May 9, 1933. C. S. FRANKLIN ET AL 1,908,595

AERIAL SYSTEM FOR USE IN WIRELESS TELEGRAPHY AND TELEPHONY

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Fig. 1

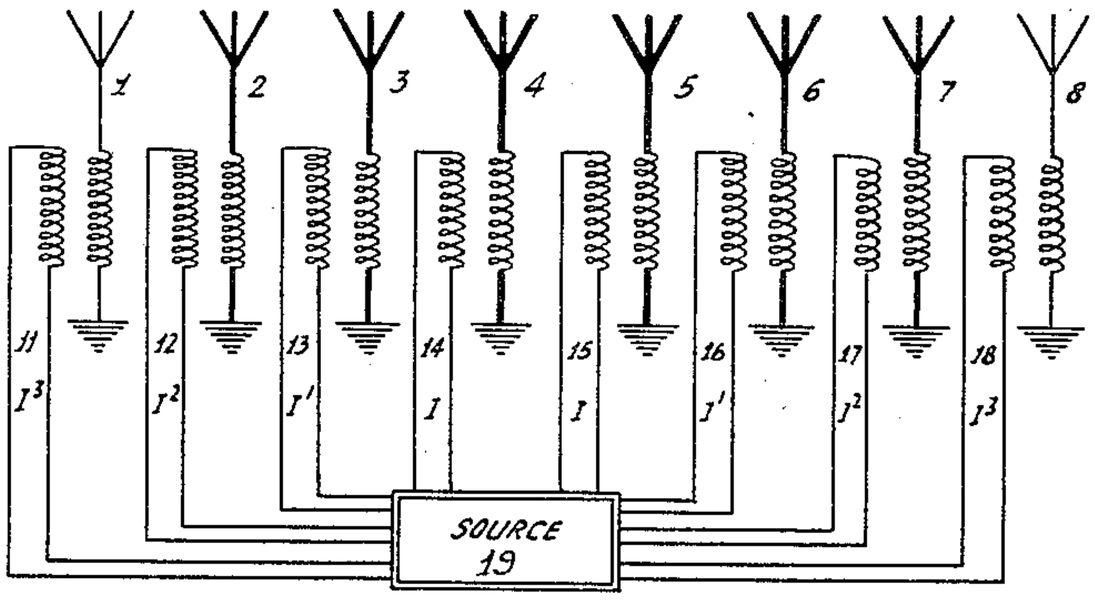


Fig. 2

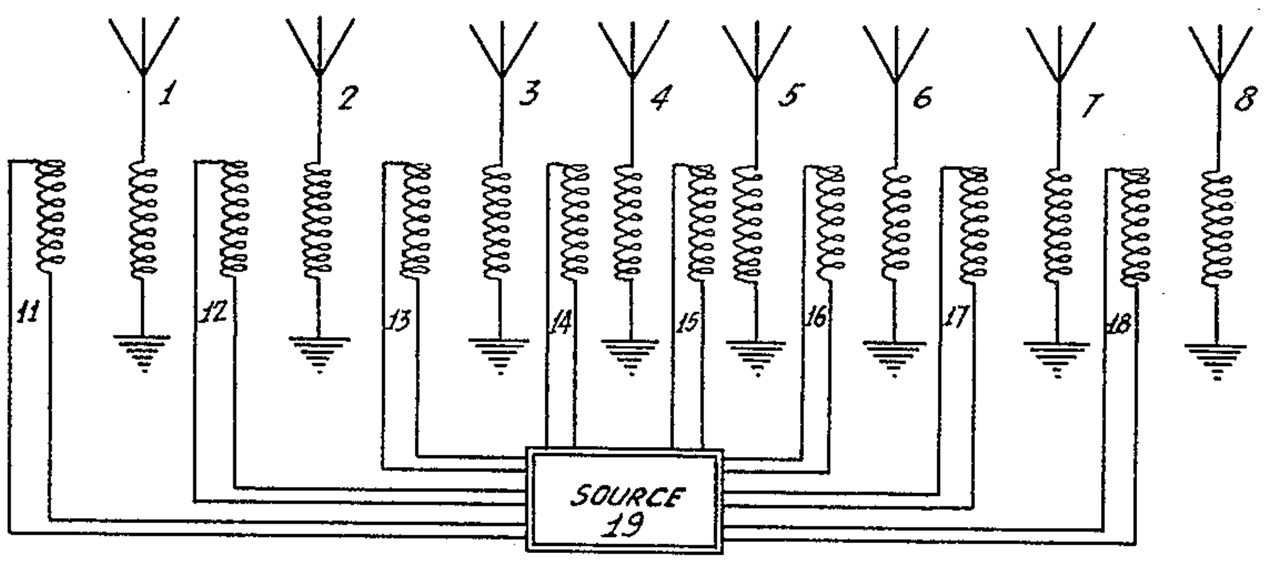
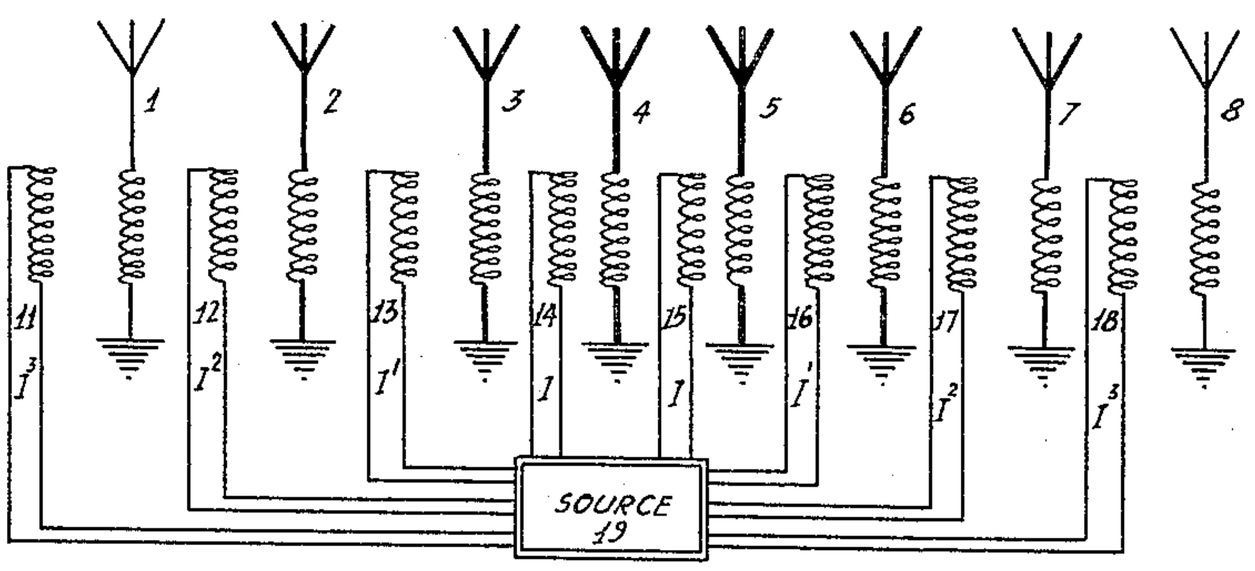


Fig. 3



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UNITED STATES PATENT OFFICE

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AERIAL SYSTEM FOR USE IN WIRELESS TELEGRAPHY AND TELEPHONY

Application filed October 16, 1926, Serial No. 142,517, and in Great Britain October 19, 1925.

This invention relates to aerial systems for use in wireless telegraphy and telephony, and more particularly to aerial systems comprising a number of aerials arranged in a plane and adapted to radiate most strongly in a direction at right angles to that plane.

The object is usually to produce by such aerial systems a substantially plane current sheet which will radiate a substantially plane electromagnetic wave.

The directional properties of such an aerial system, as expressed by its polar curve of radiation, are a known function of its dimensions relative to the wave length.

If the aerials comprised in such a system are supplied with currents in phase with one another, and of substantially the same strength, the pilar curve of radiation of the whole system comprises a main beam and a number of small loops. For example, in the case of an aerial system comprising a number of vertical aerials, spaced apart at less than half a wave length in a plane and fed with equal currents all in phase, then if the width of the whole aerial system be n wave lengths, the horizontal polar curve of radiation will have $n-1$ loops on either side of the main beam between the direction of maximum radiation and a line at right angles thereto. The maximum intensities of these loops bear constant ratios to the maximum intensity of the main beam, viz:

$$\frac{2}{3\pi}, \frac{2}{5\pi}, \frac{2}{7\pi}, \ldots$$

beginning with the side loops nearest to said main beam.

