JULY 14th
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15
CENTS

Vol 13 — No 17

Mechanical Problems in Television!

RADIO WORLD

REG. U.S. PAT. OFF.

The First and Only National Radio Weekly

329th Consecutive Issue—Seventh Year

Transformer Magic!

Facts on Fusing!

Unusual Uses for Screen Grid!

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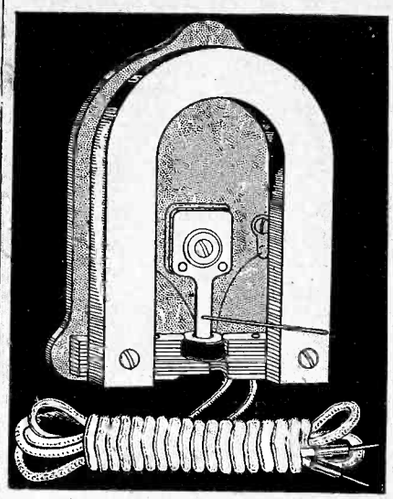

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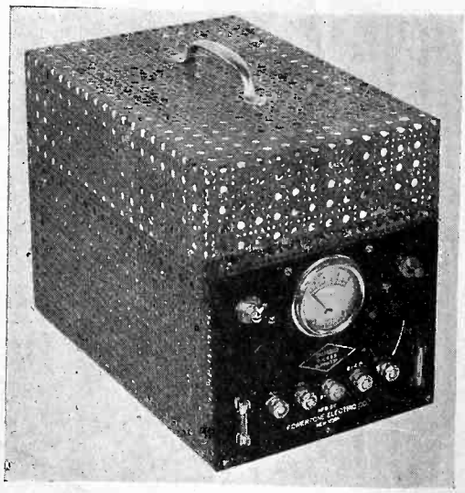

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Mechanical Problems in Television Reception

By J. E. Anderson
Technical Editor

SCANNING discs are being offered to the radio public. Scanning discs for what? For television it is alleged. But for what system of television? There are many systems in use, or about to be put in use, and the scanning disc for one system will not do for another.

The purchaser of a scanning disc today has no assurance that it will be the right one tomorrow. Television broadcasters change systems and when they do so they do not immediately inform the public of the change.

An example is the change made by the General Electric Company. Information at first sent out by the publicity department of the General Electric Company was that the scanning disc was 24 inches in diameter and had 48 scanning holes so arranged in a spiral on the disc that square area of 1.5 square inches was covered, each scanning hole being .035 inch in diameter. Later information was sent out that only 24 holes were used. No change in the other specifications was announced.

Inconsistent Change

A change from 48 holes to 24 would seem to require other changes in the disc to keep things consistent, particularly in the size of scanning holes. If the size of each scanning hole is .035 inch when 24 holes are used, the scanning will not cover the entire surface, for there will be black bands between the adjacent scanning lines.

When 48 holes are used with the same size scanning holes adjacent scanning bands will overlap slightly.

It would seem that when 24 holes are used the diameter of each scanning hole should be .070 inch to produce the same size image and cause the same overlapping of adjacent scanning lines as when 48 of the .035 inch holes are used.

If a radio fan intends to experiment with television he should have a scanning disc for each type of transmission. He will then have more signals to choose from and have a greater chance of picking up something.

Number of Scanning Holes Used

In the latest system used by the General Electric Company the number of holes is 24, in the system used by Theodore Nakken over WRNY it is 36, and in the system used by WLEX at Lexington, Mass., it is 48. The new speed of the scanning disc is 20 per second for the General Electric and the WLEX transmissions and the speed proposed for the Nakken system is 10 per second.

In any of these systems it is not necessary to use a receiving scanning disc of the same dimensions as that of the transmitter. It is only necessary that it be geometrically similar in every respect. If it is larger the received picture will be larger, if it is smaller the received picture will be smaller.

But the speed of the receiving disc in any one system must be exactly the

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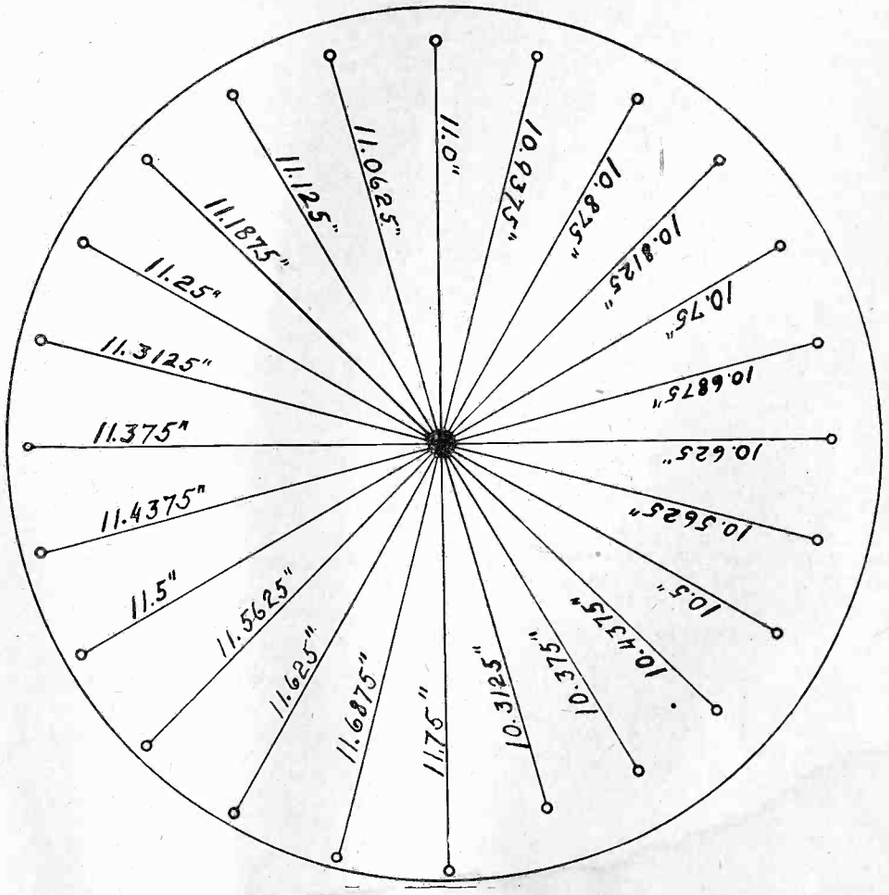


Diameter of Disc 24". Diameter of small holes .07". Diameter of central hole 5/16". Radial Separation 15°.

THE DESIGN OF A 24 INCH SCANNING DISC HAVING 24 HOLES ARRANGED SO AS TO COVER A PICTURE 1½x1½ SQUARE INCHES. ROTATED 20 REVOLUTIONS PER SECOND IT CAN BE USED TO RECEIVE THE WGY TELEVISION TRANSMISSION.

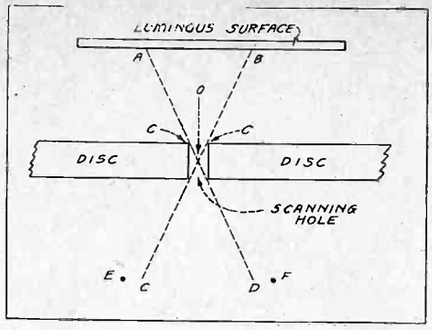


FIG. 1

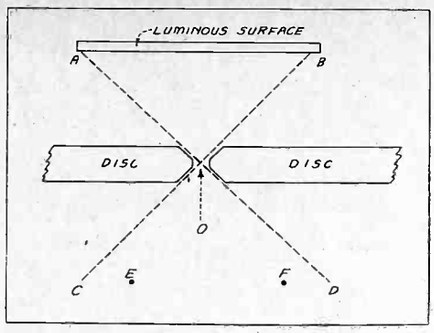


FIG. 2

IF THE THICKNESS OF THE SCANNING DISC IS LARGE IN COMPARISON WITH THE DIAMETER OF THE SCANNING HOLES THE FIELD OF VIEW IS LIMITED AS SHOWN BY THE LINES AD AND BC. OUTSIDE THESE LINES AS AT E AND F THE LUMINOUS SURFACE CANNOT BE SEEN. (FIG.1). IF THE SCANNING HOLES ARE BEVELED OR COUNTERSUNK THE ANGLE OF VIEW IS WIDENED. THE LUMINOUS SURFACE CAN NOW BE SEEN FROM THE POINTS E AND F. (FIG. 2.)

(*Continued from preceding page*)
same as the speed of the transmitting disc in that system.

Persistence of Vision

It is a well known psychological fact that if a spot of light passing the eye at a rate of less than about 16 times per second will be seen as a flickering light and that if it passes more rapidly it will appear as a steady light. For this reason in motion pictures the individual pictures on the film are shown at the rate of 16 per second. This is the slowest rate which can be used without an annoying flicker on the screen.

The same holds true in television. Therefore if the scanning disc rotates 10 times per second there will be a decided flicker in the received image. But if the speed of rotation is 18 times per second the image will appear quite steady as far as the luminosity is concerned.

This fact may be used as a rough guide in synchronizing the receiving disc with the transmitting disc. Suppose a small marker of a color in sharp contrast with the color of the disc be placed near the periphery of the disc. While the disc is rotating slowly the eye can follow this marker around. As the speed of rotation increases the eye will no longer be able to follow it and the marker will flash by once every revolution.

Increasing the speed still further will cause the marker to appear as a flickering ring. When the speed of rotation is 16 per second the flicker is very feeble but still appreciable on careful observation. At 18 the ring seems to be continuous and free from flicker.

Thickness of Disc

A necessary condition for sustained synchronization is that the disc run steady and at constant angular speed. To insure this a heavy flywheel may be coupled to the disc or the disc itself may be so constructed that it acts as a flywheel. The simplest way of obtaining this effect is to make the disc of thick metal. But this raises a different problem, a problem which is present for any practical thickness of the disc.

In Fig. 1 is shown an enlarged section of the scanning disc, including one scanning hole. The luminous surface of the neon or kino lamp is shown on one side of the disc and the field of view on the other. The lines AD and BC drawn through the center *O* of the scanning hole and touching the edges *e* of the hole determine a cone inside of which the light of the neon lamp may be seen from the side of the disc opposite the lamp.

Outside this cone, as at E and F, the light cannot be seen. Hence the observer must stand directly in front of the disc to see the image. If he moves outside the cone the light is cut off. This puts a serious limitation on the device. And this limitation is greater the smaller the diameter of the scanning hole is as compared with the thickness of the disc.

Holes Beveled

A simple way of overcoming the contraction of the angle of the transmitted luminous cone is to bevel the edges of the scanning holes, that is, countersinking them, as shown in Fig. 2. The angle of the cone is now greatly enlarged and the points E and F previously outside the cone are now inside.

Motors for Driving Disc

If the transmitter and the receiver discs are driven by power from the same AC distributing system and if a synchronous motor is used to drive the transmitting disc, then a synchronous motor of the same type can also be used to drive the receiving disc. It is only neecssary to start the receiver motor and synchronization will be automatic. However, in this case it is necessary to provide some means for preventing hunting of the motor. (Jumping back and forth). This can be done by the use of a flywheel loaded with mercury.

If the transmitter and receiver are not on the same power system a synchronous motor cannot be used for the receiver no matter what motor is used to drive the transmitter because then the speed of the receiver could not be changed.

Universal Motor Best

In all cases a universal motor can be used for driving the receiver disc, for its speed be controlled at will with a rheostat or with a mechanical brake. And it can be used on either DC or AC.

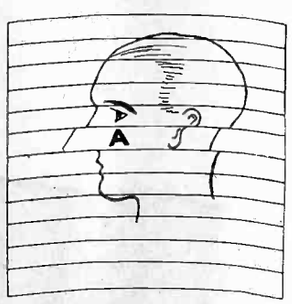


FIG. 4

IF ONE SCANNING HOLE IS ANGULARLY OUT OF PLACE THE PICTURE LINE A FORMED BY THIS HOLE WILL BE SHIFTED TO ONE SIDE. THIS ILLUSTRATES THE "FAULT" DISTORTION. THIS IS THE ACTUAL SIZE OF PICTURES NOW BEING RECEIVED.

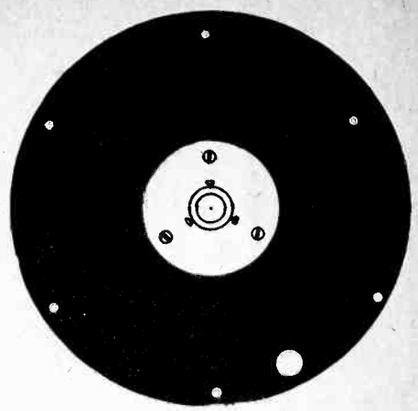


FIG. 3

The size of the motor used is not so very important, just so it is large enough to spin the disc. Extremely little power is required to keep this in motion, for there is little friction, except that due to air turbulence around the disc. This is small at a speed of 20 revolutions per second. Electric motors of the universal type designed for small vacuum cleaners, dictaphones and phonographs are powerful enough.

Must Run True

The disc must be mounted so that it runs true without any wobbling. To aid in truing it up three set screws 120 degrees apart may be put in the hub. The disc can then be attached to the shaft of the motor and the screws adjusted so that the plane of the disc is at right angles to the axis of rotation. This will prevent wobbling, provided that the disc is flat and symmetrical.

The scanning holes must be clean cut, without any burs or rough edges. If not, all the light will not get through and the image will not be as bright as it should be.

The scanning holes must be accurately placed in the radial direction. If one hole is nearer the center than it should be and the next is farther from the center than its correct position the field as seen through the holes passing in review before the noon lamp will be streaky.

Distortion Effects

Non-uniformity of the field of view, when the light from the neon lamp gives out a steady glow, would result in a distortion of the image when the light is flickering according to the picture values received. If a hole is displaced the corresponding picture line across the field would be correspondingly displaced. This would make the picture appear streaky and the distortion may be called band distortion.

Angular inaccuracies in placing the holes also would produce a certain distortion. Suppose one hole is displaced one degree. The angular separation between two holes would then be 14 degrees and between the next two holes 16 degrees, when the separation should be 15 degrees. The displaced hole would then draw a picture line across the field a fraction of a second too early or too late. Every picture point in that line would then be displaced. If the displacement is one degree and the speed of the disc is 18 per second the time displacement of this line would be 154 microseconds. The linear displacement in a 1.5 x 1.5 inch picture would be about .1 of an inch. The effect is shown in Fig. 4, in which the picture line marked A is displaced to the left. This type of distortion may be called fault distortion because of its similarity to faults in geological structures.

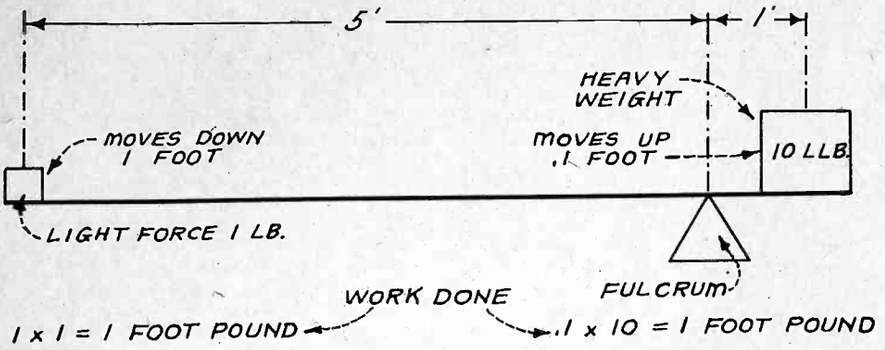
Skew Distortion

If the receiving disc rotates at a slightly different speed than the transmitting disc,

(*Continued on page* 20)

Magic of Transformers

By Neal Fitzalan



A MECHANICAL TRANSFORMER OR LEVER

"IN a recent article on a complete radio installation for alternating current you specified a voltage control rheostat in the supply line which could only safely carry one ampere. Yet that circuit contained one heater type tube which required 1.75 ampere, three —26 type tubes requiring a total filament current of 3.15 amperes, a power tube requiring 1.25 amperes, and two rectifiers tubes, each drawing 1.25 amperes. Besides these filament requirements the plate currents and the voltage divider current amounted to about 85 milliamperes. The total current is therefore nearly 9 amperes. Is it then not inconsistent to specify a line rheostat which can carry only one ampere?"

So wrote one of our readers who is still struggling with the problems and principles of transformers.

Quite Consistent

There is no inconsistency at all in the specification because the rheostat is not only large enough to carry all the current which will be drawn from the line for that set, but much larger. Our correspondent is struggling with the prevalent misconception that all the amperage required for the receiver is drawn from the line.

The current flowing in the secondaries of the filament and power transformers is not drawn from the line at all. Not one of the electrons constituting the secondary current comes from the primary side of the line. The secondary current is created, so to speak, in the secondary winding.

If all the current required for the filaments of the tubes in an electric set were taken from the line the cost of operating a radio receiver of that type would be excessive.

Hypothetical Cost

Suppose all the current required for the receiver referred to by our correspondent were taken from the supply line. That current was about 9 amperes. The voltage of the primary line is 115 volts. Therefore the wattage is 1,035 watts, or roughly one kilowatt.

The cost of one killowatt hour may be taken at 8 cents. Thus the cost of operating the receiver would be 8 cents an hour. If the set is operated on an average of 4 hours daily for 30 days the monthly cost would be $9.60. That is perhaps three times as much as the total monthly light bill for all purposes of the average family. Under such conditions it would be almost as cheap to get all the entertainment at the theatre or concert hall.

The fact is that the receiver in question, which is a rather elaborate one comprising power tube and high voltage, requires only a small wattage, and the monthly cost is only a small fraction of the light bill. A simple calculation will show this.

The wattage required by the detector tube is 1.75x2.5, or 4.375 watts. The wattage required for the three —26 type tubes is 3.15 x 1.5, or 4.725 watts. That required for the three 1.25 ampere, 7.5 volt filaments is 1.25 x 7.5, or 9.375 watts. The total wattage is 18.475 watts for the filaments.

