March 26, 1940. N. WELLS ET AL 2,195,232

AERIAL AND ASSOCIATED FEEDER SYSTEM

Filed Oct. 8, 1938

Fig. 1

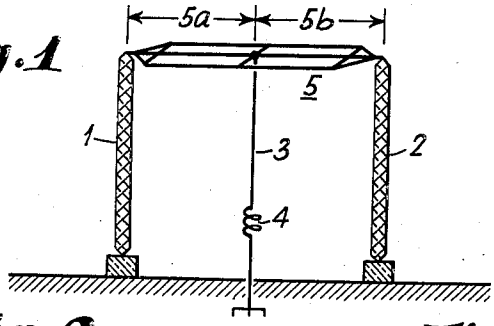


Fig. 2

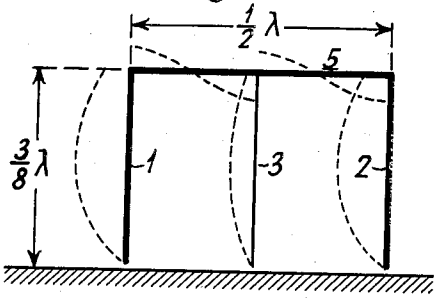


Fig. 3

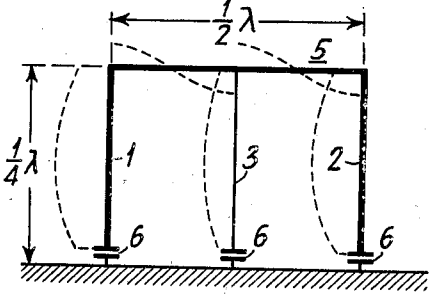


Fig. 4

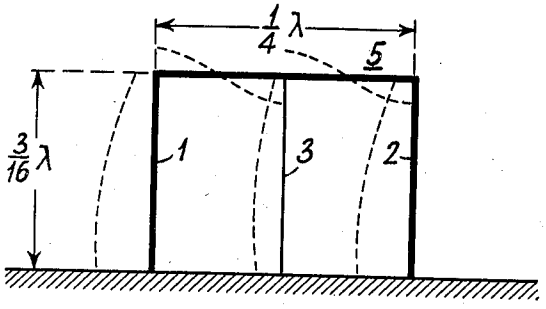


Fig. 5

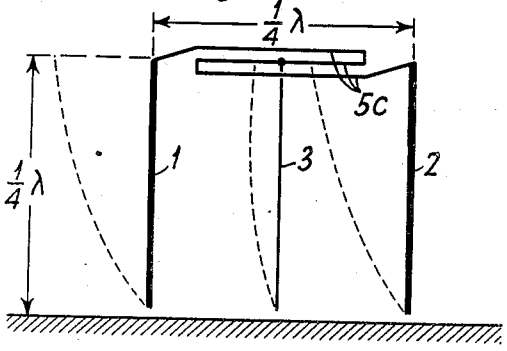
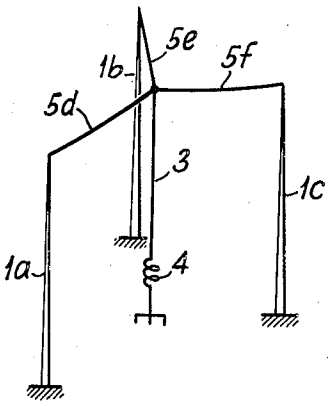


Fig. 6



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Patented Mar. 26, 1940 2,195,232

UNITED STATES PATENT OFFICE

2,195,232

AERIAL AND ASSOCIATED FEEDER SYSTEM

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Application October 8, 1938, Serial No. 233,928
In Great Britain October 28, 1937

4 Claims. (Cl. 250—33)

This invention relates to aerial and associated feeder systems and more particularly to feeder systems for aerial systems of the type comprising a plurality of vertical aerials—commonly, though not necessarily, constituted by masts—which are spaced apart. Aerial systems of this type are commonly used for directional transmission the individual aerial spacing being chosen at a predetermined relation to the wave length and the system as a whole being energized from a common transmitter through a feeder system. The invention is, however, not limited to its application to directional aerial systems since, as will be apparent later the said invention can be applied to aerial systems which are non-directional or nearly so. The object of the present invention is to provide improved feeder system arrangements for aerial systems of the general type referred to.

