(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 676 677 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **95104966.7**

(51) Int. Cl.[6]: **G03G 15/20**

(22) Date of filing: **03.04.95**

(30) Priority: **04.04.94 JP 66215/94**

(43) Date of publication of application:
11.10.95 Bulletin 95/41

(84) Designated Contracting States:
DE FR GB

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(54) Fixing device equipped with separating means having a sheet separation function and fixing temperature detection function.

(57) A fixing device includes a fixing roller (11) having a heater (11a), a press roller (12) for pinching a sheet (P) with the fixing roller, and a separating member (22) for separating the sheet from the fixing roller after the sheet has passed between the pinching area between the two rollers. The separating member (22) has a leaf spring contacting the fixing roller to separate the sheet therefrom, and a detector (23), provided on the contact portion of the spring, for detecting the surface temperature of the fixing roller and for controlling the heater to set the surface temperature at a predetermined value.

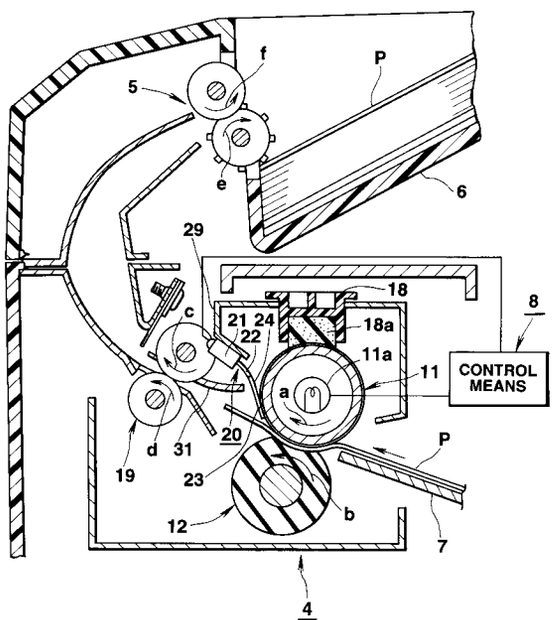

FIG.1

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The present invention relates to a fixing device which is incorporated in an image forming apparatus, such as a printer, copier and facsimile equipment all of which adopt an electrophotographic system, and is used to heat a toner image transferred from an image forming portion to a sheet in the image forming apparatus, so that the transferred toner image is fixed on the sheet, and

particularly to a fixing device which includes a moving member having an outer surface cyclically movable in a predetermined direction and a sheet pressing member pressing a sheet on the moving member so that the sheet is pinched between the pressing member and the moving member and is conveyed with the moving member, and which further includes fixing means supplied with heat energy from a heat source and is controlled surface temperature thereof to a predetermined value on the basis of a result of detection by a temperature detection element, and separating means for separating the sheet from the fixing means after the sheet have passed the pinching area between the moving member and the sheet pressing member.

FIG. 6 schematically shows a main portion of a conventional fixing device 10 incorporated in such an image forming apparatus as described above.

The conventional fixing device 10 comprises fixing means including a fixing roller 11 and a pressing roller 12 pressed on the fixing roller 11 and functioning as a pressing member. The fixing roll 11 has a heat source 11a therein and serves as a moving member having an outer surface cyclically movable in a direction of an arrow a, and the pressing roller 12, such as an elastic rubber roller, is driven by the fixing roller 11 so that the pressing roller 12 is rotated in a direction of an arrow b in FIG. 6. Further, the conventional fixing device 10 comprises a thermistor 13 serving as a temperature detecting element for detecting a surface temperature of the fixing roller 11, and controls the surface temperature of the fixing roll 11 to a predetermined temperature (for example, about 160 °C to 180 °C) via control means (not shown) and the heat source 11a on the basis of the detection by the thermistor 13. Here, the thermistor 13 is supported by a holder 14 mounted on a frame in the fixing device 10, with an elastic sponge 15 being interposed between the thermistor 13 and the holder 14, and is pressed on the circumferential surface of the fixing roller 11. The surface of the thermistor 13 pressed on the circumferential surface of the fixing roller 11 is covered with a heat-resistant tape 16 made of polyimide. A separating claw 17 makes its projecting end contact the circumferential surface of the fixing roller 11 at a position near to the pinching area in the exit side thereof, and serves as separating means for separating a sheet P from the fixing roller 11 after a toner image has been transferred from the image forming portion in the image forming apparatus. Further, the fixing device 10 includes a cleaner 18a held on a cleaner holder 18 to remove an attached material, such as disuse toner, from the circumferential surface of the fixing roller 11, a pair of conveying rollers 19 rotated in directions designated by arrows c and d to convey the sheet discharged out from the pinching area toward a sheet discharge portion. It is also known that the thermistor 13 and separating claw 17 are arranged to contact the circumferential surface of the pressing member 12.

In the conventional fixing device 10 arranged as described above, the toner image is transferred to the surface of the sheet P at the image forming portion (not shown), and the sheet P carrying the transferred and unfixed toner image is conveyed along a guide plate 7 from the image forming portion toward the pinching area between the fixing roller 11 and the pressuring roller 12 and is held at the pinching area between the pressuring roller 12 and the fixing roller 11 temperature of which is controlled by the thermistor 13 and the control means, so that the toner image is fixed to the sheet P by heat applied by the fixing roller 11 and pressure applied from the pressing roller 12 while the sheet P is conveyed by the fixing roller 11 and the pressing roller 12. The sheet P on which the toner image has been fixed is separated by the separating claw 17 from the circumferential surface of the fixing roller 11 or that of the pressuring roller 12, and is conveyed by the paired conveying rollers 19 toward the sheet discharge portion (not shown).

