

Sept. 24, 1957

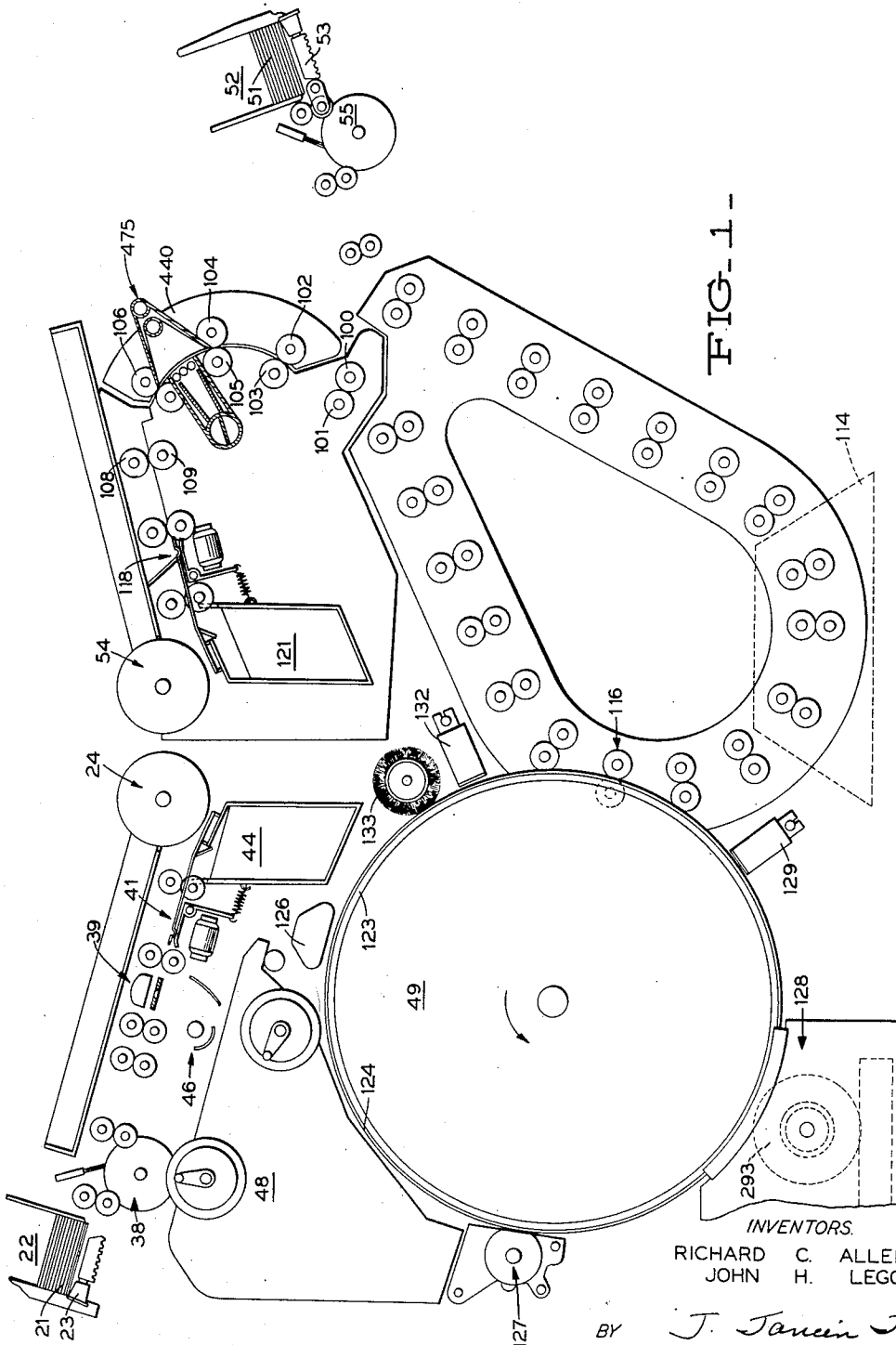
R. C. ALLEN ET AL

2,807,704

XEROGRAPHIC IMAGE FIXING APPARATUS

Filed June 14, 1956

3 Sheets-Sheet 1



