

July 21, 1942.

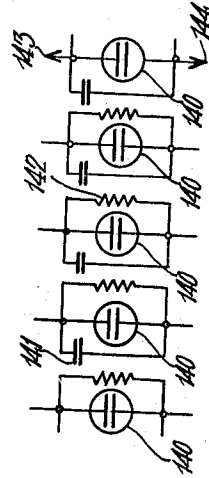
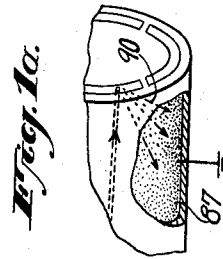
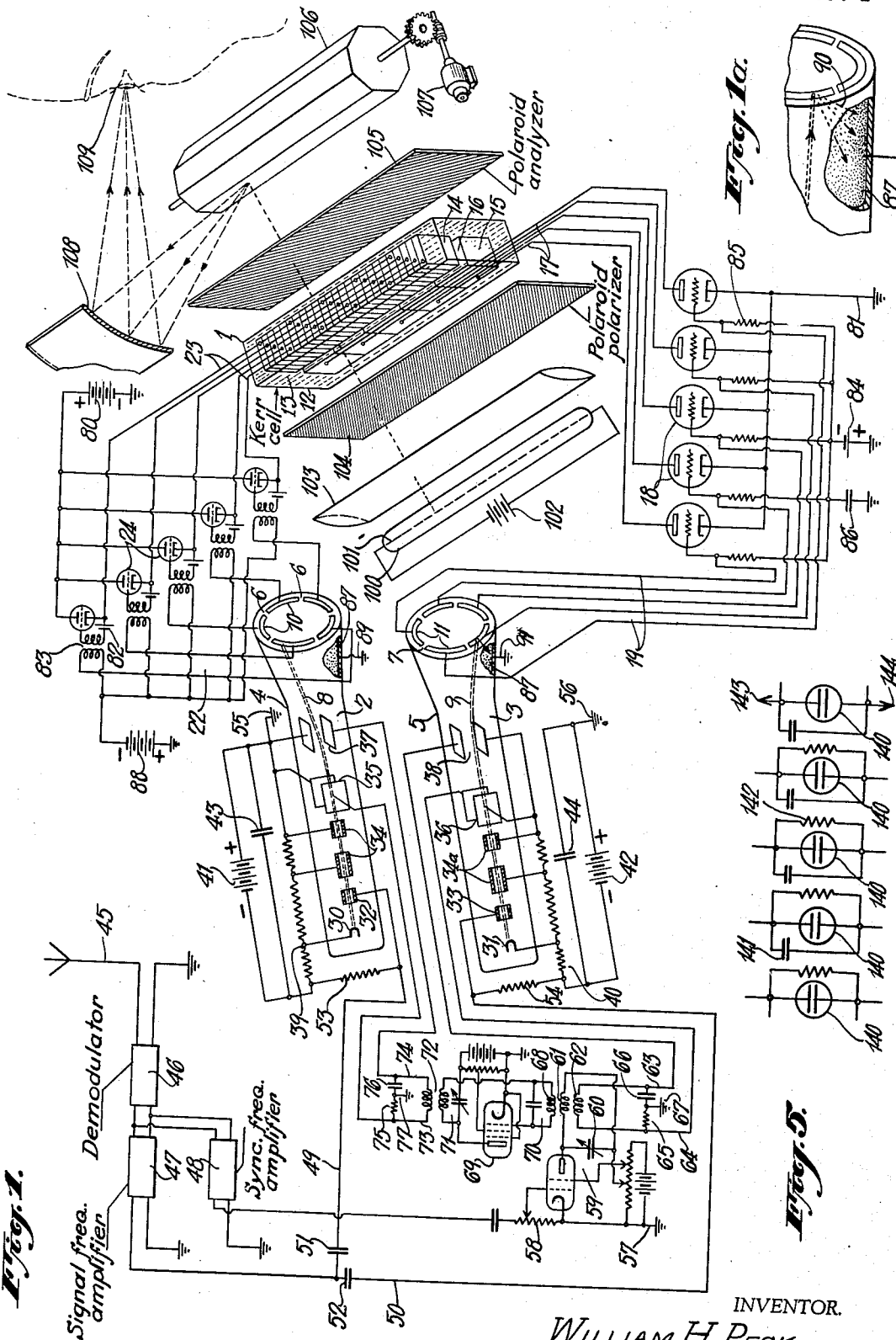
W. H. PECK

2,290,651

TELEVISION SYSTEM

Filed Sept. 26, 1939

2 Sheets-Sheet 1



INVENTOR.

WILLIAM H. PECK.

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ATTORNEYS

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W. H. PECK

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2 Sheets-Sheet 2

Fig. 2.

