United States Patent [19]

Smith et al.

[11] **3,757,081**

[45] **Sept. 4, 1973**

[54] **APPARATUS FOR HEATING COPY PAPER FOR ELECTROSTATIC COPIERS**

[75] Inventors: **Ian Edward Smith,** Lockleys; **Peter John Hastwell,** Elizabeth Grove; **Marinus Cornelus Vermeulen,** Valley View, all of South Australia

[73] Assignee: **Savin Business Machines Corporation,** Valhalla, N.Y.

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[21] Appl. No.: **212,081**

[52] **U.S. Cl.** ..... **219/216,** 219/388, 263/6 E

[51] **Int. Cl.** **H05b 1/00**

[58] **Field of Search** ..... 219/216, 388; 34/48; 355/9; 263/6 E; 338/316; 250/65 T, 65 ZE; 118/620; 117/17.5

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Primary Examiner—C. L. Albritton

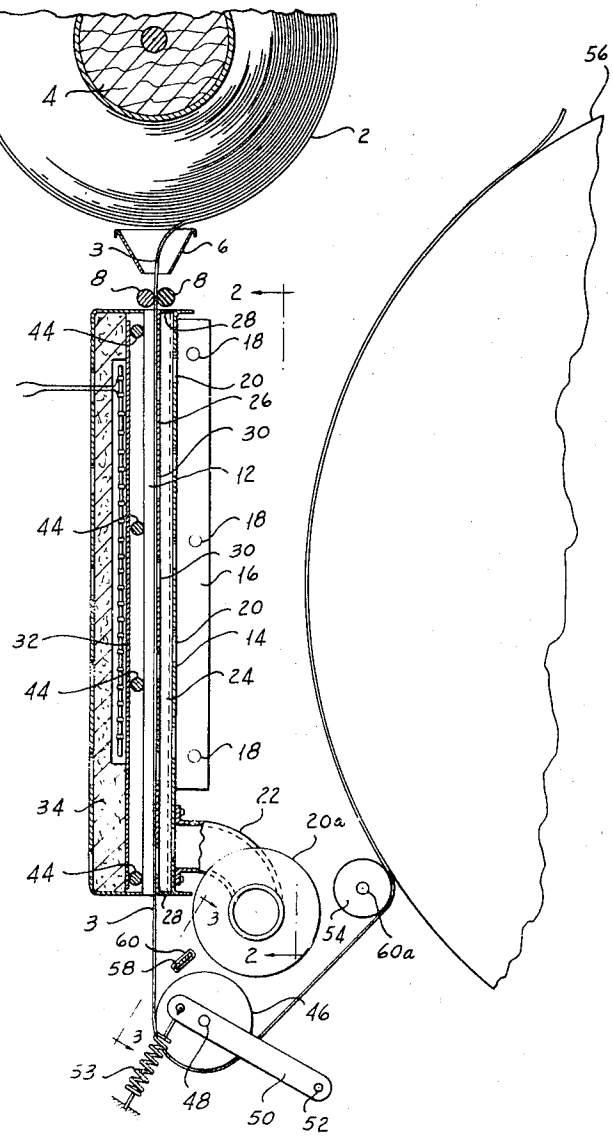
Attorney—Henry L. Shenier, Francis M. O'Connor et al.

[57] **ABSTRACT**

In using the method of contact transfer of electrostatic images developed by a tacky toner shown in our co-pending application, Ser. No. 155,108, filed June 21, 1971, it is advantageous to heat the plain paper to which the developed images are to be transferred.

An improved heating assembly is provided which will ensure that the paper will not burn or char. A passageway is formed between a radiant heating assembly and a manifold which connects with an exhaust blower. The paper is drawn from the storage roller through this passageway around a tensioning roller which may be independently heated and then brought into contact with the photoconductive surface bearing the tacky toner developed image.

