Send to: NANCHAHAL, NEHA
PIERCE LAW CENTER
2 WHITE ST
CONCORD, NH 03301-4176

Time of Request: Wednesday, August 01, 2007 11:22:12 EST
Client ID/Project Name:
Number of Lines: 352
Job Number: 1862:40494094

Research Information

Service: Terms and Connectors Search
Print Request: Current Document: 28
Source: Utility, Design and Plant Patents
Search Terms: inventor(robert /2 rines)

28 of 81 DOCUMENTS

UNITED STATES PATENT AND TRADEMARK OFFICE GRANTED PATENT

2833854

Link to Claims Section

May 6, 1958

Electric system

INVENTOR: HARVEY RINES ROBERT

APPL-NO: 520988 (02)

FILED-DATE: February 3, 1944

GRANTED-DATE: May 6, 1958

PRIORITY: February 3, 1944 - 19440520980, United States (US)

PUB-TYPE: May 6, 1958 - Utility Patent having no previously published pre-grant publication (A)

PUB-COUNTRY: United States (US)

US-MAIN-CL: 342#179

CL: 342

SUMMARY:

The present invention relates to electric systems, and more particularly to radio-receiving systems that, while having more general fields of usefulness, are especially adapted for use in television.

An object of the invention is to provide a new and improved radio-locator system for both detecting the presence of a body and rendering it visible.

Other and further objects will be explained hereinafter and will be particularly pointed out in the appended claims.

The invention will now be more fully explained in connection with the accompanying drawings, in which Fig. 1 is a diagrammatic view of circuits and apparatus arranged and constructed in accordance with a preferred embodiment thereof; Figs. 2 to 7 are explanatory diagrams, drawn to scale in relation to one another, diagrammatically illustrating the timing of the operation of the various parts; Fig. 2 is a sine-wave illustration of the operation of the hsreindescribed alternator 508; Fig. 3 is a graph illustrating the operation of the hereinafter-described pulse generator 138; Fig. 4 represents a saw-tooth wave produced by suitable design of the resistance of the hereinafter-described resistor 144 and the capacitance of the hereinafter-described capacitor 140; Figs. 5, 6 and 7 correspond to Figs. 2, 3 and 4, but representing the operation of the hereinafter-described positive-pulse generator 159, instead of the positive-pulse generator 138; Fig. 8 is a diagram showing the airplane object from which ths radio waves are reflected and scattered to the receiving system of Fig. 1; and Figs. 9 and are explanatory schematic circuit diagrams.

An electromagnetic-wave generator 4 is shown exciting a dipole 2 to produce ultra-high-frequency pulsed-radio energy, say, of 3 or 1.5 centimeters wave-length. A continuous-wave or any other type of modulated-wave generator may be employed, but pulsed energy, at present, has the advantages of economical and easy high-power ultra-high-frequency generation.

The waves emitted from the dipole 2 may be directed by a reflector 3 upon a parabolic reflector 6. The parabolic reflector 6 is shown directing the v/aves toward an object, say, an airplane 8, from which they are reflected and scattered toward a receiving station. The beam of radio waves directed toward the object S by the parabolic reflector 6 is wide enough to include the whole object 8.

At the receiving station, the radio waves thus reflected and scattered from the object 8 may be focused by an electromagnetic dielectric lens 5, such as polystyrene, upon a bank or array 7, comprising a plurality of normally ineffective insulated radio-receiving pick-up unit anienna elements, such as dipoles. The dielectric lens 5 may bs replaced by any other type of well-known lens, mirror or other directive system for focusing the electromagnetic energy scattered and reflected from the object 8 en the bank or array 7 of dipole elements.

The dipoles of the bank or array 7 are shown arranged in the form of rows and columns, in the proximity of .

the focal plane of the lens 5. The first or uppermost row of the bank is illustrated as comprising the dipoles 10, 12, 14, 16, etc., shown as equally spaced horizontally. The second row from the top is shown comprising the dipoles 18, 20, 22, etc. The third or next-lower row is shown comprising the dipoles 24, 26, etc., and so on for the remaining rows of dipoles. Though only a small number of dipoles is shown in each row, this is merely for illustrative purposes, and in order not to confuse the disclosure. It will be understood that, in practice, a large number of dipoles will be employed in each row. In order to fix the idea, for purposes of description, let that number be chosen as 36. In actual practice, the number of dipoles in each row may be quite large, say, 180.