The aerials of a system of the type in question are usually energized by a branched feeder system the branches of which are connected or coupled to the individual aerials at their bases. The directional qualities of such an aerial system—if it has directional qualities at all—depend inter alia on the distances (in terms of the wave length) between the aerials of the system and on the phase and amplitude relationships of the currents in the individual aerials. Thus the horizontal polar diagram of a system of the type referred to and comprising two vertical aerials separated by a distance equal to one quarter of the working wave length and fed by currents which are in phase and of equal amplitude, is roughly elliptic with its major axis at right angles to the line joining the two aerials. If the distance between the aerials is increased the polar diagram is changed, becoming, when the said distance has been increased to one half of the working wave length, a figure of eight diagram.

According to the present invention an aerial system of the type referred to is energized by a branched feeder system comprising a centrally disposed vertical feeder which is branched outwards at its upper end into a plurality of horizontal feeder branches each feeding one of the vertical aerials at its upper end.

The vertical feeder length of course constitutes an additional (centrally placed) vertical aerial and since, in general, the separation between the other aerials will not exceed one half the working wave length, it is preferred where maximum directivity is required, so to arrange matters that the radiation from the vertical feeder is reduced as far as possible in order to prevent its producing a detrimental effect upon the desired directional diagram of the aerial system. To some extent the amount of directivity can be controlled either by adjusting the total electrical length of conductor in the horizontal feeder branches (as distinct from their overall lengths) or by loading the main vertical aerials or masts so as to vary the form of current distribution therein to that in the centrally placed vertical feeder length.

Alternatively to the reduction of radiation from the centrally placed vertical feeder length its vertical polar diagram may be made such that in conjunction with the vertical polar diagram due to the main aerials, there is provided a resultant vertical polar diagram having a reduced proportion of high angle rays (as compared to the result which would be obtained due to the vertical diagram of the main aerial system alone) and therefore of improved anti-fading properties. This is of particular advantage because it means that for a given allowable proportion of high angle rays, lower main aerials or masts can be used than would be possible were the central vertical feeder length not present.

Another, and very important advantage of the present invention arises from the fact that the phasing and tuning of the main aerials can be controlled by suitably disposing either symmetrically or otherwise, the horizontal feeder branches and employing only a single tuning circuit at the base of the central vertical feeder length. This results in a greater simplification of the otherwise difficult process of ensuring correct phasing and tuning of the main aerials in the system.

The invention is illustrated in and further explained in connection with the accompanying drawing in which Figure 1 shows one embodiment of the invention while Figures 2, 3, 4, 5 and 6 illustrate modifications thereof. In Figure 1 there are employed two main vertical aerials 1, 2, in the form of masts insulated from earth. These aerials are fed by means of a feeder system comprising a vertical feeder length 3 placed mid-way between the two masts and of substantially the same height, this feeder length being terminated through a suitable input transformer represented by the coil 4 at its lower end. The upper end of this feeder length is connected to and supported from the midpoint of an ordinary three wire triatic 5 suspended between the masts and provided with cross wires as shown. The two halves 5a, 5b of the triatic constitute the two horizontal branches of the feeder system.

With this arrangement, owing to the proximity of the central vertical feeder length to the two main aerials, there will be a coupling effect tending to oppose the formation of current in the said feeder length. This effect on the feeder length will be, by virtue of the position of the latter, appreciably greater than the effect of the corresponding coupling of the said feeder length

and either main aerial upon the other main aerial. Again the cross sections of the main aerials—especially if they be masts—and of the triatic arrangement will be normally considerably greater than the cross section of the vertical feeder length, which is made purposely small, and accordingly the wave impedance of the vertical feeder length will be high (e. g., of the order of 550 ohms) while the wave impedance of each horizontal feeder branch and main aerial will be low (e. g., 200 to 300 ohms in the case of main aerials in the form of masts or towers). Hence for a given potential at the common junction of the two horizontal feeder branches and the vertical feeder length there will be appreciably less current in the said length than in either of the horizontal branches and main aerials.

Radiation from the horizontally disposed feeder branches is almost completely cancelled by reason of their symmetrical disposition.

