United States Patent

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[54] **HEAT-FIXING APPARATUS FOR LENGTHY FUSIBLE MATERIAL**
1 Claim, 5 Drawing Figs.

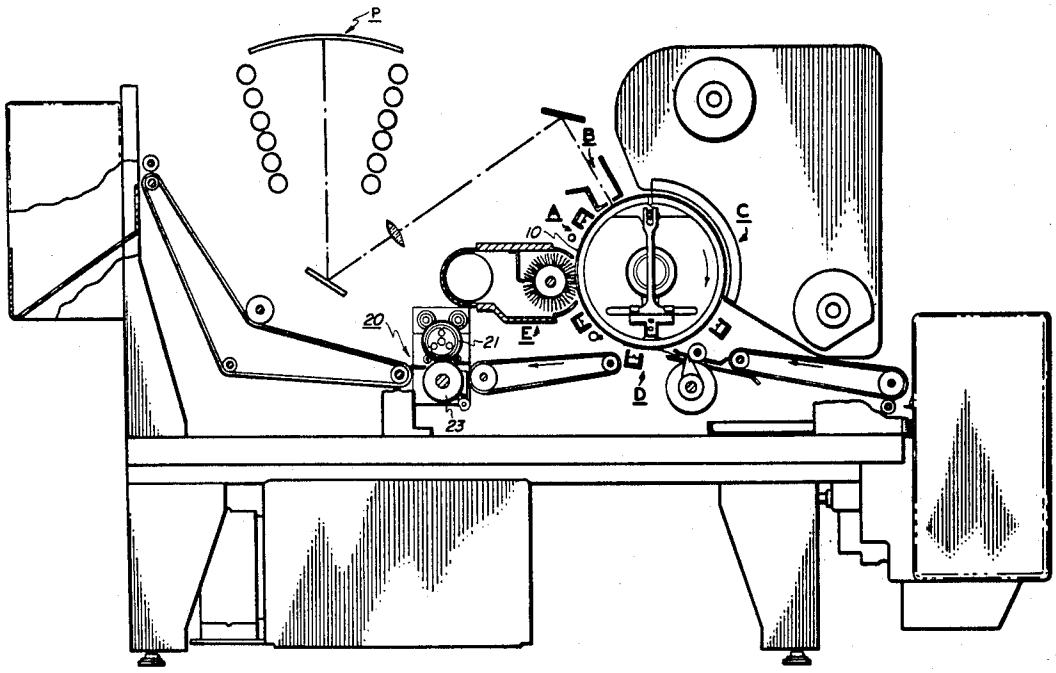
[52] **U.S. Cl.** **219/216,** 219/470
[51] **Int. Cl.** **H05b 1/00**
[50] **Field of Search** ..... 219/216, 388, 469–471; 100/93 RP; 250/65.1 T, 65.2 ZE; 355/9, 11; 263/6; 156/583

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ABSTRACT: A fixing system for fixing fusible material such as electroscopic particles upon wide support material embodying the principle of low-thermal losses for conserving heat. The system includes two rollers in pressure contact between which the support material is transported. One of the rollers is heated from an interior lamp which remains fixed so that portions of the roller along its entire length are heated continuously and conducted to the side of the support material carrying the particles. The heated roller is driven externally by a plurality of roller members positioned at the ends thereof to enable heat losses to support fixtures to be minimized.



