

[54] **CONTROL DEVICE FOR AN
ELECTROPHOTOGRAPHIC PRINTING
MACHINE**

[75] Inventor: **Robert P. Rebres**, Fairport, N.Y.

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

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[58] Field of Search 355/14, 133; 354/174, 275,
354/276, 284; 271/145, 154, 171; 219/216

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Primary Examiner—Fred L. Braun

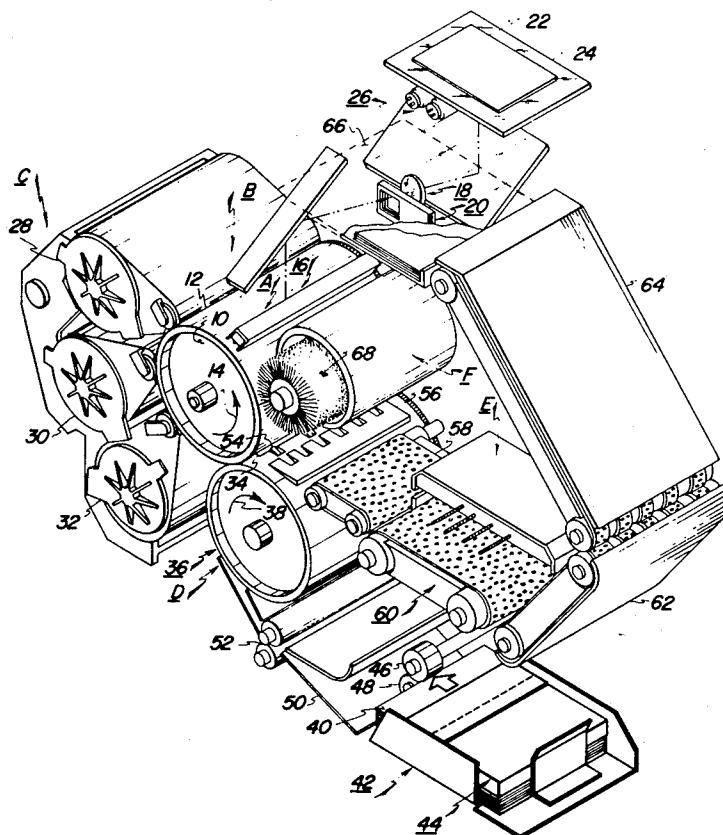
Attorney, Agent, or Firm—H. Fleischer; J. J. Ralabate;
C. A. Green

