JULY 9

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RADIO WORLD

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America's First and Only National Radio Weekly

WHY

Do Radio Waves Leave Certain Spots Unvisited?

WHO

Says He Has a Sure-Fire Motor-boating Cure?

Navy Messages Sent In Facsimile

(Harris & Ewing)

PHILIP G. CRONAN, Chief Radioman, U. S. N., scanning a specimen of naval messages sent via the new radiophotogram machine. With this system it is possible to do away with a radio operator, since all messages are sent in facsimile. The equipment has been installed in the office of Naval Communications in Washington, D. C.

WHEN

Can Type A Tube Filaments Be Series Joined?

WHAT

is the Relation Between Radio and the Aurora?

WHAT

Constitutes Matching of Intermediate Frequency Transformers?

WHEN

is an RF Choke Coil Imperative?

WHO

Played Dirty Trick on KMTR, Spoiling Program?

WHICH

Type of Sounding Board Facilitates Reproduction of Low Notes?

WHERE

Are the Sets for the 16,000,000 Families Now Without Radio?

WHY

German Count Won't Sail without a Set.

Dancing Volume

But No Extra Tubes!

When you're dancing to radio music you often wish your set were just a bit louder. Compliments to partners, shuffle of feet, distance from the speaker all put on the set a demand for extra volume.

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1/4 Amp. Filaments in Series

How 350 ma ABC Power Supply is Worked

By Andrew E. Joliet

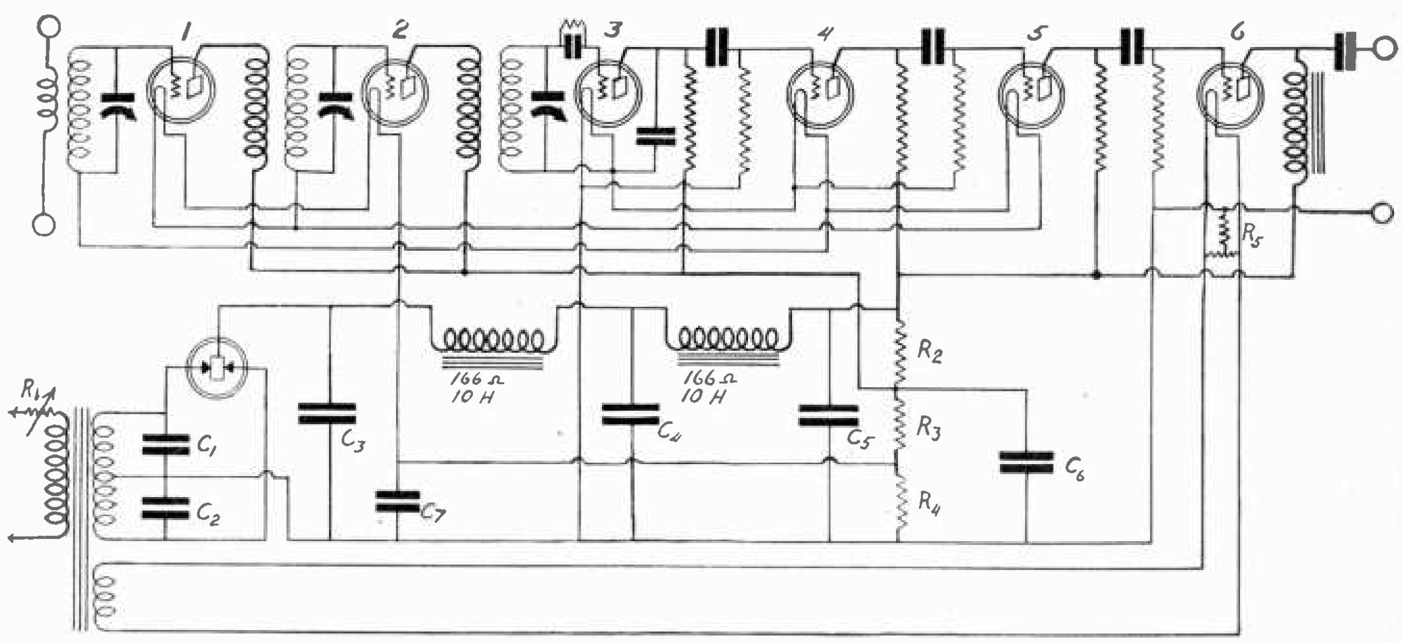


FIG. 1.

Complete circuit diagram of a six-tube receiver in which all the filament, plate and grid voltages are obtained from the output of a filter, except the filament of the final AF tube. Five of the filaments are connected in series and heated with rectified and filtered current while the sixth filament is heated directly by alternating current.

SINCE the advent of heavy duty rectifier tubes it has been possible to design and build practical receivers with type A tubes which operate entirely from the direct current obtained from the output of a rectifier-filter circuit. To make this operation satisfactory, however, it is necessary to connect the receiving tube filaments in series. This is done to keep the total current drawn from the rectifier as low as possible for a low current is easier to filter, and such operation is also more economical than parallel operation.

Many satisfactory schemes for electrifying a receiver in this manner can be worked out. Fig. 1 shows one arrangement in which the filaments of five type A tubes are connected in series and in which the filament of the 112 power tube is heated with alternating current. In this receiver all grid, plate and filament voltages are obtained from the rectifier.

The requirements of the rectifier and filter are that they be able to pass about 275 milliamperes continuously without heating up excessively. Rectifier tubes that will give as high as 350 or 400 milliamperes are available, as are 10 henry filter chokes of low resistance which will pass the required current.

Much Voltage Dropped

Since the output voltage of the filter is much higher than is required for the five filaments connected in series it is necessary to insert a resistance of suitable value in series with the line. This resistance can well be a part of the output potentiometer ordinarily used with eliminators. This output potentiometer is divided into three sections R2, R3 and R4.

The first two of these are used for dropping the filament current to suitable value. To determine the correct values to use it is necessary to know the regulation of the rectifier and the resistance of the filter chokes. Taking a typical case, the regulation was such that the voltage across the output of the filter was 157 volts when the current was 275 milliamperes. The voltage drop across the five filaments is 25 volts.

The difference between 157 and 25 must be the drop in resistances R2 and R3. The sum of these then must be 480 ohms. R4 is connected in shunt with the filaments and is used for regulation of voltages. It can be a variable resistance having a range of from 0 to 2,000 ohms. Under the assumptions made the resistance should be 1000 ohms when the circuit is adjusted properly.

Effect on Plate Voltage

The plate voltage for the last three tubes is taken off the whole output resistance, which gives a maximum of 157 volts. The effective plate voltage on the last tube is this amount less the grid bias, which is about 10.5 volts. The grid bias on this tube is obtained from the drop in resistance R5. The value of this can be determined from the facts that the current through it will be 7.9 milliamperes and the drop in it must be 10.5 volts. Ohm's law gives 1,330 ohms as the required value.

The plate voltages on the two resistance coupled tubes depend on the positions they occupy in the filament series. The applied voltage on the first resistance coupled tube is 157 less the 5 volt drop in the filament of the detector, or 152 volts. The voltage on the second is 157 less the drop in two filaments, or it is 147 volts.

The grid bias voltages on these two tubes is 5 volts, both obtained by connecting the grid return leads to the appropriate points on the filament series. That is, each grid return has been connected to one filament below its own.

As the grid bias is 5 volts and the plate voltage is only about 150 volts, it is obvious that very high mu tubes cannot be used in the amplifier. The high grid bias would reduce the plate current to zero for such tubes. But mu 8 tubes will work all right.

Needs Good Filter

The plate voltages on the detector and the radio frequency amplifier not only depend on the point to which the common plate return is connected but also on the positions of the tubes in the filament series. Suppose we wish to make the voltage drop across R3 and R4 equal to 75 volts. We know that the voltage drop across R4 is 25 volts. Therefore the drop in R3 must be 50 volts. The current flowing in R3 can be taken as 275 milliam-

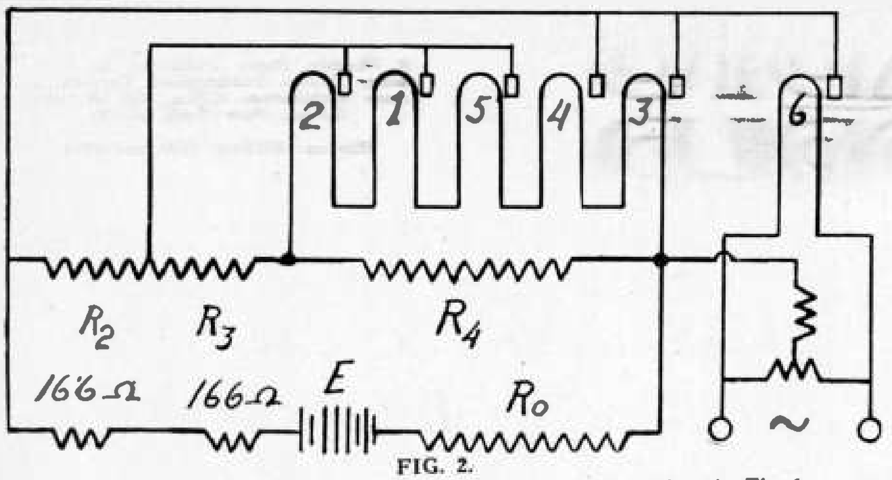


FIG. 2.

A simplified circuit showing the connections of the receiver in Fig. 1.

peres Hence the value of R3 must be 182 ohms. But the total resistance of R2 and R3 was found to be 480 ohms. Hence R2 should be 298 ohms.

When the resistances in the output potentiometer are thus proportioned the effective voltage on the plate of the detector will be 75 volts, the plate voltage on the first radio frequency tube will be 60 and that on the second radio frequency tube will be 55 volts.

The grid bias on the detector is of course plus 5 as usual. The grid bias on each of the two RF tubes is 5 volts, and it is obtained in the same manner that the bias for the audio tubes was obtained. The bias is a little high for the plate voltages used but not so high that the circuit will not operate effectively.

In a circuit of this type good filtering is necessary. In this case it is done with a number of large bypass condensers and two 10 henry choke coils. The coils are especially constructed to pass the current without heavy loss or much heating. It is for this reason that the resistances of the coil have been held as low as 166 ohms.

Thordarson and Acme Apparatus make such chokes, as well as the power transformer.

Large Condensers Used

Condensers C1 and C2 should be .1 mfd., Condensers C3 and C4 should be not less than 4 mfd. each. C5 should not be less than 8 mfd. C6 is connected across the plate supply for the RF tubes and the detector. While it is customary to specify a relatively small condenser here to take care of the radio frequency current only, it is better to use a large one, say 1 mfd. or more. Condenser C7 is connected across the five filaments and this also should be of a fairly large capacity in order to minimize the interstage coupling through the filament resistance.

A rheostat R1 is placed in the primary of the supply transformer to hold the output of the eliminator constant for varying voltages in the line. A twenty-ohm rheostat will do provided that it is of the heavy duty type.

The resistors in the output circuit of the eliminator-filter should preferably be wire-wound and they should also be of the heavy duty type. The power dissipation is these resistors, particularly in R2 and R3, is quite heavy. As a matter of fact the total power dissipation is about 23 watts.

The Tube's Resistance

The operation of an electrified receiver like the one discussed above can be more clearly understood from the simplified drawing shown in Fig. 2. The transformer and rectifier have been replaced by a battery E and the choke coils are only represented by their direct current resistances.

This figure shows the distribution of direct current among the plates and the filaments. The resistance Ro represents the internal resistance of the rectifier tube as measured from the output terminals. It is that resistance which determines the regulation of the rectifier. But the regulation of the rectifier and the filter depends also on the resistances in the two chokes. The smaller the resistances in the chokes and in the rectifier the better is the regulation. The numbers of the filaments in Fig. 2 correspond to the numbers of the tubes in Fig. 1. It is of course not necessary to maintain this order in the arrangement of the tubes. One suitable arrangement is (1, 2, 4, 5, 3), the detector being placed lowest in the scale so as to get a grid bias of at least 5 volts on all the amplifiers.

Since the voltage across the output terminals of the filter is supposed to be 157 volts, the maximum voltage recommended for 112 tubes, and since the choke coils will cause a considerable drop in the voltage, it is necessary to make the output voltage of the rectifier considerably higher. The total resistance of the two chokes is 332 ohms and the current through this resistance is 275 milliamperes. Hence the voltage drop in the filter will be 91 volts. Therefore if the output voltage is to be 157 volts the voltage across the output of the rectifier should be 248 volts.

19,350 Attend Show Of R. M. A. at Chicago

The Radio Manufacturers Association Convention and Trade Show, of June 13 to 17, at the Stevens Hotel, Chicago, according to figures furnished by the Hotel, drew a jobber and dealer attendance of 14,800, press attendance of 1,750, and an R. M. A. membership attendance of 2,800. The banquet held on June 16 was attended by 2,200.

Estimates by the hotel show that there was over $150,000 spent at the hotel and approximately $55,000 at other hotels. There was approximately $500,000 spent by those attending the Convention and Trade Show, including railroad fare, during the week.

Bigger Rectifier Tube Is a Poor Replacement

It is doubtful whether the average radio enthusiast fully appreciates the delicate balance existing between rectifier tube and power unit for satisfactory operation. Especially is this true with gaseous rectifiers, such as the Raytheon. Excessive hum, distortion, premature wear of rectifier tube or power unit, and even the breakdown of one or more of the components, are generally traced to lack of proper engineering in the first place, or to the use of rectifier tube and power unit which were never intended for use together.

The gaseous rectifier is designed for a given working voltage, supplied by the split secondary of the transformer. Excessive voltage will shorten the life of the tube, while insufficient voltage will fail to operate the tube at its proper capacity. The tube itself has a certain voltage drop, which controls the voltage delivered by the radio power unit.

Strain on the Filter

This voltage drop can be reduced by the tube manufacturer if desired, but while such procedure will result in a higher voltage output from the power unit, it will place an extra strain on the filter system, resulting in at least an increased hum, which may or may not be directly audible but which nevertheless has an influence on the tone quality of the set, or at worst a breakdown of the filter condensers now subjected to excessive wear and tear.

It is well to note that the filter condensers in the average commercial radio power unit are designed for a given service, with little allowance for severe overload. Furthermore, condenser specialists have found out through extensive laboratory and life tests that an overload of ten per cent. on the usual paper condenser reduces the life by at least 50 per cent., with an accelerated reduction of life beyond that point in geometrical progression.

Must Be Cohesive

Gaseous rectifier tubes must be designed for specific transformer, choke coils, filter condensers and resistance networks. There is nothing interchangeable about the arrangement. Satisfactory results—clean-cut filtering with an absolute minimum of hum, together with long and economical life—can be obtained only by engineering the rectifier and the associated components as one job. The commercial success of the gaseous rectifier tube, now found in the vast majority of radio B eliminators, is due to the fact that the promoters of this type fully appreciated the delicate balance involved and approved of the use of their tube only with radio power units that met certain rigid specifications. Only in this manner, then, has it been possible to insure the desired results.

If the radio enthusiast is anxious to obtain higher voltage for his radio receiver and power amplifier, the safe and sane solution is to replace the existing radio power unit with one of higher power.

A Poor Expedient

The expedient of replacing the usual rectifier tube with one of higher voltage output is bound to cause dissatisfaction and even to jeopardize the filter condensers, leading to costly repairs.

Replacements of rectifier tubes should be of the same type as the original tubes, in order to maintain the original engineering that entered into the production of a satisfactory radio power unit.

The Vitrohm A Supply

For Use Where D C Line is 220 to 240 Volts

By Frank Logan

THE fact that 220-240 volts of direct current may be reduced to form a stable, quiet source of A current for any radio set is often puzzling to experimenters. However, if several factors which are well known to all of us are taken into consideration, it will be seen easily how this is done.

First we have a constant source of current. The potential of this current is 220-240 volt. If we place a resistor with an ammeter in series across this line, we will find that a definite current will be indicated by the ammeter and that the amount of flow through the ammeter will be determined by the resistance across the line.

This fact is in accordance with Ohm's law. Ohm's law says that:
E (Volts)=I (Current) × R (Resistance)

Two Known, Other Found

That is, if two of the factors are known, the other can be found. In this case, it indicates that a change in resistance will result in a change in current as the voltage (input) is a constant.

As the filaments of vacuum tubes possess a definite amount of resistance, and as they draw at their normal operating temperatures a definite amount of current, it is perfectly possible to place a resistance in series with them which will reduce the voltage on the filament terminals to 4 for 99s or 6 for —01 As, etc. The only thing we need know to do this is the total amount of current consumed by the tube filaments.

However, there is a disadvantage in using a straight series resistance to obtain the voltage drop essential for the production of the current voltage across the tube filaments, that is, minor fluctuations in the line voltage will be considerably exaggerated in the voltage across the filament terminals of the tubes.

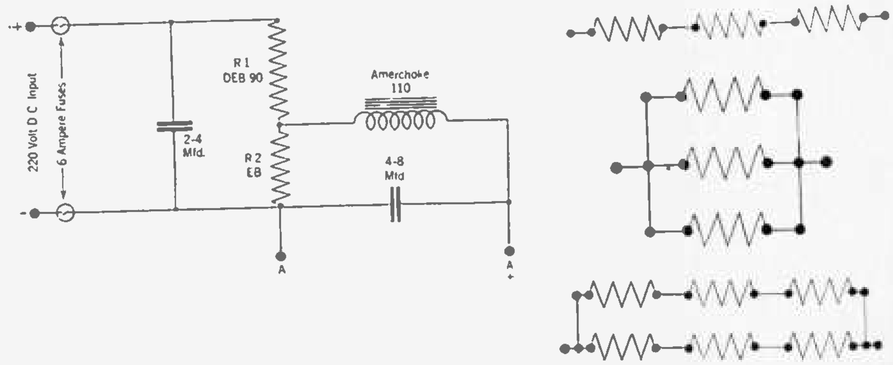
Use of Limiting Resistor

To eliminate this, a second resistance of comparatively low value is placed in shunt with the filament terminals of the tubes. The purpose of this shunt resistance is to act as a ballast. It will be seen that a voltage surge on the line which would normally force an excessive amount of current through the tube filaments would, with a ballast resistor in the circuit, divide the current between tube filaments and the shunt resistor in proportion to their resistance.

The same effect will be noted if a tube is accidentally removed from a socket while the current is on and the ballast is in the circuit. In removing a tube from the socket the comparative resistance of the filament circuit is increased, while a resistance of the shunt or ballast resistor remains constant. Therefore, the amount of current flowing through the ballast resistor will be increased, and the load on the filament line reduced, thus preventing burnouts of tubes.

Use Filter and Fuses

In practice it is necessary to have more than resistance in the eliminator circuit. Fuses must be added for protection of both the house circuits and radio set. Inductance and capacity must be added to smooth out the ripples and disturbances always found on commercial direct current lines. Glancing at the circuit diagram of the eliminator, it will be noted that there is a 2 or 4 mfd. condenser directly across the line. This condenser takes out the major disturbances found in all service lines.



(Ward Leonard)

The Vitrohm 220-volt direct current A supply unit is shown in diagrammatic form at left (Fig. 1). At right are shown series connected resistors (Fig. 2, top), parallel connection (Fig. 3, center) and series-parellel (Fig. 4, lower right.)

After that come resistors which reduce the voltage to the value noted for the operation of the radio set. The first of these resistances, marked RI consists of Vitrohm DEB 90 resistors. The second resistance, R2, which is the shunt or ballast resistor, consists of a Vitrohm EB resistor. The value of this resistor changes with the current drain of the resistor.