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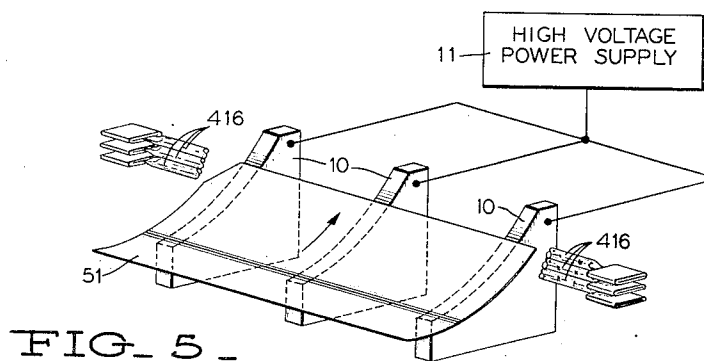
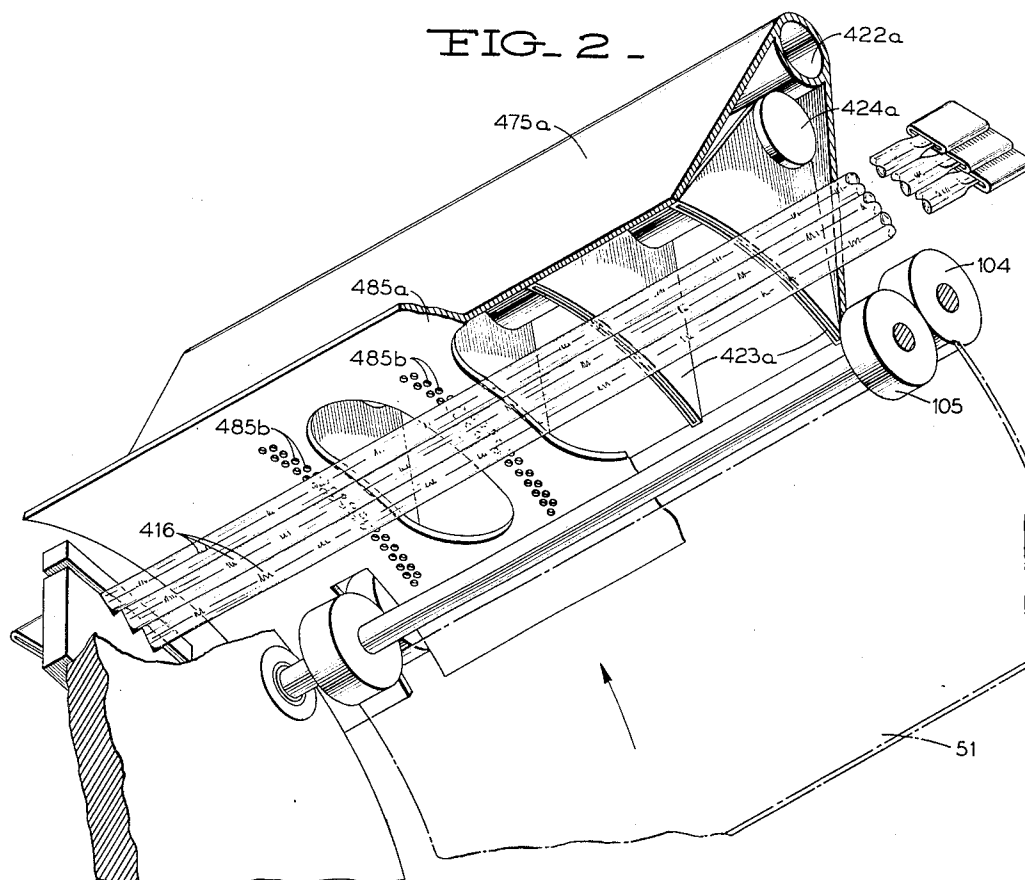
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XEROGRAPHIC IMAGE FIXING APPARATUS

