

APPLICATION ACCEPTED AND AMENDMENTS

ALLOWED 5-1-90

FORM 1

SPRUSON & FERGUSON

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

74602/87

APPLICATION FOR A STANDARD PATENT

Canon Kabushiki Kaisha, incorporated in Japan, of 30-2, 3-chome, Shimomaruko, Ohta-ku, Tokyo, JAPAN, hereby apply for the grant of a standard patent for an invention entitled:

Process cartridge and image forming apparatus using same which is described in the accompanying complete specification.

Details of basic application(s):-

Basic Applic. No: 147421/1986 Country: JAPAN

Application Date: 24 June 1986

The address for service is:-

Spruson & Ferguson Patent Attorneys Level 33 St Martins Tower 31 Market Street Sydney New South Wales Australia

DATED this TWENTY THIRD day of JUNE 1987

Canon Kabushiki Kaisha

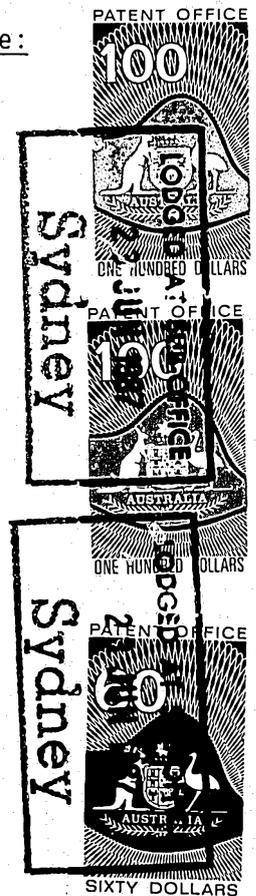
By:

[Handwritten Signature]

Registered Patent Attorney

TO: THE COMMISSIONER OF PATENTS OUR REF: 29043 S&F CODE: 63055

5845/2



FEE STAMP TO VALUE OF \$260.00 ATTACHED MAIL OFFICER *[Signature]*

DECLARATION IN SUPPORT OF A
CONVENTION APPLICATION FOR A PATENTIn support of the Convention Application made for a
patent for an invention entitled:

CPE0562-AU

Title of Invention

Process cartridge and image forming apparatus
using sameFull name(s) and
address(es) of
Declarant(s)

I/We Giichi Marushima, Director

of CANON KABUSHIKI KAISHA
3-30-2 Shimomaruko,
Ohta-ku, Tokyo,
Japan

do solemnly and sincerely declare as follows:-

Full name(s) of
Applicant(s)1. I am/We are the applicant(s) for the patent
(or, in the case of an application by a body corporate)1. I am/We are authorised by
Canon Kabushiki Kaishathe applicant(s) for the patent to make this declaration on
its/their behalf.2. The basic application(s) as defined by Section 141 of the
Act was/were made

Basic Country(ies)

in Japan

Priority Date(s)

on 24 June, 1986

Basic Applicant(s)

by Canon Kabushiki Kaisha

Full name(s) and
address(es) of
inventor(s)3. I am/We are the actual inventor(s) of the invention referred
to in the basic application(s)
(or where a person other than the inventor is the applicant)

3. Shinji Kanemitsu and Tokihide Ebata

of 2-1-17 Shinkamata, Ohta-ku, Tokyo, Japan and
4-10-13 Mukoudaimachi, Tanashi-shi, Tokyo, Japan

(respectively)

is/are the actual inventor(s) of the invention and the facts upon
which the applicant(s) is/are entitled to make the application are
as follows:Set out how Applicant(s)
derive title from actual
inventor(s) e.g. The
Applicant(s) is/are the
assignee(s) of the
invention from the
inventor(s)Canon Kabushiki Kaisha is entitled by Contract of Employment
between the inventors as employees and Canon Kabushiki
Kaisha as employer, as a person who would be entitled to
have the patent assigned to it if a patent were granted
upon an application made by the inventors.4. The basic application(s) referred to in paragraph 2 of this
Declaration was/were the first application(s) made in a Convention
country in respect of the invention (s) the subject of the application.

