Gmail

[antiqueradios] Loop Explanation circa 1924

1 message

Hi

Loop Antenna Radio Age
https://otrr.org/FILES/Magz_pdf/Radio%20Age/Radio%20Age%202405.pdf

40 RADIO AGE May. 1924 The Magazine of the Hour
The Loop Antenna By R. H. LANGLEY, Radio Engineer, General Electric Co.
The loop antenna is a very interesting device. It is uniquely different in its method of operation from the outdoor antenna. The outdoor antenna is in effect nothing more nor less than a condenser. It is a very large condenser to be sure so far as its physical dimensions are concerned, but electrically it is a relatively small condenser. The loop on the other hand is an inductance. This fundamental difference between the two is the reason why it is necessary to use different methods of tuning in the two cases.
Let us examine this special form of inductance, which we call a loop, and see why it serves as a pickup device for radio signals and how it should be made to be effective. There is a very close parallel between the ordinary direct current generator or dynamo and the loop antenna exposed to passing radio waves. In the dynamo, the number of coils corresponding to the loop antenna is rotated in a powerful magnetic field. The purpose of rotating them is in order that they may move with respect to the field and thus have a voltage generated in them. The amount of this voltage depends, of course, upon the strength of the field and the speed at which the wires are swept through it.
In the radio case, the coil stands still, but the field moves swiftly past the coil, thus accomplishing the same result. The speed at which the field moves cannot, of course, be varied and is always the speed of light, which is 186,000 miles per second.
Let us see now what form of a loop would have the greatest voltage generated in it by a passing radio wave. Let us think of this radio wave as very much like great smooth waves on the ocean, which, of course, also move forward with a very definite velocity. The turns of wire on our loop antenna are necessarily in series with each other, that is to say, they form a continuous winding. If the maximum voltage is to be generated in any one turn of the loop, then the voltage generated in the two sides of this turn should be in the opposite direction so that they may add and not oppose each other.
If the voltage generated in both sides of the loop were in the upward direction at any one instance, then these two voltages would cancel each other, but if the voltage on one side of the turn was up and on the other side of the turn, it was down, then they would add and if the loop were connected to a receiver, a current 'would flow around the turns of the loop. This is, of course, exactly what we wish to have happened.
Now in order to have the voltage generated on one side of the loop in the opposite direction to that generated on the other side of the loop, the loop would have to be one-half a wavelength long, that is to say, it would have to be long enough in the horizontal direction so that one side was in the crest of the wave when the other side was in the trough of the wave. Since the distance between the crest of the wave is the wavelength itself, then the distance from the crest to the trough is one-half the wavelength.
The higher the sides of the loop are, that is, the longer the vertical wires are, the greater will be the voltage generated, and of course, the voltage generated in each turn is added to the voltage generated in all the other turns.
But a loop one-half a wavelength long is quite out of the question. It would be as long as a steamship and almost as

difficult to handle. The loops which we are using every day are of quite reasonable dimensions. They are only a few thousandths of a wavelength long. How do they function? In order to answer this question

(Continued on page 43) Loop Antenna (Continued from page 40)

let us ask ourselves how we would build a coil of wire in order that absolutely no voltage should be generated in it by the passing wave. The only way in which this could be accomplished would be to so build the coil that the same voltage would be generated on both sides of it and that the voltages generated on the two sides would be opposed to each other.

This would give a complete cancellation and no voltage at all at the terminals of the loop or coil. It is obvious that the only way in which this could be done would be by so arranging the loop that it had no length at all. That is to say, arranging it so that the two sides were exactly in the same position in space.

This would mean that the horizontal wires across the top and bottom of the loop would cease to exist and the loop would become nothing but a wire laced up and down between pegs on the plain surface of a board.

If there be any difference at all between the two sides of the loop, then there will be some difference not in the amount of voltage generated on the two sides, but in the time at which this voltage is generated and there will consequently be some voltage at the terminals of the loop since complete cancellation of voltages cannot occur.

If the loop is rotated so that its horizontal wires are at right angles to the direction in which the signal is coming, then the loop has no length so far as those signals are concerned. The passing wave strikes both sides of each turn in the loop at exactly the same instance and the voltages generated are therefore equal and opposed and there is no terminal voltage.

This is, of course, the fact which gives the loop antenna its very useful directional property. It is to be noted, however, that if the loop is turned ever so slightly from this zero position then the voltages no longer cancel and there is a voltage at the terminal. This means that the zero position of the loop is very sharp, but the maximum position is very broad.

In applying the loop antenna to an actual radio receiver, it is necessary that provision be made to tune it to resonance with the desired signal. This is accomplished by means of a variable air condenser, and since this condenser has a very definite maximum capacity, the amount of inductance which the loop can have is also limited. This maximum inductance with the maximum capacity of the variable condenser must give resonance to the longest wave to be received. The specification for the best loop antenna, therefore, is that it shall have just as many turns as possible, each turn being just as long as possible and just as high as possible, and still have no more than the required maximum inductance. The higher the loop is, the greater will be the voltage generated in each side of each turn, and the longer it is, the greater will be the difference in time at which these voltages are generated in the two sides of the loop, and consequently the greater will be the voltage at the terminals, but it must not have an inductance value greater than that required for tuning