TRADE SHOW NUMBER

JUNE 6 1931

RADIO WORLD

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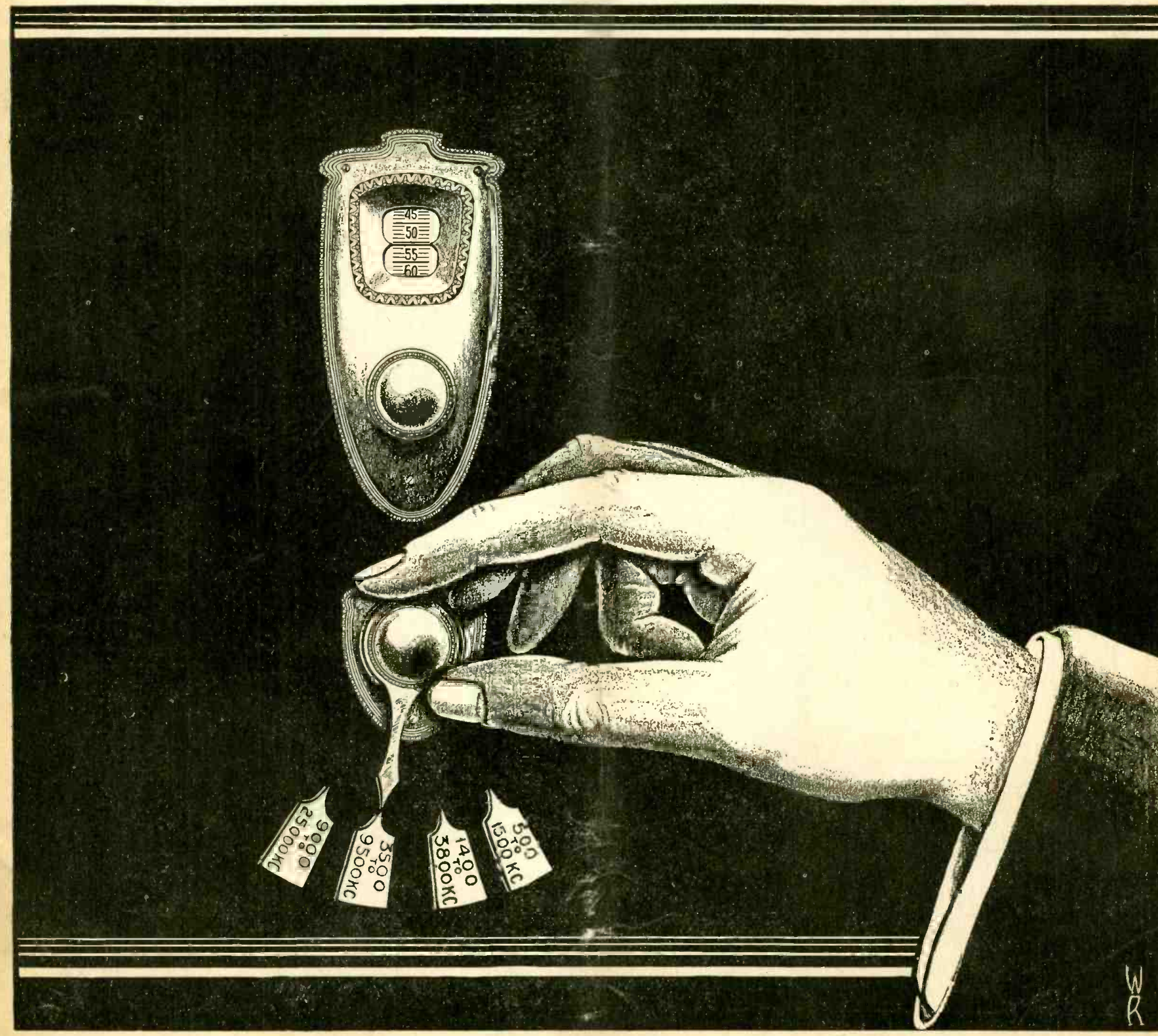

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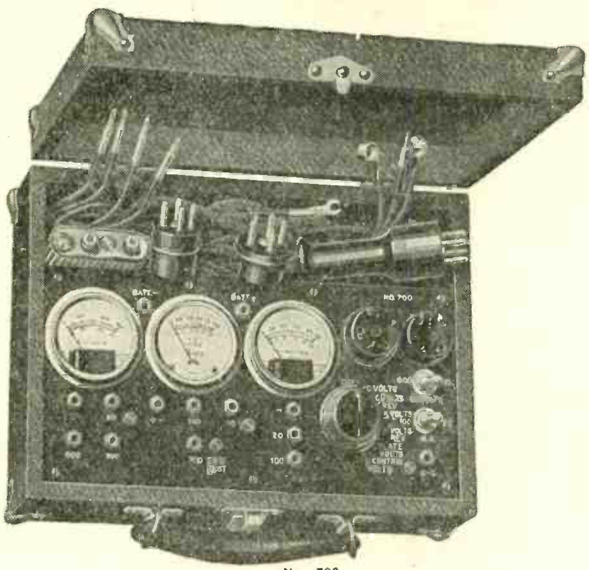

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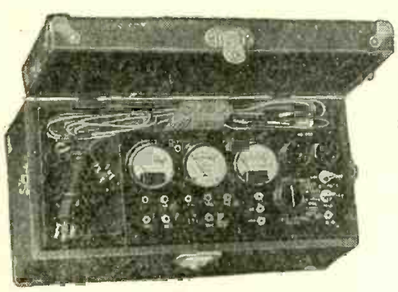

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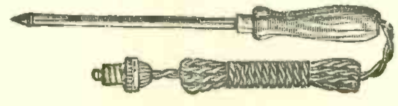

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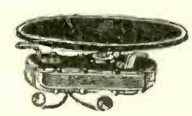

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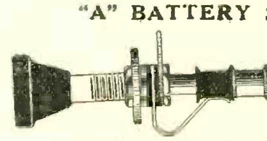

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A Frequency Meter

By Brunsten Brunn

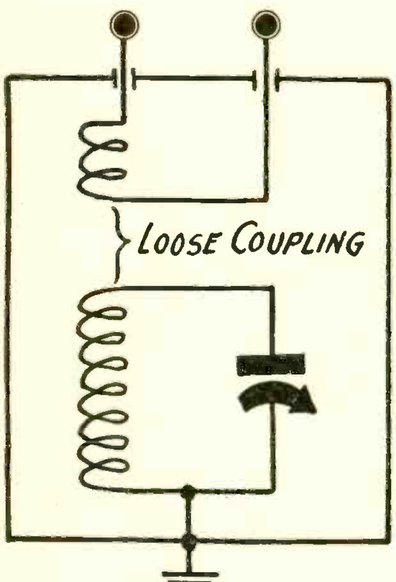


FIG. 1
The circuit of a simple wave or frequency meter consisting of two windings, a condenser and a shield.

ONE of the simplest frequency meters is a circuit formed of a coil of fixed inductance and a variable condenser provided with a good dial with a large scale, one that may be read accurately.

The reason such a circuit is a good frequency meter is that there are very few sources of frequency variation. There is no tube attached to it and therefore there is no change of frequency with change of voltage or change of tube. If the circuit is inclosed in a metal container of comparatively large dimensions there will be no change in frequency, as the circuit is moved about with reference to other objects, especially metals. If the shield box and the rotor of the condenser are always grounded when the circuit is used, the frequency can always be depended on.

The only two sources of error are temperature variations and inaccuracy of setting the dial, both in the calibration and in subsequent use. The temperature changes the frequency slightly because both the inductance and the capacity change with temperature. But the coefficient of change of frequency with temperature is small and changes in temperature in an ordinary room are also small.

Wide Tuning Range

Another advantage is that the tuning range of the circuit is wide because the minimum capacity is small. There are three main sources of minimum capacity, the zero setting capacity of the condenser itself, the self capacity of the coil, and the capacity introduced by the presence of the shield container. This is smaller than the larger shield box, and for that reason the can should be large enough to give ample room to both the coil and the condenser.

It is quite possible to hook up a circuit of this simple type, which has a total minimum capacity no greater than 25 mmfd., and that even if the maximum capacity of the condenser is as large as 500 mmfd. Suppose we assume that the maximum capacity in the circuit is 500 mmfd. and the minimum is just 25 mmfd. The capacity ratio is then 20 and the ratio of the highest to the lowest frequency to which the circuit will tune is equal to the square root of 20, that is, 4.47. Thus if the lowest frequency is 540 kc, the highest is 2,415 kc.

The condenser used in such a circuit should be of the straight line frequency type, for this will make the accuracy of any setting greater, especially at the higher frequency end. Since most condensers of this type have stops at both ends, care must be exercised that the dial does not slip as the condenser approaches the stops, for this would spoil the calibration.

Making Use of Frequency Meter

In order that the calibrated circuit may be used for frequency measurement, it is necessary to have some means of coupling it to another circuit. The coupler must be such that it does not change the frequency. If we use a few turns of wire, loosely coupled to the coil of the frequency meter, there will be very little change in the frequency due to the coupling. This coupling coil may be connected in series with the antenna of a receiver, in which case the frequency meter becomes a wave trap. If the receiver is tuned in on a station of unknown frequency, the condenser of the frequency meter can be turned until the station disappears, or until it is weakest. The tuning condenser on the frequency meter, in conjunction with the calibration chart, shows what the frequency of the unknown station is.

A coil suitable for this purpose is one wound with 59 turns of No. 28 enameled wire on a 1.75 inch bakelite form. This makes a coil which has nearly the optimum ratio of diameter to length.

Luminous Indicator of Resonance

In most cases of simple frequency meters a luminous indicator of resonance is used. This usually consists of a miniature lamp connected in the resonant circuit. This, however, requires closer coupling between the source of power and the meter circuit. Suppose, for example, that a lamp requiring .25 ampere and a voltage of 1.5 volts is used. This lamp has a resistance of 6 ohms. The circuit comprising the coil and the condenser may have a resistance of 10 ohms itself. At resonance the only impedance in the circuit is the resistance, which in this assumed case would be 16 ohms. If the lamp is to get its .25 ampere, therefore, the voltage induced in the coil would have to be 4 volts. If we assume that the mutual inductance between the source of AC power and the meter coil is 20 microhenries and the frequency is one million cycles, the current in the primary would have to be 31.8 milliamperes in order to light the lamp at full brilliancy. Of course, resonance will be indicated even if the lamp only glows a dull red.

There is also a very small neon glow tube which is sometimes used to indicate resonance. This is voltage operated and is connected across the tuning condenser or the coil. When the lamp is most brilliant the circuit is in resonance for then the voltage across either the coil or the condenser is maximum.

Another resonance indicator used in many meters is a thermocouple type milliammeter. One common type instrument requires a maximum current of 115 milliamperes for full deflection. This meter is therefore much more sensitive than the miniature lamp, but it is also much more costly. A miniature lamp can be obtained for a dime or less. A thermocouple milliammeter costs around $15.

Whatever indicator is used, it should be an integral part of the circuit so that there will be no chance for changes.

Reception More Reliable

By Brainard Foote

RADIO reception—in its ideal condition—would be uninterrupted and dependable all the time.

There are numerous obstacles to perfect radio reception which are outside of the capability of the radio set itself to control. Several extensive tests and studies have been made in the past few years to find out what these obstacles are, in order to guide the radio business and radio leaders in improving receiving conditions.

A study made a few years ago by a large group of radio listeners on the transmissions from KDKA illustrates this work very well. The listeners were within 500 miles of the station and were provided with special report blanks to fill out frequently. Average conditions were determined from these thousands of reports, and the chief obstacles to good radio reception were listed as: (1), other broadcasting stations; (2), static; (3), miscellaneous interference; (4), fading.

Inter-Station Interference Less

The test showed these obstacles in the above order. In the short time since this survey was made, the interference from other broadcasting stations has been tremendously reduced, so that it is no longer the primary cause of radio interference. The methods used to effect this improvement are principally more cleared channels or exclusive frequencies; fewer stations operating at the same time on the same or adjacent frequencies; more accurately maintained frequencies; more selective receiving sets; unceasing vigilance by the Federal Radio Commission and the Department of Commerce in enforcing frequency assignments and accuracy. Much more is yet to be done on this line. However, you can receive more stations with less interference now than at any previous time.

Static—the second cause of interference in these tests—is being battled unceasingly, too. Less success has been achieved, but even as regards static, radio conditions are better than heretofore. In effect, static is less bothersome because of the increased power used by the stations. This overpowers the static, so that we have good entertainment available from local stations even in August and September—the worst months for static. Sharper tuning of the sets has improved the situation, and in a few cases by the use of special or loop aerials, less static has been encountered.

Under miscellaneous obstacles we find code station interference, electric device and machine noises, etc. Code interference is rapidly being eliminated through the modernizing of ship and shore station apparatus. The old-fashioned spark transmitter is being replaced with tube sets, and amateur stations in this country are permitted to use no spark sets whatever. The spark set is outclassed, anyway, because the tube is so very much more effective, covering enormous distances at so slight expense.

Electrical interference is probably one of greatest obstacles today—more so than when the KDKA experiment was conducted. One reason for an increase in this form of noise is the extremely rapid growth in the use of electrical equipment in the home, such as refrigerators, oil burners, fans, mixing devices, heating pads, motor devices, etc.

Nevertheless, public opinion supports work against electrical noise simply because of the extensive dependence upon radio for pleasure. Power corporations are awake to their responsibility, and maintain men and equipment for locating and repairing defective lamps, street lights, insulators, power wiring, etc., which cause radio noises. For electrical devices in stores and home, filters are constructed inexpensively, which may be attached to them to trap out the radio interference waves which they would otherwise radiate in their vicinities. Legislation has been passed in many localities to assist this move toward uninterrupted radio.

Reliability Improves

Fading is an outstanding obstacle for listeners located 50 to 100 miles or more from a station. Fading is for anyone an obstacle when it comes to long-distance receiving. However, fading is not present to interfere with our programs from the stations nearby, upon which most of us depend for day in and day out entertainment. For more remote listeners new locations and better distribution of radio broadcasting services is rapidly solving their problem, too.

Radio reliability in general is showing a remarkable improvement every year, and it is naturally to the combined interests of the radio public, the radio manufacturers and the power companies to see that the improvement goes on.

Choke Coils and Their Uses

Two forms of choke coil are found in modern radio outfit—the radio frequency choke coil and the audio frequency choke coil. The choke coil is a coil of wire made to certain specifications, to prevent the flow of certain kinds of electric current through it, or to cause a voltage drop across the coil. The audio frequency choke coil, also called a filter coil, is principally used in the power pack section of an AC set. It consists of a very large amount of wire, wound on a special iron core, consisting of many thin pieces of soft iron. A coil of this kind builds up a very strong magnetic field, similar to the magnetism existing at the ends of an ordinary horseshoe magnet. The effect of this magnetic field on the coil itself is to tend to prevent any variation in the strength of the current passing through it.

The rectifier tube or unit changes the alternating current obtained from the house socket to direct current, i.e., current flowing in one direction. However, this direct current is jumpy, or impure, and it is the function of the filter coil or choke to smooth such current to a steadily flowing electric supply like that obtained from a battery.

The audio frequency choke coil is also employed in parts of the circuit where it is desired to prevent the flow of any audio frequency current, such as removing the hum which may be present in some part of the set. As a coupler in an audio amplifier it is used for the voltage drop developed across it.

The radio frequency choke coil is a much smaller unit, not having an iron core in most cases, and having a sufficient amount of wire to have a wave length greater than that of the circuit in which it is used. Such a coil permits the flow of any direct current, but stops almost completely the passage of any high frequency or radio frequency current through it. Such coils are finding wider and wider use in modern sets because they permit simpler circuits, allowing the plate current for the tubes to reach the tubes easily, but confining any radio frequency current in the desired part of the set. The type of choke to use depends on the frequency.

Current List Prices On Receiving Tubes

The following table gives the prevailing price lists of the various tubes:

Tube	Price	Tube	Price	Tube	Price
227	@ $1.25	551*	@ $2.20	WD-11	@ $3.00
201A	@ $1.10	171A	@ $1.40	WX-12	@ $3.00
245	@ $1.40	112A	@ $1.50	200A	@ $4.00
280	@ $1.40	232	@ $2.30	222	@ $4.50
230	@ $1.60	199	@ $2.50	BH	@ $4.50
231	@ $1.60	199	@ $2.75	281	@ $5.00
226	@ $1.25	233	@ $2.75	250	@ $6.00
237	@ $1.75	236	@ $2.75	210	@ $7.00
247	@ $1.90	238	@ $2.75	BA	@ $7.50
223	@ $2.00	120	@ $3.00	Kino	
235	@ $2.20	240	@ $3.00	Lamp	@ $7.50

** This is comparable to the 235.*

Television Differences

By Einar Andrews

ONE of the factors that deter the development of television and its acceptance by the public is the lack of standardization of scanning and speed. There are speeds of 15, 16, 20, 24, and more frames per second. Each speed requires a different synchronous motor, if this type of motor is used, or an accurate speed control on an induction type motor.

There are also different numbers of scanning lines per frame, such as 24. 45, 48, 50. and 60, and possibly still higher in experimental laboratories. Each requires a different scanning element, whether it be a disc, a belt or revolving mirrors. This is a more serious obstacle than differences in the speed.

Sequence of Scanning Varies

In addition to these variations there are differences in the order of scanning the image, such as the single spiral and three-spiral methods. The single and triple spiral scanning elements are not interchangeable.

A tentative standard was agreed upon by the Radio Manufacturers Association and this is 15 frames per second and 48 lines per frame. But this standard had no sooner been set than the deviations from it were more numerous than the adherences. The reason obviously was that insufficient details are reproduced by this rate of scanning. There is a growing acceptance of 20 frames per second and 60 lines per frame.

There is an agreement on one thing, and that is in scanning from left to right and from top to bottom, just as a book is read. But even this is not strictly possible when a triple spiral method of scanning is used. This scheme divides the frame into three paragraphs, so to speak, the scanning being standard in each paragraph, a line being scanned first in the first paragraph, then one in the second, then one in the third.

Need for Standardization

Standardization must come before the public will take much interest, for nobody will be satisfied with looking at the signals from a single station, nor will anybody equip himself with scanning devices for all systems.

It seems that one thing that could be standardized immediately is the number of frames per second, that is, the speed. A speed of 20 frames per second seems to meet the requirements well enough. In respect to lines per frame there does not seem any chance for immediate standardization.

Improvement in detail of the picture must come in the direction of increasing the number of lines per frame. If this could be raised to 100 or more, pretty good images could be produced. But there are both electrical and mechanical difficulties in increasing the lines per frame. However, could the electrical difficulties be overcome, the mechanical difficulties would be solved quickly.

Table of Scanning Details

In transmitting from films the rate is nearly always 20 frames per second and 60 lines per frame. For the time being this could well be used in transmitting directly.

In the table below is a list of the more active television transmitting stations, together with their type of scanner, frequency, frames per second, and lines per frame:

Type Scanner	*Station*	*Frequency*	*Frames*	*Lines*
3-spiral disc	**W9XAP**	2150 kc	15	45
1-spiral belt	**W1XAV**	2900 kc	20	60
3-spiral disc	**W9XAO**	2050 kc	16	45
1-spiral disc	**W2XCR**	2035 kc	20	60
1-spiral disc	**W2XCD**	2050 kc	15	48
for film pick-up	**W2XCD**	2050 kc	20	60
1-spiral disc	**W3XK**	2065 kc	15	48
1-spiral disc	**W3XBS**	2150 kc	20	60
1-spiral disc	**W2XR**	2910 kc	15	48
subject to change	**W8XAV**	2150 kc	20	60

They Say Comment

HAROLD A. LAFOUNT, Federal Radio Commissioner: "Many set owners pay too little attention to the hearts of receivers. The tubes do the real work, but like most mechanical devices they will wear out. An automobile, no matter how perfectly constructed, would not travel a great distance without oil. Manufacturers tell us to change the oil every five hundred miles; not because it has disappeared, but because it has lost its efficiency. Many of its virtues and characteristics have disappeared, although the fluid itself still exists. This to a great extent is true with the tubes in your radio set. People often complain that reception is not satisfactory, when perhaps they are using tubes from one to three years old. For efficiency you should replace all your radio tubes once a year. Unsatisfactory reception is also often produced by replacing a burned out tube. The new tube is so much more efficient than those remaining in the set it causes distortion. I may compare this with the placing of a new string in your piano, and then failing to tune the piano, or blend all of the strings. If you expect the reproduction of all sounds and the harmony which is transmitted, it is wise to replace all the tubes, even though they have not completely burned out. Depreciation of tubes is gradual consequently unnoticeable. If your old tubes are all replaced with new ones. you would notice a marked improvement, in fact the old receiving set would surprise you."

* * *

ALFRED N. GOLDSMITH, vice-president and general engineer, Radio Corporation of America: "During the nineteenth century electric communication between individuals developed rapidly, and during the first few decades of the twentieth century it has expanded further until today it is possible for individuals in practically any portion of the civilized countries of the world to communicate with fair facility with each other either telegraphically or telephonically. The utilization of the resources which have become available is far from what may be anticipated for the future. There is still a certain hesitancy to employ these novel and hard-won facilities. Furthermore, economic aspects of their use leave something to be desired in certain instances. Yet it is clear that, as the centuries pass, men will increasingly communicate with each other individually over any desired distance. They will employ not merely the telegram but also the telephone message, the facsimile method for the transmission of graphic material, and television itself for the transmission of the appearance of persons or objects in motion. The twentieth century has seen the advent of a startling innovation in human affairs, namely, mass communication on a world wide scale. Broadcasting, latest child of the electrical sciences, has converted the world into a vast whispering gallery."

Antenna Outlets To Grace Rooms

Bing & Bing, New York City builders, have made arrangements with RCA-Victor Company to have the antennaplex system installed in eight large apartment houses now building. This system affords a single antenna for all the occupants of the house, and provides for easy connection to a wall plate. Ground is established also. The wall plate will be in the living room of every apartment. The houses will be from thirteen to seventeen stories high.

The antennaplex consists of an antenna, with tube amplification preceding specially designed output impedances that render the antenna immune from the tuning effects of the sets. Therefore every one will have the same aerial facilities, and besides will receive energy that has undergone some amplification. The antenna characteristics are not changed, whether all sets are tuned to one frequency or all to different frequencies.

New Polo Products

In preparation for the coming season Polo Engineering Laboratories, of 125 West 45th Street, New York City, has several new kit-sets and some built-up receivers to offer. A special feature in the all-wave class is a four-tube receiver of exceptional performance, both as to sensitivity and tone, in a small cabinet, with built-in speaker, to be offered at a price reported at less than $35. When this issue was going to press the director of the laboratories, Capt. Thomas G. Forshaw, was at work on a full announcement of the details of the four-tube all-waver, for publication in the ensuing issue, dated June 13th.

Polo Laboratories have been working on the DX-4 de luxe all-wave converter, 15 to 600 meters, and have evolved a specially attractive cabinet. The dial used is the modernistic disc type, made by National Company, of Malden, Mass.,

Coupling All-Wave Conver

By Herman

A SHORT-WAVE converter works with any set. This statement is true even if a short-wave converter does not work when hooked up to a set. How come? Well, the converter may merely seem to be hooked up to the set, as it may be as independent of operation with the set as if miles intervened between them.

