

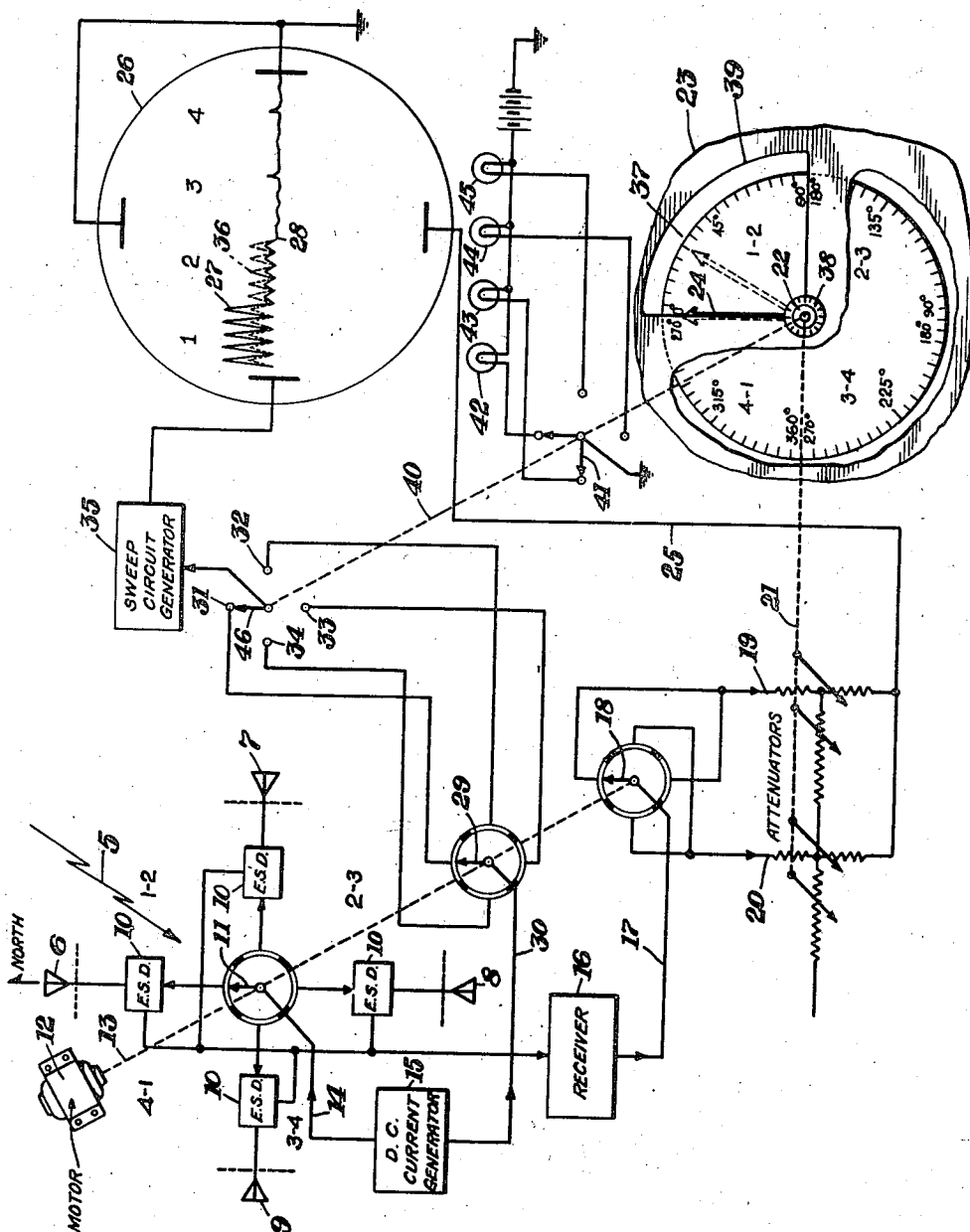
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RADIO DIRECTION FINDER

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RADIO DIRECTION FINDER

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1

This invention relates to an indicating means for selecting a given one of a series of energy impulses. More particularly it deals with a means for correlating a movable dial with the oscillograph patterns on the screen of a cathode ray tube.

