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POROUS DRUM FUSER

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2 Sheets-Sheet 1

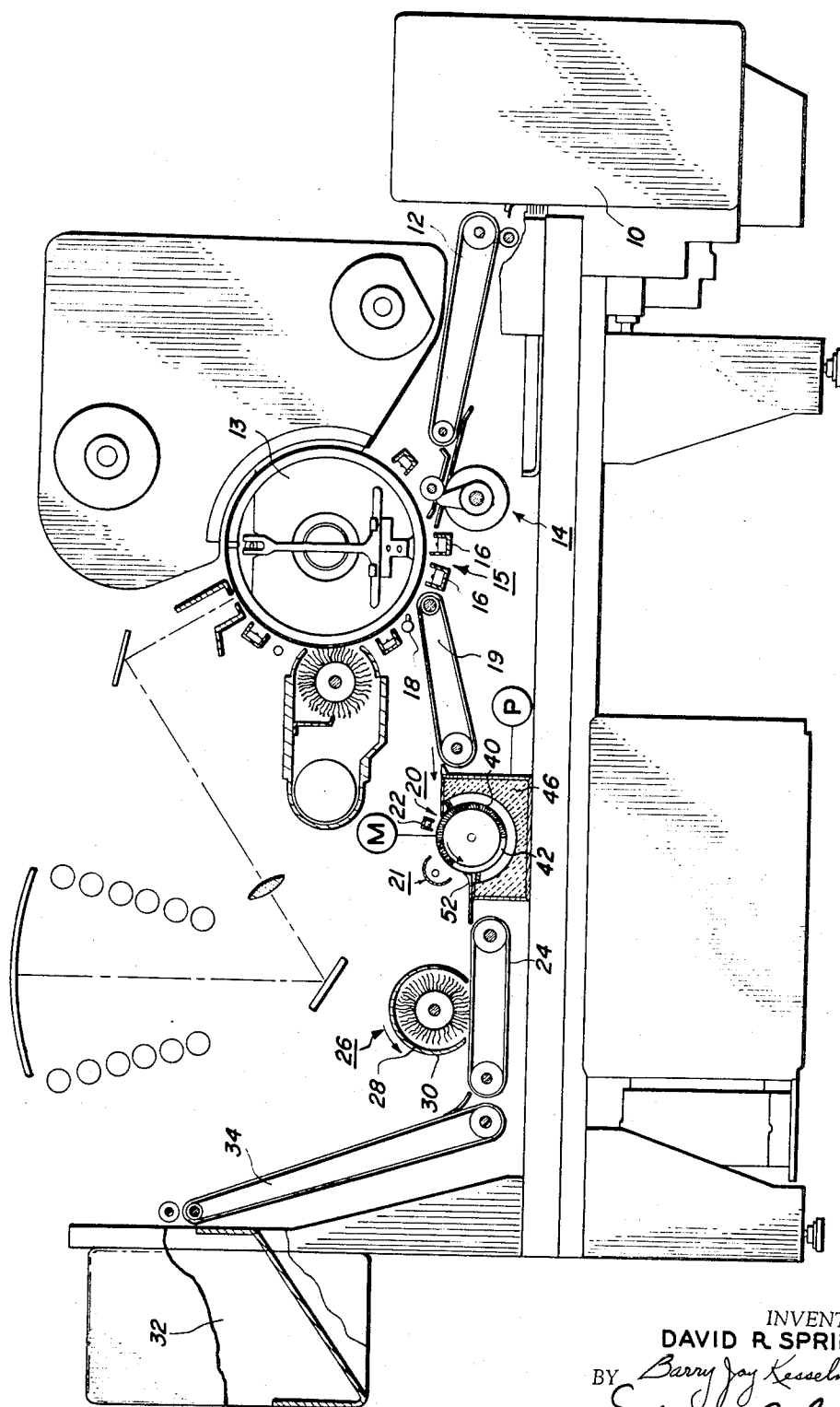


FIG. 1

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1

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POROUS DRUM FUSER

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ABSTRACT OF THE DISCLOSURE

A porous drum fusing apparatus for heating a support material and selectively melting a resinous powder previously placed thereon. The porous drum has an internal heat source and an internal vacuum system maintaining the support material tightly on the drum and a supplemental external heat source to melt the powder into the support material as the heated porous drum rotates, carrying the support past the supplemental heat source.

