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Using Loop or Outside Aerial

Sometimes It Is Well to Change From One Kind to the Other

By HORACE V. S. TAYLOR

DOES your set use a loop or outside aerial, or both? That is a question often being asked the radio fan these days. Sets which can use either one or the other are sometimes preferred over those which can not make such a change.

Perhaps it will be interesting to compare the two types and see the advantages, which one may have over the other.

To start with, the most obvious point is one of size. The outside aerial picks up a great deal more energy than the loop, because it is a great deal bigger. It is foolish to think you can carry as much in a pint bottle as is possible in a ten gallon can. The same thing applies in comparing a loop, which may be two feet square, with a wire which reaches up into the air, perhaps twenty-five or thirty feet, and then runs along for fifty to 100 feet. If you should construct a loop with the same dimensions as these you would find that the amount of energy brought in would be about the same.

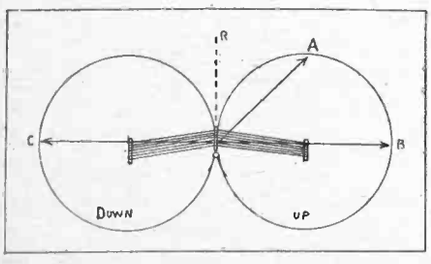

Fig. 1. A Loop Knows Directions

Loop Has Sense of Direction

The big advantages which this form of aerial enjoys are first the small size, and second its sense of direction. Since it is so small, it can be easily carried from room to room, and indeed can be taken with you on your vacation without any trouble. If you wish to loan your set to a friend some evening for a dance, the whole thing can be easily loaded into the back of your machine. This is a good point and influences many people to try out a loop set in their homes, since all the demonstrator has to do is to bring in the equipment and put it on the table. The second advantage, that of knowing which direction a program comes from, has often been mentioned.

To be exact we should not say "which direction" since the loop can tell the general line, but does not know which end of the line is sending. For instance, suppose the sending station is located due north of you. The loop will be able to ascertain that it lies in a north and south line, but whether the waves come from the north or from the south cannot be told. This property of the loop is made use of by the radio inspectors when they go around to locate some source of interference.

Finding the Interference

Perhaps some one near you is sending out code during the silent hours from 8 to 10:30. If this is reported and a radio inspector sets out to locate the offending station, which has not given its call letters, he will use a loop. By mounting this on an automobile and listening in, he finds that the station lies in a certain line, as say east and west from where he is at the moment. He pulls out a map and draws a line through the spot. Then he goes to some other place perhaps half a mile away from that line, and listens again. This time he hears it in a new direction. He draws another line on the map to correspond. These two lines will meet somewhere, and at the intersection he will find the offending source of trouble.

The way a loop receives is shown in Fig. 1. In the center of the picture you will see a top view of the loop itself, looking down on it from above. The two curves, which are approximately circles, are drawn to such a scale that they represent the loudness of a message received in any direction, as the loop is rotated. The way it is drawn is this: Pick up some good station and point the loop straight at it. You can tell its direction because the signal will be strongest. It will be heard fairly loud. Call this loudness 100%, and draw the line OB in the direction along the loop, since it was pointing like that when the station was heard. The line

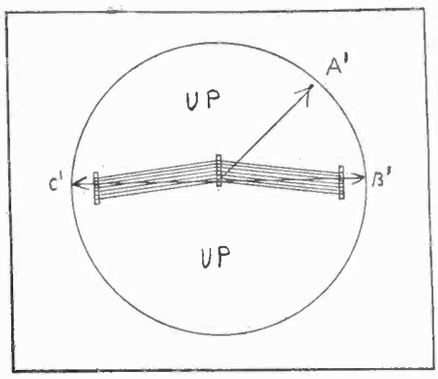

Fig. 2. Straight Wire Reception

OB may be any convenient length, which you like, but when drawn it will represent 100% of loudness. Then point the loop in some other direction say about 45° away. This is represented by line A. Now the loudness will be about two-thirds what it was before, so make OA two thirds as long as OB. Point the loop then just at right angles to the sta-

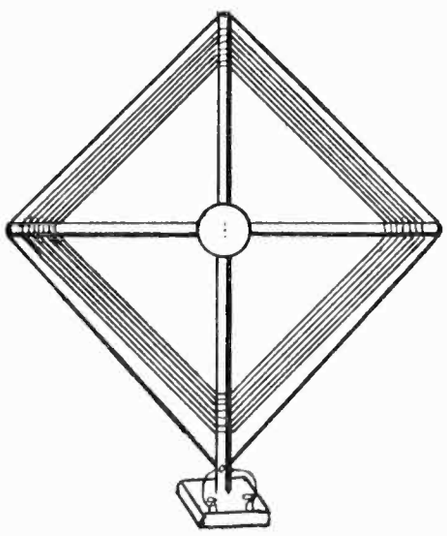

Fig. 3. Wrap One Turn Around Loop

tion. If you have a good loop it will now fade out entirely. Line OR shows this, and it is drawn in dotted since it will have no length at all. By drawing various other lines in the same way and making them proportional to the strength of the signal, we get the circles as shown in Fig. 1.

