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446th Consecutive Issue—NINTH YEAR

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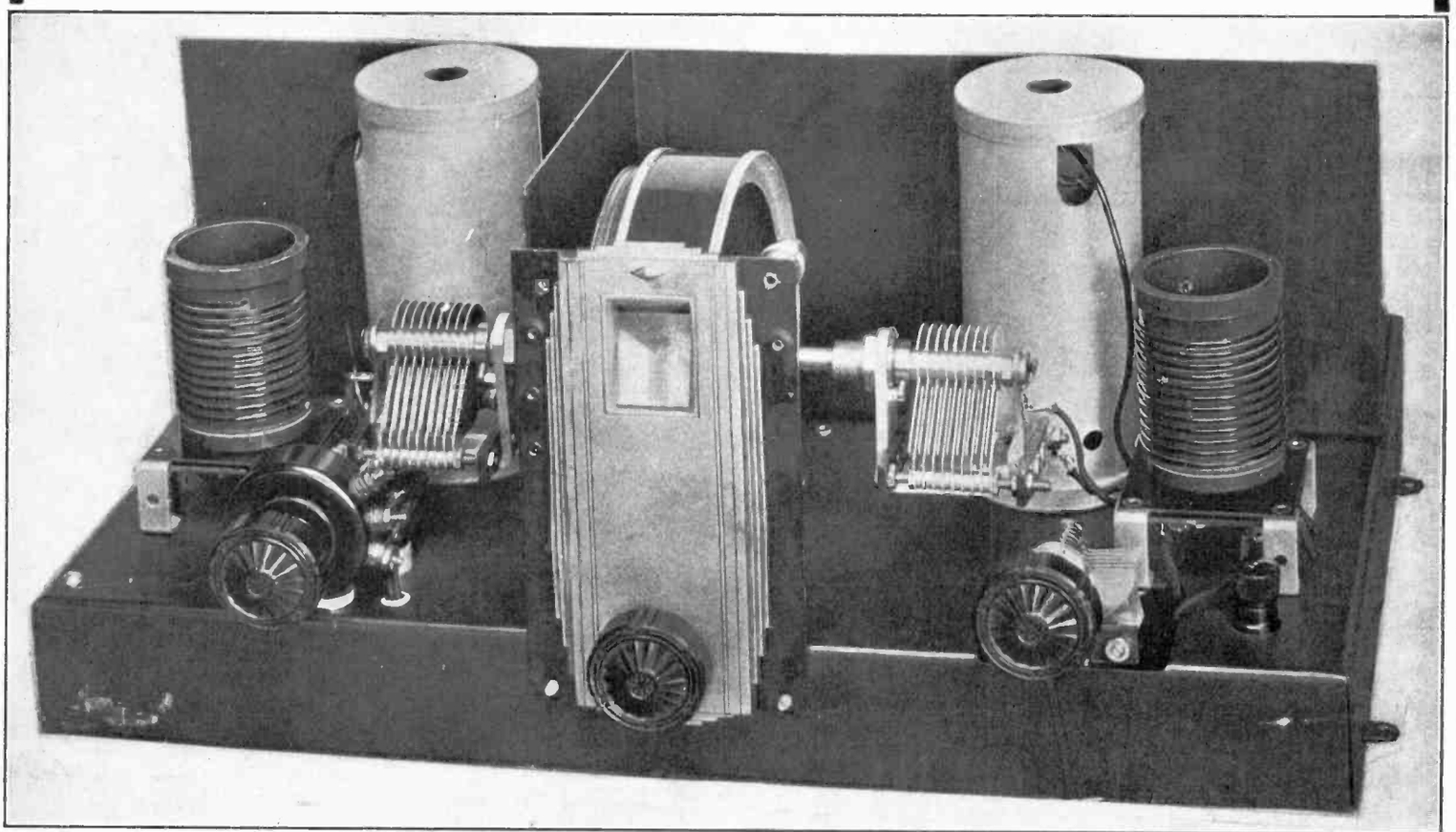
How Radio Began

THE NEW NATIONAL THRILL BOXES

FOR RECEPTION OF FOREIGN STATIONS ON SHORT WAVES



View of the AC Model Thrill Box. The chassis has been removed from the steel cabinet. See article on pages 3, 4 and 5 on AC and Battery models.

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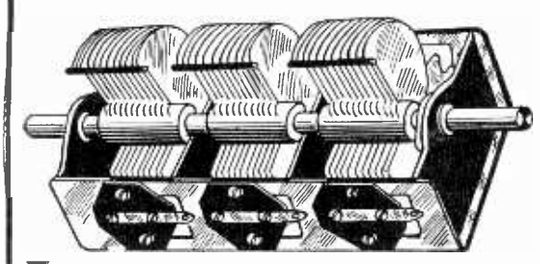

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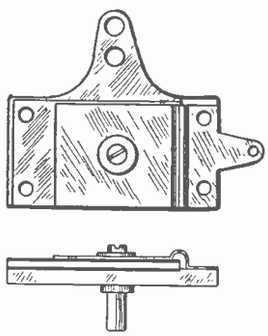

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The Thrill Boxes

By Vincent Wharton

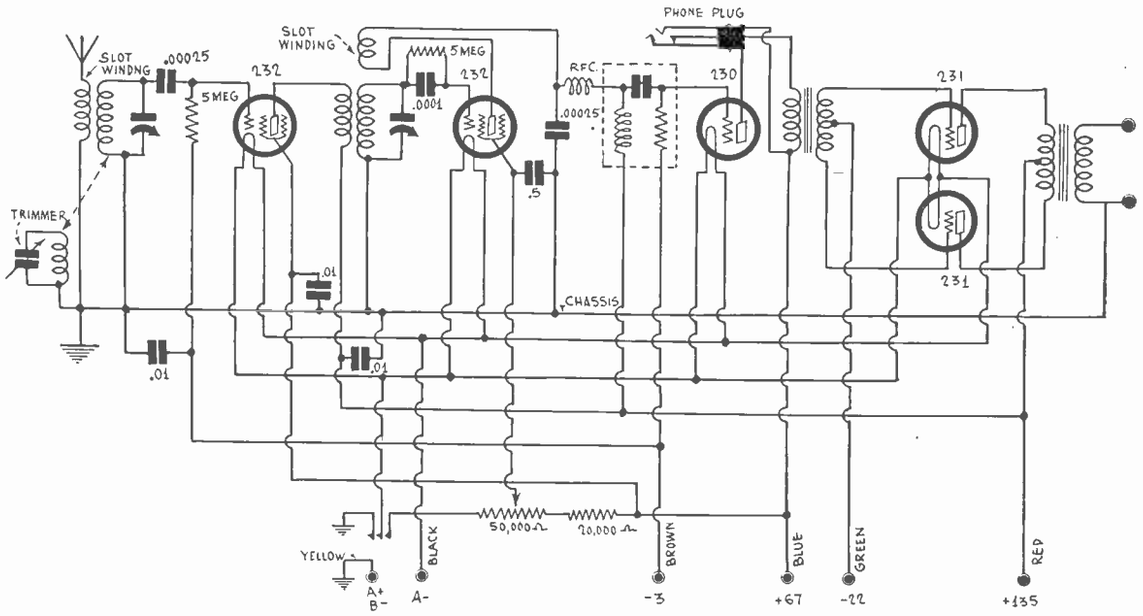


FIG. 1
THE CIRCUIT DIAGRAM OF THE NATIONAL THRILL BOX SW-5, DC MODEL, WHICH HAS BEEN DESIGNED TO TAKE THE NEW 2-VOLT TUBES.

THE National Thrill Box is now available in both AC and battery-operated models in improved and refined form. The battery model is referred to as the DC one. Both models are five-tube receivers, each consisting of a tuned, screen-grid, radio frequency amplifier, a sensitized detector, using a screen grid tube, and audio amplifier coupled to the detector by means of impedance-resistance, and a stage of push-pull amplification. There are practically no performance differences between the AC and DC models, except those imposed by the characteristics of the tubes employed.

The circuit diagram of the DC model is reproduced in Fig. 1, from which we note that the new 2-volt tubes have been used throughout. The radio frequency amplifier and the detector are 232 screen grid tubes, the audio amplifier is a 230 general purpose tube, and the two tubes in the push-pull amplifier are 231 power tubes. Thus the total filament current requirement is only 0.44 ampere, which may be supplied either with a single 2-volt storage cell or by four No. 6 dry ½-volt cells connected in series-parallel.

The plate voltages specified are those recommended for the tubes used, namely, 135 volts on the plates of the power and the screen grid tubes and 67 volts on the audio amplifier tube. The screen voltage on the radio frequency amplifier is also 67 volts. This is higher than the recommended value, but experiment has proved that this gives greater amplification in a radio frequency amplifier. The bias on the power tubes is 22.5 volts and that on the radio frequency amplifier and the audio tube is 3 volts.

New Type Volume Control

The screen voltage for the detector tube is adjustable between zero and 48 volts. The main object of making this variable is to provide an effective volume and sensitivity control. The adjustment is effected by means of a 50,000 ohm potentiometer, which is connected in series with a fixed resistor of 20,000 ohms, the two being connected across 67 volts. It will be noted that this is a new type of volume and sensitivity control. This control is effective because the detecting efficiency and the amplification of a screen grid tube, for fixed values of control grid bias and plate voltage, depend on the value of the voltage impressed on the screen. The 20,000-ohm resistor is connected in series with the potentiometer in order to insure the proper working range of the control. The same range could be obtained by connecting the potentiometer across 45 to 50 volts but this would require an extra lead in the supply table. The simplest way has been adopted by the designer of this circuit.

The potentiometer and the resistor are connected across a portion of the battery only when the set is in operation. To prevent current flow from the battery when the set is turned off the potentiometer is disconnected when the filament switch is turned off, and a special push type switch is provided.

Special Tuning Coils Used

The coils are specially designed for the receiver. The antenna coupler contains three windings, one for the tuner, one for the antenna, and another for a novel type of trimmer. A small variable condenser is connected across the trimmer winding, and when the condenser is turned the tuning of the main circuit is changed slightly to accommodate for differences between the two tuned circuits, the condensers of which are ganged.

The interstage coil also contains three windings, a primary,

(*Continued on next page*)

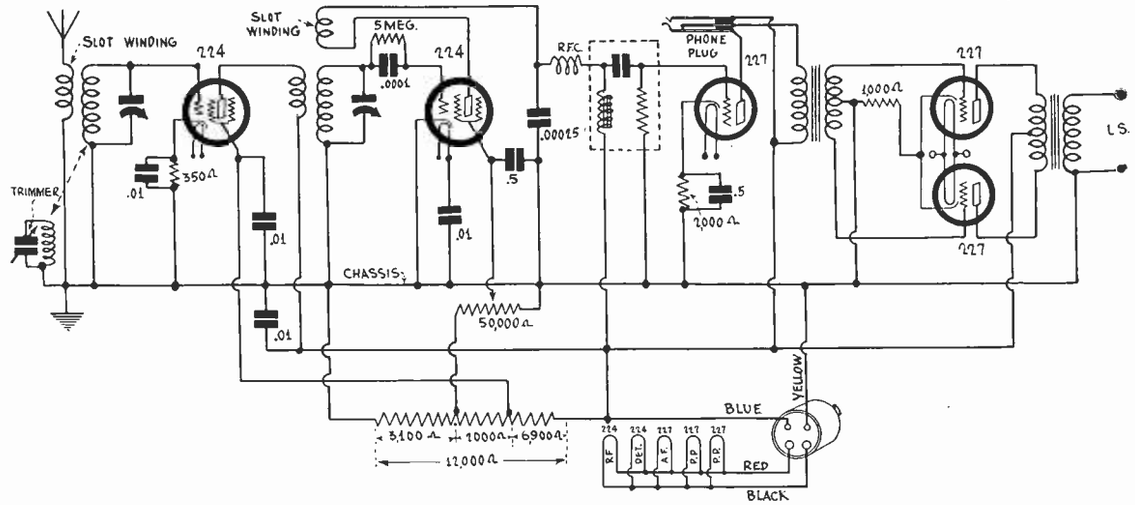


FIG. 4

THE CIRCUIT DIAGRAM OF THE AC MODEL THRILL BOX SW-5.

(*Continued from preceding page*)

a tuned secondary and a fixed tickler. The method of controlling the sensitivity by this fixed tickler has already been mentioned.

These coils are of the plug-in type in special receptacles similar to tube sockets and there are four coils in each set. The smallest of these covers a range from 22 to 13 megacycles the next from 13.5 to 7 megacycles, the next from 8 to 4.25 megacycles, and the largest from 4.5 to 2.5 megacycles. Thus there is ample overlapping. In terms of wavelength the variation is from 13.6 meters to 131.25 meters. A calibration chart of the tuner is reproduced in Fig. 2. This applies to the circuit as a whole rather than to any one set of coils, and it applies to the AC as well as the DC model. The coil forms are a new low-loss material developed by Radio Frequency Laboratories.

The rotors of the two main tuning condensers are grounded, a connection imposed on the design by the fact that the condensers are ganged. Since the detector control grid is returned to the positive of the filament it is necessary to provide an arrangement for getting a negative bias on the first tube. This is done by connecting a 0.00025 mfd. condenser in the grid lead of that tube and connecting a 5 megohm resistor from the control grid to the 3-volt terminal on the bias battery. The lower end of this grid leak is connected directly to ground through a 0.01 mfd. condenser to eliminate any feedback through the grid battery and its leads.

A condenser of the same capacity is also connected from the screen of the first tube to ground and another of the same value from the low end of the primary of the primary following this tube to ground. The screen of the detector is also connected to ground with a condenser, but in this case the capacity is 0.5 mfd. because audio frequency are involved in this part of the receiver. The by-pass condenser in the plate circuit of the detector has a capacity of only 0.00025 mfd., which is ample in view of the fact that only high frequency signals are to be received with the circuit. It offers a very low impedance to any signal carrier to which the circuit may be tuned.

Audio Coupler

circuit as a means of preventing the carrier currents from wandering into the audio amplifier.

When a screen grid tube is used either for detection or audio amplification it is necessary to provide a high impedance in the plate circuit to the audio frequency. In this receiver a special impedance-resistance coupler is used, which presents a very high audio impedance to the signal and thus insures a very high detecting efficiency. The usual push-pull input and output transformers are used for coupling the output stage to the AF amplifier tube and the loudspeaker.

A jack is provided in the output of the first audio frequency amplifier in case it is desired to listen in on the short-wave stations with head-phones. This jack is arranged so that when the plug is inserted the push-pull amplifier is disconnected and the proper connections made to the phones.

Layout of DC Receiver

Fig. 3 gives a rear view of the DC receiver. The audio amplifier is arranged in a row in front and the radio amplifier and the detector in a row at the back, the two parts being separated by a metal shield.

The maximum undistorted output of one of the 231 tubes under the conditions of operation in this receiver is 170 milliwatts. and since there are two of them in the output stage the output is 340 milliwatts. Since the signal voltage on each tube in a push-pull stage is greater than when the same tube is in a single-sided amplifier, it is possible to get an even higher output than 340 milliwatts without excessive distortion. But for the average home a power of 340 milliwatts is ample provided that the loudspeaker has average efficiency.

The AC Model Thrill Box

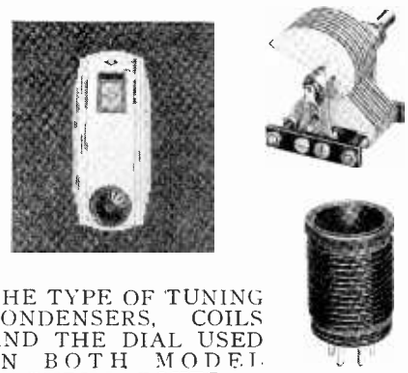
As stated previously, the AC Thrill Box differs from the DC model only in so far as the tubes used make a difference in design necessary, as may be seen from the circuit diagram in Fig. 4. The radio frequency amplifier is a 224 screen grid tube and the detector is a tube of the same type. The audio frequency tubes are all 227 heater type tubes. All the coils, tuning condensers and by-pass condensers have the same values as the corresponding parts in the DC model. There are two additional by-pass condensers in the AC circuit, one of 0.01 mfd. capacity connected between one side of the heater circuit to ground, and another of 0.5 mfd. capacity across the grid bias resistor for the first 227 amplifier.

Grid bias for the first screen grid tube is obtained from the voltage drop in a 350 ohm resistor placed in the cathode lead, which provides a negative voltage of about 1.5 volts for the control grid. The bias for the first audio amplifier is obtained from the drop in 2,000 ohm resistor in the cathode lead to that tube, which puts a negative voltage of about 13.5 volts on the grid of that tube. Similarly, the bias for the push-pull tubes is obtained from a 1,000 ohm resistor in the common portion of the cathode lead of those tubes. The bias provided for these tubes through this resistance is also 13.5 volts. No by-pass condenser is used across this 1,000 ohm resistor because when the circuit is balanced there is no AC or signal current in the resistance and therefore nothing to balance out.

Controlling Volume and Sensitivity

The volume and the sensitivity are controlled in exactly the same way in the AC as in the DC model. However, only a 50,000 ohm potentiometer is used, because the high voltage end of this resistor is returned to a voltage divider where the voltage has the proper value to give the right range of control.