Background of the invention

This invention relates to apparatus for fixing a xerographic powder image and, in particular, to apparatus for heat fusing a xerographic powder image to a support material.

More specifically this invention relates to an improved fuser apparatus capable of fusing resinous powder images xerographically adhering to a support material in selected areas according to an exposure pattern generated by a xerographic copying machine. In the process of xerography, a plate comprising a photoconductive insulating coating on a conductive backing is provided with a uniform electrostatic charge and then exposed to a light image whereupon the coating becomes conductive under the influence of the light so that the electrostatic charge is selectively dissipated to produce a latent image. This image is then developed by means of a variety of pigmented resins specifically designed for this purpose. The resins, or toners, are electrostatically attracted to the latent image on the plate. The developed image is then transferred to a support material and permanently fixed. For more specific details involving these and other important features of xerographic copying see J. W. Melville Patent No. 3,260,455 issued on July 12, 1966.

Once an image is transferred to the support material onto or into which it will be permanently affixed, it must be treated by some suitable method such as heat fusing to enable it to achieve a permanent bond with the support material. A convenient method for achieving this permanent adherence is by heat fusing the resinous toner material to the support material. It is beneficial and advantageous to fuse or affix the high density image areas containing large amounts of toner while reducing the affixation of non-image areas, or background as it is known in the art, of toner particles on the support material. To this end a fuser device was developed as described in copending application Ser. No. 585,971, of G. A. Aser filed on Oct. 11, 1966. The invention herein is an improvement over the fusing apparatus therein disclosed for selective fusing, i.e., the fixing of toner areas of higher density without affecting relatively low density areas, in that it solves the previously existing problem of maintaining the support material on the heated drum surface of the fuser while selective fusing of the toner images thereon occurs. This is accomplished without special equipment for pre-treating the support material to control the moisture content thereof.

Summary of the invention

It is an object of this invention to improve xerographic fusing apparatus.

2

Another object of this invention is to improve fusing apparatus using a drum to maintain the support material onto which another material is to be fused.

Yet another object of this invention is to prevent curling of flexible support materials while in the fusing apparatus of a xerographic machine.

Still another object is to selectively fuse toner to a support material without preconditioning the support material or controlling the moisture therein.

These and other objects of this invention are accomplished by means of the heated drum fuser with an internal infrared heating source and an external supplementary infrared source to heat and fuse images to flexible support material carried on the drum while held thereonto by a vacuum drawn through the inside of the drum fuser, said drum being at least partially porous to effect vacuum holding of the support material passing thereover.

Brief description of the drawings

For a better understanding of the present invention as well as other objects and 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 an automatic xerographic reproducing apparatus including a schematic embodiment of the heat fuser of the present invention;

FIG. 2 illustrates schematically fusing apparatus of the present invention; and

FIG. 3 is a partial sectional view of another embodiment of the heated fuser roll.

Description of the preferred embodiment

Referring now to the figures, there is shown in FIG. 1 an embodiment of the present invention incorporated within a high-speed xerographic machine. Cut sheets of bond paper are deposited in a stack tray 10 prior to delivery into the machine. The sheets of paper are transported by means of a vacuum transport system 12 being aligned by registry device 14 and then moved into contact with the xerographic drum 13 at the transfer station 15.

The drum 13 which is moving at the same peripheral speed as the transport 12, has a latent image on its surface with a xerographic developing powder adhered thereto in the image configuration as well as some background powder in non-image areas. The powder is transferred electrostatically to the paper support by exposing the back of the paper to an ion discharge from one or more transfer corotrons 16 which are of sufficient strength to attract the powder from the drum to the paper. After transfer, the image bearing support is removed from the drum 13 by means of an air puffer 18 and placed image side up upon vacuum belt transport system 19. The support material, which is preferably paper but may be any flexible material capable of maintaining the xerographically developed image and having such an image fixed thereto by heat fusing is then moved into contact with a heated porous drum 20 by means of the belt transport 19.

