

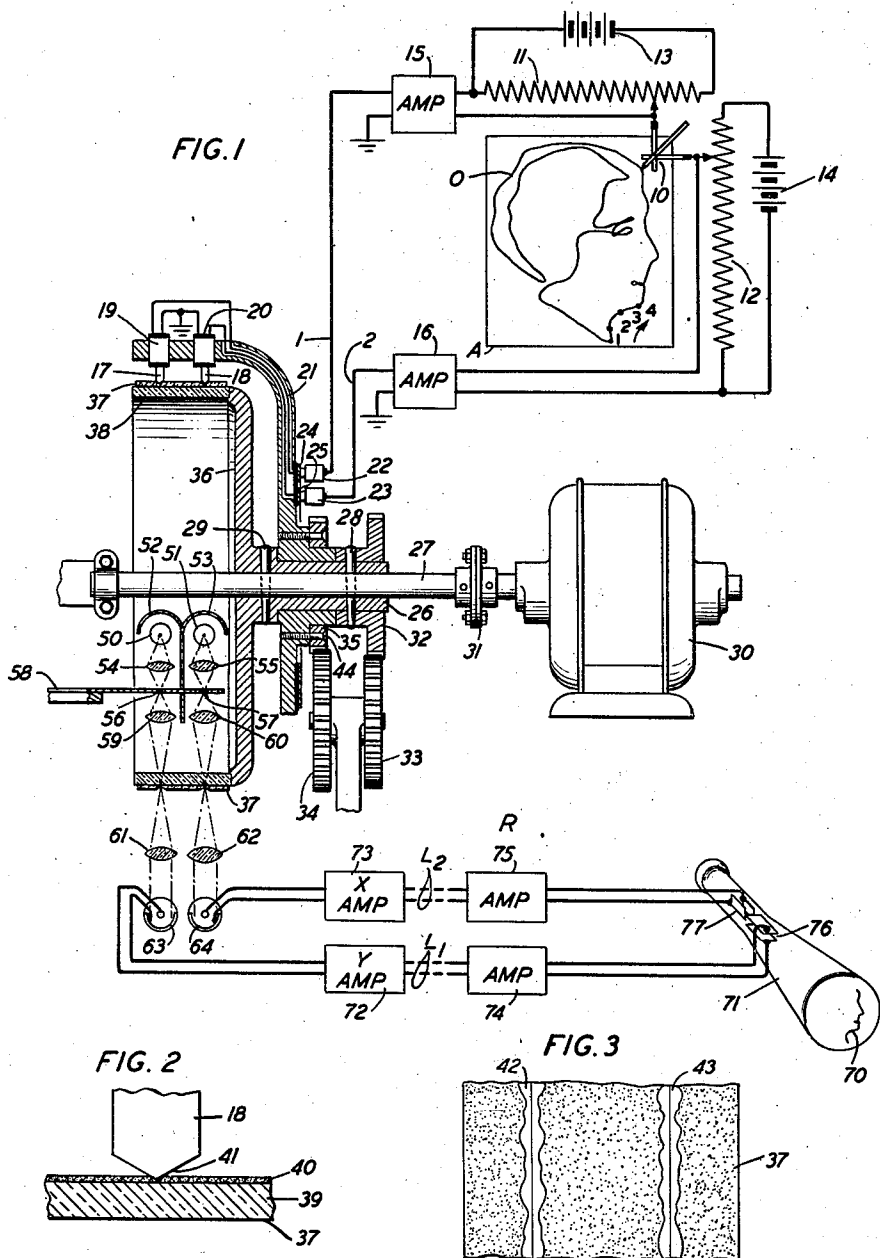
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ELECTRO-OPTICAL SYSTEM

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ELECTRO-OPTICAL SYSTEM

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9 Claims. (Cl. 178—20)

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

In copending applications of A. M. Skellett, Serial No. 117,521, filed December 4, 1936, and Serial No. 117,522, filed December 4, 1936, there are disclosed electrographic systems for producing images from currents produced by moving a stylus over the subject along selected paths such as the boundary lines between distinctive areas. The frequency bands required for the transmission of these images are small compared with the frequency bands required in ordinary television systems. In the electrographic systems disclosed in these copending applications, boundaries of distinctive areas of the subject are traced with a stylus and record members corresponding to the movements of the stylus made therefrom. At some later time, which may be very soon thereafter, signal currents are generated from these record members and transmitted to a receiving station. There frequently arises a situation where it is desirable to transmit signals as the stylus traces the outlines of the subject. For example, it may be desired to transmit images of a drawing as it is taking shape at the transmitting station.

It is an object of this invention to provide an electrographic system having an instantaneous transcriber and converter, that is, one which transmits image currents corresponding to the movements of a stylus over the boundaries of distinctive areas of a subject at the same time that the stylus is passing over these boundaries.

