

March 9, 1943.

F. OKOLICSANYI

2,313,286

TELEVISION RECEIVER

Filed April 28, 1939

2 Sheets-Sheet 1

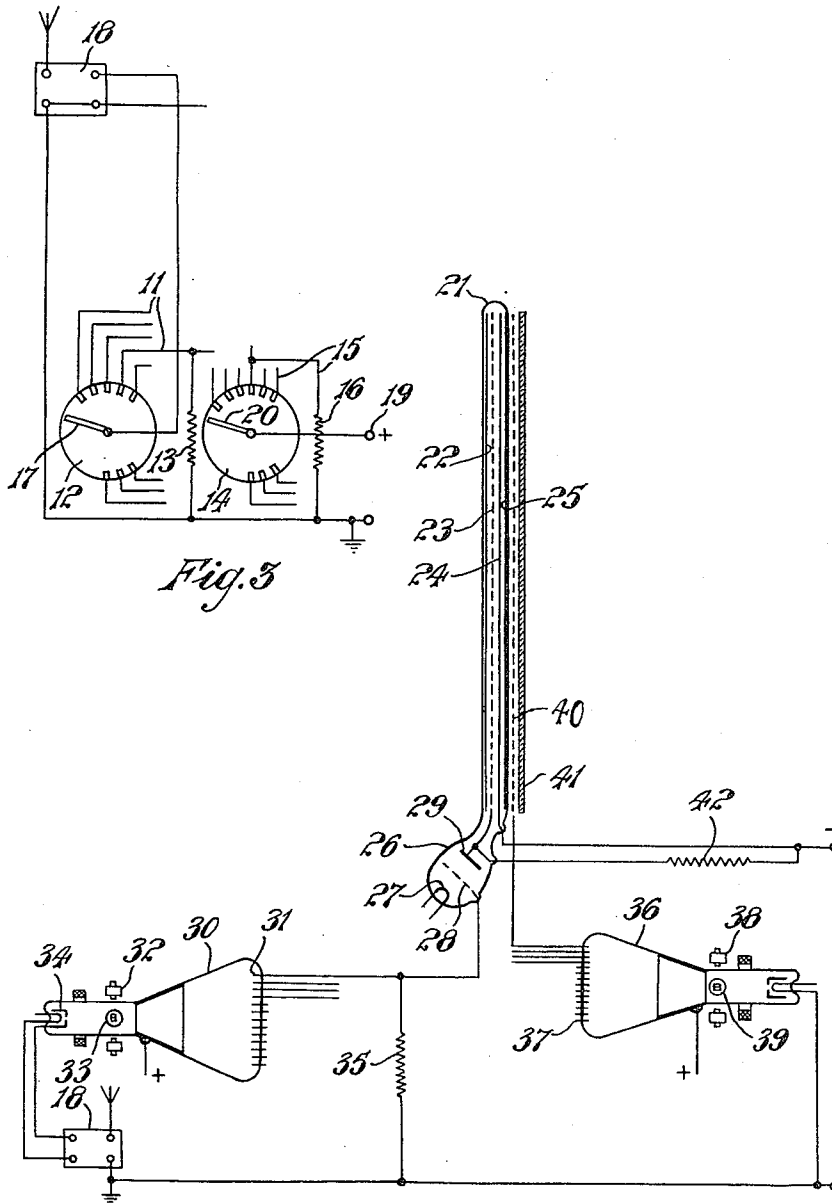


Fig. 1

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2 Sheets-Sheet 2

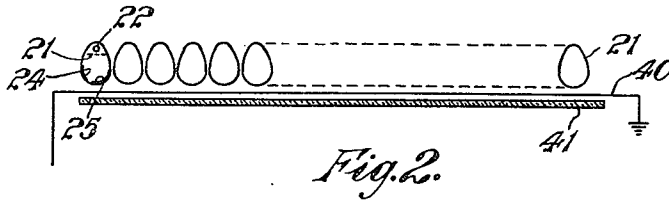


Fig. 2.

