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December 9, 1958

Radio-receiving and scanning system

INVENTOR: HARVEY RINES ROBERT

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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. The present application is a division of application, Serial Number 527,375, filed March 18, 1944.

An object of the invention is to provide a new and improved radio-receiving system embodying a novel cathode-ray-tufae member having a novel radio-receiving mosaic.

Another object is to provide a new and improved television system.

Another object of the present 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 more 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; Fig. 2 is a view of a modification; Fig. 3 is a diagram showing an airplane object from which radio waves are reflected and scattered to the receiving system of Fig. 1; and Fig. 4 is a view of a further modification.

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-lengths. A continuous-wave or any other type of modulated-wave generator may be employed, but pulsed energy, at present, has the advantage of economical and easy high-power ultra-high-frequency generation.

The waves emitted by the dipole 2 may be directed by a reflector 3 upon a parabolic reflector 6. The parabolic reflector 6 is shown directing the waves toward an object, say, an airplane 8, from which they are reflected and scattered toward a receiving station.

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 radio-receiving pick-up unit antenna elements. The dielectric lens 5 may be 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 on the bank or array 7 of pick-up elements.

The pick-up elements of the bank or array 7 are shown arranged in two dimensions 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 sections 10, 12, 14, 16, etc., shown as equally spaced horizontally. The second row from the top is shown comprising the sections 18, 20, 22, etc. The third or next-lower row is shown comprising the sections 24, 26, etc., and so on for the remaining rows of pick-up elements. Though only a small number of pick-up un ts is shown in each row, this is merely for illustrative purposes, in order not to confuse the disclosure. It will be understood that, in practice, a large number of pick-up units will be employed in each row, say, 180.

The sections 10, 18, 24, etc., are arranged in the first or right-hand column. The sections 12, 20, 26, etc., are disposed in the second column from the right. The sections 14, 22, etc., are disposed in the third column from the right, and so on. There may be as many columns as there are pick-up units in each row. Though each column is shown as comprising only a few pick-up units, this is again in order not to complicate the drawings.

The pick-up units will, of course, all receive the reflected or scattered radio waves through the lens 5 simul-taneously. There will be focused on each pick-up unit radio-frequency energy of a voltage corresponding to the scattering from a corresponding view 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 pickup elements by the lens 5. A radio-energy picture o the object 8, as will presently be explained, 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 fluores-cent viewing screen 106 of a display cathode-ray oscilloscope tube 90. Though the tube 90, and also the hereinafter described cathode-ray oscilloscope-like member 89, are 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 1S6 images corresponding to the radio frequency energy received by the pick-up elements.

Provision is made for first rendering the normally in-effective pick-up units 10, 12, 14, 16, etc., of the first row successively effective momentarily in the display circuits; for then rendering the pick-up units 18, 20, 22, etc., of the second row successively effective momentarily; for then rendering the pick-up units 24, 26, etc., of the third row successively effective momentarily; and so on, the pick-up units thus being rendered effective in two-dimensional order.

The pick-up units are shown arranged in an insulating disc, bank or array 9, at the screen end of the

oscillo-scope-like member 89, and the pick-up units may be constituted of small crystal beads of uranium oxide in-sulatingly set into the support disc 9. Any similar mosaic of radio-wave absorbing and rectifying crystals such as silicon, for example, may be employed. The beads 10, 12, 14, 16, etc. of the first row are all connected to a grounded strip 43. The beads 18, 20, 22, etc., of the second row are similarly shown all connected to another grounded strip 51. The beads 24, 26, etc., of the third row are similarly shown all connected to a third grounded strip 57, and so on.

The cathode-ray-oscilloscope-like member 89 is shown provided with a cathode 95, a control-grid electrode 93 and an anode 97. Electrons emitted from the cathode will become enabled, in response to proper stimula-tion of the grid 93, to pass by the grid 93 to the anode 97 of the member 89. The electrons will continue to travel in a stream from the anode 97 between a pair of vertically disposed deflector plates 99 and 101, of which the plate 99 is shown grounded, and between a pair of horizontally disposed deflector plates 103 and 105, of which the plate is shown grounded, to impinge finally on the disc 9 of the member 89. A horizontal-sweeptime base, applied, as hereinafter more fully explained, to the vertically disposed deflector plates 99 and 101, will cause the electron stream from the cathode to become deflected horizontally, and a vertical-sweep-time base, applied to the horizontally :dispo"s"ed "deflector plates 103 and. 105, will cause the electron stream to become deflected vertically. The rows of pick-up units may be positioned along the successive paths of the electron stream so that the stream can impinge on them as the electron stream successively sweeps out the successive rows of the array 7. The front surface of each crystal pick-up element is exposed in the direction of the incoming radio waves, and the rear surface of each element is exposed within the cathode-ray-tube member; 89 to the electron stream.

