

March 26, 1968

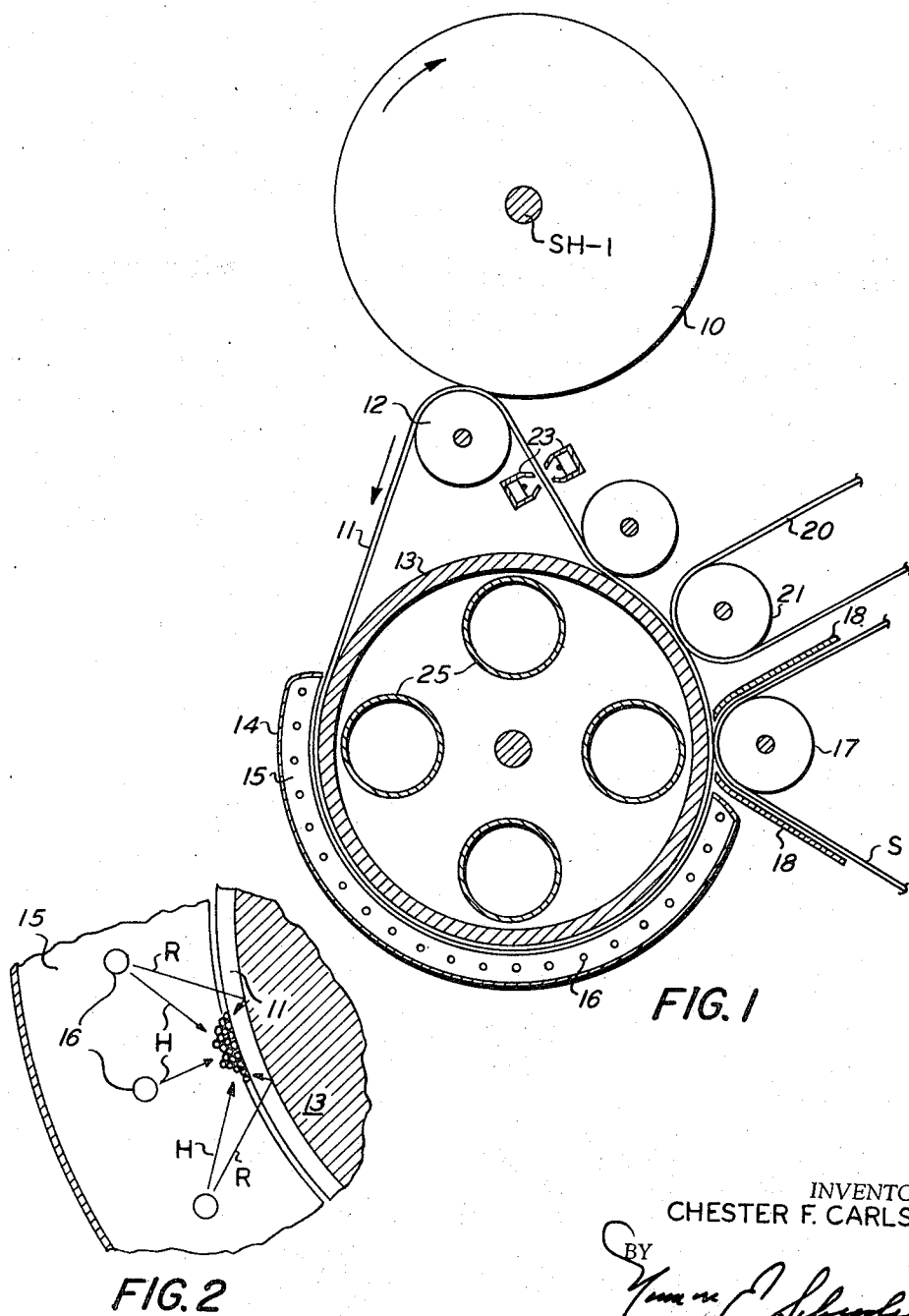
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TONER FUSING APPARATUS

