

Feb. 8, 1938.

V. K. ZWORYKIN

2,107,464

TELEVISION SYSTEM

Original Filed Aug. 5, 1932 3 Sheets-Sheet 1

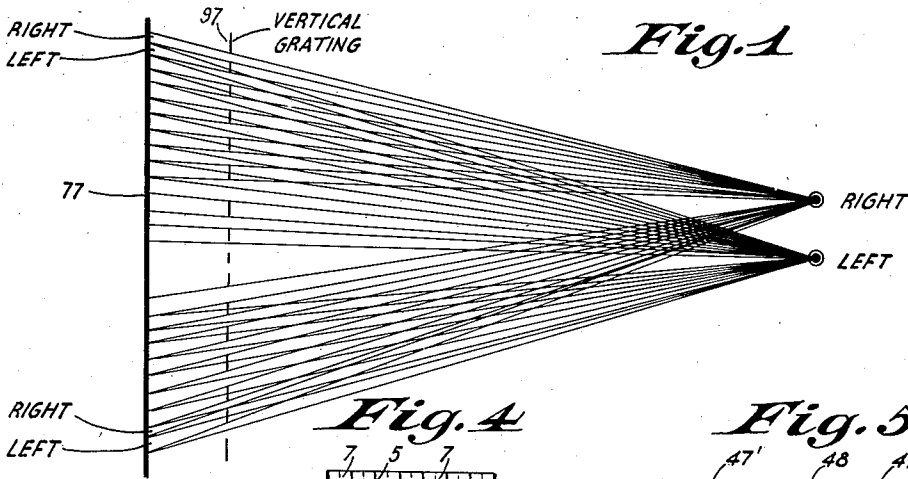


Fig. 1

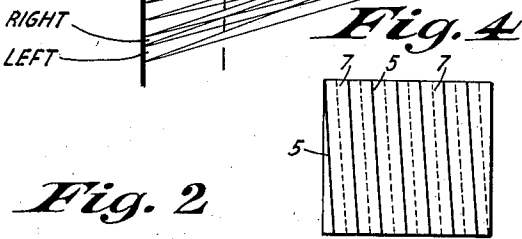


Fig. 2

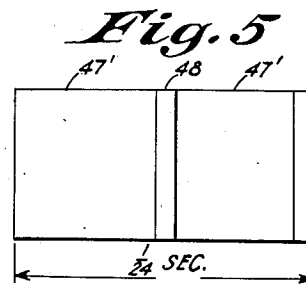


Fig. 5

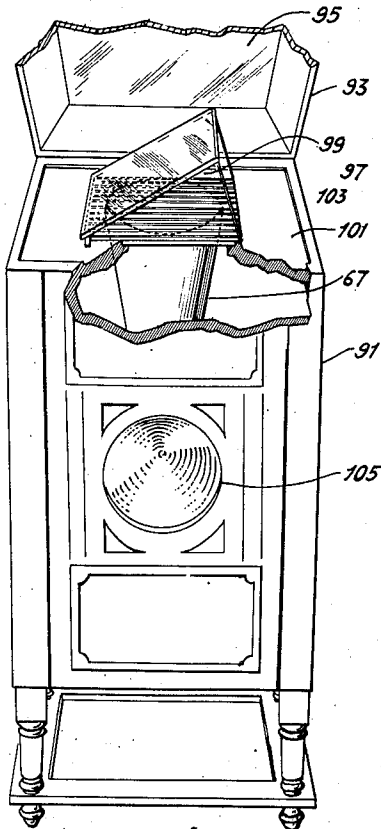


Fig. 6

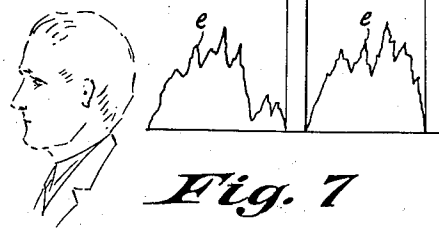
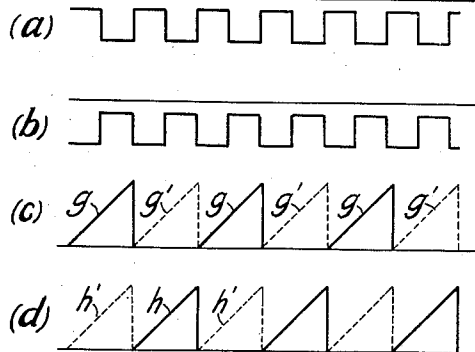