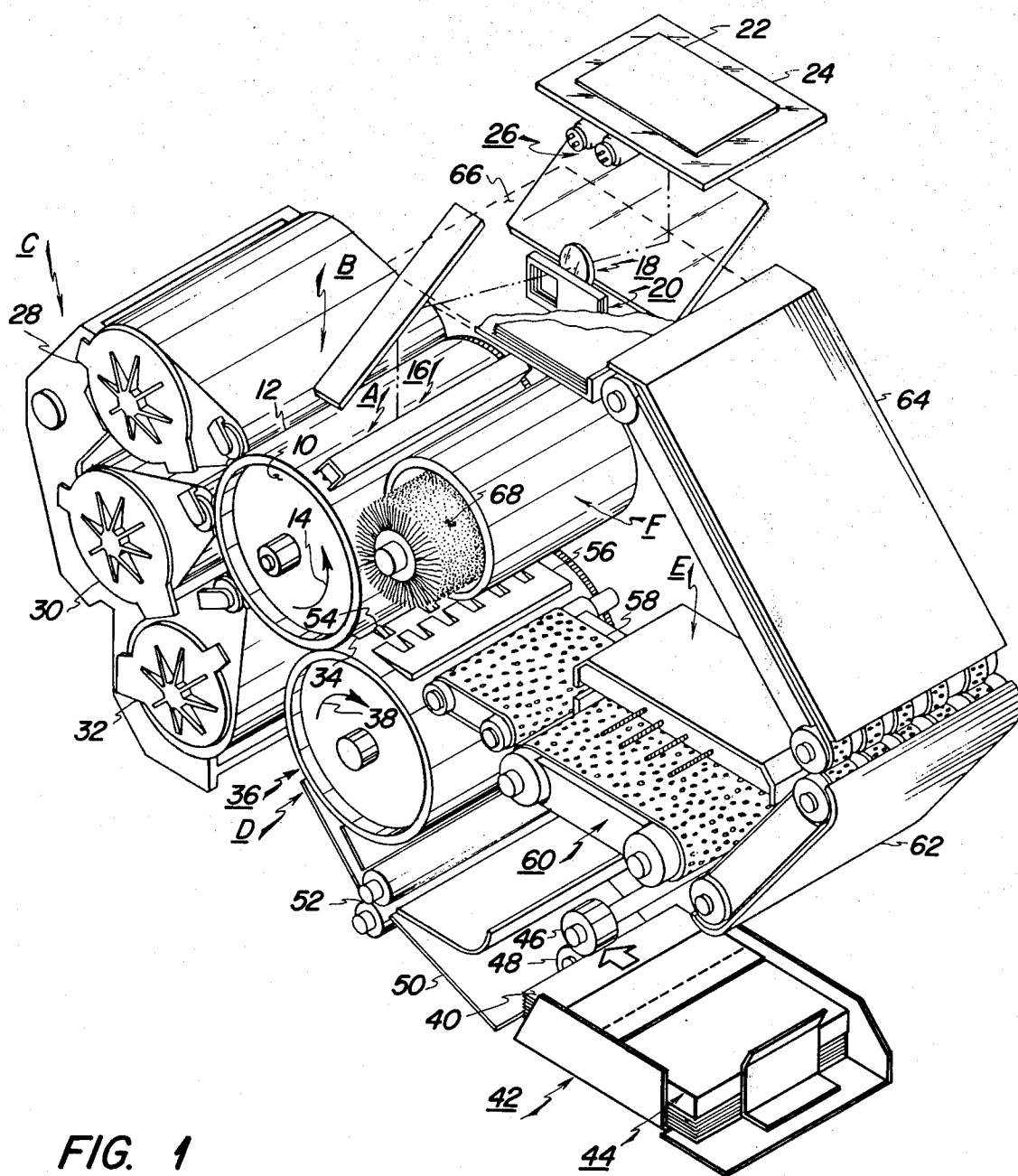
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ABSTRACT

A cassette which holds a stack of sheet material in an electrophotographic printing machine. The printing machine includes a fuser having at least two temperature set-points. When positioned in the sheet feeding apparatus, the cassette is arranged to switch the fuser temperature set-point from a first temperature to a second temperature.