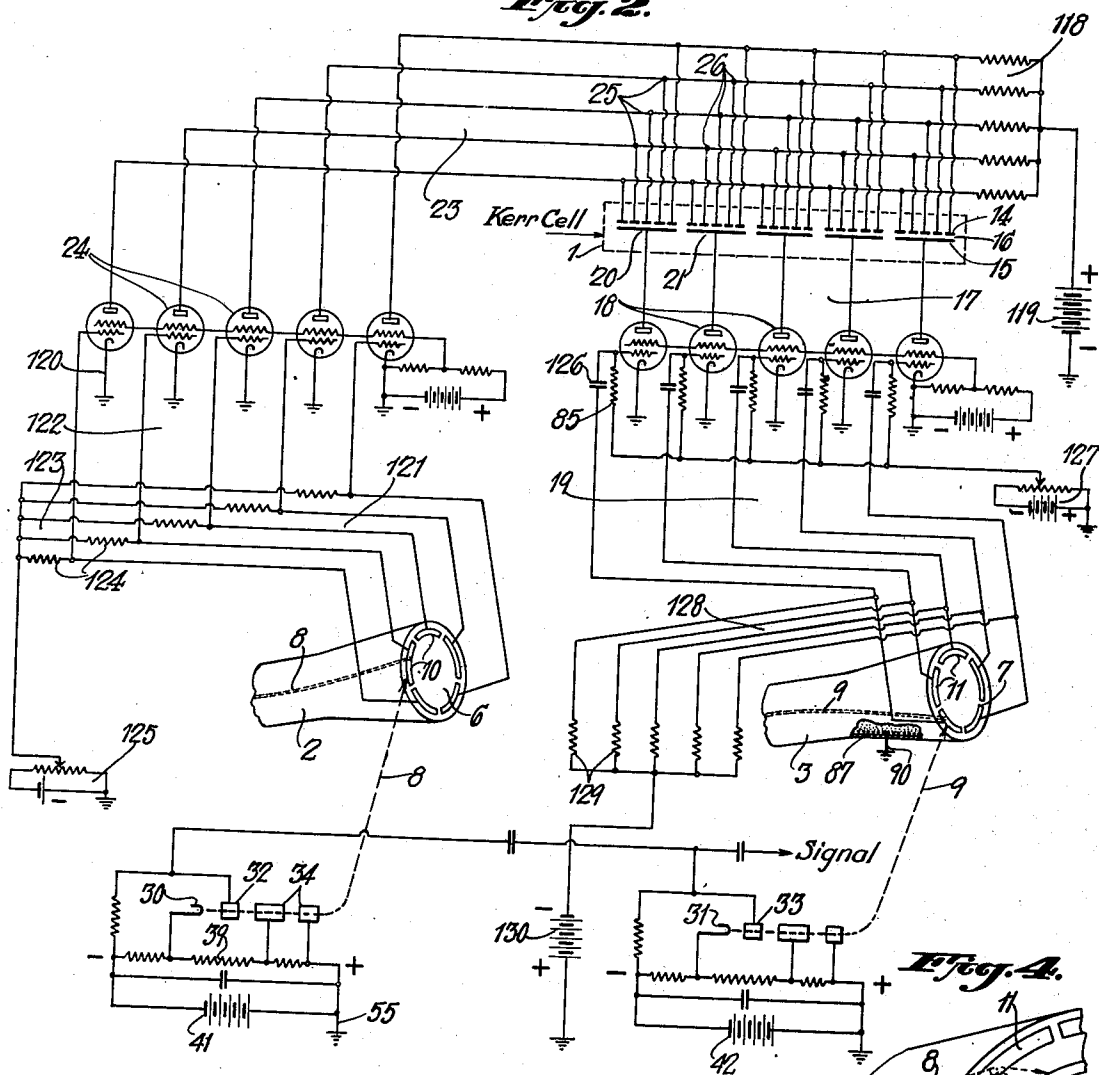


Fig. 3.

