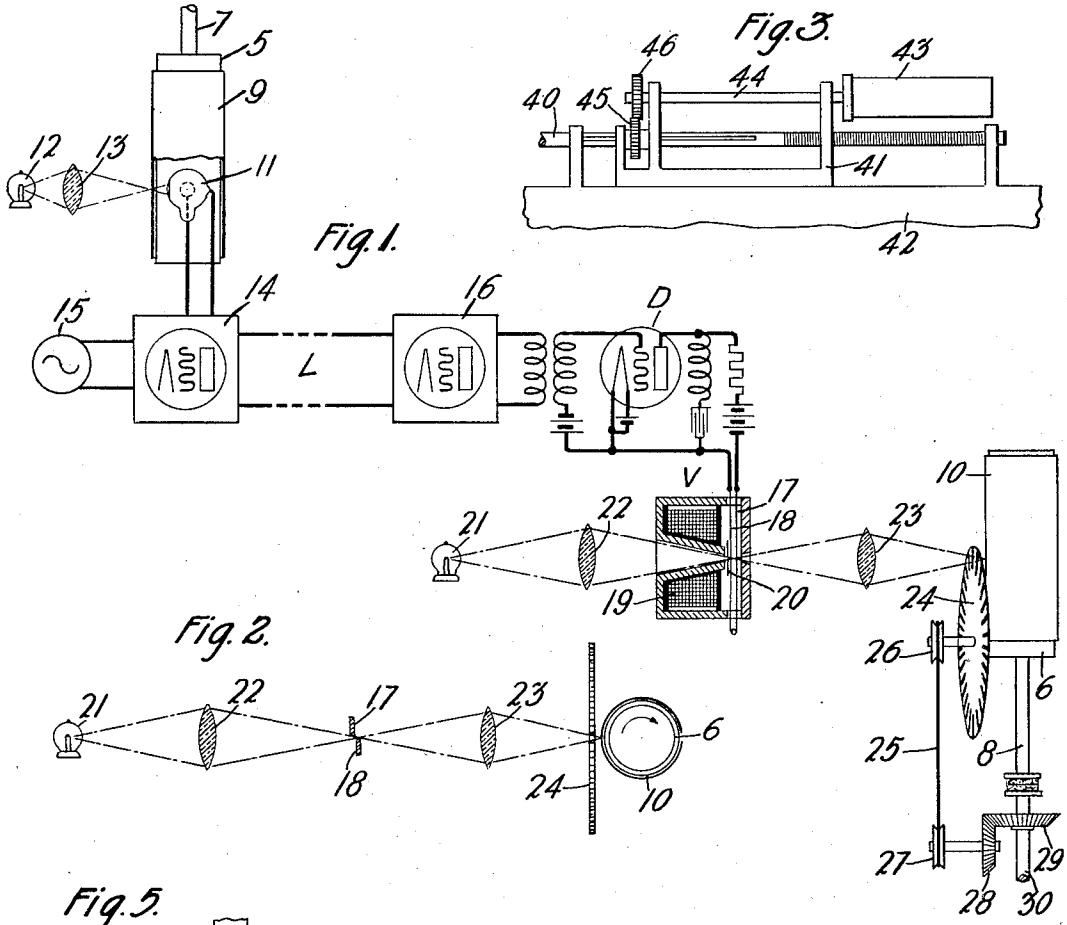
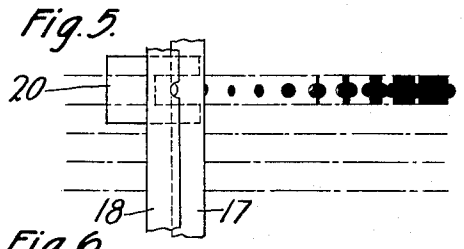
Sept. 11, 1928. 1,683,894

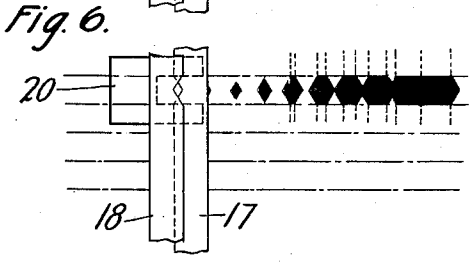
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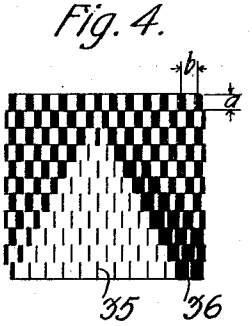
REPRODUCING PICTURES TRANSMITTED ELECTRICALLY

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Inventor:
Herbert E. Ives
by E. W. Adams Att'y.