Heating and melting of the toner image is accomplished in the present invention by initially electrostatically tacking the paper material into intimate contact with the heated roll 20 by use of corotron 22 and the application of a vacuum through the inside of the hollow cylindrical drum 20. The paper remains on the porous portion of the drum surface 20 for a time sufficient to insure thorough fusing of the toner in the image areas thereon by conductive heat through the porous drum surface 20 and radiant heat through supplementary heater 21. It is then removed from the drum by a puffer or finger 23 or any other stripping means which lifts the leading edge of the support material and guides it by suitable means to

transport 24 where the paper is brought beneath brush assembly 26 for removal of residual or unfused toner therefrom.

The brush 28, which can be fabricated of synthetic or natural fibers, is mounted in respect to the transport 24 so that some interference exists between the paper support material and the brush fibers. Rotating the brush at a relatively high speed in a direction opposite to that of the paper removes unfused residual toner. The toner so removed is exhausted by means of a vacuum system maintaining a negative pressure under hood 30. The fused and brushed paper support is then vacuum transported to receiving tray 32 by means of transport system 34.

In operation, the fuser acting in conjunction with the remainder of the xerographic machine accepts a cut sheet 38 of paper egressing from transport 19. The drum 20 is apportioned with a porous area containing apertures 40 therein and a solid area 42 positioned between the seals 44 and 45 used for maintaining the heat and partial vacuum within the insulated housing 46. This embodiment (FIG. 2) is particularly well adapted for cut sheet feeding and can be dimensioned such that it will accept the largest cut sheet normally used in the machine in which it is embodied. For example, in a machine having a capability of accepting up to 14 inch paper the drum could have an 8 inch diameter and still fuse the toner to the paper in the area of the drum having holes while providing a solid portion to prevent excessive heat or air loss to or from the atmosphere.

In order to properly fuse most toners that are used to image on cut sheets in machines such as that shown in FIG. 1, it is necessary to maintain the paper support material in contact with the drum surface for approximately six inches in order to fuse copy at the rate of 10 inches per second. This is necessary to insure that the paper is brought to a proper temperature by contact with the drum surface so that the paper will be properly preconditioned for selective fusing of the toner thereon by the supplemental heating element 48 and its reflector 49 which comprise heater 21. In the embodiment shown, a flow rate of 10 inches per second of support material is required. The surface temperature of the drum would be approximately 400° F. and it is desirable to bring the temperature of the paper on the drum to between 150 and 200° F. and the temperature at the image areas to approximately 250° F., the latter is accomplished by use of the quartz infrared lamps of the supplemental heater.

The paper would need to be in contact with the drum surface for distance of approximately six to eight inches thereby giving 0.5-0.6 second of contact with the drum, at the rate of peripheral drum movement of ten inches per second being equal to the transport speed of a sheet through the machine. The open or contact area between seal 44 and 45 should be approximately six to eight inches, therefore, requiring a drum diameter of between approximately six to ten inches depending largely on the area between seals 44 and 45 that act as the transport contact fuser. The requirement is that at least six to eight inches of the drum surface be available for contact with the support material but there is flexibility as to the percentage of the drum surface that is required.

The main energy source 50 inside the drum is preferably a radiant energy source although an oven convection heater would operate. The drum is porous over part of its area and solid over the remainder, the solid portion of the drum having a length at least equal to the length of drum exposed between the seals 44 and 45. The rotation of the drum through motor M-1 would be synchronized with the sheet entry at the drum surface such that the start of the porous area would arrive at the sheet entry position at the same time as the leading edge of the sheet arrives at that position. At the sheet exit position from the drum, strippers 52 such as mechanical fingers, veins or air blast strippers or any other suitable means could be used.

The fuser would require a warm up time to permit the main heat source 50 to heat the outside drum surface to approximately 400° required for preconditioning the sheet to permit fusing of toners presently available. It should be understood, however, that this is by way of example only and suitable adjustments could be made for support materials and toners of differing characteristics than the support materials and toners referred to herein and it is not beyond the scope of the present invention to vary the temperatures of the sources or drum in order to effectively fuse to different support materials than those referred to herein.

The supplementary infrared source would provide the necessary fusing capabilities to insure complete fusing of the toner image areas to the paper. By having both the main and supplementary heating units available, the system becomes flexible as to the percent of heating contributed by the drum surface and supplementary infrared source. This allows changes for different materials being used within the machine in which the fuser functions.

