

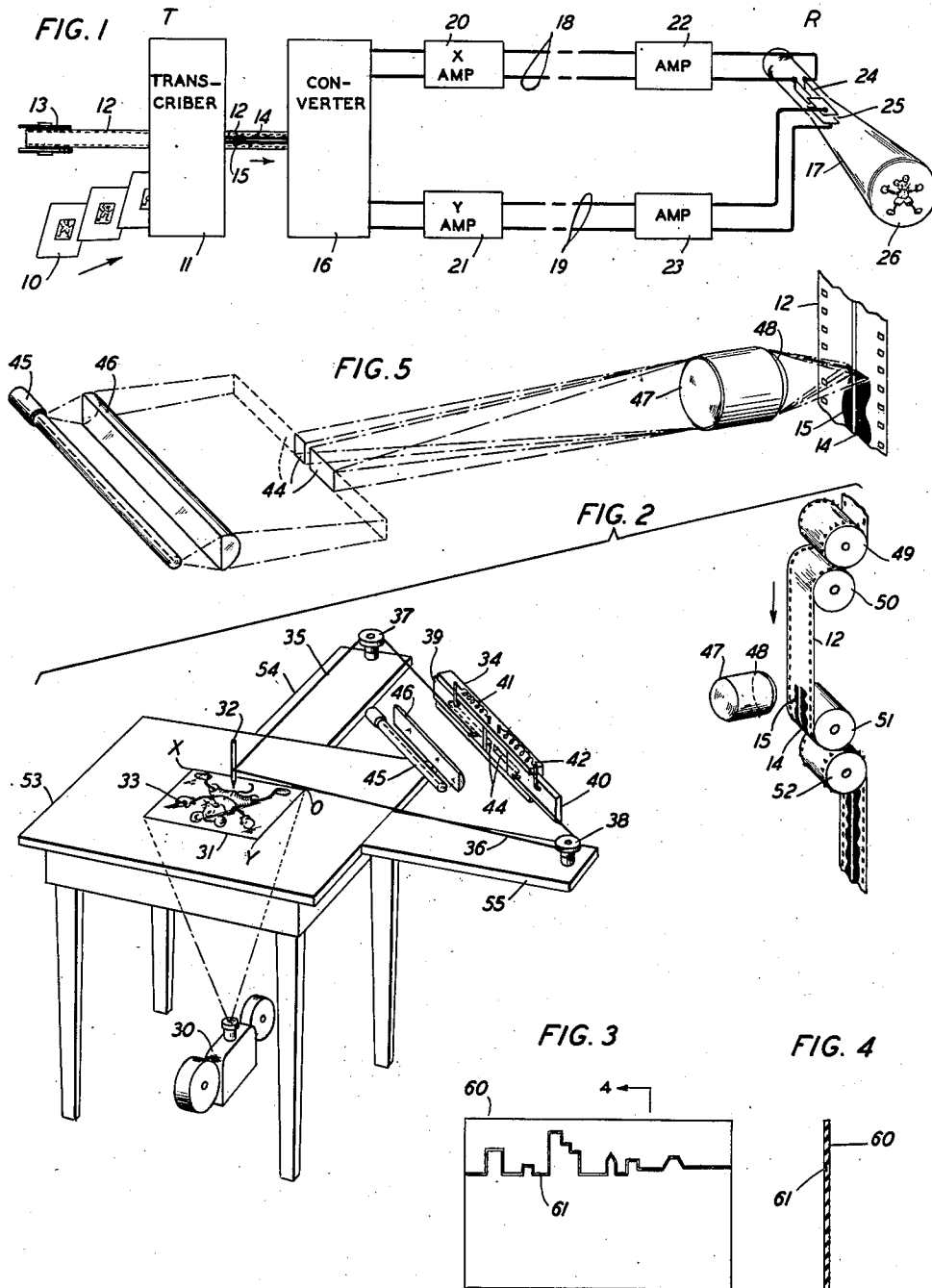
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ELECTRO-OPTICAL SYSTEM

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ELECTRO-OPTICAL SYSTEM

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10 Claims. (Cl. 178—20)

This invention relates to electro-optical systems and more particularly to the electrographic transmission of images.

