Nov. 30, 1948. R. HARDY 2,454,797

RADIO-ELECTRIC RECEIVER, PARTICULARLY FOR WATCH ON BROAD FREQUENCY BANDS

Filed May 24, 1943 4 Sheets-Sheet 1

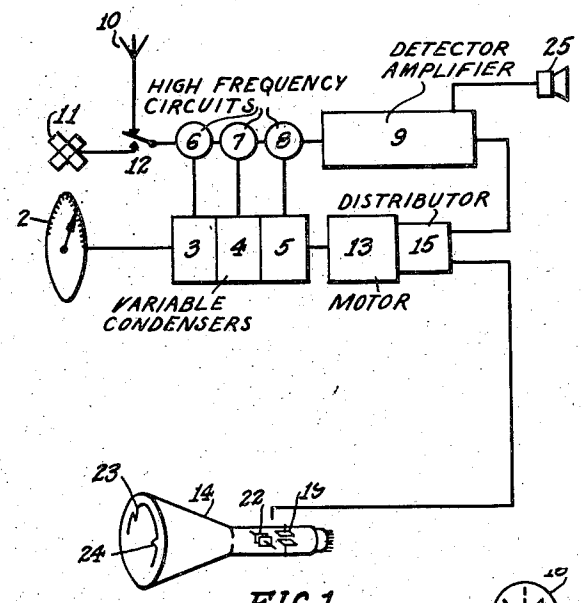


FIG.1

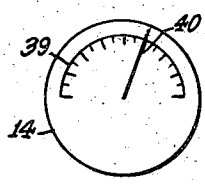


FIG4A

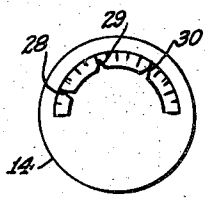


FIG.4B

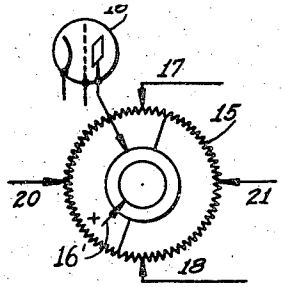


FIG.2

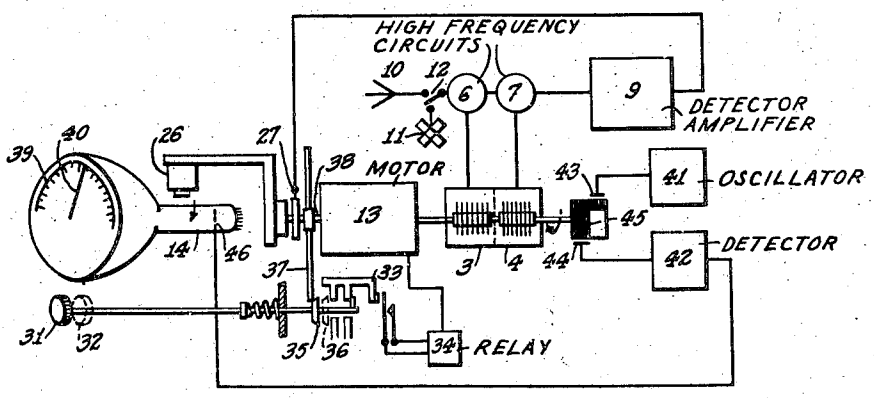


FIG.3.

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RADIO-ELECTRIC RECEIVER, PARTICULARLY FOR WATCH ON BROAD FREQUENCY BANDS

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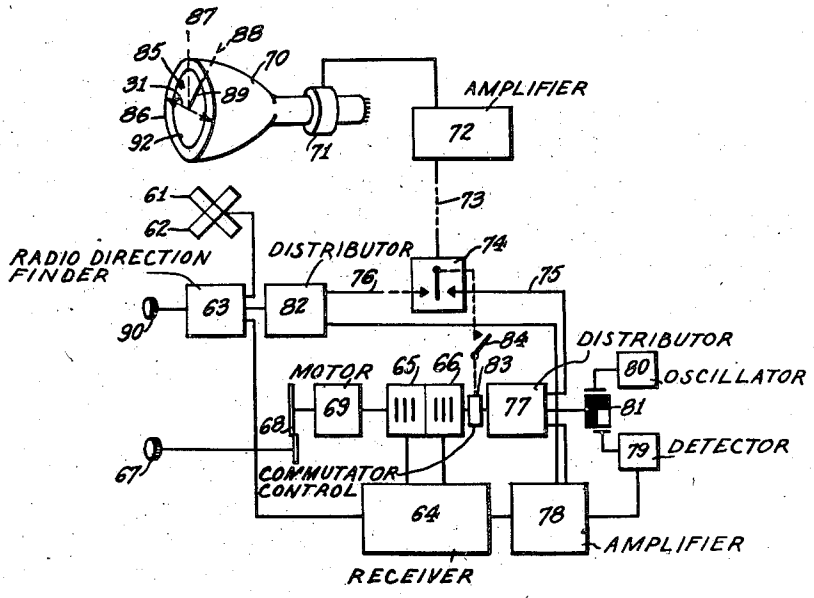


FIG. 5

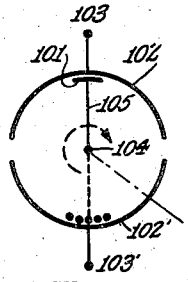


FIG. 6

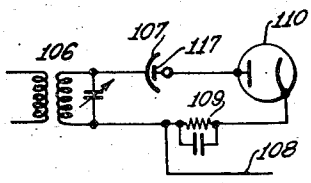


FIG. 7

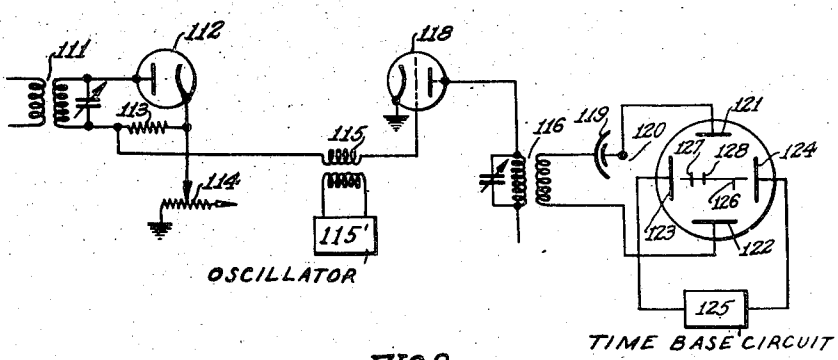


FIG. 8

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RADIO-ELECTRIC RECEIVER, PARTICULARLY FOR WATCH ON BROAD FREQUENCY BANDS

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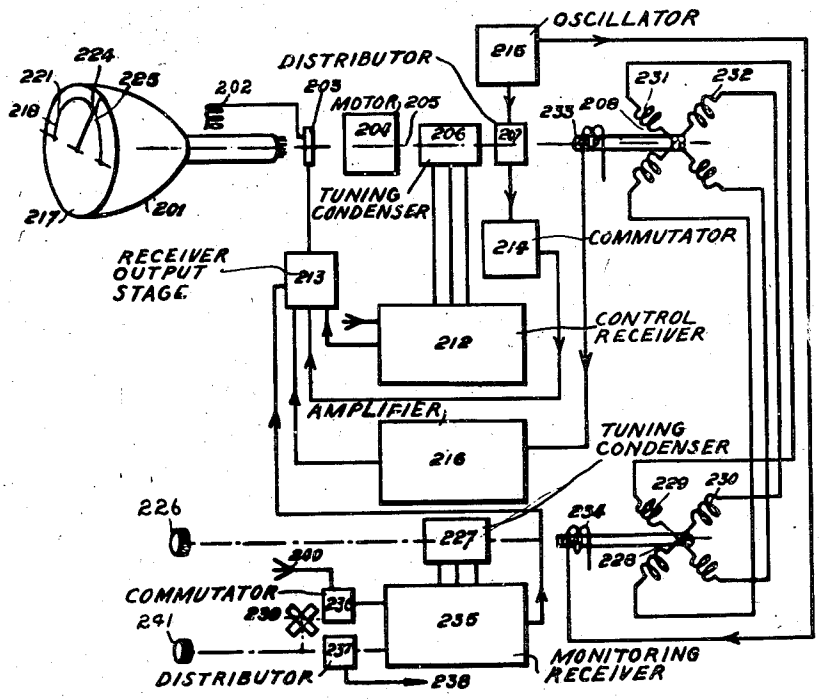