There is a method of connection of one to the other that has come to be regarded as standard. It consists primarily of removing the aerial from the antenna post of the receiver, and connecting it instead to the aerial post or leadout wire of the converter, while to the vacated antenna post of the receiver is connected the output lead of the converter, sometimes designated "set antenna post." With some converters there is a ground post to be connected by wire to the ground post of the set, ground being left connected to the set, while others also require that a positive B voltage be supplied.

Where the home is wired with alternating current supply it is usual to have the B voltage cource built into the converter. Only battery-operated converters therefore would require an external supply, which might be the same B battery block used on a receiver.

To pick up the B voltage externally it is necessary to connect the B minus lead of the converter to B minus of the set.

The diagrams published herewith therefore include the B supply in AC model converters but omit it from battery-operated converters.

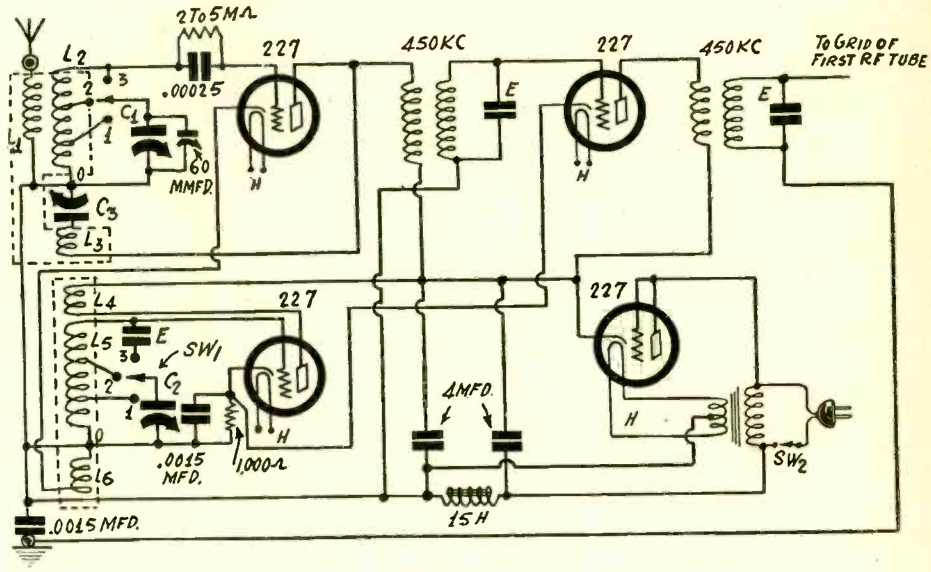


FIG. 1

An all-wave converter, using a front panel switch for band selection (15 to 600 meters), and having a stage of intermediate frequency built in, with 227 rectifier also. The tuned output is delivered to the grid of the first radio frequency amplifier to avoid the uncertainty of coupling through a set's antenna coil. There are two manually tuned circuits.

In most instances the standard method of connecting to the set antenna post, from the converter output, works all right, but when it does not work all right it usually does not work at all. The reason is lack of coupling, or, which is the same thing, a virtual short-circuit of the output of the converter when it is connected across the antenna input of the receiver.

Remedy Proposed

If the antenna load of the receiver is a low value of resistor, or if it is a coil or a resistor with affixed condenser across it, or if the antenna winding is an extremely small one, there may be little coupling between the converter and the set, or the coupling may detune the set's first stage, and either no results are obtained or results are disgustingly poor.

There is a remedy for these conditions.

Suppose the set is of the tuned radio frequency type. Suppose that the first radio frequency amplifier is a screen grid tube. Then you have a very easy way to establish a fine connection. Simply remove the grid clip from the grid of the tube and connect the output of the converter to the cap of this tube. As a trial the end of the leadout wire of the converter may be bared and looped around the cap of the tube, but after you have found that this method of coupling works excellently you should solder a grid clip to the end of the leadout wire from the converter.

This method wholly avoids the uncertainties of antenna coil coupling in the receiver itself, and introduces the output circuit of the converter into the grid circuit of the first radio frequency amplifier, provided, however, that the return circuit is grounded.

Establishing Grid Return

If you have a converter you built yourself, or if you are familiar with the technical details of a factory-made converter, you can establish this grounded connection by putting a radio frequency choke coil from the converter's output lead to ground. Experimentally this may be done also at the first radio frequency tube of the receiver, from cap of tube to metal chassis or other grounded point. If this is not done, there would be no grid return for the first radio frequency tube of the receiver.

The inductance of the choke is not critical. Since it will be in parallel with a coil in the converter, it may be an 800-turn honeycomb choke, or any choke of the usual commercial ratings of 10, 50, 60 or 85 millihenries.

One tuned stage is sacrificed by this method of connection, since there were a tuning condenser and coil connected in the grid circuit of the first radio frequency amplifier, and this tuned circuit has been removed. However, the gain is present nevertheless, since it will be remembered that previously you obtained no results, while it is hoped that now you are getting along excellently.

Even if you have been doing well with the standard connection, if you have a screen grid tube as the first radio frequency amplifier, it is well to try the alternative connection, to see whether results are even better.

Where Other Type Tubes Is Used

Should your receiver use any other type of radio frequency amplifier than a screen grid tube the problem of gaining access only to the grid of the tube, without picking up the tuning system associated with it in the set, would be one quite difficult to solve. In fact, you could not solve it without disconnecting the two, which means unsoldering leads, were it not for the existence of a service man's adapter.

This device is plugged into the socket of the tube under discussion, and the tube is then placed in the adapter. The circuit from tube prong to the socket spring is completed through a removable brass brad, so if the brad representing the grid circuit G is removed, the grid circuit is rendered discontinuous, there being an opening between the coil-condenser circuit and the actual grid prong of the tube. Therefore you have access to the grid alone, and will connect the output of the converter to this post.

There are two tips, not identified as between the tube grid and grid circuit, but by easy trial you will soon find out which one to use.

Receiver Must Have Some Sensitivity

Since the adapter is obtainable for four-prong (UX) and five prong (UY) sockets, all types of tubes other than screen grid, which need no adapter, are open to this remedy.

The foregoing assumes that you have a receiver that is not almost completely devoid of sensitivity. If your receiver is so nearly dead that it tunes in only local stations, you will not get good results from the converter, for the poor sensitivity of the receiver is proven generally by the failure to get some distance. It need not be a set that's a wow on DX, but it should be at least a fair performer.

Tuned radio frequency receivers have been discussed first, since the sets in use are so largely of that type, but this is a superheterodyne year, so they say, so let us see what problems arise in making connection to that type of receiver.

Superheterodynes, for purposes of short-wave or all-wave converter discussion, may be grouped into two general classes: (1), those that have radio frequency amplification ahead of the first detector, and (2), those that have no radio frequency amplification ahead of the first detector.

Application to Superheterodyne

If there is radio frequency amplification, which means amplification at the level of broadcast frequencies, and which is usually denoted by the presence of a three-gang or four-gang tuning condenser, then the same method of treatment applies as in the case of tuned radio frequency receivers, already discussed.

If there is no tuned radio frequency amplification, it means that the output of the converter would be connected to the modulator

ters to a Broadcast Set

Bernard

(first detector) of the superheterodyne. This is a bad situation. The output of the converter most likely is itself a modulator, and the coupling is therefore that of one modulator to another.

Such a situation means that in the converter there is one mixing process, with or without prior amplification, while in the set there is another mixing process, without prior amplification. Every instance of mixing entails a loss, so if the superheterodyne with which you intend to use the converter has no radio frequency amplification ahead of the modulator, do not connect to the antenna post of the converter output to the antenna post of the set, but instead remove the first detector tube from the set, leave it out, and stick the bared end of the converter leadout wire into the plate spring of the socket.

Results May Surprise You

The situation is now such that the sole mixer in use is in the converter, and the output of the converter is made immediately to the intermediate frequency amplifier of the superheterodyne. Even if there is tuned radio frequency amplification ahead of the modulator in the set. and even though good results were obtained by the direct BF grid method of connection previously discussed, it is well, nevertheless, if you have a superheterodyne, to try out the connection to the intermediate channel.

The frequency of response will be increased, and if you had an all-wave converter you may not get the broadcast band when the output of the converter is made to the equivalent of the P post of the first intermediate frequency transformer, but you may gain a surprising advantage sensitivity.

Although in other connections the advice often has been given to try a short aerial for short waves, one should use a long outdoor aerial when working a converter. It appears that the watchful regard for the natural period of the antenna is of much greater importance in short-wave transmission than in short-wave reception, at least by the converter method, since the long aerial gives a greater field intensity at the input, and the benefit of secondary tuning may be enjoyed nevertheless, provided the coupling is not too tight.

Case of a Loop

It is still true, therefore, that an all-wave or short-wave converter works with any receiver, but it is also true that the coupling has to be effective for any results to be obtained, and that there must be some sensitivity in the receiver itself.

The foregoing disposes of practically every problem of connection from converter to set, excepting those receivers that use a loop. If the loop is in a tuned radio frequency set, proceed as for a tuned radio set that uses an aerial, and introduce the service man's adapter. If the loop set is a superheterodyne without tuned radio frequency amplification, and most loop supers have no TRF, then connect direct to the first intermediate transformer at socket plate spring.

New Circuits Presented

The methods previously outlined relate to remedies to existing conditions, while the circuits to be discussed were designed with the object of greatly reducing, if not completely eliminating, the difficulty right in the converter, and with a recommended method of connection.

As an example, see Fig. 1, which shows a four-tube circuit, in which one tube is a modulator (upper left), another is an oscillator (lower left), a third if an intermediate frequency amplifier, and the fourth is a rectifier. The 227 as a rectifier works well indeed, in the circuit as diagrammed, which was invented by J. E. Anderson.

It so happens that this converter uses the switch method of wave band changing, through a single knob actuated at the front panel, but the particular features pertinent to the present discussion are the built-in stage of intermediate frequency amplification, and the output from this tube through a transformer with tuned secondary.

Where the "High" Side Goes

Notice very particularly that the tuned secondary is to be connected with "high" side to the grid of the first radio frequency tube if of a tuned radio frequency receiver, or in the case of a super with TRF the "high" side of the output from converter goes to the first TRF tube thereof, or in a super without TRF, to the plate post of the first detector socket (with tube removed), or optionally to grid of the first intermediate amplifier tube. In the instances of recommended grid connection, if screen grid tubes are in the set, no adapter is needed, if they are not in the set, an adapter is needed.

For Fig. 1, therefore, the connections would be:

1—Remove aerial from the antenna post of the receiver and connect it instead to the antenna post or leadout wire of the converter, usually marked "aerial."

2—Connect the ground post or leadout wire of the converter to the ground post of the receiver, leaving ground where you found it at the receiver post.

3—Connect the output of the converter (marked "grid of first RF tube") to the cap, if that tube is a screen grid tube, otherwise to the grid jack of a service man's adapter, after removing the brad from the two grid openings of that device. The only exception is that of a superheterodyne that has no TRF, in which case it is practical with this circuit to connect to the cap of the first intermediate tube, if a screen grid tube is positioned there, or to grid through an adapter otherwise, for *the grid return will take care of itself by the special method of circuiting the converter.*

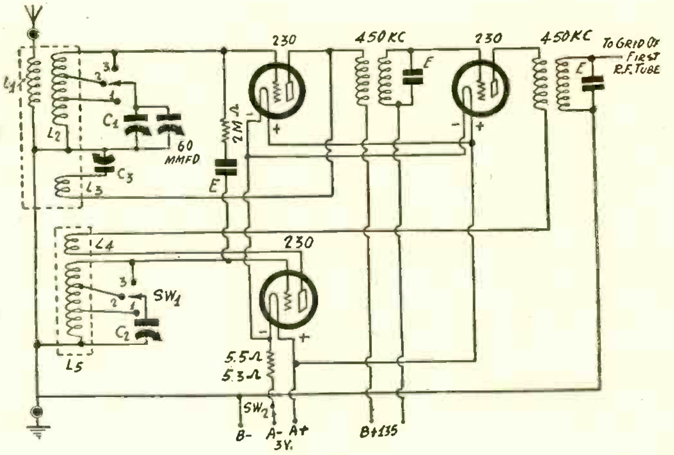


FIG. 2

The battery-operated equivalent of the converter diagrammed in Fig. 1.

Same Frequency Required

Notice, therefore, that while a fixed condenser of .0015 mfd. (or higher capacity, if desired) is connected between the B minus of the converter and ground, the return for the secondary of the output coil is made directly to ground. Therefore the grid return of the tube to which the output is connected is automatically grounded.

Establishment of an intermediate frequency in the converter requires that the set be tuned to the same frequency. The range of the 450 kc transformed is from 400 kc to 550 kc.

Although a B supply is built into this converter, with the 110-volt AC line connected across the rectifier and the tube circuits fed by it, no possibility of short-circuit of the line can arise due to the rectifier hookup, because, aside from the extra precautionary .0015 mfd. fixed condenser in series with external ground, there is the new precaution of the choke in the negative leg. So if the ground were actually connected, even by mistake, to what is shown as the grounded side of the 15 henry B supply choke, this choke would be across the line, and therefore no short circuit would result.

Coil Winding and Use

Those interested in the wave band switching device will be interested to know the nature of the switch. It is a double one with two insulated pointers or moving arms, and with three taps on each switch, known as a three-point double throw switch.

The coil windings from 0 to 1 and 1 to 2 are equal, while those from 2 to 3 may be equal also, if a series condenser is used in the oscillator circuit. See E between point 3 and oscillator grid. A 20-100 mmfd. equalizer will serve the purpose, being set once, for loudest volume on a low frequency station, and left thus.

While three-point switches are shown, because it is assumed C1 and C2, the tuning condensers, are .00035 mfd. two-gangs, or of higher capacity, any smaller capacity than .00035 mfd., to afford coverage of from 15 to 600 meters, normally would require four points.

The number of turns to put on the secondaries is determined by the capacity of the condensers to be used and by the provision for or absence of shielding. For .00035 mfd., using 1¾ inch diameter tubing, no shielding, the secondaries wold have 70 turns, tapped, say, at the 30th and 5th turns. If shielding is used the total number of secondary turns would have to be around 91, with the shield diameter no less than 3 inches, and the shield height no less than 3½ inches. The taps would be in the same proportion.

Reasons for Good Operation

L1 may have 10 turns, L6 (which is not part of the tuned secondary) have 4 turns, and L3 and L4 each have 20 turns, provided C3 has a capacity of 150 mmfd. or more.

The letter E represents the 20-100 mmfd. equalizers, and the other constants are designated on the diagram.

The principal reasons for the development of a good output volt-

(Continued on next page)

Battery and AC Cir

Direct Connection to Grid Favored

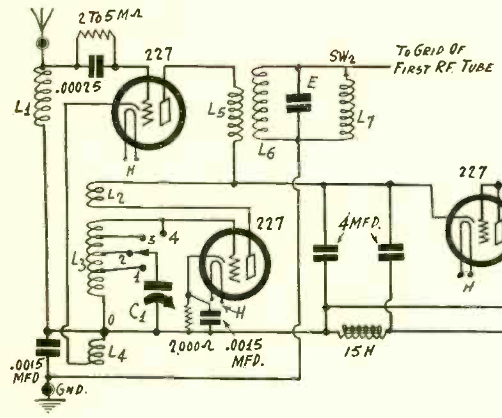
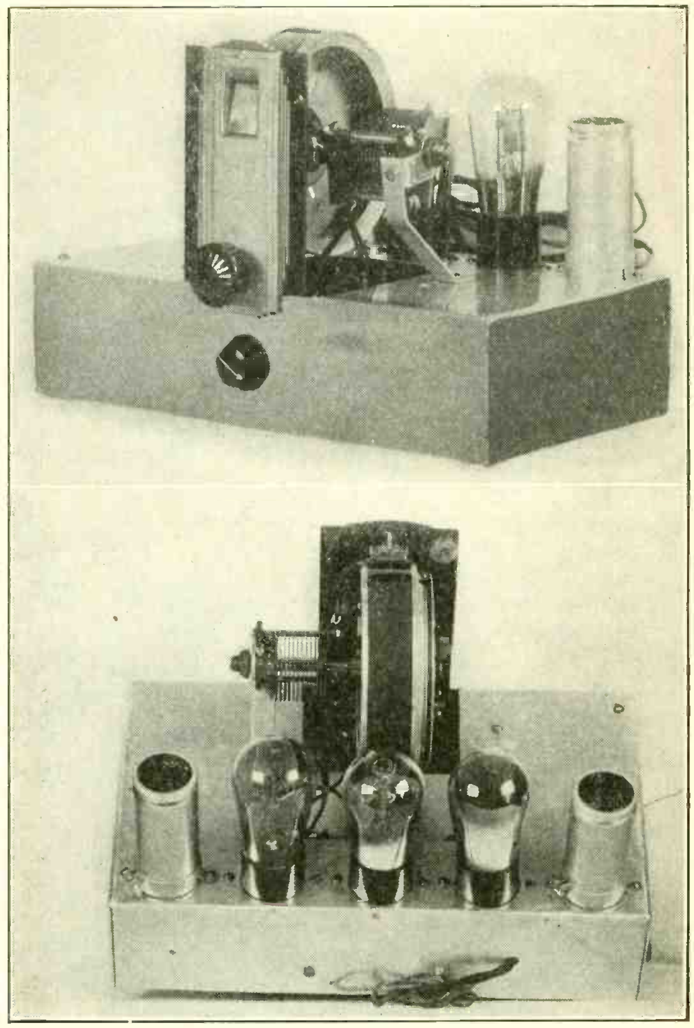


FIG. 3

One manually tuned circuit is used in this design of an all-wave converter. The output is to be tuned to the intermediate frequency established in the receiver with which the converter is used.



FIGS. 4 AND 5

Two views of the single tuned circuit converter, built from the diagram, Fig. 3, but with 8 mfd. filter condensers of the electrolytic type.

(*Continued from preceding page*)

age and satisfactory coupling to any receiver are: a stage of intermediate frequency amplification built in, and a tuned output to be substituted for a grid load in the receiver. No loss by detuning is suffered, as the output secondary has an adjustable condenser across it.

Battery Model

The same fundamental circuit as in Fig. 1 is adapted to battery operation in Fig. 2. The coupling between the modulator and oscillator, instead of being through a small winding on the oscillator coil, is through series-connected condenser and resistor (E and 2 meg.). The condenser E would alone suffice, in fact, might more than suffice, therefore the resistor is suggested for reduction of the degree of coupling. Lower resistance increases coupling, higher resistance decreases it. If the condenser alone is used it may be placed from stator lug to stator lug on the two-gang condenser, which would constitute a slight change in the diagram, by connection of the resistor to the switch arm.

The tubes are 230's throughout. The resistor required to drop a battery voltage of 3 volts to the 2 volts for the filaments should be 5.5 ohms, and that value is marked beside the resistor, while below it, the 5.3 ohm designation, represents a commercial value consisting of a 4 ohm resistor and a 1.3 ohm resistor in series. If you have a 6 ohm or higher value rheostat you may use that, but be sure when seeking the correct adjustment, that the total resistance is in circuit first. If you can not determine this readily, connect only 1 1-2 volts of the A battery to the filament circuit. Maximum resistance will dim the brilliancy of the tube.

Simple AC Model

Both the diagrams, Figs. 1 and 2, show hookups using two manually tuned circuits, with the modulator regenerated. Fig. 3 is a converter with only one tuned circuit, and represents the utmost simplicity and economy in a good converter with B supply built in.

The modulator is untuned, the oscillator alone is tuned, and the third circuit is the rectifier's. The output from the modulator is made through a transformer, consisting of two loosely coupled honeycomb choke coils. In fact, L5, L6 and L7 are 200-turn coils of this type, but L7 is separate, and is not inductively related to the others.

The object of L7 is to reduce the secondary inductance. The condenser E, across a 200-turn coil, will tune to about the lowest broadcast frequency, while when the two coils are in parallel, as by closing switch SW2, the highest broadcast frequency can be tuned, therefore the two coils make up for the capacity limitation of the condenser E.

If you use a regular broadcast coil and tuning condenser, L5 and L6 may be the primary and secondary of a radio frequency transformer, while E would be .00035 mfd. or .0005 mfd. Then L7 and Sw2 would not be needed. However, if compactness is desired, the other system is preferred.

Coil For Single Tuned Circuit

The same consideration of compactness would prompt the use of a midget tuning condenser. One of .0002 mfd. capacity is available, the Hammarlund junior midline condenser. Due to the smaller maximum capacity of the tuning condenser, and also to the uncertainty of the intermediate frequency selection, a greater leeway in the coil switching arrangement is advisable.

In the previous examples the intermediate frequency may be regarded as being fixed, as there is only a small frequency margin from which the select, due to the intermediate frequency transformers in the converter. But Fig. 3 has no intermediate frequency amplifier, so the intermediate frequency may be anything within the tuning span of the receiver with which the converter is worked. Therefore if an intermediate frequency of 1,600 kc were used, and the lowest broadcast frequency, 550 kc, were to be tuned in, the oscillator frequency would be about four times as great as the frequency of the desired incoming carrier. If 520 kc were used as the intermediate frequency, to receive 550 kc, the oscillator frequency would be only about twice the frequency of the incoming original carrier.

As the intermediate frequency is lowered, the frequency to which the converter is tuned, without molesting the converter condenser, is increased, and the increase is equal to the change in intermediate frequency. So the coil should be designed to bring in the lowest broadcast frequency even if the lowest possible intermediate frequency is used, that is, must have more wire on the secondary than would be the requirement otherwise.

Effect of Extreme Intermediate Frequencies

No shielding is necessary in a simple circuit like the one in Fig. 3, therefore for .0002 mfd. capacity the total number of secondary turns on a 1¾-inch diameter tubing would be 60, tapped at the 28th, 12th and 4th turns. Therefore the number of turns between

cuits for Converters

and Method of Application Outlined

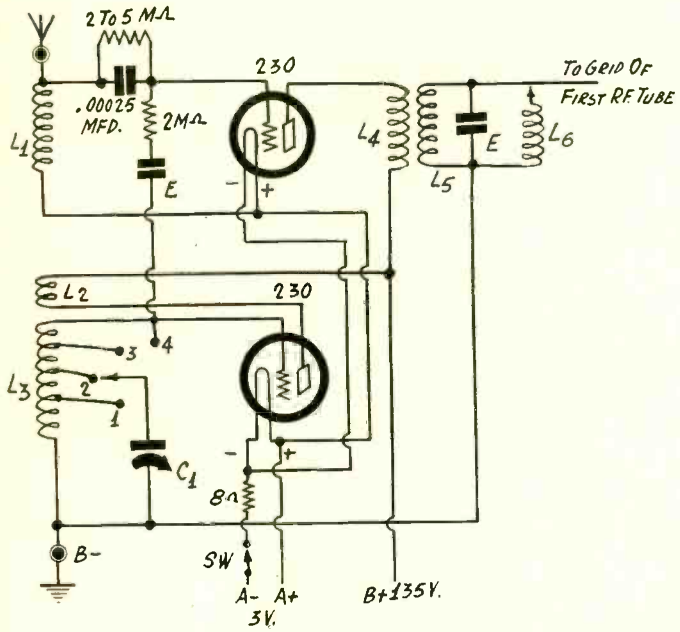


FIG. 6
A single tuned circuit converter for batteries

the grid end of the coil (4) and the first actual tap (3) would be 32. A four-point single throw switch is used.

