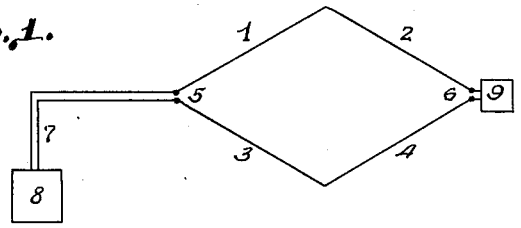
July 4, 1950 A. NIUTTA 2,513,736

DIRECTIVE TRAVELING WAVES ANTENNA

Filed Feb. 25, 1948

Fig. 1.



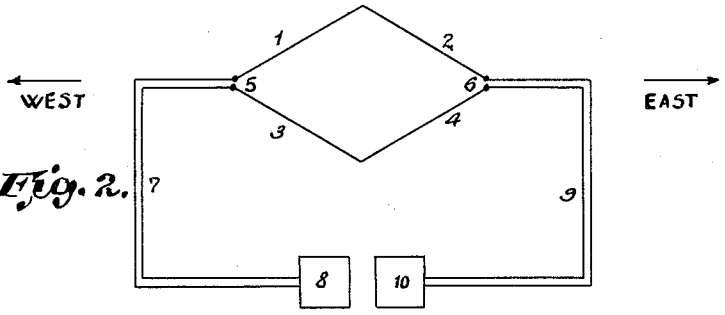


Fig. 2.

Fig. 3.

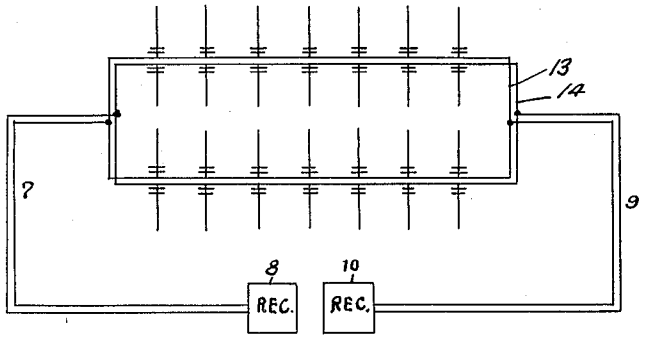
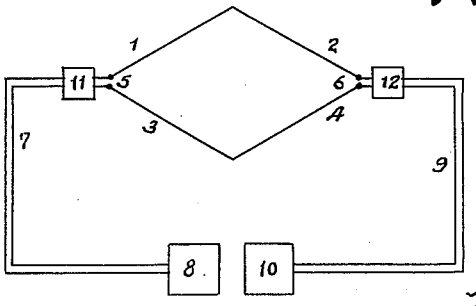


Fig. 4.



INVENTOR.
Ascanio Niutta
BY Henry H. Snelling
ATTORNEY.

Patented July 4, 1950 2,513,736

UNITED STATES PATENT OFFICE

2,513,736

DIRECTIVE TRAVELING WAVES ANTENNA

Ascanio Niutta, Rome, Italy

Application February 25, 1948, Serial No. 10,903
In Italy June 24, 1946

Section 1, Public Law 690, August 8, 1946
Patent expires June 24, 1966

8 Claims. (Cl. 250—33.51)

1

This invention relates to antennas and has for its principal object the provision of a system whereby an antenna may receive simultaneously in either direction on a great circle. A further object of the invention is to alter a unidirectional receiving travelling-wave antenna so that it may receive not only in the previous direction but at an angle of 180° to the first direction, this result being obtained by adding a second receiver at the other end of the unidirectional antenna and arranging so that the input impedance of the two receivers and the characteristics impedance of the lines connecting the receivers to the antenna are made equal to the antenna output impedance.

