Jan. 14, 1964 B. NORTON 3,117,847

XEROGRAPHIC POWDER IMAGE FIXING APPARATUS

Filed March 28, 1961 3 Sheets-Sheet 1

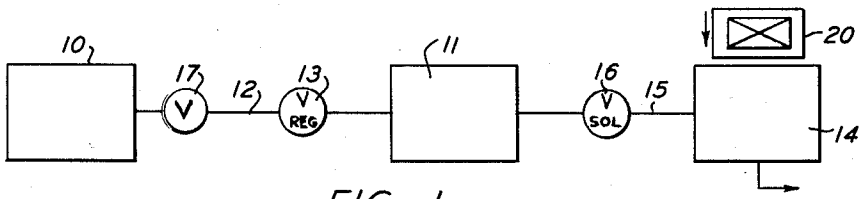


FIG. 1

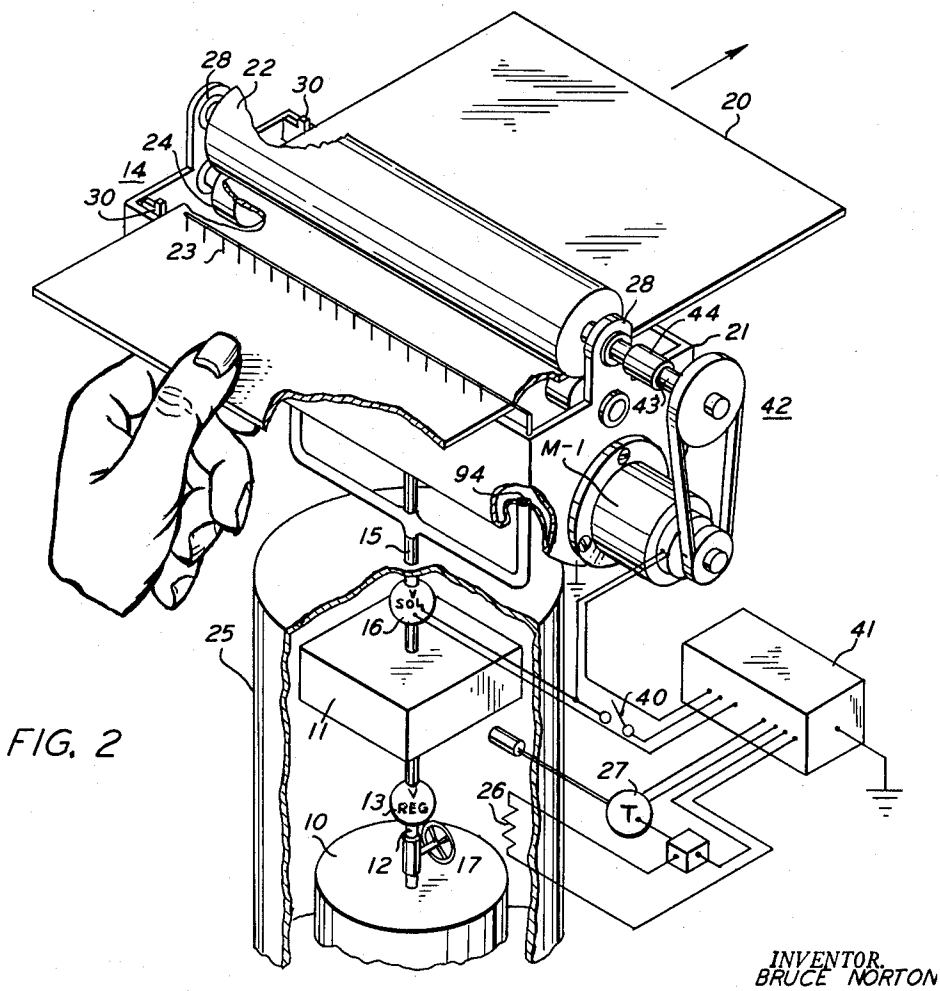


FIG. 2

INVENTOR.
BRUCE NORTON

BY Daniel Rubin

ATTORNEY

Jan. 14, 1964 B. NORTON 3,117,847

XEROGRAPHIC POWDER IMAGE FIXING APPARATUS

Filed March 28, 1961 3 Sheets-Sheet 2

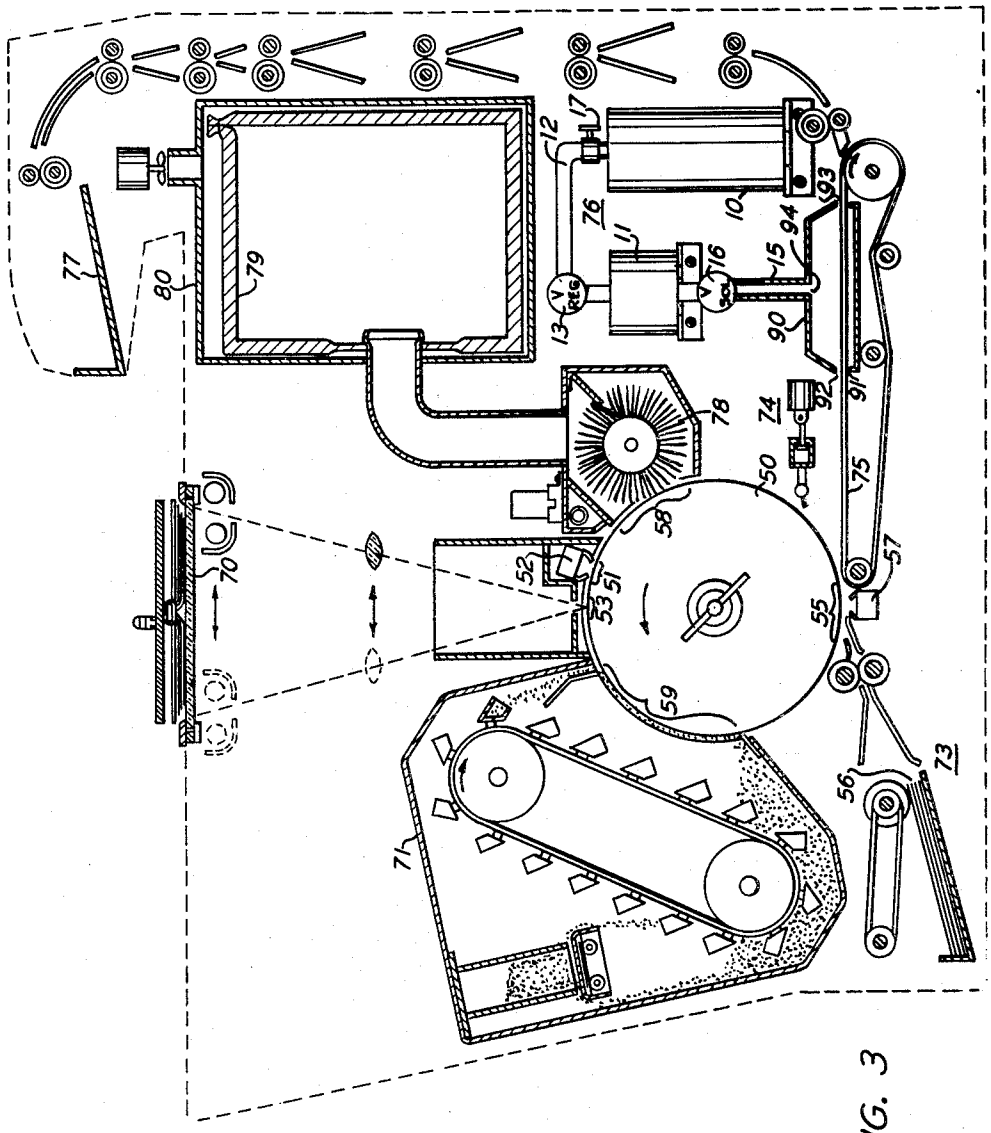


FIG. 3

INVENTOR.
BRUCE NORTON

BY Daniel Rubin

ATTORNEY

Jan. 14, 1964 B. NORTON 3,117,847

XEROGRAPHIC POWDER IMAGE FIXING APPARATUS

Filed March 28, 1961 3 Sheets-Sheet 3

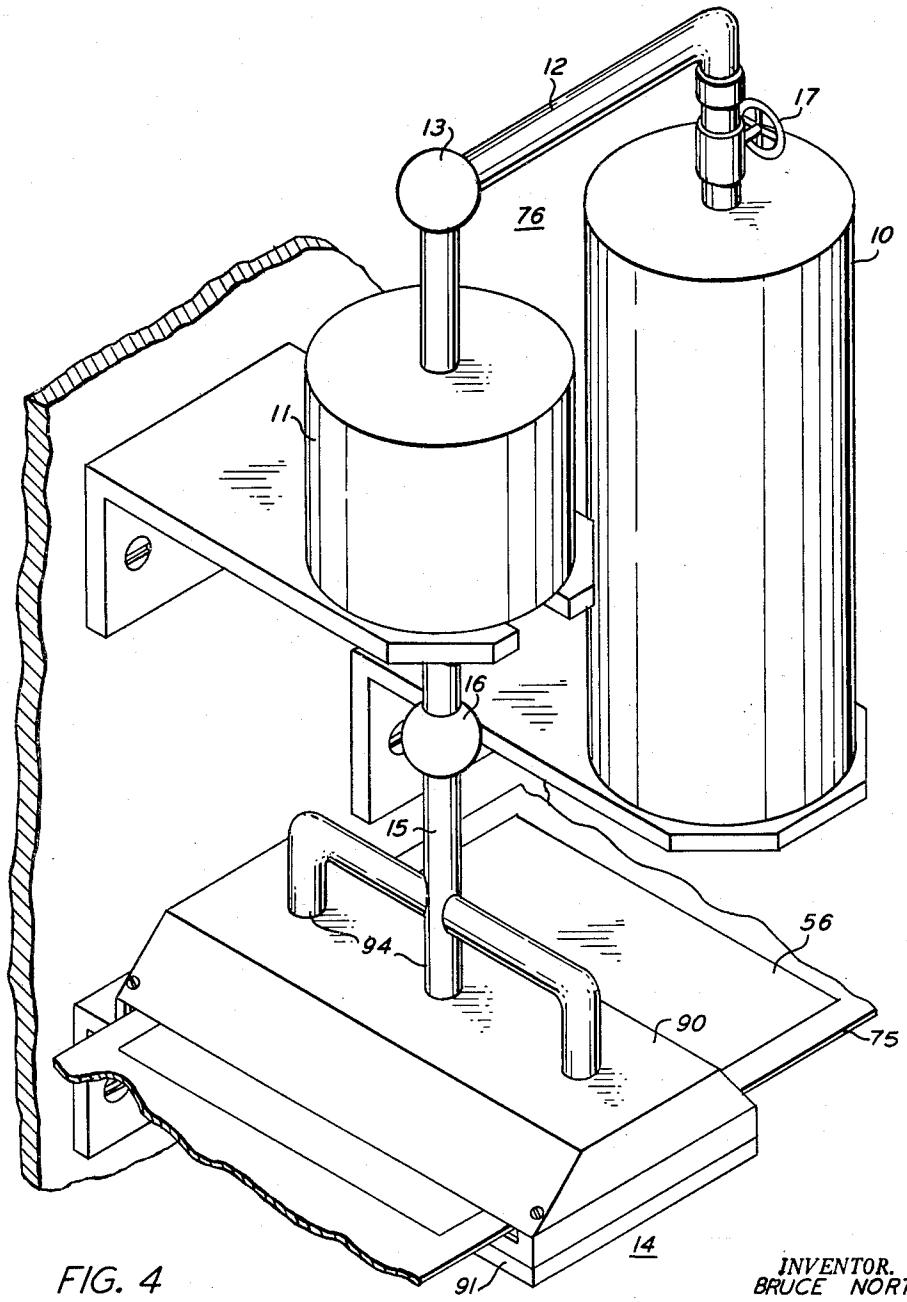


FIG. 4

INVENTOR.
BRUCE NORTON

BY Daniel Rubin

ATTORNEY

United States Patent Office 3,117,847 Patented Jan. 14, 1964

3,117,847 XEROGRAPHIC POWDER IMAGE FIXING APPARATUS