13 Claims, 4 Drawing Figures



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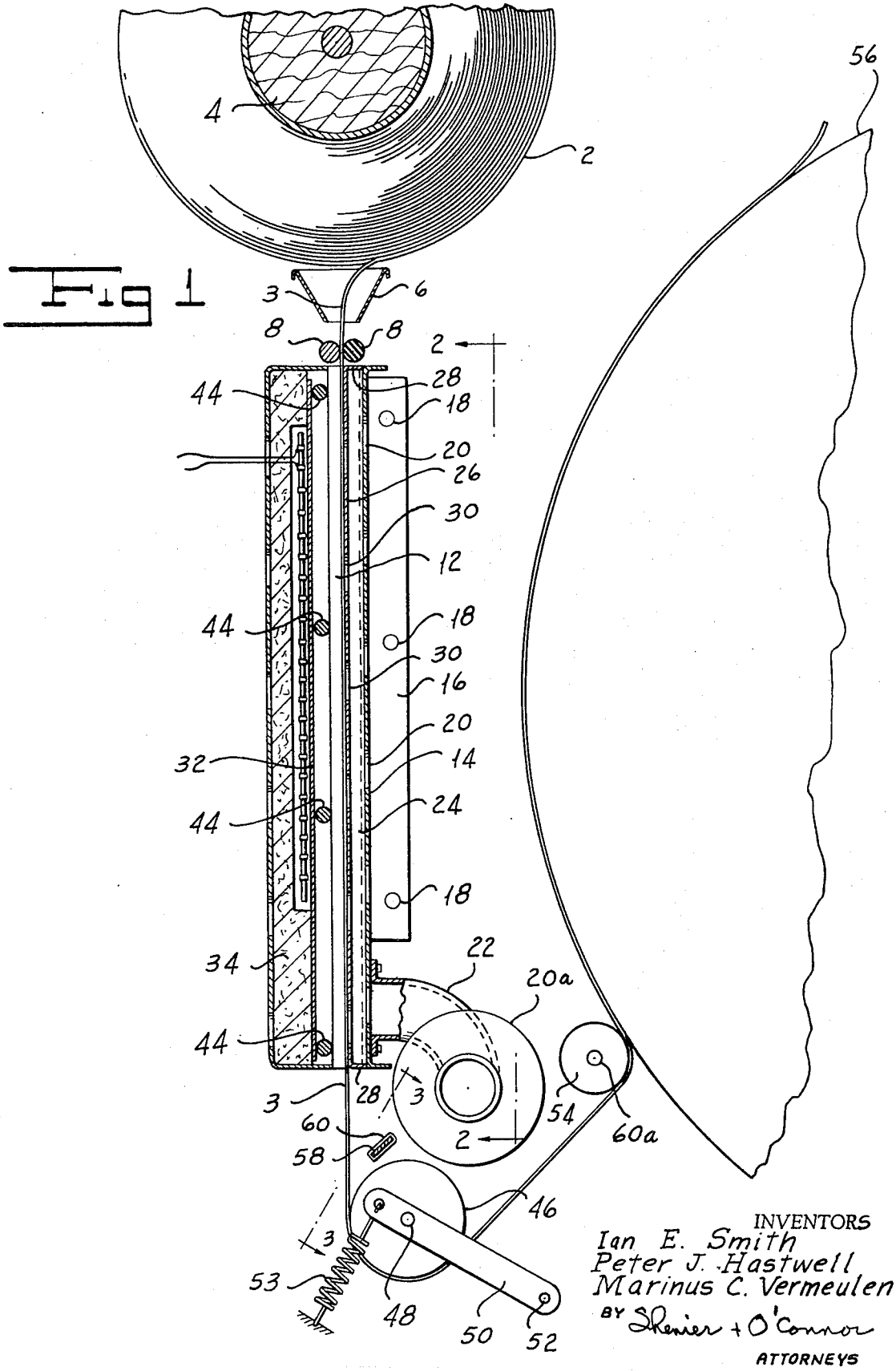
SHEET 1 OF 3