The dipoles 1, 18, 24, etc., are arranged in the first or left-hand column. The dipoles 12, 20, 26, etc., are disposed in the second column from the left. The dipoles 14, 22, etc., are disposed in the third column from the left, and so on. Dipoles 51, 53 and are shown to represent a random row of dipoles. There may be as many columns as there are dipoles in each row-36 or 180, or whatever other number is adopted. Though each column is shown as comprising only a very few dipoles, this is again in order not to complicate the drawings. In actual practice, the number of dipoles in each column may be quite large, say, again, 180. A system of rows and columns will produce good picture definition of large close-range objects for a three-centimeter wave, assuming a tcn-ioch oscilloscopic face.

As the v/hole array of the dipole antenna sections is disposed in the path of the waves reflected and scattered from the object 8, the antennae will, of course, all receive the reflected or scattered radio waves through the lens 5 simultaneously. There will be focused on each antenna section a radio-frequency voltage corresponding to the scattering from a corresponding area of the object 8. The pick-up elements will thus receive different field strengths of radio energy, corresponding to the amount of energy reflected or scattered from the various parts of the object 8 and converged upon the array 7 of dipoles by the lens 5. A radio-energy picture of the object 8 is thus recorded upon the array, specific elemental areas of which will correspond to specific elemental areas of the object 8. By means of the present invention, this radio-energy picture may be converted into a visible picture 123. According to the preferred embodiment of the invention, the visible picture 123 is caused to appear upon the fluorescent viewing screen 106 of a display cathode-ray oscilloscope tube 9. Though the tube is shown operating on the electrostatic principle, magnetic deflection or a combination of magnetic and electrostatic forces may be employed. The invention provides a means for producing upon the screen 106 images corresponding to the radio-frequency energy received by the dipoles. Provision is made for first rendering the normally ineffective dipoles 1, 12, 14, 16, etc., of the first row successively effective momentarily; for then rendering the dipoles 18, 20,22, etc., of the second row successively effective momentarily; for then rendering the dipoles 24, 26, etc., of the third row successively effective momentarily; and so on.

A preferred way of effecting this result is with the aid of a plurality of photoelectric cells, equal in number to the

number of dipoles, and arranged in a bank or array 9 of rows and columns to correspond to the bank or array 7 of the rows and columns, respectively, of the dipoles. The first or uppermost row comprises the equally spaced photoelectric cells 28, 30, 32, 34, etc., corresponding to the dipoles 10, 12, 14 and 16, etc., respectively, of the first row of dipoles. The second row from the top comprises the equally spaced photoelectric cells 36, 38, 40, etc., corresponding to the dipoles IS, 20, 22, etc., of the second row of dipoles. The third row comprises the equally spaced photoelectric cells 42, 44, etc., corresponding to the third row of dipoles 24, 26, etc., and so on. The first column of photoelectric cells 28, 36, 42, etc., corresponds similarly to the first column of dipoles 10, 18, 24, etc. The second column of photoelectric cells 30, 38, 44, etc., corresponds to the second column of dipoles 12, 20, 26, etc. The third column of photoelectric cells 32, 40, etc., corresponds to the third column of dipoles 14, 22, etc., and so on. A photo-electric cell is thus provided corresponding to each dipolc. Thus, photo-electric cells 45, 47 and 49 of a random row of the bank 9 of photo-cells are illustrated as corresponding to dipoles 51, 53 and 55, respectively, of the corresponding random row of the bank 7 of dipoles. Corresponding photoelectric cells and dipoles may occupy corresponding positions.

Provision is made for momentarily illuminating the photoelectric cells successively in the order in which the corresponding dipoles are rendered successively effective. To this end, according to the illustrated embodiment of the invention, a scanning-telescope carrier 46 is continuously rotated uniformly, in the direction of the curved arrow, by a motor 48. The carrier 46 supports a number of preferably horizontally disposed telescopes 50, 52, 54, 56, etc., each telescope a little below and to the left of the preceding telescope, in the form of a helix. The outer lenses 59 of the telescopes are shown disposed along a vertical cylindrical surface 67. The vertical distance between adjacently disposed telescopes should cor-respond to the vertical distance between the corresponding adjacently disposed rows of photoelectric cells. If rows of dipoles and photoelectric cells are used, there should desirably be telescopes, one for each row, arranged along a helical curve that extends throughout exactly degrees. The telescopes may be spaced equiangularly. If telescopes are employed, for example, they will naturally be angularly displaced two degrees from one another. For the sake of simplicity of description, however, only 36 telescopes are illustrated, corresponding to the assumed 36 rows of dipoles.