Bruce Norton, Rochester, N.Y., assignor to Xerox Corporation, a corporation of New York

Filed Mar. 28, 1961, Ser. No. 98,878
10 Claims. (Cl. 34—53)

This invention relates to xerography and in particular to improved apparatus for affixing a xerographically formed powder image onto the surface of support material on which the powder image is loosely supported.

In the process of xerography, as first disclosed, for example, in Carlson patent U.S. 2,297,691, a previousy formed electrostatic latent image on the surface of a xerographic plate is rendered visible by developing with a powder deposited on the plate surface. The powder image thus formed is then affixed to the surface upon which it has been deposited or onto the surface of another support material to which it may have been transferred by techniques known to those skilled in the art.

Conventionally there are two usual methods by which a powder image is affixed. The first of these methods is with the application of heat in which case the powder image must be formed of a thermo-adhesive material, such as a fusible resin, which becomes adhesive when heated. The second of these methods is to introduce the image-bearing support material into an atmosphere of the vapor of a solvent for the developing powder as disclosed in Carlson patent, U.S. 2,776,907. In the solvent vapor process, the powder image is rendered tacky while in the presence of the atmosphere of solvent vapor and while still tacky is removed to ambient air for evaporation of the solvent, leaving the image bonded to the support member. The solvent vapor process is sometimes referred to as "vapor fixing."