FIG. 14

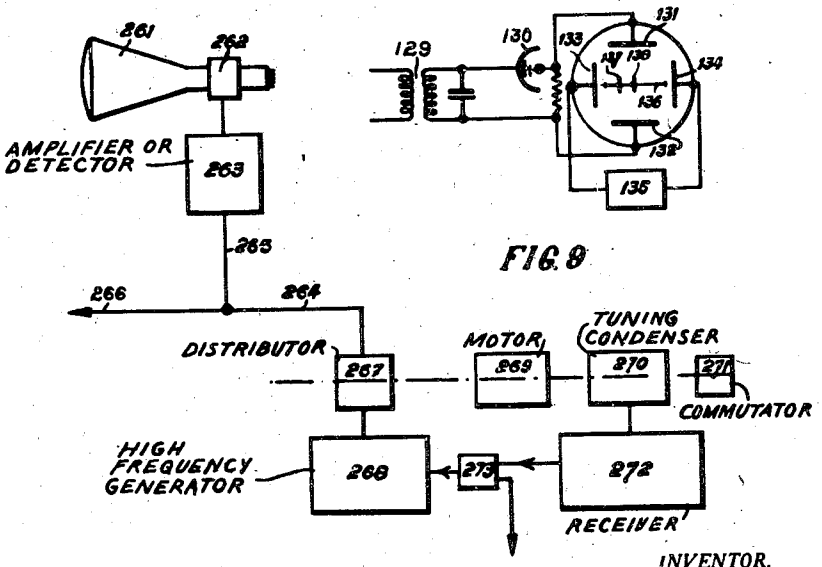


FIG. 8

FIG. 17

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RADIO-ELECTRIC RECEIVER, PARTICULARLY FOR WATCH ON BROAD FREQUENCY BANDS

Filed May 24, 1943 4 Sheets-Sheet 4

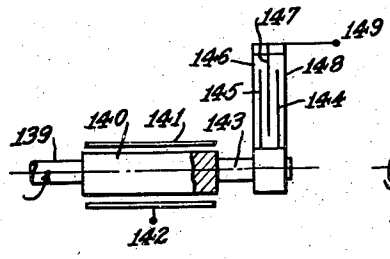


FIG. 10

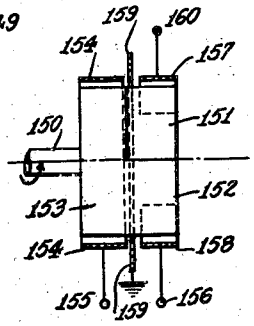


FIG. 11.

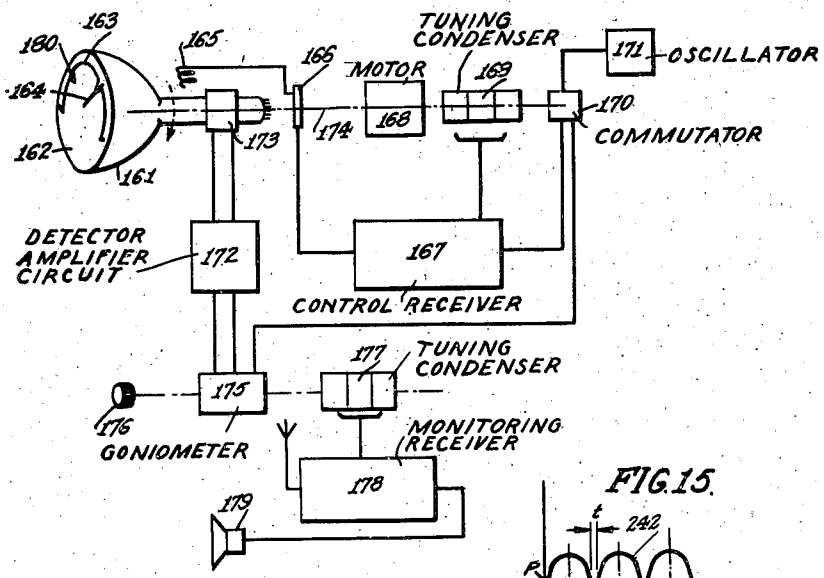


FIG. 12




FIG. 15.

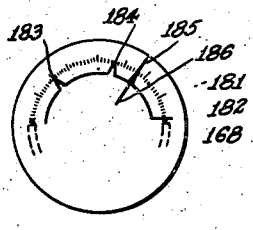


FIG. 13

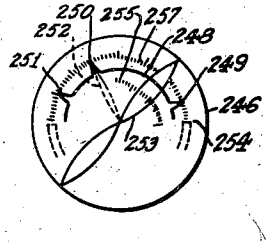


FIG. 16.

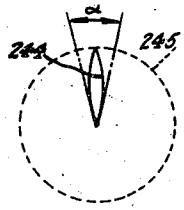


FIG. 15A

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Patented Nov. 30, 1948

2,454,797

# UNITED STATES PATENT OFFICE

2,454,797

## RADIO-ELECTRIC RECEIVER, PARTICULARLY FOR WATCH ON BROAD FREQUENCY BANDS

René Hardy, Lyon, France, assignor to International Standard Electric Corporation, New York, N. Y., a corporation of Delaware

Application May 24, 1943, Serial No. 488,294
In France May 17, 1941

Section 1, Public Law 690, August 8, 1946
Patent expires May 17, 1961

25 Claims. (Cl. 343—115)

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This invention relates to radioelectric receiving systems, and a particular object thereof is to provide a radio direction finding system which simultaneously provides supervision of the transmissions in progress in a certain range of frequencies.

Another object of the invention is to provide a radio direction finding receiver system in which there is a considerable reduction over known systems in the time devoted to the search for stations, which are desired to be detected by radio.

Another object of the invention is to provide a radio direction finding receiver system which insures continuous supervision of the transmissions taking place in a definite frequency range and which permits individual monitoring of each of the transmissions in progress without interrupting the supervision of the transmissions and without interfering with the direction finding operations.

Another object of the invention is to provide improved indicators for radio direction finding receiver systems of this kind that permit the obtaining of various combinations of the indications required in these systems without superfluous indications or ambiguity.

Another object of the invention is to provide a radio direction finding receiver system insuring supervision of the transmissions in progress in a definite range of frequencies and permitting individual monitoring of transmissions in progress which will make possible the transportation and remote repetition of the indications obtained locally.

According to certain features of the invention, a radio direction finding receiver system comprises a receiver that is provided with means for modifying its tuning continuously or automatically in a predetermined range of frequencies, and indicating instruments such as a cathode ray oscilograph connected to the said receiver by means of circuits causing the appearance on its screen of simultaneous traces of all the radio transmissions in progress within the supervised range, a directional wave collector system of orientable reception pattern feeding the receiver in order to permit successive cancellation of the various traces of the transmissions that appear on the indicating instrument, and means for obtaining a visual indication of direction each time that the

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trace of a transmission is blotted out or disappears on the indicating instrument.

According to another feature of the invention, means are provided, in a radio direction finding receiver of this kind having continuous supervision of the transmission, for avoiding the appearance of a double series of indications that would result from the fact that the elements that modify the tuning of the receiver produce two successive scannings of the reciever that are asymmetrical in frequency for one single complete scanning of the indicating instrument.

According to another feature of the invention, means are provided in a radio direction finding receiver of this kind for producing the appearance of the indications of direction on the screen of the indicating instrument that is used for the supervision of the transmissions in progress.

According to another feature of the invention, means are provided in a transmission supervising radio direction finding receiver of this kind for changing, as desired, from an automatic supervision of the transmission to a manual search and to the monitoring of the various transmissions, and, in this case, for employing as regulating frequency indicator the same indicating instrument as for the supervision of the transmissions in progress.

According to another feature of the invention, arrangements are made in the above-mentioned receiver systems for use of an additional receiver for the monitoring of the transmission, the same indicating instrument being used to obtain, on a single scale of frequencies, the simultaneous directional indications of the transmissions in progress and of the manual adjustment of the monitoring receiver.

According to another feature of the invention, an additional monitoring receiver is employed and means are provided for using the same indicating instrument for obtaining simultaneously the indications of the frequencies of the supervised transmissions and of the monitored transmissions and the indications of the directions of the transmissions located by radio.

According to another feature of the invention, an additional monitoring receiver is employed and the radio direction finding circuit may or may not be changed over from the control receiver to the monitoring receiver.

A radio direction finding receiver system which incorporates features of the invention comprises a directional wave collector assembly which feeds a receiver that has its tuning modified continuously, e. g. by rotation of the variable tuning condenser, and the output of the receiver is applied to an indicating instrument such as a cathode ray oscillograph in such a way as to effect the scanning of this indicator and consequently cause the appearance on the screen of luminous traces that correspond to the various emissions of different frequencies received on the directional aerial system. A direction scanning is then superposed on the frequency scanning by modification of the characteristics of the aerial collectors, e. g. by rotation of these aerials or by rotation of a finder associated with stationary directional aerials. Each time that the directional system passes over a position of zero reception of a transmission, the luminous trace that corresponds to this transmission disappears on the screen of the oscillograph. The direction of this transmission is then read on a dial associated with the collector assembly.

