Stated otherwise, it has a straight line output characteristic. The practical value of such a radiator is that it is capable of faithfully reproducing whatever is impressed on the driving unit. It is distortion free. By the "most uniform sound radiator" is meant the most nearly uniform radiator. The fidelity of the output of such a radiator depends directly on how "nearly" it is uniform.

Nearest to Perfection

The well-constructed exponential horn radiator is as close to the uniform as can be attained in practice, and hence it is capable of quality as near perfection as possible, provided that perfect quality is delivered to it by the receiver and driving unit.

There are certain practical limitations which prevent the exponential horn from being a perfect radiator. The main one is the necessity of termination. The horn cannot be indefinitely long. Neither can it have an indefinitely wide flare. This limitation militates against the lower notes. But horns 20 feet in length will be uniform radiators down to a frequency of about 16 cycles per second; and lower it is never necessary to go since that is the lowest frequency that anyone can hear.

Now what characterizes an exponential horn? The rate at which the cross sectional area increases as the distance from the end increases.

The Mathematical Side

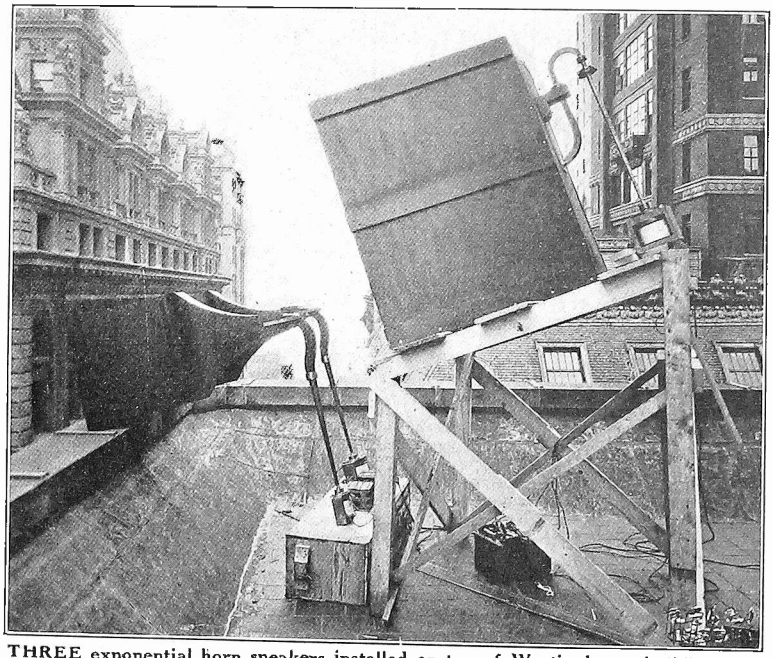
Suppose that the area of the small end is one square inch, that at one inch from the end it is 2 square inches, at two inches the area is 4 square inches, at three inches it is 8 square inches, and so on to the end, the area of the cross-section increases exponentially. A horn constructed according to this law would be an exponential horn, but the shape would not be practical.

Mathematically the requirements of an exponential horn can be stated thus:

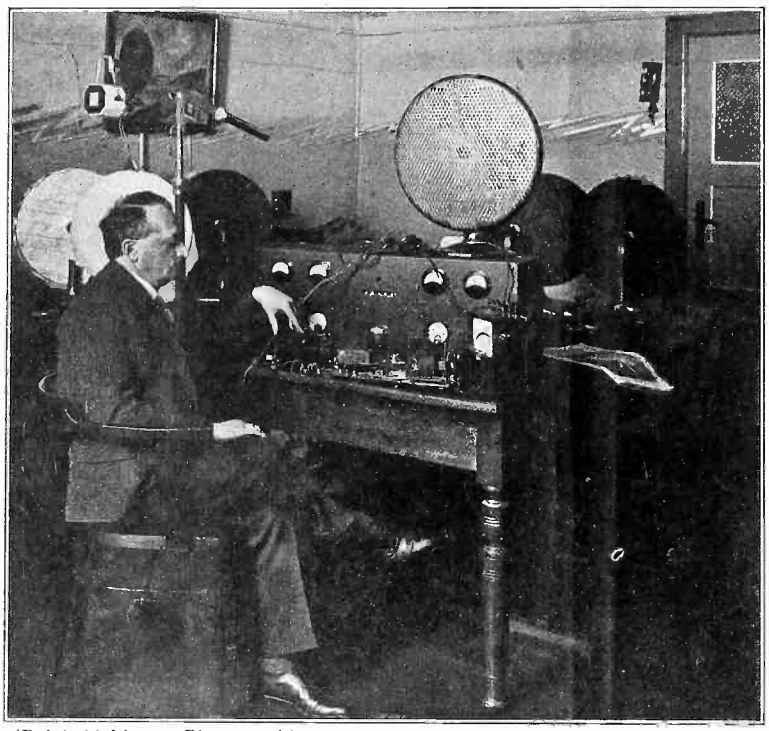
$$D=(Do)\ B^{L}$$

in which D and Do are the diameters at the large and small ends respectively and L is the length of the horn. B is a number which determines the shape of the horn in between the two ends when the length and end conditions are known. While this formula gives a relation between the linear dimensions of the horn it is not inconsistent with the requirement stated in the preceding paragraph

(*Continued on page 22*)



THREE exponential horn speakers installed on top of Westinghouse building lower Broadway on the occasion of Commander Richard E. Byrd's return from France.



(Reinhold Lissner Photograph)

EUGEN REISZ, the inventor of the Marbleblock microphone and the electro-static loudspeaker, is seated in his laboratory among some of his inventions. Note the marbleblock microphone suspended just above the inventor's head. Also note electro-static loudspeakers in various stages of construction.

Something

Condenser Type Being American Use—Original

By Eugen Reisz

MICROPHONE and telephone, these two elements of every electrical transmission of sound, have gone through a great many constructive improvements since the time of their invention. The principle of their mode of operation has, on the whole, remained the same up to the present time.

In the case of the microphone the sound is received by a diaphragm, the oscillations of which either cause changes of pressure in carbon particles, or alter the size of the capacity of a condenser. In the case of the telephone the sound is transmitted in the following way: the sound waves, which are produced by the microphone, alter the intensity of an electro-magnetic field, and these field-oscillations create the varying pressure on the diaphragm.

The sole improvements in the course of the last few years, regarding the construction of the transmission elements, microphone and telephone, consisted on the one hand in giving the microphone diaphragm a high self-oscillation, by means of a tight stretching of material, and on the other hand in changing the originally small metal diaphragm of the telephone into a large,

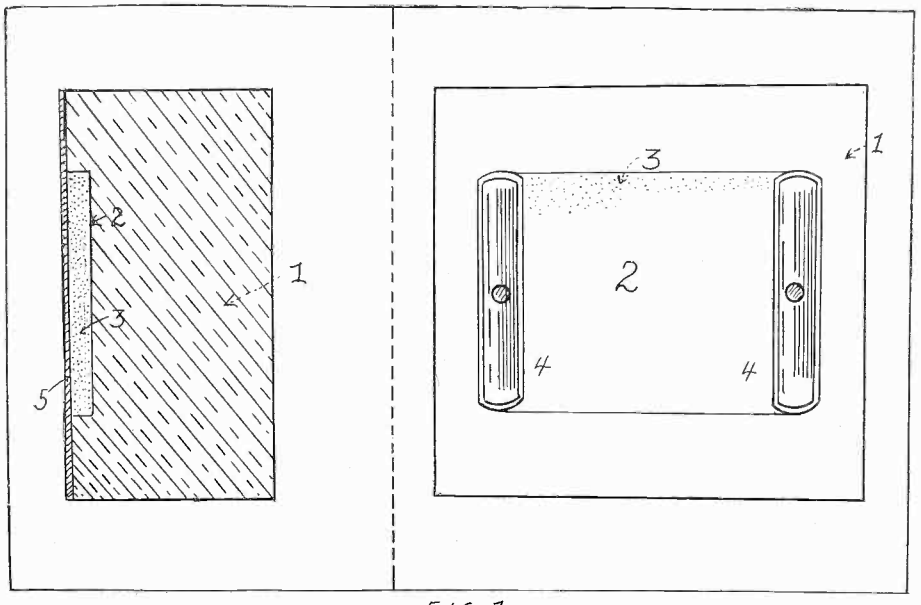


FIG. 1

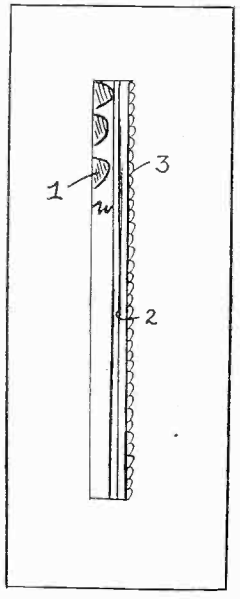


FIG. 2.

When Baron von Ardenne, the twenty-year-old German radio scientist, visited America a couple of months ago, he occupied a suite at the Hotel Commodore, New York City, while on the floor below Eugen Reisz, Berlin acoustical engineer and manufactuwer, occupied a suite. The Baron insisted he was not here on business, but simply to learn, and to make arrangements for a free exchange of ideas between the two countries. But Mr. Reisz was here admittedly to arrange for the introduction into the United States of his microphone, earphone and speaker, all of which are most extraordinary. He was aided in his negotiations by Eric Palmer, who was the official welcomer to both Germans, and who made all arrangements for their comfort and convenience while they were in this country.

One afternoon the Baron entertained some radio writers at luncheon in his suite and demonstrated a small receiver he had brought from Germany, which embodied a German three-in-one tube, the joint invention of the Baron and Siegmund Loewe. The set worked a pair of earphones, just ordinary ones. The Baron took keen delight in demonstrating the difference between mere earphones and Reisz phones, which were of the condenser type with a resistance as the impedance. The Baron's guests were startled at the thrilling realism of the low-note reproduction, notes coming through that were utterly unheard in the ordinary phones, and the whole music of the orchestra becoming endowed with crispness and sparkle.

Mr. Reisz was interviewed a few days later, through the courtesy of Mr. Palmer, and arrangements were made for the publication of the first article on the theory and practice of the Reisz microphone, earphone and Speaker. The article, written in English in Germany, is published in full herewith.

EDITOR.

New in Speakers

Perfected in Berlin for One Comes to Radio World

oted German Acoustical Engineer and Inventor

in most cases conical shaped, diaphragm of cardboard or other material of this kind.

Tightness Invites Distortion

The tightly stretched diaphragm of the microphone had the disadvantage that the sensitiveness of such a microphone was very small, so that amplifiers with several amplifying tubes had to be used in order to obtain better results. Though there are no difficulties to-day in constructing suitable amplifying sets with several tubes, i.e., to obtain a distortionless amplifying by means of good amplifying valves and transformers, it is most advantageous for practical use if rather the sensitiveness of the microphone is increased. In the case of amplifiers with several tubes there will often be a reaction between the input and output of the amplifier, especially if the conductors to the microphone are extremely long, or the output conductors vary too much in their character. In the case of carbon microphones the increase of the sensitiveness is already advisable for reducing the self-resonance of the microphone.

The object of all improvements, as regards the microphone, must always be the increase of the sensitiveness, which is identical with the problem of a stretched diaphragm.