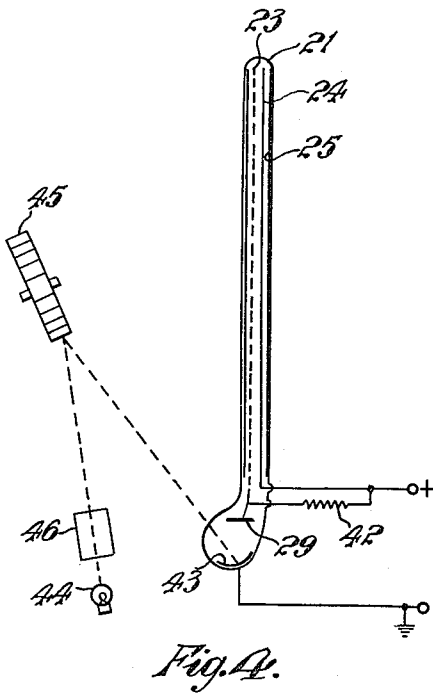


Fig. 4.

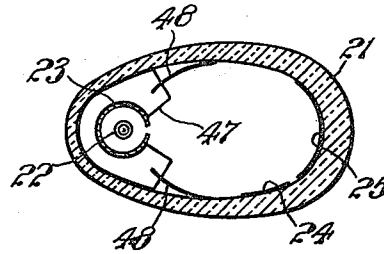


Fig. 5

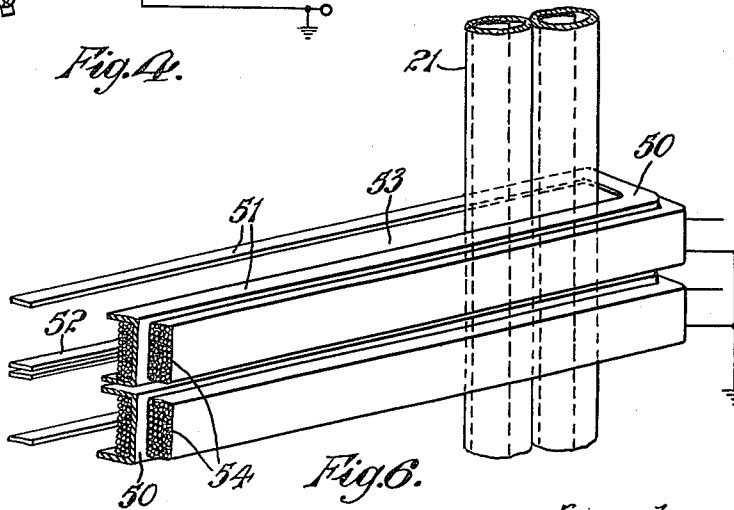


Fig.6.

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UNITED STATES PATENT OFFICE

2,313,286

TELEVISION RECEIVER

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Application April 28, 1939, Serial No. 270,672
In Great Britain April 29, 1938

18 Claims. (Cl. 178—7.5)

The present invention relates to television receiving systems of the type in which the various elements of the receiving screen are rendered luminous by the action of one or more commutators.

Many forms of such receivers have been proposed. For example it has been proposed to use a bank of small lamps each of which is in galvanic connection with one contact of a commutator and which are rendered operative one after the other by applying to each of them in turn by the armature of the commutator a voltage modulated in intensity in accordance with the received picture signals. Such systems are quite unsuitable for high definition television owing to the large number of lamps and commutator contacts which are necessary, and in order to reduce the latter number it has been proposed to use two commutators connected in series with the lamps and the voltage source, one commutator containing a number of contacts equal to the number of picture lines and operating at frame frequency, and the other commutator containing a number of contacts equal to the number of picture elements in a picture line and operating at line frequency. Even with this arrangement the number of lamps is still equal to the desired number of picture elements, and the apparatus is still further complicated by the necessity of providing a separate unidirectional conducting device in series with each lamp to prevent the current flowing in the undesired shunt circuits which are set up.

