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TELEVISION RECEIVING SYSTEM

Original Filed Jan. 7, 1927

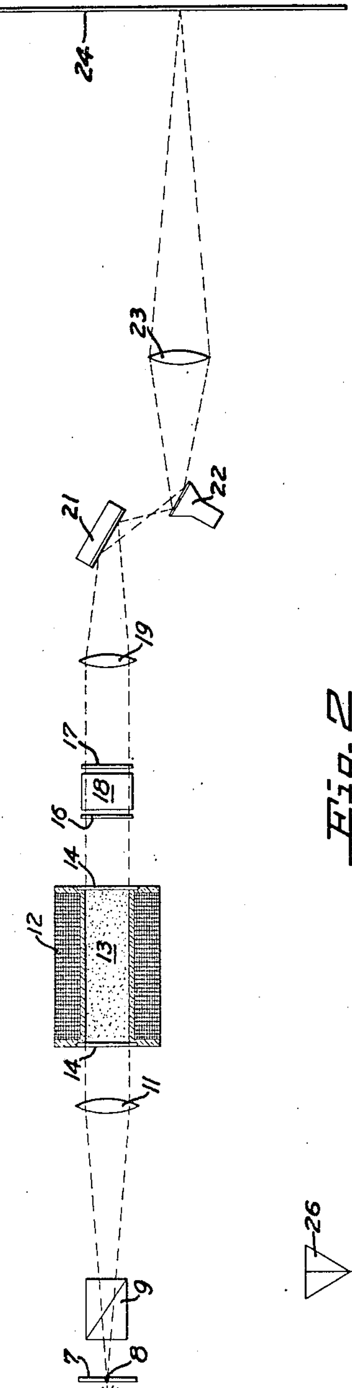

Fig. 1

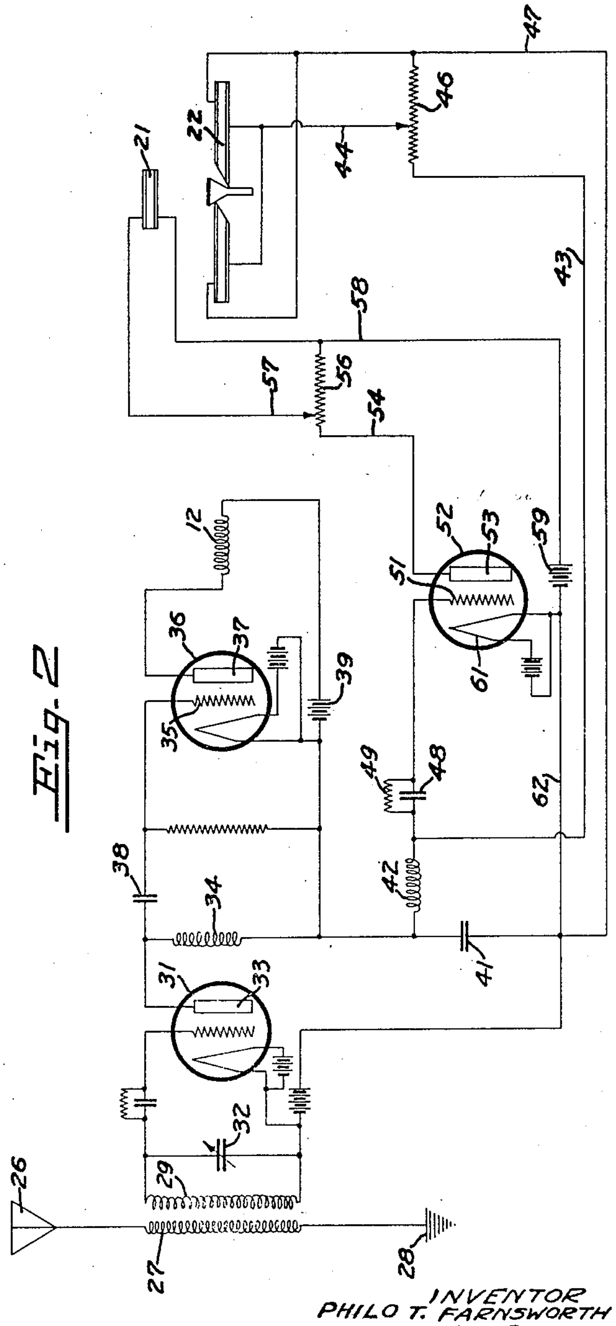

Fig. 2

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UNITED STATES PATENT OFFICE

PHILO T. FARNSWORTH, OF BERKELEY, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO TELEVISION LABORATORIES, INC., OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA

TELEVISION RECEIVING SYSTEM

Original application filed January 7, 1927, Serial No. 159,540. Divided and this application filed November 7, 1927. Serial No. 231,691.