Since the separating claw 17 and the thermistor 13 are provided respectively as separate component members around the fixing means (that is, the fixing roller 11 in FIG. 6) in the above described conventional fixing device 10, the number of the component parts of the conventional fixing device 10 is large thereby requiring lots of time for assembling the component parts of the large number. Further, members for supporting the thermistor 13, such as the holder 14 and the elastic sponge 15, are also required as separate component parts. This makes the structure and manufacturing cost of the conventional fixing device 10 being complex and high.

Further, the conventional fixing device 10 needs urging means for pressing the separating claw 17 on the circumferential surface of the fixing roller 11 the temperature of which is maintained at a high value such as about 160 °C to 180 °C as described above, and the separating claw 17 must be made of a high-temperarure-resistant material which is higher in cost than a material used for molding a common molding member.

The present invention is derived from the about described circumstances, and an object of the present invention is to provide a fixing device which can reduce the number of the component parts, be manufactured at low costs, and be readily assembled.

In order to achieve the above-mentioned object of the present invention, there is provided a fixing device comprising:

fixing means including a moving member having an outer surface cyclically movable in a predetermined direction, a sheet pressing member for pressing a sheet carrying an unfixed toner image transferred thereon in an image forming apparatus, onto the moving member and for pinching the sheet along with the moving member to convey the sheet, and a heat source for applying heat energy to the unfixed toner image on the sheet pinched between the moving member and the pressing member so that the toner image is fixed on the sheet;

a temperature detection element for detecting a surface temperature of the fixing means;

control means for controlling, based on the surface temperature detected by the temperature detection element, the heat energy applied to the fixing means by the heat source to set the surface temperature of the fixing means at a predetermined value; and

separating means, pressed on the surface of the fixing means, for separating the sheet which has been passed between the moving member and the pressing member in the fixing means, from the fixing means, wherein

the temperature detection element is mounted on a contact portion of the separating means being in contact with the outer surface of the fixing means whereby the separating means has both a separating function by which the sheet is separated from the fixing means so as to prevent the sheet from sticking to and moving along with the fixing means after the sheet has been passed between the moving member and the pressing member and the unfixed toner image has been fixed on the sheet, and a temperature detection function for making the temperature detection element detect the surface temperature of the fixing means and outputting a detected surface temperature to the control means.

Here, it is preferable that the heat source is provided in the inside of the moving member to apply the heat energy to the moving member, the moving member is a fixing roller, and the pressing member is structured by a pressing roller contacted with the fixing roller and rotated by the fixing roller.

Further, it is preferable that the separating means is so arranged as to correspond to a substantial center position of a sheet having the smallest width among sheets used in the image forming apparatus, in a width direction perpendicular to the conveying direction of the sheet in the fixing device. And it is also possible that the separating means is a leaf spring, and supporting means is further provided which supports one end of the leaf spring and makes a free end of the leaf spring contact the outer surface of the fixing means.

The fixing device of this invention can further comprises separation assisting means, provided in a position spaced apart from the outer surface of the fixing means, for assisting separation of the sheet from the fixing means by the separating means. Here, it is preferable that the separation assisting means is arranged in a downstream side of the separating means in an imaginary moving direction in which the sheet is moved if the sheet is attached on the outer surface of the fixing means. It is particularly preferable that the separation assisting means is provided on both sides of the separating means in a width direction of the sheet.

In the fixing device according to this invention and characterized by being structured as described above, the temperature detection element is provided in the contact portion of the separating means at which the separating means contacts the fixing means. In consequence of this, the surface temperature of the fixing means is controlled to a predetermined temperature value on the basis of the temperature detection by the temperature detection element provided in the contact portion of the separating means, and the sheet on which the toner image has been fixed is separated from the fixing means by the separating means. As seen from the above, since the separating means has both the sheet separating function and the temperature detection function, and it is not necessary to separately provided any extra member for supporting the temperature detection element, the fixing device of this invention can reduce the number of the component parts so that the assembling time and the manufacturing cost can be reduced.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a longitudinal cross-sectional view showing a fixing device according to one embodiment of the present invention, and its neighborhood in an image forming apparatus;

FIG. 2A is a side view showing a detailed structure of a film thermistor member 20 used in the fixing device of FIG. 1;

FIG. 2B is a front view showing the film thermistor member 20 in FIG. 2A;

FIG. 3 is a longitudinal sectional view schematically showing a whole of the image forming

apparatus in which the fixing device of FIG. 1 is incorporated;

FIG. 4 is a cross-sectional view, as taken along line IV-IV in FIG. 5, showing a fixing device according to another embodiment of the present invention, and its neighborhood, in an image forming apparatus;

FIG. 5 is a front view showing the fixing device of FIG. 4 as viewed from a downstream side in a sheet conveying direction, and showing a positional relation ship between a film thermistor member 20 and claw members 30; and

FIG. 6 is a longitudinal cross-sectional view showing a conventional fixing device and its neighborhood in a conventional image forming apparatus.

In the following descriptions, one and another embodiment of the present invention will be explained with reference to FIGS. 1 to 5 of the accompanying drawings.

FIGS. 1 to 3 show one embodiment of the present invention, FIG. 1 is a longitudinal cross-sectional view showing a fixing device and its neighborhood, FIGS. 2A and 2B are a side view and a front view, respectively, showing a detail structure of a film thermistor member 20 used in the embodiment, and FIG. 3 is a longitudinal cross-sectional view schematically showing an image forming apparatus in which the fixing device of FIG. 1 is incorporated.

