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2,334,247

DETECTED SIGNAL DIRECTION FINDER

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FIG. 1.

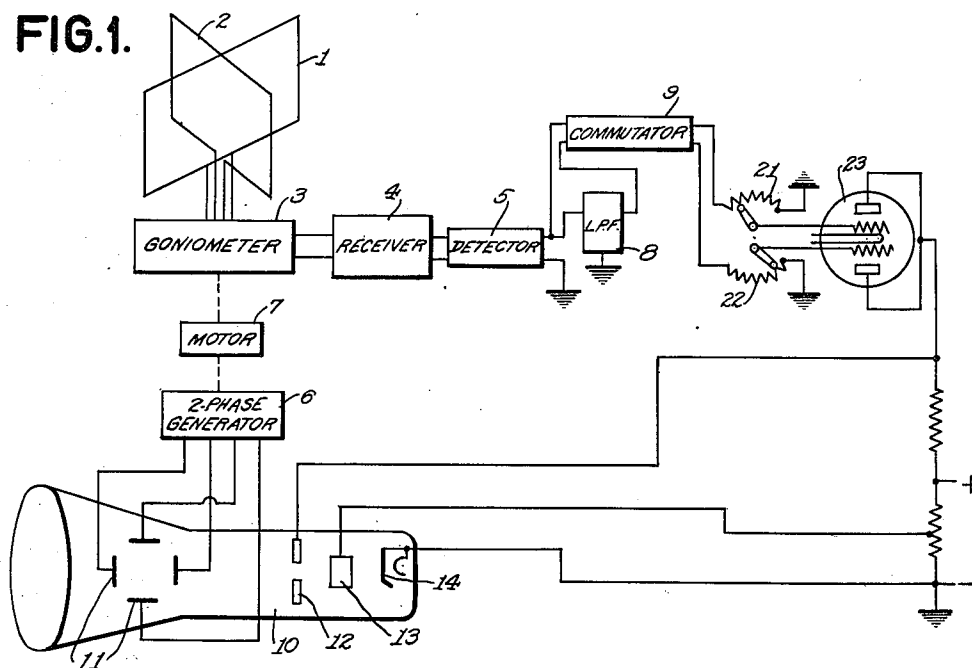


FIG. 2.

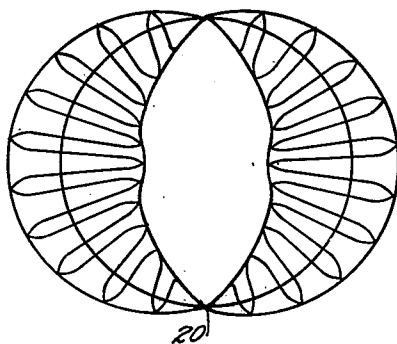


FIG. 4.

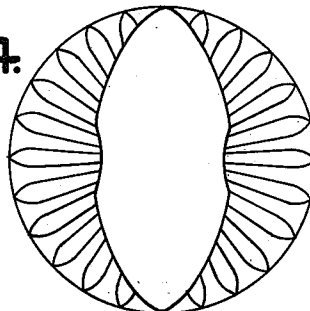
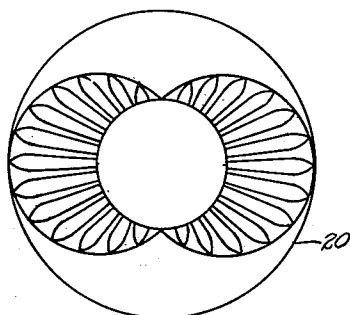


FIG. 3.



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DETECTED SIGNAL DIRECTION FINDER

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4 Claims. (Cl. 250—11)

This invention relates to direction finding systems and more particularly to direction finders using cathode ray indicators.

In cathode ray indicators used with direction finders, it has been proposed to use cathode ray tube indicators in which the signal is used to cause radial deviation of the cathode ray beam so that a pattern is traced on the screen of the tube. It has also been proposed to apply the carrier together with the modulating signal so that the pattern is outlined in a screen which is normally bright. However, in these latter types of indicators the beam is only on the screen part of the time, the remaining portion of the time the beam is deflected to the sides of the tube off the screen. Thus, considerable cathode ray power is wasted and the screen is not lighted to the greatest possible brilliance.

