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(54) Title: METHOD FOR REFURBISHING PRESSURE MEMBERS

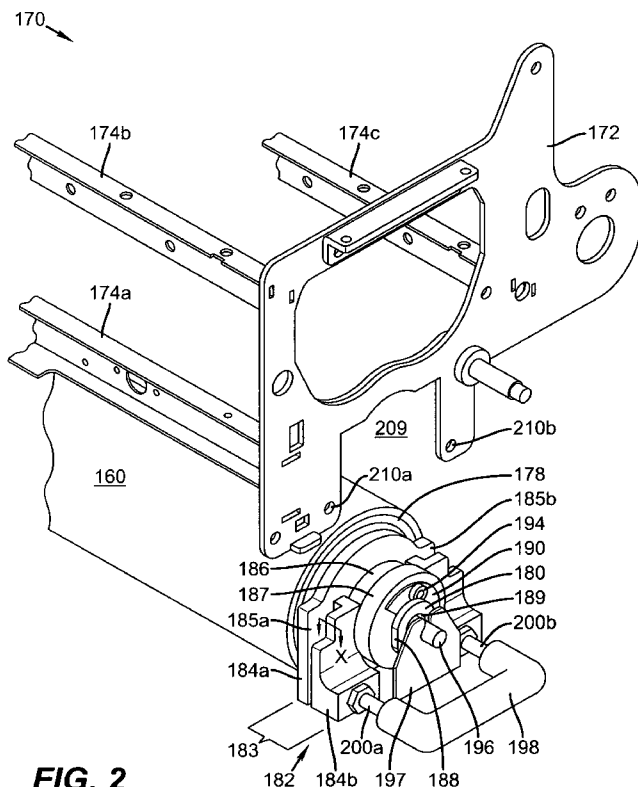


FIG. 2

(57) Abstract: The present invention provides a method of resurfacing a pressure member in a printer having a fuser member that is externally heated by a heater roller. The method includes providing a pressure member having an outer surface of a high temperature fluorothermoplastic. When it is determined that the outer surface is in need of resurfacing, the fuser member is removed from the printer, and the pressure member is mounted in the place of the fuser member. The pressure member is rotated at a speed of at least 1 rpm while engaging the outer surface of the fuser member with the heating roller normally used to heat the fuser member at a pressure of at least 5 psi at a temperature of at least 10°C below the fluorothermoplastic melting temperature for a time sufficient to resurface of the outer surface of the pressure member.



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TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
ML, MR, NE, SN, TD, TG).

— *with international search report (Art. 21(3))*

METHOD FOR REFURBISHING PRESSURE MEMBERS

FIELD OF THE INVENTION

This invention generally relates to electrostatographic devices and methods for refurbishing fuser and pressure members, and is particularly concerned with the refurbishment of a pressure roller or member which is coated with an outermost layer of fluoropolymer resin.

BACKGROUND OF THE INVENTION

The surface (or the topcoat) for both fuser and pressure members in oil-less fusing of toner material requires ultra low surface energy to release the substrate. An improved topcoat material for oil-less fusing is high-temperature tolerant thermoplastic, such as FEP, PFA, or PTFE described in US Published Applications 2007/0298252, 2007/0298251, 2007/0298217, and 2007/0296122 each of which were published on December 27, 2007.

However, the applicants have observed during fuser printing performance tests that paper edges, particularly of thick paper, can occasionally leave wear marks on the topcoat of the fuser surface. These paper edge marks can show up on wider paper as gloss-variation artifacts when subsequent prints are made on a substrate covering the worn area. Moreover, for printing special images, particularly one with in-track stripes of area of no toners, foreign materials from paper are seen to periodically accumulate on the surface of the topcoat due to the absence of toners. Such foreign materials may be, for example, the fine particulate clay or calcium carbonate fillers often present on the surface of the paper being printed. The accumulation of such foreign particulate material on the surface of the topcoat can result in undesirable artifacts, such as a gloss variation band artifact occurring when printing a different image content subsequently as a full page image.

In the past, to avoid such artifacts, the fuser members were simply replaced. To obviate the need and expense associated with completely replacing the fuser members, the applicants developed an in-line method for refurbishing fuser members in-situ which is described and claimed in commonly assigned, copending U.S. Application Serial No. 11/746,083.

The applicants have subsequently observed that paper edges, particularly of thick paper, can also leave wear marks on the topcoat of the pressure member surface, and that foreign materials from paper can also periodically accumulate on the surface of the pressure member topcoat. Consequently, undesirable image artifacts may be caused by the pressure members as well as the fuser members in electrophotographic printers. The present invention is a method for refurbishing pressure members within an electrophotographic printer that obviates the need and expense associated with completely replacing the pressure members

The practice of the proposed refurbishing scheme and the accessory surface cleaning scheme depends on the severity of the artifact present on the pressure member surface, which in turn is a function of the service history of the pressure member.

SUMMARY OF THE INVENTION

The present invention provides a method of resurfacing a pressure member having an outer surface formed from a high temperature fluorothermoplastic. When it is determined that the outer surface is in need of resurfacing, the pressure member is rotated at a speed of at least 1 rpm while engaging the outer surface of the fuser member with at least one heating roller at a pressure of at least 5 psi at a temperature of at least 10 °C below the fluorothermoplastic melting temperature for a time sufficient to resurface of the outer surface of the pressure member.

