

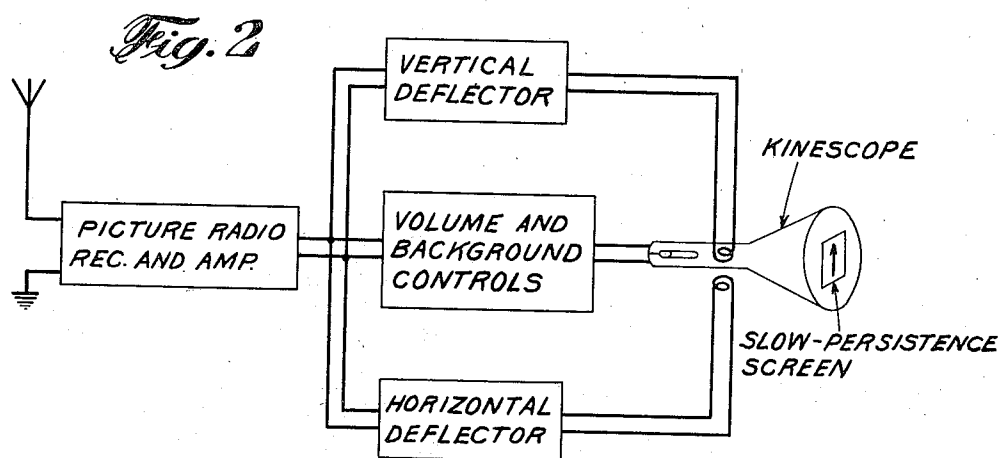
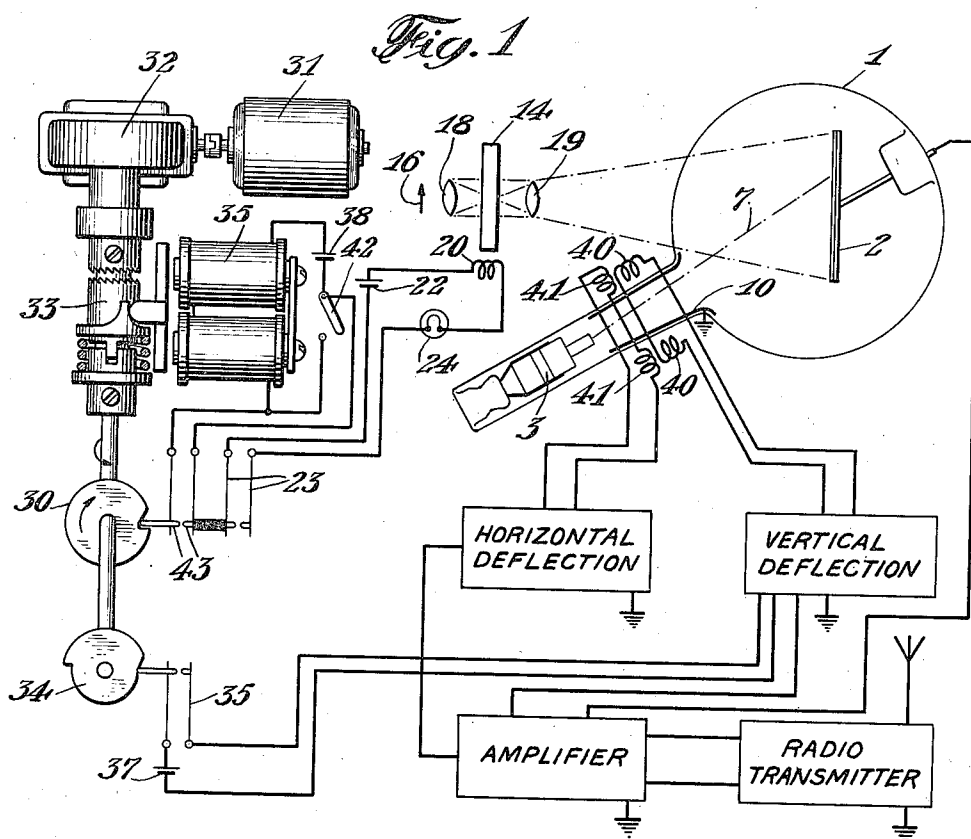
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SYSTEM FOR PHOTOTRANSMISSION

