

Nov. 16, 1937.

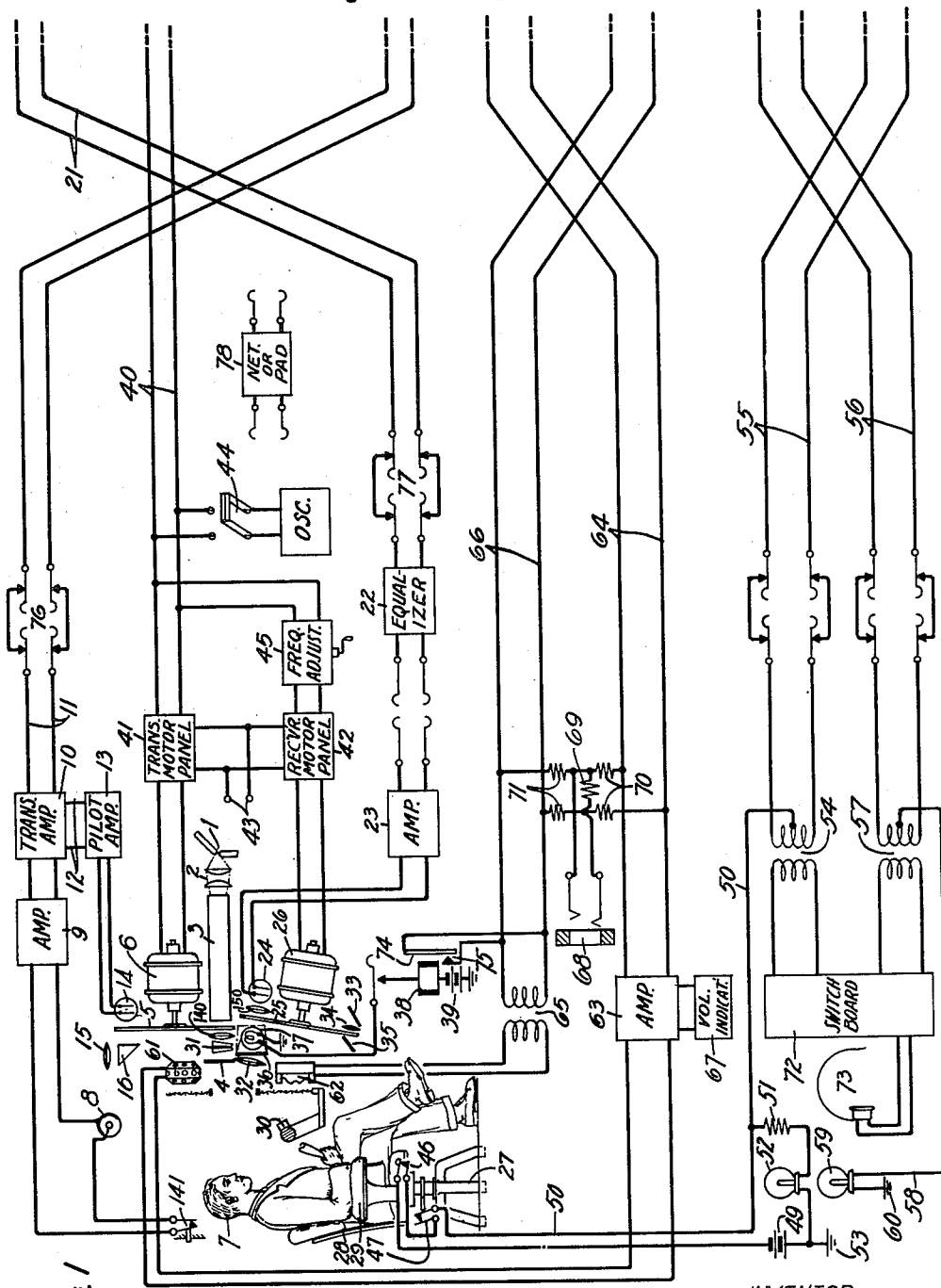
H. E. IVES

2,099,115

COMMUNICATION SYSTEM

Original Filed April 8, 1930

3 Sheets-Sheet 1



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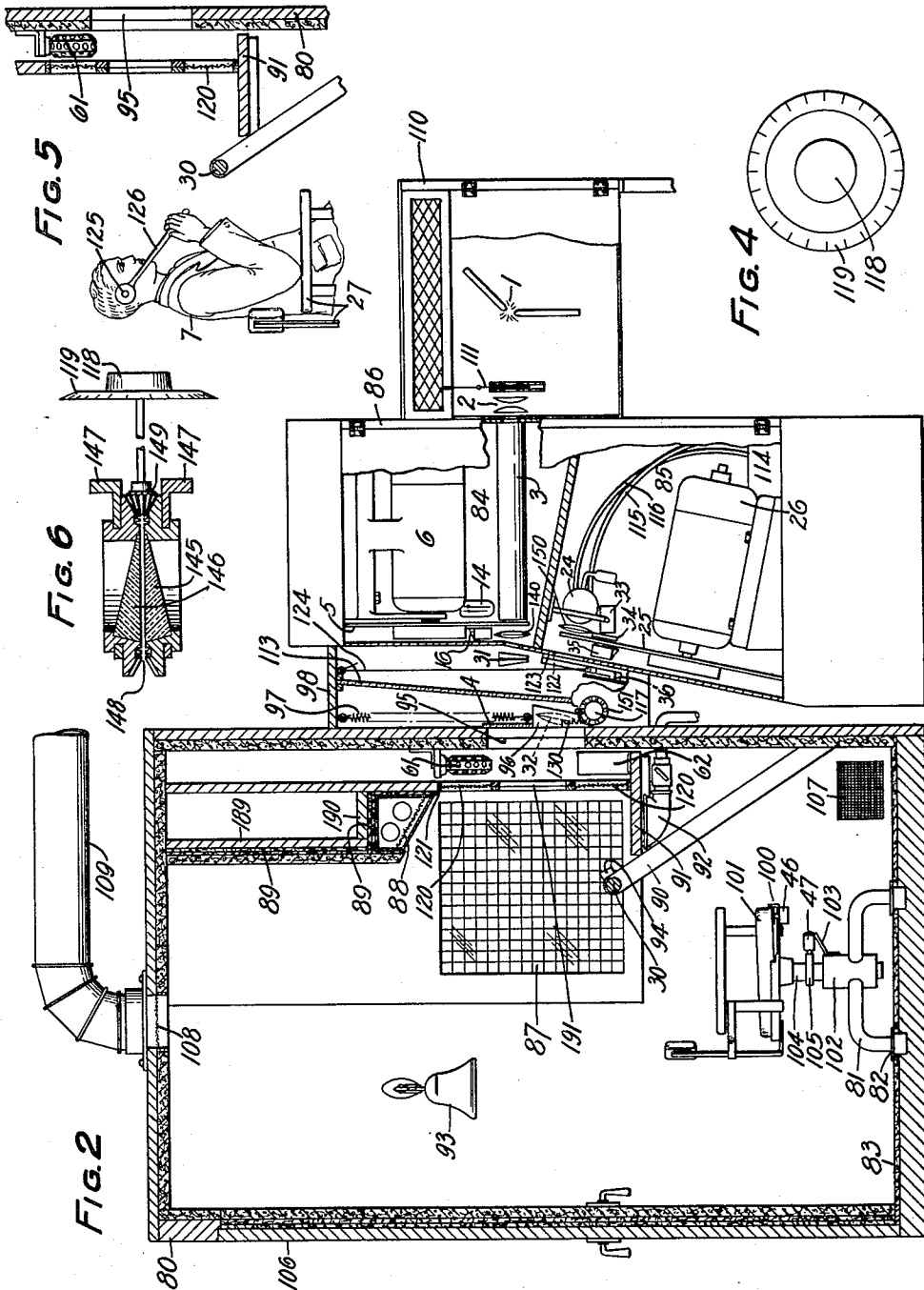
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COMMUNICATION SYSTEM

