

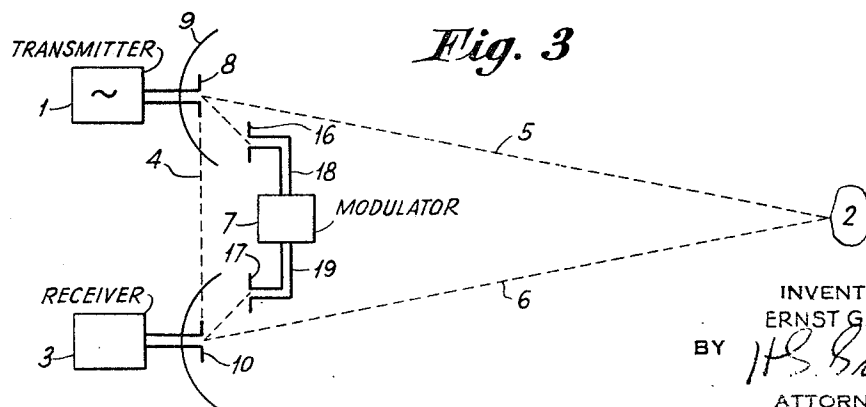
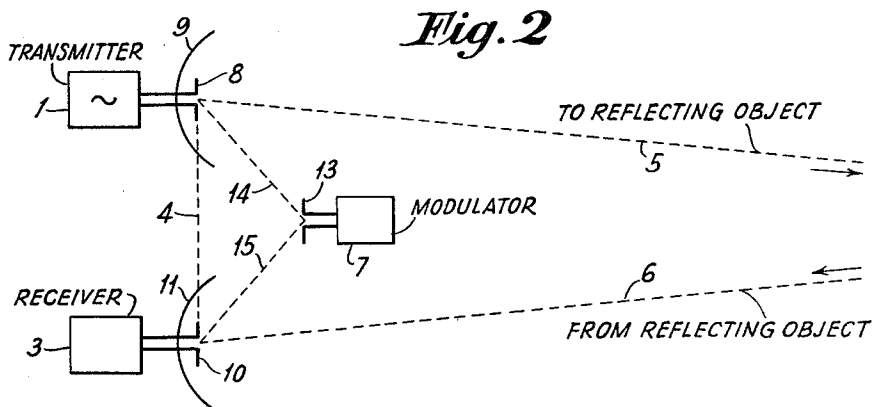
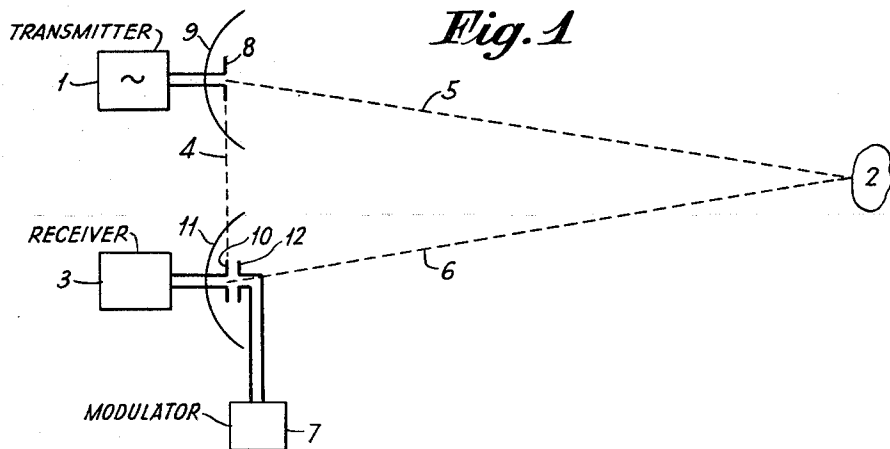
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RADIO SYSTEM FOR LOCATING OBJECTS

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RADIO SYSTEM FOR LOCATING OBJECTS

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The present invention relates to a system and a method suitable for detecting or locating distant objects by the aid of ultra-short waves.

