United States Patent [19]

Thettu

[11] **3,929,096**

[45] **Dec. 30, 1975**

[54] **ROLL FUSER**

[75] Inventor: **Raghulinga R. Thettu,** Webster, N.Y.

[73] Assignee: **Xerox Corporation,** Stamford, Conn.

[22] Filed: **Jan. 2, 1975**

[21] Appl. No.: **537,884**

[52] **U.S. Cl.** **118/60;** 118/104; 427/22; 432/60; 432/75

[51] **Int. Cl.²** **G03G 15/20**

[58] **Field of Search** 118/60, 101, 104; 432/60, 432/75, 228; 427/22

[56] **References Cited**

UNITED STATES PATENTS

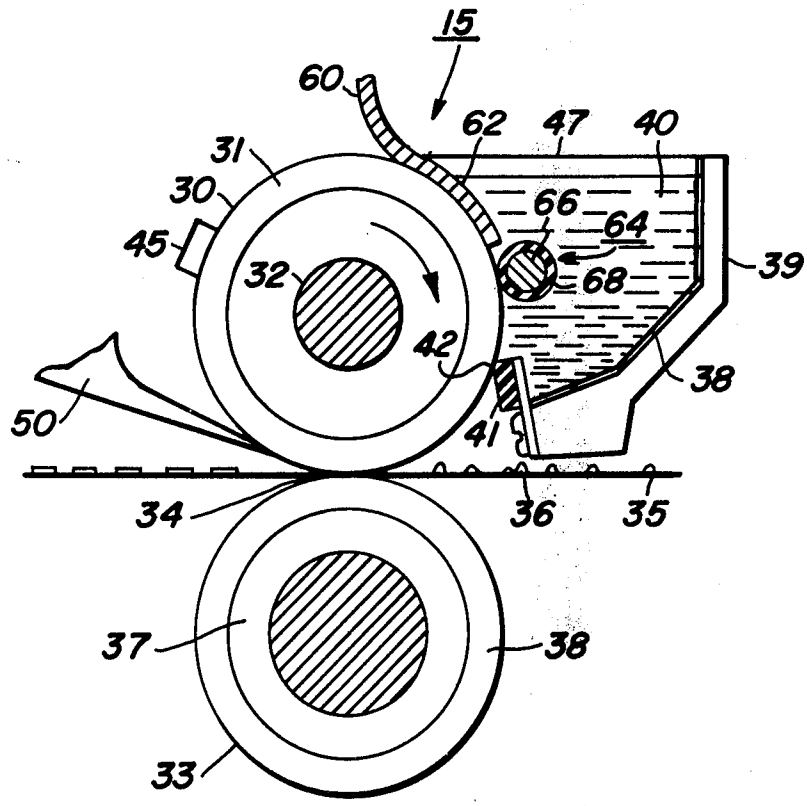
3,268,351	8/1966	Van Dorn	118/60
3,649,992	3/1972	Thetty	118/60
3,716,018	2/1973	Ohta et al.	118/60
3,716,221	2/1973	Gorka et al.	118/60
3,810,776	5/1974	Banks et al.	432/60
3,811,821	5/1974	Ariyama et al.	118/60

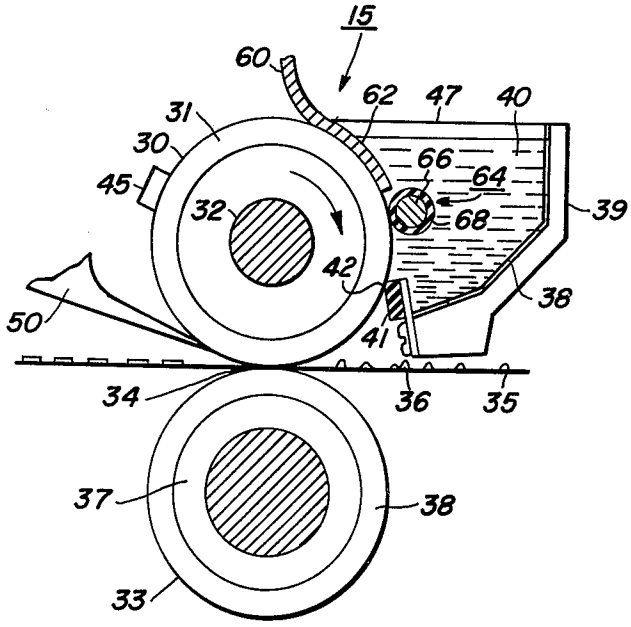
Primary Examiner—Mervin Stein
Assistant Examiner—Douglas Salser

[57] **ABSTRACT**

A contact fuser assembly for use in an electrostatic reproducing apparatus including an internally heated metal core cooperating with a resilient backup roll to form a nip through which substrates carrying toner images are moved with the toner images contacting the metal core. The fuser assembly is characterized by the provision of a sump of release agent material which material coats the fuser roll structure. A polymer covered cleaning member immersed in the release agent material contacts the fuser roll structure for removing non-visual toner and other contaminates offset thereto during the reproduction process.