If, accordingly, the lens 5.is caused to focus the radio-energy picture on the oscilloscope-like, member. 89, the bank of uranium-oxide globules will act to absorb the incident energy. Silicon and uranium oxide detectors and similar crystals are known to absorb radio-frenquency energy, and to. exhibit negative temperature coefficients of resistance. Because of its high temperature coefficient of resistance, the resistance of the uranium oxide will change with the intensity of the impinging radio-frequency energy.

The radio:frequency energy will become" rectified to produce direct-current potential differences across the resistance of the uranium oxide. This results from the detecting properties of the uranium oxide in the radio-receiving circuits traceable from the crystal electrodes through the crystals to the grounded conductor 78. These potential differences are respresentative of the radio-frequency energy impressed on the uranium oxide in the radio-receiving circuits comprising the uranium oxide units and the ground conductor 78. The variations of resistance and potential along the bank of globule beads are thus a measure of the radio-frequency energy impinged on the array by the lens 5. The resistance of the uranium oxide, since its temperature coefficient is negative, changes with the intensity of the impinging radio-frequency energy. The resistance variation thus also produced along the bank of uranium-oxide beads is representative of the radio-frequency energy received by the respective beads.

A radio-energy image of the object 8 becomes thus recorded upon the array of uranium-oxide beads.

The bank of uranium-oxide: globules may be scanned according to either of two principles or according to a combination of the same. One principle involves measuring the variation in the resistance of the--bank at the moment that the electron stream impinges upon the successively disposed beads to short-circuit them. This provides, a measure-of the-resistance across the-uranium-oxide beads, indicative of the radio-frequency energy impinged on the particular .bead upon which the electron stream has impinged. The other principle involves measuring in the amplifier 79 the current along the electron stream as it impinges upon areas of different potential of .the variably resistive beads/completing the circuit to the. ground through the successive crystals by way of the conductor 78.

Each .uranium-oxide bead will absorb and rectify "the radio-frequency energy. Dependent upon the magnitude of this energy, it will change the resistance of the uranium oxide. This change will "result as a consequence of the. absorption and the rectifying action by the uranium oxide of the radio-frequency energy "received by it. As. the ..electron stream successively impinges upon the successively disposed uranium-oxide"beads, during the scanning, :it successively measures-the resistance of the successive crystals. This produces a corresponding change in the input

voltage to a grounded preferably linear amplifier 79, indicative of the radio-frequency energy impinged on the respective uranium-oxide beads.

The scanning of these crystals may obviously also operate on the principle of change in electron-beam current upon impinging ori su ffaces of vafious pb tentials. As the stream hits these crystals of different potentials, a change in beam current occurs, which manifests itself in the input circuit of the amplifier 79.

Mosaics of silicon, as shown in Fig. 1, or alternate sections of silicon and metal,: as shown in Fig. 4, or dielectric and silicon, may be mounted in the disc 9 of the oscilloscope S9, "and may similarly be used as a scanning mosaic. Radio-frequency energy-impinged on the metal sections 200, 202, etc., will produce rectified voltages across me adjacently-disposed silicon sections 201, 203, etc.,"in""the radio-receiving circuits traceable from the metal sections through the adjacently disposed silicon sections by way of the common lead 78. The rectifying sections of silicon may follow the square law in their response, but this can be compensated for by proper design of the amplifier 79- (page 492 of "Ultra High Frequency .Technique.;," by" Brairie rd, Koehler, Reich and tVbbdruff, 1942 edition).

The exposed silicon" -sections will also absorb "radio energy and exhibit a negative-resistance effect. The electron scanning of the successive silicon sections will thus operate, as before described, to measure the resistance variation of the sections, or "the" change in beam current upon impinging on sections of different potential, or according to a combination of the "two principles.

