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(54) **FUSING APPARATUS AND METHOD.**

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(73) Proprietor : **INDIGO N.V.**
Luchthavenweg 59-VII
NL-5507 SM Veldhoven (NL)

(72) Inventor : **LANDA, Benzion**
10010-119 Street
Edmonton, Alberta T5J 0J0
Alberta (CA)
Inventor : **YACOUB, Naseem**
8 Hashomer Street
Herzlia (IL)
Inventor : **PINHAS, Hanna**
29 Shprinzak Street
Holon (IL)

(74) Representative : **de Bruijn, Leendert C. et al**
Nederlandsch Octrooibureau
Scheveningseweg 82
P.O. Box 29720
NL-2502 LS Den Haag (NL)

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Description**FIELD OF THE INVENTION**

5 The present invention relates generally to imaging apparatus and techniques and more particularly to apparatus and techniques for fusing of images on a substrate.

BACKGROUND OF THE INVENTION

10 Various techniques for image fusing are known in the patent literature. The Background of the Invention section of U.S. Patent 4,724,303 includes a survey of the patent literature relating to the use of thermal energy for fixing toner images. The disclosure of U.S. Patent 4,724,303 describes an instant-on fuser including a cylindrical, relatively thin metal cylinder supporting a resistive heating foil or printed circuit secured on the inside surface of the cylinder by a high temperature adhesive. The interior of the cylindrical tube contains ambient
 15 air. The heating foil or printed circuit is carried on a fiber glass substrate and the heating element is connected to electrical leads extending through caps on the ends of the cylindrical support. The combined thickness of the cylindrical member, the heating circuit and the adhesive is described as being between 0.125 and 0.25 mm (0.005 and 0.01 inches).

U.S. Patent 3,948,214 also describes instant start fusing apparatus. Here the fuser roll has a cylindrical
 20 member made of quartz or other material which transmits radiant energy from a source located on the interior of the cylindrical member. The cylindrical member has a first layer made of elastomeric material which transmits radiant energy. The first layer is covered with a second layer of material which absorbs radiant energy. A third layer of material covers the second layer of heat absorbing material to effect a good toner release characteristic on the fuser roll surface. The fuser roll layers are relatively thin and have an instant start capability to fuse
 25 toner images onto support material, such as paper.

U.S. Patent 3,471,683 describes a heater roll suitable for use as a fuser roller in which heating is produced by a printed circuit formed into the surface of the roll, which receives electrical power through the roller shaft.

U.S. Patent 4,015,027 describes an electrophotographic toner transfer and fusing method wherein a heated image is supported on a roller or belt intermediate transfer medium employed for pressure transfer of dry
 30 toner images onto paper. At column 11, line 29 - column 12, line 38 there appears a detailed discussion of heating of images upon transfer thereof as proposed therein and as taught in the prior art including specifically U.S. Patent 3,591,276 to Byrne.

Reference is made to Figs. 5a - 5c, 6a - 6c, 7a and 7b of U.S. Patent 4,015,027. It is seen that in nearly all cases described, the toner is heated to at least its melting point during the transfer stage. In a technique
 35 proposed in U.S. Patent 4,015,027 and exemplified by Fig. 6(a), the toner is heated to at least its melting point prior to the transfer zone. In the transfer zone, the toner cools below its melting point during transfer and fusion.

A belt construction characterized in that it has a very low heat capacitance and a thickness of between 15 and about 200 microns (micrometers) is proposed in U.S. Patent 4,015,027. In one embodiment the belt
 40 comprises a 50 micron layer of aluminized Kapton having a 25 micron coating of silicon rubber. Another embodiment employs a 12.5 micron layer of stainless steel instead of the Kapton together with a silicon rubber coating. A reflecting layer is incorporated in the belt to reduce heating thereof.

Reference is now made to the following published patent applications and issued patents in the field of electrophotography: GB published Patent Applications Nos. 2,169,416A and 2,176,904A and U.S. issued Patents Nos. 3,990,696, 4,233,381, 4,253,656, 4,256,820, 4,269,504, 4,278,884, 4,286,039, 4,302,093,
 45 4,326,644, 4,326,792, 4,334,762, 4,350,333, 4,355,883, 4,362,297, 4,364,460, 4,364,657, 4,364,661, 4,368,881, 4,378,422, 4,392,742, 4,396,187, 4,400,079, 4,411,976, 4,412,383, 4,413,048, 4,418,903, 4,420,244, 4,435,068, 4,439,035, 4,454,215, 4,460,667, 4,473,865, 4,480,825, 4,501,486, 4,522,484, 4,531,824, 4,538,899, 4,582,774, 4,585,329, 4,586,810, 4,589,761, 4,598,992, 4,603,766, 4,620,699, 4,627,705, 4,678,317.

SUMMARY OF THE INVENTION

The present invention seeks to provide improved fusing apparatus.

There is thus provided in accordance with a preferred embodiment of the invention apparatus for fusing
 55 a liquid image onto a substrate including apparatus for providing a liquid image on the substrate, a fuser element urged against the image on the substrate and apparatus for heating the fuser element, characterized in that the liquid image includes carrier liquid and toner particles which solvate the carrier liquid at elevated temperatures, the fuser element and the apparatus for heating being arranged to heat the liquid image to an ele-

vated temperature at which the particles solvate said carrier liquid but below the melting point of the dry toner particle material such that the image adheres to the substrate.

In a preferred embodiment of the invention the fuser element and the apparatus for heating are arranged for cooling the fuser element subsequent to heating the liquid image to the elevated temperature such that adhesion of the image to the fuser element is less than the cohesion of the image.