Diaphragmless Microphone

My microphone construction, which is known as Reisz Microphone or Marble-block Microphone, and used by all European broadcasting stations, has no diaphragm. The changes of pressure, caused by sound, can directly influence the carbon particles. In this construction there is no difficulty to increase the sensitiveness so much that the sensitiveness of the old carbon microphones is obtained. In this case it would suffice to use amplifiers with only two tubes in the broadcasting stations. The danger of a reaction between the input and output will be absolutely done away with. Distortion with good one-tube or two-tube amplifiers is almost impossible, and the whole microphone will become cheap and simple for practical use. Owing to the great sensitiveness all undue resonances are absolutely eliminated. The construction of this microphone is to be seen in Fig. 1.

In the marble block (1) a chamber (2) has been worked out, containing carbon particles (3) of various sizes, which are supplied with direct current by the two fixed carbon electrodes (4). The chamber (2) is covered with a very thin and non-stretched rubber sheet or with a mica plate (5). This rubber sheet is no diaphragm, but only serves the purpose to separate the inside of the chamber from without.

The described microphone consists only of elements which are free from oscillations, of a marble block and carbon powder. Thus it is quite different from the known carbon microphones, which work with oscillating elements. Owing to a special construction of the chamber and enlargement of the carbon surface the sensitiveness may be increased ad libitum.

Curve Called Ideal

In the near future microphones will be placed on the market which have the same sensitiveness as the old carbon microphones. Carefully executed measurements have shown that the Reisz Microphones have an ideal working curve, i.e. they possess the same sensitiveness for sound waves of 30 to 10,000 cycles. As the making of these microphones is very simple and always shows a uniformity and as the effect cannot be influenced by climatic conditions, these microphones are superior to all other constructions.

Almost all constructed telephones are working with electro-magnetic fields, and have diaphragms of metal or paper. These diaphragms are conducted by the electro-magnetic field practically from one point, so that the oscillating elements are coupled loosely to each other. The result is that the whole surface of the diaphragm shows acoustic figures, and that the sound waves, when reproduced, do not correspond to the primary sound waves.

Again, Stiffness Means Distortion

The larger and more rigid the surface of the diaphragm, the more the distortion will grow in sound reproduction.

The self-oscillations of the vibrating elements on the surface of the diaphragm can only be eliminated if the whole surface of the diaphragm is in the magnetic field, as in this case the self-oscillation is damped considerably.

However, it is not possible to extend magnetic fields on a large surface with simple means, so that it seems impossible, from a theoretical point of view, to operate an electro-magnetically conducted surface of a diaphragm without resonances. The more rigid the material used for the diaphragm, the stronger the disturbing acoustic figures. On the other hand, a rather great rigidity is necessary to reproduce the high notes, so that it seems impossible to attain a satisfactory result in this way.

The condenser telephone has, compared with the electro-magnetic telephone, the advantage that the electro-static field can be equally extended over a large surface, damping the self-oscillations of each element. A faithful reproduction, even with the electro-static telephone, can be expected only if the self-oscillations of the surface elements of the diaphragm are outside the musical frequency range.

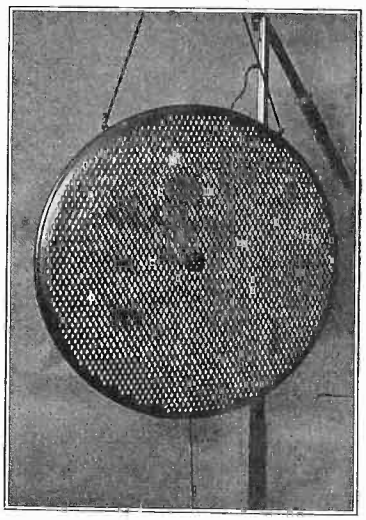
Meets Conditions

This condition is fulfilled by my condenser telephone, the construction of which is indicated in Fig. 2. A very thin sheet of rubber (2), which is closely connected with a powdery conductor (3), lies on a perforated plate. This plate represents one electrode of a condenser, the metal powder the other.

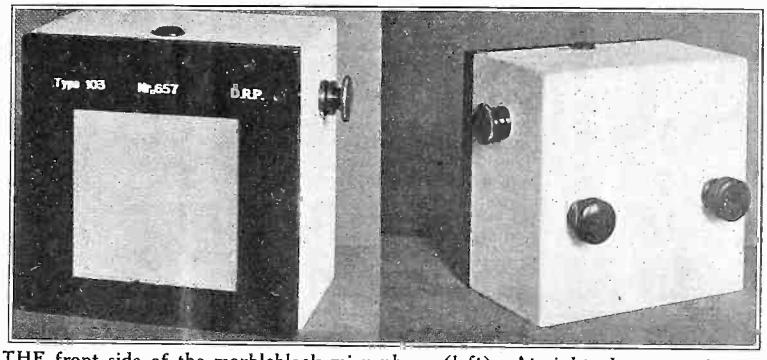
In the case of varying electric pressure between these two electrodes, the thin rubber sheet will oscillate and transmit these oscillations to the surrounding air. As the rubber sheet lies loosely, i.e. almost without any stretch, on the fixed electrode, thus its self-oscillation is outside the musical frequency range.

To attain a good working curve of the telephone it is necessary that the holes in the fixed metal plate be shaped conically, so as to facilitate, in the case of great amplitudes, a free oscillation of the elements of the diaphragm. Those earphones, which have already been constructed on this principle, have an ideal working curve, i.e., the sensitiveness is constant for a frequency range of 30 to 10,000 cycles. The loudspeaker, which is built with electrodes of 52 to 60 cm diameter, has an ideal working curve of 250 to 10,000 cycles. In the near future a model will be brought out in which the range will be extended to 30 cycles.

Judging from the results attained up to now, it seems most probable that it will soon be possible to give a perfectly faithful reproduction of speech and music with this electro-static loudspeaker.



THE front view of the Reisz condenser speaker.



THE front side of the marbleblock microphone (left). At right, the rear side of the marbleblock microphone, showing the marble and the terminal posts.

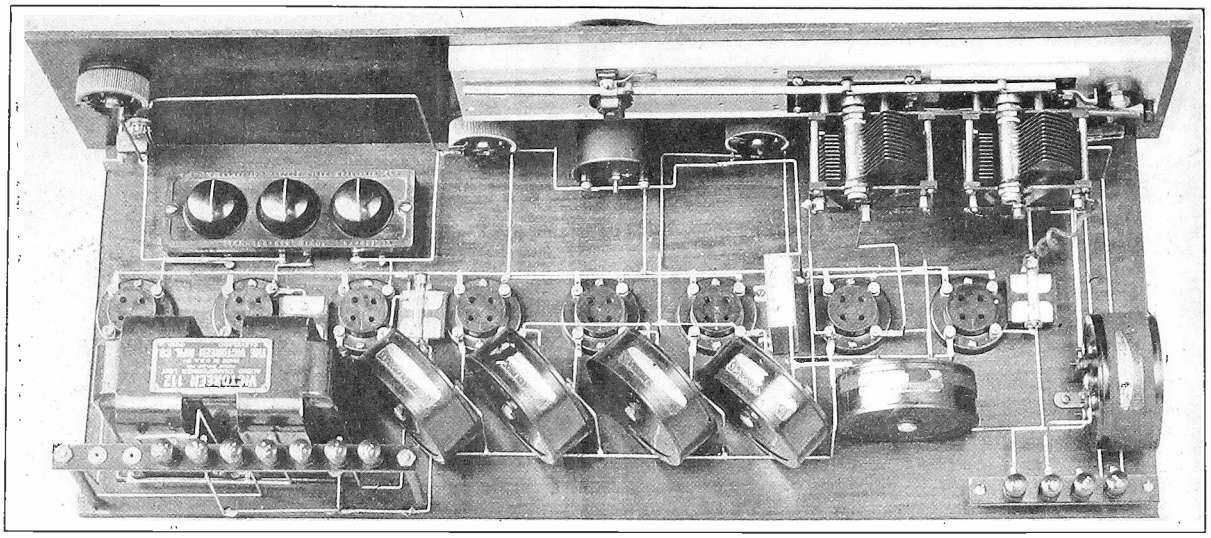
Lowest Notes Are Heard On New Reisz Speaker

Berlin, Germany, August 15, 1927.

Mr. Herman Bernard,
c-o Radio World,
145 West 45th Street,
New York, N. Y.

In my laboratory a loudspeaker is now being made, based upon the electrostatic principle. This loudspeaker reproduces completely the lowest notes, and I will see that it is sent to you as soon as it is finished.

Yours faithfully,
EUGEN REISZ.



HERE is an advance showing of the 1928 Victoreen Universal Circuit, soon to be described in Radio World. Note the placement of the intermediate coils and also the position of the new Victoreen 112 Audio Unit. The Victoreen was subjected to months and months of testing and experimenting and the above was the choice.

A Club Based on a Circuit!

Victoreen Admirers Elect President—Hold Meetings and Weighty Discussions

By James H. Carroll

Contributing Editor; Associate, Institute of Radio Engineers

THAT a club has been built up around a radio circuit is a fact indeed. And the circuit is the famous Victoreen-eight tubes, but oh, what a kick! Eight tubes last year, eight tubes this year, and eight tubes next year.

The Victoreen Club, of which I am a member, mets at the office of its president, Paul R. Fernald, at 168 Washington Street, New York City. There members discuss the circuit, report on kinks they've tried in connection with it, tell of remote stations they picked up through the local barrage, and discuss radio topics in general. No doubt branches will spring up throughout the country.

It is the consensus of members of this club that the Victoreen is the simplest Super-Heterodyne to build and operate.

Some Efficiency Data

In spite of the Victoreen's ease of construction, tuning and operation, a small percentage of fans encounters what is called "trouble." In 99 per cent. of these cases, upon investigation, the fault is found to be their own. These fellows would encounter trouble in the most simple and fool-proof diagram or apparatus that could be devised, because they will insist on following their own ideas of what they think should be done regardless of what is specified or what they are advised to do.

Most of these chaps have a psychological reflex which causes them to go to the right when you say "left," or to rush onward when you cry "stop."

Others are preternaturally bright and believe they can improve the results of hard-fraught research and testing by the designer of the circuit—these experiments being made entirely in their behalf to save them time, money and worry and to give them the best results.

Figures compiled from the card-index reports filed in the H. & F. Radio Laboratories, New York City, show that 75 per cent. of the Victoreen so-called troubles inspected were due to mistakes by fans in wiring, and deviations from the blueprint; 20 per cent. were due to the substitution of inferior parts for those specified, and the remaining 5 per cent. were due to what we might call natural causes This record covers the past two years.

Our next pointer is on increasing efficiency in battery operation. With the regulation placement in line of block B batteries, two for 90 volts, three for 135 volts and four for 180 volts, it will be found that the intermediates are functioning on one battery of the series only, thus causing a higher resistance in that particular battery than in the rest, not evenly distributing the load throughout the circuit. This is liable to cause some noise and trouble in tuning for extreme distance, in some instances blocking the signal entirely.

Plate Voltages

Placing a variable resistance, such as the Clarostat, in the detector line and stepping the source voltage from 45 to 90 volts input we can control to almost a millivolt the current flow on to the intermediates and the oscillator. And still finer results may be accomplished with a separate control on the oscillator voltage.