As the electron stream produced from the cathode 95, in response to appropriate horizontal sweep-time-base voltages applied to the vertically disposed deflector plates 99 and 101 of the cathode-ray-tube-like member 89, travels across the pick-up elements in the disc 9, it will successively discharge into the amplifier 79, by way of a conductor 78. If desired, "the amplifier"79 may be replaced by a bank of linear amplifiers, one corresponding to each of the pick-up elements.

The output of the amplifier 79 will obviously -vary, at successive instants, in accordance with the radio-frequency energy received by the successive corresponding pick-up elements.

A pulse generator may be employed to trigger a horizontal-time-base-sweep circuit 63--and a vertical-sweep circuit 69, according to conventional "and well-known television technique. The pulse generator may feed, through an attenuator and rectifier 1, to an oscillator or any similar or equivalent television circuit. One such -circuit is shown ; as a pulse-recurrence-frequency multiplier 65, for applying, many pulses corresponding to each radio-frequency pulse for the period between successive radio pulses, to trigger the horizontal-sweep circuit 63. The horizontal-time-base sweep will thereby be produced between the vertically disposed deflector plates 99 and 101, occurring as many times, say, between successive radio-frequency transmissions, as there are rows of pick-up antennas. The pulse generator may also feed, through the attenuator and rectifier 1, to trigger the vertical-sweep circuit 69, once corresponding to every radio-frequency transmission. One vertical sweep will then occur between the horizontally disposed plates 103, 105 during the period between successive radio-pulse transmissions, corresponding to as many horizontal sweeps as there are rows of antennas, causing each of the horizontal sweeps to appear at successively lower levels on the oscilloscope-sweep face.

If the circuit comprises an oscillator, "the oscillations may be employed to-trigger the horizontal sweep. The period of the oscillations which; as "previously explained, is much less than the duration of each radio-pulse, corresponds to the time of sweep across one row of the pick-up :units in the disc 9. If, as previously mentioned, continuous-wave radio transmission is employed, the vertical sweep circuit 69 may be triggered to produce one vertical sweep corresponding to as many horizontal sweeps from the horizontal-sweep circuit 63 as there are rows of receiving units.

Means is provided for producing upon the screen 106 of the display oscilloscope 90, images corresponding to the radio-frequency energy received by the corresponding pick-up mosaic antenna elements. The screen 106 is illuminated by an electron stream in the oscilloscope 90. 5 This electron stream is synchronized to travel with the electron stream of

the cathode-ray-like member 89. The horizontal-sweep circuit 63 is connected to the horizontal-deflector plate of the oscilloscope by a conductor 67, and to the horizontal-deflector plate 101 of the oscilloscope-like member 89 by the conductor 67 and a conductor 124. The vertical-sweep circuit 69 is connected to the vertical-deflector plate 102 of the oscilloscope by a conductor 71, and to the vertical-deflector plate 103 of the oscilloscope-like member 89 by the conductor 71 and a conductor 146.

The amplifier 79 is connected, by conductors 84 and 86, to a phase-inverter stage or stages 81 which, in turn, are connected, by conductors and 87, to the control-grid electrode 92 and the cathode 94 of the oscilloscope 90. 20 The mosaic beads become thus successively connected, through the amplifier 79 and the phase-inverter 81, to the control electrode 92. Electrons emitted from the cathode 94 will become enabled, in response to the action of the amplifier 79 and the phase-inverter 81, to pass by the grid 25 92, to the anode 96 of the oscilloscope tube 90. The electrons will continue to travel in a stream from the anode 96, between the pair of vertically disposed oscilloscope deflector plates 98 and 100, of which the plate 98 is shown grounded, and between the pair of horizontally disposed oscilloscope deflector plates 102 and 104, of which the plate 104 is shown grounded, to impinge finally on the fluorescent viewing screen 106 of the oscilloscope 90. The horizontal-sweep-time base applied to the vertically disposed deflector plates 98 and will cause the electron 35 stream from the cathode 94 to become deflected horizontally, and the vertical-sweep-time base, applied to the horizontally disposed deflector plates 102 and 104, will cause the electron stream to become deflected vertically, in synchronism with the horizontal and vertical sweeps 40 .scanning the mosaic 7 of the oscilloscope-like member 89.