The voltage divider is in three sections, one of 3,100, one of 2,000, and another of 6,900 ohms, making a total of 12,000 ohms. If we assume that the total voltage across the 12,000 ohms is 180 volts and that the voltage drop is proportional to the resistance, the drop in the 3,100 ohm section is 46.5 volts. Hence the screen voltage on the detector tube is variable between zero and 46.5 volts. The drop in the 2,000 ohm section 30 volts. Hence the voltage applied to the screen of the first tube is 76.5 volts.



THE TYPE OF TUNING CONDENSERS, COILS AND THE DIAL USED IN BOTH MODEL THRILL BOXES.

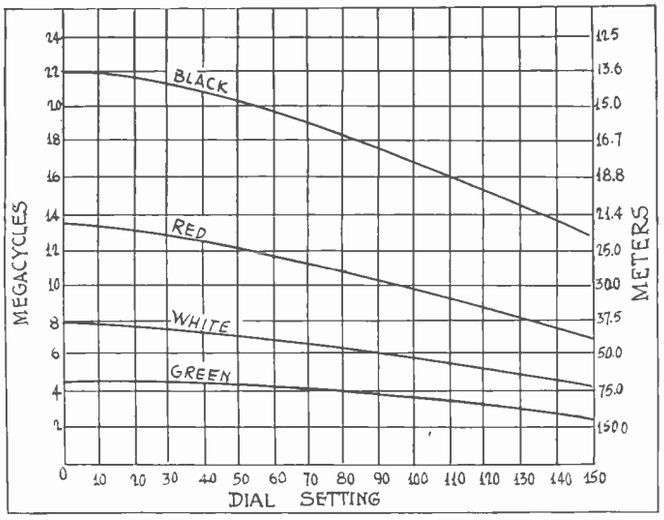


FIG. 2
A CALIBRATION CHART FOR THE NATIONAL THRILL BOX SW-5, APPLICABLE TO EITHER THE AC OR THE DC MODEL.

The voltage on the plates of all the tubes is the total voltage drop in the 12,00 ohm resistance, which is equal to the total applied voltage. If a voltage lower than 180 is applied across the voltage divider all the voltages are reduced in the correct proportion. The plate voltage is applied between the lead marked "Blue" and the lead marked "Yellow," and the yellow is grounded.

The heater circuits are not completed for simplicity, but attached to the plug is a dummy filament circuit showing the connection of the five heaters to the plug. The two main leads are marked "Red" and "Black."

The layout of the AC model is the same as that of the DC model in so far as the principal parts are concerned, and is shown in Fig. 3. Fig. 5 is a view of the wiring under the sub-panel of the AC model.

The Power Supply

The filament voltage should be supplied by a transformer which is capable of maintaining 2.5 volts when the current drawn is about 9 amperes. The leads from the 2.5 volt winding of this transformer should be extra heavy so that the voltage drop in them will be as small as possible. For the same reason they should not be any longer than is absolutely necessary.

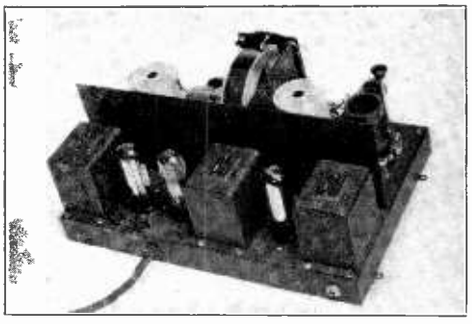


FIG. 3
REAR VIEW OF THE DC MODEL THRILL BOX. THE AUDIO AMPLIFIER IS IN THE FRONT ROW AND THE RADIO AMPLIFIER AND THE DETECTOR IN THE BACK ROW

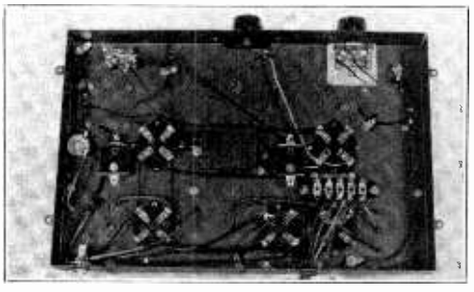


FIG. 5
VIEW OF THE WIRING OF THE AC MODEL THRILL BOX UNDER THE SUB-PANEL.

This, of course, applies to the leads on both sides of the plug in Fig. 4. The plate voltage can be supplied by any B battery eliminator or a battery of suitable voltage. The positive of this voltage source should be connected to the terminal marked "Blue" and the negative to the terminal marked "Yellow."

A special wired power supply for the AC model is manufactured by National Company. The supply furnishes the heater and plate voltages, and the plug fits into the power receptacle on the set.

Synchronization of Talkies

IN general, there are two ways of making a moving picture "talk." One way is to make a phonograph record at the same time the camera is taking the picture, and then play the record while the picture is being shown. That doesn't sound like a hard thing to do—the difficult part is to keep the sound record in step with the picture—"synchronize" sound and scene. Now that word "synchronize" is made up of a couple of Greek words meaning "time" and "together"—and for quite a while the business of exactly synchronizing the voice and the picture was all Greek to the people who tried it. And it isn't as easy as it sounds, either. Here's an experiment that will show you one reason why it isn't easy.

Try It On Your Lawn

Step out on the front lawn some day and draw two circles. Suppose you fastened one end of a five-foot string to a stake and then, holding the string tight, walked all around the stake. Then replace the five-foot string by one ten feet long, and walk around again. In the second case you'd have twice as far to walk—so that, if you were going to get around both circles in the same length of time, you'd have to walk twice as fast in the second case.

That's just one of the problems the needle that makes or reproduces the talking moving picture has to solve. The film is running through the camera in a straight line, and at a uniform speed. But the needle has to cut a spiral groove in a soft wax disc, and each time around the distance it travels is a little bit more, or a little bit less—depending, of course, on whether the needle starts at the inside and works outward, or starts at the outside and works inward.

Many Uses for Small Motors

Here again the tiny motor—the little fellow whose ability to do work is rated only in fractions of a horsepower, but whose other abilities make possible accurate speed adjustment and speed control—is a most important member of the firm.

These small motors do their work so quietly, so reliably, that they are often overlooked. "Little ones should be seen and not heard," 'tis true—but the half and the quarter horsepower, the eighth and the sixteenth horsepower motors, are seldom seen, rarely heard from, and almost never heard of.

Television and talking pictures are, of course, just two of many, many jobs done by motors whose power ratings are expressed in common fractions. Washing, sewing, ironing machines—dishwashers, refrigerators, even exercisers—depend on fractional horsepower motors. Adding machines and typewriters are these days run by motors. The fan that keeps you cool in Summer—and "the hand that 'shovels oil' into your burner to keep you warm in winter"—both depend on fractional horsepower motors.

Electric motors are so exactly the right sort of servant to do so many jobs, we often fail to appreciate their usefulness. Just try to imagine a gasoline engine driving a vacuum cleaner as you walk it across the living room carpet. Or a steam engine furnishing the power that beats eggs, squeezes lemons and grinds up meat in the kitchen!

Electricity Most Convenient

Certainly electricity is the most convenient, most available form of energy for many purposes. And the original idea of making electricity move something continuously goes back about 100 years to two men—one an Englishman named Faraday, and the other an American, Joseph Henry, who for some years was a school teacher in Albany.

To Faraday and Henry we owe the discovery of the principle that makes motors "mote"; to hundreds of scientists and engineers, working skillfully, patiently and with increasingly effective tools each year, goes the credit for the compact, efficient and sturdy motors of today.

A Tube-Operated Fork

By Wadsworth Adams

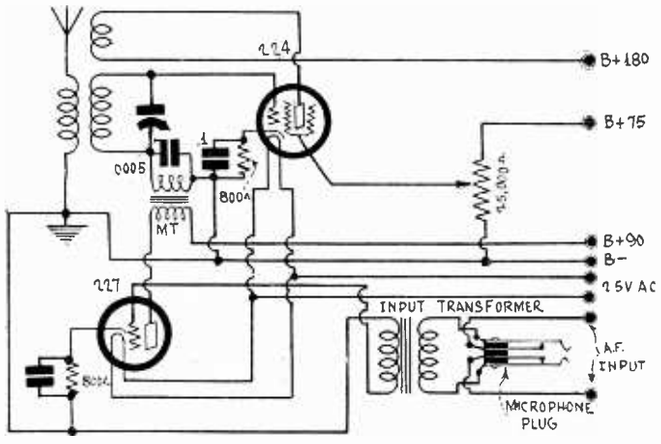


FIG. 1
AN AC-OPERATED TUNABLE RF OSCILLATOR USING A 224 AND A 227 TUBE

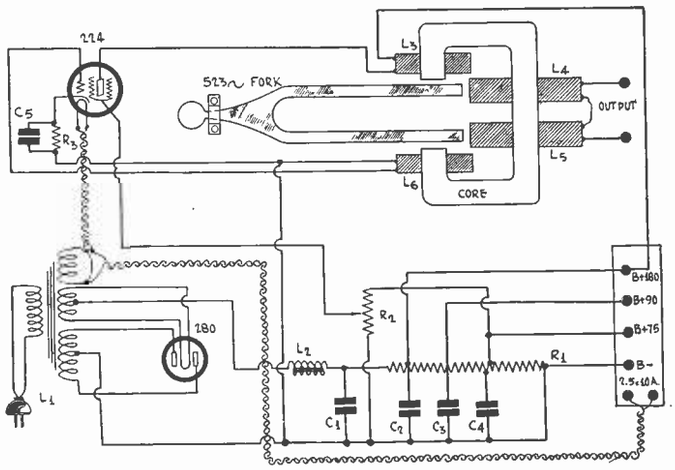


FIG. 2
A TUBE-OPERATED TUNING FORK AND A B VOLTAGE SOURCE COMBINED. THE FORK MAY BE USED FOR MODULATION PURPOSES OR AS AN INDEPENDENT STANDARD

THE experimenter who likes to build his own apparatus doubtless will be interested in the project of owning and operating a device that provides a source of readily variable and controllable radio frequency, whether modulation is used or not. The successful carrying out of RF coil comparisons or other desired tests, where a knowledge of operative conditions is imperative, demands that a reliable source of the required frequency be available, and that the circuit be capable of maintaining a given adjustment over a period of time, that is, constant frequency.

This apparatus makes it possible for those who make their own coils to check the accuracy of the finished product. Two models of the oscillator are shown, one AC, the other DC or battery-operated.

When the experimenter builds a set right from the ground up the process involves the carrying out of some tests by means of which it is determined whether the various circuits are going to function as it is intended they should. It may be perhaps justly argued that the large number of broadcasting stations on the air renders the operation of a local oscillator merely for test purposes an extravagence.

There are two good arguments with which to offset this. One of them is that the broadcast band, from the point of view of a person making a frequency test, is not best because it is not continuous, and the second objection is that the various broadcasting stations are usually so located that the signals emanating from them vary so much that the coil comparisons made as a result of dependence on this source of signal voltage would lead to many errors.

The logical source of a desired radio frequency is a tunable oscillator because it permits you to select any frequency you want, which means that when you test your own coils there is no reason why they will not be just right. Paradoxically, you will have to depend on the standardized frequency stations for the calibration of the local oscillator initially but after this the settings found need not be altered even if the span of the present system be changed somewhat.

Use Care in Assembly

The parts used in the construction of the circuits of Figs. 1 and 2 are not strange to the builder, having been used in the construction of all kinds and many forms of circuits already quite familiar to the radio fan, but are merely combined in a slightly different manner. The only necessary requirement is that ordinary good judgment be exercised when the parts are being located, and there will be no special distress when the "juice" is turned on.

No doubt some fans will want to use their own coils and other parts to build up either one of these oscillators, and here we advise that if this be done it must be known in advance that the coils, or other parts that you intend to use, are going to work out all right. This usually is taken to mean that if the particular coil and condenser are of the correct inductance and capacity respectively the maximum of waveband coverage is assured. This is true only if coil shields are used that they be large, say 4" in diameter or square, that, if smaller, then the tuning capacity should be full .0005 mfd.

It has become such common practice to consider the shield can as used in the regular radio set as standard, that the fan could hardly be blamed if he accepted it an essential part of oscillator construction. The shield need not be used, because it does cause inductance loss, making the wave band coverage less and reduces the RF modulated output intensity over the entire frequency scale.

It should be remembered that the magnetic field of the inductance coil is quite extensive and therefore it is a good plan to locate the coil at a distance from any sizable metal object, say, the variable condenser, so as to avoid the effect already spoken about above. The portion of the wiring that carries the RF currents should not be the small sized conductor that is all too frequently used, but instead should be No. 12 B & S bare copper, or, if the insulated kind is bought, the insulation should be removed, by scraping, and not by being burned off. The filament conductor may be any size that carries the required current without overheating.

Kind of Chassis Material Important

When radio sets are built the customary chassis material is metallic and no particular attention seems to be paid to the kind of metal composing it. It may be magnetic or non-magnetic. But in the construction of the type of oscillator described here the use of metal panel material is preferably avoided. Excellent insulation is obtained by using either hard rubber or bakelite, and a convenient size, or rather thickness, is the ¼".

The object of using non-magnetic panel material is that the losses due to its use should be avoided, as even the wires that carry the RF currents have surrounding them an oscillatory field, hence the chance for leakage is ever-present.

In either model of the oscillator circuit shown the tubes are to be operated under standard conditions correct for the type of tube indicated in the sketch, no specially tricky values of plate, grid, cathode, or screen-grid voltages being necessary at any time.

Features of Circuits

The principal features of the circuits that are portrayed is that they are very simple to construct and once built and calibrated they need no other attention, and furthermore the channel width of this little oscillator may be adjusted by the builder, a scheme that permits the builder to have the control of the output characteristics of his source, that is, provide himself with as broad a carrier as he may want, or it may be made sharp, as a contrast. The precise method of doing this is either to change the coupling, that is, loosen it, or the re-reverse, and also the use of an adjustable resistor in the grid circuit, preferably between the control grid and the junction of the tuning condenser. Otherwise there are no other special instructions at this point.

An accompanying device to the above is the tube maintained tuning-fork, which has as its purpose the supplying a standard frequency audio note, in fact it is an alternating current, or if, you wish, voltage generator, and it is the source of modulation for operating the RF oscillator.

(Part II, conclusion, next week)

The Most Sensitive Tube

By E. L. Manning

Research Laboratory, General Electric Company

A BRAND-NEW tool has just been developed in the General Electric laboratories at Schenectady. It may be difficult to see the connection between this new vacuum tube and the fractional horsepower motor—and in truth, the connection isn't either direct or obvious.

But vacuum tubes have helped us to do so many new things, it won't be long before they are serving every branch of engineering. Just to illustrate: Electric motors have a lot of iron in their make-up. The doctor puts iron in medicine for sick people to give them strength, and the engineer puts iron into a motor to strengthen its magnetic personality.

Now magnetism is somewhat of a puzzling business—scientists since the time of Faraday and Henry have known how to make use of magnetism in building motors, transformers and other electrical gadgets—but no one knows much about why the iron behaves as it does when it is magnetized.

Must Measure Tiny Values

As vacuum tubes were perfected, it became possible to measure, accurately, smaller and smaller electrical quantities —so now there are scientists, using vacuum tube devices to penetrate still further into the mysteries of magnets.

Because vacuum tubes are able to "sense the presence" of extremely small amounts of energy, and then make this tiny incoming energy control a much larger amount, they have been used to measure—detect—small quantities of electric current.

The ammeter on the dashboard of your car is a current-detecting, current measuring device. Such an ammeter will do a satisfactory job of indicating the current flowing through the battery of your car, but it wouldn't do so well if you asked it to measure, accurately, the current through an X-ray tube, which is a thousand times smaller.

The point is: Your yardstick, your measuring instrument, whatever it is, must be properly related to the thing being measured. A yardstick would do well enough to measure the size of the plot of ground your house occupies, but it wouldn't do at all to measure the thickness of a sheet of paper.

Grid Current Eliminated

Vacuum tubes—that is, ordinary ones—are very effective tools in measuring small currents. But even they have their limitations. Astronomers are people who try to make physics laboratories out of far-distant stars, by measuring the minute quantities of heat and light such stars send to our earth. Even vacuum tubes haven't been too successful in giving astronomers the accurate measurements they'd like to have.

The reason accurate determinations couldn't be made is somewhat like that connected with the paper and the yardstick. You can read a yardstick pretty accurately down to eighths of an inch, but when it comes to measuring thickness of paper—which may be 5 or 10 thousandths of an inch—the yardstick fails miserably.

In ordinary vacuum tubes, stray currents are always present in what the engineer would call the "grid circuit of the tube." These stray currents are very small—they interfere in no way with the usual operation of the tubes—but such currents are large in comparison with the ones astronomers have to work with.

So, laboratory scientists set out to find the causes of these undesired grid currents, and gradually, over a period of a year or more, eliminated them one by one.