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3 Sheets-Sheet 2



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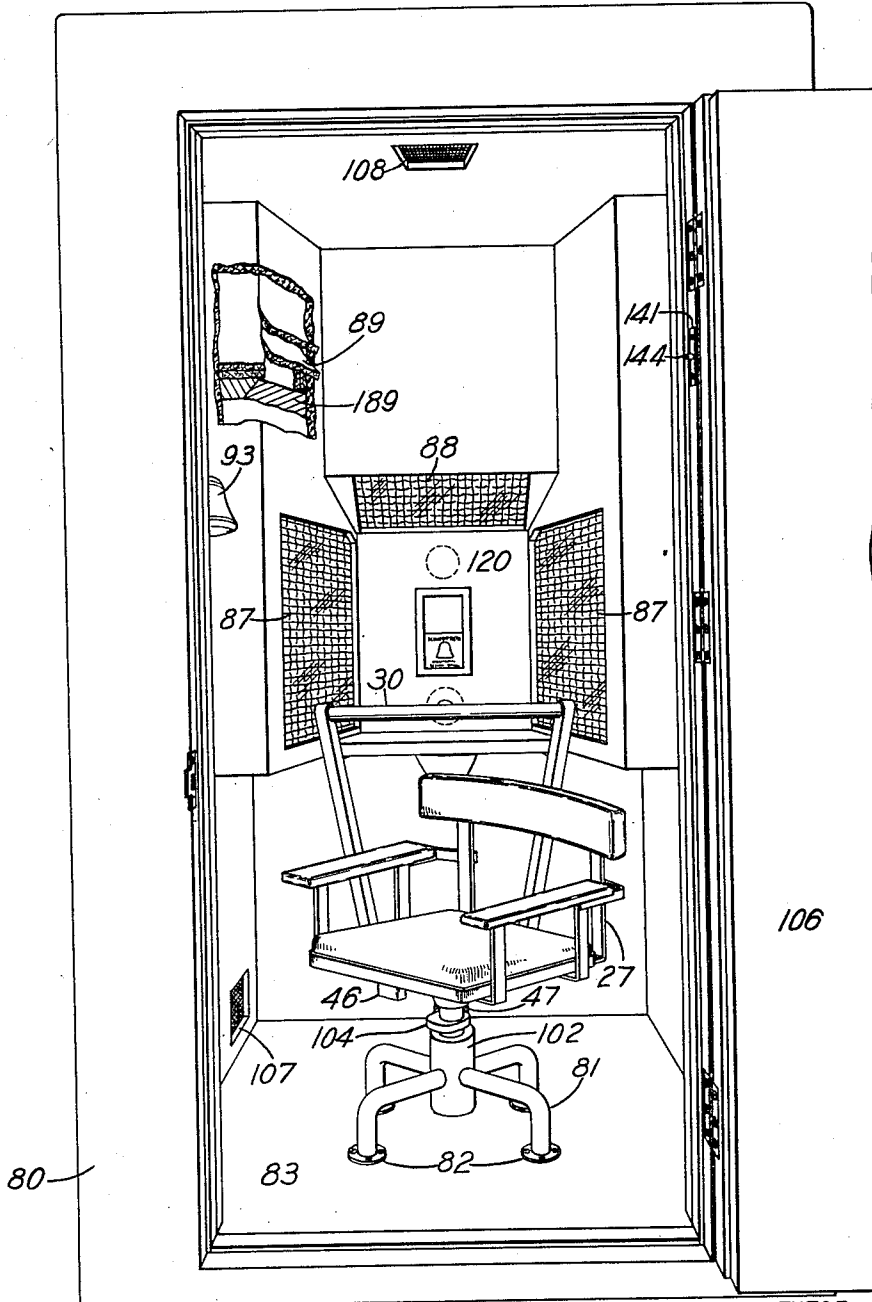
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COMMUNICATION SYSTEM

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3 Sheets-Sheet 3

FIG. 3



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2,099,115

COMMUNICATION SYSTEM

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Application April 8, 1930, Serial No. 442,503
Renewed June 5, 1936

42 Claims. (Cl. 178—7.1)

This invention relates to communication systems and more particularly to systems embodying the joint use of a two-way signal channel and simultaneously operable two-way television channels.

It has heretofore been proposed to provide a simultaneously operable two-way television system and also such a system provided with means for enabling the two observers to carry on a two-way conversation. Such a system is disclosed in application Serial No. 138,845 of applicant filed October 1, 1926, now Patent No. 1,932,253, granted October 24, 1933. The specific embodiment of the invention described employs flood-lighting of the persons scanned, and in which it is also pointed out that scanning may be effected if desired by a moving beam of light in place of flood-lighting the subjects and scanning images of them.

The present invention in one aspect contemplates a two-way simultaneously operable television system in which elemental areas of the fields to be transmitted are successively illuminated, as disclosed in application of F. Gray Serial No. 227,649, filed October 21, 1927, to provide a system which is especially designed for practical operation either with or without an associated two-way speech circuit.

In systems of the type referred to above the image field is visible in its entirety to give an undistorted image only when viewed in substantially one direction and at such a distance from the field that the face of the observer may be properly scanned. Because of these limitations there is provided in accordance with the present invention means to properly position the observer in the scanning field, means for correlating the image and scanning fields, and, in order to accommodate observers of different statures, means for adjusting the direction of the scanning beam and means for varying the position of the image. To secure the most efficient use of the illumination provided by the scanning beam, the observer preferably occupies an enclosed space. A beam is provided which does not blind or inconvenience the observer nor cause reflection from eyeglasses worn by the observer. The operator without entering the enclosure is able to ascertain whether an observer is properly positioned in the scanning field and the time when the observer finishes using the system. The operator is provided with means to monitor the operation of the television transmitting and receiving apparatus and the conversation.

In order to enhance the illusion of a face-to-face conversation, the telephone instruments are

located so that they do not appear in the images produced at the respective stations.

An object of the invention is to permit persons at the respective terminals of a system to be scanned and to view an image of the other party unobstructedly while communicating with each other.

A feature of the invention relates to the provision of means for controlling the position of the user relatively to the television terminal apparatus.

Another feature relates to means for locating the image position relatively to the observer and the scanning field.

Still another feature relates to means for properly aligning the scanning mechanism and the person to be scanned.

An additional feature relates to means for adjusting the image with respect to the line of vision of the party being scanned.