Fig 1



INVENTORS
Ian E. Smith
Peter J. Hastwell
Marinus C. Vermeulen
BY Shenier + O'Connor
ATTORNEYS

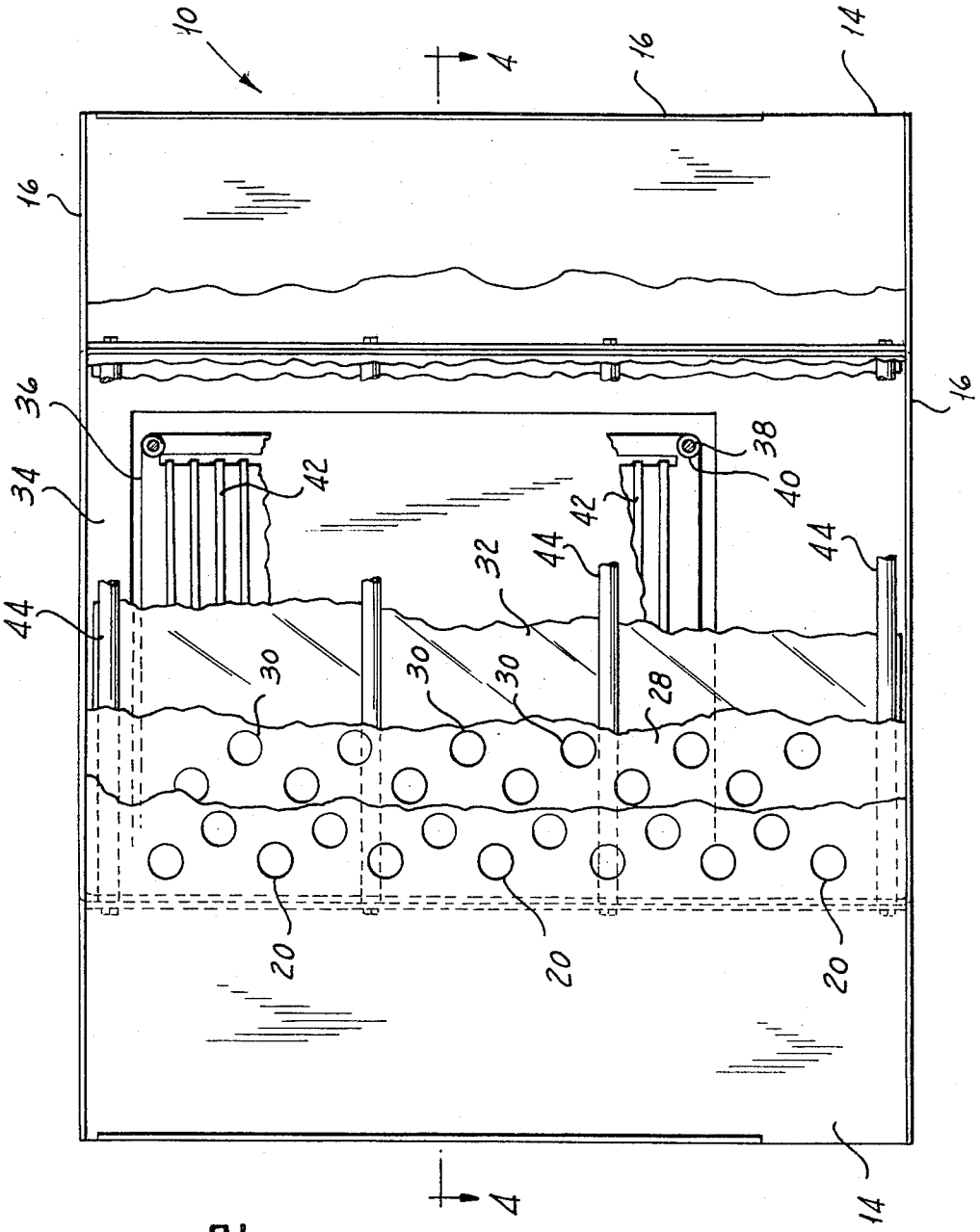


Fig 2

INVENTORS
Ian E. Smith
Peter J. Hastwell
Marinus C. Vermeulen
BY Shenier + O'Connor
ATTORNEYS

