

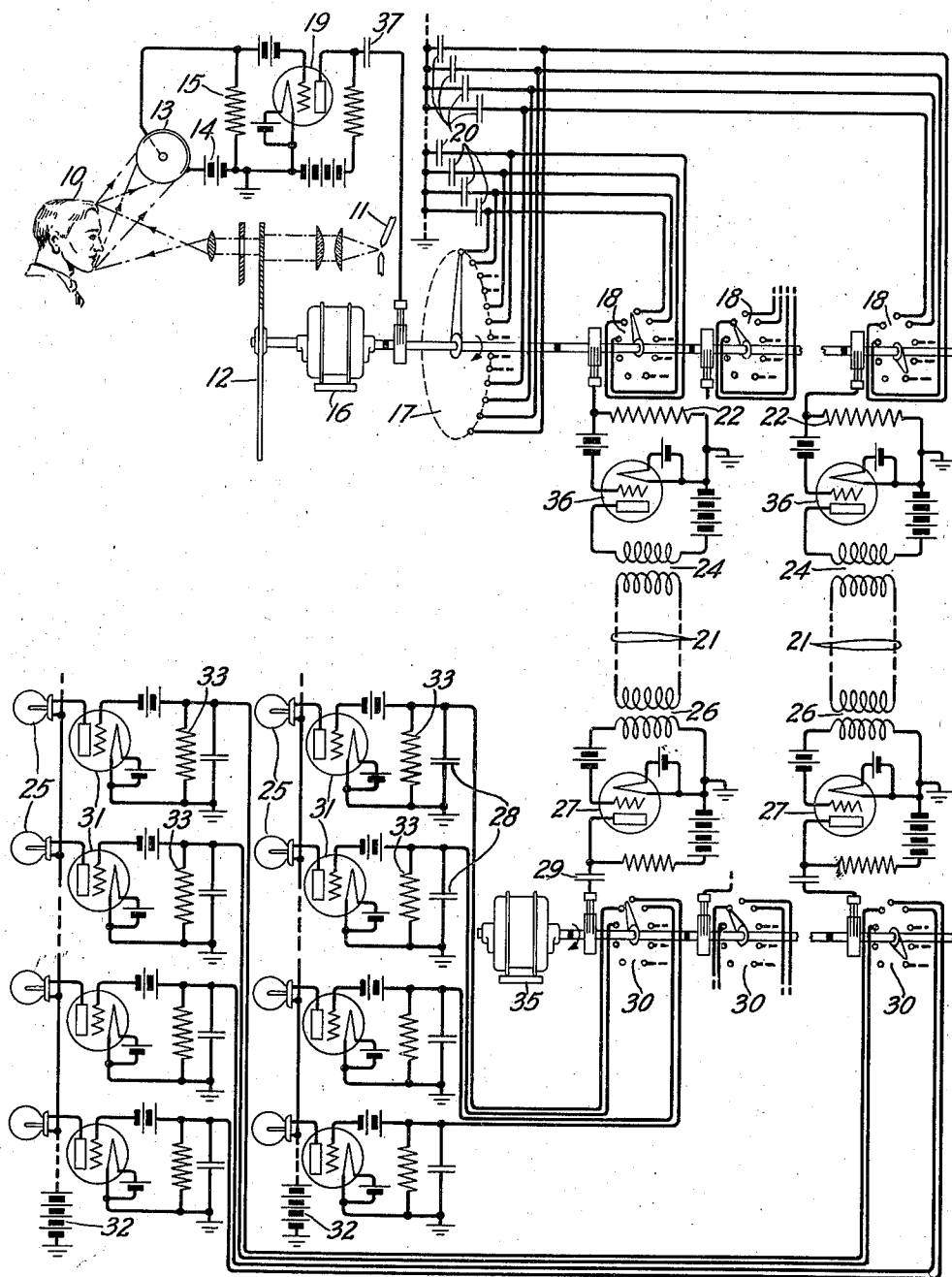
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SIGNALING SYSTEM AND METHOD

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SIGNALING SYSTEM AND METHOD

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This invention relates to signaling systems and methods and particularly to systems and methods for producing images electro-optically.