If a high intermediate frequency is used (say, 1,600 kc) then only taps 1, 2 and 3 would be useful, unless it is desired to tune in frequencies lower than the lowest broadcast frequency, i.e., ships calling and the like.

The size of wire to use on any of the secondaries (Figs. 1, 2, 3 and 4) is not very important, except that it is preferable to use no smaller than No. 18 from tap 3 to 0. The other wire may be fine, both in the secondary and in the associated coils.

L1 in Fig. 3 is a radio frequency choke coil of the 200-turn honeycomb variety, or if short waves are to be particularly favored, 100 or 50 turn honeycombs.

The battery equivalent of Fig. 3 is shown in Fig. 4, where the filament resistor of 8 ohms may be two 4-ohm types in series; that is, resistors ordinarily used for 5-volt tubes of the quarter-ampere variety from a 6-volt source. Here, however, the battery voltage is 3 volts, consisting of two dry cells.

The battery model, Fig. 6, as can be seen, is extremely simple, and yet it gives good performance on short waves, and is fair on the broadcast band.

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GRADUATE of National Radio Institute, age 19, two years in repair and set building, would like work anywhere in repair shop or research work. Willing to start at small pay with opportunity for advancement. References: National Radio Institute, Washington, D. C.; Layton's Radio Shop, Corsicana, Texas. Address: Miles Washburn, R. F. D. No. 3, Corsicana, Texas.

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Regeneration in IF A

One IF Stage May Be

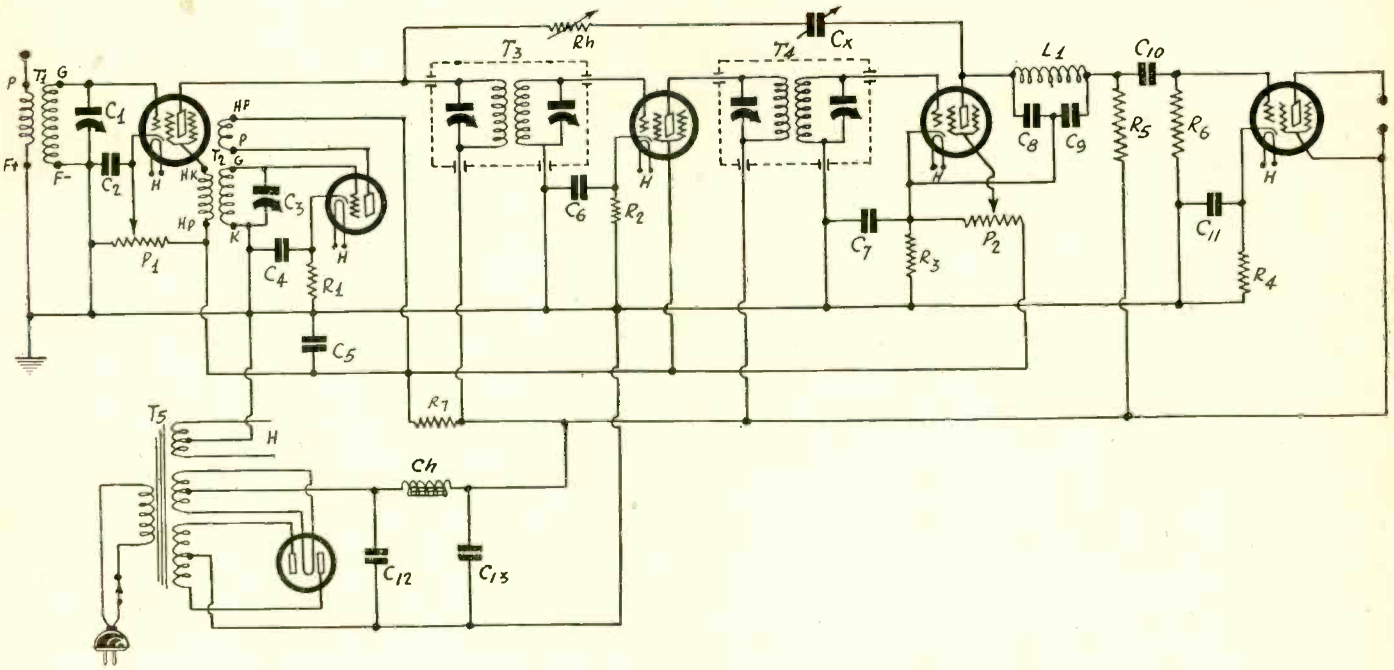


FIG. I
The circuit diagram of a five-tube regenerative short-wave superheterodyne utilizing the 6.3 volt tubes.

ONE of the uncertainties of short-wave converters is that all broadcast sets with which they are to work are different. It is easy enough to build a converter for a particular broadcast set that will work, but it is not so easy to build one that will work with all broadcast sets. To attempt it requires that there be a variable factor in the converter output which will make the coupling between the two effective. Moreover, if a converter is to be successful there must be a great deal of radio frequency amplification in the broadcast receiver. This statement is usually emphasized in conjunction with converters but it seems that it is always ignored. So many seem to think that a converter will work satisfactorily with all receivers regardless of the sensitivity of these receivers. They will only work well when there is much amplification at radio frequency.

It would seem that a superheterodyne type of receiver should be an exception and that all converters, if they work at all, should work exceptionally well with broadcast receivers of this type. The fact is that they will only work well, if at all, when there is much radio frequency amplification in the receiver. That is, a superheterodyne is no exception to the general rule. With some superheterodynes converters work well, with others not at all. The main trouble with those that do not work is that they do not have enough radio frequency amplification at high frequency. Most of the amplification is at intermediate frequency. Those that work with converters do have radio frequency amplification and radio frequency selection ahead of the first detector tube.

Of course, another trouble is unsuitable coupling between the converter and the input to the broadcast superheterodyne. Most receivers are so designed that they will be selective and sensitive when an average antenna is connected to the input terminals. But an average antenna has a low impedance. The output tube of a converter has a comparatively high impedance. The result is that when the two are combined, there is the worst kind of mismatching. A step-down transformer of 4-to-1 or 5-to-1 ratio should improve the match. But in other receivers the input impedance is very high, in which case best results are obtained if the output tube of the converter is a high mu tube.

A Solution

One solution to the problem of matching the converter to the set is to build the entire intermediate frequency amplifier into the converter and only use the power supply and the audio amplifier of the broadcast receiver. But using the power supply of the receiver for the converter lead to troubles which demanded that a power supply be built into the receiver. The difficulty is sometimes that of making the proper connections and sometimes of finding any place in the receiver where the connection can be made. When the converter has the power supply built in, thse troubles are eliminated, and thus all we have left of the broadcast receiver is the audio amplifier. And in modern receivers there is very little of that, so that, too, might just as well be built into the converter.

A Short-Wave Super

And when we have done all this to the converter, what have we? We have a complete short-wave receiver. We have a receiver which should bring in thousands of short-wave stations just as easily as a broadcast receiver brings in broadcast stations. That is, if short waves can be brought in with a superheterodyne type receiver at all. And they surely can be.

In Fig. 1 is the circuit of a short-wave superheterodyne based on the converter idea. The first detector of this circuit feeds

LIST OF PARTS

Coils

T1—One set of antenna coupling coils as described
T2—One set of oscillator coils as described
T3, T4—Two shielded 450 kc intermediate transformers (or 650 kc)
T5—One power transformer having three center tapped windings of 360, 6.3 and 5 volts, total in each case
L1—One 800-turn duolateral choke coil
Ch—One 30 henry choke coil

Condensers

C1, C3—One pair of ganged 250 mmfd. tuning condensers
Ca—One 50 mmfd. trimmer condenser
C2, C4, C6—Three 0.1 mfd. condensers
C5—One 1 mfd. condenser
C7, C11—Two 2 mfd. by-pass condensers
C8, C9—Two 250 mmfd. fixed condensers
C10—One 0.02 mfd. condenser
C12, C13—Two 8 mfd. electrolytic by-pass condensers
Cx—One 25 mmfd. midget condenser

Resistors

P1, P2—Two 30,000 ohm potentiometers
R1—One 1,500 ohm bias resistor
R2—One 300 ohm resistor
R3—One 5,000 ohm resistor
R4—One 1,250 ohm resistor
R5—One 250,000 ohm resistor
R6—One one megohm resistor
R7—One 5,000 ohm resistor
Rh—One 30,000 ohm variable resistance

Other Parts

Two UY sockets
Six UY sockets
Four grid clips
One vernier dial
Four binding posts

mplifier Boosts Gain

Omitted in Short-Wave Super

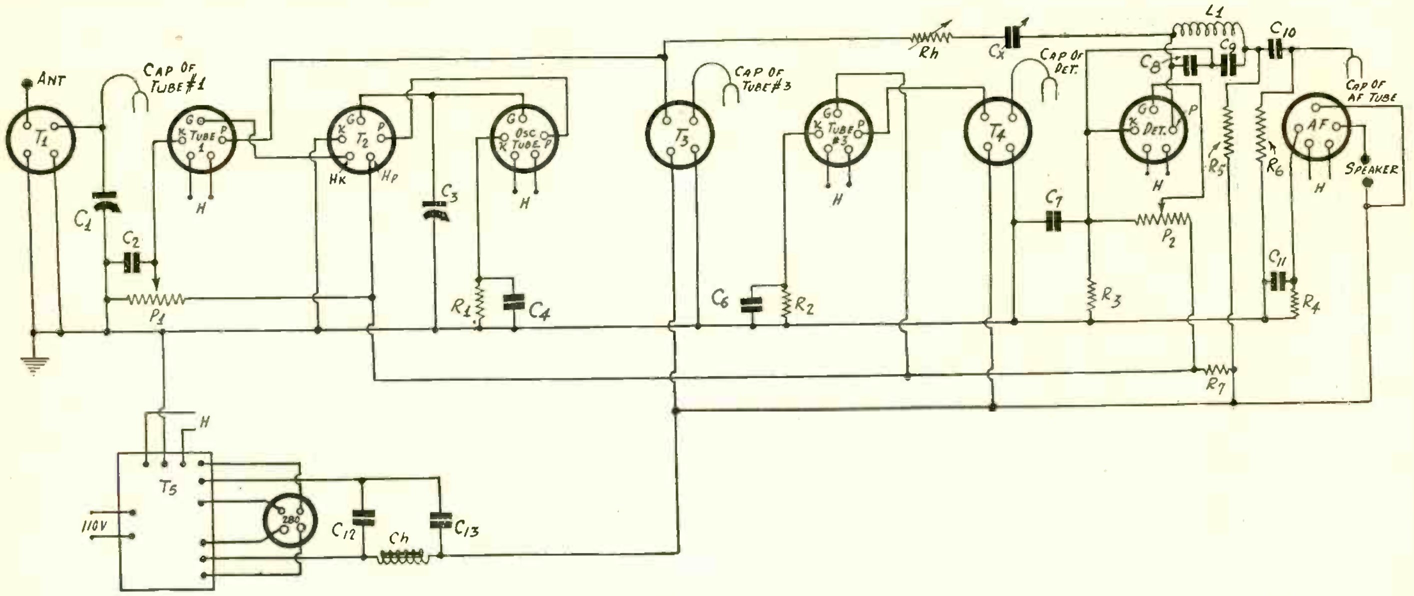


FIG. 2
A type of wiring diagram of the superheterodyne in Fig. 1 showing the connections to the coils and tubes.

into a tuned circuit, which is the most effective coupling for a screen grid tube detector, except a high resistance, which cannot be used because we must have selectivity. This tuned circuit feeds into a screen grid tube, which in turn delivers the signal to another tuned circuit, and this impresses it on a screen grid detector. If the signal is strong at the detector grid and the coupling between the detector and the following audio tube is suitable to the screen grid tube, not much amplification should be needed at audio frequency. Sometimes only one tube is used in modern receivers, and that a tube like the 245, which has a low amplification. Coming radio receivers will be equipped with pentode power tubes, which have a much greater amplification. Hence if we put in a pentode power tube we should get a satisfactory output in respect to volume. That is the reason the last tube in Fig. 1 is a pentode.

The power supply is a regular B battery eliminator utilizing a 280 rectifier tube. If that tube can supply enough rectified current for a set using 10 tubes, two of which are 245 power tubes, it certainly is large enough to supply the current for a little short-wave receiver utilizing only five tubes. We could use a smaller rectifier tube if we had it.

Regeneration Used

There are only two intermediate frequency transformers in the circuit, and only one intermediate frequency amplifier. The question may arise as to whether this is enough to load up the second detector. That depends on how much there must be to be enough. That is, it depends on what is expected of the receiver. If it is to pick up a little weak station across the ocean any time it is on the air and make the signals overload the loudspeaker, one amplifier is not enough. But such sensitivity is of no practical use, for the receiver would bring in so much noise that this would overload the loudspeaker without the signal, and the signal could probably not be distinguished. We can get along with less amplification if we are practical.

A way of increasing the amplification without the use of extra tubes is to employ regeneration in the intermediate frequency amplifier. By this means it is possible to increase the amplification as much as another stage would increase it without adding another tube. And it can be used in an intermediate amplifier of fixed frequency just as well as in a radio frequency amplifier, provided that the frequency is not too low. Frequencies now used range from 175 kc up to frequencies above the broadcast band.

Reverse Feedback Possible

But how is the regeneration to be obtained and how is it to be controlled? A tickler can be used as in radio frequency amplifiers and the amount of regeneration may be controlled by changing the number of turns on the tickler, by changing its coupling to the grid coil, or by any one of a number of methods. In case a tickler is not desired, or in case it is inconvenient, an arrangement like that shown in Fig. 1 can be used. Here the plate of the detector tube is connected to the plate of the modulator tube by means of a small adjustable condenser Cx and an adjustable resistance Rh.

With this connection it is possible that the feedback is in reverse so that it will decrease the amplification rather than increase it. In that case it is only necessary to reverse one pair of leads of the transformers. There are four pairs to select from, but only one should be reversed. In testing whether the connection of the feedback circuit increases or decreases the amplification the circuit should be retuned after the change, and this retuning should be done with the trimmers on the intermediate frequency coils. This retuning is necessary because the added connection may change the capacity of one of the circuits by an amount sufficient to change the output. The condenser that will have something added to it is the first one in T3.

If the circuit breaks into oscillation when connection is made the leads should not be reversed because oscillation is an indication that there is more than sufficient regeneration. Oscillation in the intermediate frequency amplifier can be detected by squealing when the radio frequency amplifier is tuned. These squeals do not depend on any signal that may enter the receiver, for it should go on even with the antenna disconnected or with the grid clip on the first tube off the tube.

If there is oscillation in the intermediate frequency amplifier it is only necessary to decrease the feedback by one of the controls provided, either Rh or Cx, until it just stops.

It may be that the by-pass condenser C8 is so large that not sufficient energy will go through the feedback circuit to cause any appreciable oscillation. Two courses are then open. C8 may be reduced or a very small inductance coil may be connected between the plate of the detector tube and this condenser.

In view of the fact that the normal amplification between the two detectors is high, it takes an extremely small amount of energy to cause oscillation, and the trouble may not be that it will not oscillate but rather that the oscillation cannot be controlled. It is for this reason that two controls are provided. Cx should be a trimmer type of midget and Rh a variable resistance of about 50,000 ohms.

Regeneration Fixed

It is not necessary to provide a manual control for either Rh or Cx. The regeneration once adjusted may be left, provided that it is not made so near the critical value that the circuit will break into oscillation at the slightest provocation. The frequency at which the regeneration is always the same and therefore there is no change in the feedback with frequency of the signals tuned in.

If the circuit is to be used exclusively for short-wave reception the intermediate frequency transformers R3 and T4 may be tuned to a frequency of 650 kc, for which a tuning curve is given elsewhere in this issue, but if broadcast stations also are to be tuned in, or if a broadcast frequency is unsuitable for intermediate because of local interference, a frequency of 450 kc may be selected for T3 and T4. Both are available in compact and shielded form.

(Continued on next page)

An Oscillator Coil Calibrat

By J. E.

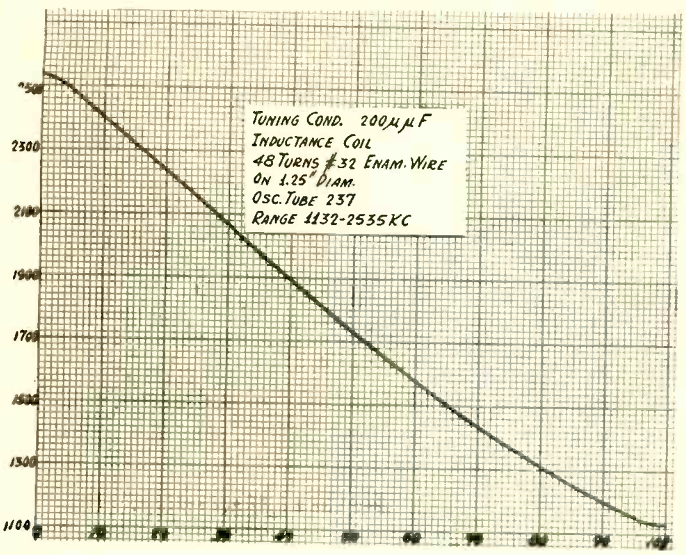


FIG. 1
A calibration curve for the second coil in the modulated oscillator published in the May 3rd issue. The range is from 1132 to 2535 kc.

IN the May 23rd issue we published the circuit of a modulated radio frequency oscillator and in the following issue, May 30th, we gave winding data for oscillator coils.

In the first instalment we also gave a calibration curve for the oscillator covering the frequency range 510 to 1,210 kc. In the present instalment we publish a calibration curve, Fig. 1, for the second largest coil, or the 48 turn coil. This coil covers the range from 1,132 to 2,535 kilocycles. The overlapping of these two coils is satisfactory, being the range from 1,132 to 1,210 kc, or 78 kilocycles. While so much overlapping is not absolutely necessary, it is well to have it for three reasons. First, the calibration near the limits of the tuning condensers is not certain due to the fact that the condenser can be moved several divisions without any frequency change. Second, it is sometimes unnecessary to change coils when operating near the ends of the scale. Third, it is desirable to have several points of cross-check of the calibrations without resorting to harmonics.

Calibration by Harmonics

The calibration of the second coil was done entirely by the harmonic method. An auxiliary oscillator was set up covering the range of the largest coil and this oscillator was also calibrated against the oscillator previously calibrated against broadcast frequencies.

As long as the auxiliary oscillator could be tuned to the same frequency as the oscillator in which the 48 turn coil was used, the first harmonics were used. But outside the overlapping range second and third harmonics were used. For example, the auxiliary oscillator was set at 600 kc and the beat between the second harmonic of this and the fundamental of the smaller oscillator was found. Thus a 1,200 kc was established for the smaller oscillator. Again, the auxiliary oscillator was set at 700 kc in order to find the 1,400 kc point on the smaller. This was continued until the second harmonic no longer would work, when the auxiliary oscillator was set so that its third harmonic could be used against the frequency of the smaller oscillator.

The calibration of the oscillator may be done in the same manner for the smaller coils, and calibration curves will be published at a later date for at least two more coils.

The auxiliary oscillator set up for this calibration was put into permanent form and its calibration was carefully preserved but since it is practically the same as that of the other it is not necessary to give the curves. The circuit, however, is interesting because it is intended for taking curves on radio frequency transformers and for this purpose it is excellent.

Circuit of Auxiliary Oscillator

The circuit diagram of this oscillator is given in Fig. 2. The first tube is a 227, which is the oscillator, the second is a 224, which is used as radio frequency amplifier, and the third is a 227, which may be used either as a vacuum tube voltmeter or an amplifier depending on the bias and the connection of the 0.1 mfd. condenser in the plate circuit.

When the circuit is used as a vacuum tube voltmeter a suitable grid bias is connected at the terminals marked C plus and C minus and the 0.1 mfd. condenser is connected as shown. When the last tube is used as an amplifier the terminals for the C battery are short circuited and the switch Sw is opened. The bias for the tube when it is used as radio frequency amplifier is obtained from the 2,000 ohm resistance.

When the tube is used as vacuum tube voltmeter a suitable current meter is connected at the output terminals M and when it is used as an amplifier some output device such as a tuned radio frequency transformer is connected to these terminals. When this circuit was used as an aid in calibrating the other oscillator the headphones were connected to the terminals marked P and B. Thus the 224 tube served as detector of the beats. While it is not a good detector it served the purpose very nicely.

All the constants used in the circuit are given on the diagram except for the windings on transformer T1. These were exactly the same as the windings on the oscillator transformers published last week for the oscillator given May 23rd. They are, 140, 48, 16, and 6, the grid windings being 50, 32, 11, and 4. For this oscillator however, the coils were wound on forms having four prongs so that they would not be mixed with the coils intended for the other oscillator. All dimensions otherwise were exactly the same.

It will be observed that the oscillator published May 23rd also has an amplifier tube. In that circuit this tube is at the left. The connections in the two circuits are the same, although they look different. In the first circuit the amplifier tube is a 227 or 237. They were made different so that tests on radio frequency transformers could be made both when connected to a screen grid tube and a three element tube.

Testing Coils

A resonance curve on a 650 kc intermediate frequency transformer was taken with the circuit in Fig. 2 herewith. The leads of this transformer were connected to terminals marked P, B, G, and K and the grid bias connected to the C terminals was adjusted until the meter M, a 0-1 milliammeter in series with a 100,000 ohm resistance, just barely showed a reading when G and K were short circuited. Then the short across G and K was opened and the frequency changed by means of the oscillator condenser until the current in M was maximum. Then the tuning condensers on the coil under test were adjusted until the deflection on the meter was maximum. The coil had a small adjustable condenser across each winding. Then the frequency was varied until it passed from one side of the resonance curve to the other, close readings being taken near the peak of the curve and also at those frequencies where the change was rapid. The result is the curve shown in Fig. 3. The peak falls at 627 kc and at that point is 0.42 milliamperes. A test on the transformer for possible variation of the peak by means of the trimmer condensers showed that the resonance frequency could be varied from 625 to 700 kc. Thus the curve was taken very close to the lowest frequency to which the transformer could respond.

The resonance curve gives only the current in the plate circuit of the indicating milliammeter but the current is nearly proportional to the AC voltage on the grid of the tube. The peak voltage was measured by the grid bias variation method and it was found that the peak corresponded to a peak voltage of 16.5 volts. The bias

Construction of

(*Continued from preceding page*)

If the intermediate frequency is of the order of 450 kc it is practical to gang the two tuning condensers C1 and C3 provided that a trimmer, available from the panel, is connected across the first condenser. This trimmer is indicated by Ca. When this arrangement is made the inductances of the tuned windings of T1 and T2 should be the same, and the primary of T1 should be loosely coupled to the secondary so that the antenna constants do not upset the effective inductance too much. If the intermediate frequency is 450 kc and the lowest frequency is to be 1,500 kc, and also if C1 and C2 are .00025 mfd. condensers, then the value of Ca should be at least 17.5 mmfd. Thus a very small trimmer condenser will do.