In a system of this kind, it is evident that the luminous traces that indicate the positions in frequency of the various transmissions are more or less clearly marked according to the position of angular keying of the directional aerials. If it is desired to cause the disappearance of such irregularities during the intervals between the radio direction finding measurements it is possible, according to one feature of the invention, to make use of a non-directional aerial to which the receiver is connected during these intervals, the input of the receiver being switched, e. g. by means of a key, to the directional aerials when it is desired to take a bearing.

According to one feature of the invention, the use of a single indicating instrument for the simultaneous supervision of transmissions in progress and for successively locating these transmissions is made possible by adding to the radio direction finding circuit a scanning system similar to the one used for causing the appearance of the control indications. These two scanning circuits are synchronized with each other and are switched to a cadence that is sufficiently rapid to insure the persistence of the two series of luminous indications on the screen of the cathode ray oscillograph.

In order to be able to switch from supervision of the transmissions on the frequency band of the receiver to the manual locating of these transmissions, one feature of the invention provides for the use of a device for the manual control of the receiver's tuning condenser in association with a coupling system that enables this manual control to be hooked in at the same time as the disconnecting of the continuous drive motor or the opening of the excitation circuit of this motor. This manual control device may be provided with a special indicating dial but, according to one feature of the invention, it is preferably disposed so as to control the scanning of the indicating cathode ray tube in such a way as to cause the appearance of a luminous trace corresponding to its angular position, thus acting as a luminous index of the frequency adjustment of the receiver. This index may be switched with the indication of direction in the manner described above.

During the frequency scanning of the receiver by its tuning element, whether this scanning is done by rotation or oscillation of the said tuning



element, the same positions will be found twice in the explored range of frequencies for one complete scanning of the indicating instrument. It is not possible to use a double speed scanning of the indicating instrument because the identical positions in the frequency range are not reproduced at symmetrical locations in time with respect to the moment when the scanning of the indicator begins. Two different series of indications will thus be produced on the screen of this indicator. It is consequently suitable to suppress one of these series of indications in order to avoid any risk of error. In the particular case in which the scanning of the indicator is arranged to be circular, it is sufficient to mask one half of the screen. As a rule however, the invention provides for the use of means for extinguishing the luminous image which appears on the screen of the cathode ray oscillograph during the half of the scanning that corresponds to the superfluous series of indications.

According to certain features of the invention, these means consist of electrostatic commutators having two elements or structures coupled capacitively and rotating with respect to each other, the shapes given to these elements or structures being such that the capacitive coupling varies during their rotation from a value which permits the transmission of an alternating voltage from one element or structure to the other to a value which prevents any transmission of alternating voltage. The rotation or the relative displacement of the two elements or structures is synchronized to the scanning of the indicating instrument in such a way that the transmitted voltage may serve for blocking the cathode beam during desired periods of the scanning.

In order to permit simultaneous monitoring of the operations of supervision and direction finding, an auxiliary receiver is added to the control receiver in the above systems. This receiver may have a non-directional aerial, for example, and may be arranged so as to cover the same band width as the control and radio direction finding receiver. In this case, in order to make it easier to adjust the said monitoring receiver to the frequency of a detected transmission and consequently to increase the rapidity of this adjustment, another feature of the invention provides means for causing the appearance of a luminous index superposed on the luminous traces that reveal the presence of transmissions in progress, this luminous index indicating the adjustment position of the tuning elements of the monitoring receiver. These means consist of a scanning circuit whose action is commutated with that of the similar scanning circuit controlled by the control receiver. The cadence of the commutation of the two scanning circuits is sufficiently rapid to insure the persistence of the supervision and adjustment indications of the monitoring receiver on the screen of the cathode ray oscillograph. In order to monitor one of the transmissions detected by the control receiver, it will then suffice, by adjustment of the manual tuning element of the monitoring receiver, to bring the luminous index indicating its position on to the luminous trace of the wanted transmission. The cadence of commutation of the two scannings may suitably be that which is furnished by the periodical blocking of the control receiver's scanning circuit in order to avoid the appearance of two series of indications on the screen of the cathode ray tube. The electrostatic commutator or other means used for this purpose is then mod-

ified in order to set in operation the monitoring receiver's scanning circuit during the periods when the control scanning circuit is blocked instead of simply omitting all scanning of the oscillograph during these periods.

When two separate receivers, with only one indicator, are used for supervision and monitoring, the radio direction bearings may be obtained as mentioned above by modifying the directional pattern of the control receiver's aerials in order successively to efface the luminous traces that correspond to the transmissions in progress, and by reading the directions thus obtained on a separate dial. By another method, non-directional aerials may be provided for the two receivers, and one of these aerials may be switched to a radio direction finding commutator system that is set in operation at the moments when bearings are to be taken.

However, according to certain of its features the invention likewise provides for also producing the appearance of the direction indications on the same cathode ray tube screen as the indications of the frequencies of the supervised and monitored transmissions. Use may be made for this purpose of a third scanning circuit of the same speed as the two others and controlled by the angular position of the radio direction finding or other circuit. The three scanning circuits are to be switched alternately, e. g. by applying the radio direction finding scanning to the indicator and then in succession both complete frequency scannings of the control receiver. In order to avoid the use of complicatedly designed cathode ray tubes as indicators in these systems, another feature of the invention provides for the use of only one scanning circuit to which there are applied successively, and at a sufficiently rapid cadence to retain the persistence of the indications on the screen, the respective control voltages proceeding from the control receiver circuit, the monitoring receiver circuit and the radio direction finding circuit that is associated with one of these receivers. Three different simultaneous indications then appear on the screen of the indicator.

According to still other features of the invention, the different indication currents are used to modulate a current or a carrier wave, and this current or this modulated wave is then remote-transmitted to one or more indicators similar to the locally employed indicator in order to effect remote transportation and repetition of the obtained angular indication.

These objects and features, as well as others, will be explained in detail in the following description given with reference to the appended drawings, in which:

Fig. 1 illustrates schematically one example of an embodiment of a radio direction finding receiver that effects simultaneous supervision of transmissions in progress;

Fig. 2 shows schematically one example of a resistance-coupled distributor that can be used in the circuit of Fig. 1;

Fig. 3 is a schematic view of one example of a radio direction finding receiver effecting simultaneous supervision of transmissions in progress that is provided with means for causing the appearance on the indicating cathode ray tube screen either of traces of the transmissions in progress in the case of automatically controlled operation, or of a trace that corresponds to the angular position of the receiver's tuning condenser in the case of manual adjustment, as well as means for suppressing on the said screen the traces that would be obtained during the superfluous portion of the frequency scanning;

Figs. 4A and 4B respectively show how the indicating tube screen looks when the operation is manual and when it is automatic;

Fig. 5 illustrates schematically another embodiment of a radio direction finder with supervision of transmissions in progress which comprises means for causing the appearance of the various desired indications on a single screen of an indicating instrument;

Fig. 6 illustrates schematically one example of an electrostatic commutator that can be used for periodically supplying a blocking voltage to a cathode ray indicator;

Figs. 7, 8 and 9 illustrate schematically, as examples, various applications of an electrostatic commutator of this kind;

Figs. 10 and 11 are schematic views of two modifications of the electrostatic commutator of Fig. 6;

Fig. 12 illustrates schematically one embodiment of a radio direction finding receiver that effects simultaneous supervision of transmissions in progress and the monitoring of one particular transmission from among the transmissions in progress, using one single indicating instrument for the various desired indications;

Fig. 13 is a view of a cathode ray tube screen with the supervision and monitoring indications obtained with the circuit of Fig. 12;

Fig. 14 illustrates schematically another example of an embodiment of a radio direction finding receiver which, with a single indicating instrument, effects supervision of transmissions in progress, monitoring of a particular station, and taking of the bearings of the supervised transmissions;

Figs. 15 and 15A show diagrams used in the explanation of the operation of the arrangement of Fig. 14;

Fig. 16 is a view showing the use of the cathode ray tube screen as an indicator of the embodiment of Fig. 14, and

Fig. 17 illustrates schematically one example of a radio direction finding receiver system of one of the types described in connection with the preceding figures that is specially adapted for easily repeating the obtained indications to a distance.

