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(54) ROLL FUSER APPARATUS

(71) We, XEROX CORPORATION, a corporation organised under the laws of the State of New York, United States of America, of Rochester, New York 14644, United States of America, do hereby declare this 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:-

This invention relates generally to xerographic copying apparatus and, more particularly, to a contact fusing system and cleaning mechanism therefor for fixing electroscopic toner material to a support member.

In the process of xerography, a light image of an original to be copied is typically recorded in the form of a latent electrostatic image upon a photosensitive member with subsequent rendering of the latent image visible by the application of electroscopic marking particles, commonly referred to as toner. The visual image can be either fixed directly upon the photosensitive member or transferred from the member to a sheet of plain paper with subsequent affixing of the image thereto.

In order to permanently affix or fuse electroscopic toner material onto a support member by heat, it is necessary to elevate the temperature of the toner material to a point at which the constituents of the toner material coalesce and become tacky. This action causes the toner to be absorbed to some extent into the fibers of the support member which, in many instances, constitutes plain paper. Thereafter, as the toner material cools, solidification of the toner material occurs causing the toner material to be firmly bonded to the support member. In both the xerographic as well as the electrographic recording arts, the use of thermal energy for fixing toner images onto a support member is old and known.

One approach to thermal fusing of electroscopic toner images onto a support has been to pass the support with the toner images thereon between a pair of opposed roller members, at least one of which is internally heated. During operation of a fusing system of this type, the support member to which the toner images are electrostatically adhered is moved through the nip formed between the rolls with the toner image contacting the heated roll to thereby effect heating of the toner images within the nip.

By controlling the heat transferred to the toner, virtually no offset of the toner particles from the copy sheet to the fuser roll is experienced under normal conditions. This is because the heat applied to the surface of the roller is insufficient to raise the temperature of the surface of the roller above the "hot offset" temperature of the toner whereat the toner particles in the image areas of the toner would liquefy and cause a splitting action in the molten toner to thereby result in "hot offset". Splitting occurs when the cohesive forces holding the viscous toner mass together are less than the adhesive forces tending to offset it to a contacting surface such as a fuser roll.

The foregoing notwithstanding, toner particles will be offset to the fuser roll by an insufficient application of heat to the surface thereof (i. e. "cold" offsetting); by imperfections in the properties of the surface of the roll; or by the toner particles insufficiently adhering to the copy sheet by the electrostatic forces which normally hold them there. In such a case, toner particles may be transferred to the surface of the fuser roll with subsequent transfer to the backup roll during periods of time when no copy paper is in the nip.

Moreover, toner particles can be picked up by the fuser and/or backup roll during fusing of duplex copies or simply from the surroundings of the reproducing apparatus.

One arrangement for minimizing the problems attendant the foregoing, particularly that which is commonly referred to as "offsetting" has been to provide a fuser roll with an outer surface or covering of polytetrafluoroethylene, commonly known as Teflon (registered Trade Mark), to which a release agent such as silicone oil is applied, the thickness of the Teflon being on the order of several mils and the thickness of the oil being less than 1 micron. Silicone based oils, which possess a relatively low surface energy, have been found to be materials that are suitable for use in the heated fuser roll environment where Teflon constitutes the outer surface of the fuser roll. In practice, a thin layer of silicone oil is applied to the surface of the heated roll to thereby form an interface between the roll surface and the toner images carried on the support material. Thus, a low surface energy layer is presented to the toner as it passes through the fuser nip and thereby prevents toner from offsetting to the fuser roll surface. The foregoing notwithstanding, "non-visual offsetting" (i. e. offsetting of very fine particles of toner) does occur. In prior art constructions (fuser structures where the outer surface comprises Teflon) such offsetting has been combated by the employment of various cleaning members, the wick material employed for applying the silicone based oil to the fuser roll serving this purpose. Continued contamination of a wick applicator in the foregoing manner is undesirable.

By means of the present invention it is possible to provide a roll fuser apparatus, including a release agent applicator which comprises a roll adapted to apply a coating of release agent material to the fuser without contacting the fuser roll. A doctoring blade may also be employed for doctoring the release agent material to the desired thickness.