The principal object of the invention is to utilize in a novel manner a plurality of transmission lines, such for example as telephone lines, to transmit currents for the production of a television image.

It has been proposed heretofore to scan simultaneously different portions of a picture or object for producing separate currents corresponding to the scannings and to transmit these currents over separate channels. See, for example, Patent No. 1,796,931, of H. E. Ives, granted March 17, 1931.

The type of scanning employed in the preferred embodiment of the present invention is that disclosed in a copending application of F. Gray, Serial No. 181,538, filed April 6, 1927. This copending application discloses a scanning arrangement in which a rotating apertured disc is employed to cause an intensely bright spot of light to sweep across the elemental areas of an object periodically in succession. The light reflected from the object impinges on the photo-sensitive surface of one or more photoelectric cells for producing an image current.

In accordance with the invention, in its preferred form, energy derived from the image current produced by scanning elemental areas in succession, preferably by the method mentioned just above, is utilized to control a plurality of transmission lines simultaneously for separately transmitting energy corresponding to groups of the elemental areas, respectively. In a somewhat different and specific aspect of the invention as applied to a television system, a varying electromotive force proportional to an image current is impressed on a plurality of electric storing elements or condensers, one at a time, at a predetermined rate and the potentials of the charges stored in these elements are impressed on a transmission channel or channels at a rate different than said predetermined rate. The electric storing elements may be divided into a number of groups and currents corresponding to the potentials of the charges stored in different groups may be transmitted over different transmission channels, respectively. Thus a multi-channel system may be provided in which the frequency range which it is required to transmit over each channel is equal to the frequency range of the image current produced as a result of scanning divided by the number of transmission channels employed. These received image cur-

rent impulses are impressed on an apparatus for producing an image. While the image may be produced by causing instantaneous flashes of light to be emitted from the elemental areas thereof, it is sometimes preferable to sustain the emission of light from each elemental area so that several or all of the elemental areas emit light at the same time. This is preferably accomplished by employing, for each elemental area of the image, a light emitting element which is actuated by the space current of an electric discharge device and impressing the received image current potential corresponding to each elemental area on a storage element connected to the control electrode of the electric discharge device for varying its biasing potential, and therefore, the space current. This is in accordance with features of Patent No. 2,058,882, H. E. Ives and R. C. Mathes, granted Oct. 27, 1936, and Patent No. 2,058,898, of R. C. Mathes.

The accompanying drawing, a description of which follows, shows diagrammatically a television system embodying features of the invention.

Referring to the drawing, the elemental areas of the field of view comprising the subject 10 are illuminated in succession along a plurality of parallel lines by light from the source 11 passing through the spirally arranged apertures in the revolving disc 12. Light reflected from the successively illuminated elemental areas of the subject 10 reaches the light sensitive surface of a photo-electric cell 13 and causes the current from the source 14 flowing through the cell and the resistance 15 to vary in amplitude in accordance with the intensity variations of the reflected light. The motor 16 which drives the scanning disc 12 also drives the distributor 17, which has a plurality of contacts, one for each elemental area of the field of view being scanned, and the distributors 18 each of which has contacts corresponding to a group of the elemental areas. The rotatable brushes of the distributors 17 and 18 and the disc 12 are mechanically coupled to the motor 16 and are driven at the same angular velocity.