Fig. 1 gives a schematic view of one embodiment of a direction finding and transmission system which employs features of the invention. The dial 1, or the indicating needle 2, is mechanically connected to an assembly of variable condensers 3, 4 and 5, for example. These variable condensers 3, 4 and 5 are electrically connected to high frequency circuits 6, 7 and 8 which serve as input circuits to the detecting amplifier 9. As a whole they accordingly form a scanning condenser. The first high frequency circuit 6 may be connected by means of a changeover switch 12 either to a vertical antenna or other non-directional aerial 10 or to a radio direction finder circuit 11, which may comprise any system of rotary commutators or crossed or directional antenna arrangements which permit the taking of radio direction bearings. The variable condensers, such as 3, 4 and 5, may be operated manually as a whole, as in an ordinary radio receiver, so as to search for a station. However a driving system by means of a motor 13 can make them rotate continuously, e. g. at the rate of 25 or 50 revolutions per second, and the assem-

bly of variable condensers will accordingly effect a complete scanning of the reception range covered by the receiver for each revolution of motor 13.

Each time that the frequency exploring or scanning condensers 3, 4, 5 pass over an adjustment that corresponds to the reception of a station, a rapid variation of the output current of receiver 9 will occur during the brief time of passage over this wavelength. It is then possible to use an indicator such as a cathode ray tube 14 that is suitably fed by the circuit of receiver 9 in such a way that each received station will correspond to a luminous trace that will permit indication of its presence and knowledge of its frequency. Receiver 9 may be connected to the cathode ray tube 14 by any suitable circuit and particularly by a resistance-coupled distributor 15 driven in rotation by the motor 13.

This kind of distributor is well known in radio direction finding and a schematic example of it is shown in Fig. 2. The output tube 16 of the detector-amplifier 9 and the high voltage 16' for the receiver feed at diametral points a resistance-coupled commutator 15 that consists of a chain of resistances all connected to circular contact studs. When the output tube 16 is not modulated, the supply current of the resistance-coupled commutator is constant and the distribution of the values of the resistances is such that when the assembly rotates there is obtained at the stationary brush terminals 17 and 18 a sinusoidal voltage which consists of values of very close successive voltages. This sinusoidal voltage is applied to a pair of deflection plates, e. g. 19, of cathode ray tube 14, while sinusoidal voltage tapped at the terminals of the stationary brushes 20 and 21 is applied to the other pair of plates 22 of the cathode ray indicator 14. When the current of the output tube is constant, the luminous spot of the indicating tube describes a circle on the fluorescent screen as a result of the two sinusoidal voltages in quadrature produced by the rotary commutator 15. Now if the plate current of the output tube 16 is modulated, the more the grid is negative, the less the voltage will be on the commutator 15, and the diameter of the circle will be all the smaller. A high frequency modulation, e. g. pulses acting on the grid of the output tube 16, will be reproduced in the form of radial deflections on the screen of the cathode ray tube 14. If, for example, at a given moment the variable condenser assembly 3, 4, 5 passes in rotation through a frequency at which the receiver receives the signals of a station, a rapid modulation of the output tube 16 will give the pip 23 on the screen of tube 14, and by a rapid modulation of the tube, as the condenser assembly tunes through the frequency band, a second station will produce the pip 24. This occurrence is repeated upon each rotation of the scanning condensers driven by motor 13.

If the input of the circuit 6 is connected to the radio direction finder 11, it is evident that when the finder is adjusted manually or in any other way to an annular position such that the transmission that corresponds to the pip 23 lies in the zero reception plane of the finder, this pip will become extinguished on the screen of the cathode ray tube. Consequently, by manual adjustment of the radio direction finder 11, it will be possible to cause the successive disappearance of any one of the indications of stations that appear on the screen of cathode ray tube 14. It will be sufficient to read on each occasion the finder's angular position that causes the disappearance of the trace of a station on the cathode ray tube screen in order immediately to know the direction of this station.



Furthermore, an audible indication may be given by an earphone or a loudspeaker, such as 25, connected to the output of the detecting amplifier 9.

A modification of the system of Fig. 1 is shown in Fig. 3. According to certain features of the invention, the circuit of this Fig. 3 is arranged in such a way that it is possible to cause the simultaneous appearance on the screen of the indicating cathode ray tube 14 of the stations that are operating, in case the variable condensers 3, 4 are driven mechanically in a uniform rotating motion by motor 13, or the position of adjustment of the variable condenser, which is usually read by means of a needle that moves in front of a dial, in case manual adjustment is used for receiver.

In the embodiment shown in Fig. 3, the indicating cathode ray tube 14 is shown in the form of an oscillograph in which the deflection of the beam is effected by a magnetic circuit 26 that rotates around the tube. This magnetic circuit 26 is driven by motor 13 with a continuous and sufficiently rapid motion for the luminous spot that appears on the screen of the cathode ray tube to have the form of a regular circle. The variable condenser 3—4, which is double in the example shown in this figure, is driven by the motor 13 and controls the tuning of the high frequency circuits 6 and 7 which, together with the detector-amplifier 9, form a part of the receiver. The antenna 10 or any other radio direction finding device is arranged at the input of this receiver. The output circuit of detector-amplifier 9 controls the deflection of the spot by means of the magnetic circuit or winding 26 which is connected to the output of detector-amplifier 9 through the brush 27. If the output circuit of receiver 6—7—9 does not receive any modulation resulting from the passage of the tuning condenser through the frequency of a station, the path described by the spot is indeed a uniform circle, but the variations of voltage produced by the reception of a transmission correspond to radial deflections of the spot which produce the images 28, 29 and 30, shown in Fig. 4B, for example. These images represent transmitting stations that are operating at different frequencies. They may be directed toward the outside of the screen or toward the center according to the way the modulation is arranged.

The variable condenser 3—4 may be actuated manually by an adjusting knob 31 which occupies the uncoupling position 32 when the motor 13 is in rotation. The motor is set in operation, e. g. by the stop 33 which controls the closing of relay 34. The coupling disc 35 of the manual drive system is then in position 36. When it is desired to adjust the receiver manually, the driving disc 35 applies against a disc 37 that is integral with shaft 38 of the variable condenser 3—4. When the knob 31 sets the condenser assembly in rotation, it also drives coil 26 which is integral with shaft 38. The spot then occupies on the graduated scale 39 of the screen of cathode ray tube 14 a position that depends on the adjustment of the condensers. By manual adjustment it is then possible to observe the exact location of a station, not only from the fact that the station can be heard if a loud-

speaker is connected to the output circuit, but also from the fact that at this position the spot will describe a radial path, e. g. toward the center of the screen, that will be all the greater with better synchronization of the receiver.

In the case of the manual adjustment position it is also possible to have coil 26 fed by an alternating voltage so as merely to cause the appearance on the cathode ray tube screen of a radial line 40 (Fig. 4A) that serves as index or pointer for the regulating dial. To do this it is sufficient to arrange for a switching of the power supply of coil 26.

When the condenser rotates, it successively scans for a displacement of 180° the entire range of frequencies of the receiver, and, unless the condensers are made of special designs, the same stations will be found twice for each rotation, but the distribution of the stations is not the same for these two half turns. It is therefore advisable to cut out the feed of the cathode ray tube during the undesired half turn in order to eliminate the corresponding luminous indications on its screen. For this purpose, use is made of a commutator or other means that can act in any suitable manner to cause the disappearance of the luminous trace or the radial modulation of the spot at the angular positions for which the condenser repeats its cycle of variations.

One example of this kind of a commutator is shown in Fig. 3. It comprises an oscillator 41 having a frequency that is sufficiently high to require only a low coupling capacity with the detector circuit 42. This coupling capacity is furnished by two electrodes 43 and 44 disposed in such a way that the high frequency voltage can only pass from one electrode to the other during a half turn of the variable condenser 3—4. As shown in Fig. 3, this can be done by using an armature 45 attached to the condenser shaft 38 and arranged to rotate in between plates 43 and 44; this may consist of a circular segment of such a shape that it is only capacitively coupled to the two plates 43, 44 over 180° of its circumference. The detector circuit 42, during the portion of the rotation in which it is coupled to oscillator 41, detects a high frequency voltage that proceeds from oscillator 41. It consequently applies a suitable direct voltage to the control grid 46 of the indicating tube 14 which extinguishes the spot each time that the high frequency proceeding from oscillator 41 arrives in detector 42, i. e. during a half turn per complete rotation, with the above arrangement. Various other examples of designs and uses of such commutators will be described further on in this specification.

