

Oct. 18, 1949.

E. C. CORK

2,485,482

BROAD BAND ANTENNA

Filed July 21, 1945

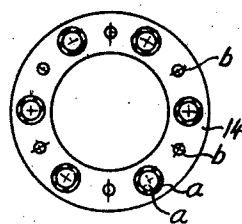
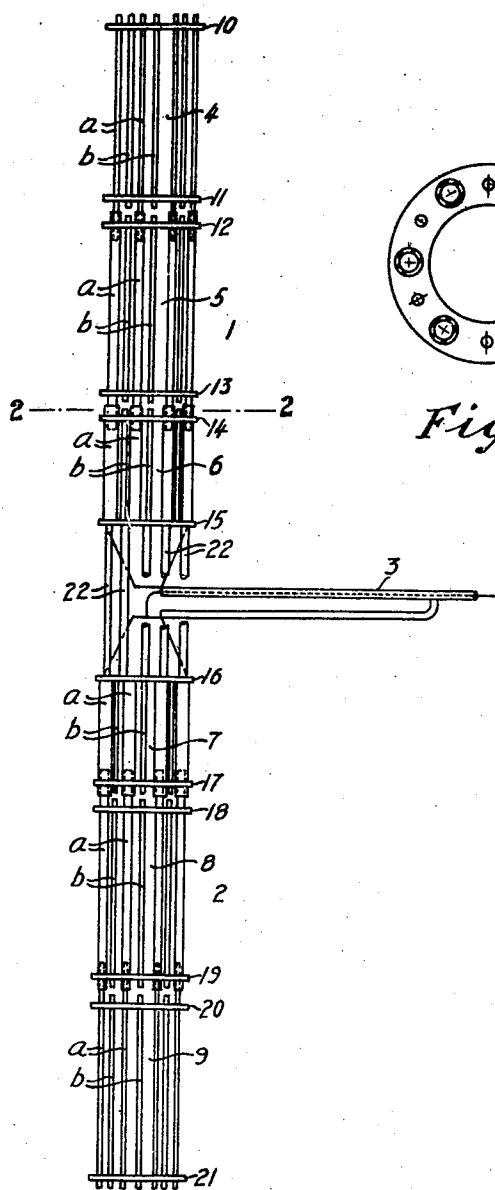


Fig. 2.

Fig. 1.

INVENTOR
EDWARD C. CORK

BY *H. S. Brewer*
ATTORNEY

UNITED STATES PATENT OFFICE

2,485,482

BROAD BAND ANTENNA

Edward Cecil Cork, Ealing, London, England, assignor to Electrical & Musical Industries Limited, Hayes, England, a company of Great Britain

Application July 21, 1945, Serial No. 606,401
In Great Britain May 2, 1944

5 Claims. (Cl. 250—33)

1

This invention relates to resonant aerials for radiating or receiving electro-magnetic waves in a wide range of frequencies.

For some purposes, particularly in television, it is required to provide an aerial which is capable of radiating or receiving electro-magnetic waves whose frequency spectrum extends over a wide range. When resonant aerials are used for such purposes, it is necessary so to construct them so that they have a comparatively poor selectivity. Thus, in aerials such as dipole aerials, it is common for this purpose to increase the diameter of the aerial conductor or conductors by employing tubular conductors rather than single solid wires. By increasing the diameter of the conductors in this way the inductance of the aerial is diminished and the capacity of the aerial is increased, so that the characteristic impedance and with it the selectivity of the aerial is reduced. If, however, an attempt is made, greatly to reduce the selectivity of the aerial in this way, by further increasing its diameter it is necessary to shorten the length of the aerial in order to obtain the desired resonance. As a consequence of this shortening the radiation resistance of the aerial is diminished. Such diminution results in a tendency to increase the selectivity of the aerial. In an example it was required to provide a dipole suitable for radiating waves with substantially the same efficiency in the frequency spectrum extending from 50 to 70 megacycles per second. In attempting to obtain such a wide pass range, a diameter of aerial conductor of the order of 56 centimeters was employed, but it was found that the length of the dipole had to be so shortened that the radiation resistance of the dipole was reduced from the normal value of about 70 ohms to the very low value of 13 ohms and moreover a pass-range of only about 5 megacycles was achieved. Thus the reduction of radiation resistance rendered it impossible to achieve the desired wide pass-range of frequencies. It is the object of the present invention to provide an improved aerial with a view to overcoming the above-mentioned difficulties.

