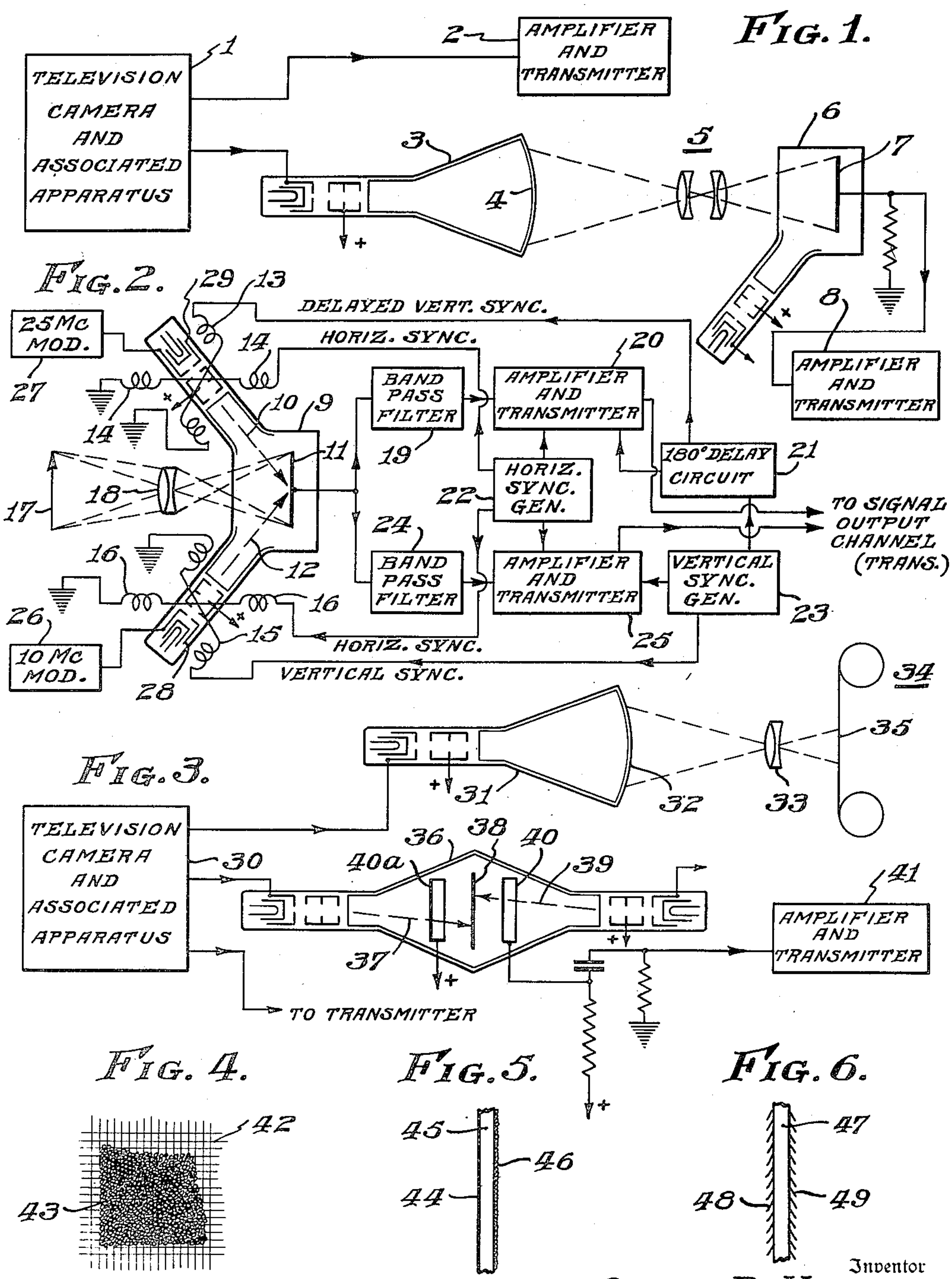
Aug. 25, 1942. O. B. HANSON 2,293,899

TELEVISION SYSTEM

Filed Aug. 23, 1940



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Patented Aug. 25, 1942

2,293,899

UNITED STATES PATENT OFFICE

2,293,899

TELEVISION SYSTEM

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Application August 23, 1940, Serial No. 353,796

7 Claims. (Cl. 178—6.8)

This invention relates to television transmission systems and more particularly to means for translating television images of one degree of resolution to an image of another degree of resolution.