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UNITED STATES PATENT OFFICE.

HERBERT E. IVES, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

REPRODUCING PICTURES TRANSMITTED ELECTRICALLY.

Application filed August 22, 1924. Serial No. 733,464.

This invention relates to the transmission of pictures by electricity and more particularly to the reproduction of such pictures in the form of dot images.

In the reproduction of a picture from an electric current which varies in accordance with the light characteristics of the original, the picture may be built up of line traces of varying density, of lines of uniform density and varying width, or of dots of various sizes. Pictures reproduced in the last mentioned manner are similar in appearance to the ordinary half tone pictures so well-known in the printing art. Such pictures have a more pleasing appearance than those consisting of parallel lines of equal spacing and so are somewhat preferable from the standpoint of appearance. The dot pictures also possess certain advantages when used to print directly upon copper or zinc plates by the photo-engraver in making typographic printing plates.

An arrangement for producing dot images is described in applicant's Patent No. 1,631,963, June 14, 1927, Serial No. 683,632, filed December 31, 1923. In the specific arrangement therein described, the dots appear in the form of squares of various sizes. In order therefore that each dot may be proportional to the density or tone value of the corresponding elemental area of the original picture, the picture current corresponding thereto must vary as the square root of the light intensity of the original elemental areas. To effect this relation a special adjustment of the transmission equipment is required.

An object of the present invention is the reproduction of pictures in the form of dot images with simplified apparatus.

Another object is to accomplish the reproduction in a form suitable for newspaper reproduction more nearly resembling present newspaper practice.

In one embodiment of the invention a direct current double string light valve is employed which is energized by the output current from a demodulator. The light valve is arranged with the strings horizontal so that the variable exposure is in the direction of motion of the record blank. The length of exposure in an axial direction is uniform. An image of the light valve opening is formed on the light sensitive record blank by a simple lens arrangement. Exposure in the form of dots is effected by a rotating sectored disc belt-driven direct from the drum driving motor, the speed of the disc being such that the dots formed during successive revolutions of the reproducing drum are staggered. Various shaped notches may be introduced in the aperture forming members of the valve so as to increase the contrast between the lightest and darkest portions of the picture and still retain a suitable printing structure.

The novel features which are considered characteristic of this invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation together with other objects and advantages thereof, will be further explained in the following description having reference to the accompanying drawing.

Fig. 1 of the drawing illustrates schematically a system for the transmission of pictures by electricity according to this invention.

Fig. 2 shows diagrammatically the optical arrangement of Fig. 1 as viewed from above partially in cross section.

Fig. 3 illustrates an arrangement for rotating the picture drums and simultaneously moving them axially.

Fig. 4 is an enlarged section of one form of a developed record.

Figs. 5 and 6 illustrate modified forms of records.

Identical reference characters are used in the several figures to indicate like elements.

Referring now to Fig. 1 two rotatable drums 5 and 6 are mounted on shafts 7 and 8 which are caused to rotate in any suitable manner. As the drums rotate they are caused to move axially with respect to the shafts. A transparency 9 of the picture to be transmitted is mounted on drum 5 in the form of a cylinder. Mounted upon the drum 6 is a light sensitive record blank 10, such as a sensitive photographic paper or film. Located within the drum 5 is a photo-electric cell 11, the electrical characteristic of which is affected by the amount of light received from a source 12 through a lens 13. The amount of light reaching the photo-electric cell 11 is determined by the tone value of the elemental area of the transparency 9 which is opposite the focal