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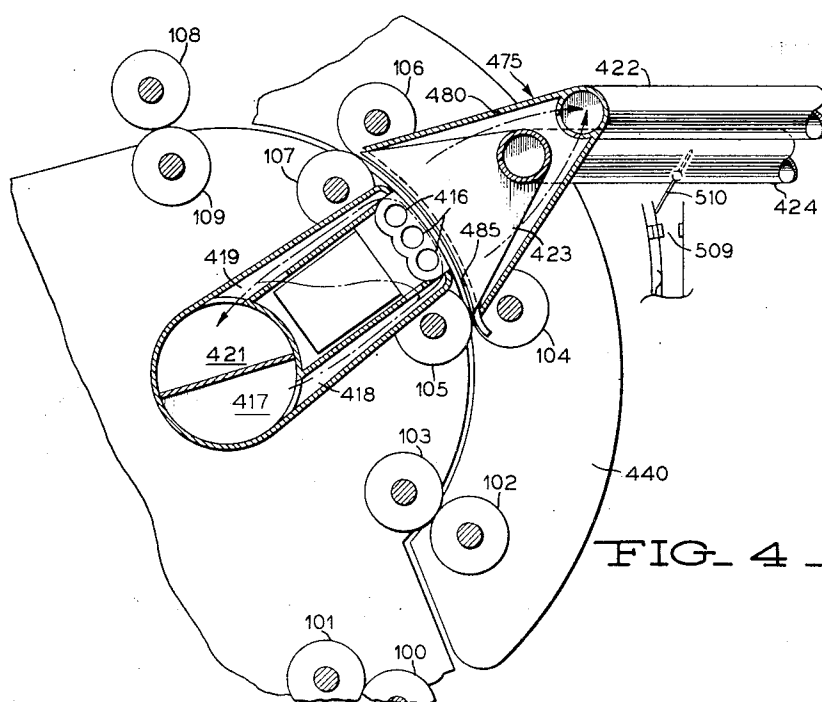
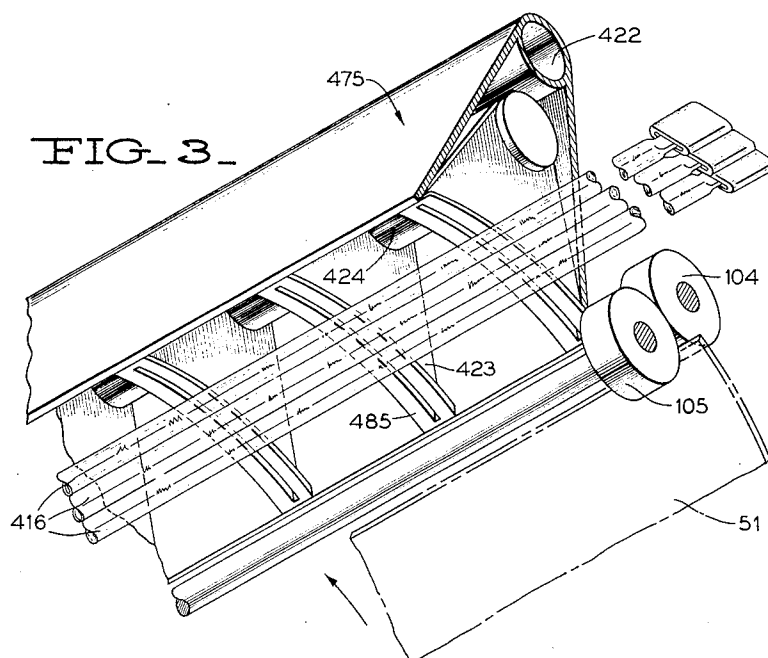
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XEROGRAPHIC IMAGE FIXING APPARATUS

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XEROGRAPHIC IMAGE FIXING APPARATUS

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Application June 14, 1956, Serial No. 591,495

6 Claims. (Cl. 219-45)

This invention relates to electroscopic toner heat fixing apparatus for use in xerographic printers to permanently affix toner images onto their respective receiving materials.

An object of this invention is to provide an improved electroscopic toner heat fixing apparatus that is compact in design and efficient in operation, one which is unlikely to get out of order, and yet a device that may be manufactured at relatively low cost.

