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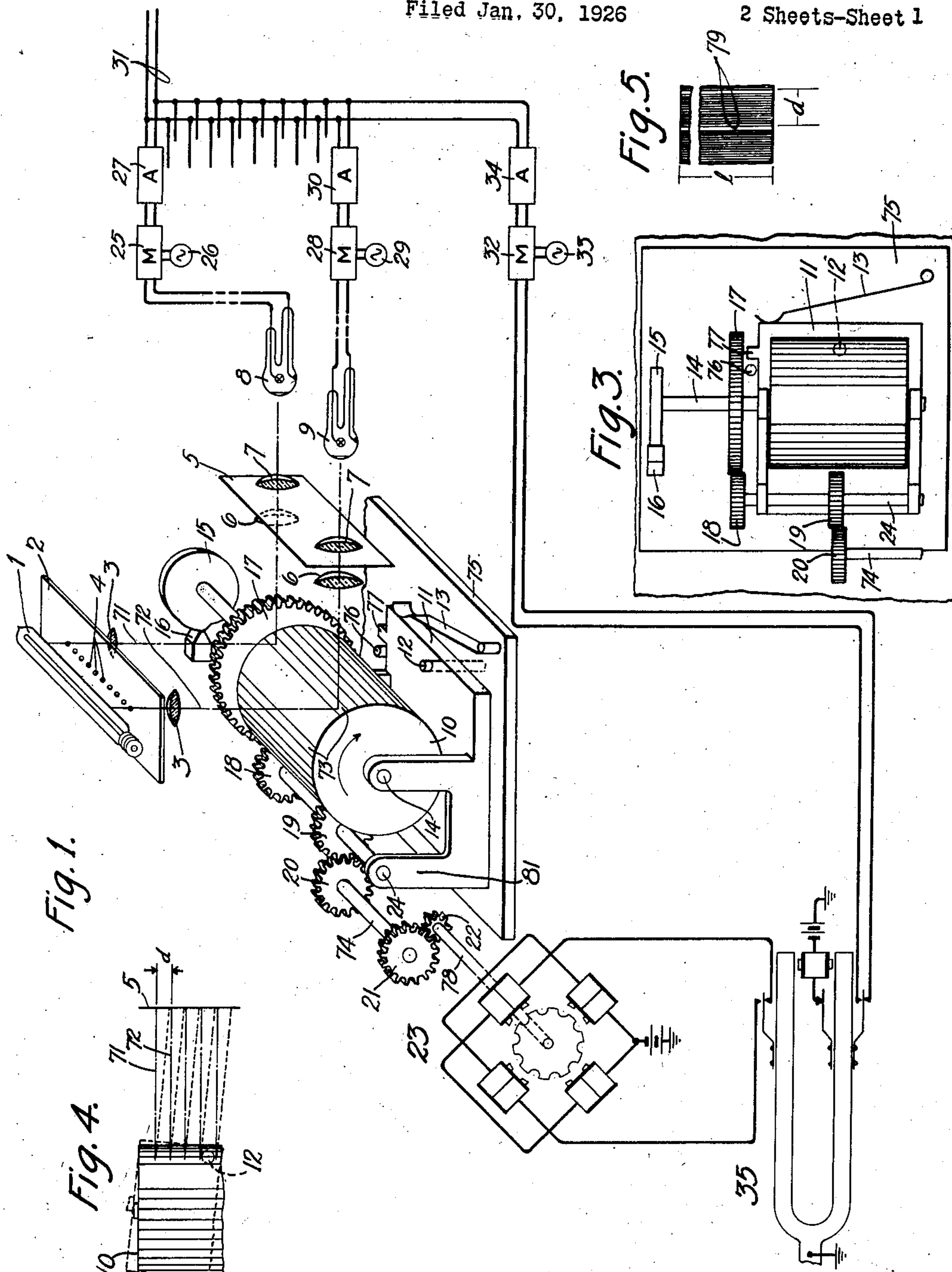
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1,649,819

SYSTEM OF TELEVISION

Filed Jan. 30, 1926

2 Sheets-Sheet 1



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Fig. 6.