In accordance with a preferred embodiment of this invention, shown by way of example for purposes of illustration and hereinafter described in detail, an arrangement is provided for resolving each point traced by a stylus or drawing instrument in its passage along the boundaries of distinctive areas of a subject, such as a graphic or pictorial representation, into its X and Y coordinate voltages. The coordinate voltages produced are used to control the armatures of two electromagnets. These armatures have on one end thereof cutting tools which are used to engrave track records on a film. The cutters are mounted on a rotating structure, as is also the film, but the cutters rotate at a slightly higher speed than the film. The relative speeds of the cutters and the film are such that the cutters make one complete revolution with respect to the drum upon which the film is mounted in one to twenty minutes, a time which is usually sufficient for the artist to draw his sketch or trace the sketch with the stylus. Associated with the mov-

ing drum and located inside thereof are stationary photocell pick-ups for generating at intervals within the period of persistence of vision image currents which are generated from as much of the film record as has been engraved up to that time. Currents generated by the photo-cell pick-ups may be amplified and transmitted to a receiving station and there used to control the production of voltages which are applied across the deflector plates of a cathode ray tube to deflect the cathode ray beam therein in accordance with the successive values of the coordinate voltages. Due to the fact that as much of the representation as the artist has already traced is retransmitted over and over, each transmission within a time interval within the period of persistence of vision, the observer at the receiver sees the sketch as it is being drawn. This arrangement is not applicable to the transmission of animated images.

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 the electrographic system of this invention;

Fig. 2 shows a method of engraving a film; and

Fig. 3 shows a section of film with the engraved tracks therein.

Referring more particularly to the drawing, Fig. 1 shows an arrangement for producing an image of a subject, such as a pictorial or graphic representation, while the boundaries of distinctive areas of this subject are being traced at the transmitting station. In general, the system comprises means such as a stylus 10 for tracing the boundaries of distinctive areas of a subject O, apparatus for generating two potentials corresponding to the successive positions of the stylus with respect to X and Y coordinate axes, means for recording these coordinate voltages on a record member, and means for immediately transmitting from this record member as much of the record as has been recorded and repeating this transmission over and over every twentieth of a second until the whole subject has been traced and there is a complete track record thereof.

For producing the two coordinate voltages, a device similar to a telautograph may be used. The stylus 10 may be connected to two resistances 11 and 12 arranged at right angles to each other so that as the stylus draws or traces over the boundaries of areas of distinctive tone values of the design O, varying voltages are produced at the resistances which correspond to the X and Y coordinates of the successive positions of the

stylus with respect to a pair of coordinate axes. Connected in circuit with the potentiometer resistances 11 and 12, respectively, are batteries 13 and 14 which cooperate with the varying resistances 11 and 12 to produce potentials which vary respectively with the X and Y coordinates of the successive positions of the stylus point.

After amplification by the amplifiers 15 and 16, the image currents in channels 1 and 2 are used to control the movement of armatures 17 and 18 of electromagnets 19 and 20 to control the making of a record of the coordinate voltages as they are generated. Electromagnets 19 and 20 are preferably mounted on a rotating frame member 21. Any suitable means such as the brushes 22 and 23 cooperating with slip rings 24 and 25 may be used to make moving contact to the wires leading to the electromagnets 19 and 20. The rotating frame 21 is loosely mounted on a sleeve 26, which sleeve is keyed to the shaft 27 by any appropriate means such as keys 28 and 29. Frame 21 is adapted to be driven by the shaft 27 (which is in turn driven by the motor 30 through a coupling device 31) by means of the gear train 32, 33, 34 and 35. The gear 32 is keyed to the shaft 27 by means of key 28 and the gear 35 is fastened to the frame 21 by any suitable means such as the screws 44. The gears 32, 33, 34 and 35 have numbers of teeth in such ratio to each other that the frame member 21 makes one complete revolution with respect to the shaft 27 in a period of time which is approximately from one to twenty minutes, which should be ample time to allow the artist to completely trace or draw the subject O. Mounted on the shaft 27 and keyed thereto by means of the key 29 is a rotating drum 36 having a transparent portion 38 upon which a film 37 is mounted.

The film 37 comprises a film base 39 having a thin opaque layer 40 thereon (see Fig. 2). Armatures 17 and 18 of the electromagnets 19 and 20 have cutter edges 41 which move up and down according to the respective values of the coordinate voltages. In moving up and down on the surface of the moving film 37 the cutters engrave tracks similar to tracks 42 and 43 of the film 37 shown in Fig. 3. These tracks are of variable depth and because of the wedge shape of the cutter edge, a path of variable width or area is engraved in the opaque coating 40 of the film 37. It will thus be understood that as the stylus 10 traces the subject to be transmitted, tracks 42 and 43 will be simultaneously engraved upon a film 37 which corresponds to the variations in the distance of the stylus from the coordinate axes in its successive positions as it traces the boundaries of areas of distinctive tone values of the graphic or pictorial representation O.