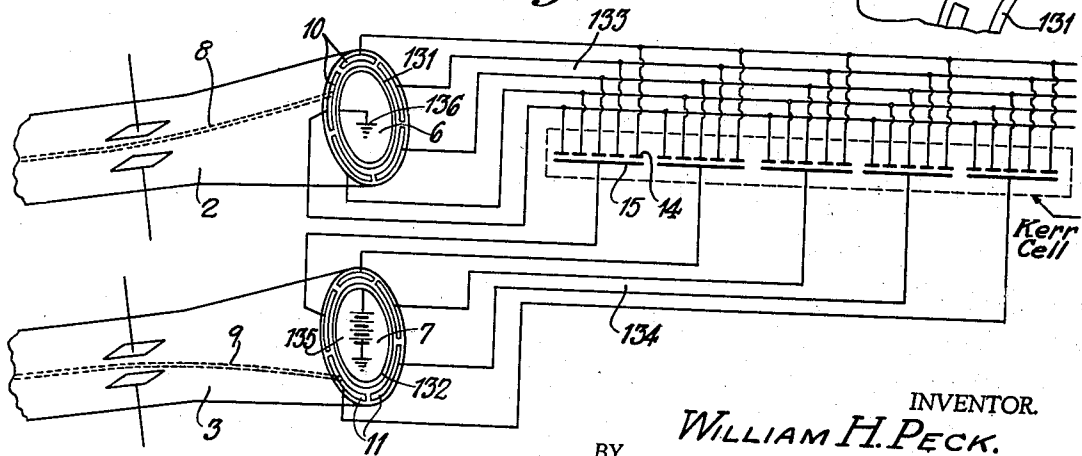
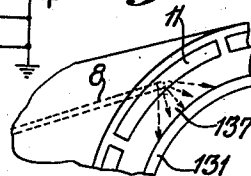


Fig. 4.



UNITED STATES PATENT OFFICE

2,290,651

TELEVISION SYSTEM

William H. Peck, Tarrytown, N. Y.

Application September 26, 1939, Serial No. 296,546

2 Claims. (Cl. 178-7.3)

This invention pertains to improvements in television systems, and more especially television receiving systems.

The invention introduces into such systems, a number of basically new features both as to mode of operation and as to apparatus employed. Thus, in accordance with one aspect of the invention, line scanning is effected by a new type of multiple unit Kerr cell, the individual cell units of which are successively energized in accordance with television signals over a relatively small number of leads, sealed through the glass container thereof, by means of a novel switching arrangement employing novel switches selectively actuated by electronic beam deflection, and hence involving no mechanically moving elements or inertia effects. The electronic beam referred to is also modulated in accordance with the television signals whereby switching and signal energization of the Kerr cells, are simultaneously effected by the same apparatus.

In the preferred embodiment, the electronic switching devices take the form of specially constructed cathode ray tubes in which the electronic cathode ray beam is caused to repeatedly traverse a plurality of conductive segments disposed about the circular screen thereof and insulated from one another, whereby switching is accomplished as the beam sweeps from segment to segment. The electronic beam is modulated in the usual way by television signals so that its incidence upon a given segment provides the signal intensity for appropriately energizing an associated Kerr cell in accordance with the signal.

By employing a pair of cathode ray tube electronic switches of the character above described, the requisite connections for successively energizing the Kerr cells may be greatly minimized. This is accomplished, in accordance with one feature of the invention, by connecting the Kerr cells in successive multiple groups to successive segments of one cathode ray tube, and by further successively connecting the cells within each such group to successive segments of the second cathode ray tube. It will be found that when so arranged, only one Kerr cell is connected between each different combination pair of segments in the first and second tubes respectively, a different cell for each such combination, and that the total number of Kerr cells which may be thus uniquely connected, is equal to the product of the segments in the one cathode ray tube by those in the other. If each tube contains the same number of segments, as is preferred, the number of Kerr cells which may be thus uniquely connected, is equal to the square of the segments in one tube; or stated conversely, the number of segments required per tube is equal to the square root of the number of Kerr cells. It will be

seen, therefore, that a large number of Kerr cells may be successively and uniquely energized over a relatively few connections sealed through the glass containers of the Kerr cell and of the cathode ray tubes, the total number of connections amounting to twice the square root of the number of Kerr cells.

For repeatedly energizing the Kerr cells in succession to effect line scanning, the cathode ray beams of the respective tubes are swept at different rates across the segments thereof, and such that the beam of one tube traverses all segments thereof while the beam of the other tube is passing over but one segment. This is in conformity with the mode of connecting the Kerr cells to the segments to provide the unique Kerr cell connections above stated for each combination pair of segments.

In accordance with various modifications of the invention as described hereinafter, the Kerr cells may be directly connected to the cathode ray tube segments, or may be connected thereto through vacuum tube amplifiers, either individually energized or energized from common battery sources as explained hereinafter.

With the system arranged as above outlined, each Kerr cell unit will respond to the impressed signal only so long as the cathode beams of the cathode tubes are simultaneously incident on the pair of segments to which such Kerr cell is connected. This may be a matter of but a few millionths of a second or usually even less. The interval of energization of each Kerr cell unit may be prolonged in accordance with a further aspect of the invention, by shunting each unit with a condenser and resistor in parallel. With this arrangement, the condenser charges up to the full signal strength the instant the signal voltage is impressed on its associated Kerr cell. Thereafter and while the impressed signal is passing on to succeeding cell units, the condenser by slowly discharging through its shunt resistor, maintains the signal voltage across the Kerr cell. The time constant of each such unit is so adjusted as to retain the signal on each cell for an interval approximating one line scan, while assuring, however, that the condenser will be fully discharged and the signal thus extinguished in time for the next signal energization.