There is further provided in accordance with a preferred embodiment of the invention, apparatus for fusing a liquid image onto a substrate including apparatus for providing a liquid image on the substrate, a fuser element urged against the image on the substrate and apparatus for heating the fuser element, characterized in that the liquid image includes carrier liquid and toner particles which solvate the carrier liquid at elevated temperatures, wherein the fuser element has a heat capacity sufficient to heat the image to an elevated temperature at which the particles solvate said carrier liquid but below the melting point of the dry toner particle material such that adhesion of the image to the substrate is improved.

In a preferred embodiment of the invention the heat capacity is low enough to cause substantial cooling of the fuser element during fusing such that the adhesion of the image to the fuser element is less than the cohesion of the image.

In a preferred embodiment of the invention the elevated temperature is at least the solvation temperature and the cooling of the fuser element cools the fuser element to a temperature below the solvation temperature.

Preferably the fuser element and the apparatus for heating are operative to increase the viscosity of the image during fusing thereof.

In a preferred embodiment of the invention the apparatus also includes a backing roller adjacent to the fuser element and apparatus for passing the substrate between the fuser element and the backing roller at a fusing region whereby the fuser element is urged toward the backing roller thereby to apply pressure to the image. Preferably the fuser element deforms the backing roller at the fusing region.

In a preferred embodiment of the invention the fuser element preferably includes end portions having a thin walled cylinder including a cylindrical fuser surface therebetween, the thin walled cylinder having a thickness less than 125 micrometers preferably unbacked by a solid structural support between said end portions and preferably supported by gas pressure. In a preferred embodiment of the invention the cylinder has a thickness of less than 50 micrometers, more preferably less than 30 or 12 micrometers.

There is also provided in accordance with a preferred embodiment of the invention a method for fusing a liquid image onto a substrate including the steps of providing a liquid image on the substrate, urging a fuser element against the image on the substrate and heating the fuser element, characterized in that the liquid image includes carrier liquid and toner particles which solvate the carrier liquid at elevated temperatures, the step of heating being operative for heating the liquid image to an elevated temperature at which the particles solvate said carrier liquid but below the melting point of the dry toner particle material such that the image adheres to the substrate.

In a preferred embodiment of the invention the method includes the step of cooling the fuser element subsequent to heating the liquid image to the elevated temperature such that adhesion of the image to the fuser element is less than the cohesion of the image.

There is further provided in accordance with a preferred embodiment of the invention a method for fusing a liquid image onto a substrate including the steps of providing a liquid image on the substrate, urging a fuser element against the image on the substrate and heating the fuser element, characterized in that the liquid image includes carrier liquid and toner particles which solvate the carrier liquid at elevated temperatures, wherein the fuser element has a heat capacity sufficient to heat the image to an elevated temperature at which the particles solvate said carrier liquid but below the melting point of the dry toner particle material such that adhesion of the image to the substrate is improved.

In a preferred embodiment of the invention the heat capacity is low enough to cause substantial cooling of the fuser element during fusing such that the adhesion of the image to the fuser element is less than the cohesion of the image.

In a preferred embodiment of the invention the elevated temperature is at least the solvation temperature and the cooling of the fuser element cools the fuser element to a temperature below the solvation temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and appreciated more fully from the following detailed description taken in conjunction with the drawing in which:

Fig. 1 is a generalized schematic sectional illustration of fuser apparatus constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 2A is a side sectional illustration of a heated thin-walled fuser element constructed and operative in

accordance with a preferred embodiment of the present invention;

Fig. 2B is a sectional illustration taken along the lines IIB - IIB of Fig. 2A;

Fig. 3A is a side sectional illustration of a heated thin-walled fuser element constructed and operative in accordance with an alternative embodiment of the present invention;

5 Fig. 3B is a sectional illustration taken along the lines IIIB - IIIB of Fig. 3A;

Fig. 4A is a side sectional illustration of a heated thin-walled fuser element constructed and operative in accordance with a further alternative embodiment of the present invention;

Fig. 4B is a sectional illustration taken along the lines IVB - IVB of Fig. 4A;

10 Fig. 5A is a side sectional illustration of a heated thin-walled fuser element constructed and operative in accordance with yet another embodiment of the present invention; and

Fig. 5B is a sectional illustration taken along the lines VB - VB of Fig. 5A.

DETAILED DESCRIPTION OF THE INVENTION

15 Referring to Fig. 1 there is shown fusing apparatus constructed and operative in accordance with a preferred embodiment of the present invention and comprising a fuser roller 10 which is operative to fuse an image, such as a toner image 12, on a substrate 14, such as paper. The image bearing substrate 14 moves in a direction indicated by an arrow 16 between fuser roller 10 and a platen roller 18.

20 Toners suitable for the present invention include, but are not limited to, powder toners, toners of the type described in the examples in Published Patent specification GB 2169416A, or liquid toners, comprising pigmented solid particles which solvate at temperatures below the melting point of the solid particles, as well as liquid toners which do not solvate at a temperature below the melting point of the pigmented solid particles therein.

25 The fuser apparatus of Fig. 1 may be used in connection with and form part of imaging apparatus such as an electrostatographic printing machine or alternatively any other suitable type of imaging apparatus. Examples of systems in which the present invention may be employed include electrophotography, electrography, ionography, xero-printing, gravure-like printing and electrostatic printing.

For convenience, the description which follows is presented in the context of an electrophotographic system employing liquid toner, but without limiting the applicability of the present invention.

30 Reference is now made to Figs. 2A - 5B which illustrate four alternative embodiments of fuser rollers constructed and operative in accordance with a preferred embodiment of the invention.