The wattage required for the plate supply may be calculated on the assumption that the total effective voltage in the plate circuit is 600 volts. The current assumed in the receiver under consideration is .085 ampere. Hence the wattage is .085x600, or 51 watts. Thus the total power required for the set is 75.475 watts. To this should be added about 15 percent for losses in the transformer, so that the total power drawn from the line is 86.8 watts, or .0868 kilowatt.

The monthly cost of operating the set then for four hours a day is 83 cents. This is only the cost of power and not depreciation charges.

Power Drawn from Line

Note that it is power that is taken from the line and not current. The power used in the secondary is the same as the power taken from the line. Current is not power. Neither is voltage power. But the product of current and voltage is power. A given amount of power may be composed of high voltage and low current or low voltage and high current.

The transformer steps up the voltage of the supply line and it steps down the current in the same proportion or it steps down the voltage and down the current. For example, if the transformer steps up the voltage 10 times the secondary current is stepped down by the ratio .1. Or if the transformer steps down the voltage in the ratio 10 to 1 the current is stepped up in the ratio 1 to 10.

A power transformer used in a radio set is both a step-up and a step-down transformer, which is possible when there are two or more secondary windings.

No Power Used, None Taken

When the secondary winding in a transformer is open, that is when no secondary current flows, there is only a small magnetizing current flowing in the primary winding. A small power loss accompanies this current, and this loss is divided betwen the hysteresis loss in the iron core and copper loss in the primary winding. The total power loss when the secondary is open is very small and hence very little is lost if the primary is left connected to the power source when the secondary is open.

In an AC power distributing system the transformer out on the pole is always left connected to the main supply line, but the secondary is not always closed. Whenever a light is turned off the secondary is partially opened. When all the lights and motors on the secondary of that transformer are turned off the entire load is taken off and the secondary is entirely opened. Yet a primary current flows in the transformer out on the pole.

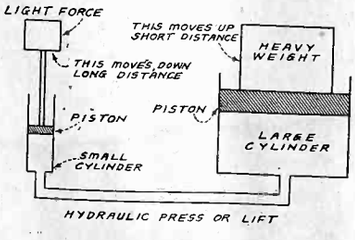
But when the load is off the transformer takes only a negligible amount of power from the power house. The same holds true of the power transformer supplying a radio set. This does not mean that the primary of the transformer should be left connected when the circuit is not in use. There is some power loss. Besides there will be voltage in the secondaries.

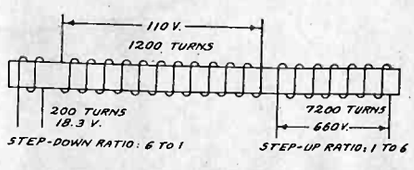
Hydraulic Analog

It was stated above that the secondary current was created in the secondary winding and that no part of the current in the primary flowed in the secondary. This action may be illustrated with a hydraulic analog.

Suppose a water circuit be made up of

(*Continued on page* 8)





LEFT—A HYDRAULIC ANALOG OF AN ELECTRIC TRANSFORMER. AT LEFT A WEAK FORCE AND GREAT DISPLACEMENT IS TRANSFORMED INTO A STRONG FORCE AND LITTLE DISPLACEMENT ON THE RIGHT. THIS IS A STEP-UP TRANSFORMER.

RIGHT—A COMBINED STEP-UP AND STEP-DOWN TRANSFORMER. AT THE LEFT END OF THE CORE THE VOLTAGE IS STEPPED DOWN IN THE RATIO 6 TO 1. AT THE RIGHT END IT IS STEPPED UP IN THE RATIO OF 1 TO 6.

The Binaural Chimera

By Roger Hampton St. John

A NEWS dispatch from Cincinnati states that engineers of the Crosley Radio Corporation have conducted binaural broadcast experiments over WLW and WSAI with the object of obtaining absolute realism in broadcast reception. Persons equipped with two receivers were enabled to tune in the same program from two different stations at the same time, but picked up by two microphones placed in the transmitting studio in the same relative positions as the ears of a listener in that studio.

Reports from observers indicate that the received programs were so natural that the observers were enabled to draw a correct sketch of the orchestra, showing that realism was a fact and not a piece of imagination.

What is Binaural Hearing

Binaural hearing is two-eared hearing. It is that which gives acoustic depth, or that which gives the sense of direction in sound. With a single ear we hear a sound only, but we have no means of telling from which direction that sound comes. With two ears we are able to determine from which direction a sound comes, except that we are unable to tell whether the sound comes from directly behind, directly ahead or directly overhead.

Binaural hearing is similar to stereoscopic sight. With a single eye we cannot see depth of a scene but only a flat picture like a photograph, except as this is changed by focusing of the eye and by our experience that if one thing is partly obscured by another thing this one must be closer.

With two eyes we partly see around the obstruction, thus getting the sense of depth.

Cause of Stereoscopic Vision

It has been supposed that the reason a stereoscopic picture appears to have depth is that the two pictures are slightly different, that the two views were taken from slightly different points of view.

Whether it is necessary that the two pictures should have been taken from slightly different points of view in order that the pictures shall appear stereoscopic is open to serious doubt. Two prints from the same negative placed in the stereoscope will appear as deep as two pictures taken with a stereoscopic camera. The stereoscopic view seems to be more psychologic than physical.

In binaural broadcasting is it necessary that the two microphones be placed in the same relative positions as the ears in order to bring out the depth? If two prints of the same negative will produce stereoscopic vision when placed in a stereoscope, why should not two receivers of a broadcast program from the same microphone produce binaural hearing? And if two microphones are used, is it certain that the hearing will be binaural even when two receivers are used? Would not the hearing depend on the position of the two loudspeakers?

Why Binaural Hearing

What is the reason that we can determine the direction of a sound when listening with two ears? One theory is that difference in intensity of sound as heard by the two ears is sufficient to give the sense of direction. The ear which is away from the sound will receive less sound than that which is pointed toward the source of the sound. But is that difference sufficient to make an impression on the ears? The difference in intensity must be considerable to have any such effect on the ear, even when the change occurs suddenly. And the difference in intensity at the two ears would be extremely small unless the source of the sound was close to the observer, so close that the distance to the source was comparable to the distance between the ears.

If the distance to the source of the sound is ten times the distance between the ears, the difference in the intensity at the two ears is less than 3 percent. That is inappreciable. Therefore, it would seem that this is not an adequate explanation of binaural hearing.

Phase Difference

Another explanation is that the difference in phase of the sound wave reaching the ears at any instant causes the sensation. If that is true it should be very difficult to determine the source of a sound of low pitch. That does not seem to be the case, as it is quite easy to point in the direction from which a sound of low pitch comes.

It should also be easy to locate the origin of a sound of medium pitch. That seems to be the case.

It should also be practically impossible to locate a sound of very high pitch, a pitch near the upper limit of audibility. That also is a fact. Hence evidence points to phase difference as the cause of the binaural sensation.

The facts in the case probably are that both difference in intensity and difference in phase contribute to the binaural sense, and that phase is the more important.

In either case it should not be possible to tell whether a sound comes from directly in front or directly in the rear.

How does this affect binaural broadcasting? Suppose two microphones suitably placed are used and that the pick-ups are sent and received by two independent channels. What becomes of the intensity? The intensity of the signal as received by the two receivers depends on the adjustment of the volume by the operator. He can choose any volume adjustment he chooses but he cannot adjust it within 3 percent. Therefore if binaural reception depends on intensity it will not be practical.

Even if the volumes from the two speakers could be adjusted to the proper intensities at some frequency it would not remain so for other frequencies, unless the two transmitters and receivers were identical in every detail. That is not a practical possibility.

Phase More Important

But phase is the more important? How is phase affected by the transmitter and the receiver of either channel? The sound waves of all sounds may reach the two microphones in the proper phase but they will not reach the listener in the same relation. Phase shifts will be introduced all along the line, in the microphone, in the speech amplifier, in the modulator, in the ether, in the detector, in the audio amplifier, and in the room between the loud speaker and the listener.

If the phase shift introduced in one channel were exactly the same as that introduced in the other channel all would be well with phase difference. But there will be a wide difference in phase shift in the two channels so that the difference at the ears of the listener will not be the same as that at the two microphones.

The phase difference for one frequency may be correct but then it will not be correct for other frequencies. To have the same phase shift for all frequencies the two channels would have to be identical. That would not be possible in broadcasting but it may be possible in a point to point communication system.

Results Obtained

Although binaural broadcasting is apparently impossible, tests have shown, it is claimed, that it is possible. Receiver operators of the binaural transmission of WLW and WSAI have been able to draw a sketch of the orchestra before the microphones. Perhaps there is a psycological effect independent of the sound intensity and phase just as there is in a stereoscope when two identical pictures are viewed.

If the accepted theories fail to explain the observed facts it will be necessary to reconstruct the theory and see to it that it fits the facts. But before constructing a new theory it will be necessary to make sure of the facts.

Mixing Panels and Phase Shift

As is well known, in a broadcast studio mixing panels are used by means of which the pick-up of several microphones are combined into one signal and adjusted so that the proper intensity is obtained. Thus the broadcast listener hears the program through many ears. Any one of these microphones "hears" all the instruments in an orchestra and transmits what it hears.

But all the microphones do not transmit the sound from any one instrument in phase, because they are purposely placed in different positions. The sound picked up by the nearest goes out first. That is the loudest sound. The sound from the microphone farthest away from an instrument goes out a moment later, and that sound is the weakest.

The effect of this multiple pick-up is the same as if many musicians were playing identical instruments, all sitting at different distances from one microphone and all playing in exact synchronism. A 25 piece orchestra and five microphones would be equivalent to one 125 piece orchestra. Dual pick-up may double the effective size of the orchestra but it does not seem to give rise to binaural reception.

SUMMER RECEPTION FINE

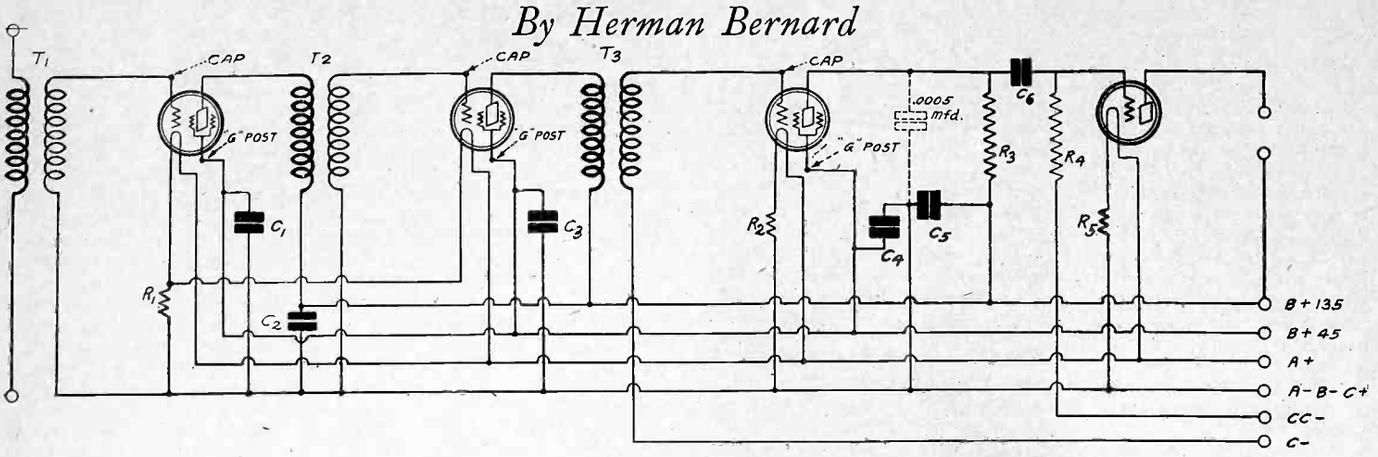
Summer static no longer affects radio reception to anywhere near the extent it did in the early days of broadcasting, is the opinion of KNX, directors. Improved receiving sets and better broadcasting make Summer programs as easily enjoyed as mid-winter programs.

NEW KNX PLANT SEPT. 1

The new KNX transmitter of 5,000 watts capacity will be dedicated about September 1. Construction on studio buildings and transmitter housing has begun.

The All-Range Super

By Herman Bernard



DESIGN FOR AN INTERMEDIATE FREQUENCY AMPLIFIER, WITH A SINGLE AUDIO STAGE, TO OPERATE A SPEAKER. TWO STAGES OF INTERMEDIATE FREQUENCY ARE USED. A TUBE IS SHOWN AS A SCREEN GRID DETECTOR, WHILE A 112A IS IN THE AUDIO STAGE. THE DETECTOR ALSO SHOULD BE TRIED AS A SPACE CHARGE DETECTOR, BY REVERSING THE CONNECTIONS TO CAP AND G POST. C1, C2 AND C3 ARE .001, C4 AND C5 ARE .5 MFD. OR HIGHER, C6 IS 1 MFD. OR HIGHER, R3 IS .5 MEG., R4, 5 TO 10 MEG., AND CC— IS THE HIGHEST BIAS THAT GIVES GOOD VOLUME, USUALLY AROUND 4½ VOLTS AT THE STATED VALUES. THE .0005 MFD. RF SHORTING CONDENSER IS OPTIONAL.

[*In last week's issue, dated July 7th, the author argued in favor of a Super-Heterodyne as the best circuit for short wave reception, pointed out some of the difficulties, and suggested a design for a mixer. The system he proposed would tune in the broadcast band without change of coils or condensers, but plug-in coils would be used for short wave reception, and half the tuning capacity cut out with a switch. This week he elaborates on some other difficulties and points out another method of handling the capacities. He asks readers who construct the mixer to report results, good, bad, or indifferent, so that a receiver may be worked out, as it were, by the readers of* RADIO WORLD, *in conjunction with himself, the final product to be recommended to the general run of builders in simplified and trouble-free form for their own construction. At present only experienced Super-Heterodyne enthusiasts are asked to build, and breadboard models only, as for the other readers the problems will prove too difficult electrically.*]

* * *

IF the oscillator does not oscillate it is not an oscillator. If you don't have an oscillator you don't have a Super-Heterodyne. A very serious problem exists if you can't get oscillation where and when you need it, because on short wave work the situation is complex, having to do not only with the tuning characteristics but with the frequency of the intermediate channel.

One of the principal reasons why constructors do not get oscillation in the oscillator is that the oscillator plate coil, if one is used, as L7 in the diagram suggested last week, has its phase reversed in respect to the phase of the voltage and current in the secondary.

All three windings—plate, grid and pick-up—should be in phase. This is easy enough. If you regard the coil as on a baseboard, with axis toward you, then connect the terminals nearest you on each winding, respectively, to plate, grid and end of the modulator grid coil. Or to connect to the "low" end of the plate coil (at the C7 joint, in last week's diagram), to A minus and to A plus, respectively. In other words, the terminals must be consistently connected in the same relative manner in respect to high and low radio frequency potentials.

If the plate coil L7, which is a part of the plug-in unit, is dephased by wrong connection, negative feedback results. This may give regeneration, if the capacity of C7 is large enough, but as the oscillator tuning condenser is turned for higher frequencies, where larger coupling capacity would be necessary to afford oscillation, you encounter a long "dead spot". Reverse feedback works that way—the higher the frequency, the larger the capacity needed, in other words, it is just the reverse of tuning.

Change the coil connection, as suggested, and get positive feedback, because in the mixer diagrammed last week the coupling capacity C7 is fixed, so obtain oscillation at the highest broadcast frequency, since this assures you of oscillation at any other frequency. The plate windings of the fewer-turned coils for short waves take care of avoiding excessive oscillation.

Other reasons why oscillation fails in the oscillator are incorrect filament potential, incorrect plate voltage and disadvantageous intermediate frequency. If the intermediate frequency is too low, the percentage of difference between the oscillator and the modulator frequencies necessary to provide the intermediate frequency is not enough. When this is so the modulator has an absorbing effect upon the oscillator, or vice versa, and the oscillator tends to oscillate only at the same frequency as that of the modulator. Hence no difference exists, and no amplification, indeed, no reception. In such an instance only sum frequency intermediate amplification would be possible. Hence 10 kc, 45 kc and similar intermediate frequency transformers will not do for the combination long-and-short wave purpose.

Try Broadcast Receiver, Too

Experienced Super-Heterodyne constructors are invited to dabble with the intermediate frequency, using a moderate intermediate frequency of about 70,000 cycles, and trying others, as well, particularly just above 1,500,000 cycles and just below 550,000 cycles, these two latter frequencies being available in any TRF broadcast receiver. All frequencies in the broadcast band must be taboo for an intermediate frequency.

In constructing the mixer, if tuning condensers ordinarily used for short waves are not available, then two regular broadcast condensers of .00025 mfd. capacity each may be used for the largest tuning coil, and to afford suitable capacity for tuning the short waves a .00025 mfd. fixed condenser may be connected in series with each tuning condenser to give .000125 mfd., which is near enough to the .00014 mfd. tuning capacity ordinarily used. A switch will cut out the series capacity by short-circuit. Last week's diagram showed the same end gained by parallel capacity.

In the last week's diagram of a suggested mixer, the constants may be as follows: L1 L2 L3, as well as L5 L6 L7, are plug-in short wave coils of the usual type designed for .00014 mfd. tuning. To cover the broadcast band, if two .00014 mfd. condensers are connected in parallel, a special coil will have to be constructed. The base may be made of a strip of bakelite, with General Radio tip jacks. Use the pattern on the coils you employ on short waves. The inductance is procurable by utilizing 70 turns for the grid coils, 30 turns for the plate coils. Hence a 100-turn winding, such as is commercially procurable, may be mounted on the base. This will give you broadcast range tuning and proper oscillation. C1 is a .00025 mfd. fixed condenser, with leak clips, while the grid leak may be .1 meg.

L4 is a small RF choke coil. Remler makes a very small one. You may wind one yourself by putting 150 turns of No. 38 or 40 wire on a one-inch diameter. L8 is another RF choke coil, 65 or 85 millihenrys. C3 is .00035 or .0005 mfd. variable, while C7 is .00025 or .0005 mfd. C9 should be .5 mfd. or more.