Fig. 5 shows a modification of the circuit of Fig. 1 in order to be able to obtain simultaneously the indication of stations that are operating and the indication of the angular position of the radio direction finder on a single cathode ray tube. The wave collectors or direction finding circuits 61 and 62 are connected to the receiver 64 by means of the finder 63. The tuning circuits of this receiver are controlled by the variable condensers 65 and 66 which may be driven, either manually by the knob 67 and the coupling 68 or continuously by the motor 69. Cathode ray tube 70, whose magnetic deflection circuits 71 are connected to amplifier 72, serves for giving simultaneous indications of angles and of frequencies of the received stations. Amplifier 72 may be connected to the receiver equipment by a line 73 of any required length. A commutator 74 permits the alternating connection of the cathode



ray tube's deflation circuits 71 to the distribution lines 75 or 76 by means of amplifier 72 and line 73; these distribution lines being respectively connected to circuits 77 and 82. Circuit 77 may consist of a rotating potentiometric distributor, similar to that shown in Fig. 2, or of an induction circuit, such as a radio direction finder with reversed connections. This circuit 77 has its rotor fed by the carrier current amplifier 78 modulated by receiver 86.

The cathode ray tube that is connected by line 73 to the brushes of the stators of circuit 77 is accordingly controlled in such a way that the luminous spot will describe a circle on its screen and occupy an angular radial position that corresponds to the angular position of the rotor of circuit 77. If the condenser rotates continuously, the rotor of circuit 77 will rotate at the same time, since it is on the same shaft, and the spot will describe a circle 92 on the screen 88 of cathode ray tube 70.

If the receiver passes through a transmission station for a position corresponding to the frequency of this station, there will appear on screen 88 the luminous trace 93 that reveals the presence of this station. This phenomenon appears continuously if the rotation of the mechanical assembly 65, 66, 77 is effected at sufficient speed, i. e. of the order of 50 revolutions per second.

When the contact of commutator 74 is connected to the distributor circuit 76, amplifier 72 is fed via line 73 by distributor 82 which is similar to distributor 77, and the luminous spot will occupy an angular position as for instance the position 98, which will give the angular position of the rotor of distributor 82, i. e. the angular position of the rotor of radio direction finder 63 that is controlled by the manual knob 90.

When commutator 74 is connected to the distributor circuit 82, it is easy to superpose by means of this circuit on the constant deflection current an alternating current that radially modulates the spot of the cathode ray tube in such a way as to transform point 98 into a radial line 99. This line 99 represents the angle made by the rotor of the radio direction finder 63 with respect to a predetermined fixed guide mark 97. Circuits 79, 80 and 81 serve for extinguishing the semi-circumference 92 described by the spot for the undesired angular positions of the variable condensers 65 and 66. The circuit 80 may be an oscillator similar to that described in connection with Fig. 3, circuit 79 a detector, and 81 the commutator for interrupting the oscillations during the unwanted half of the tuning cycle.

Commutator 74 may be arranged automatically to alternate the distributor circuits 75, 76 at a sufficiently rapid cadence for alternate production of luminous images 95 and 99 at a frequency sufficient to insure persistence of the indications in the retina. This control may be effected by means of a mechanical device of any suitable kind, as indicated at 83, which may be connected or not, as desired, to commutator 74 by a switch 84.

Advantage may also be taken of the periods during which the variable condensers 65 and 66 cannot be used for indication of the stations in course of operation in order to produce the trace 99 of the angle of the rotor with respect to a fixed guide mark. It is evident that the mechanical commutator 74 may be replaced by an electronic commutator in the known manner.

79, 80 and 81 illustrate an assembly similar to that described in connection with Fig. 3 for sup-

pressing the illumination of the cathode ray tube during the undesired periods of the condenser's rotation. However, generator 80, instead of controlling the extinction of the cathode ray tube, may be used for controlling the operation of distributor 82 in order to alternate the indications of frequency and of direction of the received stations.

The manual control 67, which may be used for adjustment of the receiver by means of the coupling 68, can also serve for causing the appearance of an angular indication in a manner similar to that described in connection with Fig. 3.

On the screen 86 of the cathode ray tube 70 there are accordingly obtained a certain number of traces 85 that indicate the position in the frequency spectrum of the transmitting radio stations actually operating in a definite wave range covered by the receiver. There is obtained at the same time an indication 89 which has the shape of a luminous radial line that corresponds to the angular position of the radio direction finder and makes it possible to determine successively the direction of each of these stations.

In the case of manual adjustment of the receiver by knob 67, another luminous trace can be produced that makes it possible to know the frequency to which the receiver is adjusted. The mechanical or electronic commutator 74 may in this case be set in oscillation in any suitable manner for rapidly alternating the indications of the angular positions of the finder 63 and of the variable condenser 65—66.

In all the cases in which a circular scanning is employed, it is of course possible to arrange a simple shutter on the undesired portion of the screen in order to avoid seeing the superfluous indications. However, as already indicated, it is preferable to provide means for blocking the scanning during the undesired periods in order to be able to use them for other purposes, e. g. for different indications.

Figs. 3 and 5 illustrate schematically a type of an electrostatic commutator that makes it possible to cut off the illumination of the cathode ray tube during one half of each scanning rotation by acting on the control grid of the cathode ray tube or on any other electrode that controls the illumination of the screen.

It is not always possible to employ grid controlled tubes in cathode ray indicators for receivers used for supervision or other purposes. There are, for example, cathode ray tubes in which the luminous intensity is controlled by the adjustment of an auxiliary plate voltage. Besides, it may be desirable to avoid modulating the control grid of a cathode ray tube.

The modulation that permits extinction of the undesired indications may consequently be applied to an auxiliary anode of the tube in the form of an additional voltage that is suppressed or considerably reduced during the undesired periods. It is also possible, by modifying the value of the anode voltage, to increase the radius of the circle during a half-turn in order to bring it out of a visible region of the screen.

Various examples of elecrostatic commutators and of their applications for suppressing undesired indications on a cathode ray tube screen will now be described with reference to Figs. 6 to 11 inclusive. These designs and circuits may consequently be used instead of the corresponding designs and circuits of Figs. 3 and 5.

The electrostatic commutator illustrated in Fig. 6 comprises a stationary sector 102 which may be of any shape and which is connected to a terminal 103. A voltage of high value is applied between terminal 103 and shaft 105 of the commutator which rotates in synchronism with the other rotating elements of a circuit similar to those shown in Figs. 3 and 5. This shaft 105 carries, for example, a small sector 101 which is capacitively connected to the stationary sector 102 during a portion of the rotation. A high frequency voltage is transmitted from terminal 103 to terminal 104 during the time sector 101 takes to pass in front of sector 102. During the other portion of the rotation of shaft 105 and of sector 101, they may be capacitively coupled to another stationary sector 102', which makes it possible to pass a high frequency voltage from terminal 103' to terminal 104, or else the terminal 103' may be left unconnected, the device simply playing the part of a current interrupter.

One example of the application of the electrostatic interrupter of Fig. 6 is shown in Fig. 7. In this Fig. 7, the high or mean frequency transformer 106 transfers the amplified current of the receiver to the diode detector circuit 110. When sector 117 of the electrostatic commutator is in front of the stationary electrode 107, the high frequency current will be detected at the terminals of resistance 109 and by means of the connection 108 it may be applied to any modulation or other amplifying system that can cause the appearance on the cathode ray tube's fluorescent screen of the indication of the traces of the received stations. During the portion of the undesired rotation of the rotating plate condenser, sector 117 is idle and the modulation does not act further on the cathode ray tube.

According to one modification of the circuit as shown in Fig. 8, the mean frequency transformer 111 feeds the detection diode 112. Resistance 113, at the terminals of which the detected current appears, controls the potential of the grid of amplifier tube 118 which is suitably biased by potentiometer 114. A coupling transformer 115 whose secondary winding is connected in the control grid circuit of tube 118 and whose primary winding is connected to a source 115' of high frequency oscillations makes it possible for tube 118 to act as a modulator tube, so as to obtain in the output transformer 116 a high frequency voltage modulated by the detected signal. The output circuit of transformer 116 is connected to the vertical deflection plates 121 and 122 of a cathode ray tube whose horizontal plates 123 and 124 are, for example, fed by a scanning voltage that proceeds from a linear time base circuit 125.

When there is no modulation, the deflection of the spot on the cathode ray tube's screen is confined to a line 126 and use can be made of the electrostatic commutator 119, controlled by shaft 102 in synchronism with the receiver's rotating plate condenser or with any other element that forms part of the assembly driven by the motor or by the manually controlled knob, to cause the production of the vertical modulation during a definite time interval only. The traces of stations 127 and 128 can appear during this period. The amplitudes and the shapes of current desired at the terminals of plates 121 and 122 may be obtained by means of connected-in networks of impedances arranged in any well known manner according to requirements.

This Fig. 8 and the following one show a cathode ray tube used with a linear scanning, but it must be understood that the invention is of course not limited to the use of the circular scan-

ning employed in the other examples of embodiments shown and described, but, on the contrary, may be adapted to any desired known method of scanning.