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SYSTEM FOR PHOTOTRANSMISSION

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5 Claims. (Cl. 178—6.8)

This invention relates to a method of and system for electrically transmitting pictures or images at a relatively slow rate as compared with the transmission of successive pictures in television systems whereby a comparatively narrow frequency band is suitable for transmission and certain difficulties encountered at present in television systems are obviated.

The object of the invention is to simplify and improve phototransmission and reproduction systems and methods.

According to one feature of the invention apparatus is provided for quickly forming an electron image or electrical charge image to be retransmitted and for then transmitting and reproducing said picture at a relatively slow rate, for example during an interval of several seconds. In this manner successive snapshots of news events and the like may be transmitted at frequent intervals and reproduced for an observer for a suitable period with comparatively simple transmission and receiving apparatus. Since the speed of transmission may be only about one one-hundredth as great as that employed in television, an ordinary radio channel of a width of ten kilocycles or less may be employed for the transmitting channel or ordinary wire lines may be used whereby the space or distance limitations of the high-frequency television channels are overcome and the radio transmitting and receiving apparatus is greatly simplified.

In accordance with the invention suitable storage mechanism for the picture at the transmitting station is employed whereby the picture may be transmitted at a desired rate after it has been formed upon a picture sensitive element such as the mosaic screen of an "iconoscope." Likewise at the receiving station a transitory or evanescent image is formed and retained for a short time. The received picture is stored for a sufficient time to be viewed by the observer, as for example, by forming the picture on an electro-luminescent screen of the retentive or slow-persistence type utilizing a phosphorescent material which remains luminescent for, say, several seconds.

Another object of the invention is to provide automatic and/or manually operated means for selecting and spacing the pictures to be transmitted. Thus in transmitting a news event, the individual snapshots or transmitted scenes may be selected in accordance with the desired progress of the game or other event being transmitted.

In the preferred form of the invention an elec-

tronic image of the picture to be transmitted is produced on the screen of an iconoscope similar in most respects to that described in a paper by V. K. Zworykin in the January, 1934, "Proceedings of the Institute of Radio Engineers." In a television system employing the iconoscope the picture carrier contains high-frequency components which require a wide frequency band for transmission and necessitates the use of extremely high-frequency radiation in order to avoid interference with the broadcast range of frequencies. The use of these high frequencies, however, involves great engineering problems and since the waves can be received only over relatively short distances, a great many repeaters must be employed to cover more than a small area. In addition to the complexity and cost of this system, serious difficulties result from interaction between the separate transmitters and other phenomena.

In accordance with the invention, however, transmission is effected by the use of a narrow frequency band of ten kilocycles or less similar to that employed in the transmission of sound programs. Thus the transmission involves no more difficulty than in sound broadcast systems which are in general use, and the transmitting station can utilize one of the regular broadcast channels and broadcast the photo-transmission signals over a large area.

The screen of the iconoscope is preferably arranged to be subjected to the picture to be transmitted for only a short time, for example a tenth of a second or less. The screen may be subdivided into minute areas as by ruling dividing lines to separate the elements thereof in order that the charges applied to the elements of the screen will not be unduly diminished for two or three seconds or until transmission can be effected. The scanning beam of the iconoscope is operated to scan the picture which has been produced upon the screen in a desired period, for example two or three seconds. As this period is approximately one hundred times as great as the scanning speed of a television system the frequency band required for transmission is only a small fraction of that required for television. The time required for transmitting each picture obviously depends upon the size of the picture and fineness of detail, and upon the band width of the transmitting channel but as indicated is ordinarily of the order of one hundred times as long as the time required to transmit one frame in television.