It is an object of this invention to simplify the reading of an oscillograph indicator.

Another object is to increase the accuracy of the visual indication, on the screen of a cathode ray tube.

Another object is to prevent errors in reading the indications on the screen of the cathode ray tube.

Another object is to simplify and to reduce the error in reading of a radio direction finder, comprising a cathode ray tube, and particularly a radio direction finder of the amplitude comparison type.

Still another object is to read the actual direction of an incoming wave accurately and directly on the dial of a radio direction finder.

Other objects of this invention will appear from time to time in the description which follows:

This invention comprises an indicating means which may be used in conjunction with the viewing screen of a cathode ray tube in order to directly correlate the pattern of the screen with the visual figures on the indicating means. The oscillograph pattern on the screen is produced by energy impulses through a switching means and a sweep circuit synchronized with that switching means. This switching means couples the cathode ray tube repeatedly and successively with a series of contacts any one or more of which are capable of transmitting energy for indication on the tube screen. The indicating means is provided with a dial which is divided into zones corresponding with each one of the series of contacts successively coupled by the switching means; so that when one or more of the contacts transmits energy to produce a pattern on the screen, the proper corresponding zone of the indicating means may be selected to give a direct reading. A second indicating means cooperating with a corresponding zone of the first indicating means may be movably connected in the circuit from the contacts to the cathode ray tube to compare the patterns produced in two adjacent zones on the screen of the tube.

A better understanding of this invention and the objects and features thereof may be had by reference to a particular description of an embodiment thereof made with reference to the ac-

2

companying drawing. This drawing is a schematic circuit diagram, partly in block, of an amplitude comparison type of a direction finder circuit embodying the indicating means of this invention.

Referring to the drawing the area about the receiver may be divided into quadrants 1—2; 2—3; 3—4 and 4—1. An incoming radio signal 5 in quadrant 1—2 is picked up partly by antenna 6 and partly by antenna 7 of the group of unidirectional antennas 6, 7, 8, and 9 positioned at the four directions of the compass. These antennas are shielded from each other, so that at the most two antennas will respond to one signal coming from one direction. Each antenna may be directly connected to an electronic switching means 10. The antenna circuits are separately and successively and repeatedly energized by the commutator arm 11 rotated by a suitable motor 12 through shaft 13. Direct current is applied to the arm 11 through line 14 from direct current generator 15. By this means, only one antenna circuit is connected to the receiver 16 at one time. A more complete understanding of this type of direction finder comparison system may be had by reference to the copending application of N. Marchand, Ser. No. 565,142, filed November 25, 1944, now Patent No. 2,448,041, which issued August 31, 1948.

The motor 12 should be rotated at a speed sufficient to produce from each one of the contacts contacted by the arm 11 an oscillograph pattern that is persistent to vision. For example, a speed of about 20 R. P. M. has been found sufficient although faster speeds may be employed if desired.

Since no two oppositely positioned antennas can receive an impulse from one direction at the same time, the circuits of opposite antennas may be coupled for comparison of impulses from adjacent antennas. This is accomplished by passing the circuit from receiver 16 through line 17 to a commutator having arm 18 mounted on shaft 13 and rotated in synchronism with arm 11 by motor 12.

In a direction finder of this type, wherein the direction is determined by comparing the amplitude of the signal from two adjacent antennas, a pair of coupled attenuators 19 and 20 are positioned in each one of the pair of circuits from commutator at 18. The impulses from antennas 6 and 8 pass through attenuator 19, while impulses from antennas 7 and 9 pass through attenuator 20. These attenuators are both coupled together through shaft 21 such that when one

attenuator is at its maximum, the other one is at its minimum control position. Shaft 21 is directly connected to the center manual knob 22 (on the instrument panel 23) and to the pointer 24 which cooperates with the dial 37 described later.