Declared at Tokyo, Japan this 16th day of June 1987.

To: The Commissioner of Patents


Signature of Declarant(s)
Giichi MARUSHIMA, Director

11/81

(12) PATENT ABRIDGMENT (11) Document No. AU-B-74602/87
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 595044

(54) Title
ELECTROGRAPHIC PROCESS CARTRIDGE AND IMAGE FORMING APPARATUS

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(56) Prior Art Documents
AU 17975/83 G03G 15/00 15/22 21/00 G03B 17/50

(57) Claim

1. A process cartridge detachably mounted to an image forming apparatus, comprising:

a rotatable photosensitive member;

helical gear operatively coupled to said photosensitive member and adapted to receive driving force from the image forming apparatus when mounted thereto to drive said photosensitive member and to urge said photosensitive member in the direction of its rotational axis with the driving force received from the image forming apparatus;

process means contributable to repetitive formation of an image on said photosensitive member; and

supporting means for supporting as a unit said photosensitive member and said process means.

13. An image forming apparatus, comprising:

a process cartridge including a rotatable photosensitive member, a helical gear operatively coupled to said photosensitive member, process means contributable to repetitive formation of an image on said photosensitive member, and supporting means for supporting as a unit said photosensitive member and said process means;

means for detachably holding said process cartridge; and

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a second helical gear which is provided in the image forming apparatus meshed with the first mentioned helical gear to drive said photosensitive member;

wherein said helical gears are twisted in such directions that when said photosensitive member is driven said photosensitive member is urged toward a side of said process cartridge where said first helical gear is provided.

FORM 10

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COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

Class Int Class

This document is a copy of the original specification filed under Section 40, and is correct for printing.

Complete Specification Lodged:
 Accepted:
 Published:

595044

Priority:

Related Art:

Name and Address
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Complete Specification for the invention entitled:

Process cartridge and image forming apparatus using same

The following statement is a full description of this invention, including the best method of performing it known to me/us

ABSTRACT OF THE DISCLOSURE

A process cartridge containing as a unit a photosensitive drum and processing elements for repetitive image formation on the photosensitive drum.

5 The process cartridge is mountable into an image forming machine. The process cartridge is provided with a helical gear for driving the photosensitive drum. The helical gear is engaged with another helical gear in the image forming machine, when it is mounted
10 into the image forming machine. The helical gears are twisted in such directions that when the photosensitive drum is driven, the photosensitive drum is urged toward a rear side of the apparatus, whereby during an image forming operation, the process cartridge and/or the
15 photosensitive member is correctly positioned. More particularly, the helical gear of the process cartridge is twisted in a direction which is the same as the direction of rotation of the photosensitive drum during the image forming operation.

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PROCESS CARTRIDGE
AND IMAGE FORMING APPARATUS USING SAME

FIELD OF THE INVENTION AND RELATED ART

5 The present invention relates to a process cartridge and an image forming apparatus using the process cartridge, wherein the process cartridge is detachably mountable into the image forming apparatus such as a copying apparatus and printer, more
10 particularly to a driving system for the photosensitive member or drum contained in the process cartridge.

 A process cartridge is known which is detachably mountable into a copying apparatus. The process cartridge is correctly positioned in the main
15 assembly of the image forming apparatus by holding a part of a casing of the process cartridge by a positioning member mounted in the main assembly, as disclosed in U.S. Patents Nos. 4,591,258; 4,566,777; 4,575,221; and 4,588,280; and U.S. Serial No. 787,260.

20 As for the photosensitive drum contained in the process cartridge, a more or less clearance is provided between the casing and the photosensitive drum in order to allow smooth rotation of the photosensitive drum in the process cartridge casing. This, however, may result in
25 a change of the photosensitive drum position with respect to the main assembly when the photosensitive drum is driven from the main assembly side, and

therefore, the image quality is deteriorated.