After each simultaneous horizontal sweep of both the oscilloscope and the oscilloscope-like member 89 has been completed, a successively larger voltage will be applied to the horizontally disposed deflector plates 103, 45 and 102, 104, respectively, by the vertical sweep circuit. After the last such horizontal sweep, the voltage between the horizontally disposed plates 103,105 and 102, 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 of the oscilloscope will therefore correspond to the similarly disposed mosaic-antenna sections in the disc 9 of the member 89. Each spot along a particular horizontal sweep, therefore, will become brightened on the screen 106 according to the amount of radio energy received by the corresponding pick-up elements, and fed, by way of the amplifier 79 and the phase-inverting-and-amplifying circuit 81, to the control electrode 92 of the cathode-ray oscilloscope 90.

A more sensitive video signal device might be any well-known resistance-measuring circuit, such as a bridge detector of, say, the Wheatstone construction. If the uranium-oxide or other crystal globules have their resistances connected in a direct-current series circuit, then the bank of crystals may serve as an extremely sensitive radio-detecting element of a Wheatstone bridge, in which they may be balanced against fixed elements 212, 214 and 216, as shown in Fig. 2. The short-circuiting of each successive globule or resistance by the electron stream, diagrammatically shown as short-circuiting switches 205, 207, 209, 211, in parallel with the globules 204, 266, 20S, 210, would thus be markedly indicated in the amplifier 79 and fed to the control electrode 92 of the display oscilloscope 90, Although the invention has been described in connec-> tion with mosaic-antennas arranged in rows and columns, it will be understood that this is not essential, for other arrangements are also possible. Antennas arranged along concentric circles covering the field, or a continuous spiral, will also serve, though the oscilloscope arrangement would, of course, be correspondingly modified, as is well-known in the art, to render successive circles of the receiving units successively effective, in two-dimensional order.

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:
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What is claimed is:

1. An electric system having, in combination, an oscilloscope-like member having a mosaic of radio-receiving eiements for absorbing radio waves and means for producing an electron stream for impinging directly upon the elements, and means for causing said stream to scan the elements.

2. An electric system having, in combination, an oscilloscope-like member having a mosaic of absorbing-and-rectifying radio-receiving elements and means for producing an electron stream for impinging on the elements, and means for causing said stream to scan the elements.

3. An electric system, having, in combination, an oscilloscope-like member having a mosaic of uranium-oxide absorbing-and-rectifying radio-receiving elements and means for producing an electron stream for impinging on the mosaic, and means for causing said stream to scan the mosaic.

4. An electric system having, in combination, an oscilloscope-like member having a mosaic of silicon absorbing-and-rectifying radio-receiving elements and means for producing an electron stream for impinging on the mosaic, and means for causing said stream to scan the mosaic.

5. An electric system having, in combination, an oscilloscope-like member having a mosaic of alternately disposed silicon and metal radio-receiving elements and means for producing an electron stream for impinging on the mosaic, and means for causing said stream to scan the mosaic.

6. An electric system having, in combination, radio-receiving means, means for producing an electron stream for impinging directly upon the radio-receiving means, and means for causing the electron stream to scan the radio-receiving means.

7. An electric system having, in combination, radio-receiving-and-rectifying means, means for producing an electron stream for impinging on the radio-receiving-and-rectifying means, and means for causing the electron stream to scan the radio-receiving-and-rectifying means.

8. An electric system having, in combination, a plurality of radio-rectifying elements exhibiting negative temperature coefficients of resistance when exposed to radio waves, and means for producing an electron stream impinging on the elements.

9. An electric system having, in combination, an oscilloscope-like member having a mosaic of radio-receiving elements disposed in two dimensions and means for producing an electron stream for impinging directly upon the mosaic, and means for causing said stream successively to scan the elements in two-dimensional order.

10. An electric system having, in combination, an oscilloscope-like member having a mosaic of normally ineffective radio-receiving elements, means for producing an electron stream impinging directly upon the elements, and means for causing said stream to scan the elements successively to render them effective.

11. A cathode-ray-tube oscilloscope having a screen provided with a plurality of radio-receiving elements and means for producing an electron stream for impinging upon the screen, the front surfaces of the elements being exposed in the direction of the incoming radio waves and the rear surfaces of the elements being exposed within the cathode-ray-tube to the electron stream.