It is known that by the aid of a combination of transmitter and receiver instruments, separated one from another by a known distance, distant objects having reflecting properties may be located. Use is made of triangulation methods. The antenna connected to the transmitter is caused to propagate waves in a sharply focused beam. The antenna connected to the receiver has a marked directional characteristic and is adapted to be rotated until a maximum response is obtained. It is then an easy matter to calculate the distance of the reflecting object from the base line joining the transmitter and receiver antennae.

By the methods heretofore practiced, the energy propagated from the transmitter is usually modulated with either audio frequency or radio frequency waves or the carrier energy may be keyed on and off. If the carrier is not modulated but is interrupted, say at a frequency of something like 20 cycles per second, it becomes very difficult to amplify the signals. If, however, the transmitted energy is modulated with an audio frequency wave, then difficulties arise in regard to the control of the energy because both frequency modulation and amplitude modulation are usually present. Erroneous indications are, therefore, apt to be given.

By another known method the ultra-short wave carrier frequency energy may be modulated by another radio frequency. Here again the same drawbacks are present that were attendant upon audio frequency modulation. Still another drawback is encountered in the case of modulation with, say, one megacycle with a distance from a reflecting object of say 1.5 kilometers, since the phase of the modulation waves reaching the receiver is reversed thereby causing an interference pattern with the transmitted energy, and thus the waves tend to cancel out and it becomes practically impossible to detect the reflected energy.

It is, therefore, an object of my invention to overcome the drawbacks of the known systems by providing a new system in which the transmitter propagates an unmodulated carrier wave and a part of the radiation which reaches the receiver directly from the transmitter is modulated and combined with the reflected unmodulated energy so as to produce satisfactory signals in the receiver.

The invention will now be explained in further

detail, reference being made to the accompanying drawing in which

Fig. 1 shows diagrammatically one embodiment of my invention including transmitting and receiving apparatus and a modulator associated with the receiver;

Fig. 2 shows a different embodiment of the invention in which the modulator has its own antenna system located so as to receive and retransmit waves in between the transmitter and the receiver; and

Fig. 3 shows still another modification in which the modulator is provided with two antenna systems and transmission line for shortening up the paths of radiation between the transmitter and the receiver.

Referring to Fig. 1, I show an ultra-short wave transmitter 1 having connections to a dipole antenna 8 which is preferably mounted in the focus of a paraboloidal reflector 9. The energy may then be radiated in a sharply focused beam, the directional axis of which is indicated by the line 5. The directional axis may, of course, be oriented suitably for exploring a field and when the beam encounters a reflecting object 2 it may be reflected along the axis 6 and be collected by the antenna 10 which is associated with a receiver 3. The antenna 10 is also preferably mounted in the focus of a paraboloidal reflector 11 and closely adjacent to this receiving antenna 10 is an auxiliary antenna 12 which is connected to a modulator 7.

It will be seen from the arrangement just described that the energy which goes out in the direction 5 and is returned in the direction 6 represents an unmodulated carrier wave which is relatively free from distortion. The modulations from the source 7 are then locally applied adjacent the point of reception 10. The combination of carrier wave and modulated energy may readily be amplified and detected in the receiver 3, and hence reliable indications may be made as to the distance and direction of the reflecting object 2 with respect to a base line 4 joining the transmitting and receiving antennae 8 and 10 respectively.

Referring to Fig. 2, the modification of my invention therein shown is simply one in which the modulator 7 has its antenna 13 located at some suitable point intermediate between the transmitter and the receiver so that a portion of the unmodulated carrier frequency energy may be picked up by the antenna 13 when transmitted along the line 14.