SUMMARY OF THE INVENTION

5 Therefore, it is desirable in order to produce a good quality image that the photosensitive drum does not shift or displace in the direction of its rotational axis during image forming operation so that it rotates correctly at a predetermined position in spite of existence of a clearance between a casing of a process cartridge and the photosensitive drum.

10 Accordingly, it is a principal object of the present invention to provide a process cartridge and an image forming apparatus wherein the photosensitive drum in the process cartridge can be maintained correctly at a predetermined position during its rotation for image formation.

According to an embodiment of the present invention, there is provided a process cartridge detachably mounted to an image forming apparatus, comprising:

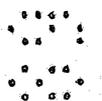
15 a rotatable photosensitive member;

20 helical gear operatively coupled to said photosensitive member and adapted to receive driving force from the image forming apparatus when mounted thereto to drive said photosensitive member and to urge said photosensitive member in the direction of its rotational axis with the driving force received from the image forming apparatus;

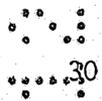
process means contributable to repetitive formation of an image on said photosensitive member; and

supporting means for supporting as a unit said photosensitive member and said process means.

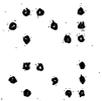
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These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a longitudinal section of a part of a process cartridge and a part of an image forming apparatus according to an embodiment of the present invention.

Figure 2 is a cross-section of an image forming apparatus containing a process cartridge according to the embodiment of the present invention.

Figure 3 is a perspective view illustrating a helical gear for driving a photosensitive drum contained in the process cartridge.

Figure 4 is a sectional view illustrating force imparted to the photosensitive drum during the photosensitive drum being driven.

Figures 5 - 9 are sectional views of various modifications of the process cartridge according to embodiments of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A copying apparatus will be taken as an

example of the image forming apparatus according to an embodiment of the present invention.

Referring to Figure 1, a part of the image forming apparatus and a part of a process cartridge according to an embodiment of the present invention are shown as a longitudinal section with respect to an axis of a photosensitive drum. The photosensitive drum is designated by reference numeral 1. To an end of the photosensitive drum 1, a flange 2 and a drum gear 3 which is a helical gear are fixed. The drum gear 3 is meshed with an unshown driving gear for driving a developing roller 11 to rotationally drive it. The process cartridge has a casing 4 having a drum positioning pin 5, which is engaged into a central bore of the flange 2, and a portion 3a of the drum gear 3 is engaged into a bore 4a of the cartridge casing, so that the photosensitive drum 1 is rotatably supported in the casing. A main assembly 6 of the copying apparatus has a cartridge positioning pin 7, which is inserted into a hole 4b of the process cartridge casing when the process cartridge is inserted into the main assembly in a direction indicated by an arrow in Figure 1. On the other hand, a pin 8 mounted to the main assembly 6 is inserted into a central bore of the drum gear 3. Thus, the process cartridge 4 is detachably received by the main assembly of the image forming apparatus. The main assembly 6 has a helical gear meshable with the

aforementioned helical gear and is effective to drive the photosensitive drum 1 through the helical gear of the process cartridge. The helical gear 9 is driven by an unshown motor and it drives the drum gear 3.

5 As shown in Figure 2, wherein the process cartridge is shown as being inserted in place in the main assembly, the image forming apparatus further comprises a corona discharger 10, a developing roller 11, a developing device 12 and a cleaning device 13,
10 which constitute in this embodiment process means contributable for forming repetitively on the photosensitive drum. Those process means are contained in the process cartridge 6 as a unit in this embodiment. The main assembly comprises a sheet feeding roller 14
15 and an image fixing device 15.

In operation, a copy sheet P of paper is fed by sheet feeding roller 14 and is advanced to a photosensitive drum 1 where a transfer corona discharger 16 is opposed thereto and is then processed by the image
20 fixing device 15 and is discharged. The photosensitive drum 1 is rotated in the direction indicated by an arrow, that is, a clockwise direction as shown in Figure 2.