Use of the Amerchoke

The choke indicated in the positive leg of the filament supply is an Amerchoke 110. This is a special current carrying choke with a capacity up to 3 amperes. Do not use ordinary audio frequency chokes on this point, because they will not pass the amount of current necessary for the operation of the tube filaments. The shunt condenser across the filament supply should have a value of from 4 to 8 mfds. It is this condenser which smooths the filament supply to a point where no noise will be heard when the eliminator is used.

The table gives the values and arrangement of the various resistors in the circuit:

Filament Amperes	No. R1 Type	R2
0.18 to 0.36	*2 DEB90	EB3.5
0.75	*2 DEB90	EB12.5
1.00	**4 DEB90	EB4.25
1.25	**4 DEB90	EB5.
1.50	**4DEB90	EB6.
1.75	**4 DEB90	EB8.5
2.00	***6 DEB90	EB3.5
2.25	***6 DEB90	EB4.25
2.50	***6 DEB90	EB5

Note: *Units connected in series.
**Units connected in series-parallel.
***Units connected two sets of three in parallel.

Rules to Observe

The statement that the resistors DEB90 are to be placed in series or parallel or series parallel need not cause worry. Fig. 2 shows resistors in series. Fig. 3 shows resistors in parallel, Fig. 4, resistors in series parallel.

There are a few precautions to take in the operation of the 220-volt A eliminator. Therefore it is essential that these four simple safety measures be followed:

1—Never remove tubes from the socket while the eliminator is in service.
2—Condensers of .5 mfd. or larger value should be placed in series with both the ground and antenna circuits.
3—Do not place the eliminator in confined locations such as console cabinets, closets, etcetera. The resistors dissipate a considerable amount of energy and get hot. This heat should be allowed to escape into the open air.
4—Do not make changes in the set or eliminator while the current is on. 220 volts will often give a severe shock.

LIST OF PARTS

Two 6 ampere fuses.

One 2 to 4 mfd. condenser with an operating voltage of 250.

One 4 to 8 mfd. condenser with an operating voltage of 100.

One EB resistor as specified in table.

One Amerchoke 110.

Baseboard, solder, wire, switch.

DEB 90 resistors as required.

One Wave, One Station, One Boss in Latvia

Broadcasting in Latvia is a state monopoly, the American Commercial Attache at Riga, C. J. Mayer, has reported in a statement just made public by the Department of Commerce. The statement follows:

"Radio broadcasting is a State monopoly in Latvia and no private company can get a concession for the opening and operating of a broadcasting station.

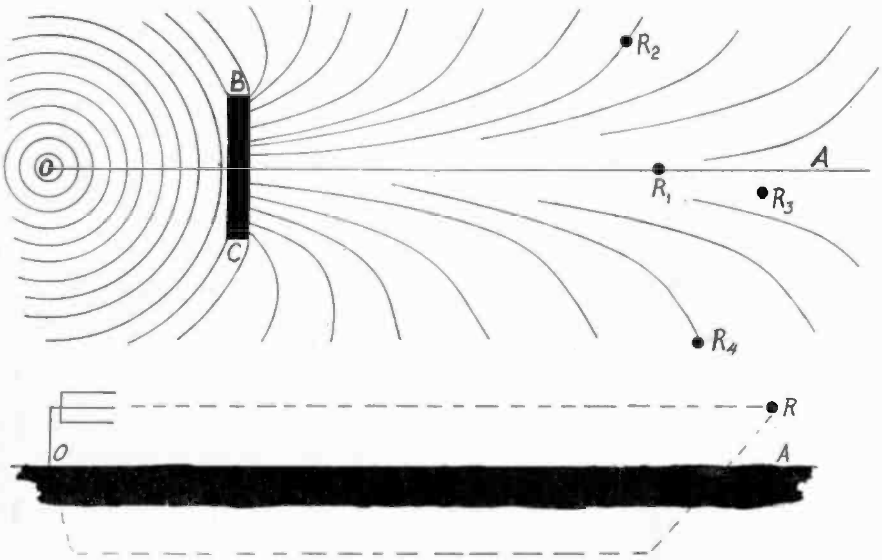
"Latvia also has been allotted only one wavelength, 526 meters, thus not permitting the operation of more than one broadcasting station in that country.

"The State-owned broadcasting station is operated without any special law except the general radio law on the establishment and operation of radio stations in Latvia."

Waves Scientifically Fickle

Leave Some Areas in Shadowland of Silence

By Dudlo Emerson



FIGS. 1 AND 2

(Upper) The manner in which the signals from one station can be received from two different directions when an opaque body of large dimensions intervenes between the transmitter and receiver. O is a broadcasting station sending out waves equally in all directions, that is, so that the wave front is always a circle. The wave hits the opaque body BC. The wave is partly reflected, partly absorbed. Behind the body in the direction A is a shadow. On the sides of the body the waves pass on, but bend around and gradually fill in the shadow. Waves coming in from the two directions overlap, and therefore interfere. Along the line OA the distance to any point as R1 is the same whether it goes via OBR1 or OCR1. Hence along this line there is constructive interference and signals are loud. Above the OA line the distance to any point as R2 is shorter via OBR2 than via OCR2. Below the line the reverse holds. If distance from O to R3 via OBR3 is greater than OCR3 by an odd number of half wavelengths there is destructive interference at R3 and no signals are received. If the distances differ by a whole number of wavelengths there is constructive interference.

(Lower) About the same effect can occur if part of the wave could reach a distant point R by the air route and another part via a good transmission layer below ground, supposing that the surface layer, shown in black, is impenetrable. The dashed line shows the two possible routes. There would be constructive or destructive interference at R if the effective distances differed by a whole number of wavelengths or by an odd number of half wavelengths. Of course, the so-called impenetrable layer would have to be relatively so, or the wave could neither get down below it nor up above it again. One distance does not have to be geometrically greater than the other. They can be equal geometrically and yet differ electrically.

IT is well known that reception of radio in certain localities is irregular and unsatisfactory. Thus in Westchester County (N. Y.) and the southern end of New England the reception of New York City stations is uncertain and often accompanied by distortion. Why this particular locality should be so ill-favored in this respect was at first a mystery. But now the phenomenon is well understood due to the pioneering research work of the engineers of the Bell Laboratories.

The work showed that the irregular and distorted reception encountered in that locality was due to the radio waves from New York City, particularly from station WEAF, arriving to points in that section by two paths. There were two causes which contributed to the double reception. One was the absorption of the radio energy by the steel skyscrapers in the midsection of Manhattan and the other was the peculiar lay of the watercourses. The steel structures lay directly in the path of the waves starting for Westchester and Southern New England and through a radio shadow on that part of the country. The only radio energy that could reach points located in the umbra of the skyscrapers reached there by the indirect routes of the two water courses, one the Hudson river and the other the East river and Long Island Sound.

Depression in the Middle

These two watercourses guided the waves and helped to maintain a high energy level in the wave. Thus there was an energy depression in the middle and two high ridges on either side. Energy naturally flowed into the depression from either side. Thus at any point inside the shadow energy was received from two different directions but from the same source. This fact accounts for the irregular reception, but it does not directly account for the distortion of the signals received.

Those who are familiar with wave motion in general readily understand why this condition would cause irregular reception. For those who have not made a study of wave motion it is well to make an explanation. Suppose we consider the motion of a transverse wave, such as a water wave. At some given point the motion is up. At another point situated either half a wavelength behind or ahead of the first point the motion is down. The motions at the two points are in opposite phase. If by some means we could combine the effects of the two motions at the same point, the result would be no motion at all at that point.

Suppose now that we consider two points situated exactly one wavelength apart. The motions at these two points are in the same direction and the intensity the same. If by some means we could combine the effects of the motions at the two points at a single point, the motion at that point would be twice that at either point. That is, the two would reinforce.

Effects of Combination

At any two points in the wave separated by a whole number of wavelengths the motion will be the same in intensity and direction, and at any two points separated by a whole number of wavelengths, plus or minus a half wavelength, the motion will be the same in intensity but in opposite directions. If by any means the effects of the motions at two points separated a whole number of wavelengths could be combined at one point the effect would be to double the intensity of the motion; and if by any means the effects of the motions at two points located at a whole number of wavelengths plus or minus a half length apart could be combined at one point the motion at that point would be zero.

When we have two identical waves we have a means of combining the effects of the two at a single point either so as to double the intensity at every point or to neutralize it at every point. But it is difficult to maintain two independent waves so that they will be identical in wavelength or frequency. Unless they come from the same source they cannot be maintained in any one adjustment because one will be faster than the other. In that case the effect at any one point will be a gradual waxing and waning between zero intensity and twice the intensity of either. This is akin to fading in radio.

Now suppose that we have a single source of wave motion and we divide the wave into two equal parts by some obstacle and send these parts by separate routes to a given point beyond the obstacle. If the distances between the source and the receiving point by the two routes are exactly equal, the two waves will combine at the point and the effect will be the sum of the two separate halves.

Constructive Interference

Similarly, if the distances along the two routes differ by a whole number of wavelengths, the two halves will combine and the effect at the point will be the sum of the two halves. This is called constructive interference in wave motion.

Suppose the two paths differ by half a wavelength. The effect at the receiving point of one wave will exactly neutralize the effect of the other. Similarly if the two paths differ in length by a whole number of wavelengths plus or minus a half a wavelength, the two will neutralize each other. This is called destructive interference in wave motion.

If then the two paths between the sending and receiving points differ by a whole number of wavelengths there will be constructive interference and a loud signal will be received, but if the paths differ by an odd number of half wavelengths there will be destructive interference at the receiver and no signal will be received. If the intensities of the waves along the two paths are not equal, the points of destructive interference will not experience zero intensity of signal but a minimum, which will be lower, the more nearly equal are the intensities of the two components.

Violent Variations in Small Area

It is apparent that different points in the field of interference between the two component waves will have different degrees of interference. Thus at one point there may be constructive interference with very strong signals, and but a block away may be destructive interference with minimum signal strength or with no signal at all. That is the condition of reception in Westchester and in the southern end of New England as far as WEAF is concerned. There exist violent variations in signal intensity within a comparatively small area.

But if that were the whole story it would not be so bad. Most receivers would get fairly good signals provided the sensitivity of each were adjusted to the signal level at the point where it is located. Some points would be dead, but very few. The main difficulty as far as intensity is concerned is that the distances by the two routes do not remain the same. Any one of the two components does not always follow the same course, and consequently the path difference between the two varies from time to time.

This variation may be due to a geographical change in route or to a change in the medium. Atmospheric conditions will change the effective distances. This will cause the intensity of received signal at any point to vary from time to time. A given point may be located in a dead spot one instant and a minute or a second later it may be located at a point of constructive interference. The received signal will fluctuate, and the sensitivity of the receiver would have to be changed continuously. This fluctuation might be so slow that reception at a given point would be good one day and poor the next.

Alteration of Transmitted Signal

The distortion of the quality of the received signal follows indirectly from the interference of the two components in the wave. Any modulated wave consists of at least three separate waves, the carrier wave and the two side frequency waves. Each of these has a different wavelength. Consequently the points of destructive and constructive interference of the three waves will not coincide. The receivers set might be at a point of destructive interference for one of the side bands and at a point of constructive interference for the other side and at a neutral point with respect to the carrier. One of the side bands would then not be effective in producing an audible response in the receiver and the other would be too vigorous in relation to the carrier. The received signal would not be like the transmitted.

Again the receiver might be located so that with respect to the carrier it was at a point of destructive interference and with respect to the side bands it was at a point of constructive interference. With the carrier absent the side bands would not be intelligible. The case would not be much more favorable if the carrier were very weak in comparison with either or both of the sidebands.

Some Late, Some Early

If the paths taken by the two parts of the wave differ very much for the two sidebands, one of these would arrive at the receiver ahead or behind the other. This would give rise to an unintelligible medley of sound. Just how much of this time difference between the two sidebands can be tolerated is difficult to say, but it seems probable that only a small time difference would suffice to introduce noticeable distortion. Fortunately the time difference cannot be very great when the distance between the transmitter and receiver is small.

The fact that the effective path length between transmitter and receiver depends on frequency or wavelength and the fact that interference between parts of a wave arriving by two paths depends on path difference account for both irregular reception and for distorted signals.

It might be interesting to consider some of the factors which will cause a change in the effective distance between two points. Two important factors are atmospheric conditions and the nature of the terrain over which the waves travel. Both affect the velocity of propagation of the wave.

It is a basic law of wave motion that the velocity of the wave is equal to the wavelength multiplied by the frequency. The frequency of the wave remains constant, or at least if a change occurs it is equal for both parts of the wave. It is affected by the conditions of the medium. But the velocity of the wave depends directly on the nature of the medium, and therefore the wavelength also depends on the medium. Hence the type of interference between the two parts of a wave at any point depends on the medium through which the parts travel.

The density of the air enters into the nature of the medium, and this varies with the temperatures, humidity and solid content. These also depend on the terrain. Over water they have one value, over dry land another, and over verdant land still another. And they never remain constant, in time or in space. Their effect on the velocity of radio waves is small but enough to produce undesirable effects on both quality and reliability of reception.

It is quite probable that the ground wave has something to do with the two-path phenomena discussed above, and by ground wave is here meant that part of the transmitted radio wave which actually enters the ground.

Neither the soil nor the water is by any means a perfect conductor or reflector, and a goodly portion of the transmitted energy is traveling below the surface. This is slower than that part which travels in the air. It is quite conceivable that the top layer of soil would act as a shield or obstruction and that a lower layer is a better medium of propagation. In such cases the transmitted wave would be traveling by two paths, one of which would be effectively much greater than the other. Considerable path difference between the transmitter and the receiver would result, and interference phenomena of considerable intensity would follow.

SHORT WAVES HELP RUN TRAINS

(Wide World)

A FREIGHT TRAIN engineer communicating with a brakeman in the caboose, over a mile away, with the aid of a specially constructed short wave transmitter and receiver, the development of the General Electric Company. Train movements along the line, as well as in the yards, are expedited with this system.

Danish Schools Plan Teaching By Radio

A development of importance in Danish radio during April was the appointment of a committee by the Danish Department of Education as a result of a proposal by the official Radio Control Board, to negotiate and arrange for the installation of radio equipment in Danish schools, according to advices from Vice Consul Ellis A. Johnson, Copenhagen, Denmark, made public by the Department of Commerce.

It is intended that radio instruction will be made part of the daily school routine.

Hungarian Import License Is Removed

The Hungarian Government has recently removed the license requirement in the importation of radio apparatus, the Department of Commerce announced on the basis of a report from the office of the commercial attache at Vienna.

The announcement set forth:

"A recent order of the Hungarian Ministry of Commerce permits the importation of both receiving and sending apparatus without an import license."

Trade is expected to be stimulated.

The Matching of Transformers

For Use In Super-Heterodyne Intermediate

By Major Robert Embolt

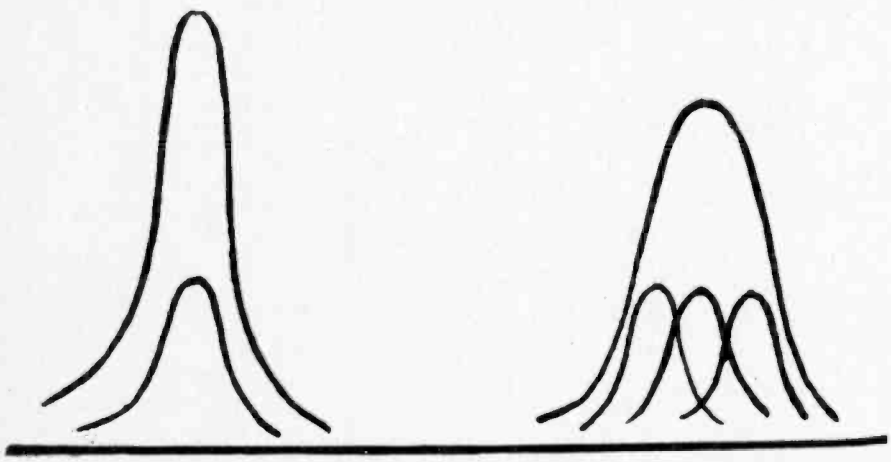


FIG. 1.

This illustrates the effect of sharp, accurate tuning and approximate tuning. The small curve, at left, represents the transmission of a single intermediate transformer. The large curve at left represents the transmission of three such transformers accurately tuned. The amplification is assumed. At right are shown three transmission curves of as many transformers which have not been adjusted to the same frequency. The large curves show the effect of the three combined, amplification between them being assumed.

The subject of matching of the intermediate frequency transformers in Super-Heterodynes to the tubes with which they are to be used is worrying many radio enthusiasts. Just what is this matching of transformers and tubes which the radio fan thinks so important?

What can matching mean? It may be that the transformers are tuned accurately to some intermediate frequency when used with a particularly type of tube. Or it may be that the impedance of the primaries of the transformers have been adjusted for optimum transfer of energy from the tube to the transformer. Or again it may be that the transformers have been adjusted to give the highest possible voltage step-up. There is no way of knowing what such a term as "matched" may mean when applied to transformers and tubes. But the term sounds very important!

The first possible meaning of matching mentioned above was that the transformers were accurately peaked at the same frequency when used with a given type of tube. It is quite necessary so to adjust the transformers that the peaks coincide, otherwise the intermediate frequency amplifier will be broad and inefficient. But the individual peaks of the transformers must not be too sharp nor must the composite peak be too sharp, or the high and middle frequencies will be suppressed and nothing will be reproduced by the Super-Heterodyne but the notes of the tuba and the bass viol.

Won't Be Too Sharp

It is not likely, however, that the peaks of commercial transformers, even if they have been matched, will be so sharp and so closely placed that the selectivity will be greatly excessive. The transformers may have been matched to some standard transformer in the factory in a given setting. When a set of these transformers is paced in a receiver the coils are not necessarily matched, for their peaks may no longer coincide. Tubes of the same types have different capacities between the electrodes. Similarly the sockets have different capacities between their terminals and leads. Also the tubes will be placed different with respect to other objects in the set. All these things tend to affect the peaks will diverge more or less.

The results of this divergence are decreased selectivity, decreased amplification, improved quality, and a decided gain in the stability of the amplifier. The divergence ordinarily will be very slight. In fact in many cases these small divergences from true matching make the Super-Heterodyne function so satisfactorily. Extremely close matching is not desirable, particularly if there is self-regeneration in the intermediate amplifier and if the selectivity of each individual tuned circuit is very high.

The Primary Considered

Now it may be that "matching" the transformers may mean that the primaries have been adjusted to have the same impedance as the plate circuit of the tube to which it is connected. It is a very simple manner to figure out just what the inductance of the primary should be to match the plate impedance of a given tube at any desired frequency, but it is extremely difficult to make an intermediate transformer which complies with the requirements.

If by matching is meant that the transformers are adjusted so that the voltage step-up per stage is the greatest possible, the case is not different from the preceding. To have greatest voltage step-up per stage the inductance of the primary must be very large compared with the plate resistance of the tube, and the ratio of the transformer should be large. Both are limited by the capacities of the leads and wiring, and much more so than the adjustment for maximum transfer of energy from tube to primary.

There is one way in which the primary impedance of the transformer can be made equal to the load resistance of the tube, and that is by making the primary a parallel tuned circuit by connecting a suitable condenser across the winding. This is critical and often leads to excessive selectivity as well as to a loss in the amplification as compared with untuned primary and chance tuning in the secondary.

