Jan. 27, 1970 W. E. WHITE ET AL 3,492,458

THERMOFUSING DEVICE

Filed Oct. 30, 1967

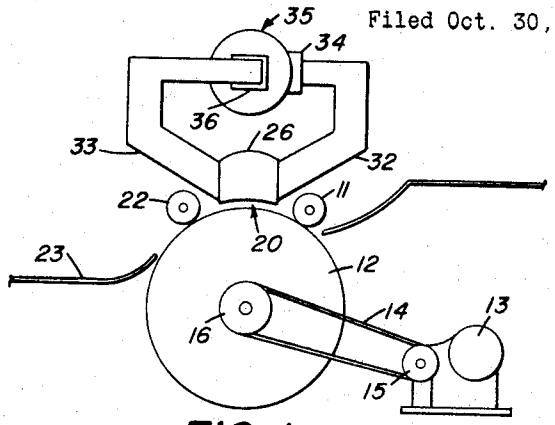


FIG. 1

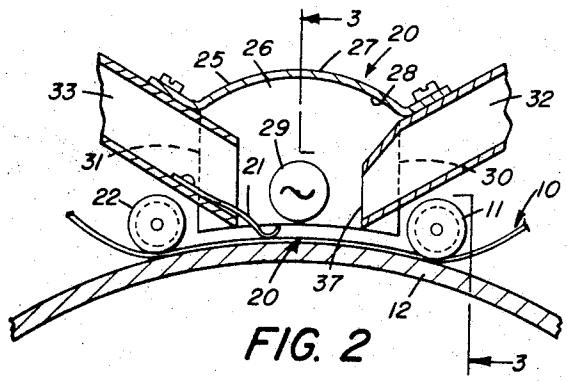


FIG. 2

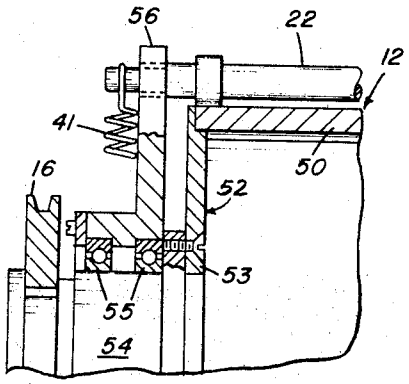


FIG. 4

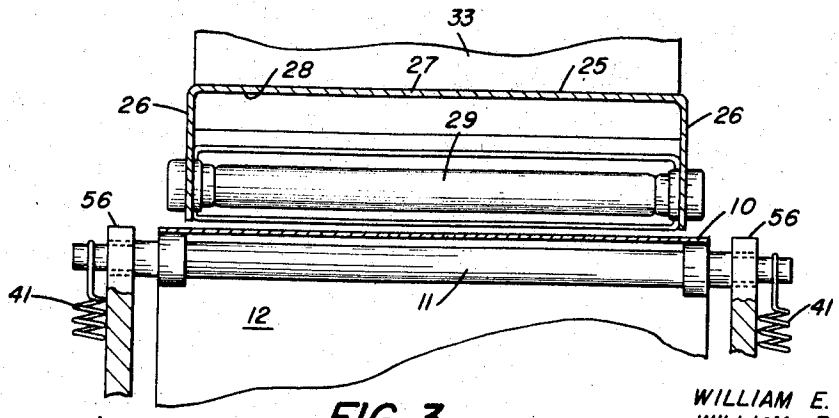


FIG. 3

WILLIAM E. WHITE
WILLIAM F. GARBE
INVENTORS

BY Lloyd F. Beebach

AGENT

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THERMOFUSING DEVICE

William E. White and William F. Garbe, Rochester, N.Y., assignors to Eastman Kodak Company, Rochester, N.Y., a corporation of New Jersey

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U.S. Cl. 219—216 2 Claims

ABSTRACT OF THE DISCLOSURE

A device for thermofusing an electroscopic toner image to the surface of a carrier by moving the carrier relative to a radiant heating element, the later being retained within a casing which is connected by suitable ducts to a supplementary heating and circulating system comprising a fan and air heating means. The heated air is directed onto the carrier in close proximity to the space between the carrier and the radiant heating element so that the toner image is fused to the carrier by the conjoint action of the radiant heat and hot air.

FIELD OF THE INVENTION

The present invention relates to a device for fusing powder-toned xerographic images, and more particularly to a device for fusing powder-toned xerographic images in which such fusing is accomplished by a combination of radiant heat and a flow of hot air.