The invention is, of course, not limited to the use of Kerr cells as the light controlling elements. These may be replaced by a row of neon tubes or other appropriate light valves on making the requisite, obvious circuit modification. The shunt condenser and resistor arrangement above described, is particularly applicable for adapting neon tubes to high speed scanning. As is well known, neon tubes alone are too sluggish in response for this to be actuated by a signal impressed thereon for but a few millionths of a

second. However, such response can be received in accordance with the invention by shunting the same with a condenser and resistor selected to retain the charge for approximately one line scan. The condenser, as stated, changes instantly to the full signal strength, while the resistor holds the charge until the tube has time to respond. With this arrangement, therefore, neon tubes may be employed for high speed televising as effectively as Kerr cells or the like.

In the drawings:

Fig. 1 is a schematic layout of a complete television receiving system in accordance with one modification of the invention, the optical system being shown in perspective and the electrical circuits diagrammatically. In this modification, individually energized vacuum tubes are interposed between the cathode ray tubes and the Kerr cells;

Fig. 1a is a fragmentary detail of one of the cathode ray tubes of Fig. 1;

Fig. 2 is a circuit diagram showing the requisite modification of the Fig. 1 layout for energizing the vacuum tubes from common battery sources;

Fig. 3 is a diagrammatic layout showing energization of the Kerr cells directly from the cathode ray tube segments and omitting the vacuum tubes of Figs. 1 and 2; while

Fig. 4 is a fragmentary detail of one of the Fig. 3 cathode ray tubes.

Fig. 5 is a diagrammatic showing of a row of neon tubes, Kerr cells or the like, employing the shunt condenser and resistor arrangement above described for holding the signal energization.

Referring to Fig. 1, the above-mentioned multiple unit Kerr cell, is shown at 1, and the cathode ray tube electronic switches at 2 and 3. Each tube 2, 3, comprises the usual hermetically sealed glass container 4, 5, the flared base 6, 7 of which provides a screen upon which the cathode ray beam 8, 9 is incident. Disposed about the screen on the interior of each tube, are the conductive segments, such as 10, 11, the number of which in each tube is determined by the number of Kerr cells to be energized as above explained. In the modification shown, and merely for purposes of illustration, each tube contains five such segments, whereby the cathode ray tubes are adapted to successively energize the units of a Kerr cell containing twenty-five cell units.

The Kerr cell 1, in the modification shown, comprises a rectangular glass container 12, filled with a liquid 13, such as nitrobenzine, adapted when subjected to a voltage, to rotate a beam of polarized light. The container also houses an upper row of twenty-five rectangular electrodes, such as 14, insulated from one another by mica or the like, and a lower row of five rectangular electrodes, such as 15, likewise insulated from one another by mica or the like, and spaced from the upper row of electrodes to provide a linear light aperture or slot 16 therebetween, each lower electrode, such as 15, spanning five of the upper electrodes as shown in perspective in Fig. 1 and diagrammatically in Figs. 2 and 3.

Sealed through the glass container 12 of the Kerr cell are five conductors 17 which are successively connected to the lower electrodes 15, conductors 17 in turn being linked, as explained hereinafter, through vacuum tubes 18 individual thereto, and over conductors 19 to successive segments 11 of cathode ray tube 3. Since each lower Kerr cell electrode 15 spans five of the upper electrodes 14, the connections 17, 18, 19, are tantamount to connecting the Kerr cells in

successive multiple groups of five each, such as 20 and 21, Fig. 2, to successive segments 11 of the lower cathode ray tube 3. The upper electrodes 14 within each multiple group 20, 21, etc., are in turn successively connected to segments 10 of the upper cathode ray tube 2 over conductors 22, 23 and interposed vacuum tubes 24, conductors 23 being for this purpose sealed through the glass container of the Kerr cell, and connected successively to the upper electrodes in each multiple group 20, 21, etc., in the manner shown at 25, 26, Fig. 2. It will be observed that with this mode of connection, only one Kerr cell unit is connected between any segment 10 of the upper cathode ray tube 2 and any segment 11 of the lower tube 3 through the interposed vacuum tubes 24, 18; that, moreover, there are twenty-five different combinations by which segments 10 and 11 may be thus paired; and that a different one of the twenty-five Kerr cells is connected between each different such pair of segments 10 and 11. As will be explained hereinafter, the manner in which simultaneous incidence of the cathode ray beams 8, 9 on any particular pair of segments 10, 11, energizes the Kerr cell connected between such pair over the circuits traced, but assuming this to be so for the moment, it is further to be noted that if cathode ray beam 8 of tube 2 is caused to traverse segments 10 thereof at five times the speed with which beam 9 of tube 3 is caused to traverse segments 11 thereof, that the twenty-five cell units in the Kerr cell will be successively and repeatedly energized. If, furthermore, the cathode ray beams 8 and 9 are modulated in accordance with television signals as they are thus swept across segments 10 and 11, the Kerr cell will be likewise successively energized in accordance with said signals.

