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VIBRATING ELECTRODE PICKUP FOR THE TRANSMISSION
OF ELECTROSTATIC RECORDINGS
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2,830,114

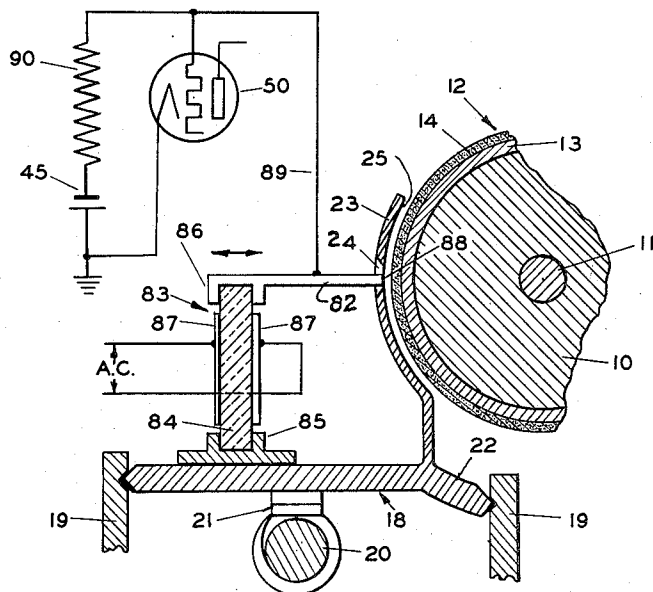


FIG. 1

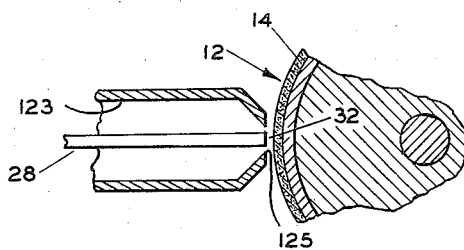


FIG. 2

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VIBRATING ELECTRODE PICKUP FOR THE TRANSMISSION OF ELECTROSTATIC RECORDINGS

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Divided and this application October 26, 1951, Serial No. 253,436

6 Claims. (Cl. 178—7.1)

This invention relates to methods and apparatus for the electric transmission of electrostatic recordings.

This is a division, of copending application Serial No. 26,663, filed May 12, 1948, now Patent 2,583,546, granted January 29, 1952.

An object of the invention is to improve such methods and apparatus.

Another object is to provide methods and apparatus for converting an electric charge pattern on an electrophotographic plate or other electrostatic record element into electric signals or variations.

A further object is to improve methods and devices for facsimile, telepicture and phototelegraphic purposes, electric image transmission and related purposes.

An additional object is to provide a method and apparatus for reproducing sounds and related variations.

Other objects of the invention will be apparent from the following description and accompanying drawings taken in connection with the appended claims.

The several objects of the invention are attained, in conjunction with a system for transmitting electrical signals representing variations in electrostatic charge of differing portions of an electrostatic charge pattern, by an apparatus comprising a record member having an insulating surface for carrying an electrostatic charge image, a scanning member cooperating therewith, movable supports for both of said members, driving means to move the scanning member over the insulating surface of the record member for scanning the electrostatic image thereon, wherein the scanning member includes a conductive electrode and means for mounting the electrode in closely spaced relation to the insulating surface, said mounting means including an ultrasonic vibrator connected to the electrode to vibrate the electrode toward and away from the insulating surface at fixed frequency and amplitude, and wherein the input circuit of an amplifier is connected to the electrode whereby variations in the electrostatic charge induced on the electrode are fed to the amplifier as an input signal.

The invention accordingly consists in the features of construction, combination of elements, and arrangement of parts as will be exemplified in the structures to be hereinafter described and the scope of the applications of which will be indicated in the following claims.

For a more complete understanding of the invention reference can be made to my Patent Number 2,583,546 of which this is a division, and to the accompanying drawing in which:

Figure 1 is a diagrammatic illustration partly in section, of part of a transmitting system and apparatus; and

Figure 2 is a detail view of a modified transmitting apparatus.