The telescopes may he provided with any desired source of illumination. The illustrated source of illumination is a phosphorescent tube 58 located at the focus of the telescopes, and the axis of which coincides with the axis of the cylindrical surface 67.

During the rotation of the carrier 46, the first telescope will scan the first row of photoelectric cells 28, 30, 32, 34, etc., to illuminate them momentarily at successive intervals. If the carrier 46 is rotated uniformly, the photoelectric cells 28, 30, 32, 34, etc., of this first row will be scanned by the first telescope at equal time intervals. The second telescope 52 will similarly scan the second row of photoelectric cells 36, 38, 40, etc. The third telescope 54 will similarly scan the third row of photoelectric cells 42, 44, etc., and so on.

The carrier 46 should preferably be positioned at such distance from the photoelectric cells that the angle subtended at each telescope between the first and last columns of the bank 9 of photoelectric cells shall be approximately the same as the angle between two adjacently disposed telescopes. If telescopes are employed, this will be two degrees. The second telescope 52 will then scan the first photoelectric cell 36, of the second row, at approximately the same time interval after the first telescope illuminates the last photoelectric cell of the first row as the tune interval between successive scannings of the successive photoelectric cells 28, 30, 32, 34, etc., of the first row of photoelectric cells. The third telescope 54 will similarly scan the first photoelectric cell 42, of the third row, at approximately the same time interval after the second telescope 52 has illuminated the last photoelectric cell of the second row, and so on.

During a single rotation of the telescope carrier 46 by the motor 48, therefore, all the photoelectric cells of the bank 9 will be scanned, in succession, at equally spaced intervals of time, beginning with the first cell 28 of the first row, and ending with the last cell of the last row. Continued rotation of the carrier 46 by the motor 48 will result in successive repetitions of this scanning process.

It is now in order to explain how the momentary illuminations of the photoelectric cells, resulting from this

scanning, renders the corresponding dipoles successively effective momentarily.

Tbe photoelectric cell 28 is provided with a cathode and an anode, shown respectively connected, by conductors and 62, into the input circuit, between the control electrode 64 and the cathode 61, of an electron tube 66. This input circuit is shown provided with a biasing means 63. An impulse is accordingly produced in this input circuit in response to the momentary illumination of the photoelectric cell 28. The effect of this impulse is to transmit an impulse into the output circuit of the tube 66, between the cathode 61 and the plate 68. In this output circuit, connected by conductors and 72, there is disposed an armature winding 74 for closing a switch 76. Upon the closing of the switch 76, one element of the dipole becomes connected by a conductor 78 to an amplifier tuned to the radio frequency of the received radio waves. The other element of the dipole is permanently connected by a conductor 82 to the amplifier 80. When the switch 76 becomes closed, the input impedance to the amplifier becomes matched, and any radio wave received by the antenna dipole from the airplane 8 through the lens 5 will therefore become amplified by the amplifier 80.

The amplifier is connected, by conductors 84 and 86, to a rectifier 81 which, in turn, is connected, by conductors and 87 to the control-grid electrode 92 and the cathode 94 of the vacuum-tube part 88 of the oscilloscope 90. The normal electrode-voltage supplies are omitted from the drawing, for simplicity. The connections 78, 82 and 84, 86 are shown as wires, whereas they would actually be preferably low-loss ultra-high-frequency coaxial lines.

The antenna dipoles become thus successively connected, through the amplifier and the rectifier 81, to the control electrode 92. Electrons emitted from the cathode id 94 will become enabled, in response to the action of the amplifier and the rectifier 81, upon the closing of the switch 76, to pass by the grid 92, to the anode 96 of the oscilloscope tube 88. The electrons will continue to travel in a stream from the anode 96, between a pair of vertically disposed oscilloscope deflector plates 98 and 100, and then between a pair of horizontally disposed oscilloscope deflector plates 102 and 104, to impinge finally on the fluorescent viewing screen 106 of the oscilloscope 90. A horizontal-sweep-time base, applied to the vertically disposed deflector plates 98 and 100, will cause the electron stream from the cathode 94 to become deflected horizontally, and a vertical-swept-time base, applied to the horizontally disposed deflector plates 102 and 104, will cause the electron stream to become deflected verti00 cally.