According to the invention there is provided a roll fuser apparatus including a heated fuser roll co-operating with a back-up roll for forming a nip through which support material having toner images adhered thereto may move, the apparatus comprising, a vessel for containing a quantity of release fluid; an applicator member for applying release fluid to the fuser roll, the applicator member being spaced from the fuser roll whereby there is no contact between the surfaces of the applicator member and the fuser roll; means for moving the applicator member through the release fluid so as to coat the surface of the applicator member to a thickness sufficient to bridge the gap between the fuser roll and the applicator member thereby to transfer release fluid from the applicator member to the fuser roll; and means for doctoring the release fluid transferred to the heated fuser roll to a predetermined thickness.

When the support material passes through the nip, the toner images contact the heated fuser member and thereby become softened. Subsequent cooling of the toner renders the images permanently fixed to the substrate.

Preferably, the applicator member comprises a roll, spaced from the fuser roll, which is rotated through a sump of silicone oil release material and applies a liberal amount of the oil to the surface of the fuser roll. A doctor blade may be provided which contacts the surface of the fuser roll, thereby to remove substantially all of the silicone oil applied to the roll, along with any contaminants which appear on the fuser roll.

After the cleaning of the roll in the foregoing manner, a second release agent or material applicator may apply release fluid to the surface of the fuser roll without contacting said roll, and the release fluid may subsequently be smoothed to a desired thickness by means of a doctoring blade.

The invention is now described, by way of example, with reference to the accompanying drawing which is a schematic representation of a roll fuser apparatus for fixing toner images to substrate material.

Since the xerographic reproducing process is well known, a detailed description thereof is omitted. For those who would consider the description of the xerographic process necessary for a complete understanding of the present invention reference may be had to U.S. patents 3,718,116 and 3,745,972.

As shown in Figure 1, the present invention comprises a fuser roll assembly 15 including a heated roll structure 30 including a hollow cylinder or core 31 having a suitable heating element 32 disposed in the hollow portion thereof and which is coextensive with the longitudinal axis of said cylinder or core. The core 31 has provided on the outer surface thereof a layer of Teflon 34 or other suitable material which has adhesive characteristics, therefore, tendency to release tone type contaminants therefrom. The heating element 32 may comprise a suitable type heater for elevating the surface of the Teflon layer to operational temperatures, therefore, temperatures on the order of 250° to 450°F. For example, the heating element may comprise a quartz lamp. The cylinder or core 31 is fabricated from any thermally conductive material, for example, copper, aluminum or alloys thereof. The resulting structure has an outside diameter on the order of 1.5 to 3.0 inches and a length on the order of 10 to 15 inches.

Power requirements for the foregoing are 500-2500 watts, peak power with an average

power 300-2000 watts and 75-250 watts for standby.

The surface temperature of the fuser roll structure may be controlled by contacting the surface thereof with a thermistor probe (not shown) in a manner described in U. S. Patent 3,327,096. To this end, the end of the roll contacted by the thermistor probe may be specifically designed to accommodate such control of the operating temperature. In other words, means may be provided to reduce friction between the probe and the surface of the fuser roll structure. One method of accomplishing the foregoing would be to manufacture the fuser roll structure 30 such that the end thereof is devoid of Teflon material in the area contacted by the probe and the set point of thermistor is adjusted accordingly.

The fuser assembly 15 further comprising a backup roll structure 38 which cooperates with the fuser roll structure to form a nip 40 through which copy paper or substrate material 42 passes such that toner images 44 thereon contact the surface of the fuser roll structure 30. Backup roll structure 38 may comprise any suitable construction, for example, a steel cylinder, preferably comprising a rigid steel core 46 having a Viton (registered Trade Mark) elastomer layer or surface 48 which, as can be observed, has a relatively large thickness in order to provide a soft member which can be indented by the fuser roll structure 30 in order to form the nip 40.

After the copy sheet or substrate material 42 passes through the nip 40 it tends to stick or adhere to the surface of the fuser roll structure 30. Accordingly, a stripper finger structure (not shown) may be provided for stripping the copy paper or substrate material from the surface of the fuser roll structure 30 so that the copy sheets can continue on their path of movement toward the exit of the copier apparatus.

As noted hereinabove, as the copy sheets 42 pass through the nip 40 and in contact with the surface of the fuser roll structure 30 contaminants are offset to the surface of the fuser roll structure 30.