When it is desired to transmit television signals wherein images having different degrees of resolution are provided over different transmission channels in order to insure service for television receivers designed to receive the transmission of images of the selected degrees of resolution, or, in some instances, to record photographically the image in one degree of resolution and then to broadcast or rebroadcast the image at another degree of resolution, it is impractical to have a battery of cameras for developing the signals to be utilized, for each system from a single production. A number of objections to the use of a plurality of cameras are at once evident. Among these are the necessity of providing equipment for the correction of parallax due to viewing the scene or object from different angles. Still further, a plurality of cameras in a studio of limited space is bulky and crowds the studio so as to make impossible satisfactory mobility and thus the desirable shift of camera location for different scenes of action.

Throughout this specification, reference is made to images having one degree of resolution and those having a second degree of resolution. Any one degree of resolution may herein be understood as relating to a scanning operation having any assumed degree of resolution by reason of a certain number of lines per frame, fields per frame, and repetition rate of frames per second.

It frequently becomes desirable to record a televised program made up of images having one predetermined degree of resolution as, for example, for syndication, and then to convert the program to images having a second degree of resolution for radio transmission.

It is sometimes desirable to change the range of the broadcast transmitter by lowering the frequency. This necessarily requires a narrower band width because of limited space in the lower frequency range and by the use of this invention, a picture having a given degree of resolution may be converted to a train of image signals having a lower degree of resolution, so that transmission over a narrower band width is possible.

It is also sometimes desirable to scan the electrical representation of a selected optical image with a predetermined number of lines per frame and broadcast or rebroadcast a train of signals representing the same image at a greater number of lines per frame.

One of the objects of this invention is to provide means for converting television images having one degree of resolution to images of another degree of resolution.

Another object of this invention is to provide means for transmitting separate trains of image signals from a single television camera, each train of image signals being adapted to form an image having a different degree of resolution.

Another object of this invention is to provide means for recording photographically the televised program at a degree of resolution different from the degree of resolution used for radio transmission.

Another object is to provide an electronic means for changing between television images of different selected degrees of detail.

Still another object is to provide an electro-optical means for changing between different television images having different degrees of resolution.

Other and incidental objects of the invention will be apparent to those skilled in the art from a reading of the following specification and an inspection of the accompanying drawing in which

Figure 1 shows, in block diagram, an electro-optical system for converting television images from one degree of resolution to another;

Figure 2 shows, in block diagram, means for transmitting a plurality of trains of image signals, each train having a different degree of resolution, from a single television camera;

Figure 3 shows means for recording photographically images having one degree of resolution and converting the same train of image signals to a train of image signal having another degree of resolution for radio broadcasting; and

Figures 4, 5 and 6 show different forms of double mosaic cathode structures.

Referring to Fig. 1, the television camera and associated apparatus 1 supplies the amplifier and transmitter 2 with a train of image signals having a first predetermined degree of resolution. Such a system is described in an article by R. R. Beal in RCA Review of January, 1937. The television camera and associated apparatus 1 also supplies the same train of image signals to picture tube 3 which forms an optical image on surface 4. The lens system shown at 5 is used to focus this image on a second television camera inconoscope 6, whose cathode 7 furnishes a second amplifier and transmitter 8 with a train of image signals representing the original picture image in a second degree of resolution.

The proposed electro-optical method of translation in which a picture scanning tube furnishes one image for scanning by a second image scanning tube operated to form a train of image signals representing a second degree of resolution of the same image would have some losses in contrast, range, definition, etc., and for this reason, an all electronic device for accomplishing the translation is preferable. Several modifications of a device of this general type are herein described.