It is an object of this invention to provide improved means for transmitting animated images using a comparatively narrow frequently transmitting band.

In a copending application of A. M. Skellett, filed December 24, 1936, Serial No. 117,521, there is disclosed an electrographic system for producing images from currents produced by moving a stylus over the subject along selected paths such as the boundary lines between areas of distinctive tone values. The frequency band required for the transmission of these images is small compared with the band required in ordinary television systems. The present invention is directed to the improvement of apparatus of the electrograph type for transmitting animated images and particularly to an improved apparatus for transcribing the movements of a stylus along the boundaries of distinctive areas of the subject into tracks on a film or other record member for use particularly with animated cartoons or similar sketches.

It is another object of this invention to provide an improved transcribing device for animated subjects.

It is a further object of this invention to provide a novel transparent template to assist in tracing the background of the subject field.

In accordance with one embodiment of this invention, shown for purposes of illustration and hereinafter described in detail, the images of individual frames of an animated film are projected upon a ground glass screen. The boundaries of distinctive areas of the image figure on the screen are then traced by a stylus and as the stylus moves around in the field two cables attached to it open two slits in a light valve in proportion to the rectangular coordinates of its successive positions with respect to a pair of coordinate axes. The images of the slits are projected upon a continuously moving film, the width of the recorded tracks varying as the coordinates of the various positions of the stylus. The dimension of the track along the film represents the length of time taken to trace a particular portion of the image and may be used to control variations in density of the received image. A transparent template with a continuous groove to fit over and coincide with the background may be mounted so as to be quickly swung in position on the ground glass and with it the background may be transcribed at a speed

greater than that of the central figure. As soon as one frame is transcribed, another frame is shifted into place in the projector and the transcribing process repeated. For reproducing or converting the tracks on the film into signal currents, the images of the tracks on the film are projected upon two photocells. These cells may be connected respectively through amplifiers to the two pairs of deflecting plates of a cathode ray receiver.

The invention will be more readily understood by referring to the following description, taken in connection with the accompanying drawing forming a part thereof in which:

Fig. 1 is a schematic diagram of an electrographic system embodying this invention;

Fig. 2 is a perspective view of the transcriber;

Fig. 3 is a top view of a transparent template used in the arrangement of Fig. 2;

Fig. 4 is a cross-sectional view of the template of Fig. 3; and

Fig. 5 is an enlarged diagrammatic showing of the optical system of Fig. 2.

Referring more particularly to the drawing, Fig. 1 shows schematically an electrograph system embodying this invention. In this figure sketches 10, which may be views of the same animated subject representing successive aspects of the subject taken at a definite fixed time interval apart which interval is within the period of persistence of vision, are represented as being fed into a transcribing device 11 into which a film 12 from a roll 13 is also fed. In the transcriber 11, the description and method of operation of which will be considered more fully below, a stylus traces the boundaries of distinctive areas of the successive photographs 10 and the successive positions of the stylus are recorded on the film as tracks 14 and 15.

After proper development and, if desired, fixing, the film 12 is passed into a device 16 which is called a converter. If desired there may be a time interval between the transcribing and converting operations. In other words, the tracks 14 and 15 on the film 12 may be made well in advance of the time the program is transmitted or broadcast. In the converter 16, the tracks on the film are used to generate signal currents which are transmitted to a receiving station which preferably includes a cathode ray device 17. The converter preferably comprises a pair of photocells actuated by the images of the tracks 14 and 15 on the film 12 to produce varying signal currents respectively proportional to the successive positions of the stylus with respect to the

pair of coordinate axes. For a more complete description of a converting device somewhat similar to the device 16, reference may be made to the above-mentioned Skellett application.