The porous drum 60 of the embodiment of FIG. 3 shown partially in section has a heating element 50 mounted along the axial center line of the drum. The drum 50 is closed at each end by means of caps 66 and 68 in which are seated bearings about which the drum rotates in machine frame 73. The drum 60 is being driven at the same peripheral speed as the transport bringing support material, such as a paper web, thereto and therefrom by means of a motor drive (not shown) acting through sprocket 75. An exhaust line 70 is mounted on a machine member 72 and is in communication with vacuum chamber 74 contained within the porous drum 60. The exhaust line 70 connects with the chamber 74 through a hollow shaft 76. The exhaust line 70 is operably connected to a motor drive vacuum pump 78 which is capable of drawing a vacuum through the chamber 74 and thereby maintaining support material on the surface of drum 60 by pulling it tightly to the holes 80 therein through pressure exerted by the atmosphere external to the drum and support material since there exists a pressure differential across the paper through the apertures 80 in the drum 60.

The sheet or web to which this embodiment is particularly adapted tightly adheres to the porous drum 60 due to the vacuum drawn through the hollow portion 74 and is removed by suitable strippers. As the support material is being stripped from the roll, it is driven forward along baffles 88 into contact with the transport system.

The vacuum system serves several functions in the apparatus shown. First it maintains a close intimate contact between the support material to be preconditioned and the drum surface over which material rides. This is necessary to insure efficient thermal transfer by conduction heating from the drum surface to the support material. Even with the electrostatic tacking of the paper to the drum, the paper has a tendency to curl off the surface of the drum as moisture is driven from the paper by the heat of the fuser. This could be eliminated by staggering several corotrons or the like around the periphery of the drum where the support material contacts it. However, this is poor design and ignores the necessary room for the supplemental heater that is required to totally fuse the toner image on the support material. Also, it would be essential that an insulating layer be placed around the drum to permit electrostatic tacking and holding of the support material to the drum or else the electrostatic charge would bleed off the conductive surface of the drum. This insulating layer tends to decrease the efficiency of the conductive heating from the drum surface to the support material.

Further, the drum surface itself preconditions, so to speak, the support material for the total fuse that occurs under the influence of the infrared radiation of the supplemental heater. Whereas in prior art devices special equipment was used to control the moisture content of

5

the support material (see copending application Ser. No. 585,971 of Gil Aser referred to above), this process step is eliminated by the present invention. The support material, generally paper, has a high moisture content which, upon evaporation due to the high heat surrounding the support material in the fuser, tends to give up its moisture in the form of vapor. This causes vapor pockets, of moisture or gaseous boundary layers to form between the support material and the fuser drum causing unequal heating across the surface of the support material thereby leading to erratic fusing. By providing the apertures in the drums herein and the vacuum pressure behind the apertures, it is possible to draw off any vapor pockets or gases that form due to the release of the moisture of the support material in the heated fuser assembly.

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. In an apparatus for fusing xerographic toner to flexible support materials with toner areas thereon include a drum journaled for movement about an axis, a heat source internal to said drum having a capability of heating said drum to a predetermined temperature, an infrared heat source externally positioned to said drum relatively close to the outside surface thereof and propagating sufficient radiant energy to fuse a xerographic toner, and means to rotate said drum, the improvement comprising apertures in said drum, means to provide a partial vacuum internal to said drum

6

thereby maintaining the support material in intimate contact with the outer surface of said drum such that heat from said drum passes to the support material heating the same,

said means to provide a vacuum further preventing slippage between the support material and said drum as said drum rotates thereby driving the support material through the radiant energy propagated by the infrared heat source for a time sufficient to fuse the toner thereto.

2. The apparatus of claim 1 wherein said drum has further associated therewith

an insulated housing to maintain the heat near said drum,

sealing means enclosing a portion of said drum within said housing to maintain the heat from said heat source internal to the drum and prevent a free flow of air external to the drum from circulating through the apparatus,

a stripping means adapted to remove the support material from the surface of the drum.

3. The apparatus of claim 2 wherein said drum includes a solid portion normally positioned between said sealing means external to the housing whereby the heat and partial vacuum are better maintained when a support material is not passing thereover.

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