June 26, 1934. O. BOHM ET AL 1,964,190

ANTENNA

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Fig. 1

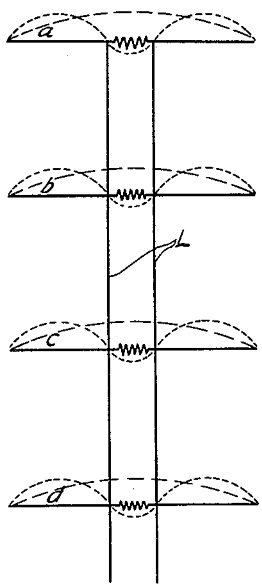


Fig. 2

Fig. 3

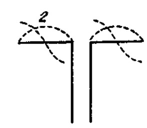


Fig. 4

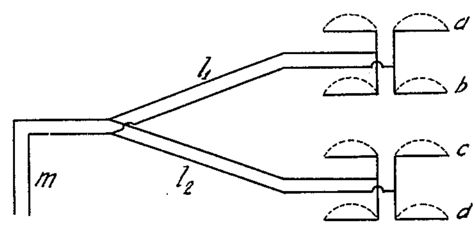
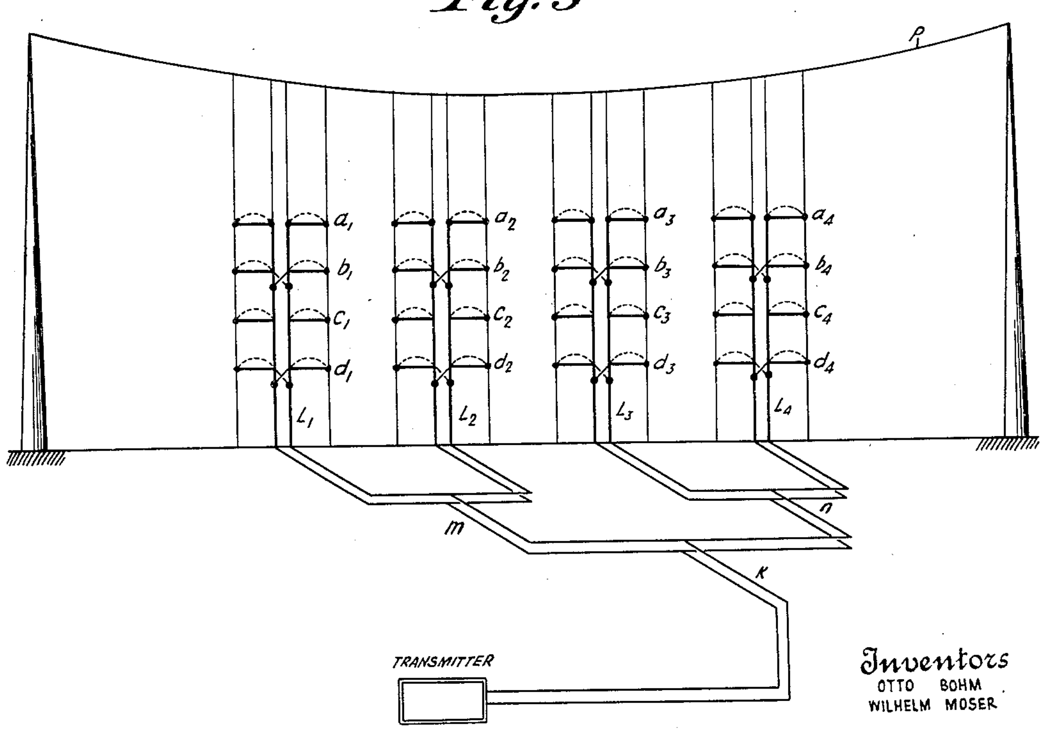


Fig. 5



Inventors
OTTO BOHM
WILHELM MOSER

By their Attorney Ira J. Adams

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ANTENNA

Otto Böhm and Wilhelm Moser, Berlin, Germany, assignors to Telefunken Gesellschaft für Drahtlose Telegraphie m. b. H., Berlin, Germany, a corporation of Germany

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4 Claims. (Cl. 250—33)

In order to insure favorable conditions for the transmission of short waves in wireless telegraphy, a suggestion is found in the earlier art to dispose a number of vertical wires in one plane at right angles to the sense of radiation. Such antennæ are employed also successfully for the reception of short waves from a definite direction.

However, experiments have shown that the transmission of energy with horizontal antennæ is more favorable than the transmission with vertical antennæ. According to the present invention, an antenna arrangement is disclosed which comprises a number of linear horizontal antennæ which are superposed in a vertical plane. In this manner vertical bunching of the radiation is insured.