Fig. 2 shows one embodiment of my invention in which a single television camera is used to provide trains of image signals representing images having different degrees of resolution. A modified form of scanning tube is shown at 9 in which the mosaic electrode element 11 is scanned by electron beams 10 and 12 applied to the same side of the mosaic element 11. An image from the subject 17 is focused on the mosaic element 11 through lens system 18. The mosaic element may be of any suitable form such as that described in Essig Patent 2,065,570, issued December 29, 1936, and assigned to Radio Corporation of America. The mosaic element 11 comprises an insulating supporting base member to which are applied, or which carries, individual, minute, photosensitive, electrically conductive elements insulated from each other.

Electron beam 10 is modulated by the voltage of modulator 27 at a high frequency, for example, 25 mc., and, likewise, electron beam 12 is modulated by the voltage of modulator 26 at a frequency different from that of modulator 27, for example, 10 mc. These modulators may take the form of any of the well known ultra high frequency oscillators. The electrical representations or signal resulting from scanning the optical image focused on the mosaic element 11 are then transmitted through band pass filters 19 and 24, each of which is designed to select a band of frequencies covered by each of the modulators 26 and 27 and their associated side bands so that the train of image signals caused to flow from the mosaic element 11, by the modulated electron beam 10, are passed by band pass filter 19 to its amplifier and transmitter 20. Likewise, the train of image signals, or signal resulting from scanning the image upon the mosaic electrode 11 by the modulated electron beam 12 is passed by band pass filter 24 to the amplifier and transmitter 25. The horizontal synchronizing pulse generator 22 supplies pulses at two predetermined rates which are coordinated with the selected degrees of resolutions. One series of pulses is supplied to the horizontal deflection coils 14 associated with scanning tube 9. This same series of pulses also furnishes amplifier and transmitter 20. The other series of pulses are supplied to the horizontal deflection coils 16 of the scanning device. This same series of pulses also furnishes amplifier and transmitter 25.

In one form of this invention a vertical synchronizing pulse generator 23 is arranged to develop a single form of synchronizing pulses at a selected rate of repetition. These pulses are then transmitted directly to amplifier and transmitter 25 and the vertical deflecting coils 15, which are associated with the scanning tube 9. Amplifier and transmitter 25 combines the horizontal synchronizing pulses, the vertical synchronizing pulses and the picture signals, and transmits them to the associated television channel. The same character of pulses is also supplied to a delay circuit or delay network 21 (which may be of any known form) so as to be delayed in phase by 180° or other selected phase angle. The delayed pulses are then transmitted to amplifier and transmitter 20 and are utilized to energize the vertical deflecting coils 13 of the scanning tube 9. Thus, the vertical deflection of the electron beam 10 across the mosaic element 11 follows the electron beam 12 by 180° or one-half a picture frame, or by any other degree selected. This delay is essentially to provide adequate time for the optical image which is cast upon the photosensitive mosaic 11 to cause the development of an electrical representation (e. g., an electrostatic change) upon the mosaic so that when that element is scanned by each of the electron beams 10 and 12, there will result an output signal energy train which characterizes the optical image in two forms of resolution or standards. This delay also prevents interfering effects between scanning lines. Amplifier and transmitter 20 combines this second series of horizontal synchronizing pulses, vertical synchronizing pulses and picture signals, and transmits them to a second television channel.

An alternative method of generating carriers would be by the use of a fine grating in front of the mosaic. The different scanning rates for the two beams would give different carrier frequencies with the same grating.