Considering now the precise manner in which the Kerr cells are successively energized by the cathode ray tubes in accordance with received television signals, it will be observed from the drawings that aside from the segments 10 and 11, the cathode ray tubes are generally of standard construction. The tubes are provided with the usual cathodes 30, 31, grids 32, 33, beam concentrating tubes 34, 34a, and vertical and horizontal deflector plates 35, 36 and 37, 38. The tube electrodes are energized in the usual manner from the potentiometers 39, 40 fed by batteries 41, 42, across which are shunted by-pass condensers 43, 44.

For modulating the cathode ray beams 8, 9 in accordance with television signals, and for simultaneously causing the same to traverse the segments 10, 11 in the manner above stated, modulated television and synchronizing frequency signals received from antenna 45 are fed through a demodulator 46, the output of which is connected in parallel to a television signal frequency amplifier 47, and a synchronizing frequency amplifier 48. The output of the signal frequency amplifier 47 is fed in parallel over conductors 49, 50 containing blocking condensers 51, 52 respectively, directly to grids 32, 33 of the cathode ray tubes 2, 3, and also through resistors 53, 54, and through the by-pass condensers 43, 44 to ground at 55, 56 respectively. Since resistors 53, 54 are connected to the points on potentiometers 39, 40 adjacent the cathodes 30, 31, the voltage drops across these resistors which are traversed to ground at 55, 56 by the television frequency signalling currents, causes the necessary signal frequency voltages to be impressed between the

grids and cathodes of the tubes 2, 3 for modulating the cathode ray beams thereof in accordance with received television signals.

The output of the synchronizing frequency amplifier 48 is fed to ground at 57 through a potentiometer 58 connected between the grid and cathode of a dynatron oscillator 59, for locking this oscillator in step with the incoming synchronizing signal, the oscillator being adjustable to this end by variable condenser 60. The output of oscillator 59 is impressed by means of transformer windings 61, 62 between a pair of conductors 63, 64, across which is bridged a connection containing a resistor 65 and condenser 66 in series, which connection is grounded at 67 between the condenser and resistor. Conductor 63 extends to one of the horizontal deflector plates 38 of cathode ray tube 3, and conductor 64 to one of the vertical plates 36 thereof, the opposite vertical and horizontal deflector plates being grounded at 56 as shown. The horizontal and vertical deflector plates are accordingly energized in phase quadrature at the synchronizing frequency, due to the phase splitting action of resistor 65 and condenser 66, and the ground return path from 56 to 67. The cathode ray beam 9 of tube 3 is, therefore, caused to repeatedly traverse segments 11 thereof at the synchronizing frequency.

The output of oscillator 59 is also coupled through transformer windings 61, 68 of the input of an amplifier tube 69 tuned by means of tuned input and output circuits 70, 71, to select and amplify the fifth harmonic of the synchronizing frequency. The amplified fifth harmonic of the synchronizing frequency is impressed through output transformer 72 between conductors 73, 74, the first of which extends to one of the vertical deflector plates 35 and the second of which extends to one of the horizontal deflector plates 37 of the cathode ray tube 2, the remaining deflector plates of which are grounded at 55. Bridged between conductors 73, 74 is a series connection containing a resistor 75 and condenser 76, which connection is grounded at 77 between the resistor and the condenser, thereby to energize the vertical and horizontal deflector plates of tube 2 in phase quadrature, and at a frequency corresponding to the fifth harmonic of the synchronizing frequency. In this way, the cathode ray beam 8 of tube 2 is caused to repeatedly traverse the segments 10 thereof at five times the speed with which the cathode ray beam 9 of tube 3 traverses segments 11 thereof, whereby the cell units of the Kerr cell 1 are successively energized in accordance with the received television signals, in the manner above outlined and now to be explained more in detail.

