March 2, 1937. C. A. BIRCH-FIELD 2,072,419

TELEVISION METHOD AND APPARATUS

Filed June 26, 1931

Fig. 1.

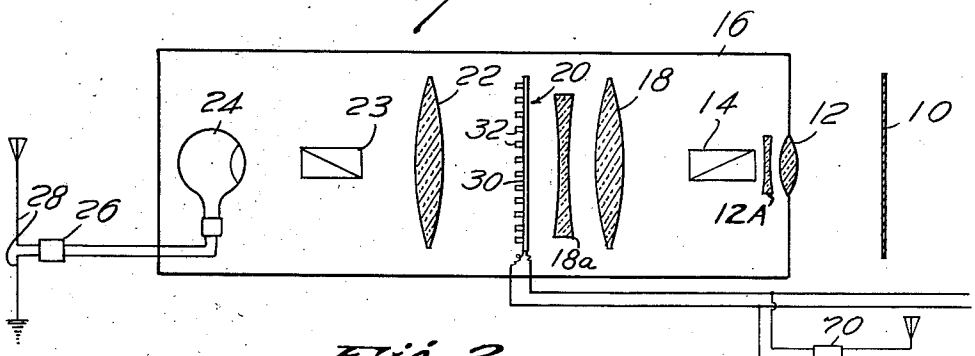


Fig. 2.

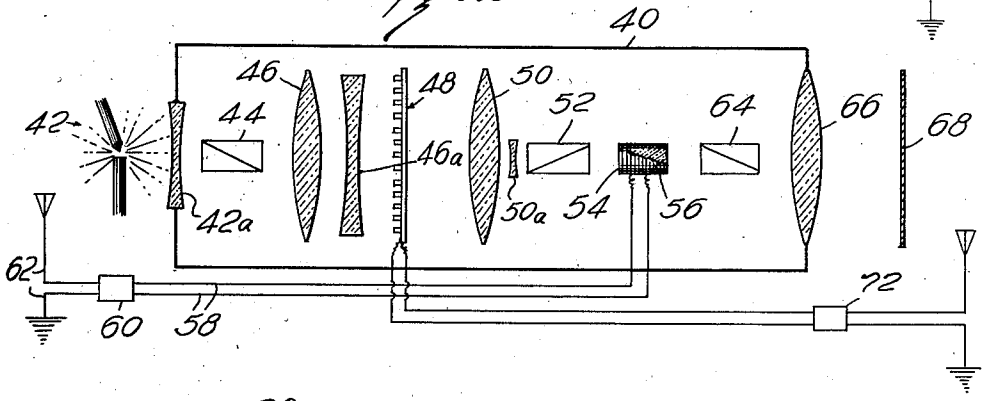


Fig. 3.

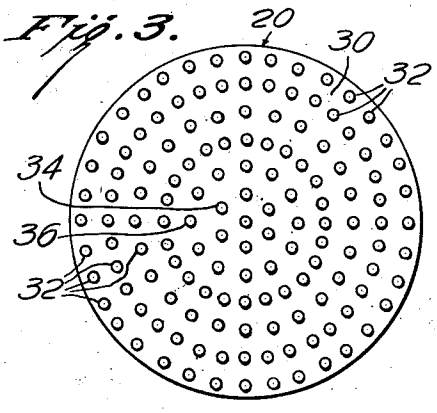


Fig. 4.

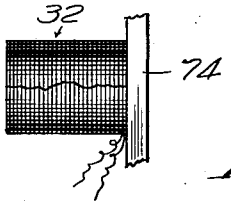


Fig. 5.

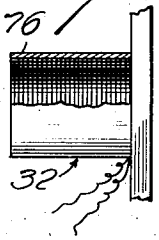


Fig. 6.

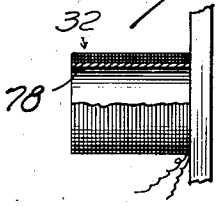
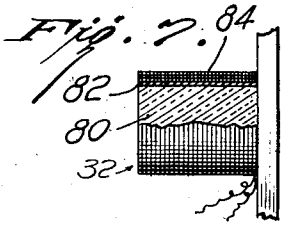


Fig. 7.