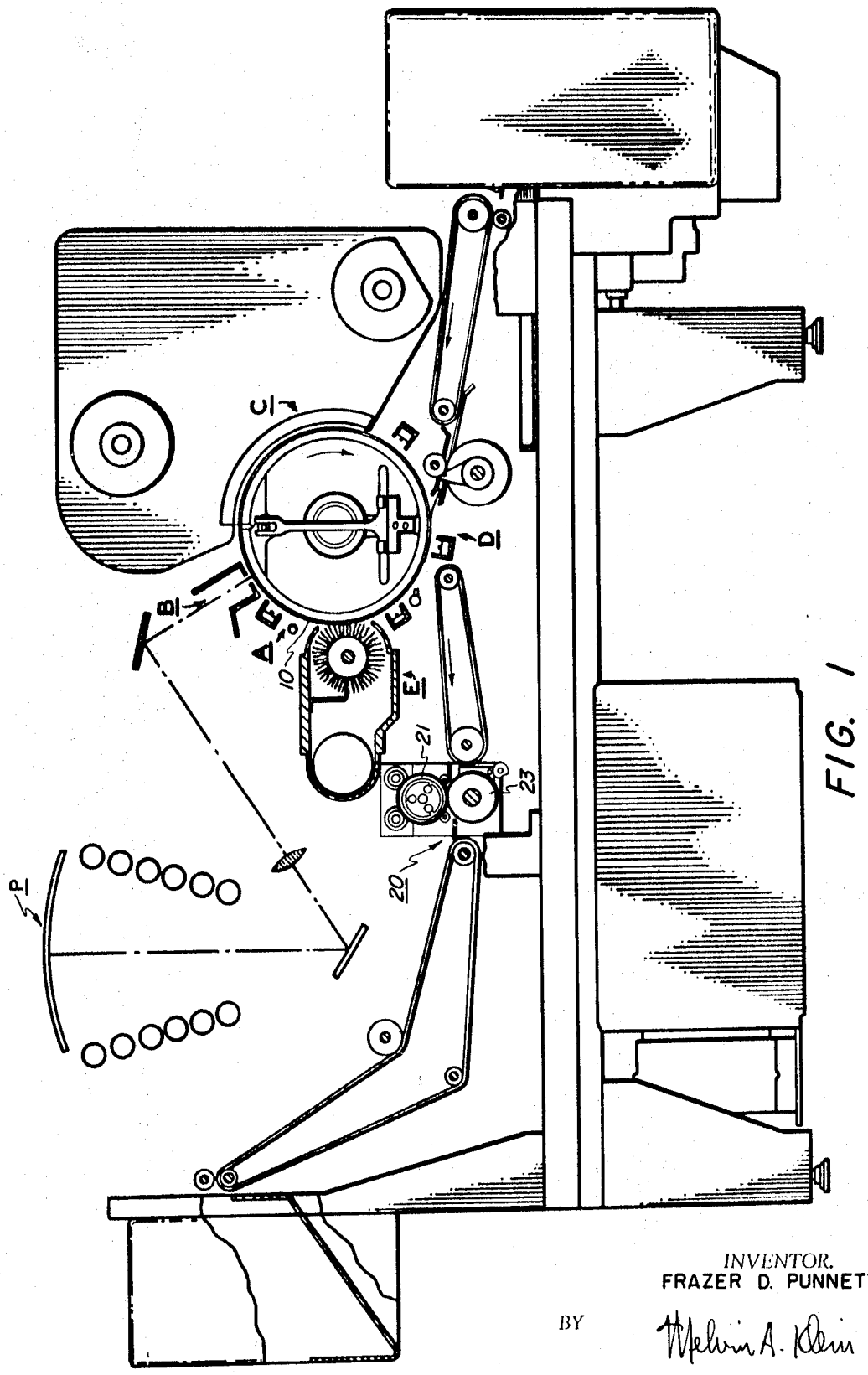


FIG. 1