* * *

(*The author will be glad to answer questions concerning a system of Super-Heterodyne reception adapted to short wave and broadcast reception, where the broadcast work is done without change or coils or condensers. Also he would be glad to receive reports on what results constructors may have obtained from experimenting along the suggested lines. Next week he will recount some of his own experiments.*)

Salvage for Portable

By H. G. Cisin

THE Double Shield Portable, a four-tube receiver contained in a single Hammarlund QS Shield, makes a splendid groundwork for building up a portable installation of any sort, including batteries, speaker and loop. For instance, a week-end case may be used, particularly as one that no longer appeals to milady's fancy is likely enough hidden in some closet corner. Into this case the receiver itself will fit nicely, for the shield is only 8 11/16 inches wide and 7 7/8 inches deep, and the equipment may be disposed in the remaining space in a variety of ways.

Some persons like to have a portable as one unit, with batteries loop and speaker virtually built in, while others prefer to use a receiver in a makeshift portable, so that the receiver may be given a decorative housing for home purposes after the weather has vacated all ideas of portability.

In either instance the Double Shield Portable, as the receiver basis, will meet the requirement, because it operates on a loop to bring in locals excellently, the selectivity being derived from the regeneration afforded by the junior condenser and by the directional qualities of the loop. The amplification is taken care of by the screen grid RF amplifier, the screen grid detector, one resistance coupled audio stage and one transformer coupled audio stage.

Meets Requirements

The total weight of what you have to carry will be less than 20 pounds, exclusive of the bag or case or wooden framework you may prefer to construct.

LIST OF PARTS

Lo—One loop.
L1, L2—Two Hammarlund 85 millihenry RF choke coils.
C1—One Hammarlund .00035 mfd. Midline tuning condenser.
—C2, C3—Aerovox fixed condensers of .001 mfd. each.
—C4—One .00025 mfd. Aerovox fixed condenser.
C5—One Hammarlund junior condenser (5 plates).
R1—One 1A Amperite.
R6, R3—Two 4v-199 Amperites.
R2—One Lynch 2 meg. metallized grid leak.
R4—One Lynch 100,000 ohm metallized resistor.
R5—One Lynch 5 to 10 meg. metallized grid leak.
T1—One Karas Harmonik audio frequency transformer.
C6—One .5 mfd. Aerovox by-pass condenser.
SW—One Yaxley No. 10 switch.
One Hammarlund OS Aluminum shield.
Four Frost sockets.
Two binding posts (Ant. and gnd.)
Two output (speaker) posts.
One Karas Micrometric dial.

And when you build the set you will find it meets portable requirements, because it is sensitive enough to bring in signals of only fair strength, and, besides, when in the country, where you don't need much selectivity, you can connect ground to A minus (at the loop terminal post) or add an outdoor antenna strung across trees, to go to the other post, or do both.

Take a given example of what was done with this receiver. A week-end case was used. Into it was placed the receiver proper. This was put at one end of the case. At the other end were the small B batteries, the C battery and the three No. 6 dry cells for heating the filament of the two screen grid and two —99 tubes.

Not only was there enough room left for a folding loop but also for a specially constructed airplane cloth type speaker.

Therefore every requisite was "in the bag," as they say, and when one wanted to tune in it was the work of only five minutes to erect the components into an operating outfit. In fact, one skilled at it accomplished the tiny task in two minutes and ten seconds. Unfold the loop, stick it in its own base, connect the loop terminals to the two binding posts on the receiver, connect the battery cable to the battery terminals and join the speaker cord tips to their proper posts. That tells the story completely.

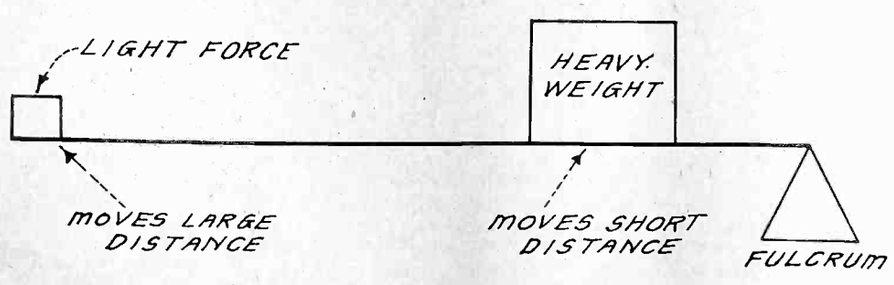
Simplified by Blueprint

The wiring had better be done from the official blueprint, as the actual course of each wired connection from post to post is shown clearly ,and in a manner coinciding with the designations of the constants and the list of parts.

Finally you will have a portable that will stand hard knocks and one that will lend itself to excellent home installation, as will be shown in an early issue.

The construction of the Double Shield Portable was fully described in the June 23rd and 30th and the July 7th issues.

Analogy of Pump Depicts Transformer



(*Continued from page* 5)

a pump, a pipe line and a turbine. The system is entirely closed so that no water can escape. It can only circulate.

If the pump is started a water current will start and this current will drive the turbine. The pump corresponds to the emf in the electric circuit, the pipe line, the electric conductor or wire and the turbine represents the load, which may be a motor, a lamp or some other electrical device.

To complete the analog let us suppose that the pump is water driven. That is, a waterfall drives a turbine which in turn drives the pump. None of the water passing over the fall and through the turbine ever enters the secondary water circuit, yet the power developed by the fall is transferred to that circuit and drives the secondary turbine.

In the electrical transformer the fall of potential across the primary winding corresponds to the "head" in the waterfall. The current through the transformer primary corresponds to the flow of water over the fall.

If the natural waterfall be high it will only take a little water to drive the pump. If it is low it takes much water. That is, the power developed by the waterfall is the product of the current by the height of the fall. In the electrical case the power developed is the product of the voltage fall by the amount of current.

Iron-Core Reactances Dissected in Bulletin

Ever since socket power B supply devices first became an important factor in the radio industry several years ago, and especially since the more recent trend of design toward completely socket-power-operated radio sets. there has been a very apparent need for a simple yet reliable method of designing iron core filter reactors through the windings of which must pass both alternating and direct currents.

Realizing the meagre data heretofore available, much of which applied to steels not generally available to most radio manufacturers, the Raytheon Laboratories have undertaken extensive studies based on commercially available grades of silicon steel.

The results of these studies are now made available in Raytheon Technical Bulletin Vol. 1, No. 1, under the title of "Design of Iron Core Reactances." This bulletin contains the necessary mathematical data for the calculation of iron core reactances, including permeability curves, incremental permeability curves, design chart, procedure in design, chokes for large range of direct current, flux density, and a synopsis of method of calculation employed by Hanna in obtaining design charts for iron core reactances which carry direct current.

A copy of the foregoing described bulletin is available for the asking by addressing the Technical Service Department, Raytheon Manufacturing Company, Cambridge, Mass. Mention RADIO WORLD.

Fuse First then Laugh

By James H. Carroll

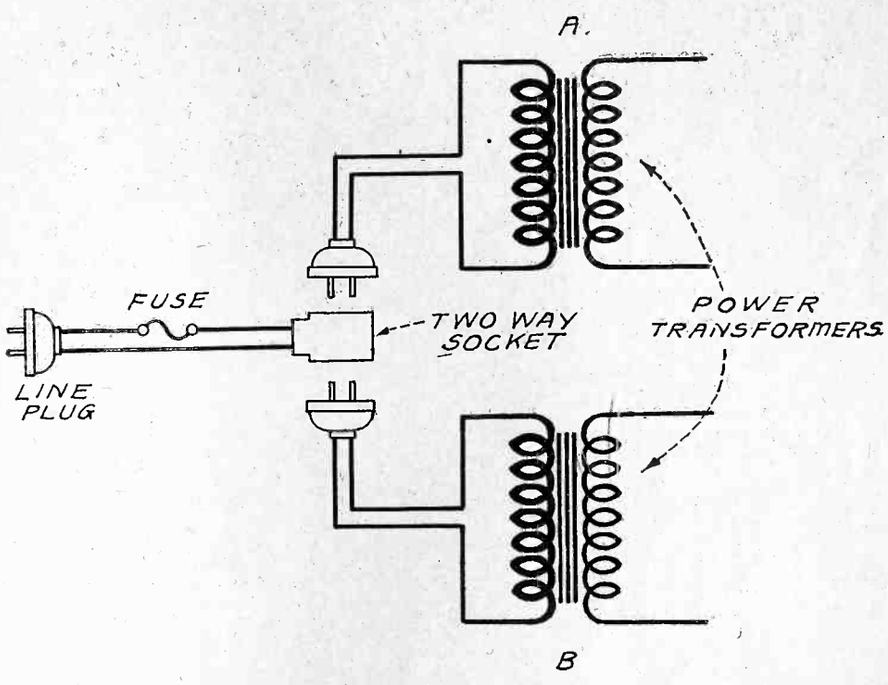
Contributing Editor

IN every house and every apartment wired for electric light and power there is a sentinel which stands guard at all hours protecting the house or apartment against fire. It stands at the point where the power line first enters the house, and it stands in a fireproof sentinel box. It is the line fuse which limits the amount of current that flows into the house. The instant the limit of the fuse is reached the sentinel gives its life for the safety of the house.

A new sentinel can be purchased for a nickel or a dime but it protects human life and much valuable property.

The size of the fuse depends on the size of the conductors in the house and on the power that is normally taken from the line. If the fuse is too small it blows up before there is any danger. If it is too large it will not blow at all and will not give any protection. If it is just right it blows just before the danger point is reached, and it serves as never-failing guard against damage.

In electric radio installations many mishaps may occur which would do serious damage to the set if the power were not instantly cut off the moment the mishap occurred. A fuse is the logical thing to use to open the supply line as soon as danger threatens. The general house fuse is not sufficient for the purpose, for in practice it has a value so large that the slight increase in current caused by some mishap in the radio set is not great enough to cause the fuse to blow. A much smaller fuse is necessary for the radio installation alone.



THIS DIAGRAM SHOWS WHERE TO CONNECT THE FUSE WHEN THE POWER IS SUPPLIED TO THE RECEIVER THROUGH TWO OR MORE TRANSFORMERS. IN THIS CASE TWO TRANSFORMERS, A AND B, ARE USED. THE PRIMARIES ARE PLUGGED INTO A TWO-WAY SOCKET AND THE FUSE IS INSERTED IN THE LEAD FROM THIS SOCKET TO THE NEAREST CONVENIENCE OUTLET

Size of Protective Fuse

The fuse protecting the radio set should be installed in the primary of the supply transformer, or in the power lead running from the supply line to a number of transformers. The size of the fuse would depend on the power that is normally drawn for the radio set. It may be determined by estimating the power used in the set and from that the current which will flow normally in the primary of the transformer or supply line. The thing to remember in this calculation is that the total power used in the set is the same as the power taken from the line.

Let us consider an example. We must estimate all the power that is used in the different parts of the set, the filament power, the plate power and the power losses in transformers and chokes. Suppose we have a power tube requiring a filament voltage of 7½ and a current of 1¼ amperes. The power required for its filament is therefore 9.375 watts. We add 15 percent for losses in the transformer. Therefore the power is 10.78 watts.

We may also have a detector tube requiring a voltage of 2½ volts and 1¾ amperes, that is a power of 4.375 watts. We add 15 percent for losses in the transformer and get 5.03 watts. Now we may have three tubes requiring 1.05 amperes each at 1½ volts, or a power of 4.725 watts. Adding 15 percent we get 5.43 watts.

Plate Circuit Power

There also may be a filament type rectifier which requires 1¼ amperes at 7½ volts. That requires a power equal to that of the power tube, namely, 10.78 watts. Thus the total power required by the various filaments in the set is 32 watts.

To this power must be added the plate circuit power. Let us suppose that the total effective voltage in the plate circuit is 500 volts, which is a reasonable assumption when a power tube is used in the final stage. We may also assume that the total direct current is 50 milliamperes. This includes all the plate currents and the current which flows through the voltage divider. Thus the total power in the high voltage circuit is 25 watts.. Our assumption included the copper losses in the transformer but not the iron losses. Instead of adding 15 percent this time we add only 7½ percent, since the copper and iron losses are about equally divided. Hence the power taken from the line to supply the high voltage circuit is 26.375 watts. Thus the total power taken from the line is 58.4 watts.

The line voltage may be assumed to be 110 volts. If we divide the power taken from the line, that is 58.4 watts, by the line voltage we get the primary current under normal conditions. Thus in this assumed case the primary current is .53 ampere.

This is the normal operating current. If tubes are taken out of the set this current decreases. If any short circuit occurs anywhere in secondary the current increases.

Where to Look for Shorts

The short circuit may be in one of the filter condensers, in the voltage divider, in the filament circuit of one of the tubes, or any other place which would cause an increase in the secondary current. If the secondary current increases for any cause whatever there will be a proportional increase in the primary current.

Now if the normal current in the primary is .53 ampere a fuse which will carry up to .75 ampere may be inserted in the primary for protecting the radio installation. Any short-circuit in the secondary would then increase the primary current until the fuse would blow, and thus cut the power off.

Low rating fuses may now be obtained as they are made for the protection of the trickle chargers.

Number of Tubes Decried as Gauge

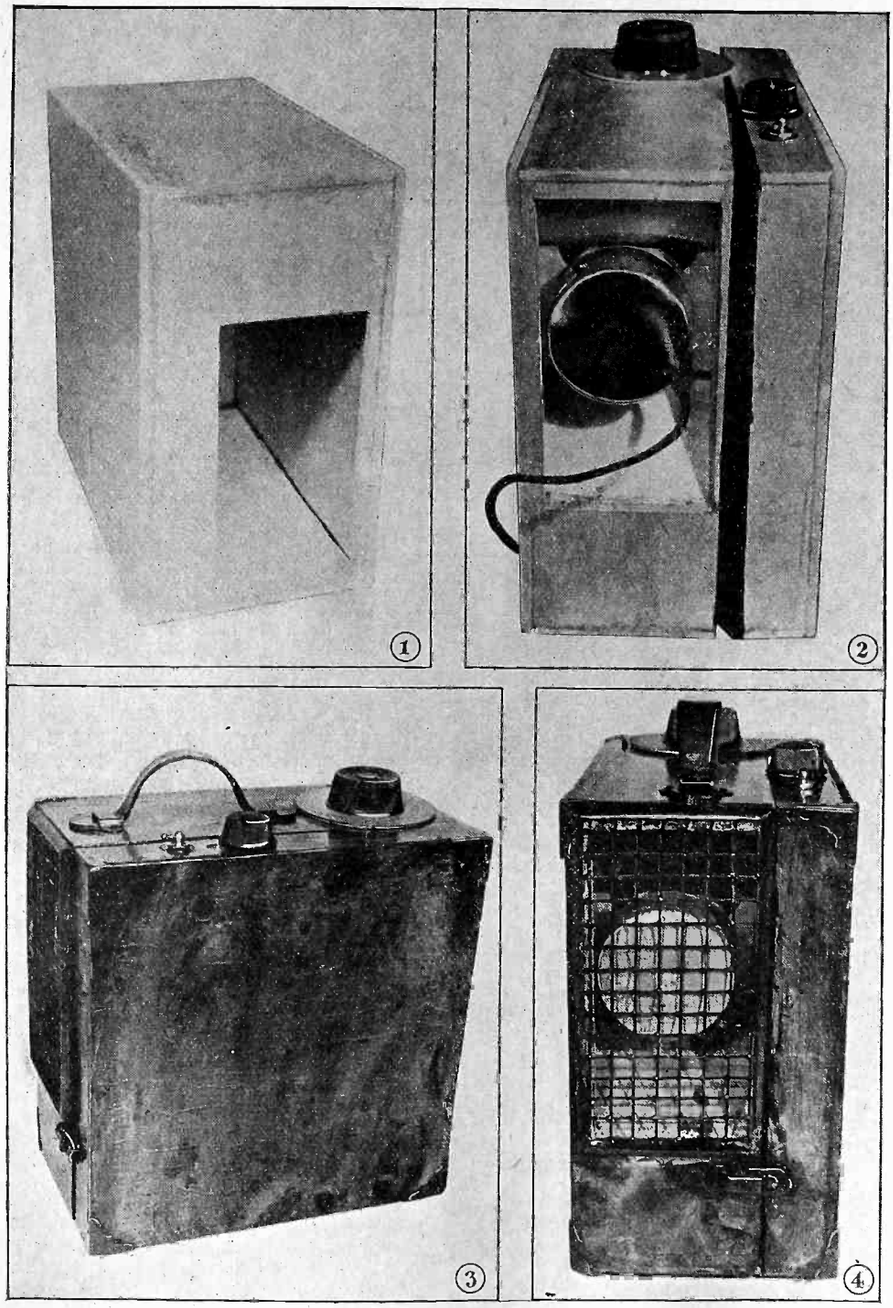
With the introduction of rectifier and ballast tubes into radio sets, confusion arose as to just what tubes should be included in the rating of a set. At the meeting of the Engineering Division, held in Chicago in June of last year, it was voted that only tubes used in the radio and audio circuits should be included. Rectifier and ballast tubes are specifically excluded.

What about push-pull? In accordance with the definition, the two push-pull tubes required for a single stage of audio amplification would be counted as two tubes. These tubes accomplish more than would a single tube. Furthermore, when two tubes are actually used in parallel, they may be counted as two. This situation is not particularly fair, but there seems to be no easy way out of it.

The whole classification of a set by the number of tubes is unsound. It is similar to the classification of a variable air condenser by the number of its plates. The Engineering Division of the Radio Manufacturers Association) recommends that, as far as practical, reference to sets by the number of tubes they contain be dropped. But no substitute rating exists. —*"The R. M. A. News."*

How to Box Any

By Herbert



(Hayden)

(1) A VIEW OF THE ASSEMBLED BOX WITH THE LOUDSPEAKER OPENING OUT IN ONE END. (2) THIS SHOWS THE BOX SAWED INTO TWO SECTIONS WITH THE LOUDSPEAKER UNIT MOUNTED IN PLACE. (3) A VIEW OF THE ASSEMBLED RECEIVER FROM THE SIDE. (4) END VIEW OF CASE WITH LOUDSPEAKER.