Why Two Circles Are Drawn

You will notice that there are two in this diagram. That is because one side of the loop is just like the other, and so it makes no difference whether the left hand half or the right hand is toward the broadcasting station. As you turn it round through a complete circle it starts loud, then fades out, gets strong and fades out a second time, and so the two circles must be drawn to show this double action.

The action of a straight verticle wire extending up into the air for 25 to 50 feet is shown in Fig. 2. The wire appears in the center as a dot, because you are looking down on it from the top and see only the end. Of course, you can not turn your whole house around, and so you will not be able to plot a curve for it in the various directions. However, this has been tried on ship board where the whole vessel can be steered around in a circle.

In such a test it is found that it receives equally well from all directions. A drawing of its strength would appear as in Fig. 2. Direction A′, B′ and C′ are all made of equal length to tell us that a station would come in equally strong, no matter in which direction it might be situated. If you have an ordinary aerial with a flat top, then the reception will not be quite the same in all directions, but will be slightly stronger at the leading in end of the flat part. The increase is not very great in this direction, however, provided that the level part of the aerial is at least 30 feet high.

Two Aerials in One

If you have a loop aerial, and find that it does not give enough strength on some of the distant stations, you can

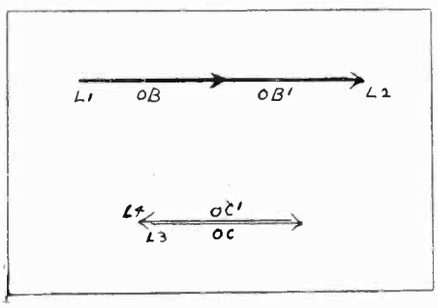

Fig. 4. One Side Adds, One Subtracts

improve the operation by combining with it a long antenna, either inside or outside your house. Of course, the one outside, since it is considerably larger will give more volume than the inside wire, unless your house is so big that you can get 100 feet without going out doors. The way to connect such a wire is shown in Fig. 3. The loop, as illustrated, is wound in a spiral, with the turns all lying in the same plane. Instead of this it might have been wound around a box, in which case all turns would be the same diameter or edgewise around a cylinder, like the loop which is used by the Radio Corporation. In any event, to adapt it for use with an outside aerial, it is necessary to wrap a single turn of wire around the outside as shown. It is convenient to bring this down to two binding posts mounted somewhere on the frame. The wire itself may be almost any kind which you have handy, but should be as large as the rest of the aerial, and must be insulated from the other turns.

When nearby stations are going, this extra turn may be disconnected, but when it is desired to reach out just as far as possible, then run the aerial to one binding post (either one) and the ground lead to the other. Of course, a good ground is a great advantage. Your cold water pipe, just where it enters the cellar, is the best place to attach it. You will find that hooking this up as well as the loop, will increase your range several hundred miles. The reason is clear. A big net will catch more fish than a small one.

Losing One Direction

It is interesting to notice how the directional effect of the loop is changed by this extra wire. If this latter is very long and the loop is small, the combination will receive about equally well from all points of the compass, as in Fig. 2. But if it happens to be made exactly the right length, so that the maximum loudness from the loop just equals that from the wire antenna, then a strange effect is noticed. The loop loses one of its two directions, and in the case mentioned at the biginning of this article, the broadcasting station would be picked

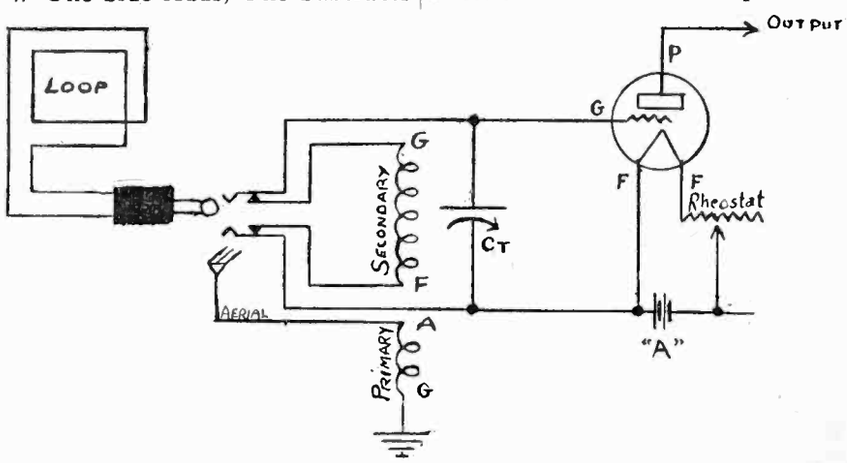

Fig. 5. Automatic Jack Cuts in Loop or Aerial at Will

up with the loop pointing to the North, but when swung around 180 degrees toward the South, it would be no longer heard. The reason for this action is shown in Fig. 4.