Fig. 7



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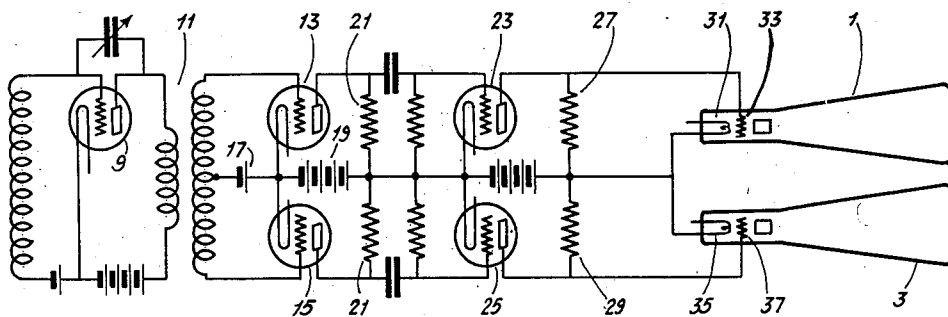
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Fig. 3



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TELEVISION SYSTEM

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Fig. 8

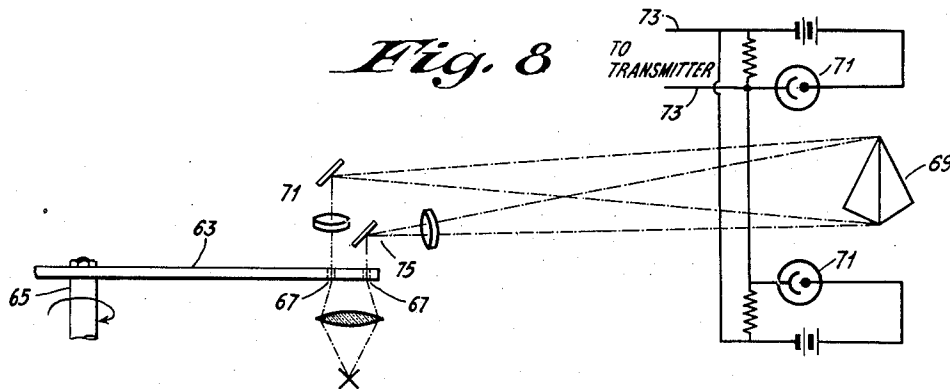


Fig. 9

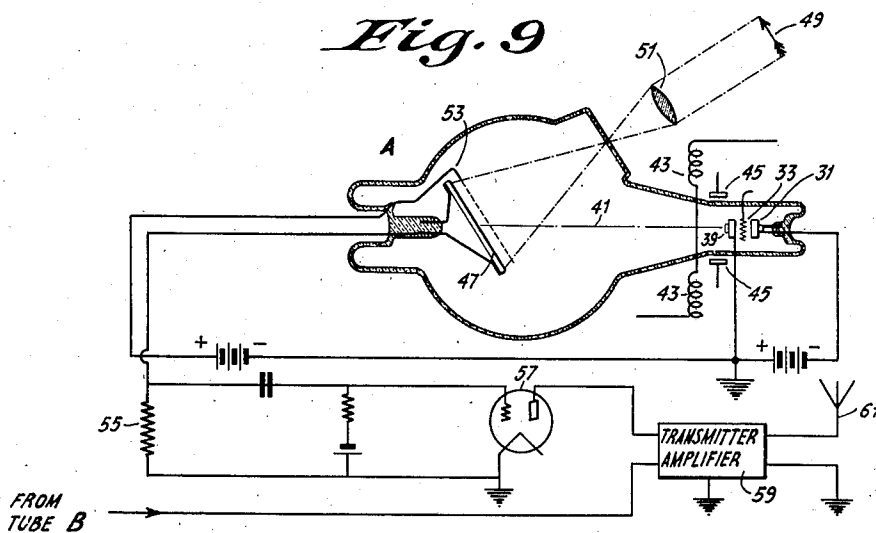
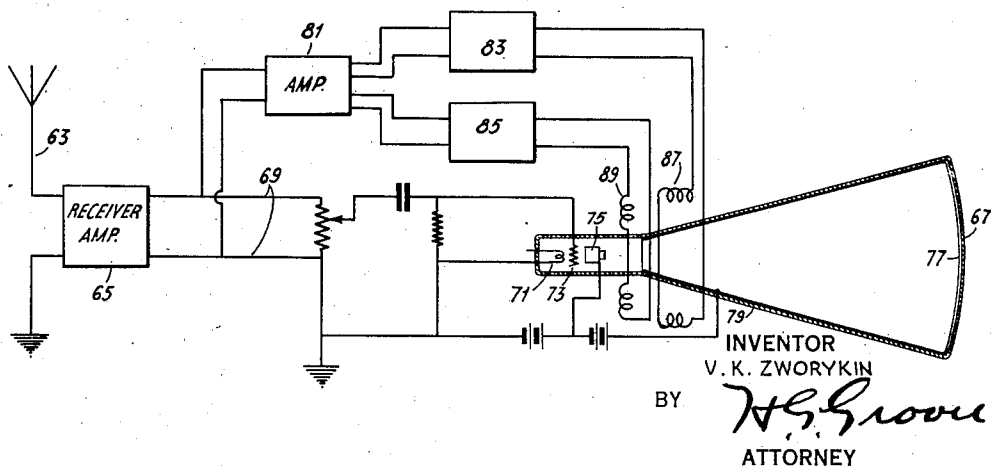