Inventor

CHARLES A. BIRCH-FIELD,

By William Bluet

Attorney

Patented Mar. 2, 1937

2,072,419

UNITED STATES PATENT OFFICE

2,072,419

TELEVISION METHOD AND APPARATUS

Charles A. Birch-Field, Larchmont, N. Y., assignor, by mesne assignments, to Mildred S. Reisman, New York, N. Y.

Application June 26, 1931, Serial No. 546,984

21 Claims. (Cl. 178—6)

This invention relates to television methods and apparatus.

Present day apparatus for translating a scene or a picture into electrical pulsations of such character that, after transmission of such impulses, either by wire, or by the radiated electromagnetic waves of wireless or the so-called "wired wireless" methods of transmission, to some point removed from the neighborhood of such scene or picture, there to be retranslated into light gradations to reproduce the appearance of the picture or scene, requires the use of some mechanical moving part, such as a scanning disk, well known to the experimenter in this field. The synchronization of a disk for this purpose at the transmitting station, with a similar disk at the receiving station, the accuracy and identity necessary in the relation of number of apertures, their size, their exact arrangement on the disk, and similar details of construction of both disks, the great number of holes necessary in order to produce a seemly picture or image of any real value, the fact that the picture or scene as reproduced by the rotating disk has a curved-line, as against the desired straight-line, appearance, and many other like features, have been the problems with which the experimenters have contended in their efforts to make practical the transmission to and proper visualization at, a distance removed from their location, of scenes, or the like.

Furthermore, the light medium showing the necessary reactivity with relation to variation in signal strength that is practical in instantly translating such variations in signal strength into sharp variations of lighting for such operations has been the neon bulb, the lighting value of which is very low, the color of the light given off by such bulb also not being very agreeable when an image is constantly to be viewed in such light.

Furthermore, the customary rapidly rotating scanning disk requires accurate control of motor speed at both transmitting and receiving stations for proper synchronization during the production of television pictures. Even where synchronous motors are used, if there be but a slight difference between the frequencies at the two stations, the scanning disks are thrown out of synchronization and the image, which, after considerable labor, has been brought to visibility, will be distorted.

It is an object of the invention to provide a television system in which mechanical scansion is eliminated. In this method of television, advantage is taken of the effect upon light rays, and especially upon polarized light, of magnetic fields of varying intensity.

It is also an object of the invention to provide a system of television in which variations of the light intensity of the light source as dependent upon the intensity of the received signal is not a part of the scanning system of the receiving unit; in the essential operation followed in the practice of this invention, the light source itself produces a constant illumination during the operation of the scanning means. The receiving system is of such character that light rays, derived from a light source of any color characteristic, and especially those sources generally characterized as emitting white light, such as the electric arc, the customarily used incandescent filament bulb, or similar illuminating element, may be used so that an image in the customary variations of white and black may be produced.

It is a further object of the invention to provide a television system in which variations of magnetic fields, used in scanning elements at the receiving station, may be accurately synchronized with similar scanning elements at the transmitting station. In carrying out certain features of the invention, polarized light is passed to an analyzer set to blot out all light passing normally thereto. By means of properly controlled magnetic fields, the polarized light rays are affected at particular points transversely of their extent so that, at such points, the rays will be out of phase with the analyzer and will pass therethrough, whereupon such rays, properly located with reference to the pattern of a screen, may, in the transmitting system where the light rays have passed through the scanning magnetic fields in varying intensities, be used to affect, in varying degrees, a light sensitive cell for converting such light variations into a similarly varying electric current for modulating a transmitting circuit, or, in the receiving system, rays of polarized light be varied in intensity in proportion to the intensity of the signal received from a transmitting system of the above type. It is to be understood that this system may also be applied in such cases where the analyzer is set to be entirely, or to some predetermined degree, in phase with the normal polarized light, while the rotating fields will be active to rotate the light toward an out-of-phase relation to the analyzer.