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UNITED STATES PATENT OFFICE.

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SYSTEM OF TELEVISION.

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This invention relates to a picture transmission system and also to systems of television wherein images of objects may be produced and observed at a distance.

5 In television systems relying upon the persistence of visual impression, it is necessary that the object or picture whose image is to be transmitted be scanned with sufficient frequency and rapidity to provide an apparent continuous visual sensation in the eye of an observer. For this purpose there have been devised numerous means for providing this requisite rapidity of scanning such, for example, as rotating or oscillating mirrors. 10 The scanning means at the sending and receiving stations must necessarily be maintained in accurate synchronism so that the scanning beam at the receiving station shall traverse a path which will correspond at every instant with that of the scanning beam at the sending station. When a single scanning beam is employed, the same must scan the entire picture or object in a continuous path. This continuous scanning necessarily consumes an appreciable time which in certain cases may be deleterious as regards the faithfulness of the reproduced image.

It is proposed to employ a number of separate scanning beams at both the sending and receiving stations. Each beam according to this arrangement, therefore, scans a restricted area of the object and the total time required for a complete scanning is reduced in proportion to the number of separate beams employed. 30

The principal object of the invention, therefore, is to improve and render more efficient and practicable picture transmission systems and particularly systems of television. 40

A feature of the invention resides in the use of a plurality of separate light beams for simultaneously scanning definite areas of the object whose image is to be transmitted.

45 Another feature relates to a scanning mirror which is adapted to be rotated about coordinate axes.

Other novel features will be pointed out with particularity in the appended claims.

50 The drawing comprises five figures. With Figure 2 to the right of Fig. 1, there is shown a picture transmission system in sufficient detail to enable a complete understanding to be attained of a preferred form of practicing the invention. 55

Fig. 1 is a semi-perspective view of apparatus and circuits at the sending station of a picture transmission system.

Fig. 2 is a semi-perspective view of apparatus and circuits at the receiving station. 60

Fig. 3 is a detailed plan view of one of the scanning mirrors employed at the sending and receiving stations, and the means for rotating the same about coordinate axes.

Fig. 4 is a schematic diagram showing the relative displacement of the scanning beams because of the horizontal displacement of the scanning mirrors. 65

Fig. 5 is a magnified view of contiguous elemental areas of the receiving film to show the relative width of the areas scanned by the separate beams. 70

Fig. 6 is a diagram showing the manner in which the invention may be applied to television systems. 75

At the sending station illustrated in Fig. 1 of the drawing, the picture to be transmitted may be in the form of a transparent film 5 which is illuminated by rays of light reflected from the facets of the polyhedral mirror 10. For the purpose of providing a plurality of equally spaced scanning beams, there is interposed between the lamp 1 and mirror 10 a plate 2 having a number of openings 4 therein. By means of the openings 4 the light from lamp 1 is broken into a number of separate and distinct beams. Two of these beams are represented schematically by the lines 71 and 72. For the sake of clarity in the drawing, other intermediate beams are not shown. A series of lenses 3 is employed for the purpose of focusing the individual beams upon the mirror facets. The number of facets of mirror 10 is entirely arbitrary and is determined by the speed at which the drum is to be rotated. The mirror 10 is fastened on shaft 14 for rotation therewith, shaft 14 being mounted in any desired manner in appropriate bearings constituting part of the frame 11. A pin 12 fastened to the base plate 75 extends through an opening in the frame 11. Frame 11 is free to be rotated around pin 12 against the force of spring 13. 100

The power for rotating mirror 10 is furnished by the phonic wheel motor 23 which is driven in the well-known manner by means of impulses from the tuning fork 35. The motor shaft 78 carries the pinion 22 which co-operates with gear 21 mounted 110

on the end of shaft 74. At the opposite end of shaft 74 is a gear wheel 20 loosely meshed with gear 19 mounted on shaft 24, which rotates in standards 81 forming part of frame 11. Shaft 24 also carries a gear wheel 18 which co-operates with gear 17 fastened on the mirror shaft 14. The ratio of the successive gears in the train may be such as to provide the most practical speed of rotation of mirror 10. As mentioned above, the mirror frame 11 is adapted to be rotated about pin 12. The means for rotating frame 11 comprises a cam 15 which is fastened on the end of shaft 14 and co-operates with post 16 secured to the base plate 75. A stop such as a pin 76 may be fastened to the plate 75, co-operating with a lug 77 on frame 11 to limit the horizontal displacement of said frame.