Fig. 10



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2,107,464

TELEVISION SYSTEM

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Application August 5, 1932, Serial No. 627,565
Renewed September 12, 1936

13 Claims. (Cl. 178—6.5)

The present invention relates to television receiving systems and is directed particularly to television receiving systems for reproducing stereoscopic television images.

It has been known for many years in physics that in order to produce a stereoscopic or relief type image which is intended to show depth, it is necessary to look with each eye upon two separate pictures which were taken with the objective lenses of the viewing mechanism separated by approximately the same separation as that of the human eyes. Various other separations may be used, depending upon the optical systems being utilized and depending upon the losses encountered therein, so long as the net result is substantially the equivalent of the aforementioned separation. It is customary in viewing stereoscopic pictures to use a double optical system.

In the prior art the above principles were applied to television where stereoscopic images were to be desired, but, as in other systems of this general type, elaborate optical systems were necessary.

In order to provide a convenient means to view television pictures my copending application Serial No. 529,653, filed April 13, 1931, now United States Patent 1,870,702, assigned to Radio Corporation of America, of which this application forms a continuation in part, disclosed a television viewing cabinet in which a cathode ray tube, or similar image reconstructing device, has been so arranged as to be mounted within a cabinet and, when activated by received signals, produce a television image which appears on a plane at ninety degrees to the desired viewing plane. By means of a lid provided for the receiving cabinet, and a reflecting medium carried within the lid, it has been found possible to position the reflector at such an angle that the reconstructed image could be viewed in the desired plane in the reflecting medium by an observer and remain visible throughout a wide angle.

In the aforementioned copending application I also disclosed a self-contained sound and television system, and it is to be understood that the present invention is intended to embody all of the details of my above named copending application with such additional new details as are found in the present specification.

It is a primary object of the present invention to simplify stereoscopic television and to avoid the use of any optical systems for viewing the stereoscopic television picture.

Another object of the invention is to provide a stereoscopic television system wherein the image

signals are produced either by purely electrical scanning apparatus or by the so-called mechanical scanning devices and to produce a system wherein the image signals from the two or more independent scanning devices used at the transmitting point to produce the stereoscopic effects are coordinated one with the other in such manner that successive scanings of adjacent elemental strips of the subject of which the image is to be produced are coordinated both in time and position definitely with the proper scanning device to produce the desired effects.

Other objects of the invention are to provide a self-contained receiver system for television which is compact, pleasing in appearance, capable of being viewed through a wide angle, responsive to both stereoscopic and ordinary television signals and efficient in use and operation.

Other objects of the invention will, of course, appear and become more apparent from reading the following specification and claims in connection with the accompanying drawings, wherein:

Fig. 1 shows a conventional arrangement by which the image as viewed is so screened that alternate sections are observable;

Fig. 2 shows one form of viewing arrangement by which the stereoscopic image is viewed;

Fig. 3 illustrates a suitable form of circuit arrangement to control separate scanning tubes;

Fig. 4 is a schematic showing on a considerably enlarged scale of a section of the pattern traced by the plurality of scanning or elimination devices;

Fig. 5 is a modification of the pattern of Fig. 4 at the transmitting end of the system;

Fig. 6 illustrates diagrammatically the wave form of the signals transmitted with the arrangement of Fig. 5;

Fig. 7 graphically illustrates the wave formation and control of the separate scanning tubes shown by Fig. 3 and in this figure portions 7a and 7b illustrate the alternate operation of the two scanning tubes of Fig. 3 and the portions 7c and 7d illustrate the alternate deflection of the scanning ray with the arrangement of Fig. 3;

Fig. 8 is a mechanical system for scanning or reproducing images in the present invention;

Fig. 9 diagrammatically indicates a suitable connection of one of the transmitter tubes of Fig. 3 with the transmitter, and from this showing it will be understood that the other scanning tube is similarly arranged, as has been conventionally indicated; and,

Fig. 10 illustrates a suitable receiving system

using a cathode ray tube as the image reconstructing element.

In reproducing television pictures, from the earliest times it has been customary to rebuild the picture from a series of lines each formed from a plurality of adjacent elemental areas and, in accordance with this customary method of reconstructing the image, it is also possible to re-form the picture from two series of lines alternating with each other which serve to give the effect of depth to the produced images. The method by which this image reconstruction is accomplished forms a part of the present invention in so far as it cooperates with the arrangement shown at the receiving point for reproducing the pictures so constructed.