Another object of this invention is to provide an electroscopic toner heat fixing apparatus having means for maintaining the toner print receiving material at a fixed predetermined distance from the heat energy source of said apparatus.

In keeping with the foregoing, another object of this invention is to provide an apparatus for heat fixing electroscopic toner images on individual record cards which are caused to be moved one by one at a fixed distance from the heat energy source.

Still another object of this invention is to provide an apparatus wherein all of the variable parameters relative to heat fixing toner images onto individual record cards can be maintained constant so as to obtain uniformly fixed toner images.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of examples, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a diagrammatic view of a xerographic card printer in which the present invention is shown to be embodied.

Fig. 2 is an isometric view, with parts in section, of one embodiment of the present invention capable of use in the aforesaid xerographic printer.

Fig. 3 is an isometric view, with parts in section, of another embodiment of the present invention capable of use in the xerographic card printer.

Fig. 4 is a front elevation, with parts in section, of the aforesaid another embodiment.

Fig. 5 is a diagrammatic view of an electrostatic card holder.

INTRODUCTION

In order to permanently affix an electroscopic toner image onto a print receiving material by heat, it is necessary to raise the temperature of the electroscopic toner which defines the image, to a point where at least one of the constituents of the toner, or the toner as a whole, is caused to melt or fuse. This action will cause molten droplets thereof to form, of course, which are capable of being absorbed in the fibers of the print receiving material, e. g., paper, so as to produce a permanent image imprint thereon. Subsequent toner image cooling will cause solidification of the toner defining said image so as to produce an indelible image which is firmly bonded to the print receiving material.

It is well recognized that heat fixing is old in this phase of the graphic arts as a method for permanently fixing toner images. One of the earliest and, in fact, most common heat fixing arrangements prior to the con-

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ception of the present invention, was to employ a hot plate, oven or the like device adjacent the print receiving material supporting the toner images to be fixed. However, these oven-type heating arrangements afforded one significant disadvantage. That is, sufficient moisture was driven from the print receiving material so as to cause the same to become brittle if it were in the form of a web, or to warp and curl as well as become brittle if it were in the form of individual cards. Accordingly, the preceding oven-type heating arrangements as well as other toner heat fixing apparatus known heretofore, have been found to be inadequate particularly for use with a xerographic printer of the type disclosed and claimed in the copending U. S. patent application, Serial No. 556,176, filed on December 29, 1955, by M. J. Kelly. Briefly described, this machine which is similar to the commercially available IBM Type 938 Electrostatic Card Printer, is one whereby electroscopic toner images are caused to be developed on the peripheral surface of a xerographic drum, and then transferred, one by one, onto the surface of a related one of successively fed print receiving record cards similar to the well-known IBM type record cards.

The preferred embodiment of the present invention effects selective heating of the electroscopic toner that defines an image on a record card, in a manner similar to that accomplished by the apparatus disclosed and claimed in another copending U. S. patent application, Serial No. 591,466, which was filed by D. D. Roshon on June 14, 1956. When a record card supported toner image is fixed in accordance with the selective heating principle, the electroscopic toner material is heated to the fusing point thereof while the temperature of the record card per se is caused to be kept at a value sufficiently below the boiling point of water which, in turn, is below the fusing point of the toner. Accordingly, card dimensional changes and warping are kept to within tolerable limits. The selective heating is accomplished by directing radiant energy, such as infrared radiations, for example, onto the surface of a record card whereon the electroscopic toner image is supported as the said card is moved past the radiant energy source. Furthermore, the transfer of heat energy from the aforesaid source by either conduction or convection is prevented for the most part by suitable means.

