Theory and Construction of Frame Antennae

Concluded from Last Week

By "CATHODE"

LAST week's instalment was concluded with a description of the method of using an aerial and a ground with a loop antenna to increase the signal strength. This is one of the easiest and most commonly used methods, but probably the best method of increasing the volume of sound produced from this arrangement is, as with ordinary receivers, the use of regeneration, or the feeding back of signals into the grid circuit of the detector valve. In an ordinary receiver this is brought about by very many methods. The usual is a swinging coil, a continuation of the grid coil, controlled by either a series or a parallel variable condenser, or a fixed condenser and a means of varying the voltage on the plate of the detector. These methods can in general be applied to a receiver using a loop.

Tabulating the methods we get:—

1 Loop antenna applied in parallel to the grid coil of a normal receiver and regeneration applied by the usual method.
2. A series coil as in diagram 1.
3. Reinartz method of a tapped inductance and a series condenser. (Diagram 2.)

In view of the wide application of reaction to loop antenna these methods must be elaborated a little.

1. Parallel coil. Where it is desired to use a frame antenna with an existing receiver without in any way altering the wiring, probably the most convenient arrangement is that of employing the loop in parallel to the grid coil of the detector or radio frequency valve. This method merely consists of attaching one end of the loop to the aerial terminal and one to the earth. Reaction is applied in the usual method.

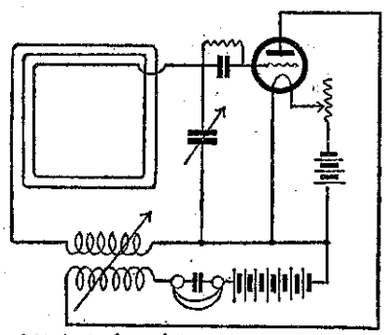
This system enables the experimenter to make a simple preliminary test to determine what measure of efficiency the loop antenna will possess. There is no necessity to disturb the wiring of the receiver. It should be noted in this case, however, that since the coil and the frame are in parallel the effective inductance of the two will be less than either singly, so that the total inductance

$$L \text{ equals } \frac{L1 \times L2}{L1 + L2}$$

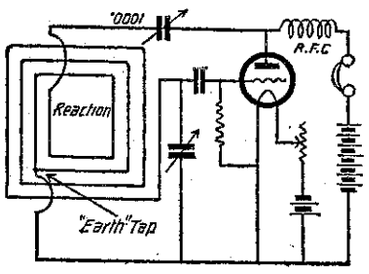
where L1 and L2 are the inductances of the grid coil and the frame antenna respectively. It is apparent then to obtain maximum efficiency that both the grid coil and the loop must have a greater inductance than usual, in other words, both coils must be enlarged.

2. The method of obtaining the reaction by placing the coil in series with the frame is shown in the diagram. The size of the coil between the loop and the filament return need only be 20 or 25 turns, while the reaction coil should be as small as possible consistent with getting oscillation control over the whole tuning band of the receiver. It should be noticed, however, that if this coil is too large it will not be possible to tune up to the higher frequencies, unless also the size of the loop is reduced.

Since, however, the application of the above method will require a certain alteration of the receiver it will be worth making further alterations in order to further increase the efficiency. Where there is so little damping the control of reaction becomes a matter requiring a little added skill and the use of the swinging coil becomes rather clumsy and in some ways difficult to control. The method known as throttle control gives wonderful ease of adjustment though it means the introduction of two extra components. A high frequency choke must be introduced between the swinging coil and the 'phones. From the side of this nearest the coil a connection must be taken to the fixed vanes of the .00025



A Method of obtaining Reaction on Loop



Reinartz type Circuit for Loop

Diagram I, upper; II, lower.

moving condenser. The moving vanes are connected with A +. In practice it is found that smooth and progressive control of reaction is given by this method, for it has less effect on the tuning than has the method employed with swinging coil. It is free from any possibility of any mechanical backlash such as may exist in a moving coil holder.

3. The most widely used method is that known as the Reinartz system. Assuming that the frame consists of twelve to fourteen turns on a 2ft. side, a further three to five turns should be wound on for reaction. The direction of winding must be the same as for the frame. The actual number of turns depends upon the method of winding employed, and the valves and "B" battery used. The extra turns are employed on the "A" battery side. A series condenser characteristic of the Reinartz circuit is employed between the plate and the extra turns. The value of this condenser need not even have a greater value than .0001 in view of the low damping of the frame.

Construction of a Loop.

FROM the foregoing remarks it will be seen that the amount of energy dealt with by the frame is very small and it is clear that the greater distance between the two upright portions of the winding, the greater will be the difference in voltage reduced. It is, therefore, an advantage to keep the size of the frame large than small. In building a loop for a receiver the safest method is to use an excess of wire to begin with. After a loop is wound a low frequency broadcasting station should be tuned in. If the dial setting of the loop tuning condenser is much too low, wire should be removed from the loop. Take off half a turn at a time.

The inductance of the loop and the maximum capacity of a tuning condenser used with it determine the lowest frequency to which the combination will be resonant. Ideal conditions cannot exist and it is necessary to make certain compromises. The smaller the condenser the better the results, but a very small condenser cannot adequately cover the broadcast band. Furthermore the distributed capacity of the loop forms a much larger proportion of the whole capacity of the circuit when the variable condenser is a small one, and this distributed capacity does not enter to the variable portion which alters the resonance to different frequencies. It will be found that a tuning condenser of .00025 mfd. capacity is slightly too small for loop work in many cases. With a carefully constructed loop, having the wires well spaced, a .00035 condenser will generally cover the entire range. A .0005 condenser will be still easier to tune and the signal power will be reduced only slightly.

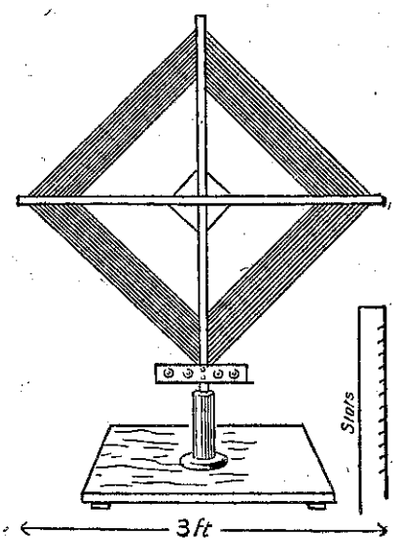


Diagram III.

Loops with a few turns have a greater range of tuning than those with many turns. The problem is to cover the whole band of frequencies with a condenser small enough to en-