When the loop is pointing toward the station, which we will represent in the direction B, then the loop has a signal strength, OB, and the wire the strength, OB′. We will assume that at that instant the radio frequency oscillation runs up through the aerial, and up through the right hand half of the loop. They will then flow down through the left hand half. Since the directions OB, and OB′ are both the same, (up) the two effects will add and we get the line, L1, L2, in Fig. 4. Now suppose we turn the loop around 180 degrees to point in just the opposite direction. The aerial wire does not know the points of the compass, and as Fig. 2 shows, is the same in all directions. OC′ will then equal OB′ and the direction is still up.

However, the loop has now reversed. To be sure OC still equals OB, but the current at the instant is down. Since the strength of the signals in loop and aerial are the same in magnitude, but opposite in direction, they will just neutralize each other, and cancel as in Fig. 4. OC plus OC′ is shown as L3, L4, which has no strength at all. This combination of loop with aerial wire of just the right length, gives a single direction instead of a double to the loop.

Converting the Set

Perhaps you may wish to fix your set so that either loop or aerial may be used without the bother of connecting and disconnecting a wire on the outside. Such a scheme is shown in Fig. 5. This illustrates the hook-up of the tuner in any kind of radio set. Only a single tube is shown, which will represent the first one, no matter what make yours is. Ordinarily the loop is tuned by a variable condenser Ct. Instead of having the terminals for this condenser connected to binding post or directly to the loop, they are brought to the outside blades of an ordinary four spring jack. The loop is connected to a common telephone plug. It makes no difference which terminal is which. To use the loop, it is only necessary to insert the plug in the jack, and then the operation will be just as it was before the change was made.

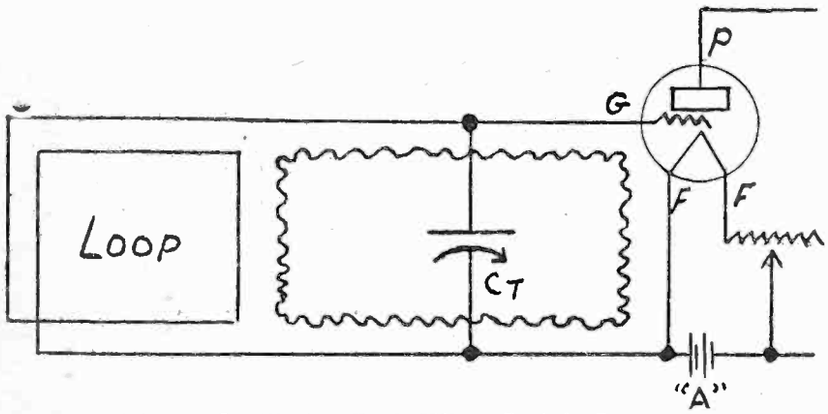

Fig. 6. Oscillation Path When Jack is Inserted

This appears in greater detail in Fig. 6. The oscillation from the loop, tuned by the variable condenser, vibrates back and forth between the grid and the filament as illustrated by a radio frequency line. With such a connection the primary and secondary coils and aerial play no part in the operation at all.

Connecting the Aerial Transformer

When the plug is withdrawn, it cuts into circuit the secondary of the aerial transformer. The primary of this unit is connected to the aerial and ground. The action is then shown by Fig. 7. Primary oscillations flow between aerial and ground, as represented by the radio frequency line labelled P. This is coupled closely to the scondary coil, which causes the waves to vibrate between the grid and filament. The tuning is accomplished by the same variable condenser, Ct, as before. The only operation needed to switch over from aerial to coil and back is merely to push the loop plug in or pull it out. When it is in, the loop is inserted, and you will get all the advantages of being able to tune out a loud local station because of the directional effect of the loop. When it is withdrawn it connects the outside aerial, and you have the large amount of energy which this type collects. This allows you to pick up the distant stations which would be too soft to enjoy any other way.