As was indicated in the foregoing paragraphs, the stereoscopic picture may be transmitted in several different ways. One suitable transmitter arrangement is to provide two cathode ray tubes so arranged that each observes, so to speak, the subject from separate points which are spaced apart a distance comparable to the separation of the human eyes for example, about $2\frac{1}{2}$ inches, and are then so arranged as to scan the subject with each tube in such manner that alternate lines are scanned by alternate tubes. With such a system the deflecting fields serving to control the cathode ray pencil within the tube are produced from a single source as has been indicated by Fig. 3 and through appropriate control systems function alternately upon each tube in such manner that one tube scans one line and then becomes inoperative to scan during the period required for scanning an adjacent line, whereas the other scanning tube operates exactly opposite so that while the first tube is operative the second tube is inoperative, and when the second tube is operative the first tube is inoperative and so on. Other suitable scanning systems function somewhat similarly as will be apparent from the description which is to follow.

For transmitting a signal to the various points of reception the varying intensity of light and shadow are resolved into appropriate image current signals which are used to modulate a suitable generator carrier frequency which is transmitted by wire or radio to each receiving point.

To analyze briefly the arrangement of my present apparatus at the receiving end of the system, to which this invention is directed primarily, the two sets of stereoptic images are produced upon the fluorescent screen of a cathode ray tube, and, in contrast to the usual method of reception for ordinary pictures by which the image intensities represented in the fluorescent end wall of a cathode ray tube would be visible throughout a wide angle in the mirror surface carried on the inside cover of the cabinet lid of the arrangement described in my above named application, the present arrangement is so designed that the lines along which the image appears to be reconstructed apparently extend vertically rather than horizontally. This effect is produced by viewing the tube from a normal viewing angle approximately ninety degrees to the position of viewing ordinary pictures directly normal to the reflecting member carried within the lid of the cabinet cover.

To provide for this type of viewing, I have arranged an attachment in the nature of an adapter which rests upon a plurality of supporting feet directly on top of the television receiving cabinet. The lower surface of this viewing attachment has supported therein a grating formed

of alternately opaque and transparent strips or sections. At one end of the grating member I have provided a reflecting member similar to the reflecting member carried within the cover of the cabinet for viewing optical pictures and have arranged this reflector so that it may be tilted to any desired and suitable angle for viewing purposes.

Reference may now be made to the accompanying drawings, more specifically wherein there are several methods by which stereoscopic pictures may be transmitted are shown. By Fig. 3 a method which involves two separate transmitting cathode ray tubes 1 and 3 has been illustrated. In this arrangement the two transmitting tubes 1 and 3 are separated at substantially the same distance as the eyes, or approximately $2\frac{1}{2}$ inches apart, and the scanning line so arranged that the lines are scanned alternately as shown, for example, by Fig. 4 wherein the solid lines 5, for example, indicate the scanning path of tube 1, whereas the dotted lines 7, for example, indicate the scanning path of the tube 3 or, in other words, the system is so arranged that the tube 1, for example, may scan the odd lines and the tube 3 scan the even lines. The circuit arrangement shown by Fig. 3 is provided for producing these results and in this figure the oscillator 9, for example, is arranged to transfer the generated oscillation frequencies, which are equal to the scanning line frequency, through the transformer 11 to the push-pull connected vacuum tubes 13 and 15 which are supplied with suitable bias upon the input electrodes thereof by means of a biasing battery 17 for example. Upon alternate half cycles one or the other tube is blocked completely and the other tube completely conducting. The output circuit of the push-pull amplifiers 13 and 15 is energized from a battery or power supply unit 19 connected with the output electrode through suitable resistors 21 for example. The output path from each independent push-pull amplifier tube 13 and 15 leads through a suitable resistance couple to the input of a second pair of amplifiers 23 and 25 whose output energy is connected across the input circuit of the cathode ray tubes 1 and 3 through resistors 27 and 29, so that the output energy from the first tube 3 for example is connected between the cathode 31 and control grid 33 of the scanning tube 1 and the output from the other amplifier 25 is connected across the cathode 35 and control grid 37 of the tube 3. In this manner, as will be apparent from the showing in Figs. 7a and 7b, the control grid electrodes 33 and 37 of the tubes 1 and 3 are alternately biased above and below cut-off so that the wave formation of Fig. 7a, for example, indicates the control on the tube 1 and the wave formation shown as 7b, for example, indicates the control on the tube 3, each of which is such that the tubes operate alternately, that is, while one tube is biased to cut-off, the other tube is passing current so that one tube is able to scan while the other tube is inoperative and vice versa.