Each of the photoelectric cells 30, 32, 34, ... 36, 38, 40, . . . 42, 44, ... of the bank 9 of photoelectric cells is connected to the input circuit of a vacuum tube similar to the tube 66 in the same way that the photoelectric cell 28 is connected to the input circuit of the tube 66. The photoelectric cell 30, for example, is thus connected to the input circuit of a vacuum tube 266, the photoelectric cell 32 to the input circuit of a vacuum tube 366, the photoelectric cell 36 to the input circuit of a vacuum tube 466, and so on. Most of these vacuum tubes and their connections are omitted from the drawings, for clearness. The connections of the photoelectric cells 30, 32 and 36 to the tubes 266, 366 and 466, respectively, are designated by reference numerals the same as those designating the connections of the photoelectric cell 28 to the tube 66, but augmented by 208, and 400, respectively. I the output circuit of the tube 266, conductors and 272 are shown connected to an arma< ire winding for closing a switch 108. In the output circuit of the tube 366, conductors and 372 are shown connected to an armature winding 114 for closing a switch 112. In the output circuit of the tube 466, conductors and 472 are shown connected to an armature winding for closing a switch 118.

The armature winding 110, when energized, closes the switch 18, to connect one of the elements cf the dipole 12 to the conductor 78. The armature winding 114, when energized, similarly closes the switch 112, to connect one of the elements of the dipole 14 to the same conductor 78. The armature winding 120, when energized, similarly closes the switch 118, to connect one element of the dipole 18 by way of a conductor 122, to the conductor 78. Each of the photoelectric cells is provided with an armature winding of this nature, for closing a corresponding switch, to connect one of the elements of ths corresponding dipole to the conductor 78. The other element of each of the dipoles is permanently connected to the conductor 82. This permanent connection is shown for the dipole 18 by way of a conductor 116.

Each dipole 10, 12, 14, 16, ... 13, 20, 22, ... 24, 26, . . . etc., of the bank 7 of dipoles becomes thus momentarily connected to the amplifier 80, in response to the successive illumination of the corresponding photoelectric cells 28, 32,

34, ... 36, 38, 40, ... 42, 44, ... etc., by the telescopes on the carrier djj, and the successive closing of the switches 76, 108, 112, . . . 118, etc.; and the control electrode 92 becomes thus successively energized by the amplifier 80. through the rectifier 81, to affect the operation of the electron stream from the cathode 94.

The magnitude of the voltage fed into the amplifier SIX from the dipoles 10, 32, 14, 16, ... 18, 20, 22, ... 24. 26, . . . etc., as they become successively matched to the input circuit of the amplifier by the momentary successive closing of the switches 76, 108, 112, . . . 118, etc., will depend upon the intensity of the radio-frequency voltage received from the object 8 through the lens S by the corresponding dipoles. The output of the amplifier will therefore vary, at successive instants, in accordance with the potential upon the successive receiving dipoles. Successive energizing positive voltages are thus produced from the amplifier 89 on the control electrode 92 of the tube part 88 of the cathode-ray tube 90, of magnitude proportional to ths radio-frequency energy received by the corresponding dipoles. This will permit the passage of the electrons, in quantities dependent upon the radio-frequency energy impinging on the particular dipole, to the anode 96, and between the pairs of vertically disposed deflecting plates 98, and horizontally disposed deflecting plates 102, 104. to the viewing screen 106.

It remains now to explain how to modify the electron stream, thus impinging on the viewing screen 106, in order to produce on the screen the visual likeness 123 of the original object 8.

