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ANTENNA SWITCHING SYSTEM

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FIG. 1.

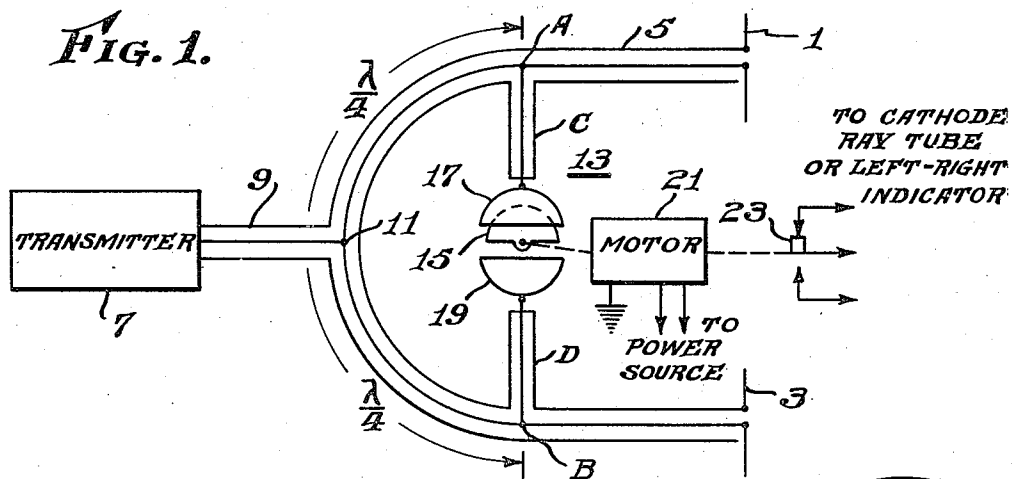
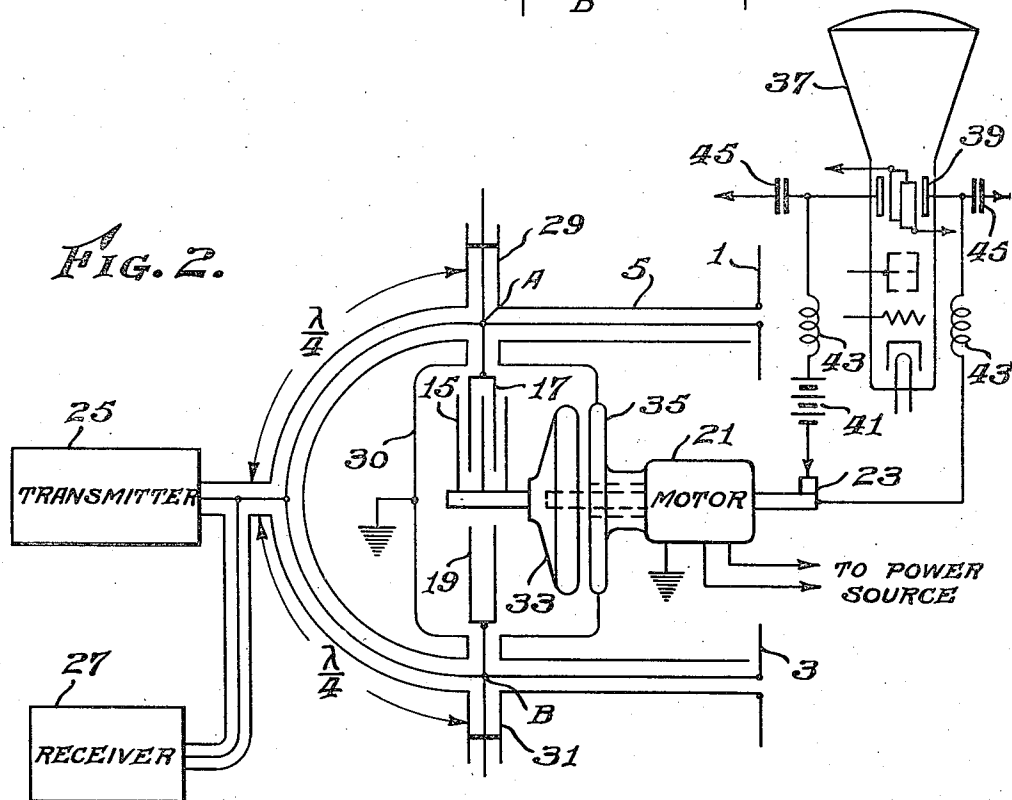


FIG. 2.