In accordance with my invention the advantage of having a fully illuminated screen without the disadvantage of waste cathode ray is achieved.

This may be most simply accomplished by detecting the envelope signal before applying it to the cathode ray tube indicator to produce the radial deflection. In the preferred form the lower portion of the detected signal is used.

In using a cathode ray indicator of the type described above, it is sometimes advantageous to have a system in which the simple outline pattern may be produced on the screen. This is particularly the case when inverted modulation signals are formed so that the normal minimum or zero signal level produces the greatest deviation of the cathode ray beam. When such a receiver is used, the interruptions caused by keying at the transmitter produce lines of light which may obscure the directional indication.

It is a further object of my invention to provide an arrangement which will permit selective indication by a solid pattern system or by outline of the pattern only to render the system universally applicable regardless of the nature of the signal.

A better understanding of my invention and the objects and features thereof will be had from the particular description thereof made with reference to the accompanying drawing, in which

Fig. 1 is a diagrammatic illustration of a circuit incorporating my invention, and

Figs. 2, 3 and 4 are diagrams of cathode ray screens illustrating the operation in accordance with my invention.

In Fig. 1, 1 and 2 indicate right angularly arranged directional antennae which may be loops

as shown or any other desired antenna form. The output of these loop antennae feed into a goniometer 3 from which an envelope frequently dependent upon the rate of rotation of the goniometer is applied to receiver 4. A cathode ray indicating tube 10 provided with deflection plates 11, accelerating electrode 12, concentrating electrode 13 and emitting cathode 14, is utilized. A two-phase generator 6 is operated in timed relationship with the goniometer by a common driving motor 7. The energy from two-phase generator 6 is applied to deflecting electrodes 11 to normally rotate the cathode ray beams in timed relation with the goniometer rotation.

The signals from receiver 4 are detected at 5. The detected envelope derived in detector 5, may be applied directly to accelerating electrode 12, if desired, to produce a radial deviation of the cathode ray beam, so that a pattern corresponding to the directive envelope of the received waves is produced on the screen of the cathode ray tube.

If the envelope from receiver 4 were applied without detection to the accelerating electrode, then a pattern of the form shown in Fig. 2 would be obtained. It can be seen that a large percentage of the carrier envelope would then occur outside the surface of cathode screen 20. This energy represents losses and tends to reduce the brilliance of the illumination of the cathode screen. Of course, the amount of deflection could be reduced so that the entire pattern would be reproduced within the limits of the cathode ray screen. However, in such a case the image tracing the directive pattern would be greatly reduced and would only constitute a relatively small spot near the center of the cathode ray screen.

In Fig. 3 is shown the envelope pattern tracing on the cathode ray screen 20 when the upper half of the detected wave is used to produce the indication. In this arrangement the indicating portion of the screen is relatively small but the brilliance of the illuminated portion of the screen is not reduced as it would be were the entire pattern without detection reproduced. In order to obtain the pattern obtained in Fig. 3 the output from detector 5 may be employed directly to produce the deflection by connection to accelerating electrode 12, as will be clear. The output of detector 5 may comprise, say the upper or lower half of the received carrier as modulated in accordance with the effective orientation of antenna 1, 2. By applying this output to electrode 12 with appropriate polarity, electrons in the cathode ray may be accelerated with various de-

grees less than normal, thus rendering them more susceptible of radial deflection when they encounter the sweep circuit field supplied by generator 6 and applied between deflector systems 11—11. Under these circumstances, the pattern of Fig. 3 may result, which pattern may indicate maximum reception and hence directivity in a left and right sense with respect to the orientation of Fig. 3. It is clear that if appropriate phase displacement means be included in the receiver the minima defining a generally vertical axis in the sense of Fig. 3 may be employed for direction indication.