Esquimo in Igloo to Talk To American Listeners

Boston.

WBZ-WBZA will put an Eskimo concert on the air direct from the Arctic this Summer, if plans of Captain Donald B. MacMillan materialize. Before starting on his sixth dash to the Polar regions the famous explorer equipped his flagship, the Bowdoin, with a short wave transmitter.

With this equipment, Captain MacMillan hopes to have some of his Eskimo friends sing from their igloos to the radio listeners in America. WBZ-WBZA would pick up the short wave signals and rebroadcast them on a 900 kilocycle wave.

Discussing the arrangements for radio communication between his Arctic party and relatives and friends in the States, Captain MacMillan declared the Eskimo concert would be an entirely new venture of great interest to thousands of listeners, he said.

The expedition is known as the Rawson-MacMillan-Field Museum Expedition and will pursue scientific studies of Arctic plants and animal life.

WBZ-WBZA have arranged a schedule of exclusive transmission to keep the party, frozen in close to the magnetic pole, in weekly contact with the United States. They will be given every Saturday evening.

Dry Batteries Intact After 25,000-ft. Drop

Just how durable is a radio dry battery? Capt. Hawthorne C. Gray, of the U. S. Army Air Corps, satisfied himself on this point recently when he broke all previous world altitude records for free balloon flights in reaching a height of 42,470 feet at Scott Field Air Depot, Belleville, Ill.

At a height of approximately 25,000 feet the radio B batteries and dry cells, with which his balloon was equipped, were hurled overboard in a specially made parachute. They were recovered uninjured and returned by parcel post to Capt. Gray without packing, in the condition verified by photographs.

Capt. Gray, in a letter to National Carbon Company, makers of the Eveready batteries so ignominously treated, writes:

"The same set of batteries was used in my altitude flight of March 9 and is still in condition to be used again. The B batteries tested 21 volts each, and A batteries tested 23 amps."

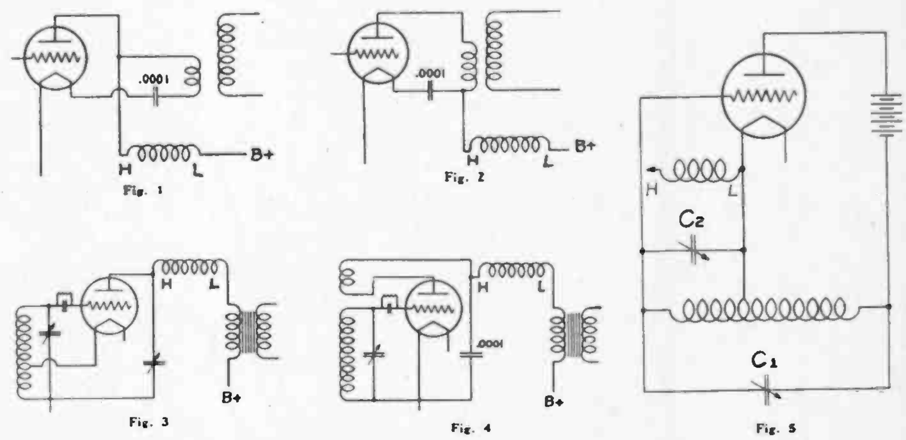
The Design of a RF Choke Coil

3,000 Turns of No. 34 Enamel Used on Spool

By Horatio W. Lamson
Engineering Department, General Radio Co.

THE amount of radio frequency amplification which can be employed successfully in the design of a broadcast receiver is very largely limited by the regenerative or feedback tendency of such an amplifier. If the arrangement of the circuits is such that there exists even a small amount of inductive, capacitive or resistance coupling between the first and succeeding stages a certain portion of the energy from the last tube may be fed back onto the grids of the previous tubes, giving rise to the phenomenon of regeneration.

A limited amount of regeneration is beneficial, as it effectively reduces the resistance losses of the inter-tube coupling elements. It is well known, however, that an excess of regeneration will cause the whole amplifier system to go into a state of sustained oscillation, which is fatal to its proper operation.



THE radio frequency choke coil is shown in the plate circuit of an RF tube in Figs. 1 and 2, which are equivalent circuits, and in a regenerative detector tube plate circuit, Figs. 3 and 4. The oscillator used for testing the choke coil is Fig. 5.

The Neutrodyne Principle

This tendency towards self-oscillation may be combated in a number of ways, one of the most important being the so-called process of "neutralization," whereby a certain amount of energy is fed backward through the amplifier but with a reversal of phase so that it tends to oppose the natural regeneration of the circuits. This is the principle employed in the popular Neutrodyne receivers.

Excessive regeneration may also be prevented to a certain extent by shielding the individual stages, by controlling the grid bias of the amplifier tubes, or by the deliberate insertion of resistance into the individual tube circuits.

Another method of accomplishing the same result consists of more effectively separating the radio frequency circuits of the tubes from one another. The plate circuits of these tubes are almost invariably fed from the same B battery.

Reduces Stray Coupling

This battery has necessarily a certain amount of resistance, depending upon its form and condition, which, being common to the plate circuits of the tubes, affords a source of resistance coupling between them if the radio frequency currents are allowed to pass through this battery.

When, however, the individual plate circuits are supplied with radio frequency chokes, which prevent the radio frequency currents from traversing the common B battery, this resistance coupling with its regenerative tendencies can be reduced considerably.

Some of the methods for accomplishing these results are shown. The radio frequency choke (HL) consists of a small inductance coil which has a very large impedance at radio frequencies so that it effectively blocks the passage of radio frequency currents.

Use in RF Plate

At the same time, its resistance to the steady emission current of the tube is low, so that only little B battery voltage is wasted across it, while its impedance at audio frequencies is sufficiently small to offer no appreciable hindance to voice frequency currents.

Fig. 1 shows the use of such a choke in the plate circuit of a radio frequency amplifier tube. On account of the choke the high frequency currents in the plate circuit are forced to pass through the primary of the RF transformer and thence through the condenser directly back to the filament of the tube, while the emission current of the tube passes through the choke to the B battery. The condenser, which offers no great impedance to the radio frequency is, of course, necessary to prevent the B battery from short circuiting to the filament.

Fig. 2 shows essentially the same circuit, except that here the emission current passes through the primary of the transformer.

In a Regenerative Set

Fig. 3 illustrates how the choke may be placed in the circuit of a regenerative detector to keep the radio frequency currents out of the audio amplifier and the B battery. The emission current of the tube, together with the rectified audio frequency currents, pass readily through the choke to the primary of the audio frequency transformer. Regeneration of the detector is, in this case, controlled by the variable by-pass condenser in the plate circuit.

Fig. 4 likewise shows the use of the choke in the plate circuit of a detector of the familiar tickler coil type.

Many other uses of a radio frequency chokes will suggest themselves to the experimenter.

Careful Construction

The construction of a successful radio frequency choke consists of more than merely winding a coil to a sufficient inductance so that it will offer an effective barrier to radio frequency currents. The coil must also be wound in such a manner that its distributed capacity will be very low, else the capacity between the two end portions of the windings may be sufficient to pass the radio frequency currents around the inductive impedance and defeat the whole purpose of the choke.

The General Radio laboratories have recently developed a radio frequency choke which, in order to reduce this capacity to a negligible amount, is wound in three sections on a small wooden bobbin. After the coil is wound the bobbin is then sealed into a moulded bakelite case and the coil extremities brought out to two terminal posts (H and L). The winding sections are respectively 1/16, 1/8 and 1/16 inch in width.

(H) is High RF Potentiality

The end of the winding in the smallest section is brought to the terminal marked (H), and this terminal should be connected to the "high potential" or radio freuency side of the circuits as indicated on the diagrams. The other terminal may be regarded as (L).

In order to find the best relation between inductance and distributed capacity a number of identical bobbins were wound with different sizes of wire and tested for distributed capacity in the following manner: An oscillator circuit of the Hartley type was set up as shown in Fig. 5. A small calibrated micro-condenser C2 of 8 mmfd. capacity was connected between the grid and filament. This had a slight effect upon the tuning of the oscillator circuit.

Working the Oscillator

The oscillator was first accurately tuned to a given wavelength with the condenser C1 by adjusting for zero heterodyne beats against a separate crystal-controlled oscillator not shown. The choke under test was then connected between the grid and filament in parallel with C2. If now the choke coil had an effective positive capacity at the frequency in question it would, of course, raise the wavelength of the oscillator slightly.

The oscillator would then be returned to the original wavelength by reducing the variable condenser C2 by an amount equal to the effective capacity of the radio frequency choke. From the calibration of C2 the capacity of the choke could thus be measured directly. On certain occasions it was found that the circuit could be returned only by increasing the value of C2 after the choke was added, indicating that the choke had a negative capacity effect.

Results Listed

The results of these tests at various wavelengths are shown in the following table which lists the effective capacity in micro-microfarads of several samples at different wavelengths.

(*Concluded on page* 15)

Now the Baron Has Cure for Motorboating

Boston.

Few expensive radio receivers are in use in Germany, declared Manfred Baron von Ardenne, of Berlin, who visited the Harvard and other scientific laboratories in the East for the interchange of views with leading research engineers. He said:

"The rich do not listen to broadcasting, so there is no call for de luxe equipment. The economic situation is such that the average person can afford only cheap or moderately priced sets—and the main reliance is still upon crystal receivers."

The Baron is accompanied on his tour by Edward Dietze, who is a student at the University of Hamburg and although only 18 years of age is scientific adviser to the North German Radio League.

Unusual RC Constants

Mr. Dietze describes Baron von Ardenne's work as follows:

"Baron von Ardenne's first invention was that of a new resistance-capacity-coupling unit used in conjunction with special tubes of high mu factors. Anode resistances are in contrast to the more conventional methods employed up to now, of much higher value, about 3 megohms. By the use of such high anode resistances together with special high mu tubes amplification has been brought up to 25 to 30 per stage.

"Quality with this coupling method is better than with the best transformer coupling, since grid condenser and leak are also dimensioned on new lines, enabling a practically uniform frequency response to be obtained.

"Eliminates Motorboating"

"Coupling capacities are smaller than those usually employed and the grid leaks are of correspondingly higher value.

"It is of the greatest importance in this connection that Baron von Ardenne has devised a new battery eliminator for use with these higher anode [plate] resistance amplification stages which entirely eliminates motorboating and at the same time allows frequencies as low as ten cycles to be amplified without noticeable cutoff."

Mr. Dietze explained somewhat the method of detection that the 20-year-old Baron has invented:

"This method of anode bend [plate characteristic] detection is entirely different from and much more sensitive than the conventional method of anode bend detection which works on a curved portion of the valve characteristic. The Baron's method works on the steep and straight part of the characteristic and is of greatest importance for measuring purposes in tube voltmeters which can be calibrated with low frequency in order to measure radio frequency potentials. The detrimental stray capacity of this tube voltmeter is of much lower value than that of other similar meters in use up to now."

Working on Neutralizer

At present the Baron is engaged in evolving a device of effectively stabilizing radio frequency amplifiers at all frequencies, regardless of the tuning range of the set and thus to eliminate all the disadvantages still pertaining to the Hazeltine and similar methods of neutralization.

The Baron's new and very simple method of measuring grid currents will be of some interest to American fans. The amplification factor of the tube is here used to raise the sensitivity of the grid current meter to 10,000 times the original degree. By this means it has become possible to measure tenths of a microampere in the grid circuit by means of an ordinary milliammeter contained in the plate circuit. These devices are now incorporated in the leading sets being built in Germany.

Vacuum Tube Meter

The Baron has developed theories and formulas for the optimum dimensions of last-stage power tubes. Said Mr Deitze:

"For the first time in the history of radio research exact dynamic formulas have been evolved for the distortion reproduction of all audio frequencies. The choice of the amplification factor of the power tubes has also been exactly defined for any given working condition. The exact formula giving the amount of anode [plate] potential together with the optimum grid potential necessary to obtain maximum distortionless output from a given valve to a given loudspeaker has also been recently evolved."

High Leakage Condensers Called "Usually Better"

There appears to be much misunderstanding regarding the leakage factor in paper condensers. Some engineers, quite as well as laymen, are under the impression that high leakage spells a poor condenser. Yet careful laboratory tests conducted by the Dubilier Research Laboratories clearly indicate that the leakage factor is not a basis for passing on the goodness or poorness of a paper condenser. In fact, quite contrary to what might be expected, high leakage usually indicates a better condenser—that is to say one that will last longer and withstand higher breakdown voltage.

Thus in the case of Dubilier paper condensers, according to Harry F. Houck, chief engineer of the Dubilier Condenser Corporation, the leakage actually runs higher than that set forth in the N. E. M. A. Standards for Radio Apparatus. Yet laboratory tests on a large number of condensers of various leakage values have proved that condensers with a low leakage, or high resistance, break down sooner than those with higher leakage and therefore lower resistance.

Leakage depends on the temperature at which the condenser is operating. The higher the temperature, the greater the leakage. For this reason the N. E. M. A. Radio Standards specify the temperature at which the leakage of paper condensers shall be measured.

All of which means that leakage is a factor that must be included in the calculations for condenser design. The condenser specialist must know just how much leakage is permissible, consistent with the greatest efficiency, longest life, and ample safety factor.

NEARS TOP O' WORLD

EDWARD MANLEY, radio operator of Putnam-Baffin Island Expedition, testing out his transmitting apparatus.

Putnam Takes Sets To Magnetic North

When the schooner "Morrissey," in charge of Captain "Bob" Bartlett, Peary's skipper of his North Pole days, comes abreast of West Baffin Island with the members of the Putnam-Baffin Island Expedition aboard, it will mark the nearest that radio has ever been taken to the Magnetic Pole.

The Putnam-Baffin Island Expedition, headed by George Palmer Putnam, left New York on June 11 for West Baffin Island, a region unvisited by white men since its discovery by Luke Fox in 1631. Sponsored by a number of scientific societies, the expedition is equipped for a thorough survey of the geographical, oceanographic and anthropological aspects of the rugged North country.

Radio scientists are especially interested in the outcome of radio experiments so near the actual center of the earth's magnetic force. Radio operations and experimental work are in charge of Edward Manley, of Marietta, Ohio. The Morrissey's radio equipment includes a generator-powered transmitter, a battery-powered transmitter with the UX852 tube (shown at top of wooden shelf), two specially built radio receivers, one short wave, one long wave, and a portable battery transmitter. Equipment includes 37 dry batteries, all Eveready, which can be used for portable purposes.

Through Mr. Manley's transmitters, the expedition expects to be in constant touch with civilization throughout its travels, which will include search for a giant ice cap, and for traces of the Blonde Eskimos which were reported to have been seen in Baffin Island three centuries ago by Nicholas Tunes.

Himmer Tours Europe

Vitalis Himmer, head of the Vitalitone Radio Corp., 88 University Place, New York City, is making a combined pleasure and business tour of Europe. He took his wife and his automobile with him. Mr. Himmer, designer and manufacturer of the Vitalitone ship model speaker, will visit leading radio concerns in Germany, Austria, Italy, France and England. He took a movie camera with him and will bring back films of factories in operation.

Relationship Is Traced Between Aurora and Set

Montreal.

"Does the aurora borealis, when in visible display, interfere with radio reception?" A. R. McEwan, Director of the Radio, Canadian National Railways, was asked. Mr. McEwan's department has unusual opportunities for observing the manifestations of the Northern Lights, and the effect of that phenomenon on reception.

During a period of three years logs have been prepared daily by operators in charge of receiving sets on trains, an average of 120 such reports being filed each week dealing with reception conditions across Canada from the Atlantic to the Pacific, this material being obtained from the performance of sets installed on the principal trains of the Canadian National System.

Out of his own personal experience amplified by the observations contained in the train radio logs Mr. McEwan answered the question by saying:

Aurora Is Blamed

"Periodic cycles of poor radio conditions have occurred recently and no doubt the aurora display has been given a share of the blame by owners of radio receiving sets.

"Canada, being closer to the magnetic pole than most countries, offers greater opportunity for the study of this effect on radio transmission. These Northern Lights are believed to be due to clouds of electrons shot off from the sun, causing ionization in the rare upper atmosphere. The aurora is generally accompanied by large disturbing currents on the earth's surface effecting land telegraph lines and ocean cables which use the earth as a return path. These wandering currents appear to be of low frequency and therefore would not directly effect radio reception, unlike the case of static.

"There is on record at the headquarters of the Radio Department of the Canadian National Railways a letter from the Federal Government agent at Fort Smith, situated on the Athabasca at the northern boundary of Alberta and Northwest Territory, to the effect that on more than one occasion he had splendid reception at that point from CNRA (Moncton, N. B.), CNRO (Ottawa, Ont.), and other stations in Canada and the United States during periods when the aurora was particularly brilliant.

MacMillan Ought to Know

"This testimony, coming from a point where there are no local disturbances or interference, is of some interest in the general discussion regarding the effect of such phenomena on broadcasting and the reception at distant places.

"One man who should know the effect of the Northern Lights on radio is Donald MacMillan, who passed night after night under the aurora display during his previous trip to the Arctic and reported that it had no effect on static.

"Referring again to cycles of poor radio reception, the theory has been advanced that abnormally large disturbances on the sun have been accompanied by violent expulsions of tremendous clouds of electrons. In order to understand how radio channels may be affected when these extra electrons are shot off from the sun, we must first take into consideration the theory devised by the late Oliver Heaviside. This theory assumes that should a person ascend through the earth's atmosphere he would eventually reach a point at which the atmospheric pressure is so slight that the gas becomes a good conductor of electricity, hence a good reflector of radio waves.

"Thus we can consider the earth as being surrounded by a reflecting medium. Near the earth is mere, which is a conductor during the daytime, and an insulator during the night, because during the daytime the sun's rays ionize the air.

Relationship Traced

"The reflecting medium can then be considerable downward or as being nearer the earth's surface during the daytime than it is at night, for after the sun sets de-ionization occurs in all the lower atmosphere and there is left the upper layer, or shell, surrounding the earth. Heaviside then assumed that radio waves glide along the inside of this shell for great distances with very little loss. The irregularities of reception are accounted for by the changes in the Heaviside layer. Changes in signal strength at a given point are accounted for in this way.

"Probably the best indication we have of the existence of this so-called Heaviside layer is the aurora borealis display. This display as observed by the individual may be merely an indication that the Heaviside layer, or electron-charged atmosphere, a hundred or more miles above the earth's surface really exists. At any rate, whether the aurora borealis appears or not, the electrical condition of the Heaviside layer seems to affect the transmission of radio frequency waves."

The conclusions to be drawn from the foregoing are that while the aurora cannot be said to actually affect radio transmission and reception, at the same time this phenomenon is at times the visible sign of other causes which do affect radio, and, therefore, there is a certain relation between them.

Air Waves Spur Crops, Bullard Tells College

Speaking before the seniors and members of the college staff, at the 101st commencement exercises of Trinity College, Admiral William H. Bullard, chairman of the Federal Radio Board, said that radio had a remarkable effect on the raising of large crops and even cited some examples.

He stated that when he was in charge of the Navy's high-powered station at Arlington, he made this remarkable discovery. So as to beautify the grounds underneath the antennas, some barley was planted. To the surprise of all, the crop grew to such a height that a full-grown man could walk through it unseen.

"This apparent freak of nature," Admiral Bullard continued, "was undoubtedly caused by the energy released from the waves, due to the vibrations between the high antennae and the ground below.

"As a side light to radio communication with its attendant dissipation of electric energy radiated from many powerful transmitters through the numerous antennae comes the remarkable fact that plant life subjected to the bombardment of these electric waves shows extremely rapid growth."

