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OBSERVER CONTROLLED TELEVISION SYSTEM

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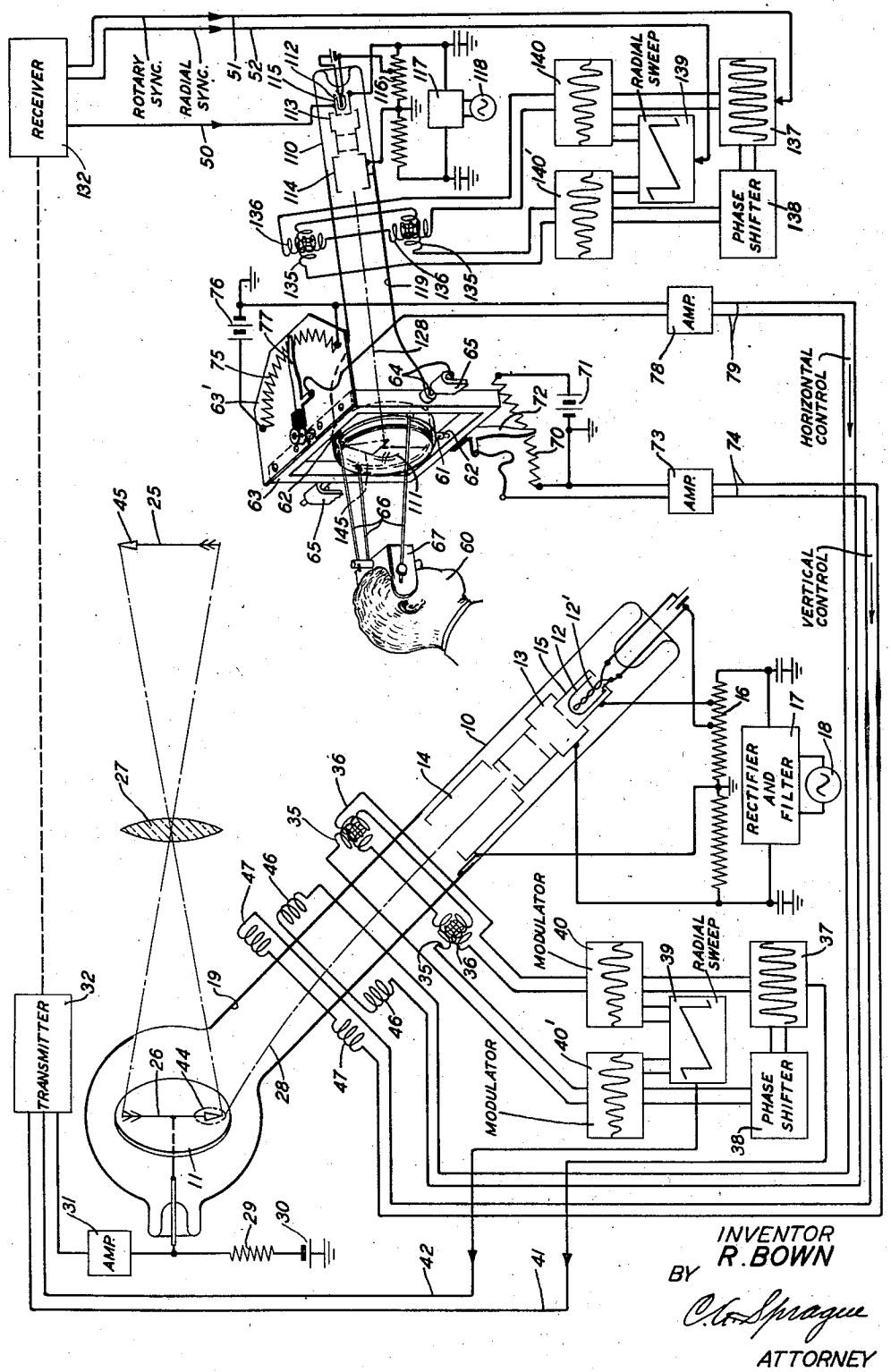

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OBSERVER CONTROLLED TELEVISION SYSTEM

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This invention relates to remote control and particularly to the control of a television camera device by an observer of an associated television received device located at a remote point.