It will be observed that each of the upper electrodes 14 of the Kerr cell is connected over a conductor 23 to the ungrounded cathode of tube 24 connected to such conductor, and that all of the plates of tubes 24 extend to the positive terminal of a battery 80, the negative terminal of which is grounded. Likewise, it will be observed that each of the lower Kerr cell electrodes 15 is connected over a conductor 17 to the plate of the associated vacuum tube 18, the cathode of which is grounded at 81. Therefore, the voltage of battery 80 will be impressed between the upper and lower Kerr cell electrodes through the space paths of tubes 18 and 24 in series, provided the grid voltages of these tubes are such as to permit the flow of plate current therein. Normally, however, each of tubes 24 is biased to cutoff by

the grid biasing batteries 82 individual thereto, and connected between the cathode and grid thru the secondary winding of an input transformer 83 having a separate primary winding. Likewise, each of tubes 18 is normally biased to cutoff by the common negative grid biasing battery 84 connected to the grids of each tube 18 through the individual resistors 85, battery 84 being shunted to ground at the positive terminal with the by-pass condenser 86. Therefore, the space paths of all of tubes 18 and 24 are normally open, to prevent voltage of battery 18 from being impressed across any of the Kerr cell units. Should, however, the negative grid bias on any one of tubes 24 and any one of tubes 18 be simultaneously reduced to such an extent as to permit the flow of plate current therein, then the voltage of battery 80 would be impressed across the particular one of the Kerr cell unit having its upper electrode connected to the cathode of the particular tube 24 and its lower electrode connected to plate of the particular tube 18 in question. Simultaneous reduction of the negative bias on but one tube 24 and but one tube 18 to permit the flow of space current therein would cause voltage 80 to be impressed across but one Kerr cell unit, the balance of the units remaining unaffected. This results from the mode of connecting the upper and lower Kerr cell electrodes to the conductors 17 and 23 above described, whereby each Kerr cell unit is connected between a different combination pair of tubes 24 and 18 corresponding to the connection thereof through the tubes to a different combination pair of cathode ray tube segments 10 and 11 as above explained.

Simultaneous reduction of the negative grid biases on different combination pairs of tubes 24 and 18, such as to impress a variable fraction of voltage 80 across the Kerr cell unit successively in accordance with received television signals, is brought about by the cathode ray beams 8, 9 of tubes 2, 3, modulated in accordance with the received television signals, as explained, and sweeping across the conductive segments 10, 11 in the manner and at the relative speeds above described. To this end, the cathode ray tubes 2, 3 are so constructed, and the velocity of the electrons in the cathode ray beams incident upon segments 10, 11 so adjusted by battery 41, as to produce secondary electronic emission from these segments upon incidence of the beam thereon. For collecting these secondarily emitted electrons, the flared necks adjacent the screens 6, 7 of the glass tube receptacles 4, 5 are provided on their interior surfaces with conductive coatings of graphite or the like as shown at 87 in Figs. 1 and 1a. The secondary emission thus produced in tube 2 is utilized to reduce the negative bias on tubes 24 successively by connecting the primary windings of their respective input transformers 83, between their associated conductors 22 and the negative terminal of a common battery 88, the positive terminal of which is grounded as shown. Likewise the conductive interior coating 87 of tube 2 is grounded at 89. Accordingly, as the cathode ray beam 8 sweeps across any given segment 10, the secondary emission therefrom will produce a flow of electrons, i. e. current from battery 88, through the primary winding of transformer 83 connected to the segment in question, and over conductor 22 thereto, thence through the space within the tube to the conductive interior 87, returning thence to battery 88 through ground 89 and the

grounded battery terminal. The resulting flow of current in the primary of transformer 83 will induce a voltage in the secondary thereof of such polarity and magnitude as momentarily to decrease the negative bias on the grid of the associated tube 24, sufficiently to render its space path conductive and proportional to the television signal. This action is of course repeated for each of tubes 24 in succession as the cathode ray beam sweeps across segments 10 connected thereto respectively.

The action with respect to cathode ray tube 3 is quite similar. During incidence of the cathode ray beam 9 on any segment 11, secondary emission occurs to produce a flow of current from the common grid biasing battery 84 through the grid resistor 85 of tube 18 connected to the segment 11 on which the cathode beam is incident, and over conductor 19 thereto, thence from this segment in the space within the tube to the conductive interior 87, as shown at 90 in Fig. 1a, thence to ground at 91, returning to battery 84 through its grounded positive terminal. A booster battery with the negative terminal grounded may be inserted on ground lead 91 if necessary. The resulting voltage drop across grid resistor 85 by using up some of the voltage of battery 84, reduces the negative bias on the associated grid of tube 18 to such an extent that its space path is rendered conductive in proportion to the television signal at that instant. This action is of course repeated for tubes 18 successively as the cathode ray beam sweeps across segments 11. Therefore, the simultaneous sweeping of the television modulated cathode ray beams 8 and 9 across segments 10 and 11, the one at five times the speed of the other, causes voltage from source 80 to be successively impressed across the Kerr cell units and in proportion to the television signals.