In the normal position of mirror 10, shaft 14 is parallel to film 5 and the lower portion of cam 15 is in engagement with post 16. Frame 11 is thus held against the stop pin 76 by means of spring 13. In this position of frame 11, the bundles of rays 71, 72, etc., are reflected from the mirror 10 in the manner indicated by the lines 71, 72, etc., of Fig. 4. As shaft 14 rotates, the action of post 16 against cam 15 causes the mirror frame to be gradually rotated about the pin 12 until the mirror assumes the position indicated by the dotted lines of Fig. 4. Each light ray during a complete revolution of shaft 14 is therefore displaced horizontally at distance d . Assuming there to be 36 facets 73 on the mirror 10, each facet in rotating causes the reflected rays to completely scan vertically the film 5. Thus a single revolution of shaft 14 provides, for each ray, a series of 36 complete vertical scanings of film 35. This is indicated in Fig. 5 by the vertical lines 79. An inspection of Fig. 5, therefore, reveals the fact that each light beam scans the total length of the picture for a horizontal distance d .

For the purpose of allowing the rays reflected from the mirror facets to strike film 5 perpendicularly, a series of lenses 6 is provided. The reflected rays, after passing through film 5, are focused by means of a series of spherical lenses 7 upon the respective photoelectric cells 8, 9, etc., there being a photoelectric cell for each separate beam employed. Thus the currents from the photoelectric cells 8, 9, etc., are varied according to the intensity of the light incident thereon, which intensity is determined by the relative transparency of the successive elemental areas of film 5 scanned by the several beams. Associated with each photoelectric cell is a source of oscillating current 26 and a modulating device 25. By means of device 25, the varying output of the associated photoelectric cell causes the current from the oscillator 26 to be correspondingly modulat-

ed. The modulated currents are then amplified by device 27 and impressed upon the transmission line 31. It is to be noted that the sources 26, 29, etc., generate currents of different frequencies, so that the currents modulated by the respective cells may be simultaneously applied to line 31 without intermodulation.

A separate source of oscillation 33 of a distinct frequency from that of the picture current oscillators is provided for synchronizing purposes. Consequently, this synchronizing current may be applied continuously during the transmission of the picture current.

At the receiving station, for each of the picture current channels, there is provided a filter 39 and amplifying apparatus 40. Similarly, the filter 41 and amplifier 42 are provided for the synchronizing channel. The synchronizing currents, after being amplified by device 42, are applied in the manner described in the application of Horton, Ives and Long, Serial No. 714,466, filed May 19, 1924, to the magnet 67, causing the fork 66 to be driven at a synchronous rate with respect to the fork 35. Fork 66 in turn drives the phonic wheel motor 65 which, by means of a gear train similar to that already described in connection with Fig. 1, causes the mirror 57 to be rotated in synchronism with mirror 10. Mirror 57 is mounted upon a frame 58 which is adapted to be rotated around the pin 59 in a manner identical with that already described in connection with the corresponding mirror at the sending station. Similarly, a cam 50 is fastened to the end of shaft 82 and co-operates with the post 51 to displace the mirror 57 horizontally against the action of spring 60. The dimensions of cam 50 are the same as cam 15, so as to provide the same horizontal displacement of frame 58 as is provided for frame 11 by cam 15.