When the pressure member is in operation in an electrophotographic printer having a fuser member that is externally heated by a heater roller assembly, the method may further include the steps of replacing the fuser member with the pressure member, rotating the pressure member at the aforementioned speed via the fuser member drive, and implementing the aforementioned temperature and pressure on the outer surface of the pressure member via the heater roller assembly of the printer. To expedite the these steps of the method, both the fuser member and the pressure member may be mounted within the electrophotographic printer by a quick-release assembly that allows the

operator to quickly and easily remove the fuser and pressure members from their normal, operational positions on the frame of the printer and to install the pressure member in the operational position of the fuser member.

BRIEF DESCRIPTION OF THE DRAWINGS

5 FIG. 1 is a side, cross-sectional schematic view of an electrophotographic printer where the method of the invention may be easily implemented, including a fuser member, a heater roller assembly for externally heating the fuser member, a pressure member having substantially the same diameter as the fuser member, and quick-release assemblies for removing and
10 mounting the fuser and pressure members with respect to the printer frame.

FIG. 2 is an exploded, perspective view illustrating how a fuser or pressure roller is detachably connected to the fuser roller mounting frame via a quick-release assembly.

15 FIG. 3 is a side, partial cross-sectional view of the quick-release assembly shown in FIG. 2, illustrating in phantom how the spring-loaded locking pins are manually extended and retracted to lock and unlock a fuser or pressure roller to the mounting frame.

20 FIG. 4 is a side, cross-sectional schematic view of the electrophotographic printer of FIG. 1 illustrating how the first steps of the method of the invention are implemented by removing the fuser roller from the printer frame and mounting the pressure roller into the operational position of the fuser member.

25 FIG. 5 is a side, cross-sectional schematic view of the electrophotographic printer of FIG. 1 illustrating how the last steps of the method of the invention are implemented by using the heater roller assembly to refurbish the outer surface of the pressure roller.

For a better understanding of the present invention together with other advantages and capabilities thereof, reference is made to the following description and appended claims in connection with the preceding drawings.

DETAILED DESCRIPTION OF THE INVENTION

30 The present invention can be applied to refurbishing pressure members with thermoplastic topcoat materials, such as FEP (polyfluorinated

ethylene-propylene), PFA (perfluoroalkoxy –tetrafluoroethylene), or PTFE (polytetrafluoroethylene). The instant invention is not dependent on how the pressure member is manufactured, i.e., not affected by whether the topcoat is sleeve molded, sintered with dispersion, sprayed or transfer-coated, etc. The method of the present invention will increase the usable life of the pressure member owing to its ability to remove surface irregularities and restore a uniform gloss surface finish to the pressure member.

In all embodiments, the pressure members are preferably cylindrically symmetrical, i.e., a cross-section of the roller taken at a right angle to the roller axis anywhere along the length of the member or roller has radial symmetry around the roller axis. The length of the roller thereof determines the range of the printing width of the substrate.

FIG. 1 schematically illustrates an electrophotographic printer 100 where the method of the invention may be easily implemented, including a fuser member 110, a heater roller assembly 135 for externally heating the fuser member 110, air jets 155, 156 for simulating a thermal load on the fuser member during the warm-up up the printer 100, a pressure member 160 having substantially the same diameter as the fuser member 110, and quick-release assemblies 182 for removing and mounting the fuser and pressure members 110, 160 with respect to a printer frame 170 (shown in Figure 2). During normal operation of the printer 100, paper sheets 168 having an image formed by a pattern of dry, particulate toner are conveyed via a conveyor 169 into the nip defined between the fuser member 110 and the pressure member 160. The heat and pressure applied to the paper sheets fuses the toner into a permanent image into the paper.

The fuser member 110 includes a plurality of annular layers 112, 113, and 114 that surround a generally concentric central core 116. Core 116 is usually formed from a metal, such as stainless steel, steel, aluminum, etc. The primary requisite for the material for core 116 is that it be sufficiently stiff to support the force placed upon it during a printing operation, and able to withstand a possibly higher temperature than the surface of the member 110 where there is an optional internal heating source, such as the quartz-halogen light 117 illustrated in cross-section at the center of rotation of the member 110. For externally heated

fuser members, the internal heat source 117 can be optional, though in most practical cases, the internal heat supply is used in combination with the external heat provided by the heater roller assembly 135 to fuse the toners for print quality manipulation. The various annular layers that overlie the core 116 include a
5 resilient layer, also termed a cushion layer 113, and tie layers, adhesion promotion layers, and primer layers 114 for bonding the cushion layer with the outmost layer 112. The outmost layer 112 is a toner release layer which includes a thermoplastic fluoropolymer such as PTFE, PFA, and FEP, etc. and blends thereof. The fuser member 110 is detachably mounted to a frame 170 in the
10 printer 100 by way of a quick release mechanism 182 (indicated in phantom).

The pressure member 160 preferably has the same structure and diameter as the previously described fuser member 110, including a plurality of annular layers 162, 163, and 164 that surround a generally concentric central core 166 formed from a metal, such as stainless steel, steel, aluminum, etc. Like the
15 fuser member 110, the pressure member 160 includes an internal heat source in the form of a quartz-halogen light 167 illustrated in cross-section at the center of rotation of the member 160. The various annular layers that overlie the core 166 include a resilient layer, also termed a cushion layer 163, and tie layers, adhesion promotion layers, and primer layers 164 for bonding the cushion layer 163 with
20 the outmost layer 162. Like the fuser member 110, the outmost layer 162 of the pressure member 160 is a toner release layer which includes a thermoplastic fluoropolymer such as PTFE, PFA, and FEP, etc. and blends thereof. The pressure member 160 is likewise detachably mounted to a frame 170 in the printer 100 by way of a quick release mechanism 182 (indicated in phantom).