The expense involved in providing the 200,000 separate lamps, and associated equipment, which would be necessary for high definition television, is not the only difficulty to be encountered in such proposals. Provision must be made for ensuring that the characteristic of each lamp is approximately the same, so that a given signal voltage applied to any lamp will give the same luminous output. This would seem to necessitate the provision of a separate adjustment for each lamp, for even if the lamps themselves could be manufactured to the necessary high standard of uniformity, slight differences in the characteristics of the conducting paths to the lamps and of other associated equipment would seem to be inevitable. The prospect of having to make 200,000 separate adjustments to such apparatus reduces its practical value very considerably.

It is an object of the present invention to provide a television receiver of the type described which can be used for high definition reception,

and in which the cost and complexity of the above mentioned systems is avoided.

According to the present invention there is provided a television receiver comprising a plurality of long evacuated tubes, said tubes being arranged vertically in one plane in close proximity to one another, a set of elongated electrodes for each tube arranged parallel to the axis thereof, the electrodes comprising a source of electrons, a control electrode and an anode. There is also provided an elongated fluorescent layer for each tube to receive the electrons from the source of electrons, and a line frequency commutator in operative connection with the control electrodes of the tubes, a picture signal receiver for applying picture signals to the armature of the line frequency commutator, and a frame frequency commutator for controlling all of the tubes simultaneously the incidence of said electrons on the fluorescent layer from point to point along the length of each tube.

In the case where the source of electrons is thermionic, there are preferably provided a series of horizontal magnetic controlling members which are energised by the frame frequency commutator in turn. The arrangement is then made such that in each tube electrons can only reach the fluorescent layer where the corresponding magnetic member is energised, the electrons in the remainder of the tube being deflected away from the fluorescent layer on to the anode.

The source of electrons may be photo-emissive, and in this case the frame frequency commutator may comprise means such as a mirror drum and co-operating optical system for sweeping a horizontal strip of light in the vertical direction down all the tubes simultaneously. Electrons are emitted in each tube only at the point where the strip of light falls on the photo-emissive cathode.

A certain storage effect can be attained by arranging that the control of the vertical columns persist for a short length of time which must not be greater than the line duration period. The electrons can then reach the picture area at the many crossing points of the simultaneously controlled vertical columns with a single controlled horizontal line.

The term "commutator" is intended to include not only mechanical devices in which an armature moves over fixed contacts, but also electronic devices in which the armature is constituted by an electron beam, and optical devices in which it is constituted by a light beam. In the latter case the usual fixed contacts are re-

placed by photoelectric cathodes, which may also serve as the electron controlling means referred to above.

By controlling continuous vertical columns with one commutator and continuous horizontal rows with the other, instead of controlling individual elemental areas, the above mentioned difficulties arising out of the use of an individual device for each elemental area are largely overcome. Thus even in the case of large picture areas of a size comparable with that of a full sized cinema screen, the number of discharge devices required can be equal to the number of picture lines, and in the case of smaller picture areas, a single device may be employed.

The invention will now be described by way of example with reference to the accompanying drawings in which

Figs. 1 and 2 illustrate the use of vertical tubes for building up the picture area;

Fig. 3 shows a mechanical commutator arrangement as an alternative to part of the arrangement of Fig. 1;

Fig. 4 illustrates the use of an optical commutator for the line frequency scanning;

Fig. 5 is a sectional view of a preferred form of tube;

Fig. 6 is a perspective view of one form of magnetic control for the frame scanning.

Referring to Figs. 1 and 2; each tube 21, which is preferably of oval or pear-shaped cross section, is provided with a heated cathode 22, a grid 23, an anode 24 and a fluorescent screen 25, these electrodes running the whole length of the tube. Each tube has an extension 26 at the lower end which contains the heated cathode 27, grid 28 and anode 29, the latter being directly connected to the grid 23 of the main tube. The anodes 24, 29 are connected to a source of positive potential, the latter through a resistance 42, so that it is at a lower potential than the anode 24.

