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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION Contact Heat Fusing Device

5 We RANK XEROX LIMITED of Rank Xerox House, 338 Euston Road, London, N.W.1., a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to a contact heat fusing device, for fixing a thermoplastic resin material on a support material. A possible application of the invention is to fixing toner material on a support material in a xerographic reproduction apparatus.

15 According to the invention there is provided a contact heat fusing device for fixing a thermoplastic resin material carried on a support material in image configuration, said device including a frame, a heated roller
20 pivotally secured to the frame, a pair of support arms journaled in the frame, a second roller journaled in the support arms in parallel relation to the heated roller, an actuator arm connected to the support arms, actuator means operatively connected to pivot the support
25 arms from a first position wherein the second roller is out of operative relation with the heated roller to a second position wherein the second roller is in cooperative relation to the heated roller to forward a support material
30 in pressure contact therebetween, the actuator means pivoting the roller into cooperative relation with heated roller sufficiently to effect flowing of thermoplastic resin material carried
35 on support material in image configuration only within the pattern in which the material is formed, the peripheral surface of the heated roller having a coating of an offset preventing material, means to apply an offset preventing liquid to the offset preventing
40 material on the heated roller and driving means connected to the heated roller and to

the second roller to drive the rollers for advancing a support material therebetween.

An example of the invention will now be described with reference to the accompanying drawings in which:—

Figure 1 illustrated schematically a preferred embodiment of an electrophotographic apparatus adapted for automatic operation, and incorporating a heat fuser constructed in accordance with this invention; 50

Figure 2 is a right-hand end view of the heat fuser of the invention;

Figure 3 is a left-hand end view of the heat fuser; 55

Figure 4 is a sectional view taken along line 4—4 of Figure 2;

Figure 5 is a sectional view taken along line 5—5 of Figure 4;

Figure 6 is a top view of the heat fuser with parts broken away to show details of the heat fuser; and 60

Figure 7 is a view taken along line 7—7 of Figure 5, with parts broken away to show details of the heat fuser. 65

Although it forms no part of the subject of the invention, there is shown schematically in Figure 1 a continuous xerographic apparatus for the purpose of illustrating a suitable environment for the heat fuser of the subject of the invention. 70

As shown schematically in Figure 1, the automatic xerographic reproducing apparatus comprises a xerographic plate 20 including a photoconductive layer or light-receiving surface on a conductive backing and formed in the shape of a drum, which is mounted on a shaft journaled in a frame to rotate in the direction indicated by the arrow to cause the drum surface sequentially to pass a plurality of xerographic processing stations. 75

For the purpose of the present disclosure, the several xerographic processing stations in 80

[Price 4s. 6d.]

the path of movement of the drum surface may be described functionally, as follows:

5 A charging station, at which a uniform electrostatic charge is deposited on the photoconductive layer of the xerographic drum;

10 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;

15 A developing station, at which a xerographic developing 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;

20 A transfer station, at which the xerographic powder image is electrostatically transferred from the drum surface to a transfer material or a support surface; and,

25 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.

30 The charging station is preferably located as indicated by reference character A. As shown, the charging arrangement includes a corona charging device 21 which includes a corona discharge array of one or more corona discharge electrodes that extend transversely across the drum surface and are energized from a high potential source and are substantially closed within a shielding member.

35 Next subsequent thereto in the path of motion of the xerographic drum is an exposure station B. An optical scanning or projection system is provided to project a flowing image onto the surface of the photoconductive drum from a stationary original.

40 The optical scanning or projection assembly comprises a stationary copyboard which consists of a transparent curved platen member 22 such as, for example, a glass plate or the like positioned on the exterior of the cabinet, which is adapted to support a document to be reproduced, the document being uniformly illuminated and arranged in light projecting relation to the moving light-receiving surface of the xerographic drum. Uniform lighting is provided by banks of lamps LMPS arranged on opposite sides of the copyboard. Scanning of the document on the stationary copyboard is accomplished by means of a mirror assembly which is oscillated relative to the copyboard in timed relation to the movement of the xerographic drum.