As the field of view is scanned the varying voltage drop across the resistance 15, corresponding to the tone values of the successive elemental areas of the field of view, is amplified by the electric discharge amplifier 19. A plurality of condensers 20, one corresponding to each elemental area of the field of view are provided for storing charges corresponding to the varying image current, that is, each condenser as it is

connected to the anode circuit of the electric discharge device 19 through the distributor 17 and a blocking condenser 37, is charged to a potential corresponding to the potential existing between the anode and cathode of the electric discharge device 19 at the time that the elemental area to which this condenser corresponds is being scanned. These condensers are divided into groups and the potentials to which the condensers of each group are charged are impressed, through one of the distributors 18, upon a circuit associated with one of the transmission channels 21 for causing image current to be transmitted thereover. For example, if the scanning disc is provided with 50 apertures for scanning the field of view in 50 parallel lines each of 50 elemental areas, 50 groups of 50 condensers each may be provided for storing charges corresponding to the tone values of the elemental areas of the field of view and 50 distributors may be provided for impressing the potentials to which these condensers are charged upon circuits associated with 50 channels for transmitting the currents which control the production of the image at the receiving station. The brush of each distributor 18 lags the brush of distributor 17 sufficiently so that it completes a circuit to the first charged condenser of the group with which it is associated soon after this condenser has been charged through the circuit including the brush of distributor 17. The potentials to which the condensers of each group are charged are impressed across one of the impedance elements 22 which is preferably largely resistive. This resistance should preferably be high enough so that it does not appreciably discharge the condensers 20 during the time it is associated with any one of them. These potentials are impressed between the control electrode and cathode of one of the electric discharge amplifiers 36 to which one of the impedance elements 22 is connected. The anode circuit of each of these electric discharge devices is connected to one of the transmission channels 21 through a transformer 24. As a result a current which varies in amplitude in accordance with the potentials of the successive charges impressed on the condensers 20 of each group of condensers is transmitted over the transmission channel 21 associated with this group.

At the receiving station there is provided an image producing device consisting of a bank of light emitting elements such as the lamps 25. These elements are preferably arranged in groups corresponding to the groups of elemental areas of the field of view and the groups of condensers at the transmitting station. The image current transmitted over each of the transmission channels 21 is impressed on the primary winding of one of the transformers 26, the secondary winding of which is connected to the input circuit of one of the electric discharge amplifiers 27. The varying potential across the anode and cathode of each electric discharge amplifier 27 is impressed across the condensers 28 of one of the groups of condensers through a blocking condenser 29 and one of the distributors 30. The distributors 30 are similar to the distributors 18 and are driven in synchronism therewith by the motor 35. A suitable system such as that disclosed in Patent No. 1,763,909, to H. M. Stoller and E. R. Morton, may be provided for maintaining the motors 16 and 35 in synchronism. The potentials to which the condensers 28 are charged are impressed on the control electrodes of the electric discharge devices 31 for controlling the

anode current of these devices which flows from the source of current 32 to the light emitting elements 25.

The charging circuits for the condensers 20 should have such a time constant that the condensers may be charged to the potential impressed thereon in the time required for scanning a single elemental area of the field of view. The charging circuits for the condensers 28 should be such that these condensers can be charged to the potential impressed thereon in the time required for scanning a single elemental area multiplied by the number of transmission channels employed for transmitting the image currents. The value of each resistance 33 shunted across each condenser 28 is preferably sufficiently high so that charges are maintained on the condensers 28 without appreciable diminution for at least a considerable portion of the time required for a complete scanning of the field of view, this time being preferably $\frac{1}{16}$ of a second or less so that the eye may be given the impression of seeing an object in motion.

In the system just described there is produced, as a result of scanning a field of view, a single electric current whose amplitude varies in accordance with the tone values of the elemental areas of the field of view and energy derived from this current is utilized to control a plurality of transmission channels simultaneously for separately transmitting energy corresponding to groups of the elemental areas over these transmission channels, respectively. The frequency range required to be transmitted over each of these channels is equal to the entire frequency range required for image production divided by the number of transmission channels employed. At the receiving station in this system, the actuation of each element of the image producing apparatus is sustained over a period during which the actuation of other elements takes place. If desired, of course, the actuation of the elements may be instantaneous. Instead of simultaneously actuating one element from each of the groups of elements of the image producing device in accordance with the image current impulses transmitted simultaneously over the plurality of transmission channels 21, it is obvious that the received image current impulses may be stored in a plurality of elements and then distributed to the image producing elements one at a time. It is possible, of course, to store energy corresponding to the image current impulses in mechanical or other devices instead of in condensers.