SHE REAPS THE FRUIT

J. DALE STENTZ, director of the radio department of the Asheville, N. C., Chamber of Commerce, and Celeste Nesbitt, who won a two weeks' vacation in Asheville for having written the best description of the first broadcast from WWNC, the new station at Asheville.

Schwab Ready to Try Vision Business, Too

That radio vision will be worked out as a practical commercial proposition within the next few years, is the opinion of E. H. Schwab, chairman of the board of directors of the Splitdorf Radio Corporation and brother of Charles Schwab of steel fame.

"Radio audition has now reached the point," said Mr. Schwab, "where it is possible to reproduce with fidelity the spoken word and music and even that industry is yet in its infancy. With firms of broad vision coming strongly into the field at this time, backed by unquestioned financial resources and placing the merchandising of radio on a sounder basis, it may be truthfully said that what we now know as radio is hitting its stride. That we believe the auditory side of wireless is in itself a gigantic undertaking well under way toward unheard of possibilities is revealed by the comprehensive plants made by such firms as Splitdorf.

"And when the other phase of radio—that of vision—enters the commercial phase, then will be born another of the world's great industries if one wishes to consider the two as separate entities. As a matter of fact it is quite likely that the outstanding firms engaged in the one will take an active and leading part in the other. Speaking for myself, my interest will be as keen in the newer development as it now is in the building of broadcast receivers for present-day radio reception."

TEAM GOES INTO VAUDEVILLE

Los Angeles.

Badger & Mueseler, novelty team, who have sung a great deal over KNX, are on a vaudeville tour. They have been in Texas recently. Radio fans will be pleased to hear that the team will be heading back this way within a few more months.

AMBASSADOR FEATURES

The Ambassador Sales Co., 108 Greenwich Street, New York City, is featuring its Baby Coils, Cone Saver (choke coil and condenser speaker output) and Tone Gates.

16,000,000, Homes Minus Sets, Caldwell Laments

By Orestes H. Caldwell

Federal Radio Commissioner

Sixty-day licenses have been issued to stations up to Aguust 15, and the operation of the new allocation will be carefully watched in the light of actual experience during this period, so that necessary changes can be made where interference is experienced. Such actual experience is necessary in view of the irregular and unpredictable transmission in different directions which almost every station sends out.

If the ordinary station's radiation went out equally in all directions, making the station's interference area a big circle, the task of fitting stations together without interference at minimum distances would be simple. But as every listener knows, some stations are unaccountably heard for many miles in one or more directions, while being shut off by natural "barriers" in other directioins.

Experience Will Tell

Advantage must be taken of all these curious unpredictable phenomena, and adjustments made, before the new station set-up will be really working at its best. Here only actual experience, and not engineering theory, can be the guide. The Commission is, therefore, likely to continue issuing only short-term licenses of 60 to 90-day duration on through the Winter months, in order to test out the transmission conditions during the cold-weather period of greatest radio effectiveness, before any long term licenses are granted.

Meanwhile, I can promise you greatly improved radio conditions for the coming radio season, with the Fall of 1927, just as thousands of appreciative listeners have already written in to the Commission and explained that since May 1 they have again been able to use their radio sets with satisfaction and pleasure, so I can assure you even further improvement and good radio reception for the indoor season ahead.

The Commission is thus bringing good radio reception conditions to 6,000,000 families with radio sets. We believe we are performing the task assigned us by Congress, and getting it done conscientiously, fairly and with all possible dispatch that concentrated energy and long hours can accomplish.

But as against the 6,000,000 families already supplied with radio sets whom the Commission can benefit, there are 16,000,000 homes in America today without radio sets. What about them? Who will bring the blessings of good radio to them?

There, as I see it, is the far bigger job that faces you, the radio manufacturers, jobbers and dealers of the country—the job of putting adequate radio service into every one of America's 22,000,000 homes! For what will it avail the American public to have good broadcast programs and clear undisturbed reception if only a small fraction of our citizens actually have radio sets in their homes as at present?

So far, only a bare start has been made on this huge task of equipping the great American family with radio, for to date we have fitted up only 6,000,000 homes with radios, out of the 22,000,000 homes on the continent—a saturation of barely 25 per cent. Yet the people of the United States have 18,000,000 automobiles, 16,000,000 wired homes, 16,000,000 telephones, and 11,000,000 phonographs and only 6,000,000 radios.

We are now selling radio sets at the rate of only 1,750,000 a year, half of this number probably going to replacements, so that the net gain is actually only a million or less sets a year. At this rate, it will take more than 14 years just to saturate the present market. This is too slow. We must find new methods and new energies to apply to the distribution of radios, if the selling job is to be finished before the present generation becomes old men.

Plea for Best Sets

And we must equip the public with better radio sets, encouraging each purchaser to make a really adequate investment in this, the world's most marvelous merchandise. In a home where furniture, rugs, pictures and draperies are items running into three and four figures, is there any justification for economizing on a radio set at $50 to $90?

If the average radio listener wants to take full advantage of the wonderful programs which are now nightly pervading his vicinity he should in his own interest invest in the best radio set he can afford. For the radio impulses, as they come in over the air, are today of splendid tone value, and far better than the reproduction limits of the average receiving set.

That's worth thinking about.

Caldwell Is Satisfied

After listening in at home in Bronxville, N. Y., to the stations in and about New York for the first time since the reallocation of waves, Orestes H. Caldwell, Federal Radio Commissioner, said that he was satisfied with the changes.

"After making a careful and systematic survey in New York, I certainly feel very much gratified with the clear reception obtained and the well separated condition of the stations," Mr. Caldwell continued. "My observations in this district check with the reports received from other listeners, and also coincide with the reports that the commission has received from other sections of the country.

"Another obstacle that must be overcome is the poor carrying power of the waves in Summer as compared with exceptional Winter conditions.

"All these antics of the transmitted signals must be tested under actual operation throughout certain seasons.

"Some listeners do not understand that the recent wave reallocation in the United States was necessary, perhaps because they have not been able to get a good mental picture of the haphazard system of the past and compare it with the orderly arrangement of waves now in effect."

Many commented on the improvement.

BALTIMORE BAND

THE MUNICIPAL BAND OF BALT heard regularly from WBAL every Frida band, one of the largest south of the Mas Summer when Frederick R. Huber, direc proved to be so popular that when the S September the City of Baltimore, through special broadcasting fund to enable this concerts. Nelson C. Kratz, well known this

Other Statio Squeal Stifl

Washington.

The Federal Radio Commission has ordered an investigation to determine, if possible, the station responsible for the alleged "deliberate and malicious interference" with KMTR, Hollywood, Calif., on the evening of June 20 following an advertised talk over the air by C. C. Julian.

The effect of the interference, the Commission stated, was to ruin the address scheduled to have been made over that station and to bar thousands of listeners from receiving it. The inquiry followed numerous protests against the alleged malicious interference. The announcement:

"On Monday night, June 20, Radio Broadcasting Station KMTR, Hollywood, Calif., advertised a talk over the air by C. C. Julian, who has been represented to be from several sources, the owner of the station. The records in possession of the Federal Radio Commission do not bear this statement out that Mr. C. C. Julian is the owner of the station, but that is a matter not concerned with the present issue.

"It appears that the moment after Mr. Julian was announced over the air by Station KMTR, immediately a powerful carrier wave was introduced on the air from some unknown source which had the effect of causing severe heterodyne interference which extended the entire length of the Pacific Coast as far North as Canada. The effect of this interference was to ruin the address scheduled to be made over that station and thousands of listeners were thereby barred from receiving it.

"Immediately the following morning, the Federal Radio Commission received

AGAIN AT WBAL

MORE has returned to the air and is now y night from 9 to 10 o'clock E. S. T. This on and Dixon Line, first went on the air last or of WBAL, obtained it as a feature. It ummer outdoor musical season was over last its Board of Estimates, voted to establish a musical organization to continue its radio musical leader of this city, is conductor of band.

's Malicious es Broadcast

a telegram from the KMTR Radio Corporation operating station KMTR, stating these facts and asked that steps be taken to locate such interference.

"Following this telegram many other telegrams arrived from individual sources giving in effect the same information and asking for an investigation. The Commission acted immediately and caused a telegram to be sent to the Radio Inspector on the West Coast, asking that a thorough investigation be made of this reported deliberate and malicious interference to discover if possible the station responsible for the offense, and asking that the Commission be furnished a copy of his report.

"At this time it should be noted that this action was taken on the 22nd of June, one day afer the first protest was received, which came in the late afternoon of June 21. Since this telegram was sent, the Radio Commission has been deluged with mail from private individuals of all kinds in the neighborhood of Los Angeles and Hollywood and other places in California, protesting against this so-called malicious interference and asking that steps be taken to have an investigation made.

"At this time, according to many of the letters, suspicion is attached to one particular station in the neighborhood of Los Angeles, but a telegram from that station was received before any of the numerous letters arrived denying such an interference and stating that that station requested an immediate and thorough investigation and welcomed an opportunity to show that it was not responsible for this interference, also offering all assistance possbile to the Radio Inspector."

Large Sounding Board Facilitates Low Notes

By Sidney Stack

A perfect loudspeaker will radiate the same amount of energy in a given time at all frequencies in the audible scale, or it will radiate the same power no matter at what frequency it is operated. Any speaker consists of a driver element and a sound radiating surface.

Sound energy is dependent on two things, the amplitude of the sound wave and the frequency. It is proportional to the product of the two. Thus if the amplitude of the sound wave is A and the frequency of the sound is F, the energy in the wave is proportional to AF. The power is the energy radiated in a unit of time, or it is the time rate of energy radiation at any instant if the rate is not constant.

It is apparent that if the power is to be constant for all frequencies, the amplitude of the wave must be inversely proportional to the frequency.

Large Amplitude for Low Notes

Thus the amplitude of low frequency sounds must be large and the amplitude of high frequency sound can be small. Therefore one condition for reproducing low frequency sounds is that the amplitude of the sounding board or sound radiating surface be large. This requires that the driving unit be so constructed that the armature be free to swing over a wide amplitude without striking the field pole pieces. The lack of this freedom is one of the most frequent causes of failure of speakers to reproduce the low tones.

Driver elements are usually made to be as sensitive as possible with given strength of field magnet. This requires that the space between the armature and the pole pieces be very small, so small that the armature cannot swing widely without striking.

Such speakers will work very well on the high frequencies but will develop a rattle at the low, provided that the input to the driver element on the low notes is adequate. The amplitude of the input current and voltage must also be larger on the low notes than on the high to keep the power constant, and this is quite a problem.

Armature Must Swing Free

Supposing that the input to the driver is correct for all frequencies and that the design of the driver element is such that the armature can swing freely for all inputs, how does the size of the sounding board affect the distribution of the sound radiated? A small radiating surface usually cannot swing widely for mechanical reasons. Hence such a surface cannot radiate the low notes well. But even if the amplitude at the low notes is great enough, a small radiating surface will not bring out the low notes as well as the high.

The small radiating surface kicks up an air disturbance of sufficient amplitude very close to the surface, but the intensity of the sound decreases much more rapidly with distance than it does when the sounding board is of large dimensions.

This effect can be illustrated with a speaking tube. In such a tube the sound energy impressed at one end does not spread out at all but is confined in one dimension. Hence at a very long distance away the intensity of the sound is almost as great as it was at the beginning. The only diminution is due to friction and to reflection at bends of the tube. In open air the sound varies inversely as the distance away from the source, assuming the source is a point.

A small sounding board can be regarded as a point a short distance away, but a large sounding board cannot be so regarded at the same distance away. It is necessary to go much farther away. Hence when the sounding board is very large there is not the same rate of diminution of amplitude of the sound as distance increases as with a small sounding board.

No Mystery in Battery

Storage batteries of the lead-acid type are still mysterious devices to many fans. Why the battery man always insists upon emphatically stating that acid should never be added, or that pure water should only be used, or that the hydrometer is a good means of testing the condition of the battery, the radio user often cannot understand. Certain chemical action taking place within the battery is the cause for the statements.

In the average battery there are three hard rubber or glass cells, containing lead plates and diluted acid. There are a number of positive and negative plates in each cell. The more plates, the larger the cell and the longer the life of that cell will be, before it is necessary to recharge it. The positive plates are composed of lead peroxide. This is what is known as the active material. Then we have the negative plate, made up of spongy porous or metallic lead. This latter plate is gray in appearance, while the peroxide plate is reddish brown. When the plates have this color and chemical form, they are in a charged condition.

Now when a conductor is connected between the terminals current flows from the positive to the negative post outside the battery. The lead peroxide of the positive plate and the active material of the negative plate is changed to lead sulphate . This covers the surface. As the pores of the plates become clogged up, current ceases to flow, the battery becoming totally discharged. It is then necessary to reverse the action with the aid of a charger, so as to clear the plates of the sulphate. The charger drives the acid off the plates, allowing the pores to open up and the acid to circulate freely.

All that happens to the acid, during the charging is that it is returned to its full strength. It can be seen that no acid is lost and consequently none should be added. The acid does not evaporate, either. The only way it is lost is by actually spilling it or allowing it to leak out. The water with which the acid has been diluted does evaporate and therefore the water is the only necessary addition. In most cases a 20% solution of acid is used. The water which must be added must be the purest possible, e.g., distilled. Never use tap water.

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Fan In Uruguay Brings In KGO Well

H. Molfino, of Calle Gaboto, Uruguay, is one of the lucky DX fans to have logged KGO, Oakland, California, according to a letter just received by the General Electric station.

"I would inform you that I have heard station KGO on several occasions," he writes. "The day I heard it best was on March 8 with strong signal strength and high modulation, but somewhat troubled with static. I have been using one stage radio frequency amplification, detector and one stage of audio, with headphones. I have heard your station since, but with less signal strength."

ZENITH WONT CONTEST LAW

The Zenith Radio Corporation, of Chicago, has denied that it intends to contest the constitutionality of the radio law. Dissatisfied with its assignment of 263 meters, it appealed to the Radio Commission and lost. The company's lawyer, in telling the Commission he thought the law unconstitutional, was voicing only personal legal views, said Paul B. Klugh, vice-president and general manager of Zenith, adding that the company is a defender of the law.

KEEP this copy. It has the list of stations. See page 16.

Triumph of the *Short Wave*

How Set Presented to the Skeptical Count Von Luckner of Sea Adler Fame for Use on His Yacht, Got Him and Vessel Out of Trouble

San Francisco.

Few incidents lately have done more to demonstrate the value of the radio amateur and his short wave apparatus than the visit to this country of Count Von Luckner, commander of the famous German war-raider Sea Adler, who is touring the world in his yacht Vaterland.

When the Count and his yacht arrived at New York from Germany, several New York amateurs went aboard to see the radio equipment which was being carried. They were rather startled at finding only the usual 600-meter ship installation and urged the radio operator and the ship's captain to install a low-power, short wave outfit in addition to the bigger set, pointing out that the chances of covering long distances under adverse conditions were much better with the short wave apparatus.

The captain, however, thought little of short waves. It was intimated, too, that the party was in this country to make money and not to spend it, and that there were no funds available for the purchase of short wave instruments.

The Count Gets a Present

However, so convinced were the New York amateurs of the value of their type of apparatus that one of their number, George Freisinger, 2ABT, donated a complete 50-watt transmitter and short wave receiver, while another, William Irwin, 2CUQ, saw to their proper installation on the boart and instructed the operator in their use.

During the cross-country lecture tour of the Count, the Vaterland, with Countess Luckner aboard, made its way south to the Panama Canal. During this time the short wave apparatus found increasing use for radio traffic, due to the inability of the long wave set to pierce the curtain of static which was encountered. Many contacts were established with amateur stations in the eastern and central parts of the United States, and a large number of messages handled that it would otherwise have been impossible to transmit.

The trip up the West Coast, however, furnished the real test of the amateur set. Shortly after leaving the Panama Canal the Vaterland encountered heavy gales, which drove her steadily southwest off her course.

For two weeks the 600-meter set was worked in a vain attempt to get communication with land. Finally, the short wave set was resorted to. Communication was immediately established with amateurs in California, chief of whom were Clair Foster, 6HM, of Carmel, and Horace Wilbert, 6RW, of this city. On learning of the Vaterland's plight, these amateurs at once arranged a series of daily schedules for relaying news to the Count, who was becoming worried at the long silence from the ship.

Within a day after the ship established amateur communication with shore, one of the engines on the Vaterland broke down completely. Orders for spare parts, which could be obtained only in Germany, were immediately dispatched via 6HM, who put them on the cables for Germany.

For the next three weeks, the short wave outfit comprised the sole means of communication between the Vaterland and shore. During this time dozens of messages were handled between the Count and the ship's party, as well as orders for spare parts and supplies.

Tug Brings Oil

Following the storm which drove her far off her course, the Vaterland ran into a series of head winds, greatly impeding progress, and had it not been for the short wave contact, great anxiety for the party would have been felt. To make matters worse, the fuel and lubricating oil supply became low, it being necessary to use olive oil and oleomargarine for lubricating purposes. Amateur contact was again used to order a tug to meet the Vaterland at sea with several barrels of oil.

All the way up the coast to this city, the 600-meter set remained out of operation, while an increasing number of schedules was maintained with the amateurs of California. It was only when the vessel arrived within a short distance of the port that the large set could be put to use.

On the boat's arrival at San Francisco, the entire ship's party was high in praise of the short wave outfit and the skill and cooperation of the California amateurs who made the contact possible.

The Count and Countess Luckner personally met and thanked the men for their work, while the radio operator vowed never to put to sea again without short wave apparatus. In view of the circumstances, one amateur has donated to the Count's party the best receiver available, while others are giving their services to the refinement of the transmitter. Amateur contact will be maintained during the boat's trip up the coast to Seattle, and thereafter as the party proceeds across the Pacific.

The Count is "sold" on short waves.

Check Put on a Station Going Up Without Permit

Washington.

Organizations planning to erect radio stations must first comply with the requirement of the Radio Law of 1927 that a permit be obtained before actually beginning construction of such stations.

Notice to this effect was given by O. H. Caldwell, Federal Radio Commissioner in a letter to J. R. Vance of the Fellowship Forum of Washington, D. C., whose organization, Mr. Caldwell stated, he had learned indirectly, is constructing a radio station.

"This letter is simply to call your attention to the Radio Law of 1927, which requires that a permit be obtained from the Radio Commission before construction of a station is commenced.

"For your convenience, application for a new station is inclosed herewith. At the present time, however, the Commission has on file some 300 applications for new stations for which it is unable to find wavelengths. I can, therefore, give you very little encouragement looking toward a wavelength on which to operate in the near future."

An answer is awaited.

U. S. Leads in Practice, Germany in Theory

By Manfred Von Ardenne

[Baron von Ardenne, authority on audio frequency amplification, inventor of many radio devices, author of standard technical books, is in the United States on his first visit. He is 20 years old.]

Organization of broadcasting in Germany is such that most listeners have not the choice of different programs as in the United States.

That condition is to be remedied in the near future by the erection of a mammoth station working with 100 kilowatts of power in the antenna, using a wavelength of 1,250 meters at Zeesen, which is about 20 miles from Berlin.

This station will commence working at the beginning of next year and ought to be picked up across the Atlantic.

Will Choose the Best

The new station will relay every night the best program running in Germany, from whichever city it is being given, and will thus be the first station of its kind in the world.

My arrival in New York was simultaneous to the readjustment of the American wavelength situation. This is of special interest to me because such a policy of readjustment became necessary in Europe sometime ago on account of the heterodyning taking place between the large number of different stations of various countries.