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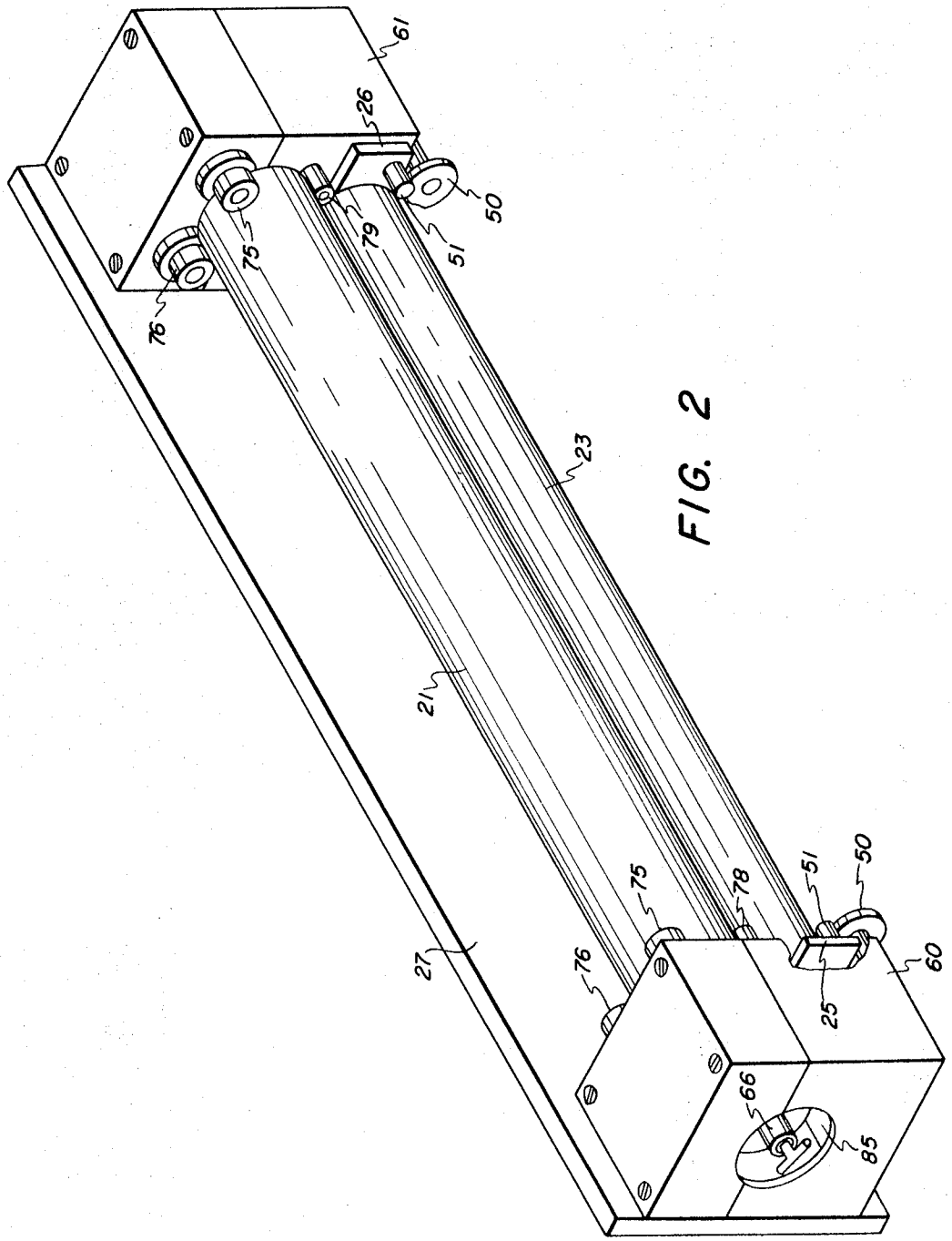