Winding the Aerial Transformer

If you wish to wind your aerial transformer, it may be done as shown in Fig. 8. This employs a bakelite tube 3 inches

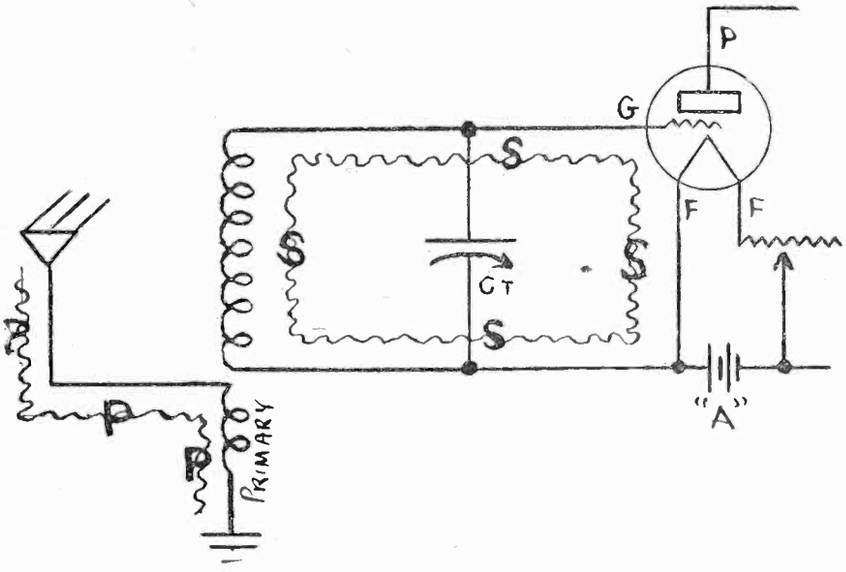

Fig. 7. Path When Outside Aerial is Used

outside diameter and 3 inches long. Begin by winding on eight turns of insulated wire. No. 23 is a good size to use, although any other of about the same diameter will be equally good. This should have one covering of either cotton or silk. This is the primary and goes in series with the aerial. The secondary is wound with the same kind of

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wire, using 50 turns. It is connected to the jack springs, so that when the plug is withdrawn (Fig. 5) the leads run to the grid and the filament of the first amplifier tube.

As a further refinement on this scheme where the utmost in distance is wanted, it is possible to use a variometer in series with a primary for tuning it to the incoming waves. It should be connected in the ground lead at the point G on the coil. By adjusting this variometer, the primary can be brought into resonance with the incoming wave. This will give the largest amount of current possible in the primary circuit, and of course this will increase the volume in the secondary. Since such a variometer always increases the effective length of the aerial, you must be careful not to start with one that is already too long. For such use the total length, including the lead-in, should not run much over 100 feet. If you find, when listening to a short wave station, that the signals get louder and louder as you turn the variometer towards the zero, then it means that you will have to shorten the aerial still more in order to get good results. Such a use of the variometer causes increased complication on the set, and makes one more handle to adjust, and since the gain will not be very large anyway, it is usually not recommended.

Changing From Aerial to Loop

If you already have a set which works on an outside aerial, you are probably interested in the method of making it work on a loop. Unfortunately, there is no simple means of making this change. Owing to the small amount of energy picked up by the latter, it is absolutely necessary to use at least two steps of radio frequency amplification ahead of the detector to get good signals. And even at that, a radio like the neutrodyne, which is not designed for it, does not usually work very well on a loop, even though it does use two tubes of radio amplification.

The only kind of sets which are reported as being very successful without an aerial, are those which have two or three steps of untuned radio amplifier, and those which make use of the superheterodyne principle. These, of course, have to be built from the ground up, and cannot be adapted very well from other styles of hook-ups. To those who ask how to change from an ordinary set using an outside aerial so that it will work on a loop our advice is "Don't."

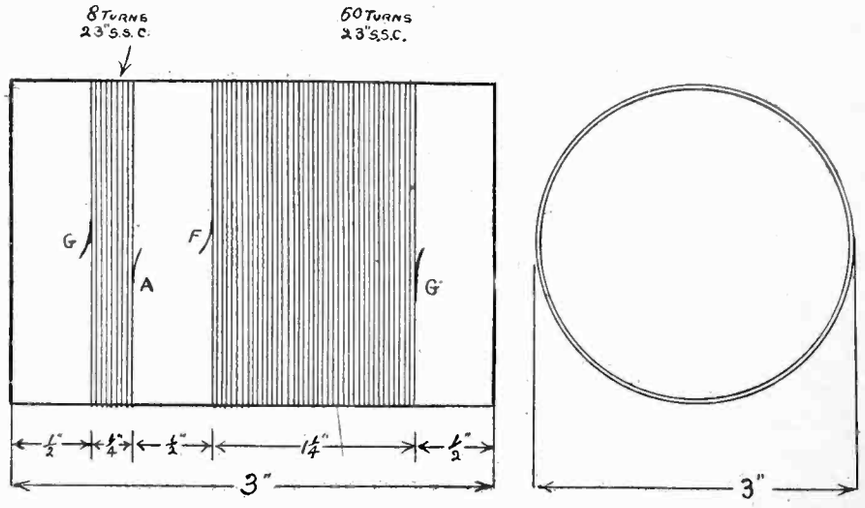

Fig. 8. How to Wind Aerial Transformer Coils