A principal object of the invention is to permit substantial restrictions of the field instantaneously viewed by the system and consequent substantial reductions in the frequency channel width required for transmission without a corresponding reduction in the effective field of view of the observer.

Another object is to place the direction of view of a television camera or other directed device under control of the physiological direction of view of the observer's eyes or the placement of his head.

Another object is to remove the directional controls from the observer's hands to free them for other uses such as writing, operating other control elements, and the like.

To these ends there are provided electrically controlled means for altering the direction of view of a television pick-up device or camera to which are fed control signals originating at a receiver. At the receiver station controlling elements are linked to a frame suitably shaped for movement by the observer's head in such a manner that as he moves his head from side to side or up or down arcuately about a fixed point, (for example, a point fixed at the distance of most distinct vision where a viewing screen may be placed), the field viewed by the transmitter follows his head movements. In a preferred embodiment the head frame is a bridle which is fixedly attached to the receiver device, for example, the cathode-ray receiver tube, on a line normal to the fluorescent viewing screen and at a suitable distance therefrom, the cathode-ray tube and bridle together being universally mounted as in gimbals with respect to a fixed frame. The tube or bridle may carry the movable member of a circuit control element, for example the moving contact of a potentiometer, the resistor or impedance element of which is fixed to the frame, so that the observer's head movements produce corresponding changes in an impedance and, therefore, in a control voltage or current.

The television camera lens may conveniently be selected for comparatively high magnification and wide angle of view.

It is a feature of the invention that the observer receivers from the system the illusion that he is looking through a restricted aperture, such as that of a telescope, directly at the center of interest of the field, which, in turn, shifts from point to point of the whole available field in response to movements of his head, just as does the restricted field of a telescope as the operator points it in one direction or another.

The invention will be fully understood from the following detailed description of an illustrative embodiment thereof taken in connection with the appended drawing which partly schematically and partly in perspective shows a television system embodying the principles of the invention.

Referring now to the figure, there is provided an image pick-up device suitably disposed with respect to a field of view which it is desired to televise. The pickup device may be of any desired type, and is shown by way of illustration as a device of the charge storage type. This device is well known per se, and comprises, briefly, an evacuated envelope 10 containing a mosaic screen 11 composed of insulated photosensitive elements backed by a conducting plate, means such as a cathode 12 for projecting electrons on the screen in the form of a beam, anodes 13 and 14 for accelerating the beam electrons and focussing them on the screen 11, a beam-modulating electrode 15 and cathode heater element 16. These electrodes, all well known per se both as to arrangement and construction, may be supplied with suitable operating potentials from any suitable power source such as the low resistance 16, rectifier and filter 17 and generator 18. A suitable point of this resistor may be grounded to provide stability and other points may be bypassed to ground through condensers. The beam-receving end of the tube is preferably provided with a conductive lining 19 which may be electrically connected to one of the anodes 14. When an image of a field of view, schematically indicated in the figure by the arrow 25 is imaged, as by a lens on the photosensitive screen and the image 26 is scanned by an electron beam whose path is indicated by the dashed line 28, vision signals may be drawn from the conductive backing plate of the mosaic screen 11, which may return to ground through a loading resistor 29 and a source of potential 30 and appear as voltage drops across a loading resistor. These signals may then be amplified and transmitted in any desired manner to a receiver station. Amplifying and transmitting apparatus which are well known are indicated by blocks 31 and 32.