In another variant of the circuit of Fig. 7, which is shown in Fig. 9, the mean frequency transformer 129 symmetrically applies the output current of the receiver to the vertical deflection plates 131 and 132 of cathode ray oscillograph 134. This vertical modulation, e. g. as shown at 137, 138, of the horizontal trace of the scanning 136 that is produced by plates 133 and 134 to which the linear time base circuit 135 is connected, is effected when the movable sector of rotating commutator 130 permits the passage of the alternating voltages.

It must be understood that the electrostatic commutator discussed above may be used in all cases in which it is desirable in general to permit the passage of a high or mean frequency voltage, or simply an alternating voltage, from one circuit to another during a portion of the rotation of an assembly, and to prevent the passage of these alternating currents when it is desired to avoid their effects in the second circuit.

A commutator of this kind may be of any suitable design, e. g. of designs like those shown in Figs. 10 and 11. In Fig. 10 the rotating shaft 139 is made integral with an insulating member 140 that has a metallic coating, a secondary shaft 143 being carried by this insulating member 140 in order to be driven in rotation by shaft 139 without metallic connection between them. Secondary shaft 143 carries condenser blades or segments 144, 145 which rotate between segments 146, 147, 148 that are stationary and are connected to terminal 149. The high frequency voltage proceeding from the oscillator may be applied by terminal 142 to the mid-point of a cylinder 141 that is concentric with the insulating member 140. The alternating voltages distributed according to the profiles of the stationary and movable sectors of the condenser segments 144 to 148 are accordingly tapped at 149. Inversely, the high frequency voltage may be applied to terminal 149 and be tapped at terminal 142. A connection arrangement of this kind permits insulation of the electrostatic commutator with respect to earth. If however this precaution is not advisable, shafts 143 and 139 may be of one piece and terminal 142 may be connected to earth, for example.

The design shown in Fig. 11 comprises an insulating cylinder 151 driven by a shaft 150. This cylinder 151 has its outer surface metallized in the manner indicated at 152 and 153, for example. A metallic ring 154 surrounds the metallized portion 153 and is spaced therefrom, while sectors, such as 157 and 158, are capacitively joined to the metallized portion 152. A grounded electrostatic screen 159 separates the two assemblies of electrodes. With this arrangement, it is only during a portion of the rotation of drum 151 that electrode 154 can transmit the alternating voltages applied to it by terminal 155 to electrodes 157 and 158, accordingly to terminals 160 and 156, respectively.

It is evident that electrostatic commutators as described above may be used in other circuits than those of the kind shown in Figs. 3 and 5 for periodically blocking the cathode beam of an indicating oscillograph. They can be used in a general way for periodically transmitting alternating voltages from one circuit to another.

Instead of using a single receiver that alternatively permits supervision of the transmissions in progress in a predetermined range and individual monitoring of the various transmissions thus located, it may be preferable in certain cases to use two receivers in order to be able to continue the supervision of the operating transmitting stations while monitoring one of them and while radio direction finding indications are obtained as desired, as in the case of the preceding systems. In this case, certain features of the invention also provide means for only using one single indicating instrument for supervision of the transmissions in progress, adjustment of the monitoring receiver, and the indications of directions. Figs. 12 to 17 show various examples of embodiments of these two-receiver systems.

In the example of embodiment illustrated in Fig. 12, a control receiver 167 and a monitoring receiver 178 are shown associated in such a way as to use only one single indicating instrument, such as a cathode ray oscillograph 161.

The tuning circuit of control receiver 167, e. g. a rotating plate condenser 169, is driven in continuous rotation by means of a motor 168 in such a way as successively to tune receiver 167 through all the frequencies of the range covered by condenser 169, e. g. at a speed of the order of 50 revolutions per second, or of any other suitable value for producing a circular pattern 163 on screen 162 of the cathode ray tube 161. The stations operating within the supervised frequency range appear on this pattern 163 in the form of radial traces 180 directed outward or inward according to the direction selected for the variation of the voltage that produces them and distorts the circular scanning. The thus "modulated" circular scanning is produced, for example, by an induction rotating system 165, such as an electromagnetic deflection coil driven in rotation around the neck of cathode ray tube 161 by the same motor 168 that drives the tuning circuit 169 of control receiver 167 in the manner indicated by the connection 174, or at least in synchronism with this tuning circuit. This coil 165 is fed by the output of receiver 167, e. g. by means of a wiper collector ring 166.

Since tuning condenser 169 has only one useful 180° rotation, the portion of its rotation from 180° to 360° that reproduces the frequency exploration obtained in its rotation from 0° to 180° but asymmetrically with respect to this first exploration, it is necessary to suppress on the screen of the indicating oscillograph 161 the luminous traces that correspond to this undesired portion of the exploration. As mentioned above, the operation of receiver 167 is blocked during the undesired halfturn of variable condenser 169. This can be effected by means of an oscillator 171 and a commutator 170 that is also driven in synchronism with condenser 169, so as to apply to receiver 167 a blocking voltage proceeding from oscillator 171 during the undesired periods of the rotation of condenser 169.

In this way, each time that the tuning circuit of receiver 167 comes across a transmission during the exploration of the frequency range covered by this receiver, there will appear on screen 162 a radial trace that makes visible the presence of the transmitting station. It is of course advisable to choose extreme selectivity for the receiver 167, so that the stations may appear on screen 162 of the indicating tube 161 in the form of well separated radial traces 180.

The monitoring receiver 178 is of similar design to control receiver 167, but its tuning circuit, e. g. a rotating plate condenser 177, has an angular position that is manually adjustable by means of a knob 176. In order to effect easy and rapid adjustment of this monitoring receiver to the frequency of any of the transmitting stations located by the radial traces 180 on screen 162, the rotor of a reversed radio direction finder of goniometer 175 is keyed to the shaft of rotation of the manually adjustable condenser 177. This rotor is fed by a suitable high frequency source which, in the example shown in the drawing, consists of the oscillator 171 already used for suppressing the undesired indications on screen 162 of the indicator. This high frequency voltage may be directly applied to the rotor of the reversed finder 175 from commutator 170, so that the voltage transmitted to rotor 175 is periodically interrupted at the cadence of interruption of the feed of coil 165 but during supplementary periods.

The high frequency voltage applied to the rotor of the reversed finder 175 is transmitted to the two stators, and the two voltages in quadrature thus obtained are applied by the detecting amplifier circuit 172 to a circular scanning circuit 173 arranged for radial deflection of the spot. This deflection circuit may be of any well known electrostatic or electromagnetic type. This will result in the appearance on screen 162 of oscillograph 161 of a radial line 164 whose angular position will depend on the angular position of the rotor with respect to the stators of the reversed finder 175, accordingly on the angular position of tuning condenser 177 under control of the manual knob 176.

The rotation of motor 168, accordingly the operating time of commutator 170, is to be selected sufficiently rapid, e. g. 50 cycles per second as mentioned above, for the alternation of the two scannings produced by circuits 165 and 173 to take place at a cadence that will insure persistence of the luminous indications due to these two scannings. Accordingly, on screen 172 there will actually be obtained the simultaneous indications of the stations detected by the control receiver 167 and of the adjustment position of monitoring receiver 178.

Since the tuning condensers 169 and 177 of receivers 167 and 178 are disposed so as to cover the same frequency range during their rotation, and since the two scannings are controlled at the same speed, it results that when the luminous spot actuated by the circular scanning system 165 is at a definite frequency, it will positively occupy the same angular position as when it is deflected by scanning circuit 173 for the angular position that corresponds to the same frequency of condenser 177. In order to adjust the monitoring receiver 178 to one of the transmitting stations that appears in the form of a radial trace 180 on the screen of the cathode ray tube 161, it will then suffice to turn the control knob 176 for the manual adjustment of receiver 178 until the radial pointer 164 is brought into coincidence with the radial trace 180 of the station that it is desired to monitor.

Receiver 178 may be connected to a monitoring device 179, e. g. a loudspeaker or an earphone, and/or to any other indicating or servicing device, either for the recording or retransmission of signals or for radio direction finding purposes, by connecting the input circuits of receiver 178 to suitable aerial systems. Besides, the outputs of the two receivers 167 and 178 may be connected either separately or simultaneously to any circuit for remote angle repetition, e. g. to a circuit terminating in one or more cathode ray indicators similar to that of Fig. 1, in order directly to reproduce the angular indications substantially without inertia and with all desirable fidelity.