What is claimed is:

1. The method of television which comprises scanning a plurality of elemental areas of a field of view one at a time in succession to obtain a single electrical image current and utilizing energy derived from said current to control a plurality of transmission lines simultaneously.

2. An electro-optical image producing system comprising means for scanning a plurality of elemental areas of a field of view one at a time in succession, a circuit in which is set up an image current as the result of said scanning, and means for utilizing energy derived from said current to control a plurality of transmission lines simultaneously.

3. An electro-optical image producing system comprising means for producing a moving beam of light to successively illuminate, one at a time, a plurality of elemental areas of a field of view,

light sensitive means for receiving light from each elemental area as it is scanned, a circuit in which is set up an image current as the result of the light activation of said light sensitive means, and means for utilizing energy derived from said current to control a plurality of transmission lines simultaneously.

4. In an image producing system, a source of energy characteristic of the tone values of successively scanned elemental areas of a field of view, a plurality of condensers, means for impressing energy from said source on said condensers in succession at a predetermined rate, and means for utilizing the energy stored in said condensers for producing impulses of energy in succession at a rate different than said predetermined rate for controlling the production of an image of said field of view.

5. An electro-optical image producing system comprising means for producing an electromotive force which varies in accordance with the tone values of successively scanned elemental areas of a field of view, a plurality of condensers, means for impressing said electromotive force on said condensers in succession at the rate of scanning the successive elemental areas for charging them in accordance with the instantaneous values of said electromotive force, and means for utilizing the charges stored in said condensers for producing impulses of electromotive force in succession at a rate different than said predetermined rate for controlling the production of an image of said field of view.

6. The method of transmitting signaling current, the frequency components of which extend over a wide frequency range, over a plurality of transmission channels, each of which is adapted for transmitting current components extending over only a relatively narrow frequency range, which method comprises capacitively storing impulses of electromotive force corresponding to different instantaneous values of said signaling current in a plurality of condensers, respectively, one at a time at a predetermined rate, and transmitting the impulses stored in different groups of condensers over different transmission channels, respectively at a rate different than said predetermined rate.

7. The method of transmitting signaling current, the frequency components of which extend over a wide frequency range, over a plurality of transmission channels, each of which is adapted for transmitting current components extending over only a relatively narrow frequency range, which method comprises separately capacitively storing in different condensers, respectively, impulses of electromotive force corresponding to different instantaneous values of said signaling current in succession at a predetermined rate, transmitting separate groups of stored impulses over different transmission channels, respectively, the impulses of each group being transmitted at a rate different than said predetermined rate, storing the transmitted impulses, and producing signals by said stored impulses.

8. In an electro-optical image producing system, means for scanning the elemental areas of an object periodically in succession to produce an image current, a plurality of electrical storing elements, means for impressing an electromotive force corresponding to said image current on said storing elements in succession at a predetermined rate, a plurality of transmission channels, means for impressing the components of electromotive force stored in different groups of said elements

on different transmission channels, respectively, a plurality of electric storing elements for storing electromotive forces corresponding to said transmitted image current components, and an image producing device, the actuation of which is controlled in accordance with the potentials of the charges stored in said last-mentioned storing elements.

9. In an image producing system, scanning means for producing energy for controlling the production of an image, said scanning means comprising means for illuminating a single elemental area of a field of view at a time, an image producing device comprising a plurality of elements corresponding to the elemental areas of said field of view, and means for utilizing said energy for simultaneously initiating or changing the actuation of a plurality of the elements of said image producing device.