As shown in FIG. 3, the fixing device 4 according to one embodiment of this invention is incorporated in the image forming apparatus (here, a printing apparatus). This image forming apparatus comprises: a sheet supply cassette 1 for storing sheets P in a stacked way; a sheet supply roller 2 for supplying the sheets P one by one from the sheet supply cassette 1; an image forming portion 3 for forming a toner image on the sheet P which is supplied from the sheet supply roller 2, on the basis of image information supplied to the image forming portion 3; a guide plate 7 for guiding the movement of the sheet P discharged from the image forming portion 3 after the toner image has been formed on the sheet P; a fixing device 4 provided on an extending end of the guide plate 7, for fixing the toner image to the sheet P; a pair of discharge rollers 5 for discharging the sheet P on which the toner image has been fixed, out of the image forming apparatus (one of the discharge rollers 5 being rotated in a direction of an arrow e and the other in a direction of an arrow f in FIG. 3), a sheet discharge tray 6 for receiving the sheet discharged out from the image forming apparatus, and so on. The image forming portion 3 includes a photosensitive drum 3a rotated in a direction of an arrow g, and a charger 3b, an optical write head 3c, a developing unit 3d, a transfer unit 3e, a cleaner 3f, etc., all of which are sequentially arranged around the photosensitive drum 3a in a rotational direction of the photosensitive drum 3a.

As shown in FIG. 1, the fixing device 4 includes a fixing roller 11 having a heat source 11a, such as a halogen lamp, arranged inside thereof, and having a surface heated by heat energy produced from the heat source 11a and the fixing roller 11 serving as a moving member, and a pressing roller 12 formed of an elastic roller, such as a silicon rubber roller pressed on the fixing roller 11 with a predetermined pressure force and the pressing roller 12 serving as a pressing member. Further, the fixing device 4 includes a cleaner 18a held by a cleaner holder 18 and removing a matter deposited on the circumferential surface of the fixing roller 11. Such structure of the fixing device 4 as described above is the same as that of the conventional fixing apparatus 10 as shown in FIG. 6.

In the specific structure of the present embodiment, the film thermistor member 20 is provided to make its one end contact the circumferential surface of the fixing roller 11 at a sheet exit-side of the pinching area between the fixing roller 11 and the pressing roller 12, and serves both as a separating claw acting as a separating means and as a thermistor acting as a temperature detection element. Here, the film thermistor member 20 is so arranged as to correspond to a substantial center position of a sheet p having the smallest width among sheets used in the image forming apparatus, in a width direction perpendicular to the conveying direction of the sheet in the fixing device 4. In the image forming apparatus in which the fixing device 4 of this embodiment is incorporated, sheets having different widths are so supplied and conveyed with their centers being arranged on one line. However, the fixing device 4 of the present invention can of course be applied to an image forming apparatus in which sheets P having various widths are supplied and conveyed with one of side edge of each of the sheets P being arranged on one line. Even in this case, the film thermistor member 20 are so arranged as to correspond to a substantial center position of a sheet p having the smallest width among sheets used in the image forming apparatus, in the width direction of the sheet P.

As shown in more detail in FIGS. 2A and 2B, the film thermistor member 20 has a leaf spring 22 supported at its one end portion by a holder 21 made of a heat resistant-resin and serving as support means, and a bead-like thermistor 23 provided at a free end of the leaf spring 22 and serving as a temperature detecting element. In this embodiment, the leaf spring 22 is made of such as a thin stainless steel sheet having a thickness of about

100 μm to 200 μm. Both the thermistor 23 and the leaf spring 22 are sandwiched between a polyimide tape 24 and a terefluoroethylene tape 25. Here, the polyimide tape 24 having heat-resistant nature is arranged on a side on which it directly contact the thermistor 23, and the surface of the polyimide tape 24 provides a heat-sensitive surface which contacts the circumferential surface of the fixing roller 11. Further, the thermistor 23 is electrically connected to control means 8 (FIG. 1) through a conductive line 26 extending from the surface of the leaf spring 22 into the interior of the holder 21 and a conductive line 27 extending from the conductive line 26 toward an outside of the holder 21, a connecting portion between the conductive line 26 and the conductive line 27 is covered with a silicone rubber 28.

In the film thermistor member 20 being structured as described above, the holder 21 is fixed to a top cover 29 of the fixing device 4, and the leaf spring 22 presses its free end on which the thermistor 23 is arranged, through the polyimide tape 24 with a proper pressure on the circumferential surface of the fixing roller 11 at the exit side of the pinching area between the fixing roller 11 and the pressing roller 12. The fixing of the holder 21 to the top cover 29 is achieved by, as shown in FIGS. 2A and 2B, engaging an engaging pin 21a projected from the holder 21 into a hole 29a formed in the top cover 29, and by tightening a screw 21c inserted into a hole 21b formed in the holder 21 and screwed into the top cover 29. In the film thermistor member 20 fixed at a predetermined position on the top cover 29, the leaf spring 22 functions as separating means for separating the sheet on which the toner image has been fixed, from the fixing roller 11, and the thermistor 23 functions as a temperature detection element. And, the control means 8 controls the surface temperature of the fixing roller 11 through the heat source 11a on the basis of the detection by the thermistor 23 so as to set the surface temperature to a predetermined temperature level (for example, about 160 °C to 180 °C). The film thermistor member 20 can fully achieve its sheet separating function because it is so arranged as to correspond to the substantial center position of the sheet having the smallest width among sheets used in the image forming apparatus, in the width direction perpendicular to the conveying direction of the sheet. The minimal condition under which the film thermistor member 20 exhibits its separating function is that the leaf spring 22 of the film thermistor member 20 can contact the sheet conveyed in the image fixing apparatus at any position in the width direction of the sheet.