By international agreement the broadcast band was divided into 99 different wavelengths, each separated by 10 kilocycles. Of these 99 wavelengths the greater number were allocated to the more important stations of every country in proportion to the number of licensed broadcast listeners in each country.

Strict Enforcement

A smaller number of wavelengths is divided among the smaller and less important relay stations, approximately half a dozen of which operate on each of these common wavelengths.

The strict enforcement of this scheme has eliminated mutual interference of stations in Europe, all the more since the technical development of exact wavemeters working on the quartz crystal principle has been brought to great perfection in Germany.

In a country where the same program is broadcast through the National Broadcasting Company's networks by many stations all working on different wavelengths, it may be of interest to hear that in Germany successful experiments have been carried out between Berlin and Stettin with a new arrangement which may be of great importance in the future of European broadcasting.

By means of quartz wavemeters two or more broadcasting stations are tuned to exactly the same wavelength and broadcast the same program without the slightest mutual interference.

Crystal Set Popular

Thus only the number of programs but not that of stations is limited, a fact of the greatest importance in Germany, where every larger town desires its own station to make strong reception possible with the simplest of receivers. The crystal receiver is still very widely used over there.

Interference from coastal stations and ships is not serious in Germany because most of them transmit with plain continuous waves on longer wavelengths.

As regards the technical quality of broadcast transmission I have the impression that the microphones in use in Germany, especially the well-known Reisz microphone, are very good in the transmission of the violin, the soprano and the distinctive instruments of large orchestras.

Sing High, Sing Low

The main reason for this is that the German stations transmit the high frequencies faithfully. The American stations, however, seem to me to reproduce the lower notes extremely well.

Another remarkable fact is that in spite of the far greater distances here in America the land line relays are better than those in Germany. This is probably due to better land line equalizing which cannot be carried out in Germany to the same extent as here for lack of sufficient means, although the theory of these equalizers is very well known over there.

The economic situation in Germany is such that little or no expensive receivers are in use, the main proportion still being crystal receivers. The great importance in Germany of the multiple tubes invented by Dr. Loewe and myself is also to some extent due to the bad economical situation. These tubes comprise a complete three-tube receiver in one tube, are surprisingly cheap, and are slowly replacing the crystal receivers. Again for economical reasons the filament and plate current consumption has to be kept as low as possible and therefore the power valves in use over there are somewhat too small.

Strong for Resistance AF

About seventy per cent of all tube receivers manufactured in Germany incorporate resistance coupling on the audio side, a special resistance coupling method devised by me two and a half years ago.

Programs on the whole are on a rather high level in Germany, because thanks to the paying basis of organization in broadcasting listeners relatively large sums are placed at the disposal of the program committees of the broadcasting stations. These committees which determine the nature of programme to be broadcast are composed of leading educators, civic workers and artists.

The educational value of broadcasting in Germany is very great, since the less prosperous and educated part of the people constitute by far the greatest number of regular listeners, while in the homes of the more wealthy and highly educated there is a surprising lack of radio equipment.

Expect Too Much

Germany being the land of Wagner and Beethoven, these wealthy or highly educated people expect too much of radio in the classical music line to be much interested. But with the advent of new devices now being developed which will make reproduction practically perfect radio is sure to gain ground in these circles as well.

These new devices now being developed in German laboratories include a new Reisz loudspeaker working on the electrostatic principle, which will insure uniform reproduction of all audio-frequencies down to 30 cycles, some special battery eliminators for resistance coupled receivers evolved in my laboratories and new types of power tubes.

The technical development of broadcasting in Germany practically always moves along theoretical lines and the theory of radio and kindred subjects is very far advanced over there, while in the United States I have found the practical side extremely well developed.

Pleads for Scientific Union

A unison of the two would be sure to bring about a great advance in the science of broadcasting.

We in Germany will be very much interested in the new receivers and accessories that are to be shown at the Radio World's Fair in New York (week of September 19). I am very sorry that I cannot remain here to participate in the discussions that this convention and particularly to note the advance that is being made in American radio apparatus.

Design of RF Choke Discussed by Expert

(*Concluded from page 9*)

A winding identical with No. 7 has been chosen as the General Radio RF choke Type 379. This has an approximate inductance of sixty millihenrys and, as seen from the table, is an effective choke for all wavelengths from twenty meters to considerably above the upper limit of the broadcast band. It may therefore be used to advantage in short wave receivers as well as broadcast receivers. The resistance of this instrument is about 140 ohms and its current rating 90 milliamperes, corresponding to a DC power rating of 1⅛ watts. This current rating is for continuous use. For intermittent use, however, as for instance in a transmitter which is being keyed, the rating may be doubled with safety. The choke may, therefore, be used with success in the construction of low power amateur transmitting sets where the above ratings are not exceeded.

Wavelength	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9
20	NG	3.5	NG	NG	3.2	1.9	2.4	NG	NG
40	3.1	3.4	1.7	1.8	3.1	2.3	2.5	4.2	2.5
90	.6	2.9	3.0	3.0	3.2	-2.9	3.0	4.3	3.6
160	1.9	3.9	6.6	6.0	4.0	1.0	1.6	4.2	3.7
320	8.4	.6	2.9	-3.1	1.0	8.8	3.7	4.0	3.6
640	-2.3	2.4	-10.8	-12.0	3.5	-2.2	2.9	3.2	3.2
L=mh.	14.5	152	7.8	7.9	153	15.3	64	92	243
Winding	1500T No. 36SCC	4800T No. 36 En	1075T No. 34SCC	1075T No. 34SCC	4800T No. 36 En	1500T No. 36SCC	3000T No. 34 En	.. .. ..	.. .. ..

FIG. 6

Table showing effective capacity in mmfd. of choke coils at from 200 to 640 meters. The designation (mh) is millihenrys. The number of turns and wire are at bottom.

LIST OF STATIONS

With new wavelengths, frequencies, location and power, corrected to June 28. Time sharers in parentheses.

Station	Kc	M	Watts
WAAD—Cincinnati, O.	1120	267.7	25
WAAF—Chicago, Ill. (WBBM, WJBT)	770	389.4	500
WAAM—Newark, N. J. (WGBS)	860	348.6	500
WAAT—Jersey City, N. J. (WGBB), WSOM)	1200	245.8	300
WAAW—Omaha, Nebr. (Before 7 p. m. only)	800	374.8	500
WABC—Richmond Hill, N. Y. (WBOQ)	920	325.9	2500
WABF—Pringleboro, Pa.	1460	205.4	250
WABI—Bangor, Me.	770	389.4	100
WABO—Rochester, N. Y. (WHEC)	1290	232.4	100
WABQ—Philadelphia, Pa.	1410	212.6	500
WABR—Toledo, O. (WTAL)	1070	280.2	50
WABW—Woester, O.	1210	247.8	50
WABY—Philadelphia, Pa.	1210	247.8	50
WABZ—New Orleans, La.	1210	247.8	50
WADC—Akron, O.	1250	239.9	1000
WAFD—Detroit, Mich. (WTHO)	1370	218.8	250
WAGM—Royal Oak, Mich.	1330	225.4	50
WAGS—Somerville, Mass.	1390	215.7	5
WAIT—Taunton, Mass	1400	214.2	10
WAIU—Columbus, O. (WEAO)	1060	282.8	5000
WALK—Bethayres, Pa. Portable)	1490	201.6	50
WAMD—Minneapolis, Minn.	1330	225.4	500
WAPI—Auburn, Ala.; daytime only	610	491.5	1000
WARS—Brooklyn, N. Y. (WSDA, WBBC)	1320	227.1	500
WASH—Grand Rapids, Mich.	1170	256.3	250
WASN—Boston, Mass.	990	302.8	100
WATT—Boston, Mass	1490	201.6	100
WBAA—West Lafayette, Ind (WRM)	1100	272.6	500
WBAK—Harrisburgh, Pa. (WPSC)	1000	299.8	500
WBAL—Baltimore, Md.	1050	285.5	3000
WBAO—Decatur, Ill.	1120	267.7	100
WBAP—Fort Worth, Tex. (WFFA)	600	499.7	1500
WBAW—Nashville, Tenn.	1210	247.8	100
WBAX—Wilkes Barre, Pa. (WBRE)	1200	249.9	100
WBBC—Brooklyn, N. Y. (WARS, WSDA)	1320	227.7	500
WBBL—Richmond, Va.	1210	247.8	100
WBBM—Chicago, Ill. (WJBT, WAAF)	770	389.4	1000
WBBP—Petoskey, Mich.	1250	239.9	100
WBBR—Rossville, N. Y. (WJBI and WEBJ)	1170	256.3	1000
WBBW—Norfolk, Va.	1270	236.1	50
WBBY—Charleston, S. C.	600	499.7	75
WBBZ—Chicago, Ill. (Portable)	1470	204.0	100
WBCN—Chicago, Ill. (WENR)	1040	283.3	250
WBES—Takoma Park, Md.	1010	296.9	100
WBET—Boston, Mass.	1240	241.8	500
WBKN—Brooklyn, N. Y. (WWRL, WIBI, WBMS)	1120	267.7	100
WBMH—Detroit, Mich. (WMBC)	1420	211.1	100
WBMS—Union City, N. J. (WBKN, WWRL, WIBI)	1120	267.7	100
WBNY—New York, N. Y. (WHAP, WMSG)	1270	236.1	500
WBOQ—Richmond Hill, N. Y. (WABC)	920	325.9	500
WBRC—Birmingham, Ala.	1230	243.8	250
WBRE—Wilkes Barre, Pa. (WBAX)	1200	249.9	100
WBRL—Tilton, N. H.	1290	232.4	500
WBRS—Brooklyn, N. Y. WCDA, WCGU, WRST)	1420	211.1	100
WBSO—Wellesley Hills, Mass. (WDWF)	780	384.4	100
WBT—Charlotte, N. C.	1160	258.5	500
WSMK—Dayton, Ohio	1010	296.9	200
WBZ—Springfield, Mass.	900	333.1	15000
WBZA—Boston, Mass.	900	333.1	500
WCAC—Mansfield, Conn. (WDRC)	1090	275.1	500
WCAD—Canton, N. Y.	820	365.6	500
WCAE—Pittsburgh, Pa.	580	516.9	500
WCAH—Columbus, Ohio	560	535.4	250
WCAJ—Lincoln, Nebr.	860	348.6	500
WCAL—Northfield, Minn. (KFMX)	1270	236.1	500
WCAM—Camden, N. J.	1340	223.7	500
WCAO—Baltimore, Md. (WCBM)	780	384.4	250
WCAT—Rapid City, S. D.	1210	247.8	100
WCAU—Philadelphia, Pa.	1150	260.7	500
WCAX—Burlington, Vermont	1180	254.1	100
WCAZ—Carthage, Ill.	880	340.7	50
WCBA—Allentown, Pa. (WSAN)	1350	222.1	100
WCBD—Zion, Illinois (WLS)	870	344.6	5000
WCBE—New Orleans, La.	1320	227.1	5
WCBH—Oxford, Miss.	1240	241.8	100
WCBM—Baltimore, Md. (WCAO)	780	384.4	100
WCBR—Providence, R. I. (Portable)	1490	201.6	100
WCBS—Springfield, Ill.	1430	209.7	250
WCCO—Minneapolis, Minn.	740	405.2	5000
WCDA—Brooklyn, N. Y. (WRST, WBRS, WCGU)	1420	211.1	500
WCFL—Chicago, Ill. WLTS)	620	493.6	1500
WCGU—Coney Island, N. Y. (WCDA, WBRS, WRST)	1420	211.1	500
WCLO—Camp Lake, Wisc.	1320	227.1	100
WCLS—Joliet, Ill. (WKBB)	1390	215.7	150
WCMA—Culver, Ind.	1160	258.5	250
WCOA—Pensacola, Fla.	1200	249.9	500
WCOC—Columbus, Miss.	1300	230.6	100
WCOM—Manchester, N. H.	1260	238.0	100
WCOT—Olneyville, R. I.	1330	225.4	50
WCRD—Chicago, Ill. (WFKB & WPCC)	1340	223.7	500
WCSH—Portland, Me.	830	361.2	500
WCSO—Springfield, Ohio	1170	256.3	500
WCWK—Fort Wayne, Ind. (WOWO)	1310	228.9	500
WCWS—Bridgeport, Conn. (Portable)	1490	201.6	100
WDAD—Nashville, Tenn.	1330	225.4	500
WDAE—Tampa, Fla.	1120	267.7	500
WDAF—Kansas City, Mo.	810	370.2	1000
WDAG—Amarillo, Texas	1140	263.0	250
WDAH—El Paso, Texas	1280	234.2	100
WDAY—Fargo, N. Dak.	830	361.2	250
WDBJ—Roanoke, Va.	1300	230.6	250
WDBK—Cleveland, Ohio	1320	227.1	250
WDBO—Winter Park Fla.	1250	239.9	500
WDBZ—Kingston, N. Y. (WOKO)	1390	215.7	50
WDEL—Wilmington, Del.	1130	265.3	100
WDGY—Minneapolis, Minn. (WRHM)	1150	260.7	500

Station	Kc	M	Watts
WDOD—Chattanooga, Tenn.	1180	254.1	500
WDRC—New Haven, Conn. WCAC)	1090	275.1	250
WDWF—Cranston, R. I. (WBSO)	780	384.4	500
WLSI—			
WDWM—Newark, N. J. (WHAP, WMSG)	1270	236.1	500
WDZ—Tuscola, Ill. (Daytime only)	1080	277.6	100
WEAF—New York, N. Y.	610	491.5	5000
WEAI—Ithaca, N. Y. (WOAX)	620	483.6	250
WEAM—North Plainfield, N. J.	1250	239.9	250
WEAN—Providence, R. I. (WNAC)	1130	265.3	500
WEAO—Columbus, O. (WAIU)	1060	282.8	750
WEAR—Cleveland, O. (WTAM)	750	399.8	1000
WEBC—Superior, Wisc.	1240	241.8	250
WEBE—Cambridge, Ohio	1210	247.8	10
WEBH—Chicago, Ill. (WJJD)	820	365.6	2000
WEBJ—New York, N. Y. (WJBI and WBBR)	1170	256.3	500
WEBQ—Harrisburg, Ill.	1340	223.7	15
WEBR—Buffalo, N. Y.	1240	241.8	200
WEBW—Beloit, Wisc.	1160	258.5	500
WEDC—Chicago, Ill. WGES)	1240	241.8	500
WEEI—Boston, Mass.	670	447.5	500
WEHS—Evanston, Ill.	1390	215.7	100
WEMC—Berrien Springs, Mich.	1260	238.0	1000
WENR—Chicago, Ill. (WBCN)	1040	283.3	500
WEPS—Gloucester, Mass.	1010	296.9	100
WEW—St. Louis, Mo.	850	352.7	1000
WFAA—Dallas, Texas (WBAP)	600	475.9	500
WFAM—St. Cloud, Minn.	1190	252	10
WFBC—Knoxville, Tenn.	1280	234.2	50
WFBE—Cincinnati, Ohio	1220	245.8	250
WFBG—Altoona, Pa.	1070	280.2	100
WFBJ—Collegeville, Minn.	1100	272.6	100
WFBL—Syracuse, N. Y.	1160	282.8	750
WFBM—Indianapolis, Ind.	1330	225.4	250
WFBR—Baltimore, Md.	1330	225.4	100
WFBZ—Galesburg, Ill. (WRAM)	1210	247.8	50
WFCI—Pawtucket, R. I.	1330	225.4	50
WFDF—Flint, Mich.	860	348.6	100
WFHH—Clearwater, Fla.	820	365.6	500
WFI—Philadelphia, Pa. (WLIT)	740	405.2	500
WFIW—Hopkinsville, Ky.	1220	245.8	500
WFKB—Chicago, Ill. (WCRW & WPCC)	1340	223.7	500
WFKD—Philadelphia, Pa.	1460	205.4	10
WFLA—Boca Raton, Fla.	1410	212.6	1000
WFRL—Brooklyn, N. Y. (WKBQ, WKBO, WBNY)	1370	218.8	500
WGAL—Lancaster, Pa. (WKJC)	1190	252.0	15
WGBG—Freeport, N. Y. (WAAT, WSOM)	1220	245.8	400
WGBC—Memphis, Tenn.	1080	277.6	15
WGBF—Evansville, Ind.	1270	236.1	250
WGBI—Scranton, Pa. WQAN)	1300	230.6	100
WGBS—Astoria, L. I., N. Y. (WAAM)	860	348.6	500
WGCP—Newark, N. J. (WNJ)	1070	280.2	500
WGES—Chicago, Ill. (WEDC)	1240	241.8	500
WGHP—Mt. Clemens, Mich.	1230	243.8	1,500
WGL—New York, N. Y. (WODA)	1020	293.9	500
WGM—Jeannette, Pa.	1440	208.2	50
WGMU—New York, N. Y., Portable (WRMU)	1490	201.6	100
WGN—Chicago, Ill. WLIB)	980	305.9	15000
WGR—Buffalo, N. Y.	990	302.8	750
WGST—Atlanta, Ga. (WMAZ	1110	270.1	500
WGWB—Milwaukee, Wisc.	1370	218.8	500
WGY—Schenectady, N. Y. (WHAZ)	790	378.5	30000
WHA—Madison, Wisc. (WLBL)	940	319.0	750
WHAD—Milwaukee, Wis. (WTMJ)	1020	293.9	500
WHAM—Rochester, N. Y.	1080	277.6	500
WHAP—New York, N. Y. (WBNY) WMSG)	1270	236.1	1000
WHAR—Atlantic City, N. J. (WPG)	1100	272.6	750
WHAS—Louisville, Ky.	650	461.3	500
WHAZ—Troy, N. Y. (WGY)	790	379.5	500
WHB—Kansas City, Mo. (WOQ)	890	336.9	500
WHBA—Oil City, Pa.	1150	260.7	10
WHBC—Canton, Ohio	1270	236.1	10
WHBD—Bellefontaine, Ohio	1350	222.1	100
WHBF—Rock Island, Ill.	1350	222.1	100
WHBL—Chicago, Ill. (Portable-Carrell)	1470	204.0	100
WHBM—Chicago, Ill. Portable-Carrell)	1490	201.6	100
WHBN—St. Petersburg, Fla.	1010	296.9	10
WHBP—Johnstown, Pa.	1310	228.9	250
WHBQ—Memphis, Tenn.	1290	232.4	100
WHBU—Anderson, Ind.	1360	220.4	15
WHBW—Philadelphia, Pa. (WIAD)	1360	220.4	50
WHBY—West De Pere, Wisc.	1200	249.9	50
WHDI—Minneapolis, Minn (WLB)	1220	245.8	500
WHEC—Rochester, N. Y. (WABO)	1290	232.4	100
WHFC—Chicago, Ill.	1390	215.7	200
WHK—Cleveland, Ohio (WJAY)	1130	265.4	500
WHN—New York, N. Y. (WQAO)	760	394.5	500
WHO—Des Moines, Iowa	560	535.4	5000
WHPP—New York, N. Y.	1450	206.8	10
WHT—Chicago, Ill. (WIBO)	720	416.4	5000
WIAD—Philadelphia, Pa. (WHBW)	1360	220.4	50
WIAS—Burlington, Iowa	630	475.9	100
WIBA—Madison, Wisc.	12050	239.9	100
WIBG—Elkins Park, Pa. Sunday, day time only)	680	440.9	50
WIBI—Flushing, N. Y. (WBKN, WWRL, WBMS)	1120	267.7	100
WIBJ—Chicago, Ill. (Portable-Carrell)	1490	201.6	100
WIBM—Chicago, Ill. (Portable-Carrell)	1490	201.6	100
WIBO—Chicago, Ill. (WHT)	720	416.4	500
WIBR—Steubenville, Ohio.	1200	249.9	50
WIBS—Elizabeth, N. J. (WTRC, WLBX)	1470	202.6	150
WIBU—Polynette, Wisc.	1380	217.3	20
WIBW—Chicago, Ill. (Portable-Carrell)	1470	204.0	100
WIBX—Utica, N. Y.	1260	238.0	150
WIBZ—Montgomery, Ala.	1300	230.6	15
WICC—Bridgeport, Conn.	1400	214.2	250
WIL—St. Louis, Mo.	1160	258.5	250
WIOD—Miami Beach, Fla.	1210	247.8	1000
WIP—Philadelphia, Pa. (WOO)	590	508.2	500
WJAD—Waco, Texas	670	447.5	500
WJAG—Norfolk, Nebr.	1350	222.1	250
WJAK—Kokomo, Ind.	1280	234.2	50
WJAM—Cedar Rapids, Ia. (KWCR)	780	384.4	100
WJAR—Providence, R. I.	620	483.6	500
WJAS—Pittsburgh, Pa. (KQV)	1110	270.1	500