Filed Dec. 6, 1965

2 Sheets-Sheet 1



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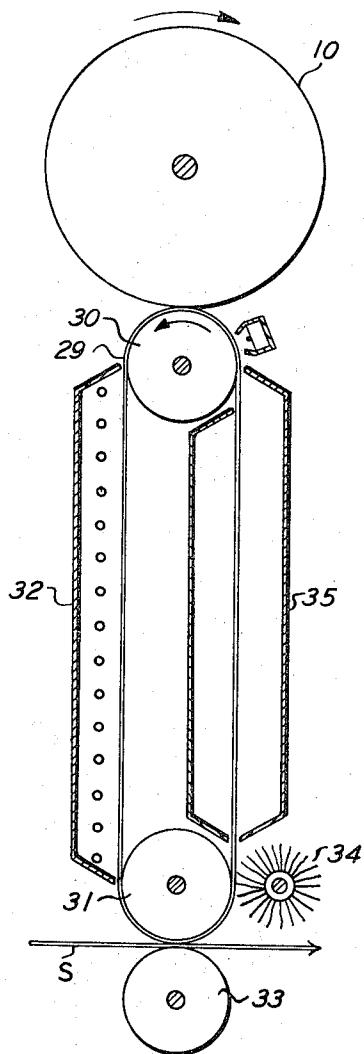


FIG. 3

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TONER FUSING APPARATUS

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Filed Dec. 6, 1965, Ser. No. 511,652

3 Claims. (Cl. 118—641)

ABSTRACT OF THE DISCLOSURE

A fusing apparatus for fixing developed powder images having an intermediate transparent belt upon which is transferred the developed image and from which the developed image is placed upon a sheet of paper after being tackified while on the belt. To tackify the image, the image is passed between heater elements on one side of the belt and a reflective surface on the other for directing heat to both sides of the powder image layer.

This invention relates to improvements in xerographic reproduction apparatus and particularly to an improvement in the toner fusing arrangement useful in such machines.

More specifically, the invention relates to an improved toner fusing arrangement which will provide high-speed fusing of the toner particles placed upon a copy sheet being processed in a xerographic machine. In this arrangement, a web or belt of plastic film is utilized as an intermediate image transfer media upon which an image is transferred from a xerographic drum and from which the image is transferred to a sheet of copy paper. While on the intermediate plastic belt, heat is supplied to the toner image for rendering the same slightly tacky before transfer to the copy sheet, thereby enhancing the ability of the toner image in its transfer to the sheet. The plastic belt is then cleaned and conditioned for the reception of successive toner images from the xerographic plate usable in the machine.

It is therefore the principal object of this invention to improve xerographic reproduction machines by fusing xerographic toner images at a relatively high speed.

Another object of the invention is to fuse xerographic toner images utilizing lower temperatures normally required for melting the toner particles, thereby minimizing the powder consumption needed to fuse images and minimizing the fire hazards that may be possible in the machine.

For a better understanding of the invention as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in conjunction with the accompanying drawings, wherein:

FIG. 1 illustrates schematically a mechanism for fusing images transferred from a xerographic plate;

FIG. 2 is a fragmentary view showing the effect of heat rays upon some of the toner particles utilized in a fusing process; and

FIG. 3 is a schematic illustration of another embodiment of a detail of the present invention.

Although it forms no part of the subject invention, there is shown schematically in FIG. 1 and described below portions of a xerographic reproduction machine which is described for purposes of illustration only as a suitable environment for the toner fusing mechanism of the subject invention. Further details of a typical xerographic machine and the xerographic process is found in the patent to Mayo et al. Patent No. 3,062,109.

As shown schematically in FIG. 1, the automatic xerographic reproduction machine includes a xerographic plate 10 including a photoconductive layer or light-re-

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ceiving surface on a conductive backing and formed in the shape of a drum which is mounted on a shaft SH-1 journaled in a frame upon the machine to rotate in the direction indicated by the arrow to cause the drum surface sequentially to pass a plurality of xerographic processing stations (not shown).

For purposes of the present disclosure, the xerographic reproduction machine includes the following processing stations in the path of movement of the drum surface as is well known in the field of xerography: a charging station at which a uniform electrostatic charge is deposited on the photoconductive layer of the xerographic drum; an exposure station at which a light or radiation pattern of copy to be reproduced is projected onto the drum surface to dissipate the drum charge in the exposed areas thereof and thereby form a latent electrostatic image of the copy to be reproduced; a developing station, at which a xerographic development material including toner particles having an electrostatic charge opposite to that of the electrostatic latent image are cascaded over the drum surface, whereby the toner particles adhere to the electrostatic latent image to form a xerographic powdered image in the configuration of the copy being reproduced; a transfer station at which the xerographic powder is electrostatically transferred from the drum surface to a transfer material or support surface; and a drum cleaning and discharge station at which the drum surface is brushed to remove residual toner particles remaining thereon after image transfer, and at which the drum surface is exposed to a relatively bright light source to effect substantially complete discharge of any residual electrostatic charge remaining thereon.