In the arrangement of Fig. 3 the tubes 1 and 3 have been illustrated merely in a conventional manner and do not show the suitable deflecting fields for controlling the cathode ray nor show the anode potential supply to control the development of the cathode ray which is caused to scan the image pattern. By Fig. 9, however, a modification is shown wherein there is a cathode ray transmitting tube generally designated as A which corresponds, for example, to the tube 1

of Fig. 3. This tube is conventionally shown as being of the form disclosed by me in the application which I have filed jointly for Letters Patent in the U. S. as Serial No. 574,772 on November 13, 1931. In the form shown, the scanning tubes A and B are adapted for any general type of scanning and preferably include, in addition to the features disclosed by my aforesaid copending application, the addition of the control grid 33 designated on Fig. 3. According to the preferred form of arranging this tube, I have provided a source of electrodes 31 and between this source and an anode member 39 serving to accelerate the electrons issuing from this source and to cause the pencil of electrons to scan the image area, I have arranged the control grid which is adapted under the above mentioned condition to cut-off completely the cathode ray.

As the cathode ray pencil 41 is projected from the anode member 39 it is controlled in its path by means of suitable deflecting fields shown conventionally as including the electromagnetic field 43 to control the horizontal motion of the ray and an electrostatic field 45 to control vertical motion of the ray. These fields are provided by means of the electromagnetic coils and the electrostatic plates and connected with a suitable source of energy fluctuating at desired frequency to control the rate of motion in either or both of the desired deflecting directions.

The scanning ray pencil 41 having been suitably controlled in its vertical and horizontal paths by the deflecting fields is arranged to impinge upon a light sensitive electrode 47 contained within the tube A for a purpose which was made apparent in my above referred to copending application.

To scan an image such as is indicated at 49, this image is projected, for example, by a suitable optical system conventionally shown at 51 upon the light sensitive electrode 47 and produces over the entire area of the electrode a space charge in the area between the light sensitive electrode 47 and the anode electrode 53. This space charge produced, which corresponds in electron density substantially to the intensity of light which is to be represented, is released at each elemental area subjected to the action of the cathode ray in its traversal of the light sensitive electrode 47 so as to produce across the resistor 55 varying voltage drops which may be then amplified by a suitable amplifier 57 and conveyed to the transmitter amplifier 59 and transmitted by wire or radio line to various points of reception by any suitable form of connecting line or antenna 61.

In the transmitter amplifier signals originated from tube B, which correspond to tube 3 of Fig. 3, are mixed with the signals from tube A so that due to the cut-off action produced by the oscillator 9 upon the cathode ray transmitting tubes 1 and 3, there is a sequence of image signals first from tube A, then from tube B, then from tube A and so on until the complete image is transmitted, after which the process is repeated.

Where desired for synchronizing purposes, each line of the image may be followed by a synchronizing signal as has been indicated in application filed, for example, by an application of A. W. Vance, Serial No. 544,959, filed June 17, 1931 and by an application of R. D. Kell, Serial No. 565,953, filed September 30, 1931, so arranged the transmitted signals may appear as shown by Fig. 6 wherein the portions e indicate the image signals

and the portions f indicate the synchronizing signals which follow each series of image signals to produce at the point of reception synthesis of the received image.

In Fig. 7, portions c and d indicate the deflecting paths of the cathode ray 41 within the tubes A and B and illustrate conventionally a suitable saw-tooth path of scanning so that the portions g of Fig. 7c indicate the time period when the scanning ray pencil 41 is active to scanning in the tube A and the portions g' indicate the inactive or inoperative positions. Similarly in Fig. 7d, the portions h indicate the active or operative position of the scanning ray pencil in the tube B and the portions h' indicate the inactive or inactive positions of the scanning ray pencil within this tube.

A modified arrangement of a transmitting system using a mechanical scanning device has been shown in Fig. 8 wherein a disc 63 adapted to rotate at suitable scanning speed about the shaft or spindle 65 has been shown. This may be a single disc, provided with two spirals or may be one disc with one spiral arranged as herein shown; in the latter case the ordinary Nipkow disc is used and is so arranged that each hole or aperture 67 of the disc scans the same object 69, for example, twice through two separate optical systems 71 and 73 respectively which are separated one from the other by approximately the same separation as was suggested above for the transmitting tubes A and B.

The light reflected from the object 69 is then collected by an ordinary system of photoelectric cells 71 which are placed symmetrically to both scanning systems and are connected through suitable conductors 73 to a transmitter which is similar to the usual television circuit arrangement.

A still further modification of the arrangement shown by Fig. 9, for example, is herein indicated conventionally by the arrangement of Fig. 5 wherein only a single transmitting tube such as the tube A is utilized. This tube however has a special screen 47' replacing the screen or light sensitive area 47 shown in Fig. 9 and is arranged so that the light from the object of subject of which the stereoscopic image is desired is projected on this double screen with a pair of matched objective lenses, as in the photographic camera. In the area between the two light sensitive areas 47' of the screen of Fig. 5, there is a narrow margin 48 which is not covered with light sensitive material and this area permits the scanning of the image in such manner that at the receiving end the two separate images overlap each other. It is believed that full and complete illustration in addition to that shown by Fig. 5 is unnecessary to a complete understanding of the invention.