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ANTENNA SWITCHING SYSTEM

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3 Claims. (Cl. 250-11)

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This invention relates to antenna switching systems, and especially to an improved antenna switching system which alternately connects the antennas of a pair of directive antennas to a radio device and which distinctively indicates the operative antenna. The instant invention is an improvement over the one described and claimed in applicant's U. S. Patent 2,189,549, which is assigned to the same assignee as the instant application.

The system disclosed in the patent depended primarily upon short circuiting, conductively or electronically, the transmission lines connecting a pair of antennas to a radio device. The short circuits were arranged alternately at quarter wave points on either side of the common line to the device so that first one, then the other, of the antenna lines offered a high impedance to currents to (or from) the inoperative antenna, while a matched impedance was offered to currents to (or from) the operative antenna.

While the system of the said patent is suitable for certain installations, in some arrangements it has been found preferable to use reactors in place of conductive shorting means. One suitable reactor proved to be a variable differential capacitor which was continuously varied so that a very high reactance may be offered to the antenna currents in first one, then the other, of the antenna transmission lines by applying the reactive connection at quarter wave points. In one use of the instant invention, the residual reactance of the smaller differential capacitor unbalanced the line to the operative antenna, this effect may be neutralized by shunting the residual reactance with a suitable reactance of opposite sign so that the combination is resonant and therefore a high shunt impedance.

It is one of the objects of the invention to provide improved means for antenna switching. Another object is to provide a variable differential capacitor for connecting alternately antennas having different directive characteristics to a radio device and for indicating which of said antennas is operative. Another object is to provide an antenna switching system with a variable capacitor operating continuously to provide short circuiting reactances for first one, then the other, of a pair of antenna transmission lines and for minimizing the effect of residual capacity reactances in the unshorted line. An additional object is to provide a motor driven variable capacitor with a low impedance connection to ground.

The invention will be described by referring to

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the accompanying drawing, in which Figure 1 is a schematic circuit diagram of one embodiment of the invention; and Figure 2 is a circuit diagram of a preferred embodiment of the invention. Similar reference characters indicate similar elements in the drawing.

A pair of antennas 1, 3, which are preferably directive, are connected by a transmission line 5. A radio device 7 is connected by a line 9 to an electrically symmetrical point 11 on the transmission line. The point of symmetry may coincide with the geometrical mid-point between the antennas, or the point may be displaced therefrom provided it is at a point at which substantially equal currents would flow for equal currents in the antennas.

A variable differential capacitor 13, having a grounded rotor 15 and a pair of high potential plates 17, 19 is connected as follows: The high potential plates are connected respectively to high potential points located on the transmission line 5 an odd number of quarter wave lengths, of the applied antenna currents, on opposite sides of the point 11 of electrical symmetry. These points are indicated as A and B on the diagram. The rotor plate is driven by a motor 21, which may also drive a cam operated switch 23. The switch may be connected to a cathode ray tube or left-right indicator to indicate which of the antennas 1, 3 is operative.

The mode of operation is as follows: When the differential capacitor 15, 17 offers the minimum reactance to the antenna currents, the point A is effectively short circuited. Owing to the proper choice of the length of the transmission line C between 17 and A, a short circuit at A is transformed into a high impedance at point 11, looking toward A. At the time when point A is short circuited to ground, the maximum reactance of the then smaller capacitor 15, 19 appears between point B and ground viewed through a corresponding transmission line D between 19 and B. If this reactance is large enough, it will have no effect upon the antenna currents in the transmission line connected to antenna 3. As the motor turns the rotor plate 15, the reactance of the capacitors 15, 17 and 15, 19 will vary so that first one, then the other, becomes a maximum. The antennas 1, 3 are thus alternately effectively connected to and disconnected from the radio device and at the same time the cam driven switch operates to apply suitable currents to the indicator from which designates the operating antenna.