10. An electro-optical image producing system comprising means for illuminating the elemental areas of a field of view one at a time, means for producing an image current corresponding to the tone values of the successively illuminated elemental areas, a bank of light emitting elements corresponding to the elemental areas of said field of view, and means for utilizing energy derived from said image current for simultaneously initiating or changing the actuation of a plurality of said light emitting elements.

11. An electro-optical image producing system comprising means including an apertured rotatable element for scanning a field of view to produce an image current which varies in accordance with the tone values of the successively scanned elemental areas of the field of view, a plurality of transmission channels, a plurality of distributors whose rotatable brushes are mechanically coupled to said rotatable element, one of said distributors being employed to impress the image current potential upon a plurality of condensers in succession, and the remaining distributors being employed for impressing the potentials of the charges stored in groups of said condensers upon different transmission channels respectively, and means for utilizing the energy transmitted over said transmission channels for controlling the production of an image of said field of view.

12. An electro-optical image producing system comprising means including an apertured rotatable element for scanning a field of view to produce an image current which varies in accordance with the tone values of the successively scanned elemental areas of the field of view, a plurality of transmission channels, a plurality of distributors whose rotatable brushes are mechanically coupled to said rotatable element, one of said distributors being employed to impress the image current potential upon a plurality of condensers in succession, and the remaining distributors being employed for impressing the potentials of the charges stored in groups of said condensers onto different transmission channels, respectively, a second group of distributors operating in synchronism with the aforementioned distributors for impressing the image currents received over said transmission channels onto a plurality of groups of condensers, and means controlled in accordance with the charges stored in said last mentioned condensers for controlling production of an image of said field of view.

13. In an electro-optical image producing system, a bank of condenser elements, means for charging said condenser elements in accordance

with the tone values of different elemental areas, respectively, of a field of view, a transmission medium, and means for associating said condenser elements one at a time in succession with
 5 said transmission medium over a period of time different from the time required for charging said condenser elements in accordance with the tone values of said field of view.

14. In an electro-optical image producing system, a bank of electric capacity elements, means for charging said elements in accordance with the tone values of different elemental areas respectively of a field of view, a transmission medium, and means for associating said elements
 10 one at a time in succession with said transmission medium over a longer period than the period during which the electric capacity elements are being charged.

15. The method of electro-optical image production which comprises capacitively storing in an electric capacitive element at the transmitting station energy representative of the light tone value of an elemental area of an object, and intermittently associating said element with a
 20 transmission medium for a period longer than that during which said storing takes place.

16. In an electro-optical image producing apparatus, an electric capacitive element for storing at the transmitting station energy representative of the light tone values of an elemental area of an object, a transmission medium, and means for intermittently associating said element with said transmission medium for a period longer than that during which said storing takes place.

35 17. An electro-optical image producing system comprising means for repeatedly scanning a field of view to produce an image current which varies in accordance with the tone values of the suc-

cessively scanned elemental areas of a field of view, each complete scanning taking place within the period of persistence of vision, a plurality of condensers, means for impressing the potential of said image current upon said condensers in
 5 succession and repeatedly to charge each condenser in accordance with the tone value of an elemental area of the field of view, a plurality of transmission channels and means for successively impressing upon one transmission channel the
 10 potentials of the charges stored in the successive condensers of one group of said condensers and for impressing on another transmission channel the potentials of the charges stored in the successive condensers of another group of said con-
 15 densers.

18. An electro-optical image producing system comprising means for repeatedly scanning a field of view to produce an image current which varies in accordance with the tone values of the
 20 successively scanned elemental areas of a field of view, each complete scanning taking place within the period of persistence of vision, a plurality of condensers, a distributor for impressing the potential of said image current upon
 25 said condensers in succession and repeatedly to charge each condenser in accordance with the tone value of an elemental area of the field of view, a plurality of transmission channels, a second distributor for successively impressing
 30 upon one of said transmission channels the potentials of the charges stored in the successive condensers of one group of said condensers, and a third distributor for impressing upon another transmission channel the potentials of the charges
 35 stored in the successive condensers of another group of said condensers.

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