Fig. 3 shows an arrangement in which the electrical representation of an image received from the television camera and its associated apparatus is utilized to furnish a train of image signals, a portion of the energy of which is fed directly to a transmitter. Another portion of energy from the same train of image signals is reconstructed as an optical image on surface 32 of picture tube 31 and focused by optical system 33 to a photographic film 35 of a photographic camera 34. Another portion of the energy of the same train of image signals is also utilized to form an optical image on the image cathode 38 of a tube 36. This tube 36 includes a double sided mosaic indicated at 38 and shown in more detail in Fig. 4. Tube 36 is of a double ended construction in which a highly evacuated envelope contains oppositely disposed electron guns, each of which may be of conventional construction, including the usual cathode, control electrode, first anode and second anode. One side of the envelope contains an auxiliary collecting ring 40 maintained at a positive potential with respect to its associated cathode and designed to collect secondary electrons emitted from the mosaic 38 by reason of the electronic bombardment of electron gun beam 39. It is preferably designed so that it will not be struck by electron beam 39 and so that none of the secondary electrons caused by the beam 37 on the opposite side of the mosaic are collected. The amount of secondary electrons present will depend upon the electrical image on the mosaic 38. Therefore, a train of picture signals may be taken off from the collector 40 and amplified in amplifier 41. A second collector 40a is positioned adjacent the electrode 38 on the same side as electron gun 37. The rates upon which the deflection of the electron beam 37 is based is the same as those rates of deflection used for the television camera and associated apparatus 30. A second predetermined rate or rates of deflection is chosen to control the electron beam 39 so that the amplifier and transmitter 41 will produce a train of image signals whose optical image has a degree of resolution different from that produced by television camera and associated apparatus 30.

A discharge device such as that shown at 9 in Fig. 2, that is a converter tube having two electron guns on the same side of a single sided mosaic, may be used in the system shown in Fig. 3.

Fig. 4 shows one type of image cathode suitable for the tube 36 of Fig. 3. This cathode mosaic is of the type in which the elements 43 are contained in the interstices of mesh 42 and are exposed on both sides of the mesh so that they will come in contact with both the electron beams operating from opposite sides of the cathode. For example, it may be constructed in accordance with the teachings of Patent No. 2,045,984, issued February 28, 1934, in the name of Leslie E. Flory, and assigned to the Radio Corporation of America.

Fig. 5 shows another image cathode suitable for the tube 36 of Fig. 3. A very thin transparent material 45 supports a fluorescent screen 44 on its one side and on its other side a mosaic of minute photosensitive electrically-conductive elements insulated from each other. Light produced by fluorescent screen 44 under bombardment from its associated electron gun deflected at a first selected rate passes through the transparent dielectric and charges the front elements 46 by photo-emission. This electrical representation of an optical image is then converted to a train of image signals representing an image with a second degree of detail or resolution by the scanning action of the other electron gun. The second collector 40a is not needed in tube 36 of Fig. 3 if this type of electrode is used.

Fig. 6 shows still another form of double sided image cathode in which a supporting element of mica or other insulating material 47 supports small metallic particles 48 on one side and particles 49 on the other side. The particles 48 on one side of the supporting member 47 will be given an electrical charge in accordance with potential of an electron beam which is in turn controlled by a train of signal energy. The particles on the opposite side will receive a corresponding charge by the capacitive effect of the supporting member 47 to be scanned off by a second electron beam to produce a second train of signal energy having a second degree of resolution and repetition rate.

In either of the proposed methods of conversion of an image from one degree of resolution to another, it would be desirable to employ the same vertical scanning frequency for the two parts of the system, but a rather large difference in phase between the two would be desirable to eliminate beats between the two rates of line scanning.

In one embodiment of this invention, the line scanning rates used in the two systems bear an integral relation to one another (such as 441 and 882 lines), and adjustment of vertical scanning in the two parts of the translating device for the most efficient translation of vertical detail is provided.

In another embodiment of this invention, the converting devices are used in pairs in a sort of "push-pull" arrangement; under certain conditions, this makes possible translation between two systems having different vertical, as well as different horizontal, scanning rates. For example, a plurality of translating tubes may be operating such that an image is constructed in one tube while the image of another tube previously created is being scanned; the tubes would so alternate at a rate depending on the relative rates of repetition rates. According to this embodiment only one electron beam in each tube would be operating at any one time so that there would be no interference between the two beams.