Incredible Sensitivity

The result was a new vacuum tube—one called the F. P. 54 Pliotron by the engineers—which will measure currents of a hundredth of a millionth of a billionth of an ampere. That's a fraction for you, its numerator would be 1, and its denominator 1 with seventeen zeros after it.

It's difficult to picture numbers like that—suppose we try to get it in more familiar terms. The current that flows through the filament of a 50-watt lamp is about half an ampere. Now suppose that current—that half ampere—represents the water that flows through the Niagara River and down over the Falls, every year. If you'll do that, then this hundredth of a millionth of a billionth of an ampere represents just two drops of water —two drops a year, compared with that enormous volume that, annually, tumbles over the Falls.

Here, indeed, is a tool the astronomer can use in his stellar experiments. And not only the astronomer, but hundreds of scientists, working in many different fields, will have their work extended and made easier by this new measuring instrument. There may be very little of the Earth's surface left to explore —but there still remain vast, unexplored areas in the realm of science—and tools like this will inspire the scientists to still greater effort.

Tiny Motor Aid to Television

IF you had been in Schenectady several weeks ago you might have seen a remarkable public demonstration of television. A complete vaudeville program was sent "through the ether," the actors were two miles away from the theater, and yet the audience "saw" and "heard" them perfectly. And, mind you, the performance was staged not just once, but several times, and on regular theater schedule.

Thousands of people went to see the demonstration and came away convinced that television is really possible.

Furthermore, they came away talking about scanning discs, photoelectric tubes and glow lamps—and, so far as I know, everyone completely overlooked one of the "gadgets" that made the demonstration possible.

Of course, you must have photoelectric tubes. These electric eyes are able to "see" much more rapidly than human eyes. That means that if you want to broadcast the picture of a man you don't have to send the whole thing at once. You can chop up the picture into a lot of little parts and let the photo tube "see" each little part separately. That makes it much easier to send pictures by radio, and on the receiving end you fit it so that each little piece of the total picture is fitted into its proper place—something like fitting tiles into designs on the bathroom floor.

The scanning disc is the gadget that chops the original picture into pieces—and a similar disc in the receiving set puts the pieces together again.

It's a good idea, this sending pictures piecemeal, but when it was first tried, it didn't work so well. Everyone remembers the story of Humpty-Dumpty—all the King's horses, to say nothing of all the King's men, couldn't put Humpty together again. It was much the same way with those first television pictures. The receiving apparatus got all the little pieces of the original picture, but it had a great deal of trouble putting them together again in the right order. Today the job is done, and done well, by a tiny electric motor; the engineers didn't use horses, but horsepower, and fractional horsepower at that, to do a very difficult job. And yet the motor seldom gets a word of praise.

Check Line Voltage As Tube Precaution

There is no special secret involved in getting the utmost in performance out of your radio tubes. Regardless of what kind of a set you have or contemplate buying or building, tube care will be found to be the same process in all cases.

The first precaution in the case of an electric set is to be sure that the lighting circuit voltage is not less than 105 volts, and not more than 115 volts.

In case a check-up of the line voltage should show that other voltages than the prescribed limits prevail, then appropriate means must be taken to correct the condition. The type of electric set most subject to this variation is the AC 50-60 or 25 cycle model, the DC variety being not as subject to overload voltage.

Tube filaments, however, must be protected, no matter what the type of set, as these slender threads of emitting surface, or sources of heat, are the backbone of your set's ability to give constant and satisfactory service. Therefore a check on the line voltage insures a heater voltage not exceeding 2.5 volts.

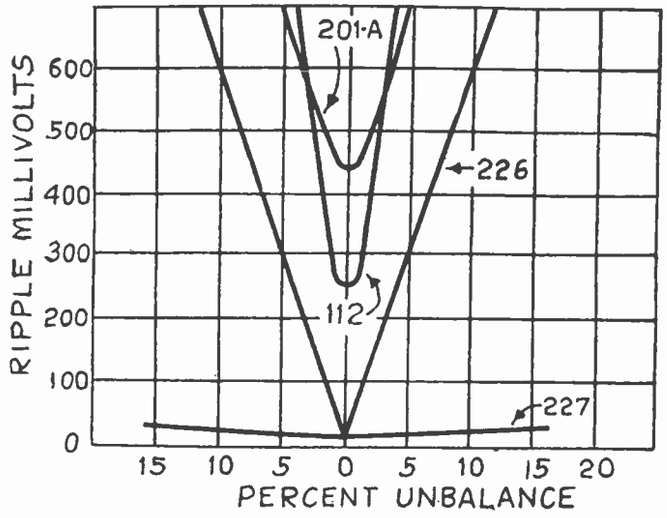


FIG. 80
CURVES SHOWING THE VARIATION IN RIPPLE VOLTAGE DUE TO AC ON THE FILAMENT AS IT VARIES WITH GRID RETURN UNBALANCE. NOTE THE RIPPLE FOR THE 327 AND THE 226 ARE ABOUT THE SAME AT EXACT BALANCE.

[This is the tenth instalment of "Modern Radio Tubes," a series of articles which began in the August 9th issue. In previous instalments all the smaller standard radio tubes have been discussed and characteristics given. In future instalments the 210, 245, and 250 power tubes will be discussed, as well as many special purpose tubes. —EDITOR.]

226

THE 226 is a three-element tube of the directly heated type. It has been designed especially for operation on alternating current and has a filament voltage rating of 1.5 volts and a filament current rating of 1.05 amperes. The object of the low voltage across the filament and the heavy current is to eliminate as much as practicable the hum which results when alternating current is used on the filament, the filament also being the cathode.

The tube is not suitable for detection but is suitable for amplification both in radio and audio frequency circuits. In order to insure hum-free amplification, however, it is necessary to return the grid to the mid-point of the filament circuit, either directly to the 1.5 volt winding on the supply transformer or to a center-tapped resistance connected across the filament terminals. The amount of residual hum depends largely on the accuracy with which the return of the grid is made to the electrical center of the filament circuit.

When there are several similar tubes on the same 1.5 volt transformer winding it is preferable to use one center-tapped resistor for each tube than to use the common center-tap on the transformer or to use a common center-tapped resistance. The only serious objection to this arrangement is that each resistor takes current which adds to the load on the transformer. To limit this extra load each resistance can be made as high as 30 ohms. Since it is difficult to design and build a center-tapped resistor with the tap exactly in the electrical center, it is good practice to use one provided with an adjustable tap so that it may be set where the hum is least.

Importance of Center-tapping

The importance of accurate center-tapping of the resistance or the transformer winding is clearly set forth in the curves in Fig. 80. These curves show the amount of ripple voltage for different percentages of unbalance, not only for the 226 but also for the 227, the 112, and the 201A tubes. The ordinates give the ripple in the plate circuit in milivolts and the abscissas the amount of unbalance. When the balance is exact the ripple is approximately 20 millivolts and when the unbalance is only 5 per cent. it is 300 millivolts. Since the total voltage across the filament is 1.5 volts, 5 per cent. represents a voltage of only 75 millivolts. Or if we have a resistance of 30 ohms, 5 per cent. represents a resistance of only 1.5 ohms.

The advantage of the heater type tube in this respect is clearly shown by the lowest curve. Even when the tap is off 15 per cent., the hum voltage is only about 30 millivolts, while at exact balance the hum is about the same for both tubes. With respect to the heater tube it is the 2.5 volts heater winding which is returned to ground either directly or indirectly through a tapped resistor. The curves also show the comparatively high

Data on th

By J. E.

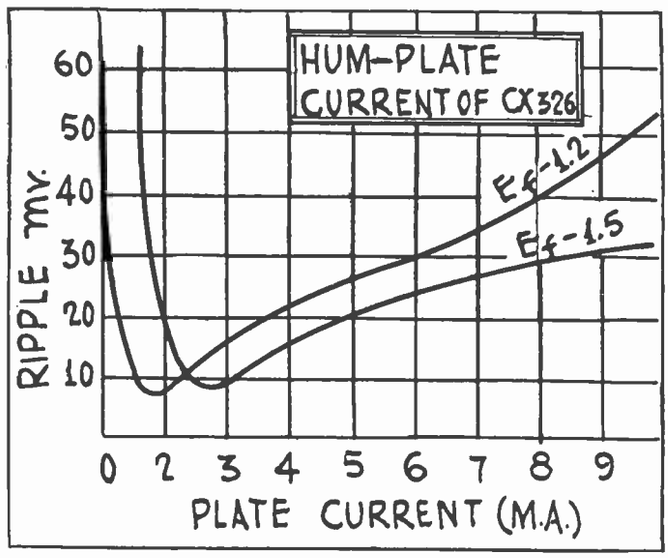


FIG. 81
THESE CURVES SHOW THE VARIATION IN THE RIPPLE VOLTAGE WITH THE PLATE CURRENT FOR TWO DIFFERENT FILAMENT VOTAGES. THE RIPPLE IS DUE TO THE AC ON THE FILAMENT.

Right or

QUESTIONS

(1)—A condenser connected across a choke coil in the filter of a B supply improves the filtration on all frequencies.

(2)—The higher the ratio of the inductance to the capacity in a tuned circuit the louder will the signals be, that is, the higher the voltage that the signal will build up across the tuned circuit.

(3)—The tone of a radio receiver can be varied considerably by connecting capacities of different values across the antenna coil in the receiver.

(4)—Twisting the leads to the heaters of 227 and 224 tubes in a receiver is a sure remedy against infiltration of hum into the signal.

(5)—The amount of bleeder current in the voltage divider of a B supply practically determines the value of the total resistance in the voltage divider.

(6)—There is no advantage in separating the DC from the AC in the plate circuit of a tube for the purpose of preventing core saturation, because the necessary stopping condenser cuts the low frequencies just as much as the reduction in the impedance of the transformer would. Moreover, the choke coil that must be used adds more frequency discrimination, because there is also saturation effects due to the choke.

(7)—When a screen grid tube is used for audio amplification in a resistance coupled amplifier, the higher the screen voltage the greater is the amplification.

(8)—Power detection means that the detector is adjusted so that it is capable to put out enough power to operate a loudspeaker without the usual amplifier tube or tubes.

(9)—The usual statement that a vacuum tube inverts the phase of the signal voltage is not true because all curves showing the relationship between the grid voltage and the plate voltage show that as the bias increases the effective plate voltage increases. Hence the plate and grid voltages must be in phase and there can be no inversion.

ANSWERS

(1)—Wrong. A condenser across a coil increases the filtering on one frequency only. It reduces it on all other frequencies. The reason a condenser is sometimes used is that the hum occurs on only one frequency to any great extent. There are higher harmonics but these are effectively by-passed by the condensers across the circuit.

(2)—Right. When an amplifier is designed for a particular frequency the aim is to get as high ratio as practical in order

e 226 Tube

Anderson

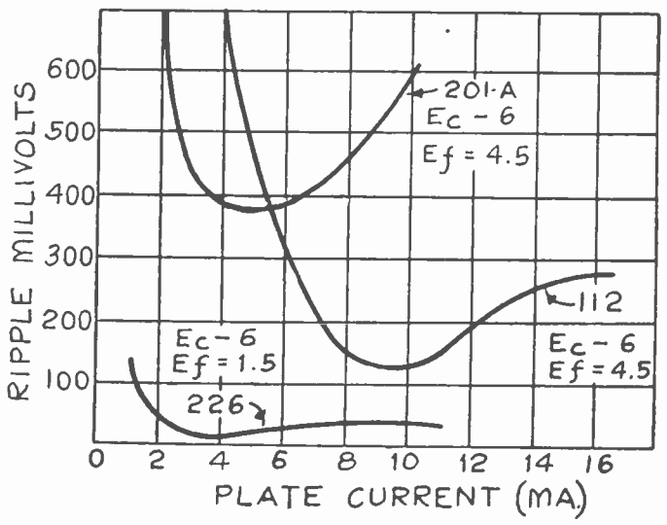


FIG. 82
THESE CURVES SHOW HOW THE RIPPLE VOLTAGE VARIES WITH PLATE CURRENT IN DIFFERENT TUBES. THE HUM FOR THE 226 (326) IS MUCH LOWER THAN THAT FOR THE OTHER TUBES

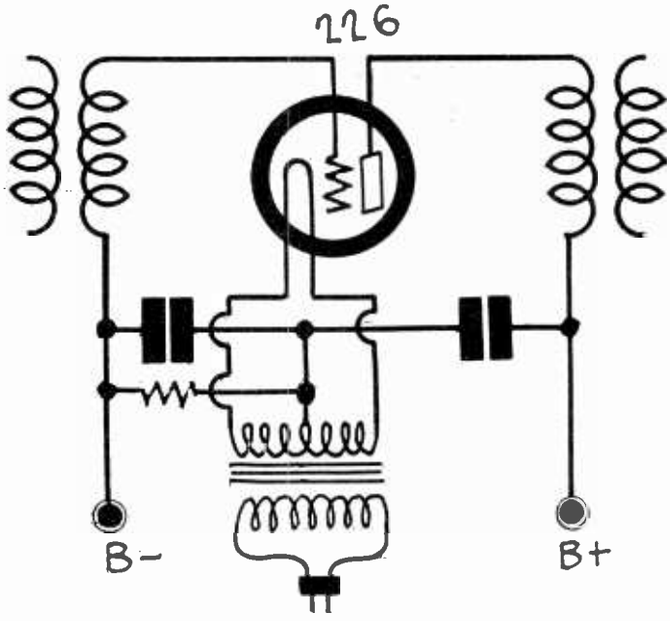


FIG. 83
A CIRCUIT SHOWING HOW THE GRID SHOULD BE RETURNED WHEN THE FILAMENT TRANSFORMER WINDING IS CENTER-TAPPED

Wrong?

to get a high voltage. It can be shown mathematically, as well as experimentally, that the higher L/C is the higher the voltage across the tuned circuit for a given input.

(3)—Wrong. The condensers only cut down the input to the receiver. They don't change the tone. If the antenna circuit were tuned with the condenser there would be a slight change in the tone due to the increased suppression of sidebands, but to tune the circuit a particular capacity would be needed for each frequency.

(4)—Wrong. While twisting helps to eliminate hum it is only one of the desirable precautions that should be taken to eliminate the hum.

(5)—Right. When the bleeder current is specified the value of the resistance between ground and the lowest voltage tap is determined. The resistance between any other two voltage taps is determined by the bleeder current plus the current flowing into the taps below the resistor in question. But in any case. the resistance is largely determined on the value of the first resistance determined.

(6)—Wrong. Those who have studied the question most thoroughly have standardized on the use of a choke and the condenser for keeping out the direct current from the primary of the audio transformer. The choke coil is so constructed that the plate current has very little saturation effect and the condenser is made so large that the suppression of the low frequencies is negligible. Hence there is a decided advantage in using the arrangement.

(7)—Wrong. Curves taken with screen grid tubes in resistance coupled circuits show that the screen voltage which gives best results should be much lower than the usually recommended values. For example, when 180 volts are used in the plate circuit with a resistance of 250,000 ohms the screen voltage should be 15 volts instead of the recommended for of 75 volts.

(8)—Wrong. Power detection means, at the present at least, that a high plate voltage and a high bias are impressed on the tube so that a high signal voltage may be impressed on the tube without overloading it. While the output may be enough to operate a speaker it would not be enough to give satisfactory volume unless at least one more tube were used to amplify the signals.

(9)—Wrong. While the statement of facts in Question 8 is true the interpretation is wrong. The effective plate voltage does increase as the bias increases; the bias is not the grid voltage. Grid bias is measured in the opposite direction from the grid voltage. For example, a bias of one volt is a higher grid voltage than a bias of 6 volts. The bias is inherently negative.

hum voltage in the 112 and the 201A tubes. The least hum at exact balance for the 112 is about 250 millivolts and for the 201A tube 440 millivolts. It is obvious that these tubes cannot be used for amplification in the earlier stages of an amplifier, whereas the 327 can be used even without special balance and the 226 provided the balance is within one per cent.

Hum Variation with Plate Current

The amount of hum voltage in the plate circuit of the 226 depends also on the plate current and on the filament terminal voltage, as is shown by the curves in Fig. 81. Each of these curves has a point where the hum is a minimum. When the filament voltage is 1.5 volts, which is equal to the rated filament voltage, the minimum occurs when the plate current is 3 milliamperes, while when the filament terminal voltage is 1.2 volts the minimum occurs when the plate current is 2 milliamperes. As the plate current decreases below the point of minimum ripple, the hum increases very rapidly, and as the plate current increases beyond the point of minimum ripple, the hum also increases rapidly, although not nearly so fast as when the current decreases.

These curves show clearly that it is of utmost importance to design the circuit so that the plate current operating point is where the hum is minimum. The necessary adjustment can be made in several ways. First, the filament voltage can be altered to bring about the desired effect, which is proved by the fact that the two curves have mimima at different points. Second, the plate voltage can be varied so as to bring the plate current to the value which gives least hum. Third, the grid bias can be changed until the same effect is obtained. Fourth, the load impedance can be changed to minimize the hum voltage. Of these four methods those of changing the grid bias and the plate voltage are the easiest to apply. In a practical circuit probably both methods would be used, the plate voltage change for rough adjustment and the grid bias change for fine adjustment.