DESCRIPTION OF THE PRIOR ART

There are many known methods for fusing powder-toned xerographic images. In most of such methods heat is used to melt the toner carrier so that it readily fuses to the copy sheet. The sources for such heat can be hot air, radiant heat, etc. With each of such heat sources, problems are encountered with respect to the powdered toner and the image carrier. The primary problem is that none of the aforementioned heating sources permits a high rate of fusing speed; in other words, the movement of the image carrier or copy relative to the heating source must be quite slow in order to accomplish adequate fusing. With such a slow rate of copy speed and the extremely high temperature of the heating source, it is difficult to provide adequate controls in order to insure that the copy sheet does not become discolored or even charred due to the heat. Further, in roll contact fusing, offsetting of the toner particles to the heated roll can occur, unless special provisions are made for preventing such offset. In the case of fusing with vapor or an atomized form of solvent, special provisions must be made to dispose of the solvent and to safeguard against the inherent fire hazard.

SUMMARY OF THE INVENTION

One object of the present invention is to provide a fusing device for powder-toned xerographic images which permits relatively high speeds of copy sheet movement with insured fusing of the toner image to the copy sheet.

Another object of the invention is to provide an apparatus for fusing powder-toned xerographic images on a continuous basis so that the copy paper can be either in sheet or roll form.

Yet another object of the invention is to provide a device for fusing powder-toned xerographic images in which the time to fuse successive portions of an image area is reduced to a small fraction of a second so that the copy sheet is subjected to heat for only a sufficient period of time to effect fusing of the toner particles, which period is not sufficient to cause discoloration or charring of the copy sheet.

Still another object of the invention is to provide a device for fusing powder-toned xerographic images in which the device can be available for use in a relatively short period of time without any relatively long warm-up period as usually necessitated by known fusing devices.

Other objects and advantages of the invention will be readily apparent to those skilled in the art when the more detailed description set forth hereinbelow is read in conjunction with the attached drawing.

The above objects of the invention are attained by a device for thermofusing an electroscopic toner image to the surface of a carrier by moving the carrier relative to a radiant heating element, wherein the radiant heating element is retained within a casing which is connected by suitable ducts to a supplementary heating and circulating system. The circulating system comprises a fan and means for heating air, the heated air being directed onto the carrier in close proximity to the space between the carrier and the radiant heating element to supplment the heat generated by the latter. The air surrounding the radiant heating element is withdrawn for return to the circulating system in which it is reheated and again recirculated. The successive portions of the toned xerographic image on the carrier being moved past the radiant heating element are fused to the carrier by the combined effect of the radiant heat and the hot air. By means of such a combination of radiant heat and hot air satisfactorily fused xerographic images can be obtained, with no smearing of the image as evidenced by wiping tests, even when the linear movement of the carrier past the fusing station is as high as about 8" per second, or more.

DESCRIPTION OF THE DRAWING

Reference is now made to the accompanying drawing wherein like reference numerals designate like parts and wherein:

FIG. 1 is a schematic representation of a fusing device embodying the invention and showing the path through which the carrier is moved and the relation of the fusing station to the path;

FIG. 2 is a partial vertical section through the fusing station shown in FIG. 1 and showing the relation of the radiant heating element to the toned image carrier and the means for introducing and withdrawing the hot air for supplementing the radiant heat;

FIG. 3 is a vertical section taken substantially along line 3—3 of FIG. 2 and showing the manner in which the fusing areas are enclosed by the casing and the ducts associated with the circulating system; and

FIG. 4 is a vertical section through the carrier moving drum showing the drum structure.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIG. 1, a sheet **10** carrying a toned xerographic image is moved either manually or by a feeding device into the nip of a hold-down roll **11** and a drum **12**. The drum **12** is driven continuously by means of a motor **13** which is connected to drum **12** by means of a belt **14** interconnecting pulley **15** associated with motor **13** and a pulley **16** which can be a part of drum **12**. The drum **12** moves the carrier **10** past the fusing station **20** and under a plurality of holddown fingers **21**, see FIG. 2, and a holddown roll **22**, the latter aiding in directing the carrier to an exit chute **23**.

The fusing station **20** comprises a substantially U-shaped casing **25** having spaced end walls **26** that are joined by an intermediate portion **27**. The portion **27** can be curved as shown in FIG. 2 with the inner surface plated to provide an internal reflecting surface **28** for at least one elongated radiant heating element **29**, the latter being mounted between the side walls **26** and in

closely spaced relationship to the surface of drum **12**. The opposite sides **30** and **31** of casing **25** are to a large extent enclosed, respectively, by a duct **32** and a duct **33**. As shown in FIG. 1, the duct **32** is connected to the outlet **34** of circulating means **35** comprising a fan and a heating element of well known structure but not shown in detail. The duct **33** is connected to the inlet **36** of the circulating means **35**. It will be noted, as best shown in FIG. 2, that the end **37** of duct **32** is formed so as to direct the flow of hot air onto the carrier **10** and into the space between the carrier **10** and the heating element **29**. The duct **33** serves to withdraw the air from the casing **25** and return it to the circulating means **35** in which it is reheated to the required temperature and then returned via duct **32** to the fusing station **20**.