In Carlson Patent 2,297,691, issued October 6, 1942, is described a process of Electrophotography and an electrophotographic plate for use therein. The plate, in its preferred form comprises a conductive backing, such as a sheet of metal, coated with a layer of photo-

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conductive insulating material. An electrostatic charge pattern or latent image can be produced on or in the layer by a suitable combination of electric charging and photographic exposure, as described in that patent.

Carlson Patent 2,357,809 of September 12, 1944, shows in Figure 10 a modified form of electrophotographic plate, and in Figure 11 a form of master plate capable of acquiring an electrostatic latent image or charge pattern. Methods of producing charge patterns on such plates are described, for example, on page 6 of that patent.

Another Carlson Patent, namely 2,277,013 of March 17, 1942, describes methods and devices for the Electric Recording and Transmission of Pictures and shows another form of electrophotographic element adapted for such purposes.

The present invention contemplates apparatus for transmitting electric signals or like variations from electrophotographic plates of the kind described in Carlson Patents 2,297,691 and 2,357,809. It is also contemplated that, in some instances, signals may be transmitted from other electrostatic record elements such as master plates of the kind shown in Figure 11 of Patent 2,357,809.

In a preferred embodiment the invention contemplates a scanning system and method for detecting and transmitting element by element and line by line the electrostatic charge pattern on an electrophotographic plate or other electrostatic charge-carrying element, whereby pictures, intelligence, sound recordings and the like may be transmitted over facsimile systems or the like, or may be transferred from the plate or element to another plate or element or electro-mechanically engraved in metal, wax, plastic or other material to form printing cuts, sound recordings and the like.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the construction of parts without departing from the spirit of the invention. In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Referring to the drawings Figure 1 shows the essential features of an apparatus for scanning an electrophotographic plate carrying a charge pattern or electrostatic latent image and for converting the charge variations obtained by scanning in sequence individual areas of the plate into signal currents. The apparatus comprises a drum 10, shown in cross-section mounted on a driven shaft 11 for rotation for scanning purposes. The electrophotographic plate 12 comprising a flexible metal foil or sheet 13 having a coating 14 of photoconductive insulating material is wrapped around drum 10. Reference is made to Carlson Patent 2,583,546 and to Figures 7 and 8 of Carlson Patent 2,277,013 for further details of construction.

A carriage 18 is slidably supported on a pair of guides 19 for movement along the side of the drum and a motor-driven advance screw 20 extending parallel to shaft 11 meshes with a threaded lug 21 on carriage 18 to advance the carriage slowly along the side of the drum.

The carriage comprises a grounded metal frame 22 slidable in guides 19 and integral upstanding wall 23 concavely rounded to follow the contour of the cylindrical surface of drum 10 and thereby provide a concave wall uniformly spaced from the surface of the drum throughout its area. The spacing is sufficient to leave a narrow air gap between the surface of coating 14 of the electrophotographic plate and the concave surface of wall 23.

A small aperture 24 is formed in the middle of wall 23, the sides of the aperture being tapered or flared out-

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ward on the back face of the wall. The wall of aperture 24 which intersects with inner face 25 of wall 23 is brought sharply to an angular edge defining the smallest diameter of the aperture. This diameter depends upon the width of the line it is desired to scan on the plate 12. Thus, if it is desired to scan with a resolution of 100 lines per inch the diameter of aperture 24 is preferably in the order of 0.01". This diameter may be somewhat greater than the width of the line to be scanned, however, and useful results are obtainable even with diameters twice that of the line width. The spacing between face 25 and the surface of coating 14 is made as small as possible and preferably is not greater than the line width, such as 0.01 inch.

A pin-like scanning electrode 82 having a flat or slightly rounded scanning tip 88 disposed in the center of aperture 24 and substantially flush with inner face 25 of wall 23 is mounted for longitudinal vibration at ultrasonic frequencies on a vibrator, such as piezo-electric crystal vibrator 83. Piezo crystal 84 is supported rigidly at one end in a mounting 85 secured to carriage 18 and electrode 82 is secured by mounting 86 to the free end of the crystal to extend parallel to the direction of vibration. A pair of electrodes 87 applied to the faces of the crystal are supplied with alternating current of a voltage and frequency sufficient to vibrate the scanning tip 88 of the electrode toward and away from the coating 14 of plate 12 carrying a charge image. Electrode 82 is connected by conductor 89 to the grid of triode 50. Grid bias battery 45 is connected through high resistance 90 to the grid. During scanning the vibration of tip 88 varies the capacity between the tip and the coating 14 at the frequency of vibration so that an alternating voltage is superimposed on the grid bias whenever a charged area of the coating passes the tip. The amplitude of the variations will depend on the density of charge on the elemental area being scanned. The output of tube 50 will comprise an alternating signal superimposed on the plate current. The signal can be further amplified and transmitted by well-known means.