A still further object of the invention is to arrange a single antenna to receive simultaneously in two opposite directions thereby permitting a saving in cost due to the less material and a saving in space because a second antenna is thereby rendered unnecessary whether receiving on equal or on different frequencies. A great advantage of such a system is that an emission from a great distance is sometimes received on the shorter path of a great circle passing through the sending and receiving stations but at other times the signal is best received by the longer route. By the present invention a single antenna or a group of antennae is used in which the impedance of the receiving equipment on either side of the antenna is equal to the antenna output impedance.

In the drawings:

Figure 1 shows a unidirectional antenna system.

Figure 2 shows a system having two receivers and in which the messages can be received from directions at an angle of 180° to each other.

Figure 3 shows a similar system in which the antenna is of the so-called fish-bone double antenna type.

Figure 4 shows a system in which matching devices having a wide frequency response characteristic are inserted in the line between each end of the bi-directional antenna and the two receivers.

It is well known that when a receiving travelling-wave antenna is terminated on a circuit having the same impedance as the antenna, it becomes unidirectional, receiving at the end opposite to the end at which the circuit is connected. Referring particularly to Figure 1, the conductors 1, 2, 3, and 4 form a rhombic antenna in which the end 5 is connected by a transmission line 7 to the input circuit of the receiver 8.

Since, as is well known, the travelling-wave state is obtained only when the characteristic

2

impedance Z_c of the line 7 and the input impedance Z_r of receiver 8 have their value equal to that of the antenna impedance Z_a which gives the relation Z_c equals Z_r equals Z_a, the opposite end 6 of antenna 1, 2, 3, 4 is connected with a circuit 9 whose impedance is equal to the antenna impedance Z_a. When we have such a condition of equality between the impedance values of the antenna and the terminal circuit 9, theoretically there is no limitation to the constitution of the terminal circuit. However, from a practical standpoint in the case of a receiving antenna the circuit is generally formed by a pure resistance of appropriate value whereas in the case of a transmitting antenna it is usual to construct this circuit of a long dissipative line having characteristic impedance equal to that of the antenna. In order to understand more fully the utility and advantages inherent in this invention, it may be well to note that the unidirectivity of an antenna is a peculiarity of fundamental importance particularly when receiving emissions from great distances because in this way we obtain the highest signal-to-noise ratio and we also eliminate interferences which come from a rearward direction, these including the very annoying interference due to various kinds of echo.

Furthermore, in receiving radio communications from great distances there are periods of the year and often certain hours of the day in which it is easier to receive electro-magnetic waves by the longer path on the great circle through the corresponding station than by the shorter path along the same great circle. It is because of such conditions as these that it has previously been thought necessary to build a second antenna arranged at 180° to the first antenna in order to receive the signal with greatest assurance. In the case of diversity reception a second antenna group has been used. In other conditions which occur sometimes in practice there are two and sometimes even more transmitting stations which are located substantially on the same great circle which passes through the receiving station and the sending station. Under these conditions two oppositely directed antenna, or two antenna groups for diversity reception have been thought essential for proper reception.

In accordance with my invention, however, I am enabled by a very simple system to use a single travelling-wave antenna of practically any type and constitution for a satisfactory simultaneous reception of radio signals coming from either or both of the two opposite directions at the same or at different frequencies while preserving all of

the advantages of the unidirectivity and aperiodicity and without altering in any way the original shape of the directive pattern of the antenna substantially irrespective of the type of antenna. The economy of installation is an important feature of my invention as it is readily seen that a considerable saving of necessary material is obtained and in addition my system will cover a much smaller area of ground.

It is to be understood that the illustrations herewith are drawn in order to present the system clearly and they are not intended in any way to constitute a limitation on the basic principle of my invention. In Fig. 2 the same rhombic antenna is illustrated as in Fig. 1 and its impedance again is Z_a. The end 5 of the antenna is again connected with receiver 8 by means of line 7 having as before the characteristic impedance Z_c. The impedance input circuit of the receiver 8 is Z_r and we have again the relation Z_a equals Z_c equals Z_r. In this figure, however, the other antenna end 6 instead of being connected to the line 9 alone is now connected with a second receiver 10 preferably corresponding with the receiver 8. In this case the characteristic impedance of line 9 is equal to the input impedance of receiver 10 and both of them are equal to the antenna impedance.