The scanning of the image 26 on the screen 11 may be effected in any desired manner. For the sake of illustration, magnetic deflecting means are shown in the figure. Furthermore,

the scanning pattern may be of any desired type, but spiral scanning which lends itself particularly well to the invention is preferred, and is shown by way of example. Thus two pairs of deflecting coils **35, 36** may be disposed about the neck portion of the tube **10** to produce magnetic fields in space quadrature, being supplied with sinusoidal currents in time quadrature to produce a resultant rotating magnetic field. Such phase-displaced currents may be derived from a generator **37** feeding one pair of coils **35** directly and the other **36** through any suitable phase shifting device **38**. This, without more, causes the electron beam **28** which passes through the resultant field to be circularly deflected. At the same time the radius of the circle may be caused to increase by changing the amplitude of the sinusoidal rotary sweep currents. This may be accomplished, for example, by modulating the sinusoidal current outputs of the generator **37** to a saw-tooth wave envelope. To this end a frame frequency saw-tooth wave generator **39** is provided and modulators **40** and **40'**, supplied by the generator **39**, are included in both paths from the generator **37** to the coils **35** and **36**. Choice of the amplitude of the saw-tooth wave envelope of the deflecting currents determines the radius of the last outer turn of the spiral along which the scanning spot travels just before it flies back to its central starting point. If desired, provision may be made to extinguish the beam during flyback, though the flyback may take place with such rapidity that this is unnecessary. Provision may also be made to deliver synchronizing signals during the flyback time, for transmission along with the vision signals to the receiver. Such apparatus is well known, and is indicated in the drawing merely by control channels **41** and **42** from the generators to the transmitter **32** and from the latter to the receiver.

In accordance with the invention it is preferred to so adjust the radial scanning generator **39**, or such other apparatus as may be employed to govern the radial sweep amplitude, that the scanned spiral (or, if rectilinear scanning be employed, the scanned rectangle) occupies a comparatively small portion **44** of the screen **11** and covers a comparatively small portion of the image **26** projected thereon, corresponding to a small portion **45** of the field **25**. The resulting vision signals are, of course, representative only of the portion scanned. At the same time means are provided for shifting this scanned portion over the whole image at the will of an observer who may be located at a remote point. To this end additional horizontal and vertical deflecting coils **46, 47** may be disposed about the neck of the envelope **10** which may be supplied with current from control lines from the receiver.

At the receiver a suitable image synthesizing device may be provided which, in turn, may be of a type well known per se. By way of illustration it is shown as comprising an evacuated vessel **10** provided with a fluorescent screen at its beam-receiving end **111** and containing electrodes which may be generally similar to those of the transmitter device except for the fact that provision is made to impress vision signals, derived from terminal receiver apparatus **132** which receives them from the transmitter on one of the electrodes **115** as by a conductor **50**, which thus serves to modulate the intensity of the beam **128**.

The device may likewise be provided with means for causing the scanning spot to travel in a spiral path in phase with the spiral travel at the transmitter. Such means may comprise coils **135, 136**, a sinusoidal generator **137**, a phase shifter **138**, a saw-tooth wave generator **139** and modulators **140** and **140'**, all of which apparatus may be similar in construction and interconnection to the corresponding transmitter apparatus. Correst phase relations may be maintained by synchronizing signals received from the transmitter and supplied to control elements of the generators **137** and **139** in well-known manner, as by conductors **51, 52**. Demodulating and amplifying apparatus, in so far as they may be necessary or desirable are to be taken as being included in the terminal receiver **132**, as is also apparatus for separating the vision signals from the synchronizing signals and the radial and rotary synchronizing signals from each other As the scanning spot sweeps out its spiral path on the screen **111** while the beam intensity is changed in dependence on the vision signals, an image **145** of the original field portion **45** scanned is synthesized for an observer **60** to see. Since the vision signals are representative of only a portion of the original field, this portion alone is synthesized on the receiver screen. In accordance with the invention the amplitudes of the receiver scanning fields are adjusted to cause this image to occupy substantially the whole screen area. If the receiver screen **111** be of approximately the same size as the transmitter screen, this image **145** is a magnified image. If, on the other hand, the possibilities offered by the invention for magnification are not taken advantage of, a receiver screen of considerably reduced area may be employed with consequent economies in the cost of apparatus.