According to this invention an aerial system of the type described is constructed of a number of coplanar aerials which are spaced apart at equal distances and fed with currents of strength decreasing from the centre outwards; or the aerials may be spaced apart by distances increasing from the centre of the system outwards, and fed with equal currents; or a combination of these two methods may be employed, i. e. the spacing of the aerials may be increased from the centre outwards, and the strength of the currents decreased from the centre outwards.

We have found that with such an arrangement the strength of the side loops of the polar curve of radiation can be greatly diminished.

In one form of construction an aerial system comprises a number of coplanar aerials equally spaced from one another, at less than half a wave length, and supplied with currents whose strengths diminish uniformly from the centre aerial to zero at the end aerials. With such a construction we have found the number of the loops on either side of the main beam to be reduced to

$$\frac{n}{2}-1$$

(where the aerial system is n wave lengths wide) and their maximum intensities to be reduced to

$$\left(\frac{2}{3\pi}\right)^2, \left(\frac{2}{5\pi}\right)^2, \left(\frac{2}{7\pi}\right)^2, \ldots$$

that of the main beam.

A more complete understanding of the invention will be had from the specification when read with the drawing in which;

Figure 1 shows an aerial system arranged in accordance with the present invention, while

Figures 2 and 3 shows modifications of the arrangement of Figure 1.

Referring in particular to the drawing throughout which like reference numerals indicate like parts, Figure 1 shows an arrangement in which a plurality of aerials, 1, 2, 3, 4, 5, 6, 7, and 8, spaced apart equal distances in a plane, are energized by feeders 11, 12, 13, 14, 15, 16, 17 and 18 respectively. The feeders each terminate in an inductance coupled,

as shown, to an inductance in the respective aerial on the one hand and in a source of energy 19 on the other hand.

Means is provided between the source and each feeder for progressively decreasing the current effective in the several aerials from the center aerials outwards in both directions. This has been indicated in the drawings by using heavy lines to show the center pair of aerials and by decreasing the weight of the lines in the aerials from the center pair of aerials outwards in both directions. The specific form, which the amplitude reducing means may take, is immaterial and, since it forms no part of the present invention, has not been included separately but is included with the showing of the source. All that is required is that the amplitude of currents fed to aerial 1 is less, as indicated at I, than the amplitude of the current fed to aerial 2, which is, as indicated at I′, in turn less than the current fed to aerial 3, etc. In a similar manner the amplitude of the current in aerials 5, 6, 7, and 8 decreases progressively from 5 to 8.

Figures 2 shows a modification in which the aerials 1 to 8 inclusive are spaced apart unequal distances, the distances between aerials increasing from the center of the system outwards in both directions. The aerials are fed by feeders 11 to 18 inclusive as in Figure 1. In this modification, however, the amplitude of the currents in all of the aerials is maintained the same. Accordingly the amplitude determining means used with the modification of Figure 1 is unnecessary. The fact that the amplitude of the current in all of the aerials is the same has been denoted by showing all of the aerials with the same weight lines. The current from the source may be fed directly to the different aerials in phase.

In Figure 3 is shown an aerial system in which is incorporated the energy concentrating features of the modifications shown in Figures 1 and 2. In this system the spacing of the aerials 1 to 8 inclusive increases from aerials 4 and 5 outwards in both directions and the strength of the currents in the aerials decreases as indicated by I, I′, I^2, etc., and by the relative thickness of the aerials in the system from aerials 4 and 5 outwards in both directions.

It has been found that by providing an aerial system arranged as illustrated hereinbefore, a concentrated center beam of energy will be radiated in a direction normal to a plane through the several aerials when the aerials are excited in phase, while radiations in directions other than that taken by the main beam will be greatly diminished.

Having described our invention what we claim is:

1. An aerial system of the kind comprising a number of coplanar aerials fed with currents in phase with one another, means for setting up in said aerials currents which diminish in strength from the centre aerial outwards, said aerials being spaced apart by distances increasing from the centre outwards.

2. An aerial system as claimed in claim 1, in which the currents diminish uniformly.

3. An aerial system as claimed in claim 1 in which the spacing distances between the aerials increase uniformly, substantially as herein described.

4. An aerial system comprising a plurality of aerials located in a plane and spaced apart by distances increasing from the center outward in both directions, and means for energizing said aerials, in phase, whereby said system will radiate a sharp beam of energy.

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