Additional features relates to supervisory signals for the system, to the use of a scanning light beam which does not interfere with the observer's view of the image, to a lighting system for the enclosure or booth and to an arrangement of telephone instruments within the enclosure or booth.

Other objects and features will appear from the following description and the appended claims.

In one preferred embodiment of the invention, to be hereinafter described by way of example, each terminal television equipment embodies the following units.

A transmitting apparatus including a scanning disc having a spiral row of apertures associated with a light source for producing a beam of light, for spot-scanning the user, as described in the above noted application of Gray.

A variable angle prism through which the scanning beam passes and which may be adjusted to change the direction of the scanning beam with respect to the user or observer.

A filter in the path of the scanning beam for transmitting blue radiations so that the observer is not "blinded" or inconvenienced thereby.

A television receiver including a scanning disc having its axis of rotation inclined relatively to the scanning field and having a spiral row of apertures through which is viewed a light source controlled by incoming image currents, whereby an image of a person at another station is produced close to the scanning frame.

An adjustable lens to magnify the image and to permit the position of the image to be ad-

justed with respect to the line of vision of the user.

A booth provided with a swivel chair which is fixed to the floor and carries switching means, adapted to be closed when the customer is seated in the chair and faces the scanning mechanism, for controlling a supervisory signal circuit.

Means actuated by the door of the booth for controlling the circuit including the photoelectric cell and a system of amber lighting for the booth.

Monitoring means which produces an image, controlled by the outgoing image current, and means for viewing the incoming image; both of which are located at an operator's position outside the booth.

A detail description of the invention follows and is illustrated in the attached drawings in which,

Fig. 1 shows a circuit diagram of one terminal;

Fig. 2 is a side view of the terminal equipment showing an interior view of apparatus cabinets and a booth partly in cross section;

Fig. 3 is an interior view of the booth;

Fig. 4 illustrates a detail of means for controlling the scanning beam;

Fig. 5 shows a detail of a system embodying a telephone receiver; and

Fig. 6 illustrates the variable angle prism.

Referring to Fig. 1 there is shown a source of light 1, associated with a lens 2, a tube 3, a lens 140, a variable angle prism 31, a color filter 4 and a scanning disc 5 having a spiral of apertures.

The scanning disc is driven by the motor 6 to supply a beam of light, which for each revolution of the disc completely scans the field of view, i. e. the face of the observer 7. The motor 6 is operated at such speed that the field of view is repeatedly scanned at a rate within the persistence of vision. In other words, the system employs beam-scanning as disclosed in the above-identified application of F. Gray.

Light reflected from the observer's face and varying with the tone values of its elemental areas, is impressed upon photoelectric cells, here-in exemplified by a single cell 8, to produce image currents in the input circuit of an amplifier 9. Energizing voltage is supplied to the photoelectric cells from a source (not shown) through a switch 141.

The amplifier may consist of the desired number of stages of resistance coupled space discharge devices. Any other amplifying device which is suitable for the purpose, may be used. A suitable amplifier is disclosed in the above identified application of F. Gray.

An amplifier 10 is provided to raise the energy level of the image current to the desired value for transmission over a channel exemplified as a line 11, to a remote station.

The outgoing image current is monitored, as disclosed in U. S. Patent 1,717,782 issued June 18, 1929 to Ives et al. For this purpose a certain amount of the transmitted image current energy is diverted through the circuit 12, is amplified by the amplifier 13 and is used to control the lamp 14. The operator views the lamp 14 through the lens 15, prism 16 and apertures of the disc 5. The monitoring apparatus is shown as removed about 180° from the scanning position. This has been done solely in the interest of clarity. The two positions need only be separated by an angle which permits the operator to view the image without interfering with the observer, provided the spiral of apertures is extended a correct

amount and the observing and monitoring fields are correspondingly radially positioned.

As disclosed in the above noted Ives et al. patent the spiral of apertures in disc 5 is continued beyond 360° by an amount equal to the angle of offset of the monitoring position from the scanning position. The frames, identifying the monitoring and scanning positions, are radially displaced so that the apertures passing before the openings in the respective frames extend over a total angle of only 360°.

Image currents, incoming over the line 21, from the remote station, are transmitted through the equalizing network 22 to the amplifier 23.

The network 22 operates to compensate distortion of the image due to frequency discriminatory effects of the system within the frequency range employed, as disclosed in the application of H. E. Ives and V. Subrizi, Serial No. 442,504 filed April 8, 1930, now Patent 2,058,883, issued Oct. 27, 1936.

The image current is amplified by the amplifier 23 and is applied to energize the lamp 24, which may be a glow lamp, or a lamp of any other suitable type adapted to supply light of intensity which varies with the variable amplitudes of the image current. A preferred design of glow lamp is disclosed in application Serial No. 441,792, filed April 5, 1930, by H. W. Weinhart, now Patent 1,918,309, issued July 18, 1933.

The observer 7 views lamp 24 through a spiral of apertures in the disc 25 which is driven by the motor 26. If the disc 25 is maintained in synchronism with a scanning disc similar to the disc 5, included in the transmitter of the co-operating station, the observer will see an image of the person scanned at that station.

To assure that the observer shall be properly positioned with respect to the scanning mechanism, a swivel chair 27 is provided. The chair has a back 28, arms 29 and is fastened to the floor. Immediately in front of the chair looking toward the scanning means is a barrier or rail 30. When an observer is seated in the chair and faces the scanning apparatus, he is very definitely placed and the amount of movement permitted to him is limited. In this manner, the scanning field of view is rather definitely fixed.

The path of the scanning beam includes the lens 140 and also a variable angle prism 31, which is adjustable to change the direction of the scanning beam with respect to the observer 7. This is necessary in order that the single scanning apparatus may be used to completely scan observers of different statures whose faces are at different levels. Obviously, the same result could be accomplished by raising or lowering the seat of the chair. To secure accurate positioning of each observer, this would require preliminary measurement of each party before occupying the chair, or manipulation of the chair after it is occupied. In any event, it would result in the observer being subjected to some inconvenience or annoyance.

The axis of the disc 25 is inclined at an angle such that a plane, passing through the middle of the viewing field defined thereby and normal thereto, passes through the scanning field traversed by the beam of light. In other words, the receiving scanning field is tilted so that it lies in the line of vision of an observer of average stature, when he is seated in the chair 27 and is facing the scanning mechanism.

Associated with the disc 25 is an optical system, comprising a lens 32 and a lens 150, which serves to magnify the image viewing field. The lens 32

is eight inches by five inches and is adjustable, i. e., it may be raised or lowered, so that the viewing field may be brought into the line of vision of observers whose eyes are at different heights above the floor.

The lens 150 cooperates with the lamp 24, having a glow area smaller than the opening in the image frame to produce the effect of an illuminated area at least equal to this opening. Obviously, if a lamp having a glow area equal to the opening in the image frame were used, the lens 150 could be omitted.

The lens 150 is adjacent to the lamp 24, for example about one and a half inches from its cathode and very close to the disc 25, while the lens 32 is at a relatively great distance from the disc. This distance may be twelve inches or more. This optical system cooperates with the chair 27 and rail 30 in establishing an optimum position for the occupant. The optical system is designed to somewhat limit the position from which the complete image may be seen, so that an appreciable amount of movement of the observer, forward, backward or sidewise from the optimum position, will result in his seeing a less satisfactory image.