The impulses, after passing through their respective attenuators, pass through line 25 and are applied vertically across the cathode ray tube 26. The impulse from the signal wave 5 corresponds here to full line waves 27 and 28 shown on the screen of the cathode ray tube 26.

The sweep circuit for the tube 26 is synchronized through the commutator arm 29 connected to shaft 13 together with arms 11 and 18. Direct current from the generator 15 is coupled through line 30 to arm 29 to separately energize the four contacts 31, 32, 33, and 34, each one of which may be connected to the sweep circuit generator 35. This generator 35 is shown in the drawing to spread the impulses applied over line 25 across the tube horizontally at a speed so that one sweep equals one revolution of the motor 12 or the arm 11. This divides the horizontal sweep line into four equal zones (1), (2), (3), (4), corresponding to each one of the four unidirectional antennas 6, 7, 8 and 9 respectively.

Since the northern component of the signal 5 is greater than the eastern component of the signal 5, the amplitude of the signal received by antenna 6 is greater than that received by antenna 7; and, correspondingly, the amplitude of the wave pattern in zone (1) of the cathode ray tube 26 is greater than that in zone (2), (see waves 27 and 28). In order to determine the exact direction of the signal 5, the amplitude of the impulses in the respective circuits of the two antennas are attenuated to form two waves of equal amplitude (see dotted line wave 36) by turning the knob 22 to operate the attenuators 19 and 20. This turns the pointer 24 also connected to the knob 22, to a definite position with respect to the dial 37, thus indicating thereon the exact angle in degrees of the incoming signal.

If the signal were coming in over antennas 7 and 8 (or in quadrant 2—3) instead of over antennas 6 and 7, the oscillograph pattern would occur in zones (2) and (3) of the tube screen, instead of zone (1) and (2). In quadrants 2—3 and 4—1 the attenuators 19 and 20 are coupled to give impulses in the reverse sequence to those impulses received from signals in quadrants 1—2 and 3—4. This causes the adjustment of knob 22 for signals from quadrants 2—3 or 4—1 to be in the opposite direction from a corresponding adjustment for signals from quadrants 1—2 or 3—4. In order to prevent confusion, the angular degrees on dial 37 in each quadrant are alternately numbered; quadrants 1—2 and 3—4 being numbered in a clockwise direction, and quadrants 2—3 and 4—1 being numbered in a counterclockwise direction. Furthermore to prevent confusion, dial 37 may be rotated by outer knob 38 and may be masked so that only one quadrant of the dial 37 is made visible at one time through the aperture 39 in the front panel 23 of the apparatus.

In order to know which quadrant to place in front of the aperture 39, the quadrants on the dial and the zones on the tube may be similarly numbered (as shown (1), (2), (3), (4)). Thus, before the attenuator knob 22 is adjusted, the dial must be turned by large knob 38 so that the numbers for the zones showing patterns on the tube screen are the same as numbers on the visible quadrant of the dial 37.

Instead of using marks on the tube screen zones and the dial quadrants, the large knob 38 may be connected through shaft 40 to switch 41 which operates any adjacent pair of the series of lights 42, 43, 44 and 45, located directly under and corresponding to zones (1), (2), (3) and (4) respectively, on the screen of the cathode ray tube 26. Thus, to make sure that the proper quadrant or zone will appear in the opening 37, knob 38 is rotated until the lights are lighted under the two zones of cathode ray tube 26 which show patterns. By this visual means direct reading of the angle of the incoming wave on the correct quadrant of dial 37 may be obtained.

Another form of quadrant indication of this invention is included by connecting the shaft 40 directly to a switch 46 which changes the phase or initiation timing of the synchronism of the sweep circuit 35 of the tube 26 over contacts 31 and 34 so that a pattern from a signal in any quadrant may be always placed in the same two zones; for example, zones (1) and (2). Thus, when knob 38 is turned so that the pattern is always shown in zones (1) and (2), the proper corresponding quadrant of the dial 37 is visible through the aperture 39. The lights 42 to 45 inclusive are simultaneously switched to indicate the different quadrants. When using switch 46 the series of lights 42 to 45 inclusive, and switch 41 as well as the markings on the tube screen and dial 37 may be dispensed with if desired.