CHARACTERISTICS OF THE 226

Filament voltage	1.5
Filament current, amperes	1.05
Amplification factor	8.2
Plate voltage, maximum	180.
Plate voltage, average	135.
Grid voltage for 135 V. plate	10.5
Mutual conductance, micromhos	1,100.
Plate resistance, ohms	1,100.
Plate resistance, ohms	7,400.
Plate current, milliamperes	6.0
Maximum undistorted power, milliwatts	
at Ep = 180 and Eg = 13.5 volts	160.
at Ep = 135 and Eg = 9 volts	70.
Grid-plate capacity, mmfd	10.5
Grid-filament capacity, mmfd	6.2
Plate filament capacity, mmfd	5.6

Type of filament, oxide coated ribbon.
Type base, standard UX.

'Phone Connections

By William N. Baker

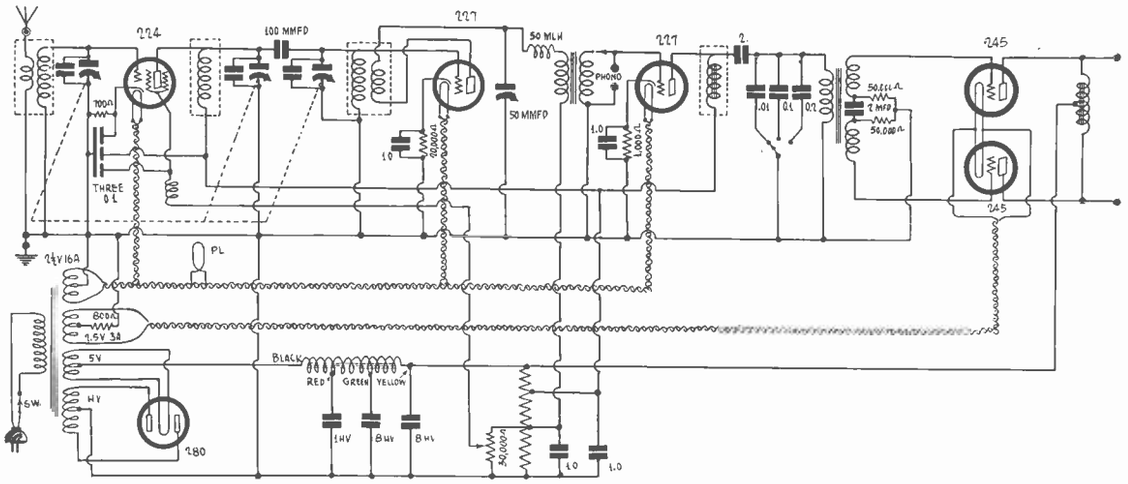


FIG. 1

THE DIAGRAM OF AN AUDIO POWER AMPLIFIER SHOWING HOW THE PHONOGRAPH PICK-UP UNIT MAY BE CONNECTED ACROSS THE SECONDARY OF THE FIRST AUDIO TRANSFORMER

THERE are many methods of connecting a phonograph pick-up unit to an audio amplifier and the question often arises as to which is the best. In general it is not possible to say which is the best because it depends on the design of the amplifier, the amplification, the efficiency of the pick-up unit, the efficiency of the loudspeaker, and on the volume desired.

In most instances it is best to connect the pick-up unit in the grid circuit of a tube used as amplifier. But this tube may be the detector in the radio receiver or it may be any tube succeeding the detector. The next best place is to connect the pick-up unit in series with the primary of one of the audio transformers, usually the one that follows the detector. Another method of connecting is to put the pick-up unit in series with the cathode lead of an amplifier tube such as the 227.

When the pick-up unit is connected in the grid circuit it may be connected across the secondary of an audio transformer as is illustrated in the drawing herewith. The impedance of the secondary winding is so high compared with that of the pick-up unit that there is practically no loss from the shunting effect of the secondary. However, by means of a simple switching arrangement the transformer secondary can be opened on one side when the pick-up unit is connected and this will eliminate the small shunting effect.

Double Throw, Double Pole Switch

A very good way of switching is to use a double throw, double pole switch, the moving blades of which are permanently connected to the input of the amplifier. One pair of poles would then be connected to the pick-up unit and the other pair to the output of the radio receiver detector or the first audio amplifier. This method is employed by one of the large phonograph companies.

One common method of connecting the pick-up unit is to connect one terminal to the grid of an amplifier tube, or of the detector, and the other side to ground. This method, however, is directly applicable only to circuits in which there is a stopping condenser in the grid lead as in the case of resistance coupled amplifiers and in circuits utilizing grid leak and condenser detection. The only object of the stopping condenser is to prevent any shunting effect of the pick-up unit.

When there is any danger of shunting the pick-up unit when it is connected in this manner its switch can be used to open the shunting circuit, and only a single pole, double throw switch is needed. One side of the pick-up unit is permanently grounded, or connected to a suitable negative point, and the other is connected to one pole of the switch. The output of the radio receiver detector is connected to the other. The moving blade is permanently connected to the grid of the tube to which the pick-up is to be connected. When the switch is thrown in one direction the pick-up unit is connected and the receiver is disconnected. When it is thrown the other way the pick-up unit is disconnected and the radio receiver is restored to its normal condition. This scheme should not be used in the detector grid circuit because the switch will introduce undesirable capacity effects. It is all right to use it in the first audio amplifier grid, or any other amplifier grid after the detector tube, because here small capacities do not matter.

When the pick-up unit is connected to the primary of an audio transformer perhaps the best way is to use the double pole, double throw switch referred to above. The primary terminals are then connected to the middle points of the switch, the pick-up unit to the two points on one side and the leads to which the primary was previously connected to the remaining two points. When this is done the plate voltage is disconnected when the switch is thrown to the pick-up unit, which is desirable.

Connecting to Primary

Nothing has yet been said about matching of impedances. Some regard it as essential that the pick-up unit work into an impedance equal to its own. When the unit is connected in the grid circuit without any shunting device it works into what amounts to an infinite impedance. When it works into a primary of an audio transformer it works into an impedance much higher than its own. There is no particular disadvantage to make it work into an infinite impedance because the signal voltage is generated in the unit just the same and all this voltage is impressed on the grid. When it works into a transformer primary it may be worth while to introduce a matching device between the unit and the primary, and this device should be a transformer the primary impedance of which is equal to the impedance of the pick-up unit and the secondary impedance of which is equal to the primary impedance of the audio transformer. There are such transformers available.

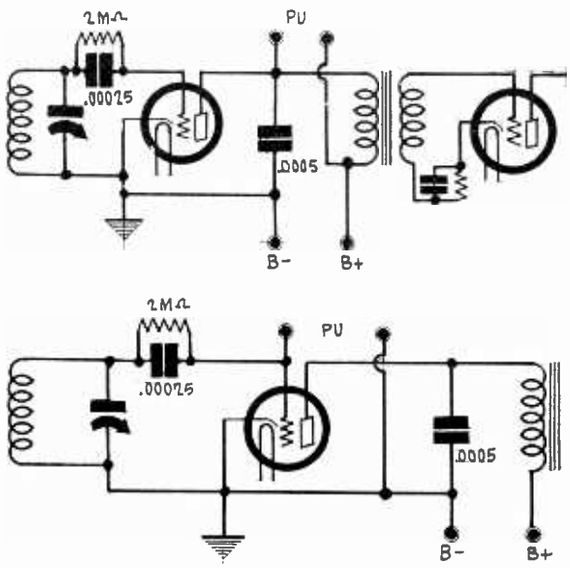


FIG. 2

TWO OTHER METHODS OF CONNECTING THE PICK-UP UNIT

Antenna Heights

By Hood Astrakan

THE collectible signal voltage strength may be said to increase as the height of the antenna above the earth increases. As an observation this is true, but in the metropolitan area the height above ground is a fictitious measurement, because the ground here is the tops of the skyscrapers, a fact that no one viewing an aërial photograph of a big city would deny. But in suburban locations this height "error" is not as critical a factor, hence it will not be necessary to pay such strict attention to it.

The suitability of a certain length of antenna to a given radio set is measured by the reception results, to a large extent. In general, the longer the antenna the louder the signals, also the less the apparent selectivity. Find the shortest length of conductor that gives the best average results with the given height of collector and receiver. Then if the signal is not loud enough, raise the pick-up system until a height has been found that gives the desired results, and leave it there.

This statement opens room for discussion as to the relative effect of conductor length and its height above the earth, on the strength of the desired signal, another point in which the several quizzers were interested in, and at which we can have a look at now.

One function of an antenna is that it tends to respond to the frequencies induced in it to an extent that is influenced by the intensity of the incident flux wave, and since the waves have length, or the property of recurring every so often, the length of the system has a much more pronounced effect on the selective processes, whereas the height has a more direct effect on the resultant loudness of the receiver.

How Waves Travel

Fig. 1 concerns a related topic. Here we have the two systems, transmitter and receiver, so placed this time that we can see the propagation of the wave form, and how it decreases in amplitude from the transmitting antenna on its way to the receiving antenna. The dotted line "A" shows how the carrier envelop width decreases as the wave form travels away from the point oforigin, this slope representing the decrease of signal voltage.

Two horizontal conductors are shown, and the wave from one is seen to coincide with that of the other. Also the two waves are represented as being of uniform height in the region directly over the two transmitting wires, a state of affairs that is true for the relative locations of the two systems, but which might not be an exact representation if these were to be chanbed. In other words, the precise effect of a given wave form depends on the manner of its incidence upon the receiving antenna. This fact explains some of the contradictory results observed by fans who state that their antennas extend in the same direction.

Unexpected Interference

The explanation of this phenomenon is found in the effect of refraction of radio waves, a kind of bending of the advancing entirely new one, and therefore if a path change occurs in between two systems, the observers at each are bound to reach totally different conclusions.

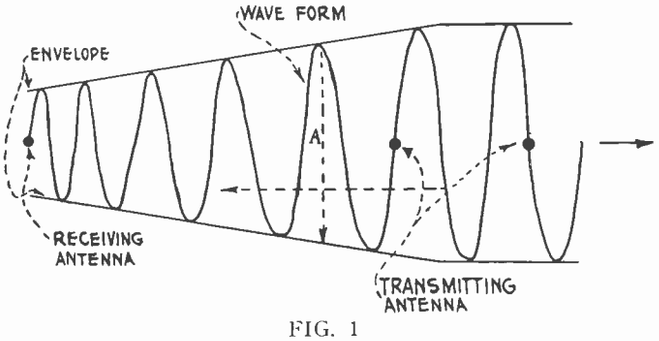


FIG. 1

A HORIZONTAL COMPARISON-VIEW OF THE TRANSMITTING AND RECEIVING ANTENNAS

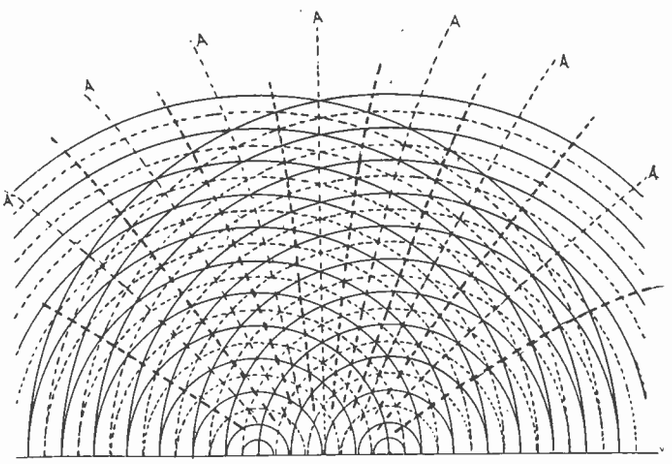


FIG. 2

AN INTERFERENCE PATTERN SHOWING A CASE WHERE TWO SOURCES OF FREQUENCY PRODUCE INTERFERING WAVES OVER A WIDE AREA.

Fig. 2 is a diagram that very likely is not familiar to the reader, since it deals with a phase of reception that the fan cannot put his finger on readily. If the two slits from which the concentric waves issue outward radially, are imagined as two transmitting wires, parts of the same system, each sending out its own set of waves independently, a time will arrive when the two wave forms, meeting each other, set up an interference area in a specific place. If this place happens to be the region of your antenna the logical result is that you will hear this interference, as a noise called a heterodyne.

Interference may result from several causes, but in the case shown the two waves have the same frequency, although they issue from sources some distance apart. This similarity of the waves does not preclude their interfering with each other. Inspection shows that the lines of this interference are very definite indeed and also uniformly distributed with regard to the central axis.

Diverse Distribution

In radio this interference path does not assume very uniform distribution, but is more likely to be erratic. But the listener can do little but complain if the reception is faulty. A study of the wave-path chart shows that the alternate lines are full and dotted. The full lines are the wave crests, while the dotted lines are the troughs, these designations being the points of minimum flux intensity, and the places where the dotted lines cross the full lines are the points of neutralization, or interference, whereas the points where the similar lines cross are additive, either negatively or positively.

Britain to Erect Strong S W Station

London.

The British Post Office has announced that the British Broadcasting Corporation shortly will be operating a new world-wide short wave transmitter that is to be located in Daventry, and which will be on a par with the well-known short wave transmitters of Holland and Germany.

The service range of the new station is expected to be of material benefit in enabling continuous radio communication to be maintaned between the British Isles and various possessions. Work on the new transmitter is to begin in a few days, and when the station starts operating the first service schedule will be of intermittent nature, during the adjustment period.

How the Science of

By John C

HEINRICH HERTZ, AS HE LOOKED ABOUT THE TIME HE READ HIS NOTABLE PAPER ON INDUCTION. THIS ENGRAVING WAS THE FRONTISPIECE OF SIR OLIVER LODGE'S "THE WORK OF HERTZ AND HIS SUCCESSORS," PUBLISHED IN 1890 BY THE ELECTRICIAN PRINTING AND PUBLISHING COMPANY, LTD., OF LONDON.

A STUDY of the historical aspect of the radio art brings many interesting details to light, as the early scientific workers, to get at thesolution of difficult problems, in many instances had to spend considerable time, due largely to the lack of suitable apparatus, and the result of all this was the compilation of a vast mass of preliminary experimental data. These were recorded in such manner that it is necessary for one to read through a mass of literature covering a period of nearly fifty years, prior to 1870, before it is possible to begin to collate an orderly sequence of discoveries pertinent to the radio, art.

If it were to be asked, "Where did. the art of radio communication derive its foundation?" it would be impossible, for many reasons, to point to the work of any one individual. In fact the researches of those interested in the possibilities of transmission of intelligence without wires were so diverse that for many years there was no concerted effort along any one line of endeavor, although records show that plenty of thought had been spent on various phases.

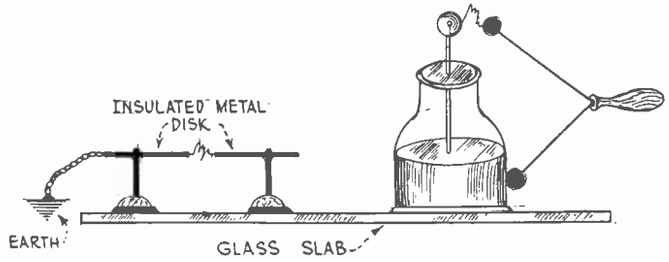
This all meant that it was necessary to do a very considerable amount of experimental work, by which the physical workings of predicted electrical laws were investigated; that is, were shown as manifestations, and these laws subsequently were confirmed. Later, after a considerable amount of experimental data was collected in various forms, the foundation work of our present electrical units system was laid. So to the scientists of the early eighteenth century belongs the credit of discoveries, through the medium of which later scientists in a large measure have progressed.

To the present-day students the early lack of knowledge of facts now commonly known may seem to have acted as a natural barrier to progress, but if it will be reflected that the discrepancy here was countered by an almost limitless imagination on the part of those workers, a very different complexion is put on the whole case. When it is remembered the outstanding theory of that day, the electromagnetic theory of light, and associated phenomena, were presented by the famous mathematician, Clerk Maxwell, in 1765, long before anyone had the idea of attempting to confirm the theoretical conclusions that were set forth, the magnitude of the pioneer work becomes obvious.

Electricity and Amber

The word "electricity," so universally known, is derived from the Greek word "elektron," which means amber. One of the fundamental requirements of the production of electrical phenomenon is that we must have insulators and conductors, because without these there would be no means of storing or releasing a charge.

The preliminary study of radio or any other phenomenon utilizing a form of electrical discharge is best approached by considering some examples shown by effects manifested when an insulator is rubbed briskly by another one, preferably a cloth.



THE EXPERIMENT OF ADAMS

Interest Aroused

Interest in electric signaling had been fostered in the principal European countries, notably Germany, Italy, France and England.

The ideas considered fundamental to an understanding of the electrical art prior to 1851 are just as necessary now as they were then, the only difference being that the ideas are more highly developed now. For instance, the idea of charge transference and its relation to two associated phenomena. When a charge is transferred slowly, the effect is called a current flow, but an extremely rapid current flow was called a discharge, and while the validity of this definition cannot be questioned, it is readily admitted that we do not think about the phenomena of current flow in the same way. We associate the idea of a discharge with high-voltage, at least in a relative sense, while we don't associate current with high-voltage necessarily. But nearly all early scientists agreed that an understanding of the phenomenon of induction was very necessary; in fact it was held to be basic where electric signaling was concerned, and as a consequence several experiments were made that stimulated unusual interest in what was then an obscure subject.