THE exodus of the city dwellers to the country and seashore is now in full swing and will continue for about three months. They go to seek relaxation and a brief respite from their everyday troubles and worries. But they do not want to forego the pleasures which radio brings them when at home. In fact, they want their radio more on their vacation than they do at home. And it is for this reason that there is a great demand for portable receivers.

There is not a radio fan anywhere who, while listening to the exquisite music that radio brings to his home, has not felt the enchantment that the same music would bring to the camp fire on a still moonlight night by the side of a brook, or a lake or in the woods. This feeling just before vacation time is the force that creates the demand for portable receivers.

Low Power Adequate

Those who would take along a receiver capable of delivering the same volume that the home receiver delivers are laboring under a misapprehension as to the requirements in the open. Large volume is not required, not even desirable, and generally not obtainable. Everybody knows how music carries far on a still night. The strains of a banjo across the bay a mile away sound as if produced near at hand. The happy laughter of young vacationists several miles away comes to your ears across a lake as if you were one of the happy party.

The same holds true of the radio. A little receiver giving just comfortable volume in the home will prove fair enough in camp, as to the volume it delivers, if the circuit is sensitive. The music will be heard above the gurgling of the brook, the lapping lake ripples, the playing cricket. Its pleasing sound will predominate, but it would not be pleasing if it were loud and overwhelming. That is one conpensation for the fact that woodland reception is almost never voluminous.

Portable Set Design

It is fortunate that lower volume is desirable in camp than in the home, for this makes it possible to build a receiver that is really portable and not merely transportable. It is possible to build an adequate receiver for the camp that can be carried as easily as a large camera.

The chief problem in building a portable receiver that can be carried without the aid of a porter is that of power. The only suitable power source is dry cell batteries. But these weigh a great deal, unless small ones are used. Since there are dry batteries of all sizes available any builder of a portable receiver may choose his own power source according to his own strength and desires.

Small Batteries Selected

We shall assume that the receiver is to be used for a week-end outing, or in places where the batteries can be replaced after a few evenings' use. With that assumption we are in a position to build a very small portable set, yet one which will function as well as one which embodies larger batteries.

The case for housing for this portable will be of a size determined by contents. So get a ready-made box of the desired size.

All the parts should be selected with the idea of light weight in mind. Small transformers of good enough grade can be obtained. Similarly, tuning condensers can be selected because of low weight and small space requirements. Coils, too, can be selected which are built to small dimensions and without any useless supports and brackets.

The low weight idea can be carried to the loudspeaker unit and the horn. Every ounce saved here and there in the parts will aid in keeping the total weight of the receiver down to a reasonable value.

Sample Carrying Case

The size of case selected by one builder is given by the following outside dimensions: height 11 inches, width 11 inches, depth (front to back) 6¼ inches.

It is well to strengthen the case with wire brads.

After the box has been obtained, and secured in this fashion, draw a line 1.75 inches from one side, all the way around, and then saw the box in two along this line. The small section is to be used as a cover for the set and it is fastened to the larger section with hinges.

Batteries in Cover

The cover section is used for the A batteries and the RF coils. The larger section will contain all the rest of the apparatus, including the loudspeaker. A look at the photographs of the arrangement will show how the various components are disposed.

Portable You Like

E. Hayden

The next thing to do is to prepare an opening for the loudspeaker. On the large section measure of a rectangle 7.75 inches long and 4.25 wide and cut it out with a hack saw. The opening is cut out of one end as shown in Fig. 1.

Inside the box just back of this opening a novel sound box is placed, a sound box which gives surprisingly fine results. Two pieces of ¼ inch wood, 5.5 by 4.25 inches are glued and nailed to the box in the form of a V with the apex toward the middle of the cut-out section.

A loudspeaker designed for a horn speaker is mounted on a crosspiece of wood, as shown in Fig. 4, and this is cemented to the sound chamber so that the sound is first thrown in against the apex of the V and then reflected back through the opening in the box.

The speaker leads are passed through a ¼ inch hole drilled in the side of the V into the compartment where the last tube in the circuit is located.

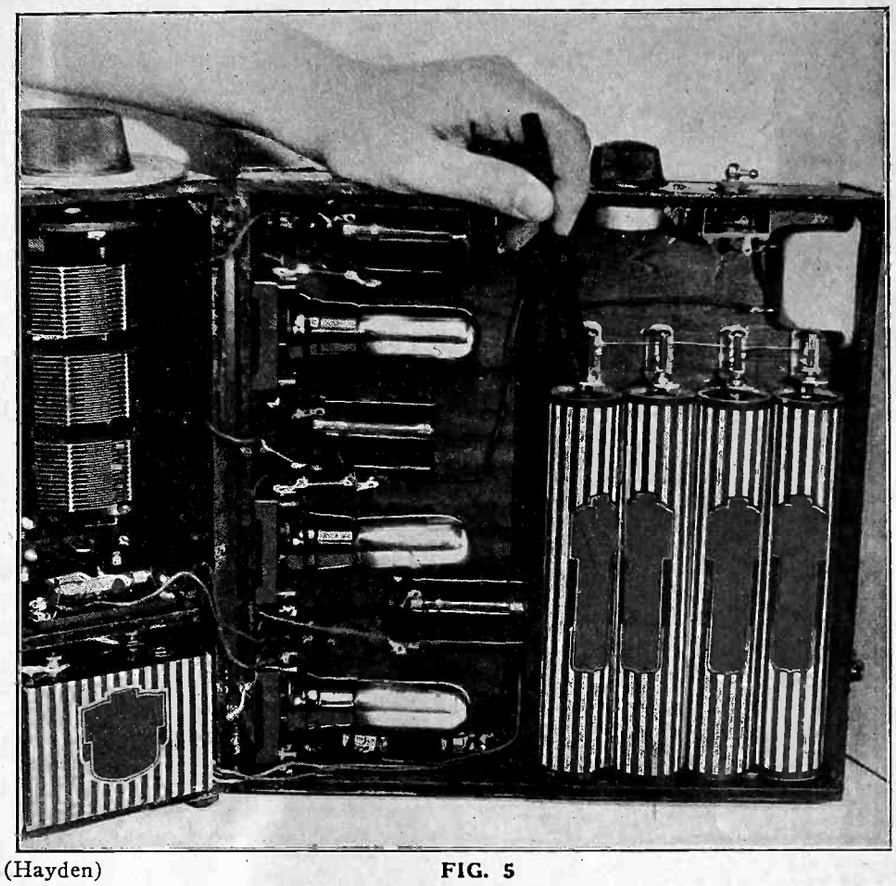
This done a third piece of wood, triangular in shape, is cemented to the V-shaped horn to complete the job.

Opening Covered

The opening of the horn should be covered with a wire mesh, nailed to the edges of the hole, and the edges of this wire screen should be covered with ¼ inch quarter round moulding. The wire screen protects the speaker unit but it does not prevent the sound from emerging.

A compartment for the dry cell B battery is built into the large section of the case. It consists of a shelf 3.25 inches from the bottom and 4.25 inches deep. It is built clear across the case.

The filament batteries are flashlight cells which will light the filaments of the —99 tubes long enough to last for a week-end trip. For home use No. 6 dry cells can be substituted. These will operate the set for several months before replacement will be necessary.



(Hayden) **FIG. 5**

INSIDE VIEW OF THE SMALL SECTION CONTAINING THE "A" BATTERY CELLS, CONDENSERS, COILS AND TUBES. WHILE NO BATTERY TERMINALS ARE NEEDED FOR THE RECEIVER WHEN USED WITH BUILT-IN DRY CELLS THEY ARE NEEDED WHEN EXTERNAL BATTERIES ARE USED. FOR THIS REASON PROVISION HAS BEEN MADE FOR CONNECTING A BATTERY CABLE, WHICH MAY BE ATTACHED WITHOUT THE AID OF A SOLDERING IRON. THUS WHEN THE SET IS USED AT HOME THE SMALL CELLS MAY BE DISCONNECTED WITHOUT REMOVING THEM FROM THE CASE AND AN EXTERNAL VOLTAGE SOURCE USED.

Ingenious Beacons Make Flying Safer

Washington.

Radio aids to minimize danger from fog in aviation, consisting of a radio beacon system and telephone service from the ground to aircraft, have been successfully demonstrated by the Bureau of Standards, it was announced by the Department of Commerce. The full text of the statement follows:

Intensive work extending over two years has resulted in the development and practical demonstration of a complete set of radio aids to flying on the civil airways. This development was carried on by the Bureau for the Aeronautics Branch of the Commerce Department under Assistant Secretary W. T. MacCracken, Jr.

10-Foot Pole Aerial

The radio aids, which will now be installed on the principal airways, comprise a radio beacon system and telephone service from ground to aircraft. The required radio equipment on the airplanes is reduced to a 10-foot pole antenna and a simple receiving set weighing a few pounds, including a visual indicator which tells the pilot whether he is on the course or how far off.

The radio beacons operate in the frequency band 285 to 315 kilocycles, and the telephone stations in the band 315 to 360 kilocycles. These are allocated to air service by the 1927 International Radio Convention. For the present the beacons are adjusted to the frequency of 290 kilocycles, and the telephone stations to 333 kilocycles.

Special Station

The directive radio beacon is a special kind of radio station, usually located at an airport, just on the landing field. Instead of having a single antenna like an ordinary radio station, it has two loop antennas at an angle with each other. Each of these emits a set of waves which is directive, i. e., it is stronger in one direction than others.

When an airplane flies along the line exactly equidistant from the two beams of radio waves, it receives signals of equal intensity from the two. If the airplane gets off this line it receives a stronger signal from one than the other.

The indicator connected to the receiving set on the airplane shows when the signals from the two beams are received with equal intensity, by means of two vibrating reeds which are tuned to different modulating frequencies used on the two antennas at the directive radio station. When the beacon signal is received the two reeds vibrate.

Equality Spells Safety

The tips of these reeds are white in a dark background so that when vibrating they appear as a vertical white line. The reed on the pilot's right is tuned to a frequency of 65 cycles and the one on the left to 85 cycles.

It is only neecssary for the pilot to watch the two white lines produced by the vibrating reeds. If they are equal in length, he is on his correct course.

If the one on his right becomes longer than the other, the airplane has drifted off the course to the right (into the region where there is more of the 65 cycles). If he drifts off the course to the left, the white line on the left becomes longer.

Details of Indicator

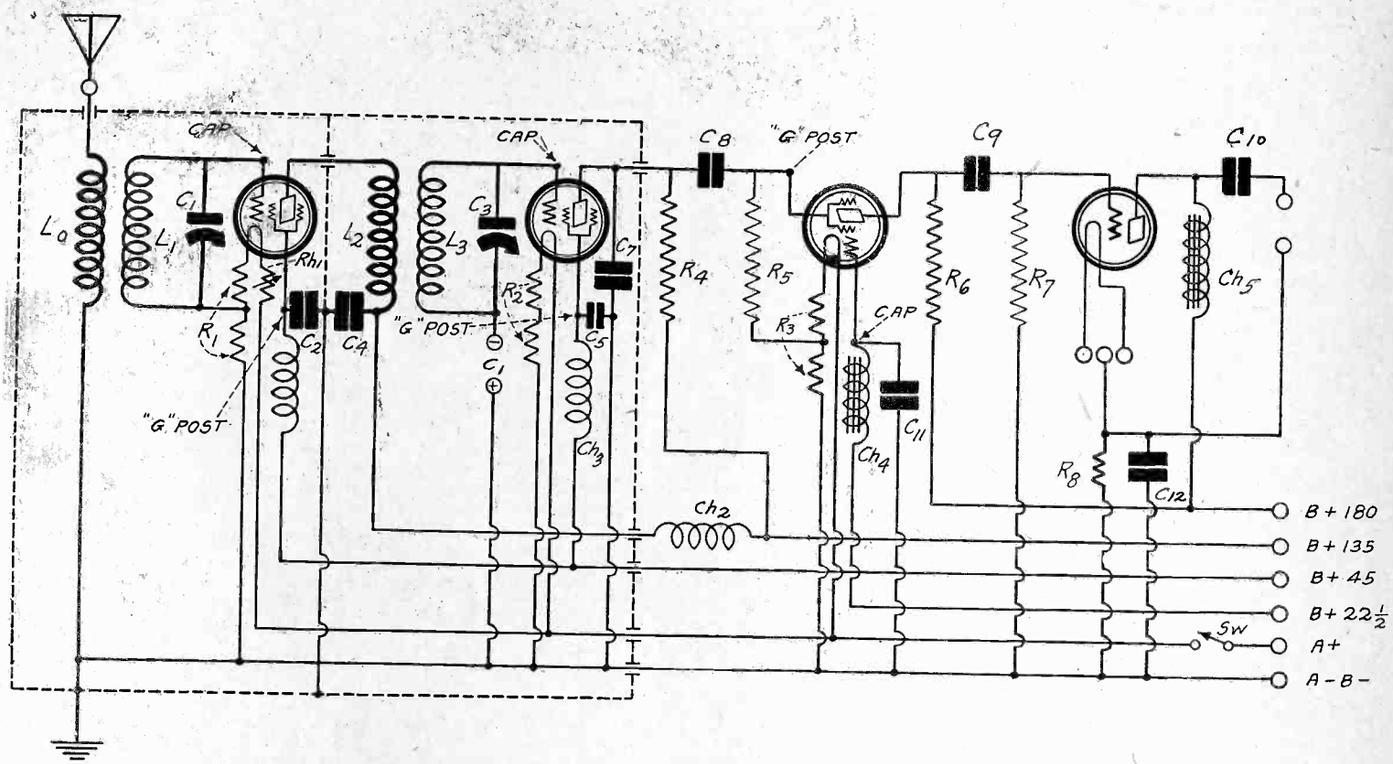
The visual indicator system comprises a small indicator unit and a receiving set weighing between twelve and sixteen pounds, with batteries weighing an additional fifteen pounds. Very successful flights have been made up to 135 miles.

The device is little affected by interference, including airplane engine ignition interference. Such interference does not change the operating characteristic of the indicator signal, but merely reduces the distance range from the beacon station.

Two Unusual Uses for

Grid Bias Detection on One Val on the Other, Make

By Capt. Peter



CRCUIT DIAGRAM OF A FOUR TUBE RECEIVER EMPLOYING ONE SCREEN GRID AMPLIFIER, ONE SCREEN GRID DETECTOR, ONE SPACE CHARGE AMPLIFIER AND ONE -71A POWER AMPLIFIER.

THERE are two ways in which the screen grid tube may be used to good advantage which have not been exploited generally in circuit design. One of these is the use of the tube as a plate bend detector and the other is the use of the tube as a space charge amplifier.

We shall incorporate both of these in a simple four tube receiver in which the first tube is a screen grid amplifier, the second a screen grid tube used at plate bend detector, the third a screen grid tube used a space charge amplifier and the fourth a -71A type power amplifier.

Resistance Coupling Used

The simplest way of taking advantage of the high detecting efficiency of the screen grid tube is to use resistance coupling between the detector and the succeeding audio amplifier. There are two conditions that must be satisfied in the plate circuit to obtain a high audio frequency voltage on the first audio tube for a given radio frequency input to the detector. The first is that the radio frequency impedance in the plate circuit be as low as practical and the second is that the audio frequency impedance be as high as possible.

The radio frequency impedance is made low by shunting the line with a suitable by-pass condenser C7. The size of this condenser is determined by effecting the best compromise between detecting efficiency and high amplification of the higher audio frequencies. If the value is .005 mfd. the faithfulness of the reproduction will be somewhat better than if the value is .001 mfd., but .001 mfd. gives a greater sensitivity. Both of these should be tried and the one that gives the better results should be retained.

High Audio Impedance

A high audio impedance is obtained by using a large value of coupling resistance and a high grid leak. Thus R4 should have a value of one-half megohm and R5 should be not less than 2 megohms. If R4 is .5 megohm and R5 is 2 megohms the effective load resistance for all but the extremely low audio frequencies will be 400,000 ohms, With this combination, and suitable bias on the detector control grid, it is possible to impress an audio voltage on the first audio tube equal to 10 times the radio frequency voltage impressed on the grid of the detector tube. This applies when the detector is used as a screen grid tube with plate bend rectification (otherwise known as grid bias detection).

When the screen tube is used as a space charge amplifier its amplification constant is 60 and its internal plate resistance is 150,000 ohms. Then if we use the same coupling impedances between the space charge tube and the power amplifier as between the detector and the space charge tube it is possible to get a voltage step-up of 44. This may be shown by a simple calculation.

Amplification Calculated

Let R6 be .5 megohm and R7 2 megohms. Then for all but the lowest audio frequencies the combined impedance of the coupler is 400,000 ohms. The total impedance in the plate circuit is 550,000 ohms, obtained by adding the internal plate resistance of the tube to the coupling impedance. The ratio of the load impedance to the total impedance is 8/11, and the voltage amplification is 60 times this ratio, since 60 is the mu of the tube. Thus the voltage amplification is nearly 44 times. If then a signal voltage of 1 volt can be developed across R5 the maximum permissible signal voltage will be developed across R7. This maximum is 40.5 volts, peak value.

It is not difficult to develop a signal voltage of one volt across R5 because this requires only a radio frequency voltage of .1 volt across the second tuned circuit. When the screen grid tube is operated as a plate bend detector it is possible to impress a voltage of 2 volts across the tuned circuit before overloading sets in. Hence .1 volts is well within the operating limits of the detector.

Radio Frequency Amplification

It remains to obtain the .1 volt to impress on the detector. The amplification of the first radio frequency tube easily can be made 50. Hence a voltage of 2 millivolts across the first tuned circuit will be sufficient. With an antenna of average height this signal voltage can be obtained from most of the stations within a 1,000 mile range.