According to a preferred embodiment of the invention, the fuser roller comprises a thin-walled cylinder 70. Cylinder 70 preferably is formed of two rigid end portions 72 and 74 and a thin cylindrical layer 76 typically coated with a release layer 78. Typical materials and thicknesses are as follows:

35 Layer 76 - Material: Kapton (DuPont)
 - Thickness: 20 microns
Release layer 78 - Material: Teflon (DuPont)
 - Thickness: 10 microns

40 According to an alternative embodiment of the invention, the layer 76 may be a 10 micron thick film of nickel alloy, such as nickel cobalt or nickel chromium and the release layer may be a 2 micron thick layer of Teflon.

In accordance with a preferred embodiment of the invention, the thin cylindrical layer 76 is axially tensioned, as by a spring arrangement 80, sufficient to eliminate most surface irregularities. For the above-described example employing Kapton, a suitable tension is 200 Kg/cm².

45 Further in accordance with a preferred embodiment of the invention, enhanced rigidity and surface uniformity of the thin-walled cylinder 70 is provided by pneumatically pressurizing the interior of the cylinder, by any suitable pressurized gas. A valve 82 may be provided for this purpose.

In accordance with a preferred embodiment of the present invention, the thin walled cylinder 70 is heated by the passage of electrical current along layer 76 via conductors 84 and 86, which establish an electrical circuit via end portions 72 and 74. In this case layer 76 must either be or include a layer which is an electrical conductor of suitable characteristics.

In the above stated example, the electrical power required to provide desired heating of fusing element 70 is relatively low.

55 Reference is now made to Figs. 3A and 3B which illustrate an alternative embodiment of heated fuser element wherein heating is provided by radiation. Here a heating lamp 90 is disposed interior of a radiation transmissive tube 92, such as a quartz tube. Disposed in generally coaxial surrounding relationship with quartz tube 92 and supported on annular end supports 94 is a fuser layer 96 having formed therein a release layer 98.

According to a preferred embodiment of the invention, layers 96 and 98 may be identical to layers 76 and

78 in the embodiment of Figs. 2A and 2B. In such a case tensioning apparatus of the type illustrated in Fig. 2A is preferably employed.

Reference is now made to Figs. 5A and 5B, which illustrate an alternative arrangement of heated fuser roller. The roller 100 is preferably of the thin walled type described above. Heating of the roller 100 is provided externally of the roller by a heating station 102. In the illustrated embodiment, the heating station 102 employs radiant heaters, which heat the roller by radiation. Alternatively the heating station 102 may heat the roller 100 by conduction through direct contact with the roller.

Reference is now made to Figs. 4A and 4B, which illustrate a further alternative of heated fuser roller. Here, once again, a roller 110 is preferably thin walled. Heating of the roller 110 is provided by an internal radiant heater assembly 112 which is mounted internally of roller 110. Radiant heater 112 comprises an elongate radiative heat source 114 which is associated with a reflector 116, which prevents direct radiation from source 114 from reaching the area at which fusing occurs, thus providing differential heating of roller 110 and permitting cooling of the image during fusing as described hereinabove.

The weight of the reflector 116 ensures that when the reflector 116 is pivotably mounted with respect to the roller, they will retain the orientation illustrated notwithstanding rotation of the roller 110.

It will be understood that it is a particular feature of the invention that the hot fuser roller has a heat capacity per unit area which is sufficient to heat the toner material to the proper fusing temperature during the contact period, with the effective heat capacity per unit area being such that the thermal transfer to the paper is high enough to reduce the temperature of the roller surface, so that adhesion of the image to that surface is reduced. Simply stated, the thin cylindrical member has an effective heat capacity sufficient to heat the toner material during fusing sufficiently, and then cool itself, before disengagement from the paper-image combination. Functionally, the fuser roller delivers a measured amount of heat energy while cooling.

Furthermore, the particular features of provision of the tensioning and/or pressurizing features of the roller allow for the use of material thin enough to provide this particular amount of heat capacity, and thin enough so that lateral heat transfer is relatively small, without which features the thin walled cylinder would not have the required rigidity.

As the image is cooled, its viscosity and cohesiveness are increased. The adhesion of the image to the substrate is greater than its adhesion to the release coated fuser roller, thus substantially preventing transfer of the image to the roller. Clearly the temperature to which the image must be heated and cooled depends on the characteristics of the material. For solid toners and for non solvating liquid toners this temperature preferably approximates the melting point of the solids, for solvating toners, this temperature preferably approximates the solvation temperature. The solvation temperature is defined as the temperature at which the maximum amount of carrier liquid can be solvated by the toner particles while remaining a solid.

Additionally, it is the provision of a thin walled cylinder which makes the direct heating of the surface possible.

Additionally, the low heat capacity and transverse heat conduction combine to allow the fuser to heat substantially during the relatively long period before the fusing operation, without high heat requirements and without excessive heat transfer to the paper.

It is thus a particular feature of the present invention that there is provided a fuser element including a thin surface or member which supports the image during transfer, the thin surface having an effective heat capacity which is less than that of the substrate.

The thin surface may be a cylindrical surface or any other suitable configuration. Normally, due to its thinness, the thermal conductivity along the surface is sufficiently small such that the thermal mass of the supports, such as end rollers for a cylindrical surface such as that shown in the drawings, may be disregarded.

The advantages of the use of a fuser element having the proper effective thermal mass are summarized below:

- a. enabling the image being fused to cool during transfer, as has already been described;
- b. enabling rapid cooling of the fuser;
- c. limiting the amount of thermal energy passed to the paper and thus limiting paper deformation.
- d. low electrical power requirements.
- e. "instant on" start up.

It will be appreciated by persons skilled in the art that the present invention is not limited by what has been particularly shown and described hereinabove. Rather the scope of the present invention is defined only by the claims which follow:

Claims

1. Apparatus for fusing a liquid image onto a substrate comprising:
 means for providing a liquid image on said substrate;
 5 a fuser element urged against said image on said substrate; and
 means for heating said fuser element,
 characterized in that said liquid image includes carrier liquid and toner particles which solvate said
 carrier liquid at elevated temperatures, said fuser element and said means for heating being arranged to
 heat the liquid image to an elevated temperature at which said particles solvate said carrier liquid but below
 10 the melting point of the dry toner particle material such that the image adheres to the substrate.
2. Apparatus for fusing a liquid image onto a substrate comprising:
 means for providing a liquid image on said substrate;
 a fuser element urged against said image on said substrate; and
 15 means for heating said fuser element,
 characterized in that said liquid image includes carrier liquid and toner particles which solvate said
 carrier liquid at elevated temperatures, wherein said fuser element has a heat capacity sufficient to heat
 the image to an elevated temperature at which said particles solvate said carrier liquid but below the melt-
 ing point of the dry toner particle material such that adhesion of the image to the substrate is improved.
- 20 3. Apparatus according to claim 1 wherein said fuser element and said means for heating are arranged for
 cooling said fuser element subsequent to heating said liquid image to said elevated temperature such that
 adhesion of the image to said fuser element is less than the cohesion of the image.
- 25 4. Apparatus according to claim 2 wherein said heat capacity is low enough to cause substantial cooling of
 the fuser element during fusing such that the adhesion of the image to said fuser element is less than
 the cohesion of the image.
5. Apparatus according to claim 3 or claim 4 wherein said elevated temperature is at least the solvation tem-
 30 perature and the cooling of the fuser element cools the fuser element to a temperature below the solvation
 temperature.
6. Apparatus according to any of the preceding claims wherein said elevated temperature is the solvation
 temperature.
- 35 7. Apparatus according to any of the preceding claims wherein said fuser element and said means for heat-
 ing are adapted to increase the viscosity of the image during fusing thereof.
8. Apparatus according to any of the preceding claims and also comprising:
 a backing roller adjacent to the fuser element; and
 40 means for passing the substrate between the fuser element and the backing roller at a fusing region
 whereby the fuser element is urged toward the backing roller thereby to apply pressure to the image.
9. Apparatus according to claim 8, wherein said fuser element deforms the backing roller at the fusing region.
- 45 10. Apparatus according to any of the preceding claims wherein said fuser element comprises a cylinder hav-
 ing a thickness less than 125 micrometers.
11. Apparatus according to claim 10 wherein said cylinder comprises end portions and wherein said cylinder
 is unbacked by a solid structural support between said end portions.
- 50 12. Apparatus according to claim 11 wherein said cylinder is supported by gas pressure.
13. Apparatus according to any of claims 10-12 wherein said cylinder has a thickness less than about 30 mi-
 crometers.
- 55 14. Apparatus according to claim 13 wherein said cylinder has a thickness less than about 12 micrometers.
15. A method for fusing a liquid image onto a substrate comprising:
 providing a liquid image on said substrate;

- urging a fuser element against said image on said substrate; and heating said fuser element, characterized in that said liquid image includes carrier liquid and toner particles which solvate said carrier liquid at elevated temperatures, said step of heating being operative for heating the liquid image to an elevated temperature at which said particles solvate said carrier liquid but below the melting point of the dry toner particle material such that the image adheres to the substrate.
- 5
16. A method for fusing a liquid image onto a substrate comprising:
 providing a liquid image on said substrate;
 10 urging a fuser element against said image on said substrate; and heating said fuser element, characterized in that said liquid image includes carrier liquid and toner particles which solvate said carrier liquid at elevated temperatures, wherein said fuser element has a heat capacity sufficient to heat the image to an elevated temperature at which said particles solvate said carrier liquid but below the melting point of the dry toner particle material such that the image adheres to the substrate.
- 15
17. A method according to claim 15 and including the step of cooling said fuser element subsequent to heating said liquid image to said elevated temperature such that adhesion of the image to said fuser element is less than the cohesion of the image.
- 20
18. A method according to claim 16 wherein said heat capacity is low enough to cause substantial cooling of the fuser element during fusing such that the adhesion of the image to said fuser element is less than the cohesion of the image.
- 25
19. A method according to claim 17 or claim 18 wherein said elevated temperature is at least the solvation temperature and the cooling of the fuser element cools the fuser element to a temperature below the solvation temperature.
- 30
20. A method according to claim 15 or claim 16 wherein said elevated temperature is the solvation temperature.

Patentansprüche

- 35 1. Vorrichtung zum Aufschmelzen eines Flüssigbildes auf ein Substrat, mit einer Einrichtung zum Aufbringen eines Flüssigbildes auf das Substrat, einem Aufschmelzelement, welches gegen das Bild auf dem Substrat gedrückt wird, und einer Einrichtung zum Aufheizen des Aufschmelzelements, dadurch **gekennzeichnet**, daß das Flüssigbild eine Trägerflüssigkeit und Tonerteilchen enthält, welche die Trägerflüssigkeit bei erhöhten Temperaturen solvatisieren, wobei das Aufschmelzelement und die Einrichtung zum Erhitzen so angeordnet sind, um das Flüssigbild auf eine erhöhte Temperatur zu erhitzen, bei welcher die Teilchen die Trägerflüssigkeit solvatisieren, die jedoch unter dem Schmelzpunkt des trockenen Tonerteilchenmaterials liegt, derart, daß das Bild an dem Substrat anhaftet.
- 40
- 45 2. Vorrichtung zum Aufschmelzen eines Flüssigbildes auf ein Substrat, mit einer Einrichtung zum Aufbringen eines Flüssigbildes auf das Substrat, einem Aufschmelzelement, welches gegen das Bild auf dem Substrat gedrückt wird, und mit einer Einrichtung zum Aufheizen des Aufschmelzelements, dadurch **gekennzeichnet**, daß das Flüssigbild eine Trägerflüssigkeit und Tonerteilchen enthält, welche die Trägerflüssigkeit bei erhöhten Temperaturen solvatisieren, wobei das Aufschmelzelement eine Wärmekapazität hat, die ausreichend ist, um das Bild auf eine erhöhte Temperatur zu erhitzen, bei welcher die Teilchen die Trägerflüssigkeit solvatisieren, die jedoch unter dem Schmelzpunkt des trockenen Tonerteilchenmaterials liegt, derart, daß die Adhäsion des Bildes an dem Substrat verbessert wird.
- 50
- 55 3. Vorrichtung nach Anspruch 1, bei der das Aufschmelzelement und die Einrichtung zum Erhitzen dafür ausgebildet sind, um das Aufschmelzelement nachfolgend auf das Erhitzen des Flüssigbildes auf die erhöhte Temperatur derart zu kühlen, daß die Adhäsion des Bildes an dem Aufschmelzelement geringer ist als die Kohäsion des Bildes.

4. Vorrichtung nach Anspruch 2, bei der die Wärmekapazität ausreichend niedrig ist, um im wesentlichen ein Abkühlen des Aufschmelzelementes während des Aufschmelzens zu bewirken, derart, daß die Adhäsion des Bildes an dem Aufschmelzelement geringer ist als die Kohäsion des Bildes.
- 5 5. Vorrichtung nach Anspruch 3 oder Anspruch 4, bei der die erhöhte Temperatur wenigstens die Solvatisierungstemperatur ist, und bei der der Abkühlvorgang des Aufschmelzelements das Aufschmelzelement auf eine Temperatur abkühlt, die unter der Solvatisierungstemperatur liegt.
6. Vorrichtung nach irgendeinem der vorhergehenden Ansprüche, bei der die erhöhte Temperatur die Solvatisierungstemperatur ist.
- 10 7. Vorrichtung nach irgendeinem der vorhergehenden Ansprüche, bei der das Aufschmelzelement und die Einrichtung zum Erhitzen dafür ausgebildet sind, um die Viskosität des Bildes während des Aufschmelzens desselben zu erhöhen.
- 15 8. Vorrichtung nach irgendeinem der vorhergehenden Ansprüche, die folgendes enthält:
eine Abstützwalze nahe dem Aufschmelzelement, und eine Einrichtung, um das Substrat zwischen dem Aufschmelzelement und der Abstützwalze bei einer Aufschmelzzone hindurch zu leiten, wobei das Aufschmelzelement gegen die Abstützwalze gedrückt wird, um dadurch Druck auf das Bild auszuüben.
- 20 9. Vorrichtung nach Anspruch 8, bei der das Aufschmelzelement die Abstützwalze an der Aufschmelzzone deformiert.
10. Vorrichtung nach irgendeinem der vorhergehenden Ansprüche, bei der das Aufschmelzelement einen Zylinder mit einer Dicke kleiner als 125 Mikrometer aufweist.
- 25 11. Vorrichtung nach Anspruch 10, bei der der Zylinder Endabschnitte aufweist, und bei der der Zylinder durch eine feste Abstützkonstruktion zwischen den Endabschnitten unverstärkt ausgeführt ist.
12. Vorrichtung nach Anspruch 11, bei der der Zylinder durch Gasdruck abgestützt bzw. gehalten ist.
- 30 13. Vorrichtung nach irgendeinem der Ansprüche 10 bis 12, bei der der Zylinder eine Dicke aufweist, die kleiner ist als ca 30 Mikrometer.
14. Vorrichtung nach Anspruch 13, bei der der Zylinder eine Dicke aufweist, die kleiner ist als ca 12 Mikrometer.
- 35 15. Verfahren zum Aufschmelzen eines Flüssigbildes auf ein Substrat, mit den folgenden Schritten:
Aufbringen eines Flüssigbildes auf das Substrat,
Andrücken eines Aufschmelzelementes gegen das Bild auf dem Substrat, und
Erhitzen des Aufschmelzelementes,
40 dadurch **gekennzeichnet**, daß das Flüssigbild eine Trägerflüssigkeit und Tonerteilchen enthält, welche die Trägerflüssigkeit bei erhöhten Temperaturen solvatisieren, und daß der Schritt der Aufheizung dazu dient das Flüssigbild auf eine erhöhte Temperatur zu erhitzen, bei der die Teilchen die Trägerflüssigkeit solvatisieren, die jedoch unterhalb des Schmelzpunktes des trockenen Tonerteilchenmaterials liegt, derart, daß das Bild an dem Substrat anhaftet.
- 45 16. Verfahren zum Aufschmelzen eines Flüssigbildes auf ein Substrat mit den Schritten:
Aufbringen eines Flüssigbildes auf das Substrat,
Andrücken eines Aufschmelzelementes gegen das Bild auf dem Substrat, und
Erhitzen des Aufschmelzelementes,
50 dadurch **gekennzeichnet**, daß das Flüssigbild eine Trägerflüssigkeit und Tonerteilchen enthält, welche die Trägerflüssigkeit bei erhöhten Temperaturen solvatisieren, wobei das Aufschmelzelement eine Wärmekapazität besitzt, die ausreichend ist, um das Bild auf die erhöhte Temperatur zu erhitzen, bei der die Teilchen die Trägerflüssigkeit solvatisieren, jedoch unterhalb des Schmelzpunktes des trockenen Tonerteilchenmaterials liegt, derart, daß das Bild an dem Substrat anhaftet.
- 55 17. Verfahren nach Anspruch 15, mit dem Schritt einer Abkühlung des Aufschmelzelements anschließend an das Aufheizen des Flüssigbildes auf die erhöhte Temperatur, in solcher Weise, daß die Adhäsion des Bildes an dem Aufschmelzelement geringer ist als die Kohäsion des Bildes.

18. Verfahren nach Anspruch 16, bei dem die Wärmekapazität ausreichend niedrig ist, um ein wesentliches Abkühlen des Aufschmelzelementes während des Aufschmelzens zu bewirken, derart, daß die Adhäsion des Bildes an dem Aufschmelzelement geringer ist als die Kohäsion des Bildes.
- 5 19. Verfahren nach Anspruch 17 oder Anspruch 18, bei dem die erhöhte Temperatur wenigstens die Solvatisierungstemperatur ist, und bei dem das Abkühlen des Aufschmelzelements dieses Aufschmelzelement auf eine Temperatur unterhalb der Solvatisierungstemperatur abkühlt.
- 10 20. Verfahren nach Anspruch 15 oder Anspruch 16, bei dem die erhöhte Temperatur die Solvatisierungstemperatur ist.

Revendications

- 15 1. Appareil pour fixer par fusion une image liquide sur un substrat, qui comprend :
- un moyen pour fournir une image liquide sur ledit substrat,
 - un organe de fixage par fusion poussé contre ladite image placée sur le substrat, et
 - un moyen pour chauffer ledit organe de fixage,
- 20 caractérisé en ce que ladite image liquide contient un liquide porteur et des particules de toner qui solvatent ledit liquide porteur aux températures élevées, ledit organe de fixage et ledit moyen de chauffage étant conçus pour chauffer l'image liquide jusqu'à une température élevée pour laquelle lesdites particules solvatent ledit liquide porteur mais qui est inférieure au point de fusion du matériau sec des particules de toner de telle sorte que l'image adhère au substrat.
- 25 2. Appareil pour fixer par fusion une image liquide sur un substrat, qui comprend :
- un moyen pour fournir une image liquide sur ledit substrat,
 - un organe de fixage par fusion poussé contre ladite image placée sur le substrat, et
 - un moyen pour chauffer ledit organe de fixage,
- 30 caractérisé en ce que ladite image liquide contient un liquide porteur et des particules de toner qui solvatent ledit liquide porteur aux températures élevées, sachant que ledit organe de fixage a une capacité calorifique suffisante pour chauffer l'image jusqu'à une température élevée pour laquelle lesdites particules solvatent ledit liquide porteur mais qui est inférieure au point de fusion du matériau sec des particules de toner de telle sorte que l'adhérence de l'image au substrat est améliorée.
- 35 3. Appareil selon la revendication 1, dans lequel ledit organe de fixage et ledit moyen de chauffage sont conçus pour refroidir ledit organe de fixage après le chauffage de ladite image liquide à ladite température élevée de telle sorte que la force d'adhérence de l'image audit organe de fixage est moindre que la force de cohésion de l'image.
- 40 4. Appareil selon la revendication 2, dans lequel ladite capacité calorifique est suffisamment faible pour provoquer un refroidissement substantiel de l'organe de fixage pendant la fusion de telle sorte que la force d'adhérence de l'image audit organe de fixage est moindre que la force de cohésion de l'image.
- 45 5. Appareil selon la revendication 3 ou la revendication 4, dans lequel ladite température élevée est au moins égale à la température de solvatation et le refroidissement dudit organe de fixage refroidit ledit organe de fixage jusqu'à une température inférieure à la température de solvatation.
6. Appareil selon l'une quelconque des précédentes revendications, dans lequel ladite température élevée est la température de solvatation.
- 50 7. Appareil selon l'une quelconque des précédentes revendications, dans lequel ledit organe de fixage et ledit moyen de chauffage sont aptes à augmenter la viscosité de l'image pendant sa fusion.
- 55 8. Appareil selon l'une quelconque des précédentes revendications, qui comprend également :
- un rouleau d'appui adjacent à l'organe de fixage, et
 - un moyen pour faire passer le substrat entre l'organe de fixage et le rouleau d'appui au niveau d'une zone de fusion, ce qui fait que l'organe de fixage est poussé vers le rouleau d'appui pour appliquer ainsi une certaine pression à l'image.

9. Appareil selon la revendication 8, dans lequel ledit organe de fixage déforme ledit rouleau d'appui au niveau de la zone de fusion.
- 5 10. Appareil selon l'une quelconque des précédentes revendications dans lequel ledit organe de fixage est un cylindre ayant une épaisseur inférieure à 125 micromètres.
11. Appareil selon la revendication 10, dans lequel ledit cylindre comporte des parties d'extrémité et dans lequel ledit cylindre n'est pas appuyé sur un support structurel massif entre lesdites parties d'extrémité.
- 10 12. Appareil selon la revendication 11, dans lequel ledit cylindre est soutenu par une pression de gaz.
13. Appareil selon l'une quelconque des revendications 10 à 12, dans lequel ledit cylindre a une épaisseur inférieure à environ 30 micromètres.
- 15 14. Appareil selon la revendication 13, dans lequel ledit cylindre a une épaisseur inférieure à environ 12 micromètres.
- 15 15. Procédé pour fixer par fusion une image liquide sur un substrat, qui comprend les étapes consistant à :
 - fournir une image liquide sur ledit substrat,
 - pousser un organe de fixage par fusion contre ladite image placée sur ledit substrat, et
 - 20 - chauffer ledit organe de fixage,caractérisé en ce que ladite image liquide contient un liquide porteur et des particules de toner qui solvotent ledit liquide porteur aux températures élevées, ladite étape de chauffage servant à chauffer l'image liquide jusqu'à une température élevée pour laquelle lesdites particules solvotent ledit liquide porteur mais qui est inférieure au point de fusion desdites particules de telle sorte que l'image adhère au substrat.
- 25 16. Procédé pour fixer par fusion une image liquide sur un substrat, qui comprend les étapes consistant à :
 - fournir une image liquide sur ledit substrat,
 - pousser un organe de fixage par fusion contre ladite image placée sur ledit substrat, et
 - chauffer ledit organe de fixage,
 - 30 caractérisé en ce que ladite image liquide contient un liquide porteur et des particules de toner qui solvotent ledit liquide porteur aux températures élevées, sachant que ledit organe de fixage a une capacité calorifique suffisante pour chauffer l'image jusqu'à une température élevée pour laquelle lesdites particules solvotent ledit liquide porteur mais qui est inférieure au point de fusion desdites particules de telle sorte que l'adhérence de l'image au substrat est améliorée.
- 35 17. Procédé selon la revendication 15, comprenant en outre l'étape qui consiste à refroidir ledit organe de fixage après le chauffage de ladite image liquide à ladite température élevée de telle sorte que la force d'adhérence de l'image audit organe de fixage est moindre que la force de cohésion de l'image.
- 40 18. Procédé selon la revendication 16, dans lequel ladite capacité calorifique est suffisamment faible pour provoquer un refroidissement substantiel de l'organe de fixage pendant la fusion de telle sorte que la force d'adhérence de l'image audit organe de fixage est moindre que la force de cohésion de l'image.
- 45 19. Procédé selon la revendication 17 ou la revendication 18, dans lequel ladite température élevée est au moins égale à la température de solvation et le refroidissement dudit organe de fixage refroidit ledit organe de fixage jusqu'à une température inférieure à la température de solvation.
- 50 20. Procédé selon la revendication 15 ou la revendication 16, dans lequel ladite température élevée est la température de solvation.

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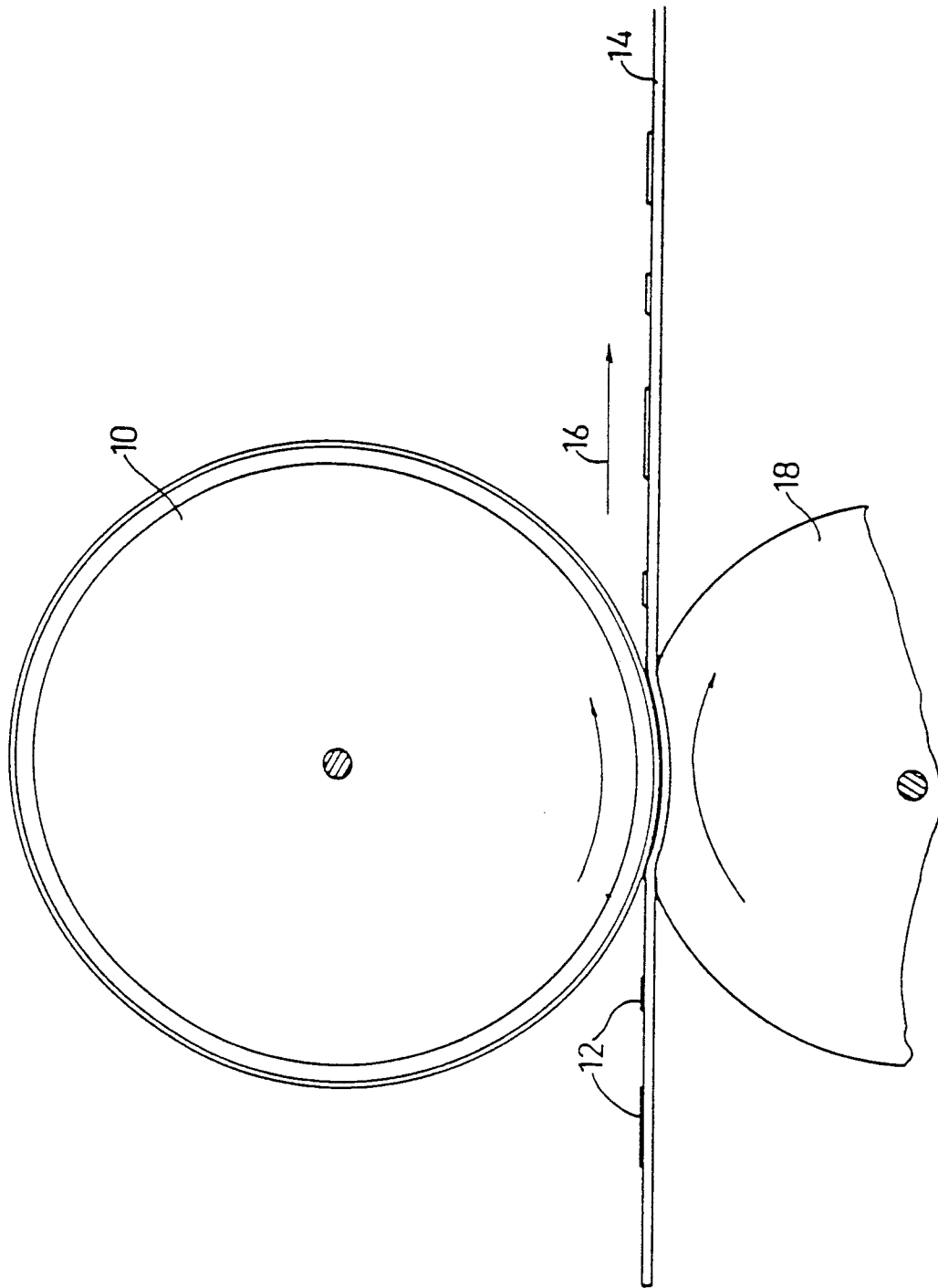