12. An electric system having,: in combination, an oscilloscope-like member having a mosaic of radio-wave absorbing-and-rectifying crystals, means for producing an electron stream for impinging on1 the crystals, and means for causing said stream "to scan the crystals.

13. An electric system having, in combination, an oscilloscope-like member having an insulation support and a

plurality of absorbing-and-rectifying" radio-receiving dements carriedthe -support, means for producing an electron stream for impinging onthe elements, and means for causing said stream to scan the elements.

14. An electric system having, in; combination, a plu-Tality of sets of radio-rectifying elements exhibiting negative temperature coefficients of resistance when exposed to-radio waves, the elements of each set being connected together to a common-terminal, a load, means for connecting the common terminals to the load, and means for producing an electron stream impinging on the elements.

15. An electric system having, in combination, an oscilloscope-like member Having a mosaic of-radio-wave absorbing-and-rectifying crystals disposed in two dimensions, means for producing an electron stream for impinging on the mosaic, and means for causing said stream successively to scan the crystals in two-dimensional order.

16. An electric system having, in combination, an oscilloscope-like member having a mosaic of normally ineffective radio-wave absorbing-and-rectifying crystals, means for producing an electron stream impinging on the crystals, and means for causing said stream to scan the crystals successively to render them effective.

17. A cathode-ray-tube oscilloscope having means for producing an electron stream and a screen provided with a plurality of radio-wave absorbing-and-rectifying crystals, the front surfaces of the crystals being exposed in the direction of the incoming radio waves and the rear surfaces of the crystals being exposed within the cathode-ray-tube to the electron stream, and means for directing the electron stream upon the rear surfaces of the crystals.

18. A mosaic having an insulating support, a plurality of radio-receiving-and-rectifying elements insulatingly set into the support in order independently to receive and rectify radio waves, and means for impinging an electron stream upon the mosaic.

19. A. mosaic of mutually insulated radio-receiving antenna elements each provided with means capable of absorbing and rectifying the radio waves received thereby, and means for impinging an electron stream upon the mosaic.

20. A mosaic having an insulating support, a plurality of antennas for independently receiving radio waves insulatingly set into the support, and means for impinging an electron stream upon the mosaic.

21. An electric system having, in combination, a mosaic comprising a plurality of antenna elements for receiving radio waves each provided with a radio-wave absorbing and rectifying element having a negative temperature coefficient of resistance, the resistance-of each absorbing and rectifying element varying in accordance with the radio waves received by: the -corresponding antenna element, means for focusing a distribution of radio waves upon the mosaic in order to produce a corresponding resistance distribution upon the absorbing and rectifying elements, and means for scanning the mosaic.

22. An -electric system having, in: combination, a mosaic comprising a plurality of antenna elements for receiving radio waves each provided with a rectifying element for producing a rectified voltage in response to the radio waves received, by the corresponding element, means for focusing a distribution of radio waves upon the mosaic in order to produce a corresponding rectifiedvoltage distribution upon the rectifying elements and means for scanning : the rectified-voltage distribution.

; 23.: An : electric system having, in: combination, a mosaic comprising a: plurality of antenna "elements for receiving. : radio Waves each"provided with a rectifying element for--producing" a rectified voltage: in response; to the radio "waves receivedthe corresponding., element, means for"; focusing-a "distribution of radio -wavesupon the mosaicrin order to produce a corresponding rectifiedvoltage : distribution upon the rectifying - elements. and electron-stream means for scanning: the : rectified-voltage upon the successive rectifying elements.

24. An electric system having, in combination, a mosaic -comprising a plurality of antenna elements, for receiving,

radio waves-each provided with a rectifying element for producing a rectified voltage in response to the radio waves received "by the corresponding : elernent, means for ..preventing ; interference between -adjacent antenna elements,: and means for impingingan .electron stream; upon :.the; mosaic.

-25. A. mosaic .having ..an insulating support andean antenna array comprising a .plurality of closely: spaced conductors of dimensions : appropriate to receive radio waves of a predetermined frequency, insulatingly sup-So .ported by the support in order independently to receive -the radio waves, each conductor being-provided with a rectifying element for rectifying the radio waves, received by the corresponding antenna conductor, and means for scanning the mosaic.