Associated with the lamp 24 is a monitoring means comprising a mirror 33, a lens 34 and a mirror or prism 35. This apparatus operates in the manner disclosed in applicant's application Serial No. 440,908, filed April 2, 1930, now Patent 2,052,298, issued Aug. 25, 1936, and for the purpose therein set forth, namely to enable the operator to monitor the image viewed by the local observer.

By the use of the large lens 32 and a sufficient degree of definition of the image, it has been possible to produce entirely recognizable images of faces and, moreover, to give the illusion that the image is full size and within reasonable conversing distance from the observer. To give this illusion it is necessary that the image, and the angle of sight subtending it, be relatively large, since the observer unconsciously locates the image from past experience in accordance with this subtended angle. In the present case the image is of such size that it appears to be within easy conversing distance of the observer—a distance of the order of ten feet, and enables the volume of the incoming speech to be adjusted to give the illusion that the speech is emanating directly from the image. If the image is very much smaller this illusion is lost. To obtain an image of this size in which the grain does not become conspicuous the resolution or definition has been greatly increased beyond that heretofore employed. Each of the scanning discs is provided with seventy-two apertures arranged in a single 360° spiral and the scanning period is one eighteenth of a second. The resulting component frequencies of the image signal encompass a range of from 10 to 40,000 cycles per second.

In front of the lens 32 is a shutter, herein identified as an iconophone sign, 36 carrying an incandescent lamp 37 in series with a relay 38 and battery 39. The purpose and function of this circuit will be described later.

The motor 6 with its cooperating receiving motor at the other station, and the motor 26 and its cooperating transmitting motor at the other station, are included in a synchronizing circuit 40. At each station the circuit 40 is branched. One branch includes transmitting motor panel 41, and the other a receiving motor panel 42. Power is supplied to the motors from a one hundred and

ten volt direct current source (not shown) which is connected to the terminals 43.

An oscillator, adapted to generate oscillations of a fixed frequency, is used for controlling synchronism. It may be connected to the circuit 40 by closing the switch 44.

The branch including the receiving motor 26 at the respective stations is provided with an adjustable member 45 for varying the frequency of the oscillations supplied to the motor, whereby its speed may be adjusted to be identical with that of the cooperating transmitting motor 6 at the other station. The synchronizing system is not a feature of the present invention, consequently it will not be further described herein. Its organization and mode of operation are completely disclosed in U. S. application of H. M. Stoller, Serial No. 442,564, filed April 8, 1930, now Patent 1,999,376, granted April 30, 1935.

The chair 27 is provided with two switches 46 and 47. When the observer is seated in the chair switch 46 will be closed, and when the chair is swung round so that the observer faces the scanning mechanism the switch 47 is closed. These two switches are in series and when both are closed a circuit is completed from one terminal of battery 49 through switches 46 and 47, conductor 50, resistance 51, lamp 52 and the other terminal of battery 49, which is connected to ground at 53. The conductor 50 extends to an intermediate point on the secondary of a transformer or repeating coil 54, included in an order-wire line 55 extending to the other station.

The system includes a second order-wire line 56, which includes a repeating coil 57, having an intermediate point connected through a conductor 58 and a lamp 59 to ground at 60. In this respect both stations are identical. Closure of the switches 46 and 47, therefore, completes a circuit, via the extension of conductor 50, through the secondary winding of transformers 54, the conductors of circuit 55 in parallel and the primary winding of transformer 57, conductor 58, lamp 59 and ground 60 at the other station.

In this manner, lamp 52 at one station and lamp 59 at the other station are lighted, and both operators are advised of the fact that not only is there an observer at the television at one station, but that he is in proper scanning position. When an observer occupies the chair and faces the scanning mechanism at the other station, a signal lamp 52 thereat and the lamp 59 at the station illustrated are lighted.

The observer may carry on a conversation by means of a microphone 61 and a loud speaker 62. These instruments are similar to those used in public address and radio broadcasting systems. They are of known design and hence need no further description.

The speech wave produced by the microphone 61, after being amplified in the amplifier 63, is transmitted over the line 64 to the loud speaker 62 at the other station.

The two stations are identical as regards the telephone circuits, consequently at the other station the speech currents incoming over the line 64 are transmitted by a repeating coil or transformer, similar to 65, to the loud speaker.

In the station illustrated the speech currents, originated by the distant observer, are transmitted over the line 66 and coil 65 to the loud speaker 62.

As a check upon the speech circuits, two means for observing their operation are provided. A

volume indicator 67 is connected to the output circuit of the amplifier 63, so that the operator may ascertain the level of the speech current energy supplied to the line and thereby determine whether adjustment of the apparatus supplying the speech current is necessary.

The operator may also listen to the conversation by inserting the plug of his receiver cord into the jack 68.

At each station, the circuits 64 and 66 are connected together by a resistance network including four series resistances and a shunt resistance 69. The jack 68 is connected across the shunt resistance 69. The terminals of this resistance are connected to the transmission line 64 through resistances 70 and to the receiving line 66 through resistances 71. Obviously the connections to the respective lines are reversed at the other station.

The ratio of the value of resistances 70 to the value of the resistances 71 is so chosen that the volume of the speech heard by the operators is substantially the same, in spite of the fact that the level of the energy supplied by the transmitting line is many times that derived from the receiving line.

The order-wire lines 55 and 56, terminate in a telephone switchboard 72, upon which the jack 68 is preferably mounted. Each switchboard is provided with an operator's telephone set 73. The operators at the respective stations may use these sets to communicate with each other over either order-wire line 55 or 56.

Referring to Figs. 2 and 3 there is shown a booth 80 to be occupied by the observer 7. The booth is lined with celotex or any other sound absorbing material.

The legs 81 of the chair 27 are inserted in sockets 82 provided in the floor 83 of the booth, whereby its position is fixed with respect to the scanning mechanism, image producing mechanism and the photoelectric cell system.

The scanning mechanism and image producing apparatus are mounted in separate compartments 84 and 85 of a cabinet 86.

The photoelectric cell system consists of three sections, each comprising a plurality of cells. The sections are mounted in an inwardly projecting portion of the booth and two of them occupy positions 87 at the right and left of the observer's position. The third section is at 88, in front of the observer's position. This system is designed and operates in the manner disclosed in Ives-Gray application Serial No. 373,769, filed June 26, 1929, now Patent 1,873,411, issued Aug. 23, 1932.

Each group of photoelectric cells is enclosed in a container of shielding material, provided with a window facing the observer's position. The non-transparent portions of the boxes are completely enclosed in the inwardly projecting portion of the booth. In order that sounds or noises produced in the booth may not affect the photoelectric cells and thereby cause distortion of the image produced at the other station, the wall of the projecting portion is lined with felt 89 supported by backing of wood 189. The partitions 190, which cooperate with the walls to complete the enclosures for the photoelectric cell containers, are separated from the latter by a lining of felt 89.

The rail 30 is carried by brackets 98 secured to the wall of the booth. These brackets also support a shelf 91 which extends toward but not into contact with the wall.