This latter modification involving switch 46 without the lamp permits a further modification wherein it is unnecessary to provide a sweep circuit of such a length as to show all four quadrants at one time on the tube screen. Since the pattern on the screen is always turned to a given position, no more than two zones need to be seen at one time on the screen. Thus, the sweep circuit for the screen may be made only two zones wide by a suitable means (not shown) coupled in the sweep circuit. This enables the size of the pattern to be doubled and thereby increases the accuracy with which it can be attenuated. This in turn increases the accuracy of the direction reading on dial 37.

While the above is a specific application of this invention it is clear that many modifications will appear to those skilled in the art. For example, instead of using the motor 12 and the contact switches, electronic or other switching means may be employed to synchronize and control the impulses to the respective contacts to switch arm 19. Instead of using a deflection control for producing indication on the oscillograph screen, other known methods such as control of beam intensity may be used if desired. Moreover, other types of scanning indicators may be used in place of the oscillograph indicator. It should be understood that various types of unidirectional antennas may be provided, and that any number of antennas that is a multiple of two may be employed, if desired.

In view of the above, this invention can be applied to many other types of control apparatus involving recordation, indication and/or correlation of a series of impulses which are cyclically repeated. Thus, the above example shown in the drawings and described in the specification is merely by way of illustration and not to be considered a limitation of this invention as defined in the objects and in the accompanying claims.

I claim:

1. In a direction finder comprising a receiver a cathode ray tube four oppositely paired shielded unidirectional antennas, a switching means to

5

couple each antenna independently and successively to said receiver, a variable attenuation means for each oppositely paired antenna circuits and coupled with said switching means for coupling the output of said receiver to one set of deflection means of said tubes, said tube having a screen divided into at least two adjacent zones corresponding to at least two adjacent antennas, a sweep circuit means having its output coupled to another set of deflection means of said tube and synchronized with said switching means an azimuth dial having sectors corresponding to each of said antennas to select that sector on said dial corresponding with a given zone on said screen of said tube, and means for varying said attenuation means and said azimuth dial simultaneously to obtain an indication of said selected sector of said dial of the direction of radiant energy received by said antennas.

2. In a radio signal direction finder comprising at least four oppositely paired shielded unidirectional antennas, a switching means to couple each antenna independently and successively to a receiver, a variable attenuation means for each oppositely paired antenna circuits synchronously connected to said receiver by said switching means, a cathode ray tube having a screen divided into at least two adjacent zones corresponding to at least two adjacent antennas; the improvement comprising an adjustable sweep circuit for said tube synchronized with said switching means, an adjustable azimuth dial having sectors corresponding to each of said antennas, means for adjusting said sweep circuit means to indicate energy from a given one or more of said antennas on said screen of said tube, said latter means being directly connected to select that sector on said dial corresponding with the given antenna energy being indicated on said screen, and means for varying said attenuation means and said

6

azimuth dial simultaneously to indicate the actual direction on said selected sector of said dial of a radio signal imparting energy to said adjacent antennas.

3. In a direction finder comprising a receiver, a cathode ray tube, positioned antennas to receive signals approaching from different quadrants, means for successively coupling combined ones of said antennas to said receiver, switching means in the output of said receiver operated synchronously with the successive coupling means to apply the output energy received from said combined antennas to different lines, a variable attenuation means in each of said lines for coupling said lines in parallel to said indicator to control a characteristic of said beam in accordance with the amplitude of the received signals, an azimuth dial having sectors corresponding to each of said quadrants, and means for selecting a given sector, means for sweeping the beam of said oscilloscope across the screen thereof in synchronism with the coupling of said antennas, and in accordance with said selected sector, means for varying an indicator of said azimuth dial in accordance with the balancing of said attenuating means to indicate a bearing direction of radiant energy received in said given sector.

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