According to the present embodiment, the film thermistor member 20 is comprised of a simple component part, functions both as the separating means (leaf spring 22) and the temperature detection element (thermistor 23), and further is not necessary to provide any independent members for supporting the thermistor 23 (that is, those members, such as the holder 14 and the elastic sponge 15 as shown in FIG. 6). Since the separating means is pressed on the fixing roller 11 with an elastic force of the leaf spring 22, there is no need to provide any extra urging member, such as the separating claw 17 as shown in FIG. 6. This requires less component parts than a conventional fixing device. It is, therefore, possible to assemble a whole of the device at lower cost in a shorter period of time in comparison with the conventional fixing device. Further, the structure of the film thermistor member 20 can be made lower in cost than a conventional combined structure of the thermistor 13 and supporting members 14, 15.

In the above-mentioned embodiment, the separation of the sheet P from the fixing roller 11 is achieved by the film thermistor member 20 only, but an extra separation assisting means may be used together with the film thermistor member 20 of FIG. 1 to more ensure separation of the sheet P from the fixing roller 11.

FIG. 4 is a longitudinal cross-sectional view showing a fixing device according to another embodiment and its neighborhood, the fixing device and the neighborhood being incorporated into an image forming apparatus with the separation assisting means mounted therein. FIG. 5 is a front view showing the fixing device of FIG. 4 from a downstream side in a sheet conveying direction. In FIG. 5, positional relationship between the film thermistor member 20 and a pair of claw members 30 which serving as the separation assisting means. FIG. 4 is a cross-sectional view as taken along line IV-IV in FIG. 5.

As shown in FIGS. 4 and 5, in the fixing device 9 of this embodiment, in addition to the structure shown in FIG. 1, claw members 30 each of which is a normal molding member are arranged at a plurality of places (preferably on both sides of the film thermistor member 20 in FIG. 5) different from the place in which the film thermistor member 20 is arranged, in a longitudinal direction of the top cover 29, that is, in an axial direction of the fixing roller 11 and the pressing roller 12. These claw members 30 assist the separation of the sheet P from the fixing roller 11 by the leaf spring 22 of the thermistor member 20 serving as the separation means.

These claw members 30 are different from the conventional separation claw 17 shown in FIG. 6, and forward ends 30a of the claw members 30 are spaced by a small distance d ($\neq 0$) away from the circumferential surface of the fixing roller 11. Fur-

ther, as shown in FIG. 5, the forward ends 30a of the claw members 30 are arranged at places spaced by a distance T (≧ 0) from the free end (that is, contacting portion to the fixing roller 11) of the film thermistor member 20 in the down stream side in the rotational direction of the fixing roller 11.

As shown in FIG. 5, these claw members 30 are so arranged on both sides of the film thermistor member 20 as to be situated preferably in a region corresponding to the smallest width S of a sheet among the sheets used in the image forming apparatus. In FIG. 5, "L" shows a maximum width of a sheet among the sheets used in the image forming apparatus.

These claw members 30 separate surely both the sides of the sheet to which it is hard to affect the separating function of the film thermistor member 20, so that the sheet can be prevented from being conveyed along with the fixing roller 11 with both side portions of the sheet sticking to the fixing roller 11.

In the fixing device 9 structured as described above, the sheet on the surface of which a toner image has been formed but not unfixed by the image forming portion 3 (FIG. 3), is pinched between the fixing roller 11 (the temperature of the fixing roller 11 is controlled on a basis of a temperature detection by the thermistor 23 at the free end of the leaf spring 22) and the pressing roller 12, and is conveyed so that the toner image on the sheet is heated and is fixed on the sheet. The sheet on which the toner image has been fixed is separated surely from the circumferential surface of the fixing roller 11 by the leaf spring 22 serving as the separation means and by the claw members 30 serving as the separation assisting means, and then is conveyed by the paired conveying rollers 19 toward the sheet discharge tray 6.

In this embodiment, each of the claw members 30 serving as the separation assisting means to ensure the sheet separating function has substantially the same shape as that of the conventional separating claw 17 in FIG. 6, but the claw members 30 are not in direct contact with the fixing roller 11 as described above. Therefore, the claw member 30 does not need to employ an expensive high temperature-resistant material used for the conventional separation claw 17. Since an inexpensive molding material can be used for the claw members 30, the manufacturing cost of the claw members 30 can be lowered by that extent. Since the number of the claw members 30 to be fixed on the top cover 29 is determined to 2 to 4 in accordance with the size, etc., of a sheet used in the image forming apparatus, assembly of the separation assisting means can be readily achieved for a short period of time.

In the above-mentioned embodiment, the claw member 30 as an independent member is used as the separation assisting means, but the top cover 29 or the guide plate 31 can be used as the separation assisting means by extending its forward end toward a position near to the circumferential surface of the fixing roller 11.

Although, in the embodiments shown in FIGS. 1 to 5, the cleaner 18 is used for removing matter deposited on the circumferential surface of the fixing roller 11 after the toner image has been transferred from the circumferential surface of the fixing roller 11 to the sheet P, and the paired conveying rollers 19 are used for assisting conveyance of the sheet from the fixing roller 11 toward the sheet discharge tray 6, but these cleaner 18 and paired conveying rollers 19 can be omitted.

In the above described respective embodiments the fixing means including a combination of the fixing roller 11 with the pressing roll 12, but the combination of the moving member having the circlically movable surface with the pressing member is not restricted to a pair of rollers. For example, the moving member can be so structured as to wind an endless belt on a plurality of rollers, and the pressing member can be structured by a fixed type guide.