6 Claims, 1 Drawing Figure




15
60
62
47
40
31
30
45
66
64
32
68
39
42
38
50
41
34
36
35
37
38
33

ROLL FUSER

BACKGROUND OF THE INVENTION

This invention relates generally to xerographic copying apparatus and, more particularly, to a contact fusing system 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 well 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 liquify 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.

However, 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, 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 offset" (i.e. offsetting of very fine particles of toner) does occur. In prior art constructions (fuser structures where the outer surface comprises Teflon or silicone rubber) 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.

However, it has been found that cleaning systems which are known to work with the aforementioned types of fuser roll surfaces are not acceptable for utilization with metal roll fusers.

Accordingly, the primary object of this invention is to provide a new and improved contact fuser system for fixing toner images to substrates.

A more particular object of this invention is to provide a fuser roll cleaning structure for utilization with a metal roll fuser.

Another object of this invention is to provide a contact fuser system employing a metal fuser roll structure and a sump of release agent material wherein a cleaning member for said fuser roll structure is immersed in the release agent and said cleaning member is coated with a polymer material.

BRIEF SUMMARY OF THE INVENTION

Briefly, the above-cited objects are accomplished by the provision of a contact fuser apparatus comprising a metal fuser roll structure cooperating with a resilient backup roll to form a nip through which substrates carrying toner images are passed with the toner images contacting the fuser roll structure.

A sump of release agent material, preferably polyethylene, is provided for coating the fuser roll structure to enhance the release of toner particles and other contaminates from the surface of the fuser roll structure. A polymer coated cleaning roll structure which is supported adjacent the fuser roll structure and rotated thereby is immersed in the polyethylene release agent material. The cleaning roll is coated with a polymer which at the operating temperatures of the fuser apparatus is in a tacky state, in which condition, together with the aid of the release agent material is useful in cleaning toner and other contaminates from the fuser roll structure.

Other objects and advantages of the present invention will become apparent when read in conjunction with the accompanying drawing.

DESCRIPTION OF THE DRAWING

The FIGURE is a side elevational view of a contact fuser representing the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

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

As shown in the FIGURE, the present invention comprises a fuser 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 which is coextensive with the cylinder. The heating element **32** may comprise any suitable type heater for elevating the surface temperature of the cylinder to operational temperatures, therefore, 250°–400°F. For example, it may be a quartz lamp. The cylinder or core **31** is fabricated from any suitable material capable of accomplishing the objects of the present invention. Typical materials are copper, anodized aluminum and alloys thereof, steel, stainless steel, nickel and alloys thereof, nickel plated copper and chrome plated copper. The resulting structure has an outside diameter on the order of 1.5 to 3.0 inches and has 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 of 300–2000 watts and 75–250 watts for standby.

The surface temperature of the fuser roll structure is controlled by contacting the surface thereof with a thermistor probe **45** in a manner described in U.S. Pat. No. 3,327,096, issued in 1967 to Bernous and incorporated herein by reference.

The fuser assembly **15** further comprises a backup roll structure **33** which cooperates with the fuser roll structure **30** to form a nip **34** through which a copy paper or substrate **35** passes such that toner images **36** thereon contact the fuser roll structure. The backup roll structure may comprise any suitable construction, for example, a steel cylinder, but preferably comprise a rigid steel core **37** having a Viton elastomer surface or layer **38** thereon. A suitable roll has a core approximately 1.8 inches in diameter with a 0.1 inch cover a layer structure of Viton elastomer or other suitable high temperature elastomeric layer structure, for example, silicone rubber and a combination of Viton or silicone rubber with Teflon thereon. Viton is a trademark of the E. I. duPont de Nemours and Company. The specific dimensions of the members making up the backup roll will be dictated by the requirements of the particular copying apparatus wherein the fuser assembly **15** is employed, the dimensions being greater or less depending upon the process speed of the machine. The heated roll and backup roll structures may be mounted on fixed axes, therefore not requiring movement in and out of engagement or they may be mounted in accordance with prior art devices wherein the backup roll is moved into and out of engagement with the fuser roll structure.

Means (not shown) for applying a loading force in a conventional manner to the fuser assembly **15** serves to create nip pressures on the order of 15 to 150 psi average. The durometer of the backup roll is chosen such that "dwell times" of 5 to 100 milliseconds can be obtained with loading forces within the aforementioned range of pressures. Dwell time is proportional to the ratio of the nip length to the surface speed of the rolls. For a given angular velocity the surface speeds will vary depending upon the diameter of the rolls. For example, with a two inch fuser roll, speeds of 0 to 30 inches per second are attainable and for a 3 inch fuser roll, speeds of 0 to 45 inches per second have been attained. Accordingly, it can be seen that the aforementioned dwell times can be obtained by varying one or the other or both of the dwell time relationships. Durometers of 20-90 Shore A have been found to provide satisfactory results.