This method also distributes the resistance more fully throughout the line and does not cause any one battery to bear the burden. This results in longer battery life, fewer frying noises and absolute control of the set for DX tuning. In installing this system, use a 1 mfd. condenser to by-pass this resistance.

Another pointer for those who favor the use of by-pass condensers, we find that if the .001 condenser bypassing the plate of the second detector is taken to the negative of its own tube rather than directly to the negative battery lead clearer results will be obtained. If a milliammeter is used be sure to bypass it with a .001 between the poles.

The Audio Unit

As to pointers on the audio, exclusively, there are many audio ends in vogue and all popular with their owners. However, for the real Victoreen fan there is now ready the new Victoreen 112 Audio Transformer Unit, designed especially for them by John A. Victoreen and built into perfect form by the engineers of the Victoreen research laboratory. Its quality is wonderful.

Physically and mechanically it is a beautiful piece of work, and severely tested and charted it shows a fine curve and marvelous characteristics. There are many unusual features about this unit and many preconceived notions of some of our experts are upset but it looks mighty good to the seeker after perfection. Two power tubes are called for with its use 112s being recommended and the power prescribed to operate them is 250 volts or over so that ample volume with perfect tone quality, the best that a 36-inch cone can deliver, is the result.

The quality is a revelation to even the most experienced fan.

Push-Pull for Pep 'n' Power

80 Volts on Last Grids BUT Let 'em Swing!

By J. E. Anderson

Contributing Editor; Associate, Institute of Radio Engineers; Consulting Engineer

HUNDREDS of thousands of receivers are in use throughout the country in which there is no provision for high power amplification. In many of the sets the output tube is only a —99 type while in many others it is only an —01A type. Neither of these tubes can handle enough power to drive properly a good loudspeaker. Even such tubes as the —20 and the 112 cannot handle enough undistorted power to satisfy modern demand for quality and volume. To get really good results when using a first-rate loudspeaker it is necessary to use a —71 or a —10 tube in the output stage. To get the very best results two of either of these tubes should be used in a push-pull arrangement in the last stage.

It is not necessary to rebuild the old set nor to buy a new one in order to take advantage of modern power amplification. An inexpensive addition can he connected to the old set and make it handle all the power that will be required for the best loudspeaker.

Need of High Plate Voltage

An objection will be raised against this solution to the problem on the ground that those who have inadequate receivers are not provided with suitable voltages to operate the power tubes. That objection is met, if you have alternating current, by the installation of a battery eliminator in the addition. This eliminator will not only supply the high voltage necessary to feed the power amplifier tubes but also to supply the plate voltage to the tubes in the old receiver.

Fig. 1 is the diagram of a stage of push-pull power amplification with a B eliminator attached. The cost of construction of this circuit is not prohibitive and it will pay for itself in satisfaction many times a year.

The input transformer T1 may be any good coupling transformer, e. g., Karas, Amertran AF7, Silver Marshall 220, Pacent Super Audioformer, Samson AW3, etc. Its ratio is of little importance, but usually the better transformers stick to low or medium ratios. The secondary voltage of this transformer is divided equally between the two tubes of the push-pull amplifier by means of resistances R1 and R2. These resistances should be equal, and it will pay the constructor to take steps to insure that these resistances are closely the same. Each should be about 0.5 meg.

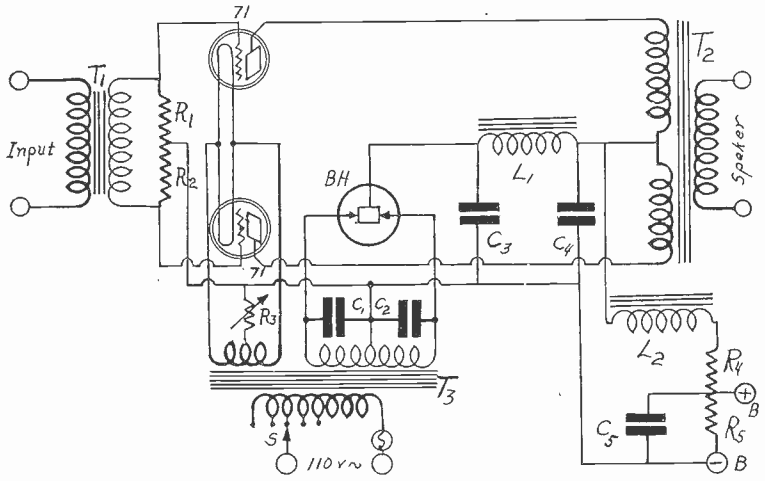


FIG. 1

The circuit diagram of a push-pull stage of power amplification using two —71 tubes, in conjunction with a B and C eliminator employing a Raytheon BH tube.

LIST OF PARTS

R1, R2—Two .5 meg. Lynch resistors.
R3—One Ward Leonard Adjustat, 2,250 ohms.
R4, R5—Two Ward Leonard 5,000-obm resistors.
C1, C2—Two Tobe .1 mfd. condensers, 1,000-volt test.
C3—One Tobe 2 mfd. condenser.
C4—One Tobe 4 mfd. condenser.
C5—One Tobe 4 mfd. condenser (up to 12 mfd., if possible).
T1—One audio frequency transformer.
T2—One output transformer, with center tapped primary (Silver Marshall 231).
T3—One power transformer with one 700 volt or so winding, center tapped; one 5-volt winding center tapped (Thordarson; Acme .2 kw).
S—One indicating snap switch.
F—One fuse and receptacle.
L1—One Acme BA2 choke.
L2—One fine wire choke coil of about 100 henrys.
Three standard tube sockets.
Six binding posts.
One baseboard 7x10 inches.
One extension cord with plug.
Two —71 tubes amplifiers.
One Raytheon BH rectifier.

An Insight Into Overloading

Since the maximum input peak voltage to a —71 tube is forty volts, the circuit will not become overloaded until the total voltage across the secondary of the transformer exceeds 80 volts.

This will insure a high output power which will be sufficient for even the lowest audible notes. The 40-volt swing is the maximum allowable when a single —71 tube is used. When two of them are used in push-pull arrangement this may be exceeded without causing distortion. Hence there is considerable reserve power available to take care of unusual demands.

The question now arises as to whether an 80-volt input swing can be undistorted if the previous output of the existing set employs a —99 tube or an —01A tube, as the output (the tube preceding the Fig. 1 arrangement). This can be decided only when the ratio of the transformer T1 is known. Let us suppose that the ratio is 4-to-1. To get 80 volts across the secondary the primary voltage must be 20 volts, or a little more. Now the —99 type tube has an amplification constant of 6.5. If we assume that the impedance of the transformer primary is high enough so that the voltage across the primary at the lower audible frequencies is 2/3 of the total voltage in the plate circuit of the tube, the total voltage must be 30 volts. Dividing this by the amplification constant of the tube, or by 6.5, we get the voltage swing that must be put on the grid of the —99 type tube to give us a voltage of 80 across the secondary of the transformer T1. The division gives about 4.6 volts, which is not excessive to give undistorted output provided that the proper plate and grid voltages are used on the —99 tube. If the —99 type tube will work without overloading with the push-pull amplifier, the larger tubes will also work safely. This conclusion was based on a 4-to-1 transformer having a high impedance primary. The latest and best-known audio transformers meet the requirements.

AC Heats Power Tubes

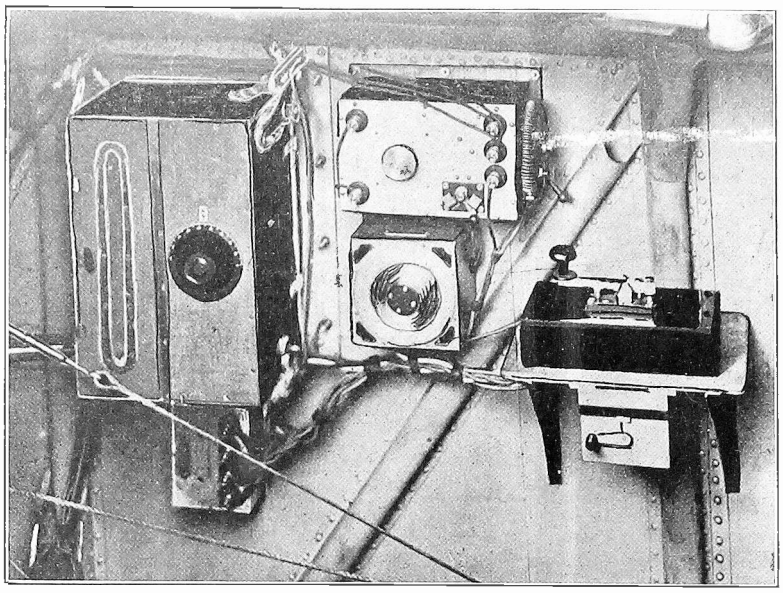
The loudspeaker can be coupled to the push-pull tubes by means of an output transformer T2. The primary of this transformer should be center-tapped for connection to the plate voltage source.

The filaments of the two power tubes are heated with alternating current taken from a low voltage secondary of the power supply transformer T3. This low voltage winding is center tapped so that the grid and plate returns can be connected to the neutral point.

The grid bias for the power tubes is obtained in the usual manner by means of a resistance placed in the common return. This is R3 (lower left). When one tube is used the value of this resistance is 2,000 ohms, but when two tubes are used it should only be 1,000 ohms, since the plate current will be twice as great. This will give a bias of 40 volts to the grids when the plate voltage is 180 and the plate current in each tube is 20 milliamperes. R3 might well be a Ward Leonard variable wire-wound resistor with a maximum at 2,250.

The plate voltage is obtained from a high voltage winding on the power transformer with the aid of a Raytheon double wave rectifier and a filter system. The total voltage across the high winding should be about 700 volts. The buffer condensers C1 and C2 across either half of the high voltage winding are of .1 mfd. capacity of 1,000 working volts.

COURTNEY PLANE'S INSTALLATION



(Herbert Photos)

THE COCKPIT of the Whale, Captain Frank T. Courtney's Dornier-Napier Seaplane, in which he planned to fly from Ireland to New York. The neat arrangement of the radio installation is shown. The transmitting key is at the right and the receiver at the left, both within easy reach of the operator's hand. Electric power is obtained from a wind-driven generator atop the fuselage. The antenna system is built above the fuselage and supported by the wings. This is an improvement suggested by the radio troubles of Commander Richard E. Byrd and the Hawaiian fliers, obviating destruction of the aerial in case of a landing in the ocean or flying very close to the water.

Bellows Lists Board's Three Major Problems

Washington, Aug. 8.

Three major problems, according to Commissioner Henry F. Bellows, are now up for decision before the commission, all exemplified in as many applications.

The first is whether a station which is primarily cultural shall have priority over a station which is primarily engaged in advertising for profit.

The second is how far the Radio Commission may go in enforcing the location of a station over the protests of the inhabitants of the community.

The third relates to the claim that each state is entitled under the radio act to have at least one powerful "key" station.

The first involves the application of station KMA, operated by a seed distributing house, for division of time with the frequency of 710 kilocycle with station WSUM, which is maintained by the University of Iowa. Both stations are operating in Shenandoah, Iowa. Station WSUM objects to dividing time on the ground that it is an educational institution and as such is entitled to preferential treatment over a station which is devoting part of its time to direct advertising of its wares to stimulate profitable sales.