The booth is illuminated by lamps carried by

the fixtures 92, 93 and 94. The fixture 92 is beneath the shelf, 93 is on the wall behind the observer, and 94 is carried by the rail 30. These lamps are provided with amber shades or filters, and they are so placed that they do not supply light directly to the face of the observer. The photoelectric cells are less sensitive to this amber light than to the blue light of the scanning beam.

The lamp 94 serves to illuminate the screen 120 and may be used as a reading lamp. The illuminated area of the screen surrounding the lens from which the scanning beam proceeds, substantially reduces the glare effects which would be experienced if the observer were directly subjected to scanning illumination while looking at a black background, and hence makes the image appear brighter and more distinct. This is an important result from a practical standpoint. The use of blue light materially reduces the annoyance caused by the scanning beam passing across the eyes of the observer, and illumination of the screen serves to further reduce this annoyance. It, therefore, contributes to the production of an image of the observer having a more natural expression.

On the shelf and inside the wall of the booth is the loud speaker 62, above this is an opening 95 closed by the magnifying lens 32 mounted in a carrier 96 and the light filter 4.

The carrier 96 is supported by springs 97, secured to the top of an extension 98 of the booth, and is provided with a rack 130 meshing with a pinion secured on a stub shaft provided with a knob 117, by means of which the position of the lens 32 may be adjusted.

Above the opening 95 is the microphone 51.

Switch 46 is of the door operated type and is connected to the frame 100 of the chair underneath the seat 101, which is maintained in a raised position so that the switch is normally open. When an observer sits in the chair the switch is closed, but it is opened again as soon as the weight of the observer is removed from the seat.

The switch 47 is similar to 46 and is secured to the fixed portion 102 of the standard of the chair by a bracket 103. Mounted on the rotating portion 104 of the chair standard is a cam 105. When the chair is in the position shown in Fig. 2 the switch 47 will be closed, but when it is in any other position, for example, as shown in Fig. 3, the switch 47 will be open.

The booth is provided with a door 106 having associated therewith the switch 141, see Fig. 3, for controlling the supply of energizing voltage to the photoelectric cells. The booth is ventilated by a system including an air inlet 107 near the floor and an outlet 108 in the ceiling. The latter leads into a duct 109 provided with an electric fan for drawing the air out of the booth.

Switch 141 is of the well-known door actuated type and operates to complete the energizing circuit of the photoelectric cells when the door is closed and to break this circuit when the door is open.

While no undesired effect is produced in the photoelectric cells by the rather feeble steady light used for illuminating the booth, since the direct component of the photoelectric current is suppressed before transmission and its absence is compensated for by proper adjustment of the receiving terminal apparatus as set forth in the above identified application of F. Gray, certain types of photoelectric cells will be adversely af-

fect, if they are simultaneously supplied with energizing voltage and are subjected to intense illumination.

The switch 141 is provided to permit the use of photoelectric cells of the type mentioned in the preceding paragraph, even though the booth is surrounded by an area illuminated by light of such intensity that it would adversely affect the cells when they are supplied with energizing voltage.

The switch 141 is mounted on the door frame, in the well-known manner with its button 144 in the path of the door.

The arc 1 is of the projector type and is enclosed in a container 110, which includes a safety shutter 111 and a lens 2, whereby a concentrated beam of light is produced. The shutter 111, serves to prevent material, sputtered by the arc when its operation is unsteady, from being deposited in the lens 2. In general, the arc will sputter for a short time after it is started into operation.

With the shutter open, light from the arc passes through the lens 2, the tube 3, included in compartment 84, the directing lens 140, the variable angle prism 31, a glass partition 113, the color filter 4 to the scanning field within the booth. The glass partition 113 provides a seal, whereby noises due to the motors, etc. are excluded from the booth.

The compartment 84 includes the motor 6, upon the shaft of which is the scanning disc 5, the outgoing image monitoring glow lamp 14, and the prism 16, with which is associated the lens 15 shown in Fig. 1.

The compartment 85 includes the motor 26, the shaft of which carries the disc 25, the glow lamp 24, mirror 33, lens 34 and prism 35. Water is supplied from a tank 114, through the tubes 115 and 116 for circulation through the cooling chamber in the glow lamp 24 as disclosed in the above mentioned Weinhart patent.

The door, shown broken away, which closes the side of the cabinet 86, is provided with two openings through one of which the operator may, without entering the booth, view the outgoing image through the lens 15 and prism 16, and through the other of which he may view the incoming image by means of the prism 35, lens 34 and mirror 33.

The position of the image, with respect to the line of vision of the observer, may be adjusted by actuating the knob 117 to raise or lower the lens 32.

The variable angle prism may be adjusted by a knob 118 mounted on a stub shaft (see Figs. 4 and 6). Associated with the knob is a scale 119, which is marked to identify positions of the lens 32 corresponding to positions of the variable angle prism.

A scale 151, identical with the scale 119, is associated with the control knob 117 and serves to indicate that the lens 32 has been adjusted to a position corresponding to that occupied by the variable angle prism.

The microphone and loud speaker are concealed in a compartment in the booth directly in front of the observer, when he is in proper position to be scanned. These instruments are so placed that their axes lie in parallel planes.

The front of the compartment is closed by a fabric curtain 120 provided with transparent window 191 and mounted on a frame 121. The curtain permits the microphone and loud speaker to, respectively, pick-up sound waves produced

in the booth and to produce sound waves therein. Because of the parallel adjustment of the microphone and loud speaker, as well as the fact that the curtain is porous and substantially dead-beat and the walls of the booth are sound absorbing, the amount of energy transferred from the loud speaker to the microphone is substantially negligible, and hence singing over the speech circuits connecting the stations is prevented.

The microphone and speaker are located one above the other in a vertical plane which passes through the middle of the opening 95 through which the scanning beam passes and image is viewed. The loud speaker occupies a position close to the image viewing area and the vertical alignment of the microphone and speaker permit the use of binaural effects as an aid to the illusion that the voice emanates from the image. By controlling the volume of the loud speaker and using a curtain of sound absorbing material, the illusion is produced that the sound emanates from the image.

The upper half of the window 191 constitutes the area through which the scanning beam passes, and the image is viewed through the lower half.

The net result is that the telephone instruments do not interfere with the operation of the scanning means nor with the observer's view of the image, and an observer cannot use them for this purpose. Again the illusion of a face-to-face conversation is strikingly enhanced, because the voice appears to emanate from the image viewed by the observer.

While the above described arrangement of telephone instruments is well adapted for transmission under definite operating conditions, there are limits beyond which it would be impossible to go without causing singing in the telephone circuits, due to the transfer of sound waves from the loud speaker to the microphone.

If the telephone apparatus is adjusted to raise the power level of the speech wave above a definite value, a transfer of energy will take place between the loud speaker and the microphone such that singing will occur over the telephone circuits.

Fig. 5 illustrates an arrangement of telephone instruments which may be used where the operating conditions are such as to tend to cause singing.

An observer occupies the chair 27 in the booth 80, a portion of which is shown, and faces the scanning and image producing mechanisms above which is the microphone 61. The compartment enclosing the microphone is closed by the screen 120. As thus far described, the system is identical with the one previously set forth.