The vertically disposed plate 98 is shown grounded, so as to connect with a grounded cathode of a horizontal-sweep electron tube 128. The other vertically disposed plate is shown connected, by a conductor 124, to the anode 136 of the electron tube 12?. The vertically disposed plates 98 and are thus connected in parallel with the cathode and the anode 126 of the tube 128, and in parallel also with a condenser 140, having a canacitance Ci, in the output circuit of the vacuum tube 128. This output circuit may be traced from the cathode 130, through a plate-supply battery 142 and an anode-load impedance, shown as a resistor 14<J, having a resistance Rj, to the anode 126. As will presently appear, the resistor 144 serves also as a charging resistor for the condenser 140. The condenser and the resistor 144 comprise a horizontal-sweep circuit.

The grounded cathode and the control electrode 132 of the tube 128 are shown respectively connected, by conductors 134 and 136, to a positive-pulse generator 138. The generator 138 is thus connected in the input circuit of the tube 128, to trigger the horizontal time-base sweep.

The generator 138 may be of any convenient type, such as is illustrated in Figs. 9 and 10. The motor 48 that rotates the scanning-telescope carrier 46 may rotate also a small multi-pole alternator of the generator 138. To this end, tJ2 motor 48 is shown connected to the generator by a shaft 139. The alternator may be provided with a sufficient number of poles to produce a train of sine-wave voltages, as shown in Fig. 1, having as many wave cycles as there are rows of photocells or dipoles. The sine-wave peaks are shown at 43. For the assumed number 36 of rows of photocells or dipoles, there may be 72 poles. This result may, of course, be brought about by suitable design in other ways also. Corresponding to each rotation of the motor 48, therefore, the said train of sine-wave voltages will be produced, equal in number 1o the number of dipoles or photocells in a row.

These voltages may be subjected to squaring by a squaring device 502, to differentiating by a differentiating circuit 504, and to clipping and inverting by clipping and inverting stages 506, according to customary television technique, to produce a short-duration positive pulse 59 (Fig. 3) and a long period 57 of quiescence, corresponding to each cycle of sine-wave voltage. There 3fJ will be one positive pulse 59 corresponding to each positive-cycle peak 43 of the sine waves. The number of these pulses 59 will therefore be 36, or 180, or whatever other number of rows of photocells and dipoles is adopted. By suitable design, as before described, the cycle of the short positive pulse 59 and the long subsequent quiescence 57 will be made to occur during a time interval equal to the period of illumination of all the photocells of one complete row.

The squaring circuit 502 may comprise a double triode, one of the triodes of which is shown at and the other at 107, and comprising cathodes 11 and 13, control-grid electrodes and 17 and anodes 19 and 21. The multi-pole generator

feeds a sine-wave voltage to the input circuit of the triode 105, between the cathode 11 and the control electrode 15. A conductor 23 connects the multi-pole generator to the control electrode and, through a biasing battery 25, to the cathode 11 of the triode 105. The conductor 23 is also connected to a grounded terminal 103 through the cathode-bias resistor 29.

The battery heavily biases the grid of the triode negatively with respect to the cathode 11. Thus the negative cycle of the sine-v/ave voltage input to the triode is squared off. This appears as a squared positive cycle voltage at the anode 19 of the triode 105, which is fed by a conductor 27 through a coupling condenser 22 to the control electrode 17 of the other triode 107. The anode 19 is also connected through the plate-load resistor 53 by a conductor 81 to the positive-plate-supply battery 101. The negative terminal of the supply battery 101, like the conductor 23, is grounded at 103.

The cathode 13 of the other triode 107 is biased by the battery and the resistors S7 and 29, so that ths cathode 13 is positive with respect to the ground, thus accomplishing the same purpose of effectively operating the tube 107 near cut-off; only positive or slightly negative voltages can cause conduction. The triode 107 therefore squares the undistorted cycle of its input voltage, producing a square-wave voltage at the anode 21. The anode 21 connects through a plate-load resistor to the plate-supply conductor 81. The anode 21 is also connected by a conductor 31 to the differentiating circuit 504, shown as comprising a series differentiating condenser 33, and a shunt resistor 35. One terminal 39 of the resistor is connected to the condenser 33 and the other terminal 71, by the conductor 37, to the grounded terminal 103. The square-wave output voltage of the tube 107 is thus fed from the anode 21 to the differentiating circuit 33, 35.

Other squaring and differentiating circuits may also be employed; for example, the double-diode square-wave generator and the differentiating circuit shown on pages 177-179 of Ultra-High-Frequency Techniques, by Brai-nerd, Koehler, Reich and Woodruff.