Located adjacent the drum 36 is a stationary pick-up mechanism for generating signal current corresponding to the tracks 42 and 43 on the film 37. This pick-up mechanism preferably comprises a pair of light sources 50 and 51, darkened partition members 52 and 53 for separating the two light sources and for confining the light to the desired optical channels, lenses 54 and 55 which focus the light upon suitable slit apertures 56 and 57 of the supporting member 58 for the partition members 52 and 53 and the rest of the optical system located within the drum 36, and lenses 59 and 60 which form images of the apertures 56 and 57 upon the film 37 to control the production of photoelectric currents by the stationary photocell devices 63 and 64. These aperture images are just large enough to cover small areas of the tracks 42 and 43 of the film 37. The tracks 42 and 43

vary the amount of light passing through the film 37 and this light of varying intensity is focused by means of lenses 61 and 62 upon the stationary photocell devices 63 and 64 which generate signal currents corresponding to the potentials generated by means of the potentiometer arrangement comprising the resistances 11 and 12 and the batteries 13 and 14.

To better understand the operation of the device in Fig. 1, let it be assumed that the transcriber is drawing or tracing a line (a boundary of distinctive areas) defined by the points 1, 2, 3, 4, etc., of the graphic or pictorial representation O in the direction of the arrow. Point 1 will have two potentials generated by the potentiometer arrangement which correspond respectively to its X and Y coordinates taken from the origin A. These voltages will actuate the cutters 17 and 18 of the electromagnets 19 and 20 to form an elemental section of the tracks 42 and 43 on the film 37. As the drum 36 is continually rotating with respect to the stationary photoelectric cells 63 and 64 at a speed of, for example, twenty times a second, current will be generated by these cells 63 and 64 every twentieth of a second corresponding to the X and Y coordinates of this point 1. As the transcriber progresses with his tracing over the successive points 2, 3, 4, etc., the tracks 42 and 43 of the film 37 get progressively longer and every twentieth of a second the image currents generated by the cells 63 and 64 extend for longer durations of time as the image currents correspond to a greater number of points on the boundaries of the subject O. Inasmuch as the rotating structure 21 is only slightly faster than the drum 36, the tracks 42 and 43 gradually increase in length, the length of these tracks being continually increased until the whole representation O has had its boundaries of areas of distinctive tone values traced by the stylus 10. When this final point of the tracing has been reached, the tracks 42 and 43 represent the entire representation O and the image currents generated every twentieth of a second by the photocells 63 and 64 are in turn representative of the X and Y coordinates of the successive points of the stylus 10 as it traced the boundaries of areas of distinctive tone values of the entire representation O. With proper timing, the tracks 42 and 43 will extend around the entire circumference of the drum 36 so that there is maximum efficiency in the use of line time. This desirable situation is not necessary, however, to the operation of the device, as satisfactory pictures are presented on the fluorescent screen 70 of the cathode ray device 71 at the receiving station regardless of whether the entire length of the film 37 has been used to record the tracks 42 and 43.

The method of recording the coordinate voltages, while not being claimed as novel per se by the present inventor, offers decided advantages for use in this system. The recording is instantaneous, no development or fixing is required and reproduction may be made from the record any number of times without destroying the tracks. It is to be understood, however, that this invention is not limited to this specific means of recording, as any other suitable means possessing these advantages may be used instead. For example, the potentials in channels 1 and 2 may be used to generate sounds of the proper frequency and these sounds recorded on a metal or wax disc, reproduction being made from this disc every twentieth of a second by the usual reproducing devices for this type of recording.

The signal currents generated by the photo-

electric cells 63 and 64 may be used to modulate carrier waves, if desired, and these waves transmitted to the receiving station R over suitable line or radio channels L1 and L2. Amplifiers 72 and 73 at the transmitting station and 74 and 75 at the receiving station may be used to step up the signals.

The signals in channels L1 and L2, after being received at the receiving station R and amplified by the devices 74 and 75, may be applied across two pairs of deflecting plates 76 and 77 of the cathode ray receiving tube 71. These potentials when applied to opposite plates of the pairs of sweep plates 76 and 77 cause the beam to be deflected in such a manner that the image on the fluorescent screen corresponds to so much of the representation O at the transmitting station as has been traced or drawn up to the particular instant and the observer at the receiving station will thus see the image as it is being formed. As the signals corresponding to the points previously traced by the stylus 10 are repeated over and over twenty times a second, a steady image appears on the receiving screen 70, which image increases in detail until the whole representation has been traced.