In the above-mentioned embodiments the heat source 11a is provided in the inside of the moving member (fixing roller 11), but the heat source 11a may be provided on an outside of the moving member or either an inside or an outside of the pressing member.

Needless to say, according to the purpose of the present invention, the separating means may be provided not only on the moving member side but also on the pressing member side.

Further, the above described structure of the film thermistor member 20 is one example and is not restricted thereto. Any other structures can be used so long as the separating means is equipped with a temperature detection element at the contacting portion which contact the fixing means and can perform both the separating function and the temperature detection function.

According to the present invention as described above, the separating means and temperature detection element are incorporated in one member and it is not necessary to provide any independent member for supporting the temperature detection element. It is, therefore, the number of the component parts can be reduced so that the assembling time and the manufacturing cast of the whole of the image forming apparatus can be reduced.

Claims

1. A fixing device (4) comprising:

fixing means including a moving member (11) having an outer surface cyclically movable in a predetermined direction, a sheet pressing member (12) for pressing a sheet (P) carrying an unfixed toner image transferred thereon in an image forming apparatus, onto the moving member (11) and for pinching the sheet (P) along with the moving member (11) to convey the sheet (P), and a heat source (11a) for applying heat energy to the unfixed toner image on the sheet (P) pinched between the moving member (11) and the pressing member (12) so that the toner image is fixed on the sheet (P);

a temperature detection element (23) for detecting a surface temperature of the fixing means (11);

control means (8) for controlling, based on a surface temperature detected by the temperature detection element (23), the heat energy applied to the fixing means (11) by the heat source (11a) to set the surface temperature of the fixing means at a predetermined level; and

separating means (22), pressed on the surface of the fixing means, for separating the sheet (P) which has been passed between the moving member (11) and the pressing member (12) in the fixing means, from the fixing means, characterized in that

the temperature detection element (23) is mounted on a contact portion of the separating means (22) being in contact with the outer surface of the fixing means whereby the separating means (22) has both a separating function by which the sheet (P) is separated from the fixing means so as to prevent the sheet (P) from sticking to and moving along the fixing means after the sheet (P) has been passed between the moving member (11) and the pressing member (12) and the unfixed toner image has been fixed on the sheet (P), and a temperature detection function for making the temperature detection element (23) detect the surface temperature of the fixing means and outputting the detected surface temperature to the control means (8).

2. A fixing device according to claim 1, characterized in that the heat source (11a) is provided in the inside of the moving member (11) to apply the heat energy to the moving member (11).

3. A fixing device according to claim 2, characterized in that the moving member (11) is a fixing roller.

4. A fixing device according to claim 3, characterized in that the pressing member (12) is structured by a pressing roller being in contact with the fixing roller (11) and rotated by the fixing roller (11).

5. A fixing device according to claim 1, characterized in that the separating means (22) contacts an outer surface of the moving member (11).

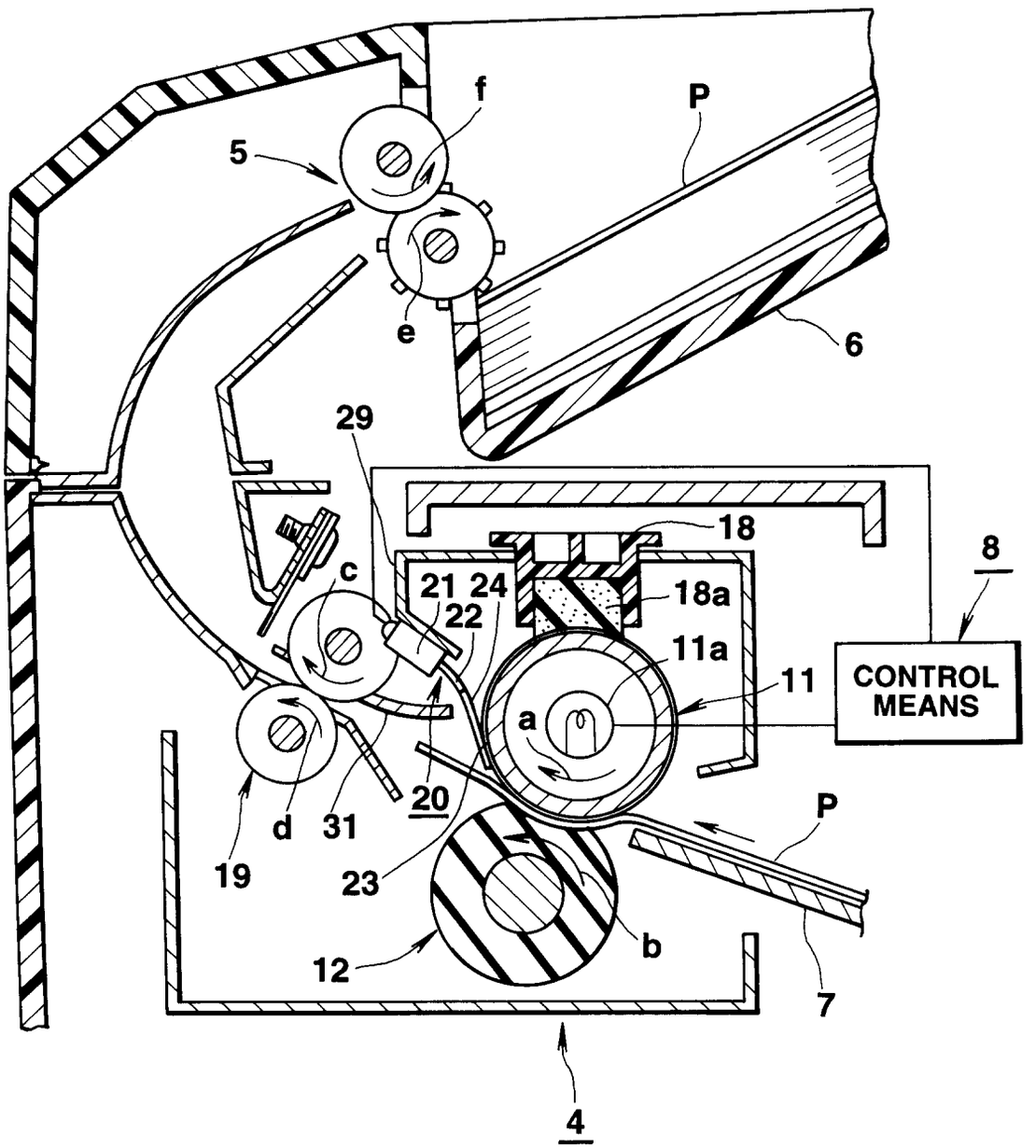
6. A fixing device according to claim 1, characterized in that the separating means (22) is so arranged as to correspond to a substantial center position of a sheet (P) having the smallest width among sheets used in the image forming apparatus, in a width direction perpendicular to the conveying direction of the sheet (P) in the fixing device (4).