At the receiving station the picture may be re-

produced upon any suitable means which will retain the elements of the picture long enough to be viewed, for example during the transmission period and for two or three seconds thereafter. A "kinescope" may be employed to reproduce the picture from the received signals, the kinescope being a conventional television receiving element described by Zworykin in the "Proceedings of the Institute of Radio Engineers" in December, 1933. However the kinescope in the present system preferably employs a phosphorescent screen or so-called "slow-persistence" screen in which the luminescence of the activated portions of the screen persists for the desired period. Screens of this character have been known and used in cathode ray tubes for various purposes, one example being disclosed in the patent to DuMont No. 2,000,014, dated May 17, 1935; and standard RCA cathode ray tubes designed for other uses are available with a "slow-persistence" screen having suitable characteristics.

Other objects and advantages of the invention will appear from the following description of the preferred embodiment shown on the accompanying drawing wherein

Fig. 1 shows an arrangement according to the invention for transmitting pictures intermittently; and

Fig. 2 shows an arrangement for receiving and reproducing picture signals.

With reference to Fig. 1, the reference numeral 1 designates the cathode ray tube for generating picture signals. This tube or iconoscope comprises a suitable photosensitive, mosaic screen 2 which may be made up of a great number of minute, photosensitive silver globules supported on a metallic base plate and each being insulated from the latter and also from each other either by their spacing or by ruling dividing lines between adjacent areas of the screen surface. A suitable electron gun 3 operates to develop a ray 7 of electrons and to direct the same at the screen structure. The tube is provided with a grounded anode, for example, in the form of a silver coating 10 on the inside surface. The ray 7 is caused to scan the screen structure during intermittent periods and during the periods between the intermittent scanning periods the ray is returned to the initial starting point for the next succeeding scanning movement. During each scanning period, the ray scans the screen along a saw-tooth path. The control circuits and elements of the transmitting and receiving apparatus, except as hereinafter described, may be similar to those described in articles by Kell, et al., and Holmes, et al., in the "Proceedings of the Institute of Radio Engineers" for November, 1934.

According to the invention it is desired to expose the mosaic screen 2 momentarily in order to snap a picture of a scene in much the same manner as is done with the ordinary form of camera in taking a "snapshot" and to accomplish this result I provide a shutter 14 of the type which opens for any desirable period, such as $\frac{1}{100}$ th or $\frac{1}{250}$ th of a second. The light rays from the object 16 are focused through the shutter on the mosaic screen 2 by means of a suitable optical system represented by the lenses 18 and 19. In order to control the shutter 14 I provide an electrical control comprising a solenoid 20 for operating the shutter which is connected across the battery 22 and in series with the switch 23 and lamp 24. Lamp 24 is provided for the convenience of the operator so that he may know

when picture transmission and reception is completed. The switch 23 may be controlled by a motor driven cam 30 which is driven from the motor 31 through the reduction gear train 32 and clutch 33. The gear train 32 drives the cam shaft at one revolution every six seconds, assuming that the successive pictures are sent at intervals of not less than six seconds. The clutch 33 is electrically controlled by means of the solenoid 35 which is connected across battery 38 and in series with the switches 42 and 43 respectively. With the arrangement shown, the solenoid 35 controls a latch engaging the movable element of the clutch and the clutch remains engaged until the cam shaft returns to its initial position. When the operator sees a scene which he desires to transmit, he closes the switch 42 to engage the clutch 33 to in turn drive the cam 30. As cam 30 rotates the switches 43 and 23 will be closed thus operating the shutter control 20. Switch 43 is provided in order to prevent the operator from stopping transmission of an individual picture. When he opens switch 42 the transmission does not cease until a complete picture has been transmitted and switch 43 opens the clutch circuit; or the clutch control elements may be constructed as shown so that the cam shaft always comes to rest in the position shown irrespective of the time of release of the armature of the magnet 35.

