Nov. 7, 1933. C. S. FRANKLIN 1,934,182

ANTENNA

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Fig. 1 Fig. 2 Fig. 3

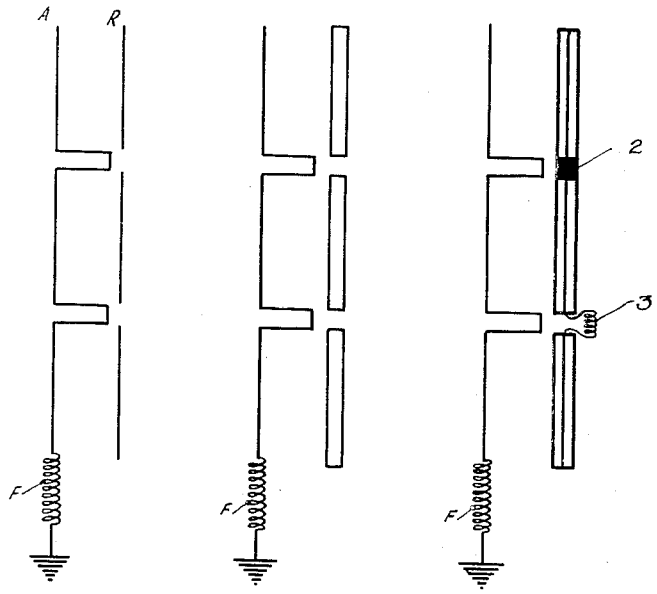
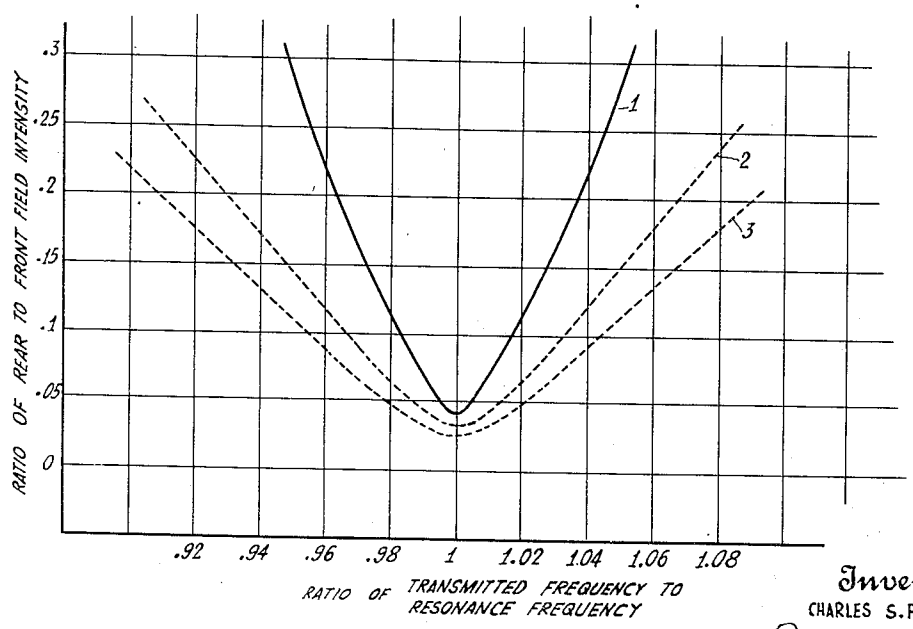


Fig. 4



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6 Claims. (Cl. 250—33)

This invention relates to aerial systems, and more particularly to reflecting aerial systems of the kind comprising a plurality of tuned conductors arranged, for example, in a plane or as a parabola for the purpose of giving enhanced directional properties.

According to this invention an aerial system comprises a plurality of multi-conductor elements each having a ratio of inductance to radiation resistance less than that obtainable by a single conductor. Such multi-conductor elements may be formed as cages or grids, of wires or rods.

It is found that the use of multi-conductor elements in accordance with this invention results in greater efficiency than is obtainable with the single conductors hitherto employed, while the tuning is rendered less critical and an aerial system therefore rendered operable over a wider wave band than has hitherto been possible.

Aerial systems comprising multi-conductor elements in accordance with this invention may be built up of a plurality of aerial units, spaced a fraction of a wave length apart, each such unit consisting of a number of tuned multi-conductor elements located above one another and insulated from one another. Alternatively, the said elements may all be connected directly in series through inductance coils or their equivalents in a manner similar to that already proposed in known aerial systems, so that the elements act as reflectors and radiators, while the coils or their equivalents are of comparatively small reflecting or radiating power.

The invention is explained in connection with and illustrated by the accompanying drawing, in which

Figure 1 illustrates an antenna section employing simple reflector conductors; Figure 2 illustrates the use of double reflector conductors; Figure 3 shows the use of cage reflector conductors; and Figure 4 is a graph explanatory of my invention.

Referring to Figure 1, which shows a known aerial and reflector system, A represents an aerial of the kind described in the specification of British Patent No. 242,342, and which is energized from a distant transmitter (not shown) through a feeder F. Located substantially one quarter of a wave length in rear of the aerial A is a reflector R consisting of three rods or wires, each one half wave length long, situated above and insulated from one another.