In the second case the Commission is asked to prevent the transfer of station WICC from Bridgeport, Conn., to Easton, Conn., a town near Bridgeport. The spokesmen for Easton claim that the establishment of the station in Easton would prevent reception of outside service. The proposed removal of station WICC is a result of the order of the Commission to stations to locate in the country at a distance from large population centers.

The third case involves the request of Station WEBM for an assignment to the frequency, 1,330 kc with 1,000 watts power. The station claims that Indiana is entitled to at least one large broadcasting station. It also contends that it is unfair for the commission to give New York, Chicago or the other centres priority in high-power.

Sudden Distortion a Mystery

Distortion recently heard in receivers where real quality usually is emitted was traced to two particular stations, one of them the usually incomparable WJZ. There was no such misfortune on several other channels tested. As the complaint was widespread, the sets, blamed at first, were eagerly exonerated. As the distortion lasted, though not steadily, for a few nights, much comment resulted. A fierce rainstorm preceded the first instance of distortion in transmission, so some surmised that damaged apparatus was temporarily replaced by others not so good, pending repairs.

New Engine House for Naval Station

WASHINGTON.

Sealed bids for alterations to buildings and appurtenances and construction of a new engine house at the Naval Radio Station at Otter Cliffs, Bar Harbor, Me., have been invited by the Bureau of Yards and Docks of the Department of the Navy.

The full text of the invitation for bids follows:

"Sealed bids, indorsed 'Bids for Alterations to Buildings, Specification No. 5416,' will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until 11 o'clock a. m., Sept. 7, 1927, and then and there publicly opened, for alterations to buildings and appurtenances and construction of a new engine house, at the Naval Radio Station, Otter Cliffs, Bar Harbor, Me. Specification No. 5406 and accompanying drawings may be obtained on application to the Bureau or to the Commandant, Navy Yard, Boston, Mass.

"Deposit of a check or postal money order for $10, payable to the Chief of the Bureau of Yards and Docks, is required as security for the safe return of the drawings and specification. B. L. Reed, Acting Chief of Bureau, July 25, 1927."

Repair Station Ready In Canal

WASHINGTON.

A radio repair shop has been established by the Panama Canal, and it is now prepared to do radio repair work for any vessel requesting it, the office of the Panama Canal in Washington announced. Establishment of the shop, the statement said, is in line with the desire of the Canal to afford facilities for practically any class of repairs to vessels.

The statement set forth:

As a part of its provision of facilities for practically any class of repairs to vessels, the Panama Canal is prepared to do radio repair work for any vessel requesting it. The Electrical Division generally employs one mechanic qualified to make repairs on radio equipment and at present has two such in the organization. There are also in stock some supplies for this class of repair work. With these facilities the organization has been able to make such repairs as have been requested, and it is believed that if there should arise cases which could not be handled satisfactorily they would be exceptional.

How Radio Works for Train Talk

Successful tests of radio communication between the engine and the caboose of mile-long trains have been made by the New York Central Railroad. Short waves and low power are used to minimize interference with other radio services.

The caboose and the engine will carry identical apparatus—a transmitter and a receiver—and both will carry a transmitting and a receiving antenna. Communication can be started from either end by the mere act of lifting the receiver off the hook and pressing a button.

WNYC IS PRECAUTIOUS

WNYC has added a quartz piezo crystal to its equipment for keeping the station on its frequency. It cost $200.

Higher Power Sought By Two

Washington.

Backed by affidavits from persons and organizations supporting their claims, WTAD, Quincy, Ill., and KOW, Denver, Colo., appealed to the Federal Radio Commission for higher power on their present wavelengths at hearing. The opposition came from stations now on the same respective frequencies and was in the form of affidavits and other papers, no personal appearances being made.

WTAD, owned by the Illinois Stock Medicine Company, asked for an increase from 250 to 500 watts on a frequency of 1,270 kilocycles, basing its request on its desire to broadcast its programs to the farmers of Illinois, Missouri, and parts of Iowa.

One of the owners of the station, which derives its funds from the concern whose name it bears, is W. Emory Lancaster, who presented a letter from the president of the American Farm Bureau Federation, Sam Thompson, endorsing the activities of the station. According to Mr. Lancaster, WTAD broadcasts farm programs and speakers and courses from the Gem City Business College which are all in the interests, he said, of its farm constituency.

The station does not now permit advertising, but expects to do so if it gets enough power to reach a wider audience. The advertising, however, will be indirect, the witness testified.

The application of KOW (formerly KFVR) was for an increase in power from 250 to 1,500 watts on a frequency of 630 kilocycles. The object of the station, which is owned by the Olinger Corporation, described as a group of associated industries with assets of $4,000,000, is to broadcast to prospective home builders the advantages of living in the State of Colorado, according to the attorneys for the station, George S. Strong and John W. Price, both of Washington.

Objections to adding higher powers to the same wave were forwarded by WSB, Atlanta, Ga., because of possible interference. The objections were contained in affidavits. The Commission also had before it affidavits from other interests opposing the application of the Denver station.

License Given To Klan Weekly

Washington.

The issuance of a license to WTFF, owned by the Independent Publishing Company, of Washington, D. C., was announced by the Federal Radio Commission. The station will operate on a frequency of 1,470 kilocycles (204 meters), using 50 watts of power, according to the terms of the license.

Broadcasting programs are under the auspices of "Fellowship Forum" a pro-Klan weekly newspaper, from the title of which its call letters were drawn. WTFF, will be located at Mt. Vernon Heights, Va., where its manager have announced they will shortly begin experimental broadcasting on their assigned wave and using the designated power.

WHAT HERTZ DID

Heinrich Hertz, the famous German physicist, was the first to send and receive radio waves. He did this in the course of experiments designed to test Maxwell's electro-magnetic theory. Hertz used very short waves and simple apparatus. The distance between transmitter and receiver was only a few feet.

SET FITS VARIOUS CABINETS

A STANDARD SET, which may be removed from its metal cabinet and placed in any one of several more pretentious pieces of furniture he makes, is being marketed by a prominent manufacturer. This strikes a new idea in sets.

New Power Allotment Basis Being Worked Out

Washington.

Federal Radio Commissioner O. H. Caldwell has announced that a new system of determining the amount of power to be assigned to broadcasters is being investigated by the federal body in conjunction with leading engineers throughout the country. It has been found that radio transmitters, he said, are generally more effective in certain directions than others, and that they cause the greatest interference in the direction of greatest effectiveness.

To overcome this difficulty under the present system of allocating several transmitters to one channel, it has been found necessary to ascertain the area of effectiveness of each station for certain operating powers.

"Broadcasting engineers and radio experts are expected to meet with the commission within a few days in Washington," said Mr. Caldwell "Extensive field tests will be made on wave and radiated energy of several stations throughout the country to determine the comparative amounts of power sent out in various directions. Then the broadcasting system in the United States will be studied with regard to the field intensity of individual transmitters, and the whole fitted together.

"At present it is impossible to tell how effective a station will be, that is, just what 500 or 5,000 watts of power will mean in terms of field strength about the broadcaster in various directions.

"We are trying to correct just such a case of interfering waves at the present time," he said. "WDRC of New Haven, Conn., operating in the 1,090-kilocycle channel with 250 watts power, interferes with WPG of Atlantic City, N. J., operating on 1,100 kilocycles with 2,500 watts power. Ordinarily the distance between the two stations would be great enough to avoid any interference on the powers used. However, the waves seem to follow the Atlantic Ocean, and geographical separation counts for little."

Others debate this point.

Oh! *How I Love to Listen to* the Toot-Toot of the Tuba

By Tim Turkey

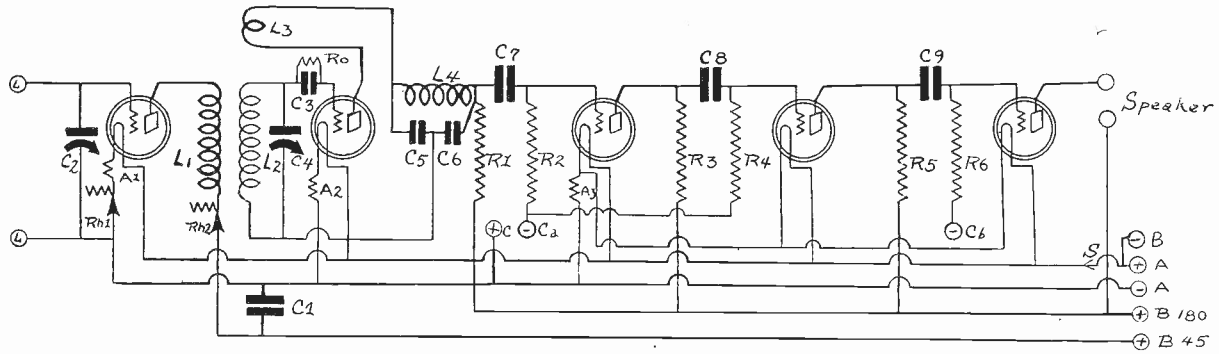


FIG. 1

The circuit diagram of the Tuba Special. A special type of low pass filter is used to stop the radio frequency currents at the detector. The detector and the three audio frequency amplifiers are all put on 180 volts as a means of preventing motorboating.

WHEN I listen to a musical program with the aid of my radio set I want to hear the low notes. I am partial to the sounds of the tuba, the bass drum, the bass viol, the bassoon, the lowest octave of the piano, and to the basso profundo voice. I am even fascinated by the sonorous boom of the savage tom-tom. It is because of my fondness for these base and lowly sounds that I built the Tuba Special receiver, and it is because this set has served me so profoundly that I now describe it so that others with equally base predilections may descend with me into the nether realms of musical sounds, there to enjoy such rare treats as a bass viol solo, a tuba solo, and a rendition of "Rocked in the Cradle of the Deep."

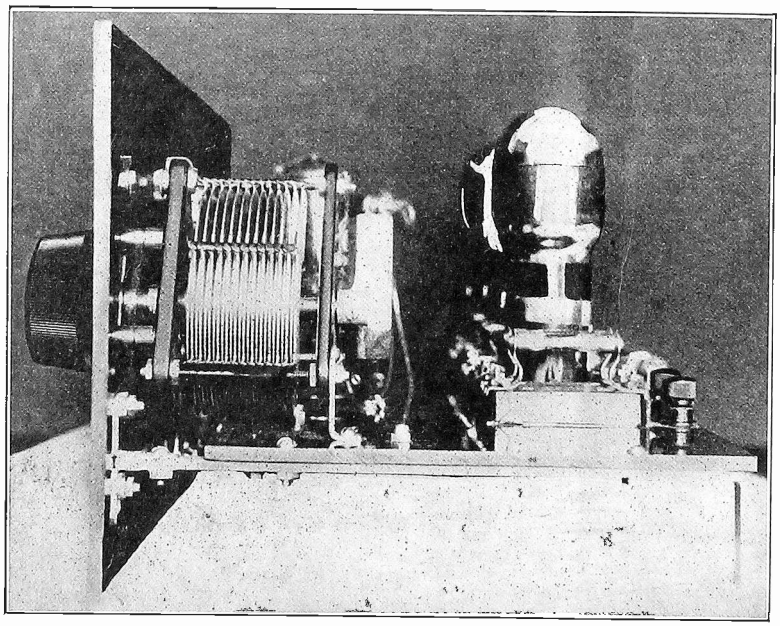
I am keenly interested in having other radio fans join me at the base of the musical scale in a thunderous demand for more broadcasting of the profound elements of music.