9 Claims, 4 Drawing Figures





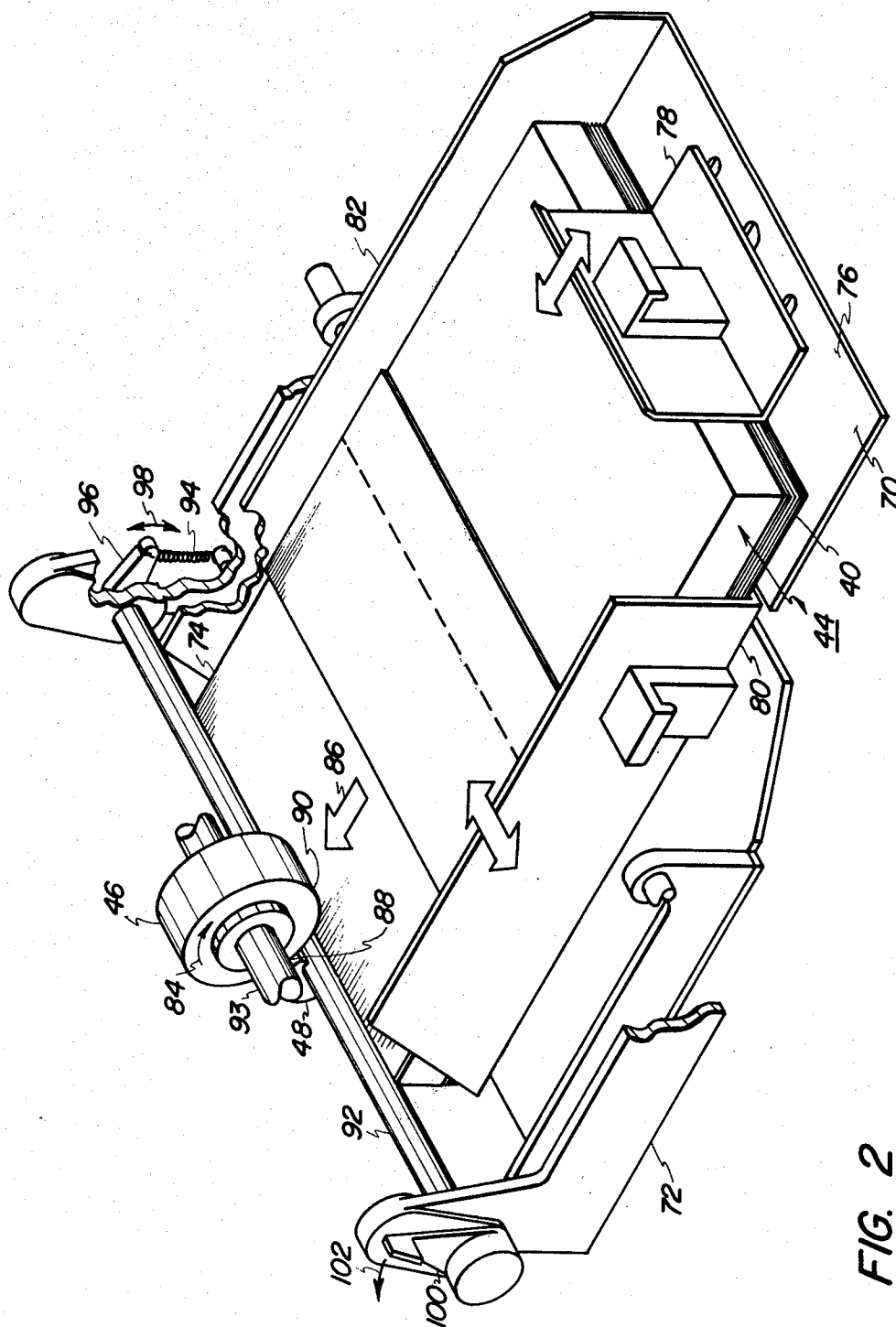
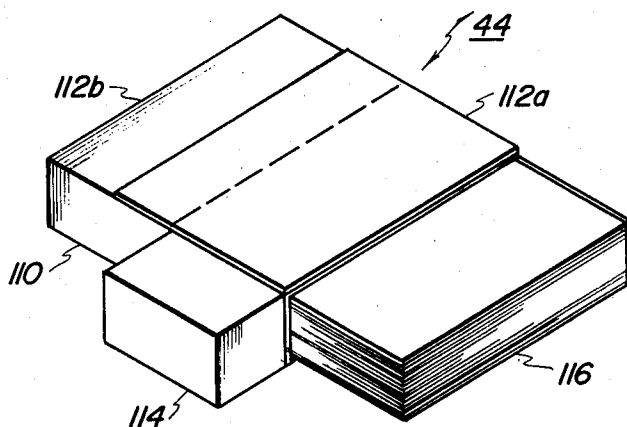
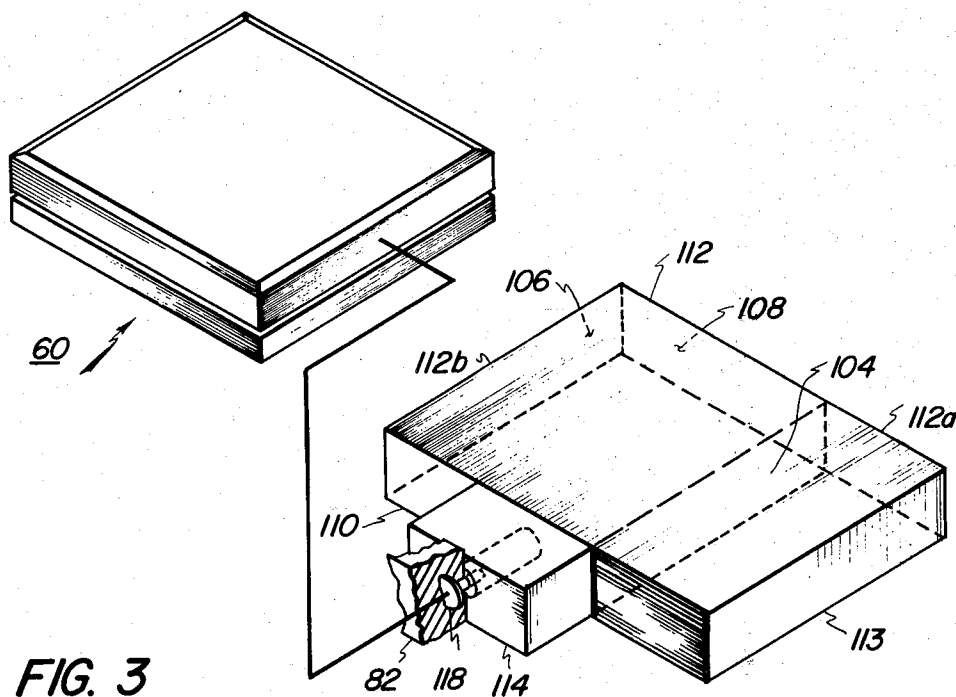