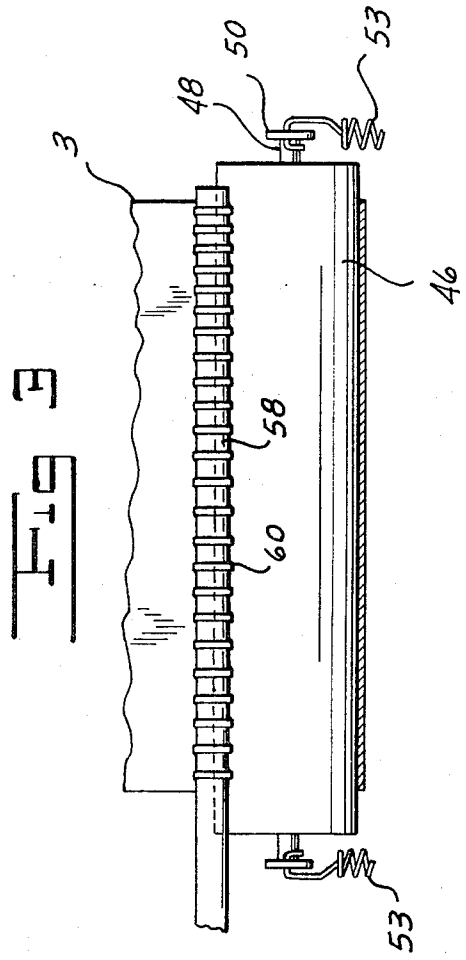


FIG 3

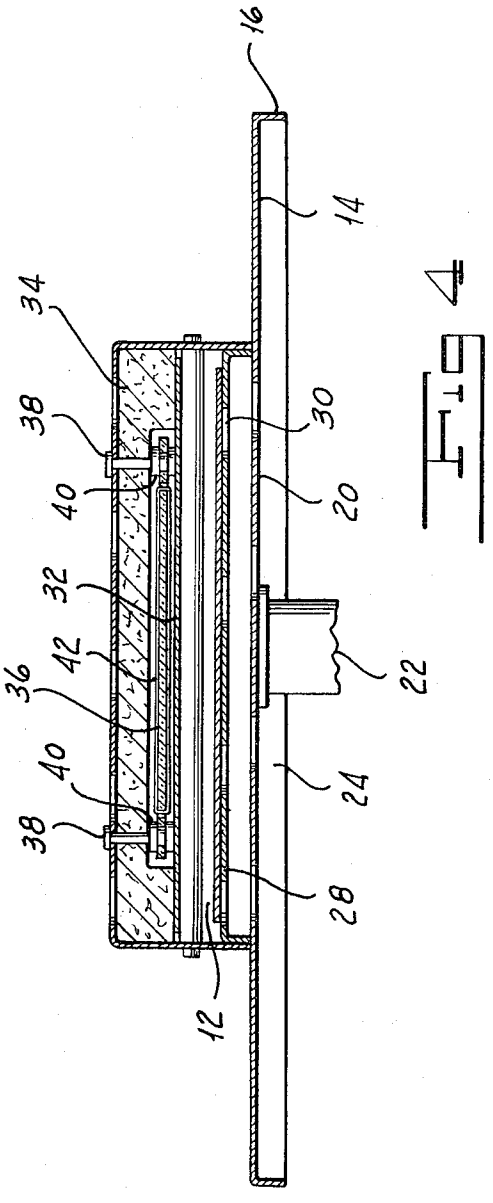


FIG 4

INVENTORS
Ian E. Smith
Peter J. Hastwell
Marinus C. Vermeulen
BY Spencer + O'Connor
ATTORNEY