In Fig. 4 the preferred type of pattern obtained on the cathode ray screen is illustrated. In this arrangement the entire diameter of the screen may be used for direction indication since only the lower half of the envelope is produced at the output of the detector. Consequently all the energy of the cathode ray may be usefully employed to produce illumination on the screen and yet a relatively large, easily read indication is obtained. As in the case of Fig. 3, output of detector 5 may be applied directly to accelerating electrode 12. However, the polarity of such energy as so applied is opposite to that employed to produce the pattern of Fig. 3. Thus, as the varying accelerating potential is applied, cathode ray electrons may be accelerated with various degrees greater than normal, thus rendering them less susceptible of radial deflection when they encounter the sweep circuit field, as will be clear.

It should be understood that the principles outlined above apply equally well to systems wherein the radial deviation is obtained by applying the detected output, together with the carrier frequency component to the deflecting plate of the cathode ray tube through suitable distributing means, instead of utilizing the accelerating electrode for the purpose of producing the radial deviation of the beam. Moreover, the receiver may be of a type such that an inverted wave on an intermediate carrier is produced at the output. When such type of receiver is used, the maximum deviation from the center is always produced at the same level and easily read directional indications are, therefore, obtained.

It should be understood that the means for obtaining effective rotation of the antenna may be an electronic goniometer system or an actual rotatable directive antenna without altering the principles of this invention as described.

When inverted modulation signals are used to produce the indication, it is often desirable that a single line outlining the pattern on the cathode ray screen be used instead of the solid illumination produced when the carrier is also applied. This is particularly true if the signals are being received from a transmitter in which the energy is keyed. In order to take care of this matter I provide in Fig. 1, a low pass filter 8 connected in the output of detector 5. Filter 8 is preferably designed so as to pass frequencies in the neighborhood of the goniometer effective rotation frequency, and to exclude the carrier frequency. A commutator 9 is provided so that the unfiltered output from detector 5 and the filtered wave may be alternately applied to accelerating electrode 12. In the output of commutator 9 are provided resistance elements 21 and 22, respec-

tively, for applying the unfiltered output or the filtered output to one of the grids of a double element valve 23. The anodes of the valve 23 are connected together in parallel and are so arranged that the output from valve 23 is applied to accelerating electrode 12. By using the resistance elements 21, 22, the effectiveness of the pattern containing the carrier ripple or the filtered envelope frequency, free of ripple may be selectively applied to the accelerating electrode 12 so that either of these patterns may selectively be reproduced. It is clear that both patterns, that is, the carrier-characterized one or the plain envelope free of carrier ripple, may be reproduced simultaneously if desired, in which case one of the patterns may be made more brilliant than the other according to the relative adjustment of potentiometers 21 and 22. It should also be understood that the output from tube 23 may, if desired, be applied to the deflecting electrodes of tube 10 to cause the radial deviation instead of being applied to the accelerating electrode.

It should be distinctly understood that the above described circuit illustrates only a preferred embodiment of my invention and does not indicate the scope of my invention. Many alterations and variations of the system within the scope of my invention will occur to one skilled in the art.

What is claimed is:

1. A direction finding system including an effectively rotatable receiving antenna, a receiver coupled to said antenna, a cathode ray indicator, means for causing a radial displacement of the cathode ray beam of said indicator, a detector in the output of said receiver for producing a detected envelope pattern of energy derived from said antenna, said detector being of the type which produces at the output thereof only one of the upper and lower halves of the received carrier wave and means for applying said detected envelope together with the carrier frequency to said means for causing radial displacement of said beam, to produce an illuminated pattern on the screen of said cathode ray tube.

2. A direction finder according to claim 1, wherein said means for causing radial displacement of said beam comprises an accelerating electrode in the path of the cathode ray beam.

3. A direction finder according to claim 1, wherein said detector is of the type producing at its output only the lower portion of the detected wave envelope.

4. A direction finding system including an effectively rotatable receiving antenna, a receiver coupled to said antenna, a cathode ray indicator, means for causing a radial displacement of the cathode ray beam of said indicator, a detector in the output of said receiver for producing a detected envelope pattern of energy derived from said antenna, a low pass filter means in the output of said detector to derive the low frequency envelope, and means for selectively applying desired proportions of said complete detected envelope or said low frequency envelope to said means for causing radial displacement of said beam, to produce the desired pattern on said cathode ray screen.

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