FIG. 2



CONTROL DEVICE FOR AN ELECTROPHOTOGRAPHIC PRINTING MACHINE

This invention relates generally to an electrophotographic printing machine, and more particularly, to a cassette for holding a stack of sheet material therein.

A typical electrophotographic printing machine employed in a business office is provided with cut sheets of support material. These sheets are utilized as an image receiving member for the printing machine. Although paper is the most commonly employed sheet material, certain non-fibrous plastic sheets characterized generally by having a high surface gloss and a smooth surface finish are increasingly being employed. These non-fibrous sheets are frequently more durable than paper and, when transparent, have utility as transparencies, i.e. a conventional projector may project images therefrom onto a screen.

In general, the sheet material is of a pre-selected size and advances through the printing machine, one sheet at a time, for suitable processing therein. Inasmuch as copies may be made at high speeds, it is advantageous to stack a pile of sheets in the printing machine feeding mechanism which advances the sheets one at a time therefrom. The sheets are advanced until the stack thereof is depleted, whereupon the operator refills the machine with a new stack of sheets. However, it has been found that when a non-fibrous sheet material is substituted for conventional paper, operational difficulties frequently occur. For example, the fusing temperature in the case of a transparency or a thermoplastic material is different from that of a sheet of paper. This results in the operator having to reset the fuser temperature set-point manually. In addition, it is frequently difficult to furnish a large stack of sheet material and place it in the sheet feeding apparatus when a stack of paper has been previously disposed therein. In the past, this has not been a significant problem in that the utilization of transparencies has been somewhat limited. However, with the advent of multicolor printing, these problems have become somewhat more significant.

In a multi-color electrophotographic printing machine, it is highly desirable to have the capability of creating multi-color transparencies. Transparencies of this type are frequently employed for display purposes, i.e. by projection onto screens for seminars or business meetings. Hence, there is a continuing need for trouble-free maintenance and supplying of thermoplastic transparencies particularly in the case of multi-color electrophotographic printing machines.

Accordingly, it is the primary object of the present invention to provide an improved cassette for use in a sheet feeding apparatus of a multi-color electrophotographic printing machine.

SUMMARY OF THE INVENTION

Briefly stated, and in accordance with the present invention, there is provided a cassette for holding a stack of sheet material in a sheet feeding apparatus of an electrophotographic printing machine. The printing machine includes a fuser having at least two temperature set points.

Pursuant to the present invention, the cassette includes a bottom member positioned in the sheet feeding apparatus and having a generally planar surface arranged to support the stack of sheet material thereon.

A protuberance is secured to and extends in an outwardly direction from a marginal region of the bottom member. Means are provided for switching the fuser temperature set-point. The switching means is in communication with the protuberance of the bottom member and the fuser. The protuberance is adapted to actuate the switching means to change the fuser temperature set-point from a first temperature to a second temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the present invention will become apparent upon reading the following detailed description and upon reference to the drawings, in which:

FIG. 1 illustrates a schematic perspective view of an electrophotographic printing machine incorporating therein the cassette of the present invention;

FIG. 2 depicts a schematic perspective view of the FIG. 1 printing machine sheet feeding apparatus with the cassette of the present invention disposed therein;

FIG. 3 shows a schematic perspective view of the cassette controlling the FIG. 1 printing machine fuser temperature set-point; and

FIG. 4 depicts a perspective view of the cassette opened with the sheet material extending outwardly therefrom.

While the present invention will be described in connection with a preferred embodiment thereof, it will be understood that it is not intended to limit the invention to that embodiment. On the contrary, it is intended to cover all alternatives, modifications, and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

A general understanding of an electrophotographic printing machine, in which the present invention may be incorporated, is had by referring to FIG. 1. FIG. 1 schematically illustrates the various components of a printing machine adapted to produce color copies from a multi-colored original document. Continued reference will hereinafter be made to the drawings wherein like reference numerals have been used throughout to designate like elements.

Turning now to FIG. 1, the printing machine depicted therein employs a drum 10 with a photoconductive surface 12 entrained about and secured thereto. Drum 10 is mounted rotatably within the machine frame (not shown) and is adapted to rotate in the direction of arrow 14. A timing disc (not shown) is mounted in the region of one end of the shaft of drum 10. In association with the timing disc is a photosensor and a light source. The timing disc includes a plurality of slits in the periphery thereof with the remainder being opaque. The disc is interposed between the light source and the photosensor to act as a light chopper periodically exciting the photosensor to control the various processing stations within the printing machine.

As drum 10 rotates in the direction of arrow 14, it passes through a plurality of processing stations. These processing stations will be described briefly hereinafter.

Initially, drum 10 rotates in the direction of arrow 14 to move photoconductive surface 12 through charging station A. At charging station A, a corona generating device, indicated generally at 16, produces a spray of ions with charge photoconductive surface 12 to a rela-

tively high, substantially uniform potential. To achieve this, corona generating device 16 extends in a generally transverse direction across photoconductive surface 12. A suitable corona generating device is described in U.S. Pat. No. 2,778,946 issued to Mayo in 1957.

Thereafter, drum 10 rotates to exposure station B where the charged photoconductive surface 12 is irradiated with a color-filter light image of the original document. A moving lens system, generally designated by the reference numeral 18, and a color-filter mechanism, shown generally at 20, are located at exposure station B. U.S. Pat. No. 3,062,108 issued to Mayo in 1962 is one type of moving lens system suitable for use in the foregoing electrophotographic printing machine. As illustrated in FIG. 1, original document 22 is supported stationarily face down upon transparent viewing platen 24. Successive incremental areas of original document 22 are scanned by lamp assembly 26 and lens system 18 moving in a timed relationship with drum 10. This scanning process produces a flowing light image of original document 22 on photoconductive surface 12. During exposure, filter mechanism 20 interposes selected color filters into the optical light path of lens 18. Each filter operates on the light rays passing through lens 18 to record an electrostatic latent image on photoconductive surface 12 corresponding to a preselected spectral region of the electromagnetic wave spectrum, hereinafter referred to as a single color electrostatic latent image.

After the single color electrostatic latent image is recorded on photoconductive surface 12, drum 10 rotates to development station C. At development station C, there are located three individual developer units, generally designated by the reference numbers 28, 30 and 32, respectively. Each of the foregoing developer units is of the type described in copending application Ser. No. 255,259 filed on May 19, 1972 now U.S. Pat. No. 3,854,449. As disclosed therein, developer units 28, 30 and 32, respectively, are all of a magnetic brush variety. A typical magnetic brush system employs a magnetizable developer mix having carrier granules and toner particles therein. This developer mix is continually brought through a directional flux field to form a brush thereof. Development is achieved by bringing the electrostatic latent image recorded on photoconductive surface 12 into contact with the brush of developer mix. Each of the respective developer units, i.e. 28, 30 and 32, contain discretely colored toner particles corresponding to the complement of the spectral region of the wavelength of light transmitted through filter 20. For example, a green filtered electrostatic latent image is rendered visible by depositing green absorbing magenta toner particles thereon. Similarly, blue and red electrostatic latent images are developed with yellow and cyan toner particles, respectively.

Once the single color electrostatic latent image is developed, drum 10 rotates to transfer station D. At transfer station D, the single color powder image adhering electrostatically to photoconductive surface 12 is transferred to a sheet of final support material 34. A suitable final support material may be plain paper, or a thermoplastic sheet, amongst others. A bias transfer roll, shown generally at 36, recirculates support material 34 and is electrically biased to a potential of sufficient magnitude and polarity to electrostatically attract toner particles from photoconductive surface 12 to sheet 34. U.S. Pat. No. 3,612,677 issued to Langdon, et

al. in 1971 describes a suitable electrically biased transfer roll. Transfer roll 36 rotates in synchronism with drum 10 enabling a plurality of successive single color toner powder images to be transferred to sheet 34 in registration with one another. As shown in FIG. 1, transfer roll 36 rotates in the direction of arrow 38. Sheet 34 is advanced either from a stack 40 housed in the sheet feeding apparatus, indicated generally by the reference numeral 42, or from a cassette 44 disposed therein. The sheet feeding apparatus 42 and the cassette 44 will be discussed hereinafter in greater detail. Feed roller 46 in operative communication with retard roller 48 advances the uppermost sheet into chute 50. The sheet then moves into the nip between register rollers 52. Register rollers 52 align and forward the sheet to gripper fingers 54. Gripper fingers 54 are mounted on transfer roll 36 and secure releasably thereto the sheet of support material for movement therewith in a recirculating path.

After a plurality of toner powder images have been transferred to sheet 34, gripper fingers 54 release sheet 34 and stripper bar 56 separates sheet 34 from transfer roll 36. Sheet 34 is stripped from transfer roll 36 and transported on endless belt conveyor 58 to fixing station E.

At fixing station E a fuser, indicated generally at 60, permanently affixes the multi-layered toner powder image to sheet 34. Fuser 60 and the operation thereof in conjunction with the cassette 44 will be described hereinafter in greater detail with reference to FIG. 3. After the fusing process, sheet 34 is advanced by endless belt conveyors 62 and 64 to a catch tray 66 for subsequent removal therefrom by the machine operator.

Although a preponderance of the toner particles are transferred to sheet 34, invariably some residual toner particles remain on photoconductive surface 12 after the transfer thereof. These residual toner particles are removed from drum 10 as it passes through cleaning station F. At cleaning station F, the residual toner particles are initially brought under the influence of a cleaning corona generating device (not shown) adapted to neutralize the electrostatic charge remaining on photoconductive surface 12 and the residual toner particles. These neutralized toner particles are then cleaned from photoconductive surface 12 by a rotatably mounted fibrous brush 68 in contact therewith. A suitable brush cleaning device is described in U.S. Pat. No. 3,590,412 issued to Gerbasi in 1971.

It is believed that the foregoing description is for the purposes of the present application to illustrate the general operation of an electrophotographic printing machine embodying the teachings of the present invention therein.

Referring now to FIG. 2, sheet feeding apparatus 42 is depicted therein in detail. Sheet feeding apparatus 42 includes a sheet tray, indicated generally by the reference numeral 70, mounted pivotably on frame 72 secured fixedly to the printing machine. Sheet tray 70 pivots in a clockwise direction so that the leading marginal edge portion of the uppermost sheet 74 engages feed roller 46. A pair of springs, (not shown) suitably mounted to tray 70 resiliently urge tray 70 to pivot in the clockwise direction. Tray 70 includes a base plate 76 having a generally planar surface for supporting stack 40 thereon. Stack 40 is positioned both longitudinally and laterally on base plate 76 by means of margin guides 78 and 80. Margin guide 80 is mounted movably

on base plate 76 and adjusts the stack so that the side opposed therefrom is in registration with stationary wall 82. In this manner, the sheet feeding apparatus is adjustable to accommodate various width stacks thereon. Similarly, margin guide 78 is adjustable lengthwise so as to align and position the stack on base plate 76. Feed roller 46 is driven by a suitable motor (not shown) in the direction of arrow 84 to advance the uppermost sheet 74 in the direction of arrow 86. Shaft 88 secures feed roller 46 fixedly to the printing machine. Feed roller 46 is preferably arranged only to rotate in the direction of arrow 84 and does not articulate in any manner but remains stationary, the uppermost sheet of the stack being brought into engagement therewith. Feed roller 46 has a first portion 88 of the circumferential surface thereof engaging retard roller 48 and a second portion 90 of the circumferential surface thereof engaging sheet 74. As positioned, feed roller 46 has first portion 88 engaging retard roller 48 substantially simultaneously with second portion 90 engaging sheet 74. Retard roller 48 is mounted eccentrically on shaft 92. Shaft 92 is mounted rotatably within the printing machine frame and is adapted to pivot retard roller 48 from a first position spaced from feed roller 46 to a second position in engagement therewith. Biasing means or spring 94 pivots handle 96 in the direction of arrow 98. Handle 96 is secured to one end portion of shaft 92. In this way, retard roll 48 is pivoted into engagement with feed roller 46. Spring 94 is secured to handle 96 and attached fixedly to frame 72. Preferably, spring 94 has 7 coils and an initial tension of about 0.5 pounds with an outer diameter of 0.5 inches. The spring wire has a thickness of about 0.016 inches. Handle 100 is secured to the other end portion of shaft 92 and adapted to be manually moved in the direction of arrow 102 to disengage retard roller 48 from feed roller 46. Cassette 44 is shown positioned on top of stack 40 with feed roller 46 in engagement with the sheet material extending outwardly from cassette 44. In this way, feed roller 46 advances successive sheets from cassette 44 rather than from stack 40. The detailed structure of cassette 44 will be discussed hereinafter with reference to FIGS. 3 and 4.

Referring now to FIG. 3, cassette 44 includes a bottom member 104 with a back member 106 secured to and extending in an upwardly direction therefrom. A first side member 108 is normal to bottom member 104 and back member 106 and is secured to both of the foregoing. A second side member 110 extends over a portion of bottom member 104 and is secured thereto in a normal direction. Top member 112 is substantially parallel to bottom member 104 and is secured to side members 108 and 110 as well as back member 106. Front member 113 is secured to the leading marginal portion 112a of top member 112 and extends in a downwardly direction substantially normal thereto. Leading portion 112a is hinged to rear portion 112b of top member 112. Similarly, front member 113 is hinged to leading portion 112a and is secured releasably to bottom member 104 when in a closed position, by a suitable latch (not shown). When in the opened position, leading portion 112a is flipped back over rear portion 112b and lies substantially flat thereon. Front member 113 also lies substantially flat on rear portion 112b when cassette 44 is in the opened position. Top member 112, side member 108, side member 110, bottom member 104, back member 106 and front

member 113 together define a substantially box-shaped container for storing a stack of sheets therein.

Protuberance 114 is secured to side member 110 and extends in an outwardly direction therefrom. When the leading top portion 112a and front member 113 are pivoted to the opened position it defines an open ended box. In this way, the stack may be encompassed within cassette 44 and the leading top portion 112a of top member 112 and front member 113 pivoted back to expose the leading marginal portions of the stack contained therein. Hence, when a stack of transparencies 116 are to be employed in the printing machine, cassette 44 is placed on top of stack 40 and the leading edge portion 112a of top member 112 and front member 113 are pivoted to the opened position exposing the leading edge portion of stack 116 (FIG. 4).

When cassette 44 is disposed in sheet feeding apparatus 42, protuberance 114 engages switch 118. Switch 118 is mounted on stationary side wall 82 of sheet feeding apparatus 42. Switch 118 is electrically connected to fuser 60 and adapted to change the mode of operation thereof from a first temperature to a second temperature. Thus, when cassette 44 is positioned in sheet feeding apparatus 42, switch 118 is actuated. This changes the temperature set point of fuser 60 so as to be optimum for the sheet material contained within cassette 44. Additionally, switch 118 controls the sheet feeding apparatus so that single sheets are advanced from cassette 44 each time the operator presses the print button. This prevents the automatic multiple copying of a single original document. Thus, in this mode of operation, multiple copying is prevented and for each copy the print button must be actuated.

Fuser 60 includes a radiant energy source and an auxiliary heater. Initially, the radiant energy source operates at a full power of about 1750 watts. When the endless belt conveying the support material is raised to a pre-selected temperature condition which may range from about 390°F to about 420°F, depending upon humidity conditions, the radiant energy source is de-energized. Fuser 60 is maintained at a standby temperature by an auxiliary heater disposed beneath the endless conveyor for transporting the sheet of support material. As a sheet of support material enters fuser 60, the machine logic energizes the radiant energy source at the upper power level (in this case 1750 watts) and de-energizes the auxiliary heater. As the sheet of support material exits fuser 60, the machine control logic energizes the auxiliary heater and de-energizes the radiant energy source. This type of control cycle continues as long as the thermostat positioned in the air space between the outer and inner reflectors of the radiant energy source indicate a temperature below about 440°F. If, however, the temperature exceeds about 440°F, the radiant energy source is energized at a lower power level (in this case 1250 watts) when the sheet of support material enters fuser 60. In addition thereto, the auxiliary heater remains energized. As the sheet of support material exits fuser 60, the machine control logic de-energizes the radiant energy source while the auxiliary heater remains energized. When cassette 44 is disposed on sheet feeding apparatus 42, protuberance 114 actuates switch 118 which de-energizes the radiant energy source and maintains the auxiliary heater activated. Thus, fuser 60 has the temperature set point thereof changed from a first temperature to second temperature which is substantially optimum for permanently affixing the toner powder image to a

substantially transparent sheet of thermoplastic material. The detailed description of fuser 60 and the control circuitry associated therewith is described in U.S. Pat. No. 3,781,516 issued to Tsilibes, et al. in 1973, the disclosure of which is hereby incorporated into the present application.

Referring now to FIG. 4, there is shown cassette 44 with the leading edge portion 112a pivoted to the opened position so that stack 116 extends outwardly therefrom. As shown therein, leading edge portion 112a is secured hingedly to the remaining portion 112b of top member 112. Once again, side member 108 is secured to bottom member 104 and portion 112b of top member 112. Thus cassette 44 defines a substantially rectangular chamber adapted to house a stack of transparencies 116 therein. The leading portion 112a thereof and front member 113 are flipped back over rear portion 112b exposing the leading portion of stack 116.

In recapitulation, the cassette of the present invention is adapted to regulate the temperature of the fusing apparatus. Thus, fuser 60 may be arranged to permanently affix the toner powder image formed on a sheet of paper at a first temperature set point, whereas a second temperature set point is required for a transparency. Hence, when cassette 44 is disposed in sheet feeding apparatus 42 it actuates switch 118 which, in turn, resets the temperature set point of fuser 60. Hence, the temperature set point of fuser 60 is adjusted from a first set point to a second set point substantially optimum for permanently affixing toner powder images to sheets of thermoplastic material.

Thus, it is apparent that there has been provided, in accordance with this invention, a cassette for regulating the temperature set point of a fusing apparatus in accordance with the type of sheet material being employed in the electrophotographic printing machine. This cassette fully satisfies the objects, aims and advantages set forth above. While this invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications, and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims.

What is claimed is:

1. An electrophotographic printing machine of the type having a fusing apparatus to substantially permanently affix a powder image to a sheet of support material, including:
 - means for separating and advancing successive sheets of support material from a stack thereof;
 - means for supporting a first stack of sheet material in said separating and advancing means;
 - removable means for supporting a second stack of sheet material in said separating and advancing means; and
 - means, responsive to insertion of said second stack supporting means in said separating and advancing means, for automatically switching the fuser temperature set-point from a first temperature for the first stack of sheet material to a second temperature for the second stack of sheet material.
2. A printing machine as recited in claim 1, wherein said switching means controls the number of copies made from an original document disposed in the printing machine for each energization thereof.

3. A printing machine as recited in claim 1, wherein said first stack supporting means includes:

- a frame member; and
- a base plate mounted pivotably on said frame member and arranged to hold the first stack of sheet material thereon.

4. A printing machine as recited in claim 3, wherein said second stack supporting means includes:

- a bottom member positioned on the first stack supported on said base plate, said bottom member having a generally planar surface arranged to support the second stack of sheet material thereon;
- a first side member secured to and extending in a direction substantially normal to said bottom member; and
- a protuberance secured to and extending in an outwardly direction from said first side member, said protuberance being adapted to actuate said switching means to change the fuser temperature set-point from the first temperature to the second temperature.

5. A printing machine as recited in claim 4, wherein the first stack of sheet material includes a plurality of fibrous sheets.

6. A printing machine as recited in claim 4, wherein the second stack of sheet material includes a plurality of substantially transparent non-fibrous sheets.

7. A printing machine as recited in claim 4, further including:

- a back member secured to said bottom member and extending in an upwardly direction substantially normal thereto;
- a top member secured to said back member with the leading marginal portion thereof hinged to the rear portion thereof, said top member extending in a direction substantially parallel to said bottom member; and
- a front member hinged to the leading marginal portion of said top member and extending in a downwardly direction substantially normal thereto.

8. A printing machine as recited in claim 7, further including a second side member secured to and extending in a direction substantially normal to said bottom member and the rear portion of said top member opposed from said first side member, said second side member extending over a portion of said bottom member and the rear portion of said top member.

9. A printing machine as recited in claim 1, wherein said separating and advancing means includes:

- a frame member;
- a retard roller mounted eccentrically on said frame member;
- biasing means for resiliently urging said retard roller to pivot from an inoperative position spaced from one surface of an advancing sheet to an operative position in contact therewith; and
- a rotary driven feed roller having a first portion of the circumferential surface thereof engaging the other surface of the advancing sheet and a second portion of the circumferential surface engaging the circumferential surface of said retard roller disposed in the operative position thereof prior to the advancing sheet being interposed therebetween, said feed roller being adapted to advance the sheet into the nip defined by said feed roller and said retard roller to prevent multiple sheet feeding.

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