point of the lens 13 at the surface of the transparency at any given time. The circuit of the photo-electric cell 11 is connected to a modulating device 14, whereby carrier waves from a source 15 are modulated and transmitted to the transmission line L. At the reproducing terminal, light valve V is actuated by demodulated picture current from electron discharge demodulator D. Modulated current from the line L is impressed upon the demodulator D by means of amplifier 16. The modulating and amplifying devices 14 and 16, respectively, may preferably consist of electron discharge devices as indicated. A suitable arrangement for synchronously rotating the drums 5 and 6 and for transmitting the picture characteristics as modulations of a carrier wave are disclosed in a copending application of M. B. Long, Serial No. 681,347, filed December 18, 1923.

The light valve V is similar in general arrangement to the light valve disclosed in Patent No. 1,638,555, Aug. 9, 1927, of E. C. Wente, Serial No. 635,886, filed May 1, 1923. It consists of two wires 17 and 18 suspended in a magnetic field which is produced by coil 19 which may be energized from any suitable source (not shown). The aperture between the wires 17 and 18 varies with the intensity of the picture current which is proportional to the lights and shades of the transparency 9 at the sending terminal. The strings 17 and 18 are each parallel to the axis of the reproducing drum 6 so that the variable aperture formed between the strings 17 and 18 varies in the direction of the trace on the record blank 10. The size of the exposure parallel to the axis of the drum 6 is determined by the size of the aperture in a screen 20. The exposure of the record blank 10 is effected by light from a source 21 which is directed upon the aperture formed by strings 17 and 18 and screen 20 by lens 22. An image of the illuminated aperture is projected upon the record blank 10 by projection lens 23, whenever a transparent sector of disc 24 permits light to fall upon the record blank 10. The relative locations of the elements of the optical system are shown in Fig. 2. Screen 20 has been omitted in that figure for the sake of simplicity.

In order to form dots the sectored disc is rotated by means of a belt 25 running over pulleys 26 and 27. Pulley 27 is driven by gears 28 and 29 from driving shaft 30. The gear ratio between gear wheels 28 and 29 and the relative diameters of pulleys 26 and 27 are so chosen that the centers of the exposures in successive traces are displaced half the distance between the centers of the exposed areas along the trace. Thus, the center of an exposed area of one trace is equidistant from the centers of adjacent exposed areas in an adjacent trace. The distance between centers of exposed areas is determined by the relative speeds of the picture drum 6 and the sectored disc 24. Preferably, this is so chosen that the distance between centers of adjacent exposed areas along the trace is equal to the width of the trace.

The widths of the sectors in the disc 24 are of such a size that the exposure is substantially instantaneous. The disc is so located that the area of the light beam where it is intercepted by the disc is not greater than the disc sector.

An arrangement for moving the picture drums axially as they are being rotated is shown in Fig. 3. A driving shaft 40 has threaded engagement with a carriage 41 which slides along a support 42. A picture drum 43 secured to shaft 44 is supported by the carriage 41. A gear wheel 45 slidable along the shaft 40 but keyed thereto engages with gear wheel 46 to cause the rotation of shaft 44 as shaft 40 rotates.

One form of the reproduction greatly exaggerated is shown in Fig. 4. In that figure distance a represents the width of the trace and distance b the distance between centers of adjacent exposures along the trace. The form of exposure is thus seen to be areas of uniform dimensions in one direction that is across the trace and of varying dimensions in the other direction that is along the trace. By viewing this surface at a suitable distance the exposed areas appear as dots and give the same effect as would be obtained by reducing the area to the proportions actually employed; in other words, by reducing the areas so that the dimensions a and b would be approximately one hundredth to one hundred and fiftieth of an inch.

In the form of reproduction illustrated in Fig. 4 the lightest portion of the picture is determined by the width of the exposed area 35 and the darkest portion by the width of the unexposed area 36. The exposed area 35 and the unexposed area 36 are required in the printing structure for reasons which are well-known in the printing art. In Figs. 5 and 6 the aperture forming edges of strings 17 and 18 are modified so as to reduce the area exposed for the light portions and also to reduce the unexposed area for the darkest portions.

In Fig. 5 a semi-circular notch is made in the aperture forming edges of strings 17 and 18 so that the lightest portions of a reproduction are in the form of small oval-shaped exposed areas. In Fig. 6, a notch, the edges of which form an obtuse angle is employed. In the arrangement of both Figs. 5 and 6, it is preferable that the demodulated picture currents used to operate the strings 17 and 18 bear a linear relation to the picture currents flowing through the photo-electric cell 11. The reproductions obviously will not be exacty linear from the lightest to the

darkest portions, but the increased contrast thus obtained more than offsets the lack of linearity thus introduced. The small exposed areas in the lightest portions and the small unexposed areas in the darkest portions give a suitable printing structure on the photo-engraving plate.

Other similar modifications may obviously be made. Such modifications come within the scope of this invention as defined in the appended claims.

What is claimed is:

1. In a system for the transmission of pictures by electricity, means to produce picture currents, means for exposing varying portions of elemental areas of a record blank in accordance with said picture currents, and means comprising an interrupting device to stagger said elemental areas.

2. In a system for the transmission of pictures by electricity, means to produce picture currents, means including an electromagnetic light valve responsive to said currents for reproducing the picture in the form of a dot image, and means comprising a light interrupting device for arranging the dots of adjacent lines of dots in staggered formation.

3. In a system for the transmission of pictures by electricity, means including an electromagnetic light valve, a rotating picture drum and a sectored disc for reproducing the picture in the form of a dot image, and means to rotate the disc at such a speed with respect to the picture drum than the dots of adjacent lines of dots are staggered.

4. In a system for the transmission of pictures by electricity, a source of picture current varying in amplitude as a function of the tone values of elemental areas of the picture to be reproduced, an electromagnetic light valve having aperture forming members actuated by picture current from said source, a picture drum capable of being rotated and moved axially with respect to the aperture formed by said light valve, means to illuminate said aperture, a light sensitive record blank mounted upon said picture drum and a rotating sectored disc so located as to expose elemental areas of said record blank to light from said aperture, the relative speeds of rotation of said picture drum and said disc being such that the centers of adjacent elemental areas in successive traces lie upon a line which is not perpendicular to the direction of the trace.

5. In a system for the transmission of pictures by electricity, a source of picture current varying in amplitude as a function of the tone values of elemental areas of a picture to be reproduced, an electromagnetic light valve having aperture forming members actuated by picture current from said source, a picture drum capable of being rotated and moved axially with respect to the aperture formed by said light valve, means to illuminate said aperture, a light sensitive record blank mounted upon said picture drum, and a rotating sectored disc so located as to expose elemental areas of said record blank to light from said aperture, the relative speeds of rotation of said picture drum and said disc being such that the center of an elemental area in one trace is substantially equidistant from the centers of two adjacent elemental areas in an adjacent trace.

6. In a system for the transmission of pictures by electricity, a source of picture current varying in amplitude as a function of the tone values of elemental areas of a picture to be reproduced, an electromagnetic light valve having aperture forming members actuated by picture current from said source, a picture drum capable of being rotated and moved axially with respect to the aperture formed by said light valve, means to illuminate said aperture, a light sensitive record blank mounted upon said picture drum, and a rotating sectored disc so located as to expose elemental areas of said record blank to light from said aperture, the relative speeds of rotation of said picture drum and said disc being such that the center of an elemental area in one trace is substantially equidistant from the centers of two adjacent elemental areas in an adjacent trace, and the shape of the aperture being such that the dimensions of the exposed elemental areas are all equal in one direction but varying in the other direction according to the amplitude of the picture current at the particular time of exposure.

7. In a system for the transmission of pictures by electricity, means to produce picture currents, a light sensitive record blank, means to produce a spot of light on said record blank, means to produce relative movement between said spot and said record blank, means to maintain the dimensions of said spot constant in a direction transverse to the direction of relative movement and proportional to the amplitude of the picture current in the direction of relative movement, and interrupting means to cause staggering of the exposed areas of said record blank.

In witness whereof I hereunto subscribe my name this 21st day of August, A. D., 1924.

HERBERT E. IVES.