The linear antennæ so used may be excited in any desired manner, for instance, in such a way that each of the horizontal antennæ oscillates at one-half its wave-length and thus constitutes a simple dipole. Or else excitation may be effected so that it oscillates like a double dipole, both halves being excited cophasally.

The superposed antennæ are excited cophasally by being connected to vertical feed leads a wave length apart, or a half wave length apart with reversed connections to alternate antennæ.

Our invention is described more in detail in the following specification, acompanied by a drawing in which Figure 1 is one form of antenna; Figure 2 is a detail of a radiator a half wave long; Figure 3 is a detail of a radiator a full wave long; Figure 4 indicates one method to obtain cophasal excitation; and Figure 5 is a complete antenna system the sections of which use another method of obtaining cophasal excitation.

One fundamental embodiment of the invention is illustrated in Figure 1 where the constituent linear antennæ *a, b, c, d,* are disposed above one another, though being fed cophasally from a common lead L.

Figures 2 and 3 illustrate diagrammatically two special cases of excitation of the horizontal antennæ. In Figure 2 a dipole antenna is excited by series coupling at its middle. In Figure 3 a double dipole antenna is excited by coupling in the middle at one half of its wave length. This may be considered parallel coupling, because it excites both halves of the antenna cophasally, just as if each half was coupled as in Figure 2, and both feed lines were then connected in parallel. Of course, in either case a coupling coil may be connected in series with the halves of the antenna and across the feed line, as was indicated in Figure 1, and in such case the coil applied to Figure 2 should be merely a coupling coil, whereas that applied to Figure 3 should be of sufficient inductance to represent a half wave of the energy being radiated, so that it will act as a substantially non-radiating phase reversing coil. The arrangement shown in Figure 3 is the one which has been illustrated also in Figures 4 and 5, though that shown in Figure 2 may optionally be employed.

Figure 4 illustrates a scheme for feeding energy cophasally to two systems of horizontal antennæ *a, b,* and *c, d,* respectively, by way of leads *m*, l_1, and *m*, l_2, respectively. The desired phase is obtained in this case by equal length lines, but it will be understood that cophasal excitation of the horizontal antennæ may be insured also in some other manner, and the dimensions of the antennæ may be so chosen that they are caused to oscillate in some other multiple of a half-wave.

If the directive action of the radiation is not to be utilized primarily in a horizontal direction, but rather at a certain angle of inclination with reference to the surface of the earth, then the constituent horizontal antennæ mounted superposed-fashion must be placed not in one plane, but rather in parallel phase, or in one tilted plane.

In Figure 5, four vertical systems comprising respectively the horizontal antennæ *a*1, *b*1, *c*1, *d*1, *a*2, *b*2, *c*2, *d*2, *a*3, *b*3, *c*3, *d*3, and *a*4, *b*4, *c*4, *d*4 are arranged in one plane, and are fed by means of the symmetrically branched leads L1, L2, L3, L4, *m, n, k*. The horizontal antennæ of each system are suspended from a carrier cable P. The distances between the constituent horizontal antennæ of each system in the arrangement as illustrated in Figure 5 amount in each case to one-half wave, antennæ *b* and *d* being connected crosswise with the feed leads, so that all of the antennæ are energized cophasally.

We claim:

1. An antenna system comprising a single, unbroken pair of vertical linear feed leads and a plurality of pairs of superposed horizontal antennæ of harmonic length coupled to said feed leads a multiple of a half wave length apart, alternate pairs of antennæ being coupled with crossed connections for cophasal operation.

2. An antenna system comprising a single, unbroken pair of vertical linear feed leads, and a plurality of pairs of horizontal antennæ of harmonic length coupled to the feed leads a half wave length apart, each pair of antennæ being coupled to both feed leads alternate pairs of an-

tennæ being coupled with crossed connections, for cophasal operation.

3. A directional radio system comprising a plurality of antenna sections lying in a vertical plane and spaced apart transversely of the direction of desired communication, each of said antenna sections having a single, unbroken pair of vertical feed leads and a plurality of horizontal antennæ of harmonic length coupled to the feed leads a half wave length apart, alternate antennæ being coupled with crossed connections for cophasal operation, radio equipment, and a symmetrically branched feeder system for coupling the vertical feed leads cophasally to the radio equipment.

4. A directive radio system comprising a plurality of antenna sections lying in a vertical plane and spaced apart transversely of the direction of desired communication, each of said antenna sections having a single, unbroken pair of vertical linear feed leads and a plurality of horizontal radiators of harmonic length coupled to the feed leads a half wave length apart, alternate radiators being coupled with crossed connections for cophasal excitation, a radio transmitter, and a symmetrically branched feeder system for coupling the vertical feed leads cophasally to the transmitter.

OTTO BÖHM.
WILHELM MOSER.