5 The signal currents generated by the photoelectric cells in the converter 16 may then be used to modulate carrier waves generated by suitable oscillators (not shown) and these modulated carrier waves are transmitted over respective channels 18 and 19, which may be either line or radio channels, to the receiving station R. Suitable amplifying devices 20 and 21 may be used at the transmitting station and amplifying devices 22 and 23 at the receiving station to produce greatly amplified signals.

10 The signals in channels 18 and 19 are then applied to two pairs of deflecting plates 24 and 25 of the cathode ray receiving tube 17. Cathode ray tube 17 comprises suitable means (not shown) for producing a beam of electrons and for accelerating this beam towards a fluorescent screen 26. The voltages from the channels 18 and 19, respectively proportional to the signal currents generated at the transmitting station, create electrostatic fields between the members of pairs of deflecting plates 24 and 25 respectively which deflect the beam to positions corresponding to the changing locations of the stylus at the transmitting station. If desired, means may be provided for generating a signal when the stylus is lifted from the surface of the representation (as when it is moved from one boundary to another) and this signal used to cut off the cathode ray beam of the tube 17 during this interval of time. For a description of apparatus for producing this signal together with a more complete description of the system shown in Fig. 1 on the right of the transcribing device 11, reference may be made to the above-mentioned Skellett application. If desired, the stylus may be moved quickly from one boundary to another and this will show on the image at the receiving station only as a faint trace.

15 The improved transcribing device of this invention for making tracks on film corresponding to the successive positions of the stylus with respect to a pair of coordinate axes is shown in Fig. 2, the arrangement being particularly applicable to animated cartoons or similar subjects. In this arrangement, a projecting apparatus 30 is arranged to project upon a ground glass screen 31, one frame at a time, the images of the frames of a motion picture film which may be, for example, of the type generally known as "animated cartoons". A stylus 32 traces boundaries of the distinctive areas of the image 33, preferably in a continuous line, and the motions of the stylus 32 operate the opening and closing of a double light valve 34 by means of appropriate cables 35 and 36 passing over reels 37 and 38 and attached to moving slide members 39 and 40. The slide members 39 and 40, acting against the pressure of springs 41 and 42, control the size of the slits 44 in accordance with the position of the stylus with respect to its coordinate axes. A point O represents the intersection of the X and Y axes. A table or other supporting device 53 supports the screen 31 and it may be provided with arms 54 and 55 to support the reels 37 and 38.

20 Light from a suitable elongated source 45 is focused by any suitable device, such as a cylindrical lens 46, upon or near the plane of slits 44, and the image of these slits is formed on film 12 by means of suitable lenses 47 and 48 to produce variable width image tracks 14 and 15,

The film 12 is adapted to move continuously in the direction of the arrow by means of suitable rollers 49, 50, 51 and 52. If it is desired to make all the boundaries of the same density, the stylus is moved along the boundaries at a uniform rate of speed. Shading can be accomplished by varying this rate of speed. After the film 12 has been developed, fixed and dried in accordance with well-known photographic technique, the tracks on the film may be used to generate the signal currents for transmission to the receiving station as stated above in connection with Fig. 1.

10 It is estimated that a skilled operator will spend no more time in transcribing the drawing than was required by the artist in drawing it originally. As there are time-saving tricks peculiar to the art of producing animated cartoons so there are also such artifices peculiar to this transcription technique which will save time and labor considerably. When one frame has been completely traced, the next frame is imaged by means of the projector 30 upon the ground glass screen 31 and this image traced by the stylus as described above. When the image of every frame has been traced by the stylus, the film 12 will comprise a coordinate track record of the entire moving picture film used in the projector 30. Regardless of the time taken to transcribe the images on a film from the projector 30 into tracks on the film 12, the film 12 is run past the photoelectric cells in the converter device 16 at a speed such that a continuous animated image is produced on the fluorescent screen 26 of the cathode ray tube 17 at the receiving station. For example, film 12 may be run through the converter at a speed such that twenty-four complete frames are produced per second in the cathode ray tube 17. Since this period of time is within the period of persistence of vision, the image on the screen 26 will "move" without flicker effect.