The terminals 39 and 71 of the differentiating resistor are connected to the control-grid electrode 73 and the cathode of one triode 109 of a further double triode 109, 111, of the clipper-phase-inverter circuit 506. The anode 77 of this triode 109 is connected by a conductor 99 through a coupling condenser 92 to the control grid 97 of the other triode 111. The resistor 79 is the plate-load resistor of triode 109 and connects to the positive plate-supply conductor 81. The cathode is connected to the ground 103, so is at ground potential. Only voltages positive with respect to ground on the grid 73 can therefore cause the tube 109 to conduct. Only the positive peaks of the differentiated form can, therefore, pass; the negative peaks becoming clipped off.

The negatively progressing voltage pulse at the anode 77 of the tube 109 is thus applied to the control electrode 97 of the triode 111. The cathode 91 of the triode 111 is connected through a cathode-bias resistor 89 to the cathode 75. The anode 93 of this triode 111 is connected, through a plate-load resistor 95, to the plate-supply conductor 81. The anode 93 also connects by conductor 136, through a coupling condenser 127, to the control electrode 132 of the horizontal-sweep tube 128. A positive pulse is thus produced on the anode 93, constituting a phase inversion of the voltage input to triode 111, and providing a triggering pulse for the horizontal-sweep tube 128.

In summary, since the triode is heavily biased by the negative voltage upon the control electrode from the battery 25, most of the negative cycle of the sine wave of Fig. 2 from the multi-pole generator is squared off, yielding a squared positive cycle of the voltage at the anode 19. This is fed to the control electrode 17 of the triode 107, by way of the conductor 27 and the coupling condenser 22. Since the triode 107 is operated with high cathode bias, to clip the negative cycle, a resulting square wave is fed through the condenser 33 and the resistor of the differentiating circuit 504. This circuit produces positive and negative pulses, the negative parts of which are clipped off by the triode 109. The resulting negatively progressing pulses at the anode of the triode 109 are converted into positive pulses at the anode 93 of the triode 111. These positive pulses are fed by the conductor 136, through the coupling condenser 127, to the control electrode 132 of the horizontal-sweep tube 128.

Since the generator 138 is connected in the input circuit of the tube 128, the control electrode 132 will be energized from the positive-pulse generator 138 at the same frequency as the frequency of the illumination of the successive rows of photoelectric cells; and at the same frequency, therefore, as the frequency with which the rows of dipoles are rendered successively effective. There will be one short pulse 59 during part of the time of the illumination of the first photoelectric cell of any particular row of photoelectric cells, followed by a period 57 of quiescence during the illumination of all the remaining photoelectric cells of that row.

In the normal operation of the tube 128, the condenser becomes charged from the battery 142 through the charging resistor 144 during the period 57 of quiescence of the tube 128. In response to an impulse from the positive-pulse generator 138 upon the input circuit of the tube 128, the condenser rapidly discharges through the output circuit of this tube, between the cathode and the anode 126. The frequency of charging and discharging of the condenser is once to every complete scan of a photocell row by the telescope carrier 46, or once to every corresponding complete scanning of a row of dipoles. A corresponding effect is produced, of course, between the vertically disposed plates 98 and of the oscilloscope 90, since they are also connected in the output circuit of the tube 128, in parallel with the condenser 140. The electron stream will therefore be deflected horizontally, between the vertically disposed plates 98 and 100, duriis the above-described period 57 of quiescence. The charging and the discharging of the condenser 140, to produce a horizontal sweep across the oscilloscope, may be according to the saw-tooth-wave form shown in Fig. 4. Each peak 41 of the saw-tooth wave is timed to take place with a short pulse 59 and a sine-wave peak 43.

As the tube 128 operates without bias, it will conduct only upon the application of the positive pulse from the generator 138. The electron stream becomes, therefore, quickly returned to its normal horizontal position through the oscilloscope tube 90, at this time, during the period of the application of the short pulse from the pulse generator 138. The electron stream will then again sweep across horizontally, as the condenser again charges through the resistor 144, during the period of quiescence of the tube 128. The time constant RiCi should be adjusted to produce the saw-tooth-wave form illustrated in Fig. 4, so that the exponential charging, during the periods of quiescence of the tube 128, shall be as nearly linear as possible for the period of quiescence of the tube 128. A paraphase or push-pull amplifier or similar device (not shown) may be used to make the sweep between the vertically disposed plates 98, even more nearly linear. The paraphase amplifier may constitute another stage to feed the plate 98 with the opposite phase of exponential voltage, so exerting a push-pull effect between the vertically disposed plates 98, 100, thus to improve the linearity.