My invention relates to television, and particularly to the reception of pictures or views transmitted by radio. The receiving system comprising my invention is especially adapted for receiving pictures transmitted as described in my co-pending application, Serial No. 159,540, filed January 7, 1927, of which this is a division.

An object of my invention is to provide a receiving apparatus of general usefulness in television systems.

Another object of my invention is to provide an apparatus for receiving radio television waves of the type generated by the apparatus described in my co-pending application above mentioned.

A further object is to provide a system for scanning a field in two dimensions, operative by a single wave.

My invention possesses other objects and valuable features, some of which will be set forth in the following description of my invention which is illustrated in the drawings forming part of the specification. It is to be understood that I do not limit myself to the showing made by the said description and drawings, as I may adopt varying forms of my invention within the scope of the claims.

Referring to the drawings:

Fig. 1 is a diagrammatic view of the optical system and light valve.

Fig. 2 is a circuit diagram of the receiving apparatus.

In terms of broad inclusion my invention comprises circuits for receiving and detecting the radio wave upon which two components are modulated. One of these components is utilized to modulate a light beam. The other component, itself a modulated wave, is operative to cause the light beam to scan a field of view in one direction. A second detector circuit simultaneously detects this latter wave, separating out the modulating component, which is used to scan the field in another direction.

In terms of greater detail the apparatus of my invention is constructed and operates as follows: Preferably there is employed a source of light of constant intensity, such as an arc light 6 and to obtain a pencil of light therefrom, there is placed a shutter 7 with a small aperture 8 in front of the arc light. The light from said shutter is then passed through a polarizer 9. The polarizer is indicated as preferably in the form of a Nicol prism. The polarized light from the Nicol prism 9 is then passed through a lens 11 which parallels the polarized light and the parallelled light is then passed through a device for rotating the plane of the polarized light. This device may be any device suitable for rotating the plane of the polarized light in accordance with the fluctuations of the light current received at the receiver. The method of receiving and separating this light current from the transmitted wave will be hereinafter pointed out. The preferred form of such device is illustrated as comprising a means for producing a magnetic field fluctuating in accordance with the light current, such as the coil 12, surrounding an electrically optically active medium 13, such for example as a thin film of iron, cobalt, or nickel, or carbon disulfide, glass, or any other material in which a beam of polarized light rotates considerably when subjected to a magnetic field. I prefer to employ carbon disulfide and said carbon disulfide is held in the core of the coil 12 by glass plates 14.

The light from the light rotator is then passed through a device adapted for restricting the passage of light in accordance with its degree of rotation. I preferably employ a combination of a pair of gratings 16 and 17 and a bi-axial crystal 18. The gratings 16 and 17 may be any usual form of light gratings, for example, ruled upon a silvered transparent surface, and are placed at opposite ends or sides of the bi-axial crystal with their gratings opposed. The bi-axial crystal employed between the gratings is adapted to produce a conical refraction of the light. As an example of a suitable crystal of this kind, I have employed a crystal of arragonite one centimeter thick between the gratings ruled with 100 lines per millimeter. With this combination, the rotation between complete extinction and complete restoration is of the order of two degrees. Thus with this analyzer, very small currents may be employed upon the rotator, permitting the use of a coil of very high natural period.

In explanation of the action of the bi-axial crystal 18, it is understood that the light is directed on said crystal along one of its optic axes. When this is done, the light is refracted to an extent depending on the position of the plane of polarization. When unpolarized light from an aperture is directed on such a crystal along one of its axes, said light will appear as a circle from the other side of the crystal, but when a beam of polarized light is directed along one of the axes of the crystal, it appears as a point of light lying in the circle produced by the unpolarized light, but its position is dependent on the position of the plane of polarization of the beam of light. A 90 degree rotation of the plane of polarization of the beam of light will rotate the light from the crystal from one side of the circle to the opposite side. During the passage of the light through the bi-axial crystal, the wave front of the beam of light remains parallel and the wave front of the beam passes through perpendicularly to the optic axis of the crystal.