The frequency band width required by the system of this invention is relatively small compared with that required in ordinary television systems. It is so small that it is no larger than those of the ordinary high fidelity radio transmitting stations of today. If desired, a sound track may be provided so that as the observer views the image of the representation O taking shape, he may hear the proper sound accompaniment. This system may be very useful in connection with advertising manufacturers' products. For example, the trade mark or distinctive brand of a manufacturer's product may have its boundaries of various distinctive tone values quickly traced by a stylus in the hands of a skilled person at the transmitting station and the impression upon the observer at the receiving station will be very effective. This impression should stimulate sales.

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 distinctive areas" is intended to be inclusive of the case where a distinctive area is a line, as in an outline sketch. 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. This term, "along the boundaries of distinctive areas", is also intended to be inclusive of the case where the areas are distinguishable by differences in elevation as, for example, a figure cut from cardboard and placed or mounted upon a flat support having the same or different tone value or an element of wax forming a field in which a line drawing, figure or design of any kind is produced by indentations in the wax, thus forming depressed line areas.

What is claimed is:

1. A method of image production comprising the steps of tracing or drawing the boundaries of distinctive areas of a subject, simultaneously generating by said tracing two potentials continuously varying in accordance with the positions of successively traced elements of said boundaries recording these potential variations, transmitting these variations from the recording means imme-

diately thereafter, and retransmitting from this record at intervals within the period of persistence of vision as much of the record as has been made up to that time.

2. In combination, means for generating two potentials continuously varying in accordance with successive positions of a stylus used to trace the boundaries of distinctive areas of a subject, means for transmitting image currents corresponding to these potentials immediately after said potentials are generated, and means for retransmitting at intervals within the period of persistence of vision as much of the image currents as have been generated up to that time.

3. An electrograph system for the production of an image of a subject while the boundaries of distinctive areas of said subject are being traced by a stylus, comprising means for generating image currents representative of the location of a portion of one of said boundaries being traced by the stylus with respect to coordinate axes at substantially the same time said stylus has traced said portion, and means for generating image currents thereafter at predetermined intervals within the period of persistence of vision corresponding to the location of said portion together with the location of such additional portions with respect to said coordinate axes as have been traced by the stylus since the tracing of said first portion.

4. An electrograph system for the production of an image of a subject while the boundaries of distinctive areas of said subject are being traced by a stylus, comprising means for generating two potentials representative of the location of a portion of one of said boundaries being traced by the stylus with respect to coordinate axes, apparatus for recording said potentials, means for immediately thereafter transmitting image currents representative of the location of said portion with respect to the coordinate axes from said record member, and means for generating image currents thereafter at predetermined intervals within the period of persistence of vision corresponding to the location of said portion together with the location of such additional portions with respect to said coordinate axes as have been traced by the stylus since the tracing of said first portion.

5. In combination, a rotating drum having a transparent portion thereof, a film adapted to be fitted over the transparent portion of said drum, said film having an opaque coating on the side remote from said transparent portion, a rotating member, the rate of speed of said rotating member with respect to said rotating drum being such that said member makes a complete revolution with respect to the rotating drum in a relatively long period of time compared with the period of time necessary for a complete revolution of either the rotating drum or the rotating member, electromagnetically operated cutters carried by said rotating member, and a stationary photocell pick-up device for generating image currents from said tracks.

6. In combination, a record member, means for moving said record member with respect to a point of fixed position, means having movement with respect to said moving record member and also with respect to said point of fixed position to form a track on said record member, and means stationary with respect to said point of fixed position for reading from said track at a rate different from that at which said track was formed.

7. In combination, a drum, a record member in the form of a closed band mounted around the periphery of said drum, means for rotating said drum, means having movement with respect to said moving drum to form tracks on said record member representative of electrical signals, and stationary means for producing electrical signals from said tracks at a rate different from that at which said tracks were formed.
8. In combination, a drum, a record member in the form of a closed band mounted around the periphery of said drum, means for rotating said drum, means having movement with respect to said moving drum to form tracks on said record member representative of electrical signals, and stationary means for producing electrical signals from said tracks at a rate different from that at which said tracks were formed, said rotating means and said stationary means cooperating to repeat signals from said record member at periodic intervals.

9. In combination, a drum, a record member in the form of a closed band of film mounted around the periphery of said drum, said drum having a transparent portion contiguous to said film, means for rotating said drum, a member carrying electromagnetic cutters, said cutters being so positioned that they contact said film, means for producing relative movement between the rotating member and said drum whereby tracks are formed on said record member representative of electrical signals which actuate said electromagnetic cutters, and stationary photocell equipment within said drum for producing electrical signals from said track at a rate different from that at which said tracks were formed, said drum rotating means and said photocell equipment cooperating to repeat signals from said record member at periodic intervals.

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