Twice mention was made above of the fact that for all except the very low audio frequencies the impedance of the resistance coupling units was 400,000 ohms. The reason the value is not the same for low frequencies is that the stopping condensers become somewhat inef-

Screen Grid Tubes

ve, Space Charge Amplification Fine Combination

V. O'Rourke

LIST OF PARTS

LoL1—One antenna coupler with secondary for .0005 mfd. condenser.
L2L3—One RF transformer with secondary for .0005 mfd. condenser.
Ch1, Ch2, Ch3—Three RF 85 mh choke coils.
Ch4—One AF choke coil like the secondary of an AF transformer.
Ch5—One heavy duty 100 henry choke coil.
C1, C3—Two .0005 mfd. tuning condensers.
C2, C8, C9—Three .01 mfd. by-pass condensers.
C4, C5—Two .1 mfd. by-pass condensers.
C6—One 1 mfd. by-pass condenser.
V7—One .0005 mfd. by-pass condenser (or .001 mfd.).
C10, C12—Two 4 mfd. by-pass condensers, 100 volts rating or greater.
C11—One 4 mfd. condenser, 400 volt rating.
R1, R2, R3—Three 20 ohm center-tapped ballast resistors.
R4, R6—Two 500,000 ohm resistors.
R5, R7—Two 2 megohm grid leak resistors.
R8—One 2,000 ohm resistor.
Rh1—One 20 ohm rheostat.
S—One filament switch.
Three standard UX sockets
Three screen grid tubes.
One .71A type power tube.
One grid bias battery, 7.5 volts.
Ten binding posts.
One 7x24 inch panel.
One 7x23 baseboard.
Two shields.

ficient at these frequencies. The larger these condensers are, the lower the frequency at which they change the impedance appreciably. A value of .01 mfd. for each of these condensers, C8 and C9, is a good minimum. With this value there is practically no change in the coupling impedance within the audible range, but higher values may well be used.

Shielding Precautions

Due to the enormous amplification at radio frequency obtainable with screen grid tubes it is necessary to take extraordinary measures to prevent feedback of radio frequency energy. Each of the radio frequency stages should be completely enclosed in a metal compartment.

This should be of such size that the tuning coils will not be too close to the metal, anywhere, and the thickness of the metal should be at least 1/16 inch. As a guide in determining the dimension of the shielded compartments the metal should not come within 1.5 inches of the coils. Thus the size of the compartments depends on the size of the coils.

The lead from the plate of a tube should be well shielded from the parts on the grid side of that tube. Since it is not practical to place the shield so close to the plate of the tube that the entire plate lead is shielded, it is well to surround the plate lead with a metal tubing or to wind a metal ribbon around that part of the lead which must be inside the compartment housing the tube. The heavy lines in the drawing, Fig. 1, show the relative positions of the parts and the shielding.

Parts Placed in Shields

The antenna enters the first compartment through a hole in the shielding. This hole should be provided with an insulating bushing so as to keep the antenna lead away from the grounded shield and to protect the insulation on the lead. The ground lead is connected directly to the shield.

In the first shielded compartment are the antenna coil Lo, the first tuning coil L1, the first tuning condenser C1, the filament ballast R1, first screen grid tube with its socket, the choke coil Ch1 in the screen grid circuit and the by-pass condenser C2. C2 is connected between the screen grid binding post on the socket to the shielding by the shortest lead practical. It it well to mount choke coil Ch1 so that its field is at right angles with the field of the tuning coil L1.

Volume Controlled by Rheostat

Although the volume control rheostat Rh1 is shown inside the first shielded compartment it is placed on the panel of the set. If the construction is such that it may also be inside the shield it is well, but it may be outside. In that case the leads to and from the rheostat should be twisted. Wrapping these twisted leads with a grounded metal ribbon will aid a great deal.

This rheostat is the only volume control in the set. It will completely control the volume if the shielding is thorough and if the rheostat's value is 20 ohms.

A shield on the tube itself, like a Vac-Shield will help you to do a thorough job.

Second Shielded Compartment

In the second shielded compartment are the by-pass condenser C4, the radio frequency transformer L2L3, the second tuning condenser C3, the filament ballast R2, the second screen grid tube, the choke coil Ch3 and the by-pass condenser C7.

Note that the plate lead to L2 passes through the shield through an insulated hole and that the plate lead to R4 passes through a similar hole. It is these two leads from the plate binding posts on the sockets to the shields that should be short or else separately shielded from the grid side of the circuit.

Just as Ch1 is placed at right angles to L1 so should Ch3 be placed at right angles to L3. Choke coil Ch2 should be placed outside the shielding, otherwise its field will interact with the field of the tuning coil.

Space Charge Grid Connection

In the circuit of the space charge grid an audio choke Ch4 is placed and this is by-passed by a large condenser C11. The object of this filter is to insure that the space charge voltage is kept constant and independent of the plate voltage fluctuations. The steady voltage applied to the space charge grid is 22½ volts.

The filament of the power tube is heated with AC. The 5 volt winding for this purpose is center-tapped for the grid return. Between this center-tap and the grid return is placed a 2,000 ohm grid bias resistor R8. This resistor is shunted with a 4 mfd. condenser C12.

The plate voltage on the power tube is supplied through the 100 henry choke coil Ch5. The voltage is 180 volts. Since the drop in R8 is 40 volts the actual voltage applied across B plus power and B minus is 220 volts. This voltage is also applied to the plate of space charge tube through the half megohm resistor R6.

The loud speaker is connected in series with a 4 mfd. condenser and it returns to the mid-tap of the filament rather than to B minus. This connection is used because it improves the low reproduction.

Grid bias for the first tube is obtained by taking advantage of the voltage drop in half of the ballast resistor R1. The grid bias for the third tube is obtained in the same way. The bias for the detector is obtained partially in this way and partially from the grid bias battery "C." The total grid bias on this tube should be from six to 7.5 volts. The drop in R2 is 2.7 volts. The battery must supply the difference.

Polymet Publishes Engineering Manual

The Polymet Manufacturing Corporation, of 599 Broadway, New York City, makers of electric radio set essentials, announced the publication of a new loose-leaf manual of special interest to radio engineers and radio manufacturers' purchasing agents. The manual presents complete descriptions, working drawings, prices, and test results of all Polymet products—filter and block condensers, wire wound resistances, large and small molded Bakelite condensers, fixed mica condensers, metallized and wire wound strips Polytrols (automatic rheostats), potentiometers, rheostats, Bakelite grid leak mountings and phone plugs. The loose-leaf form of the Manual will permit of additional pages of information being inserted to take care of future developments. The Polymet Manual was first shown at the radio trade show in Chicago. This manual is not for general circulation but the Polymet Company offers to send it free to engineers and purchasing agents. Mention RADIO WORLD.

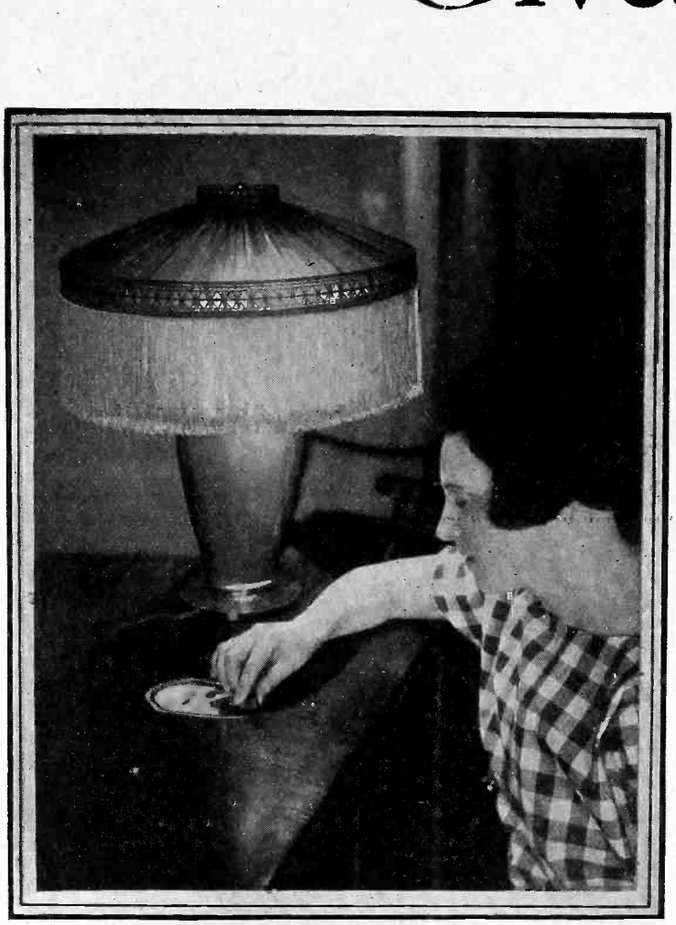
Name Baby This Way

If you name a baby for an artist or announcer of the National Broadcasting Company, or report such an instance, you can earn a gift for the newcomer. "Feature Service," published by the N. B. C. at 711 Fifth avenue, New York City, prints the following:

"Reports have reached the N. B. C. studios of gold fish, kittens and even a mine mule being named after famous radio announcers. Faint rumors have been heard of babies being named for radio celebrities. If radio editors can furnish authentic reports of children being named for N. C. B. announcers or artists, we'd appreciate the details. Also there'll be a letter and a little gift for the baby from the person he (or she) was named after."

The Table Top Gives New and

By H. B.



LIST OF PARTS
for the Tuner

L1, L2L3L4, C1, C2, PL—One National Single Dial Tuning Unit BD No. 222 with No. 28 Illuminator (unit consists of drum dial, antenna and detector coils, two knobs, two tuning condensers, mounted on frame).

C, OC—Two Aerovox .0001 mfd. moulded mica condensers.

C3—One Aerovox .00025 mfd. moulded mica condenser.

C6—One Aerovox .001 mfd. moulded mica condenser.

C4, C5—Two Tobe .5 mfd. bypass condensers.

1, 2—Two Benjamin sockets.

S—One Yaxley No. 10 Switch.

L5, L6—Two National RF chokes, with two Lynch single mountings.

R3—One Lynch 2 meg. grid leak with single mounting.

R4—One Lynch No. 4/5 Filament Equalizor with single mounting.

One fuse clip or No. 45 Universal Peewee clip for cap of CeCo RF 22 tube.

One extra knob with ¼ inch hole, or drill National knob to ¼ inch diameter.

Two 3/16 inch washers.

Two small brackets.

Four binding posts.

A RADIO table may be defined as a piece of furniture, with a finished flat top, covering a doored compartment in which the equipment may be kept. The receiver, in a separate cabinet and on a separate front panel, is placed on top of the table. Thus a table is distinguished from a console, which is higher, the receiver, in chassis form alone or in a cabinet, being placed in the console from the front, instead of being laid on top.

Now, there never was any good reason why a person possessing a table with a door or two in front had to get a panel and a cabinet for a set, and thus build up a bulky, console-like effect. It has always been his opportunity to build the receiver in such fashion as to constitute the top of the table the panel, in this instance the "top panel" instead of the "front panel."

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Some Bravery Needed

Perhaps it was because a radio table is likely a decent piece of American walnut or mahogany, and diffident hands balk at drilling into this good woodwork, and there is some even less confident woman ready to back up the tendency to cease and desist.

I might as well confess that the first drillhole I made in my radio table was not quickly done. After a few turns of the hand-drill I removed the bit from self-formed repository and wondered if I could not disguise the hole and quietly call the whole thing off.

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Positive Bias

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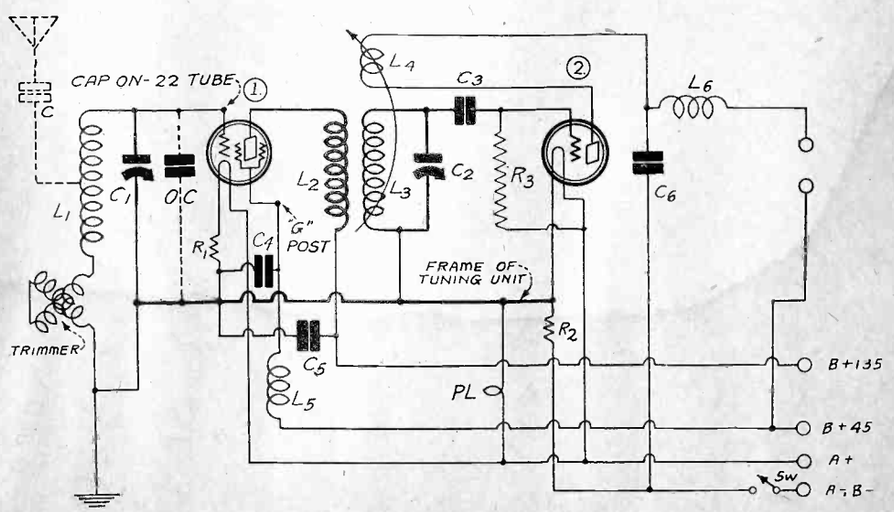
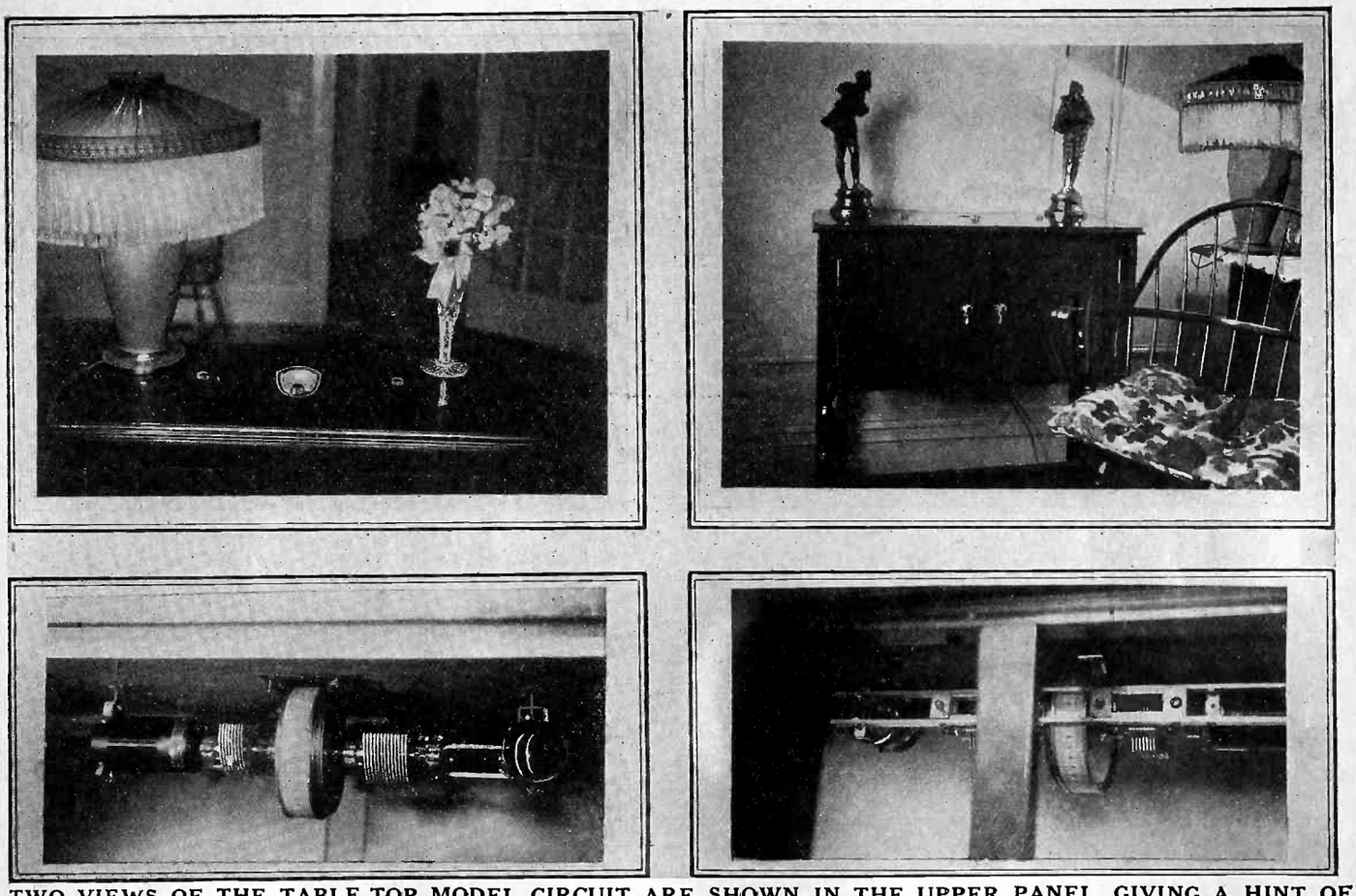


THE CIRCUIT USED IN THE TABLE TOP MODEL INSTALLATION WAS THAT OF THE NATIONAL SCREEN GRID FIVE. THE SET WAS BUILT WITH TUNER SEPARATE FROM THE AUDIO AMPLIFIER. THE DIAGRAM SHOWS THE TUNER HOOKUP, WITH CONSTANTS IDENTIFIED. FOR VALUES OF CONSTANTS SEE LIST OF PARTS.

Used as the Panel Fetching Effect

Herman



TWO VIEWS OF THE TABLE-TOP MODEL CIRCUIT ARE SHOWN IN THE UPPER PANEL, GIVING A HINT OF THE ORNAMENTAL VERSATILITY THIS SYSTEM AFFORDS. A DECORATIVE TABLE LAMP AND FLOWER VASE IS ONE COMBINATION AND TWO BRONZE GENTLEMEN OF VERONA IS THE OTHER. THE LOWER PANEL SHOWS VIEWS OF THE TABLE INTERIOR. AT LEFT IS THE REAR VIEW OF THE TUNER, AT RIGHT A GLIMPSE OF THE FRONT THROUGH OPEN DOORS. THE MIDPIECE IS THE PARTITION AGAINST WHICH THE DOORS (NOT SHOWN) CLOSE.

while the knob actuating the tuning mechanism stuck up half an inch.

The dial was illuminated, which took care of the legibility problem, and so I got started on what was to be a circuit and installation that met with my entire approval and which, I am still prouder to relate, struck the aesthetic sense of the commandress so completely as to overpower all customary negative impulses.

It was a sort of feminine positive bias applied to the whole proposition, and I was not only satisfied but happy.

Back to Science Again

Thus has it come to pass that you will find, in checkered gingham dress, fresh from household duties, the empress of the four rooms and bath stopping long enough to tune in her favorite station, so as to have it on the air when I arrive home from work. It is a standing rule that (1) her favorite station always is my favorite station, different tastes to the contrary notwithstanding and (2) the radio keeps going from the moment that I arrive home until the moment that she goes to bed. After that I sit up and read.