It is necessary that the light pulsations produced at the transmtting and the receiving sta-

tions should not only be synchronized but each pulsation at the transmitting station, resulting from light intensity at a particular location upon a screen at that station, should result in an exactly timed light effect at the receiving station of substantially the same, or proportionately the same, light strength as that of the light rays from which the pulsation arose, this light effect being located upon the receiving screen in identically the same position as that from which the pulsation arose. For this purpose, as a part of this invention, the scanning circuits and their currents are arranged for instantaneous synchronization, without the use of mechanical means, so that the pulsations of light at the receiving station will be controlled entirely by the current of the transmitting station without the necessity of mechanically synchronizing the two stations, as is now necessary in the cases of mechanical transmission and reception.

Other objects of this invention will be hereinafter set forth, or will be apparent from the description and the drawing, in which are illustrated a number of embodiments of apparatus for carrying out the invention.

The invention, however, is not intended to be restricted to the particular constructions and arrangement of parts of such apparatus, nor to the particular applications of such apparatus, herein shown and described, nor to the specific methods of operation, nor to the various details thereof, as the same may be modified in various particulars or be applied in many varied relations without departing from the spirit and scope of the invention, some practical embodiments being herein illustrated and described without attempting to show all the various forms and modifications in which the invention might be embodied.

For the attainment of these objects and of such other objects as may hereinafter appear or be pointed out, I have illustrated an embodiment of my invention in the drawing wherein:—

Fig. 1 is a diagrammatic layout of a television transmitting system embodying the invention;

Fig. 2 is a similar view of a receiving system embodying the invention;

Fig. 3 is a layout for a scanning element of the type used in the systems shown in Figs. 1 and 2; and

Figs. 4, 5, 6, and 7 are detailed elevational views, partly in section, of coils used for the scanning element.

Light rays, when transmitted through many types of media, one of which is the well known Nicol prism, become polarized, that is, the light rays become imbued with certain properties which distinguish them from ordinary light rays. For instance, if such polarized light be directed through a Nicol prism which has had the common plane of the united prisms turned 90° from the position of the original polarizing prism, the polarized light rays will be incapable of transmission. However, if the prism, so arranged, is now rotated on its axis, some light will pass through, the amount increasing until a maximum will be reached, after which the amount of light passed will decrease.

It has been found that the same effect of passage of the light rays through the so-called analyzer is produced, without actual physical rotation of the analyzer prism, by the action of magnetic fields upon the light rays which are rotated with relation to the analyzer prism so as to permit their passage. Furthermore, the intensity or quantity of the light passed varies as the degree of rotation, and, therefore, with the intensity of the magnetic field; the intensity of the latter may, of course, be made a factor of the strength of an electric current passing through a solenoid or similar magnetic-field-producing element which depends for its magnetic strength upon an electric current flowing through a circuit.

For the purpose of this invention, these principles are embodied into a system of scanning a scene, or similar light ray emitting element, and for translating the varying current thus produced back into a scene or picture similar to the original. On the drawing, the scene is represented at 10, which, in this case, is intended to be the face of a clock, or similar circular object. The particular purpose for which the disclosed apparatus is designed is to transmit the light effects produced as the hands of a clock rotate. For this purpose, light rays radiating from the clock face are converged by a condensing lens 12 through a paralleling lens 12*a*, thence through a Nicol prism 14, all within a housing 16, which here is represented entirely diagrammatically. These light rays, in their polarized condition, are now affected by a diverging lens 18 and a paralleling lens 18A so that their effect will be spread over substantially the entire effective surface of the scanning element 20 through which they now pass. The specific construction of the scanning element, embodying the invention in preferred form, will be described more fully hereinafter.