The horizontally disposed plate 104 is shown grounded, so as to connect with a grounded cathode 154 of a vertical-sweep electron tube 150. The other horizontally disposed plate 102 is shown connected, by a conductor 146, to the anode 148 of the vacuum tube 150. The horizontally disposed plates 102 and 104 are thus connected in parallel with the cathode 154 and the anode 148 of the electron tube 150, and in parallel also with a condenser 160, having a capacitance Cj, in the output circuit of the tube 150. This output circuit may be traced from the cathode 154, through a plate-supply battery 162 and an anode-load impedance, shown as a resistor 164 having a resistance R2, to the anode 148. The resistor 164 serves as a charging resistor for the condenser 160, and to measure the voltage charge on the condenser 160, which operates similarly to the operation of the condenser 140. The grounded cathode 154 and the control electrode 152 of the tube are shown respectively connected, by conductors 156 and 158, to another positive-pulse generator 159, preferably similar to the generator 138, illustrated in Figs. 9 and 10, for controlling the vertical deflection of the oscilloscope. The generator 159 is connected to the motor 48 similarly to the connection of the generator 138, by the shaft 139. The pulse generator 159 should be designed to operate in a manner similar to that of the operation of the generator 138. It should not, however, be multi-poled, but should rather be designed to produce one complete sine-wave voltage 113, as shown in Fig. 5, corresponding to every complete rotation of the motor 48, and hence to every complete scan of the bank of photocells and dipoles. The zero of the sine wave 113 is timed with the zero 117 of the group of sine waves shown in Fig. 2. This sine-wave voltage may be subjected to pulse-generating circuits similar to the squaring circuit 502, the differentiating circuit 504 and the clipper-andphase-inverter circuit 506, to produce a short pulse 167 at the time of the zero to the sine wave 113, and a long period of quiescence 1C9, as shown in Fig. 6, once to every complete scan of all the rows of photocells and dipoles.

The operation of the tube is similar to that of the tube 128. The condenser 16 becomes charged from the battery 162 through the charging resistor 164 during the period of quiescence of the tube 150. In response to an impulse from the positive-pulse generator 159 upon the input-circuit of the tube 150, the condenser discharges through this tube, between the cathode 154 and the anode 148. The frequency of the charging and discharging of this condenser is once to every complete rotation of the telescope carrier 46, or once to every complete scanning of the bank of dipoles. A corresponding effect is produced between the horizontally disposed plates 102 and 104, since they are also connected in the output circuit of the tube 150, in parallel with the condenser 160. The electron stream is correspondingly deflected, as described above, but vertically, between the plates 102 and 104.

The charging and the discharging of the condenser 160, therefore, provide a graded voltage applied on the horizontal plates 102 and 104 of the oscilloscope, as illustrated by the curve 119 in Fig. 7. A successively lowered time base is thus provided, corresponding to the successive rows of dipoles.

The operation is in other respects the same as already described in connection with the vertically disposed plates 98 and and the tube 128. The tune constant of the condenser and the resistor 164, R2C2, should be so adjusted that the exponential charging, during the periods of quiescence of the vacuum tube 150, shall be as nearly linear as possible. Paraphase amplifiers or similar devices (not shown) may here, too, be used to improve the linearity, if desired.

After each horizontal sweep has been completed, a successively larger voltage will be applied to the horizontally disposed deflector plates 102 and 104 by the vertical-sweep circuit 160, 164. After the last such horizontal sweep, the voltage between the horizontally disposed plates 102 and 104 will become restored to zero. The next horizontal sweep, therefore, will start again at the first or top row.

Successively disposed areas of the screen 106 will therefore correspond to the similarly disposed antenna dipoles. Each spot along a particular horizontal sweep will become brightened on the screen 106 according to the amount of radio energy received by the corresponding dipole, and fed, by way of the amplifier 89 and the rectifier 81, to the control electrode 92 of the tube 88 of the cathode-ray oscilloscope 90.