The line frequency commutator comprises a cathode ray tube 30 having a ring of contacts 31 in place of the normal fluorescent screen. The beam of this tube is deflected in a circular fashion over this ring of contacts by means of line frequency synchronizing impulses applied to the deflecting coils 32, 33. The picture signals from the receiver 18 are applied to the grid 34 to modulate the intensity of the beam. Each of the contacts 31 is connected to a grid 28 and to earth through a leakage resistance 35. As the beam of the cathode ray tube strikes each contact 31 in turn, negative impulses carrying in amplitude in accordance with the received picture signals will be applied in turn to the grids 28 of triode extensions 26, and consequently, amplified positive impulses will be applied in turn to the grids 23 of the main tubes 21, thus allowing the electrons from the cathode 22 to pass and reach the anode 24. The leakage time of the negative charges applied to the grids 28 will depend upon the time constant of the circuit formed by the resistance 35 and the shunt capacity between the grid 28 and earth. This time constant can be chosen so that the negative charges persist for a time which approaches but does not exceed the duration time of a picture line, so that a storage effect can be obtained.

In some cases the triode extension 26 to each tube can be dispensed with, and the contacts 31 connected directly to the grids 23 of the main tubes. In this case, however, the contacts must be coated with a secondary electron emitting layer having a very high ratio of secondary elec-

trons emitted to primary electrons incident thereon, so that positive charges are set up on the contacts in proportion to the number of secondary electrons ejected therefrom. The normal collecting electrode for collecting the secondary electrons must be provided.

The frame frequency commutator comprises a second cathode ray tube 36 with contacts 37 and deflecting coils 38, 39 energized by the received frame synchronizing impulses to deflect the beam over the contacts. Each contact is connected to a wire 40 running across the front of the tubes 21 at right angles to their axes. The opposite ends of all the wires 40 are connected to earth, so that as the beam of the cathode ray tube 36 strikes one of the contacts 37, a current will flow through the wire 40 connected to that contact. This current will produce a localized magnetic field having a component parallel to the axes of the tubes 21, and this localized field will act on the electron stream in that portion of each tube which lies opposite the wire to deflect it from the anode 24 on to the fluorescent screen 25. Thus as a current flows in each of the wires 40 in turn, this localized field will move down the tubes, thus effecting the frame scanning. In actual practice the number of wires 40 can be much greater than the required number of picture lines, and by using a correspondingly greater number of contacts in conjunction with a cathode ray beam of such a cross section that it covers a group of these contacts, the magnetic field can be given a substantially continuous movement.

In front of the wires is placed a suitable diffusing screen 41 arranged at such a distance from the tubes 21 that the light emitted from the fluorescent material is slightly spread by the screen to give a continuous illumination.

Instead of cathode ray commutators, mechanical commutators can be used, in the manner shown in Fig. 3. Potentials can be applied in turn to the grids 26 through the armature 17 of the commutator 12 from the signal receiver 18, these potentials being modulated in amplitude in accordance with the received picture signals. Also, positive potentials can be applied in turn to the wires 40 through the armature 20 of the commutator 14 to cause currents to flow therein. The armature 17 rotates at the line scanning frequency and the armature 20 at the frame scanning frequency, the rotation being controlled by the received line and frame synchronizing impulses respectively.

The line frequency commutation can also be performed by means of an optical commutator. This is illustrated in Fig. 4, in which the tube 21 is modified by omitting the grid 28, and replacing the heated cathode 27 by a photo electric cathode 43. A beam of light from the source 44 is swept over the cathode 43 in turn by means of a mirror drum 45, which rotates at the line scanning frequency. The intensity of the light beam is modulated in accordance with the received picture signals by means of any suitable form of light modulator 46, such as a Kerr cell or super-sonic wave cell. The anode 29 incorporates a secondary electron emitting layer, so that as each photo-cathode 43 is illuminated, the electrons emitted will eject a proportionately greater number of secondary electrons from the anode 29, which are collected by the usual collecting electrode (not shown), and which leave the anode 29, and consequently the grid 23, with a proportionate positive charge. The remainder

of the apparatus is similar to that shown in Figs. 1 and 2. Instead of modulating the light beam in accordance with the picture signals, an unmodulated light beam can be used, in which case the grid 28 is retained, and the picture signals are applied to all the grids 28 simultaneously.