Being partial to the bass notes is equivalent to being partial to a resistance coupled audio frequency amplifier. There is no other circuit, in my opinion, which will bring out the basses so strongly as the resistance coupled amplifier. But to make a resistance coupled amplifier a success it is necessary to take certain precautions, which will be pointed out in the progress of this article.

Two Conditions to Be Met

There are two conditions for the amplification of the lowest notes. One of these is that the stopping condensers in the grid circuits of the amplifier be large. The other is that the grid leak resistances be high. These conditions can be combined into one condition by stating that the product of the capacity of the stopping condenser and the resistance of the leak be large.

The capacity of the stopping condenser cannot be increased indefinitely, because a large condenser will leak more than a small one, and when there is considerable leakage through the condenser the circuit will not behave properly. In this circuit a compromise of .1 mfd. has been effected. With this fixed value of the stopping condenser, the resistance can be made high to increase the product of the capacity and the resistance. Under certain conditions there is practically no limit to the resistance of the leak. I have used successfully 10 megohm resistors in all the grid circuits, that is, for R2, R4 and R6. Higher values can be used if the insulation of the grids is of a high order. The values for the grid leaks mentioned in the list of parts are conventional. They will give good results but it is not necessary to cling to these low values. The use of high grid leak resistances increases the amplification at all frequencies but more at the low.



VIEW of right side of the receiver.

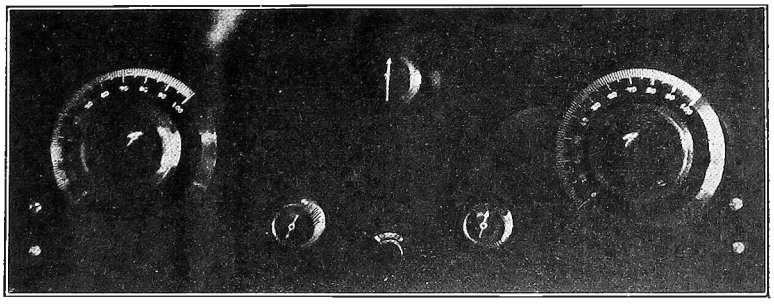
Conventional and Otherwise

It is also conventional to use .1 megohm resistors in the plate circuits of the tubes, that is, for R1, R3 and R5. But in the interest of high amplification much greater values can be used. I am now using .5 megohm and get excellent results. The use of high values for coupling resistances helps to prevent motorboating by overwhelming the cause of it, and at the same time it increases the amplification. When unusually large plate coupling resistances are employed the applied plate voltage may be increased if desired, but it is not necessary to do so to get distortionless amplification. The question of applied plate voltage will be taken up later.

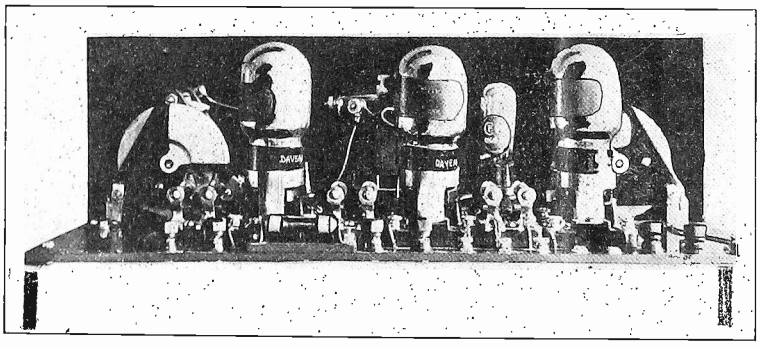
A point of utmost importance in a resistance coupled amplifier is to use adequate and correct grid bias on all the amplifier tubes. Clearly it is not necessary to do so to protect the tubes from excessive filament emission or to reduce the plate current, as the coupling resistors do that effectively. But it is necessary to use grid bias to get any real amplification and to prevent the tubes from choking up. The grid current will not maintain the grids negative. It will merely prevent the grid voltage from

LIST OF PARTS

L1, L2, L3—One three-circuit No. 99 Bruno coil to go with .0005 mfd. condenser.
L4—One General Radio RF choke coil.
C1—One Dubilier .01 mfd. condenser.
C2, C4—Two General Radio .0005 mfd. tuning condensers.
C3—One Polymet grid condenser with resistance clips.
C5, C6—Two .0005 Polymet condensers.
C7, C8, C9—Three .1 mfd. Daven condensers (built into couplers).
Rh1—One Carter 10-ohm midget rheostat.
Rh2—One Carter midget 25,000-ohm variable resistance.
S—One Carter filament switch.
Ro—One 2 megohm Daven glastor grid leak.
R1, R3, R5—Three Daven Glastor .1 megohm resistors.
R2—One Daven Glastor 1 megohm resistor.
R4—One Daven Glastor .5 megohm resistor.
R6—One Daven .25 megohm Glastor resistor.
A1, A2—Two No. 1A Amperites.
A3—One 1 ampere Amperite (No. 4).
Three Daven resistance couplers with resistor clips.
Five UX sockets.
Eight Eby binding posts.
Three small binding posts.
Two Carter phone tip jacks.
Two dials.
One tickler knob.
One hard rubber panel, 7 x 18 inches.
One hard rubber baseboard, 7 x 17 inches.



THE FRONT PANEL



REAR VIEW.

going very much positive. A grid bias of suitable value will prevent grid current and distortion and it will increase the amplification.

The correct bias to use will depend on the mu of the tubes and on the applied plate voltage. If the mu is 20 and the voltage is 180, the bias should be between 3 and 4½ volts. If the last tube is a mu 6 and the plate voltage is 180, the grid bias should be about 18 volts, or a little more.

180 Volt Line to Detector

Note that the plate returns of the detector and the three audio frequency tubes are connected to the common 180-volt bus. There is nothing unusual in connecting the resistance coupled tubes and the power tube to the same high voltage, but it is not often that the detector is thus connected. The reason for connecting the detector plate return to the 180-volt point is to prevent low frequency motorboating. As the circuit is connected, there are four tubes on the common impedance which causes motorboating, and such a circuit is stable on low frequencies. The plate return of the RF tube is connected to 45 volts.

Although the detector plate return is connected to 180 volts it does not mean that the effective plate voltage on the tube is 180 volts. It is considerably less, on account of the voltage drop in the resistor R1. But effective plate voltage on the detector is not the criterion of correct adjustment. Detection efficiency is. The detector is more efficient when the applied voltage is high than when it has the conventional value.

High Mu Detector Tube

As the coupling between the detector and the first audio tube is by means of resistance, it is desirable to use a high mu tube for detector. A mu 20 tube gives excellent results as detector under the conditions of operation in this circuit.

The loudspeaker is connected directly to the output of the last tube. This is permissible for the semi-power tube employed. If desired, an output transformer can be used, or the speaker can be coupled to the tube by means of a series condenser and a choke coil. The condenser in series with the speaker should be at least 8 mfd. and the choke coil should have an inductance of at least 100 henrys. In the interest of the low notes the speaker should be connected directly to the tube, since both of the other two methods depress the intensity of the lower notes.

Phone tip jacks are used for the output.

It is necessary to employ some means of separating the radio from the audio frequency currents in the output of the detector. A special filter arrangement has been employed for this purpose. It consists of two equal condensers C5 and C6, of .00025 mfd. each, and a radio frequency choke coil, L4. It is customary to employ a filter composed of a choke coil and one condenser C5, but in such a filter the coil is useless on account of the high resistance R1 in series with. The second condenser C6 by-passes this resistance and gives the coil a chance to choke.

Avoids Suppressing AF

While the radio frequency currents can be prevented from reaching the audio amplifier much more effectively by using larger condensers and a greater inductance in the choke, it is not advisable to do so because such a combination would also suppress the amplitude of the higher audio frequencies. The filter as described very effectively stops the radio frequencies as low as 500 kilocycles, yet it has no appreciable effect on any audio frequency as high as 10,000 cycles.

The detector is regenerative, thus adding enormously to the sensitivity of the receiver. A Bruno No. 99 three-circuit tuner L1L2L3 is used. The secondary L2 of this tuner is designed to work with a .0005 mfd. condenser C4.

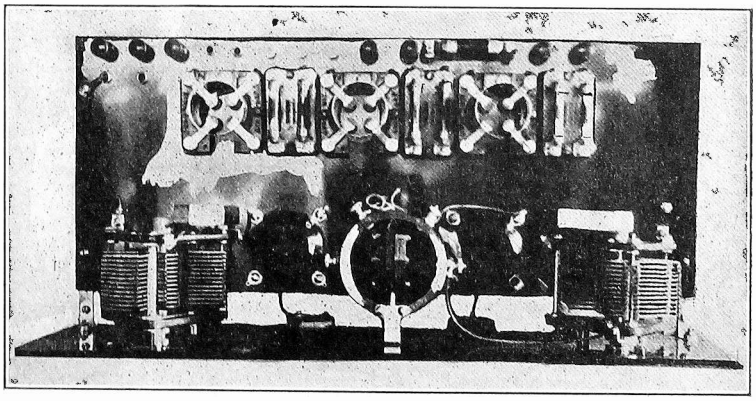
The grid condenser and leak have the usual values of .00025 mfd. and 2 megohms, respectively.

The set is particularly intended for local reception and consequently a loop is used. This is tuned with a .0005 mfd. condenser, C2.

Three Volume Controls

There are three methods of controlling the volume in the set, and all three are necessary at times. The first is the rheostat Rh1 in the filament circuit of the RF amplifier. This rheostat is in series with a 1A Amperite, so that the filament current can be varied from normal down to zero. A 10-ohm rheostat is sufficient.

[Theoretical data next week.]



LOOKING at the set from the top.

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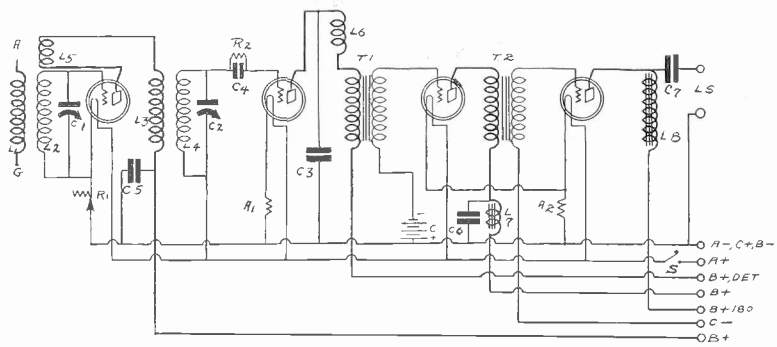

FIG. 560

The circuit diagram of the two tube receiver requested by Lincoln Wadsworth.

WHILE LOOKING over some old copies of radio magazines I found the circuit diagram of an eight-tube Super-Heterodyne. Standard air-core intermediate frequency transformers are prescribed. In the oscillator hookup, the Hartley system is employed. I have a three-circuit tuner of the standard type. Could this be used in the oscillator circuit?