The motor 31 also controls the vertical motion of the cathode ray 7 by means of a cam 34 which closes the switch 35 to impress a starting impulse from battery 37 on the vertical deflecting circuit so labeled in the drawing. The cam 34 is arranged as shown in the drawing to control the vertical deflecting circuit. When the mosaic screen 2 is exposed and the electron image is created, switch 35 is closed to start the saw-tooth wave generator and thereby start the scanning of the electron image, the scanning period being approximately three seconds. At the end of the three second period, switch 35 is opened for three seconds by cam 34 so that the vertical deflecting circuit causes the vertical scanning to cease while the picture is being viewed at the receiver. This deflecting circuit may be of the conventional type comprising a saw-tooth oscillator of the type wherein a condenser is alternately charged by a battery and discharged when a discharge tube is tripped to create a low resistance path therethrough. The starting impulse generated when switch 35 is closed will bias the grid of the discharge tube in the saw-tooth oscillator circuit to such a potential that the tube is blocked and allows the potential across the condenser to rise. Thus the condenser is charged slowly for three or more seconds and discharged rapidly when switch 35 is opened to generate a saw-tooth voltage which may be impressed on an amplifier which may convert the saw-tooth voltage wave to a saw-tooth current wave and impress it on the vertical deflecting coils 40. The effect of the saw-tooth current is to cause the vertical scanning movement of the cathode ray 7 and the rapid return of the same to its initial position after the vertical scanning movement is completed.

In order to provide horizontal deflection of the cathode ray 7 a self-oscillating saw-tooth wave generator so labeled in the drawing is provided for the purpose of impressing saw-tooth current through the horizontal deflecting coils 41. This horizontal deflection circuit may comprise a condenser alternately charged to a po-

tential which will be of sufficient amplitude to break down a path through a gas discharge tube of the conventional type the output of which will be a voltage wave of a saw-tooth formation since the condenser is slowly charged and rapidly discharged. The saw-tooth voltage is in turn impressed across an amplifier the output of which is a saw-tooth current. This current produces horizontal deflection at the required rate or "n" lines in three seconds, where "n" is the number of lines in the picture and three seconds is the transmitting time.

The picture signals from the mosaic screen 2 and the horizontal and vertical deflecting voltages are all impressed across the amplifier shown in the drawing whereby the output of this amplifier will be a voltage wave comprised of vertical and horizontal synchronizing signals interspersed with picture signals. This may be fed to the input of a conventional radio transmitter and broadcast in the usual manner.

Fig. 2 shows a television receiver comprising a conventional picture radio receiver and radio frequency amplifier. The output of the radio frequency amplifier is connected to the vertical deflecting circuit, the picture signal amplifier and the horizontal deflection circuit. The deflecting circuits may be of the conventional type wherein filters are used for selecting the proper synchronizing impulses and saw-tooth wave generators are controlled thereby. The output currents of the deflecting circuits are connected in the usual manner to the deflecting coils of a slow persistence picture reproducing cathode ray tube and the picture signal amplifier is connected to the control electrodes of the same tube whereby the picture signal is reproduced on a fluorescent or phosphorescent screen. In accordance with this invention the fluorescent or phosphorescent screen must be of the kind which has a considerable lag for instance 3 to 10 seconds so that when the picture is reproduced on the screen it may be viewed for a period of 3 to 5 seconds before the following picture is received. The brightness and duration of the reproduced picture is also dependent upon the intensity of the cathode ray beam and may be regulated by varying the same as in the ordinary cathode ray oscillograph.

According to this invention it is desired to create quickly or practically instantaneously an electron image on the mosaic screen of the transmitting tube 1 and subsequently scan the electron image by means of the cathode ray 7 at a slow rate, for instance during a period of 2 seconds or more, depending upon the band width of the transmission channel available and the number of picture elements to be transmitted or reproduced. The purpose of this slow scanning rate is to reduce the frequency of the picture current variations and thereby minimize the difficulties of long distance transmission. To start transmission the operator of the transmitting camera will close the switch 42 to start the cams 30 and 34. Cam 30 controls the shutter 14 through switch 23 so that the switch 23 energizes the shutter to momentarily expose the mosaic screen to the light reflected from the object 16. At the same time that the operator closed his starting switch the cam 34 closed the switch 35 to allow the saw-tooth generator to start the generation of a saw-tooth voltage whereby the vertical deflecting circuit starts the scanning ray across and down the mosaic screen. The horizontal deflecting circuit is allowed to