With this arrangement currents are induced in the reflector rods by radiation from the aerial A, and, provided that the said reflector is in tune with the transmitted wave, these currents will be in phase with the inducing voltage. There will thus be obtained from the combination of aerial and reflector a radiated field having a maximum intensity in front of the aerial in a direction away from the reflector and a minimum intensity in the opposite direction, the said minimum, however, never reaching zero owing to the effect of the ohmic resistance of the reflecting elements. If the radiated fields be measured at appreciable distances in front of and behind the whole system it will be found that the intensity of radiation in rear of the system is greater at frequencies different from the resonant frequency of the reflector—an effect which may be explained by the fact that when the transmitted frequency is not equal to the resonant frequency of the reflector, the currents induced therein are neither sufficiently large nor in correct phase to give a minimum radiation as low as that obtained at resonance.

If, now, in accordance with the present invention, multi-conductor elements are, as shown, for example in Figures 2 and 3, substituted for the single conductor elements in the reflector, a very considerable improvement results. In Figure 3 cages of conductors are substituted for the single conductors shown in Figure 1. These may be separated by insulators, 2, or phase reversing reactances, 3, both being shown in Figure 3, by way of example.

It will be understood, of course, that in the case of each of the illustrated arrangements the complete antenna may comprise a large number of antenna sections, such as have been illustrated, positioned transversely of the direction of desired communication, and coupled cophasally to a transmitter or a receiver, or, if preferred, a single antenna conductor surrounded by a parabolic formation of reflector conductors, and further, that a greater or lesser number of superposed half wave length units may be employed.

Such cages or grids of wires, while having substantially the same radiation resistance as single wire elements, are of considerably lower inductance and resistance, and in consequence, at frequencies a given distance removed from the resonant frequency of the reflector, the currents induced therein are larger and more nearly in phase than those which would be obtained with the known single wire element reflectors, the result being that the field of radiation in rear of the reflectors is of smaller intensity.

This improvement is shown graphically in Fig-

ure 4, by means of curves whose ordinates are ratios of field intensities in rear of a reflector to field intensities in front, and whose abscissæ are ratios of transmitted frequencies to reflector resonant frequencies. The curve 1 was obtained with a reflector as shown in Figure 1, while the curves 2 and 3 were obtained with reflectors as shown in Figures 2 and 3 respectively. It will be noted that not only do the improved reflectors give lower minima but that for given ratios of front to rear field intensities, the improved reflectors may be operated over a considerably wider band of frequencies.

If desired, multi-conductor elements in accordance with this invention may be connected together in series by means of inductance coils or equivalent devices of small radiating or reflecting power.

Multiple conductor aerial systems in accordance with this invention are applicable with advantage not only to reflecting aerial systems but also to transmitting aerial systems. With such application, the advantage obtained is not an improved directional effect but the fact that the aerial will accept power from a feeder system over a wider band of frequencies.

As is explained in the specification of British Patent No. 281,762, the impedance of a wire, long compared with a given energizing wave length, varies (as the length of the wire increases) between maximum and minimum limiting values; or, alternatively, the impedance of a given wire or aerial varies between maximum and minimum limits as the energizing wave length is varied. By employing multiple conductor aerials in accordance with this invention, the separation of these limiting values is reduced, compared to that which obtains with a known single wire element aerial. The rate of change of impedance with respect to change of energizing frequency is therefore also reduced and in consequence, a multiple conductor aerial, which has been adjusted in known manner to accept energy at a given frequency through a transformer or the like from a feeder, will accept that energy within specified limits over a wider range of frequencies than would an otherwise similar aerial made up of single wire elements; in other words, the multiple conductor aerial will accept the same amount of energy at a frequency a given amount different from the design frequency, as will the single conductor element aerial at a frequency nearer the design frequency.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A unidirectional antenna comprising a plurality of antenna conductors each approximately a half wave in length and connected end to end by substantially non-radiating phase reversing reactances, and a plurality of reflector conductors each approximately a half wave in length spaced approximately an odd number of quarter wave lengths away from the antenna conductors and comprising structurally a group of closely adjacent directly connected parallel conductors, connected end to end by insulating means.

2. A unidirectional antenna comprising a plurality of antenna conductors each approximately a half wave in length and connected end to end by substantially non-radiating phase reversing reactances, and a plurality of reflector conductors each approximately a half wave in length spaced approximately an odd number of quarter wave lengths away from the antenna conductors and comprising structurally a group of closely adjacent directly connected parallel conductors, connected end to end by substantially non-radiating phase reversing reactances.

3. A unidirectional antenna comprising a plurality of vertical antenna conductors each approximately a half wave in length and connected end to end by substantially non-radiating phase reversing reactances, and a plurality of vertical reflector conductors each approximately a half wave in length spaced approximately an odd number of quarter wave lengths away from the antenna conductors and comprising structurally a group of closely adjacent directly connected parallel conductors, connected end to end by insulating means.

4. In a communication system the combination with a multi-sectional aerial of a vertical reflecting system having a length a multiple of half the length of the communication wave comprising a plurality of substantially half wave length multi-conductor elements insulated from each other, each element having a ratio of inductance to radiation resistance less than that of a single conductor.

5. In a communication system the combination with a multi-sectional aerial having radiating sections in a straight line each of which is at least equal to half the length of the communication wave, of a plurality of separated reflector arrangements placed end to end, each of the latter being individual to one of said radiating aerial sections and located approximately an odd multiple of a quarter wave length away from said sections, each of said reflectors comprising a plurality of adjacent directly connected parallel conductors.

6. In a communication system the combination with a multi-sectional aerial having radiating sections in a straight line each of which is at least equal to half the length of the communication wave, of a plurality of separated reflector arrangements placed end to end, each of the latter being individual to one of said radiating aerial sections and located approximately an odd multiple of a quarter wave length away from said sections and comprising multi-conductor elements having a ratio of inductance to radiation resistance less than that of a single conductor.

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