25 The heater rollers 140, 150 of the heater roller assembly 135 are made of rigid materials, such as chrome-plated steel. FIG. 1 also schematically shows the temperature sensors 142, 152, the over-temp devices 143, 153, the heating elements 141, 151 of the heater rollers 140, 150 and a program-controllable loading assembly C for engaging the heater rollers 140, 150 against
30 the surface of the fuser member 110 at a desired pressure both during normal printing service for externally heating the fuser member 110 to fuse printer toner, and during the pressure member 160 during the implementation of the method of

the invention. The loading assembly C may include any one of pneumatic cylinders, a motor-cam combination, a lead screw mechanism or solenoids to control engagement pressure. For this invention, the proximity of the over-temp devices 143, 153 to the topcoat 112 is adjustable and the temperature sensors 142, 5 152 are calibrated for temperature range up to around the melting point of the topcoat 162 allowing much higher temperature set points needed for pressure member surface refurbishing than those used in the normal printing. When the pressure member refurbishing program is activated, the proximity of the over-temp sensor is adjusted to be farther away from the topcoat surface 162 to a pre- 10 determined distance in the range of 0.5mm to 3mm such that it can serve its function as the fusible safety device for higher than the normal printing temperature set points. The heater roller engagement pressure, and temperature and rotational speed of the pressure member 160 then follow a programmed function which is known to best produce a refurbished pressure member surface.

15 Both the fuser member 110 and pressure member 160 can be a fuser or pressure plate, fuser or pressure roller, fuser or pressure belt or any other member on which a release coating is desirable. The support for the fuser or pressure member can be a metal element with or without additional layers adhered to the metal element. The metal element can take the shape of a cylindrical core, 20 plate or belt. The metal element can be made of, for example, aluminum, stainless steel or nickel. The surface of the metal element can be rough, but it is not necessary for the surface of the metal element to be rough to achieve good adhesion between the metal element and the layer attached to the metal element. The additional support layers adhered to the metal element consist of layers of 25 materials useful for fuser and pressure members, such as silicone rubbers, and an adhesion promoter layer to the metal element.

The fluoropolymer resin outer layer includes a fluoropolymer material, such as a semicrystalline fluoropolymer or a semicrystalline fluoropolymer composite. Such materials include polytetrafluoroethylene 30 (PTFE), polyperfluoroalkoxy-tetrafluoroethylene (PFA), polyfluorinated ethylene-propylene (FEP), poly(ethylenetetrafluoroethylene), polyvinylfluoride, polyvinylidene fluoride, poly(ethylene-chloro-trifluoroethylene),

polychlorotrifluoroethylene and mixtures of fluoropolymer resins. Some of these fluoropolymer resins are commercially available from DuPont as Teflon™ or Silverstone™ materials.

With reference now to FIGS. 2 and 3, both the fuser and the pressure member 110, 160 are detachably connected to their respective support frames by way of quick-release mechanisms 182 disposed on either side of the members. FIG. 2 specifically illustrates how the pressure member 160 may be detachably mounted in particular to the fuser mounting frame 170, since such mounting is a key step in the implementation of the method of the invention.

The fuser mounting frame 170 includes a pair of opposing side plates 172 (of which only one is shown) connected together by horizontal support members 174a, b, and c. The pressure roller 160 has a pair of opposing, disc-shaped side plates 178, each of which includes a stub shaft or gudgeon 180 extending from its center. The gudgeons 180 on either side of the pressure member 160 are rotatably mounted in the quick-release assemblies 182. As will be explained in more detail hereinafter, the quick-release assemblies 182 may be slid into and secured within a square shaped recess 209 present in each of the side plates 172 of the mounting frame 170.

Each quick-release assembly 182 includes a support frame 183 having plate-like inner and outer portions 184a, 184b which are spaced apart to define slots 185a, 185b on either side of the support frame 183. These slots 185a, 185b are dimensioned to slidably receive the side edges of the square shaped recess 209 of the fuser mounting frame 170. The support frame 183 also carries a roller bearing 186 into which the gudgeon 180 is journalled, and a drive gear 187 that is non-rotatably coupled to the gudgeon by a keyway formed by the engagement of a flat side 188 of the gudgeon against a flat side 189 in the central opening of the drive gear 187. A locking plate 190 slides into an annular groove 192 at the distal end of the gudgeon 180 to secure the quick-release assembly 182 to the gudgeon 180 in much the same fashion that a common cotter pin functions. A set screw 194 secures the locking plate 190 in place. The stem 196 of the quartz-halogen light extends from the distal end of the gudgeon 180 as shown, and is mounted on a support flange 197.

With specific reference to FIG. 3, the locking and unlocking components of each of the quick-release assemblies 182 include a handle 198 connected to a pair of spring-loaded locking pins 200a, 200b. Each of these locking pins 200a, 200b is disposed in a bore 201 in the outer portion 184b of the support frame 183 having an enlarged diameter portion 203. Each of these locking pins 200a, 200b includes an annular flange 205 that captures a compression spring 207 between itself and an opposing end of the enlarged diameter portion 203. In operation, the handle 198 is pulled out to the position indicated in phantom, which in turn withdraws the end of the pins 200a, 200b inside the bore 201. The pressure member 160 is then moved upwardly such that the edges of the side plate 172 on either side of recess 209 are slid into the slots 185a, 185b on either side of the quick-release frame 183. When the ends of the locking pins 200a, 200b are in alignment with pin receiving holes 210a, 210b, the handle 198 is then released, which allows the biasing force of the spring 207 to insert the ends of the locking pins 200a, 200b into the holes 210a, 210b in the side plate 172.