According to one feature of the invention there is provided a resonant aerial for radiating or receiving electro-magnetic waves comprising an aerial conductor having effectively a large area and provided with series capacities at intervals along its length, the length of said aerial and the values of said capacities being such that the selectivity of the aerial is less than it would be if said capacities were not provided and the length of the aerial modified to afford the same resonance so that said aerial is capable of radiating or receiving waves in a wide frequency range.

According to another feature of the invention there is provided a resonant aerial for radiating or receiving electro-magnetic waves comprising

2

an aerial conductor having effectively a large area such that its characteristic impedance is not greater than 500 ohms and provided with series capacities at intervals along its length, the length of said aerial and the values of said capacities being such that the selectivity of the aerial is less than it would be if said capacities were not provided with the length of the aerial modified to afford the same resonance so that said aerial is capable of radiating or receiving waves in a wide frequency range.

According to a further feature of the invention there is provided a resonant aerial for radiating or receiving electro-magnetic waves comprising an aerial conductor provided with series capacities at intervals along its length which are smaller than $\frac{1}{4}$ of the operating wavelength and preferably of the order of $\frac{1}{12}$ or less of the operating wavelength, the length of said aerial and the values of said capacities being such that the selectivity of the aerial is less than it would be if said capacities were not provided and the length of the aerial modified to afford the same resonance so that said aerial is capable of radiating or receiving waves in a wide frequency range.

The length of the aerial can be made such that it is approximately equal to a half-wave dipole so that it possesses a desired radiation resistance and by suitable choice of said capacities the desired resonance can be obtained. An aerial constructed in accordance with the invention enables a wide pass-range to be obtained without employing an aerial which has an excessively large diameter. Furthermore, it is found that an increase in directivity of the aerial is obtained. It is known that by increasing the length of an aerial the radiation resistance is also increased and it will be appreciated therefore that in some cases an aerial according to the invention may be made of a length greater than a half-wavelength. The half-wavelength referred to is of course a half-wavelength at the mid-frequency of the pass-band of the aerial.

The aerial according to the invention may comprise tubular conductors of large diameter but in cases where it is desired to reduce windage the aerial may comprise a plurality of conductors of small diameter so arranged as to provide in effect said large area. The capacities may be provided by forming said large diameter tubular conductors or said small diameter conductors in sections and by overlapping and insulating their adjacent ends.

In order than the said invention may be clearly understood and readily carried into effect, it will now be more fully described with reference to the accompanying drawings, in which:

Figure 1 is an elevation of an aerial constructed according to one embodiment of the invention, and

Figure 2 is a cross-sectional view on an en-

3

larged scale taken along the line 2—2 of Figure 1.

As shown in the drawings, the aerial is a dipole aerial comprising two portions 1 and 2 each portion being fed by a conductor of feed 3. The portion 1 of the aerial is divided into three sections 4, 5 and 6 and the portion 2 is similarly divided into three sections 7, 8 and 9, each section comprising a plurality of conductors which are disposed parallel to one another and arranged in circular manner as shown in Figure 2, the conductors in one section being aligned with those in an adjacent section. The arrangement thus constitutes in effect a cylindrical or tubular conductor of large area. The individual conductors in said sections are supported by conducting rings 10 . . . 21 to which the conductors are secured in any suitable manner. The portion 1 of the aerial is insulated from the portion 2 apart from the connections of the feeder 3, by insulated supports 22 connected to the supporting rings 15 and 16. As shown in the drawing, each section of the aerial comprises six conductors *a* and six conductors *b* the ends of the conductors *a* in one section being received within the ends of the conductors *a* in an adjacent section, said ends being insulated from one another so that, due to the overlapping surfaces, capacities are formed. Thus, each portion of the aerial is provided with capacities at intervals along its length. The conductors *b* which are arranged intermediate the conductors *a* of one section are separated from the intermediate conductors *b* in adjacent sections by spacing the ends of said intermediate conductors apart, as shown in the drawings. The conductors are, however, electrically connected together via the conducting rings 10 . . . 21 and via said capacities.