7. A fixing device according to claim 1, characterized in that the separating means (22) is a leaf spring, and characterized by further comprising support means (21) which supports one end of the leaf spring (22) and makes a free end of the leaf spring (22) contact the outer surface of the fixing means.

8. A fixing device according to claim 1, characterized by further comprising separation assisting means (30), provided in a position spaced apart from the outer surface of the fixing means, for assisting separation of the sheet (P) from the fixing means by the separating means (22).

9. A fixing device according to claim 8, characterized in that the separation assisting means (30) is arranged in a downstream side of the separating means (22) in an imaginary moving direction in which the sheet (P) is moved if the sheet (P) is attached on the outer surface of the fixing means.

10. A fixing device according to claim 8, characterized in that the separation assisting means (30) is provided on both sides of the separating means (22) in a width direction of the sheet (P).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CONTROL MEANS
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FIG.1

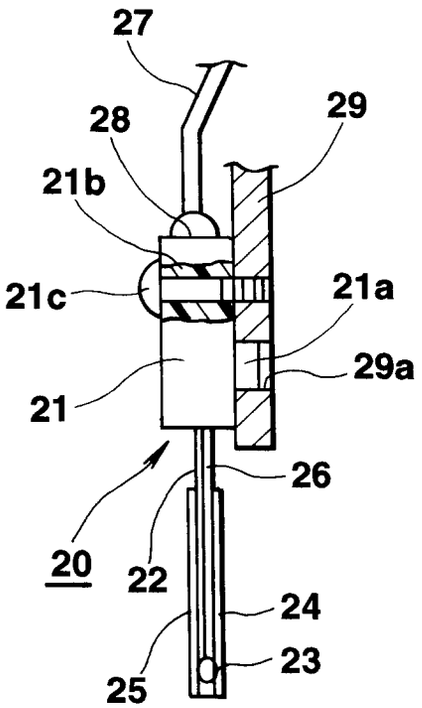
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FIG.2A

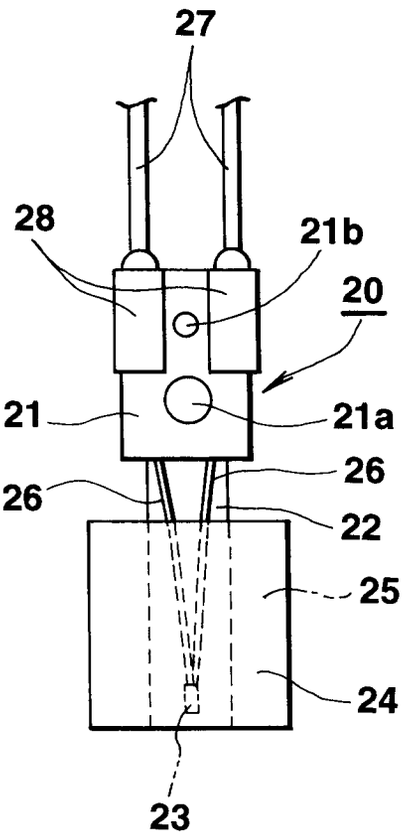
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FIG.2B

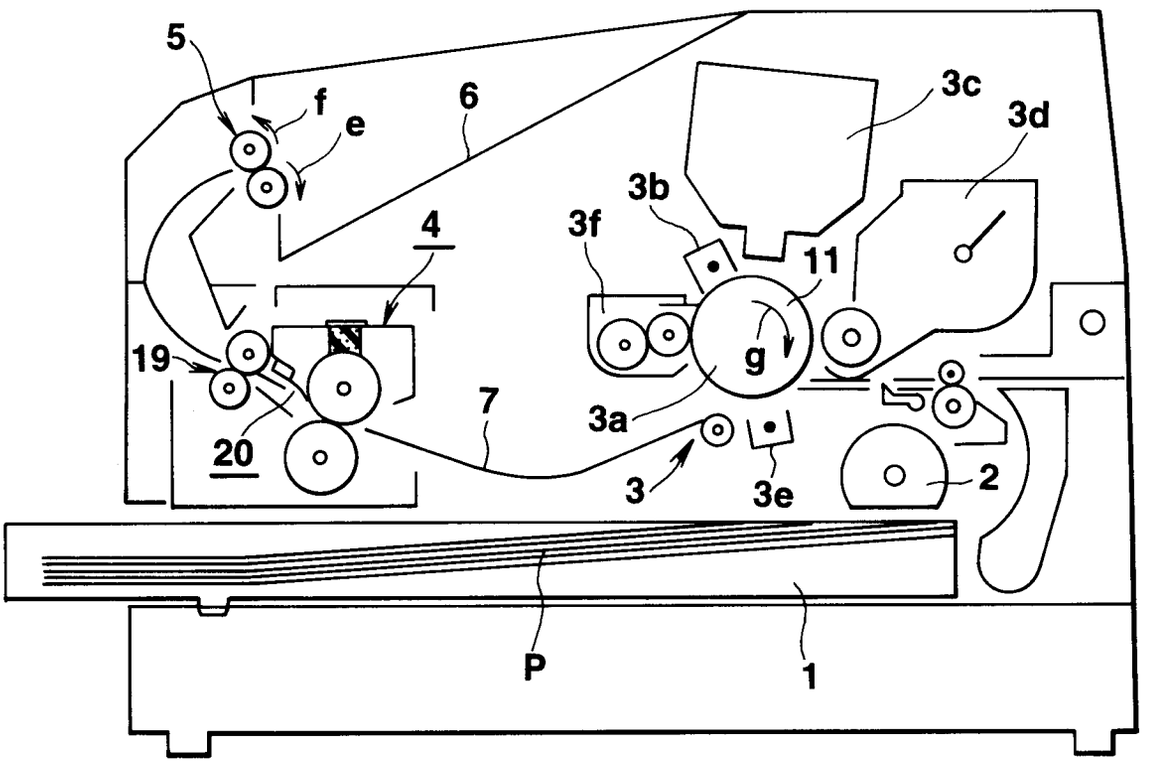

FIG.3

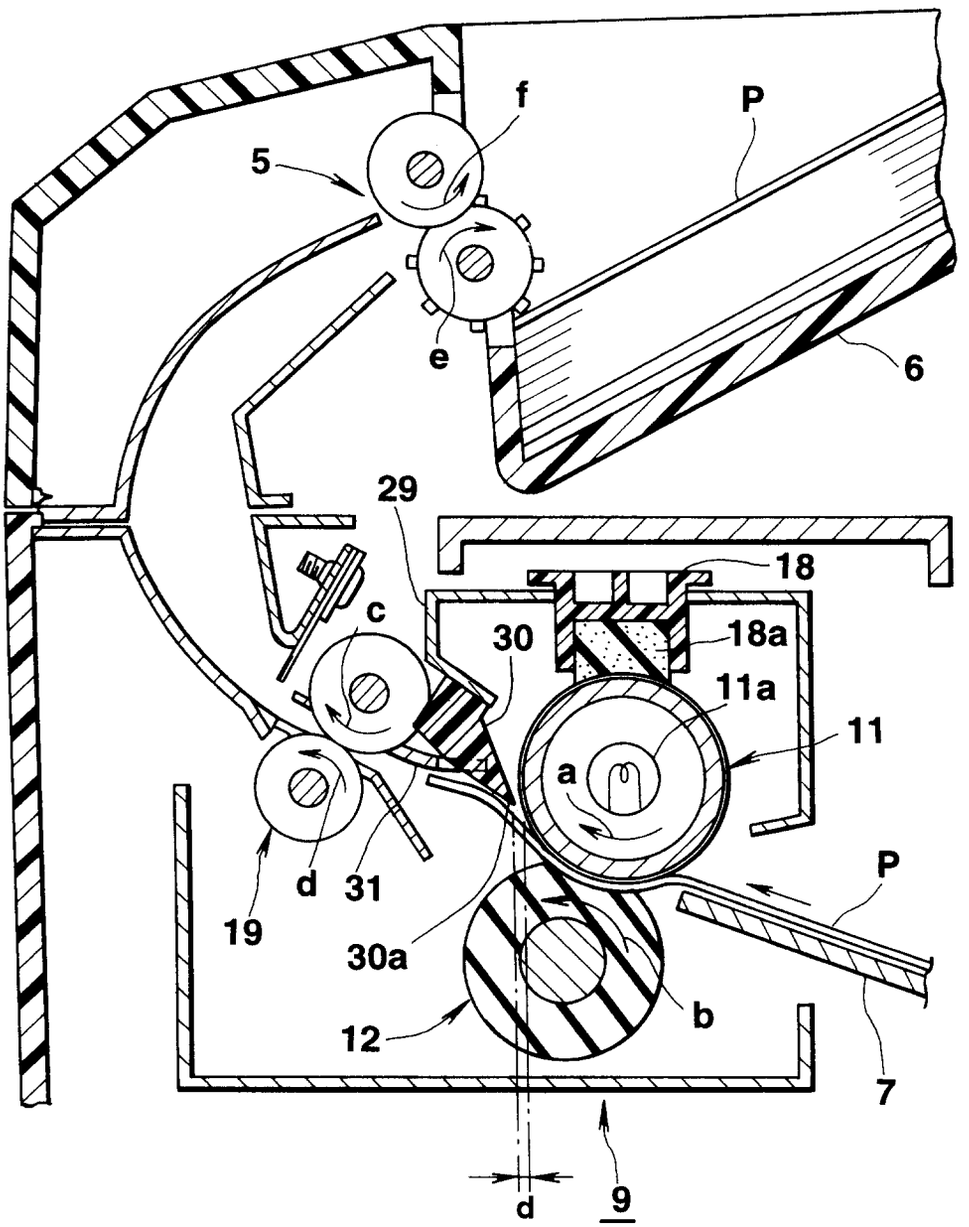

FIG.4

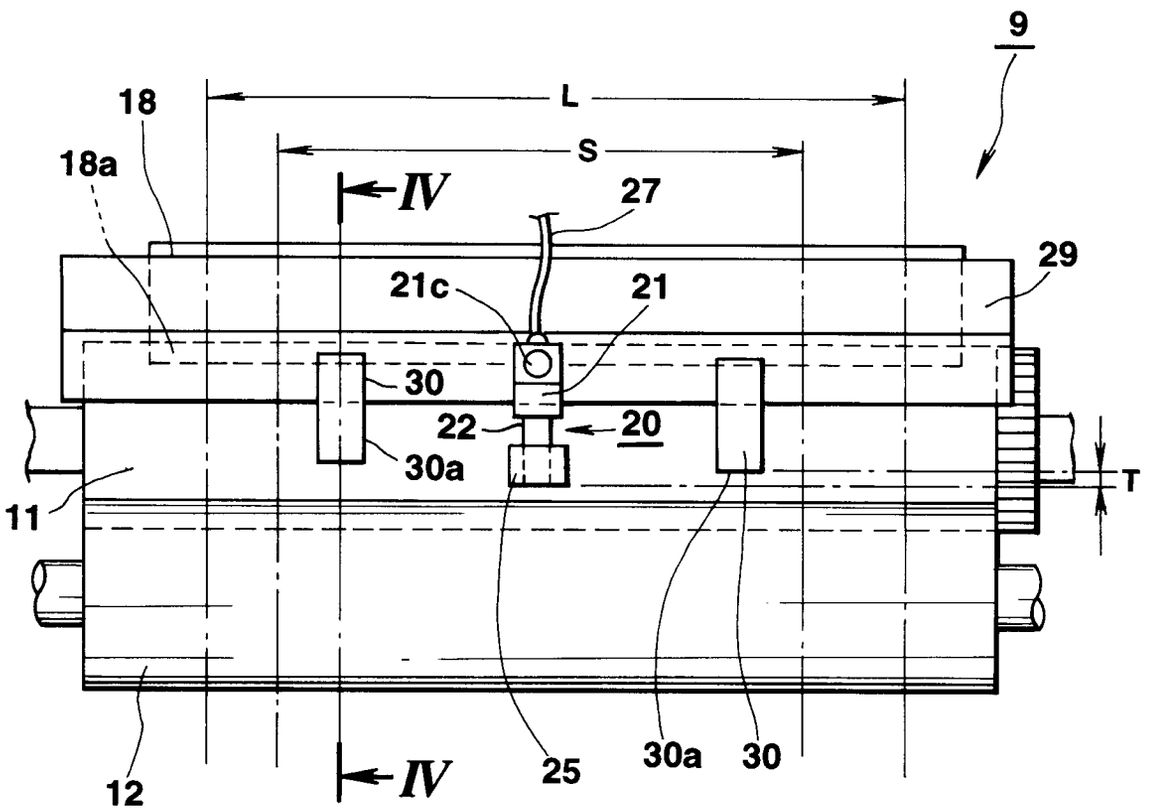

FIG.5

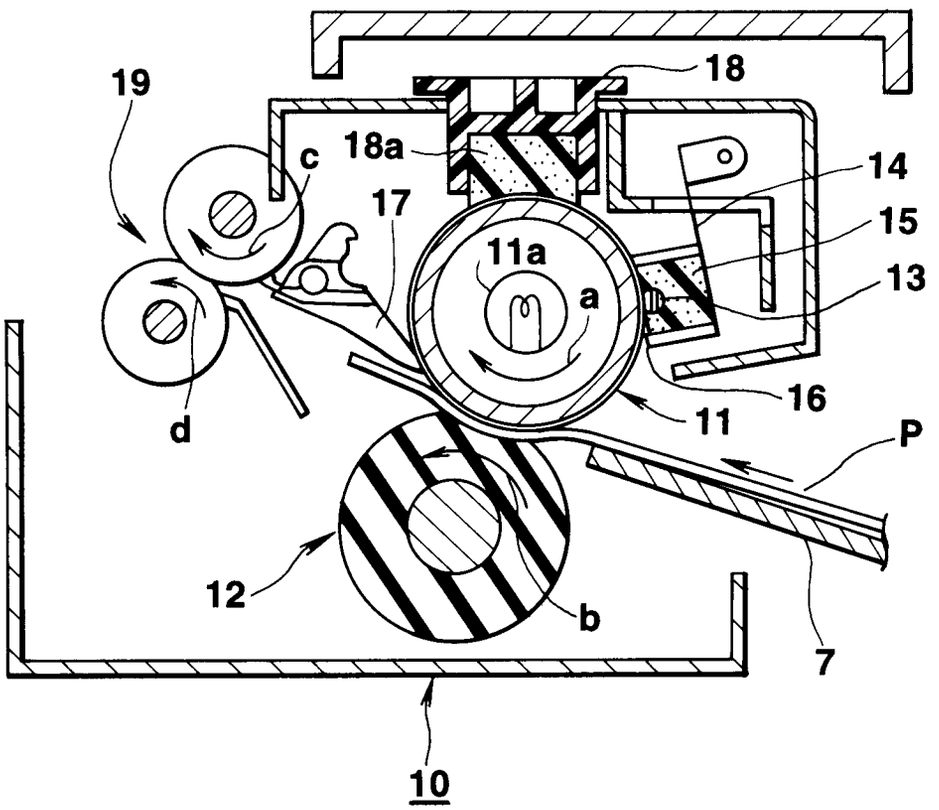

FIG.6
(PRIOR ART)