Jan. 21, 1936. E. KRAMAR 2,028,510

TRANSMITTER FOR ELECTROMAGNETIC WAVES

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Fig.1

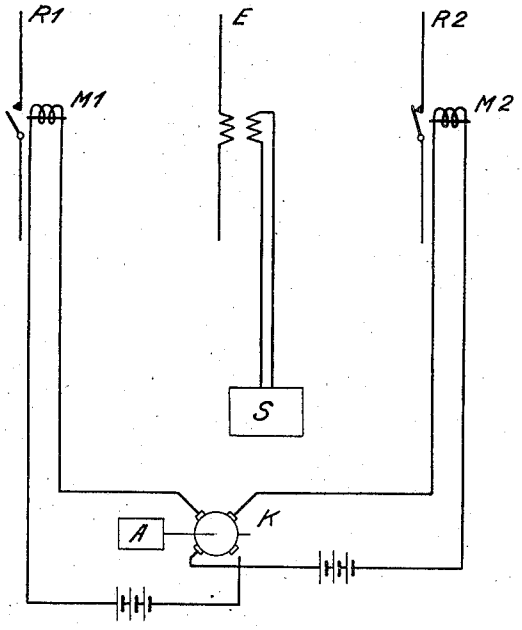

Fig.1a.

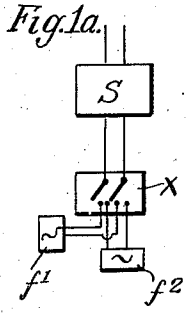

Fig.2

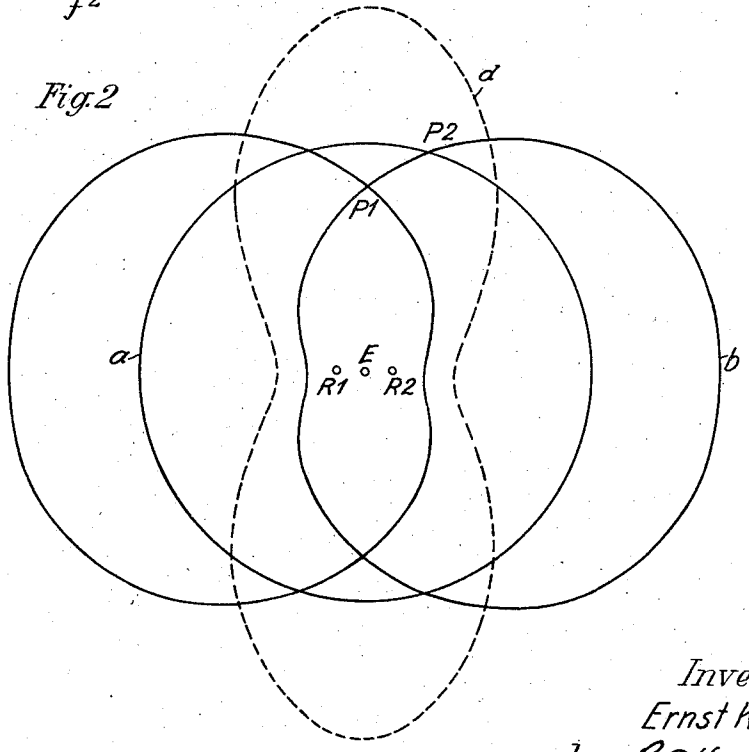

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Fig. 3

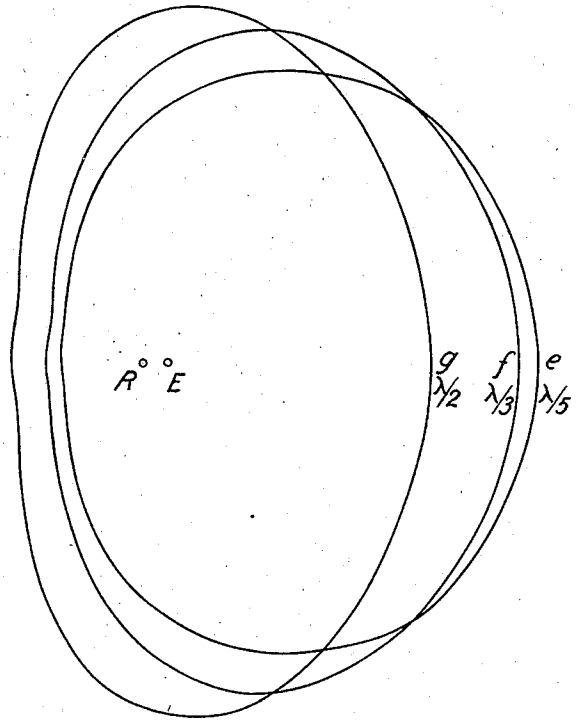
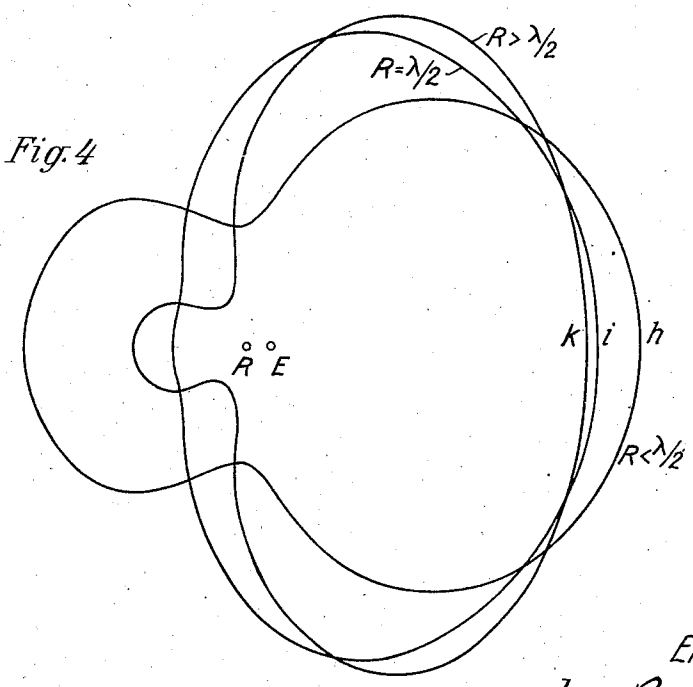


Fig. 4



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TRANSMITTER FOR ELECTROMAGNETIC WAVES

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15 Claims. (Cl. 250—11)

In radio direction finding systems, particularly in aerial navigation, directional antenna systems have been employed, which radiate at a certain angle to each other and are alternately manipulated in accordance with the so-called a-n-method. It has further been suggested to facilitate the landing of aeroplanes by means of gliding-path beams. For this purpose beams of ultra-short rays are radiated obliquely upwards. The aeroplane then descends in the line of constant field intensity. It has also been suggested to combine these two methods. In accordance with this suggestion two beams of rays are emitted at a certain angle to each other, but at the same angle with respect to the surface of the earth.

The invention is concerned with devices for direction finding methods of this type. It employs, instead of directional antenna systems which are alternately keyed, antenna arrangements, in which reflectors or only one thereof and an exciter antenna are provided. This exciter antenna is fed continuously from the high frequency generator, and the reflector or reflectors are keyed.

The invention is illustrated by way of example in the accompanying drawings. Figure 1 is a schematic elevation of an example of the device.

Fig. 1*a* shows schematically an arrangement for differently modulating the radiated high frequency in each direction. Figures 2, 3 and 4 are diagrams relating to the method of operation.