In systems of this kind, it is of course possible to modify the luminosity of the various portions of the obtained images by displacement of the spot. Thus in Fig. 13 which illustrates the screen 162 of a cathode ray tube employed as indicator in the manner just described, the radial traces 183, 184 and 185 of the stations in course of operation may appear strongly luminous, as well as the luminous pointer 186 for adjustment of the monitoring receiver. On the other hand, the circular scanning pattern 182 that moves along the graduated scale 181 and gives the scale of the frequencies is of attenuated luminosity. Since such methods for varying the luminosity of indications on a cathode ray tube screen by variations of bias are well known per se, they will not be explained in detail.

Fig. 14, to which reference is now made, shows schematically one embodiment which permits the observation of transmitting stations in course of operation over a wide frequency range, the adjustment of a monitoring receiver to a particular transmission, and the taking of the radiodirectional bearing of this transmission manually or by automatic direct reading. In this embodiment, certain features of the invention provide for the use of only one single circular scanning system for producing the various desired indications on a cathode ray tube screen.

This method is specially suitable when use is made of cathode ray tubes that have a large screen diameter. Only magnetic deflection is employed with this kind of tube, and, in view of the dimensions and the considerable voltages that are used, it is advisable to concentrate the deflection field as much as possible, since this permits construction of tubes that are of small diameter in the cylindrical portion. In order to employ only one single deflection system, the receiving circuit shown in Fig. 14 provides for a magnetic circuit 202 which rotates around the neck of cathode ray tube 201. The rotation of this circuit 202 permits circular displacement of the spot on screen 217 of the cathode ray tube 201. This deflection system 202 is connected by commutator 203 to the output stages 213 of the control receivers 212 and the monitoring receiver 235. A commutation, e. g. electronic, is provided in order to permit alternate connection of the supply circuit of the circular deflection element 202 either to the control receiver 212 or to the amplifier circuit 216 which is fed in such a way as to furnish the position of the frequency adjustment of monitoring receiver 235. Motor 204 drives in continuous rotary motion the assembly of the devices secured to shaft 205, i. e. the deflection system 202, the rotating tuning condenser 206 of control receiver 212, the high frequency static distributor such as 207 that feeds the commutation device 214 of the output stages 213, and the induction distributor or finder 208 whose orthogonal stators 231 and 232 occupy a definite fixed angular position.

As described above, instead of effecting the scanning of cathode ray tube 201 by means of a variable condenser of special profile, the scanning is performed by a tuning condenser of the

control receiver 212 that is of normal shape during only 180° of its rotation. The second half-turn is used for causing the appearance of the other desired indications.

The static distributor 207 is fed by a high frequency oscillator, for example, and during the half-turn when receiver 212 is blocked, i. e. during the undesired half-turn of variable condenser 206, distributor 207 gives the output circuit 213 of receiver 212 such a bias that receiver 212 no longer acts on the circular scanning of magnetic element 202, and this causes the spot to appear on the cathode ray tube screen only during one half-turn 216.

On the same shaft as the variable tuning condenser 227 of the monitoring receiver there is keyed an induction distributor 228 whose two orthogonal stators 229 and 230 occupy fixed positions. Variable condenser 227 may, for example, be controlled manually by the adjusting knob 226 and this condenser is given a profile similar to that of the rotating variable condenser 206, so as to use the same scale of frequencies on screen 217 for the indication of the adjustment of monitoring receiver 235 as for the indications of supervision. Induction distributor 228 comprises a rotor which has its angular position controlled by knob 226 and which determines the phase relations of the sinusoidal voltages induced in the orthogonal stators 229 and 230. The rotor of distributor 228 receives over the constant coupling transformer 234 a high frequency voltage proceeding, for example, from the oscillator 215 already used for the commutation of the output circuits. The high frequency voltage induced in the stators 229 and 230 is transmitted to the two other stators 231 and 232 within which the rotor of induction distributor 208 rotates, which distributor, by means of the constant coupling transformer 233, restores to output amplifier 216 the high frequency voltage proceeding from the first induction distributor. The angular position for which the induced voltage will be nil in the rotor of distributor 208 will of course depend on the angular position of the rotor of induction distributor 228.

In Fig. 15, curve 242 shows the variation in amplitude during the progressive rotation of shaft 205 of the high frequency current that enters amplifier 216. This voltage variation is used by means of output circuit 213 for operating this circuit during the half-turn when the cathode ray tube 201 does not serve for giving the control indication. The directly amplified high frequency voltage might be used over known types of circuits, but it is preferable to detect the envelope curve 242 in order to use the continuous component. In Fig. 15A, the circle 245 illustrates the circular path described by the spot on a cathode ray tube whose rotating deflection circuit is fed by the continuous component, and the image 244 illustrates the trajectory of the spot when the circular deflection system 202 is fed by a curve of the type of component 242 that actuates an output tube whose cut-off point P only permits amplification of the voltage tip 243 during the time $t$. It is this tip 243 that furnishes the image 244. This image would be double, i. e. there would be two similar images staggered by 180° if cathode ray tube 201 was used during the complete rotation of the circular scanning for giving an indication of the component detected by amplifier 216. But since the tube is only used during a half-turn, as mentioned above, only the single image 244 will appear. The shape of this image will depend on the saturation point of the output tube, on the characteristics of the detection, on the polarizations, and on the size of the signal. It is usual to obtain very tapered images in which the angle $a$ is very small, which corresponds to a very short time $t$. The image 244 may then be almost confused with a radial line.

On screen 217 of cathode ray tube 201 of Fig. 14 there is consequently obtained the luminous ray 225 which indicates the angular position of the variable condenser 227 that tunes the monitoring receiver 235. Since the same frequency scale is used, it is easy to bring the luminous pointer 225 into coincidence with one of the luminous traces 224 furnished by control receiver 212 and representing a transmission to be monitored.

Furthermore, in order to avoid too intense an illumination of the screen by the continuous circle of the scanning, it is possible by suitable biasing and modulation in the known manner of the control grid of the cathode ray tube to reinforce the luminous traces 249, 250, 251 (Fig. 16) that represent stations detected by the control receiver 212 and to diminish to a great extent the luminosity of the reference semi-circle 248. In order to avoid any confusion with the image 252 of the index that shows the adjustment in frequency of the monitoring receiver to the other images produced on cathode ray tube 240, it appears preferable to have the image 252 of this luminous index appear as a dotted line. This is accomplished during the appearance of this index by modulating the grid of the cathode ray tube by means of a high frequency signal that permits successive illumination and extinction, or simply very rapid modulation in intensity, of the spot of the cathode ray tube during the relatively slow radial displacement that furnishes the image 252.

The monitoring receiver 235 may be connected to an electronic or mechanical commutator 238 that permits monitoring or traffic over a non-directional aerial 240, or else the taking of a radio-directional bearing of a station by paralleling the receiver to an antenna system 239 of the kind usually employed in radio direction finding, it being possible to take the bearing manually by the control knob 241 or by an automatic finding device. It is then possible to key on the same shaft an induction distributor 237 of a kind usually used for the remote transmission of the radio-directional or other indications in order to repeat to a distance the angular indications of the radio direction finder.

By a combination similar to that just described for causing the indication of the adjustment frequency of the receiver to appear on cathode ray tube 201 simultaneously with the control indication, the image of the direction of the monitored station may be produced on this same tube by alternating this indication with the others but at a cadence that is sufficient for retaining the luminous persistence of all the indications. This image may be the one that corresponds to the manual adjustment of control knob 241, but it may also be the one produced automatically by any suitable radio-directional direct reading device. On the screen of the cathode ray tube 240 (Fig. 16) the image 253 shows the direction of the transmitter producing the signal 250 to which

the monitoring receiver is adjusted, as shown by the luminous pointer 252. The circular graduated scale 257 may be divided in degrees, or indeed the measurement of the directions may be effected on a second graduated scale 255, preferably of different radii, so as not to overcrowd the same scale.

The radiodirectional image 253 may be obtained by keying on the rotary shaft 205 a resistance coupled distributor having a sinusoidal distribution of the voltages. By means of the commutation circuit of the output stages 213, direct use may also be made in the circular scanning circuit 202 of the output voltage of receiver 235 which may itself be fed by a rotating radio direction finder, either manually or at a constant speed in synchronism with the rotation of the scanning circuit 202.

In the various embodiments that have just been described, the cathode ray tube that is used as indicator is located directly in the axis of rotation of the frequency scanning system. According to certain of its features, the invention also provides circuit arrangements that permit the indicating cathode ray tube to be located at a certain distance from the axis of the mechanical scanning system while retaining the synchronous circular deflection, and while using a single deflection system. An arrangement of this kind also makes it possible to use several indicating systems that may without particular difficulty repeat the indications to considerable distances.