The receiver means may be of any suitable type such as that shown in Carlson Re: 20,700, issued April 19, 1938, or it may be of any other well known type. It is desirable to provide a receiver that is equipped to switch from one rate of scanning to another selected rate of scanning. This can be done by making a suitable adjustment of the blocking oscillator. Such an arrangement is shown by Tolson et al. Patent 2,101,520, issued December 7, 1937, and assigned to the Radio Corporation of America. Under certain conditions, it would be preferable to provide a switch to change the blocking oscillator grid leak to a predetermined value so that the blocking oscillator would fall in step with any of the deflection rates used at the broadcast transmitter.

From the foregoing, it will be apparent that various other modifications may be made in this invention without departing from the spirit and scope thereof.

I claim as my invention:

1. In a television system wherein is incorporated an electronic scanning tube having therein a light-responsive mosaic electrode element, the method of intelligence transmission which includes the steps of projecting optical images upon the mosaic electrode element, scanning the mosaic electrode element with a plurality of electron beams, modulating each of said beams at different frequencies, deriving from the scanning a plurality of independent trains of signalling energy representing different degrees of resolution of the optical images and independently transmitting each of the plurality of produced trains of signalling energy.

2. In a television system wherein is incorporated an electronic scanning tube having therein a light-responsive mosaic electrode element, the method of intelligence transmission which includes the steps of projecting optical images upon the mosaic electrode element, scanning the mosaic electrode element with a plurality of electron beams, modulating each of said beams at a different frequency such that the output signal therefrom occupies a plurality of independent bands of frequencies deriving from the scanning a plurality of independent trains of signalling energy representing different degrees of resolution of the optical images and independently transmitting each of the plurality of produced trains of signalling energy.

3. In a television system wherein is incorporated an electronic scanning tube having therein a light-responsive mosaic electrode element, the method of intelligence transmission which includes the steps of projecting optical images upon the mosaic electrode element, scanning the mosaic electrode element with a plurality of electron beams, modulating each of said beams at a predetermined frequency, deriving from the scanning a plurality of independent trains of signalling energy representing different degrees of resolution of the optical images and independently transmitting each of the plurality of produced trains of signalling energy.

4. In a television system wherein is incorporated an electronic scanning tube having therein a light-responsive mosaic electrode element, the method of intelligence transmission which includes the steps of projecting optical images

upon said mosaic electrode element, scanning the mosaic electrode element, deriving from the scanning a train of signal energy, utilizing one part of said energy to reconstruct said optical image in a plane parallel and closely adjacent to a second light responsive mosaic electrode element, and scanning said second light responsive mosaic electrode element to derive a train of signal energy representing an image having a degree of resolution different from that of said recorded image.

5. In a television system, a photosensitive mosaic electrode element included within a cathode ray scanning device, means to project optical images upon the mosaic element, a plurality of independent electron beams for repeatedly scanning the mosaic element, means including a signal generator for modulating each of said beams at different and substantially constant frequencies and means to derive as a result of the scanning operation independent trains of signalling energy representative in different degrees of resolution of the optical images projected upon the mosaic electrode, and a plurality of transmission channels individually responsive to individual trains of the produced signalling energy.

6. In a television system, a photosensitive mosaic electrode element included within a cathode ray scanning device, means to project optical images upon the mosaic element, means for repeatedly scanning the mosaic element comprising a plurality of electron beams, means for modulating each of said electron beams with signals having different frequencies and means to derive as a result of the scanning operation independent trains of signalling energy representative in different degrees of resolution of the optical images projected upon the mosaic electrode, and a plurality of transmission channels individually responsive to individual trains of the produced signalling energy.

7. In a television system, an electronic tube including therein a photoelectric mosaic element, means to project optical images upon said mosaic, a plurality of independent cathode ray scanning means for deriving from the optical images projected upon said mosaic element a plurality of trains of electric signalling wave energy, means for causing each of said energy trains to have a different predetermined frequency band width representative of different degrees of optical resolution of the optical images, and means to transmit the derived plurality of said energy wave trains each over separate transmission channels.

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