Station	Kc	M	Watts
WJAX—Jacksonville, Fla.	890	336.9	1000
WJAY—Cleveland, Ohio (WHK)	1130	265.3	500
WJAZ—Mt. Prospect, Ill. (WMBI)	1140	263.0	5000
WJBA—Joliet, Ill.	930	322.4	50
WJBB—St. Petersburg, Fla.	870	344.6	250
WJBC—LaSalle, Ill.	1320	227.1	100
WJBI—Red Bank, N. J. (WBBR and WEBJ)	1170	256.3	250
WJBK—Ypsilanti, Mich.	1360	220.4	15
WJBL—Decatur, Ill.	1410	212.6	250
WJBO—New Orelans, La.	1140	283.3	100
WJBR—Omro, Wisc.	1320	227.1	100
WJBT—Chicago, Ill. (WBBM, WAAF)	770	389.4	100
WJBU—Lewisburg, Pa.	1400	214.2	100
WJBW—New Orleans, La.	1260	238.0	30
WJBY—Gadsden, Ala.	1280	234.2	50
WJBZ—Chicago Heights, Ill.	1440	208.2	100
WJJD—Mooseheart, Ill. (WEBH)	820	365.6	1000
WJPW—Ashtabula, Ohio	1440	203.2	30
WJR-WCX—Pontiac, Mich.	680	440.9	5000
WJZ—Bound Brook, N. J.	660	454.3	30000
WKAF—Changed to WTMJ Milwaukee, Wis.			
WKAQ—San Juan, P. R.	880	340.7	500
WKAR—East Lansing, Mich. (WREO)	1300	230.6	1000
WKAV—Laconia, N. H.	1340	223.7	50
WKBB—Joliet, Ill. (WCLA)	1390	215.7	150
WKBC—Birmingham, Ala.	1370	218.8	10
WKBE—Webster, Mass.	1310	228.9	100
WKBF—Indianapolis, Ind.	1190	252.0	250
WKBG—Chicago, Ill. (Portable)	1490	201.6	100
WKBH—La Crosse, Wis.	1360	220.4	500
WKBI—Chicago, Ill.	930	322.4	50
WKBL—Monroe, Mich.	1460	205.4	15
WKBM—Newburgh, N. Y.	1440	208.2	100
WKBN—Youngstown, O. (WMBW)	1400	214.2	50
WKBO—Jersey City, N. J. (WKBQ WBNY WFRL)	1370	218.8	500
WKBP—Battle Creek, Mich.	1410	212.6	50
WKBQ—New York, N. Y. (WKBO WBNY WFRL)	1370	218.8	500
WKBS—Galesburg, Ill. (WLBO)	1380	217.3	100
WKBT—New Orleans, La.	1190	252.0	50
WKBU—New Castle, Pa. (Portable)	1470	204.0	50
WKBV—Brookville, Ind.	1380	217.3	100
WKBW—Buffalo, N. Y.	1380	217.3	500
WKBZ—Ludington, Mich.	1500	199.9	15
WKDR—Kenosha, Wis.	930	322.4	15
WKJC—Lancaster, Pa. (WGAL)	1190	252.0	50
WKRC—Cincinnati, Ohio	900	333.1	500
WKY—Oklahoma City, Okla.	1040	283.3	150
WLAP—Louisville, Ky.	1120	267.7	30
WLB—Minneapolis, Minn. (WHDI)	1220	245.8	500
WLBC—Muncie, Indiana	1430	209.7	50
WLBF—Kansas City, Mo.	1430	209.7	50
WLBG—Petersburg, Va.	1400	214.2	100
WLBH—Farmingdale, N. Y. (Portable)	1490	201.6	30
WLBI—East Wenona, Ill.	1260	238.0	250
WLBL—Stevens Point, Wis. (WHA)	940	319.0	1000
WLBM—Boston, Mass.	1420	211.1	50
WLBN—Chicago, Ill. (Portable)	1470	204.0	50
WLBO—Galesburg, Ill. (WKBS)	1380	217.3	100
WLBP—Ashland, Ohio	1480	202.6	15
WLBT—Crown Point, Ind.	930	322.4	50
WLBR—Belvidere, Ill.	930	322.4	15
WLBT—Crown Point, Ind.	930	322.4	50
WLBV—Mansfield, Ohio	1450	206.8	50
WLBW—Oil City, Pa.	1020	267.7	500
WLBX—Long Island City, N. Y. (WIBS, WMBQ, WTRC and WLBX)	1470	204.0	250
WLBY—Iron Mountain, Mich.	1430	209.7	50
WLBZ—Dover-Foxcroft, Me.	1440	208.2	250
WLCI—Ithaca, N. Y.	1210	247.8	50
WLIB—Chicago, Ill. (WGN)	980	305.9	500
WLIT—Philadelphia, Pa. (WFI)	740	405.2	500
WLS—Chicago, Ill. (WCBD)	870	384.4	5000
WLTS—Chicago, Ill. (WCFL)	620	483.6	100
WLW—Cincinnati, Ohio	700	428.3	5000
WLWL—New York, N. Y. (WMCA)	810	370.2	1000
WMAC—Cazenovia, N. Y. (WSYR)	1130	225.4	500
WMAF—South Dartsmouth, Mass.	700	428.3	500
WMAK—Lockport, N. Y.	550	545.1	750
WMAL—Washington, D. C.	1310	228.9	100
WMAN—Columbus, Ohio	1280	234.2	50
WMAQ—Chicago, Ill. (WQJ)	670	447.5	1000
WMAY—St. Louis, Mo.	1210	247.8	100
WMAZ—Macon, Ga. WGST)	1110	270.1	500
WMBA—Newport, R. I. (Portable)	1470	204.0	100
WMBB—Chicago, Ill. (WOK)	1190	252.0	500
WMBC—Detroit, Mich. (WDMH)	1420	211.1	100
WMBD—Peoria Heights, Ill.	1460	205.4	250
WMBE—St. Paul, Minn.	1440	208.2	10
WMBF—Miami Beach, Fla.	780	384.4	500
WMBG—Richmond, Va.	1450	206.8	15
WMBH—Chicago, Ill. (Portable E. D. Aber.)	1470	204.0	100
WMBI—Chicago, Ill. (WJAZ)	1140	263.0	500
WMBJ—Monessen, Pa.	1290	232.4	50
WMBL—Lakeland, Fla.	1310	228.9	50
WMBM—Memphis, Tenn.	1430	209.7	10
WMBO—Auburn, N. Y.	1360	220.4	100
WMBQ—Brooklyn, N. Y. (WTRC, WIBS, WLBX)	1470	204.0	100
WMBR—Tampa, Fla.	1190	252.0	100
WMBS—Harrisburg, Pa.	1280	234.2	250
WMBU—Pittsburgh, Pa.	1380	217.3	50
WMBW—Youngstown, O. (WKBN)	1400	214.2	50
WMBY—Bloomington, Ill. (WNBL)	1500	199.9	15
WMC—Memphis, Tenn.	580	516.9	500
WMCA—New York, N. Y. (WLWL)	810	370.2	500
WMPC—Lapeer, Mich.	1280	234.2	30
WMRJ—Jamaica, N. Y. (WTRL, WHPP)	1450	206.8	10
WMSG—New York, N. Y. (WHAP, WBNY)	1270	236.1	500
WNAB—Boston, Mass. (Changed to WASN).			
WNAC—Boston, Mass.	850	352.7	500
WNAD—Norman, Okla.	1250	239.9	500
WNAL—Omaha, Nebr. (KOCH, KFOX)	1160	258.5	250
WNAT—Philadelphia, Pa. (WRAX)	1040	263.0	100
WNAX—Yankton, S. D.	990	302.8	250

Station	Kc	M	Watts
WNBA—Forest Park, Ill.	1440	208.2	200
WNBF—Endicott, N. Y.	1450	206.8	50
WNBH—New Bedford, Mass.	1150	260.7	250
WNBJ—Knoxville, Tenn.	1450	206.8	50
WNBL—Bloomington, Ill. (WMBY).	1500	199.9	15
WNBO—Washington, Pa.	1420	211.1	15
WNBQ—Rochester, N. Y.	1480	202.6	15
WNBR—Memphis, Tenn.	1310	228.9	20
WNJ—Newark, N. J. (WGCP)	1070	256.3	500
WNOX—Knoxville, Tenn.	1130	265.3	1000
WNRC—Greensboro, N. C.	1340	223.7	500
WNYC—New York, N. Y.	560	535.4	500
WOAI—San Antonio, Texas	990	302.8	2000
WOAN—Lawrenceburg, Tenn.	1050	260.7	250
WOAX—Trenton, N. J. (WEAM)	1250	239.9	500
WOC—Davenport, Iowa	850	352.7	5000
WOCL—Jamestown, N. Y.	1340	223.7	25
WODA—Paterson, N. J. (WGL)	1020	293.9	1000
WOI—Ames, Iowa; 5000, daytime, 6 to 6 (WSUI)	1130	265.3	2500
WOK—Chicago, Ill. (WMBB)	1190	252.0	5000
WOKO—Peekskill, N. Y.	1390	215.7	250
WOKT—Rochester, N. Y.	1430	209.7	500
WOMT—Manitowoc, Wis.	1350	221.1	50
WOO—Philadelphia, Pa. (WIP)	590	508.2	500
WOOD—Furnwood, Mich.	1150	260.7	500
WOQ—Kansas City, Mo. (WHB)	890	336.9	250
WOR—Newark, N. J.	710	422.3	500
WORD—Batavia, Ill. (WTAS)	1090	275.1	5000
WOS—Jefferson City, Mo.	760	394.5	500
WOW—Omaha, Nebr.	590	508.2	1000
WOWO—Ft. Wayne, Ind. (WCWK)	1310	228.9	1000
WPAB—Norfolk, Va.	1430	209.7	100
WPCC—Chicago, Ill., (WFKB, WCRW)	1340	223.7	500
WPCH—New York, N. Y. (WRNY).	970	309.1	500
WPDQ—Buffalo, N. Y. (WSVS)	1460	205.4	50
WPEP—Waukegan, Ill.	1390	215.7	250
WPG—Atlantic City, N. J. (WHAR)	1100	272.6	2500
WPRC—Harrisburg, Pa.	1430	209.7	100
WPSC—State College, Pa. (WBAK)	1000	299.8	500
WPSW—Philadelphia, Pa.	1480	202.6	50
WQAA—Parkersburg, Pa.	1390	215.7	500
WQAE—Springfield, Vt.	1200	249.9	50
WQAM—Miami, Fla.	930	322.4	750
WQAN—Scranton, Pa. (WGBI)	1300	230.6	100
WQAO-WPAP—Cliffside, N. J. (WHN)	760	394.5	500
WQJ—Chicago, Ill. (WMAQ)	670	447.5	500
WRAF—La Porte, Ind.	1440	208.2	100
WRAH—Providence, R. I.	1500	199.9	250
WRAK—Escabana, Mich.	1060	282.8	50
WRAM—Galesburg, Ill. (WFBZ)	1210	247.8	50
WRAV—Yellow Springs, Ohio	880	340.7	100
WRAW—Reading, Pa.	1260	238.0	50
WRAX—Philadelphia, Pa. (WNAT).	1040	283.3	250
WRBC—Valparaiso, Ind.	1260	238.0	250
WRC—Washington, D. C.	640	468.5	500
WRCO—Raleigh, N. C.	1380	217.3	250
WREC—Memphis, Tenn.	1180	254.1	50
WREN—Lawrence, Kans. (KFKU)	1180	254.1	750
WREO—Lansing, Mich. (WKAR)	1300	230.6	500
WRES—Quincy, Mass.	1380	217.3	50
WRHF—Washington, D. C. (Daytime only)	940	319.0	50
WRHM—Minneapolis, Minn. (WDGY)	1150	260.7	1000
WRM—Urbana, Ill.; 1000 watts before 6 p.m. (WBAA)	1100	272.6	500
WRMU—New York, N. Y. (Portable)	1490	201.6	100
WRNY—New York, N. Y. (WPCH).	970	309.1	500
WRPI—Terre Haute, Ind.	1440	208.2	100
WRR—Dallas, Texas	850	352.7	500
WRRS—Racine, Wis.	930	322.4	50
WRSC—Chelsea, Mass.	1460	205.4	15
WRST—Bay Shore, N. Y. (WCDA, WBRS, WCGU)	1420	211.1	250
WRVA—Richmond, Va.	1420	211.1	250
WSAI—Cincinnati, O.	830	361.2	5000
WSAJ—Grove City, Pa.	1340	223.7	250
WSAN—Allentown, Pa. (WCBA)	1350	222.1	100
WSAR—Fall River, Mass.	1190	252.0	100
WSAX—Chicago, Ill.	1470	204.0	100
WSAZ—Huntington, W. Va.	1240	241.8	100
WSB—Atlanta, Ga.	630	475.9	1000
WSBC—Chicago, Ill. (WWAE)	1290	232.4	500
WSBT—South Bend, Ind.	1350	222.1	250
WSDA—New York, N. Y. (WARS, WBBC)	1320	227.1	250
WSEA—Virginia Beach, Va.	1370	218.8	250
WSIX—Springfield, Tenn.	1410	212.6	150
WSKC—Bay City, Mich.	610	491.5	250
WSM—Nashville, Tenn.	940	319.0	2000
WSMB—New Orleans, La.	930	322.4	500
WAAT)	1220	245.8	500
WSMK—Dayton, O.	1010	296.9	200
WSOE—Milwaukee, Wis.	1100	270.1	500
WSOM—New York, N. Y. (WGBB,			
WSRO—Hamilton, Ohio	780	384.4	100
WSSH—Boston, Mass.	1300	230.6	100
WSUI—Iowa City, Iowa (WOI)	1130	265.3	500
WSVS—Buffalo, N. Y. (WPDQ)	1460	205.4	50
WSYR—Syracuse, N. Y. (WMAC).	1330	225.4	500
WTAD—Quincy, Ill.	1270	236.1	250
WTAG—Worcester, Mass.	1040	283.3	500
WTAL—Toledo, Ohio (WABR)	1070	280.2	100
WTAM—Cleveland, Ohio (WEAR)	750	399.8	3500
WTAQ—Eau Claire, Wisc.	1180	254.1	500
WTAR—Norfolk, Va.	1090	275.1	500
WTAS—Batavia, Ill. (WORD)	1090	275.1	3500
WTAW—College Station, Texas	970	309.1	500
WTAX—Streator, Ill.	930	322.4	50
WTAZ—Lambertville, N. J.	1360	220.4	15
WTHO—Detroit, Mich. (WAFD)	1370	218.8	250
WTIC—Hartford, Conn.	650	461.3	500
WTMJ—Miwaukee, Wisc. (WHAD).	1020	293.9	500
WTRC—Brooklyn, N. Y. (WIBS, WMBQ, WLBX)	1470	204	50
WTRL—Midland Park, N. J. WJBI, WIBI, WBMS)	1120	267.7	100
WWAT—Chicago, Ill. (WSBC)	1290	232.4	100
WWJ—Detroit, Mich.	800	374.8	1000
WWL—New Orleans, La.	1090	275.1	100
WWNC—Asheville, N. C.	1010	296.9	1000
WWRL—Woodside, N. Y. (WBKN, WJBI, WIBI, WBMS)	1120	267.7	100
WWVA—Wheeling, W. Va.	770	389.4	100
KDKA—East Pittsburgh, Pa.	950	315.6	30000