The light rays, after they have been acted upon by the scanning element, pass to and through a lens 22 by which they are condensed and focused upon an analyzer 23 of any preferred construction, from which the light rays which are not blotted out thereby are transmitted to affect the light sensitive element of a light sensitive cell 24. The variations of electrical conditions in this cell may be used to modulate the output circuit of a transmitter 26, the construction of which may follow any desired or well known form, or such variations may be used to produce a varying current in a conductor. If the variations are to be transmitted by a transmitter 26, the modulated wave may be radiated in any desired manner, as, for instance, between an antenna and ground circuit 28. The lenses 12, 12*a*, 18, 18*a*, and 22 are merely the diagrammatic representation of the necessary optical systems for bringing the light rays into the desired relationships to the elements of the transmitting system.

The scanning element 20 preferably consists of a plate of some refractive material, such as glass, quartz, or similar light transmitting substance, to one face 30 of which are secured a plurality of coils 32, the axes of which, in a preferred construction, are parallel to each other and also to the mean direction of light rays passing from scene 10 through lens 12. As appears in Fig. 3, these coils, in one desired arrangement, are arranged on face 30 in concentric circles and are wired in series so that an electric charge, entering the first circle 34, will first pass through all coils in that circle, and then pass on to the coils in the next succeeding circle 36, and so on out to the outer extremity of the element 20.

As appears from Figs. 4 to 7, inclusive, the axes of these coils are perpendicular to the plate, and, therefore, their fields, as the charge passes through them, will be most intense within their extent and along their axes. Their light rotat-

ing effect would, therefore, be a maximum within such coils.

As light, which has passed through lenses 12 and 12a, the prism 14 and the lenses 18 and 18a, arrives at and moves past coils 32, the electromagnetic effect produced by these coils will produce rotation of the plane of the polarized light, the degree of rotation depending upon the intensity of the magnetic fields, and, therefore, of the current flow in a particular coil.

The particular manner in which the scanning element is made effective is not specifically important. It is merely necessary to arrange the coils 32 and have them connected to a power source or power sources so that each of the coils at one station will become energized at a distinct time, this energization of a particular coil being simultaneous with that of a coil, identically located with respect to its screen, at the other station. The energization of each coil preferably is distinct from that of the others. To accomplish this, it may be desirable to energize each coil from an individual power source, timed with relation to the others to energize its particular coil at a desired instant. For instance, this may be done by providing each coil with a vacuum tube relay, discharging through the coil at predetermined intervals.

However, in the preferred arrangement, the coils are connected in series, as indicated above. The movement of an electric charge, originating at some source and then passing from that source, through the series connected coils, back to the source, produces what is otherwise known as an electric current, and consumes a definite time interval for its passage. By guiding an electric current through coils 32 in the predetermined order, each of the coils, during the passage of the electric current, becomes energized and a magnetic field is created immediately around it. These magnetic fields, as has previously been discussed, rotate polarized light passing through the particular coil substantially parallel to its axis. This energization is, however, made almost instantaneous, the charge passing on from coil to coil, and instantaneously energizing each one of them in rapid succession. Preferably some means, such as damping coils or the like, may be interposed, in such an arrangement, between successive coils, in order that the electric charge may be delayed in passing from coil to the next one so that but one coil at a time will be affected by the charge at any one instant. Such areas of face 30 of the plate 20 as are disposed other than at the coils may be blanked by positioning thereon some means, such as paint, for blotting out light.

The result is the rotation of polarized light at a number of different neighborhoods, so that a number of spots of light will be transmitted in accordance with the instantaneous position of the moving charge of scanning current. Of course, if the image itself is dark, no light would have originated from it in the first place, and, therefore, the scanning element would affect no light. But, if light were transmitted from light portions of the scene, this light would be transmitted to the light cell 24 by the element and the subsequent analyzer as a large number of distinct light impulses of strengths, varying in accordance with whether the portion of the scanning element, at the instant a particular coil was active, was illuminated by such polarized light.