(2)—The detector circuit is, of course, a standard one, it being non-regenerative. I would like to add regeneration. How could this be done?

(3)—Provision is made for a loop only. I would like to use an antenna. How is it possible to do so? I intend using .0005 mfd. variable condensers.—JEROME ROBERTS, Monroe, Mich.

(1)—Yes, you can use the tuner. The primary is inserted in series with the grid return of the detector tube. The secondary is connected in standard fashion in the grid circuit, while the tickler coil is connected in series with the plate and the intermediate frequency transformer.

(2)—You can add regeneration by connecting a midget condenser, having a maximum capacity of .00005 mfd., from the plate to the grid post of the same socket.

(3)—Procure a three-inch form and some No. 22 double cotton covered wire. Wind ten turns. Skip one-quarter of an inch and wind forty-five turns. The ten turn winding constitutes the primary, while the forty-five turn winding constitute the secondary winding. The primary winding is inserted in the antenna circuit, while the secondary winding is connected across the variable condenser in the grid circuit. Be sure that the end of the primary winding is brought to the ground and the beginning of the secondary winding is brought to the rotary plate post of the variable condenser as well as the minus A post.

* * *

I THINK I saw a one-tube regenerative circuit, called "The Schoolboy's Set" described in RADIO WORLD some time ago. Could you tell me what issue that was?

(2)—Is it possible to increase the strength of distant signals on a regenerative set, by using a higher value grid leak?

(3)—What is the highest plate voltage that can be applied to a UX199 tube? At this voltage, what C bias should be used?—HAROLD MURDOCK, Wheeling, W. Va.

(1)—This set was described on page 5 of the April 16 issue of RADIO WORLD.

(2)—Yes.

(3)—Ninety volts are all that can be applied to the plate of this type tube. At this voltage, a 4½ volt C bias is necessary.

* * *

SEVERAL MONTHS ago I obtained a circuit diagram of a two-tube reflex receiver. The first tube acted as a audio and a radio amplifier. The detector was regenerative by virtue of a variable condenser shunted across the coil in the plate circuit. I would like to build this set, but there are several things I wish to know before going ahead.

(1)—Could a tickler be used instead of the tuned plate method? The coils I intend using are all wound on three-inch diameter tubings with No. 24 double cotton covered wire, matched for .0005 mfd. variable condensers.

(2)—Should the RF coil be placed away from the tuner? How far?

(3)—Could a filament switch be inserted? Does it matter in which lead it is placed?—GEORGE KETTLER, Midland, N. J.

(1)—Yes. Wind thirty-six turns on a two inch tubing using No. 26 single silk covered wire.

(2)—Yes, about five inches, at least.

(3)—Yes. It does not matter in which lead it is placed.

* * *

I HAVE a three-circuit tuner and radio frequency coil, both of which are matched to .0005 mfd. variable condensers; a twenty-ohm rheostat; one one-quarter ampere ballast resistor; one three quarter ampere ballast resistor; one radio frequency choke coil; two .001 mfd. fixed condenser; one three henry audio frequency choke; a four mfd. fixed condenser; a thirty henry choke coil, a one mfd. fixed condenser; one filament switch; two low ratio audio frequency transformers and a .00025 mfd. grid condenser and 2 megohm leak. Please give me the circuit diagram of a four-tube receiver using all these parts, with a regenerative RF amplifier. I want to use a B eliminator with 180 volts output, and therefore wish to use the —71 power tube, with —01As in the other sockets.—FRANK GEORGSRON, Haines Falls, N. Y.

Fig. 560 shows the circuit diagram of such a set. L1, L2 and L5, is the 3-circuit tuner. The RF coil L3, L4 couples the detector and RF tube. The rheostat R1 is used in the RF filament circuit. The one-quarter ampere ballast A1 is used in the detector filament circuit, while the three-quarter ampere ballast is used in the audio filament circuits. L7 is the audio frequency choke. C6 is the one mfd. condenser. L8 is the thirty henry choke. C7 is the 4 mfd. fixed condenser. C3 and C5 are both .001 mfd. fixed condensers. T1 and T2 are the audio transformers. S is a filament switch. Apply 67 1-2 volts to the RF plate, 45 to the detector and 90 or 135 to the first audio. Use a 4 1-2 volt C battery, if using 90 volts for the first audio tube and 9 volts C, if 135 volts are used here. R2 is the grid leak, and C4 is the grid condenser.

* * *

LAST YEAR I built a two-tube receiver, using a stage of radio frequency amplification and a regenerative detector. The antenna input in the RF stage was direct, while the impedance method of coupling was employed in the detector circuit. The set works all right, but it is very erratic. I would like to do away with this and am therefore seeking your aid.

(1)—If I supplanted the single winding in the plate circuit of the RF tube with a regular RF coil, containing a primary and secondary winding, wouldn't the results be improved?

(2)—If so, could a coil containing a twelve turn primary and a fifty turn secondary wound on a two and three-quarter inch diameter tubing with No. 22 double cotton covered wire, be used instead? In both circuits .005 mfd. variable condensers are now used. The detector tube is made to oscillate with the aid of a tickler coil containing forty turns wound on a one inch diameter tubing with No. 30 enameled wire. The winding is made in two sections, e.g., twenty turns in each section, with a one-quarter inch separating them, this space being for the shaft.—HENLEY TROPK, Philadelphia, Pa.

(1 and 2)—Yes. This will work out very satisfactorily. The primary winding, will, of course, go in the plate circuit of the RF tube, while the secondary winding will go in the grid circuit.

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Washington.

The granting of seven construction permits and licenses to new stations was announced by the Federal Radio Commission. Although it is the stated policy of the Commision not to allow new stations to go on the air, it was explained orally by Commissioner Eugene O. Sykes, in whose district the stations are located that all had been granted construction permits prior to the passage of the Radio Act of 1927.

To have refused to allow them to broadcast would be to deprive them of their facilities, it was explained. Moreover, Mr. Sykes added, the regions involved already have only a limited number of stations.

"These permits," he said in a formal statement, "were granted to stations which were constructed prior to the passage of the Radio Act of 1927.

"They were held up by the Federal Radio Commission pending action by stations already licensed and were assigned frequencies which in the judgment of the Federal Radio Commission will not be harmful to other broadcasters.

"The Commission feels that these stations will render a real public service in States which heretofore have had very limited broadcasting facilities, and with their low power will not create material new interference."

Following is the list of construction permits and licenses as announced by the Commission.

WKBJ, Toccoa Falls Institute, Toccoa, Ga., issued construction permit specifying 1,430 kilocycles—250 watts power.

KHMC, Harlingen, Tex., Harlingen Music Company, issued construction permit specifying 1,270 kilocycles—100 watts power.

WTHS, Atlanta Technological High School, Atlanta, Ga., issued construction permit specifying 1,320 kilocycles—200 watts power.

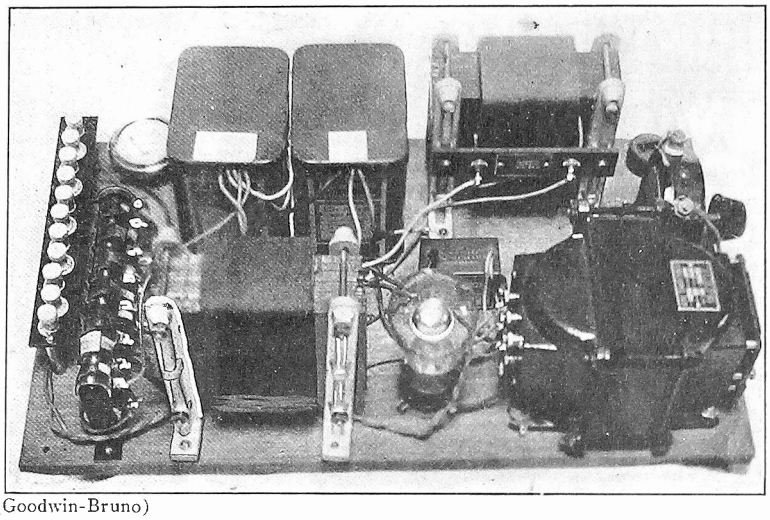
KFYO, Kirksey Bros., Battery & Elec. Co., Breckenridge, Tex., issued construction permit specifying 1,420 kilocycles—15 watts power.

KGGF, Dr. D. L. Connel, Picher, Okla., issued license to operate on 1,450 kilocycles—100 watts power.

KLCN, Daily Courier News, Edgar C. Harris, Publisher, Blytheville, Ark., issued license to operate on 1,050 kilocycles—50 watts power—6 a. m. to 6 p. m. only.

KGGH, Bates Radio & Electric Co., Cedar Grove, La., issued license to operate on 1,410 kilocycles—50 watts power—shares time with Station KDGX.

GOOD LOCATION FOR THE RESISTORS



(Goodwin-Bruno)

IN an A B C eliminator the resistance bank for affording variety of output voltages should not be bottled up nor should it be placed very close to the filter condensers. The reason is that the resistance heats up—no matter what kind it is—and requires ventilation. The photograph shows an A B C eliminator, using the Raytheon BA tube, with the Ward-Leonard resistance bank at left. The rheostat at right is for control of the input voltage and is also of Ward-Leonard manufacture. It goes in series with the power transformer primary.

WGY's 100,000 Watts A Hit With Listeners

Test programs on WGY's 100-kilowatt transmitter have brought an unexpected volume of listener response. Especially interesting for the engineer is the fact that there is almost unanimous indorsement of the temporary power increase and enthusiastic applause for the quality and volume of the signal as well as the sharpness of tuning.

A survey of the letters received at the conclusion of the third early morning test indicates that:

Signal strength over the region east of the Mississippi river and north of North Carolina is equal to that of station operating within fifty miles of the receiver.

WGY was heard with good volume and clarity in parts of country not reached since early in the Spring.

The signal strength is so great that static, even during severe electrical storms, was completely overridden and the program could be appreciated for its musical quality.

Fading is not appreciably circumvented by high power in areas within 300 miles where WGY's normal transmissions faded. But many of the distant listeners reported that fading was less frequent and less pronounced.

Modulation was excellent and quality of reproduced signal above the average.

100 kilowatt signal tuned sharply. Those with sensitive receivers were able, in many cases, to tune out WGY and tune in more distant stations whose frequency was separated but 20 kilocycles from WGY's frequency.

Tests on 100 kilowatts will be continued by the radio engineers of the General Electric Company every morning, from 12 to 1, eastern standard time, under the special license granted by the Federal Radio Commission for a period of thirty days. Reports of listeners are earnestly requested by the engineers as such letters will be of value to them to supplement the reports of field men who are making measurements and observations at many places in the United States.

N.B.C. Asks Permit for a Water Still

An application to the Bureau of Prohibition at Washington, D. C., has been made by the National Broadcasting Company for a permit to operate a still at the new transmitting station, now nearing completion, at Belmore, L. I. Distilled water is necessary to cool the giant tubes as any other water leaves deposits on the plates. Recently, in discussing apparatus for the new transmitter, it was suggested that a small still be installed to distill three gallons of water an hour. This is, probably, the first record received by the Bureau of Prohibition from a radio station for permission to operate a still, as necessary equipment for broadcasting.

Station Locates Her Missing Son

The directors of WGL, New York, were asked by a young woman to help find her son who had been missing for about four years. This poor mother had become seriously ill, owing to worry. WGL for several days broadcast a description of the missing boy as well as several other details about him.