In Fig. 17, which illustrates schematically one example of an arrangement of this kind, the cathode ray tube 261 comprises a rectangular deflection system 262. This deflection system may consist of pairs of orthogonal plates, or stationary inductances. Deflection system 262 is connected to an amplifier or detector 263 which is itself connected to a carrier current generator 268 by lines 264 and 265 and across a rotating induction distributor 267. The carrier current is modulated by the different signals that it is desired to show on the screen of the indicating cathode ray tube 261. This assembly constitutes the remote repetition circuit that permits the connection to line 266 of a certain number of amplifying elements in association with indicating cathode ray tubes similar to amplifier 263 and to cathode ray tube 261.

The motor 269 drives the rotating plate condenser 270, the static commutator such as 271, the induction distributor 267, and any other necessary member as described in the preceding embodiments. Condenser 270 is connected to receiver 272 and the output circuits that feed the carrier current emitter 268 may be actuated by any other member 273 that permits the obtaining of indications of a different kind, as described above. With an arrangement of this kind, it is accordingly possible to have as many indicating tubes as desired at different locations.

It must be understood that numerous modifications and adaptations may be made in the different examples of embodiments shown and described without departing from the scope of the invention, both as regards the methods and the corresponding scanning circuits that are employed, as well as the groups of circuits that permit the showing of the desired indications on the screen of a single cathode ray tube used as indicator. It must also be understood that the elements and circuits that are of well known design have not been described in detail since they do not specifically form part of the present invention.



I claim:

1. A combined transmission supervision and direction finding system comprising a receiver, means to tune said receiver through a predetermined band of frequencies, an indicating device, means to produce an indication on said device each time said receiver receives a signal from a transmitter, means to separate the indications thus produced so as to identify the frequencies corresponding thereto, a direction finding antenna system associated with said receiver, means to change the directivity of said antenna system, and means to indicate on said indicating device a direction of any particular transmitter being received by said receiver.

2. A combined transmission supervision and direction finding system in accordance with claim 1, in which the indicating device is a cathode ray tube and the indication of each transmission appears as a luminous trace on the face of said tube.

3. A combined transmission supervision and direction finding system in accordance with claim 1, in which the indicating device is a cathode ray tube upon which each transmission received appears as a luminous trace and in which means is provided for eliminating a particular trace when the directivity of said direction finder antenna system bears a predetermined angular relation to the direction of the transmitter at which said transmission originates.

4. A system in accordance with claim 1, in which means are provided for alternatively tuning said condenser automatically or manually.

5. A system in accordance with claim 1, in which one half cycle of the tuning of said receiver is rendered ineffective.

6. A combined transmission supervision and direction finding system comprising a receiver, means to tune said receiver through a predetermined band of frequencies, an indicating device, means to produce an indication on said device each time said receiver receives a signal from a transmitter, a direction finder antenna system associated with said receiver, means to change the directivity of said antenna system, means to indicate on said indicating device the direction of a particular transmitter being received by said receiver, driving means rotated at a substantially constant speed, and manually operated means to alternatively connect said driving means to said receiver tuning means or to connect said manual means to said receiver tuning means for manual tuning of said receiver.

7. A system in accordance with claim 6, in which the indication means is a cathode ray tube.

8. A system in accordance with claim 6, in which the indicator means is a cathode ray tube and in which means is provided to extinguish the luminous spot of said tube during a half cycle of the tuning of the receiver.

9. A combined transmission supervision and direction finding system comprising a receiver, means to tune said receiver through a predetermined band of frequencies, an indicating device, means to control the indication of said device in one coordinate of a two coordinate system with the tuning of said receiver, means to control the indication in the other coordinate by signals received by said receiver, direction finding apparatus associated with said receiver, means to adjust the directivity of said apparatus so that a particular signal received by said receiver will be ma-

terially altered when the directivity of said direction finding apparatus bears a predetermined relation to the direction of the transmitter producing said signal, and means to indicate on said indicating device the orientation of said directivity of said direction finding apparatus when a particular signal is so materially altered.

10. A system in accordance with claim 9, in which the indicating device is a cathode ray tube and means is provided to produce the indication of signals received with said band during one half cycle of the tuning of said receiver, and means is provided during the other half cycle of the tuning of said receiver to produce an indication on said tube of the orientation of the directivity of said direction finding apparatus.

11. A system in accordance with claim 9, in which the indicating device is a cathode ray tube and in which the indication is produced thereon in polar coordinates.

12. A combined transmission supervision and direction finding system comprising a receiver, means to tune said receiver repeatedly through a predetermined band of frequencies, a cathode ray tube, means to cause the spot of said cathode ray tube to trace a circle in synchronism with the tuning of said receiver, means to cause said spot to deviate from said circle when a signal is received by said receiver during one half of the cycle of the tuning of said receiver, a direction finding antenna system connected to said receiver, means to adjust the directivity of said antenna system, means to cause the spot of said cathode ray tube to trace a circular path in said tube in synchronism with the movement of the directivity of said antenna system during the other half of the cycle of tuning of said receiver and means to cause said spot to oscillate along a radial line during said other half of the tuning cycle.

13. A system in accordance with claim 12, in which the means to produce the indications from the output of the receiver during one half of the tuning cycle is an electronic commutator operated by the tuning means.

14. A system in accordance with claim 12, in which the deflection circuit for the cathode ray tube is connected alternatively to the output of the receiver and to the means for controlling the movement of the spot during the other half cycle of tuning.

15. A combined transmission supervision and direction finding system, comprising a receiver, means to tune said receiver through a predetermined band of frequencies, a cathode ray tube, a deflection circuit for said cathode ray tube, a first goniometer mechanically connected to said tuning means, means to feed an alternating current into the rotor of said goniometer, means to feed the output of said receiver into the rotor of said goniometer, a direction finder antenna system, means to adjust the directivity of said system, a second goniometer having its rotor mechanically operated by said antenna adjusting means, means to feed an alternating current into the rotor of said goniometer, means to feed the output of said receiver into the rotor of said goniometer, and means to connect the stators of said first and second goniometer alternately to said deflection circuit.

16. A system in accordance with claim 15, in which the means to connect the stators of the goniometers alternately with the deflection circuit of the cathode ray tube comprises an electronic commutator.

17. A system in accordance with claim 15, in which the means to alternate the goniometer connections to the deflection circuit of the cathode ray tube operates at a sufficiently high rate so that both indications will appear to an observer simultaneously on the face of the tube.

18. A combined transmission supervision and monitoring system comprising a control receiver, means to tune said control receiver through a predetermined band of frequencies, an indicating device, means to produce an indication on said device each time said receiver receives a signal from a transmitter, means to separate the indications thus produced on said indicating device in a predetermined manner so that the frequency of the signals received may be identified, a monitoring receiver, means to tune said receiver through said same band of frequencies, and means to produce on said indicating device an indication corresponding to the frequency at which said monitoring receiver is tuned.

19. A system in accordance with claim 18, in which the indicating device is a cathode ray tube.

20. A system in accordance with claim 18, in which the indicating device is a cathode ray tube and the deflecting device comprises a coil rotatably mounted about the neck of said tube and means is provided to connect said coil alternately to the output of the control receiver and to the indication producing means of the monitoring receiver.

21. A combined transmission supervision and monitoring system comprising a control receiver, means to tune said receiver through a predetermined band of frequencies, a monitoring receiver, means to adjust the tuning of said monitoring receiver, a first goniometer having its rotor mechanically connected to the tuning means for said control receiver, a second goniometer having its rotor mechanically connected to the adjusting means for the monitoring receiver, means respectively to connect the stators of said two goniometers together, means to supply an alternating current to the rotor of said second goniometer, means to detect the output of the rotor of said first goniometer, a cathode ray tube having a rotating deflecting coil, and means alternatively to connect said detecting means and the output of said control receiver to said deflecting coil.

22. A system in accordance with claim 21, in which means is provided to connect the output of said control receiver to said deflecting coil during one half only of the tuning cycle of said control receiver.

23. A combined transmission supervision, direction finding, and monitoring system comprising an indicating device, a control receiver, means to tune said control receiver through a band of frequencies, a monitoring receiver, means to adjust the tuning of said monitoring receiver, a direction finder apparatus, means to produce an indication on said indicating device representing the signals received when said control receiver is tuned through said frequency band with identification of the frequencies of the signals received, means to produce an indication on said indicating device of the adjustment of said monitoring receiver, means to produce an indication on said indicating device of the orientation of the directivity of said direction finding apparatus, and means sequentially to connect said three indication producing means to said indicating device.

24. A system in accordance with claim 23, in which the indicating device is a cathode ray tube.

25. A system in accordance with claim 23, in which the means for sequentially connecting the indication producing means to the indicating device comprises an electronic commutator.

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