Figure 2 is a fragmentary view illustrating a modification of the transmitter of Figure 1. In this embodiment wall 23 is replaced by a tubular metal scanning head 123 surrounding electrode pin 28 and terminating in a reduced-diameter rim 125 around end 32 of the pin and spaced from the end. It is evident from this that the shield need not be a wall of extensive area but can be simply a narrow wall or edge close to the end of the electrode, and the term "wall" as used in the claims, is intended to include such a construction.

It is obvious that the mechanical arrangements may be varied in many known ways to facilitate the scanning operation. For example, the parts here illustrated as mounted on a carriage for movement along the side of the drum may be stationary and the drum itself may be advanced on a screw to effectuate the scanning. Also, it is apparent that the electrostatic record element can vary in form and that the signals may be reproduced from, or recorded on, a flat plate electrostatic record element or a tape electrostatic record element, such as a metal tape coated with photoconductive insulating material in which electrostatic record comprises a single path or multiple paths lengthwise of the tape.

While the present invention, as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. In a device for transmitting electric signals representing electrostatic recordings, the combination of a record member having an insulating surface for carrying an electrostatic charge image, a scanning member, movable supports for said members, driving means to move said scanning member over said surface for scanning an electrostatic image thereon, said scanning member comprising a

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conductive electrode and means mounting said electrode in closely-spaced relation to said surface, said mounting means including an ultrasonic vibrator connected to said electrode to vibrate said electrode toward and away from said insulating surface at fixed frequency and amplitude, and an amplifier having its input circuit connected to said electrode whereby variations in the electrostatic charge induced on said electrode are fed to said amplifier as an input signal.

2. The combination as claimed in claim 1 in which said amplifier comprises a triode and said electrode is connected to the grid of said triode.

3. An apparatus for converting an electrostatic charge pattern on a record member to electrical signals varying in amplitude proportionally to charge variations in the charge pattern, comprising the combination of a record member having an insulating surface for carrying an electrostatic charge image, a scanning member, movable supports for said members, driving means to move said scanning member over said surface for scanning an electrostatic image thereon, said scanning member comprising a conductive electrode and means mounting said electrode in closely-spaced relation to said surface and a conductive wall surrounding said electrode in spaced relation thereto to shield said electrode from charges on said insulating surface which are not directly under said electrode, said mounting means including an ultrasonic vibrator connected to said electrode to vibrate said electrode toward and away from said insulating surface at fixed frequency and amplitude, and an amplifier having its input circuit connected to said electrode whereby variations in the electrostatic charge induced on said electrode are fed to said amplifier as an input signal.

4. The combination as claimed in claim 3 in which said amplifier comprises a vacuum tube and said electrode is connected to the grid of said vacuum tube.

5. An apparatus for converting an electrostatic charge pattern on a record member to electrical signals varying in amplitude proportionally to charge variations in the charge pattern, comprising the combination of a cylinder having an insulating surface for carrying an electrostatic charge image, a scanning member, means supporting said cylinder for rotation on its axis and means supporting said scanning member for movement parallel to the axis of said cylinder along the side of said cylinder for scanning an electrostatic image on said surface, said scanning member comprising a conductive electrode and means mounting said electrode in closely-spaced relation to said surface, said mounting means including an ultrasonic vibrator connected to said electrode to vibrate said electrode toward and away from said insulating surface at fixed frequency and amplitude, and an amplifier having its input circuit connected to said electrode whereby variations in the electrostatic charge induced on said electrode are fed to said amplifier as an input signal.

6. The combination of claim 5 in which the surface of said cylinder comprises a layer of photoconductive insulating material.

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