The beam of polarized light passes from the rotator to the grating, where a portion is intercepted or occluded, and then passes into the bi-axial crystal 18. The light is refracted in the crystal in a direction depending upon the plane of polarization, this being so adjusted that the plane in which it is refracted is approximately parallel to the lines of the gratings. The shadow of the grating 16 therefore falls upon grating 17, and if the shadow of the bars of grating 16 fall upon the interstices of grating 17, the beam will be wholly occluded. If, however, the plane of polarization be rotated slightly the plane of refraction in crystal 18 will change and the shadow will move, and when the movement is such that the shadow falls upon the bars of grating 17 a maximum of light is transmitted.

By means therefore, of the polarizer 9, light rotator, and analyzer comprising the gratings 16 and 17 and the bi-axial crystal 18, the constant supply of light through arc light 6 is caused to produce a light of varying intensity, varying in accordance with the intensity of the light current supplied to the coil 12. Thereby, without the employment of any mechanical moving apparatus, the light current is reconverted into light.

Such light is then passed through a lens 19 by which it is focused upon a pair of co-operating oscillographs 21 and 22. Said co-operating oscillographs 21 and 22 are positioned at right angles one to the other and so that the light from one strikes the other oscillograph. Said oscillographs are operated at different frequencies with the result that the light is by said oscillographs projected in horizontal vibrations, which are successively lowered or raised vertically so that the light can pass through a lens 23 upon a screen 24 and covers successively an entire rectangular area of said screen. The oscillographs 21 and 22 are operated by electrical currents of the frequencies of the two analyzer currents used in scanning at the transmitter, as described in my copending application above mentioned, so that the passage of the beam of light over the screen 24 is in synchronism with the bending of the electrical discharge from the sensitive plate of the photo-electric cell and thereby each portion of light is properly co-ordinated to produce a correct image of the object being transmitted.

Referring to Figure 2, the electrical apparatus for receiving the transmitted wave in the transmitter and correctly applying the light current and analyzing currents to the light rotator and oscillographs is as follows: 26 indicates a receiving antenna or other means for collecting wireless waves, which antenna is connected through an inductance 27 to a ground indicated at 28. Inductance 27 forms a primary of a transformer in which the secondary 29 is in the grid circuit of a detector 31. 32 indicates a tuning condenser for bringing the receiver in resonance with the carrier wave of the transmitter. The plate 33 is indicated as connected to a plurality of filters, the first of which comprises the inductance 34, the voltage across which is supplied to the grid of a second detector 36. The first filter comprising the inductance should be receptive of the first carrier wave developed in the transmitter. There is thus imposed upon the grid of a detector tube 36 a potential developed by the light current modulated upon the first carrier wave formed in the transmitter. In the detector 36, such carrier wave is detected to produce a current output from the plate 37, which is equivalent to the light current developed in the transmitter. In the second detector circuit 36, reference character 38 indicates a condenser for passing the high frequency and blocking the low frequency currents, and 39 indicates a battery for supplying the plate potential. The plate 37 is indicated as connected with the coil 12 of the light rotator.

The complete output circuit of the detector tube 31 also includes a condenser 41 of a capacity suitable for by-passing the high frequency of the first carrier wave which is detected by the tube 36 and of a capacity to block the frequency of the analyzing currents. Such analyzing currents are therefrom passed through a choke 42 and line 43 to one of the oscillographs 22, said oscillograph being connected by a line 44 with a resistance 46 shunted across line 43, and line 47 which line connects with the opposite side of the condenser 41. By this connection, the oscillograph 22 is operated by the higher analyzing frequency, e. g., a 500 cycles per second frequency. Said frequency also passes through the grid condenser 48 and leak 49 to a grid 51 of a detector tube 52 wherein said frequency is detected to deliver from its plate 53 a potential of the frequency of the first analyzing current, say 10 cycles per second. The plate 53 is indicated as connected by the line 54 to the resistance 56 which is connected by a tap 57 to the oscillograph 21 and the oscillograph is indicated as connected by line 58 through the battery 59 to the filament 61 of the detector 52. The filament 61 is also connected by the lead 62 with the condenser 41. The resistances 46 and 56 provide a means for controlling the potential of the currents applied to the oscillographs.