45 The mirror assembly, which includes an

object mirror 23, is mounted below the copyholder to reflect an image of the document through a lens 24 onto an image mirror 25 which, in turn, reflects the image onto the xerographic drum through a slot in a fixed light shield 26 positioned adjacent to the xerographic drum surface.

70 Adjacent to the exposure station is a developing station C in which there is positioned a developer apparatus 30 including a casing or housing having a lower or sump portion for accumulating developer material. A bucket type conveyor is used to carry the developing material to the upper part of the developer housing where it is cascaded over a hopper chute onto the xerographic drum to effect development. A toner dispenser is used to accurately meter toner to the developing material as toner particles are consumed during the developing operation.

75 Positioned next and adjacent to the developing station is the image transfer station D which includes a sheet feeding arrangement adapted to feed sheets of support material, such as paper or the like, successively to the xerographic drum in co-ordination with the presentation of the developed image on the drum surface at the transfer station.

80 The sheet feeding mechanism includes a sheet feed device 40 adapted by means of vacuum feeders to feed the top sheet, of a stack of sheets on a tray 41, to a set of feed rollers 42 for advancement by the feed rollers of the sheet to a paper transport 44 which, in turn, conveys the sheet to a sheet registration device 45 positioned adjacent to the xerographic drum. The sheet registration device arrests and aligns each individual sheet of material and then in timed relation to the movement of the xerographic drum, advances the sheet material into contact with the xerographic drum in registration with a previously formed xerographic powder image on the drum.

85 The transfer of the xerographic powder image from the drum surface to the sheets of support material is effected by means of a corona transfer device 51 that is located at/or immediately after the line of contact between the support material and the rotating drum. 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 therewith. Simultaneously with the tacking action, the electrostatic 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 support material.

90 Immediately subsequent to the image transfer station, there is positioned a stripping apparatus or paper pick-off mechanism 52 for

removing the sheets of support material from the drum surface. This device, which is of the type disclosed in United States patent specification 3,062,536, includes a plurality of small diameter orifices supplied with pressurized aeriform fluid by a suitable pulsator or other device. The pulsator is adapted to force jets of pressurized aeriform fluid through the outlet orifices into contact with the surface of the xerographic drum slightly in advance of the sheet of support material to strip the leading edge of the sheet from the drum surface and to direct it onto an endless conveyor 55 whereby the sheet material is carried to a fixing device 60. At the fixing device, the transferred xerographic powder image on the sheet of support material is permanently fixed or fused thereto as by heat. After fusing, the finished copy is discharged from the apparatus at a suitable point for collection externally of the apparatus by means of the conveyor 65.

The next and final station in the device is a drum cleaning station E, having positioned therein a corona pre-clean device 66, similar to corona charging device 21, a drum cleaning device 70 adapted to remove any powder remaining on the xerographic drum after transfer by means of a rotating brush 71, and a discharge lamp LMP-1 adapted to flood the xerographic drum with light to cause dissipation of any residual electrical charge remaining on the xerographic drum.

To remove residual powder from the xerographic drum, there is disposed a cylindrical brush 71 rotatably mounted on an axle and driven by a motor, not shown. For collecting powder particles removed from the xerographic drum by the brush, there is provided a dust hood 73 that is formed to encompass approximately two-thirds of the brush area. To ensure thorough cleaning of the brush, a flicking bar 74 is secured to the interior of the dust hood adjacent the edge of the outlet duct 75 of the dust hood and in interfering relation with the ends of the brush bristles whereby dust particles may be dislodged therefrom.

For removing dust particles from the brush and dust hood, an exhaust duct 76 is arranged to cover the outlet of the dust hood, the exhaust duct being connected at its other end to the wall of a filter box 77 attached to the dust hood. A filter bag 78 is secured within the filter box, with the mouth of the filter bag in communication with the exhaust duct. A motor fan unit MOT-6, connected to the filter box, produces a flow of air through the filter box drawing air through the area surrounding the xerographic drum and the dust hood, the air entraining powder particles removed from the drum by the brush as the air flows through the dust hood. Powder particles are separated from the air as it flows

through the filter bag so that only clean air reaches the motor unit.