While heat fusing has been put to practical use, certain difficulties have been encountered. When the image is to be fused to paper or other organic base, as is usually the case, the powder must be made of material which becomes adhesive at a temperature below that which will cause damage to the organic base. This imposes limitations on the choice of resins which make it difficult to meet other desirable characteristics in the powder composition. Moreover, it has become difficult to reach an entirely satisfactory design of heat fuser with regard to a short warm-up time, low electric current requirements, adequate heat insulation and uniform heat distribution without the attending disadvantage of fire hazard associated with fusers employing heat as the fusing media.

Vapor fixing of powder images by means of a solvent vapor has also been put to a practical use. However, available commercial forms of powder used for developing are usually of a pigmented resin such as disclosed in Rheinfrank et al. patent, U.S. 2,788,288, and Carlson patent U.S. 2,940,934. As stated in the above cited U.S. Patent 2,776,907, a desirable solvent for pigmented resin is trichloroethylene. While trichloroethylene achieves the desired fusing with satisfaction it is characterized by objectional odor and high toxicity. Because of these objections the use of trichloroethylene as a fusing solvent and vapor fusing in general has been limited to applications and apparatus in which solvent dilution to the ambient atmosphere is below the toxic limit for human occupancy. In view of the toxicity, the chamber in which the saturated vapor of trichloroethylene is contained is substantially vapor-tight and maintained closed except for intermittent opening for insertion and removal of the support material bearing the image. By this means, vapor escape to the ambient atmosphere is restricted to short periods when the chamber is open and consequently, vapor

fixing techniques have not successfully been adapted commercially for continuous operating applications. Furthermore, the generation of saturated vapor as disclosed in the 2,776,907 patent is usually effected by means of a wick or the like with an end partially immersed into a liquid reservoir of solvent which saturates the unimmersed portion of the wick to volatize the solvent into the contained atmosphere of the chamber. While this means of generation has been found suitable when used with solvents that volatize at room temperature and above in an enclosed chamber, it is relatively slow in operation and not suitable for use with solvents that are gaseous at room temperature nor when intended for intermittent and rapid generation of the vapor atmosphere in a relatively open chamber.

Now in accordance with the instant invention there is provided improved vapor fixing apparatus for the affixing of powder images onto a support material which apparatus is flexible in operation being adapted for either intermittent or continuous automatic operation without the attending problems associated with solvents employed heretofore and able to provide rapid generation of an atmosphere of the vapor. The advantages are many, including being more economical in operation, increased flexibility of use and higher safety of operation.

It is therefore the principal object of the invention to provide improved vapor fixing apparatus for affixing a xerographic powder image onto the surface of a support material on which the powder is loosely supported.

It is a further object of the invention to provide an improved vapor fixing apparatus for affixing xerographic powder images to support material which apparatus is adaptable for continuous automatic operation.

It is a further object of the invention to provide improved vapor fixing apparatus for affixing xerographic powder images to support material which apparatus is operable with substantially less regard to problems of toxicity affecting the ambient atmosphere than with vapor fixing techniques of the known art.

It is still a further object of the invention to provide improved vapor fixing apparatus for affixing a xerographic powder image onto support material which apparatus is adapted for intermittent operation by being able to effect rapid generation of a vapor atmosphere in a fusing chamber.

These and other objects are attained in accordance with the invention which in one preferred embodiment includes a reservoir containing a relatively non-toxic pressurized solvent which, for example, may be trichloromonofluoromethane (Freon 11) connected to a second reservoir termed "purge tank" or "cumulator tank" in turn connected to a non-pressurized fixing chamber into which a support material bearing a powder image is introduced. Solvent from the first reservoir flows to the purge tank at a controlled rate and a shutoff valve either admits or intercepts the flow of solvent from the purge tank into the chamber. The solvent flashes to a gas when expanding either in the approach to or on being admitted to the fixing chamber.

Other features of the invention will be brought out and exemplified in the disclosure hereinafter set forth, including the illustrations in the drawings in which:

FIG. 1 is substantially a block diagram illustrating the invention;

FIG. 2 isometrically illustrates an apparatus constructed in accordance with the invention and adapted for intermittent or continuous operation;

FIG. 3 schematically illustrates a type of xerographic reproduction apparatus employing the invention automatically for continuous or intermittent use; and,

FIG. 4 is an enlarged view of the vapor fixing apparatus illustrated in FIG. 3.