The current flow through the coils may be produced by a plurality of charges, discharged through the coils in a predeterminedly timed relationship so that the current will have a pulsating character, as, for instance, that produced by an alternating current, or by an interrupted direct current. The coils 32 will thus become magnetically active in a predetermined consecutive relationship, but, due to the fact that the charges will move from coil to coil there will be magnetic activity only at a predetermined point or area in the extent of the plate, at any particular time. In other words, at any specific instant, light rays will be affected by the magnetic fields only at a certain distinct point or area of very small extent so that only such rays will be rotated sufficiently that the analyzer prism 23 would not bar them from passage thereby.

It is to be realized, of course, that the intensity of light at different areas of the plate would vary in accordance with the light transmitted from scene 10. In other words, where the effective coil has no light transmitted thereto, it, of course, will rotate no light, and a dark spot, and no resultant signal from the light sensitive cell, will result; as the intensity of the light passing by the active coil increases, for the same strength of magnetic field, rotation passes more light and there results a greater signal from the cell. In this manner, the impulses created in cell 24 would be varied in accordance with the intensity of the light rays at particular areas or points in scene 10, as visualized at element 20. These light sensations would thus be converted into a series of electrical impulses of varying strengths, such that, with apparatus shown in Figure 2, or embodying principles similar thereto, they might be converted again into a visible scene exactly that of the one depicted at the element 20.

In conjunction with receiving apparatus 40, there may be used any light source, such as an electric arc 42, or similar light producing element. Since the operation of the light source is not a material item in connection with the features of this apparatus, that is, the variation in illumination and other features of the scanning system do not rely upon any time period or other activity of such source, the source may take any form desirable with relation to the particular work to be done.

Light from the source is passed through a paralleling lens 42A thence through a polarizing means such as prism 44, thereafter being diverged by a lens 46, thence through a paralleling lens 46A, so as to cover substantially the entire effective extent of a scanning element 48, similar in construction to element 20. Light, after having passed element 48, is condensed by the lens 50 and focused to pass through a paralleling lens 50A, thence through an analyzer 52. Such light as had been rotated by the magnetic fields at element 48 will pass through the analyzer; all other light will be blotted out.

Light passing analyzer 52 is directed through some refractive substance, preferably in the form of a prism or cylinder 54, the material used, in a preferred arrangement, being glass or similar highly refractive substance which cooperates with magnetic fields to effect rotation of polarized light. Wound on the cylinder or prism is a coil 56, which is connected to the output receiver circuit 58 of a receiving tuner 60, energized and controlled by the converted wave from the antenna-ground circuit 62. This circuit and the receiving tuner are intended to convert the impulses from a transmitter such as that shown in Figure 1, and to amplify such electrical impulses so that the

resultant current may be passed through coil 56 to effect rotation of such polarized light as is passed through analyzer 52 in a degree varying with the intensity of the varying received signal.

Beyond cylinder 54 is positioned another prism 64, intended to operate as an analyzer for light rays passed by analyzer 52. Normally, therefore, prism 64 would act to blot out all light passed by the analyzer. However, such of the light which would be additionally rotated by the effect of the current in coil 56 would pass prism 64, and then be diverged by a lens 66 so that the image therefrom may be viewed directly by the eye of an observer, or be projected upon a screen 68.

In order to assure proper synchronization of movement of the charges through the circuits of the respective scanning elements 20 and 48, a transmitter 70 may be used in conjunction with transmitter 26. Transmitter 70, in such case, is modulated by the surge of the charges constituting the current flow through the coils or elements 20. This modulated wave is then radiated, or otherwise transmitted, to affect the receiving tuner 72 located in conjunction with the receiving tuner 60 at the receiving station. Tuner 72 in turn may control amplification apparatus whereby a current, exactly similar in its properties to that passing through scanning element 20 and of sufficient strength to affect polarized light, will be passed through scanning element 48. In other words, the passage of light at similarly located coils of the two elements 20 and 48 will be positively synchronized without any mechanical requirement of "pulling" into phase, the light impulses passed from the polarizers and by the first analyzers in each case being exactly synchronized and identically arranged in the screen pattern of the scanning elements.

