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IMAGE PRODUCING SYSTEM

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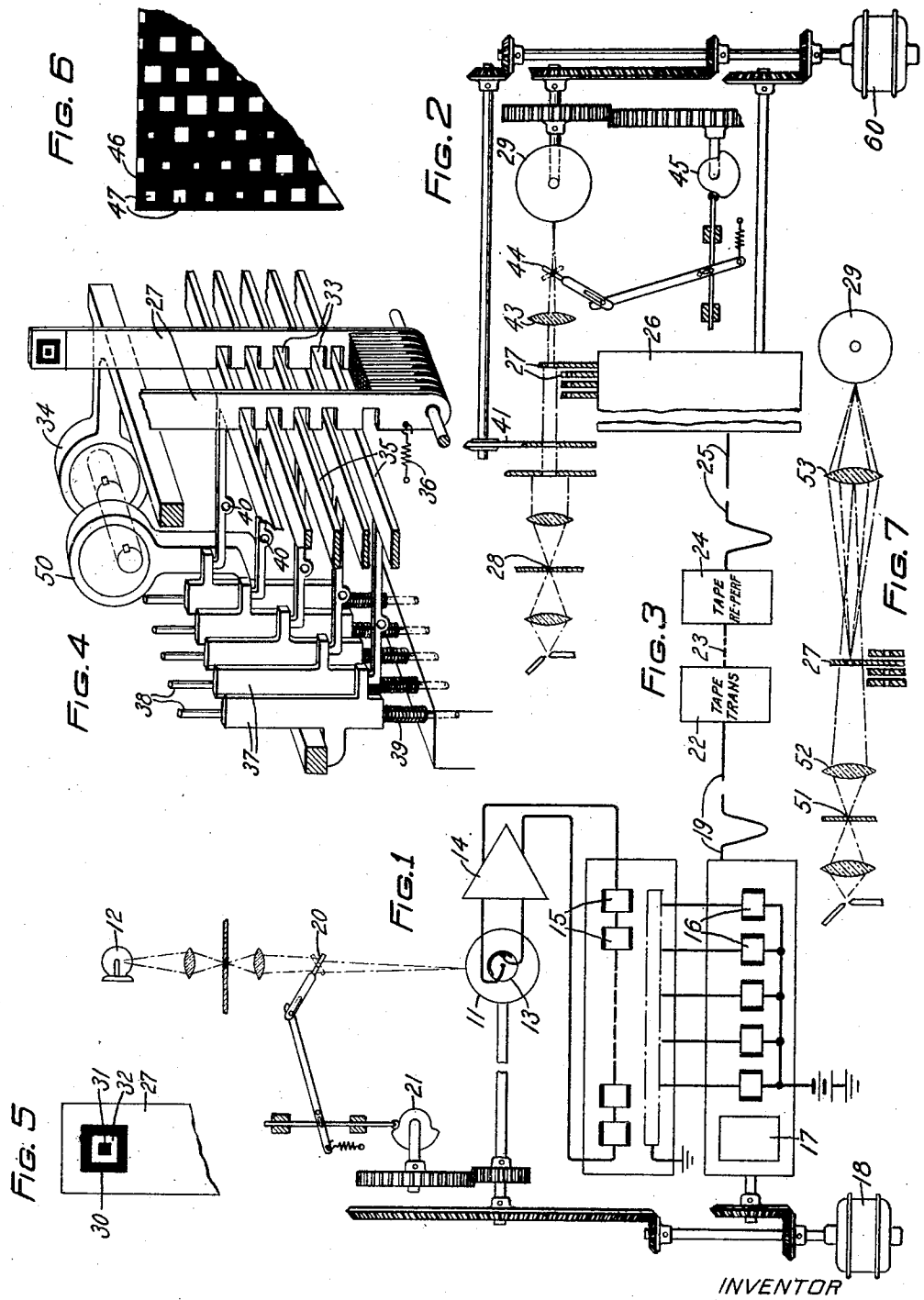

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IMAGE PRODUCING SYSTEM

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This invention relates to image producing systems, and more particularly to code telegraph systems for controlling the production of pictures in the form of dot images.

An object of the invention is to produce a simplified system for reproducing pictures in the form of dot images.

Another object is to provide an improved arrangement for scanning the elemental areas of an image field for analyzing or reconstructing an image.

In accordance with an embodiment of the invention herein shown and described for the purpose of illustration, elemental areas of a picture, an image of which is to be produced are scanned in succession for controlling the current in a circuit containing relays which control the selection of code combinations of telegraph signals in accordance with the tone values of successively scanned areas of the picture. The code telegraph signals may be transmitted directly to a station at which the picture is to be reproduced or they may be punched in a tape and subsequently transmitted. The received code telegraph signals control the punching of the tape. The elemental areas of a light sensitive picture receiving surface are exposed in succession along linear elements to a beam of light, with respect to which the light sensitive surface is moved, for the purpose of reproducing the picture in the form of a dot image. The light sensitive picture receiving surface may, for example, be mounted on a drum which is rotated and also moved in an axial direction to expose elemental areas of the light sensitive surface along a helical path. A plurality of light control elements adapted to be positioned in the path of the light beam one at a time in accordance with the code punched in the tape are provided for controlling the area of the exposure of successive portions of the light sensitive surface. Each of the light controlling elements has two opaque portions, one of which surrounds the other, and a light transmitting portion formed between the inner boundary of one opaque portion and the outer boundary of another opaque portion. These boundary lines of the two opaque portions may form two concentric squares although other forms such as circles or polygons may, in some cases, be preferable. If desired the inner boundary line may be of one form and the outer boundary of another form. The area enclosed by the outer boundary line preferably remains fixed, while that enclosed by the inner boundary line is different in different light controlling elements, respectively. By the use of this arrangement there is produced a negative picture formed of different size transparent dots on a dark ground. This picture can then be employed directly to form an image on a metal printing plate in the form of raised dots varying in size in accordance with the tone values of different elemental areas of the original picture.

It has been found preferable that the adjacent dots of the image should not lie in a single line parallel to the top of the picture, but should be staggered so as to lie in different lines, respectively. When the elements of the picture are reproduced in succession along lines extending parallel to the sides of the picture, this staggering effect can be produced by means of an oscillating glass plate in the path of the light beam which controls the exposure of the light sensitive surface. The glass plate is caused to move about an axis perpendicular to the linear elements of the picture just referred to between the periods required for reproducing adjacent linear elements. It is preferable also to employ an oscillating glass plate in the path of the scanning light beam at the transmitting station in order that the positions of the successive elemental areas of the half-tone reproduction may correspond accurately to the positions of the successively scanned elemental areas of the original picture.

A specific embodiment of the invention is described below with reference to the accompanying drawing.

Fig. 1 of the drawing shows schematically an arrangement for punching a tape with code combinations representing the tone values of elemental areas of a picture

Fig. 2 of the drawing shows schematically an arrangement for producing dot images from a tape which is punched with code signals.

Fig. 3 shows schematically a telegraph transmission system for reproducing a tape punched with code signals.

Fig. 4 is an enlarged perspective view of the light controlling apparatus shown in Fig. 2.

Fig. 5 is a detailed showing of a portion of one of the light controlling elements of the apparatus shown in Fig. 4.

Fig. 6 shows a portion of an enlarged dot image of the type produced by the apparatus shown in Fig. 2.

Fig. 7 is a diagram of an optical system which may be employed in place of the optical system shown in Fig. 2.

Fig. 1 shows schematically a system for scanning a picture to produce a varying image current which controls the punching of code combinations in a tape in accordance with the tone values of successively scanned elemental areas of the picture. A transparency of a picture to be reproduced is mounted on a drum 11 which is rotated and simultaneously moved in the direction of its axis so that different elemental areas of the picture are illuminated in succession by a beam of light from the source 12. Light reflected from or transmitted through successively illuminated elemental areas of the picture impinges upon the light sensitive surface of a photo-electric cell 13 for producing in a circuit associated therewith a current, the amplitude of which varies in accordance with the tone values of the successively illuminated elemental areas of the picture. This current, after being amplified by the vacuum tube amplifier 14, flows through a circuit containing a plurality of marginally operated devices, for example, the marginally biased electromagnetic relays 15, for causing one or more relays to operate, the number depending on the amplitude of the current. The operation of the marginal relays 15 controls the energization of one or more of the selector magnets 16 which select a code to be punched in a tape. The punch 17 driven by the motor 18 which also drives the picture drum 11, punches a tape 19 in accordance with a code selected by the selector magnets 16 which is determined by the tone value of the portion of the picture which is illuminated at the time the punch operates. The ratio of the gears through which the drums 11 and the punch 17 are driven, respectively, may be given such values that a desired number of code punchings are made per inch of movement of the picture with respect to the scanning light beam, for example, 50 per inch. A system for producing code perforations in a tape corresponding to the tone values of successively scanned elemental areas of a picture, similar to that described above, is disclosed in Patent No. 1,664,652, granted to E. F. Watson and A. Weaver, April 3, 1928.

The picture or image field may be scanned by moving it with respect to a fixed light beam, but in some cases it has been found preferable to vary the path of the scanning light beam in addition to moving the image field. When reproducing pictures in the form of dot images, it is preferable to have the dots along adjacent lines parallel to one edge of the picture lie in different lines, respectively, parallel to another edge of the picture, thus staggering the dots. It is preferable also to stagger the elemental areas of the picture, which are scanned to control the production of successive code signals, to correspond with the staggering of the dots of the reproduced image. This is preferably accomplished by changing the path of the scanning light beam between the scanning periods of successive linear elements of the picture. For this purpose the light refracting glass plate 20 having parallel faces is positioned in the path of the scanning light beam from source 12. This plate is held in the position shown while the drum 11 makes one revolution. While the drum makes a succeeding revolution, the plate is held in the position shown by the dotted line, the movement of the glass plate being under control of the cam 21 which is driven by the motor 18 through suitable gears.

The punched tape 19 may be used directly for controlling an image producing apparatus or it may be fed through a tape transmitter 22 for controlling the transmission of code signals over the transmission channel 23, such as a submarine cable, as shown in Fig. 3. The transmitted code signals are impressed on the tape reperforator 24 for controlling the production of a punched tape 25 similar to the tape 19. Instead of punching a tape 19 at the transmitting station, relays may be substituted for the electromagnets 16 for directly controlling the transmission of code signals over transmission channels 23 for controlling the punching of a tape 25 at the receiving station.

Referring to Figs. 2, 4 and 5, the tape 25 is fed into a mechanical light controlling device 26 comprising a plurality of light intercepting elements 27 which are adapted to be positioned, one at a time, in the path of a light beam from a source of light 28 for controlling the characteristic of the light beam reaching a light sensitive image receiving surface mounted on drum 29. The light source 28 is preferably small and may be in the form of a small aperture in a screen illuminated by an arc lamp as shown. The upper portion of each of the light intercepting elements 27 has a light

transmitting portion formed between two opaque portions, one of which surrounds the other. As shown in Fig. 5 the metallic element 27 has a square aperture therein along the edges of which is cemented or otherwise secured a piece of film having the opaque portions 30 and 31 and the transparent portion 32. The opaque portions may be formed by suitably exposing and developing a light sensitive film or by suitably marking a transparent element such as glass. The inner and outer boundaries of the transparent portion form two concentric squares, the outer square having the same dimensions in each of the elements 27 and the dimension of the inner square being different for different elements, respectively. Each element 27 has 5 notches 33 cut therein, the spacing of the notches being different for different elements, respectively. When the light controlling elements 27 are released due to the movement of the cam 34, they are forced into engagement with the selecting leaves 35 due to the action of the springs 36. One of the elements 27, the notches 33 of which are in alignment with the selecting leaves 35, will thus be moved with respect to the other elements 27 into the path of the light beam from source 28. The position of each of the selecting leaves 35 is determined by the position of one of the vertically mounted members 37, there being one of these members for each of the selecting leaves 35, the upper ends of which are tapered to form selecting pins 38 which are adapted to register with the holes in the tape 25 which is punched in accordance with a five unit code. When the tape has been moved so that a set of code punchings are in alignment with the pins 38, the members 37 are released due to the movement of cam 50 and one or more of the pins 38 move through the holes in the tape in accordance with the code punchings therein due to the action of the springs 39. This permits one or more of the leaves 35, which are under control of the members 37 which were moved upwardly, to move about the pins 40 to change their position. One of the shutters 27 is thus permitted to move into the path of the light beam as explained above. When an exposure has been made under control of the element 27, which was moved into the path of the light beam, the cams 34 and 50 act, respectively, to move the element 27 out of engagement with the selecting leaves 35 and to move the selecting pins 38 out of engagement with the tape. The tape is then moved to new position to control the exposure of a succeeding elemental area of the light sensitive film mounted on the drum 29, the tape being moved intermittently and the drum being moved continuously similarly to the movement of drum 11, under control of the motor 60. Each element 27 controls the production of a particular tone value of the image and each element is selected under control of a particular code combination punched in the tape.

After one of the elements 27 has been selected, as above described, an aperture in the opaque disc 41 is brought into the path of the light beam from source 28 to permit a beam of parallel light rays to reach the element 27. A portion of this light beam is transmitted through the light aperture 32 of the element 27 and reaches the lens 43. An image of the light aperture 32 is thus formed upon the light sensitive film mounted on drum 29. The size of this image may be altered by moving the lens 43 backward or forward along the light path. Instead of the optical arrangement shown in Fig. 2, the arrangement shown in Fig. 7 may be employed. In this system a lens 52 focuses an image of the small source of light 51, similar to the source 28, upon the center of the lens 53. The light controlling elements 27 are arranged so that they may be brought into the path of this light beam, one at a time, as described heretofore. The lens 53 then focuses an image of the light aperture in the element 27, which is brought into the path of the light beam, upon the light sensitive surface mounted on drum 29. Since the elements 27 are brought into the path of the light beam at different positions, respectively, difficulty may, in some cases, be encountered in forming a distinct image of the light aperture of each element upon the light sensitive surface. This difficulty may be obviated by making the distance between the first and last elements of the bank of elements 27 small with respect to the distance between the elements 27 and the lens 53, and by keeping the light source 51 small, whereby the effective operation of the lens 53 is small and great depth of focus is obtained.

Adjacent exposures of the film may be contiguous so that the image of the picture mounted on the drum 11 formed on the film, when developed, is in the form of clear dots of varying size on a solid dark ground. However, it may be desirable in some cases to make the form of the light apertures of the elements 27 or the spacing of successive exposures of the film such that all or a portion of adjacent exposures are not contiguous. It has been found preferable to have the dots lying along adjacent scanning lines lie along different lines, respectively, extending in the direction perpendicular to the scanning lines. This staggering of the dots is accomplished by changing the position of the light refracting element 44, similar to the element 20 at the transmitting station, under control of the cam 45 which is driven

by the motor 60. The position of the light refracting element 44 is changed between the periods required for reproducing successive linear elements of the picture, the element 44 being in the position shown for one rotation of the drum 29 and in the position shown by the dotted line while the drum makes a succeeding revolution.

The effect of periodically shifting the path of the light beam from source 28 is shown in Fig. 6 in which the numeral 46 designates the dark ground of a portion of a developed film and the numeral 47 designates the clear dots which vary in size in accordance with the tone values of the successively scanned elemental areas of the original picture mounted on drum 11. The faithfulness of the reproduction will, of course, depend on the number of dots produced per linear inch and the number of different sized dots representing different tone values respectively employed. Satisfactory images have been produced by employing 50 dots to the inch and 16 different tone values. Images of this type having clear dots on a dark ground can be used for directly producing metallic printing plates for use in printing half-tone pictures.

What is claimed is:

1. In an image producing system, a plurality of light controlling elements each having two opaque portions, one of which surrounds the other, and a light transmitting portion located between the inner boundary of one of said opaque portions and the outer boundary of the other of said opaque portions, the area enclosed by the inner boundary of the outer opaque portion being substantially of the same size and shape for each of said light controlling elements.

2. In an image producing system, a light controlling element having two opaque portions, one of which surrounds the other, and a light transmitting portion located between the inner boundary of one of said opaque portions and the outer boundary of the other of said opaque portions, an image receiving surface, and optical means for producing, on said image receiving surface, a clear image of said inner opaque portion of the light controlling element upon a dark ground.

3. In an image producing system, a plurality of light controlling elements each having two opaque portions, one of which surrounds the other, and a light transmitting portion located between the inner boundary of one of said opaque portions, and the outer boundary of the other of said opaque portions, said boundary lines enclosing concentric areas the larger of which is the same size for each of said elements and the smaller of which is of different size for different elements respectively.

4. In an image producing system, a light controlling device comprising a plurality of elements having light transmitting portions of different sizes, respectively, formed between two opaque portions, one of which surrounds the other, the inner boundary of said outer opaque portion forming a parallelogram, means for producing a beam of light, and means for selectively controlling the movement of said elements into the path of said light beam for controlling the production of an image.

5. The method of reproducing, under the control of code signals, pictures in the form of negative dot images suitable for directly controlling the production of half-tone printing plates, which comprises directing a beam of light upon a light sensitive surface, intercepting portions of said light beam to form clear dots upon a dark ground, and automatically controlling the size of said dots in accordance with said code signals for controlling the production of a negative dot image of the original picture.

6. In an image producing system, a source of code telegraph signals, a plurality of light controlling elements each having two opaque portions, one of which surrounds the other, and a light transmitting portion between the inner boundary of one of said opaque portions, and the outer boundary of the other of said opaque portions, means for moving each of said light controlling elements with respect to the other of said light controlling elements under control of code signals from said source, a light sensitive surface, and means for producing an image of the light transmitting aperture of each of said light controlling elements, after it is moved with respect to the other light controlling elements, upon said light sensitive surface for producing a negative dot image of an original picture.

7. An image producing system comprising means for producing a beam of light, a plate of transparent material having parallel faces, means for transmitting said light beam through said plate, and means for tilting said plate into a plurality of positions in succession with respect to the incident light base to shift the emergent beam into different paths, respectively.

8. In a system for producing a dot image of an original picture of which an image is to be produced, means for producing a beam of light, means for moving said picture with respect to the light beam for illuminating elemental areas of the picture in succession, means including a light sensitive device for producing an image current having a characteristic determined by the tone values of successive elemental areas of the picture, a light sensitive image receiving surface, means for producing a second beam of light, means for moving said light sensitive surface with respect to said second beam of light for illuminating successive elemental

areas of the picture receiving surface in succession, means for controlling a characteristic of said light beam in accordance with said image current, and separate means for periodically changing the paths of said two light beams.

9. The method of scanning, with a light beam, which comprises moving the field of view with respect to the light beam for scanning elemental areas thereof in succession, and changing the path of the scanning light beam only between the periods required for scanning a plurality of elemental areas.

10. The method of scanning an image field with a light beam, which comprises moving the image field with respect to a fixed light beam for scanning a group of elemental areas, changing the path of said light beam after the scanning of said group of elemental areas, and subsequently moving said image field for scanning another group of elemental areas.

11. In an image producing system, a field of view an image of which is to be produced, means for directing a beam of light along a fixed path upon said field of view, means for continuously moving said field of view with respect to said fixed light beam to cause different elemental areas thereof to be illuminated in succession, and means for periodically changing the path of said light beam.

12. In a system for producing a dot image of a picture, means for exposing varying portions of successive elemental areas of a record blank, and means comprising a light refracting device for staggering said elemental areas.

13. 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 a light refracting device to stagger said elemental areas.

14. In a system for reproducing pictures in the form of dot images, means including a beam of light for exposing varying portions of elemental areas along successive linear elements of a recording blank in accordance with the tone values of the picture to be reproduced, and means operative only between the periods required for reproducing successive linear elements of the picture to change the path of the light beam for staggering the elemental areas.

In witness whereof, I hereunto subscribe my name this 29th day of July, 1929.

HERBERT E. IVES.