Referring to FIG. 1 there is illustrated in diagrammatic block form the principles of the invention that includes a reservoir **10** for containment of a volatile liquid or vapor of a solvent and connected to a purge tank **11** through suitable conduit **12**. Operable within the conduit is a flow regulator **13** which may be of a type commercially marketed. The purge tank is connected to a fusing chamber **14** via conduit **15** in which there is included a suitable on-off valve **16** such as a solenoid operated valve that may be manually switched or may be switched automatically in response to an emitted signal, as for example, a signal emitted in sequential order from a xerographic apparatus in which the fixing apparatus of the invention is incorporated or associated. Reservoir **10** or conduit **12** may include a suitable closeoff valve **17** for general maintenance or replacement of the reservoir as when the supply of solvent has been exhausted or the pressure of the solvent in the reservoir has dropped to a tolerable minimum. In general, however, the reservoir is continually open to the system to permit flow of its contents therefrom to tank **11** under control of valve **13**. As stated above, desirably, although not necessarily, the contents of the reservoir are contained at a gage pressure above standard atmospheric such that continuous flow occurs whenever valve **16** is open and a flow at least sufficient to fill purge tank **11** to a predetermined pressure occurs when the valve closes. Alternatively, flow of solvent from the reservoir can be effected for example by a suitable pumping means or heat generating means operable in response to a pressure-sensitive element in operating sequence related to operation of the fusing chamber such that solvent contained in purge tank **11** is pressurized in accordance with the invention more fully described below.

A support material **20** loosely supporting a powder image on its surface is shown being introduced in the direction of the arrow into fixing chamber **14** containing an atmosphere of vapor of solvent of the powder material. For intermittent operation valve **16** is opened for a predetermined time period during which the pressurized contents in purge tank **11** are permitted to flow unimpeded to the fixing chamber while regulated flow is made up to the purge tank from the reservoir. Since chamber **15** is maintained at atmospheric pressure and the contents of tank **11** are pressurized above atmospheric pressure, on opening of valve **16** the pressure differential therebetween induces a rapid flow of sufficient volume which when expanded into the fixing chamber **14** substantially saturates the chamber with vapor for the introduction of the support material. With a relatively non-toxic solvent, vapor in the chamber is permitted to be absorbed and wasted into the ambient air. Preferably, wasting of the solvent should be economically practical, which of course is dependent upon the particular solvent selected a discussion of which is had below.

Referring to FIG. 2 there is illustrated a semi-automatic apparatus operable in accordance with the principles of FIG. 1 and including comparable elements. Fixing chamber **14** consists of an open tank **21** which adapted for fusing 8½" x 11" copy may conveniently be 9½ inches long and 4⅜ inches wide. Mounted for rotation in end supports **28** is a 4 inch diameter cylinder **22** closed at both ends and supported with its lower periphery slightly lower than the plane of the tank opening. Cylinder **22** serves a dual purpose in that it reduces the volume of air to be replaced by the vapor of the solvent and serves also as a means of locomotion for the support material through the fixing chamber as described below.

In operation, copy **20** is inserted over the tank opening image-side facing down and in the direction indicated by the arrow. For guiding copy through the tank, the edge of the copy is set against alignment guide **30** and as the copy emerges it is further guided by a second alignment guide **30**. As copy is inserted, it may optionally be contacted by a plurality of uniformly spaced needles **23** supported flexibly from the tank to contact the back surface of the entering copy. The needles are suitably grounded such that residual electrostatic charge on the copy from previous utilization is substantially neutralized. As the copy enters it is grasped in the bite of idler rolls **24** and cylinder **22** and continues to be advanced thereby until completely emerged with the image affixed.

Operation of the unit is effected from a switch **40** connecting motor M–1 and valve **16** to a potential source **41**. When valve **16** is energized the contents of tank **11** flows into the fixing chamber while cylinder **22** is continuously rotated through a belt and pulley drive **42** connecting the motor drive shaft to shaft **43** coaxially coupled to cylinder **22** by coupling **44**.

A series of uniformly spaced ports (see also FIG. 4) are provided in the bottom of tank **21** whereby the vapor can enter the chamber at several locations to achieve uniformity of distribution therewithin. In the instance of using a solvent with properties such as trichloromonofluoromethane it may be desirable to provide a sufficient length of tubing for heating from ambient room temperature to ensure the presence of gas entering the fixing chamber. Alternatively, it may be desirable to provide a means for maintaining the solvent or vapor at a predetermined quality above saturation temperature for the pressure under which it is being maintained in order to prevent chilling and liquefying of the vapor on rapid expansion.

