June 6, 1939. A. GOTHE 2,160,857

HIGH FREQUENCY SYSTEM

Filed March 25, 1936

Fig. 1

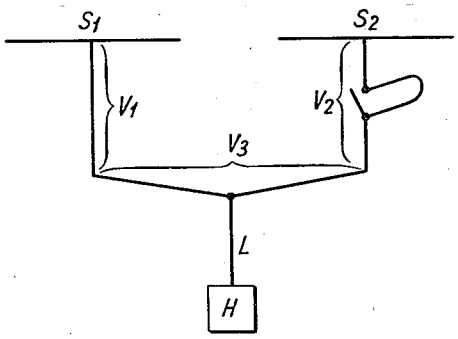
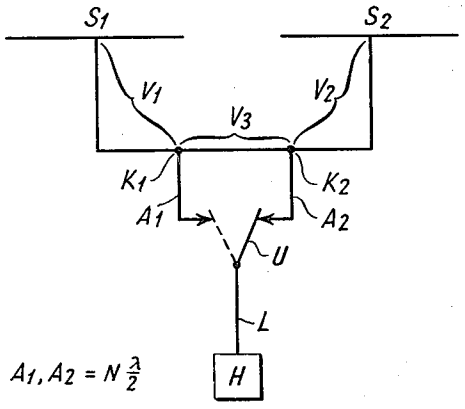


Fig. 2



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HIGH FREQUENCY SYSTEM

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7 Claims. (Cl. 250—11)

The present invention relates to a method of and apparatus for changing the direction of the ray of a directive antenna consisting of several individual radiators, especially for obtaining guide rays.

As is well known, the direction of the main ray of a directive antenna can be varied by dividing the directive antenna into several individual radiators or groups of radiators which are fed at various phases. To this end, it has been proposed already, to insert in the feed line, detour lines for the single groups or to place these in the connection lines of the groups, whereby these detour lines are variable as regards their electrical properties. Ordinarily they are formed as trombone slides. Although these mechanical devices enable an electrical change in the direction of the main radiation, this can be done only very slowly, since the length of the detour lines is to be varied by considerable fractions of the wave length. Furthermore, considerable mechanical forces are necessary to operate the trombone slides. Where the direction of the radiation is to be varied in rapid succession, a geometrical variation of the length of the detour line can no longer be depended upon. For this reason it has been proposed to maintain constant the length of the detour line proper, but to short circuit it in the rhythm of the turning movement of the ray. However, these constructions likewise have disadvantages especially in view of the necessary shortness of the switching paths of the short circuit switches causing such a high capacity of the switching points located relatively close to each other, that they as such practically already short circuit the detour line especially at very short waves.

According to the present invention, the electrical rotation of the direction of radiation of a multiple antenna sub-divided into two or a greater number of individual radiators or groups of radiators is obtained by having the individual radiators or groups of radiators continuously connected with each other through connection lines whose electrical and geometrical properties remain unchanged, and connecting the feed line in succession to different points of the connection line (or connection lines).

The feed line will advisably not be connected directly to the connection line, since in this case the required switching paths would be too long. It is preferable to place terminal lines at the points to be considered on the connection line for the radiators, and to place the said terminal lines at a reversing switch. The length of the terminal lines will be so chosen that the current distribution over the entire directive antenna system will not be changed by the respectively open terminal line i. e., the line not connected to the feed line.

The invention offers particular advantages in producing guide rays for guiding air craft of all sorts. In such case, the connection line of the single radiators will be provided for instance with two terminal lines, and provisions will be made to connect the feed line alternately across a switching arrangement in the rhythm of for instance complementary Morse signals.

Figure 1 shows a known type of arrangement, while

Figure 2 shows one embodiment of the invention given by way of example.

Referring to the drawing, S_1 and S_2 are the two individual radiators or groups of radiators of a multiple antenna. V_1, V_2 and V_3 are parts of the connection line continuously connecting the two groups electrically and geometrically to each other. In Figure 2, K_1 and K_2 are the terminal points for the feed line L. The phase displacement between the exciting currents of the radiator groups S_1 and S_2 is given by the difference in the lengths of the parts of the connection line to be considered, and in the present case these lengths differ by the value V_3. S_1 and S_2 form loading circuits the impedance of which is matched to the characteristic impedance of the lines V_1 and V_2.

Principally, the feed line could be alternatively connected at one time to K_1 and at another time to K_2. In practice this would however not be advisable since the switching paths between K_1 and K_2 are ordinarily very long, and since furthermore contact arrangements are often the cause of undesirable reflection phenomena on the connection line. For this reason, terminal lines A_1 and A_2 are connected to the points K_1 and K_2 and further connected to a switch U as shown. This switch will suitably be remotely controlled by relays or synchronous motors or the like. The side capacities of a switch are practically always lower than the capacity at a simple interrupter, and they can furthermore be rendered ineffective by placing the switch at a point having a low alternating potential relative to the ground.

The terminal lines A_1 and A_2 especially when they are open, i. e., not connected to the feed line, disturb the current distribution on the connection line, since they act at the terminal point K_1 and K_2 like a complex resistor in parallel to

the double wire line. In order to reduce this effect to a minimum, the terminal lines are so dimensioned and constructed that the electrical length thereof is a whole number multiple of $\lambda/2$, in which case, the terminal line represents a very high impedance with respect to the terminal point, and which in practice does no longer disturb the current distribution on the entire directive antenna system.

The idea of the present invention is not limited to the examples herein shown and described.

Thus the antennas may for instance be subdivided into a number of groups greater than two. The phase displacement between the individual radiators or groups of radiators can be varied by several reversing switches of any type. The feed lines and connection lines may for instance be constructed as concentric cables or parallel wire lines, and shielded if necessary.

It is to be distinctly understood that the expression "multiple" of half the wave

$$\left(\frac{\lambda}{2}\right)$$

used in the specification and appended claims is intended to cover any multiple including one.

I claim:

1. An antenna system comprising a first antenna and a second antenna, a direct connection devoid of concentrated reactance between said antennas, two leads terminating at different points on said connection, and means for alternately applying high frequency energy to said two leads, the electrical lengths and geometrical properties of said leads being such that when the high frequency energy is applied to one lead, the presence of the other lead does not cause a change in the current distribution in the antenna system as a whole.

2. An antenna system comprising a first antenna and a second antenna, a connection between said antennas, a switch having an armature and two oppositely disposed contacts, leads from said contacts to different points on said connection, each of said leads having a length substantially equal to a multiple of half the operating wave, and high frequency apparatus coupled to said armature.

3. An antenna system comprising a first antenna and a second antenna, a permanent connection devoid of concentrated reactance between said first and second antennas, high frequency translating apparatus, and means for alternately and rhythmically connecting said translating apparatus to two leads extending to different points on said connection, said leads having such electrical lengths and geometrical dimensions that when the high frequency apparatus is connected to the one lead, the presence of the other lead does not disturb the current distribution in the system as a whole.

4. An antenna system comprising a first antenna and a second antenna, a connection between said antennas, a switch having an armature and two oppositely disposed contacts, leads from said contacts to different points on said connection, each of said leads having a length substantially equal to an integral multiple of half the operating wave, and high frequency transmitting apparatus coupled to said armature.

5. In combination, a first load and a second load, a source of power, a circuit between said loads, a switch, a pair of connections terminating at different points on said circuit and extending to said switch, a line from said source to said switch, said pair of connections having such lengths that when the switch connects said source with one of said connections of said pair the other connection presents a high impedance for any useful energy at its terminating point on said circuit.

6. An antenna system comprising a first antenna and a second antenna, a connection between said antennas, a switch having an armature and two oppositely disposed contacts, leads from said contacts to different points on said connection, each of said leads having a length substantially equal to a multiple of half the operating wave, high frequency apparatus coupled to said armature, and means for moving said armature alternately between said two contacts at the rhythm of complementary Morse signals.

7. In combination, a first load and a second load, a source of power, a circuit between said loads, a switch, a pair of connections devoid of concentrated reactance terminating at different points on said circuit and extending to said switch, a line from said source to said switch, said pair of connections having such lengths that when the switch connects said source with one of said connections of said pair the other connection presents a high impedance for any useful energy at its terminating point on said circuit.

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