Station	Kc	M	Watts
KDLR—Devils Lake, N. D.	1300	230.6	15
KDYL—Salt Lake City, Utah	1160	258.5	100
KELW—Burbank, Calif. (KPPC)	1310	228.9	250
KEX—Portland, Ore.	1250	239.9	2500
KFAB—Lincoln, Nebr. (5000 before 7 p. m.)	970	309.1	2000
KFAD—Phoenix, Ariz.	1100	272.6	500
KFAU—Boise, Idaho (4,000 watts daytime)	1050	285.5	2000
KFBB—Havre, Mont.	1090	275.1	50
KFBC—San Diego, Calif.	1210	247.8	100
KFBK—Sacramento, Calif.	560	535.4	100
KFBL—Everett, Wash.	1340	223.7	50
KFBS—Trinidad, Colo.	1260	238.0	15
KFBU—Laramie, Wyo.	700	428.3	500
KFCB—Phoenix, Ariz.	1230	243.8	125
KFCR—Santa Barbara, Calif.	1420	211.1	50
KFDM—Beaumont, Texas	800	374.8	500
KFDX—Shreveport, La.	1270	236.1	250
KFDY—Brookings, S. Dak.	760	394.5	500
KFDZ—Minneapolis, Minn.	1390	215.7	10
KFEC—Portland, Ore. (KFIF)	1400	214.2	50
KFEL—Denver, Colo.	1210	247.8	250
KFEQ—St. Joseph, Mo.	1300	230.6	1000
KFEY—Kellogg, Idaho	1290	232.4	10
KFEQ—St. Joseph, Mo.	1300	230.6	1000
KFH—Wichita, Kansas	1220	245.8	500
KFHA—Gunnison, Colo.	1180	254.1	50
KFHL—Oskaloosa, Iowa.	1410	212.6	10
KFI—Los Angeles, Calif.	640	468.5	5000
KFIF—Portland, Ore. (KFEC)	1400	214.2	50
KFIO—Spokane, Wash. (KEPY)	1220	245.8	100
KFIQ—Yakima, Wash.	1440	208.2	100
KFIU—Juneau, Alaska	1330	225.4	10
KFIZ—Fond du Lac, Wisc.	1120	267.7	100
KFJB—Marshalltown, Iowa	1210	247.8	15
KFJF—Oklahoma, Okla.	1100	272.6	750
KFJI—Astoria, Ore.	1200	249.9	15
KFJM—Grand Forks, N. Dak.	900	333.1	100
KFJR—Portland, Ore. (KTBR)	1060	282.8	100
KFJY—Ft. Dodge, Iowa	1250	239.9	100
KFJZ—Fort Worth, Texas	1200	249.9	50
KFKA—Greeley, Colo.	750	399.8	200
KFKB—Milford, Kansas	1240	241.8	1000
KFKU—Lawrence, Kansas (WREN)	1180	254.1	100
KFKX—Hastings, Nebr. (KYW)	570	526.0	2500
KFKZ—Kirksville, Mo.	1330	225.4	15
KFLR—Albuquerque, N. M.	720	416.4	100
KFLU—San Benito, Texas	1270	236.1	15
KFLV—Rockford, Ill.	1120	267.7	100
KFLX—Galveston, Texas	1110	270.1	100
KFMR—Sioux City, Iowa	680	440.9	100
KFMX—Northfield, Minn. (WCAL)	1270	236.1	500
KFNF—Shenandoah, Iowa (KMA)	1110	270.1	1000
KFOA—Seattle, Wash.	670	447.5	1000
KFON—Long Beach, Calif.	1240	241.8	500
KFOR—Lincoln, Nebr.	1380	217.3	100
KFOX—Omaha, Nebraska (KOCH, WNAL)	1160	258.5	100
KFOY—St. Paul, Minn.	1050	285.5	100
KFPL—Dublin, Texas	1090	275.1	15
KFPM—Greenville, Texas	1300	230.6	15
KFPR—Los Angeles, Calif. (KFQZ)	1290	232.4	250
KFPW—Carterville, Mo.	1140	263.0	50
KFPY—Spokane, Wash. (KFIO)	1220	245.8	250
KFQA—St. Louis, Mo.	930	322.4	50
KFQB—Ft. Worth, Texas	1150	260.7	1000
KFQD—Anchorage, Alaska	870	344.6	100
KFQU—Holy City, Calif.	1200	249.9	100
KFQW—Seattle, Wash.	1380	217.3	100
KFQZ—Hollywood, Calif. (KFPR)	1290	232.4	100
KFRC—San Francisco, Calif.	660	454.3	500
KFRU—Columbia, Mo.	1200	249.9	500
KFSD—San Diego, Calif.	680	440.9	500
KFSG—Los Angeles, Calif.	1090	275.1	500
KFUL—Galveston, Texas	1160	258.5	500
KFUM—Colorado Springs, Colo.	1270	236.1	100
KFUO—St. Louis, Mo. (KSD)	550	545.1	500
KFUP—Denver, Colo.	1320	227.1	100
KFUR—Ogden, Utah	1330	225.4	50
KFUS—Oakland, Calif. (KRE)	1170	256.3	50
KFUT—Salt Lake City, Utah	600	499.7	50
KFVD—Venice, Calif. (KGFJ)	1440	208.2	250
KFVE—St. Louis, Mo.	1280	234.2	1000
KFVG—Independence, Kans.	1330	225.4	50
KFVI—Houston, Texas	1260	238.0	50
KFVR—Denver, Colo.	630	475.9	250
KFVS—Cape Girardeau, Mo.	1340	223.7	50
KFWB—Los Angeles, Calif.	830	361.2	500
KFWC—San Bernardino, Calif.	1350	222.1	100
KFWF—St. Louis, Mo.	1400	214.2	250
KFWH—Eureka, Calif.	1180	254.1	100
KFWI—San Francisco, Calif.	1120	267.7	500
KFWM—Oakland, Calif. (1000 watts day time)	1270	236.1	500
KFWO—Avalon, Calif.	1370	218.8	250
KFWV—Portland, Ore.	1310	228.9	50
KFXB—Los Angeles, Calif.	190	252.0	500
KFXF—Denver, Colo.	1060	282.8	500
KFXH—El Paso, Texas	1240	241.8	100
KFXJ—Near Edgewater, Colo.	1390	215.7	15
KFXR—Oklahoma City, Okla	1400	214.2	15
KFXY—Flagstaff, Ariz.	1460	205.4	25
KFYF—Oxnard, Calif.	1260	238.0	25
KFYR—Bismarck, N. Dak.	1250	239.9	250
KGA—Spokane, Wash.	1150	260.7	2000
KGAR—Tuscon, Ariz.	1280	234.2	100
KGBS—Seattle, Wash.	1480	202.6	100
KGBU—Ketchikan, Alaska	1310	228.9	500
KGBX—St. Joseph, Mo.	1040	283.3	100
KGBY—Shelby, Nebr.	1480	202.6	50
KGBZ—York, Nebr.	1410	212.6	100
KGCA—Decorah, Iowa	1480	202.6	10
KGCB—Oklahoma City, Okla. (KGFG)	1390	215.7	50
KGCG—Newark, Ark.	1340	223.7	100
KGCH—Wayne, Nebr.	1020	293.9	250
KGCI—San Antonio, Texas (KGDR)	1480	202.6	15
KGCL—Seattle, Wash. KPCB)	1300	230.6	50
KGCN—Concordia, Kansas	1440	208.2	50
KGCR—Brookings, S. Dak.	1440	208.2	15
KGCU—Mandan, N. Dak.	1440	208.2	100
KGCX—Vida, Mont.	1230	243.8	10
KGDA—Dell Rapids, S. Dak. (Day time only)	1280	234.2	15
KGDE—Barrett, Minn.	1460	205.4	50
KGDJ—Cresco, Iowa	1480	202.6	10
KGDM—Stockton, Calif.	1380	217.3	10

Station	Kc	M	Watts
KGDP—Pueblo, Colo.	1340	223.7	10
KGDR—San Antonio, Texas (KGCI)	1480	202.6	15
KGDW—Humboldt, Nebr.	1450	206.8	100
KGDX—Shreveport, La.	1410	212.6	250
KGDY—Oldbam, S. Dak.	1450	206.8	15
KGEF—Los Angeles, Calif.	1140	263.0	500
KGEH—Eugene, Ore.	1490	201.6	50
KGEK—Yuma, Colo.	1470	204.0	10
KGEN—El Centro, Calif.	1330	225.4	15
KGEO—Grand Island, Nebr.	1460	205.4	100
KGEQ—Minneapolis, Minn.	1480	202.6	50
KGER—Long Beach, Calif. (KRLO)	1390	215.7	100
KGES—Central City, Nebr.	1470	204.4	10
KGEU—Lower Lake, Calif.	1320	227.1	50
KGEW—Fort Morgan, Colo.	1370	218.8	10
KGEY—Denver, Colo.	1490	201.6	15
KGEZ—Kalispell, Mont.	1460	205.4	100
KGFB—Iowa City, Iowa	1340	223.7	10
KGFF—Ava, Okla.	1460	205.4	25
KGFG—Oklahoma City, Okla. (KGCB)	1390	215.7	50
KGFH—La Crescenta, Cal. (KMIC)	1340	223.7	100
KGFI—Ft. Stockton, Tex.	1360	220.4	15
KGFJ—Los Angeles, Calif. (KFVD)	1440	208.2	100
KGFK—Hallock, Minn.	1340	223.7	50
KGFL—Trinidad, Colo.	1350	222.1	50
KGFM—Yuba City, Calif.	1420	211.1	15
KGFN—Aneta, N. Dak.	1500	199.9	15
KGFO—Terra Haute, Ind.	1470	204.0	100
KGFP—Mitchell, So. Dak.	1410	212.6	10
KGO—Oakland, Calif.	780	384.6	5000
KGRC—San Antonio, Texas	1360	220.4	50
KGRS—Amarillo, Texas	1230	243.8	150
KGTT—San Francisco, Calif.	1450	206.8	50
KGU—Honolulu, T. H.	1110	270.1	600
KGW—Portland, Ore.	610	491.5	1000
KGY—Lacey, Wash.	1230	243.8	50
KHJ—Los Angeles, Calif.	740	405.2	500
KHQ—Spokane, Wash.	810	370.2	1000
KICK—Anita, Iowa	650	461.3	100
KJBS—San Francisco, Calif.	1360	220.4	50
KJR—Seattle, Wash.	860	348.6	2500
KKP—Seattle, Wash.	1130	265.3	15
KLDS—Independence, Mo.	1260	238.0	1500
KLIT—Portland, Oregon	1450	206.8	10
KLS—Oakland, Calif. (KZM)	1220	245.8	250
KLX—Oakland, Calif.	590	508.2	500
KLZ—Denver, Colo.	1120	267.7	250
KMA—Shenandoah, Iowa (KFNF)	1110	270.1	500
KMED—Medford, Oregon	1120	267.7	50
KMIC—Inglewood, Calif. (KGFH)	1340	223.7	250
KMJ—Fresno, Calif.	820	365.6	50
KMMJ—Clay Center, Nebr.	1310	228.9	500
KMO—Tacoma, Wash.	1180	254.1	250
KMOX—St. Louis, Mo.	1000	299.8	5000
KMTR—Los Angeles, Calif.	570	526.0	500
KNRC—Santa Monica, Calif.	800	374.8	500
KNX—Los Angeles, Calif.	890	336.9	500
KOA—Denver, Colo. (10,000 until 7 p. m.)	920	325.9	5000
KOAC—Corvalis, Ore.	1110	270.1	500
KOB—State College, N. M. (KWSC, KTW)	760	394.5	5000
KOCH—Omaha, Nebr. (WNAL, KFOX)	1160	258.5	250
KOCW—Chickasha, Okla.	1190	252.0	250
KOIL—Council Bluffs, Iowa	1080	277.6	1500
KOIN—Portland, Ore.	940	319.0	1000
KOLO—Durango, Colo.	1500	199.9	5
KOMO—Seattle, Wash.	980	305.9	1000
KOWW—Walla Walla, Wash.	1000	299.8	500
KPCB—Seattle, Wash. (KGCL)	1300	230.6	50
KPJM—Prescott, Ariz.	1400	214.2	15
KPNP—Muscantine, Iowa	1420	211.1	100
KPO—San Francisco, Calif.	710	422.3	1000
KPPC—Pasadena, Calif. (KELW)	1310	228.9	50
KPRC—Houston, Texas	1020	293.9	500
KPSN—Pasadena, Calif.	950	315.6	1000
KQV—Pittsburgh, Pa. WJAS)	1110	270.1	500
KQW—San Jose, Calif.	1010	296.9	500
KRAC—Shreveport, La.	1360	220.4	50
KRE—Berkeley, Calif. (KFUS)	1170	256.3	100
KRLD—Dallas, Texas	1350	222.1	500
KRLO—Los Angeles, Calif. (KGER)	1390	215.7	250
KROX—Seattle, Wash. (KRSC3	1420	211.2	50
KRSC—Seattle, Wash (KROX)	1420	211.1	50
KSAC—Manhattan, Kans.	900	333.1	500
KSBA—Shreveport, La.	1120	267.7	1000
KSCJ—Sioux City, Ia(KWUC)	1230	243.8	500
KSD—St. Louis, Mo. (KFUC)	550	545.1	500
KSEI—Pocatello, Idaho	900	333.1	250
KSL—Salt Lake City, Utah	990	302.8	1000
KSMR—Santa Maria, Calif.	1100	272.6	100
KSO—Clarinda, Iowa	1320	227.1	500
KSOO—Sioux Falls, S. D.	1430	209.7	250
KTAB—Oakland, Calif.	1070	280.2	500
KTAP—San Antonio, Texas	1310	228.9	10
KTBI—Los Angeles, Calif.	1040	282.3	500
KTBR—Portland, Ore. (KFJR)	1060	282.8	50
KTCL—Seattle, Wash.	1080	277.6	500
KTHS—Hot Springs, Ark.	880	340.7	750
KTNT—Muscatine, Iowa	1170	256.3	3500
KTSA—San Antonio, Tex. (formerly WCAR)	1130	265.3	2000
KTUE—Houston, Tex.	1410	212.6	5
KTW—Seattle, Wash. KWSC, KOB)	760	394.5	1000
KUJ—Seattle, Wash.	1500	19.9	10
KUOA—Fayetteville, Ark.	1010	96.9	500
KUOM—Missoula, Mont.	800	374.8	500
KUSD—Vermillion, S. D.	620	483.6	250
KUT—Austin, Texas	1280	232.4	500
KVI—Tacoma, Wash.	1280	232.4	50
KVOO—Bristow, Okla.	860	348.6	1000
KVOS—Seattle, Wash.	1430	209.7	50
KWBS—Portland, Ore.	1500	199.9	15
KWCR—Cedar Rapids, Ia. (WJAM)	780	384.4	250
KWG—Stockton, Calif.	870	344.6	50
KWKC—Kansas City, Mo.	1350	222.1	100
KWKH—Shreveport, La.	760	394.5	1000
KWLC—Decorah, Iowa	1210	247.8	50
KWSC—Pullman, Wash.	760	394.5	500
KWTC—Santa Ana, Calif.	880	340.7	5
KWUC—LaMars, Iowa (KSCJ)	1230	243.8	1500
KWWG—Brownsville, Texas	1080	277.6	500
KXL—Portland, Ore.	1360	220.4	50
KYA—San Francisco, Calif.	970	309.1	500
KWY—Chicago, Ill. (KFKX)	570	526.0	2500
KZM—Oakland, Calif. (KLS)	1220	245.8	100

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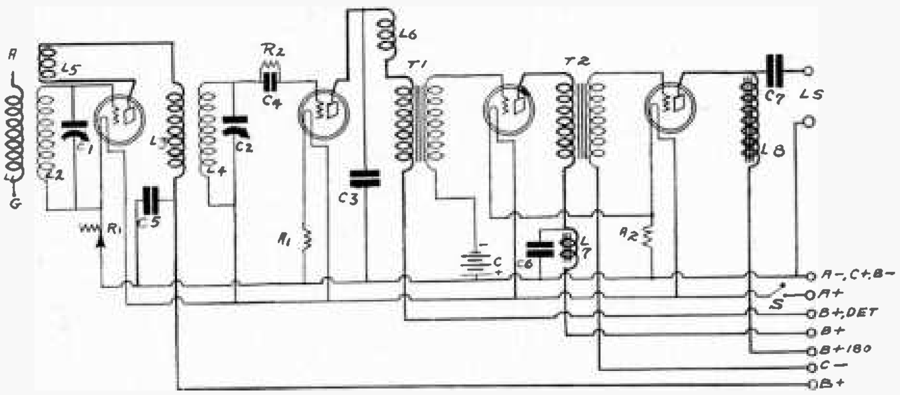

FIG. 548.
The five-tube receiver with a regenerative RF and non-regenerative detector requested by Herbert M. Foyer.

PLEASE GIVE me the circuit diagram of a four-tube receiver, employing a regenerative radio frequency amplifier, a non-regenerative detector and two stages of transformer coupled audio frequency amplification. I have an eighty-five millihenry radio frequency choke coil, a twenty ohm rheostat, a three and one half henry audio frequency choke coil, a thirty henry output choke coil and two .0005 mfd. variable condensers, which I would like to use. To obtain regeneration, I would like to employ the three-circuit tuner arrangement.—HERBERT M. FOYER, San Francisco, Calif.

In Fig. 548 you have the circuit diagram of a receiver containing the specifications you outlined. The .0005 mfd. variable condensers, C1 and C2, are used to tune the secondaries of the three-circuit tuner and the RF coil, L2 and L4, respectively. Each consists of forty-five turns, wound on a three-inch diameter tubing with No. 22 double cotton covered wire. L1 and L3 are the primaries of each of these coils and contain ten turns. They are, of course, wound on the same tubings as their secondaries, with a one-quarter inch space between them, using No. 22 dcc wire. L5 is the tickler coil, which consists of thirty-six turns of No. 26 single silk covered wire, wound on a one and three-quarter inch diameter tubing. This tubing is placed inside of the three-inch tubing carrying the L1L2 windings, but near the L2 winding. To control the filament temperature of the RF tube, the twenty ohm rheostat is used. This is placed in the negative leg. C4 is a .00025 mfd. fixed condenser, while R2 is a two megohm grid leak. C3 is a .001 mfd. fixed condenser. C5 and C6 are 1 mfd. fixed condensers. L6 is the eighty-five millihenry choke coil. L7 is the three and one half henry AF choke. To control the filament temperature of the detector tube, a ballast resistor of the one-quarter ampere type is used. The filaments of the two audio tubes are controlled by a three-quarter ampere ballast resistor, A2. T1 and T2 are three and one half to one, or thereabouts, ratio transformers. L8 is the thirty henry output choke, while C7 is a 4 mfd. fixed condenser. The —01A tubes are used in the RF, detector and first AF circuits. In the last socket the —71 type tube is used. The C bias for this tube at the voltage specified, is forty and one half. The C voltage for the first AF tube is nine volts at one-hundred thirty-five volts, plate. About forty-five volts should be applied to the detector plate and sixty-seven and one-half to the RF plate. LS are loud speaker, binding post, terminals. This may be substituted by a single circuit jack. S is the filament switch. Should you find it difficult to control the oscillatory action of this tube, bring the grid return to the minus A, instead of the minus F post, as it is now connected. The —01A tube may also be used in the last stage, in place of the power tube. In this case the same B and C voltage being applied to the first AF tube, should be used here. A indicates the antenna connection, while G is the ground connection. This complete receiver can either be built on the baseboard or the subpanel system. In either case, the mounting surface should be about twenty one inches long. The RF and tuner coils should be placed about five inches apart and at right angles. The tuner coil can be placed in the center, with the RF coil at an extreme end.

* * *

ON PAGE 7 of the May 21 issue of RADIO WORLD there appeared a circuit diagram of a two-tube set, used to illustrate some points in an article. No constants appeared with it. I think I have most of the necessary parts to build this set. Will you please tell me if I am correct and what else I need? I have a tuned radio frequency transformer with a variable condenser matched; a twenty-ohm rheostat; a three-to-one ratio AFT; a 1A Amperite; a two-megohm grid leak, and .00025 mfd. fixed condenser.—LARRY H. WORTH, Philadelphia, Pa.

These parts are all right. The grid return of the audio tube should be brought to the minus post of a four-and-one-half-volt C battery. The plate post of this tube should be brought through a speaker or pair of phones to the ninety-volt plus post of a pair of forty-five-volt batteries hooked up in series. Forty-five volts should be applied to the plate of detector tube. A filament switch should be inserted in series with the plus A post, to which the minus B should also be connected.

* * *

I HAVE a four-tube reflex, consisting of a tuned radio stage, a non-regenerative tuned detector, and two stages of transformer radio coupling. Recently I purchased a B eliminator, but didn't have time to hook it up. I would like to have some information, regarding its installation.

(1)—I now only have two B leads, one for the RF and detector and one for the AF. Should I use separate B leads for each tube?

(2)—Should I place the eliminator some distance away from the set, or could I place it right next to it?—BURRIS J. MORRIS, Bacon, Ind.

(1)—Yes, use separate leads.

(2)—Place the eliminator near the line, keeping the line wire and eliminator away from the set.

* * *

IN THE May 28 issue of RADIO WORLD there appeared on page 8 a circuit diagram of a one-tube receiver which I would like to construct as a portable. Please give the data for the coils, condensers, etc., necessary to construct the set. I note that the coil in the antenna circuit is tapped. I would like to do away with this feature.—HENRY HERSHKOWITZ, N. Y. City.

The variable condenser in series with the antenna, marked C3, has a capacity of .0005 mfd. L1 consists of twenty-five turns, wound on a three-inch diameter tubing. About one-quarter of an inch away from this winding, forty-five turns are wound, this to constitute the secondary L2. No. 22 double cotton covered wire is used. LJ is a double circuit jack, used to help switch in either the antenna or a loop, if desired.. The fixed RFT is one which will cover from 200 to 600 meters. The crystal is inserted in series with G post of the RFT and the P post of the AFT, which is three to one ratio audio transformer. R1 is a ten-ohm rheostat. C2 is a .001 mfd. fixed condenser. The condenser shunted across the secondary circuit of the audio transformer in dotted lines, is also a .001 mfd. fixed condenser. It is not necessary though. SCJ is a single circuit jack used to connect in the phones. C1 is a .0005 mfd. variable condenser. About forty-five volts should be applied to the plate of the tube.