The term "quality" as used herein relative to the solvent vapor is used in a thermodynamic sense to express the moisture content of a wet vapor. The quality is defined as being the percent by weight of vapor to the total vapor and liquid particle mixture. Similarly, "saturation temperature," also called "boiling temperature" is used in a thermodynamic sense being the temperature corresponding to a pressure at which a liquid is reversibly convertible to a gas. For example, trichloromonofluoromethane has a saturation temperature of approximately 110° F. when subjected to an absolute pressure of approximately 27 pounds per square inch. On expansion to the lower atmospheric pressure, liquid at the higher pressure flashes partially into a gas at approximately 75° F. The quality of gas at atmospheric pressure will vary as a function of the quality or temperature differential below saturation at the higher pressure. To ensure vaporizing, the solvent may be heated at the higher pressure to at least saturation temperature and therefore substantially the entire apparatus may optionally be contained in a heating chamber designated **25**. By this means a fixed pressure is created and maintained allowing continuous operation or purge tank metering. Within the heating chamber there is included a suitable heating coil **26** thermostatically controlled by thermostat **27** having the sensing element within the heating chamber and energized from potential source **41**.

An automatic xerographic reproduction apparatus is schematically illustrated in a side sectional view in FIG. 3 and which may be of a type disclosed in Eichler et al. patent, U.S. 2,945,434. In general, the xerographic apparatus illustrated is comprised of a xerographic plate in the shape of a cylindrical drum **50** which is mounted on a shaft journaled for rotation in the direction indicated by the arrow whereby the drum surface sequentially passes a plurality of processing stations. The processing stations include a charging station **51** for applying charge on the drum by means of a corona generating device **52**; an exposure station **53** at which a copy image of activating radiation is optically projected onto the drum surface to form an electrostatic latent image of the copy; a developing station **54** at which developing material for example, of pigmented resin as aforesaid that becomes triboelectrically charged opposite to that of the electrostatic latent image while cascading over the drum surface; a transfer station **55** at which the powder image is transferred from the drum surface to a support material **56** by means of a corona generating device **57**; and a drum

cleaning station 58 at which the drum surface is brushed to remove residual powder particles remaining on the drum after image transfer.

Copy to be reproduced is supported on copyboard 70 whereat it is optically projected onto the previously charged drum at the exposure station. Thereafter as the drum rotates a developing apparatus 71 cascades developing powder over the xerographic drum to form a powder image corresponding to the electrostatic latent image formed on exposure. The powder image thus formed is subsequently transferred by electrostatic transfer techniques to support material 56 by a corona generating device 57. The support material is fed by a feeding mechanism designated 73 that presents the material in proper registration with the drum as the developed image arrives at the transfer station. After transfer the support material is separated from the drum by a suitable pickoff mechanism 74 and directed onto an endless conveyor 75 for transport through fuser 76 of the invention. In the fuser the powder image is affixed to the support material after which the reprodutcion is advanced until discharged for collection on tray 77. The drum is subsequently cleaned at station 58 before recycling and residual powder removed by brush 78 is vacuum collected in a filter bag 79 contained in a hood 80.

Referring to FIG. 4 the fuser apparatus 76 illustrated in FIG. 3 is shown in increased detail. The fixing chamber 14 consists of a cover 90 and a bottom wall 91 spanning respectively above and below the conveyor belt with unimpeded openings 92 and 93 for the belts to pass through. The sides of the fuser may be either open or closed. Ports 94 are provided in cover 90 for admission of solvent vapor, and generation of the atmosphere is controlled similarly as described in FIGS. 1 and 2. Generation is preferably effected in timed relation to the formation of reproductions and preferably is actuated in timed relation to the operation of paper feed mechanism 73. By this means the consumption of vapor is eliminated when the machine is inactive, yet generation of vapor in the chamber will occur virtually instantaneously when the machine is put into operation and provides a continuous vapor flow while the machine is continuously used. Since it is intended that the purge tank will contain a pressurized volume of solvent or vapor sufficient to saturate the fixing chamber on intermittent operation, the volume of the purge tank is a function of the solvent used and the pressure to which it may be subjected relative to the volume to which it will expand when exposed to the reduced pressure. For example, with trichloromonofluoromethane contained in the purge tank at a pressure of approximately 27 pounds per square inch absolute, the volume of the purge tank would be approximately 2.4×the volume of the fixing chamber which is at atmospheric pressure.