A preferred embodiment of the invention is illustrated in Fig. 2, in which a transmitter 25

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and receiver 27 are both connected. One suitable means for connecting both devices to the antenna is described in a copending application, Serial No. 184,354, filed January 11, 1938 by Irving Wolff and William D. Hershberger. In practice, the residual reactance of the smaller capacitor may be large enough to unbalance the operative transmission line. The residual capacitive reactance is neutralized by connected stub lines 29, 31 which are connected to the points A and B and are adjusted to a length just sufficient to provide a suitable reactance of the sign opposite to the residual reactance so that the combination is parallel-resonant at the frequency of the antenna currents. Thus at point B, at the instant position of the rotor, the stub line 31 and the capacitor 15, 19, viewed through its connecting line D, are resonant and are a high shunt impedance which has substantially no effect on the antenna currents to or from the operative antenna 3. At the same instant the larger capacitor 15, 17 effectively short circuits the line so that the effect of the stub 29 is negligible.

In one arrangement, which was operated at a carrier frequency of about 500 megacycles per second, the ground connection of the rotor plate 15 through the motor bearings 21 was insufficient. A disc 33, several inches in diameter, was attached to the rotor assembly. The disc was spaced approximately a hundredth of an inch from a similar disc 35 which was mounted fixedly and was grounded. The capacity reactance of this path to ground proved low enough to eliminate the difficulties of the uncertain ground through the motor bearing. The reactor device is preferably located within a grounded housing 39.

One suitable cathode ray indicator connection is illustrated in Fig. 2. The cathode ray tube 37 is provided with deflecting elements 39 which are biased by a battery 41. The bias is applied in synchronism with the variation of the capacitor by employing the cam switch 23 which is connected in the biasing battery circuit. The choke coils 43 and the capacitors 45 keep the biasing currents and the signaling currents separated.

Thus the invention has been described as an antenna switching system in which currents from a transmitter are applied alternately to first one, then the other antenna of a pair antennas, or the currents from the antennas may be applied alternately to a radio receiver. The alternate

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application of the currents is accomplished by applying a short circuiting reactor to the transmission line connecting the antennas at a point thereon a quarter wave length from the point at which the radio device is connected. Any undesired residual reactance is neutralized or tuned out by shunting a suitable reactance of the opposite sign across the residual reactance. The reactor may be a motor driven differential variable capacitor provided with supplemental grounding means to minimize variations in the electrical resistance of the bearings.

I claim as my invention:

1. An antenna switching system including in combination a pair of antennas, a transmission line connecting said antennas, a radio device, means connecting said radio device to an electrically symmetrical point on said line, a pair of differential reactors connected respectively between ground and points spaced an odd number of quarter wave lengths from said symmetrical point and including a common rotatable member, means for increasing first one then the other reactance of said reactors at the operating frequency of said device and supplemental fixed capacitive means rotatable with said common rotatable member for minimizing the impedance between said common rotatable member and ground.

2. An antenna switching system including in combination a pair of antennas, a transmission line connecting said antennas, a radio device, means connecting said radio device to an electrically symmetrical point on said line, a pair of differential reactors connected respectively between points spaced an odd number of quarter wave lengths from said symmetrical point and ground and including a common rotatable member, means for increasing first one then the other reactance of said differential reactors, means for balancing out the smaller reactance so that the larger reactance offers an effective short circuit and the smaller reactance offers high impedance at the operating frequency of said device and supplemental fixed capacitive means rotatable with said common rotatable member for minimizing the impedance between said common rotatable member and ground.

3. A system according to claim 1 including means operated in synchronism with said reactance increasing means for indicating which antenna is operative.

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