ELECTROSTATIC CARD PRINTER

A diagrammatic showing of the afore-mentioned xerographic printer shown and described in the copending Kelly application, is shown in Fig. 1 hereof. Briefly described for present purposes only, source information primary cards 21 to be operated on are stacked in a hopper 22 and are fed therefrom, one by one, each primary card feed cycle by a conventional card picker mechanism 23. Successive pairs of feed rollers cause a primary card to be advanced during succeeding card feed cycles past a punched hole indicia brush reading station 38, a source information optical scanning station 39, and into a card stacker 44. There is associated with the optical scanning station 39 a light ray projector apparatus 46 for effecting a conventional light scanning operation of the source information on the moving primary record cards, whereby the image of optically visible printed source information carried by each primary card, is transferred by an optical projecting apparatus 48 onto the electrostatically charged surface of the xerographic drum 49. This drum includes an electrically conductive cylinder 123 having thereon a light sensitive photoconductive insulating layer 124 such as amorphous selenium. It should be clear that the xerographic drum which is driven in a counterclockwise direction, must rotate at a speed such that the peripheral speed thereof is correlated to the

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lineal speed of feeding primary cards past the optical scanning station 39.

As successive incremental areas of the light sensitive insulating layer 124 are moved past the ion-producing charging unit 126, the aforesaid layer is caused to be electrically charged positive. Thus, there is a positive latent electrostatic image formed on said insulating layer consequent upon the exposure thereof to the optical image of the source information carried by a primary card 21. A rotating developing brush 293 of the type described in detail in another copending U. S. patent application, Serial No. 554,515, which was filed on December 21, 1955, by W. D. Bolton et al., is employed to apply the electroscopic toner which is a pigmented thermoplastic powder, onto the latent electrostatic image bearing surface of the insulating layer 124. Continued rotation of the xerographic drum 49 causes each toner image on the surface of insulating layer 124 to be moved out of the developing station 128, past another ion-producing unit 129, and into a transfer, or printing, station 116 having a conductive image transfer roller (not shown) thereat. This transfer apparatus which per se is not a part of the present invention, is substantially similar to that which is shown and described in the copending U. S. patent application, Serial No. 419,314, which was filed on March 29, 1954, by C. J. Fitch. For the present, it need only be stated that the operation of the apparatus at transfer station 116 is such as to effect a transfer of each of a plurality of spaced developed toner images appearing on the surface of xerographic drum 49, onto a related one of a plurality of successively fed secondary record cards 51.

The secondary record cards 51 to be operated on are stacked in a secondary hopper 52, and are fed therefrom, one by one, each secondary card feed cycle towards a secondary card stacker 121 by a conventional card picker mechanism 53 which is similar to the primary card picker mechanism 23. Thereupon, successive pairs of feed rollers cause each secondary card to be advanced during the succeeding secondary card feed cycles past a punched hole indicia brush reading station 55, an in-flight card aligner mechanism identified by the reference numeral 114, the afore-mentioned toner image transfer station 116, an electroscopic toner fixing station 117, and into the stacker 121.

The electroscopic toner image transferred from the surface of xerographic drum 49 onto the surface of a related secondary card 51, must, of course, be permanently affixed thereto. As stated previously, the present invention is directed to this end and the preferred embodiment is employed in the afore-described printer in order to permanently affix the toner images onto respective secondary cards.

HEAT FIXING APPARATUS

As stated previously, one embodiment of the present invention is shown in Figs. 3 and 4, the apparatus of which may be correlated with the diagrammatic showing of the aforesaid printer by way of the feed rollers 100—109 shown in the Figs. 1, 3 and 4. This heat fixing apparatus includes a plurality of infrared heating lamps 416 which are so constructed as to span the toner image on a secondary card. These lamps are energized via conventional electrical circuits so that the temperature realized at the surface of each lamp is in the range of 2000° F. As a result, special heat removing or heat fixing apparatus cooling means must be provided in order to avoid the heating of the fixing station apparatus to a point whereby the temperature of each of the advancing secondary cards might be increased to an extent such that the same would be caused to warp. The aforesaid heat removing means shown in Fig. 4 include a blower apparatus (not shown) for continuously withdrawing a steady stream of air from an air intake opening 417 through various passages depicted by the several areas shown around the heat lamps

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416, as well as the passages 418 and 419, and into the air exhaust opening 421. The same blower apparatus may be connected to the air flow tube 422 to aid in the withdrawing of heated air from around the fins 423 (see also Fig. 3) at the toner heat fixing station.