The solvent primarily referred to herein has been trichloromonofluoromethane, although it is not intended thereby to be a limitation of the invention since the solvent employed will be a function of the powder material and any powder material can have any number of suitable solvents. However, trichloromonofluoromethane has been found suitable for the purposes of the invention when developing with a pigmented resin material of the type described, in that its availability, consumption rate, cost, toxicity and fusing effect enjoy advantages over solvents commonly used heretofore. For example, it has been found that images become fusibly tacky in a trichloromonofluoromethane atmosphere of 95% trichloromonofluoromethane to air by volume (98% by weight) with less than 2 seconds exposure. Thereafter the image-bearing support material is removed to ambient air for evaporation of the solvent and the image permitted to bond which appears to occur substantially instantaneously. This condition of fusing was found to occur in an atmosphere without any perceptible temperature difference between the vapor mixture and the powder image. For continuous operation it was found that approximately ⅛ gram of liquid trichloromonofluoromethane was consumed per copy as compared to 1.0 gram per copy for trichloroethylene and the cost at this rate of consumption was approximately 40% that of trichloroethylene.

Whereas trichloromonofluoromethane has been treated herein as substantially non-toxic it is to be understood that this reference is used in a relative sense as compared to a more toxic material such as trichloroethylene. Comparative data is published in a book by Sax entitled "Dangerous Properties of Industrial Materials," published by Reinhold Company and dated 1957, in which it is stated that the maximum allowable concentration (MAC) of trichloroethylene is 200 parts per million (p.p.m.) while trichloromonofluoromethane has a MAC of 100 p.p.m. Since the rate of consumption of trichloromonofluoromethane is considerably less than is required of trichloroethylene toxicity is not regarded as a problem with trichloromonofluoromethane in a normally ventilated room. Conceivably however, at high rates of reproduction increased room ventilation may be necessary.

The speed at which fixing occurs depends on the rate of solvent action of that solvent on the resins of the developer powder and the rate of solvent condensation which is determined in part by the thermoconductivity of the materials involved and the means by which vapor is applied to the image surface. This includes fixing by permitting the image to absorb vapor of the solvent or by causing solvent vapor to condense a liquid on the image surface. Drying time of the solvent fixed image will depend on the vapor pressure of the solvent, thermoconductivities, ambient temperature and extent of air circulation at the drying zone.

It is desirable that a suitable solvent have the following properties: high solvent power for resins, saturation temperature (boiling point) within the approximate range of 70° F. to 250° F., relatively low toxicity, nonirritating, non-inflammable, high chemical stability, non-corrosive to metals, odorless, and negligible solubility of water in the solvent. For the purposes of the invention solvents which have been found suitable are the halogenated compounds of which aliphatic fluoro- and fluorochloro-compounds are preferred.

By the apparatus described above, there is disclosed a novel vapor fixing apparatus that eliminates warmup time, as compared for example, to a commercial unit using a heat fuser in which the first copy is not available until approximately 30 seconds after startup with subsequent copy being available at approximately 10 second intervals thereafter. By means of the invention the first copy can proceed directly through the apparatus being available in approximately 10 seconds and subsequent copy can proceed in approximately 10 second intervals thereafter. This advantage is particularly important for a unit operating intermittently, i.e., one requiring only periodic use in contrast to a unit utilized continuously. As stated above, fire hazard is eliminated as is a need for a heavy power conduit normally required for energizing a heat fuser. As compared to the vapor fixers of the known art the vapor fixing apparatus of the invention offers increased flexibility and utility such as to be adaptable commercially for use on a continuous basis.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A vapor fixing apparatus for affixing an image of resin powder onto the surface of a support material on which the powder image is supported, including a fixing chamber at ambient pressure adapted to receive a support material bearing an image to be affixed, a pressurized reservoir to contain solvent for the resin powder, a

second reservoir connected between said fixing chamber and said first recited reservoir to receive a predetermined volume of solvent from said first reservoir and to discharge solvent to said fixing chamber, means to maintain the solvent in said second reservoir at a predetermined pressure between the ambient pressure in said fixing chamber and the pressure of said pressurized reservoir, pressure sensitive means operative in the connection between said reservoirs and responsive to a reduction in pressure in said second reservoir to admit additional solvent thereto from said first reservoir, and means operable in said connection between said second reservoir and said fixing chamber adapted to openly connect said second reservoir to said fixing chamber for a controlled time period to discharge the solvent from said second reservoir and form an atmosphere of solvent vapor in said fixing chamber.

2. The apparatus according to claim 1 wherein the contents of said second reservoir are at least partially vaporized.

3. The apparatus according to claim 1 wherein there is included means to regulate the content flow rate from said second reservoir into said fixing chamber.