Since the powder-toned xerographic image must be heated to a temperature sufficient to fuse the toner particles to the carrier without overheating the carrier itself, the carrier is introduced into the fusing station so that its powder-toned image faces the heating element **29**. In the form that the carrier with its powder-toned image is introduced into the fusing station, the toner particles are adhered to the carrier only by the electrical field existing between the charged particles and the carrier in the image areas. As a result, the image bearing portion of the surface of the carrier facing heating element **29** is preferably not in contact with any other surface prior to fusing of the image. For this reason, as shown in FIG. 3, the width of drum **12** is greater than fusing station **20** and rolls **11** and **22** are undercut, as shown in FIG. 2, throughout their length except at the ends which engage the edges of the carrier outside of or beyond the actual image area. In order to insure good driving contact between the carrier **10** and drum **12**, rolls **11** and **22** are preferably biased toward drum **12** by means of springs **41**.

With reference to FIG. 4, the drum **12** comprises a sleeve **50** that is mounted between a pair of spaced flanges **52**, each of which comprises a plate **53** and a stub shaft **54** journaled in a pair of spaced bearings **55** mounted in a support **56** fixed to a suitable base (not shown) on each side of drum **12**. One of the shafts **54** carries pulley **16** for rotating the drum **12** as described above.

From the description, it should be readily apparent that a carrier having a powder-toned xerographic image can be moved past the fusing station **20** at a relatively high rate of speed to accomplish satisfactory fusing of the toned image. The combination of the hot air introduced through duct **32** and the radiant heat generated by heating element **29** fuses the toner in a relatively short period of time without any danger of imparting so much heat to the carrier **10** that the image-bearing surface discolors or is in danger of being charred.

The radiant heating element **29** can conveniently be a quartz incandescent lamp which generates about 100 watts per inch and which is spaced from the surface of drum **12** by about one-quarter to on-half inch. The temperature of the air introduced by duct **32** will vary in accordance with the melting point of the toner and the desired fusing rate. With the application of such hot air, good fusing is accomplished without discoloration of the image-bearing surface of the carrier.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

We claim:

1. Apparatus for thermofusing an electroscopic toner image comprising:

a carrier bearing an electroscopic toner image on a surface thereof;

at least one elongated, radiant heating element;

a rotatable member for supporting and moving said carrier past said heating element at a uniform rate with said toner image facing and directly exposed to and in closely spaced relationship to said heating element;

heating means independent of said heating element and having an air outlet and an air inlet for generating and circulating a continuous flow of hot air;

first duct means having one end thereof connected to said air outlet and the other end disposed adjacent one side of said heating element for directing said flow of hot air onto said carrier in close proximity to the space between said carrier and said heating element to supplement the radiant heat generated by the latter; and

second duct means having one end thereof connected to said air inlet and the other end disposed adjacent the other side of said heating element for withdrawing the air from the space around and between said carrier and said heating element;

the successive portions of said toner image moved past said heating element being fused to said carrier by the conjoint action of said radiant heat and said flow of hot air.

2. Apparatus for thermofusing an electroscopic toner image comprising:

a carrier bearing an electroscopic toner image on a surface thereof;

a substantially U-shaped casing comprising spaced end walls joined by a refecting surface to provide an opening and a pair of spaced open sides;

at least one elongated, radiant heating element disposed between said end walls and spaced from said reflecting surface in a direction toward said carrier;

a rotatable drum for supporting and moving said carrier past said opening and said heating element at a uniform rate and in a direction normal to the axis of said heating element with said toner image facing and directly exposed to and in closely spaced relationship to said heating element;

circulating means having an air inlet and an air outlet for generating a continuous flow of hot air;

first duct means having one end connected to said air outlet and the other end connected to one of said open sides for directing said flow of hot air onto said carrier in close proximity to the space between said carrier and said heating element to supplement the radiant heat generated by the latter; and

second duct means having one end thereof connected to said air inlet and the other end connected to said other open side for withdrawing the air from the space around and between said carrier and said heating element;

the successive portions of said toner image moved past said heating element being fused to said carrier by the conjoint action of said radiant heat and said flow of hot air.

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JOSEPH V. TRUHE, Primary Examiner

P. W. GOWDEY, Assistant Examiner

U.S. Cl. X.R.

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