It will be readily apparent from the description of the apparatus and operation thereof, how the detected light current imposed upon the coil 12 modulates the light in accordance with the intensity of light at the particular point from which said light current originated from the light sensitive plate of the transmitter described in my co-pending application, Serial No. 159,540. It will also be seen that said light is projected upon the screen 24 by the oscillations of the oscillographs 21 and 22 to form a correct image of the object transmitted, the light being caused to travel back and forth across the screen similar to the action of the shutter of the transmitter, making in the example given 500 reciprocations across the screen in covering the complete area thereof, and said reciprocations are made within a period of 1/20th of a second. It is understood, however, that the process and apparatus of the present invention is not necessarily limited to the use of the particular frequiencies given for the purpose of facilitating the description of a preferred process and apparatus.

The process and apparatus of the present invention permit the selection of such small elementary areas of the image to be transmitted that the produced image on the screen 24 follows all of the light shades of the object, producing a correct image thereof. This is accomplished without the employment of mechanically moving parts, excepting the vibrating strips of the oscillographs. The apparatus is thus free from mechanical problems.

While the process and apparatus for producing television herein described is well adapted for carrying out the objects of the present invention, it is understood that various modifications and changes may be made without departing from the invention, and the invention includes all such modifications and changes as come within the scope of the following appended claims.

I claim:

1. In television reception, the method of scanning which comprises traversing the field of view in one direction with a modulated wave, detecting said wave, and traversing the field in another direction with the detected component of the wave.

2. In television reception, the method of scanning which comprises traversing the field of view in one dimension with a modulated wave, detecting said wave, and traversing the field in the other dimension with the detected component of the wave.

3. In a television receiver a detector, input and output circuits for said detector, a scanning device operatively connected to said input circuit, and a second scanning device operatively connected to said output circuit.

4. In a television receiver an audion, input and output circuits for said audion, a scanning device operatively connected to said input circuit, and a second scanning device operatively connected to said output circuit.

5. In a television receiver, a detector, input and output circuits for said detector, an oscillograph element operatively connected to said input circuit, and means in said output circuit cooperating with said oscillograph element to produce a picture.

6. In a television receiver, a detector, input and output circuits for said detector, and oscillograph elements operatively connected to said circuits.

7. In a television receiver, a circuit carrying a complex wave, a detector actuated by one component of said wave, a light valve in the output circuit of said detector, a scanning device operable by a second component of said wave, a second detector, actuated by said second component, and a second scanning device in the output circuit of said second detector.

8. In a television receiver, a circuit carrying a current comprising two components, one of said components being a modulated wave, means operable by one of said components to produce a modulated beam of light, and scanning means operable in one direction by said wave, and in another direction by the modulation thereof.

9. In a radio television receiver, a detector having an output circuit, a circuit deriving from said output circuit, operative means in said derived circuit for producing a modulated light beam, a second circuit deriving from said output circuit, and operative means in said second derived circuit for causing said beam to scan a field.

10. In a radio television receiver, a detector having an output circuit, a circuit deriving from said output circuit, a second detector in said derived circuit, and an output circuit for said second detector comprising means for producing a modulated beam of light.

11. In a radio television receiver, a detector having an output circuit, a circuit deriving from said output circuit, a second detec-

tor in said derived circuit, and an output circuit for said second detector comprising means for modulating a beam of light from a constant source.

12. A device comprising a polarizer, a light rotator receiving polarized light therefrom, means for refracting the light in accordance with its degree of rotation, and means for coordinating successive portions of light to form a picture.

13. A device comprising a polarizer, a light rotator receiving polarized light therefrom, means for refracting the light in accordance with its degree of rotation, a plurality of gratings for diverting light in accordance with its degree of rotation, and means for coordinating successive portions of light to form a picture.

14. In a television receiver, a detector, input and output circuits for said detector, a scanning device directly connected to said input circuit, and means in said output circuit cooperating with said scanning means to form a picture.

In testimony whereof, I have hereunto set my hand.

PHILO T. FARNSWORTH.