To provide now for a suitable system by which the pictures transmitted in any of the systems of Figs. 5, 8 or 9 may be received, reference may be had to a conventional illustration shown by Fig. 10 wherein the signals received upon a suitable form of receiving element 63, which may be either a wire line or a radio antenna, are then suitably amplified into the receiving amplifier 65. The image signals which are to portray in the receiving picture the effects of light and shadow of the subject of which the image is produced are then transferred to a suitable form of receiving tubes 67 through the conductors 69 which are connected across the cathode 71 and a control electrode or grid 73 of the image re-

constructing tube 67. The cathode ray pencil in the form of an electron stream originating in the electrode 71 is then projected by accelerating electrode 75 toward the fluorescent end wall 77 of the tube 67 and is focused in suitable manner by means of an electrostatic field produced in the area between the anode 75 and a second anode 79 to which a voltage of the order of four times the voltage of the anode 75 is supplied.

Synchronizing signals transmitted from the point of transmission are then suitably selected as has been disclosed in the above mentioned application of R. D. Kell and by means of an amplifier 81 are suitably amplified and arranged to control the deflecting circuits 83 and 85 including the deflecting coils 87 and 89 respectively in which the former controls the vertical deflection of the cathode ray pencil and the latter controls the horizontal deflection.

In order to view the image produced on the fluorescent end wall 77 of the viewing tube 67, the tube is arranged to extend vertically within a cabinet 91 which is provided with a lid 93 capable of being pivoted along one edge thereof and having on its interior surface a reflecting member 95. These features have already been disclosed in my copending application, Serial No. 529,653 which was filed on April 13, 1931 and with an arrangement of this type the signals from the receiver amplifier 65 when used to control the effective brilliancy of the light spots produced upon the fluorescent end wall of the cathode ray receiving tube may be viewed in the reflector 95.

For stereoscopic television work it is, however, suitable, in order to obtain the effect of depth in the picture or, in other words, to obtain the effect of a relief picture, to provide what has herein been termed an adapter 97 capable of being positioned directly above the viewing tube 67. The adapter has on its surface adjacent the fluorescent end wall 77 of the viewing tube 67 a grating 97 so arranged that the observer viewing the fluorescent end wall of the tube through the mirror surface 99 will see two sets of reconstructed image lines due to the construction of the grating and the position of the grating relative to its point of observation since one eye of the observer will be unable to see certain portions of the fluorescent end wall 77 of the cathode ray image reconstructing tube 67 since, whereas these same particular portions will be observable to the other eye of the observer, but the portion of the fluorescent end wall which were visible to the other eye will not be observed. Thus, the observer's right eye can observe certain portions of the fluorescent end wall of the tube and other portions will be invisible or masked whereas the left eye will be able to observe the portions of the fluorescent end wall of the tube which are masked with respect to the right eye, but the same portions visible to the right eye will be masked with respect to the left eye of the observer.

With the grating 97 arranged in a vertical plane with respect to the field of view of the observer, the arrangement has been so provided that horizontal scanning at the point of transmission is suitable but it is of course obvious that the adapter structure including the reflector 99 supported from the upper surface of the cabinet 101 in any desired position by means of the adjustable legs 103 can be omitted where the scanning takes place at the point of transmission in a vertical plane provided the grating is turned at ninety degrees from the position shown and the resulting image on the fluorescent end wall of the

tube is observed in the reflector 95 mounted within the lid 93 of the cabinet 91. The field which the eyes of the observer can view when the grating 97 is interposed between the eyes of the observer and the fluorescent end wall of the tube is more particularly discernible from a further consideration of the showing of Fig. 1 where the right eye of the observer has been indicated by the letter R and the left eye of the observer by the letter L, and the grating 97 is interposed between the observer's eyes and the fluorescent screen 77 so that the observer's right eye can see the several areas or elemental strips of the fluorescent screen designated as 107 and the left eye of the observer will see the several areas or elemental strips generally designated as 109. From the combined combination of both of these sets of elemental strips, the observer is able to obtain an impression of depth in the resulting image on the fluorescent end wall of the tube.