To render the above described energization of the Kerr cells effective for scanning, an optical system is associated therewith, comprising, an electric bulb 100 having a rectilinear filament 101 energized by battery 102, the illumination from which is condensed by a cylindrical lens 103, and directed through an interposed polaroid polarizer 104 onto the rectilinear slot 16 of the Kerr cell, behind which is positioned a polaroid analyzer 105 and a rotatable polyhedral mirror drum 106, worm driven by motor 107, the mirror drum being arranged to deflect the emergent light beam onto a deflector 108, whereby the image produced may be viewed at 109. The polaroid polarizer and analyzer are each arranged with their polarizing axes at 45 degrees to the Kerr cell slot, and at 90 degrees to each other, so that in the absence of received television signals, no light is incident on the mirror drum 106. The mirror drum is rotated at such speed as to provide frame or picture scanning, as line scanning is effected by the Kerr cells. Line scanning by the above cells is of course accomplished by rotation of the polarized light incident thereon to permit passage through the analyzer in accordance with the television signal, as these cells are successively energized in the manner above described.

In the modification of Fig. 1, the cathodes of tubes 24 can not be grounded, otherwise battery 80 will be rendered ineffective to impress a voltage on the Kerr cells. For this reason, each of tubes 24 requires individual cathode and grid batteries. Fig. 2 shows an arrangement whereby these tubes may be energized from a common

battery source. In Fig. 2, the plates of the vacuum tubes 18 are connected as before over conductors 17 to the lower electrodes 15 of the Kerr cells, the upper electrodes of which are connected in multiple groups as previously to conductors 23, which conductors in this instance, however, extend to the plates respectively of tubes 24, the cathodes of which are directly grounded as shown at 120. Conductors 23 are also connected through the resistors 118 to the positive terminal of a battery 119 grounded at its negative terminal. The segments 10 of cathode ray tube 2 are connected respectively over conductors 121 and 122 to the control grids of tubes 24, and connections 123 containing resistors 124 extend from the junction points between conductors 121 and 122 to a negative grid biasing battery and potentiometer 125, grounded at the positive end. Cathode ray tube 2 is, in this instance, so constructed and arranged that there is no secondary emission from the segments 10. The segments 11 of cathode ray tube 3 are connected, as previously, over conductors 19 to the grids respectively of tubes 18, through blocking condensers 126, the control grids also being connected, as before, through the individual resistors 85 to the common negative grid biasing potential source, comprising the negative biasing battery and associated potentiometer 127 grounded at the positive terminal. Cathode ray tube 3 is the same as in Fig. 1, namely, of the secondary emission type as indicated at 87. For utilizing this secondary emission in the manner to be described, conductors 128 containing resistors 129, extend from the cathode ray tube segments 11 respectively, to the negative terminal of a common battery 130 grounded at its positive terminal.

In the operation of this system, tubes 18 are normally biased to cutoff by the potentials supplied to the grids thereof from source 127, so that the plate circuits of these two are normally open. The grid potentials of tubes 24 on the other hand, are so adjusted by source 125 operating through resistors 124, as normally to permit a sufficient flow of plate current in these tubes from their grounded cathodes and over conductors 23 and through resistors 118 and common battery 119 back to ground, that substantially the entire voltage of battery 119 is dissipated across the resistors 118. Normally, therefore, no voltage is impressed between the upper and lower electrodes 14 and 15 of the Kerr cell units, since the upper electrodes are normally substantially ground potential, while the lower electrodes are connected to the open plate circuits of tubes 18.

When, however, the cathode ray beam 8 of tube 2 is incident on a segment 10 thereof, the electron stream comprising the cathode ray beam flows through the segment 10 on which it is incident, over conductor 121 connected thereto and through the associated resistor 124 to ground through the grid biasing source 125, returning thence to the cathode 30 of the cathode ray tube through its battery circuit 39, 41 grounded at 55. The current flow thus established in resistor 124 increases the negative potential on the grid of tube 24 connected thereto, thereby decreasing the flow of plate current therein in proportion to the intensity of the cathode ray beam 8 at that instant. This reduces the voltage drop across the corresponding resistor 118 in the conductor 23 connected to the plate of tube 24 in question, which in turn increases the voltage impressed from source 119 on the upper

Kerr cell electrode 14 connected to this conductor 23.

During the existence of this condition, the cathode ray beam 9 of tube 3 will also be incident on one of its conductive segments 11. The cathode ray beam of this tube is of such intensity, as explained, as to produce secondary emission from the segment 11 on which it is incident. In consequence of this secondary emission, a flow of electronic current will be established in the circuit traced from battery 130 and through resistor 129 and over conductor 128 connected to the segment 11 in question, thence in the space within the tube through segment 11 to the conductive inner wall 87 to ground at 90, returning thence to the grounded positive terminal of battery 130. The voltage drop in resistor 129 due to this current flow, will momentarily reduce the negative biasing voltage on the grid of associated tube 18, to such an extent as to render the plate circuit thereof conductive in proportion to the received television signal. Voltage from source 119 will therefore be impressed between the particular upper and lower electrodes 14 and 15, which are connected between the pair of tubes 24 and 18 that have been energized in the manner above described. As the cathode ray beam 8 of tube 2 sweeps across the segments 10 thereof at five times the speed at which beam 9 of tube 3 sweeps across segments 11 thereof, tubes 24 and 18 will be successively energized as above described, to permit battery 119 to impress a voltage across the Kerr cells successively, which varies in accordance with television signals.