Nothing further concerning this matter was heard for several weeks. Then a long distance telephone call was received from Baltimore by the mother of the missing boy. It was from none other than this missing person himself. To quote from the letter written to WGL by this now joyful mother: "Believe me, gentlemen, it certainly has given me a new grip on life, thanks to management of WGL, to have my son with me again."

Fairs Aplenty on Radio Day

Wednesday, September 21st will be National Radio Day.

On this date in addition to radio shows in Rochester and St. Louis the Radio World's Fair will be held in New York City in the New Madison Square Garden with more than 300 exhibitors and an attendance estimated at more than 150,000 people with more than 10,000 radio visitors from all parts of the country present in the form of exhibitors and dealer visitors.

Local banquets in conjunction with the Radio Industries Banquet in New York City are being planned in many of the fifty-odd cities where the radio banquet program will be broadcast.

At these local banquets the speeches from New York will be received.

SIXTH YEAR

RADIO WORLD

The First and Only National Radio Weekly

Member, Radio Publishers Association

Radio World's Slogan: "A radio set for every home."

TELEPHONES: BRYANT 0558, 0559
PUBLISHED EVERY WEDNESDAY
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FROM PUBLICATION OFFICE
HENNESSY RADIO PUBLICATIONS CORPORATION
145 WEST 45th STREET NEW YORK, N. Y.
(Just East of Broadway)
ROLAND BURKE HENNESSY, President
M B HENNESSY Vice-President
HERMAN BERNARD, Secretary
European Representatives The International News Co.
Breams Bldgs., Chancery Lane, London, Eng.
Paris, France: Brentano's, 8 Avenue de l'Opera

EDITOR, Roland Burke Hennessy
MANAGING EDITOR, Herman Bernard
TECHNICAL EDITOR, Lewis Winner
CONTRIBUTING EDITORS:
J. E. Andersen, Capt. Peter V. O'Rourke, and James H. Carroll

SUBSCRIPTION RATES

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Interesting Fallacies

Motorboating is caused by residual ripple in the plate voltage supply.

* * *

Motorboating is caused by blocking of the grids in the amplifier.

* * *

Motorboating is non-oscillatory if the frequency is less than 16 cycles per second.

* * *

Radical reduction of the grid leak resistance stops motorboating without affecting the amplification of the low notes.

* * *

A high inductance choke coil is effective when it is connected in series with a grid leak or a plate coupling resistor.

* * *

Small stopping condensers and low value grid leaks can be used with no decrease in the amplification of the low notes.

* * *

Large by-pass condensers can be placed across the line without reducing the higher audio notes.

* * *

Volume can best be controlled by cutting down the filament current in the power tube, because there the volume is greatest.

Interesting Facts

The worst radio quality is heard in some radio stores. It is not fair to the radio industry nor to the individual himself to take this stuff as typical of what radio can do.

* * *

Complete radio installations in which all batteries have been replaced by AC operated substitutes are now available.

* * *

Over-selectivity cuts the higher frequencies from the output and renders the signal less pleasing and less intelligible.

* * *

There is too much dance music broadcast these days.

* * *

Marconi was the first man to erect an antenna for radio transmission and reception.

* * *

Benjamin Franklin was the first man to erect an antenna for receiving static.

* * *

A signal strength of 5 millivolts per meter is satisfactory for reception. If the signal strength is still more intense the reception is more reliable.

* * *

The field strength of a radio wave is measured in millivolts, or microvolts, per meter. If the potential difference between two points one meter apart, one above the other, is one millivolt, the intensity of the vertical component of the wave is 1 millivolt per meter. An antenna 10 meters high would pick up a voltage of 10 millivolts in such a field. If the field strength were 5 millivolts per meter, the antenna would pick up 50 millivolts.

* * *

A radio wave which leaves the transmitting station with the front vertical, or perpendicular to the ground, gradually topples over so that the wave front is parallel to the ground, provided that it travels faster in air than in ground. Compare the wave front with a reed which is lodged in the ground at one end and is free at the other. The wind bends it over. Also compare the wave front with water waves near shore and out at sea. No matter what the direction of the wave out at sea, near a sloping shore line, the wave front is always parallel to the shore. This is due to the fact that the velocity of the wave is slower in shallow water than it is in deep water.

* * *

The power output of a tube is measured by the current times the voltage. In the —71 type tube the current is heavy and the voltage moderate; in the —10 type the current is relatively low and the voltage is high. Although the current in the —10 tube is less the power is much greater than in the —71 due to the difference in plate voltage.

* * *

A high impedance speaker can be connected to a low impedance tube without great loss in output, but a low impedance speaker cannot be connected efficiently to a high impedance tube.

* * *

Resistors used in radio circuits will not always carry all the current which is sent through them. They burn out. To prevent burnout ascertain the safe wattage dissipation of the resistor and then use it only within the limits.

* * *

Stopping condensers can only withstand a certain voltage. When this is exceeded the insulation breaks down and the condenser is useless. It is better to buy a condenser with a large margin of safety in the first place than to do it after the cheaper condenser has broken down.

* * *

Condensers of the electrolytic type are self-healing after a breakdown. So are air condensers. Condensers with solid dielectric are not and after breakdown they are useless.

GOOD SINGERS ARE SCARCE

Even a radio singer must know how to sing.

It seems almost impossible to convey this thought to the thousands of woefully deficient vocalists who weekly descend upon the broadcasting stations of the country say officials of KFI.

Students of a month's standing besiege radio stations sure that overnight fame and fortune await them. Many cannot read music. Few can produce a correct scale. None would dare to approach concert or theatrical managers, but all consider the microphone legitimate prey. Of one thousand applicants, less than ten are really acceptable, and perhaps only one is a valuable find.

"A good radio singer must have a flawless production," Earl C. Anthony, owner of KFI points out. "This perfection is not necessary in concert work for there facial expression, costume, personality and the distance of the singer from the listener mask even major defects. A radio singer stands within three feet of the microphone and the loud speaker is only a few feet from the auditor. Few artists can sing in your ear and make you like it.

"The concert artist may work with the vigor and broad strokes of a mural painter," Anthony continues, "while the radio singer must sing with the meticulous exactness of a painter of miniatures. The radio voice must not be 'breathy' as the impact of the breath column on the microphone may overload the tubes. Correct breathing from a well supported diaphram is necessary for a firm free tone. Clean unexaggerated diction is imperative to prevent hisses and gurgling noises. Playing to what is really a blind audience, color and feeling are the soul of the radio voice. Great volume is not necessary, but the muscular ability to maintain a certain tone level and color is. Also the artist must have an innate sense of dramatic effect; must be able to pull down volume on forte passages and still achieve power. Tempo, so often disregarded,, is one of the rarest and most valuable aids of the broadcast vocalist."

In the ruck of the three gold rushes—'49, movie and radio—have trailed thousands of incompetents. Time weeds them out, however, and in the next five years the supply of bad radio artists will have exhausted itself running from studio to studio. Then radio stations will be able to concern themselves with using the suitable material at hand rather than struggling to evade the inadequate.

Announcer Not Rattled; It's the Manuscript

When you hear an announcer speaking rhythmically and monotonously accompanied by a crackling noise, don't blame the noise on static. It may be the rattling of paper from which the announcer is reading. KFI, Los Angeles, has a rule which prevents its announcers from holding papers in their hand at the microphone. The sheets must be flat on a table.

June Exports up; Kindred Lines Slow

While the value of exports of radio apparatus during June gained considerably, total exports of electrical equipment during the month declined from May and from June of last year, according to a statement issued by the Electrical Division of the Department of Commerce.

Exports of radio apparatus during June, 1927, recorded a gain over June of last year of $138,221 to $651,664. Shipments of batteries, including flashlight, other primary, and storage, also showed an increase of $103,346 to $673,721.

All classes of radio sets and parts showed increases with the exception of receiving set accessories, which class decreased $16,058 to $134,197.

The largest individual increase was for tubes, which registered a $53,905 increase to $112,756 as compared with June last year. Total shipments of radio apparatus for June this year amounted to $45,431 more than for May, which were valued at $606,233.

All items under the class of batteries showed a gain during June, flashlight batteries gaining $69,104, other primary batteries, $8,862, and storage batteries, $25,380. The total for this class, $673,721, is more than a $100,000 gain over the $570,375 of June, 1926.

Women Musicians Prefer the Piano

Baltimore.

The piano is the most popular instrument with women musicians, according to facts gleaned from the files of WBAL, Baltimore. The majority of pianists heard over WBAL have been women, and of all the many instruments now available for instruction, more women "take" to the piano than any other instrument. There are, of course, numerous women organists, but these are not included in this survey.

There are four instruments which women musicians play, according to WBAL's artists' file. These are the piano, then the violin, cello and harp. Apparently, feminine musical fancy does not include flights to fields that have been occupied solely by men artists for generations, and, seemingly, women musicians are content to remain in the better known instrumental fields, and are leaving such instruments as the clarinet, oboe, cornet, flute, viola, horn, etc., entirely free for their masculine contemporaries.

Oscillation Bothers Him On the Low Waves

MY receiver oscillates too violently on the shorter wavelengths and I cannot stop the oscillations even by turning the tickler full on in reverse. What can I do about it? — FRANK EDMONDS, Bridgeport, Conn.

(1)—Put a rheostat of higher value in the filament circuit of the radio frequency tube so that the current in that tube can be cut down below normal.

(2)—Put a variable resistor of 0 to 25,000 ohms in the plate lead to the radio frequency tube. Use as much of this resistance as necessary to stop the oscillations.

Power Clarostat Sizes

The Power Clarostat is now available to builders of home-made radio power devices in three resistance ranges, namely: 0-10 ohm, intended for the control of standard tube filaments wired in parallel, or again for line voltage control and the group control of secondary voltages; 25-500 ohm, intended for the control of series-connected filaments especially when used in series with the B-voltage tap resistances; and the 200-100,000 ohm, especially intended for the control of series-connected filaments when controlled alone, or directly from the maximum voltage terminal of the A B C radio power unit.

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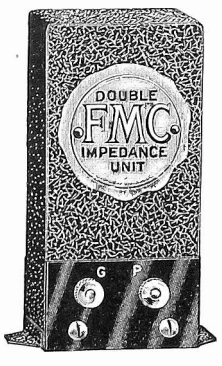

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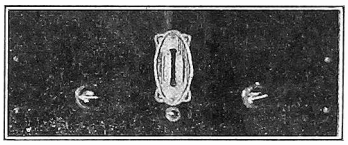

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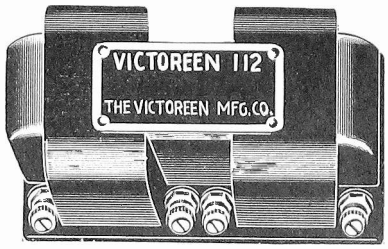

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Thoriated Filaments Are Called Critical

Three types of substances are used as the source of electrons in present-day vacuum tubes, according to S. Ruttenberg, chief engineer of the Radiall Company. These are the oxides of certain metals, such as calcium, barium, strontium, etc.; the pure metals themselves, such as tungsten or molybdenum; and these pure metals mixed with a small amount of thoria to produce the so-called thoriated or X-L filament.