In the conventional xerographic reproduction machine, the image transfer is generally effected upon a sheet of copy paper which is brought into contact with the xerographic drum in coordination with the presentation of the developed image on the drum surface at a transfer station. By means of a transfer corotron device, the developed powder image on the drum is electrostatically transferred from the drum surface to the copy sheet which is then stripped off the drum and conveyed to a fuser station wherein the toner particles are heated to the melting point for causing adherence of the toner particles to the surface of the copy sheet. In operation, the electrostatic field created by the corona transfer device is effective to tack the support material electrostatically to the drum surface whereby the support material moves synchronously with the drum while in contact thereof. Simultaneously with the tacking action, the resulting electric field is effective to attract the toner particles comprising the xerographic powder image from the drum surface and cause them to adhere electrostatically to the surface of the copy sheet.

In the present invention, however, there is provided an intermediate media at the transfer station between the drum surface and the copy sheet and which is effective for causing toner image transfer. In this station, there is utilized a transparent transfer belt or web 11 made of Teflon or other plastic film having low adhesion and of good heat resistance characteristics. The belt 11 is extended and driven around an electrostatic transfer roller of small diameter which is positioned adjacent the drum surface 10 and adapted to place a charge on the belt in order to permit transfer of the developed toner image on the web 11 while in contact with the drum surface. The web extends around a fuser drum 13 which has a larger diameter than roller 12.

The width of the belt or web 11 is approximately equal to the width of the xerographic photoreceptive surface on the drum 10, or perhaps slightly larger, in order to be able to receive the entire developed image that the drum

is capable of producing. The roller 12 and the drum 13 are mounted on suitable fixed shafts and driven by a suitable drive mechanism (not shown) which is adapted to provide the belt 11 with a peripheral speed equal to the peripheral speed of the drum 10 and in the same direction thereof. The peripheral surface of the drum 13 is made highly reflective to heat rays.

Spaced evenly and slightly from the lower surface of the drum 13, for approximately half of the circumference thereof, is a fuser or heating device 14 which has a length approximately equal to the length of the drum 13. The belt 11, as it travels around the drum 13, moves between the adjacent portions of the fuser or heater 14 and the surface of the drum 13. The heater 14 is provided with a curved reflector 15 and radiant heater elements 16 arranged therein which may be connected to a suitable source of electrical power (not shown) which in turn may be connected to the electrical system for the xerographic reproduction machine for control thereby.

Upon emerging from the spacing between the heater 14 and the surface of the drum 13, the belt 11 is brought into contact with copy material S which may be in web form or sheet form and carried around a pressure-transfer roller 17 between suitable guide plates 18 positioned on either side of the roller. As will be described hereinafter, the powdered image upon the outer surface of the web 11 is transferred to the adjacent surface of the material S as it is moved adjacent the roller 17. After the powder image is transferred to the material S, the belt is moved to a cleaning station in the form of a cleaning belt 20 which is adapted to contact the surface of the web 11 by means of a roller 21 positioned adjacent to and parallel to the drum 13. Any residual toner particles that were not transferred to the material S is wiped off the surface of the web 11 by the cleaning web 20 which may be transported in a direction reversed to the direction of movement of the web 11 or moved in the same direction but at a different speed therefrom.

In order to precondition the belt 11 for accepting another developed image from the surface of the drum 10, suitable corotrons 23 are provided one on either side of the belt 11 for neutralizing any residual charge on the web just prior to the belt coming in contact with the surface of the drum. The corotrons 23 will produce a slight corona charge with a polarity opposite that which comprises the powdered toner used in the development process for preconditioning the web for accepting another toner image. In this manner, the developed electrostatic powder image will be transferred to the belt 11 as it proceeds around the roller 12.

In operation, the mirror-reversed electrostatic toner image on the drum 10 is electrostatically transferred to the outer surface of the web 11 as it passes between the roller 12 and the drum 10. As the image is carried around the highly reflective drum 13, between the same and the fuser 14, the toner particles are subjected to incident heat rays from the top directly from the heater elements 16 and to reflected rays underneath the particles by reason of the reflectivity of the surface of the drum 13. As shown in FIG. 2, the incident rays from the heater are illustrated by arrows, illustrated by the alphabet H, while the heat rays that are reflected from the surface of the drum 13 are indicated by the reference alphabet R.

Due to the reflectivity of the drum to the heat rays emanating from the heater element 16 and the low absorptivity of radiant heat by the transparent web 11, the toner particles are subjected to incident rays from one side and reflected rays from the other side, or that side adjacent the belt 11, to bring the toner particles rapidly to a tacky condition. This action continues as the belt 11 is transported around the drum 13 until it emerges from the heater 14. The copy material S is then fed against the web by the pressure roller 17 and is adapted to pick off the tacky toner image. Preferably, the pressure upon the roller 17 is relatively light in order to prevent smearing

of the toner image on the web 11 during transfer of the image. Because the web 11 has non-adhesive properties, such as characteristic of Teflon or Mylar coated with a silicone resin material, the transfer of the tacky powder image to the material S may be effective for 100 percent of the toner thereon. In any event, the remaining toner particles are wiped from the web 11 by the material 20 as the same is conveyed back to a position adjacent the drum 10 for further image transferring.

The drum 13 is provided with suitable passages 25 through which cooling air may be conveyed in order to maintain the drum 13 in a proper cooled condition, thereby minimizing the buildup of heat that the heater 14 may cause through radiant action. It is believed, however, that such cooling of the drum 13 is unnecessary since the surface that is opposite the heater 15 is maintained in a highly reflective condition in order to reflect heat waves that would otherwise be absorbed by the drum.

In the arrangement shown in FIG. 3, the transfer web 29 is driven around the electrostatic transfer roller 30 and a return roller 31, the latter roller 31 replacing the heating drum 13 in the embodiment of FIG. 1. In FIG. 3, the web is conveyed through a straight or flat fuser or heater 32; and upon emerging from the fuser, the image is transferred to the material S which is conveyed between the pressure roller 31 and a pressure-transfer roller 33. After transfer to the material S, the web is cleaned by a brush cleaner 34 and conveyed through a cooling chamber 35 which may be provided with cooling air derived safe from a suitable fan, not shown, before the belt is conveyed to the transfer roller 30. In the embodiment of FIG. 3, the web 29 comprises a highly reflective foil coated with Teflon or silicone resin in order to provide the identical two-way heating as provided in the embodiment in FIG. 1, that is, incident radiant heat from the heater 32 and reflective heating that is derived from the transmission of heat rays through the transparent Teflon or silicone and the reflection of the rays from the highly reflective foil to the adjacent toner particles.

It will be apparent that the present invention is adapted to provide high-speed fusing of xerographic toner images and requires a low power consumption normally needed for fusing toner particles. This can be seen from the fact that a higher percentage of radiant heat is utilized to soften the toner since the heat absorption of the other surfaces in the heating zone is kept at a minimum through the use of a highly reflective surface and a transparent belt. In addition, a greater area of the toner image is subjected to heat radiation, that is, both the inner and outer surfaces of the toner image. Since there is no moisture laden paper in the system, there is no loss of heat due to that necessary to vaporize water in the paper. The moderate pressure applied by the pressure-transfer rollers will cause bonding of the tacky toner to the paper at lower temperatures at which toner is not completely liquified. Hence, the toner need not be heated to as high a temperature as in conventional fusing onto paper.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth; and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.

What is claimed is:

1. Apparatus for fixing a powder image developed on an electrostatographic surface to a support material, said apparatus including

an endless belt having a transparent layer adapted to receive on the outer surface thereof the developed powder image from the electrostatographic surface, said belt being mounted for movement between two rotary elements,

heater means, said belt being adapted for movement to position successive portions thereof in heating

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relationship with said heater means whereby the outer surface of the powder image is exposed to radiant heat rays to become heated thereby, reflective means arranged on the inner side of said belt during movement thereof relative to said heater means for reflecting heat rays emanating from said heater means through the transparent belt and directing the reflected heat rays toward the inner surface of the powder image for heating the same, and means for positioning the support material against the outer surface of said belt for effecting transfer of the image to the material.

2. The apparatus of claim 1 wherein said reflective means is provided on one of said rotary elements, said

one rotary element being positioned adjacent said heater means.

3. The apparatus of claim 1 wherein said reflective means is in the form of a foil in contact with said belt and movable therewith.

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