With the parts connected in this manner, the antenna is correctly terminated at each of its two ends in a manner to give receiver 8 a unidirectional directive diagram as, for example, in an East direction. At the same time, the antenna has similarly a unidirectional directive diagram for receiver 10 indicated by the arrow bearing the legend West, merely meaning that the two directive diagrams are at 180° to each other. By such a simple and inexpensive arrangement using only one antenna, it is possible to carry out two simultaneous receptions in the two opposite directions while preserving in each case the unidirectional characteristic, the gain and the aperiodicity, the latter being a peculiarity among others of the antenna described.

While the rhombic antenna 1, 2, 3 and 4 has been shown in the first two figures, it is quite obvious that this is in no way a limitation and the system can be applied to any antenna in which it is possible to obtain a single unidirectional effect. As a typical example I have presented in Figure 3 a so-called fish-bone type double antenna 13 and 14 connected as before by lines 7 and 9 with receivers 8 and 10. It is apparent, therefore, that the principle of the system may be used with any kind of travelling-wave antenna and for any kind of group of them provided, of course, that the impedance equality conditions are preserved.

In some cases the direct connection of the lines and the antenna do not permit the equality condition which is necessary between the values of two impedances Z_c and Z_a. In such a case it is merely necessary to employ suitable and well known matching devices such as 11 and 12 having a wide frequency response characteristic. The purpose of these two devices is to match respectively the impedances of lines 7 and 9 to the impedance of the antenna in the points 5 and 6 which are the two ends of the antenna. As previously pointed out, the impedances should be matched in the point of connection between each

line and its respective receiver for the entire frequency band of the antenna.

What I claim is:

1. An antenna system including two receivers and a plurality of conductors forming a travelling-wave antenna each end of which is connected to the input circuit of one of the receivers, the input impedances of the receivers being equal to each other and to the antenna output impedance whereby signals may be received unidirectionally from either or both of two directions at an angle of 180° to each other.

2. The system of claim 1 in which the conductors form a group of antennas.

3. The system of claim 1 in which a wide band matching device is positioned between the antenna and each receiver.

4. The system of claim 1 in which the antenna is rhombic.

5. The system of claim 1 in which the conductors form a double antenna of the fish-bone type.

6. A travelling-wave receiving antenna system in which a plurality of conductors form an antenna, a receiver is connected by a line with the end of the antenna opposite the receiving end and in which the characteristic impedance of the line and the input impedance of the receiver each have their value equal to the antenna impedance in which case the antenna becomes unidirectional, characterized by connecting a second receiver by a line to said receiving end of the antenna in which the impedance of the line and the input impedance of the second receiver are each equal to the antenna impedance whereby the unidirectional antenna becomes unidirectional in the previous direction and also in a direction at 180° thereto whereby reception may be had through the two receivers from a receiving station on either the short arc of a great circle or on the longer arc of the same great circle.

7. The system of claim 6 in which the antenna is rhombic and a wide band matching device is inserted between one of the transmission lines to the receiver and the antenna.

8. A travelling-wave antenna system for the simultaneous unidirectional reception of two radio-waves having equal or different frequencies, but coming from opposite directions, while maintaining, independently for each of said two directions, the same directivity pattern pertinent to the original unidirectional antenna, comprising two receivers, a multi-conductor traveling wave antenna and means connecting the antenna between the receivers, said connecting means comprising transmission lines and means for matching the impedance of the antenna to the transmission lines and the impedance of the transmission lines to the respective receivers for the entire frequency range of the antenna.

ASCANIO NIUTTA.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,267,945	Peters	Dec. 30, 1941
2,290,314	Carter	July 21, 1942
2,303,610	Carter	Dec. 1, 1942