The inductance of the secondary of each coil that is to cover the band of frequencies just above the broadcast band is 26.7 microhenries. This calls for 25 turns of No. 28 enameled wire on a form 1.25 inches in diameter. The oscillator coil should be wound on a form that fits a UY socket and the antenna coupler on a form that fits a UX socket. The next coil should have 9 turns and the third 3 turns. The tickler in any case should have about two-thirds as many turns as the tuned winding and

ed for from 1132 to 2535 kc

Anderson

required to reduce the plate current to zero with the G and K terminals short circuited was found to be 13.5 volts, and the bias required to reduce the current to zero when the terminals were not shorted, that is, when resonant voltage was applied to the tube, was found to be 30 volts. Hence the AC voltage was 16.5 volts, peak value.

From the shape of the curve and the reduction in the output as the frequency changes it is possible to calculate the Q, or selectivity factor, of the circuit. It turned out to be 28.6. The inductance was determined approximately to be 519 microhenries in each winding. Knowing the inductance, the Q, and the resonance frequency, it is also possible to calculate the apparent resistance. This turned out to be 72 ohms. This cannot be said to be the resistance of either the primary or the secondary since the resonance curve is due to a combination of both.

Case Must Be Grounded

The transformer under test consisted of two small duolateral coils of 200 turns each mounted concentrically, or end to end, with a distance of 1.125 inches between their centers, and mounted inside an aluminum can 2.5 inches in diameter and 2 inches high. The shield can was grounded when the curve was taken. Without the ground there was practically no increase in the output as the frequency passed through the resonance point. This essential grounding may be done either by connecting the can to the K terminal or to the grounded part of the circuit, in case they differ.

Incidentally, when the peak voltage was measured, a special high mu tube of the heater type was used in the last socket. A high mu tube is to be preferred because it cuts off the current more sharply. In case a special high mu tube is not available, a 224 tube used as a space charge tube can be used. A positive voltage of about 22.5 volts is applied to the cap, no other change being necessary. In case a 227 tube must be used, it is all right, but it requires a higher bias to cut off the plate current. A variable mu tube like the 235 should not be used for measuring peak voltage, nor as rectifier, because the current does not cut off and there is practically no detection with it.

Voltages on Circuit

The voltages indicated on the circuit in Fig. 2 are those that were used. But if the screen grid tube is to be operated at the normal maximum voltages, they may be increased to 67.5 and 180 volts. Whatever voltages are used in the calibration should be used always. The only reason why higher voltages might be used is that if the signal voltage is high the plate voltage on the vacuum tube voltmeter tube should be higher than indicated. This voltage may be boosted by connecting a battery in series with the meter without changing the voltages on the other tubes. This change in the voltage on the last tube will not change the calibration.

Now as to the manner the Fig. 2 circuit was assembled. There are four sockets required in the assembly, three of the UY type for the tubes, and one of the UX type for the coil socket.

It is recommended that batteries be used for all voltages, with the exception of the heater voltage. If the circuit is built and calibrated for 237 and 236 tubes, a storage battery may be used for this voltage also. A steadier frequency will result if batteries are used throughout.

Since the third tube in the circuit in Fig. 2 is a peak vacuum tube voltmeter, it can be used for measuring the degree of modulation, for example, the degree of modulation in the output of the oscillator published in the May 3rd issue. The way to measure the degree of modulation is as follows: First measure the peak voltage of the unmodulated wave as outlined above. Then start the audio amplifier and again measure the peak voltage. Divide the modulated peak voltage by the unmodulated peak voltage and subtract one. The result is the degree of modulation. To get the percentage modulation, multiply by 100. The two circuits may be coupled by connecting the primary of a radio frequency transformer to the output of the modulated oscillator and the secondary terminals to G and K in Fig. 2. The first and second tubes in Fig. 2 should not be in the sockets when this measurement is made for the radio frequency in the Fig. 2 oscillator may change the input to the vacuum tube voltmeter and cause a spurious result.

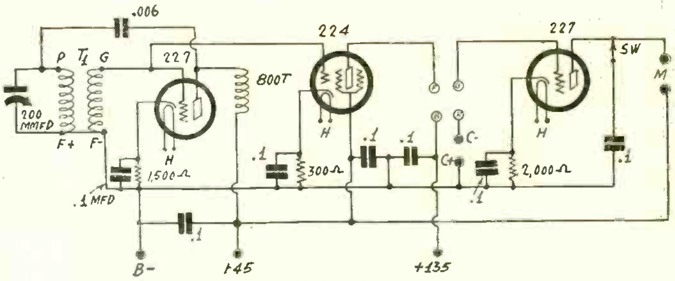


FIG. 2

The circuit of an oscillator used as an aid in calibrating the oscillator referred to above together with an amplifier and vacuum tube voltmeter for taking resonance curves on radio frequency transformers.

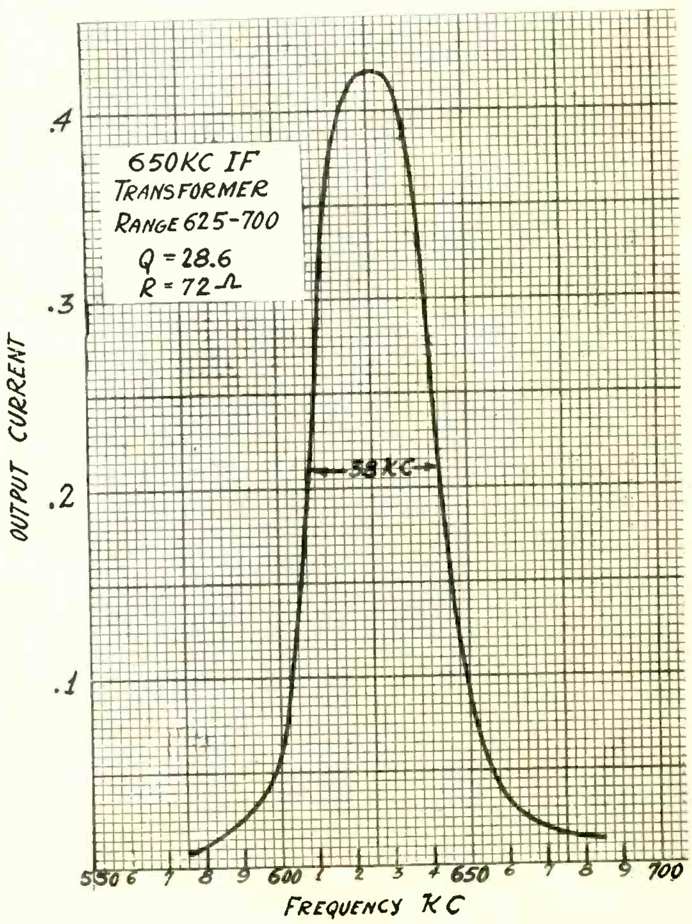


FIG. 3

A resonance curve taken on a 650 kc. intermediate frequency transformer with the circuit in Fig. 2.

a Superheterodyne

the pick-up winding one to three turns. The antenna winding on the first transformer should have about one-fifth as many turns as the secondary, but not less than one turn. The separation between the primary and secondary of T1 should be from one-eighth to one-quarter of an inch.

The screen grid tubes in the circuit are 236's, the three-element oscillator is a 237, and the output tube is a 238 pentode. These tubes are recommended because the circuit may then be used either directly on a six-volt storage battery or on a transformer. The transformer heater winding should then maintain 6.3 volts. If a 7.5 volt winding is available, a ballast resistance of one ohm should be connected in series with this winding and the heaters. However, if no ballast is used no harm will result, since the tubes may be operated on a voltage as high as 8 volts.

In Fig. 2 is a type of wiring diagram of the circuit showing how the various connections are made to the tubes and the coils. The circles represent either tubes or transformers. In the case of T1 and T2 the circles represent the sockets into which the transformers are to be plugged. In each case the socket is viewed from the top.

The Fig. 2 drawing suggests the layout be in line.

Radio's Past and Future—

Dr. Millikan's text herewith is that of a talk from Los A
Hoover, from Wash

IN a world in which the marvelous has become the commonplace, the well-nigh miraculous the expected, a world which has been made blase by the mere plethora of amazing scientific developments, I yet suspect there will be few if any of the hundred million people who are within range of my voice tonight, if they choose to listen, who will not ask themselves in wonder, these two questions: (1) How has this miracle of the radio been wrought? (2) What is its significance for the future of mankind? Pertinent questions!

To the first I shall presently give some sort of an answer; to the second I shall at once make bold to venture an estimate.

The Greek republics succeeded so long as they were closely knit city-states; as far-flung empires they disintegrated. The world's first far-flung republic, the United States, has held together for 150 years; but not without proof enough of the difficulties of the task. With every one of its 120 million inhabitants now brought by the radio within as easy range of a single voice for the purpose of instruction, entertainment and persuasion, as were the free citizens of Athens when they gathered around the Acropolis to listen to Pericles, the task will certainly be henceforth an easier one.

The possibility of letting the whole population of the country, in so far as it desires to do so, listen together not only to the best music the country has to offer, but to the spoken words of the leaders of thought in all phases of our American life, is one that is fraught with unmeasured values for our future. That possibility of course carries with it also that of the use of the radio by the demagogue and the propagandist, but this precise situation is inherent in all democracy, indeed, in every type of variant of the effort to replace the rule of bullets where the ballots are possessed by any large or even any appreciable fraction of the population. Theoretically and historically the ballot type of government can and does work wherever the electorate is reasonably homogeneous, literate, and sufficiently educated to exercise some independence and discrimination of judgment.

A Great Force

The radio is obviously one of the great new unifying and educational forces, which can be and should be one of the great factors in insuring the success of ballot governments the world over. If you do not believe in it because you fear its use by the demagogue and propagandist, then you despair of the ultimate success of wide-spread ballot governments as such, and you can logically join one of the two world groups, the Soviets, and in somewhat lesser degree the Fascists, to which the modern fanatics are just now exerting the last ounce of energy in them to push the world back along the path of progress up which it has painfully worked its way for four thousand years, back to the time when the Pharoah under the strategy of his prime minister, Joseph, became an absolute despot, owning all the property and all the people of Egypt.

That kind of philosophy is, of course, repugnant to all the instincts and traditions of every free people.

Further, any talk of the loss of liberty through the monopolistic control of the ether at this time in the United States is too grotesque to need to be given more than a line in an address like this. Any high school boy knows that it would be very simple now, and increasingly easy as science moves on, to break such a monopoly if there ever appeared to be the slightest danger of its being created. The only exception would be the case of a government monopoly, maintained by bullets, as in Russia. Monopolizing the air we breathe and monopolizing the ether are similar ideas, only possible by shooting breathers or broadcasters whom you don't like.

The National Advisory Council on Radio in Education has then been organized to attempt to realize some at least of these possible values of the radio, the necessary organizing funds being provided by the Rockefeller Foundation and the Carnegie Corporation jointly. The nation-wide broadcasting companies with extraordinary public spirit have turned over their facilities at certain times to this council, which consists of 50 or 60 of America's best known and most public-spirited men and women, namely, educators—on the sole condition that the programs are to be wholly educational and that the complete responsibility for and control of them be entirely out of their hands and in the hands of this Council, a body which gives its services freely as a public responsibility, as do all the speakers.

Cultural Values

There is a further result of this radio situation which cannot but be good. The very existence of a nation-wide audience for anybody, an audience of millions of people, is a new thing, and it must create a new type of speaking and of writing. For the speaker, however technical his field, must now divest himself completely of all his specialied lingo, whether he be lawyer, physicist, physician, or what not, and present in simple terms, understandable to all, the essential elements of his subject.

The necessity for so doing ought to improve American writing. It should also sharpen and clarify the speaker's own thinking and certainly aid largely in enabling the public to follow the developments in the various fields of thought and life as they ought to follow them to exercise well the responsibilities of citizenship and to get the maximum satisfaction out of living. My estimate is, then, that this step should help largely in the stupendous task of realizing the educational and cultural values of the radio for American life.

That is all I have to predict about the future, but now what is this miraculous thing, radio, and how did it ever come into being?

It is an altogether typical story of modern science, not of modern invention. Don't for a moment think that the radio was ever invented. It could not be. It has a long pedigree, as have all scientific advances. It grew step by step through the forgotten efforts of a long line of workers, no one of whom could have been left out without causing the whole structure to collapse.

Jewett's Problem

I should like to tell the story backwards, i.e., to start at the very latest end of this long history just as I, myself, have seen and lived through it, for it is only twenty years old.

It was in the spring of 1911, just twenty years ago, that Dr. F. B. Jewett, an old friend and associate of mine at the University of Chicago from 1898 to 1901, and at this time, 1911, transmission engineer of the American Telephone and Telegraph Company, came out to Chicago to see his old associates at the Ryerson Laboratory and said:

"My superiors have informed me that we must, if possible, get a telephone line to San Francisco by the time of the World's Fair there in 1914, and I find that the expense is prohibitive; it cannot be done unless we can somehow or other develop a telephone repeater which will do with speech what the telegraph repeater does with dots and dashes, namely, transfer the spoken word undistorted from one circuit to another, so that when the voice has become so weak through transmission over a long line as to be almost unaudible, it can be transferred to a new, fresh circuit and boosted up by it to the desired strength. In order to follow all the infinite minute modulations of the human voice this repeater must obviously be practically inertialess, and I don't see that we are likely to get such an inertialess moving part except by utilizing somehow these electron streams which you have been playing with here in your research work in physics for the past ten years. Cannot you let us have three or four research men from your laboratory, who are more or less familiar with all this electronic technique, let us take them into our employ and assign them the job of developing such a telephone repeater as I have in mind?"

I responded favorably, and in the fall of 1911 sent Dr. H. D. Arnold to the Bell laboratories in New York for this specific purpose, and a little later H. D. Nichols, H. J. van der Bijl and John Mills, to mention only the first four of quite a group of men who followed later.

These men, with others in the Bell laboratories, developed or perfected, within the first two years of their intensive effort, four different successful telephone repeaters and these four were given official tests, which I myself went from Chicago to Philadelphia to participate in in the early winter of 1914.

This was the first test on commercial lines of telephone reception or amplifiers. The perfected DeForest three electrode tube gave the best performance, and within a year of these tests six such electron-tube repeater stations had been installed on the telephone line connecting New York and San Francisco, and the job which the telephone company had set had been accomplished.

Espenschied's Pick-Up

The possibility, too, with larger banks of such amplifier tubes and therefore larger energies of shooting speech frequencies up into wireless antennas already in use for dot-dash signaling was seen, and the first large radio telephone stations were built at Montauk Point and at Wilmington, Deleware, and on Easter Sunday, 1915, in the midst of a terrific snow storm, this same group of men gathered at Montauk Point, shot up into the improvised antennas Lincoln's Gettysburg address, which rippled through the ether with perfect intelligibility, and was picked up and transcribed by listeners two hundred miles away at the Wilmington station, and within one more year by using more powerful tubes and more of them, spoken words shot up into the ether from the Arlington station, had been heard by some of the group sent to listen at the Eiffel Tower in Paris, and by one lone listener—Espenschied—who was listening at Honolulu with the aid of a receiving wire lying on a hillside six thousand miles away, and all the essential steps had thus been taken which made world-wide radio-broadcasting of human speech a possibility.

I have thus told the story of the beginings of speech broadcasting through the ether as I myself saw it. Completely unknown to this group, until the Spring of 1915, somewhat similar developments, at least so far as the perfection of the DeForest three-electrode tube

By Robert A. Millikan

Director of Norman Bridge Physical Laboratory, California Institute of Technology; isolator of the Electron; Nobel Prize winner; Authority on the Cosmic Ray.

geles over the Columbia Broadcasting System, President gton, introduced him.

into a speech amplifier or repeater, had been going on in the laboratories of the General Electric Company at Schenectady.

Who first made the three-electrode tube into a distortionless speech amplifier or repeater is not now important—it has been decided both ways by courts—for we are interested here only with the development of a scientific device and with its applications. The essential device, not only for the whole broadcasting art and not only for most of modern long distance wire telephone, but also for all forms of speech reproduction and amplification which represents the greater part of the whole modern picture business—not to mention picture reproduction at a distance in all its forms—the essential device is simply the telephone repeater or amplifier.

The multiplicity of the new and wholly unforeseen practical uses which one new device or principle introduced into physics seems invariably to find always astonishes even the physicist, who alone realizes how small and often how simple, is the fundamental scientific advance that has been made. Knock out the telephone repeater or tube amplifier and probably nine-tenths of the whole vast modern structure of communications, in all its forms, wireless, wire, talkie and picture, comes crashing to the ground. But in all that I have said so far, I haven't even begun to tell how this miracle of the radio came about.

The Discovery in 1888

I haven't yet touched its pedigree. How did Jewett come to know anything about inertialess electron streams in exhausted tubes? Who sired that idea? It had scores and scores of progenitors—physicists who had worked out the properties of these electron streams in physical laboratories from 1897, when the electron theory of matter first came into its own in the thinking of physicists, up to 1911. That date merely signalizes the point at which a commercial need set Jewett to looking into the physicist's already accumulated store of ideas to see if he could find there something that would meet his purpose. But where did the electron theory of matter come from? There is terrible promiscuity in its parentage, J. J. Thomson, 1897, and G. Stoney Johnston, 1891, and Weber, 1878, and Faraday, 1831, and Franklin, 1756, all these did some of the fertilizing which resulted in its birth.

But it isn't only electron strears and electron theories that had to be developed before broadcasting could come. These are a part of what we call the physics of matter. But what are these ether waves, these wireless waves, anyway, that the play of electrons within the tube sends out with the speed of light 186,000 miles a second to tell in Honolulu what is happening that very second in Washington?

They had never been heard of before 1888, when Hertz in Germany caught them playing about in the neighborhood of a static machine in action. No wonder, since they dart with the speed of light, they had slipped through the fingers of preceding experimenters. And Hertz wouldn't have caught them either if Maxwell, perhaps the most penetrating intellect of the nineteenth century, had not predicted in 1876, in Cambridge, England, that they must exist, nor would he have been able to make that prophecy had not the Frenchman, Fresnel, in 1830, and the English physician, Young, in 1800, proved experimentally that light has wave properties. There I will break off the pedigree for a moment to return to it later.

But I haven't yet told you what are these ether waves, nor shall I do so for I don't know myself nor does anybody else. They are fundamentally as mysterious to the physicist today as they are to the layman; more mysterious to the physicist now than they were thirty years ago, or, indeed, at any time since 1800, for in the nineteenth century he was pretty cocksure about that knowledge, but he is more modest now, for ether waves have recently been revealing new properties.

Learning More

But however mysterious their fundamental nature may yet be, this is certainly true, that every decade since 1800 we have been learning more and more about how they act and for the purpose of understanding the radio, if that word understand means anything, all that you need to know, indeed, all that anybody knows is that the sound waves which your speech produces are transformed by the microphone into which you speak, into exactly similar electrical current variations in the circuit of which the microphone is a part, are then amplified a million or so times without distortion by the telephone-tube-repeater on their way to the wireless antennas, where these giant electrical variations impress in some way their identical wave forms upon the ether which, in turn, in some way transmits this wave form with the speed of light through space to be picked up by another electrical circuit containing a microphone and retransformed by it by its well-known mechanism into sound waves exactly like those your voice emitted at the transmitting end. That the ether, or empty space, if you don't like the word ether, as some physicists do not, their dislike merely indicating that we don't know that anything whatever is out there between the stars except simply space, has this property of transmitting wave-like disturbances in all directions with the speed of light, will probably never cease to be a source of wonder as well to the informed as to the ignorant.

It is just a brute experimental fact to which we have to adjust our thinking as best we can or, better still, which we must take willy-nilly as the first basis of our thinking.

New Stupendous Field

And what I have told you so far amply explains why we must talk about wireless waves and wireless wavelengths and wireless frequencies, though we didn't know they existed at all fifty years ago, so new is this whole stupendous field of physics.

But now let me trace the pedigree of the radio a little farther back, back of 1800 A. D., at which time light was first definitely proved by Thomas Young to have wave properties. Since light is certainly transmitter from sun to earth and from star to star through the intervening space at a speed of 186,000 miles per second, that space must have some properties closely akin to those of material media, for air, for example, is well known to transmit sound waves at a speed of about 1,000 ft. per second, while water transmits sound waves at a speed of about 4,000 ft. per second and in general all material media transmit sound waves at a speed definitely determined by the properties of each particular medium, i.e., by its elasticity and density, so that we are obliged to assign something like material properties to interstellar, i.e., to empty space. Indeed, that is the sole reason the term ether was ever introduced, since in 1800 at least it was thought to be something of an hyberneanism to talk about the properties of empty space, which by definition has no properties. The radio waves which I have been talking about above are now known definitely to be identical with light save for their wavelength, which is of the order of a million times longer than that of light.

But how do we know all this about the relation of ether physics and matter physics, ether waves and electrons, which had to come together and through their joint effort create radio broadcasting? For this owes its birth on the one hand to the electron tube, one of the latest aspects of matter physics, and on the other hand to the transmitting power of ether waves, which carry my voice in a very small fraction of a second to London, England, whereas if that voice could be made strong enough so that it would carry directly by sound waves in air to London it would take it a full week* to arrive there, a situation which would badly complicate my broadcasting.

Ether physics and matter physics, then, began to come together about 1800, for before that time only one of them—matter-physics—had been created. Pull out the foundations of matter-physics which were laid in the sixteenth and seventeenth centuries by Galileo and Newton, and the whole structure not only of modern physics, but of modern civilization, comes crashing down; and by modern civilization I don't mean merely its material aspects as represented in our industrial age, I mean the intellectual and even the moral and religious aspects of modern life as well. That is what the pedigree of broadcasting as of every other scientific development of our times leads us back to.

Banking on Experience

For the scientific method, although adumbrated in Greek times, was essentially created in the sixteenth and seventeenth centuries, and it is the scientific method that is not only the basis of our whole modern civilization, but that when combined with the spirit of religion is the basis of the hope that the human race can move on continuously toward a happier and a finer future.

But now, just exactly what do I mean by the scientific method, and what was the change in mode of approach that Galileo so conspicuously employed and which resulted in what Professor Whitehead of Harvard calls the most intimate change in outlook which the human race had yet encountered? Whetham in his "History of Science" states it substantially as follows: The method consisted in discarding all apriori postulates about the nature of reality and all complete philosophic systems, such as all the philosophies of the ancient world, idealists and atomists alike, had started with, discarding likewise all intuitive axioms on the one hand and authority on the other, such as had been the foundation of mediaeval scholasticism, and appealing by the experimental method to the tribunal of brute facts—facts which bore no relation to any philosophic synthesis then possible. Natural science may use inductive reasoning at the intermediate stages of its inquiry, and inductive theories are an essential part of its procedure, but primarily it is empirical and its ultimate appeal is to observation and experiment.

(*Continued on next page*)

* It would take 8.8 hours.—Editor.

Radio Pedigree Traced

Millikan Sides with Experimental Scientists as World Leaders

(*Continued from preceding page*)

It is not too much to say that Galileo started modern physical science on the course which has extended unbroken to our own day.