A dipole E is continuously energized by the transmitter S. On both sides of the dipole E and in line therewith are arranged two dipoles R1 and R2, which act as reflectors. These reflectors are interrupted in the middle and may be closed by relays M1 and M2. Instead of interrupting the reflectors, it is possible to provide for them to be detuned, for example. The relays M1 and M2 are alternately energized and de-energized by a commutator K, which is driven by a motor A. It is assumed in the drawings that the dipole R1 is opened, that is inactive, and the dipole R2 closed, that is active. Instead of the collector, a relay device may be employed, which is so arranged that both relays are keyed in parallel and thereby the contacts of the one closed and those of the other opened.

Figure 2 shows the radiation conditions. If both reflectors R1 and R2 are opened, the horizontal characteristic of the energizer dipole E is a circle *a*. If only the reflector R1 is closed, then the characteristic *b* is obtained. If only the reflector R2 is closed, the characteristic *c* is obtained. If both reflectors are closed, then the characteristic *d* is obtained. In the normal operation for radio-beacon purposes the characteristic *d* can be dispensed with. For certain purposes, however, characteristics of this type are desirable.

This arrangement which preferably operates with ultra-short waves, is quite sufficient for the purpose in view, that is the directional characteristics are sufficiently intense, as the point of intersection of two characteristics is utilized, for example, the point of intersection P1 of *b* and *c*. Fundamentally, however, any other point of intersection, such for example as is shown by point P2, is suitable. It is therefore not always necessary to operate with two reflectors which are alternately keyed. A single reflector is quite sufficient for a simple device.

Figure 3 shows the influence of the distance between energizer E and, for the sake of simplicity, a single reflector R. The distance between E and R for the characteristic *e* amounts to $\lambda/5$, for *f* $\lambda/3$, and for *g* $\lambda/2$, when λ is the wave length.

It is thus found that by increasing this distance to $\lambda/2$ the directional characteristic is intensified in a direction perpendicular to the line passing through the energizer E and the reflector R.