Suitable drive means are provided to drive the drum, rotating mirror and sheet feed mechanism at predetermined speeds relative to each other, and to effect operation of the bucket-type conveyor and toner dispenser mechanism.

It is believed that the foregoing description is sufficient for the purposes of this application to show the general operation of the xerographic reproducing apparatus. For further details concerning the specific construction, reference is made to copending application No. 51244/64 (Serial No. 1089536).

Referring now to the drawings, there is shown a preferred embodiment of a heated roll fusing device 60 constructed in accordance with the invention.

In the embodiment shown, the heated roller fusing device includes a frame, for supporting the components of the fuser, formed by left-hand plate 801 and right-hand plate 802 secured to the base plate 10 of the frame for the xerographic apparatus.

Direct contact fusing of a powder image on a support material is achieved by forwarding a sheet of support material bearing the powder image to be fused between a heated upper roller, generally designated 803, and a rubber roller, generally designated 804, rotating in intimate contact under pressure. The support material, carrying the unfused toner images, is advanced between these two rollers with the toner images facing the heated roller so that fusing occurs when contact is made.

Roller 803 includes a cylinder 805 covered with a suitable material 806 to prevent toner offset onto this roll which contacts the powdered image on the support material. A suitable material may be a coating of a product of tetrafluoroethylene resin sold under the Trademark of "Teflon" by the Dupont Corporation. Teflon is a chemically inert, non-porous and non-absorbent, synthetic resin which is slightly elastic under low stress and which is capable of cold flowing under greater stress, and which is capable of sliding over a surface in the manner of self-lubricating relationship therewith.

The cylinder 805 is closed at opposite ends by fuser roll caps 807 and 808, which are secured to the cylinder as by a press-fit. A spindle portion of the fuser roll caps are journaled for rotation by bearings 811 mounted in the plates 801 and 802. Bushings 812 extend through the hollow spindle portion of the fuser roll caps. One of the bushings, the left-hand one as seen in Fig. 4, is supported by a bearing retaining cap 813 secured to plate 802 with a thrust washer 814 positioned between the bearing and the retaining cap. The other bushing extends through the hollow spindle portion of fuser roller cap 807 and is secured in position by

a set screw 815 in bearing retaining cap 816 secured to plate 801.

Each of the bushings 812 is provided with a suitable aperture to receive a quartz tube 817 which supports a suitable resistance heating element R1. The resistance element R1 is connected by suitable conductors to a source of power such as a commercial 120 volt, 60 cycle alternating current outlet. A thermistor THS-1 to control the power to the resistance element R1 is suitably positioned in thermal relation to this fuser roll. For further details concerning the electrical circuit of the fuser in connection with the circuit of the xerographic apparatus of Fig. 1, reference is made to the referenced copending application, Serial No. 51244/64 (Serial No. 1089536).

In the embodiment shown, the fuser 60 is driven in timed relation to the speed of the endless conveyor 55 and the conveyor 65. As shown, the fuser roll cap 808 is provided with a sprocket 821 fixed thereon as by brazing. In addition, a gear 822 is secured to the roll cap 808 by screws 823, for a purpose to be described. The endless conveyor 55, fuser 60 and conveyor 65 are operatively connected to a common source of power, not shown, by chain 701, which in the portion of the drive for the xerographic apparatus shown in Fig. 3, extends from the source of power to engage idler sprocket 707, then up to an idler sprocket 706, down to a drive sprocket 705 used to drive conveyor 65, up and around the sprocket 821 of fuser 60, then the chain belt extends around a sprocket 704 used to drive the endless conveyor 55, from where the chain belt extends back to the source of power.

With this arrangement, roller 803 is driven to advance the sheet of support material at a speed equal to the linear speed of the support material as it is delivered to the fuser by the endless conveyor 55 of the xerographic apparatus.