To listen to the incoming conversation, the observer uses a standard telephone 125 mounted on a staff 126, similar to that used in the construction of lorgnettes. In this case the receiver and a portion of the staff will appear in the image presented to the view of the other party to the conversation, but it will not interfere with the production of a full view of the face of the person scanned.

The receiver is held in contact with the ear, and hence there can be no transfer of sound wave energy from the receiver to the microphone. So far as energy transference within the booth is concerned, the outgoing speech wave may be raised to any power level without causing singing.

In Fig. 6, the variable angle prism 31 is illustrated as consisting of two sections 145 and 146

each mounted in a support 147 provided with bevel gear teeth 148, which mesh with a bevel gear 149 carried by a shaft secured to the knob 118. The supports 147 are secured to the wall of the cabinet 86. This apparatus operates in the manner disclosed in applicant's U. S. Patent 1,647,631 issued November 1, 1927.

Communication between the two stations is established in the following manner.

10 An initial framing adjustment is made as follows. The motors at the two stations are started and brought into synchronism and the direction of the scanning beam at one station is given a desired predetermined adjustment. No image 15 would then be produced at the other station without the provision at the first station of a light reflecting object within the scanning field since the booth is closed and the field is otherwise dark. There is therefore provided within the booth a 20 small object which will reflect blue scanning light to the photoelectric cells or some portion of the cells. Means are provided for positioning this object at a definite predetermined position in the scanning field, for example, at the extreme bot- 25 tom. In the preferred arrangement this object is a small mirror (not shown) permanently attached to the door of the booth in such position that when an occupant of the booth is in position to be scanned he will screen the mirror from the 30 scanning beam. This mirror reflects a bright spot of light on the photoelectric cells and framing is effected by adjusting the phase relation of the scanning discs at the two stations until the image on the mirror occupies the known desired position 35 within the receiving image field. The shutter 111 is then lowered and the apparatus is in readiness for the two observers to enter their respective booths.

An observer at the station illustrated enters the 40 booth 80, sits in the chair 27 and rotates it so as to occupy a position facing the scanning mechanism. The switches 46 and 47 are thereby closed to light lamp 52 and its cooperating lamp 59 at the distant station. Both operators are thereby notified of 45 the presence of a customer, and that he is in proper position to be televised.

The local operator raises the shutter 111. He then observes the image of his customer by means of the monitoring attachment 14-15-16. If 50 the observer is of the same stature as the preceding user, no adjustment will be necessary. However, if his face is not properly positioned in the scanning field, the variable angle prism 31 is adjusted to change the direction of the scanning 55 beam to accommodate the observer.

Having adjusted the variable angle prism, the operator reads the scale associated with its control knob 118 and actuates the knob 117, to a corresponding indication on the scale 151, whereby 60 the magnifying lens 32 is adjusted to the proper level.

The image of the other observer is also viewed through the monitoring apparatus 33-34-35, and if necessary, the receiving apparatus is ad- 65 justed to produce a good image of him.

Similar observations and adjustments, if necessary, are made at the other station.

During the adjustment periods, the shutters 36 lie in front of the image positions, and the relays 70 38 are energized to hold the armature 74 against the contact 75 and thereby short-circuit the primary winding of the repeating coils 65, at the respective stations. Consequently the observers do not see images of each other and speech cur- 75 rents cannot be transmitted over the connecting

channels. The shutter is carried by a plate 122 pivoted at 123 and is held in its raised position by the wire 124. The shutter is shown in its lowered position in Fig. 2 and in its raised position in Fig. 3.

The operators, being satisfied with the operation of the television apparatus, advise one another of this fact over one of the order-wire lines 55 or 56. They then release the shutters 36 to uncover the image viewing space and permit 10 the observers to each see an image of the other. At the same time the circuits of the relays 38 are opened and their armatures 74 fall-off to open the short-circuit across the windings of the res- 15 pective repeating coil 65 and thereby establish a two-way speech transmission circuit for the ob- servers.

When either of the observers rotates the chair, in turning away from the scanning mechanism, the switches 46 and 47 controlled by that chair 20 will be opened and the corresponding lamps 52 and 59 will be extinguished. The operators are thereby notified that the observers have finished using the system. Thus these circuits and the lamps constitute supervisory signals for the sys- 25 tem.

In one practical embodiment the speech monitoring network consisted of a resistance 69 of 250 ohms, resistances 70 of 3000 ohms each and resistances 71 of 850 ohms apiece. 30

The television circuits are provided with switches 76 and 77 whereby the terminal appa- 35 ratus may be disconnected from the line for testing purposes. In order to permit the apparatus to be tested or used locally under operating conditions, the transmitter may be connected by cord circuits through a resistance network or pad 78 to the receiver.

The present invention provides a means which may be advantageously used, in combined tele- 40 vision-telephone broadcasting systems, to permit a person broadcasting to see a replica of the image presented to those "listening-in".

This may be accomplished either by presenting the image for monitoring the outgoing television 45 channel, as disclosed in detail in the above mentioned Ives et al. patent, to the view of the person broadcasting. Again the diverted image circuit used for transmission monitoring purposes may be supplied to the lamp 24, over a connection 50 similar to that described above for testing purposes. Since the latter case makes use of the transmission and receiving scanning discs, they must be maintained in synchronism. This may be effected in the manner disclosed in the above 55 mentioned Stoller patent, or in any other well-known manner.

Obviously various features of the present invention are applicable to one-way or broadcast tele- 60 vision systems.

In general wherever amplifiers are referred to they are preferably of the vacuum tube type and include as many stages as are necessary to secure the desired operating conditions. The system 65 may be used by more than two observers.

While the system has been disclosed as including wire lines connecting the stations, it is to be understood that the terminal apparatuses herein described may be used to establish combined tele- 70 vision and speech communication, between the observers and operators, over a radio link.

The term light as used herein is intended to cover not only radiation having wave length within the so-called visible spectrum, but also 75

wave lengths lying above or below the visible spectrum.

What is claimed is:

1. A terminal apparatus for two-way tele-
vision comprising fixed transmitting means for
scanning an observer, means for producing an
image of a distant person in a predetermined
position with respect to said observer, and means,
comprising a support to be occupied by said
observer and a barrier in front of and above said
support, for limiting the movement of said ob-
server to maintain him in a position where he
may be scanned by said transmitting means and
simultaneously see an image of the distant person.
2. A terminal apparatus for two-way tele-
vision comprising fixed transmitting means for
scanning an observer, means for producing an
image of a distant person in a predetermined
position with respect to said observer, a rotatable
support to be occupied by an observer and hav-
ing its axis fixed, and a barrier in front of,
above and close to said support for maintaining
the observer in a position where he may be
scanned and may simultaneously see an image
of the distant person.
3. In a two-way television system, a terminal
apparatus comprising a television transmitting
and an image producing apparatus operatively
related to an observer, said transmitter compris-
ing means for producing a moving beam of light
for scanning said observer and said image pro-
ducer operating to set up an image field which
may be viewed by the observer while he is being
scanned, and including means for scanning said
field in a plane such that a normal thereto,
passing through the center of said image field,
passes through the path of said scanning beam.
4. A two-way television system comprising at
each terminal station means for producing a
moving beam of light for scanning an observer,
a lamp upon which received image currents are
impressed, means for scanning the light supplied
by said lamp to produce an image of a person
scanned at the other station and adapted to be
viewed by said observer while he is being scanned,
which image is offset with respect to the path
of said scanning beam, a large lens for magnify-
ing the said image, means for adjusting said lens
to accommodate the position of the image to
persons of different heights being scanned by said
beam, and means for indicating to an operator
when said lens is properly adjusted.
5. Two-way television apparatus comprising a
television transmitting and image producing ap-
paratus, a closed booth one wall of which has a
light transmitting portion through which the
scanning light from said transmitting apparatus
is directed and through which the received image
is viewed, light sensitive electric devices carried
by two other walls of said booth and in said
last mentioned walls, windows through which
scanning light reflected from the person being
scanned passes to said light sensitive devices.
6. A television transmitting apparatus com-
prising means for producing a moving beam of
light for scanning an object, light sensitive elec-
tric means activated by light reflected from said
object to control the production of an image cur-
rent, and optical means, adjustable independ-
ently of said first-mentioned means, for varying
the angular direction of said scanning beam with
respect to said object.
7. A television transmitting system comprising
means for beam scanning an object, and a vari-
able angle prism for adjusting the direction of

the scanning beam with respect to said object.

8. Television apparatus operatively related to
an object to be scanned and comprising means
for scanning said object including means for
illuminating it with light in which certain wave
lengths are weak or absent, a light actuated de-
vice particularly sensitive to said light, and a
source of light rays to which said device is less
sensitive for illuminating the space surrounding
said object.

9. Television apparatus comprising means in-
cluding a rotating element for producing a mov-
ing beam of light for scanning a field of view,
and adjustable means for varying the angular di-
rection of the scanning beam without varying the
position of said rotating element.

10. A television system having means opera-
tively related to an object to be scanned, said
means comprising means for scanning said ob-
ject including means for illuminating it with light
in which certain wave lengths are weak or absent,
and means for illuminating the space surrounding
said object with light rich in at least some of said
wave lengths.

11. A television system having means opera-
tively related to an object to be scanned, said
means comprising means including a source of
illumination in which blue rays predominate for
beam scanning said object, and a source of light
substantially free of blue rays for illuminating
the space surrounding said object.

12. A television transmitting system compris-
ing means for moving a beam of light over ele-
mental strips of a field of view within the period
of persistence of vision, light sensitive means for
receiving reflected light from said field of view,
and a variable angle prism interposed in the path
of said moving beam for producing a vertical ad-
justment of said beam without producing a hori-
zontal adjustment.

13. A television terminal station comprising
television transmitting and image producing ap-
paratus, and means for determining the position
of a user with respect to said apparatus compris-
ing a rotatable chair provided with arms and
occupying a fixed position with respect to said
apparatus, and a fixedly mounted barrier which
cooperates with said chair to limit the movement
of a user who occupies said chair and faces said
apparatus.

14. Two-way television apparatus comprising
a television transmitting and image producing
apparatus, a closed booth one wall of which has
a light transmitting portion through which scan-
ning light is directed and through which a re-
ceived image is viewed, a window in said wall and
windows respectively in two other walls of said
booth, and light sensitive devices aligned with
said windows, respectively, through which scan-
ning light reflected from the person being scanned
passes to said light sensitive devices.

15. Television terminal apparatus comprising
a closed booth, a support for an observer which
occupies a fixed position within said booth, and,
outside said booth, apparatus comprising means
for producing a moving beam of light for scan-
ning successive elemental areas of the face of an
observer occupying said support, means for pro-
ducing an image of the face of a person at a re-
mote station to be viewed by said observer, means
for observing the position of said scanning beam
with respect to the face of said observer, and ad-
justable means in the path of said beam for
adjusting it with respect to the face of said ob-
server, a scale associated with said adjusting

means, and means for adjusting the position of the image in accordance with the indication on said scale.

16. A two-way television system comprising at each terminal station, television transmitting and image producing apparatus, a closed booth, a support fixedly related to said apparatus and mounted in said booth to be occupied by an observer, and a circuit including indicating means outside of said booth but local thereto and switching means carried by said support, said switching means being actuated by an observer occupying the support at either station for producing an indication at both of said stations.

17. The combination with a booth having a doorway on one side and optical means opposite said doorway to be used in the television scanning of a person, of a rotatable chair in said booth having a fixed axis and extending nearly to the side walls of said booth, whereby a person to be scanned may correctly orient himself in said booth by first occupying said chair in a position substantially facing said doorway and then rotating the chair to cause him to face said optical means, and means for insuring that the occupant when facing said optical means will maintain his shoulders in correct scanning position.

18. Television apparatus comprising optical apparatus to be used in the scanning of a person, a support for the person to be scanned, said support being of such size and in such position with respect to said apparatus that a person occupying it uprightly will be in correct position for being scanned, and a barrier in position to be used as an arm support for preventing a departure from the upright position sufficient to prevent the person from being properly scanned and at the same time permitting the person to assume a natural easy position.

19. Television apparatus comprising a compartment for a person to be scanned, means to scan said person by light rays passing between said means and said person, a window in one side of said compartment through which said scanning rays pass, a seat for said person rotatable about a vertical axis and having means to cause a person to assume naturally approximately the same position on said seat whenever seating himself thereon, and a switch operable to effect a circuit change whenever said seat is rotated to such a position that a person seated thereon naturally faces said window.

20. Television apparatus comprising a compartment for a person to be scanned, means to scan said person by light rays passing between said means and said person, a window in one side of said compartment through which said scanning rays pass, a seat for said person rotatable about a vertical axis and having means to cause a person to assume naturally approximately the same position on said seat whenever seating himself thereon, and a barrier between said window and a person seated on said seat located below the level of said window and above the level of said seat to cause a person seated on said seat and naturally facing said window to remain a suitable distance from said window for scanning purposes.

21. Television apparatus comprising a compartment for a person to be scanned, means to scan said person by light rays passing between said means and said person, a window in one side of said compartment through which said scanning rays pass, a seat for said person rotatable

about a vertical axis and having means to cause a person to assume naturally approximately the same position on said seat whenever seating himself thereon, a barrier between said window and a person seated on said seat located below the level of said window and above the level of said seat to cause a person seated on said seat and naturally facing said window to remain a suitable distance from said window for scanning purposes, means to produce electrically an image of a distant object which image is visible to said person through said window, and a shutter located between said image producing means and said window operable by a local operator stationed outside said compartment for obscuring said image from the view of said person during a portion of the time during which said person is occupying said seat facing said window.

22. Television apparatus comprising a compartment for a person to be scanned, means to scan said person by light rays passing between said means and said person, a window in one side of said compartment through which said scanning rays pass, a seat for said person rotatable about a vertical axis and having means to cause a person to assume naturally approximately the same position on said seat whenever seating himself thereon, a barrier between said window and a person seated on said seat located below the level of said window and above the level of said seat to cause a person seated on said seat and naturally facing said window to remain a suitable distance from said window for scanning purposes, and optical means to variably deviate said scanning rays whereby said person's face may be centered in the scanned field.