FIG. 4 schematically illustrates the first steps of a preferred implementation of the method of the invention. In this preferred implementation, the heater roller assembly 135 is first moved out of pressurized engagement with the fuser roller 110. Next, the fuser member 110 is removed from the fuser frame 170 by pulling outwardly on the handles 198 of the quick-release assemblies 182 on either side of the fuser member 110. Such pulling withdraws the locking pins 200a, 200b from the pin receiving holes 210a, 210b in the side plates 172 of the fuser frame 170, allowing the quick-release assemblies 182 to be slid out of the recesses 209. Next, the pressure member 160 is released from its support frame (not shown) and is installed in the fuser frame 170 via the spring-loaded locking pins 200a, 200b of its quick-release assemblies 182 (as indicated by the curved arrow) in the same manner as described with respect to the fuser member 110.

Once the pressure member 160 is mounted in the position indicated in FIG. 5, a set of specialized programmed schemes are executed to simultaneously heat and pressurize the thermoplastic topcoat 162 of the pressure

member 160 to a temperature at least 10 °C below the melting temperature of the outer surface topcoat material, for example, from 280 to 320 °C for PFA and PTFE materials, and at a pressure of at least 5 psi, i.e. to refurbish the topcoat material, by taking advantage of the heater rollers 140, 150 which are normally
5 used for externally heating the fuser member 110 to fuse toner during the printing operation. This set of specialized programmed schemes will automatically control the flow of the following steps at a printing press by the main machine control.

(1) Raise the temperature of the heater roller higher than that for normal printing operation such that the pressure roller surface temperature is
10 brought to at least 10 °C below the melt temperature of the topcoat materials;

(2) Set the fuser roller and the heating roller over-temperature sensors to a pre-determined distance suitable for refurbishing temperature range, other than the normal printing mode set-points;

(3) Rotate the fuser member at a rotational speed at least 1 rpm,
15 engage the heater roller with a contact pressure of at least 5 psi and up to a needed level at least 10 °C below the melt temperature of the topcoat materials;

(4) Turn on the cooling air via air jets 155, 156 to cool the pressure member at a position away from the nip of the heater rollers 140, 150 to prevent overheating of the sublayers 163, 164 and to have fast recovery to the normal
20 printing mode set-points;

(5) Engage the heater rollers 140, 150 on the pressure member surface with program-controlled functions of pressure and temperature for a period of time sufficient to refurbish the pressure member, typically a range of 1 to 3 minutes.

25 The present invention preferably is initiated after the pressure member has serviced a same print job for a period of time such that artifact may show up in a subsequent different print job, depending on the printing service requirement. Artifacts that require pressure member refurbishing include paper edge wear marks, foreign materials or paper dust from paper in the area of no
30 toner stripes and/or scratch lines due to the fabric cleaning pad applied directly to the pressure roller surface or any other mishap. The initiation of the pressure member refurbishing program can also be a part of the scheduled maintenance.

Before activating the above refurbishing scheme, it is necessary to assure clean surfaces of the pressure member 160 and heater rollers 140, 150, i.e. the pressure member surface 162 should be free of contamination, such as, residual toner or deposit of foreign materials, such as from paper. A method to clean the surfaces of the pressure member 160 as well as the heater rollers 140, 150 to precede the method of the present invention is done by non-invasive methods such as by applying soft rags with solvents.

Example

An example is given on a pressure member made of 25-micron-thick PFA (of a melting temperature 305 °C) topcoat, under which is 35-micron-thick Viton, under which is 200-mil-thick silicone rubber. The pressure member serviced for 50,000 A4-equivalent prints of Tabloid sized paper of 300-micron thick on a Nexpress 2100 printing press with external heated fuser assembly and showed de-glossing along the in-track paper edge on the topcoat. The subsequent print on a wider coated paper showed a gloss drop in G60 value by 20 points along the de-glossed edge of the pressure member. The pressure member refurbishing program was activated. After exchanging positions with the fuser member, the pressure member was refurbished at temperature around 300 to 305 °C of the external heater rollers with a programmed pressure that started from 5 psi and increased to 30 psi for about 2 minutes in line to the extent that the paper edge de-glossing was not visible on the pressure member and the subsequent print on a wider coated paper showed non-measurable difference in G60 value on the print that contacted the Tabloid-sized paper edge area of the pressure member.

CLAIMS:

1. A method of resurfacing a pressure member comprising:
providing a pressure member comprising an outer surface
5 comprising a fluorothermoplastic;
engaging the outer surface of the pressure member with at least one
heating roller at a pressure of at least 5 psi at a temperature of at least 10 °C below
the melt temperature of the fluorothermoplastic;
rotating the pressure member while engaged with the at least one
10 heating roller for a time sufficient to resurface of the outer surface of the pressure
member.
2. The method of claim 1 characterized in that the
fluorothermoplastic comprises a fluoropolymer resin selected from the group
15 consisting of polytetrafluoroethylene, polyperfluoroalkoxy-tetrafluoroethylene,
polyfluorinated ethylene-propylene, polyvinylfluoride, polyvinylidene fluoride,
poly(ethylene-chloro-trifluoroethylene), polychlorotrifluoroethylene and blends
thereof
- 20 3. The method as in one of the previous claims, wherein the
pressure member is rotated at a speed of at least 1 rpm.
4. The method as in one of the previous claims, characterized in
that the outer surface of the pressure member is cleaned prior to engaging the
25 outer surface of the fuser member with the heating roller.
5. The method as in one of the previous claims, characterized in
that the pressure member is located in a printer having a heater roller for
externally heating a fuser roller, and including the steps of removing the fuser
30 member and mounting the pressure member in the place of the fuser member.

6. The method as in one of the previous claims, characterized in that the step of engaging the outer surface of the pressure member with at least one heating roller at a pressure of at least 5 psi at a temperature of at least 10 °C below the melt temperature of the fluorothermoplastic is implemented by the heater roller for externally heating the fuser roller.

7. The method as in one of the previous claims, characterized in that the fuser member and the pressure member are detachably mounted to a frame of the printer by quick-release mechanisms, and wherein the steps of removing the fuser member and mounting the pressure member in the place of the fuser member are implemented by the operation of said quick-release mechanisms.

8. The method as in one of the previous claims, characterized in that the fuser member and the pressure member are rollers having substantially the same diameter.

9. The method as in one of the previous claims, characterized in that the composition and thickness of the fluorothermoplastic comprising the outer surface of the fuser member and the pressure member is the same.

10. A method of resurfacing a pressure member having an outer surface comprising a fluorothermoplastic and located in a printer having a heater roller for externally heating a fuser roller, comprising the steps of

removing the fuser member and mounting the pressure member in the place of the fuser member;

engaging the outer surface of the pressure member with the heater roller at a pressure of at least 5 psi at a temperature of at least 10 °C below the melt temperature of the fluorothermoplastic;

rotating the pressure member while engaged with the heating roller for a time sufficient to resurface of the outer surface of the pressure member.

11. The method as in one of the previous claims, characterized in that the fuser member and the pressure member are detachably mounted to a frame of the printer by quick-release mechanisms, and wherein the steps of
5 removing the fuser member and mounting the pressure member in the place of the fuser member are implemented by the operation of said quick-release mechanisms.

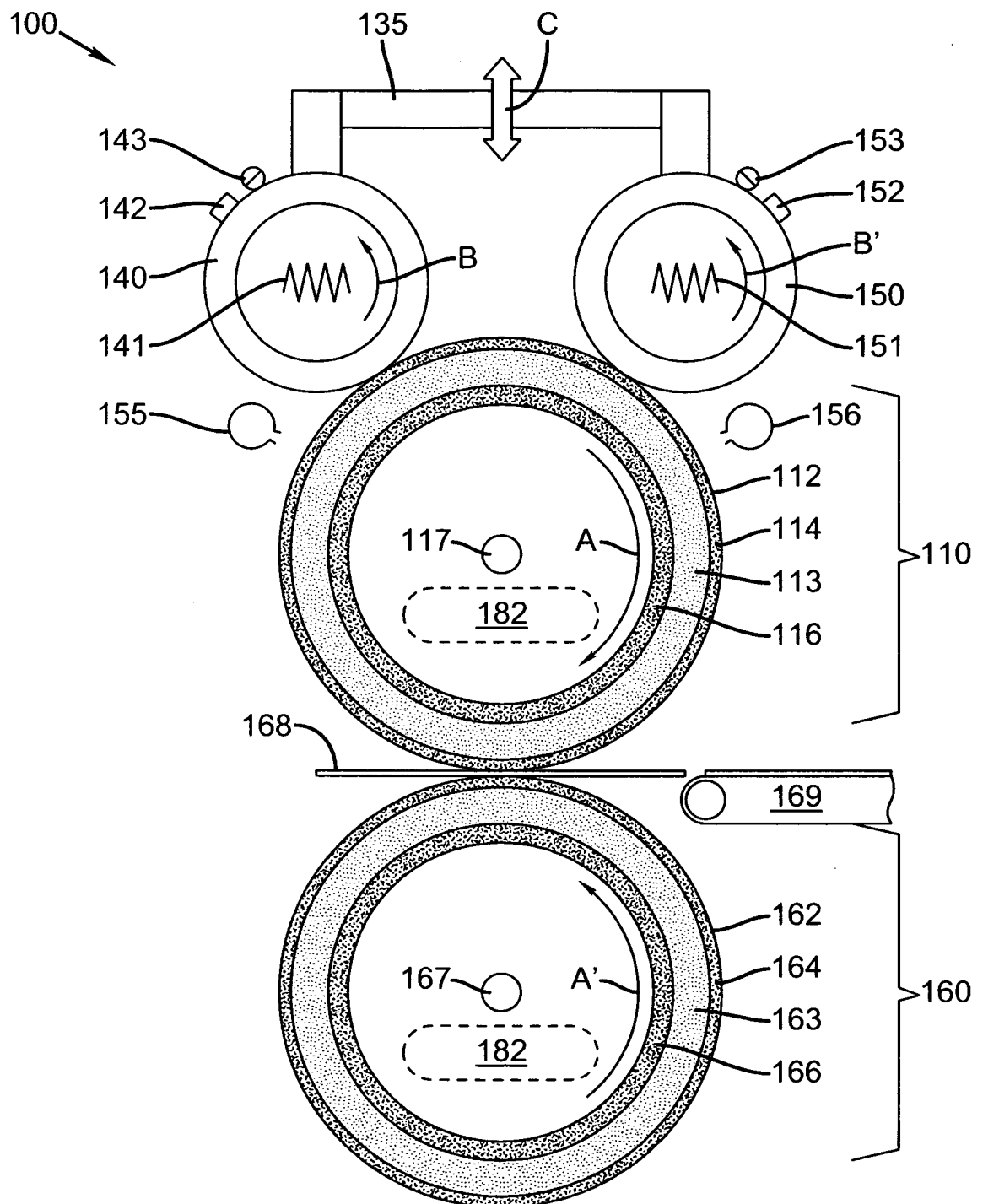
12. The method as in one of the previous claims, characterized in
10 that the quick-release mechanism of the pressure member has spring-loaded locking pins, and the printer has a fuser frame with pin-receiving holes, and the pressure member is mounted in the place of the fuser member by inserting the locking pins into the pin-receiving holes.

13. The method as in one of the previous claims, characterized in
15 that the fuser member and the pressure member are rollers having substantially the same diameter, and wherein the composition and thickness of the fluorothermoplastic comprising the outer surface of the fuser member and the pressure member is the same.

20

14. The method as in one of the previous claims, characterized in that the pressure member is rotated at a speed of at least 1 rpm.

15. The method as in one of the previous claims, characterized in
25 that the outer surface of the pressure member is cleaned prior to engaging the outer surface of the fuser member with the heating roller.

**FIG. 1**

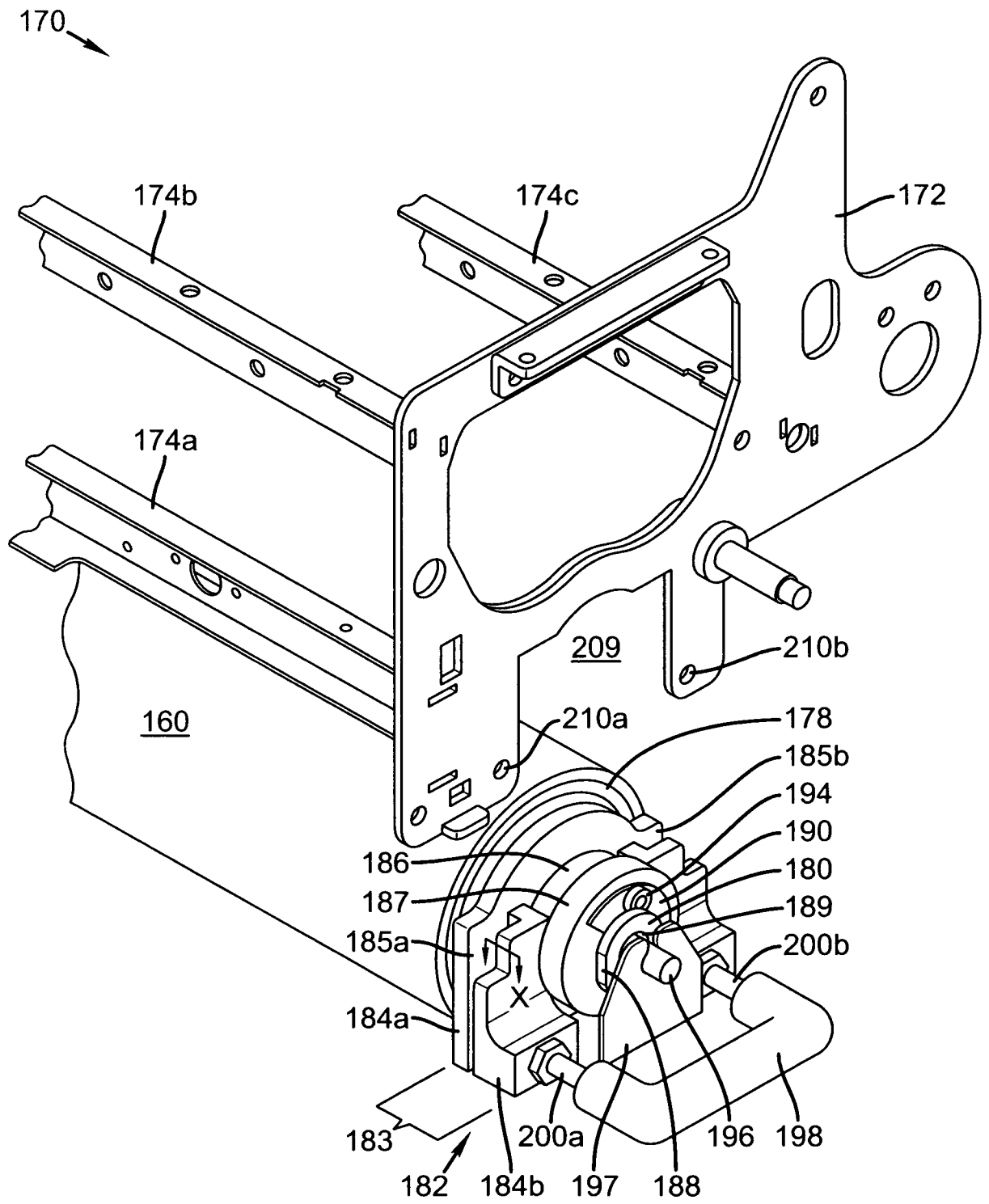


FIG. 2

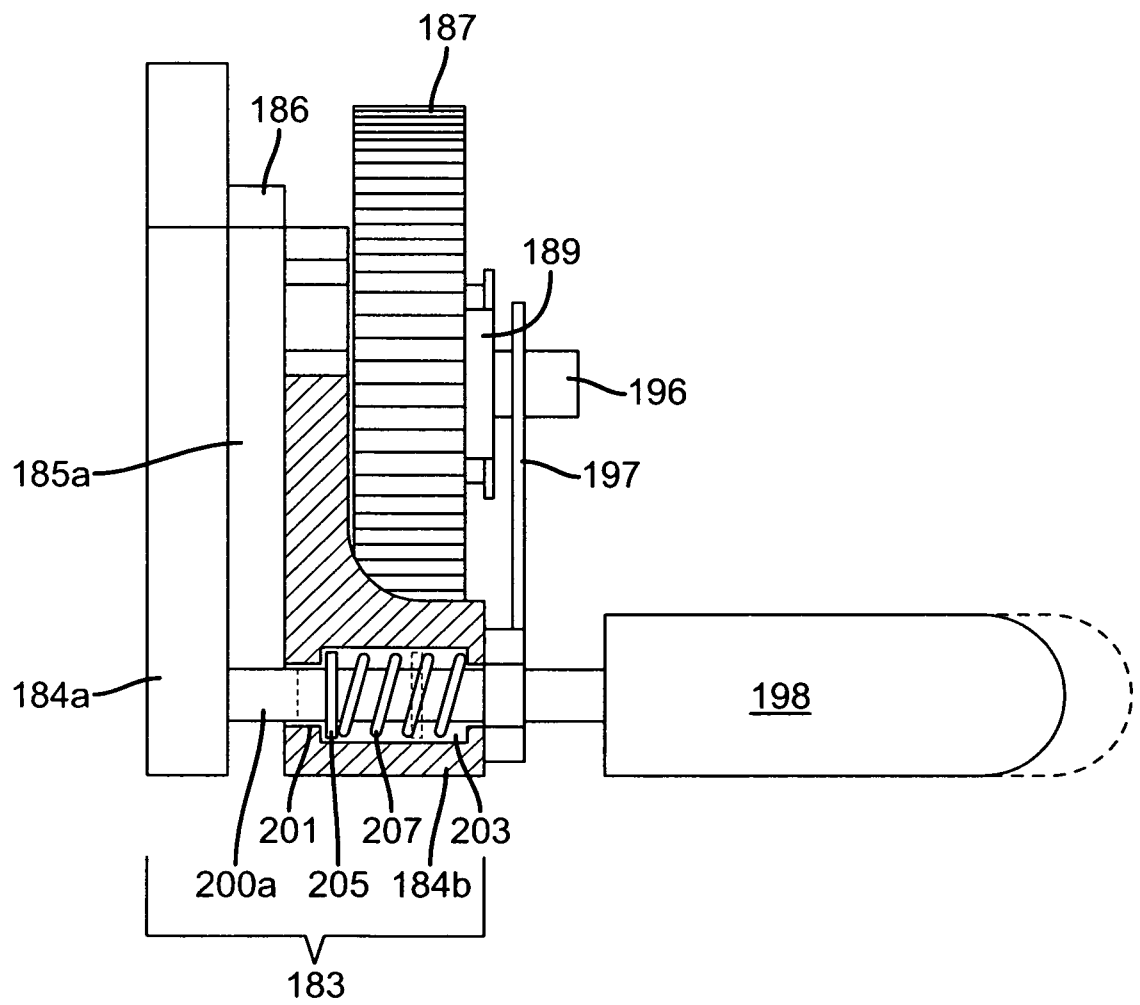
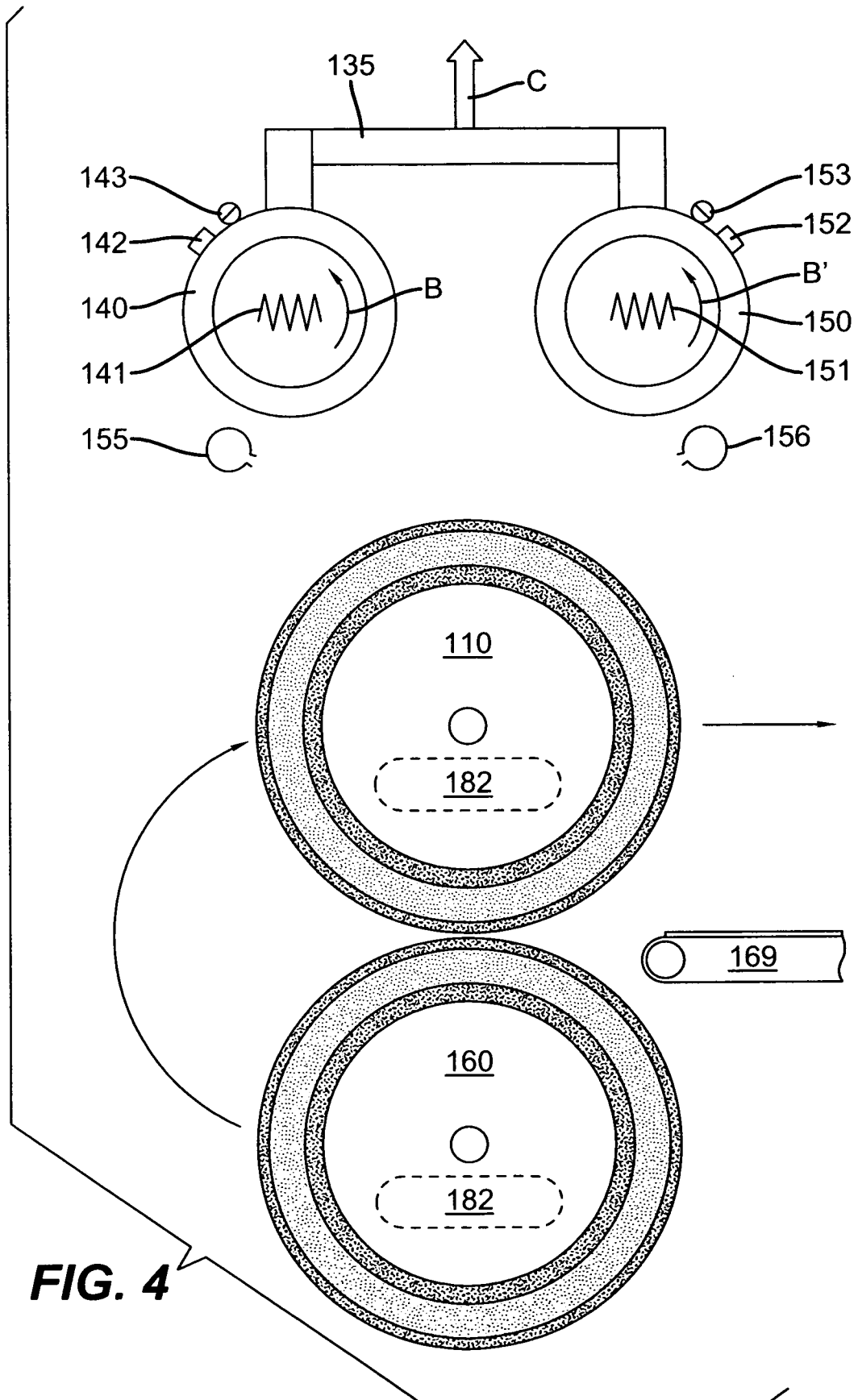