Where desired, sound signals may accompany the television signals and the sound and television signals may be reproduced simultaneously by virtue of the receiving tube 67 and the sound reproducer 105 both being connected within the cabinet, these features have been shown and disclosed in my above mentioned copending application Serial No. 529,653 and form, per se, no part of the present invention. Also it is to be understood that the method of obtaining a saw-tooth deflection of the cathode ray, per se, performs no part of my present invention only in so far as it cooperates with the remaining elements of the structure herein disclosed to produce the results desirable and while one suitable form of arrangement of producing this result has been set forth as being disclosed in the application of A. W. Vance, Serial No. 544,959 it is, of course, to be understood that other systems may be substituted and, for example, I may substitute a system such as that shown in U. S. Patent No. 1,613,954, granted to D. A. Knoop. Also, it is within the scope of this disclosure to use a single distinct dynatron or glow-tube control for each separate scanning for so long as the frequency at which each tube operates is identical and then to the different paths of scanning by means of a cathode ray or mechanical commutator serving to connect each of the transmitting tubes in cyclic sequence with the transmitting channel where the frequency of the sequence is the same as the frequency of each line of scanning.

In the event that the subject is scanned along a series of vertical paths at the transmitter the grating 97 at the receiver may be suitably tuned in its position from that shown so that the resulting interlaced image pattern in the receiver tube 67 may be viewed by the observer through the slotted portions of the grating 97 in the minor reflector 95 carried in the lid 93 of the cabinet 91 which supports the viewing tube.

This invention has been illustrated only in a general preferred form thereof but it should be understood that it is capable of many and varied modifications without departing from its spirit and scope, and I therefore believe myself to be entitled to make and to use any and all of these modifications such as suggest themselves to those skilled in the art to which the invention is directed, providing of course that such modifications and changes fall fairly within the spirit and scope of the hereinafter appended claims.

Having now described my invention, what I claim and desire to secure by Letters Patent of the United States is as follows:

1. In television apparatus, a transmitting station having thereat a plurality of scanning devices, means for causing each of the scanning devices to analyze alternately adjacent elemental sections of a subject of which an image is to be produced, means to produce by the analyzing operation image scanning currents, a receiving station, a communication channel between the transmitting and receiving stations, a single cathode ray image reconstructing device at the receiving station responsive to the signal currents of each of the plurality of transmitter scanning devices and adapted to reproduce in the sequence of the transmitting station the scanning paths, and a grating interposed between the image reconstructing device and an observer thereof so that the image reconstructing device when viewed through the grating appears to represent a three-dimensional image of the subject located at the point of transmission.

2. In stereoscopic television apparatus, a plurality of electronic scanning tubes in each of which there is produced an electronic beam for scanning a produced electrical image of a subject of which a stereoscopic image representation is to be produced, means for scanning the subject by each tube along a series of substantially parallel paths, and a single means for controlling the electronic beams of both tubes so as to cyclically render one tube operative to scan and the other tube inoperative to scan so that alternately adjacent paths of scanning are scanned by different tubes.

3. Television apparatus for producing stereoscopic television images which comprises a cathode ray image reconstructing tube, means for controlling the observable light intensities produced on the fluorescent end wall of the cathode ray tube in accordance with received signalling impulses and a grating positioned adjacent the fluorescent end wall of the tube, said grating being so positioned that the solid portions thereof extend in paths coinciding substantially with the paths of image point reproduction within the tube, a light reflecting image viewing surface positioned to receive the light passed through said grating by the light developed upon the fluorescent viewing wall of said tube, said grating also being so positioned relative to an observer of the light intensities appearing on the fluorescent end wall of the tube and said light reflecting viewing surface that the resulting fluorescent effects produced by the signals are observed in such manner that the reconstructed image appears to have depth.

4. In television apparatus for producing stereoscopic television images from transmitted image signals, a cabinet having supported substantially vertically therein a cathode ray image reconstructing tube, means for moving the cathode ray developed to trace the tube fluorescent screen according to a preestablished pattern along a series of parallel paths, means for impressing the transmitted signals upon the cathode ray tube to cause intensity controlled light spots to appear upon the fluorescent end wall thereof as said series of parallel paths are traversed, a grating supported upon the cabinet and spaced apart from the end wall of the tube by a predetermined distance, said grating having the solid portion thereof extend along paths coinciding substantially with the paths of image point reproduction in the tube, and a reflecting element associated with the grating so that an observer viewing the reflecting element observes

the fluorescent effects on the tube end wall through the grating whereby the effects of depth in the reconstructed image on the tube end wall are apparent due to the fact that the solid sections of the grating obscure predetermined paths of image point reproduction to each eye of the observer.

5. In television apparatus for producing stereoscopic television images from transmitted image signals, a cabinet having supported substantially vertical therein a cathode ray image reconstructing tube, means for causing the cathode ray developed to scan the fluorescent screen of the tube according to a preestablished pattern of selected parallel paths, means for impressing the transmitted signals upon the cathode ray tube to cause intensity controlled light spots to appear upon the fluorescent end wall thereof along the selected series of parallel paths, a grating supported within the cabinet and having the solid portion thereof extend along paths coinciding substantially with the paths of image point reproduction in the tube, and an angularly tiltable reflecting element associated with the grating so that an observer viewing the reflecting element observes the fluorescent effects on the tube end wall through the grating whereby the effects of depth in the reconstructed image on the tube end wall are apparent due to the fact that the solid sections of the grating obscure predetermined paths of image point reproduction to each eye of the observer.