There is a wide range of dimensions which can be adopted for a construction as shown in Figure 1 and Figures 2, 3, 4, and 5 show, in purely diagrammatic manner, various examples of dimensions which can be adopted. For example, as shown in Figure 2, the two main aerials or masts could be $3\lambda/8$ high (λ being the working wave length) and spaced apart by $\lambda/2$; or, as shown in Figure 3, they could be $\lambda/4$ high and spaced apart by $\lambda/2$; or, as shown in Figure 4, they could be $3\lambda/16$ high and spaced apart by $\lambda/4$; or, as shown in Figure 5, they could be $\lambda/4$ high and spaced apart by $\lambda/4$. In order to achieve the desired space phase relationship between central feeder and main aerials, these latter may be earthed at their respective bases either directly or through reactances. This is illustrated in Figure 3 where condensers 6 are shown, one being at the base of the member 3. The desired space phase relationship between central feeder and main aerials may also be achieved by suitably forming the horizontal feeder branches, for example, by constituting them by wires folded back upon themselves. This is illustrated in Figure 5 where in a system comprising two aerials each $\lambda/4$ high and spaced apart by $\lambda/4$ the upper end of the central vertical feeder length is connected to the middle of a horizontal wire 5*c* a little less than $\lambda/4$ long and in the line of separation of the two main aerials the end of said wire nearer one main aerial being connected back to the other and the end of said wire nearer said other main aerial being connected back to said one main aerial.

The invention is not limited to systems employing only two main aerials for systems employing more than two main aerials can be fed via a feeder system comprising a centrally disposed vertical feeder length which branches out at the top via horizontal feeder branches to the tops of the main aerials. For example, as shown in Figure 6, which represents a practically non-directional system, there could be three similar main aerials 1*a*, 1*b*, 1*c* symmetrically arranged around a vertical feeder length 3 at the centre, the top of said length being connected to the tops of the main aerials through horizontal radially arranged branches 5*d*, 5*e*, 5*f*. Such a system would constitute an omnidirectional system, with, however, an improved vertical polar diagram.

In Figures 2, 3, 4 and 5 the current distributions are represented conventionally in broken line curves.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed we declare that what we claim is:

1. An aerial system comprising a plurality of vertical aerials each having a length less than half the length of the operating wave and means for cophasally energizing said aerials, said aerials being spaced apart a distance not exceeding a half the length of the operating wave whereby high angle radiation is reduced, said means comprising a vertical feeder which is branched outwards at its upper end into a plurality of horizontal feeder branches each feeding one of said vertical aerials at its upper end, said feeder being centrally disposed and so proportioned with respect to said aerials that radiation from said feeder produces no disturbing effect on the radiation pattern of said system.

2. An aerial system comprising a plurality of vertical aerials having a length less than a quarter of the length of the operating wave and means for cophasally energizing said aerials, said aerials being spaced apart a distance equal to a quarter of the length of the operating wave whereby high angle radiation is reduced, said means comprising a vertical feeder which is branched outwards at its upper end into a plurality of horizontal feeder branches each feeding one of said vertical aerials at its upper end, said feeder being centrally disposed and so proportioned with respect to said aerials that radiation from said feeder produces no disturbing effect on the radiation pattern of said system.

3. An aerial system comprising a plurality of vertical aerials having a length less than a quarter of the length of the operating wave and means for cophasally energizing said aerials, said aerials being spaced apart a distance equal to a quarter of the length of the operating wave whereby high angle radiation is reduced, said means comprising a vertical feeder which is branched outwards at its upper end into a plurality of horizontal feeder branches each feeding one of said vertical aerials at its upper end, said feeder being centrally disposed and so proportioned with respect to said aerials that radiation from said feeder produces no disturbing effect on the radiation pattern of said system, said vertical aerials being grounded at their lower ends.

4. An aerial system comprising a plurality of vertical aerials having a length equal to a quarter of the length of the operating wave and means for cophasally energizing said aerials, said aerials being spaced apart a distance equal to a quarter of the length of the operating wave whereby high angle radiation is reduced, said means comprising a vertical feeder which is branched outwards at its upper end into a plurality of horizontal feeder branches each feeding one of said vertical aerials at its upper end, said feeder being centrally disposed and so proportioned with respect to said aerials that radiation from said feeder produces no disturbing effect on the radiation pattern of said system, said horizontal feeder branches being folded back upon themselves whereby the current in said vertical feeder is in phase with the current in each of said vertical aerials.

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