Lodge Active

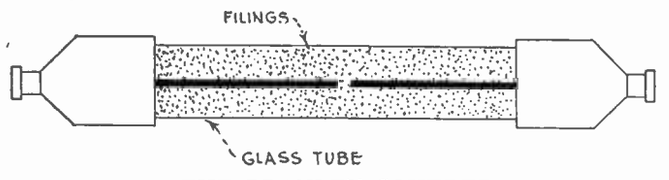
Sir Oliver Lodge in 1851, fond of making unusual experiments, found that some needles located in the basement of a building in which he was working could be magnetized quite readily if a wire parallel to their axis (horizontal), the wire being on the second floor, was in the circuit of a system through which a heavy discharge could be routed.

Even a small discharge was found to be effective, and the distance over which this effect was registered was about 50 feet. Earlier experiments were made by physicists not exactly identified with transmission research, but whose labors did contribute not a little to the better understanding of induction effects, which by this time, it was felt, held the key to long-distance transmission of intelligence "without wires."

Matteucci. in 1820, and Adams, in 1790, performed the earliest known induction experiments, and they are reproduced here, because the Matteucci experiment was identified with the phenomenon of the Leyden jar discharge, the Italian being among the first to suspect that the discharge was oscillatory in character, thus accounting for the transmission of pulses over a long distance.

The production of wave action at a distance, as induction was called in those days, resulted in Branley's induction experiments with a magnetic wave detector of ingenious design, which in its first form consisted of a glass tube which contained a mixture of fine particles, whose function was to cohere when an electromagnetic wave crossed the tube at right angles to the axis, the name of the device being the "coherer."

The advent of this device was hailed as a decisive improvement, and Branley continued with his experiments and evolved subsequent models that were to play an important part in radio developments.



THE BRANLEY COHERER

Radio Got Its Start

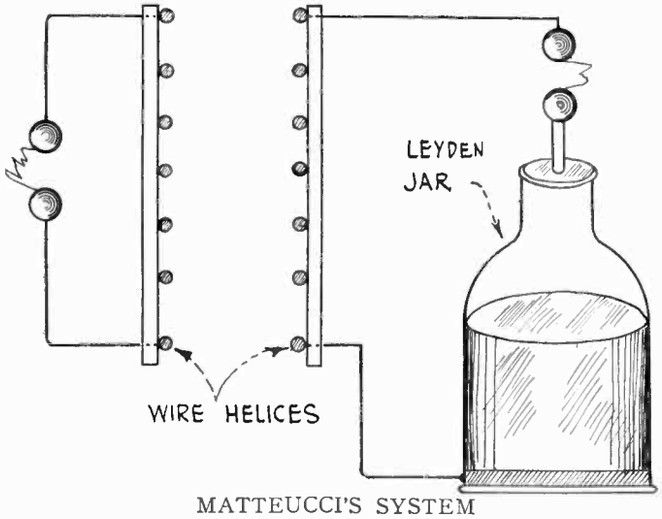
Williams

Called Decisive Improvement

Righi was also carrying on some independent research on oscillating electric fields and found that the shape of an insulated conductor influenced to a very great extent the charge that it would assume under a given condition. It may be news to some readers that the action of a charged conductor was known prior to the eighteenth century, and in experiments involving Leyden jars this is touched upon, according to Adams, who cites the writings of Cuneus and Muschenbrok.

Of singular interest is the finding of J. B. Lindsay in 1853. He pointed out the feasibility of sending messages over water and obtained a patent on the system in 1854.

The details of this system may be found in the "Philosophical



MATTEUCCI'S SYSTEM

Magazine" of the same year. Riess and Henry showed some interesting results of their researches in the nature of the oscillatory discharge of a Leyden Jar, a subject that at this time was interesting many, as this device was the only source of oscillating currents available.

Paazlow and Lodge proved the true nature of this type of discharge, and Lodge demonstrated the induction effect by charging a big Leyden Jar, and magnetized a number of needles at the far end of the lecture table, at a distance of 30 feet.

Prize Offered, Hertz Wins

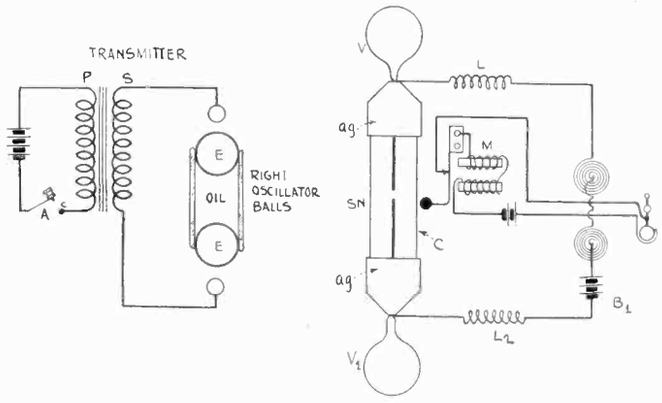
The Berlin Academy of Science offered a prize (1884) to the one who could show the relation between the dielectric polarization and electro magnetic induction. The award was won by Dr. Heinrich Hertz, of Carlsruhe and Bonn,, who presented a convincing paper which is now classic. A study of these early records reveals that circuit synchronism was realied to be of fundamental importance if signals were to be transmitted to any great distance, and therefore when two systems were adjusted so that they were electrically identical it was found that the responsive spark was of the greatest length.

The condition necessary for this effect was named "syntony" and its importance was stressed by Hertz in 1887.

The earliest approach to the antenna as we know it to-day was Matteucci's system, the transmitting and receiving conductors being large helices of heavy copper wire that were held in place in spiral form by a heavy coating of varnish applied in successive layers. Lodge's receiver, made years later, used two parallel copper rods, as the transmitter and receiver, respectively, and subsequently Lodge showed that high frequency electric waves could be reflected by a parabolic mirror to any desired degree. Hertz showed the same thing independently, but both scientists working at the same time evolved the basic ideas behind the present-day beam wireless system, extensively used abroad, especially in England.

In 1877 the names identified with the early development of the radio art were Nollet, Faraday, Henry, Preece, Bezold, Hertz, Branley, Righi and Lodge.

Prior to the classic Lodge resonance experiment, as it is known at present, was an induction experiment of Sir Henry Preece, where two parallel wires, parts of receiving and transmitting systems, were set up. In this system of signaling one of the wires was charged intermittently and the other parallel wire discharged into an electroscope.



GUGLIELMO MARCONI'S SYSTEM

Self-Induction Called "Bugaboo"

The apparatus used in the Lodge resonance demonstration consisted essentially of two Leyden jars similar in structure, one of them excited by an induction coil and associated spark gap system, the other one associated with an adjustable loop collector. The excited jar was provided with a collector, only it was fixed. The exciter jar was operated, and the length of the adjustable loop collector varied slowly until a spark appeared at the secondary gap. The spark gap length of the secondary gap is a small fraction of that of the exciter gap, so the balls have to be set quite close together in order that the spark may be observed.

Preece writes that in the early days the term self-induction was called "bugaboo" presumably because no one knew what it was, but Lord Kelvin called it a "coefficient of dynamic capacity" and Maxwell also used a similar description.

By this time there had been a lot of overlapping work done on all kinds of oscillatory circuit research work, and it was with somewhat of a surprise that the news was received that Joseph Henry (1842) confirmed the similarity between etheric disturbances and high temperature radiations, thus giving to the world of science the first intimation of the photo-electric effect, which he demonstrated most convincingly by a setup that consisted of an electroscope to which was attached an electrode of highly polished zinc. The zinc plate was charged positively first and then sunlight was allowed to fall on it.

The electroscope remained charged. Then the experiment was repeated. This time the zinc plate was chargd negatively and sunlight was allowed to fall on it, and the electroscope discharged slowly. Later Henry, by using a quartz prism, found that a short distance beyond the faintest violet lines of the sun's spectrum the discharging effect was most effective, giving part confirmation of the fact that the discharge was due to ultra-violet light. And also he pointed out the extreme difficulty in avoiding phenomena in radio transmission that were not connected with light waves.

The Ether Comes Into Consideration

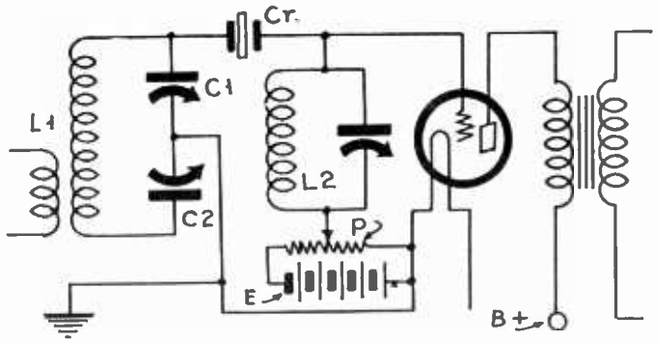
Professor Elihu Thompson, in Philadelphia (1875) showed the same effect, and also demonstrated that the discharges observed by Lodge in connection with his syntonic jars were oscillatory, and referred to them as alternating currents of very short duration. The fact that was confirmed by Thomas Edison, who drew sparks similar to those of Lodge from insulated metallic objects, and referred to them as manifestations of etheric force. This took place in 1875 also.

The field of induction phenomena had been studied quite well by now and it had been found that the experiments of Lindsay regarding the comparatively greater distances coverable over water with a given signal output were a reliable indication of what might be expected with improved apparatus, and the attention of Guglielmo Marconi was drawn to this phase of the transmission art. He foresaw the benefits that would accrue from international communication, and accordingly a series of tests (1899-1902) was inaugurated which culminated in the successful transatlantic transmission of the letter "S" from Cornwall to Nova Scotia, which marked the beginning of the modern era in radio and also telegraphy.,

(Continued next week)

Insight Into Radiostat

By A. J. Endson



THE QUARTZ CRYSTAL IN THE GRID CIRCUIT OF THE SECOND DETECTOR OF A SUPERHETERODYNE

LAST week we discussed the Stenode Radiostat, a type of Superheterodyne utilizing a quartz crystal to obtain an extraordinarily high selectivity. The claim for the new system of radio reception is that it makes possible the use of such high selectivity as to enable the crowding of several broadcast channels into the spectrum space now occupied by a single channel and to do this without sacrificing quality.

The explanation of the fairly good reception obtained with the high selectivity rests on an inconsistency. There are two ways of looking at a modulated wave: first, that it is composed of a carrier wave and two side frequency waves, each constant in amplitude as long as the modulation is constant; second, that it is composed of a single wave in which the amplitude varies in time according to the impressed modulating wave. These two views are admittedly equivalent and mathematically identical. Yet those who try to explain reception through the quartz crystal reject the side frequency view as being incapable of explaining the phenomenon and accept the variable amplitude view as being quite adequate.

Such arguments can only be accepted by those who would say that two 25-cent pieces will buy more than one 50-cent piece.

Similar to Fading

Another point in the argument was that in order to receive clear signals it was necessary that the transmitting station be free from frequency modulation, or what is sometimes called "wobbulation." Certain phenomena similar to fading noticed in the reception were ascribed to frequency modulation, but evidence was far from convincing. The fact is that there are many other sources of fluctuation in frequency more likely to cause the trouble than the fluctuation in the frequency of the broadcast station, in most of which the frequency is controlled by means of quartz crystals more selective and less subject to variation than the crystal used in the receiver in question. One cause is variation in frequency of the oscillator in the circuit itself.

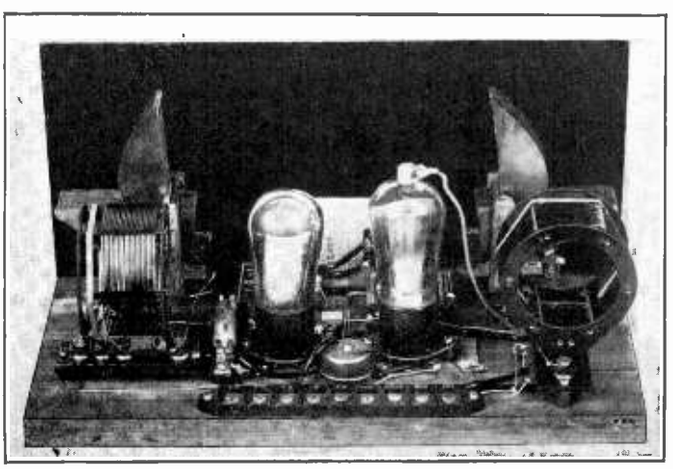
Oscillator Frequency Change

The local oscillator, apparently, was not suspected of any frequency variation at all. But all Superheterodyne oscillators vary in frequency due to several causes. If the signal went out for seconds or minutes at a time, the oscillator probably was the cause. A light touch of the oscillator control would demonstrate whether this was so. When the intermediate frequency must be held so constant as to pass through a quartz crystal it is obvious that the local oscillator must be held to an equal constancy. A quartz crystal may permit frequency variation of say 50 cycles. An ordinary Superheterodyne oscillator might vary as much as 10,000 cycles in a million cycles. Many small American broadcast stations have got into trouble with the Federal Radio Commission because they permitted their frequencies to wander off more than 500 cycles from the assigned frequencies, and their oscillators are much more constant than oscillators used in Superheterodynes.

The Stenode Radiostat has possibilities, there is no question about that, but it would seem that its greatest usefulness would be in continuous wave telegraphy. But a 50 cycle transmission band is entirely too narrow even for that, especially if the speed of communication is to exceed the speed of communication by mail. It is very doubtful that the transmission band of a quartz crystal is as narrow as 50 cycles when it is used in this manner. By itself the crystal may have a very sharp resonance characteristic but when loaded its characteristic must be considerably broader. This appears to be a hope for the system.

One of the advantages of this system is that of band pass filters. The crystal admits, say, a band of 5,000 cycles, highly attenuated at the higher audio frequencies. The audio frequency amplifier is then designed so that it amplifies the low audio frequencies very little and the high very much. If the frequency characteristic of the audio amplifier is complementary to that of the intermediate circuit, that is, the crystal, since that supplies the greater part of the selectivity, a level characteristic could be obtained when the two are put together. Furthermore, if the audio amplifier has a very sharp cut-off at 5,000 cycles, or a little above, the overall effect would be that of an almost ideal band-pass filter. There would be practically no interference from frequencies above 5,000 cycles, whether these frequencies came from heterodyning oscillators or other sources. And the quality would be good if we can say that quality is good when everything above 5,000 cycles is missing. They would be missing for both the crystal and the audio amplifier would conspire to keep them out.

SHORT-WAVE COIL TESTER



A SHORT-WAVE RECEIVER THAT MAY BE USED FOR TESTING PLUG-IN COILS FOR FREQUENCY RANGE AND DESIRED OVERLAP WAS DESCRIBED LAST WEEK IN THE OCTOBER 4TH ISSUE. THE PHOTOGRAPH SHOWS THE LAYOUT OF PARTS.

Amplification Ratio Converted to Decibels

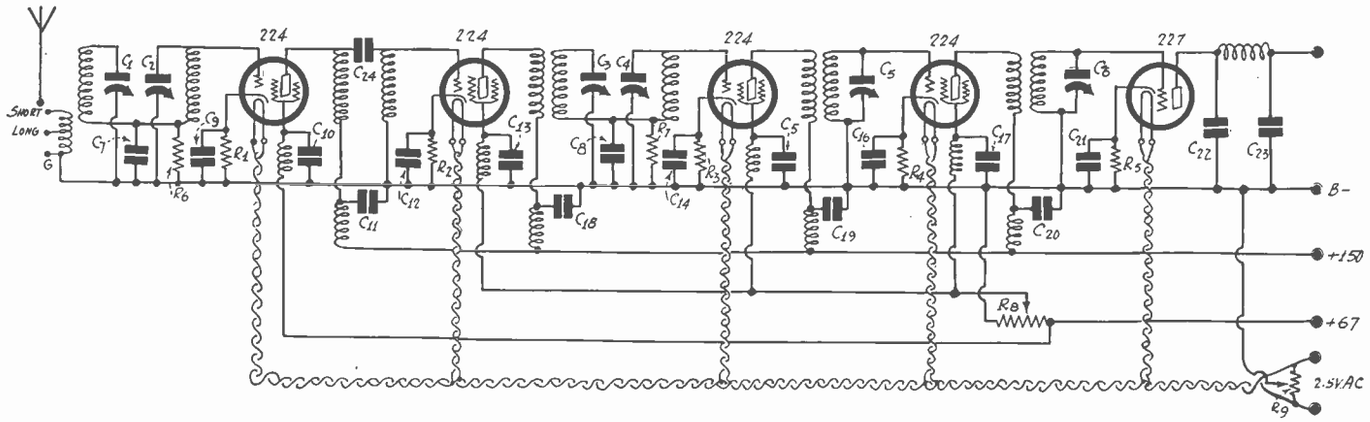
The definition of the decibel, which is twenty times the logarithm of the current (or voltage) amplification ratio means very little to most of us. But if we say that an amplification ratio of two means a gain of approximately six decibels and that each time the amplification is doubled the gain is increased by six decibels we may gain some idea of the practical applications of the unit. A few values of amplification ratios and the corresponding values of the decibel may make this clearer.