Roll 804 includes a shaft 825 covered with a suitable material 826, such as silicone rubber molded to the shaft. The shaft 825 is journaled by bearings 827 mounted in support arms 831 and 832. Bushings 833 secured to the support arms are journaled on shoulder bolts 834 threaded into the plate 801 and 802 whereby this assembly is mounted for pivotable movement about the axis of the shoulder bolts. The support arms also carry a connecting rod 835 extending therebetween.

The connecting rod is positioned to be contacted by a V-block 841 secured to a diaphragm plate 842 as by screw 843 extending through a washer 844, a diaphragm 845 and the diaphragm plate to threadingly engage the block. The diaphragm 845 is secured over a suitable cavity formed in the base plate 10 by means of a retaining ring 846 held in position by screws 847. The cavity in the

base plate 10 is connected by a threaded conduit formed in the base plate, by pipe 8, and conduit 848 to a suitable source of pressure, such as a motor driven compressor (not shown), to effect vertical movement of the diaphragm which through the V-block contacting the connecting rod pivots the supporting arms to force roller 804 into pressure engagement with roller 803 or with a sheet of support material sandwiched therebetween. With this arrangement, the roller 803, when pressure is applied to the diaphragm, is resiliently movable away from roller 803 to permit a support material to enter between these rolls.

The motor driven compressor is suitably connected to the electrical circuit of the xerographic apparatus whereby as the circuit is energized to advance sheets of material through the xerographic apparatus, the motor driving the compressor is energized to supply pressured air to actuate the diaphragm to force roller 804 into contact with roller 803 or a sheet sandwiched therebetween. The contact pressure between roller 804 and 803 is mechanically controllable by means of adjusting screws 836 threaded through the turned out portions of the support arms, lock nuts 837 being provided to lock these adjusting screws in the desired position. As the roller 804 is raised into contact with roller 803, its upward movement can be limited by contact of these adjusting screws with edge portions of plates 801 and 802. When the xerographic electrical circuit is de-energized or when sheets are not being advanced through the xerographic apparatus, the motor driven compressor is not operated, whereby roller 804 is permitted, due to its weight and the weight of this entire assembly, to pivot out of contact with roller 803. Thus during standby, when the fuser is not operating, the rollers 803 and 804 are automatically separated. This separation of the lower roller out of contact with the heated roller prevents thermal set of the rubber.

Roller 803 is driven in timed relation with roller 804 by means of gear 851 fixed to shaft 825 engaging gear 822 of roller 803.

The pivotable movement of the support arms about the axis of the shoulder bolts is limited by a stop pin 852 extending from plate 801 into interference relation with a support arm, the distance between the center of rollers 804 and 803, if they are moved out of contact with each other, is so limited that gears 822 and 851 will remain in engagement with each other.

As a sheet of support material is advanced between the rollers 803 and 804, the powder image on the support material will contact the peripheral heated surface of roll 803 whereby the powder image becomes tackified and, in this tackified condition, the powder would tend to offset onto this roll except that

it is partially prevented from doing so by the Teflon coating on this roll. However, to further prevent even this limited tendency of offset of powder onto the heated contact surface of roll 803, an applicator is used to supply a thin film of offset preventing liquid, such as silicone oil, to the Teflon coating on roll 803.

A supply of silicone oil to be applied to roller 803 is maintained in an oil pan 861 having fastened, as by welding, to opposite ends thereof brackets 862 and 863 by means of which the oil pan is mounted on the plates 801 and 802. At the left end, as seen in Figs. 6 and 7, there is provided a spring 864 secured to this end of the pan, for a purpose to be described. An applicator roll, generally designated 871, is used to convey a thin film of oil, as the applicator roll is rotated in the silicone oil to a wick 866, such as a Teflon felt pad secured as by staples, not shown, to a wiper support plate 867 adapted to rest on the peripheral surface of roll 803 and on applicator roll 871. The wiper plate is curved at one end to conform to the peripheral surface of roller 803.