A sectional view of one form of the tubes 21 is shown in Fig. 5 in order to show more clearly the constructional details. The cathode 22 comprises a long nickel cylinder coated with an electron emitting material and having a heater wire coated with porcelain running through it. The cylindrical grid 23 is supported by mica spacing pieces 47 situated at intervals along the length of the tube, which also support focussing electrodes 48. The anode 24 and fluorescent screen 25 are carried by the wall of the tube.

In Fig. 6 is shown an alternative form of the magnetic deflecting means for effecting the frame scanning. Each magnetic circuit for energizing a picture line comprises an iron core in the form of a channel section member 50, the end portion of two of these members being shown in the figure. The opposite sides 51, 52 of this member are provided with elongated apertures 53 through which the tubes 21 pass, two of these tubes being shown. The base of each member is surrounded by an energizing coil 54 wound in such a sense that the sides 51, 52 form the opposite poles of a magnetic system, the flux between these poles running parallel to the axis of the tubes to produce the necessary deflection of the electron streams in the tubes 21. Each of the coils 54 is connected to one of the contacts of the frame scanning commutator, so that the coils are energized in turn.

Storage of the received signals can be effected in all cases by controlling the leakage time of the charges which control the line scanning. Alternatively it can be effected by providing no permanent leakage path, but by periodically connecting the line scanning electrodes to earth or to a source of negative potential at predetermined time intervals after each positive charge has been applied. This can be done by providing the line frequency commutator with a second armature which follows the first and which makes the required connection after the required time interval has elapsed. The same method may be applied to the frame frequency commutator in order to ensure that the frame scanning control is cut off at the correct moment, if this proves to be necessary.

Subject-matter disclosed but not claimed herein is claimed in application Serial No. 472,240, filed January 13, 1943, for Television receivers, which is a division of this case.

I claim as my invention:

1. A television receiver comprising a plurality of long evacuated tubes, said tubes being arranged vertically in one plane in close proximity to one another, a set of elongated electrodes for each tube arranged parallel to the axis thereof, said electrodes comprising a source of electrons, a control electrode and an anode, an elongated fluorescent layer for each tube adapted to receive such electrons from said source that pass said control electrode and anode, a plurality of magnetic controlling members arranged horizontally and externally of said tubes, a line frequency commutator in operative connection with the control electrodes of said tubes, a frame frequency commutator in operative connection with said magnetic controlling members, a picture signal receiver in electrical connection with the ar-

mature of said line frequency commutator and a source of electrical current in electrical connection with the armature of said frame frequency commutator.

2. A television receiver according to claim 1 wherein said magnetic controlling members comprise a plurality of horizontal wires connected to contacts in said frame frequency commutator.

3. A television receiver according to claim 1 wherein said magnetic controlling members comprise a plurality of horizontal magnetic cores having pole pieces which extend horizontally over the whole of the picture area and are separated vertically by an amount not exceeding the width of a picture line, and an energizing winding for each of said cores, said windings being connected to contacts in said frame frequency commutator.

4. A television receiver comprising a plurality of long evacuated tubes, said tubes being arranged vertically in one plane in close proximity to one another, a set of elongated electrodes for each tube arranged parallel to the axis thereof, said electrodes comprising a source of electrons, a control electrode and an anode, an elongated fluorescent layer for each tube adapted to receive such electrons from said source that pass said control electrode and anode, an evacuated extension for each tube, said extension being provided with a cathode, control grid and anode, said anode being in electrical connection with the control electrode of said tube, a plurality of magnetic controlling members arranged horizontally and externally of said tubes, a line frequency commutator having contacts connected to the control grids of said extensions, a frame frequency commutator in operative connection with said magnetic controlling members, a picture signal receiver in electrical connection with the armature of said line frequency commutator and a source of electrical current in electrical connection with the armature of said frame frequency commutator.

5. A receiver according to claim 4, wherein said line frequency commutator comprises a cathode ray tube having said contacts within the envelope thereof, a source of cathode rays for said tube, and means for deflecting said cathode ray over said contacts.