FIG. 2

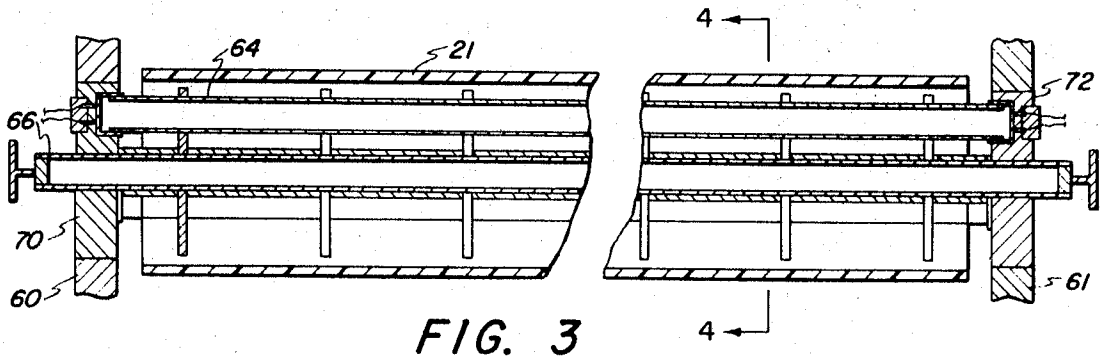


FIG. 3

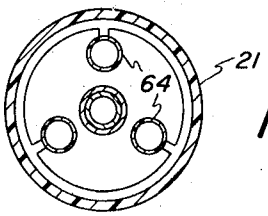


FIG. 4

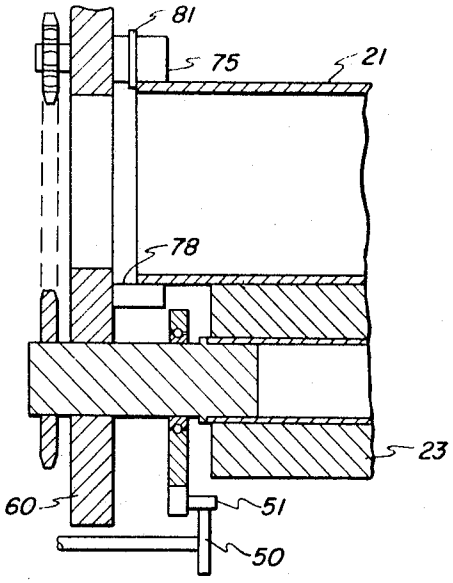


FIG. 5

HEAT-FIXING APPARATUS FOR LENGTHY FUSIBLE MATERIAL

This invention relates to heat-fixing system, and particularly, to improvements in fuser apparatus for particulate material such as resinous toner particles, that are used in electrostatic automatic copiers/reproducers capable of producing high-quality copies on sheets of great size.

It has been recognized that one of the preferred methods of applying heat for fusing the powder image to paper is to bring the powder image into direct contact with a hot surface, such as a heated roller. However, in order to produce fused images effectively and efficiently, it has been necessary to utilize relatively large and structurally dense fuser rollers which consume large amounts of heat in order to overcome heat losses effected by the roller-supporting structures. The heated roll in these fusers is generally supported by interiorly mounted antifriction bearings which have high-temperature gradients needing a relatively large power supply to overcome heat losses as well as for fusing purposes. With the requirement for long rollers to fuse copies on very wide sheets, the problems associated with heater element temperatures are further complicated.

It is therefore, the principal object of this invention to improve the construction of a direct-contact-fusing device for toner images which will require a minimum of heat to accomplish the rapid fusing of toner images.

A further object of this invention is to provide a direct-contact-fusing device for toner images having heating elements which will enable a minimum contact between the heating elements and the surrounding area.

Another object of the invention is to simplify the construction of direct-contact-fusing devices whereby the replacement of heating elements within the devices is greatly facilitated.

These and other objects of the invention are attained by means of a direct-contact-fusing device in which the toner image is fused by forwarding the sheet or web of paper-bearing toner images between two rollers one of which is heated interiorly by heating elements which remain fixed relative to an outer cylindrical member which is drivingly engaged on the exterior surface thereof to minimize heat losses to the surrounding area.

For a better understanding of the invention, as well as other objects and further features thereof, reference is had to the detailed description of the invention to be read in connection with the accompanying drawings, wherein:

FIG. 1 illustrates schematically a xerographic reproducing apparatus adapted for high-speed automatic operation, and incorporating a roller heat fuser apparatus constructed in accordance with the invention;

FIG. 2 is an isometric view of the fuser apparatus of the invention;

FIG. 3 is a side sectional view of the fuser apparatus;

FIG. 4 is a sectional view of the fuser apparatus taken along the line 4—4 in FIG. 3; and

FIG. 5 is an enlarged fragmentary sectional view of the fuser apparatus illustrating certain details of the rollers and drive mechanism.

For a general understanding of the illustrated copier/reproduction machine, in which the invention is incorporated, reference is had to FIG. 1 in which the various system components for the machine are schematically illustrated. As in all electrostatic systems such as a xerographic machine of the type illustrated, a light image of a document to be reproduced is projected onto the sensitized surface of a xerographic plate to form an electrostatic latent image thereon. Thereafter, the latent image is developed with an oppositely charged developing material to form a xerographic powder image, corresponding to the latent image on the plate surface. The powder image is then electrostatically transferred to a support surface to which it is fused by a fusing device whereby the powder image is caused permanently to adhere to the support surface.

In the illustrated machine, an original to be copied is placed upon a transparent support platen P fixedly arranged in an illumination assembly and image rays are projected by means of an optical system for exposing the photosensitive surface of a xerographic plate in the form of a drum generally indicated by the reference numeral **10**.

The drum **10** is mounted upon the frame of the machine and is adapted to rotate in the direction of the arrow at a constant rate. During this movement of the drum, it passes a charging station A where a uniform electrostatic charge is applied to the surface thereof. Next at an exposure station B exposure of the drum surface to the light image discharges the xerographic plate in the areas struck by light, whereby there remains on the surface a latent electrostatic image in image configuration corresponding to the light image projected from the original on the supporting platen. As the drum surface continues its movement, the electrostatic image passes through a developing station C in which there is positioned a developer assembly. The developer assembly deposits developing material to the upper part of the drum whereat the material is directed to cascade over the drum surface in order to provide development of the electrostatic image. As the developing material is cascaded over the drum surface, toner particles in the development material are deposited on the surface to form powder images.

The developer electrostatic image is transported by the drum to a transfer station D whereat a sheet of copy paper is moved at a speed in synchronism with the moving belt in order to accomplish transfer of the developed image. There is provided at this station a sheet transport mechanism adapted to transport sheets of paper from a paper-handling mechanism to the developed image on the drum at the station D.

After the sheet is stripped from the drum, it is conveyed to a fuser apparatus generally indicated by the reference numeral **20** whereat the developer and transferred xerographic powder image on the sheet material is permanently affixed thereto as will be described more fully hereinafter. After fusing, the finished copy is discharged from the apparatus by a belt conveyor to a suitable point for collection externally of the apparatus.

Suitable drive means are arranged to drive the drum in conjunction with timed exposure of an original to be copied, to effect conveying and cascade of toner material, to separate and feed sheets of paper and to transport the same across the transfer station D and to convey the sheet of paper through the fuser apparatus in timed sequence to produce copies of the original.

It is believed that the foregoing description is sufficient for the purposes of this application to show the general operation of an electrostatic copier using an illumination system constructed in accordance with the invention. For further details concerning the specific construction of the electrostatic copier, reference is made to U.S. Pat. No. 3,301,126 filed Sept. 30, 1964 in the name of Osborne et al.

As shown in FIGS. **2** to **5**, the fuser apparatus **20** is of the pressure-roller heat-type and includes a frame for supporting an upper roller **21** which is heated and a lower roller **23**. The frame includes two spaced-apart end plates **25**, **26** supported in parallel relationship vertically by a baseplate **27** secured to the main frame for the machine utilizing the fuser assembly.

Direct contact fusing of a powder image on a sheet of paper support material is achieved by forwarding a sheet bearing the powder image to be fused between the heated upper roller rotating into and under pressure during a fusing operation with the lower roller. The sheet of support material carrying the unfused toner images is directed between the nip of the rollers 2l, **23** by means of guide rods extending between the transport system and the adjacent end of the fuser apparatus **20**.