continuously oscillate so that the cathode ray beam constantly scans the mosaic screen in a horizontal direction. Owing to the nature of this system it is not necessary to start the vertical and horizontal deflection at the same instant since it is immaterial if a portion of a line is omitted from the picture. During idle periods when no picture is transmitted, the ray may be allowed to oscillate across the top of screen. The cam 30 is arranged to rotate once in, say, six seconds so that if continuous operation is desirable the shutter 14 will be opened every six seconds, the scanning period for each picture frame may be 3 seconds and the viewing period may also be 3 seconds. If the operator desires to photograph a particular scene which will occur within a period of 7 or 8 seconds he may stop transmission by opening the switch 42, the result of which is to continue the previous frame of the picture until the cam 30 opens switch 43 to thereby deenergize coil 35 and disengage the clutch 33. When the desired action or scene occurs the operator may start operation of the picture transmitter by again closing the switch 42. Cam 34 is arranged to close the switch 35 at the same time that the shutter 20 is operated and for a period of 3 seconds so that the picture will be scanned vertically and horizontally for 3 seconds, after which, the cathode ray will oscillate horizontally at the top of the mosaic screen for a period of 3 seconds, namely the viewing period.

The observers at the receiving stations will be shown views of the game or other event which is being photographed at six-second intervals, 3 seconds of which is the scanning period and the remaining 3 seconds of which is the viewing period during which the picture remains on the fluorescent or phosphorescent screen of the picture reproducing tube.

The particular timing described is by way of example only and may be varied to furnish any desired viewing and scanning periods.

It may be desirable to enlarge the reproduced picture, in which case a cathode ray projecting tube may be substituted for the ordinary reproducing tube. Such a device and the manner of operation is described in the "Proceedings of the Institute of Radio Engineers," vol. 25, of 1937, pages 937 to 976.

Further modifications and advantages within the scope of the appended claims will be obvious to those skilled in the art.

I claim:

1. In a photo-transmission system, means for storing and transmitting pictures or images in succession at intervals of the order of a few seconds, means for varying the start of successive cycles of said storing and transmitting means to vary the spacing of successive pictures and picture-storage receiving means for reproducing and temporarily maintaining each of the successive pictures or images for a period of at least a few seconds.
2. In a photo-transmission system, means for storing and transmitting pictures or images automatically at intervals of the order of a few seconds, manually operable means for controlling the start of successive cycles whereby selection of the pictures to be transmitted is permitted and picture-storage receiving means for reproducing and maintaining the pictures or images long enough to be viewed by an observer.
3. In a photo-transmission system, means for storing successive pictures or images, timing

means for controlling the transmission of the pictures or images at intervals of the order of a few seconds and receiving means comprising a cathode ray tube provided with a slow-persistence screen for reproducing the pictures or images long enough to be viewed by an observer.

4. In a picture transmission system, a mosaic screen, a shutter for exposing said screen to form an electron image, means for generating a beam of electrons, means for deflecting said beam of electrons in both horizontal and vertical directions, switch means for controlling said vertical deflecting means, a second switch means for controlling said shutter, cams for operating said switches, driving means for rotating said cams, a clutch through which said cams are driven, and means for controlling scanning of the mosaic screen whereby successive pictures forming sep-

arate and distinct impressions are visibly reproduced.

5. In a picture transmission system, a mosaic screen, a shutter for exposing said screen to form an electron image, means for generating a beam of electrons, means for deflecting said beam of electrons in both horizontal and vertical directions, switch means for controlling said vertical deflecting means, a second switch means for controlling said shutter, cam means for operating said switch means, driving means for rotating said cam means, a clutch through which said cam means are driven, and means for controlling the shutter and the scanning means whereby successive pictures are visibly reproduced.

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