15 Various changes may be made in the transcribing device of Fig. 2. The stylus may be coupled to the light valve by any other suitable means, either mechanical or electrical. As an example of an electrical method for coupling the movement of the stylus in the light valve, reference may be made to the above-mentioned Skellett application which discloses such a method. Projection may be made from the original drawings themselves rather than from a film. In this situation, the projector 30 will be modified so that it transmits or projects the image of the original drawings rather than from transparencies made therefrom. The tracks 14 and 15, while they have been described as of variable area type, may be, if desired, of the variable density type such as is disclosed in the above-mentioned Skellett application. The film 12 may be replaced by any other record member, such as for example magnetic tape, or a sound record on wax or metal. If any of these other record members are used, the associated recording apparatus would be used in place of the light valve 34.

20 Frequently in transcribing animated cartoons, the background remains the same for a considerable number of pictures. The transcribing of the background may be simplified by the use of a suitable device such as the transparent template disclosed in Figs. 3 and 4. This template 60 comprises a flat plate having a continuous groove 61 cut therein in the shape of the background. The stylus 32 is adapted to move in this groove and hence the background may be quickly and easily transcribed. The density of the background line on the fluorescent screen 26 may be controlled by 75

the speed at which the stylus is moved in the groove 61. If it is traced quickly the line will be light whereas if the stylus is moved at a slower rate of speed, the background line will be relatively dark. As explained above, this same general principle applies to the figure as well as to the background. A transcriber artist may use this principle to produce shaded images.

The frequency band width required by the system of this invention is relatively small compared with that required in ordinary television systems. It is inherent in well known systems in television that high definition must at all times be realized no matter how simple the transmitted image may be. Many useful and entertaining images, however, do not contain a great amount of detail and in transmitting them large blank areas on the available field are wastefully transmitted. The animated cartoon is an example of such a simple image. In this invention, the figure and line background without the blank areas is transmitted and thus a great simplification occurs, which simplification is expressed in the lowering of the frequency band required for transmission to a width sufficient so that it may be used with carriers of the ordinary broadcast frequency range. The required band widths are no larger than those of the ordinary high fidelity radio transmitting stations of today.

Various modifications may be made in the invention as above disclosed, the scope of which is indicated by the appended claims. In the claims, the expression "boundaries of areas of distinctive tone values" is intended to be inclusive of the case where an area of distinctive tone value is a line as in an outline sketch or drawing. The two parallel boundaries of a line area are for practical purposes coincident, so that a stylus tracing the line is in effect tracing each boundary of the line area; that is, tracing both boundaries of the line area simultaneously.

What is claimed is:

1. A method of image production comprising the steps of projecting successive still images of a subject upon a screen, each image differing from its immediately preceding image to an extent corresponding to a time interval within the period of persistence of vision, tracing the boundaries of areas of distinctive tone values of said images, generating two potentials continuously varying in accordance with the positions of the successively traced elements of said boundaries with respect to the axes of a coordinate system, recording said potentials, and producing electric signal currents in accordance with said recorded potentials at a rate of speed different from that at which said potentials were recorded.

2. A method for making a coordinate record member corresponding to successive images of an animated subject which comprises projecting successive images of the subject upon a screen, each image differing from its immediately preceding image to an extent corresponding to a time interval within the period of persistence of vision, tracing the boundaries of areas of distinctive tone values of each image on the screen, and utilizing the positions of the successively traced elements of said boundaries with respect to a pair of coordinate axes to produce a record member of said positions.

3. A system of image production for animated subjects comprising a screen, means for projecting a succession of still images of the subject on said screen, each image differing from its immediately preceding image to an extent corresponding

ing to a time interval within the period of persistence of vision, a stylus for tracing the boundaries of areas of distinctive tone values of each image in succession, and means for recording as tracks on a record member the movement of said stylus with respect to a pair of coordinate axes.