APPARATUS FOR HEATING COPY PAPER FOR ELECTROSTATIC COPIERS

BACKGROUND OF THE INVENTION

Our co-pending application, Ser. No. 155,108, filed June 21, 1971, discloses a novel method for contact transfer of a liquid suspended tacky toner. We have found that it is advantageous to heat the paper to facilitate the transfer of the tacky toner developed image to the paper. Heating of the paper dehumidifies it so that the moisture present on the paper on humid days will not interfere with the transfer process. The resinous material in the tacky toner may be thermoplastic. In such case, heating the paper increases the fluidity of the toner resin and enables it to flow more readily into the interstices of the plain paper to which it is being transferred. In every case, image transfer to the paper is facilitated. The elevated temperature aids in the evaportion of the light diluent in which the tacky toner is disseminated. The use of a hot air hood in the vicinity of the transfer area operates as long as there is paper present. If, however, there is no paper between the hot air stream and the photoconductive surface, there is danger that there will be an elevation of temperature to an extent which will be deleterious to the photoconductive properties of the photoconductor. Many photoconductive materials will lose some of their photoconductive properties at temperatures about 70°C.

The use of radiant heat from an infrared lamp, or an infrared source such as a resistance wire heated to redness, can be used to heat paper. This is satisfactory as long as the paper is moving. We have found that, if the paper dwells too long exposed to a high temperature infrared source, it may scorch or even ignite.

It is also possible to heat a roller around which the paper passes. We found that, if we relied solely on such as the sole source of heat, the temperature had to be so high that heat was applied too quickly, with the result that internal stresses wrinkled the paper.

Our invention solves the problem of providing a simple and efficient method of heating the paper to a desirable temperature while maintaining the paper in a smooth flat condition and ensuring that the paper will not char or ignite even though it be stopped in the heating zone for long periods of time.

SUMMARY OF THE INVENTION

One object of our invention is to provide a novel assembly for preheating copy paper before contacting it with a tacky toner liquid developed image.

Another object of our invention is to provide an improved heating apparatus adapted to remove excess moisture from the copy paper used in electrophotographic apparatus.

A further object of our invention is to provide an improved paper heater which will not scorch or ignite the paper.

A still further object of our invention is to provide a heating assembly for paper adapted to contact a tacky toner developed image in which the paper will not wrinkle or distort during the heating step.

Other and further objects of our invention will appear from the following description:

In general, our invention contemplates the provision of a paper passage through which paper is drawn from a storage roll on its way to being contacted with the photoconductive drum on which the developed image is lodged. The paper passage is provided with a radiant heater on one side and a perforated plate on the other. The perforated plate communicates with a chamber with which the suction side of an exhaust blower is connected. The chamber provides an area of reduced pressure which serves to hold the paper against the perforated plate and ensures that it remains out of contact with the radiant heater. The suction blower also removes any vapors which might be evaporated from the paper by the radiant heat. If desired, we provide auxiliary heating means adapted to heat a tensioning roller to a lower temperature than the radiant heat existing in the paper passage. The arrangement is such that, though the paper reside in the passage for long periods of time, it will not scorch or ignite.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, which form part of the instant specification and which are to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in the various views:

FIG. 1 is a sectional elevation of a paper heating assembly showing a portion of the photoconductive surface and the path of the paper from the roll to the photoconductive surface.

FIG. 2 is a rear elevation, with parts broken away, of the heating assembly shown in FIG. 1 viewed along the line 2—2 of FIG. 1.

FIG. 3 is a fragmentary sectional view showing the tensioning roller heater viewed along the line 3—3 of FIG. 1.

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

More particularly, referring now to the drawings, a roll of copy paper **2**, which is plain paper, is mounted for rotation on a shaft **4** above the heating assembly which is indicated generally by the reference numeral **10**. A funnel guide **6** is adapted to direct paper to a pair of paper guide rollers **8** for passage through the paper passage **12**. A plate **14** is provided with a pair of flanges **16** adapted to secure the assembly by screws **18** to the frame of the electrophotographic machine (not shown). The plate **14** is provided with openings **20** communicating with the atmosphere. A centrifugal exhaust fan **20***a* is provided with a duct **22** to take suction from a chamber **24**. This chamber is formed by a plate **26** spaced from the plate **14** by end flanges **28**. The plate **26** is provided with openings **30** so that the reduced pressure within the chamber **24** may act on the paper **3** which lies against the plate **26**. Spaced from the surface of plate **26**, we mount a copper or brass plate **32**, which is secured to a layer of heat-insulating material such as asbestos board **34**.

Referring now to FIGS. **2** and **4**, we mount a mica sheet **36** within a recess formed in the asbestos board **34** by means of bolts **38** and ceramic ferrules **40**. The mica sheet **36** carries a nichrome electrical resistance winding **42** adapted to be connected to any appropriate electrical potential source (not shown). As will be seen by reference to FIG. **4**, the mica sheet **36** and its electrical resistance winding is positioned in the recess or pocket formed in the heat-insulating layer **34**. The copper or brass plate **32** extends adjacent to but spaced

from the radiant heat assembly just described, as can be seen by reference to FIG. 4. In order to prevent the heat-conductive plate 32 from warping, we mount a plurality of rods 44 across the plate, as can be seen by reference to FIGS. 1 and 2. The resistance of the resistance winding, the voltage applied, and the relationship of the parts are such that the plate 32 will be maintained at a temperature between 350°F and 450°F. The paper is positioned about one-half inch from the radiating plate 32. The lower temperature of 350°F can be maintained with about 700 watts of energy. For high-speed operation, we prefer to raise the temperature of the heat-conductive plate 32 to about 450°F. This will require about 1200 watts. We have maintained a sheet of paper in the paper passage with the heat-conductive plate 32 at a temperature of 450°F for over an hour without charring the paper or having it ignite. It will be understood, of course, that in days of high humidity it is desirable to raise the temperature of the heat-radiating wall. This is done by means of a potentiometer (not shown) between the voltage source and the resistance winding 42. The length of the paper passage, as shown in FIG. 1, is twelve inches.

The blower 20*a* is operated at a speed to move about sixteen cubic feet of air per minute. The perforations 20 break the suction within the chamber 24 to such an extent that the paper, while being held against the plate 26, will not be so held with such force as to create excessive friction. Water vapor expelled from the paper by the radiant heat from the heating plate 32 is removed by the centrifugal blower.

As soon as the paper leaves the paper passage, owing to its low specific heat, it will cool rapidly. The paper must be kept tensioned and, for this purpose, we provide a tensioning roller 46 mounted on a shaft 48 between a pair of arms 50 pivoted about pins 52. Each of the arms 50 is biased by a spring 53. The roller 46 is two inches in diameter and its length is about eleven and one-half inches for a paper sheet eight and one-half inches in width. If the tensioning roller 46 were unheated, it would accelerate the cooling of the paper which must still pass around the rubber pressure roller 54 mounted on a shaft 60*a* for line contact with the surface of the photoconductive drum 56 upon which the image which has been developed by the tacky toner is lodged. To prevent the paper from becoming too cool, we may mount an infrared strip heater 58 provided with a resistance winding 60 adapted to be connected to a suitable potential source (not shown). The arrangement is such that the roller 46 will be maintained at a temperature in the vicinity of 250°F. A potentiometer (not shown) is adapted to control the heat to which the strip heater 58 is heated. On humid days and at higher speeds of operations, a greater wattage will be required by the strip heater.

We have not shown the passage of the paper after it leaves the rubber roller 54 since this is shown in our co-pending application above identified.

It will be seen that we have accomplished the objects of our invention. We have provided a novel assembly for preheating copy paper before contacting it with a tacky toner developed image. Our heating assembly is adapted to remove excess moisture from the copy paper which might interfere with rapid and complete transfer of the tacky toner developed image from the photoconductive surface to the paper. The arrangement is such that our heater will not scorch the paper or ignite it. The tensioning roller, acting with the paper guide rollers, keeps the paper taut so it will not contact the radiating surface in the paper-heating passage. In addition, we provide a chamber maintained as a zone of reduced pressure to prevent the paper from touching the heat-radiating surface. The suction fan, which creates the reduced pressure in the suction chamber, also carries away moisture liberated from the paper by the radiant heat.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of our claims. It is further obvious that various changes may be made in details within the scope of our claims without departing from the spirit of our invention. It is, therefore, to be understood that our invention is not to be limited to the specific details shown and described.

Having thus described our invention, what we claim is:

1. A copy paper heater for heating paper adapted to be moved along a path from a paper supply to a photoconductive member including in combination, a first imperforate plate of thermally conductive material, an electrical resistance winding, means including thermal insulating means mounting said thermally conductive plate with one side thereof in relatively closely spaced relationship to said resistance winding to cause said plate to be heated upon energization of said resistance winding, a second plate, means mounting said second plate in relatively closely spaced relationship to the other side of said first plate to form an elongated paper passageway in said path, said insulating material extending over said winding, and means positioning paper from said supply in said passageway adjacent to the second plate and remote from the first plate.

2. A copy paper heater as in claim 1 in which said positioning means comprises a pair of paper guide rollers adjacent one end of said passageway a tensioning roller adjacent the other end of said passageway, means mounting said tensioning roller for movement toward and away from said path and means for biasing said tensioning roller into engagement with paper moving along said path.

3. A copy paper heater as in claim 1 in which said positioning means includes a tension roller, means mounting said tensioning roller for movement toward and away from said path, means biasing said tensioning roller for movement into said path and means for heating said tensioning roller.

4. A copy paper heater as in claim 1 in which said second plate is perforated, said heater including a third plate spaced from said second plate and defining a chamber therewith, and means providing communication between said chamber and a zone of reduced pressure, and in which said positioning means comprises a pair of paper guide rollers adjacent one end of said passageway, a tensioning roller adjacent the other end of said passageway, means mounting said tensioning roller for movement toward and away from said path and means for biasing said tensioning roller into said path.

5. A copy paper heater as in claim 2 in which said second plate is formed with openings, and means for providing communication between said openings and a zone of reduced atmospheric pressure.

6. A copy paper heater as in claim 5 in which said zone of reduced atmospheric pressure comprises the intake of a centrifugal blower.

7. A copy paper heater as in claim 2 in which said first plate is free at one end to provide room for expansion during heating of the same.

8. A copy paper heater as in claim 7 including a plurality of means extending across said passageway for restraining warping of said first plate.

9. A copy paper heater as in claim 2 in which said second plate is formed with openings, a third plate spaced from said second plate and defining a chamber therewith, and means providing communication between said chamber and a zone of reduced pressure.

10. A copy paper heater as in claim 9 in which said third plate is foraminous.

11. A copy paper heater as in claim 9 in which said zone of reduced pressure comprises the intake of a centrifugal blower.

12. A copy paper heater as in claim 1 in which said radiant heater is adapted to heat said first plate to a temperature of between 350°F and 450°F.

13. A copy paper heater as in claim 12 in which said positioning means includes a tensioning roller, means mounting said tensioning roller for pivotal movement toward and away from said path, means for biasing said tensioning roller into said path and a radiant heater for heating said tensioning roller to a temperature of 250°F.

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