* * *

I AM going away on my vacation for a month, and would like to know, if I should give my battery an overcharge and let it stand, or give it to a service station and let them take care of it.—FRANK UNGERTON, N. Y. City.

If the battery is of the 120 ampere hour capacity or above type, you can overcharge it and let it stand. If it is smaller, give it to your service station and let them care for it, since it will probably need charging after the third week.

* * *

I HAVE a three-tube set. The detector tube is regenerative, variometers being used in both the grid and the plate circuits. In the antenna circuit, a standard RF coil, with a secondary winding wound to be tuned with a .0005 mfd. variable condenser is used. I wish to add a stage of radio frequency amplification to this set. I intend to make the coil, winding ten turns for a primary and forty-seven turns for a secondary, on a three inch tubing with No. 24 dcc wire. This is exactly how the antenna coil is made. A .0005 mfd. variable condenser will be used to tune the secondary. Will this work out all right?

(2)—Could I take the grid variometer out, without any decrease in the volume, distance or selectivity?

(3)—Should I use a rheostat to control the filament? How would a ten ohmer work?

(4)—The —01A tubes are used throughout. Could I use this type of tube in the extra RF stage?—MAX LEAR, Palisade, N. J.

(1)—Yes.

(2)—No.

(3)—Yes, the ten ohm rheostat would work all right.

(4)—Yes.

* * *

LAST WEEK, I was given the circuit diagram of a six-tube set, having three tuned stages of radio frequency amplification, a non-regenerative detector, and two stages of transformer coupled audio amplification. Each stage is tuned by a single .0005 mfd. variable condenser. Could I use a triple and a single condenser? How would you suggest arranging them?

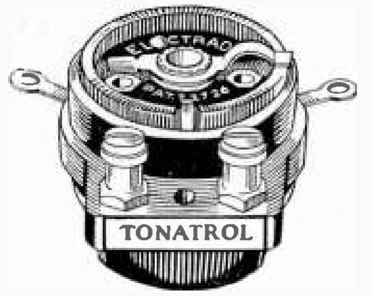

FIG. 550.
The Electrad Tonatrol, which is used in the receiver, requested by Franklin J. Walsh.

(2)—Could I supplant ballasts in first and second RF, detector and first AF tube filament circuits, with a one ampere ballast, such as the No. 1 Amperite?

(3)—I intend using a 112 tube in the last AF stage. Will this necessitate the use of 112 Amperite?

(4)—Would it be advisable to use regeneration in the detector circuit?—H. WALTER ELLWOR, Albany, N. Y.

(1)—Place the triple condenser in the first and second RF and detector circuits. The single condenser should then be placed in the first RF or antenna circuit.

(2)—Not advisable.

(3)—Yes.

(4)—No.

* * *

I RECENTLY saw a circuit diagram illustrating how to use a separate battery in the plate circuit of the detector tube, while the other batteries were being used in the amplifier plate circuit, they being hooked up in series. Is it possible to use a separate battery for the RF plate supply also, thereby reducing the tendency of feedback?—HENRY BROWER, Kansas City, Mo.

Yes, this is a very good stunt. The minus of the B battery is connected to either the plus or minus post of the A battery. The plus post of this B battery is then connected to the plates of the RF tubes.

* * *

I HAVE a five-tube receiver consisting of a single stage of radio-frequency amplification, 'a non-regenerative detector and three stages of resistance coupled audio frequency amplification. I would like to add another stage of radio frequency amplification to this set, with provision in this extra stage for a loop. I do not wish to use a jack for switching from antenna to loop, binding posts being employed, instead. Please show how this can be done, using a twenty-ohm rheostat for filament control and a .0005 mfd. variable condenser for tuning the secondary circuit and a variable resistor for volume control. In my present set, the first RF stage is controlled by a ballast resistor. The primary of the coil in this circuit contains twelve turns, while the secondary consists of fifty turns. Both are wound on a two and three-quarter inch tubing with, what appears to me to be, No. 22 double cotton covered wire. A .0005 mfd. variable condenser is shunted across the secondary winding. The -01A tubes are used throughout.—FRANKLIN J. WALSH, Fresno, Calif.

Fig. 549 shows the circuit diagram illustrating how the RF addition can be made. L1 and L2 indicate the new coil. L1 consists of twelve turns, while L2 consists of fifty turns. Both are wound on a two and three-quarter inch diameter tubing using No. 22 double cotton covered wire. Allow a quarter of an inch space between the two windings. 1, 2, 3 and 4 indicate the binding post connections. When the loop is to be used, post 1 is left disconnected from post 2, while post 3 is left disconnected from post 4. The loop terminals are then shunted across the posts 2 and 4. Using the antenna, 1 and 2 are joined and 3 and 4 are joined. The antenna and ground are then connected to points A and B, respectively. R1 is the twenty ohm rheostat. C is the point to which the antenna was formerly connected, while D is the point to which the ground was connected. The plate and B plus connections are now made here as you will note. R2 is an Electrad Tonatrol, used for controlling volume. L3 and L4 are primary and secondary windings of the RF coil in your present set, C2 being the variable condenser and R3 the ballast resistor. The —01A tube should be used in this addition. You can place the new RF addition in a separate box, or in the receiver itself. When placing it in the set, the RF coil L1L2 should be placed as far away as possible from L3L4 and the other RF coil, and at right angles to them. The variable condenser should be placed so that the leads to the coil are short. This applies to the socket also. Place the socket with the F posts facing the panel. Apply about sixty-seven and one-half volts to the plate of the new RF tube.

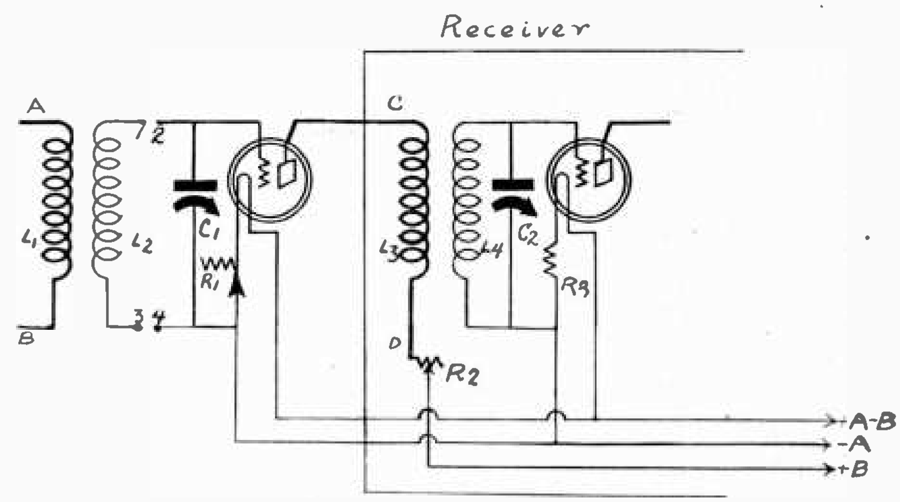

FIG. 549
Circuit illustrating row an extra stage of tuned radio frequency amplification can be added to a set.

* * *

I HAVE just built the three-tube regenerative set described in the April 2 issue of RADIO WORLD and am having some trouble with it. I used a standard three-circuit tuner with no variable primary.

(1)—It is too broad. The primary only contains ten turns. I took off a couple, but that did not help. What could be done?

(2)—I want to use more B battery voltage, so as to get more volume. I use the —01A tubes. How could this be done?—ELMER GODFRIED, West Orange, N. J..

(1)—Break the lead connecting the primary and the secondary windings. Try inserting a .0001 mfd. fixed condenser in series with the antenna.

(2)—The common B plus ninety lead should be broken. Use the ninety only on the first AF plate. On the second AF plate, apply one-hundred and thirty-five volts, with a nine volt C bias.

* * *

SOME TIME last year, a five-tube receiver, consisting of a single stage of tuned radio frequency amplification, a detector and three stages of resistance coupled audio amplification was described. I built this set about a month ago, using basketweave coils. I am troubled with over-oscillation, which I think is due to the extremely large primaries (twenty turns). Is this true? Should they be reduced? How many turns would you suggest taking off?

(2)—The coils are also only four inches apart and parallel to each other. Is that too close?—JOSEPH KRAMER, New York City.

(1 and 2)—Reduce the primaries to ten. The coils should be placed at right angles to each other at that close range. Reduce the plate voltage, or insert a variable resistance such as the Tonatrol in the B plus RF lead. See Figs. 549 and 550.

* * *

REGARDING the seven tube receiver shown on page 10 of the March 12 issue of RADIO WORLD.

(1)—Does the plate of the detector tube receive only six volts, this being a means of preventing oscillation?

(2)—Does R2 also help in stabilizing the circuit?

(3)—Is the output choke coil of the thirty-henry type and the condenser of the four mfd. fixed type?

(4)—Is C9 a one mfd. fixed condenser?—LESTER G. ALHAMBRA, Houston, Tex.

(1, 2, 3 and 4)—Yes.

Good Back Numbers of RADIO WORLD

The following illustrated articles have appeared in back issues of RADIO WORLD; 1926-1927:

1926

Oct. 9—A Practical "A" Eliminator, by Arthur H. Lynch. Building the Equamatic, by Capt. P. V. O'Rourke.
Oct. 16—The Bernard, by Herman Bernard. How to Box an "A" Supply, by Herbert E. Hayden.
Oct. 23—The 5-tube P. C Samson, by Capt. P. V. O'Rourke. Getting DX on the Bernard by Lewis Winner.
Oct. 30—The Singletrol Receiver, by Herbert E. Hayden. How to Get Rid of Squeals, by Herman Bernard.
Nov. 6—Reduction of Interference, by A. N. Goldsmith. Variations of Impedances, by J. E. Anderson
Nov. 13—The 4-tube Hi-Power Set, by Herbert E. Hayden. A Study of Eliminators, by Herman Bernard.
Nov. 20—Vital Pointers About Tubes, by Capt. P. V. O'Rourke. The 4-tube Diamond of the Air, by Herman Bernard.
Dec. 4—The regenerative 5-tube Set, by Cap. P. V. O'Rourke. The 8-tube Lincoln Super, by Sidney Stack.
Winner's DC Eliminator, by Lewis Winner.
Dec. 18—Selectivity on One Tube, by Edgar Speare. Eliminating Interference, by J. E. Anderson.
Dec. 25—A New Coupling Device, by J. E. Anderson. Function of Eliminators, by Herman Bernard.
Jan. 1, 1927—The 2 Tube DeLuze Receiver, by Arthur H. Lynch. The Twin-Choke Amplifier, by Kenneth Harkness.
Jan. 8—Tuning Out Powerful Locals, by J. E Anderson. A Choice Superheterodyne, by Brunsten Brunn. The 2-Tube De Luxe Receiver, by Arthur H. Lynch (Part 2).
Jan. 15—The DeLuxe Receiver, by Arthur H. Lynch (Part 3) The Simple Meter Test Circuit by Herbert E. Hayden. The Superheterodyne Modulator Analyzed, by J. E. Anderson.
Jan. 22—The Atlantic Radiophone feat, by Lewis Rand. An Insight Into Resistors, by J. B. Anderson. A Circuit for Great Power, by Sidney Stack.
Jan. 29—The Harkness KH-27 Receiver (Part 1), by Kenneth Harkness. Use of Biasing Resistors, by J. E. Anderson.
Feb 5—5-Tube, 1 Dial Set, by Capt. P. V. O'Rourke. The Harkness KH-27 (Part 2), by Kenneth Harkness. What Produces Tone quality, by J. E. Anderson.
Feb. 12—Phone Talk Put On Speaker, by Herbert E. Hayden. All Batteries Eliminated, by Herman Bernard. The Harkness KH-27 Receiver, by Kenneth Harkness (Part 3). Conclusion.
Feb. 19—The 6-Tube Victoreen, by Herman Bernard (Part 1.) The Big Six Receiver, by Wentworth Wood. "B" Eliminator Problem, by Wm. P. Lear. The Phasatrol Circuit, by Capt P. V. O'Rourke. The 6-Tube Victoreen, by Herman Bernard (Part 2). Conclusion.
Feb. 26—The 5-tube Diamond in a Phonograph, by Hood Astrakan. How To Read Curves, by John F. Rider. Proper Tubes for 5-Valve Receiver, by J. E. Anderson.
Mar. 5—Introduction of 4-tube Universal, by Herman Bernard. Discussion on DX, by Capt. P. V. O'Rourke. Sensible Volume Control, by Chas. Gribben.
Mar. 12—Ten Tell-Tale Points, by J. E. Anderson. How To Figure Resistors, by Frank Logan. The 4-tube Universal, by Herman Bernard, (Part .)
Mar. 19—Psycho-Analyzing Circuits by Thomas L. McKay. The Universal, by Herman Bernard (Part 2). How To Use a Wave Trap, by James H. Carroll.
Mar. 26—The Universal, by Herman Bernard. (Part 3). Flow of Current in a Vacuum Tube, by Radcliffe Parker. Broadcasting Hypnotism.
April 2—Facts Every Experimenter Should Know, by J. E. Anderson. A Ship Model Speaker, by Herbert E. Hayden. The 3-tube Compact, by Jasper Henry. The Nine-in-Line Receiver, by Lewis Rand (Part 1.)
April 9—A 5-tube Sielded Set, by Herbert E. Hayden. The Power Compact, by Lewis Winner. The Nine-in-Line Receiver, by Lewis Rand, (Part 2.)
April 16—The Schoolboy's Set, by Wally Frost. The Melo-Heald 11-tube Set, by Herbert E. Hayden. The Nine-in-Line Circuit (Part 3), by Lewis Rand.
April 23—The Melo-Heald Set, by Herbert E Hayden (Part 2). The Nine-in-Line, by Lewis Rand. (Conclusion). How Frequencies Are Cut-off, by J. E. Anderson.
April 30—A 1-tube Portable, by Jasper Jellicoe. A Ship Model Receiver, by Smedley Farnsworth. A Double Three Foot Cone, by W. H. Sinclair.
May 7—The Adams-Griffin 6-tube Set, by Dana Adams-Griffin (Part 1). A 2-tube Portable, by Hood Astrakan. How to Improve Super-Heterodyne Sets, by John L. Barrett.
May 14—A 3-tube Portable, by Herbert E. Hayden. The Adams-Griffin Receiver, by Dana Adams Griffin. (Conclusion).
May 21—The Victoreen Portable Receiver, by Capt. P. V. O'Rourke. A Low-Pass Filter, by J. E. Anderson.
May 28—The Console Cone, by Thorvald Larsen. The 3-tube Reflex by Edgar B. Francis. The Victoreen Portable Receiver, by Capt. P. V. O'Rourke. (Part 2).

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R.C.A. Wins Again In DeForest Tube War

Philadelphia, Pa.

In a decision by Judge Wooley of the United States Circuit Court, the Radio Corporation of America won over the DeForest Radio Telephone and Telegraph Company, for the second time, in a suit over an alleged infringement in the sale of vacuum tubes. Judge Hugh M. Morris, of the United States District Court of Delaware, dismissed the suit originally. He held that the Westinghouse Electric and Manufacturing Company had obtained licenses from the General Electric Company which had a manufacturing license from the DeForest company to make tubes for the Radio Corporation of America.

National Sales Unit For Spartan-Murdock

Negotiations were completed last week whereby the products of the Spartan Electric Corporation, of New York, and Wm. J. Murdock, of Chelsea, Mass., manufacturer, will be handled on a nation-wide basis by Maurice S. Despres and Julian M. Jacobs.

The set that constitutes the Murdock line has seven tubes, is single control and has completely shielded chassis.

The Murdock Company arranged with the Adler Manufacturing Co., of Louisville, Kentucky, whereby Adler Royal cabinets will be sold by Murdock to their distributor.

In announcing the new Spartan speaker models, the Spartan Electric Corporation state that it has developed an entirely new cone unit which it will use excluively in conjunction with an original and unique patented cone diaphragm. Three Spartan models are planned.

THE NEW AC TUBES

Everybody should have on hand for ready reference full data on the new AC tubes. The filaments of these tubes are heated by alternating current from a step-down transformer and anybody having AC can put these tubes into a set by making some wiring changes. Those who have AC and who are about to build a set also should possess this full information. Send 15c for the June 4 issue that contains the data on the AC tubes and also on two new rectifier tubes for B eliminators. Radio World.

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Sets, B Unit, Speaker Announced by Kent

Two new models in receiving sets, a new speaker and a B power unit are announced by the Atwater Kent Manufacturing Company of Philadelphia. The company's laboratories have been working steadily for three years to perfect a B power supply. The one adopted has a gas tube with a life in excess of 2,000 hours.

The B unit has a built-in relay which is actuated by the A supply switch of the receiving set. Provision is also made for connecting the A battery and charger to the B unit, in which case the relay also automatically starts and stops the charger. The new instrument is designed for 60-cycle, 110 to 115 volts.

A radical departure in appearance is revealed in one of the new models of receiving sets. The single dial, which characterized the company's "line" last season, is retained in this and all other models, but the new sets are higher and more nearly square, as a consequence of extensive "shielding," which is said to give "super selectivity." The tuning condenser, detector and radio amplification tubes are enclosed in special metal boxes. These shielded parts, together with the rest of the electrical assembly, are completely encased in a metal container which fits inside the cabinet.

Announcement is also made of a new six-tube receiver, similar to the present seven-tube set, which is continued.

Zinke Sells Workrite Throughout the Nation

A. H. Raetz, manager of the Radio Department of The Zinke Company of Chicago, spent two days at the offices of The WorkRite Manufacturing Company in Cleveland, Ohio, perfecting sales and advertising plans for the WorkRite line of Super-Neutrodyne radios for the coming season. The WorkRite line has been greatly improved.

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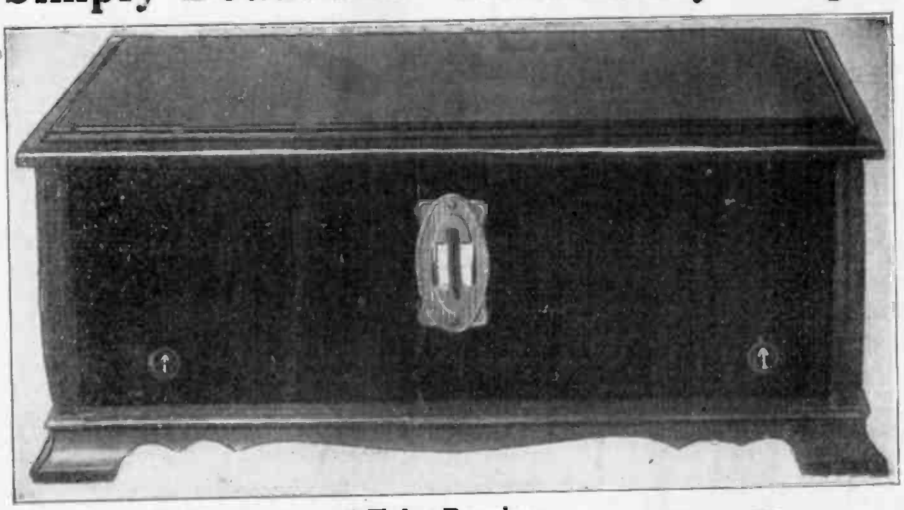

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