4. A system of image production for animated subjects comprising a screen, means for successively projecting still images of the subject on said screen, each image differing from its immediately preceding image to an extent corresponding to a time interval within the period of persistence of vision, a stylus for tracing the boundaries of areas of distinctive tone values of each image in succession, a light source, a moving film, and a pair of light apertures located between said light source and said film, the widths of which are respectively controlled by the movement of said stylus with respect to coordinate axes perpendicular to each other, whereby there is recorded on said film tracks corresponding respectively to the successive positions of the stylus with respect to said system of coordinates.

5. In combination, a motion picture film record of an animated subject, a screen, means for projecting, a frame at a time, images of said animated subject upon said screen, each frame image differing from its immediately preceding frame image to an extent corresponding to a time interval within the period of persistence of vision, means for tracing with a stylus the boundaries of areas of distinctive tone values of each of said projected images in turn, and means for making a second record member corresponding to the movements of said stylus with respect to a system of coordinates.

6. In combination, a screen, means for throwing on said screen one at a time animated images of a graphic or pictorial representation, said images differing from each other by changes which would ordinarily occur within a period of time within the period of persistence of vision, means for successively tracing the boundaries of areas of distinctive tone values of each of said images, and means for making a record member of the movements of said tracing means with respect to a system of coordinates.

7. An electrograph system comprising a transparent screen, means for projecting a series of images of an animated subject on one side of said screen, each of said images differing from its immediately preceding image in the series to an extent corresponding to a time interval within the persistence of vision and each image comprising a background which is substantially the same as the background in the other images in the series, a transparent template having a continuous groove therein which fits over and coincides with the background in each of said images, said transparent template being placed on the side of said screen remote from the side upon which the images are projected, a stylus, and means for mounting said stylus so that it may be quickly moved in said groove.

8. A system of image production for animated subjects comprising means for successively projecting an image of each frame of a film record of an animated subject upon a screen, each frame image differing from its immediately preceding frame image to an extent corresponding to a time interval within the period of persistence of vision, stylus controlled means for resolving the image of each frame into two signal currents re-

spectively corresponding to the distances of successively traced points of said image from each of a pair of coordinate axes, and means for sending these signal currents to a receiving station, said receiving station including a cathode ray receiver comprising two pairs of deflector plates to which voltages corresponding respectively to said signal currents are applied, said frames being completely transmitted at a rate of speed within the period of persistence of vision although the frames are traced at a rate of speed less than said transmission speed.

9. An electrograph transcriber comprising a screen, a supporting member for said screen, means for successively projecting an image of each frame of a film record of an animated subject upon said screen, each frame image differing from its immediately preceding frame image to an extent corresponding to a time interval within the period of persistence of vision, a stylus for tracing the boundaries of areas of distinctive tone values of each frame image, a light valve having two apertures therein, means controlled by the movement of said stylus for determining the width of said apertures, a light source, means for focusing the light from said light source upon said apertures, a moving film, and means for focusing the light passing through said apertures upon said moving film to make

tracks thereon corresponding respectively to the successive positions of said stylus with respect to a pair of coordinate axes.

10. In combination, a supporting member, said supporting member having a transparent portion therein, said transparent portion being arranged to have projected thereon a succession of still images, each image differing from its immediately preceding image to an extent corresponding to a time interval within the period of persistence of vision, an elongated plate member having two elongated slits therein, an elongated light source, means for focussing radiations from said elongated light source upon said elongated slits, a stylus, means for supporting said stylus so that as it moves over boundaries of areas of distinctive tone values of an image on said transparent portions of said supporting member portions of said elongated slits are covered so that light from said source does not reach said slits, and a record member for receiving the light which passes through the parts of said elongated slits which are not obscured, whereby a record is made of the coordinates of the successive positions of said moving stylus with respect to a pair of coordinate axes in a time interval much greater than one within the period of persistence of vision.

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