Decibels	*Amplification Ratio*	*Decibels*	*Amplification Ratio*
1	1.122	18	7.94
2	1.259	20	10.00
3	1.413	40	100.0
4	1.585	60	1,000.
5	1.778	80	10,000.
6	1.995	100	100,000.
12	3.98		

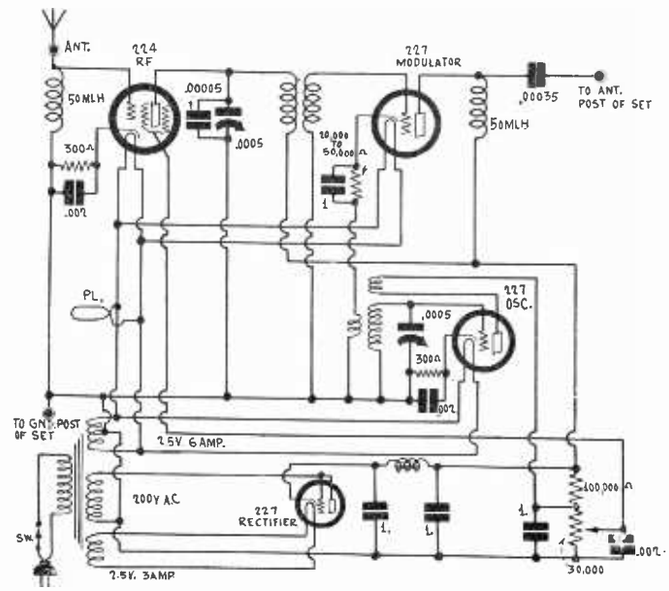
The decibel is primarily a unit of gain or loss but sometimes it is used to express level or volume and in this case some particular value has to be taken for zero level. In the case of the American Telephone and Telegraph Co., it is used extensively both as a gain and a level unit and their zero level is taken as one milliwatt into a six hundred ohm impedance which means a current of 1.29 milliamperes and a power of one milliwatt. Of course this unit would be impractical in radio. As far as I know there is no standard as yet in Radio practices.

ORA G. FRETZ.

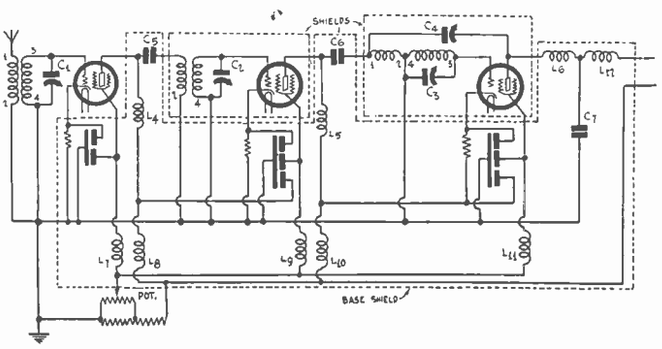
AC Circuit Diagrams



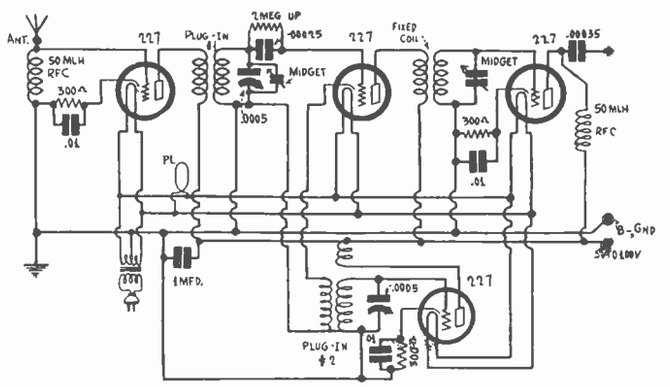
An example of careful receiver design is represented by the circuit diagram above, which is that of the National MB-30. Every plate and screen lead contains a radio frequency filter coil and every coil is by-passed with a condenser of relatively large value. The tuned circuits are of the band pass type, giving the receiver a high channel selectivity and very little frequency discrimination in the desired band. The volume is controlled by controlling the screen voltages of three of the amplifier tubes, using for this purpose a high resistance potentiometer.



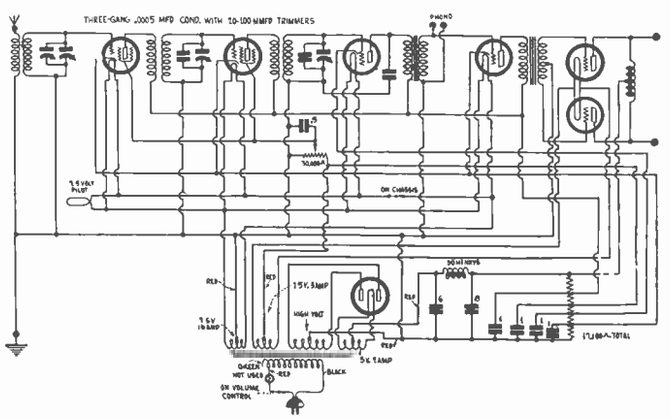
Here is the circuit diagram of a complete short-wave converter comprising one stage of untuned radio frequency amplification, a modulator with tuned input, an oscillator, and a B supply, utilizing a 227 tube for rectifier. The pick-up coil is connected in series with the grid bias resistor of the modulator tube.



The circuit diagram of an AC tuner utilizing screen grid tubes and built along the line of the famous Find-All Four. The supply leads are well filtered to insure stability of the circuit. Control of volume is effected by adjusting the screen voltages of all the tubes by means of a higher resistance potentiometer.



This circuit is also that of a short-wave converter but it utilizes grid condenser and grid leak detection in the modulator. It also has one stage of intermediate frequency amplification the input circuit of which is tuned with a midget variable condenser. The pick-up coil is connected in the cathode lead of the modulator in the position ordinarily occupied by the bias resistor.



Two stages of screen grid amplification, a 227 detector, a 227 audio amplifier, and a stage of push-pull amplification with 245 tubes make a splendid receiver, provided that it is properly tuned and powered as this circuit is. The high voltage is supplied by a B battery eliminator using a 280 tube. Provision is made for connecting a phonograph pick-up unit to the secondary of the first audio frequency transformer.

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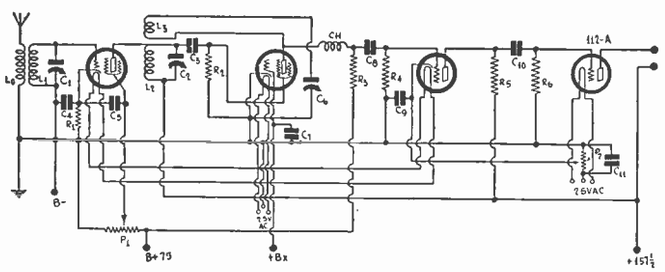

FIG. 854
THE CIRCUIT OF A FOUR-TUBE RECEIVER UTILIZING RESISTANCE COUPLED AUDIO AND A REGENERATIVE SPACE CHARGE DETECTOR

WHAT is the advantage of connecting condensers across the chokes in the filter of a B supply? If there are any disadvantages please mention them.—W. H. C.

If the condenser capacities are chosen properly with respect to the inductances of the chokes, the chokes and condensers will form tuned circuits which present very high impedances to the hum frequencies. Better filtering with less expensive chokes results. However, the condensers will pass the higher frequencies so that if there is much harmonic content in the rectified current this will get through. The condensers might be selected so that the 60, 120 and 180 cycle components are suppressed.

* * *

Tone Color

WHAT is the meaning of tone-color? I have seen this term in descriptions of certain radio sets.—C.W.J.

Tone-color is a term used by one radio manufacturer to signify a tone control. That is, it is a device by means of which the radio listener can select the particular tone that appeals to him.

* * *

Regeneration by Plate Inductance

IS IT possible to induce regeneration in a detector circuit by putting a variable inductance in the plate circuit? If a fixed coil is used is it possible to control regeneration, if regeneration results, by means of a variable condenser in series with the coil?—P. A. W.

It is possible to induce regeneration in this way and this was standard in the early days. It is safer, however, to put the plate inductance so that it is in inductive relation with the tuned circuit ahead of the detector. When this is done regeneration can be controlled by means of a variable condenser.

* * *

RECENTLY you have been showing amplifier circuits with 50,000-ohm resistors in the grid return leads of the power tubes with a condenser across the two in series and connected between the returns of the two halves of the secondary of the input transformer. What purpose do the condenser and the resistors serve?—M.C.G.

There is inevitably some unbalance in a circuit of this kind and the arrangement of the condenser and the two resistors serves to eliminate most of the unbalance. A voltage is generated in each of the halves of the secondary and the two may be slightly different. The condenser and the resistors tend to divide the total voltage across the two equally between the two power tubes. There may be a difference of opinion as to the exact way in which this is brought about but there is no difference of opinion as to the effect. The arrangement improves the quality very appreciably.

* * *

Advantage of Low Filament Voltage

WHAT is the reason three-element tubes intended for amplification with AC on the filament are designed for low filament voltage? Do such tubes have any advantages over tubes designed for higher filament voltage?—N.C.W.

When AC is used on the filament there is considerable hum, and the amount of hum depends on the value of the filament voltage as well as on the ruggedness of the filament. The lower the filament voltage the less the hum and also the more rugged the filament the less the hum. Hence amplifier tubes, especially those in stages other than the last, are designed with a low filament voltage and heavy filament current. In the power stage it is not necessary to use low voltage on the filament because the hum is not amplified by any other tubes. Hence the hum is not noticeable. It is better to use 227 type tubes than directly heated tubes in all the amplifier stages.

* * *

Winding Data for Coils

HOW many turns of No. 28 double silk-covered wire should be wound on 2-inch tubing to cover the broadcast band with a .0005 mfd. condenser? How many turns should be put on the primary if this is wound on the same diameter? —J. J. K.

For the tuned winding 58 turns will give the right inductance. If the primary is to be connected in the antenna circuit 15 turns will be enough. If it is to be connected in the plate circuit of a 227 or any other tube having approximately the same characteristics, 20 to 25 turns will be about right, and if the primary is to be connected in the plate circuit of a screen grid tube, the number of turns should be around 40. In any case, lack of turns on the primary may be made up by putting the turns closer to the secondary winding, within certain limits. It is only the secondary, or tuned winding which requires a particular number of turns.

* * *

Using Screen Grid for Control Grid

YOU have published curves showing the relation between the plate output voltage and the screen voltage, and they appear to be like curves between the control grid voltage and the plate output voltage. It occurred to me that it would be possible to apply the signal in the screen circuit on top of the positive voltage and thus get amplification. Is this feasible? —H. H. C.

It is not feasible because the control grid would then be positive and the input circuit would draw current. Moreover, even if it were practical to permit current the amplification would not be great enough to warrant the connection. This does not mean that the screen grid cannot be used as control grid when it is made negative with respect to the cathode or the filament. It is quite practical to use the screen grid for control grid provided it is made suitably negative and a positive voltage is applied to the inner or the usual control grid.

* * *

B Supply Voltage Control

I HAVE a B supply unit which gives me higher plate voltage than I can use with safety on the plate of the 245 tubes. When I put a high variable resistance in the primary of the power transformer I could cut the voltage to the desired value but this also reduced the filament voltage on the tubes to the point where the amplifier tubes would not operate right. Can you suggest a reason for this reduction in the filament voltage and also can you suggest a way of reducing the plate voltage without at the same time cutting down the filament voltage?—A. G. F.

All the voltages in the secondary windings are directly proportional to the voltage actually impressed across the primary terminals. This is true whether the voltage is stepped up or stepped down. If you put a variable resistance in the primary line you cut the voltage impressed on the transformer and therefore all the secondary voltages are reduced in the same ratio. If you want to cut down the plate voltage alone you should tap the voltage divider at the proper point, just as you tap it for the lower voltages. The only time a resistance should be used in the primary of the power transformer is when the line voltage is higher than the voltage across the primary terminals should be, and then only enough resistance should be used to cut the excess. For example, if the line voltage is 125 volts and the transformer has been designed for 115 volts, the resistance should be high enough to drop 10 volts only. Just what this resistance should be depends on the total power taken by the transformer, that is, on the current flowing when the voltage across the transformer is 115 volts. The current might be as high as one-half ampere, when the resistance should be 20 ohms to cut the voltage 10 volts.

* * *

Noisy Antennas

MY set has become very noisy lately and I have been unable to locate the cause of it. I have made many substitutions of parts and even tried a different set without any improvement. The noise is a type of crackling. Could it be possible that the antenna is the cause?—W. A. T.

The noise may originate either in your antenna or in the antenna of one of your neighbors or the trouble may be in the electric power circuit. Your first move should be to check your own antenna to make sure that it is all right. There is

a defective contact somewhere or perhaps a wire is scraping against a piece of metal. The trouble should be worse when the wind is blowing if it is due to a swinging wire. If the wire is not exposed to the wind it may be that vibrations in the building cause the trouble.

* * *

Use of Vacuum Tube Potentiometer

IN the September 20th issue you published a vacuum tube voltmeter utilizing a 227 and a 250 tube. Suppose you wish to measure a voltage higher than the range of the voltmeter V or higher than the voltage drop across the potentiometer P. How would you do it?—C. W. R.

The method is first to measure the voltage of a battery, say of 45 volts, and then connect this in the grid circuit in series with the unknown. Connect the minus of this battery to the positive Vx and then connect the positive of the unknown to the positive of the battery. Then when balance has been obtained the measured voltage of the battery should be added to the reading of the voltmeter V. When the voltage of this auxiliary battery is measured its positive terminal should be connected to the positive for Vx and its negative terminal should be connected to the negative for Vx. When it is to be used as auxiliary it is simply reversed.

* * *

Short Wave Reception

WOULD it be possible to build a short-wave set utilizing a single regenerative stage which would be sensitive enough to receive European stations on a headset?—N.N.P.

It is possible by taking every precaution to get a good tube, a good antenna suitable for short waves, and a very efficient circuit. With all these precautions it would still be necessary to await propitious moments for reception. It is very doubtful that any given station could be received any time it is on the air. In fact, it is doubtful that any set could be made sensitive enough to insure reception at all times.

* * *

Adapting an AC Set to DC

I HAVE direct current in my home and I wish to use a commercial set designed for alternating current. Is there any way of adapting the AC set to DC? If there are more ways than one will you kindly say which is the best?—J. J. O'B.

The best and only practical way of adapting an AC set to DC is to get a motor generator which changes the DC into AC of suitable voltage. Such machines may be had in different sizes but one may cost as much as the receiver.

* * *

Comments on Tone Control

IF a condenser of 0.1 mfd. capacity is put across the loudspeaker or across the primary of the first audio transformer for the purpose of cutting out the high frequencies, what proportion of the high signal voltage at 5,000 cycles is cut out?—W. V. C.

The effectiveness of a by-pass condenser depends on the impedance across which it is connected. If a 0.1 mfd. condenser is put across the voice coil of a dynamic speaker it would not have much effect. If, on the other hand, it is connected across the secondary of a first class transformer its effect would be very considerable. If it is connected across the primary of the same transformer the effect would not be so great, yet it would be greater than if it were connected across the voice coil of a speaker. And if it is connected across a coupling resistor of say 100,000 ohms the effect would also be great. At 5,000 cycles the voltage across the condenser and the resistance would only be 1/316 as great as if the condenser were omitted.

* * *

Tuning of Primary in Superheterodyne

WHICH is better, tuning the primary or the secondary winding in the intermediate frequency amplifier of a Superheterodyne when 224 screen grid tubes are used in all the stages of the amplifier?—S. M. W.

There is very little difference if the transformers are designed properly. Of course, the designs in the two cases will be different. Tuning the primary usually results in slightly higher sensitivity but a lower selectivity than in the secondary. When the impedances are proportioned so as to get the maximum amplification in both cases there is practically no difference either in gain or in selectivity.

* * *

Space Charge Detector Circuit

I AM interested in a resistance coupled amplifier which utilizes the 224 screen grid tube as a space charge detector. I would prefer a regenerative detector and one stage of 224 screen grid amplification ahead of it. Will you publish a circuit like that? What resistance values do you recommend for coupling and grid resistors?—L. A. C.

In Fig. 854 you will find a diagram of this type of receiver. Suitable resistance values are 250,000 ohms for coupling and one or two megohms for grid leaks. Use .01 mfd. condensers between the plate of one tube and the grid of the next. C3 should have a capacity of .00025 mfd.