4. The apparatus according to claim 1 wherein there is included heat generating means for said reservoirs, and control means to regulate said heat generating means whereby to effect a temperature of the atmosphere of solvent vapor in the fixing chamber above a predetermined temperature.

5. The apparatus according to claim 4 wherein said predetermined temperature is the condensation temperature of the solvent vapor.

6. The apparatus according to claim 1 wherein the means to maintain the contents in second reservoir at a predetermined pressure above the ambient pressure in said fixing chamber comprises temperature maintaining means and a valve responsive to the pressure in said second reservoir.

7. Apparatus for affixing a xerographic powder image to the surface of sheet material, the powder comprising said image including a solvent soluble component, said apparatus comprising walls defining a fixing chamber having openings for introducing and removing sheet material carrying a xerographic powder image into said chamber, second openings in said chamber for admission of solvent vapor thereto, a pressurized reservoir to contain solvent for the powder, a second reservoir connected between said first reservoir to receive a predetermined quantity of solvent therefrom and said second openings of said fixing chamber to discharge solvent thereto, means to control the pressure of the solvent in said second reservoir at a pressure that will induce a pressurized flow of solvent from said second reservoir to said fixing chamber, pressure sensitive means operative in the connection between said reservoirs and responsive to a reduction in pressure in said second reservoir to admit additional solvent thereto from said first reservoir, and means operable in said connection between said second reservoir and said fixing chamber adapted to openly connect said second reservoir to the second openings of said fixing chamber for a controlled time period to discharge the solvent and form an atmosphere of solvent vapor in said fixing chamber.

8. The apparatus according to claim 7 wherein said fixing chamber is maintained at atmospheric pressure and temperature.

9. A vapor fixing apparatus for affixing an image of resin powder onto the surface of a support material on which the powder image is supported, including a fixing chamber at ambient pressure adapted to receive a support material bearing an image to be affixed, a pressurized reservoir to contain solvent for the resin powder, a second reservoir of predetermined volume having an inlet and outlet connection, said inlet connection being connected to said first recited reservoir to receive a volume of solvent therefrom, said outlet connection being connected to said fixing chamber to discharge solvent thereto, means to maintain the contents in said second reservoir at a predetermined pressure above the ambient pressure in said fixing chamber, a pressure sensitive control valve operatively positioned in said connection between said reservoirs and responsive to a reduction in pressure in said second reservoir to admit additional solvent thereto from said first reservoir, and means operable in said connection between said second reservoir and said fixing chamber adapted to openly connect said second reservoir to said fixing chamber for a controlled time period to discharge the solvent from said second reservoir to form an atmosphere of solvent vapor in said fixing chamber.

10. A xerographic solvent vapor fixing device including a fixing chamber, a source of pressurized solvent supply, a tank connected between said source of solvent supply and said fixing chamber and having capacity to contain only sufficient solvent vapor to fix a single xerographic image in said fixing chamber, means to maintain the solvent in said tank at a pressure that will induce a pressurized flow of solvent from said tank to said fixing chamber, means to connect said tank to said fixing chamber, means operative in the connection between said source of solvent supply and said tank and responsive to a reduction in pressure to automatically admit additional solvent from said source of supply to said tank to maintain a ready supply in said tank, and means to control the temperature within said tank whereby the solvent in said tank may be maintained in a vaporized condition.

References Cited in the file of this patent

UNITED STATES PATENTS

2,284,641	Cox et al.	June 2, 1942
2,617,743	Grimm	Nov. 11, 1952
2,726,166	Greaves	Dec. 6, 1955
2,750,680	Houdry	June 19, 1956
2,880,117	Hanlet	Mar. 31, 1959
2,884,704	Bolton	May 5, 1959
2,889,758	Bolton	June 9, 1959
2,906,205	Speers	Sept. 29, 1959
2,995,464	Gundlach	Aug. 8, 1961
3,049,810	Iwerks	Aug. 21, 1962

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,117,847 January 14, 1964

Bruce Norton

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 14, for "previousy" read -- previously --; column 3, line 44, for "15" read -- 14 --; column 6, line 15, for "100 p.p.m." read -- 1000 p.p.m. --.

Signed and sealed this 4th day of August 1964.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,117,847 January 14, 1964

Bruce Norton

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 14, for "previousy" read -- previously --; column 3, line 44, for "15" read -- 14 --; column 6, line 15, for "100 p.p.m." read -- 1000 p.p.m. --.

Signed and sealed this 4th day of August 1964.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents