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E. C. CORK ET AL
AERIAL OR AERIAL SYSTEM

2,234,234

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Fig. 1

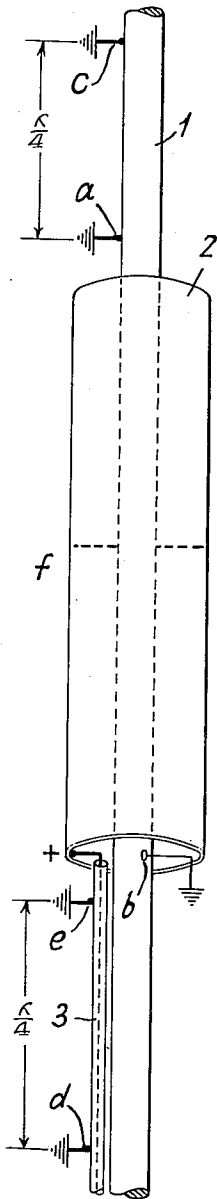


Fig. 2

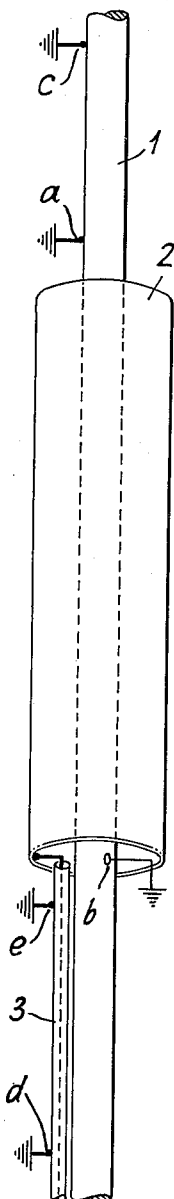


Fig. 3

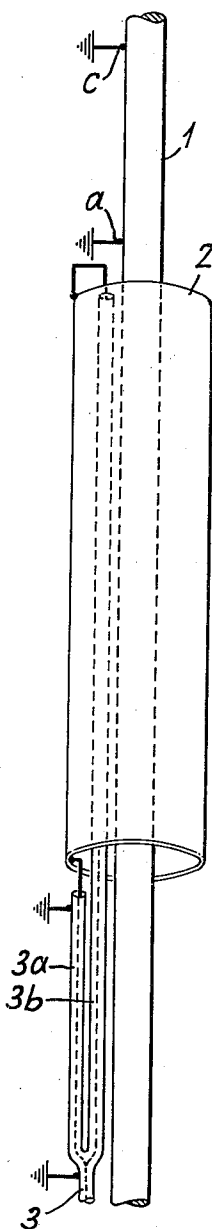
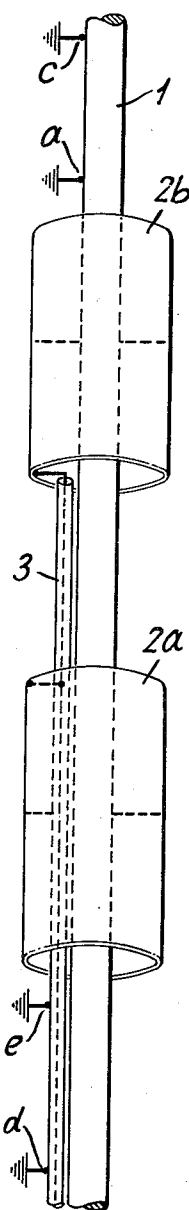


Fig. 4



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AERIAL OR AERIAL SYSTEM

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5 Claims. (Cl. 250—33)

The present invention relates to aerials or aerial systems for wireless transmitters or receivers and is more especially but not exclusively applicable to aerials or aerial systems for use in the transmission and reception of signals in the so-called ultra short wave bands, for example, such as are used in television signals transmission.

The invention has been developed largely as a result of the necessity in a particular case of having to arrange a short wave transmitting aerial around the steel mast of a ship and the principal object of the invention is to provide a method of arranging an aerial or aerial system about a conductive support such as a steel mast which is required to extend above and below the aerial, the aerial being so arranged that the loss of power due to induction from the aerial into the mast and the distortion of the radiation diagram of the aerial due to the presence of the mast is reduced to a minimum.

Further, while the invention has been developed primarily due to the above described necessity of providing an aerial surrounding a steel mast, in one of its aspects, the invention provides a novel combination including a substantially tubular aerial or aerial system arranged about and supported on a metal mast passing substantially axially through the aerial. In some cases part of the metal mast itself may be utilised as a radiation element of the aerial system.

We are, of course, well aware that it is known to arrange an aerial system on a metal mast, the system being supported from a metal mast by being suspended from the top of the mast, groups of aerial being arranged on all sides of the mast so as to substantially surround the mast, and the system has including reflector wires arranged on the inside of the groups of aerials so as to screen the mast from the actual radiating or receiving aerials in the system so that the radiation diagram and power requirements of the aerial are very little affected by the presence of the mast.

We are also aware that it has been proposed as described in U. S. Patent #2,113,136, issued April 5, 1938, to construct an aerial system comprising a straight conductor adapted to have high frequency apparatus connected or coupled thereto at or near one end thereof, alternate half-wave sections of said conductor, starting from the free end being radiating sections, radiation from the remaining half-wave length section or sections being prevented by a sleeve or sleeves surrounding said remaining section or sections, each

sleeve being carried from the section it surrounds in such manner as to be insulated therefrom at least over those portions of its length on either side of its centre and being grounded through a conductor one half-wave length, or a multiple thereof, long.

In accordance with the present invention an aerial system is provided comprising a metal mast having one or more substantially tubular radiating elements arranged without reflectors on the mast coaxially therewith, and means separate from the mast for feeding signals to or from the system said means being electrically connected directly to each of said radiating elements.

An aerial system according to the invention may comprise a single radiating element in the form of a cylinder substantially a half-wave long, said mast being effectively earthed at points adjacent each end of the radiating element and, if desired, also at a distance of substantially a quarter of a wave length from one end of said element. The radiating element may be connected at each end to one branch of a feeder having two branches, of which one is substantially a multiple of a quarter of a wave length long and the other is half a wave length longer, or it may be connected at the end opposite the above mentioned end to a feeder having concentric conductors, the outer conductor of the feeder being earthed at a point adjacent the point of connection to the element and at a point substantially a quarter of a wave length distant from said point of connection.

In another embodiment of the invention the aerial system has a pair of tubular aerials arranged end to end on said mast with their adjacent ends separated by a distance of half a wave length, said aerials being arranged to be fed from adjacent ends with signals in antiphase.

The nature of the invention and the method of carrying the invention into practice will be readily understood from the following description with reference by way of example, to the accompanying drawing of which the four figures represent typical aerial arrangements constructed according to the invention, like parts in each of the figures of the drawing being indicated by like reference letters or numerals.

In Figures 1 to 3 of the aforesaid drawing 1 is a steel mast about which the aerial or the aerial system is to be arranged and 2 is the tubular aerial or aerial system arranged to surround the mast and 3 is the aerial feeder.

Broadly speaking, in the arrangements of Fig-

ures 1 to 4, two methods are adopted either alone or in combination of ensuring that the aerial shall not induce large currents into the mast such as will give rise to a loss of power or will cause a distortion of the radiation diagram. These methods comprise respectively, de-tuning and mis-matching the mast system to the aerial system to reduce the currents flowing into the mast and the forcing of potentials on the mast equal and opposite to potentials induced therein by currents in the aerial in order to suppress the E. M. F.'s.

In the arrangement illustrated in Figure 1 of the drawing, the aerial 2 is a half wave end fed cylindrical aerial through the centre of which the mast 1 passes. The mast 1 is effectively earthed at the points *a* and *b* one at each end of the aerial and at a point *c* distant, substantially one quarter of a wave length above the upper end of the aerial, and the feeder 3, shown as a concentric conductor feeder has its outer conductor earthed at the points *d* and *e* also substantially a quarter of a wave length apart, the point *e* being adjacent the end of the aerial. Earthing the feeder at the aerial end and at another point in this manner assists in the elimination of waves from the mast. The earthing may be effected by providing half or quarter wave length bars as described in the specification of British Patent Specification #509,500, complete acceptance July 19, 1939. The middle of the aerial, is shorted to the mast as indicated at *f*. Under these conditions, since the end of the aerial is connected to the adjacent part of the mast by a short circuited quarter wave length conductor formed by the inside of the aerial and the corresponding length of the mast, the impedance between the end of the aerial and the adjacent part of the mast will be high relatively to the external aerial impedance to space so that currents tend to flow into the aerial instead of into the mast and thus standing waves on the mast are largely suppressed. If necessary, in order to ensure that the velocity of travel of a wave along the path between the inside of the aerial and the mast shall be different to that along the outside of the aerial a reactance can be inserted between the mast and the inside of the aerial, for example, by providing suitable dielectric material between the aerial and the mast, the effect of the reactance being to tune the parallel circuit between the aerial and the mast so as to form a rejector circuit in respect of frequencies to be radiated by the aerial.

It is also found that the arrangement similar to that shown in Figure 1, but with the short circuit between the conductor and the mast at the midpoint *f* eliminated, may be satisfactory, though the adjustment in this case is somewhat critical, and the band of frequencies which may be transmitted somewhat narrow. Such an arrangement is shown in Figure 2.

It is believed that the arrangement of Figure 2 operates in the following manner:

Let it be assumed that a difference of potential "*v*" is set up by the feeder between the lower end of the aerial and the point *b* on the mast. Then since the point *b* is earthed the end of the aerial must assume a potential of *v*. Since the mast and the inside surface of the aerial form a concentric half wave length transmission line the potential difference between the upper end of the aerial and the point *a* of the mast is $-v$. As point *a* of the mast is earthed then the upper end of the aerial must take the potential $-v$

and the potential and current distribution on the outside is that of a normal half wave length aerial.

Alternatively if the upper end of the aerial is at the potential $-v$ due to the distribution of potential and current on the aerial then the point *a* on the mast must be at zero potential. The arrangement of Figure 2 therefore tends to suppress standing waves on the mast.

In the case of the arrangement of Figure 2 the length of the aerial may be adjusted in the absence of the earths at *a* and *c* till standing waves between points *a* and *c* of the mast are substantially eliminated. In order to effect this suppression adjustment simultaneously with the tuning of the aerial, the space between the aerial and the mast may be loaded with a dielectric material so as to change the velocity of the propagation along it, for example, condensers may be inserted for this purpose at appropriate points between the aerial and the mast.

In the case of the arrangement of Figure 3 feeder 3 has two branches 3*a* and 3*b* each connected to opposite ends of the aerial, the branch 3*b* thus being a half wave length longer than the branch 3*a*. Preferably the branch 3*a* of feeder 3 is a quarter of a wave length long and the branch 3*b* is thus three quarters of a wave length long. With this arrangement assuming the feeder is perfect, equal currents are forced into the two ends of the aerial since the feeder branches are driven by a common voltage and are each an odd multiple of a quarter wave in length. The arrangement of Figure 3 is generally similar to that of Figure 2 except that as the aerial is fed from both ends so that losses arising in transmission from one end of the system to the other will be less important.

It will be appreciated that the aerial 2 in the above described cases may be formed of a tubular shell of sheet copper or similar conductive material or gauze or a plurality of single rods or by any other arrangement of conducting elements to simulate a conducting surface and the aerial may be used to form one element of an array instead of being the sole radiator. Thus, as shown in Figure 4 of the drawing aerials 2*a* and 2*b* may be provided arranged end to end on the mast the aerials being fed from their adjacent ends which are separated by a distance of half a wave length. The aerials 2*b* and 2*a* are each shown as being short circuited at its mid-point to the mast 1. The mast 1 is earthed at the points *a* and *c* respectively adjacent and a quarter of a wave length from the upper end of aerial 2*b*. With this arrangement, since the feeder 3 sets up a potential difference between the adjacent ends of aerials 2*a* and 2*b* and no earthing device is provided in the mast 1 at these points, the half wave section of the mast between the aerials has potentials induced in it such that it will radiate in the same phase as the aerials.

If desired, an aerial array might comprise elements such as 2*a* and 2*b* of Figure 4 each arranged in the manner described with reference to any of the preceding Figures 1 to 3 inclusive.

We claim:

1. An aerial system comprising a conductive supporting mast, one or more substantially tubular radiating elements arranged on said mast coaxially therewith, means separate from said mast for feeding signals to said radiating elements, said means being directly connected to said radiating elements, said mast being effectively earthed at points adjacent each end of said radiating ele-

ments and also at a distance equal to a quarter of the length of the operating wave from the ends of said radiating elements which are not adjacent another radiating element.

5 2. An aerial system comprising a conductive supporting mast, a plurality of substantially tubular half wave radiating elements arranged on said mast coaxially therewith, said elements being spaced apart a distance equal to a half the length
10 of the operating wave, means separate from said mast for feeding signals to said radiating elements, said means being directly connected to said radiating elements, said mast being effectively earthed at points adjacent each end of said
15 radiating elements and also at a distance equal to a quarter of the length of the operating wave from the ends of said radiating elements which are not adjacent another radiating element.

20 3. An aerial system comprising a conductive supporting mast, a single substantially tubular half wave radiating element arranged on said mast

coaxially therewith, means separate from said mast for feeding signals to said radiating element, said means being directly connected to such radiating element, said mast being effectively earthed at points adjacent each end of such
5 radiating element and also at a distance equal to a quarter of the length of the operating wave from the ends of said radiating element.

4. An aerial system according to claim 1 wherein an effective short-circuit to the mast is provided substantially at the mid-point of each of
10 said radiating elements.

5. An aerial system according to claim 3 wherein said radiating element is connected at each end to one branch of a feeder having two
15 branches, of which one is substantially a multiple of a quarter of a wave length long, and the other is odd multiple of a half wave length longer.

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