In general, as many capacities as possible should be provided along the length of the aerial but in a practical case the provision of four capacities, regarding the capacities between each section as a single capacity, was found sufficient, the capacities being disposed at intervals of a twelfth of a wavelength. Such an aerial was designed for operating at a mid-frequency of 58 megacycles per second, the total length of the aerial conductor being half a wavelength at said mid-frequency and equal to 8' 6". With such a construction the provision of said four capacities each equal to 130 micro-micro-farads was found sufficient to provide a substantially flat response curve over a frequency spectrum of 50 to 65 megacycles per second. The conductors in each section of the aerial were equidistantly disposed around a circle 6" in diameter. The external diameter of the conductors *a* in sections 6 and 7 was $\frac{7}{8}$ ", in sections 5 and 8 was $\frac{1}{2}$ " and in sections 4 and 9 was $\frac{1}{4}$ ". The characteristic impedance of the aerial was about 240 ohms, and the radiation resistance about 72 ohms.

The construction shown in the drawing is designed so as to reduce windage, although it will of course be appreciated that if desired each section 4, 5, 6, 7, 8 and 9 could comprise a single tubular conductor of large diameter, the ends of such conductors overlapping to afford said capacities. Furthermore, although in the example described the aerial is a cylindrical dipole, it is to be understood that the invention is also applicable to other forms of aerials, such as bi-conical aerials or ellipsoidal aerials. In the case of both these aerials they may be constructed from conductors suitably shaped so as to impart the desired configuration to the aerial the con-

4

ductors being arranged in sections with ends overlapping to provide capacities.

What I claim is:

1. An antenna element including a plurality of conductors arranged in the form of a hollow cylindrical body, each of said conductors having a number of series connected capacitors disposed along its length, each of said conductors including a number of coaxially arranged interfitting tubes, insulated one from the other, whereby the length of said conductors is divided by series capacitors.

2. A broad band resonant antenna having an overall length substantially equal to one half of the operating wavelength at midband frequency and including a pair of antenna elements arranged in an end-to-end coaxial arrangement, means for energizing said antenna connected to the adjacent ends of said elements, each of said elements comprising a plurality of conductors arranged in the form of a hollow cylindrical body, each of said conductors having a number of series connected capacitors disposed along its length.

3. A broad band antenna having an overall length substantially equal to one half of the operating wavelength at midband frequency and including a pair of antenna elements arranged in an end-to-end coaxial arrangement, means for energizing said antenna connected to the adjacent ends of said elements, each of said elements being constructed according to claim 1.

4. A broad band resonant antenna having an overall length substantially equal to one half of the operating wavelength at midband frequency and including a pair of antenna elements arranged in an end-to-end coaxial arrangement, means for energizing said antenna connected to the adjacent ends of said elements, each of said elements including a plurality of bodies each comprising a plurality of conductors arranged in the form of a hollow cylinder, said bodies being arranged in end-to-end relationship to provide capacitive coupling between the adjacent ends of the conductors of adjacent bodies.

5. A broad band resonant antenna having an overall length substantially equal to one half of the operating wavelength at midband frequency and including a pair of antenna elements arranged in an end-to-end coaxial arrangement, means for energizing said antenna connected to the adjacent ends of said elements, each of said elements having a plurality of cylindrical bodies arranged in end-to-end relationship and capacitor means coupling adjacent ends of said bodies, each of said bodies including a number of hollow tubes arranged to define the surface of a cylinder, said tubes at each end passing through conductive rings serving to maintain said tubes in position and to connect said tubes electrically.

EDWARD CECIL CORK.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,696,234	Heising	Dec. 25, 1928
1,839,426	Von Arco et al.	Jan. 5, 1932
2,008,286	Leib	July 16, 1935
2,180,855	Wundt	Nov. 21, 1938
2,267,613	Lindenblad	Dec. 23, 1941
2,287,220	Alford	June 23, 1942