A system for cleaning or removing contaminants such as toner from the surface of the fuser roll is generally indicated by reference character 50. The cleaning system comprises a roll 52 supported for rotation contiguous the fuser roll 30 and a doctor blade cleaning member 54 supported for scraping contact of the fuser roll 30. The roll 52 is supported for rotation by means comprising a motor 56 such that it rotates through a quantity of silicone oil 58 contained in a sump 60. The oil preferably has a viscosity of approximately 250 cs and the roll 52 is spaced from the fuser roll 30 such that a gap of 0.020 inches is provided. The roller 52 is adapted to be rotated at a surface speed of 3.8 inches per second when the fuser roll is rotated at 20 inches per second to thereby apply a coating of silicone oil to the surface of the fuser roll in a thickness of approximately 3 mils. The roll 52 is preferably fabricated from a metal, for example, steel. While the system 50 is as described above, other cleaning systems may be employed, for example, a roll or rolls covered with a tacky material such as toner may be utilized.

The doctor blade 54 which is preferably fabricated from a high durometer silicone rubber, for example, a 90 shore A durometer, scrapes the surface of the fuser roll 30 to thereby substantially remove all of the oil applied by the roll 52 and along with the oil removes contaminants such as paper fiber and toner particles.

A second sump 62 containing a quantity of silicone oil 64 is provided along with a second applicator roll 66 which is adapted to be rotated through the silicone oil 64 and to coat the fuser surface with a coating of silicone oil in a thickness substantially less than that applied by the roller 52. To this end, the roll 66 is adapted to apply less than a one mil thickness of silicone oil to the fuser roll surface. This can be accomplished in any number of ways, for example, by increasing the spacing between the fuser roll 30 and the roller applicator 66 over that of the spacing between the roller 52 and the fuser roll. Alternatively, the viscosity of the silicone oil 64 could be varied as well as modifying the speed of rotation of the roll 66 relative to that of the fuser roll 30.

A doctoring blade 68 is provided for doctoring the oil on the surface of the fuser roll to a thickness of approximately 30 micro inches. The accomplishment of such doctoring is well known to those skilled in the art and may be accomplished in accordance with well known practices, therefore, a description thereof is omitted.

WHAT WE CLAIM IS:-

1. A roll fuser apparatus including a heated fuser roll co-operating with a backup roll for forming a nip through which support material having toner images adhered thereto may move, the apparatus comprising, a vessel for containing a quantity of release fluid; an applicator member for applying release fluid to the fuser roll, the applicator member being spaced from the fuser roll whereby there is no contact between the surfaces of the applicator member and the fuser roll; means for moving the applicator member through the release fluid so as to coat the surface of the applicator member to a thickness sufficient to bridge the gap between the fuser roll and the applicator member thereby to transfer release fluid from the applicator member to the fuser

roll; and means for doctoring the release fluid transferred to the heated fuser roll to a predetermined thickness.

2. An apparatus according to Claim 1 including means positioned between the nip and the applicator member for cleaning contaminants from the fuser roll.

3. An apparatus according to Claim 1 or 2 wherein the applicator member comprises a roll member.

4. An apparatus according to any of Claims 1 to 3 wherein the release fluid comprises silicone oil having a viscosity of approximately 250 cs.

5. An apparatus according to Claim 3 or Claim 3 and 4 wherein the applicator roll member has a surface speed of 3.8 inches per second when the surface speed of said heated fuser roll is 20 inches per second.

6. An apparatus according to any of Claims 1 to 5 wherein the space between the heated fuser roll and the applicator member is 0.020 inches.

7. An apparatus according to any of Claims 1 to 6 wherein the vessel comprises a sump.

8. An apparatus according to Claim 1 wherein the predetermined thickness is approximately 30 micro inches.

9. An apparatus according to any of Claims 1 to 8 wherein the doctoring means comprises a doctor blade cleaning member engaging the surface of said heated fuser member for removing substantially all the release fluid from the heated fuser roll and any contaminants deposited thereon.

10. An apparatus according to any one of Claims 1 to 9 including means for applying a second coat of release fluid to the fuser roll subsequent to the functioning of the doctoring means, the second release fluid applying means serving to apply the release fluid in a thickness substantially less than the thickness initially applied for cleaning of the fuser roll whereby the last mentioned coating enhances release of support material from the fuser roll.

11. A roll fuser apparatus substantially as hereinbefore described with reference to the accompanying drawing.

12. A xerographic copying apparatus including a roll fuser apparatus according to any one of Claims 1 to 11.

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1560637 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*