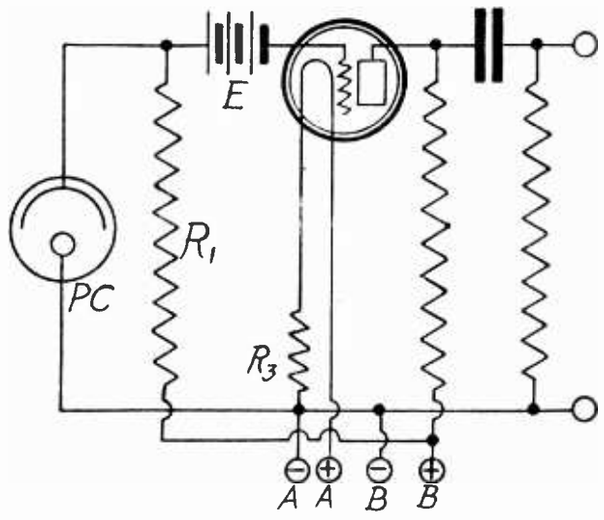

FIG. 855

THIS SHOWS HOW A PHOTO-ELECTRIC CELL CAN BE CONNECTED TO A RESISTANCE COUPLED AMPLIFIER. THE CIRCUIT MAY BE USED FOR REPRODUCING SOUND FROM FILM OR FOR THE TRANSMISSION OF PICTURES BY RADIO OR WIRE

Connection of Photo-electric Cell

WILL you kindly publish a circuit showing the connection of a photo-electric cell to a resistance coupled amplifier. Please state the values of resistors and voltages.—W.H.F.

Fig. 855 shows the connection of a photo-electric cell PC to a resistance coupled amplifier. Resistance R1 should be at least one megohm. The voltage of E must be adjusted so that the negative grid bias is right for the tube and the voltage applied on the photo-electric tube through R1. Provision should be made so that the voltage of E can be varied in steps of 1.5 volts. R3, of course, depends on the filament battery voltage and the tube in question. If the tube is a 240 and the battery voltage is 6 volts the resistance should be 4 ohms. The resistors following the tube are the usual values, 250,000 ohms for the plate resistor and one or two megohms for the leak. The stopping condenser should not be smaller than 0.01 mfd.

A THOUGHT FOR THE WEEK

NOW the racketeers are in radio. They're sending warning messages to the rum-running buccaneers of the Atlantic Coast and are stealing inside news about the stock market and flashing it to those who in turn clean up on the stolen information. One of these evenings we'll probably hear an announcer declare that "Our next offering will be 'The Radio Racketeers,' a new dramatic production by the permanent stock company of Station PDQ."

RADIO WORLD

Title Reg U. S. Pat. Off

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Ninth Year

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

Tests of Synchronization

THERE have been, and are, too many stations on the air for the existing facilities and the state of the science of broadcasting, which science somehow is almost always called an art.

It had been thought the solution lay either in the reduction of the number of stations, which would be a confession of weakness or of non-resourcefulness, or that the short waves would carry broadcast programs, by a downward shift of wavelengths of all the broadcasters. But the present outlook is decidedly different. Now synchronization looms as a solution. Should this prove wholly suitable it would provide an excellent remedy, for even high-powered stations, sufficiently separated geographically, might use the same wavelength. Now experiments are under way whereby two stations synchronize at a time, but the thought of having even a chain on a single wavelength is in the minds of many.

Recently the Federal Radio Commission voted down a proposal to make synchronization compulsory for two or three high-powered stations on one wave, and regarding several waves, in different parts of the country, but the vote was close, 3-to-1, showing that there is confidence in synchronization. Yet it is hardly the time to enforce compulson. It is indeed better to await the results of tests by the stations that have important laboratories at their disposal. Technical development of synchronization has not advanced far enough yet, despite its laudable progress, to warrant compulson. Besides, broadcasters have found that since their problem is a scientific one, and the scientific personnel of the agencies of the Federal Government that have had charge of radio regulation always have been too meagre to render the full benefit desired, private laboratories have had to work out radio solutions. The Bell Telephone Laboratories have contributed more toward the perfection of synchronization during the last year than the Federal Radio Commission and the Department of Commerce have done during the decade they have had jurisdiction over radio.

One of the earliest efforts at synchronization was that of WBZ-WBZA, operated by the Westinghouse Electric & Manufacturing Company, WBZ, in Springfield, Mass., and WBZA, in Boston. The object of a station in Boston was to provide good signal strength in the city, which WBZ could not do for geographical reasons. The plan did work, but not satisfactorily enough, and it was found more economical in this instance to use greater power on WBZ to deliver sufficient signal strength in Boston.

WGY, Schenectady, N. Y., and KGO, Oakland, Calif., both owned by the General Electric Company, tried synchronization over the wide stretch of the Continent, and while results were divergent, they were nevertheless passable on the whole. The expected enormity of complaint of interference in the middle zone between these two stations did not develop. Intereference due to a moan resulting from divergence of frequency was not serious.

WOC, Davenport, Ia., and WHO, Des Moines, Ia., tried synchronization most recently, and with best success, due to the use of newer methods. Matched quartz crystals were used, with a listening point half way between the two stations, which were less than 200 miles apart. The latest developments of the Bell Laboratories were used.

Now WEAF, New York, KDKA, Pittsburgh, and WGY are engaged in tests where two or three stations at a time operate on WEAF's wavelength. All three stations use 50,000 watts.

Experience will dictate the course to be adopted in regard to synchronization. There is no need to speculate on the subject, as two members of the Commission seemed inclined to do. It really isn't a subject on which the Commission as yet can be adequately advised, as the usual procedure has been for the Commission to obtain such advice on the basis of experiments made outside its own realms, and those outside agencies themselves are not yet ready to make a definite report. They are busy investigating, and that is synchronization's occupational need of the moment.

Problems of a Show

THE idea of having a public exhibition of radio sets and accessories each year is not as thrilling as is used to be, since models necessarily may be only exhibited, and not demonstrated, and the chief exhibition is of cabinet work. One cabinet does not look so much different from another, to a lay visitor. Moreover, attendance is less, rather than greater, a significant point.

To drive home the advantages of sets and equipment requires that one have the undivided attention of the person addressed, but the shows are examples of highly scattered attention, or wide distraction. The printed page and sponsored programs on the air work more suitably to the concentrated conveyance of adequate information. A demonstration may help, but the idea of purchasing a given receiver usually is first sold to the customer, and even a demonstration may be dispensed with, on the basis of confidence in the reputation of the manufacturer.

Because of this lack of variety at shows, and the inability to show to the eye the differences that are far more deeply underlying, the spice of adding electric washing machines, vacuum cleaners and other non-radio apparatus to the exhibition list was resorted to at the recent Radio World's Fair in Madison Square Garden. A great many persons who attended the Fair must have come to the conclusion it was not worth the price of admission. Should manufacturers charge the public for the privilege of showing the public the wares the manufacturer has for sale?

NEW CORPORATIONS

Castle Radio, Inc., Atlantic City, N. J.; attorney, John E. Iszard, Atlantic City.

Hoboken Model Radio Corp., Inc., Hoboken; deal in radios; attorney, Samuel J. Davidson, Hoboken, N. J.

Press Wireless, Inc., Fights for Channels

Washington.

Press Wireless, Inc., which is seeking short-wave channels for commercial communication in continental United States, has filed a brief with the Court of Appeals of the District of Columbia asking the revocation of the assignment of channels made to the Universal Wireless Communications Company, Inc., which was petitioned in bankruptcy recently. Press Wireless, Inc., seeks to obtain the channels for itself.

The brief sets forth that Universal and one other company, which also obtained channels but went into bankruptcy, too, are hopeless, so far as resumption of service is concerned. The court is asked to set aside stay orders that are preventing the Federal Radio Commission from giving the commercial communications assignments for continental use to any other than the licensees that originally obtained them.

W2XAF Reaches Out to British Empire

Schenectady, N. Y.

The British Empire, frequently referred to as "far flung," hasn't been scattered so very widely that any part cannot be reached by W2XAF, one of the short-wave stations of WGY, the General Electric broadcasting station here.

From the most southerly outpost of that great Empire W2XAF recently received a letter on behalf of His Excellency, the Governor, by the Colonial Secretary. The letter was from the Falkland Islands, which are directly opposite and east of the Strait of Magellan, off the southerly tip of South America. The letter told of hearing W2XAF.

Aviators Land in Fog With Stations' Aid

Some mail pilots recently have reported that they have been able to use the carrier wave of the regular broadcasting stations as a guide when "blind-flying" through heavy fog was necessary. This help was especially useful when the metropolitan airports were being approached. A recent desired landing at a New Jersey airport was effected in a highly satisfactory manner by the use of WJZ's wave, when a thick blanket of fog obscured airport floodlights.

The aviators use the direction-finding compass to determine the position of the transmitter.

Soviet Plans Big Chain

The Soviet government has recently announced that the construction of a series of broadcasting stations will soon commence, and that when the work is complete a total of 62 stations will be available.

This construction program, under the personal charge of the Comissariat of Communications, will also provide facilities for postal, telegraph and land telephone service.

WORTH THINKING OVER

"The Nah-tional Broad-cahsting Company" is the way he says it when delivering his message before the microphone. He's really a very nice chap, they say, but nobody would be surprised some night to hear him declare that "I ah-m ah-bout to ahn-nounce a new pro-grahm for the Ahb-bott Ahs-pirin Tahb-let Ahs-sociation. Miss Ahn-nie Aht-kins will now sing 'How I Ah-dore my Cahn-dy Ahn-dy Lahd.'"

Oh, well! Ahc-tors must ahct!

SYNCHRONIZED TEST BY WEAF, KDKA and WGY

Washington.

Permission was granted by the Federal Radio Commission to WEAF, New York, outlet of the National Broadcasting Company; WGY, Schenectady, N. Y., owned by The General Electric Company, and KDKA, Pittsburgh, Pa., owned by the Westinghouse Electric & Manufacturing Company, to conduct synchronization experiments on WEAF's frequency of 660 kc (454 meters).

The object of the tests is to determine the feasibility of dual operation on the same frequency, where there is adequate geographical separation, and to note the difference, if any, in results at different periods. For instance, the best time for transmission is deemed to be from midnight to dawn, but a study will be made, with results duly charted, to determine whether there is any difference in heterodyne interference intensity during this period, as compared with the most popular broadcasting hours, 8 to 10 p.m.

Each May Use 50,000 Watts

Each station is authorized to use its maximum power of 50,000 watts during the experiment. Soon KDKA will have available 200,000 watts, in its special high-power transmitter, the most powerful in the world. While the synchronization tests are authorized for only a few weeks, it is expected that one of the goals sought is to measure the effect of synchronization of WEAF and WGY, one at a time, using 50,000 watts, with KDKA's 200,000-watt wave. The present tests are regarded as a foundation for this later and more important experiment, since the relationship of super-power to interference is one of the big considerations still requiring investigation.

The synchronization tests are expected to relate principally to two stations at a time, and a wire line will be used as an adjunct, to check up on the constancy of frequency of the two transmitters.

The difficulties are regarded as large enough, and the opportunities for important observations as fertile enough, with only two stations, but if it is desired to try out three stations at a time, a field in which not much work has been done, this is permissible under the terms of the special permit issued by the Commission.

The chief difficulty with synchronization has been heterodyne interference. This is caused by a difference in the frequencies of the synchronized stations which are supposed to be on exactly the same frequency.

Can't Be Kept Exactly Same

It is not regarded as quite attainable yet to have two stations on exactly the same frequency. Recent developments in the grinding of matched crystals have aided the steadying of the two frequencies, to avoid the difference frequency which constitutes the heterodyne note. This difference frequency will vary, resulting in a waxing and waning moan.

One of the goals at present is to keep the difference frequency so low that there will be no objectionable interference. For instance, since audio amplifiers in modern receivers afford very little amplification below 50 cycles, adherence to plus or minus 20 cycles or so would be productive of slight interference, although the aim is to maintain the constancy to plus or minus only a few cycles. Momentary enlargement of deviation, corrected by monitoring, is not considered objectionable interference.

The synchronization tests were authorized also for the regular program hours, with unlimited time for each station, but with the proviso that each station announce which stations are being synchronized, and that a full report be made to the Commission at the end of the entire test period.

Finds Restriction In Dual Operation

Washington.

J. H. DeWitt, an engineer of the Bell Telephone Laboratories, which institution has done much experimenting with radio frequency synchronization, testified before Chief Examiner Ellis Q. Yost, of the Federal Radio Commission, that while synchronization works out well over local areas, it is not suitable for high-power stations for "national coverage."

He cited the example of WOC, Davenport, Ia., and WHO, Des Moines, Ia., which stations are about 190 miles apart, as satisfactory synchronization for "local coverage." Both stations, owned by the same company, transmit on the same frequency at the same time, using matched crystals and other apparatus developed in the Bell Laboratories.

Mr. DeWitt appeared in behalf of WSM, Nashville, Tenn., which requested 50,000 watts.

WEAF, New York City, WGY, Schenectady, N. Y., and KDKA, Pittsburgh, are engaged on an experiment of synchronizing by use of 50,000 watts by each station, the distance being about 300 miles.

WANTS 40 PUT ON 50 KW LIST

Washington.

Louis G. Caldwell, former general counsel of the Federal Radio Commission, appearing as attorney for WSM, Nashville, Tenn., before Chief Examiner Ellis A. Yost, advocated that all stations on cleared channels should be permitted to use 50,000 watts. The Commission's policy is to restrict the use of 50,000 watts to 20 of the total of 40 cleared channels. About two dozen stations have applied for 50,000-watt licenses.

Mr. Caldwell, in asking that WSM be permitted to increase its power ten-fold, attempted to bring his idea before the examiner in the form of a motion for the Commission to entertain, which resulted in Commission counsel asserting that this was out of order, as motions must originate with the Commission itself.

Mr. Caldwell summarized the situation as follows:

(1) That testimony has established that 50,000 watts no longer is to be considered experimental;

(2) That public interest, convenience and necessity is not served by restricting power on cleared channels to less than 50,000 watts;

(3) That public interest, convenience and necessity require that at least 50,000 watts be permitted on every cleared channel.

PLEA TO FORCE SYNCHRONIZED SENDING FAILS

Washington.

A proposal by Commissioner Eugene O. Sykes, vice-chairman of the Federal Radio Commission, that the broadcast channel assignments be revised, whereby there would be 20 instead of 40 cleared channels, with compulsory simultaneous operation of two or three stations on the same frequency, was voted down by the Commission, 3 to 2. Those who opposed the change were Charles McK. Saltzman, chairman, and Commissioners Harold A. Lafount and William D. L. Starbuck. Those who favored it were Commissioners Sykes and Ira E. Robinson.

The high-powered stations are on cleared channels, and it was proposed that considerable synchronization be imposed on high-powered stations, to lessen interference and relieve congestion, as it was contended that the latest developments in synchronization by matched crystal control had proved effective.

Would Mean New Set-up

However, those opposing the plan pointed out that the entire broadcasting structure would have to be revamped and that the burden would fall on the Western stations. The powers involved are from 5,000 watts to a total of 50,000 watts, where 25,000 watts definitely assigned, and 25,000 watts additional for experimental purposes, constitute the 50,000 watts.

Under the 1928 reallocation, setting up 40 cleared channels, only one station is permitted to operate on high power at a given time in a given area, so as to be able to enjoy a wide service range, and serve rural and remote listeners. Synchronization would have resulted in two or three such simultaneous broadcasts by high-powered stations scattered throughout the country.

Called Technically Inadvisable

"To put this order into effect," said Commissioner Lafount, "would require a sweeping revision of broadcast assignments. Also, it is technically inadvisable to force stations to resort to simultaneous operation at this stage of radio development. Besides the Western part of the country would be discriminated against, since it would have to serve as the Western terminus for practically all such shifts."

The recent synchronization of WOC, Davenport, Ia., and WHO, Des Moines, Ia., turned out more successfully than previous attempts, and since then several stations have received permission to try out synchronization experimentally.

Synchronization System

The system used is to employ matched crystals, ground to a newly established accuracy, whereby deviation does not exceed 20 cycles, and may be confined to less.

Between the two synchronized stations a listening post is established, so that any difference in frequency is heard as beat. A wire connected to one of the synchronized stations informs the operator there of the existence of the beat, and he has means for correcting this, so that accuracy to within a few cycles is maintained.

TALKIE FIRMS HIT SNAG OVER SHORT WAVES

Washington.

Talking picture producers, desiring to obtain licenses for short-wave communication, so that executive headquarters can keep in touch with directors and their parties "on location," are having difficulty obtaining permits from the Federal Radio Commission. So far the Paramount Famous Lasky Corporation, which owns a half interest in the Columbia Broadcasting System, and the Fox Film Corporation, have made applications, but no license has been granted.

Lieut. E. K. Jett, Commission engineer, declared that the policy of the Commission is to maintain communication as a public utility, whereas the applications really amount to requests to establish private point-to-point communication, which is against the Commission's policy.

Frequencies Questioned, Too

The Fox Film Corporation sought two channels, 3,256 kilocycles and 6,512 kilocycles. Lieut. Jett pointed out that about 100 experimental stations already are licensed on 3,256 kilocycles, while the other channel is reserved for maritime service.

Elmer W. Pratt, examiner for the Commission, held hearings on the applications.

Saul E. Rogers, general counsel for the Fox Film Corporation, said that a talking picture is made often "on location," at a point far removed from executive headquarters, and that a plane is used for carrying the film and the sound recording to the developing and finishing rooms at headquarters.