Fig. 3 shows a modification of the invention which does not require the interposition of vacuum tubes, such as 24 and 18, between the Kerr cell and the cathode ray tubes 2 and 3 respectively. In this case, each of the screens 6, 7 of tubes 2, 3 has a ring of insulated conductive segments 10, 11 disposed thereabout as previously, and in addition has disposed close to the segments, a continuous ring 131, 132 of conductive material. In tube 2, the cathode ray beam traverses the conductive segments 10, while in tube 3, the cathode ray beam 9 traverses the continuous ring 132. The upper and lower Kerr cell electrodes 14 and 15 are connected over conductors 133 and 134 to segments 10 and 11 respectively, in the same manner as in Fig. 1 except for omission of the vacuum tubes. Each of the cathode ray tubes 2 and 3 is so constructed and arranged, in the manner above described, that the cathode ray beam thereof produces secondary electron emission from the conductive members on which it is incident. This secondary emission is utilized to energize the Kerr cell units, by connecting the positive terminal of a battery 135 to ring 132 of tube 3, this battery being grounded at its negative terminal as shown; and by grounding ring 131 of tube 2 as shown at 136.

In the operation of this system, as the cathode ray beam 8 traverses segments 10, it will produce secondary emission from the segment on which it is incident at any given instant. Likewise, as the cathode ray beam 9 of tube 3 traverses ring 132 thereof, it will continuously produce secondary emission at the point of incidence. These secondary emissions will permit displacement current to flow from battery 135 to ring 132, thence from this ring by virtue of the secondary emission to the segment 11 which is adjacent the point of incidence of the cath-

ode ray beam at any given instant, thence over conductor 134 connected to this segment to the lower Kerr cell electrode 15 connected thereto, thence to the upper Kerr cell electrode connected over conductor 133 to the particular segment 10 of the cathode ray tube 2 on which beam 8 is incident at that instant, thence to ring 131 by virtue of the secondary emission to ground at 136 returning to the grounded negative terminal of battery 135. In this way, as the cathode ray beams 8 and 9 continue to rotate, a voltage varying in accordance with the television signals will be impressed on the Kerr cells successively to effect scanning. Fig. 4 illustrates at 137 the manner in which the secondary emission resulting from incidence of cathode ray beam 8 of a segment 11 of tube 2 produces secondary emission, the electrons resulting from which are drawn to the ring 131 by the action of battery 135 and ground 136 over the circuits above traced.

As above stated, the signal energizations of Kerr cells, neon tubes, or other light control elements employed may be retained following each energization, by shunting each element with a condenser and resistor suitably chosen to provide a desired time constant. Fig. 5 shows this arrangement diagrammatically, wherein a row of Kerr cells, neon tubes, or light controlling elements for effecting line scanning is shown at 140 in part. Shunted across each element is a condenser 141 and a resistor 142 for purposes above stated. Each unit is provided with input leads 143, 144 across which the signal is impressed.

I claim:

1. In a television receiving system: a pair of cathode ray tubes each having an insulating screen containing a conductive ring and spaced conductive segments disposed therealong, a plurality of electrically actuated translating devices, each connected between a segment of one tube and a segment of the other, a different combination pair of such segments for each device, means for causing the cathode beam of one tube to traverse the segments thereof and the cathode beam of the other tube to traverse the ring thereof, said beams producing secondary emission from said segments and ring respectively, and a source of voltage connected between said rings for selectively actuating said devices in accordance with the points of incidence of said cathode beams on said segments and ring respectively.
2. In a television receiving system: a pair of cathode ray tubes each having an insulating screen containing a conductive ring and spaced conductive segments disposed therealong, a plurality of electrically actuated light controlling elements, each connected between a segment of one tube and a segment of the other tube, a different combination pair of such segments for each element, means for causing the cathode beam of one tube to traverse the segments thereof and the cathode beam of the other tube to traverse the ring thereof, said beams producing secondary emission from said segments and ring respectively, means for modulating at least one of said cathode beams in accordance with television signals, and a source of voltage connected between said rings for selectively actuating said devices in accordance with said signals and in accordance with the points of incidence of said cathode beams on said segments and ring respectively.

WILLIAM H. PECK.