The oxides are coated on a wire of platinum or nickel, and give off their electrons at temperatures below the melting points of these metals. The pure tungsten filaments are operated at about 2,400 or 2,500 degrees Centigrade, while those containing thoria are operated around 2,000. Operating at the same temperature, the emission from the thoriated tungsten filament is about five thousand times greater than from tungsten. A pure thorium filament, however, vaporizes and melts at too low a temperature to obtain sufficient emission from it to make a successful tube. It, however, evaporates much more slowly in the form of a thin film on a tungsten base, and so it is used in this condition.

The popular —01A as well as the —99 type of tube has a thoriated filament, with a tungsten base containing one or two per cent. of thoria. This thoria, at the proper operating temperature, slowly diffuses to the surface of the filament as thorium metal.

Quite Some Emission

The large emission of the thorium is thus obtained at the high operating temperature of the tungsten filament. Some idea of the quantity of electrons given off from the hot filament is gained from the fact that 6.28X10.19 electrons escape per second from one square centimeter of surface when the emission current is one ampere.

There is a critical temperature for the filament of any vacuum tube, according to Mr. Ruttenberg. Especially is this true in the case of thoriated tungsten tubes, wherein a delicate balance must be struck between the heat necessary to boil out the required quantity of thoria to coat the surface, and the excessive heat which results in burning off the thorium coating so that veritable bald spots are formed with the paralyzing of the tube in short order.

A tube may be deactivated or paralyzed, and still light. There is also the danger of altering the crystal structure of the tungsten filament, either by excessive or by insufficient temperature, in either event weakening the filament permanently.

Tests recently conducted in the Radiall laboratory indicate that the majority of radio enthusiasts do not burn their filaments at the proper temperature when using hand-operated rheostats.

Usually Excessive

In the usual case the filaments are operated at from 10 to 30 per cent. excessive voltage, reducing the tube life by hundreds of hours, not to mention the lowered efficiency of the receiver through serious deactivation. In cases where the radio enthusiasts are fretful of harming the tubes through excessive voltage, tests indicate that tubes are operated at as much as 40 per cent. below the proper temperature, again impairing the crystalline structure of the filament while at the same time introducing distortion due to the insufficient space current in the tubes.

Two methods are recommended for the proper operation of vacuum tubes: First, a high-grade voltmeter which, in conjunction with the manually-operated rheostat, permits of adjusting the filament current for the proper filament operation from time to time in compensating for fluctuations in the filament or A battery; secondly, the use of Amperites, the self-adjusting rheostats, which automatically hold the filament temperature of each tube at the correct value despite fluctuations in filament or A battery.

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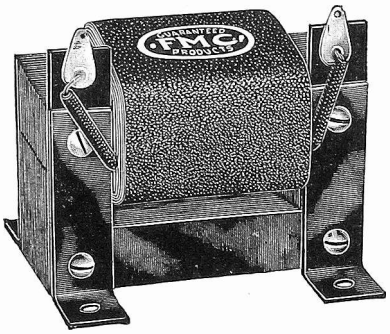

An impedance designed for use in connection with a B eliminator or as an output choke for use with a power tube in the last stage of the receiving set is made by Ford Mica Co. The core is of fine electrical steel, ample in size. The large wire used in the coils gives it a current capacity of 90 milliamperes which is ample for use in any eliminator and the resistance is low thus keeping losses at a minimum. Using the choke for a B eliminator it is preferable to use two chokes as recommended for the Raytheon tubes, although in some cases, where the output is low, one choke will be sufficient. This unit is but one of a large line of reliable radio parts made by the Ford Mica and Radio Corporation, 111 Bleecker Street, New York City.

Makers of Clarostat Double Their Space

The American Mechanical Laboratories, manufacturers of Clarostat, have moved their plant and offices from the top floor to the first and second floors of their own building at 285 North Sixth Street, Brooklyn, N. Y., thus doubling their former space. Additional equipment has been installed in the enlarged plant, so as to take care of the steadily increasing demand for the Standard type Clarostat as well as for the Power type and other types now coming into extensive use with the advent of the A B C radio power units.

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1926

Oct. 9—A Practical "A" Eliminator, by Arthur H. Lynch. Building the Equamatic, by Capt. P. V. O'Rourke.

Oct. 16—The Bernard, by Herman Bernard. How to Box an "A" Supply, by Herbert E. Hayden.

Oct. 23—The 5-tube P. C Samson, by Capt. P. V. O'Rourke. Getting DX on the Bernard by Lewis Winner.

Oct. 30—The Singletrol Receiver, by Herbert E. Hayden. How to Get Rid of Squeals, by Herman Bernard.

Nov. 6—Reduction of Interference, by A. N. Goldsmith. Variations of Impedances, by J. E. Anderson

Nov. 13—The 4-tube Hi-Power Set, by Herbert E. Hayden. A Study of Eliminators, by Herman Bernard.

Nov. 20—Vital Pointers About Tubes, by Capt. P. V. O'Rourke. The 4-tube Diamond of the Air, by Herman Bernard.

Dec. 4—The regenerative 5-tube Set, by Cap. P. V. O'Rourke. The 8-tube Lincoln Super, by Sidney Stack.
Winner's DC Eliminator, by Lewis Winner.

Dec. 18—Selectivity on One Tube, by Edgar Speare. Eliminating Interference, by J. E. Anderson.

Dec. 25—A New Coupling Device, by J. E. Anderson. Function of Eliminators, by Herman Bernard.

Jan. 1, 1927—The 2 Tube DeLuxe Receiver, by Arthur H. Lynch. The Twin-Choke Amplifier, by Kenneth Harkness.

Jan. 8—Tuning Out Powerful Locals, by J. E Anderson. A Choice Superheterodyne, by Brunsten Brunn. The 2-Tube De Luxe Receiver, by Arthur H. Lynch (Part 2).

Jan. 15—The DeLuxe Receiver, by Arthur H. Lynch (Part 3) The Simple Meter Test Circuit by Herbert E. Hayden. The Superheterodyne Modulator Analyzed, by J. E. Anderson.

Jan. 22—The Atlantic Radiophone feat, by Lewis Rand. An Insight Into Resistors, by J. B. Anderson. A Circuit for Great Power, by Sidney Stack

Jan. 29—The Harkness KH-27 Receiver (Part 1), by Kenneth Harkness. Use of Biasing Resistors, by J. E. Anderson.

Feb 5—5-Tube, 1 Dial Set, by Capt. P. V. O'Rourke. The Harkness KH-27 (Part 2), by Kenneth Harkness. What Produces Tone quality, by J. E. Anderson.

Feb. 12—Phone Talk Put On Speaker, by Herbert E. Hayden. All Batteries Eliminated, by Herman Bernard. The Harkness KH-27 Receiver, by Kenneth Harkness (Part 3). Conclusion.

Feb. 19—The 6-Tube Victoreen, by Herman Bernard (Part 1.) The Big Six Receiver, by Wentworth Wood. "B" Eliminator Problem, by Wm. P. Lear. The Phasatrol Circuit, by Capt. P. V. O'Rourke. The 6-Tube Victoreen, by Herman Bernard (Part 2). Conclusion.

Feb. 26—The 5-tube Diamond in a Phonograph, by Hood Astrakan. How To Read Curves, by John F. Rider. Proper Tubes for 5-Valve Receiver, by J. E. Anderson.

Mar. 5—Introduction of 4-tube Universal, by Herman Bernard. Discussion on DX, by Capt. P. V. O'Rourke. Sensible Volume Control, by Chas. Gritbben.

Mar. 12—Ten Tell-Tale Points, by J. E. Anderson. How To Figure Resistors, by Frank Logan. The 4-tube Universal, by Herman Bernard, (Part .)

Mar. 19—Psycho-Analyzing Circuits by Thomas L. McKay. The Universal, by Herman Bernard (Part 2). How To Use a Wave Trap, by James H. Carroll.

Mar. 26—The Universal, by Herman Bernard, (Part 3). Flow of Current in a Vacuum Tube, by Radcliffe Parker. Broadcasting Hypnotism.

April 2—Facts Every Experimenter Should Know, by J. E. Anderson. A Ship Model Speaker, by Herbert E. Hayden. The 8-tube Compact, by Jasper Henry. The Nine-in-Line Receiver, by Lewis Rand (Part 1.)

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How to Figure Out An Exponential Horn

(*Continued from page 5*)

that the exponential horn is determined by the rate of increase of cross-sectional area. If the linear dimensions increases area. If the linear dimensions increase exponentially, but at twice the rate.

The equation above presumes that the horn has a circular cross-section throughout. It can also be of square section, or any other type. No change is necessary in the formula to make it represent sections other than circular. D might be the side of a square, the diagonal of a square, or the major axis of an ellipse. (Do) would have a corresponding meaning.

Type Should Change Slowly

The section of the horn can even change from one type to another between the two ends. In that event the area of the square should be the same as the area of the circle would have been had the circular shape been continued. For example, if the circular horn requires a diameter of four feet at the large end, the area of that section is 12.57 square feet. If the section is to be square, its side must be the square root of 12.57, or it must be 3 feet and 6½ inches.

Suppose we wish to construct an exponential horn 20 feet long with a small end diameter of .625 inch and a large end diameter of 4 feet. We then have D=48 inches, Do=.625 inches, and L=20 feet. We can substitute these values in the formula as it stands, but it is more convenient to convert the formula so that we can use common logarithms directly. Rewriting it we have $D=(Do)x10^{bL}$, or $48=.625x10^{b20}$. Taking the common logarithm of both members of the last formula and solving for b we have b=.09427.

Our design formula now takes the shape $D=.625x10^{.09427L}$. We can also write this $\log D=.09427L-.2041$. This gives the value of D in inches for any value of L in feet.

The table gives D for every integral foot from the small end to the large of a 20 foot horn.

L feet	D inches	L feet	D inches
0	.625	11	6.81
1	.777	12	8.46
2	.965	13	10.50
3	1.200	14	13.05
4	1.49	15	16.20
5	1.85	16	20.04
6	2.298	17	25.00
7	2.854	18	31.10
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(*Continued on next page.*)

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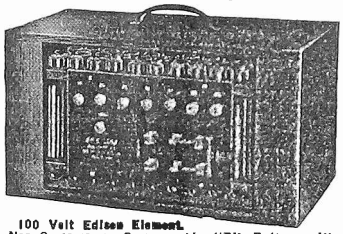

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(*Continued from preceding page*)

It is interesting to note how slowly the horn increases at first and how rapidly as the length increases. In the first ten feet the diameter has increased less than 5 inches. In the second ten feet it has increased more than 40 inches. It is still more interesting to see what will happen to it the next 20 feet. When the length of the horn is 40 feet the large end diameter is 307 feet.

If a change is made from one type of cross-section to another it should not be made abruptly. Any sudden changes in the lines of the horn will introduce reflection of sound waves, and that is just what the exponential horn prevents.

The length of the exponential horn should be at least half a wavelength of the lowest note it is desired to bring out with full volume. The lowest note on the piano is about 30 cycles per second. The wavelength of this note at room temperature 68 degrees F, is 37.6 feet.

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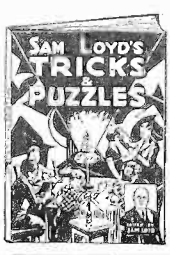

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