At the receiving apparatus, the scanning element merely produces a number of similar impulses of polarized light for each energization of one of the coils. These impulses are similar in number to those which would have been produced by the scanning element 20 if the scene 10 were completely light. The control of prism 64 and its coil 56, however, results in blotting out, or passing by, or grading, these light impulses in accordance with electrical impulses from cell 24. Since the two elements 20 and 48 are exactly synchronized, the impulses from cell 24 will vary the impulses from element 48 so that the appearance on screen 68 will be graded in light and dark, substantially as was scene 10 from which the original impulses came.

The production of light and dark points will, in the transmitting apparatus, be controlled by the object or scene itself; in the receiving apparatus, by receiving tuner 60, its output circuit 58, coil 55 and prism 64. Since the light and dark effects produced by prism 64 and its coil are controlled by its associated circuit which, in turn, is under the direct control of the varying current produced by the light and dark points of the object or scene, the light and dark points on screen 68 will correspond exactly to those of the object; since the shutter effect of the scanning elements will be exactly in tune, the image on screen 68, due to the persistence of vision, will correspond exactly to that of the object or scene 10.

Each of the scanning elements is preferably of exactly the same construction, the coils 32 of each being arranged in similar concentric circles, the coils and each of the respective circuits being of such characteristics that electric charges passed through each will have the same time period of movement for a complete cycle. The coils may be connected in any particular sequence; in one embodiment, a current impulse, originating at one circle, will first pass through the coils in that circle before proceeding to the coils in the next concentric circle. However, this arrangement is not an absolute requisite as the current may pass from any one coil to any other coil in a preferred order. It is, however, desired that a substantially uniform effect of lines or circles be produced so that the resultant persistence of vision upon which all such arrangements are based will be of the least damaging effect to the vision of the person observing the phenomenon.

The coils 32 themselves may be built up in any particular manner. In this case, four constructions have been illustrated, the one in Fig. 4 being merely that of a solenoid with an air core. Each coil is mounted upon a plate 74 of a highly refractive substance, and is disposed so that the light rays from the lens 18 or the lens 66, as the case may be, will be parallel to the axis of the coil.

In Fig. 5, the coil is shown to have been wound within a metallic cylinder 76, preferably of some magnetic metal such as iron, it having been found that the rotational effect upon the light is greatly enhanced by the introduction of such magnetic metal. In Fig. 6, the coil is wound upon a cylinder 78 which is preferably a magnetic metal. This construction operates to effect even greater rotation of the light because of the extreme concentration of the magnetic field resulting from the association of the coil and cylinder 78.

The construction of Fig. 7 is a preferred one. In this case, a portion of refractive material 80 is formed with a skin 82 of metal, such as iron, and upon the skin is wound coil 84 through which the scanning current passes. In this case, the combination of the highly magnetic field and the highly refractive material result in extreme rotations of light rays for relatively small currents passed through the coils.

Many other changes could be effected in the particular apparatus designed, and in the methods of operation set forth, and in the specific details thereof, without substantially departing from the invention hereof which is intended to be defined in the accompanying claims, the specific description hereinabove relating merely to some operative embodiments for carrying out the spirit of the invention.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent is—

1. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, and a plurality of individually and periodically active magnetic field producing means for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of a distinct portion of the source or scene.

2. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, analyzer means cooperating with the polarizing means, and a plurality of individually and periodically active magnetic field

producing means to change the phase relationship of the light rays between the polarizing and analyzing means for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of and the same relative position as a distinct portion of the source or scene.

3. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, a plurality of coils to produce magnetic fields, and means for energizing the coils in a predetermined consecutive relation for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of a distinct portion of the source or scene.

4. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, a plurality of coils to produce magnetic fields, and means for energizing the coils periodically in a predetermined consecutive relation for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of a distinct portion of the source or scene.

5. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, analyzer means cooperating with the polarizing means, a plurality of magnetic field producing means to change the phase relationship of the light rays between the polarizing and analyzing means, and means for energizing the coils periodically in a predetermined consecutive relation for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of and the same relative position as a distinct portion of the source or scene.

6. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, a plurality of series connected coils to produce magnetic fields, and means for energizing the coils so that they are magnetically active individually, periodically and in a predetermined consecutive relation for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of a distinct portion of the source or scene.

7. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, and a plurality of magnetic field producing means for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of a distinct portion of the source or scene.

8. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, and a plurality of individually and periodically active magnetic field producing means for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of a distinct portion of the source or scene.

9. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, analyzer means cooperating with the polarizing means, and a plurality of individually and periodically active magnetic field producing means to change the phase relationship of the light rays between the polarizing and analyzing means for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of a distinct portion of the source or scene.

10. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, and a plurality of series connected coils to produce magnetic fields for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of a distinct portion of the source or scene.

11. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, a plurality of coils to produce magnetic fields, and means for energizing the coils periodically in a predetermined consecutive relation for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of a distinct portion of the source or scene.

12. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, analyzer means cooperating with the polarizing means, a plurality of coils to produce magnetic fields to change the phase relationship of the light rays between the polarizing and analyzing means, and means for energizing the coils periodically in a predetermined consecutive relation for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of and the same relative position as a distinct portion of the source or scene.

13. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, a plurality of series connected coils to produce magnetic fields, and means for energizing the coils so that they are magnetically active periodically in a predetermined consecutive relation for breaking up the polarized light rays into a plurality of consecutively visible light sensations, each of which has the intensity of a distinct portion of the source or scene.

14. Scanning apparatus for the purpose of reproducing an image of a scene at points removed from the locality of the scene, which includes: means for polarizing light rays emanating from a source or scene, a plurality of series connected coils to produce magnetic fields, and means for energizing the coils so that they are magnetically active individually, periodically and in a predetermined consecutive relation for breaking up the polarized light rays into a plurality of

consecutively visible light sensations, each of which has the intensity of a distinct portion of the source or scene.

15. The method of television which consists at the transmitting station in breaking up the light, emitted from a scene to be transmitted, into a plurality of contemporaneously existent beams normally inoperative for purposes of transmission to the receiving station, causing an electric impulse to act on said beams successively and thereby render them singly and successively operative for transmission, whereby a single electric impulse will cause a scanning of the entire scenic effect, the speed of scanning being dependent on the speed of transmission of an electric impulse through the path provided for it, and transmitting said impulse to the receiving station; and which consists at the receiving station in breaking up the image-forming light rays into a plurality of contemporaneously existent beams similar in number and position to the beams at the transmitting end, and normally inoperative, and subjecting said beams successively and in the same sequence to the electric impulse received from the transmitting station, whereby said beams are rendered successively effective for a point by point image construction.

16. The method of television which consists at the transmitting station in breaking up the light, emitted from a scene to be transmitted, into a plurality of contemporaneously existent beams normally inoperative for purposes of transmission to the receiving station, causing an electric impulse to act on said beams successively and thereby render them singly and successively operative for transmission, whereby a single electric impulse will cause a scanning of the entire scenic effect, the speed of scanning being dependent on the speed of transmission of an electric impulse through the path provided for it and transmitting said impulse to the receiving station; and which consists at the receiving station in breaking up the image-forming light rays into a plurality of contemporaneously existent beams similar in number and position to the beams at the transmitting end, and normally inoperative, and subjecting said beams successively and in the same sequence to the electric impulse received from the transmitting station, whereby said beams are rendered successively effective for a point by point image construction and means for transmitting the operative beams from the transmitting station into electric energy for controlling the intensity of the corresponding beams at the receiving station.

17. In a television system in which the light emitted by a scenic effect to be transmitted is plane polarized, broken up into a plurality of light beams and subjected to an analyzer adjusted to intercept said polarized beams, a plurality of means, one of which is associated with each beam and adapted, when operative, to affect it so as to counteract the intercepting action of said analyzer, said means being electrically associated in such a manner that on passing an electric impulse therethrough they will become successively operative in a predetermined sequence, to counteract the intercepting effect of the analyzer on the successive beams, and thereby scan the scenic effect for purposes of transmission, and whereby said scanning of the entire scenic effect takes place in the time required for the passage of a single electric impulse through the system of electrically associated means.