To return to the scientific side of our discourse, every radio table is in itself a cabinet and panel, with the top as the panel, and may as well be used for accomodating the tuning and volume controls, particularly since the wave of simplification, single dial tuning and unit operation generally, has come to stay.

In other days, when you had half a dozen jiggers and what-not dodads on the front panel, and honeycomb coils sticking out to boot, it was a different story. You put everything on the front panel except baby's shoes. Now you put next to nothing on the panel and get nearly everything.

Wooden Bravery

By using the table top to retain the tuning condensers and minor adjustment knobs, locating the switch at rear or side, or within the table, so that you open the door to get at the switch, you condense the installation materialy, even if only in the direction of height, but this eradicates bulk and adds gracefulness. Besides, you economize. No extra cabinet and no extra panel are needed. What you don't have to buy you don't have to pay for, and that's always attractive, when results are not only as good, but from an aesthetic as well as from an economic viewpoint, much better.

Of course there are some problems. We like to build in the tried and true way, and the wisest ones are those who follow conventional lines, if immediate electrical results is their goal, but the present new path is an encouraging one, because it deals with nothing freakish electrically, but addresses itself solely to mechanical work for eye appeal and simple symphony of appearance.

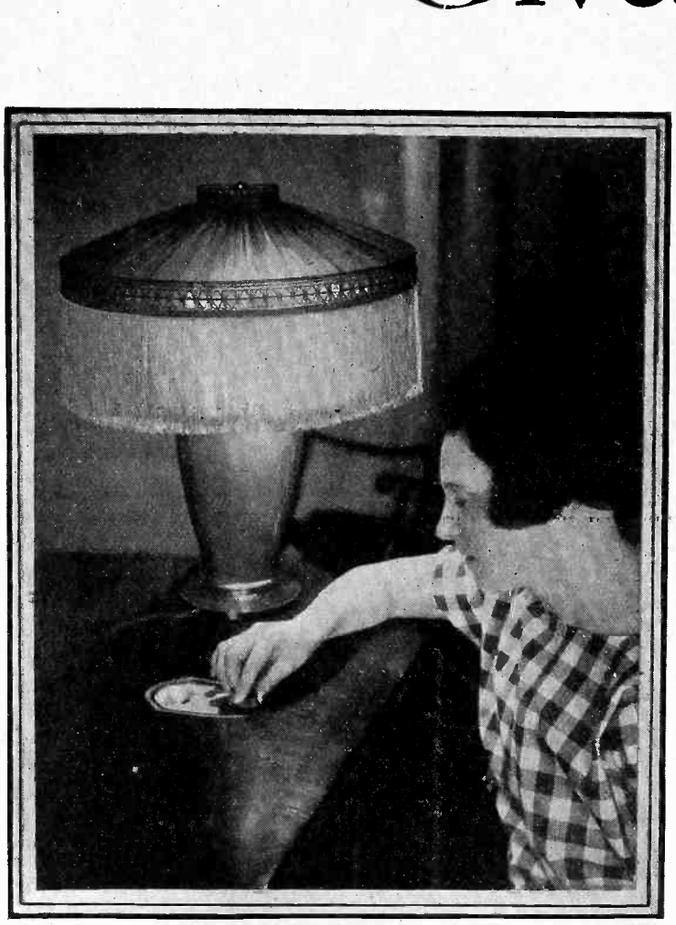
With things mechanical I myself would be tempted into new fields much more quickly than with things electrical. A piece of wood, after all, I am really not afraid of, even with the commandress on the scene. I am, I insist, brave in the face of any piece of wood, although I will not say as much for steel.

As for the problems, the first you will encounter, after the three shaft holes are drilled, will be the mounting of the dial face or escutcheon. Ordinarily the table top will be a generous slice of wood, about as thick as a $2.50 piece of steak in a Broadway restaurant, or five-eighths inch. Since one-quarter inch thickness for Bakelite front panels ordinarily used for cabinet

(*Continued on next page*)

The Table Top Gives New and

By H. B.



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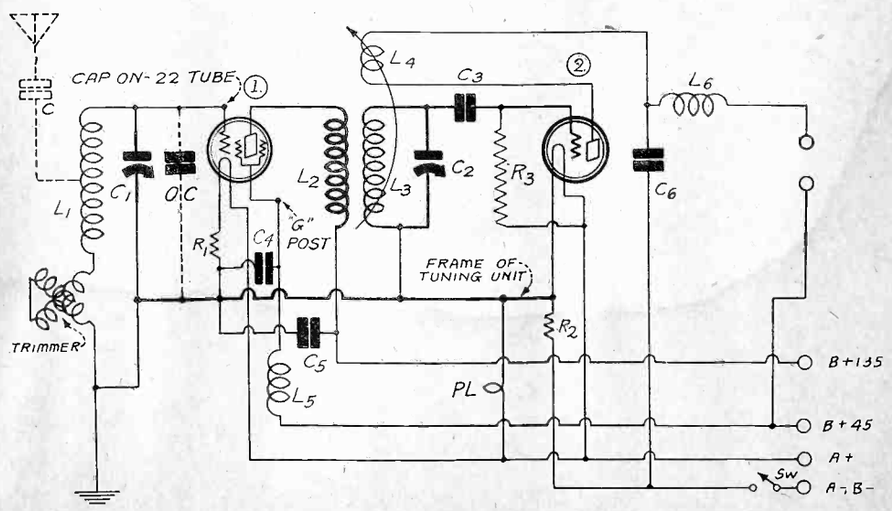

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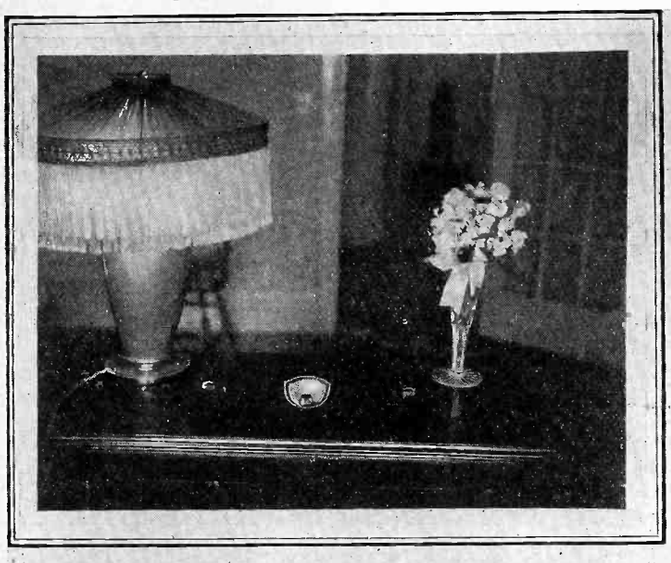
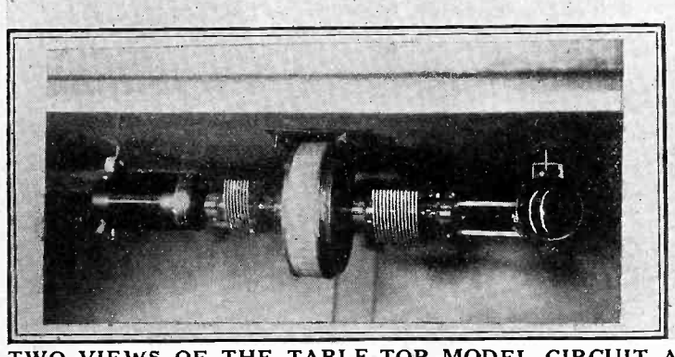
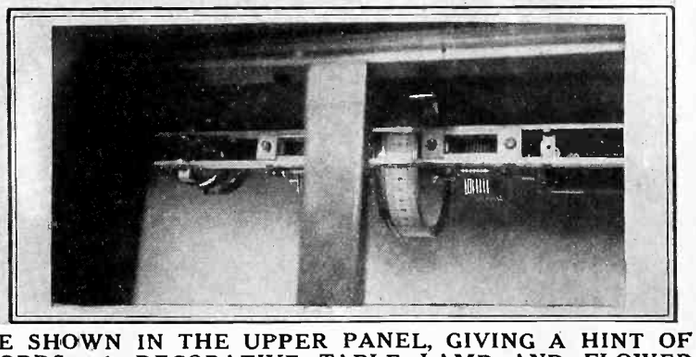






TWO VIEWS OF THE TABLE-TOP MODEL CIRCUIT ARE SHOWN IN THE UPPER PANEL, GIVING A HINT OF THE ORNAMENTAL VERSATILITY THIS SYSTEM AFFORDS. A DECORATIVE TABLE LAMP AND FLOWER VASE IS ONE COMBINATION AND TWO BRONZE GENTLEMEN OF VERONA IS THE OTHER. THE LOWER PANEL SHOWS VIEWS OF THE TABLE INTERIOR. AT LEFT IS THE REAR VIEW OF THE TUNER, AT RIGHT A GLIMPSE OF THE FRONT THROUGH OPEN DOORS. THE MIDPIECE IS THE PARTITION AGAINST WHICH THE DOORS (NOT SHOWN) CLOSE.

while the knob actuating the tuning mechanism stuck up half an inch.

The dial was illuminated, which took care of the legibility problem, and so I got started on what was to be a circuit and installation that met with my entire approval and which, I am still prouder to relate, struck the aesthetic sense of the commandress so completely as to overpower all customary negative impulses.

It was a sort of feminine positive bias applied to the whole proposition, and I was not only satisfied but happy.

Back to Science Again

Thus has it come to pass that you will find, in checkered gingham dress, fresh from household duties, the empress of the four rooms and bath stopping long enough to tune in her favorite station, so as to have it on the air when I arrive home from work. It is a standing rule that (1) her favorite station always is my favorite station, different tastes to the contrary notwithstanding and (2) the radio keeps going from the moment that I arrive home until the moment that she goes to bed. After that I sit up and read.

To return to the scientific side of our discourse, every radio table is in itself a cabinet and panel, with the top as the panel, and may as well be used for accomodating the tuning and volume controls, particularly since the wave of simplification, single dial tuning and unit operation generally, has come to stay.

In other days, when you had half a dozen jiggers and what-not dodads on the front panel, and honeycomb coils sticking out to boot, it was a different story. You put everything on the front panel except baby's shoes. Now you put next to nothing on the panel and get nearly everything.

Wooden Bravery

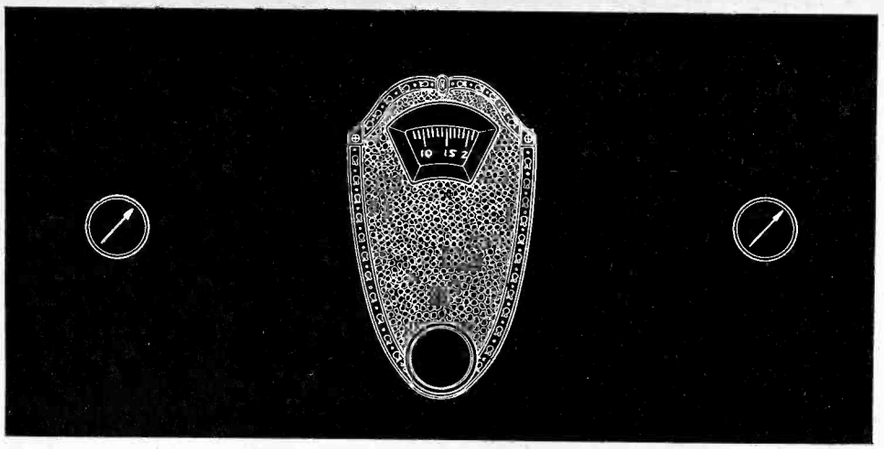
By using the table top to retain the tuning condensers and minor adjustment knobs, locating the switch at rear or side, or within the table, so that you open the door to get at the switch, you condense the installation materialy, even if only in the direction of height, but this eradicates bulk and adds gracefulness. Besides, you economize. No extra cabinet and no extra panel are needed. What you don't have to buy you don't have to pay for, and that's always attractive, when results are not only as good, but from an aesthetic as well as from an economic viewpoint, much better.

Of course there are some problems. We like to build in the tried and true way, and the wisest ones are those who follow conventional lines, if immediate electrical results is their goal, but the present new path is an encouraging one, because it deals with nothing freakish electrically, but addresses itself solely to mechanical work for eye appeal and simple symphony of appearance.

With things mechanical I myself would be tempted into new fields much more quickly than with things electrical. A piece of wood, after all, I am really not afraid of, even with the commandress on the scene. I am, I insist, brave in the face of any piece of wood, although I will not say as much for steel.

As for the problems, the first you will encounter, after the three shaft holes are drilled, will be the mounting of the dial face or escutcheon. Ordinarily the table top will be a generous slice of wood, about as thick as a $2.50 piece of steak in a Broadway restaurant, or five-eighths inch. Since one-quarter inch thickness for Bakelite front panels ordinarily used for cabinet

(*Continued on next page*)



THE TOP OF A RADIO TABLE, WHEN USED FOR THE PANEL, WITH THE NATIONAL SCREEN GRID TUNER AS THE GROUNDWORK, LOOKS LIKE THIS, ABOUT THE CENTAL PORTION. THE CENTER LINE OF ANY SIZED TOP IS MEASURED OFF, AND LIGHTLY RULED TOWARD YOU WITH A PENCIL. THE ESCUTCHEON IS LAID ON THE LINE SO THAT THERE IS ABOUT EQUAL DISTANCE FROM TOP AND BOTTOM. THE SHAFTS FOR THE TWO SMALL KNOBS ARE LOCATED BY USING THE TEMPLATE FURNISHED WITH THE TUNER KIT.

(*Continued from preceding page*)

installations is a maximum, and shafts have depth accordingly, you are three-eighths inch to the bad, and the knob therefore is prevented from fitting on the shaft of the dial or condenser.

An easy solution is to use a dial that has a three-sixteenth inch diameter shaft, and put an extension collar on it that has three-sixteenths inside diameter and quarter-inch outside diameter, substituting, of course, a knob with a quarter-inch boring for the one supplied with the dial.

Nothing has been said about cutting the hole for the dial. This is a task, and I purposely delayed mentioning it, to avoid discouraging you. Devote an entire evening to mounting the dial. The time will be well spent. Unless this piece of work is carefully done you will regret your decision to use the table top as panel, merely to save yourself the expense of a front panel and a cabinet. You will never believe the appearance has been improved unless you get that dial mounted properly.

The National Screen Grid Five was the circuit selected for this table housing, because it is a very sensitive, easily tuned, fine-sounding, and lends itself admirably to mounting of the radio frequency tuning element under the table top.

This circuit uses the National drum dial, type C, illuminated. No change was made, except to omit a rheostat as volume control and use the tickler instead for this purpose, an allowable alteration.

The dial was mounted first. This was done by removing the escutcheon and tracing the outline directly from the hammered silver face, lightly tracing the outline with a very sharp knife, time and time again, until deep engraving of the outline was accomplished, then slicing sideways to define the cutting.

The outline was cut about one-eighth inch deep. About an inch and a half up from the bottom of the dial, halfway past where the tuning shaft hole was, a line was drawn across the outline, from side to side, where the wood was to be retained for reinforcement, and then, inside the remaining space, about quarter inch in from the truncated outline, holes were drilled with a small bit, each hole as near the other as could be, and a chisel used to make the cut clean for an inch.

Then a small saw was inserted and the rest of the severance on one side completed with the saw. On the other side, still working on the top, the operation was repeated. The wood was not cleanly severed, due to splinters hanging across, so the inside piece was knocked out with a hammer and the remaining edge made clean with a file.

Now a hole was drilled, quarter inch, at the point where the shaft of the dial had to protrude, and it was possible to fit on the works of the dial, from the inside of the table.

This was done with the table upside down. Two brackets were provided, to afford security, one especially, at the top of the dial, being important. Wood screws were turned in the dial frame, inside. The dial mechanism was mounted, but no shaft would engage any knob. Hence an extension bushing, obtainable in almost any radio or hardware store, was used for the dial shaft. It was an inch high, which permitted driving it home, yet leaving enough extending from the top so that a knob would "bite" it.

The machine screws furnished with the dial for mounting the escutcheon could not be used, of course, so the escutcheon was laid in place and the three one inch wire nails hammered home through the apertures in the escutcheon.

The operation is more easily described than done, and it is handy indeed to have the assistance of a template or dimentional chart, so dimensions will be given in a diagram, which takes care of the holes for the trimmer and tickler shafts, which, by the way, need no extension bushings, but constitute a problem nevertheless.

The shaft holes automatically put the frame, on which the condensers and coils are factory-mounted, at right angles to the lower inside level of the table top. But the retention of the assembly frame—the radio frequency part of the installation—at right angles to the inside lower plane of the table top depends partly on the engagement of the trimmer and the tickler shafts with their regular knobs. Countersinking permits getting these two small knobs deep enough, but not without extra assistance. The shafts must be moved up higher to meet the knob screws, and this requires removal of the two shafts.

Take These Precautions

You will understand this better by realizing a knob fitting into a tight place, with collar of the knob sunk too deeply for access to the setscrew. Then how are you to turn an inaccessible screw? By removing each of the two shafts, and simply screwing a knob tightly to each shaft. Now you have the knob on the shaft, all right, and simply have to restore each shaft to the coil it actuates. When doing this slip a thin machine-oiled washer on the shaft, letting it come flush with the knob so the knob doesn't grate against the drilled wood, but there is a washer between.

Watch carfully the coil construction so that you get the bakelite collars and set-screw rings where they belong.

[*Part II of this interesting discussion of a departure from the ordinary method of housing a set will be described next week, issue of July* 21.]

Accurate Wave Needed Now More Than Ever

Washington.

Frequency standardization, of hitherto laboratory character only, now is considered a prime importance in reducing radio interference, and the increasing use of all available radio channels has made the requirements of frequency measurements a hundred times more rigorous than they were five years ago, according to a statement by Dr. J. H. Dellinger, Chief of the Radio Section, Bureau of Standards. The full text of the summary of Dr. Dellinger's statement follows:

The recent International Radio Conference recognized frequency as the cornerstone in the radio structure by devoting its major attention to a frequency allocation to provide for the orderly development of all radio services.