The aforementioned materials from which the fuser roll structure **30** may be fabricated are relatively high surface energy materials, consequently, hot toner material contacting such surfaces would readily wet the surface of the fuser roll. Accordingly, there is provided a sump **39** for containing release material **40** capable of interacting with the fuser roll. The release material is preferably a low molecular weight material which is solid at room temperature and which has a relatively low viscosity at the operating temperatures of the fuser roll structure. An example of such a material is polyethylene hopolymer manufactured by Allied Chemical Co. and having the designation AC-8 hopolymer. A resistance heater **38** which may be of the brush-on film type is provided for melting the polyethylene.

A metering blade **41** preferably of silicone rubber is mounted to the sump **39** by conventional means such that an edge **42** thereof contacts the fuser roll structure serving to meter the release agent **40** in its liquid state onto the fuser roll. In the preferred embodiment, a blade 0.060 inch thick and having a width of 1.0 inch and length of 15 inches has been employed. By means of such a construction a 0.1–0.5 micron thickness of release agent is applied to the surface of the fuser roll.

A pair of end seals **47**, preferably of sponge rubber are provided to contain a release agent material in the sump **39.** One or more stripper fingers **50** are provided for insuring removal of the substrate from the fuser roll.

Although the interaction of the polyethylene material with the surface of the fuser roll structure is not well under stood, it is believed that a thermal degradation of the polyethylene takes place to form a by-product of carboxylic acid which chemically reacts with the surface of the fuser roll structure. It has been noted that where the polyethylene and the fuser roll surface form a boundary layer with the ambient air, beading of the surface of the fuser roll structure takes place along such boundary. Accordingly, a wiper blade **60** is supported adjacent to the sump **39** in any suitable manner such that it contacts the core **31** to form a wiper blade/-polyethylene/air boundary **62** and thereby prevent the formation of a core/polyethylene/air boundary which would result in the aforementioned formation of a bead on the core which would print out on the copy sheets **14** and also disrupt proper operation of the combination seal and metering blade **41.** The wiper blade **60** is preferably fabricated from a material which is compatible with the polyethylene (i.e. does not chemically react therewith and to a lesser degree is dimensionally stable in the presence thereof). To this end, the wiper blade comprises an elastomeric material, for example, silicone rubber.

In accordance with the objects of the present invention, a cleaning roll structure **64** is positioned to clean

the fuser roll structure **30** of paper contamination and non-visual offset as well as visual toner offset particles. The cleaning roll structure comprises a metal core member **66** which is covered by a cylindrical sleeve member **68** made of polyester polymer material. Any suitable polyester polymer material having a melting or softening point ranging from about 120° to about 275°C can be employed. Typical materials are aliphatic, aromatic or mixtures of aliphatic, aromatic polyesters. Examples of these classes of materials are polyethylene oxolate, poly-pp[1] xylelene terephthalate, polyethylene/ neopentyl terephthalate. Preferred materials of the mixed class of polyesters are PE-100 or PE-200, trademarks of Goodyear Company, of Akron, Ohio. The sleeve member **68** has a thickness of about 0.005 to about 0.030 inches. The sleeve member may be applied to the metal core member **66** by any suitable technique such as solvent spraying, extrusion wrapping, hot melt rolling or combinations thereof. Preferably the final application is by heat shrinking the extruded polyester tube over the core member. Desirably, hot rolling is applied during the heat shrinking process.

It has been found that paper contamination on the fuser roll structure **30** is physically attracted to the sleeve **68** due to good adhesion at high temperature. The viscosity of the polyester material is such that it has high elongation at the operating temperatures coupled with excellent wetting properties.

Any loose paper fiber and/or background toner particles attracted by the fuser roll surface collect thereon and transfer to the sleeve member **68** by virtue of the physical adhesion of the contamination to the polyester polymer material. As can be observed from the FIG. of the drawing, the cleaning roll member **64** is immersed in the polyethylene release agent material. It has been found that the adhesion action of the polymer material along with the action of the polyethylene release agent material effectively removes the toner material and other contaminates from the fuser roll structure. However, the cooperative action is not understood. Cleaning of metal fuser rolls was attempted with a cleaning member such as the roll member **64** which was not immersed in the release agent. The foregoing yielded unacceptable results.

While the invention has been shown and described in conjunction with the preferred embodiment thereof, it will be understood that various modifications thereto may be made by those skilled in the art without departing from the spirit of the invention and such modifications are intended to be covered by the claims appended hereto.

What is claimed is:

1. Roll fuser apparatus for fixing toner images to support members comprising:

a metal fuser member;

a resilient fuser member forming a nip with said metal fuser member through which said support members move;

a sump containing a quantity of release agent material; and

a cleaning member supported for contacting the surface of said metal fuser member, said cleaning member being immersed in said release agent material.

2. Apparatus according to claim **1,** wherein said cleaning member comprises a polymer covered roll structure.

3. Apparatus according to claim **2,** wherein said metal fuser member comprises an internal source of thermal energy and said toner images contact said metal fuser member.

4. Apparatus according to claim **3,** wherein said release agent material comprises polyethylene.

5. Apparatus according to claim **4** including means for preventing bead formation on the fuser roll structure.

6. Apparatus according to claim **5,** wherein said fuser members comprise roll structures.

* * * * *