Each of the picture current channels PC_1 , PC_2 , etc., has associated therewith a light valve 44 and a source of light 43. The output of amplifier 40 is applied to the string of the associated light valve to control the amount of light from source 43 which is incident upon the mirror 57 in accordance with the amplitude of the received picture currents. The light rays passed by valve 44 are reflected, by means of the mirror facets, on to the receiving surface 49. The currents in the other picture current channels are similarly applied to these corresponding light valves to control respective beams reflected by mirror 57. Since the mirror 57 is rotated and displaced horizontally in synchronism with the mirror 10, the light rays reflected from the mirror 57 scan equal areas of the receiving surface 49 in a manner identical with that described in connection with the scanning of film 5. The surface 49 may be a

photosensitive surface, or any other surface capable of reproducing a picture under the influence of light rays.

The portion of the mirror drum between the first and the thirty-sixth facet is blank in order to provide sufficient time to allow spring 13 to restore the frame 11 to its normal position. If desired, the synchronizing current from oscillator 33, instead of being continuously applied, may be applied periodically to line 31, for example, during the period frame 11 is being restored to normal.

Fig. 6 shows the manner in which the scanning mirrors illustrated in Figs. 1 and 2 may be utilized for purposes of television. In this case the object 80 is intensely illuminated from an appropriate light source 87. A plurality of lenses 83, 84, etc., and an equal number of photoelectric cells 85, 86, etc., are employed. Each of the lenses 83, 84, etc., focuses upon a separate elementary area of the mirror facets. The mirror is mounted for rotation about coordinate axes, as has already been described in connection with Figs. 1 and 2. Consequently, for every revolution of the mirror frame, each of the lenses, for example, lens 83, focuses upon its corresponding cell 85 light rays corresponding to a definite area of the object as reflected in the mirror facets. Each facet of the mirror in revolving presents a succession of elementary lines of the picture to the several lenses. The output of cells 85, 86, etc., may then be used to modulate respective carrier currents as described in connection with Fig. 1 and the image may be reproduced as already described in connection with Fig. 2.

It is to be understood that various modifications may be made without departing from the spirit and scope of the invention. For example, instead of displacing the scanning mirrors horizontally, they may be mounted for rotation in one direction only and the picture 5 and receiving film 49 may be moved in directions perpendicular to the direction of rotation of the respective mirrors. It is also intended that the invention is not to be limited to systems employing transmission lines but may equally well be applied to systems utilizing other transmission mediums.

What is claimed is:

1. In a picture transmission system, a sending station, means for producing a plurality of separate light beams, an object whose image is to be transmitted, a surface for reflecting said light beams on to said object, and means for moving said surface simultaneously in coordinate directions to cause said beams to simultaneously scan definite and equal areas of said object.

2. In a picture transmission system, means for producing a plurality of separate light beams, an object whose image is to be trans-

mitted, a light reflecting surface, and means for rotating said surface about perpendicular axes to cause each of said beams to simultaneously scan equal areas of said object.

3. In a picture transmission system, an object whose image is to be transmitted, means for producing a plurality of separate light beams, a mirror having a plurality of facets, means for focusing said light beams on said mirror facets, and means for rotating said mirror simultaneously about perpendicular axes to cause said beams to scan said object in equal and linearly aligned areas.

4. In a picture transmission system, an object whose image is to be transmitted, a scanning mirror having a plurality of facets, means for producing a light beam, means for focusing said beam on said mirror, and means for rotating said mirror in a plurality of directions to cause said beam as reflected from said facets to scan said object in a plurality of parallel paths during each revolution of said mirror.

5. In a television system, an object whose image is to be transmitted, a scanning mirror for simultaneously scanning equal areas of said object, a signal channel corresponding to each of said scanned areas, a source of carrier current for each channel, means for modulating the carrier currents in accordance with the characteristics of the associated areas of said object, a receiving station, a reproducing surface at said receiving station, means for simultaneously transmitting said modulated carriers to said receiving station, a light valve and a source of light at said receiving station for each of the received carriers, means for analyzing said received carriers and applying each to its respective light valve to control the amount of light passed thereby, a mirror at said receiving station having a plurality of facets, means for simultaneously focusing the light passed by each of said valves upon said mirror, and means for rotating said mirror simultaneously in different directions to cause the rays reflected from said mirror to traverse equal areas of said surface to reproduce said image thereon.