FIG. 1

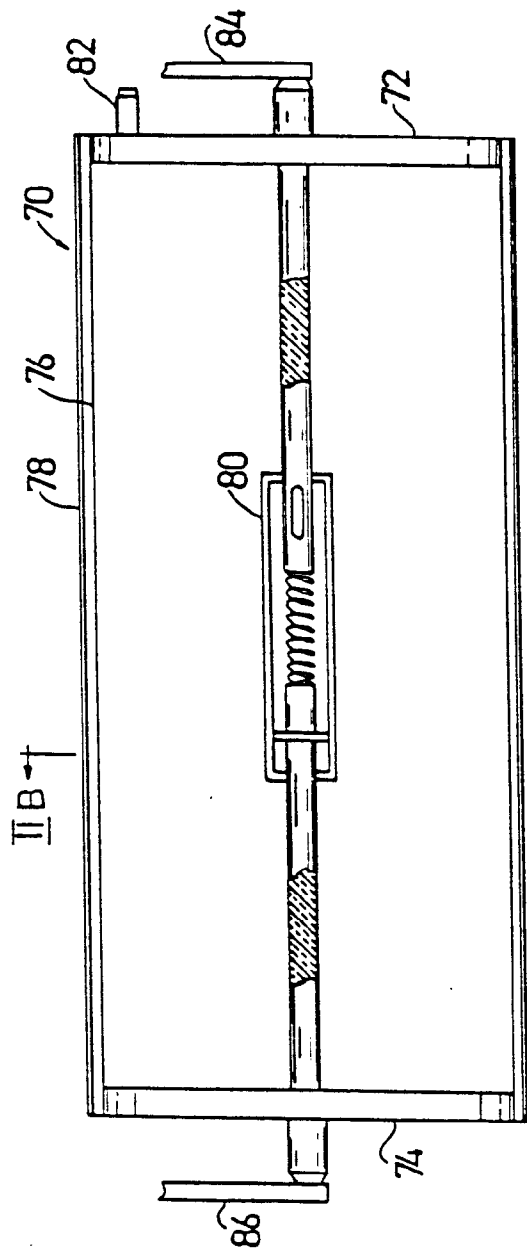


FIG. 2A II-B-II-B

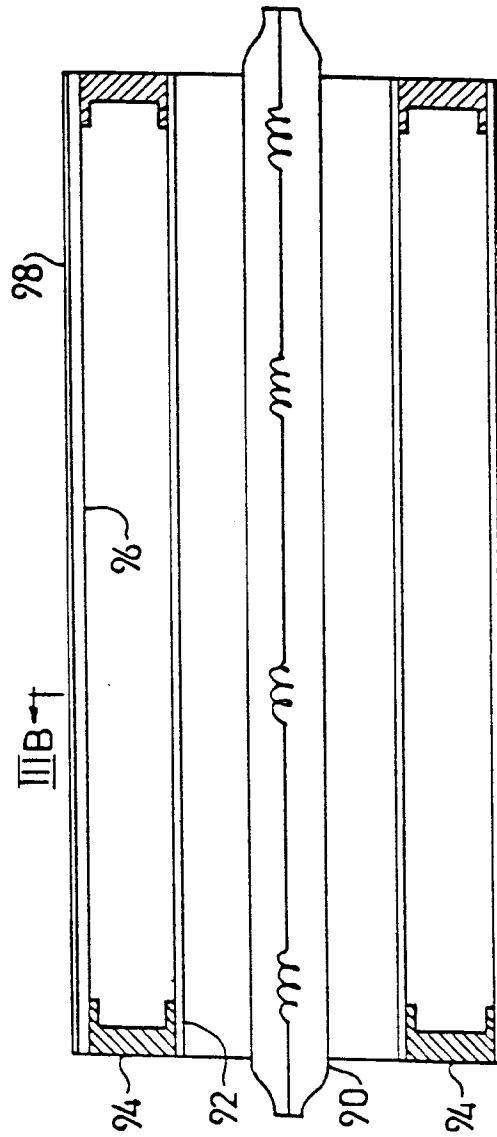


FIG. 3A III-B-III-B

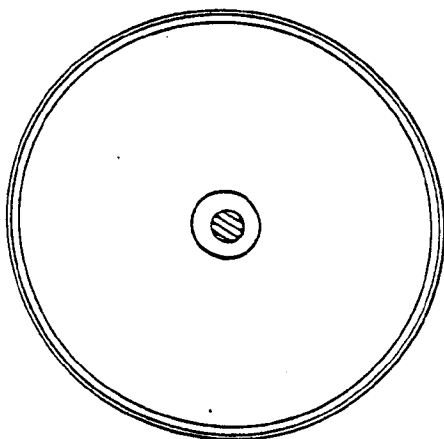


FIG. 2B

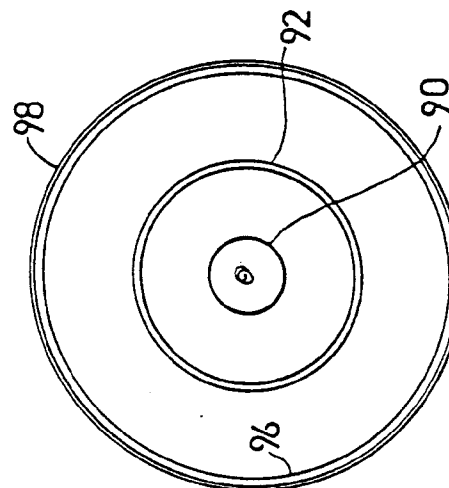


FIG. 3B