This energy may then be modulated and re-

transmitted along the line 15 so as to be received on the receiving antenna 10. At the same time the unmodulated carrier wave is propagated along the axis 5 to a reflecting object and is reflected back along the line 6 thus reaching the antenna 10 and being combined with the modulated energy which is received along the line 15. In this case, as in the embodiment previously described, the presence of the reflecting object may readily be ascertained and both its distance and its direction can be calculated from the angles made by the lines 5 and 6 with respect to the base line 4.

Referring to Fig. 3, I show still another embodiment of my invention in which the modulator 7 is provided with double conductors 18 and 19. The conductors 18 lead to an energy collecting antenna, 16 and the conductors 19 lead to an energy radiating antenna 17. The antenna 16 is advantageously located with respect to the energy radiated by the main transmitting antenna 3. Likewise the retransmitting antenna 17 is advantageously located so as to direct its energy against the receiving antenna 10. Thus the collection and reradiation of some of the energy from the transmitter 1 may be obtained through the modulator 7, while unmodulated energy is propagated as before along the axis 5, against the reflecting object 2 and then reflected along the axis 6 until it reaches the receiving antenna 10.

The modulation frequencies may be chosen at will. The advantage of the embodiments here shown and described resides primarily in the fact that slight frequency modulations will have no effect upon the accuracy of the direction and distance determinations.

This is true because the path between the transmitter and the receiver for energy which is to be modulated may be made relatively short and the path of the unmodulated carrier wave which is transmitted to and received from a reflecting object, even though it be a long path, is relatively free from interference and distortion due to the fact that the carrier wave is substantially a pure sine wave and can be transmitted and received under conditions of highest efficiency.

Various other modifications of my invention may, of course, suggest themselves to those skilled in the art. It is to be understood, therefore, that the invention itself is limited only in accordance with the scope of the claims.

I claim:

1. Radio apparatus comprising a generator of ultra-short waves, means including a directional antenna for radiating said waves in an unmodulated form, a receiver having a directional antenna, means for orienting said antenna into position for maximum reception of a reflected beam produced by a distant object in the path of the waves radiated by the first said antenna, means including an energy collecting and re-radiating device located in the vicinity of said transmitter

and receiver, a modulator in circuit with said device, and means for combining in said receiver the un-modulated waves from said reflecting object and the modulated waves obtained through said modulator.

2. Apparatus in accordance with claim 1 and having said energy collecting and re-radiating device constituted by a dipole antenna adjacent the directional antenna of said receiver.

3. Apparatus in accordance with claim 1 and having said energy collecting and re-radiating device constituted by a dipole antenna located in position to receive at least a portion of the unmodulated energy from said transmitter and to propagate said energy after modulation thereof directly toward the antenna of said receiver.

4. Apparatus in accordance with claim 1 and having said energy collecting and re-radiating device constituted by a two dipole antenna and a pair of conductors feeding energy to and from said modulator.

5. In a device for locating an object within a field of electromagnetic radiations, means including an ultra-short wave transmitter having an antenna adapted to propagate an unmodulated carrier wave, a receiver having a directional antenna suitably disposed for collecting a portion of said carrier wave which is propagated over a path including a surface of reflection on said object and for collecting another portion of said wave which is propagated over a shorter path, means for modulating the energy received via the shorter path and means for combining the energies received via the two paths.

6. Radio apparatus for determining the direction and proximity of a wave-reflecting object, comprising a transmitter and a receiver, a directional antenna adapted to radiate unmodulated energy from said transmitter toward said wave-reflecting object, means under control of said transmitter for producing modulated energy, a second directional antenna adapted to receive superimposed energies from said modulated energy producing means and from said wave-reflecting object, and means for causing said receiver to make an appreciable response to the combined reception of modulated and unmodulated energies.

7. Radio apparatus in accordance with claim 6 and having said means for producing modulated energy arranged to be receptive of a portion of the unmodulated energy from the first said antenna.

8. Radio apparatus in accordance with claim 6 and having a medium of communication of energy between the respective antennas of the transmitter and the receiver and via the means for producing modulated energy, said medium providing a relatively short path compared with the paths to and from the wave-reflecting object.

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