In accordance with the invention the receiver device as a whole, or at least that part including the screen **111**, may be pivotally mounted with its axis generally horizontal, for rotation in both directions about two axes which are mutually perpendicular and perpendicular to the principal axis of the device, i. e., normal to the screen. To this end the beam-receiving end of the tube **110** may be fixedly mounted in an inner gimbal ring **61** which may be pivoted to rock about a vertical axis as on pivots **62** in an outer ring or frame **63**, which, in turn may be pivoted as on horizontal pivots **64** to rock with respect to a fixed framework **65**. Rods **66** or other supporting members may be fixed to the frame **61** and extending in front of the screen **111**, preferably to the distance of most distinct vision, for rotation with it. To the outer end of these rods **66** a bridle or mask **67** may be attached, which bridle may be shaped to fit the head of an observer **60** viewing the screen. Thus as he moves his head from side to side or upward or downward the screen **111** follows his head movements so that he always faces it squarely and thus receives an undistorted view of the image **145** which appears on the screen **111**, his hands being meanwhile left wholly free for other uses such as the operation of control elements.

In accordance with the invention these head movements or the screen movements which follow them may be caused to deliver control signals to the control channels for actuating the biasing means at the transmitter. For example, a potentiometer **70** supplied with current from a battery **71** or other suitable source may be fixed to the framework **65** within which the receiver screen swings, in position to be contacted by a movable contacting element **72** attached to the outer gimbal ring or frame **63** so

that vertical head movements cause the movable elements 72 to slide over the potentiometer resistance 70 to vary the voltage appearing between the movable contactor 72 and one end of the resistor 70. In order to convert the variable control voltage so obtained into a correspondingly variable control current suitable for actuating the vertical bias coils 47, this voltage may be applied to the input terminals of an amplifier 73 whose output is fed to the control channel 74 leading to the transmitter. Another potentiometer may be similarly arranged to actuate the horizontal bias coils 46 in response to sideways head movements of the observer. For example, a resistor 75 may be fixedly mounted on a bracket 63' attached to the outer gimbal ring 63, being supplied with current as by a battery 76, in position to be contacted by a movable contacting element 77 attached to the inner ring 61 so that horizontal head movements cause the contactor 77 to turn with the inner ring 61 and the tube 110 about the pivots 62, to vary the voltage appearing between one end of the resistor 75 and the movable contactor 77. This variable voltage may be converted as by an amplifier 78 to a correspondingly variable control current and supplied over the control channel 79 to the horizontal bias coils 46 at the transmitter.

It is to be understood that any desired means may be employed to derive suitable signals from the observer's head movements, for transmitting them to the transmitter and for producing in response thereto corresponding changes in the transmitter direction of view. However, the embodiment described above and shown in the figure lends itself well to the system of the invention since the control is positional in character, the response at the transmitter to any movement of the observer's head being practically instantaneous.

In operation the observer sees, centered on the viewing screen of the receiver, an image of the field portion 45 scanned. Since this scanned portion is normally a comparatively small part of the whole field, the observer receives the illusion or impression that he is observing the field through a restricted aperture in an opaque partition, for example, a knot-hole in a board fence. This illusion or impression is enhanced by the fact that as he raises his head or sees an image of a lower part of the field, and as he lowers his head the image which he sees is of a higher part of the field, while horizontal movements to left or right bring into his view the right-hand and left-hand portions of the field respectively. Diagonal movements of the head likewise produce diagonal movements of the field portion scanned. Furthermore, since in the preferred embodiment the image 145 is magnified as compared with the field portion scanned the impression produced is that the observer is viewing the field through a telescope, for example, a telescope pivoted to swing in the horizontal and vertical planes about a pivot point placed, for example, at the approximate center of the telescope tube.

Since no signals representative of the portions of the field not reproduced are transmitted, large economies in frequency channel space result. The spiral scanning feature is also conducive to the same result, since with this type of scanning high definition may be had at the center of the part scanned, which is naturally the center of the observer's interest, while the definition may fall off as the radius of the spiral increases, depending on the wave form of the voltage of the radial sweep generator. In the example shown, with uniform angular velocity of rotary sweep and a saw-tooth wave shape for the radial sweep voltage, the definition, as limited by frequency cut-off, falls off as the inverse first power of the spiral radius.