In a very real sense he is the first of the moderns. With him the old assumption of a complete and rationalized scheme of knowledge has been given up. Facts are no longer deduced from and obliged to conform with an authoritative and rational synthesis. Each fact acquired by observation and experiment is accepted as it stands with its immediate and inevitable consequences, irrespective of the human desire to make the whole of nature at once amenable to reason.

Modern Science Empirical

Concordances between the isolated facts appear but slowly, and the little spheres of knowledge surrounding each fact come into touch here and there, and perhaps coalesce into larger spheres. But the welding of all knowledge, scientific or philosophic, into an all embracing unity, if not seen to be forever impossible is at least relegated to the distant future. Medieval scholasticism was rational; modern science is in essence empirical. The former worshipped the human reason acting within the bounds of authority, the latter accepts brute facts whether reasonable or not. Galileo, unlike some who followed him and founded systems upon his work, like the French philosophers of the eighteenth century, was content to wait in acknowledged ignorance upon questions that can only be answered by rash speculation or deduced from philosophic systems. He confessed that he knew nothing about the nature of force, the cause of gravity, the origin of the universe. Rather than express extravagances he declared it better to pronounce that wise, ingenious and modest sentence, "I know not."

That is the method of science. Now, what has resulted from its application:

First, not merely the radio art, whose pedigree we have been tracing, but practically the whole of modern material civilization in so far as it differs from ancient civilizations. It is easy to trace the pedigree of practically every modern industrial or scientific device back to the new knowledge which Galileo's method and indeed his own experimental researches began to bring to light. Let me give just two illustrations.

For thousands, perhaps for tens of thousands, of years before his time, men had pushed carts and pulled wagons, but not one of them had any correct idea about the exact relations between the force exerted and the motion produced. This is just what he found by studying the way his marbles acquired velocity as they rolled down his inclined plane. Without the formula, force equals mass times acceleration, which came into the knowledge of mankind through his work, not a single steam engine, automobile, airplane or any other power machine could be designed today.

Joule's Work

Further, it was precisely this formula which seventy-five years later in the hands of Newton made the discovery of the law of gravitation possible, and with it the whole development of celestial mechanics, the successes of which have at last weened the whole world away from treating with anything but ridicule "the village that ruled the earth was flat, flat as my hat, flatter than that," and opened the eyes of the world to the glories and the mysteries of modern astronomy.

Again, through hundreds of thousands of years, alike in the epochs of savagery and barbarism, and in those amazing Greek and Latin civilizations, man had warmed himself at his camp fire and his grate without ever stopping to wonder what heat was; or, if he wondered, without having any idea of how to set to work to find out. More than that, it was impossible for him to find out before the idea or concept of energy of molecular motion had been formulated, and this idea came from Galilean and Newtonian mechanics.

It was 1850, and by following exactly the method of Galileo and also by using directly the results of his and Newton's work, that the foundations were laid by Joule and a group of his contemporaries for the modern development of the steam engine, which utilizes the relations between heat and work, and which begot in its turn the internal combustion engine. In exactly the same way through Franklin, Volta, Faraday and Maxwell, all utilizing the method as well as the results of their scientific ancestors, has the age of electricity within my own life time been ushered in.

Also, the same method applied to the study of the earth's crust with its fossil records of age-long development from lower to higher biological forms and the further study of the anatomical relations between these forms have brought to light brute facts which must tell their own tale no matter what preconceived philosophers or world systems they may encounter. This whole group of observed facts about the universe around us is what is responsible for the enormous change in human outlook that has been characteristic of our century.

In that sentence I have touched the second advance, more important than the material one, which came as a result of the application of the scientific method. Let me follow it a little farther.

Not Capricious

Through all primitive thinking, and some of it not so primitive, nature is regarded as essentially capricious. Things happen because the God of the mountain, the forest, the river, or the sea wills to have them happen, and that God is in general endowed with practically all man's frailties. That God's will can be supplicated, pleased, enraged, appeased, cajoled, but that it operates in any systematic way or in accordance with fixed principles which man by study can come to understand, that was an idea which, while it was adumbrated in the Greek world, notable in the work of Aristarchus of Samos, Archimedes of Syracuse, Hiparchus of Alexandria, was after all practically without influence in human life before the real advent of the scientific method in the sixteenth and seventeenth centuries.

Galileo in establishing the laws of force and motion assumed the principle of uniformity and laid down regularities or laws which made prediction of astronomical events and of some terrestrial events a possibility. The continued and ever-increasing success of these predictions soon began inevitably to change men's thinking about the fundamental nature of the universe. With increasing knowledge men's ideas of God, the integrating factor in the universe, of course began to change. The days of child-like anthropomorphic conceptions began to draw to a close, and mankind began to move forward to a finer, bigger, more mature, more satisfying conception of God. A God of caprice and whim began to be replaced in human thinking by a God who rules through law, a universe which was not worth knowing because it could not be counted upon began to be replaced by a nature which is dependable and to some extent at least understandable even controllable by man. Man began to be no longer merely a plaything in the hands either of blind fate or of a capricious God, but himself a vital agent in the march of things. His conception of duty and therefore of religion began to change.

Under the old conception his chief duty has been to propitiate his God, hence monasteries, penances, withdrawal from the world and useless lives. Under the new conception duty came to be to try to understand God's laws, and to bring one's life and the lives of all mankind into harmony with them.

All Worth Study

Most important of all, in the old days men had made wholly artificial and irrational distinction between the natural and supernatural. Events which were sufficiently common and familiar were thought of as natural, and events which were uncommon and not understood were called supernatural. The idea of the uniformity or repeatability of events abolished completely all such child-like distinctions. All events without exception are worthy of study and of attempts at understanding, because nature is assumed to be dependable, not capricious. Familiarity or unfamiliarity have nothing whatever to do with it. Call all events natural if you will, or all supernatural if you prefer, but forget. so says Galielo's method, either one term or the other.

No wonder Whitehead called it "the most intimate change in outlook the human race had yet encountered."

All this is what we discover when we try to look up radio's pedigree.

Can Understand Electricity But Not Define What It Is

One of the first questions the radio student or electrical beginner is sure to ask, is "What is electricity?" Such a question is unanswerable! Electricity is a name for something that we are unable to see, smell, hear or feel. We know it is there because we are able to determine its effect through physical occurrences; light, heat, power, etc.

Although no one knows what electricity is. there is a vast amount of very exact and scientific knowledge about what electricity does. We can measure it, distribute it, sell it at so much a unit amount, and use it in thousands of beneficial ways.

There is a widely accepted theory that matter itself is nothing but electricity arranged in certain forms. Our growing use of electricity in every conceivable fashion makes the study of electricity increasingly popular. Radio is one of the results of the study and application of electricity. The fact that we do not know precisely what electricity actually is seems to exert no limitations upon what we can do with it.

The fact that electricity is known by its manifestations rather than by its essence has led to various theories, the latest the electronic theory of matter.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Answers printed herewith have been mailed to University Members.

Radio University

To obtain a membership in Radio World's University Club, for one year, send $6 for one year's subscription (52 issues of Radio World) and you will get a University number. Put this number at top of letter (not envelope) containing questions. Address, Radio World, 145 West 45th Street, New York, N. Y.

Annual subscriptions are accepted at $6 for 52 numbers, with the privilege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

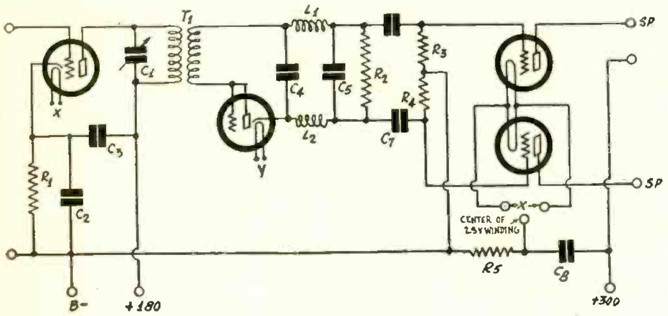


FIG. 924

By means of a diode detector, such as the one in this circuit, it is possible to couple a push-pull amplifier by means of resistances directly to the detector without killing one side of the circuit.

Coil Ranges

IF a tuning condenser in a circuit has a range of 25 to 275 mmfd., how many coils are needed in a set to cover the frequency band from 1,500 kc. to 30,000 kc?—W.G.H.

The ratio of the maximum to the minimum capacity is 275/11, or 11, and the square root of this number is equal to the maximum to the minimum frequency which can be covered with any coil. The square root is 3.315. Two coils suitably chosen will cover a frequency ratio of square of this number; that is, 11, and three will cover a frequency ratio of the cube of the number; that is, 36.5.

Now the ratio of 30,000 to 1,500 kc. is 20. Eleven is less than this. Hence, we need more than two coils. But 36.5 is considerably larger than 20 and therefore three coils are sufficient. These coils allow for a frequency ratio for each coil of 3.315, whereas the total range requires only 2.21. Hence, there will be a satisfactory overlapping of tuning ranges of the coils.

* * *

Status of Television

WHAT is your opinion of television receiving as now available?

It is hardly in the truly entertainment stage as yet, but is fascinating from the study and experimental viewpoint. If you wish to see television pictures as now receivable, get in touch with any of the television manufacturers or broadcasters. They can tell you where to see sets in use. Or, see a dealer's demonstration where television equipment is sold.

* * *

New Tube Applications

WILL the new tubes which you announced recently be suitable for portable receivers when they are heated with dry cell batteries?—T. C. R.

The new tubes take a voltage of 6.3 and a current of 0.3 ampere. Therefore, if dry cells are used for supplying the heater current, it is necessary to use at least four of them in series to make the voltage high enough. Since each tube takes 0.3 ampere and one No. 6 dry cell should not deliver more than 0.25 ampere, it is necessary to use two cells in parallel. That means that not less than eight cells are needed for each tube. Obviously, dry cells are not suitable and hence the tubes are not suitable for portable sets. The most suitable tubes for portable sets are the new 2-volt tubes, which require only 0.06 ampere per tube, except the power tube, which takes 0.13 ampere. The new 6.3 volt tubes are suitable for automobile set, however, and they have been designed for this purpose.

* * *

Coupling Push-Pull to Detector With Resistance

IS IT possible to couple a push-pull amplifier to a detector by means of non-inductive resistances and condensers without killing one side of the circuit? If so, will you kindly show how it may be done?—R. B. N.

It depends on what type of detector that is used. If you use a crystal detector or a diode rectifier it is easy to do. In Fig. 924 is a circuit showing a diode type detector connected by means of resistances and condensers to a push-pull amplifier. The diode is obtained by connecting the grid and the plate of a 227 tube together. The diode tube must be of the heater type unless a separate battery is used to heat its filament.

Regeneration in IF Amplifier

IS IT practical to use regeneration in the intermediate frequency amplifier of a superheterodyne? It seems to me that it would be, especially when the intermediate frequency is high. It should work just as well in a superheterodyne as in a tuned radio frequency amplifier.—R. B.

There is no reason why some regeneration should not be used, provided there is a good control for it. Regeneration has been tried at various frequencies. At a frequency of 45 kilocycles the increase in volume by regeneration was about equal to one stage of amplification, so that one of the stages could be omitted. However, the set became too selective so that the boominess of the output was extremely unpleasant. At higher intermediate frequencies this is not so pronounced. There is one advantage in using regeneration in a short-wave superheterodyne receiver and that is it is possible to receive code signals as pure tones rather than as key clicks. If the intermediate frequency amplifier is set oscillating feebly by advancing the regeneration continuous wave code can be heard as pure-tone dots and dashes by detuning the short-wave oscillator just a little. This detuning is so slight that it does not reduce the sensitivity at all.

* * *

Circuit Won't Oscillate

I HAVE a three-tube receiver of the regenerative type. Although the tickler coil can be turned through an angle of 180 degrees, the circuit will not oscillate in any position of the tickler. What do you think could be the matter?—F. W. R.

There are many things which could account for lack of oscillation. First, it might be a poor tube in the detector socket. Next it might be the filament or plate voltages are not high enough. Again, you may have a by-pass condenser from the plate to ground which short-circuits the tickler. And again, it may be that the tickler does not have enough turns on it, although this is not a likely cause. There is a strong probability that the trouble is due to too close coupling between the antenna and the tuned circuit. If the coupling is close the antenna virtually amounts to a short circuit of the tuned winding and there will neither be selectivity nor regeneration.

* * *

Superheterodyne Won't Work

I HAVE constructed a superheterodyne, taking every precaution to get it perfect in every way. The radio frequency amplifier works as it should. The intermediate frequency amplifier works as well as could be expected when it is used on another super. Likewise, the audio frequency amplifier functions satisfactorily. Yet not a sound can be obtained through the super. All the tubes are good and the wiring checks. No defective parts have been discovered during the most careful tests. What do you suppose is the trouble?—W. H. J.

Reverse the leads to the tickler winding on the oscillator. Everything else seems to have been eliminated as a possible source of the trouble. If the leads to the tickler are not connected in the proper way, the tube will not oscillate, and without oscillation the super is dead.

* * *

Accurate Inductance Coils

IS IT possible to wind a coil at home to a predetermined inductance that is accurate enough for use in measuring the inductance of other coils in a bridge circuit? In case it is possible, what precautions should be taken to get the inductance accurate?—W. H. V.

If extreme accuracy is not required it is quite possible. The precautions necessary are to measure all the dimensions of the form and the wire accurately because the inductance depends only on linear dimensions as can be seen from the following formula for a single layer solenoid: $L = 39.48nNR^2K$, in which L is the inductance in centimeters, n the total number of turns, N the number of turns per centimeter of axial length, R the radius of the coil in centimeters, and K is a factor which depends on the ratio of the diameter of the coil to the length of the winding. There are 1,000 centimeters in one microhenry and 2.54 centimeters in one inch. The radius of the coil is the distance from the center of the form to the center of the wire. If fine wire is used the radius may be taken as one-half of the diameter of the form. The turns per centimeter may be obtained by measuring the total length of the winding and dividing the total number of turns by this length. For K a table of this factor must be obtained and it is contained in Bureau of Standards Circular No. 74.

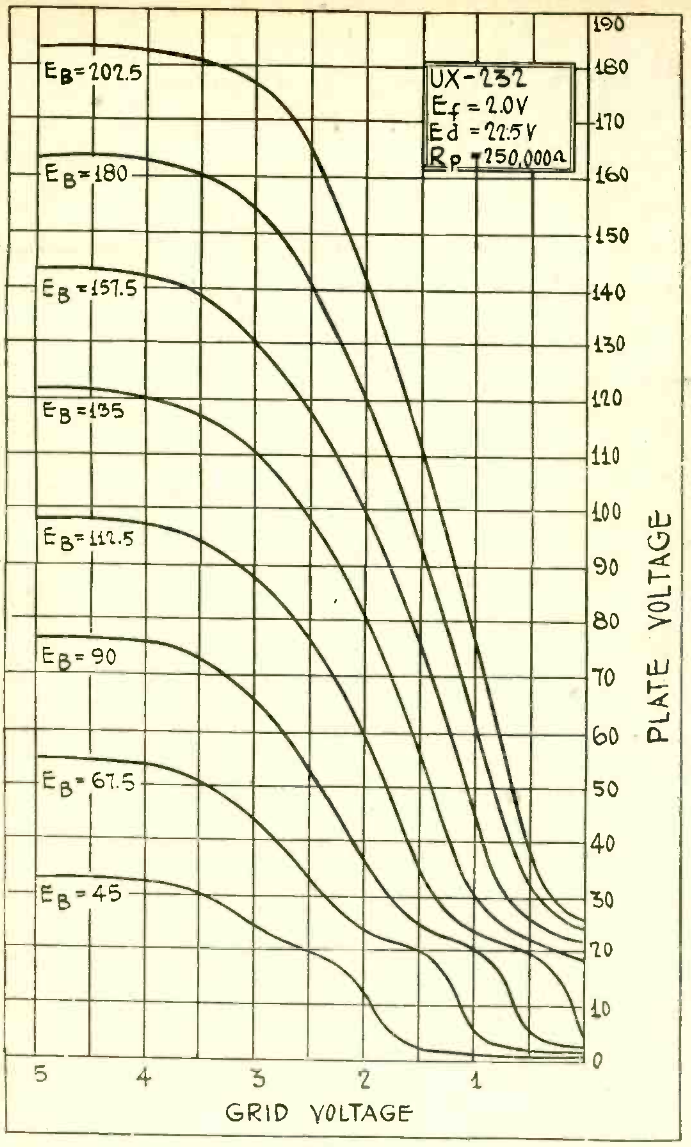


FIG. 925

Grid voltage, plate output voltage curves are the most useful characteristics of a tube in determining the amplification and the operating limits of the tube under given conditions.

Squeals Abundant

IN my regenerative receiver I can hear squeals at nearly every division on the tuning condenser dial when I use the headphones for listening in. Some of the squeals are strong, but most of them are weak. Are these squeals due to harmonics or to distant broadcast stations?—T. L. F.

Most of the squeals are undoubtedly due to distant broadcast stations, but some of them may be due to the second harmonics of the local broadcast stations. If your dial just covers the broadcast band harmonics may be heard on stations using 750 kc. or lower frequencies, provided these stations are strong in your locality. It is possible to calibrate a regenerative receiver of this kind against the squeals even if only a few stations well scattered in the broadcast band can be located by frequency. If a curve is constructed with dial settings against the frequencies of the recognizable stations, it will be found that the weak squeals will be located on the curve at the proper places on the curve, provided that account is taken of the fact that they should be 10 kc. apart. It must not be forgotten that one may be skipped now and then. But this may be discovered by the fact that there should be a certain number of squeals between the local stations. Take, for example, WEAF and WOR, operating on 660 and 710 kc., respectively. Around New York these are strong. Between them there are four channels and a squeal should be heard for every one. If only three are heard one is either silent or it is too distant to produce an audible squeal. Which one is missing can be determined from the dial settings of those that can be heard.

* * *

Rectifier Burns Out

IN my receiver I have a 280 rectifier. It worked fine for a long time, but suddenly the set stopped playing. I discovered that the rectifier would not light. I put in a new one and it immediately flared up with a bluish color, turned very hot, and then went out. I don't want to put in another rectifier before the trouble has been corrected. What, in your opinion, is the cause of the trouble?—H. J. S.

You have a short somewhere in the circuit. It may be a shorted condenser either in the filter or in the set proper. Again, it may be that the grid bias of the power tubes has been shorted. The trouble is that you are drawing too much current from the rectifier tube, and only a short would account for this if the set worked all right at first. As soon as this short has been found and opened it should be safe to put in another rectifier tube. Test all by-pass condensers and bias resistors and also examine the set for possible shorts of the high voltage leads to ground.

* * *

Using Small Tuning Condenser

WHAT is the smallest tuning condenser that may be used for covering the broadcast band? I understand that a 250 mfd. is too small and that a 350 mmfd. is sometimes too small. I should like to use even a smaller condenser than a 250 mmfd. if it is at all possible.—R. E. E.

The required capacity depends on so many things that it is impossible to say how small it may be in any case. It is only possible to give the ratio of the maximum to the minimum capacity in the circuit. This ratio is 900/121 in all cases if the condenser is just to cover the broadcast band. Just what the maximum should be depends on what the minimum happens to be. We may theorize as to the possibility. The three main factors that contribute to the minimum capacity when the coil is not shielded and when it is very loosely coupled to any other circuit, such as the antenna, are the grid-cathode capacity of the tube, the minimum capacity of the condenser, and the self-capacity of the coil. Then there are the leads to the tube and to the tuning condenser that must be taken into account. The grid-cathode capacity of the tube is not a fixed quantity, but depends on the constants in the plate circuit. The coil capacity is approximately equal, numerically, to the diameter of the coil in centimeters. Hence, a small coil should be used. Suppose it is 1.5 inches. The capacity would be about 3.8 mmfd. The grid-cathode capacity of the tube (227) is about 10 mmfd. The minimum capacity of the tuning condenser might be 15 mmfd. So far we have a total of 28.8 mmfd. The leads might well add 1.2 mmfd. Hence, the total would be 30 mmfd. This is about the minimum. In this case the maximum would have to be 223 mmfd. However, in most practical cases it is not even possible to cover the band with a 350 mmfd.

* * *

AC Versus DC

WHICH is better, AC or DC on the filaments and plates of short-wave receivers? That is, which gives the best all-around results?—B. W. C.

It is largely a matter of convenience. Where AC is available it is usually more satisfactory to use it for supplying all the voltages. When AC is not available batteries must be used. When there is oscillation, which includes regeneration, in the circuit, there is likely to be considerable hum if AC is used. Hum is particularly noticeable when a regenerative receiver is used and the circuit is adjusted to the verge of oscillation.

* * *

Push-Pull Oscillator

IS it possible to make a push-pull oscillator, and, if so, will the output be relatively more free from harmonics than the output of a single tube oscillator? If such an oscillator, will you kindly explain how it can be made?—C. W. Y.

Such an oscillator is quite practical and its output is relatively free from even order harmonics, such as the second, fourth and sixth. If the feedback is just barely sufficient to maintain oscillation it will also be relatively free from the odd harmonics. To connect such an oscillator imagine having a push-pull interstage transformer with both the primary and the secondary centertapped. Connect the two grid terminals to the grids of the two tubes and the two plate terminals to the plates of the same tube. Connect the centertap of the secondary to C minus and the centertap of the primary to B plus. B minus, C plus, and ground are connected together. The tuning condenser may be across either the secondary or the primary. Since both sides will be alive in either case the rotor of the condenser cannot be grounded. Neither can it be attached to the dial with a metal shaft. Such an oscillator can be made to oscillate at higher frequencies than single-tube oscillators because the interelectrode capacity can be balanced out.

* * *

Figuring Amplification

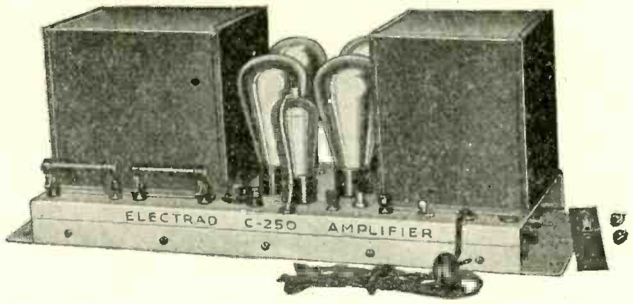
WILL you kindly explain how to figure the amplification that may be obtained from a tube when the grid voltage plate current curves are available, or grid voltage, plate output voltage curves?—W. H. C.

If the voltage between the plate and the filament, or cathode, be taken with a vacuum tube voltmeter for different grid voltages, with a resistance in the plate circuit, a curves as any one in Fig. 925 is obtained. At any grid bias the amplification can be obtained from such a curve by finding the slope of the curve at the selected bias, that is, finding the change in the plate voltage produced by a change of one volt in the grid bias. Taking the upper curve in Fig. 925 and a grid bias of one volt we note that at 0.5 volt the plate voltage is 38 volts and at 1.5 volts bias the plate voltage is 112 volts. Thus one volt change in the grid bias causes a change of 74 volts, and that is numerically equal to the amplification. Only a screen grid tube will give such high amplification in a resistance coupled circuit. If plate current curves are available it is necessary to know the resistance in the plate circuit. The change in the plate current caused by a change of one volt in the grid bias, multiplied by the plate load resistance gives the amplification.