The structure identified in Fig. 4 by reference numeral 475 includes an inverted V-shaped trough-like housing 480 within which there is located a hollow tube 424 having spaced hollow fins 423 extending therefrom. This housing is completely enclosed except for the side facing the lamps 416. The air flow tube 422 opens into one end of housing 480 so as to provide a withdrawal passage for the heated air from the toner heat fixing station in general, as is depicted by the arrows shown to be aimed into the said tube.

It should be clear that with a temperature of approximately 2000° F., should an advancing secondary card 51 be brought into physical contact with the surface of any one of the heating lamps 416, the said card would be scorched at best and might be caused to burn. In addition, the physical contact between the toner image supporting surface of the secondary card and the heat fixing lamps 416, would certainly cause the as yet unfixed image to become smeared. Since the heating lamps 416 are separated from the secondary card feed line by a very small distance which is preferably $\frac{1}{16}$ of an inch, it should be clear that it is necessary to provide some means to assure that a moving secondary card will not physically contact the surface of the heating lamps 416. This is accomplished with the present embodiment by having a plurality of hollow fins 423 (see also Fig. 3) which are spaced one from the other over a distance which is defined by the length of a record card. As stated previously, these hollow fins 423 with the slit-like apertures therein extend from a hollow tube 424 which is connected to a suitable air withdrawing unit (not shown). Since the hollow slit-like apertures within each of the fins 423 is connected to the tube 424, an air flow results from these fin openings into tube 424. Hence, as each secondary card is advanced along the secondary card feed line between feed rollers 104—106 in the direction of feed rollers 108—109, the card is held against the bottommost portion 485 of the hollow fins 423 due to the negative pressure caused by the air sucking action effected by the air movement via the hollows in the fins and tube 424. It should be clear that this action not only prevents the secondary cards from touching the heating lamps 416, but also keeps each secondary card at a substantially fixed predetermined distance from the heating lamps so as to establish this parameter at a constant value. Hence, in view of the fact that the secondary cards being fed through the secondary feed of the aforementioned printer, are moved past the toner heat fixing station thereof at a lineal speed of approximately $11\frac{2}{3}$ inches per second, and since the distance from the heat lamps 416 to the face of each succeeding secondary card is approximately $\frac{3}{32}$ inch to $\frac{1}{32}$ inch and preferably $\frac{1}{16}$ inch, the temperature of the electroscopic toner is raised to approximately 250°—300° F. Most commercially available electroscopic toners, such as those sold by the Haloid Company of Rochester, New York, under the trademarks BXT-2 and BXT-75 for example, fuse at the aforesaid temperatures. Accordingly, a good toner image fix is obtained since the temperature of the toner image on record cards being fed past the toner heat fixing apparatus shown in Fig. 4, is raised to the toner fusing point.

It is a significant feature of this invention that the fins 423 (Fig. 3) serve not only as record card guides, but are also a part of the means whereby the continuously advancing secondary cards are caused to be maintained at a predetermined distance from the heat source lamps 416.

It should be readily understandable that the slit-like apertures in the hollow fins 423 might be replaced by a series of holes 485b (see Fig. 2) each approximately $\frac{3}{32}$ to $\frac{1}{16}$ inch in diameter and located in a card guiding plate 485a. Those parts of the apparatus shown in Fig. 2

which are similar to parts of the embodiment shown in Figs. 3 and 4, are identified by corresponding reference numerals.

Another arrangement whereby the continuously moving secondary cards can be maintained a predetermined distance from the toner fixing heat energy source, includes a plurality of spaced conductors 10 (Fig. 5) which are electrified by being connected to a source 11 of high electrical potential, e. g., in the order of 6000-10,000 volts. The electrification of these card guides 10 causes each moving record card 51 to be held electrostatically against the same, while the card itself is being moved forwardly by card feed rollers.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to the preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the arts, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a machine for printing information on individual records xerographically, the combination of an electroscopic toner fixing apparatus comprising a source of radiant heat energy sufficient to fuse electroscopic toner, means for feeding toner image bearing records past said source one by one in a manner such that the toner images are opposite said source, and record holding means including a plurality of spaced record guides arranged opposite said source, said holding means adapted to operate on records as the same are moved over said record guides so as to be effective over substantially the entire area of a moving record to hold the same against said record guides, whereby the incremental surface areas of each of the moving records are maintained at a predetermined distance from said source.