Increased Hundred-fold

Because of increasing use of all available radio channels, particularly those for broadcasting and the very high frequencies, the requirements for frequency measurements are a hundred times more rigorous than they were five years ago.

The perfection of standards and measurements to the necessary accuracy requires the most intensive work by the Government and by various large organizations to produce standards and instruments that be used to keep radio stations each operating on its own channel.

This development has been facilitated by a special co-operative plan organized by the Bureau of Standards a year ago and involving the Commerce, Navy, and War Departments, the General Electric Co., the Westinghouse Co., American Telegraph & Telephone Co., Radio Corporation, and the General Radio Co.

Highly Accurate Now

Piezo-oscillators are now available to hold radio-station frequencies extremely constant. For instruments of this type equipped with temperature control, national and international comparisons have shown that they are reliable to a few parts in 100,000.

This brings in sight the possibility of the use of special piezo-oscillators in broadcasting stations, which will hold the frequency so close that several such stations can operate simultaneously without heterodyne interference on the same frequency. This is the only practical scheme so far developed for solving the problem of too many broadcasting stations.

The use of frequency standards of this high accuracy is also vital to all users of the very high frequencies. Many more high-frequency channels will become available when all stations use the best available frequency standards and keep the stations on their frequencies with great accuracy.

New AC Amperites Assure Right Voltage

When a 60 cycle alternating current is used to heat the filament, the current fluctuates, between zero and maximum, 120 times per second. If the filament were extremely thin, it would become white hot, and then cold, 120 times per second.

But due to its mass, the ordinary filament doesn't have time to cool. Nevertheless, its temperature does fluctuate to some extent with the current. It may not be noticeable to the eye, but when used as an electron emitting filament, and amplified, it becomes noticeable to the ear.

In designing vacuum tubes for alternating current it is therefore of prime importance to use an electron emitting body, which fluctuates little with the alternating current.

Two methods are used to obtain this result. First, a heavy low voltage filament is used as in the case of the four-prong -26 tube. This filament is heavy enough to retain its heat. Secondly, a cylinder is used as the electron emitting surface. The cylinder is heated by an extra heater to which the AC is applied. This heater is usually either tungsten or carbon. The idea is that the heavy cylinder will retain its heat much better. The -27 tube uses a cylinder of this type.

Large Variations

To avoid confusion of terms regarding the -27 tube the word "heater" (H) designates the AC operated part and the word "cathode" (K) the emitting cylinder

The filaments of four-prong AC. tubes are usually made of either tungsten or platinum ribbon, and designed to operate at a definite temperature, to give the required emission. Most AC tubes are not sensitive to small fluctuations in filament voltage. When these tubes are used in ordinary electric light lines, however, they are subjected to unusually large voltage variations.

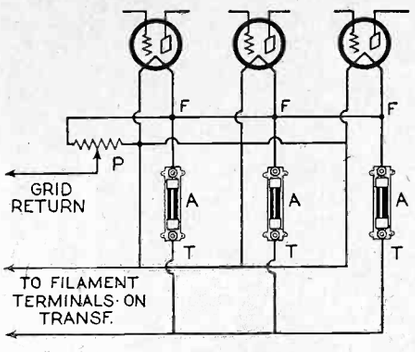
The voltage variations in ordinary light circuits are due to the variations in load on the various lines. It is quite common to find lines which vary from 95 to 125 volts. This is a variation of over 30% and much too great for the good behavior of vacuum tubes.

A common fallacy is to reason, as follows: The ordinary AC tubes have a filament of 1½ volts. The variation in the line may be 95 to 125 volts, but by the time it is stepped down to 1.5 volts, the variations are small.

Methods Used

Quite true, the line varies 30 volts, but the filament only .4 to .5 volts. But the right way to reason is that 30% is 30%, no matter where encountered, and will vary the current 30% or 0.3 amperes. This is too large.

Numerous methods have been used to take care of this variation. In some instances the primary of the transformer is tapped, in others hand rheostats are used. The inadequacy of these methods has been often demonstrated. It is quite impossible to tell when the voltage of the lines will increase. And the increase in voltage is not always accompanied by an increase in signal strength.



P = POTENTIOMETER
A = AMPERITES

HOW TO CONNECT THE NEW AC AMPERITES FOR AUTOMATICALLY CORRECT VOLTAGE AND CURRENT, DESPITE RECURRENT LINE VOLTAGE CHANGES OR EVEN STEADY DEVIATION FROM THE RATED 110 VOLTS FOR INPUT.

Vacuum tube filaments are designed to operate between definite limits. Above or below these fixed limits, less satisfactory results are usually obtained—but not always noticeable to the ear.

A good solution of the problem is a self-adjusting rheostat, which varies as the power line varies. The property of the Amperite filament to vary in resistance with changes in current makes its use in vacuum tube circuits excellent practice. Automatically and instantaneously the variations in the line are compensated by the Amperite. The tube filament is constantly kept at the same temperature—its best operating temperature. A steady flow of electrons are obtained. The result being reliable operation and long life to the tubes.

The New Amperites

The method of connecting Amperites in the tube filaments is simple, as shown in Fig. 1. One precaution should be pointed out. The leads going from the potentiometer P to the filaments should be connected in the filament side of the Amperite F and not at T.

The new Amperites that serve for AC sets are No. 226 and No. 227 for those tubes respectively.

Trouble-Shooting in AC Is Harder

With the increasing use of electrically operated sets, both by means of socket power devices and alternating current tubes, trouble shooting becomes more complex. Locating trouble in battery operated sets was simple.

Where high voltage are involved the first thing to remember in trouble shooting is to turn off the power in the supply line whenever any changes are to be made in the circuit or when any meters are to be connected.

First turn the power off, then connect the voltmeter or the ammeter and then turn the power on again. Take the reading and turn the power off. Make sure that the meter used is suitable for measuring the quantity desired, or that the meter has the required range.

No tube should be taken out of its socket while the power is on. This is particularly important in AC sets. The tubes left in the circuit may be damaged. It holds also for certain DC sets in which more than one tube is on the same ballast resistor and when the voltage source is high.

The best method of procedure in trouble-shooting any receiver is that of successive elimination. A voltmeter is the most useful instrument. For example, suppose an AC operated receiver fails to work. Do all the tubes light? If they do the filament circuits are probably all right. If one is not lighted the trouble can readily be found by tracing out the filament circuit of that tube.

Do all the tubes get their plate voltage? If all the tubes lack plate voltage the trouble is general and must be looked for in the plate voltage supply. Trace it backwards to the rectifier.

It may be found dead or the high voltage winding may be burned out. If the lack of voltage applies only to one or two tubes in the circuit the trouble may be found in a faulty connection, an open coupling unit or a burned out winding. This can be located by touching the positive terminal of the voltmeter to various points in the plate circuit, the negative terminal remaining connected to the filament circuit of a tube or to the negative side of the power supply. If a voltage reading is obtained at one point and not at another point nearer the plate of the tube the location of the trouble has been found.

The same procedure is carried through for the grid circuits, but the voltmeter used must be reversed. That is the positive terminal must be connected permanently to the filament and the negative moved around for exploring the circuit.

One of the most useful devices for checking up on a circuit is a circuit tester consisting of a milliammeter and a filament voltmeter. It indicates the filament voltage and the plate current, and it can be inserted into almost every socket. With proper adapters all the stages can be tested regardless of the type of socket which is used. A tester having an AC filament voltmeter can be used for both AC and DC sets provided that the meters have the required milliampere or voltage ranges.

Ground Used As Antenna

When testing an AC operated receiver supplied with both ground and antenna it is well to interchange the ground and antenna connections. Sometimes superior results may be obtained by this reversal. In many cases best results are obtained by disconnecting the antenna altogether and connecting the ground lead to the antenna binding post.

ISOTONE NEW SCREEN-GRID RECEIVER

The High Frequency Laboratories, Chicago, famous for the well-known Nine-in-Line kit, announce for the new season the new Isotone Screened Grid receiver. This was one of the outstanding hits of the Chicago show and is a combined phonograph amplifier. The company claims thirty new, different features in this receiver. It may be obtained in complete kit form or the Isotonic Screened Grid Amplifier unit and the Isotonic Audio Amplifier may be purchased separately. There are only a few connections to make and the whole receiver may be assembled and wired in an hour. There is also an Isotonic model 5 A-B-C power supply which provides all voltages for the receiver. The New York and New England representatives are the H. F. L. Sales Co., 377 Fourth Avenue, New York City, who will furnish full information upon request and are desirous of getting in touch with New York and New England jobbers. Mention RADIO WORLD.

J. H. C.

RADIO WORLD

Title Reg. U. S. Pat. Off

The First and Only National Radio Weekly

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

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KIND WORDS

EDITOR RADIO WORLD:

I have read and reread your June 16th issue. It is one of the meatiest, most instructive magazines I have perused since I have been a radio fan. Everything is written in such plain language, too.

I buy RADIO WORLD frequently at newsstands, but I just had to tell you of this special run.

CHARLES C. ABEL,
Box 304, Huntington Park, Calif.

* * *

EDITOR RADIO WORLD:

I have been reading your magazine for nearly one year and think it the best I have ever had.

C. H. HANSEN,
Radio Service,
Holstein, Iowa.

South and West Suffer by Law, Says Caldwell

Washington

Provision in the Radio Act of 1928, requiring equal allocation of wavelengths, station power and licenses among the five radio zones, cannot fail to work a hardship on the South and the far West, the sections which sponsored the bill in Congress, O. H. Caldwell, member of the Federal Radio Commission, stated.

It is apparent, said Mr. Caldwell, that the large Southern zone and the tremendous Pacific zone could be awarded a large number of stations without radio interference, but the law specifically provides that the number of stations and power authorized shall be the same in all zones.

The Commission's Committee on Broadcast Reallocation is making progress in its work under the new statute, Mr. Caldwell explained, and a plan should be ready by August 1.

The full text of his statement follows:

Collating the many valuable suggestions on the broadcasting situation offered to the Federal Radio Commission by radio engineers, broadcasters, the general public and interested members of Congress, the Commission's committee on Broadcast Reallocation has been working uninterruptedly, with expert help, to have a plan ready by August first.

Gratifying progress is being made toward a broadcasting set-up that will equalize the radio facilities granted to the five radio zones, while securing good radio reception, so far as the available radio facilities permit under the new Davis-Dill "equalizing law."

Law Imposes Hardships

To those who are working on this reallocation and undertaking to carry out faithfully the equalizing provision of the Davis-Dill bill, as passed by the last session of Congress, it is becoming increasingly apparent that the greatest—and unnecessary—hardships imposed by the Davis-Dill law on the listening public, will be in the South and in the far West, the very sections from which came the sponsors of the bill in Congress.

Since the Davis-Dill law requires that the wavelengths, powers and licenses shall be divided among the five zones, it is apparent that the geographically large Southern zone, and the tremendous Pacific Coast (Fifth) zone, can be granted only the same number of stations and powers as can be operated satisfactorily in the relatively small and compact First zone, which comprises New England, New York and neighboring States.

In the great geographical stretches of the Southern zone, from Florida to Texas, a large number of stations might be satisfactorily operated without radio interference, and the Southern public thus might have the advantage of ideal and adequate radio service, were it not for the fact that the Davis-Dill law limits the South's radio stations to the same number which can be worked in the small Eastern (first) zone.

A similar imposition is worked upon the radio public of the vast Fifth Zone, whose huge area includes two-fifths of the United States.

Cites California and Washington

This zone's radio stations are now using some 80 different wavelengths, and could continue to use all these without intereference to any other stations anywhere. Yet because the physically-tiny First zone sets the limit to the number of stations which can be operated, the great Fifth zone will, by the Davis-Dill law, be required to vacate nearly two-thirds of these wavelengths, which must stand idle and useless, while this zone's splendid stations are forced to double up and "divide time" on a few wavelengths, that "legal equalization" may be obtained.

Especial hardships will be worked on the States of California and Washington, whose time on the air will be cut to about one-third,—all needlessly, so far as radio interference is concerned.

In other words, all four of the geographically great radio zones must, under the Davis-Dill law, "wear the same size radio pants" as will properly fit the physically-small First or Eastern Zone.

When the radio listening public of the Pacific Coast and of the Southern States find themselves thus unnecessarily deprived of the radio facilities which, afforded by nature, might be theirs, except for legal enactment, certainly an enraged public opinion will be directed at those incompetent lawmakers which led Congress into this needless waste of the nation's previous radio wavelengths.

Caldwell Will Resign to Rejoin Magazine

Washington

Commissioner Orestes H. Caldwell of the Federal Radio Commission will resign, probably in September or October. In stating that he expected to resign he said that the work of the Commission was going on nicely and that he believed the new allocation plan would be put into effect in the Fall.

If the plan goes through, said Mr. Caldwell, his usefulness with the Commission will be ended, and if the plan does not go through he thought that he had done about all that is possible in the furtherance of the Commission's program.

Mr. Caldwell denied a rumor that he intended to join the National Broadcasting Company and stated that he is committed to return to McGraw-Hill Publishing Company, with which he has been associated for nearly 20 years. He was a magazine editor.

Mr. Caldwell was one of the original five members of the Commission appointed by President Coolidge when the Commission was first organized March 14, 1927.

During the time Mr. Caldwell has been a member of the Commission he has been at odds with members of Congress who knew nothing of the technical problems of radio and has vigorously resented criticism by Congress of the Commission for its efforts to improve the tangled radio conditions. The first time the Commissioners were up for confirmation by the Senate Mr. Caldwell was not confirmed, and the second time, about a year later, he won by a single vote. His record is one of outspokenness.

The Radio Trade

Raytheon Acquires Q. R. S. Tube Division

The Raytheon Manufacturing Company, of Cambridge, Mass., radio tube specialists, announced that they have absorbed the radio tube division of The Q. R. S. Company of Chicago, in part settlement of its suit against the Q. R. S. company for infringement of the gaseous rectifying tube patents.

The Q. R. S. Company, after making elaborate preparations and investigations to defend the suit, decided that the matter should be settled out of court.

The Rayheon organization, with additional capital, is working on plans for marked expansion of its facilities, personnel and products, not only to maintain leadership in the radio rectifying field, but also to engage in various allied endeavors. Among the new lines shortly to be announced will be neon letters for advertising signs, as well as special tubes for television, including both photo-electric cells for transmitting and kino-lamps for receiving the images.

"The Raytheon Manufacturing Company,' said D. E. Replogle, of the executive staff, "takes this opportunity of thanking the radio public and the radio trade for their support which has made possible the success of the organization, and asks for a continuance of that support in its forthcoming expanded activities."

Sonatron Enlarges

The Sonatron Tube Company, makers of the nationally known line of Sonatron tubes, has just leased 3,000 square feet at 16 Hudson Street, New York City, to take care of its increased business in this territory. Other central offices are maintained at Chicago and Detroit with factories at Newark, N. J.

In three years this company has increased its space from 180 square feet to their present enlarged quarters and much of this increased business is due to Ben Chirelstein, manager of this territory, seconded by Lew Newman, eastern sales manager.

Among the new tubes brought out by this concern is a —50 type, an AV 71 for operation direct from the AC line, a new B type, five volt tube, which draws but one-eighth of an ampere, and a new Sonatron X-401, an AC tube which has the cathode connections housed in a bakelite cap at the top of the tube, it being only necessary to connect a couple of wires for the filament, making an AC set an easy job. Full line of tubes may be had by writing to Ben Chirelstein, 16 Hudson Street, New York City, c/o Sonatron. Mention RADIO WORLD.

—J. H. C.

Survey of Market

The Radio Division, National Electrical Manufacturers Association, 420 Lexington Avenue, N. Y. City, has just announced the publication of "The Radio Market" which is said to be the most comprehensive study, based on statistics gathered by the Department of Commerce in cooperation with the National Electrical Manufacturers Association, ever made of the radio market. It was announced that this was the first issue of a similar study which would regularly be made.

New Owners Make Big Plans for Streamline

SAMUEL LAGER

Five years ago an earnest youngster went to work for Louis Lager behind the counter of the old Enter City Radio Co. He was Charles Taretsky. Today he is the treasurer and part owner of the newly formed Streamline Radio Stores, Inc., 223 Fulton Street, New York City. He and Samuel Lager, Louis' brother, bought Louis out. A wide variety of the new season's electric sets is carried and a full range of dynamic speakers.

Mr. Taretsky is a Diamond fan and plans to specialize also in service on this famous circuit. Complete kits and sets of parts for all models of the Diamond of the Air, including the new screen Grid model, will be kept in stock. A full line of Bruno products is also on hand.

This concern will also specialize in mail orders under the supervision of Mr. Taretsky, formerly manager of B. C. L. Radio Co., Inc.

Samuel Lager, president of Streamline, is a veteran radio man and the combination of these two dynamic personalities will assure good values and choice merchandise to the consumer. A new catalog now on the press will be sent to those who write to the above address. Mention RADIO WORLD.

J. H. C.

NEW UNIT COMING

A unit for cone, airplane and other diaphragm speakers, embodying new mechanical and electrical features, is being developed by Great Atlantic Radio Co., Inc., 222 Fulton Street, New York City.

NEW INCORPORATIONS

Princeton Radio Corp.—Atty., L. W. Schwartz, 150 Broadway, N. Y. City.

Joseph Radio Corp.—Atty., L. D. Schwartz, 150 Nassau St., N. Y. City.

Dynamic Unit Corp. of America—Atty., Bluemenstock, 110 E. 42 St., N. Y. City.

Collins Radio, Radio Equipment—Atty., M. A. Vogel, 1440 Broadway, N. Y. City

Porod-Safarik Corp., radio set makers; Atty., W. H. Robinson, Elmhurst, N. Y. City.

Hermann Radio Corp., Atty., A. Honig, 28 West 43d St., New York, N. Y.

Dorn Radio Co., Atty., S. L. Hirschberg, West New York, New Jersey.

Balder Radio Corp.—Atty., H. Stackell, 217 Broadway, New York, N. Y.

Literature Wanted

THE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank below may be used, or a post card or letter will do instead.

RADIO WORLD,
145 West 45th St., N. Y. City.

I desire to receive radio literature.

Name .....