The applicator roll 871 consists of a hollow cylindrical oil drum 872 sealed at opposite ends by caps 873 and 874. Cap 874, on the left end of oil drum 872 as seen in Figs. 6 and 7, is provided with a concentric button portion adapted to contact spring 864 whereby the applicator roll assembly is movably and rotatably positioned within the oil pan. Cap 873, secured to the opposite end of the oil drum, is provided with a stub shaft portion on which the bushing 875, secured to one end of control arm 876, is journaled, axial alignment being maintained by a snap ring 878 positioned in a suitable annular groove formed near the end of the stub shaft portion of cap 873.

As shown in Fig. 5, the opposite end of control arm 876 is provided with a depending cam surface portion adapted to be engaged by an actuator stud 809 extending outward from roll cap 807 on the upper roller 803. With this arrangement, as the upper roller is rotated through the drive mechanism previously described, the actuator stud 809 will strike the cam surface portion of the control arm to cause the control arm to oscillate about the axis of applicator roll 871 during each revolution of the upper roller 803.

To effect rotation of the applicator roll in one direction, the applicator roll 871 is connected to the bushing 875 secured to the control arm 876 by means of a one-way spring clutch 877. One end of the one-way spring clutch is secured to the cap 873 with the coils of the one-way spring clutch encircling the bushing 875. In this manner, the applicator roll is indexed, a portion of a revolution during each oscillating cycle of the control arm 876 through the one-way spring

clutch drive between the applicator roll and the control arm.

To prevent excessive heat loss from roll 803 and roll 804, which is heated by contact with roll 803, there is provided heat baffles 881, 882, 883, each provided with a pad of suitable heat insulating material 884. Both heat baffles 881 and 882 are provided with guide portions adapted to guide a sheet of support material advanced by endless conveyor 55 into the bite of rolls 803 and 804.

For a given temperature of the upper roller 803, the fusing rate will depend on the contact arc length of the support material against this roller and the dwell time, i.e., the time the toner image remains between the rollers. Dwell time can be varied either by changing the surface velocity of the rollers or by varying the contact arc length and holding the speed of the rollers constant. Contact arc length depends on the softness of the rubber on roller 804 and on the amount of pressure between rollers 803 and 804.

In the embodiment of the apparatus shown, the hardness of the rubber used to cover shaft 825, to form roller 804, was in the range of 25 to 65 durometer, and preferably the hardness of the rubber should exceed 40 durometer. By varying the pressure between the rollers, equal contact arc length can be obtained with the different hardness of the rubber.

Further description of the xerographic apparatus illustrated in Figure 1 is contained in co-pending application 51244/64, (Serial No. 1089536) from which this application is divided. Further description is also contained in co-pending application 11365/67 (Serial No. 1089538), divided from the same application.

WHAT WE CLAIM IS:—

1. A contact heat fusing device for fixing a thermoplastic resin material carried on a support material in image configuration, said device including a frame, a heated roller journaled in the frame, a pair of support arms pivotally secured to the frame, a second roller journaled in the support arms in parallel relation to the heated roll, an actuator arm connected to the support arms, actuator means operatively connected to pivot the support arms from a first position wherein the second roller is out of operation relation with the heated roll to a second position wherein the roller is in cooperative relation to the heated roll to forward a support material in pressure contact therebetween, the actuator means pivoting the roller into cooperative relation with the heated roller sufficiently to effect flowing of thermoplastic resin material carried on support material in image configuration only within the pattern in which the material is formed, the peripheral surface of the heated roller having a coating of an off-

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set preventing material, means to apply an offset preventing liquid to the offset preventing material on the heated roller and driving means connected to the heated roller and to the second roller to drive the rolls for advancing a support material therebetween.

5 2. A device as claimed in claim 1 wherein the actuator means includes a pressure chamber closed at one end by a diaphragm
10 operatively connected to the actuator arm and having at its opposite end conduit means

adapted to be connected to a source of pressure.

3. A contact heat fusing device as claimed in claim 1 substantially as hereinbefore described with reference to the accompanying drawings. 15

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