According to Figure 4, similar effects may be obtained by varying the length of the reflector R with respect to the length ($\lambda/2$) of the energizer dipole E. The length ratio, however, is mainly concerned with the formation of secondary maxima which extend oppositely to the intended direction. The characteristic *h* corresponds to an arrangement in which, with the same distance between the energizer E and reflector R as before, the length of the reflector R is smaller than $\lambda/2$. The characteristic *i* applies for $\lambda/2$, that is for a reflector which is the same length as the energizer, and characteristic *k* for an arrangement in which the reflector is longer than the energizer dipole. It is thus an advantage to make the reflector R longer than the energizer E, since thereby undesirable secondary maxima are avoided.

The interruption or detuning of the reflector in the manner described renders it possible for the energizer E to be continuously and uniformly fed from the transmitter. Previously the high frequency current itself was keyed between the generator and directional systems, or diverted by choke-coil arrangements or the like. This may involve difficulties, particularly with short waves, and especially with ultra-short waves. The pres-

ent invention avoids keying the high frequency current since only the reflector or reflectors are influenced. The circuits of the relays M1 and M2 carry only direct current or low frequency alternating current and can be easily protected against high frequency, for example by choke arrangements. The conductors to the relays may also consist of resistance wire, in order to prevent the passage of high frequency currents.

The invention may also be employed in arrangements in which instead of transmitting signals according to the a-n-method or the like, the radiated high frequency is modulated with different modulation frequencies, viz. at a particular frequency in each direction. In this case, in accordance with the invention, the carrier frequency, which is conveyed to the energizer antenna, is modulated differently in the same rhythm in which the reflectors are keyed. In this manner the characteristic modulation frequency is transmitted in the corresponding angular space. Such a modulating arrangement is shown in Fig. 1*a* wherein the high frequency of the transmitter S is modulated at one frequency f_1 in one direction and at a frequency f_2 in the other direction, a switch *x* being provided to operate in rhythm with commutator K so as to connect the appropriate modulating frequency with transmitter S as the respective reflecting antennæ R_1 and R_2 are keyed.

The keying of the reflector may be effected by the means A, K, M1, M2 shown in Figure 1, and a further collector or relay arrangement provided for controlling the alternate modulation of the transmitter at two modulation frequencies, or a two-frequency machine may be used which is provided with a cam disc arrangement for the actuation of contacts controlling the supply of the modulation frequencies.

What is claimed is:

1. A radio transmitting arrangement comprising a main antenna, a high frequency generator coupled thereto, a reflecting antenna on either side of said main antenna and spaced in line therewith a half wavelength therefrom, and means for abruptly rendering said reflecting antennæ alternately effective and ineffective so that one is ineffective whilst the other is effective to reflect the radiation from said main antenna.

2. A radio transmitting arrangement comprising an energizer dipole having a length equal to a half wavelength, a high frequency generator coupled thereto, two reflector dipoles of greater length than said energizer dipole and spaced therefrom on either side thereof and in line therewith a distance equal to a half wavelength, and means for abruptly rendering said reflecting dipoles alternately effective and ineffective each being ineffective whilst the other is effective.

3. A radio transmitting arrangement comprising an energizer dipole having a length equal to a half wavelength, a high frequency generator coupled thereto, two reflector dipoles of greater length than said energizer dipole and spaced therefrom on either side thereof and in line therewith a distance equal to a half wavelength, and means for alternately opening and closing said reflector dipoles so that whilst one is effective the other is ineffective to reflect the radiation from said energizer dipole.

4. A radio transmitting arrangement comprising a main antenna, a high frequency generator coupled thereto, a plurality of reflection antennæ co-operating with said main antenna, when effective, to reflect and thereby make directive the radiation from said main antenna, and means for suddenly rendering the reflection antennæ alternately effective and ineffective so that only one reflection antenna is effective at a time, said means comprising a relay for opening and closing each reflection antenna and a commutator in circuit with said relay.

5. A radio transmitting arrangement comprising a main antenna, a high frequency generator coupled thereto, a reflecting antenna on either side of said main antenna and spaced therefrom in line therewith, means for abruptly rendering said reflecting antennæ alternately effective and ineffective so that one is ineffective whilst the other is effective to reflect the radiation from said main antenna, sources of modulating signals of two different frequencies, and means for modulating the high frequency from the main antenna in accordance with the signal of one of said modulating frequencies whilst one of said reflecting antennæ is effective, and by signal of the other of said modulating frequencies whilst the other of said reflecting antennæ is effective.