6. In a television system, an object whose image is to be transmitted, a scanning mirror, means for focusing a plurality of separate light beams on said mirror, means for focusing said beams as reflected from said mirror upon said object, a transmission channel for each beam, a source of carrier current for each channel, means for moving said mirror in different directions to cause said reflected beams to simultaneously scan equal and different areas of said object to correspondingly modulate the carrier current in the associated channels, a receiving station, a reproducing surface at said station, means for simultaneously transmitting said modu-

lated carriers to said receiving station, and means at said station comprising a light beam for each carrier and a multi-faceted mirror for analyzing said carriers and for synthesizing the associated light beams to reproduce the image of said object on said surface.

7. In a television system, an object whose image is to be transmitted, a scanning mirror having a plurality of facets, means for focusing a plurality of light sensitive devices one for each beam, means for rotating said mirror in different directions to cause said beams to simultaneously scan said object in equal and linearly aligned areas, means for focusing each beam during its scanning motion upon the corresponding light sensitive device to vary the output of said device according to the elemental areas scanned by the beam, a source of carrier current for each device, means for modulating said currents in accordance with the outputs of the associated devices, means for simultaneously transmitting said modulated currents, and means comprising a multi-faceted mirror for resolving said carrier currents to reproduce the image of said object.

8. In a television system, a sending station, a receiving station, multi-faceted mirrors at each of said stations, and means for rotating each mirror simultaneously in different directions, and means for maintaining the rotations of said mirrors synchronous.

9. In a television system, the combination of an object whose image is to be transmitted, a sending station, a receiving station, means at said sending station comprising a mirror for simultaneously scanning different areas of said object and transmitting a plurality of currents each corresponding to the characteristics of one of said scanned areas, means for rotating said mirror in different directions, means at said receiving station for analyzing said received currents to control respective light beams, a mirror at said receiving station, and means for rotating the mirror at the receiving station in different directions in synchronism with the movements of the mirror at the sending station to synthesize said light beams for the reproduction of said image.

10. In a television system, an object whose image is to be transmitted, a sending station, means for producing a number of separate light beams, a mirror at said sending station, means for focusing said beams on said mirror, means for rotating said mirror in one direction to cause said beam to scan said object vertically and for simultaneously rotating said mirror to cause said beams to scan said object horizontally, a receiving station and a reproducing surface thereat,

means for producing light beams at the receiving station, a mirror at said receiving station, adapted to be rotated in one direction to reflect said light beams with a vertical motion over said surface and adapted to be simultaneously rotated in another direction to reflect said beams with a horizontal motion over said surface, and means for maintaining the motions of the mirror at the sending station synchronous with the motions of the mirror at the receiving station.

11. In a picture transmission system, an object whose image is to be transmitted, a multi-faceted mirror, means for rotating said mirror to repeatedly scan said object vertically during each revolution, means for displacing said mirror while rotating to scan said object horizontally, and means for restoring said mirror from its displaced position at the end of each revolution.

12. In a television system, an object whose image is to be transmitted, a plurality of light responsive devices, each responding to characteristics of different sections of the object, and means for reflecting light rays from linearly aligned areas of each section upon the associated light responsive devices, said last mentioned means comprising a multi-faceted mirror adapted to be rotated simultaneously in coordinate directions.

13. In a television system, an object whose image is to be transmitted, a multi-faceted mirror adapted to reflect the light rays incident thereupon from said object, a plurality of photoelectric cells each responding to light rays reflected from a definite section of each mirror facet each section of a mirror facet corresponding to a section of the object, means for revolving said mirror simultaneously in coordinate directions to cause the light rays incident on said cells to vary according to the characteristic of linearly aligned areas of the corresponding sections of the object, a transmission line, means for simultaneously applying to said line the currents from said cells, a receiving station, means at said station for producing light beams equal in number to the number of cells at the sending station, means for analyzing the received current to control the beams from said light sources, a prismatic mirror at the receiving station, and means for rotating said mirror simultaneously in different directions in synchronism with the movements of the mirror at the sending station to synthesize said light beams for the reproduction of said image.

In testimony whereof, I have signed my name to this specification this 29th day of January, 1926.

JOHN M. FELL.