23. Television apparatus comprising a compartment for a person to be scanned, means to scan said person by light rays passing between said means and said person, a window in one side of said compartment through which said scanning rays pass, a seat for said person rotatable about a vertical axis and having means to cause a person to assume naturally approximately the same position on said seat whenever seating himself thereon, a barrier between said window and a person seated on said seat located below the level of said window and above the level of said seat to cause a person seated on said seat and naturally facing said window to remain a suitable distance from said window for scanning purposes, optical means to variably deviate said scanning rays whereby said person's face may be centered in the scanned field, means to produce an image of a distant object which image is visible to said person through said window, while said person is being scanned, and means to variably deviate the image forming rays passing through said window from said image forming means so that the image may be clearly seen by persons occupying said seat at different times whose eyes are at different distances above the level of said seat.

24. Television apparatus comprising a compartment for a person to be scanned, means for scanning said person including means for illuminating said person with light in which certain wave lengths are weak or absent, a light actuated device particularly sensitive to said light, a window in one side of said compartment through which said scanning rays pass, a seat for said person rotatable about a vertical axis and having means to cause a person to assume naturally approximately the same position on said seat whenever seating himself thereon, a barrier be-

tween said window and a person seated on said seat located below the level of said window and above the level of said seat to cause a person seated on said seat and naturally facing said window to remain a suitable distance from said window for scanning purposes, and a source of light rays to which said light actuated device is less sensitive for illuminating said compartment.

25. Television apparatus comprising a compartment for a person to be scanned, means for scanning said person including means for illuminating said person with light in which blue rays predominate, a light actuated device particularly sensitive to said light, a window in one side of said compartment through which said scanning rays pass, a seat for said person rotatable about a vertical axis and having means to cause a person to assume naturally approximately the same position on said seat whenever seating himself thereon, a barrier between said window and a person seated on said seat located below the level of said window and above the level of said seat to cause a person seated on said seat and naturally facing said window to remain a suitable distance from said window for scanning purposes, and a source of light substantially free of blue rays for illuminating said booth.

26. Television apparatus comprising a compartment for a person to be scanned, means for scanning said person by illuminating small successive areas of said person's face with light from a source of light in which blue rays predominate, a light actuated device particularly sensitive to said light, a window in one side of said compartment through which said scanning rays pass, a seat for said person rotatable about a vertical axis and having means to cause a person to assume naturally approximately the same position on said seat whenever seating himself thereon, a barrier between said window and a person seated on said seat located below the level of said window and above the level of said seat to cause a person seated on said seat and naturally facing said window to remain a suitable distance from said window for scanning purposes, and a source of light substantially free of blue rays for illuminating said booth.

27. A signal system comprising, at a terminal station, television transmitting apparatus including movable means for controlling the production of a moving beam of light for scanning a user, means for producing an image of a person located at a remote station, means for indicating that the user is properly positioned relatively to said transmitting apparatus, adjustable means for varying the angular direction of the scanning beam, and means for adjusting the position of the image with respect to the user.

28. A signal system comprising, at a terminal station, a television transmitting apparatus including movable means for controlling the production of a moving beam of light for scanning a field of view, means for producing an image of a person who is located at another station, means for determining the position of a user in the field being scanned, means for indicating that the user is properly positioned in the field, adjustable means for varying the angular direction of the beam, and means for adjusting the position of the image relatively to the user.

29. A terminal apparatus for a television system comprising transmitting apparatus for scanning a field of view, a receiving apparatus for producing an image of an observer at a remote station, such image to be viewed by a person

within the field of view being scanned, refractive means for varying the effective position of said scanning apparatus with respect to said field of view, and separate means for adjusting the position of said image with respect to the line of vision of said observer.

30. A signal system including, at a terminal station, means for producing a movable beam of light for scanning a field, an apparatus for producing an image to be viewed by a person occupying said field, and refractive means for varying the angular direction of said beam relatively to said field.

31. A signal system comprising, at a terminal station, means for scanning a person, means for producing an image of an object televised at another station, such image to be viewed by a person while he is being scanned, and means, separate from said image producing means, for varying the position of the image relatively to the line of vision of the person being scanned.

32. A signal system comprising, at a terminal station, means for televising a person, means for producing an image to be viewed by the person being televised, including light refracting means, and means, separate from the image producing means, for adjusting the light refracting means to adjust the position of the image with respect to the line of vision of the person being televised.

33. A signal system comprising, at a terminal station, television transmitting and image producing apparatus occupying fixed positions relatively to an observer, adjustable means for varying the effective position of said transmitter with respect to said observer, and means, separate from said last-mentioned means, for independently adjusting the effective position of the image producer with respect to said observer.

34. A signal system comprising, at a terminal station, means for producing a movable beam of light for scanning an observer, an apparatus for producing an image to be viewed by the observer while he is being scanned, adjustable means for varying the angular direction of the beam, and means for adjusting the position of the image relatively to the line of vision of the observer.

35. The method of operating a television system which comprises scanning an observer with a beam of light, producing an image of a remote field of view to be viewed by the observer while he is being scanned, adjusting the angular direction of the scanning light beam with respect to the observer, producing an indication by said adjustment, and adjusting the image with respect to the line of vision of the observer and in accordance with said indication.

36. A television system comprising means including a movable member for controlling the production of a moving beam of light for scanning an object, means for producing an image of a person at a remote station, means for adjusting the direction of said beam, a scale associated with said adjusting means, and means for adjusting the position of the image in accordance with the indication on said scale.

37. The method of operating a television system in which scanning of elemental areas is effected in succession by means of light beams which comprises successively producing a plurality of beams of light in substantially parallel directions, subsequently variably changing the direction of each beam so that the paths of the beams are divergent, and refractively adjusting the general direction of said divergent beams without varying the position of the beam gen-

erating apparatus and without changing the ratio of the lengths of said beams.

38. A television transmitter comprising means for moving a beam of light over elemental strips of a field of view within the period of persistence of vision, light sensitive means for receiving light reflected from said field of view, and adjustable means for varying the angular direction of said beam with respect to said field.

39. A television transmitter comprising means for moving a beam of light over elemental strips of a field of view within the period of persistence of vision, light sensitive means for receiving light reflected from said field of view, and adjustable means, interposed in the path of said beam, for varying its angular direction to thereby produce a vertical adjustment thereof without producing a horizontal adjustment.

40. Television terminal apparatus comprising a closed booth, a support for an observer which support occupies a fixed position within said booth, and, outside the booth, apparatus comprising means for producing a moving beam of light for scanning successive elemental areas of

the face of an observer occupying said support, means for producing an image of the face of a person at a remote station to be viewed by said observer while he is being scanned, means for observing the position of said scanning beam with respect to the face of the observer, and adjustable means in the path of the beam for varying its angular direction with respect to the face of the observer.

41. A television system comprising apparatus for scanning a field of view, and means operative independently of said apparatus for angularly adjusting its effective position and thereby enable it to scan a field of view occupying any one of a plurality of positions relatively to said apparatus.

42. A television system comprising apparatus for producing an image of a field of view scanned at a transmitter and means operable independently of said image producing apparatus for angularly adjusting the position of the image so that it may be observed at any one of a plurality of positions relatively to said image producing apparatus.

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