The Trade Announces—

Electrad Amplifiers Proving Popular

Electrad Inc., 175 Varick street, New York City, internationally known to radio manufacturers and fans as a manufacturer of high-grade resistors, expanded its activities about a year ago into the power-amplifier and sound equipment field, and has since made rapid strides in that department.



Electrad's C-250 audio power amplifier, using the Loftin-White non-reactive circuit. This is one of three types of Loftin-White amplifiers made by this company, the tubes and wattage constituting the differences.

"The step was a logical one," says Arthur Moss, president of the company, "owing to our specializing on the new Loftin-White direct-coupled amplifier circuits. This type of circuit depends chiefly for success on the quality of resistors used, and since our engineers were thoroughly familiar with all resistor requirements it was an easy transition for us into amplifier production."

Electrad direct-coupled amplifiers have been designed for high-gain, high-undistorted output, compactness, uniform audio response curve and long life. They give excellent reproduction due to the uniform amplification throughout the audio range of frequencies. These amplifiers are suitable for amplification of signal from microphone, radio or electrical pick-up and give exceptional quality of record recording.

Three models of these Loftin-White amplifiers are supplied by Electrad, as follows:

Model A-245—has a gain of 49 decibels and undistorted power output rating of 1.6 watts. It uses one each of type '24; '45 and '80 tubes, and lists at $40.00 assembled and wired, less tubes. The model A-245 may also be had in kit form, less tubes, for $35.00.

Model A-250—has a gain of 55 decibels and undistorted power output rating of 4.6 watts. It uses one each of types '24; '50 and '81 tubes, and lists at $87.50, assembled and wired, less tubes.

Model C-250 (illustrated) has a gain of 60 decibels and undistorted power output rating of 10.35 watts. It uses one '24 type tube, two '50's in push-pull and two '81 rectifiers. It lists at $135.00 assembled and wired, less tubes.

A folder, describing these amplifiers in detail, will be mailed upon request to Electrad, Inc., Amplifier Division, 175 Varick street, New York, N. Y.

Silver-Marshall Sells Sets Direct to Dealer

Silver-Marshall, Inc., put into effect a new policy of direct sale of sets to dealers, eliminating 53 jobbers. It was said the dealers must sell more receivers at a greater profit to stay in business and that their gradual elimination is taking place due to manufacturers adhering to the 1929 prosperity policies.

Delco Has Sets for the Police Frequencies

Two new radio receivers, designed especially for police work, have just been announced by the Delco Radio Corporation, Dayton, O. One, of the automotive type, for use in automobiles, is featured by use of the pentode tube.

The other set is a police station receiver, for use in offices, and was designed as a result of establishment of police broadcasting systems not only for city departments but for state police. These sets are used in police stations and sheriffs' offices. The Delco set is built specifically for this work and can be locked on one wavelength for receiving one station, or may take in the entire range of police frequencies, if it is desired to receive state police calls as well or calls from stations in adjacent cities.

So that the message being broadcast may be heard under all traffic conditions, the speaker has been especially designed to give a reasonable high-pitched tone, easily heard above the lower pitched rumble of the car and traffic.

"One Second" is Name of New Amplifier

Bronx Wholesale Radio Co., 5 W. Tremont Avenue, Bronx, New York City, announces a "One-Second" power amplifier.

The "One Second" power amplifier has been designed for public address systems and radio frequency tuners, with sufficient supply to convert any battery set to an up-to-date AC electric set, as a B eliminator and power amplifier. Briefly, it can be used anywhere that amplification, filament and power supply are desired.

The name "One Second" has been derived from a practical angle, as that is all the time that is required to lapse after the current has been turned on for the amplifier to be in full operation.

This amplifier contains two stages of audio amplification, one single stage, and a push-pull stage, carefully designed to carry any load to an undistorted output.

A "pitch control" that varies smoothly and gradually permits the bass notes to be amplified more, as well as the pitch of a soprano. The "pitch control" makes it possible to bring out either speech or music at the desired pitch.

Absolutely humless, the filter system is composed of heavy duty chokes and dry paper condensers, designed and tested to stand more current than the device can draw, preventing the slightest hum from escaping through the speaker.

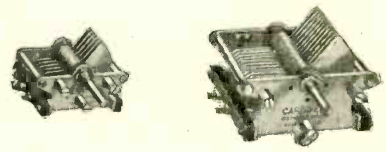
The power transformer is constructed of the highest grade of material, for 110-120 volts AC, 60 cycles or 25 cycles.

Overall dimensions, 20x4x7½.

The tubes used are two 250's, two 281's and one 226.

Cardwell Has New Midway Condensers

A new series of Midway featherweight variable condensers has just been announced by The Allen D. Cardwell Mfg. Corp., 81 Prospect street, Brooklyn, N. Y. These condensers have a wide application to short wave sets, converters and adapters. They are especially suitable in sets designed for television reception.



The comparative sizes of the standard and new Midway condensers of the Allen D. Cardwell Manufacturing Corporation. The Miidway is at left.

Hitherto Midway condensers were available only in single units and only with straight capacity tuning curves. The new line includes two-gang (dual) condensers, with shielding between the sections and with plates having a tuning curve commencing with straight frequency and changing to straight capacity. This tuning curve is regarded as most suitable for dual condensers and gives ample station separation on all wavelengths. The new dual condensers are available in maximum capacity ranges of from 26 mmfds. up to 200 mmfds. (each section). The dual 200 mmfd. condensers find particular application in television work.

The single section condensers are made in maximum capacities ranging from 26 mmfds. (3 plate), to 365 mmfds. (35 plates).

Both single and dual condensers retain the advantages of the original Midway models. They are very small and compact and of extremely light weight. They call for a panel surface of only 2¾ x 2⅛ inches and are about one-third the weight of ordinary variable condensers. Extremely light weight is attained by the use of aluminum throughout, with just a few minor exceptions. Because of their light weight, compactness and accuracy, Midway condensers are being widely used in midget sets, airplane receivers, automobile radio sets, portables, etc.

Electrolytic and Resistor New Micamold Products

Micamold Radio Corp., 1087 Flushing avenue, Brooklyn, N. Y., has developed new manufacturing methods which it says insure uniformity of capacity and power factor of molded mica condensers. The electrical characteristics are said to be much more stable than heretofore. The mica used throughout these condensers is India mica, its dielectric constant about 5.5. The company stated:

"A new molding process eliminates both gases and moisture from the condenser itself, thus providing a completely sealed unit unaffected by external conditions of time, temperature, and moisture."

Micomold has also developed two new products: a molded carbon resistor and a dry electrolytic condenser.

Lynch Metallized and Wire-Wound Resistors

Lynch metallized resistors, made by the Lynch Mfg. Co., 1775 Broadway (General Motors Building) N. Y. C., now employ

new K filament. This filament is the result of many months of intensive research.

It is the same general type the trade is acquainted with but stronger and more durable and therefore able to meet the more rigid specifications now demanded. Closer tolerances are possible with K filament, and it has the capacity to stand greater overload.

Another outstanding improvement is the molded end cap which is a feature of Lynch resistors. The cap itself is tapered for insertion in standard cartridge type mountings, where interchangeability is desired. Tinned copper pigtails, when specified, are molded into the caps and are not soldered or strapped thereto. By this method, a clean, sure 100% contact between resistance element, cap and pigtail is made certain.

Lynch metallized resistors are the result of extensive research both in the laboratory and in the field. The resistance element is based on the famous metallized principle. The metallized resistance element is produced under laboratory conditions which provide a continuous and careful check for accuracy throughout the entire length of the resistance element in the making. Subsequent tests include flashing at double the rated wattage of the unit and additional tests for accuracy before shipment.

The special ceramic casing is of sturdy construction and maximum heat dissipation. It will withstand more than average shocks and jars, as well as minimizes possibility of damage by crushing.

Lynch metallized resistors are supplied in ½, 1, 2, 3 and 5 watts, cartridge and pigtail types.

The improved Lynch wire-wound resistors are now available in either cartridge or pigtail type to meet every indi-

Precision type resistor made by the Lynch Manufacturing Company for multipliers and shunts in the use of meters.

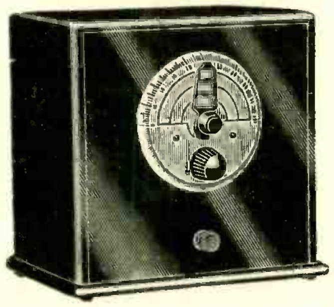
vidual requirement. Type LW-1 (cartridge) and LW-4 (pigtail) are made in all resistances from one ohm to 500,000 ohms. Type LW-2 (cartridge) is made in all resistances from 500,000 ohms to 2,500,000 ohms. Type LW-3 (pigtail) is made in all resistances from 200 ohms to 100,000 ohms.

The Lynch wire-wound resistors embody structural features which are designed to secure the utmost in electrical and mechanical efficiency. Wire and treatment eliminate breakdowns and shorted turns. Contact is insured by the same general method employed in the manufacture of Lynch metallized resistors. A molded metal end cap cuts down contact resistance and avoids the weakness encountered in a soldered or welded connection. It also provides a seal against moisture and assures noiseless operation.

Lynch precision wire-wound resistors are rated one watt; tolerance plus or minus one percent.

Supertone Uses Switch to Change Wave Band

The following devices are made by the Supertone Products Corporation, of 216 Wallabout Street, Brooklyn, N. Y.:



Three styles of all-wave foundation units, consisting of the wired tuning circuit, all with single switch selection of the wave band from the front panel.

The first foundation unit comprises two inductively coupled tuning coils in a single copper shield, 15-600 meters, with two-gang tuning condenser, trimming condenser, equalizing condenser, line switch and band selector, on a 7½ x 14 inch front panel. The catalogue number is AWFU and the price is $13.50.

The second foundation unit is similar to the other one, but instead of self-coupling by inductive relationship, the two coils are in independent aluminum shields, affording choice of the method of external coupling of oscillator and modulator. The catalogue number is AWSS and the price is $15.

The third foundation unit is for tuned radio frequency sets, as distinguished from the two others, which are for use in conjunction with an intermediate frequency. The catalogue number is AWRF and the price is $15.

If a volume control potentiometer is desired, it is obtainable with any of the above models, with line switch built in, at $1.25 extra.

All three foundation units afford band selection from the front panel, without plug-in coils, while the two-gang tuning condensers supplied as part of all three assemblies, take care of the frequencies within each band, with a substantial overlap to prevent miss-out on any frequencies. All foundation units cover from 15 to 600 meters.

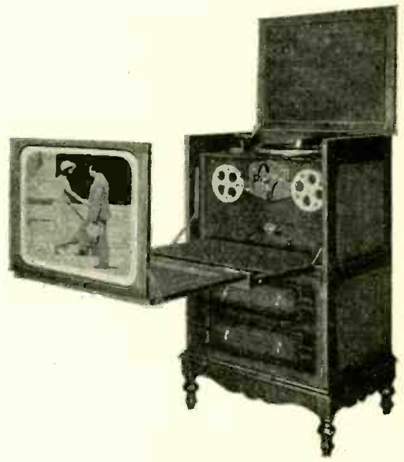
Precision type tuned radio frequency transformers also are made by Supertone Products Corporation for broadcast wavelength receivers. These coils are wound on threaded bakelite, with a slot for the primary, and are supplied with aluminum or copper shields, as preferred. The coils may be used for screen grid or other receivers, of the tuned radio frequency or superheterodyne type, in connection with a gang condenser. These coils are of two general types, one for .0005 mfd. condensers, the other for .00046 condensers.

Intermediate frequency transformers, in aluminum shields, 2¼ inches high, 2½ inches in diameter, also are manufactured by this corporation, for 450 and 175 kc.

The Selectifier, a band pass filter pretuner, comprising a powerful wave trap for killing off strong locals to permit full enjoyment of other stations, also is made by Supertone. This wave trap uses no tubes, but has two tuned circuits, with both a rejection characteristic, constituting the wave trap, and an admittance characteristic. That is, at one setting a particular station is killed off (rejection), at another setting close by, its volume is increased (acceptance). Therefore the Selectifier also may be used for building up the volume of weak stations. The device is wired in a neat walnut-finish cabinet. The catalogue number is SEL and the price is $10. See illustration.

Talkiola Perfects Device for Home

The Talkiola Corporation, 1600 Broadway, New York, manufacturing home talkie equipment which combines a talk-



Talkiola, a home talking movie outfit, with radio set built in.

ing picture machine using 16 millimeter film, together with a specially designed radio and gramophone. The cabinet is different from the usual radio type, in that it resembles a secretary and can be used as a desk. The image is cast on the screen as illustrated, or may be projected on a much larger screen farther away, all without angular distortion of image. A synchronizer easily adjusts the film speed to the record speed.

The manufacturer designed a special noiseless projector to take care of the increased speed of talking pictures over the silent pictures and at the same time eliminate noises that would interfere with the proper reproduction of talking pictures. An extensive library of films and sound records is available to Talkiola users.

Talkiola has a radio set in it. By throwing a switch one turn, from the radio to the phonograph it plays any record recorded at the speed of 78.

A shifting of a lever changes the speed of the turntable from 78 to 33 1/3 revolutions per minute, the speed used in talking pictures.

The threading of the film is easily accomplished and the plate is so marked that anyone can project picture without technical knowledge or training.

Talkiola permits running the radio in connection with a silent picture, or playing any record up to 16 inches as accompaniment.

Talkiola has an electric rewind for films.

There is no installation required as you simply plug into your AC electric light socket. Non-inflammable film is used.

The pickup may be supplanted by a microphone for a public address system for use in a small hall or large room.

A portable Talkiola is made for industrial educational and entertainment purposes.

Perryman Has New Mercury 280 Tube

Perryman Electric Co., Inc., 4901 Hudson Boulevard, North Bergen, N. J., has developed a mercury vapor, full-wave rectifier tube, P.R. 280M, characteristics being similar to the standard 280, but the tube is capable of delivering three times the available power of the standard 280. This is a special low voltage drop tube requiring special circuit for its use. Complete engineering data are available on request.

Ex-Stat Resistor Kits for Servicing

A most attractive and useful metal case, with de luxe finish, is being given by the Tilton Manufacturing Company, of

15 East Twenty-sixth street, with each order for a kit of twenty-four replacement resistors. The kit is intended for the service man, so that he can make a repair instantly, and also for the radio experimenter, who frequently finds that operating results are improved by the use of a different value of resistor than the one in a circuit.

The resistors range from 100 ohms to 2 meg. and it is said by the manufacturer that this meets the replacement requirements of more than 90 per cent. of the cases encountered in servicing a receiver.

The kits are known as Ex-Stat Resistor Kits, for the Ex-Stat resistors they contain. These resistors are of the same type as used in more than 72 per cent. of the receivers being produced. They are precision resistors and are guaranteed as to resistance value within the limits set in manufacturing receivers.

The kit with 24 resistors is known as type 24. There is also another kit, type 48, containing 48 resistors of 34 different values, from 100 ohms to 3 meg., with which a similar but larger case is given free.

The company also makes resistors for ignition filtration in automobiles, so that a set can be worked in a car without interference caused by the ignition.

A catalogue is obtainable by writing direct to the manufacturer.

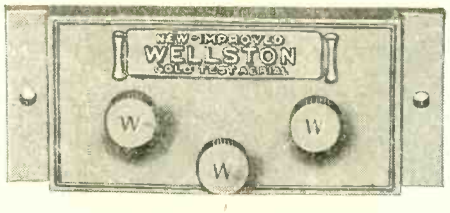
New Burgess Battery for Automobile Sets

A new Burgess radio B battery for automobile sets has been produced by the Burgess Battery Company, of 111 West Monroe Street, Chicago. It will give a greater number of ampere hours because of its special patented battery mix.

It will not break down under the constant bumping and vibration that comes with high speed driving, says the manufacturer. It is said to be absolutely waterproof and to withstand extreme hot and cold temperatures.

Improved Aerial Made by Wellston

Since their introduction to the radio field several years ago by the Wellston Radio Corporation, Wellston Gold Test



The Improved Wellston Gold Test Aerial

Products have attained popularity. In fact, these aerials and replacement parts have a world-wide reputation.

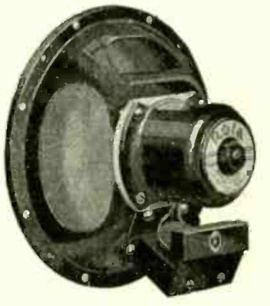
The new, improved Wellston Gold Test Aerial is claimed by the manufacturer to be one of the greatest innovations since radio itself, and eliminates both inside and outside aerials. The shell of this new improved aerial is constructed of genuine Durez, an attractive and durable substance. It follows closely the original Gold Test Aerial, which is giving satisfactory service to thousands of radio owners throughout the wordl, except that a new idea introduced causes improved performance.

Although small enough to fit in the palm of your hand, it has a capacity equivalent to 54 feet of aerial wire strung 50 feet high in the air. It reduces electrical interference, does away with lightning hazards, and because its does not connect in a light socket, all AC hum and line noise are eliminated, says the manufacturer.

In addition to the Gold Test Aerial, the Wellston Radio Company has met with unusual success on Gold Test replacement parts. These parts, designed to allow the largest amount of safety in the space allowed, are manufactured to duplicate the original parts as to hookup and external size. All parts used in assembling Gold Test replacements are manufactured and tested in the factory. No salvage or surplus parts are used—only the best of new material is utilized in the construction of transformers, condensers, resistances, etc., and each and every product is fully guaranteed by the manufacturer.

Rola Announces New Small Dynamic Speaker

A new dynamic loudspeaker unit, designed to meet the requirements of 1931 radio sets and home talkie outfits, has been announced by the Rola Company, 2570 Superior Avenue, Cleveland, O., manufacturers of electric reproducers for the industry



The new small Rola

The new Rola unit, to be known as Model F, is said to provide an astounding performance in a very small package, being only eight inches overall diameter and weighing under five pounds.

B. A. Engholm, Rola's vice-president, responsible for the development of Model F, said:

"Our problem was to design a unit that would be more compact, more efficient and more economical to manufacture than existing types, and a speaker that would match the critical load requirements of the new pentode power tubes. Our new model F successfully meets these requirements."

Baltimore Radio Has Power Amplifier

A direct coupled power amplifier of the Loftin-White type is merchandised by Baltimore Radio Corporation, 725 Broadway, N. Y. City. Sidney Fishberg, engineer of the corporation, said

"The direct coupled type of amplifier is without doubt the most radical departure from conventional amplifier design in years.

"The pentode power amplifier tube is the newest development in tube design, having an undistorted power output of 2,500 milliwatts and a power sensitivity four times as great as that of the type 245 tube.

"When the pentode tube is combined with the direct coupled amplifier, as in our model, we have the last word in modern distortionless, hum-free power amplifiers. There is practically uniform amplification of all frequencies from 30 to 10,000 cycles. An adjustable hum-reducing potentiometer practically eliminates all traces of AC hum. The PZ power amplifier reproduces speech and music with marvelous fidelity of tone, and with sufficient volume to fill a hall of 500 to 750 seating capacity.

"The amplifier may be coupled to a tuner or receiver by connecting the output of the detector tube to the primary of an audio frequency transformer. A 500,000 ohm potentiometer is connected across the secondary of the transformer, and the slider and one end terminal of the potentiometer are connected to the input terminals of the amplifier (marked "phono"). The potentiometer is then adjusted for maximum volume without howling. This model is unique among Loftin-White amplifiers in providing a readily accessible source of plate and filament current for any tuner."

Jefferson Electric Company

The Jefferson Electric Company, 1500 South Laflin Street, Chicago, Illinois, is exhibiting its complete line of radio material in Booth No. 80.

One of the new items is the No. 373 output transformer, a Universal type made up in the same form as Model No. 372 Universal input transformer. This new output unit is designed for use with Magnavox, Jensen, Oxford, Rola, Lansing, Utah, etc. It can be used for coupling power tubes to voice coil dynamics either in push-pull or cascade amplification and has flexible and universal mounting and lead arrangement.

In addition the Jefferson Company is displaying a complete line of audio transformers, fuses, cutout bases, etc., for the wholesale trade, as well as a large assortment of power transformers, chokes, audio transformers, etc., for radio set manufacturers.

Midget Condenser Leaflet

The midget condenser has always been a popular item with radio fans because of its extreme usefulness. And now with the recent introduction of the new tuning type of midget condenser, developed by the Hammarlund Manufacturing Company, 424 West 33rd Street, New York City, its value has been multiplied manifold.

This very interesting subject has been covered completely in a specially prepared leaflet, replete with diagrams and circuit data, just released by Hammarlund. Copies of this valuable bulletin are free for the asking.

A THOUGHT FOR THE WEEK

THESE are interesting times for the radio trade. Eyes are turned toward Chicago, where the 1931 Radio Trade Show will be held and where folk from all over this country and Canada will foregather for the show itself and the various social and business functions associated with it. Radio shows serve two distinct purposes: they give manufacturers the opportunity to prove their faith in the goods they are making and give dealers and jobbers a new urge to go and sell the public the new things offered. May this 1931 event set a new record in interest, attendance and importance.

RADIO WORLD

The First and Only National Radio Weekly
Tenth Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.

Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor; L. C. Tobin, advertising manager.

A Proposal for Action On the Radio Census

THE tabulation of the radio census in twenty-six States, the total number of States on which the Director of the Census has made a report, shows that 26.9 per cent. of the families have radio sets. The total number of families is 8,220,485 in these States, and the number of families having sets is 2,374,293.

When due allowance is made for the type of population, the physical geography of the terrain, and the economic status of the States, an estimate can be made of what the complete figures will show. It is believed that they will reveal that only about 40 per cent. of the families in the United States have sets.

This number is unexpectedly low, when viewed on the basis of precensus guesses, although in the light of figures already at hand it would not be surprising if the estimated total would show such a wide market.

How great a sale of sets and accessories to the hitherto unsold market is possible should be the subject of immediate study by manufacturers, because they have the economic stimulant to such activity. Aside from its its industrial possibilities, in the light of new employment it will afford and the bigger turnover it invites, the development of this new market would be of social and educational benefit to the buyers.

In fact, it is so important to the welfare of the families now without sets to see that they are provided with them that, forgetting immediate commercialism, perhaps the trade will entertain some project to co-operate in having sets supplied to those who would possess them but who perhaps have not now the means with which to buy them.

So-called trade-in sets are today little more than trade waste, even though these sets do work. It is common practice for a dealer to offer a trade-in allowance, and to deduct the allowance from the purchase price of a new set, with the actively expressed preference for never seeing the set that is supposedly traded in. If the dealers would pick up these sets, as they have been constantly advised to do in the interest of maintaining the integrity of their business conduct, co-operation could establish a clearing house for the sets, and they could be dispatched to families to whom the delivery of a set would be an appreciated kindness. Such a family would be only too glad to defray the packing and transportation expenses. As it is, the persons who want to relinquish the trade-in sets, and the dealers not interested in obtaining the sets, innocently enough contrive to deny the possession of such sets to families that really want them.

That there will be opposition to any such plan is to be expected. Set manufacturers may feel that instead of selling a set they are aiding in giving one away. These manufacturers have never sold a set to a family that never had a set, so, far from upsetting their own market, they would be creating a replacement market. Families of all types may be expected to desire the most modern receivers as fast as economic conditions in the home permit. Besides, quite a few of these manufacturers use time on the air, and they can not expect their advertising message to be effective on families who do not hear it.