Any desired variations may, of course, be made in these wave forms to cause the variation of definition with radius to meet particular needs. Likewise, any desired scanning order, for example, ordinary rectilinear scanning may be employed instead of spiral. In such case, if it be desired to increase the definition at the center of the image, the scanning spot may be caused to travel more slowly at the center of each scanning line than at its ends, for example, by including a pronounced harmonic in the horizontal sweep voltage, and like provision may be made to reduce the vertical sweep speed toward the center of the vertical sweep. However, it is to be understood that such variation of definition over the image, though believed to be of advantage in economizing frequency channel space while still retaining the highest definition at the center of interest is by no means the equivalent of the system above described which enables the observer to shift his center of interest in the object field while holding it centered on the viewing screen.

Instead of imaging a large part of the field on the screen of the pick-up device and scanning a small part of the image, the invention may also be practiced by providing that the pick-up device as a whole or its objective lens shall swing in the vertical and horizontal planes, thus being aimed toward a desired small angled portion of the whole field. For example, it may be mounted in gimbals like the receiver or in any other convenient manner and caused to rotate about horizontal and vertical axes by suitably spaced motors, solenoids or the like, controlled by appropriate control elements located at the receiver station and responsive to movements of the observer's head. Either positional control like that above described, or velocity control in which the speed of the transmitter movement is governed by the observer's head displacement, may be employed as desired.

Likewise, the partial field scanning as above described may be employed for rapidly selecting portions of the field within a restricted range, supplemented by movements of the television pick-up device as a whole, controlled from a control element operated manually by the observer whose hands, by reason of the head movement control of the invention, are left free for other employment.

What is claimed is:

1. In a television system, the combination of a pick-up device adapted to deliver vision signals representative of a selected portion of a field of view, means for altering said selected portion of said field under control of auxiliary signals, a reproducer device adapted to reproduce an image of said selected field portion from said vision signals, a movable element located at said reproducer and adapted to deliver auxiliary signals to said field portion selecting means, means located at said reproducer adapted to be fitted to the head of an observer viewing said reproduced image and to execute arcuate movements with said head about a point outside of the body of said observer, said means being coupled with

said movable element to effect selection of a desired portion of the field of view of said pick-up device under control of said arcuate movements to create the illusion that the observer is viewing the field through an aperture in an opaque partition.

2. In a television system, the combination which comprises a pick-up device adapted to deliver vision signals representative of a restricted portion of an object field toward which said device is aimed, current operated means for altering the direction in which said device is aimed, image synthesizing apparatus including a viewing screen universally mounted for rotation about a fixed point for reproducing on said screen a visible image of said field portion under control of said vision signals, means fixed to said viewing screen and adapted to be fitted to the head of an observer viewing an image reproduced thereon, circuit means operable by movements of said head-fitting means for delivering a control current in response to movements of said head, and means for actuating said direction-altering means by said control current.

3. In a television system, the combination which comprises a pick-up device adapted to deliver vision signals representative of a restricted portion of an object field toward which said device is aimed, means for altering the direction in which said device is aimed, image synthesizing apparatus including a viewing screen for reproducng on said screen a visible image of said field portion under control of said vision signals, said image being centered on said screen and occupying substantially the whole area of asid screen, said screen being universally mounted for rotation about a fixed point, means fixed to said viewing screen and adapted to be fitted to the head of an observer viewing said reproduced image, and means operable by movements of said head-fitting means for actuating said direction-altering means, whereby said observer may select the portion of said field whose image is synthesized by turning his head about said fixed point to face the receiver screen in a direction parallel with a line joining said pick-up device to said field portion.