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Frank Groue, 923A North 18th St., St. Louis, Missouri.

Wesley Lowe, 9430 Halladay Ave., Oakland, Calif.

Keith Harrison, Clinard Electric Co., High Point, N. Carolina.

A. J. Evans, 51[illegible] Taylor, Harlington, Texas.

H. W. Troop, 58 Bailey Street, Dorchester 24, Massachusetts.

Emil Van Bost, Orchard Ave., R. F. D., Apponaug, Rhode Island.

A. G. Goss 145 Temple Ave., Detroit, Michigan.

H. A. Curnan, Furnace Avenue, Stafford Springs, Connecticut.

R. W. Vogeley, 10026 92nd Ave., Richmond Hill, N. Y.

S. J. Connelly, 500 W. Glenaven Ave., Youngstown, Ohio.

Chas. J. Vetuskey, 49 Dayton St., Rochester, N. Y.

Frank Reaume, 12058 Dexter Blvd., Detroit, Michigan

F. B. Tyler, 313 Graphic Arts Bldg., Portland, Oregon.

Jim Struckmeyer, Phoenix(Arizona.

S. E. Westeren, 127 Lincoln Avenue, Rutland, Vt.

Wm. M. Dennis, Hotel Lincoln, Duluth, Minnesota.

O. B. Loud, 19 Smith Ave., Methuen, Massachusetts.

P. S. McGuigan, 831 S. Duke St., York, Pa.

C. P. Wilbur, 2321 West 4th St., Duluth, Minnesota.

Evertt Harper, 414 W. Columbia St., Oakland City, Ind.

Edward Durst, Fairview Farms, Center Hall, Pennsylvania.

Archie Pinkley, 5161 Halcomb Ave., Detroit, Michigan.

Harry Wilson, 225 West C Avenue, Oklahoma City, Oklahoma.

H. E. Miller, Jr., Box 27, Transcon, Manitoba, Canada.

Genaro Alessandro, 189 Common Street, W. Quincy, Massachuctts.

Ernest Servis, Holt, Michigan.

W. C. Sweske, Box No. 521, Hurley, New Mexico.

Jos. D. Harilon, 3942 Brush Street, Detroit, Michigan.

Arthur Wilson, 2070 E. Kingston Street, Philadelphia, Pennsylvania.

Meyer Gerstein, 1079 Hall Place, Bronx, New York.

H. S. Gardiner, Amsterdam, New York.

Morgan Radio Shop, 411 N. Erasy Street, Dallas, Texas.

G. Shedd, 132 W. Albany Street, Herkimer, New York.

Jos. W. Martin, 2162 E. Clementine Street, Philadelphia, Pennsylvania.

W. D. Goins, 501 South 24th Street, Birmingham, Alabama.

R. L. Baldwin, 529 17th Street, San Pedro, California.

Heckemeyer Produce Co., 804 N. Third St., St. Louis, Mo.

Domingo Fernandez, Havana, Cuba.

Fred Hagen, 585 Hetherington Avenue, Winnipeg, Manitoba, Canada.

F. A. Bennett, R. R. No. 2, Hume, Missouri.

Robert J. Daugherty, —Suite 6, Dow Building, Hamilton, Ohio.

H. T. Hayden, Jr., 400 East 199th Street, New York City.

Levi P. Stalford, R. No. 2, Wyalusing, Pennsylvania.

A & K Service Station, Denver, North Carolina.

J. D. Faulkner, Box 205, Moberly, Missouri.

Elmer G. Meyer, 1547 Holman St., Covington, Kentucky.

Charles A. Laughlin, 1643 Putnam Ave., Ridgewood, N. Y.

J. R. Gordon, 1511 Belmont Rd., Duluth, Minnesota.

John Gross, 3556 Moore Pl., Detroit, Michigan.

High Stanwell, Swift Current, Sask, Canada.

George D. Steele, 8126 Burthe St., New Orleans, La.

Mechanical Problems In Television Set

(*Continued from page* 4)

but at a constant speed, a straight vertical line in the image, would become a diagonal line, the direction of the inclination depending on whether the receiver was slightly faster or slower than the transmitter. Of course it would not take much difference in speed to make the image unrecognizable. This form of distortion may be called skew distortion.

Skew distortion is also noticeable in the transmission of still pictures by electricity and it is used as a means of synchronizing. A straight line is drawn on the edge of the transmitted picture at right angles to the direction of the motion of the recording point or beam of light. The receiver watches this line and controls the speed so that the line is reproduced straight.

This method can also be used for synchronizing television. It is only necessary to watch a line that is known to be straight and then control the speed of the receiver so that it reproduces as a straight line.

Indeed it would be possible to utilize this method for automatic synchronization. In fact this has been done essentially by Paul L. Clark, as described by him in the June 16th issue of RADIO WORLD. This method could possibly be simplified by making the synchronizing elements effective once for every picture line instead of once for every picture point or unit picture area. This would be in the interest of conserving light intensity in the received image.

WGY Television Put on Regular Schedule

Schenectady, N. Y.

Inauguration of a regular schedule of television broadcasting was announced recently by Martin P. Rice, manager of broadcasting for the General Electric Company, in a short talk from WGY.

Following the announcement WGY broadcast for a few minutes television so that listeners could hear the characteristic sounds that accompany the transmission. This signal is an intermittent, high pitched, whirring sound, the pitch varying with the action.

A regular schedule of television broadcasting is maintained by WGY four days a week, Tuesday, Thursday and Friday from 1:30 to 2 p.m., and Sunday from 10:15 to 10:30 on the regular 379.5 meter or 790 kc wave of that station. The signals are also carried on one of the short waves, generally on the 2XAF wave, which is 31.4 meters.

At present 24 scanning lines are used at a speed of 20 revolutions per second.

The television programs are broadcast from the laboratory of Dr. E. F. W. Alexanderson, consulting engineer for both the General Electric Company and the Radio Corporation of America.

Mr. Rice's announcement fixes a regular schedule, instead of a temporary one, adds the Sunday night television broadcast, which had been going on quietly for several weeks, and adds two revolutions a second to the speed of the disc, formerly 18 per second.

CeCo Man Tours U. S. to Visit the Trade

Edward R. Fiske, assistant general sales manager of the CeCo Manufacturing Co., Inc., Providence, R. I., is visiting every CeCo distributor in the country.

His itinerary will bring him to the West Coast after covering each distributing center in every State. From Providence his route ultimately takes him to Los Angeles and thence north to San Francisco, Portland and Seattle, the turning point for the return East.

New merchandising methods, as they apply to CeCo tubes, will be stressed, and information on several new types of vacuum tubes, exclusively CeCo, will be divulged. Mr. Fiske wishes to convey to the trade that it is his major endeavor to assist increase sales and profits for every CeCo dealer and that the dealers should not hesitate in requesting his personal help.

The entire South will be covered in a like manner immediately after the return from the West, so that each CeCo distributor will receive the earnest attention of the CeCo headquarters in addition to the cooperation of the local CeCo salesman.

Survey To Be Made

At the conclusion of the Western tour, on which Mr. Fiske will make a complete market survey, reports will be compiled for guidance over the season in forming new policies and procedure for the benefit and protection of all CeCo dealers and jobbers.

H. H. Steinle, general salesmanager of the CeCo Manufacturing Co., Inc., announced the appointment of several factory representatives as follows:

R. H. Roeb, in Indiana, will continue to serve that State. Cliff Lindgren will cover the half of New York State west of Syracuse. Arthur L. Lang will represent CeCo in the half of New York State east of and including Syracuse, but not New York City. In Metropolitan New York two men will cover the trade. E. R. Peel will operate in Iowa and Nebraska. J. R. Hedquist will cover Minnesota, Western Wisconsin, North and South Dakota. Lawrence LeVoie will take care of West Virginia. Borrough Murphy and Kenneth Murphy will cover Florida, Georgia, Alabama, Mississippi, Tennessee, North and South Carolina and Virginia.

WLEX, WCFL to Try Short Wave Television

WLEX, Lexington, Mass., has been granted permission by the Federal Radio Commission to broadcast television on the frequency band between 4,700 and 4,900 kilocycles, or about 62 1-2 meters. The station expects to go on the air shortly on the 200 kilocycle band and do considerable work.

WCFL, Chicago, also soon will be on the air on the 4,900 kilocycle frequency. Much fan interest is expected to develop as soon as regular programs of television are sent out on the short waves.

THE NATIONAL SCREEN GRID 5, described by James Millen in April 14th, 21st and 28th issues. Fully illustrated, including picture diagrams of wiring. Uses screen grid tube for the single RF stage, four other tubes standard. Send 45c for these three copies and get blueprints free. RADIO WORLD, 145 West 45th St., New York City.

New Wave Plan Due on Aug. 1

Washington

The Committee on Reallocation, composed of Radio Commissioners Orestes H. Caldwell and Sam Pickard, is engaged in collating the many suggestions offered by those interested in the problems and hopes to have a plan ready by Aug. 1.

Gratifying progress is being made toward a broadcasting set-up that will equalize the radio facilities granted to the five radio zones, while securing radio reception, as far as the available radio facilities permit, under the new Davis-Dill equalizing law.

New 50,000 Watt Plant Is Started by WLW

Cincinnati.—The whistle and exhaust of a steam shovel were broadcast by WLW and WSAI, as the final touch of realism to ceremonies marking breaking ground at Mason, Ohio, for the building that will house the new 50,000 watt transmitter purchased by the Crosley Radio Corporation to replace the present WLW equipment.

WLW on September 17 will be operating with 50,000 watts of power from the new building, 40 feet west of the present WSAI transmitter. The Crosley Radio Corporation will contiue to operate both stations. More than $250,000 will be spent in its construction.

Ruffner, Announcer, Is Now 29 Jobs Old

You get somewhere by sticking to a job, says Arthur Brisbane. But take the case of Edmund B. Ruffner, radio announcer.

Ruffner is unusual in a business where there are many unusual people. To begin with, he's the tallest radio announcer of record. His height is six feet, five and a half inches.

He always smiles, and hard work, long hours—sometimes necessary—and mishaps of various kinds never spoil his good nature.

His 29th Job Now

Most remarkable is his life's history. Before he found what seems to be his life's work in radio, he worked at twenty-eight different jobs—and acquired a musical education at the same time.

He started work when he was fifteen years old. His first job was in a shingle mill. Then he became a lumberjack. He manufactured wooden pipes, was a mechanic in a cannery, worked as a carpenter, and served as a night watchman.

Other jobs included shipping clerk in a motion picture exchange, fish trap builder in Alaska, sheet metal worker, boiler maker, longshoreman, riveter in a shipyard, truck driver and postoffice employe. Then the World War came along and Ruffner joined the infantry. He was too tall for any other branch of the service.

Tried New York

The war ended and "Tiny" tried his talents in New York. He was a floor walker in a big department store. He was a wholesale ice salesman and then he sold bread. He got a job as night watchman in a garage so he could study in the daytime. He later drove a bread wagon at night for the same reason.

He went to Los Angeles and sold doughnuts. Then he joined a quartet and went on the concert stage. Back to New York and operettas. He appeared in the Shubert production of "The Student Prince," "Princess Flavia," and "The Circus Princess."

And then, "at last, thank Heaven," to quote him literally, he joined the announcing staff of the National Broadcasting Company.

He has been a member of three different unions, was the lone man who would not walk out on a strike, and a year later led another strike.

Ruffner is an all-around athlete and won letters in football, baseball, track and tennis. He is a golf enthusiast.

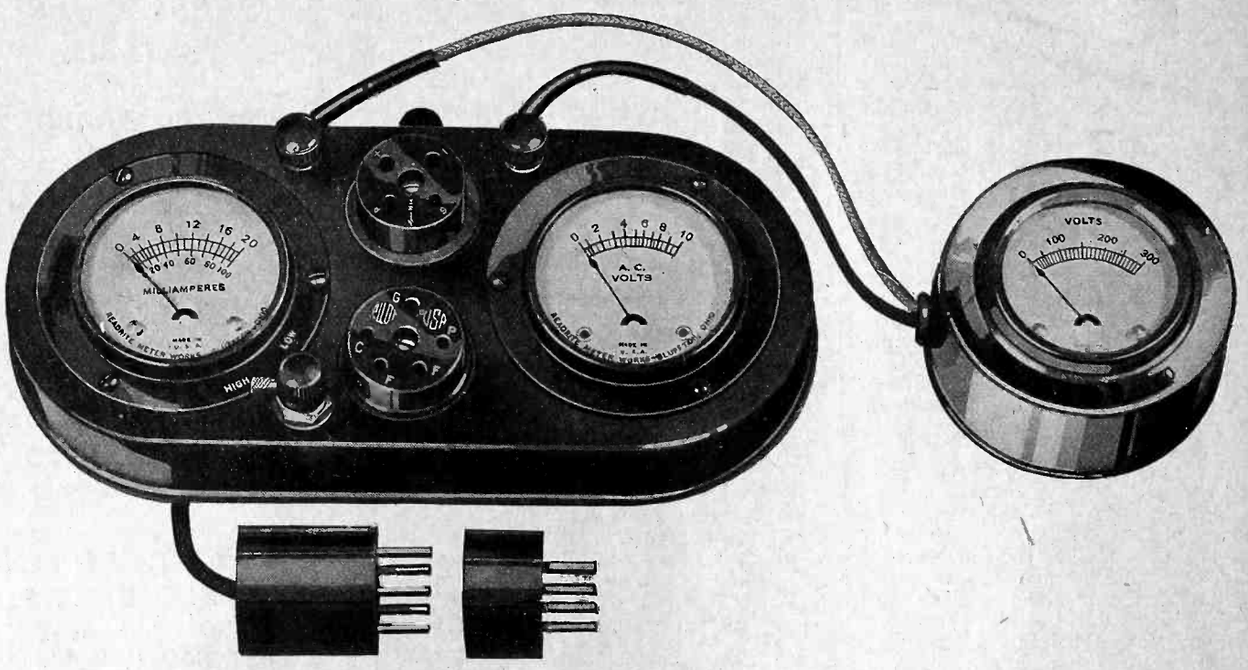
150 Stations Maximum for Full Operation

"All methods of calculating what the new radio plan must comprise for best results seem to lead back to the same results, that of a basic structure of 150 full-time stations of 500 watts or over.

"This number does not comprise the smaller stations, of which there can be almost any amount in the 100-watt class. Need for the new radio plan is not so much in evidence at present, but unless a fundamental change is effected before next Winter, when general broadcast reception will improve and listeners begin to get distant stations, interference and dissatisfaction will result. Therefore we have set Sept. 1 as the deadline. It seems everything must be working then, if ever."

12 VITAL TESTS

In Only 4½ Minutes!



The Handsome Outfit, Shown One-Half Scale

With this Scientific Trouble Shooting Combination AC and DC Tester (at left) and the high resistance voltmeter (at right) twelve vital tests were made of tubes and receivers, in 4½ minutes, because the combination can be used quickly for the following purposes:

(1) to measure the filament voltage, up to 10 volts, of AC and DC tubes.

(2) to measure the plate current of any one tube, including any power tube, from less than 1 milliampere up to 100 milliamperes;

(3) to measure the total plate current of a receiver or amplifier, up to 100 milliamperes. (Hardly any set draws more). Open common A and B of set and connect to P of tester socket and to P prong under adapter plug;

(4) to measure the B voltage applied to the plate of tube; the voltage across B batteries or B eliminators, up to 300 volts.

(5) To determine the condition of a tube, by use of the grid bias switch.

(6) To measure any tube's electronic emission (tester cuts in at no load, hence plate current equals filament emission).

(7) To regulate AC line, with the aid of a power rheostat, using a 27 tube as guide, turning rheostat until filament voltage is 2.5 or 2.25 volts.

(8) To test continuity of resistors, windings of chokes, transformers and circuits generally.

(9) To find shorts in bypass and other condensers, as well as in inductances, resistors and circuits generally.

(10) To read grid bias voltages, including those obtained through drops in resistors (bias read by noting plate current and voltage and consulting chart).

(11) to determine the presence of distortion and overloading, by noting if milliammeter needle fluctuates.

(12) to determine starting and stopping of oscillation, as milliammeter needle reads higher current for oscillation and lower for no oscillation.

GUARANTY RADIO GOODS CO.,
145 West 45th Street, New York City.

Please send me at once, on a five-day money-back guaranty, one complete Two-in-One (AC and DC) scientific trouble-shooting test set, consisting of one No. 215 and one No 346, for which I will pay the postman $13.50, plus a few cents extra for postage.

☐ If 0-500 v. high resistance voltmeter No. 347 is preferred, put cross in square and pay $14.50, plus postage, instead of $13.50, plus postage.

☐ One No. 215 alone, $10.00.
☐ One No. 346 alone, $4.50.
☐ One No. 347 alone, $5.50.
☐ Two adapters for UV-199 tubes, $1.00.

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Service Men, Custom Set Builders, Home Constructors, Experimenters, Teachers, Students, Laboratories

Order one of these combination 215 AC-DC testers and 346 meter 0-300 volts. Send no money. Just fill out coupon. If after five-day test you're not delighted, return and purchase price will be promptly refunded! Here's what you get for only $13.50.

(1) One newly-designed Two-in-One 0 to 10 voltmeter for AC and DC. Same meter reads both. Scale especially legible at 1½ to 7½ volts. This meter reads the AC and DC filament voltages.
(2) One DOUBLE reading DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with changeover switch. This reads plate current, which is always DC in all sets.
(3) One 0-300 volts high resistance voltmeter, No. 346, with tipped 30" cord to measure B voltages.
(4) One 5-prong plug with 30-inch cord for AC detector tubes, etc., and one 4-prong adapter for other tubes.
(5) One grid switch to change bias.
(6) One 5-prong socket.
(7) One 4-prong socket.
(8) Two binding posts.
(9) One handsome noire metal case.
(10) One instruction sheet.

$13.50
SEND NO MONEY

[If 0-500 voltmeter No. 347 is desired instead of No. 346, price of combination is $14.50.]

No. 215 Universal AC-DC Tester Alone.....$10.00
No. 346 high resistance 0-300 voltmeter alone..... $4.50
No. 347 high resistance 0-500 voltmeter alone..... $5.50