Surely tube manufacturers should find no objection to the plan, as all sets require tubes, and it is quite possible that if unused or discarded sets should suddenly enter the service arena in quantity that the tube manufacturers, as well as the manufacturers of other accessories, such as batteries, would find a quick increase in their business.

At least the radio census has done two things. It has stimulated the trade to consider whether the careful development of unwon markets is not immediately advisable, and it has focused the attention of educators and others, who are not persuaded by commercial motives, to consider the expansion of the listening audience. So perhaps the two divergent agencies, whose goal is essentially the same, although their motives differ, can get together.

Broadcasting stations may be relied on to render assistance. They can not well reach the families that have no sets, but almost every family that has no set must be known to some family that has a set, so that the good word can be spread quite easily. Also, the industrial and social advantages of wider use of sets, where commercialism is absent from the undertaking of supplying sets, might enlist the assistance of the Department of Commerce, the Office of Education and other Governmental agencies.

RADIO WORLD takes pleasure in presenting these proposals, which are made on the basis of its tabulation of the radio census to date, published in detail in another column. It hopes that the united agencies of business, social and educational welfare, and Government, will seriously consider the proposals, and that the good intended by the good intention will transpire.

Stewart-Warner Has Short-Wave Converter

One of the items in the new line of radio merchandise exhibited by the Stewart-Warner Corporation is a new short-wave converter intended to introduce thousands of people to a fascinating phase of radio broadcasting.

Offered as an individual unit, designed for use with practically any standard AC set, and also a built-in feature of four models in the new Stewart-Warner line, this unique device adapts set reception down to approximately 20-meter wavelengths. The converter measures 8½ inches high by 11¼ inches wide.

26.9 Per Cent. of Families in 26 States Have Sets

A compilation of the serial census reports on radio sets, covering the twenty-six States tabulated to date, shows that 26.9 per cent. of the families have sets. The total number of families in these States is 8,220,485, and the number having sets is 2,374,293.

Issued Serially

The radio census reports are issued by the Director of the Census, Department of Commerce, as tabulated, one State or two States at a time. So far, although more than half the States have been accounted for, none of the States with a population of 4,000,000 or more persons has been included, hence there is no tally yet for New York, Pennsylvania, Ohio, Texas, California, Michigan, Massachusetts or New Jersey. When the entire forty-eight States are reported, it is expected the percentage will be somewhat greater than 26.9.

Smallest Percentages

The smallest percentages of set owners are in States that have a sharply non-homogeneous type of population. For instance, Mississippi, 5.4 per cent.; Arkansas, 9.2 per cent.; Alabama, 9.5 per cent.; Georgia, 9.9 per cent.

States that have low population density, that is, a small percentage of population per square mile, are in the next higher brackets. The tally shows that there is a market for sets in a large percentage of the families of the United States, and it would not be surprising if figures for all States showed that 60 per cent. of the families have no radio set.

Proposal for Action

A proposal has been made that the radio set and accessory manufacturers appoint a committee to analyze the radio census with a view toward opening this large market in the interest of employment, industry and social and educational advantages.

Figures Listed

The compilation to date follows:

State	*Families*	*Families Having Sets*	
		Number	*Per Cent*
Alabama	592,530	56,491	9.5
Arizona	106,630	19,295	18.1
Arkansas	439,408	40,248	9.2
Colorado	268,531	101,376	37.8
Connecticut	389,596	213,821	54.9
Delaware	59,295	27,183	45.8
Dist. of Col.	126,014	67,880	53.9
Florida	377,823	58,446	15.5
Georgia	654,009	64,908	9.9
Idaho	108,515	32,869	30.3
Iowa	636,905	309,327	48.6
Kansas	488,055	189,527	38.8
Kentucky	610,288	111,452	18.3
Maine	198,372	77,803	39.2
Maryland	386,087	165,465	42.9
Mississippi	472,354	25,475	5.4
Nevada	25,730	7,869	30.6
New Hampshire	119,660	53,111	44.4
New Mexico	98,820	11,404	11.5
North Dakota	145,382	59,352	40.8
Oklahoma	565,348	121,973	21.6
Utah	116,254	47,729	41.1
Vermont	89,439	39,913	44.6
West Virginia	374,646	87,469	23.4
Wisconsin	713,576	364,425	51.1
Wyoming	57,218	19,482	34.0
Totals	8,220,485	2,374,293	*26.9

**The percentage given is the actual percentage and not the average of the percentages.*

GREATER POWER HELD BIG NEED OF TELEVISION

Television has been compared to early broadcasting of the vintage of 1922-25 when crystal sets, one tube regenerative squealers and the beginnings of tuned RF were recorded. This similarity is not only fitting in regard to the results obtained compared with present day broadcasting but even in the question of station power the analogy succeeds, according to Hollis S. Baird.

Today broadcasters use 1,000 watts for the ordinary run of regional stations, while 5,000 to 10,000 watts power is fairly common. Then there are the 30,000 to 50,000 watt broadcasters who dominate the cleared channels. Now 500 watts is considered a mere neighborhood station. Yet 500 watts is about the most that television has offered the public in power so far. This limited power gives television just one more obstacle, states Mr. Baird, since static, particularly of the man-made type, is doing its darndest at 100 to 150 meters, the television band.

Static Causes Black Flakes

A little noise in radio reception is bad enough, but static in television causes literally a snowstorm of black flakes, reminding one of the streaks in the early motion picture films, he says.

In television, however, the early experiences of broadcasters have been duly noted and immediate increase of power is on its way. Thus WIXAV, of the Shortwave and Television Corporation, Boston, has just obtained permission from the Federal Radio Commission to increase its power from its present 500 watts to 1,000 watts.

Although some twenty stations for television broadcasting are mentioned in dispatches on this subject, most of these are construction permits. Only eight stations are now on the air regularly, according to Mr. Baird. They are the Jenkins stations in Maryland and the Jenkins-DeForest stations in New York City and Passaic, which divide time and, he says, are the equivalent of a single station as far as television channels are concerned.

Concentration at Camden

Then there is the Western Television Corporation's station in Chicago, also the Chicago Daily News station in the same city, the RCA station in Camden, N. J., which follows no particular schedule and which therefore cannot be considered as a regular source for television entertainment, the NBC station in New York, Radio Pictures, John V. L. Hogan's station in New York and finally WIXAV.

Although the Westinghouse station in Pittsburgh and the General Electric station in Schenectady are regularly listed they have both been off the air for a long time. These concerns' activities in television are concentrated in the Victor plant at Camden.

While 20,000 watts has been authorized in two cases and several 5,000 watt licenses granted, about the most power used to date has been 1,250 watts. The NBC New York station, licensed for 5,000, is only using 850 watts at present. The Jenkins New York City station, also licensed for 5,000, has been using only 250 watts.

Experts Favor Higher Power

WIXAV will go up to its 1,000 watts in a few weeks. Broadcasters have learned that high power is particularly needed in the summer to override static and compensate generally for summer radio reception.

At the Washington television conference in December there was some talk of limiting television power but this was vigorously opposed, states Mr. Baird. Two noted engineers who were present spoke in behalf of more power, Dr. Frank Conrad, of Westinghouse, who said it would be unwise to limit power, and Dr. E. F. W. Alexanderson, of the General Electric Company, who pointed out that television needs more power than voice, as there is no earphone level in television as there is in ordinary broadcasting. Increased power will be television's program from now on, states Mr. Baird, insuring better and better reception.

The Radio Census

Washington.

The Director of the Census has just announced the results of preliminary counts of the number of families, with the number of families reporting radio sets, for the following States:

Oklahoma

The whole number of families in Oklahoma on April 1, 1930, was 565,348, as compared with 444,524 in 1920. The number of persons per family in 1930 was 4.2, as compared with 4.6 in 1920. The number of families reporting radio sets in 1930 was 121,973, or 21.6 per cent. of the total.

Kentucky

The whole number of families in Kentucky on April 1, 1930, was 610,288, as compared with 546,306 in 1920. The number of persons per family in 1930 was 4.3, as compared with 4.4 in 1920. The number of families reporting radio sets in 1930 was 111,452, or 18.3 per cent of the total.

Mississippi

The whole number of families in Mississippi on April 1, 1930, was 472,354, as compared with 403,198 in 1920. The number of persons per family in 1930 was 4.3, as compared with 4.4 in 1920. The number of families reporting radio sets in 1930 was 25,475, or 5.4 per cent. of the total.

Maryland

The whole number of families in Maryland on April 1, 1930, was 386,087, as compared with 324,742 in 1920. The number of persons per family in 1930 was 4.2, as compared with 4.5 in 1920. The number of families reporting radio sets in 1930 was 165,465, or 42.9 per cent. of the total.

Rule for Stations Repealed in Error

Washington.

An order dealing with technical requirements for the operation of broadcasting stations was repealed inadvertently by the Federal Radio Commission.

The Commission desired to adopt an order changing license dates, and found that not only had that been accomplished, but that the technical requirements for station operations had been repealed. Thereupon the Commission consulted its legal division, and got an opinion recommending a substitute order. The repeal was repealed and the expiration dates alone were ordered changed in a new resolution which was adopted. After that the Commissioners breathed more easily.

50-CYCLE RULE RECOMMENDED BY EXAMINER

Washington.

The proposal to establish a 50-cycle maximum of deviation from frequency for all broadcasting stations, which was the subject of a hearing before Chief Examiner Ellis A. Yost of the Federal Radio Commission, is favored by him. Due to changes required, the plan is to have the order promulgated soon, but the effective date would be set for one year thereafter.

Would Stop Heterodynes

The chief object of reduction in tolerance from the present 500-cycle limit is to eliminate heterodyne interference. At present stations on adjoining channels, whether one or both are off their assigned frequency even by more than 50 cycles, may cause whistling or moaning sounds, due to the beat between the two carriers.

Suggestions for not making the limit so strict as 50 cycles were opposed at the hearing on the ground that any greater variation would produce an audible note in a broadcast receiver due to the mixing of carriers of two stations where one or both were off frequency more than 50 cycles.

Examiner's Findings

Mr. Yost set forth the following conclusions in his report:

"(1) The requirement of plus or minus 50 cycles tolerance would result in a material increase in the service area of regional and local stations and would be of direct benefit to the stations and the listening public.

"(2) Equipment capable of meeting the proposed requirements is available at a reasonable cost.

"(3) Some stations are now maintaining the proposed tolerance and others will be able to do so with minor changes in frequency control equipment.

"(4) The requirement is consistent with the basic policy of radio regulation that equipment used in transmitting stations should be maintained abreast of technical progress in order that full and efficient use be made of the limited facilities available."

New Regime to Open Kolster Factory Again

Kolster Radio, Inc., is expected to begin business soon. It consists of a new ownership of the Kolster properties, resulting from the purchase of the assets of the old concern at the receiver's sale at $3,000,000 at Newark, N. J.

New York Quarters for Boston Vision Firm

The Shortwave and Television Corporation, of Boston, will have an experimental reception studio atop the County Trust Building in New York City.

A special program will be transmitted from Boston by WIXAV and WIXAU.

TRADE FLOCKS TO SHOW, FULL OF ENTHUSIASM

Chicago.

From all parts of the United States and Canada, as well as from across the seas, radio manufacturers, jobbers, dealers and others interested in the trade gathered in this city to attend the fifth annual Radio Trade Show. More than 150 manufacturers had contracted for booths at the show, which was held in the Stevens Hotel, under the auspices of the Radio Manufacturers Association. More than 20,000 manufacturers, jobbers and dealers were expected to visit the show.

Much interest was shown in the advance being made in preparation for the commercial advent of television, particularly as there were some televisors for exhibition, and also television tubes, including photo cells for transmission and neon lamps for reception, besides other apparatus, e. g., scanning discs, screens and short-wave receivers.

Interest in Tubes

Tubes came in for their just share of attention, interest focusing on the new exponential or variable mu tube, the 235, which, in circuits that vary the grid bias or the screen voltage, serve to reduce greatly interference due to crosstalk and crossmodulation, also hissing sounds and other extraneous noises. The tube is exclusively a radio frequency amplifier, in its present use. It is not serviceable as a detector, and its use as an audio amplifier has not been encouraged.

Another tube that had the attending forces talking was the pentode, a power tube that has higher sensitivity than any other used in broadcast sets. This tube provides much more volume for a given input than does the 245. There are also a 2 volt pentode for battery sets (233) and a 6.3 volt one for autos (238).

Optimistic on Business

Midget sets, which comprised about half the set market for the present season, appeared with the new tubes in them, for the coming season, when it is expected the compact mantel type receiver and the pier clock or thin upright models for floor use will absorb 75 per cent. of the set business.

Members of the trade were optimistic of business conditions, frankly admitting they are not good now, but reporting improvement, with expectation of gradual restoration of more auspicious conditions. The worst was over, was the concensus, and business will improve until it becomes actually good, around the holidays.

Lower prices prevail in all lines. Sets and tubes were outstanding in their lower prices, compared with last year. Parts also are at lower list prices. There was considerable interest in parts, including assemblies from kits for which parts manufacturers supplied the components.

Other Bodies Meet

The Institute of Radio Engineers held a convention at the same time, and the annual Furniture Mart, due to the close association of the furniture and the radio industries, added to the radio trade show attendance. Radio manufacturers' associations held meetings, as did the Newspaper Radio Editors' Associations and the Radio Press Association.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

St. Clair Adams, P. O. Box 35, Bound Brook, N. J.
Rudolph Williams, 13 Front St. Saxon, Spartanburg, S. C.
K. McCarron, 445 N. 14th St., San Jose, Calif.
L. Schwarzemann, 39 Avenue B, Bayonne, N. J.
Willard W. Dakin, 805½ Zack St., Tampa, Fla.
R. Grard, 0. W. Pearson St., Chicago, Ill.
Charles L. Kerstein, 437 6th Ave., S. W., Roanoke, Va.
Wm. Martin, 428 Hughey Ct., Orlando, Fla.
James McSorley, 146 Maple St., Kearny, N. J.
W. H. Nilsson, c/o Radio Station W4ALW, 19 7th St., Savannah, Ga.
Chas. J. Link, General Delivery, Kankakee, Ill.
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Dr. Morton H. Smith, Room 67, Altoona Trust Bldg., Altoona, Pa.
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Wm. Wesley, Hotel Valier, Valier, Mont.
Viking Freudenthal, c/o Standard Stores, 670 Main St., Worcester, Mass.
Clyde Sherrill, Spindale, N. C.
Lee York, 2928 Bath, Ashland, Ky.
Steve Augustne, 1141 Penna. St., Gary, Ind.
Harvey Jenkins, R. F. D. No. 6, Oswego, N. Y.
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W. G. Crowther, Room 217, Court of Common Pleas, Newark, N. J.
Olof Wallin, Comfrey, Minn.
Jesse French Sons, Inc., Box 848, Montgomery, Ala.
E. WW. Bleakie, 294 Butler Ave., Providence, R. I.
Wm. Parr, 515 S. Monroe St., Montpelier, Ohio.
K. C. Costley, Costley Radio Sales, 702 Empire Bldg., Detroit, Mich.
Geo. C. Anderson, 2236 Indana Ave., St. Louis, Mo.
Radio Service Co., 710 Lincoln St., Jackson, Mich.
Chas. Allingham, 4 Dundee Ave., Toronto, Ont., Can.
James Irving, 796 Manning Ave., VVerdun, Montreal, Can.
Howard O. Paige, Radio Service Co., 710 Lincoln St., Jackson, Mich.
Orra A. Christy, 119 Polk Ave., Lake Wales, Fla.
Miland H. Jordan, 3 Main St., Springfield, Vt.
Stanley & Pitt, 193 Brook St., Scarsdale, N. Y.
Esmond J. Cleary, 1 Lummus Ave., Danvers, Mass.
M. J. Zavadil, 2915A Sidney, St. Louis, Mo.
A. Gulloni, Proprietor, Reliable Radio Service, 11 Hibbard St., Amsterdam, N. Y.
Ralph B. Davis, Prestonsburg, Ky.
J. W. Hopmarne, Lnt. Ballester 158, San Andre's (F. C. C. A.), Argentina, S. A.
N. Nazar, 137 Templeton Parkway, Watertown, Mass.
F. R. Kennedy (Amateur Transmitting and Power Supply Equipment and Television Apparatus), 806½ Sunset St., Dallas, Texas.
G. W. Wooten, P. O. Box 589, Victoria, Texas.
E. W. Bleakie, 294 Butler Ave., Providence, R. I.
Wm. Parr, 515 S. Monroe St., Montpelier, Ohio.
K. C. Costley, Costley Radio Sales, 702 Empire Bldg., Detroit, Mich.
W. C. Grice, 1630 Topeka Blvd., Topeka, Kans.
Geo. C. Anderson, 2236 Indiana Ave., St. Louis, Mo.
Philip C. Gilliard, 1210 H. St., Brunswick, Ga.
H. C. Thomas, Box 5061, State College, Raleigh, N. C.
S. H. Sheib, Froehling & Robertson, Inc., Richmond, Va.

New Corporations

Master Radio and Electrical Supply Co.—Attys. Hyman Hyman, 103 East 125th St., New York, N. Y.
World Radio Advertising and Education Programs—Atty. S. G. Coler, 160 5th Ave., New York, N. Y.
Electrical and Radio Distributing Corp.—Newark—Attys. De Graw, Murray & Keenan, Newark, N. J.
Queen Anne Radio Sales Co.—Atty. F. E. Wright, 95 Madison Ave., New York, N. Y.
Century Broadcasting Corp.—Atty. R. B. Buffington, Buffalo, N. Y.
Thor Radio Co.—Atty. B. A. Grossman, 1 Wall St., New York, N. Y.
North Bergen Auto, Electric-Radio Supply Co., West New York—Atty. Fred Goldstein, West New York, N. J.
Clear-o-Tone Manufacturing Co., Wireless devices—Atty. O. D. Williams, 67 Williams St., New York, N. Y.

LANGMUIR TUBE PATENT VOIDED BY FINAL COURT

Washington.

The patent issued by the United States Patent Office to General Electric Company, as assignee of Dr. Irving Langmuir, covering the high vacuum now used in virtually all radio tubes except some detectors, was invalidated by the United States Supreme Court.

The decision ended a long controversy in which General Electric sued the DeForest Radio Company for infringement. It was one of the most important radio decisions ever handed down, since if the patent had been uphelf everybody's right to manufacture tubes of that type would be subject to license by General Electric.

The court, in an opinion written by Justice Stone, held that the contribution of Dr. Langmuir resulted only from skill in utilizing developments of the prior art, as practised by Dr. Lee DeForest, Sir Ambrose Fleming and others, hence did not constitute invention and was not patentable.

Settles Mixed Findings

The decision reverses the Circuit Court of Appeals, which had received the case from the District Court of Delaware. The court in Delaware had held the patent invalided, the Circuit Court at first agreed with that finding, then, on rehearing, reversed itself and found that the patent was valid.

The number of the patent at issue was 1558436.

The claims in the alleged patent, the court found, cover methods of creating the high vacuum by freeing the tube of gas otherwise retained by the glass envelope, and which would be freed in use, with resultant ionization (blue glow) that makes the tube action unsteady. The Langmuir method of accomplishing this release of "occluded" gas is by heating the tubes and electronic bombardment, at the same time evacuating the tube of air or gas by approved methods.

Langmuir was Anticipated

"It suffices to say," the court found, "that an examination of the prior art discloses that long before the earliest date claimed for Langmuir the necessity of removing occluded gas from tubes or other electrical discharge devices in order to produce a high vacuum, and the methods of doing it, were known, as was the procedure for construction of the high vacuum tube by expelling occluded gas while evacuating the tube."

While high vacuum was an effective means of producing in the old tubes of the art the stable current which could not be produced "in the presence of ionization," according to the opinion, there was no suggestion of the discovery "of a scientific truth that essentially different principles control the discharge in low vacuum tubes from those which operate in high."

Can't Patent an Explanation

Granting a difference between the low vacuum and high vacuum tubes, the court declared:

"It is no more than the scientific explanation of what Lilifield and others knew, before Langmuir."

[The full text of the opinion, which includes a scientific analysis of the vacuum tube, will be published next week, issue of June 13th.]