FIG. 3



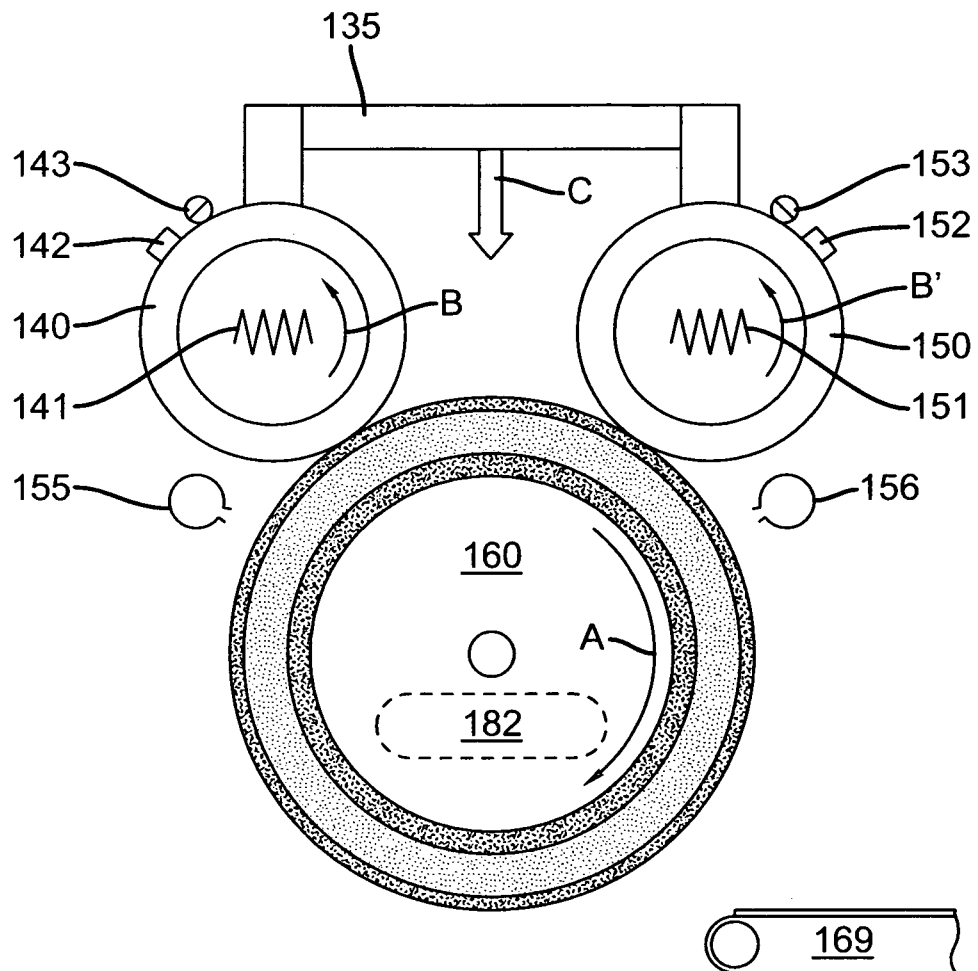


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2009/006229

A. CLASSIFICATION OF SUBJECT MATTER

INV. G03G15/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G03G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/280035 A1 (JAO SHYH-HUA E [US] ET AL) 13 November 2008 (2008-11-13) cited in the application	1-4,6,8, 9,13,14
Y	the whole document	5,10
A	-----	7,11,12
X	US 2008/279582 A1 (JAO SHYH-HUA E [US] ET AL) 13 November 2008 (2008-11-13) the whole document	1-4,6,8, 9,13-15
Y		5,10
A		7,11,12
A	US 4 050 803 A (MCCARROLL ALAN F) 27 September 1977 (1977-09-27) abstract; figures 1-7	7,11,12
A	JP 08 320626 A (TEC CORP) 3 December 1996 (1996-12-03) abstract; figures 1-5	7,11,12



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

17 February 2010

Date of mailing of the international search report

24/02/2010

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2009/006229

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