4. In a television system, the combination which comprises a pick-up device having an image receiving screen, means for forming an image on said screen of a comparatively wide angle portion of an object field, means for scanning a selected comparatively narrow angle portion of said image to derive vision signals representative of the light tone values of the portion scanned and containing component frequencies covering a band of limited range, means for biasing said scanning means to shift said selected image portion to occupy a desired position within said image, a transmission channel of band width comparable with said limited frequency range for carrying said vision signals to a receiver station, an image synthesizer at said receiver station including a viewing screen for reproducing on the full area of said screen an image of the field portion scanned under control of said vision signals, movable circuit means located at said receiver station for delivering a bias control current in response to movements thereof, means linked with said circuit means adapted to be fitted to the head of an observer viewing said reproduced image and to move with said head in arcuate movements about said image as a center for moving said circuit means in correspondence with said head movements, and means for transmitting said control currents to said biasing means whereby said observer may always seen centered on said screen and fully occupying said screen area an image of that portion of the object field which contains the center of his interest.

5. In a television system the combination which comprises a pick-up device adapted to deliver vision signals representative of a narrow angle portion of an object field toward which said device is aimed, said vision signals being composed of a relatively narrow band of component frequencies, a transmission channel of band width comparable with said limited frequency range for carrying said vision signals to a receiver station, an image synthesizer at said receiver station including a viewing screen for reproducing on the full area of said screen an image of said narrow angle field portion under control of said vision signals, movable circuit controlling means at said receiver station, means adapted to be fitted to the head of an observer viewing said reproduced image and to move with said head in arcuate movements about a point located in said screen for operating said circuit controlling means in correspondence with said head movements, means located at said pick-up device for altering the direction in which said device is aimed in correspondence with the movements of said circuit controlling means, whereby the observer receives the impression that he is viewing that part of the object field which contains the center of his interest through a restricted aperture in an opaque partition, and whereby frequency space required to transmit signals representative of portions of the object field which are angularly displaced from the portion containing the center of interest is economized without a corresponding loss of information conveyed to the observer.

6. In an electrooptical image signaling system, the combination which comprises a pick-up device adapted to deliver vision signals representative of light tone values of a selected portion of an object field, image synthesizing apparatus including a fixed frame, a screen pivotally mounted on said frame and constrained to move arcuately about a point fixed with respect to said frame, means for reproducing an image of said field portion on said screen under control of said vision signals, means constraining the head of an observer viewing said screen to move arcuately with said screen, means for selecting said object field portion under control of said screen movements, and means under control of said head for imparting pivotal movements to said screen.

7. The method of producing an image electro-optically which comprises scanning a portion of a field of view in fine detail, scanning another portion of the field of view in less detail, producing an image current as a result of said scanning, synthesizing an image from said vision signals on a screen, and shifting the position which the portion scanned in fine detail occupies in the field under control of movements of the head of an observer viewing said image, which movements are arcuate movements about said screen.

8. A television system comprising the combination with image forming means at a receiving station for forming images within an image field the center at least of which remains substantially stationary, of means whereby an observes of said image may cause the successive imaging of fractional portions of an object field of view at a

cooperating transmitting station under control of translational movements of his head, said last-mentioned means comprising means at said transmitting station for selectively scanning different portions of the object field and transmitting resulting image currents to said image forming means, control means associated with said image forming means to control the generation of signals varying in accordance with the direction and extent of said head movements, means for applying said signals to said selective scanning means to cause the scanned portion of the object field to shift in a direction to cause images of stationary objects which before appeared to said observer to be centrally located in said image field to now appear to move off center in the same general direction that the head of the observer moves, giving an effect like that of viewing the object field directly through a restricted opening which permits the view of different small portions only of the field in succession as the viewer shifts his head sidewise.

9. The combination of claim 8 in which said image forming means cooperates with said control means to cause the image field to tilt around its substantially stationary center in accordance with said head movements.

10. The combination of claim 8 in which said image forming means comprises the screen of a cathode ray tube and gimbal bearings substantially in the plane of said screen for supporting said tube, and said control means comprises rigid means extending from the screen-end portion of said tube to the observer's position adapted to be moved by translational movement of the observer's head to tilt said screen about its substantially stationary center.

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