6. A television receiver comprising a plurality of long evacuated tubes, said tubes being arranged vertically in one plane in close proximity to one another, a set of elongated electrodes for each tube arranged parallel to the axis thereof, said electrodes comprising a source of electrons, a control electrode and an anode, an elongated fluorescent layer for each tube adapted to receive such electrons from said source that pass said control electrode and anode, an evacuated extension for each tube, said extension being provided with a photo-electric cathode, and an anode, said anode being capable of a high secondary electron emission and being in electrical connection with the control electrode of said tube, a plurality of magnetic controlling members arranged horizontally and externally of said tubes, means for developing a light beam, means for modulating the intensity of said light beam in accordance with received picture signals, means for periodically sweeping said light beam over said photo-electric cathodes at the line scanning frequency, a frame frequency commutator in operative connection with said magnetic controlling members and a source of electrical current

in electrical connection with the armature of said frame frequency commutator.

7. A television receiver comprising a plurality of long evacuated tubes, said tubes being arranged vertically in one plane in close proximity to one another, a set of elongated electrodes for each tube arranged parallel to the axis thereof, said electrodes comprising a source of electrons, a control electrode and an anode, an elongated fluorescent layer for each tube adapted to receive such electrons from said source that pass said control electrode and anode, an evacuated extension for each tube, said extension being provided with a photo-electric cathode, a control grid and an anode, said anode being capable of a high secondary electron emission and being in electrical connection with the control electrode of said tube, a plurality of magnetic controlling members arranged horizontally and externally of said tubes, means for developing a light beam over said photo-electric cathodes at the line scanning frequency, a picture signal receiver electrically connected to the control grid of said extensions, a frame frequency commutator in operative connection with said magnetic controlling members and a source of electrical current in electrical connection with the armature of said frame frequency commutator.

8. A television receiver comprising a plurality of long evacuated tubes, said tubes being arranged vertically in one plane in close proximity to one another, a set of elongated electrodes for each tube arranged parallel to the axis thereof, said electrodes comprising a source of electrons, a control electrode and an anode, an elongated fluorescent layer for each tube adapted to receive such electrons from said source that pass said control electrode and anode, an evacuated extension for each tube, said extension being provided with a cathode, control grid and anode, said anode being in electrical connection with the control electrode of said tube, a plurality of magnetic controlling members arranged horizontally and externally of said tubes, a cathode ray tube constituting a line frequency commutator, a source of cathode rays for said tube, a series of commutator contacts and means for deflecting said cathode rays over said contacts, a frame frequency commutator in operative connection with said magnetic controlling members, a picture signal receiver in electrical connection with the cathode ray tube of said line frequency commutator and a source of electrical current in electrical connection with the armature of said frame frequency commutator.

9. A television receiver comprising a plurality of long evacuated tubes arranged side by side in one plane, and having their length extending in the frame scanning direction, and within each tube and extending along the length thereof, a cathode, a control electrode and a fluorescent screen; a line frequency commutator comprising a plurality of photo-electric cathodes, an anode associated with each cathode to receive electrons therefrom, means for sweeping a light beam over each cathode in turn to cause the emission of electrons therefrom and to produce a voltage change on said anodes, means for controlling said voltage changes in accordance with received television signals; and means for applying said voltage changes to said control electrodes, whereby each control electrode receives in turn a voltage such as to permit the passage of electrons to said fluorescent screen to an extent dependent

upon said received television signals, magnetic controlling means for permitting the passage of electrons to said fluorescent screen in a part only, at any instant, of the length of said tubes, and a frame frequency commutator for energising said controlling means.

10. A television receiver comprising a plurality of long evacuated tubes arranged side by side in one plane, and having their length extending in the frame scanning direction, and within each tube and extending along the length thereof, a cathode, a control electrode and a fluorescent screen; a line frequency commutator for applying to each control electrode in turn a voltage such as to permit the passage of electrons to said fluorescent screen to an extent dependent upon received television signals; a plurality of magnetic controlling members situated at right angles to and externally of said tubes for controlling the passage of electrons to said fluorescent screen in different portions of all the tubes, and a frame commutator for energising said magnetic controlling members in turn.