2. In a machine for printing information on individual records xerographically, the combination of an electroscopic toner fixing apparatus comprising a source of radiant heat energy sufficient to fuse electroscopic toner, means for feeding toner image bearing records past said source one by one in a manner such that the toner images are opposite said source, record holding means including a plurality of spaced hollow record guides so arranged that openings thereof are opposite said source, and means for applying a negative air pressure to said hollow record guides so as to cause a moving record to be held against said guides, whereby the incremental surface areas of the moving record opposite said source are maintained at a predetermined distance from said source.

3. In a machine for printing information on individual records xerographically, the combination of an electroscopic toner fixing apparatus comprising a source of radiant heat energy sufficient to fuse electroscopic toner, means for feeding toner image bearing records past said source one by one in a manner such that the toner images are opposite said source, record holding means including a plurality of spaced electrically conductive record guides arranged opposite said source, a source of high voltage, and circuit means for connecting said voltage source and said record guides so as to cause a moving record to be held electrostatically against said guides, whereby the incremental surface areas of the moving record opposite said source are maintained at a predetermined distance from said source.

4. The combination in a record card xerographic printer of an electroscopic toner fixing apparatus comprising a source of radiant heat energy sufficient to fuse electroscopic toner, record card feeding means for moving a record card having an electroscopic toner image thereon past said source and along a feed path substantially $\frac{1}{16}$ of an inch from said source, record card holding means including a plurality of spaced hollow record card guides

each including a plate along said feed path which has a plurality of small openings therein to the spaced hollow in respective ones of said guides, means for applying a negative pressure to said hollow record card guides so as to cause a moving record card to be held against said plates along said feed path, to thereby maintain the incremental surface areas of the record card opposite said source at a predetermined distance from said source, and drive means for operating said feeding means so as to effect movement of the record card past said source at a rate whereby the temperature of the electroscopic toner image is raised to the fusing point while leaving the record card at a temperature below the fusing point of electroscopic toner.

5. A device for use in a xerographic printer to permanently affix an electroscopic toner image onto a record card supporting said image comprising a source of heat energy for emitting infrared radiations therefrom; record card feeding means for moving a record card having an electroscopic toner image thereon past said source and along a feedpath substantially $\frac{1}{16}$ of an inch from said source; record card holding means including a plurality of spaced hollow record card guides so arranged that the openings thereof are adjacent said feedpath and opposite said source; means for applying a negative pressure to said hollow record card guides so as to cause a moving record card to be held against said guides along said feedpath, to thereby maintain the incremental surface areas of the record card opposite said source at a predetermined distance from said source; drive means for operating said feeding means so as to effect movement of the record card past said source at a rate whereby the temperature of the electroscopic toner image is raised to the fusing point thereof while leaving the record card at a temperature below the fusing point of electroscopic toner; and other means for preventing the transfer of heat energy from said source to a record card by conduction and convection so as to maintain the record card at a temperature below the fusing point of electroscopic toner.

6. A device for use in a xerographic printer to permanently affix an electroscopic toner image onto a record card supporting said image comprising a source of heat energy for emitting infrared radiations therefrom; record card feeding means for moving said record card having an electroscopic toner image thereon past said source and along a feedpath substantially $\frac{1}{16}$ of an inch from said source; record card holding means including a plurality of spaced hollow record card guides so arranged that the openings thereof are adjacent said feedpath opposite said source; a voltage source, circuit means for connecting said voltage source and said record card guides so as to cause a moving record card to be held electrostatically against said guides along said feedpath, to thereby maintain the incremental surface areas of the record card at a predetermined distance from said source; drive means for operating said feeding means so as to effect movement of the record card past said source at a rate whereby the temperature of the electroscopic toner image is raised to the fusing point thereof while leaving the record card at a temperature below the fusing point of electroscopic toner; and other means for preventing the transfer of heat energy from said source to a record card by conduction and convection so as to maintain the record card at a temperature below the fusing point of electroscopic toner.

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