6. In television apparatus for producing stereoscopic television images from transmitted image signals, a cabinet having supported substantially vertical therein a cathode ray image reconstructing tube, means for causing the cathode ray developed within the tube to scan the fluorescent end wall thereof along a predetermined selected series of substantially parallel paths, means for impressing the transmitted signals upon the cathode ray tube to cause intensity controlled light spots to appear upon the fluorescent end wall thereof along the selected series of parallel paths, a grating element supported within the cabinet and having the solid portion thereof extend along paths coinciding substantially with the paths of image point reproduction in the tube, and a reflecting element associated with the grating so that an observer viewing the reflecting element observes the fluorescent effects on the tube end wall through the grating whereby the effects of depth in the reconstructed image on the tube end wall are apparent due to the fact that the solid sections of the grating obscure predetermined paths of image point reproduction to each eye of the observer.

7. Television apparatus for producing stereoscopic television images which comprises a cathode ray image reconstructing tube, means for causing the cathode ray developed within the tube to scan the fluorescent end wall thereof along a predetermined selected series of substantially parallel paths, means for controlling the observable light intensities produced on the fluorescent end wall of the cathode ray tube in accordance with received signalling impulses, a grating having the solid portion thereof extend in paths coinciding substantially with the paths of image point reproduction within the tube positioned at a predetermined location between an observer of the light intensities appearing on the fluorescent end wall of the tube and the tube so that the resulting fluorescent effects produced by the signals are

observed in such manner that the reconstructed image appears to have depth, and a reflecting device in which the image representations produced upon the fluorescent end wall of the tube as passed by the grating are reflected for observation.

8. In stereoscopic television apparatus, a plurality of electron beam scanning tubes each for scanning a subject of which a stereoscopic image representation is to be produced, means for scanning the subject of each tube along a series of substantially parallel paths, a control element provided in each tube to control the scanning operation, and a single means for biasing the control element of each tube so as to cyclically render one tube operative to scan and the other tube inoperative to scan whereby adjacent and successive scanning paths are produced by different scanning tubes.

9. In television apparatus, a plurality of scanning tubes each including a photoelectric surface adapted to have projected thereon a view of the subject to be televised, means for projecting a view of the subject on each of said surfaces, means for scanning said photoelectric surfaces line by line sequentially, means for developing signals representative of the light values on each of the photoelectric surfaces for each line scanned, and means for developing a synchronizing signal in the interval between the sequential scanning of a single line on each of said surfaces.

10. In television apparatus, a plurality of spaced scanning tubes each containing a photoelectric surface adapted to have projected thereon a view of the subject to be televised, means for projecting on each of said surfaces an image representative of the subject viewed with an average spacing equal to the spacing of human eyes, means for scanning said photoelectric surfaces line by line sequentially, means for developing signals representative of the light values on each of the photoelectric surfaces for each line scanned, and means for developing a synchronizing signal in the interval between the sequen-

tial scanning of a single line on each of said surfaces.

11. In television apparatus, a plurality of spaced scanning tubes each containing a photoelectric surface adapted to have projected thereon a view of the subject to be televised, means to project on each of said surfaces an image representative of the subject viewed with a spacing equal to approximately two and a half inches, means for scanning said photoelectric surfaces line by line sequentially, means for developing signals representative of the light values on each of the photoelectric surfaces for each line scanned, and means for developing a synchronizing signal in the interval between the sequential scanning of a single line on each of said surfaces.

12. In television apparatus, a plurality of non-contiguous laterally separated photoelectric surfaces adapted to have projected thereon a view of the subject to be televised, means for projecting a view of the subject on each of said surfaces, means for scanning said photoelectric surfaces line by line sequentially, means for developing signals representative of the light values on each of the photoelectric surfaces for each line scanned, and means for developing a synchronizing signal upon the completion of the scanning of the image on all of the photoelectric surfaces.

13. In television apparatus, a plurality of non-contiguous laterally separated photoelectric surfaces adapted to have projected thereon a view of the subject to be televised, means for projecting a view of the subject on each of said surfaces, means for scanning said photoelectric surfaces line by line sequentially, means for developing signals representative of the light values on each of the photoelectric surfaces for each line scanned, means for developing a synchronizing signal in the interval between the sequential scanning of a single line on each of said surfaces, and means for developing a synchronizing signal upon the completion of the scanning of the image on all of the photoelectric surfaces.

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