11. A television receiver according to claim 10 wherein said magnetic controlling members comprise a plurality of wires connected to said frame frequency commutator so as to be energised in turn thereby.

12. A television receiver according to claim 10 wherein said magnetic controlling members comprise a plurality of magnetic cores having pole pieces which extend over the whole of the picture area in the frame scanning direction, and are separated in the line scanning direction by an amount not exceeding the width of a picture line, and an energising winding for each of said cores, said windings being connected to said frame frequency commutator so as to be energised in turn thereby.

13. A television receiver comprising a plurality of long evacuated tubes arranged side by side in one plane, and having their length extending in the frame scanning direction, and within each tube and extending along the length thereof, a cathode, a control electrode and a fluorescent screen; an extension for each tube, and within said extension an anode connected to said control electrode and a cathode; line commutating means for permitting the passage of electrons from said cathode to said anode in each tube in turn and control means for rendering the extent of said passage of electrons dependent upon received television signals, whereby each control electrode receives in turn a voltage such as to permit the passage of electrons to said fluorescent screen to an extent dependent upon said received signals; magnetic controlling means for permitting the passage of electrons to said fluorescent screen in part only, at any instant, of the length of said tubes, and a frame frequency commutator for energizing said controlling means.

14. A television receiver according to claim 13 wherein the cathode in each of said extensions is photo-electric and the anode in each of said extensions is highly emissive of secondary electrons; and said line commutating means comprise means for sweeping a light beam over said photo-electric cathodes in turn and said controlling means comprise means for modulating said light beam with said received television signals.

15. A television receiver according to claim 13 wherein the cathode in each of said extensions is photo-electric and the anode in each of said extensions is highly emissive of secondary electrons; wherein said line commutating means comprise

means for sweeping a light beam over said photo-electric cathodes in turn, to cause an emission of electrons from each in turn; and wherein said controlling means comprise a control electrode in each extension and means for feeding said received television signals to all said control electrodes simultaneously.

16. A television receiver comprising a plurality of long evacuated tubes, said tubes being arranged vertically in one plane in close proximity to one another, a set of elongated electrodes for each tube arranged parallel to the axis thereof, said electrodes comprising a source of electrons, a control electrode and an anode, an elongated fluorescent layer for each tube for receiving such electrons from said source, a line frequency commutator in operative connection with the control electrodes of said tubes, a picture signal receiver for applying picture signals to the armature of said line frequency commutator, magnetic controlling means for controlling in all said tubes simultaneously the incidence of electrons on said fluorescent layer from point to point along the length of each tube, and a frame frequency commutator for energising said control means, wherein said control means comprise a plurality of horizontally arranged magnetic controlling members placed externally of said tubes and said frame frequency commutator is adapted to energise said members in turn.

17. A television receiver comprising a plurality of long evacuated tubes arranged side by side in one plane, and having their length extending in the frame scanning direction, and within each tube and extending along the length thereof, a

cathode, a control electrode and a fluorescent screen; an extension for each tube, and within said extension an anode connected to said control electrode and a photo-electric cathode; an optical line commutator comprising means for sweeping a light beam at line frequency over said photo-electric cathodes in turn to release electrons therefrom and to generate charges on said anodes of said extensions; a picture signal receiver and electrical means in connection therewith for controlling the number of electrons reaching said anodes of said extensions in accordance with received picture signals, whereby each control electrode of said tubes receives in turn a voltage such as to permit the passage of electrons to said fluorescent screen to an extent dependent upon said received signals; magnetic controlling means for permitting the passage of electrons to said fluorescent screen in part only, at any instant, of the length of said tubes, and a frame frequency commutator for energising said controlling means.

18. A television receiver according to claim 13 wherein the cathode in each of said extensions is thermo-emissive, and said line commutating means comprise a cathode ray tube having a plurality of contacts arranged to be commutated by the cathode ray beam; wherein there is provided a control grid within each of said extensions, each control grid being connected to one of said contacts; and wherein said controlling means comprise means for modulating said cathode ray beam in accordance with said received television signals.

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