To each row of dipoles, therefore, there corresponds, on the oscilloscope screen 106, a horizontal electron stream that is graded in intensity, due to the application of signal voltages, from successive dipoles of the row, on the oscilloscope control-grid electrode 92, This intensity is distributed in synchronism with the corresponding state of charge of the condenser 140. This provides for successive horizontal-time bases on the screen, and the successive areas of the screen 106 are thus illuminated in synchronism with the effective reception of the radio energy by the corresponding dipoles. To each successive row of dipoles, moreover, there corresponds a successively lowered level of operation of the electron stream on the screen 106 of the oscilloscope, corresponding to the measured voltage applied at that instant by the vertical-sweep circuit.

The sweeps of the electron stream will thus produce intensity modulation on the oscilloscope screen 106, corresponding to the radio-frequency distribution on the dipole antennae of the bank 7. The radio waves received successively by the antenna units along the successive rows and columns will thus become converted into successive portions of the visual likeness 123, along correspondingly disposed rows and columns thereof, along the successive time bases. The visual picture 123 of the aircraft object 8 on the oscilloscope screen 106 will accordingly correspond to the radio-frequency picture on the array 7 of dipoles which, in turn, corresponds to the actual object 8. Each radio-receiving element corresponds to a predetermined elemental portion of the object, from which elemental portion it receives the radio waves.

Assuming that the size of the object 8 is known, the position of the lens 5 to produce a sharp electromagnetic image on the array 7 of dipoles, coupled with the size of the visual image 123, may be used to deduce range, by simple geometrical optics. If, for example, the object seen is a fighter, or a bomber, plane, the size of the image, divided by the known size of the fighter or bomber, will have the same ratio as the ratio between the distance of the lens 5 from the bank 7 of antennae, adjusted to obtain clear vision, divided by the distance of the object 8. The range of the object 8

may also easily be obtained by monitoring the pulse emission and reflection if radio pulses are used, on a separate oscilloscope, according to common practice.

Although the invention has been described in connection with antennae arranged in rows and columns, it will be understood that this is not essential, for other arrangements are also possible. Antennae arranged along concentric circles covering the field, or a continuous spiral, will also serve, though the oscilloscope arrangement would, of course, be correspondingly modified. In the case of the concentric circles and the spiral, the antennae would be rendered effective in two-dimensional order, as in the case of the rows and columns before described. The antennae disposed along one of the circles, for example, would first be rendered effective, then those along the next circle, and so on.

Further modifications will occur to persons skilled in the art, and all such are considered to fall within the spirit and scope of the invention, as defined in the appended claims.

ENGLISH-CLAIMS:
Return to Top of Patent

What is claimed is:

1. An electric system having, in combination, a plurality of normally ineffective means for receiving radio waves from an object, a radio-frequency tuned circuit responsive to the frequency of the radio waves, relay means for successively connecting the radio-receiving means to the radio-frequency tuned circuit to render the radio-receiving means successively effective, and means controlled synchronously with the connecting means and responsive to the radio waves received by the receiving means when rendered effective and fed to the tuned circuit for producing a likeness of the object.

2. An electric system having, in combination, a plurality of radio-receiving means for receiving radio waves from an object, radio-frequency tuned-circuit means responsive to the frequency of the radio waves, means for connecting the plurality of receiving means successively to the radio-frequency tuned-circuit means, a cathode-ray-oscil00 loscope having a screen and means for producing an electron stream impinging on the screen, means for deflecting the electron stream in synchronism \vith the successive connection of the radio-receiving means to the tuned-circuit means, and means cooperative with the tuned-circuit means for modulating the electron stream to produce a likeness of the object on the screen.

3. An electric system as claimed in claim 1 and in which the relay means comprises photo-electrically controlled means.

4. An electric system as claimed in claim 1 and in which the relay means embodies switching means.

5. An electric system as claimed in claim 1 and in which means is provided from focusing radio waves from an object upon the receiving means.

(References on following page)

LOAD-DATE: October 13, 2005

1029ZH

********** Print Completed **********

Time of Request: Wednesday, August 01, 2007 11:22:12 EST

Print Number: 1862:40494094
Number of Lines: 352
Number of Pages: 9

Send To: NANCHAHAL, NEHA
PIERCE LAW CENTER
2 WHITE ST
CONCORD, NH 03301-4176