The developed film is then exhibited to a board of reviewers, he added, while the director and actors and other employees remain "on location." Then the company officials communicate with the party on the field and instructions are given for making any corrections desired.

Finds Talkies Close to Radio

The short-wave channels are desired so that quick communication may be established, as it is expensive to maintain the party on location, due to salaries and subsistence. Also, it is desired to transmit parts of the sound recording back to the location party as a readier means of clarifying instructions.

"There is really a close affinity between sound, as it figures in our work, and radio," said Mr. Rogers. "Our company has a staff of radio engineers to help in perfecting sound recording and reproduction. Any improvements that our company may make in the acoustical phase of talkies would be made available to the radio industry."

Atlantic Company Makes Application

The Columbia Broadcasting Company, through the Atlantic Broadcasting Company, a subsidiary, made the application for the Paramount Famous Lasky Corporation. The Columbia System is one of the two large chains, the other being the national Broadcasting System. Columbia's key station is WABC, New York City, which has a 50,000-watt construction permit and is about to erect a plant of this power in New Jersey.

New Stations Obtain Licenses

The following new stations have recently been granted licenses to broadcast. Are listed according to frequency:—

1500 KC

WOPI—Bristol, Tenn. 100W
KGFI—Corpus Christi Tex. 250 and 100W

1420 KC

KTAP—San Antonio, Tex.....100W

1310 KC

KRMD—Shreveport, La., (KTSL, time shares) 50W
CP to move locally

1070 KC

KJBS—San Francisco, Cal.....100W

570 KC

WEAO—Columbus, Ohio (WKBN, time shares) 750W

ONE DEALER FOR EACH 3,130

More than 10 per cent. of the number of counties in the United States have no radio dealers. A considerable number of these unrepresented counties have a population exceeding 20,000. In Oklahoma one county with a population of 42,891, and in several other States counties with populations exceeding 30,000 have no dealers.

These figures were obtained from a tabulation made by the United States Department of Commerce.

The country's average is one dealer for each 3,130 of population. There is no steady average of the number of dealers in respect to the total number of sales, but the general rule prevails that where the number of dealers is large for the population, the number of sales is large per capita.

Mississippi Dealers Fewest

The buying power of the public in the particular area considered is an important determining factor in the relationship between the number of dealers and the population.

Mississippi has the smallest number of dealers in proportion to the population. For each 14,560 persons residing in the State there is one dealer. Alabama, second, has 12,830 for each dealer; Louisiana, third, 11,830; South Carolina, fourth, 11,480; Georgia, fifth, 11,330.

On the other hand South Dakota has the smallest population in proportion to the number of dealers, or 1,284 persons for each dealer; Iowa, second, has 1,650 persons per dealer; New Hampshire, third, 1,670 per dealer; Kansas, fourth, 1,705; Vermont, fifth, 1,720.

New York, 1,710 per Dealer

New York has a dealer for each. 1,710 persons, Pennsylvania one for each 2,900 population group, Ohio, one for 2,365, Illinois one for 2,460.

Le Flore is the county in Oklahoma that has no dealer, despite its population of 42,891.

There is no dealer in Tallahatchie County, Miss., population 35,567; in Duplin County, N. C., 35,110 population; Avoyelles County, La., 34,921; Williamsburg County, S. C., 34,914, or Monroe County, Ala., 30,068.

There are ten counties in Alabama alone, each with a population of more than 20,000, none having a radio dealer.

SITE FOR WABC 50 KW STATION IS APPROVED

Washington.

Approval was given by the Federal Radio Commission to the site half a mile from Wayne, N. J., for the erection of a 50,000-watt transmitter by WABC, key station of the Columbia Broadcasting System.

The Public Utilities Commission of New Jersey had sanctioned the selection of this site, on a petition by WABC backed up by the assertion that there would be no blanketing of local stations for New Jersey listeners, since the population is sparse about the site. The blanketing objection was raised when WABC previously tried to get a site at Columbia Bridge, N. J., when the State itself, through the Attorney General, interposed objections, particularly as WABC is rated as a New York station.

Uses 5,000 Watts Now

The present transmitter is at Cross Bay Boulevard, in the Borough of Queens, New York City, in the Far Rockaway area. The power used is 5,000 watts. but the station for many months has had a construction permit to use 50,000 watts, provided a suitable site were found. The search for such a site included New Jersey and Long Island, and much controversy attended each attempt, until now.

The Commission also extended the time limit until February 1st, 1931, when the new transmitter is to be completed. The Columbia System is ready to go right ahead with the installation, and has planned to introduce the latest improvements, including 100 per cent. modulation and precision crystal control of frequency.

Made Survey of Interference

A survey made by representatives of the Columbia System, and which largely determined the favorable action of the two Commissions, pointed out that within a radius of half a mile of the Wayne site there are only twelve homes, of which seven have no receiving sets, and within a one-mile radius there are 142 homes, of which 207 have no receiving sets.

No Undue Interference

The field strength of a 50,000-watt transmitter was estimated at a maximum of 1,210 microvolts per meter for the first mile, which was said to be consistent with good reception of the other stations listeners might desire to tune in.

TINY SYNCHRONOUS MOTOR DEVELOPED BY WESTINGHOUSE

A photograph published in the September 20th issue of RADIO WORLD of a man holding a tiny motor, carried the heading, "A Synchronous Motor," and the caption set forth that this motor was developed by engineers of the General Electric Company, of Schenectady, N. Y., and was a miniature synchronous motor of unbelievably small size.

The man in the photograph was Dr. C. E. Skinner, assistant director of engineering, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and it was the engineers of Westinghouse Company (not General Electric) who developed this remarkable motor.

"VESTED RIGHT" IN WAVE UP TO HIGHEST COURT

Washington.

The question of whether the receipt of a license to broadcast on a particular frequency, followed by continued use of that frequency, constitutes a property right, within the meaning of the Fifth Amendment of the United States Constitution, and therefore a right of which the possessor may not be divested, is before the United States Supreme Court, which has just convened after the Summer recess.

Although the same question has been raised in other cases, it was incidental in those instances, and the Supreme Court has not registered its opinion in regard to the problem.

The first time the question came before the Court was in the case involving WGY, Schenectady, N. Y., when Charles Evans Hughes, now Chief Justice of the Supreme Court, was counsel for the station. The case was decided in favor of WGY on other grounds, and the plea of "property right" was not decided.

The Two Cases

The two cases now before the court involving the property right question are: White vs Johnson and American Bond & Mortgage Company vs United States.

In the case of White vs. Johnson, WCRW, Chicago, owned and operated by Clinton R. White, wanted to be re-established on 1,340 kilocycles, full time, at 500 watts, despite an order of the Federal Radio Commission, dated September 1st, 1928, assigning the station to another frequency, with only 100 watts, and the necessity of dividing time with two other stations. The property right here alleged is that the license to use, followed by the actual continued use, of the originally assigned frequency, at the originally assigned power, with no time-shares, became inviolate.

A lower court denied the station's application for an injunction restraining the Commission from enforcing its order changing the power, frequency and time. WCRW is now listed on 1,210 kc, sharing with WEDC and WSBC, both of Chicago, and each 100 watts.

The American Bond and Mortgage Company's case concerns WMBB-WOK, former Chicago station, and relates to the previous enjoyment of the 1,190 kc channel, on 5,000 watts, prior to January, 1927. Neither WMBB or WOK is listed on the present roster of stations, due to the assignment of the license to another station, which inherits the interest of the previous owner in the contest.

Hughes Won't Participate

Both cases come to the Supreme Court on issues in which there is no question of fact, but there are only questions of law. The definition of the word "property" is the principal question involved. The protection of money invested in buildings, land and equipment is one of the issues revolving about the definition of "property."

Both stations also had to sign a waiver of their rights to the continued use of the frequency and power they previously had, to obtain license renewal, but this is contended to be without warrant in law, since the whole procedure is attacked as unconstitutional, and the enjoyment of the "property" right is held to be paramount.

Survey Finds Trade on Up Grade

Washington

A report on general business conditions for the first eight months of 1930 by the National Business Survey Conference appointed by President Hoover shows small gains in a few lines, but continued depression in many industries.

The conference, of which Julius H. Barnes is chairman, made the following report on radio:

"Reports from the radio trade from all parts of the country indicate that the radio business and tube business are on the upgrade. Manufacturers are now generally making shipments of the new models of radio receivers and distributors and dealers are reported as more optimistic as the merchandise begins to move to the public."

ORE DEPOSITS ABSORB WAVES

Washington.

High power for broadcasting is necessary in many areas of the South because of mineral and ore deposits which underlie much of the territory and impede radio reception, witnesses testified before the Federal Radio Commission.

Representatives of WSB, Atlanta, Ga., and WAPI, Birmingham, Ala., made this declaration at hearings on applications of these stations for the right to use the maximum broadcasting power of 50,000 watts.

The Commission is hearing altogether the requests of six stations in the third or southern radio zone for authority to use the maximum transmitting power. Under Commission orders there are only two channels in the zone available for this power, according to "The United States Daily."

Lambden Kay, director of WSB, stated that with the present power of 5,000 watts, the programs of the station are not received satisfactorily throughout the State.

Increases in power from 5,000 watts to 50,000 watts, if adequate service is to be provided for Georgia listeners, is necessary to the station, he asserted. By increasing the power to the maximum of 50,000 watts the station could serve approximately 2,000,000 persons within a radius of approximately 100 miles, a reasonable service area for the station, he said.

For WSB, Frank D. Scott, counsel, presented 25 affidavits to show that the programs of the station are unsatisfactorily received in many portions of the State.

Beginning presentation of the case of WAPI, operated by the Alabama Polytechnic Institute, Oscar Underwood Jr., counsel for the station, asked that the station's application be amended to provide for continuance of its time-sharing arrangement on the 1140-kilocycle channel with KVOO at Tulsa, Okla., instead of for "unlimited time." The amendent was accepted without objection.

T. D. Davis, of Birmingham, general manager of the station, described the station as one of the pioneers in broadcasting in the South. Although licensed to the Alabama Polytechnic Institute, it is owned by the State of Alabama, through its three main State universities, the Polytechnic Institute, the University of Alabama and the Alabama College, he explained. The presidents of the three institutions constitute the board of control of the station, he said.

RADIO IN HOTEL IS UP FOR FINAL ADJUDICATION

Washington.

When a station broadcasts a copyright musical number without authority, and a hotel that has radio installations in its rooms picks up the program, and enables the hotel guests to hear it, is the hotel liable as an infringer of the copyright? Does such service to the guests constitute a "performance" for profit within the meaning of the Copyright Act?

This question is before the United States Supreme Court for final decision in three cases, growing out of the same acts, and concerning the broadcasting of a musical number, "Just Imagine," by KWKC, Kansas City, Mo. This station is now listed on 1,370 kc, 100 watts.

The words and music of the piece were composed by B. C. DeSylva, Lew Brown and Ray Henderson, was copyright by them, and the copyright assigned to the American Society of Composers, Authors and Publishers.

Society's Allegation

Gene Buck, as president of the society, sued the station and the Jewel-LaSalle Realty Company, owner of the hotel. The case comes before the court as Buck vs. Jewel-LaSalle Realty Company, on three causes of action.

The society has a membership of 700, the brief sets forth, and is organized for protecting the rights of musical numbers against infringement of copyright by performance for profit. It is maintained that the service of the program to the hotel guests constituted a "performance" and that this performance was for profit, because the service was an added attraction in winning patronage of the hotel, and to the retention of the patronage of existing guests.

Question of Wide Interest

Suit was started against the station owner and also against the hotel. The station owner did not show up in the lower court, and judgment "proconfesso" was entered. The action against the hotel company was dismissed in that court on the ground that the reception of a musical composition on a radio set does not constitute a performance, and the act was not done for profit.

The question is one of lively interest. Since the institution of the suit centralized radio has become very popular, and many hotels, particularly new ones in large cities, furnish programs to guests in their rooms. Also, hospitals render the same service to patients as do other institutions and organizations to those they serve.

Those rendering such service believe that since they have no responsibility for the program, and have no part in its selection, they do not become parties to any infringement of copyright by merely furnishing the program to guests or patients or others.

If the Supreme Court decides that this contention is either right or wrong, the interest of the "outsiders" is greater than that of the defendants in the present cases, although the interest of the American Society of Composers, Authors and Publishers is the same in either instance.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of Radio World published weekly at New York, N. Y. for Oct. 1, 1930.

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

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Roland Burke Hennessy, who, having been duly sworn according to law, deposes and says that he is the Editor of the Radio World, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business managers are: Publisher Hennessy Radio Publications Corp., 145 West 45th St., N. Y. C. Editor Roland Burke Hennessy, 145 West 45th St., N. Y. C. Managing Editor Herman Bernard, 145 West 45th St., N. Y. C. Business Manager Herman Bernard, 145 West 45th St., N. Y. C.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of the stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Hennesy Radio Publication Corp., 145 West 45th St., N. Y. C. Roland Burke Hennessy, 145 West 45th St., N. Y. C. Mrs. Mary J. McArthur, Edgewater Manor, 9829 Lake Avenue, Cleveland, O.

3 That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent, or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers, during the six months preceding the date shown above is ..... weekly. (This information is required from daily publications only.)

ROLAND BURKE HENNESSY.
(Signature of Editor)

Sworn to and subscribed before me this 30th day of September, 1930.

HARRY GERSTEN.

Notary Public, Kings Co. Clks. No. 121, Reg. No. 2133, N. Y. Co. Clks. No. 121, Reg. No. 2-G-153. My commission expires March 30, 1932.

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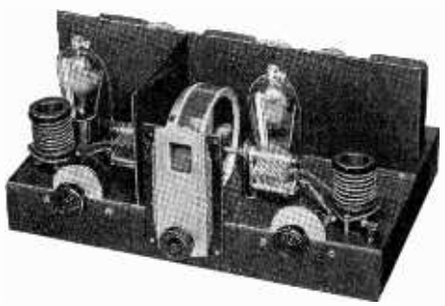

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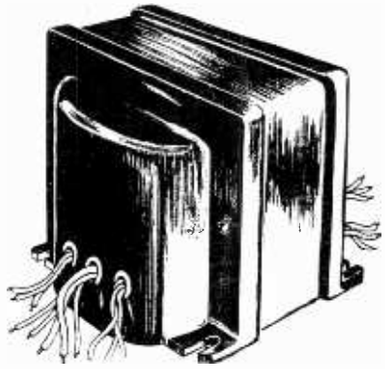

245 POWER TRANSFORMER

The 245 power transformer is for use with a 280 rectifier tube, to deliver 300 volts DC at 100 milliamperes, slightly higher voltage at lower drain, from a 110-volt AC line, 50-60 cycles. The primary is tapped at 82½ volts in case a voltage regulator (Clarostat or Amperite) is used. The black primary lead is common. If no voltage regulator is used the other primary lead is the green one, so tape the end of the red. If regulator is used, tape the end of the green and use the red with the black. The secondary voltages are all center tapped: 672 volts AC for 280 plates, 2½ v. 3 amps. for 245 output single or push-pull; 5 v. 2 amps. for 280 filament; 2½ volts 16 amps. for up to eight 224 or 227 tubes. Center taps are red and all leads are identified on name plate. The core is larger than formerly and won't saturate at 100 ma. Laminations hidden except at bottom. Eight-inch leads emerge from the sides, but if preferred may be taken off through the bottom of the transformer by pushing them through the rubber grommets. Shipping weight, 12 lbs. Overall size, 5" from left to right as illustrated; 4¼ from bulging bell end to other bell end; 4¼" high.

Order Cat. 245-PT (12 lbs.) @.....$ 9.50
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For 25 cycles order Cat. 245-PT-25 (16 lbs.) @ 12.00

250 POWER TRANSFORMER

The 250 power transformer supplies voltages for two 281 rectifiers, to power 250 output, single or push-pull. The secondaries all center-tapped, are 1,200 volts AC for 281 plates; 7½ v. 3 amps. for two 281s; 7½ v. 3 amps. for one or two 250s; and 2½ volts, 16 amps. for up to eight 224s and 227s. 5" x 5½" x 4¼"; shipping weight, 16 lbs.

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[We can supply the high voltage condensers as follows: 1 mfd., paper dielectric, @ $1.50 each; 8 mfd. electroiytic @ $1.50 each.]

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A larger choke is used for the 250 type B supply, consisting of a continuous winding tapped. Inductance, 40 henrys. DC resistance 150 ohms. Shipping weight, 5 lbs. Order Cat. 250-CH @ $5.00.

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30 henrys, 150 ohms DC resistance, 100 ma rating, with two black leads emerging, and red center tap. For use in 245 or 250 push-pull output where a dynamic speaker that has its own output transformer is used. The impedances are thus satisfactorily matched. Connect the black leads to the plates of the push-pull tubes and the red to positive B. The tipped cords of the speaker (or primary of the output transformer built into the speaker) go to the plates also. Connection must not be made direct from plates to voice coil. This choke may also be used instead for filtration of B supplies. either as a single choke, by ignoring but taping the red lead, or as a double by using all three leads. Either black lead would go to rectifier. Shipping weight, 4 lbs. Order Cat. CT-CH @ $3.50.

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