Stations in United States and Canada, Corrected to Press Time

CANADA

Station	kc
CFAC	690
CFBO	890
CFCA	840
CFCF	1030
CFCH	1200
CFCL	580
CFCN	985
CFCO	1210
CFCT	630
CFCY	960
CFJC	1120
CFLC	1010
CFNB	1210
CFQC	910
CFRB	960
CFRC	930
CHCA	690
CHCK	960
CHCS	1120
CHCT	840
CHGS	1120
CHLS	730
CHMA	580
CHML	880
CHNS	910
CHRC	645
CHWC	960
CHWK	665
CHYC	730
CJBC	690
CJBR	960
CJCA	930
CJCB	880
CJCJ	690
CJGC	910
CJGX	630
CJOC	1120
CJOR	1210
CJRM	665
CJRW	665
CJSC	690
CKAC	730
CKCD	730
CKCI	880
CKCK	960
CKCL	580
CKCO	890
CKCR	1010
CKCV	880
CKFC	730
CKGW	690
CKIC	1010
CKLC	840
CKMC	1210
CKMO	730
CKNC	580
CKOC	1120
CKOW	840
CKPC	1210
CKPR	890
CKUA	580
CKWX	730
CKX	540
CKY	780
CNRA	630
CNRC	690
CNRD	840
CNRE	930
CNRH	910
CNRL	910
CNRM	730
CNRO	600
CNRQ	880
CNRR	960
CNRS	910
CNRT	840
CNRV	1030
CNRW	780
CNRX	960
CPRY	690

UNITED STATES

Station	kc
WAAF	920
WAAM	1250
WAAT	940
WAAW	660
WABC	860
WABI	1200
WABZ	1200
WACO	1240
WADC	1320
WAIU	640
WALR	1210
WAPI	1140
WASH	1270
WAWZ	1350
WBAA	1400
WBAK	1430
WBAL	1060
WBAP	800
WBAX	1210
WBBC	1400
WBBL	1210

Station	kc
WBBM	770
WBBR	1300
WBBZ	1200
WBCM	1410
WBEN	900
WBEO	1310
WBGF	1370
WBIG	1440
WBIS	1230
WBMS	1450
WBNX	1350
WBOQ	860
WBOW	1310
WBRC	930
WBRE	1310
WBSO	920
WBT	1080
WBTM	1370
WBZ	990
WBZA	990
WCAC	600
WCAD	1220
WCAE	1220
WCAH	1430
WCAJ	590
WCAL	1250
WCAM	1280
WCAO	600
WCAP	1280
WCAT	1200
WCAU	1170
WCAX	1200
WCAZ	1070
WCBA	1440
WCBD	1080
WCBM	1370
WCBS	1210
WCCO	810
WCDA	1350
WCFL	970
WCGU	1400
WCHI	1490
WCKY	1490
WCLB	1500
WCLO	1200
WCLS	1310
WCMA	1400
WCOA	1340
WCOC	880
WCOD	1200
WCOH	1210
WCRW	1210
WCSC	1360
WCSH	940
WDAE	1220
WDAF	610
WDAG	1410
WDAH	1310
WDAY	940
WDBJ	930
WDBO	1120
WDEL	1120
WDGY	1180
WDIX	1500
WDOD	1280
WDRC	1330
WDSU	1250
WDWF	1210
WDZ	1070
WEAF	660
WEAI	1270
WEAN	780
WEAO	570
WEBC	1290
WEBQ	1210
WEBR	1310
WEDC	1210
WEDH	1420
WEEI	590
WEHC	1200
WEHS	1420
WELK	1370
WELL	1420
WENR	870
WEPS	1200
WETS	1200
WEVD	1300
WEW	760
WEXL	1310
WFAA	800
WFAN	610
WFBC	1200
WFBE	1200
WFBG	1310
WFBL	1360
WFBM	1230
WFBR	1270
WFDF	1310
WFDV	1370
WFDW	1420
WFI	560
WFIW	940
WFLA	620

Station	kc
WFOX	1400
WGAL	1310
WGAR	1450
WGBB	1210
WGBC	1430
WGBF	630
WGBI	880
WGBS	1180
WGCM	1210
WGCP	1250
WGES	1360
WGH	1310
WGL	1370
WGN	720
WGR	550
WGST	890
WGY	790
WHA	940
WHAD	1120
WHAM	1150
WHAP	1300
WHAS	820
WHAT	1310
WHAZ	1300
WHB	860
WHBC	1200
WHBD	1370
WHBF	1210
WHBL	1410
WHBQ	1370
WHBU	1210
WHBY	1200
WHDF	1370
WHDH	830
WHDI	1180
WHDL	1420
WHEC	1440
WHFC	1420
WHIS	1410
WHK	1390
WHN	1010
WHO	1000
WHOM	1450
WHP	1430
WIAS	1420
WIBA	1280
WIBG	930
WIBM	1370
WIBO	560
WIBR	1420
WIBU	1210
WIBW	580
WIBX	1200
WICC	600
WIL	1200
WILL	890
WILM	1420
WIOD	1300
WIP	610
WIS	1010
WISJ	780
WISN	1120
WJAC	1310
WJAG	1060
WJAK	1310
WJAR	890
WJAS	1290
WJAX	900
WJAY	610
WJAZ	1490
WJBC	1200
WJBI	1210
WJBK	1370
WJBL	1200
WJBO	1420
WJBT	770
WJBU	1210
WJBW	1200
WJBY	1210
WJDX	1270
WJJD	1130
WJKS	1360
WJR	750
WJSV	1460
WJW	1210
WJZ	760
WKAQ	890
WKAR	1040
WKAV	1310
WKBB	1310
WKBC	1310
WKBF	1400
WKBH	1380
WKBI	1420
WKBN	570
WKBO	1450
WKBS	1310
WKBV	1500
WKBW	1480
WKBZ	1500
WKJC	1200
WKRC	550
WKY	900

Station	kc
WKZO	590
WLAC	1470
WLAP	1200
WLB	1250
WLBC	1310
WLBF	1420
WLBG	1200
WLBL	900
WLBW	1260
WLBX	1500
WLBZ	620
WLCI	1210
WLEX	1410
WLEY	1370
WLIB	720
WLOE	1500
WLS	870
WLSI	1210
WLTH	1400
WLVA	1370
WLW	700
WLWL	1100
WMAC	570
WMAK	1040
WMAL	630
WMAQ	670
WMAZ	890
WMBA	1500
WMBC	1420
WMBD	1440
WMBG	1210
WMBH	1420
WMBI	1080
WMBO	1310
WMBQ	1500
WMBR	1370
WMC	780
WMCA	570
WMMN	890
WMPC	1500
WMRJ	1210
WMSG	1350
WMT	600
WNAC	1230
WNAD	1010
WNAX	520
WNBF	1500
WNBH	1310
WNBO	1200
WNBR	1430
WNBW	1200
WNBX	1200
WNBZ	1290
WNJ	1450
WNOX	560
WNYC	570
WOAI	1190
WOAX	1280
WOBT	1310
WOBU	580
WOC	1000
WOCL	1210
WODA	1250
WODX	1410
WOI	640
WOKO	1440
WOL	1310
WOMT	1210
WOOD	1270
WOPI	1500
WOQ	1300
WOR	710
WORC	1200
WOS	630
WOV	1130
WOW	590
WOWO	1160
WPAD	1420
WPAW	1210
WPCC	560
WPCH	810
WPEN	1500
WPG	1100
WPOE	1370
WPOR	780
WPSC	1230
WPTF	680
WQAM	560
WQAN	880
WQAO	1010
WPAP	1010
WQBC	1360
WQDM	1370
WQDX	1210
WRAF	1200
WRAK	1370
WRAW	1310
WRAX	1020
WRBI	1310
WRBJ	1370
WRBL	1200
WRBQ	1210
WRBT	1370

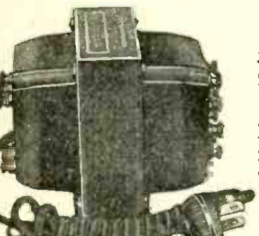
Station	kc
WRBX	1410
WRC	950
WRDO	1370
WRDL	1310
WRDW	1500
WREC	600
WREN	1220
WRHM	1250
WRJN	1370
WRNY	1010
WRR	1280
WRUF	830
WRVA	1110
WSAI	1330
WSAJ	1310
WSAN	1440
WSAR	1450
WSAZ	580
WSB	740
WSBC	1210
WSBT	1230
WSEN	1210
WSFA	1410
WSIX	1210
WSJC	1310
WSJS	1310
WSM	650
WSMB	1320
WSMK	1380
WSOC	1210
WSPA	1420
WSPD	1340
WSSH	1410
WSUI	880
WSUN	620
WSVS	1370
WSW	1500
WSYB	1500
WSYR	570
WTAD	1440
WTAG	580
WTAM	1070
WTAQ	1330
WTAR	780
WTAW	1120
WTAX	1210
WTBO	1420
WTEL	1310
WTFI	1450
WTIC	1060
WTMJ	620
WTNT	1470
WTOC	1260
WWAE	1200
WWJ	920
WWL	850
WWNC	570
WWRL	1500
WWSW	1500
WWVA	1160
WXYZ	1240
KBGX	1310
KBTM	1200
KCRC	1370
KCRJ	1310
KDB	1500
KDFN	1210
KDKA	980
KDLR	1210
KDYL	1290
KECA	1430
KELW	780
KEX	1180
KFAB	770
KFAC	1300
KFBB	1280
KFBI	1050
KFBK	1310
KFBL	1370
KFDM	560
KFDY	550
KFEL	920
KFEQ	680
KFGQ	1310
KFH	1300
KFHA	1200
KFI	640
KFIO	1120
KFIU	1310
KFJZ	1420
KFJB	1200
KFJF	1480
KFJI	1370
KFJM	1370
KFJR	1300
KFJY	1310
KFJZ	1370
KFKA	880
KFKX	1020
KFKB	1050
KFKU	1220
KFLV	1410
KFLX	1370

Station	kc
KFMX	1250
KFNF	890
KFOR	1210
KFOX	1250
KFPL	1310
KFPM	1310
KFPW	1340
KFPY	1340
KFQD	1230
KFQU	1420
KFQW	1420
KFRC	610
KFRU	630
KFSD	600
KFSG	1120
KFUL	1290
KFUM	1270
KFUO	550
KFUP	1310
KFVD	1000
KFVS	1210
KFWB	950
KFWF	1200
KFWI	930
KFXD	1420
KFXF	920
KFXJ	1310
KFXM	1210
KFXR	1310
KFXY	1420
KFYO	1420
KFYR	550
KGA	1470
KGAR	1370
KGB	1330
KGBU	900
KGBX	1310
KGBZ	930
KGCA	1270
KGCI	1370
KGCR	1210
KGCU	1200
KGCX	1310
KGDA	1370
KGDE	1200
KGDM	1100
KGDY	1200
KGFF	1420
KGEK	1200
KGER	1360
KGEW	1200
KGEZ	1310
KGFE	1420
KGFG	1370
KGFI	1500
KGFI	1200
KGFK	1500
KGFL	1370
KGFW	1310
KGFX	580
KGGC	1420
KGGF	1010
KGGM	1230
KGHF	1320
KGHI	1200
KGHL	950
KGIQ	1320
KGIR	1360
KGIW	1420
KGIX	1420
KGIZ	1500
KGJF	890
KGKB	1500
KGKL	1370
KGKO	570
KGKX	1420
KGKY	1500
KGMB	1320
KGMD	1500
KGMP	1210
KGNF	1430
KGNO	1210
KGO	790
KGRS	1410
KGU	940
KGVO	1420
KGW	620
KGY	1200
KHJ	900
KHQ	590
KICK	1420
KID	1320
KIDO	1250
KIT	1310
KJBS	1070
KJR	970
KLCN	1290
KLLB	1200
KLMB	1200
KLO	1400
KLPM	1420
KLRA	1390

Station	kc
KLS	1440
KLX	880
KLZ	560
KMA	930
KMAC	1370
KMBC	950
KMCS	1120
KMED	1310
KMJ	1210
KMMJ	740
KMO	860
KMOX	1090
KMPC	710
KMTR	570
KNX	1050
KOA	830
KOAC	550
KOB	1180
KOCW	1400
KOH	1380
KOIL	1260
KOIN	940
KOL	1270
KOMO	920
KONO	1370
KOOS	1370
KORE	1420
KOY	1390
KPCB	650
KPJM	1500
KPO	680
KPOF	880
KPPC	1210
KPQ	1500
KPRC	920
*KPPS	1420
KPSN	1360
KPWF	1490
KQV	1380
KQW	1010
KRE	1370
KREG	1500
KRGV	1260
KRLD	1040
KRMD	1310
KROW	930
KRSC	1120
KSAC	580
KSAT	1240
KSCJ	1330
KSD	550
KSEI	900
KSL	1130
KSMR	1200
KSO	1380
KSOO	1110
KSTP	1460
KTAB	560
KTAP	1420
KTAR	620
KTAT	1240
KTBI	1300
KTBR	1300
KTBS	1450
KTHS	1040
KTLC	1310
KTM	780
KTNT	1170
KTRH	1120
KTSA	1290
KTSL	1310
KTSM	1310
KTW	1270
KUJ	1370
KUOA	1390
KUSD	890
KUT	1500
KVEP	1500
KVI	760
KVL	1370
KVOA	1260
KVOO	1140
KVOS	1200
KWCR	1310
KWEA	1210
KWG	1200
KWJJ	1060
KWK	1350
KWKC	1370
KWKH	850
KWLC	1270
KWSC	1220
KWWG	1260
*KXYZ	....
KXA	570
KXL	1420
KXO	1500
KXRO	1310
KXYZ	1420
KYA	1230
KYW	1020
KZM	1370

[The list of United States broadcasting stations by frequencies, with full details of call, owner, location, power and time-sharers, was published in the April 11th issue, and comprised nine full pages. Details of any of the U. S. stations listed above may be ascertained by reference to the frequency in the April 11th list. No more complete details ever were published than were in that most comprehensive register. The list of short wave stations of the world, by frequency, with waves given, was printed in the March 28th issue, giving the hours on the air for all time zones in the Western Hemisphere. Additions to the short-wave list appeared in the April 4th issue. Send 45c for the March 28th, April 4th and April 11th issues to Radio World, 145 West 45th Street, New York, N. Y., and the copies will be mailed to you promptly.]

MIDGET
POWER TRANSFORMER



KELFORD power transformer, No. 330, overall size only 5 x 3⅞" x 4" high, for supplying filament, heater, plate and bias voltages. Supplies 245 output, single or push-pull, as maximum voltage is 300 volts, 50 for negative bias, 250 for 245 tube plate. The windings are as follows:

On one side, high voltage (1-0-1), where (0) is connected to ground; 280 rectifier filament (F-C-F), where (C) is used for taking off the positive voltage ahead of a filter. Both these windings are center-tapped.

On the other side: top, 1½ volts @ 4 amperes, for four 226 tubes, or may be used for one 224 or 227 tube, affording 2 volts; second from top, 2½ volts, 8 amperes, for four 227 or 224 tubes; third from top, 1½ volts, 1½ amperes, for one 226 or pilot lamp; fourth from top, 6 volts @ 2 amperes, for connection to two 224 or 227 heaters in series, to afford 2 volts on each tube.

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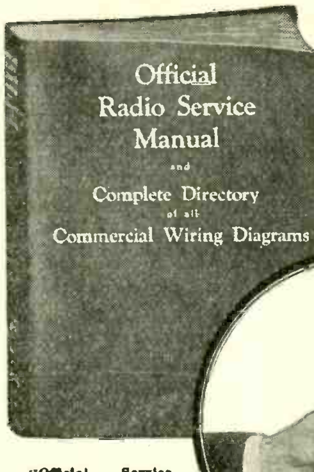

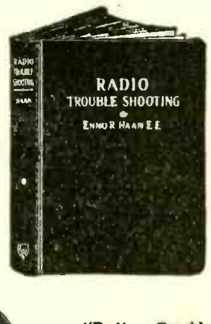

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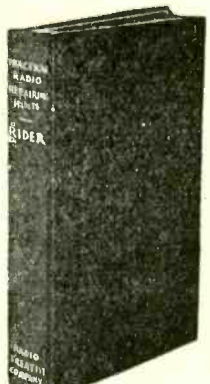

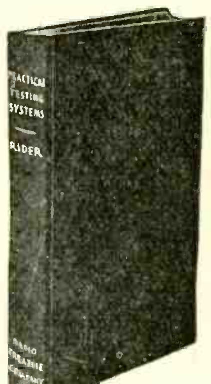

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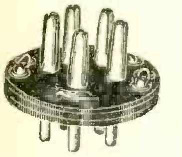

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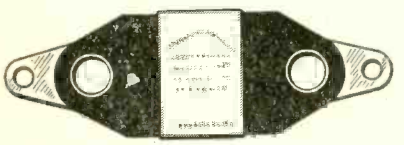

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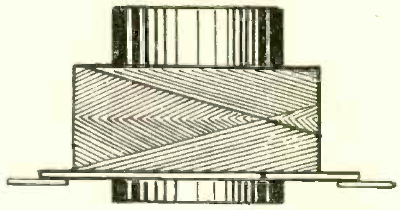

800-turn duolateral wound radio frequency choke, inductance 60 millihenrys, DC resistance 75 ohms. The distributed capacity is so low as to be negligible. The choke, therefore, may be used as plate circuit or grid circuit load, even in short-wave sets and converters, and will provide extremely high sensitivity with a low order of noise level, due to filtration by the choke. Suitable for antenna input (grid of first tube to ground) or for filtration of plate and screen grid circuits with condenser of 0.1 mfd. to ground (extra).

The choke is wound of green silk covered No. 38 wire on a pierced dowel, with bakelite base accommodating two riveted lugs. Contact is perfect. The dowel diameter is ½ inch, the hole through it (which may be used for mounting device) passes 10/32 screw. The extreme coil diameter is only ¾ inch. The distance between lug tips is 1¾ inches. The dowel protrudes ⅛ inch beyond the bottom to prevent shorting where mounting is done on a metal sub-panel. No particular polarity of connections need be observed.

Two of these chokes may be used with an isolating condenser of .00025 mfd. or higher capacity for radio frequency coupling in broadcast sets for amplification peaked broadly around 600 meters to make the total RF amplification more uniform and obviate the "rising characteristic" of tuned radio frequency amplification. 12 ma maximum current rating. Order Cat. CH-800 @.. 50c

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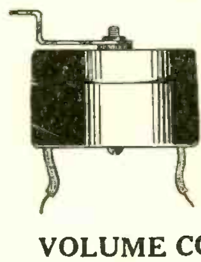

For detector circuit filtration, to choke the radio frequency, so it will not go through the audio channel, use a 50 millihenry copper-shielded RF choke. This is supplied with mounting bracket and two insulated wire leads. No particular polarity need be observed. This choke is wound of extra heavy wire, and its DC resistance will not show up on the usual type ohmmeters. Order Cat. SH-RFC (25 ma maximum current rating) @ 57c

VOLUME CONTROL TYPE

Where a receiver is to be built to incorporate automatic volume control, the shielded choke, consisting of two closely coupled separate windings, may be used. Connect one winding (yellow leads) from detector plate, to the audio input. Connect the two other leads (red and black) as follows: Black to the slider of a potentiometer (400 ohms up, without limit), red to the joined grid and plate leads of a 227 tube used as automatic volume control. Connect cathode of that tube to ground (B minus), and the grid returns of coils in controlled tube or tubes to arm of the potentiometer. Put 1 mfd. from arm to ground. Order Cat. DW-SHCH (maximum current rating, 25 ma) @ 67c

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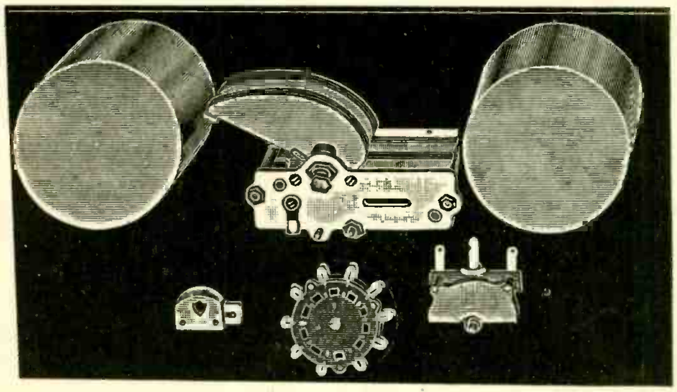
Single Switch Control of *All* Waves!

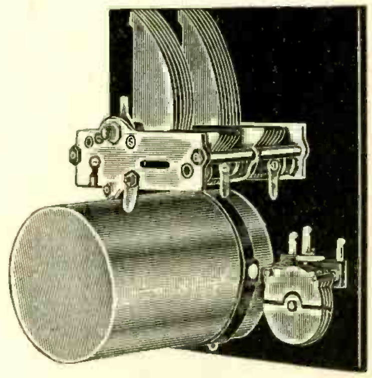
Supertone Foundation Units Apply This Convenience to Every Type of Circuit

RECEPTION of short waves, besides the reception of the regular broadcast band, is the newest rage in radio. Direct reception of European, Asiatic and other foreign stations on short waves provides a thrill all its own. Then broadcast band reception completes the service. The change from one band to another is made by single switch operation from the front panel of the Supertone All-Wave Foundation Units—*15 to 600 meters!* The frequency range of each band is engraved on the front panel, under the pointer knob of the band selector.



The double shield type of Foundation Unit (at left), illustrates Cat. AWTRF and Cat. AWSS.

Two coils are in one copper shield in the Foundation Unit illustrated at right, Cat. AWFU.



THE All-Wave Foundation Units are made in three different models, so as to be applicable to all types of circuits, whether a.c.-operated or battery-operated.

For the popular circuit comprising one stage of tuned radio frequency amplification and a sensitized detector, the double shield assembly is used (Cat. AWTRF).

For a converter to be used with a broadcast set, or for any circuit using the double detector system of reception, either a double shielded Foundation Unit is used (Cat. AWSS) or a single-shield model where two coils are inductively coupled in one copper shield.

The only difference for converters and for sets using the double detection method is that the double-shield model permits any type of external coupling between modulator and oscillator, while the single shield model requires that only the inductive self-coupling be used.

EACH Foundation Unit consists of two shielded coils (in one instance both coils are in one shield); a two-gang .00035 mfd. straight frequency line condenser matched to the coils so no switching is necessary to cover the broadcast band; a manual trimming condenser, a line switch, a wave band selector switch, a vernier dial, three knobs, and a front panel with wave band for each switch-point engraved in kilocycles. Each Foundation Unit is assembled and wired.

The front panel for the single shield assembly is 7½ x 12 inches, and that for the double shield assembly is 7 x 12 inches.

MODELS AND PRICES:

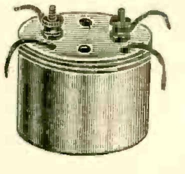
Independently aluminum shielded All-Wave Foundation Unit, for receivers using a stage of tuned radio frequency amplification and a sensitized tuned detector input; Cat. AWTRF, assembled and wired $15.00

Independently aluminum shielded All-Wave Foundation Unit, for converters or receivers using the double detection method of reception, where external coupling is to be used; Cat. AWSS, assembled and wired $15.00

Inductively self-coupled All-Wave Foundation Unit, single copper shield type, for converters or for receivers using the double detection method of reception; Cat. AWFU, assembled and wired............$13.50

(If volume control with line switch attached is desired in any of the above, add LS to the catalogue number and $1.25 to the price.)

175 KC BAND PASS FILTER TRANSFORMER



A DOUBLY TUNED fixed-frequency transformer, 1 to 1 ratio, tuned to 175 kilocycles, but adjustable from 100 to 190 kc., is another of Supertone's precision products. Two loosely coupled duolateral-wound high-inductive choke coils constitute primary and secondary, and afford a flat-top tuning characteristic, i.e., band pass filter. Suitable for all uses where high selectivity, without sideband cutting, is desired. The transformer may be mounted on the side of a chassis, in horizontal position, or upright either above or below the chassis top.

Tuning condensers are across primary and secondary, hoth accessible; in aluminum shield (which must be grounded) 2¼ inches diameter, 2½ inches high, with removable bottom. For screen grid tubes, Order Cat. FF-175, net price......$3.00

450 KC. TRANSFORMER

Same as above, except that frequency is 450 kc., adjustable from 400 to 550 kc. For screen grid tubes. Order Cat. FF-450. net price $3.00

OTHER FREQUENCIES

We can make intermediate frequency transformers to order for any frequency, utilizing our band pass filter circuit. State frequency and write for prices.

FULL BAND SPACE-WOUND COILS

SPACE-WOUND tuning coils for shielded circuits, designed with special care to insure identity of inductance and minimum distributed capacity, with assurance of covering the whole broadcast wave band, and more, with .0005 mfd.

With each coil is supplied a drawn aluminum finished shield, 3-inch diameter, 3½ inches high. Copper shield extra.

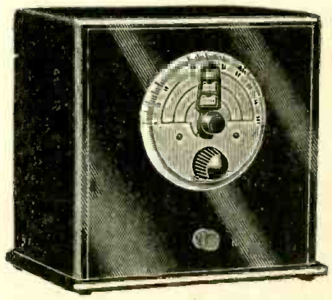
ANTENNA COIL for all circuits, also interstage coil where the primary is in the plate circuit of a general purpose tube. Order Cat. 15-85, net price........................$2.50

INTERSTAGE COIL, where primary is in the plate circuit of a screen grid tube. Order Cat. 25-85, net price......................$2.50

OSCILLATOR COIL, consisting of secondary, fixed tickler and small pickup coil winding, each winding wholly independent of the others. Order Cat. 8-30-85, net price...$2.75

COPPER SHIELD, bracket, Cat. CS-B @ $1.15
[Copper shield, 3" diam. x 4⅝" high, with bracket, substituted for aluminum shield above, extra 65c.]

BAND PASS FILTER SELECTIFIER



A BAND pass filter wave trap, two tuned circuits, in a 10-inch wide walnut finish cabinet, kills off interference, including neighboring station, and makes weak stations stronger. Cat. SEL @ $10.00

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