26: "An : electric system having,. in combination, a mosaic provided with an antenna array, comprising a plurality of closely .spaced conductors of. dimensions .appropriate to receive radio waves of a predetermined frequency, each conductor being provided with a crystal detector for rectifying the radio waves received by the corresponding antenna conductor, a load connected to the conductors, and means for scanning the antenna array to cause successive indications in the load representative of the radio waves received by the successive antenna conductors and rectified by their corresponding crystal detectors.

27. An electric system -having, in combination, a mosaic provided with - an .antenna array comprising a -plurality of closely spaced conductors of dimensions -15 appropriate : to-receive radio -waves: "of a predetermined frequency, means for rectifying the radio waves received by the antenna array, a load connected to the conductors, and means for scanning the antenna array to cause successive-, indications in the load representative of -the. radio waves received by the successive-antenna conductors-and rectified by the rectifying means.

28. A plurality of spaced rectifying . elements each having a conductor divided into two portions separated by a rectifying boundary region, means for supporting the rectifying elements in the form ; of a mosaic, each rectifying -element being poled with its conductive direction the same as the other elements in order., that radio waves received by the elements nay: give rise to alter-nating currents that are rectified at the rectifying bound -

aries to produce corresponding electric charges thereon, and electron-stream means for scanning the elements.

29. A plurality of spaced rectifying elements each having a conductor divided .into two portions separated by a rectifying boundary region, means for supporting the rectifying elements in the form-of a.mosaic, each rectifying element being poled with its conductive direction the same as the other elements in order that radio xvaves received by the elements may give rise te alternating currents that are rectified at the rectifying boundaries to pro-70-duce corresponding electric charges thereon-and means for periodically discharging the rectifying . elements in succession, thereby to produce a fluctuating current varying in accordance with the radio waves received by and the corresponding charges produced on the successive elements.

30. An electric system having, in combination, an oscilloscope-like member having a mosaic of dipole antenna radio-receiving elements and means for producing an electron stream for impinging on the elements, and means for causing said stream to scan the elements.

31. An electric system having, in combination, an oscilloscope-like member having means for producing an electron stream, a mosaic of radio-receiving elements each provided with and connected to a corresponding ing resistance distribution upon the absorbing and rectifying elements and means for measuring the resistance of the successive absorbing and rectifying elements.

34. An electric system having, in combination, a 5 mosaic comprising a plurality of antenna elements for receiving radio waves each provided with a rectifying element for producing a rectified voltage in response to the radio waves received by the corresponding element, means for focusing a distribution of radio waves electric circuit comprising a radio-wave absorbing-andupon the mosaic in order to produce a corresponding rectifying element, means for impinging the electron stream on predetermined portions of the radio-receiving-element electric circuits, and means for causing the

electron stream to scan the said predetermined portions of the radio-receiving-element electric circuits.

32. An electric system having, in combination, a mosaic comprising a plurality of antenna elements for receiving radio waves each provided with a radio-wave absorbing and rectifying element having a negative temperature corectified-voltage distribution upon the rectifying elements and means for measuring the rectified-voltage distribution. 35. An electric system having, in combination, a mosaic comprising a plurality of antenna elements for receiving radio waves each provided with a rectifying element for producing a rectified voltage in response to the radio waves received by the corresponding element, means for focusing a distribution of radio waves upon the mosaic in order to produce a corresponding rectified-voltage efficient of resistance, the resistance of each absorbing distribution upon the rectifying elements and means for and rectifying element varying in accordance with the measuring the rectified voltage upon the successive recti-radio waves received by the corresponding antenna element, means for focusing a distribution of radio waves upon the mosaic in order to produce a corresponding resistance distribution upon the absorbing and rectifying elements and means for measuring the resistance distribution so produced.

33. An electric system having, in combination, a mosaic comprising a plurality of antenna elements for receiving radio waves each provided with a radio-wave " absorbing and rectifying element having a negative temperature coefficient of resistance, the resistance of each absorbing and rectifying element varying in accordance with the radio waves received by the corresponding antenna element, means for focusing a distribution of radio " waves upon the mosaic in order to produce a correspondfying elements.

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