18. In a television system in which the light emitted by a scenic effect to be transmitted is plane polarized, broken up into a plurality of light beams and subjected to an analyzer adjusted to intercept said polarized beams, a plurality of means, one of which is associated with each beam and adapted, when operative, to effect it so as to counteract the intercepting action of said analyzer, said means being electrically associated in such a manner that on passing an electric impulse therethrough they will become successively operative in a predetermined sequence, to counteract the intercepting effect of the analyzer on the successive beams, and thereby scan the scenic effect for purposes of transmission, and whereby said scanning of the entire scenic effect takes place in the time required for the passage of a single electric impulse through the system of electrically associated means, and electric impulse retarding means interposed between each pair of said first-mentioned means, whereby said electric impulse will render only one of said first-mentioned means operative at a time.

19. In a television system, means for plane polarizing the field of light rays proceeding from the object; magneto-optic scanning means adapted to receive and transmit the said field of polarized rays and to break it up into small portions, and to transmit said portions in succession, one at a time, until the entire field is covered, said scanning means comprising a plurality of electromagnet coils each positioned with its magnetic axis substantially coinciding with the direction of the polarized light flux, and each having positioned relatively to each coil and in the path of said polarized rays and so that it will be affected by the magnetic field of the coil, a light transmitting substance that will be rendered birefringent by the action of the magnetic field thereon, and thereby change the plane of said plane polarized rays, and analyzing means positioned in the path of the rays transmitted through said light transmitting substance and adapted to transmit only those rays that have been affected by the said magnetic fields of said coils, said coils being connected in a series, and means to pass successive electric impulses through said coils, so timed that any given impulse will have completely passed through all the coils before the succeeding impulse enters the first coil; a light sensitive means adapted to receive said scanned rays and to translate them into electric impulses varying in magnitude according to the intensity of the light received thereby, and means for transmitting said varying electric impulses to a receiving station.

20. In a television system, means for producing a field of light rays, means for plane polarizing said field of light rays; magneto-optic scanning means for breaking up said field of light rays into small portions and to transmit said portions in succession, one at a time, until the entire field is covered, said scanning means comprising a plurality of electromagnet coils each positioned with its magnetic axis substantially coinciding with the direction of the polarized light flux, and each having positioned relatively to each coil and in the path of said polarized rays and so that it will be affected by the magnetic field of the coil, a light transmitting substance that will be rendered birefringent by the action of the magnetic field thereon, and thereby change the plane of said plane polarized rays, and analyzing means positioned in the path of the rays transmitted through said light-transmitting substance and adapted to transmit only those rays that have

been affected by the said magnetic fields of said coils, said coils being connected in series, and means to pass successive electric impulses through said coils, so timed that any given impulse will have completely passed through all the coils before the succeeding impulse enters the first coil, and means for controlling the intensity of each transmitted small portion of said field of light rays in accordance with one of the aforesaid electrical impulses, the action of each of said impulses being timed to correspond with the transmission of one of said transmitted small portions of the field of light rays, and means for focussing each of said transmitted portions on a screen.

21. A method of transmitting electrical impulses created by varying light effects of an object, into an image having characteristics of the object from which the light rays producing the effects originated, which comprises: producing a flow of light, plane polarizing said light, twisting the plane of polarization of fractional portions of said flow of light periodically at each point by the magneto-optical action of a periodically varying magnetic field, and timing said twisting of each fractional portion consecutively for the various points of the field, thereafter transmitting only those rays that have had their plane of polarization twisted, and magnetically varying the intensity thereof in accordance with the pulsations of the said electrical impulses created by the aforesaid varying light effects of the object.

CHARLES A. BIRCH-FIELD.