6. A radio transmitting arrangement comprising a main antenna, a high frequency generator coupled thereto, a reflecting antenna on either side of said main antenna and spaced therefrom in line therewith, means for abruptly rendering said reflecting antenna alternately effective and ineffective so that one is ineffective whilst the other is effective to reflect the radiation from said main antenna thereby to produce a zone of equal field intensity, and means for modulating the high frequency by a signal whilst one of the reflecting antennæ is effective and by a complemental signal whilst the other reflecting antenna is effective so that said signals combine to form a continuous signal within the equal field intensity zone.

7. A radio transmitting arrangement comprising a main antenna, a high frequency generator coupled thereto, a reflecting antenna on either side of said main antenna and spaced therefrom in line therewith, means for abruptly rendering said reflecting antenna alternately effective and ineffective so that one is ineffective whilst the other is effective to reflect the radiation from said main antenna thereby to produce a zone of equal field intensity, and means for modulating the high frequency in accordance with one signal whilst one of the reflecting antennæ is effective and in accordance with a different signal whilst the other reflecting antenna is effective.

8. A radio transmitting arrangement comprising a main antenna, a high frequency generator coupled thereto, a reflecting antenna on either side of said main antenna and spaced therefrom in line therewith, and means for abruptly rendering said reflecting antennæ alternately effective and ineffective so that one is ineffective whilst the other is effective to reflect the radiation from said main antenna.

9. A radio transmitting arrangement comprising, a main antenna, a high frequency generator coupled thereto, a reflecting antenna on either side of said main antenna, means for rendering said reflecting antennæ alternately effective and ineffective so that one is ineffective whilst the other is effective to reflect the radiation from said antenna, said reflecting antennæ being spaced from the main antenna an odd multiple of a half wavelength therefrom and in such relation thereto that a portion of the area of the reflected radiation from one reflecting antenna also forms a portion of the area of the reflected radiation from

the other reflecting antenna whereby said alternate operation of said reflecting antennæ produces a zone of equal field intensity in said common area.

10. A radio transmitting arrangement comprising, an energizer dipole having a length equal to a half wavelength, a high frequency generator coupled thereto, two reflector dipoles of greater length than said energizer dipoles and spaced therefrom on either side thereof a distance equal to an odd multiple of a half wavelength, said reflector dipoles being further so disposed with respect to said energizer dipole that there is produced a zone common to the reflected radiations from the two reflector dipoles, and means for abruptly rendering said reflector dipoles alternately effective and ineffective each being ineffective while the other is effective thereby to produce in said zone a field of equal intensity.

11. A radio transmitting arrangement comprising, a main antenna, a high frequency generator coupled thereto, a reflecting antenna on either side of said main antenna and so disposed with respect thereto as to produce a zone common to the radiations reflected from said reflecting antennæ, means for rendering said reflecting antennæ alternately effective and ineffective so that one is ineffective whilst the other is effective to reflect the radiations from said main antenna thereby to produce in said zone a field of equal intensity, and means for modulating the high frequency in accordance with one signal whilst one of the reflecting antennæ is effective and in accordance with a different signal whilst the other reflecting antenna is effective.

12. A radio transmitting arrangement comprising, a main antenna, a high frequency generator coupled thereto, a reflecting antenna on either side of said main antenna, means for rendering said reflecting antennæ alternately effective and ineffective so that one is ineffective whilst the other is effective to reflect the radiation from said antenna, said reflecting antennæ being spaced from the main antenna and in such relation thereto that a portion of the area of the reflected radiation from one reflecting antenna also forms a portion of the area of the reflected radiation from the other reflecting antenna whereby said alternate operation of said reflecting antennæ produces a zone of equal field intensity in said common area.

13. A radio transmitting arrangement comprising, an energizer dipole having a length equal to a half wavelength, a high frequency generator coupled thereto, two reflector dipoles of greater length than said energizer dipoles and spaced therefrom on either side thereof and so disposed with respect to said energizer dipole that there is produced a zone common to the reflected radiations from the two reflector dipoles, and means for abruptly rendering said reflector dipoles alternately effective and ineffective each being ineffective while the other is effective thereby to produce in said zone a field of equal intensity.

14. A radio transmitting arrangement comprising, a main antenna, a high frequency generator coupled thereto, a reflecting antenna on either side of said main antenna and so disposed with respect thereto as to produce a zone common to the radiations reflected from said reflecting antennæ, means for rendering said reflecting antennæ alternately effective and ineffective so that one is ineffective whilst the other is effective to reflect the radiations from said main antenna thereby to produce in said zone a field of equal intensity.

15. A radio transmitting arrangement comprising a main antenna, a high frequency generator coupled thereto, a reflecting antenna at one side of said main antenna, continuously operable means for rendering said reflecting antenna alternately effective and ineffective, said reflecting antenna being in such relation to the main antenna that a portion of the area of the reflected radiation also forms a portion of the area of the radiation from the main antenna whereby the alternate operation of said reflecting antenna produces a zone of equal field intensity in said common area.

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