To effect the desired pressure contact pivotal movement of the lower roller support plates **25**, **26** is accomplished by means of a cam-actuated drive mechanism arranged to impart pivotal movement to the plates in either direction to raise or

lower the lower roller **23** relative to the upper roller **21**. The drive mechanism includes a pair of cam members **50** each in the form of an inclined plane adapted to be moved horizontally for driving a cam follower 5l vertically. The cam followers **51** are both in the form of a wheel adapted to ride upon the inclined plane of the cam member **50** and to be moved vertically in either direction. The cam follower wheels **51** are rotatably mounted in end plates **25, 26** which are pivoted on frame blocks **60** and **61** respectively. Upon rotation of the cam members **50** both the wheels **51** will be moved vertically. Such movement of the cam followers produces corresponding movement of the end plates thereby moving both ends of the plates simultaneously and causing the roller **23** to move relative to the upper fixed roller **21**. Rotation of the cam members is by any suitable drive (not shown) controlled by machine logic only at such times that a sheet of support material is in position to be moved between the rollers.

In accordance with the invention the fuser apparatus is capable of fusing very wide sheets extending up to about 40 to 50 inches in width with the upper roller **21** serving as the heated roller of the fuser apparatus. A sheet of paper being directed to the nip between the rollers by the conveying system will carry the unfused toner image on its upper surface in direct contact with the upper roller surface. The upper roller **21** has heat applied thereto internally by means of one or more heating elements **64** mounted on a support rod **66** which is received along the length of upper roller **21** so that its axis is generally parallel thereto. The support rod **66** is supported on its ends by plates **70, 72** located external to the roller **21**. The upper heated roller **21** is supported by two drive rollers **75, 76** on each end and two idler rollers **78, 79** on each end which serve to drive the upper roller with a minimum of contact area with the surrounding structure. To accomplish this end driven rollers **75, 76** are mounted on end blocks **60** and **61** and driven by a drive mechanism which is connected to the drive for lower rollers **23** such that the surface speeds of both main rollers is alike. It will be noted that driven rollers **75, 76** each have a flange portion **81** which enables a limited amount of roller lengthwise expansion while at the same time providing axial positioning of the roller. This is especially desirable in the case of long roller structures used in fixing copy material of great size.

An important feature of the invention is that end blocks **60** and **61** have formed in them openings **85** corresponding to the diameter of end plates **70, 72** so as to enable withdrawal of the heating elements without disturbing the arrangements of the upper and lower rollers. It will be appreciated that the rollers may be covered with Teflon or other suitable material to prevent offset of the toner images onto the roller surface.

In operation, a sheet or web of support material such as paper is directed into the nip between the rollers **21, 23** in a manner wherein the toner image to be fused is on the upper surface of the horizontally moving transfer material. Heat from the heating elements **64** is applied to the interior of the roller **21** to accomplish fusing.

The upper heated roller is driven from exterior drive rollers to minimize heat losses through the supporting structure.

With this arrangement, only a very small amount of heat from the heating elements will be needed to maintain the heat balance on the roller. Since there is a minimum loss of heat by way of conduction and radiation, the amount of energy necessary to energize the heating elements may be substantially reduced in comparison to those roller fusers which utilize an internal drive support generally mounted within the heated roller. With less power requirements for the heating elements, these are capable of longer life cycles and present little or no fire hazard. With practically no heat being applied to the supporting structure for the rollers, there is less problem than when bearings supporting the same are positioned within the heated roll.

While the invention has been described with reference to the structure disclosed herein it is not confined to the details set forth and this application is intended to cover such modification or changes as may come with the purpose of the improvements or the scope of the following claims.

What is claimed is:

l. A contact heat-fusing apparatus of the type having two fusing members each mounted for rotation in an endless path and arranged in contact and adapted to receive and move a support material carrying thermoplastic particles in image configuration for fixing the image the improvement comprising a frame, lamp means associated with one of said fusing members supported in said frame and adapted when energized to flow heat radially outwardly at a sufficient temperature for tacking and fixing image particles, a cylindrical member supported by said frame enclosing said lamp means and extending in parallel relation therewith, drive means for applying force to the exterior of said cylindrical member to cause rotation thereof with a minimal of heat loss to the surrounding area, said drive means includes a plurality of roller members positioned at the ends of said cylindrical member, each of said driving rollers having a flange portion arranged in contact with the terminal portions of said cylindrical member whereby lengthwise expansion and contraction of the cylindrical member may be effected.