As shown in Figure 3, the drum gear 3 is
25 helically twisted counter clockwise, that is, the helical drum gear 3 is twisted in the same direction as the direction of the photosensitive drum rotation

during image forming operation. When the drum gear 3 is driven by a driving gear 9 which is also helical, the teeth of the drum gear 3 receive force in a direction perpendicular to the gear surface. The force
5 can be resolved into a force in the circumferential direction of the photosensitive drum which is effective to rotate the photosensitive drum, and force in the direction of the rotational axis of the photosensitive drum which provides a thrust force in the leftward
10 direction as seen in Figure 3, that is, the leftward direction as seen in Figure 1. Therefore, the photosensitive drum 1 is leftwardly urged.

As shown in Figure 4, a length 3c of the portion 3b of the drum gear 3 is shorter than a length
15 4c of the portion 4a, and therefore the portion 3b of the drum gear 3 pushes the portion 4b of the cartridge casing 4 leftwardly (arrow A), and as a result, the portion 4b of the casing 4 is leftwardly pushed (arrow B). Thus, the entire cartridge is urged to a portion
20 6a of a frame of the main assembly. Since, in this embodiment, the portion 6a of the main assembly is a reference positioning surface, to which a particular portion of the process cartridge casing 4 is abutted. As will be understood from the foregoing, the photo-
25 sensitive drum 1 and the process cartridge casing 4 is always maintained at a predetermined position precisely by the photosensitive drum 1 being driven.

As will be understood from Figure 1, the drum gear 3 and the drum driving gear 9 are disposed adjacent such an longitudinal end of the process cartridge 4 as is nearer to the reference abutment surface 6a of the main assembly when the process cartridge is mounted in the main assembly. This is effective to correctly position the drum gear 3 with respect to the drum driving gear 9 in the thrust direction irrespective of manufacturing variations in lengths of the photosensitive drum. More particularly, the drum gear 3 is in alignment with the drum driving gear in the thrust direction so that the designed meshing conditions therebetween is achieved in the actual operation. Therefore, the teeth of the gear are not loaded with extreme force, and additionally, the force is not localized, whereby the meshing efficiency (a rate of a meshing portion to the entire length of the gear) is high, thus providing smooth rotation of the photosensitive drum.

Additional advantageous effects of employing the helical gear will be described, from a technical standpoint.

Because of the use of the helical gear, it is possible to form a high quality image without deterioration of the mechanical strength, even when the diameter of the photosensitive drum is reduced. Since a certain degree of mechanical strength of the gear is

required for the drive transmission, there is a limitation to the dimension of the teeth. If the diameter of the photosensitive drum is decreased for the purpose of reducing the size and weight of the apparatus, the number of gear teeth relative to the unit circumferential length of the photosensitive drum decreases. If the photosensitive drum is driven with the relatively small number of gear teeth, the drum rotation becomes non-uniform, more particularly, the drum is substantially intermittently or stepwisely driven due to unavoidable play between gears. As a result, the image becomes not uniform in the circumferential direction of the photosensitive drum, thereby degrading the quality of the image. If the dimensions of the gear teeth are reduced in an attempt to increase the number of teeth, the mechanical strength and therefore the durability of the gear teeth decreases, and simultaneously, smooth meshing engagement at the time of the cartridge insertion is not accomplished. This is particularly important when the helical gears are automatically brought into meshing engagement with each other simply by inserting the process cartridge into the main assembly.

According to this invention, the drum gear of the process cartridge is a helical gear to provide the above described problems simultaneously, as will be understood from the discussions made hereinbefore.

Additionally, the helical gear is disposed at such a side of the process cartridge as is a leading side when the process cartridge is mounted into the main assembly, and the photosensitive drum is thrust and urged toward the leading side, when the photosensitive drum is driven through the helical gear, due to the direction of the helical twist of the helical gear. Therefore, the positioning by the helical gear is like an extension of the loading operation of the process cartridge to the correct position in the main assembly.

When the diameter of the photosensitive drum is 25 - 40 mm, the module of the helical drum gear 3 is preferably 0.5 - 1.5, and the twist angle is preferably 5 - 30 degrees, which have been confirmed through various experiments, since then the urging force and the friction between the drum gear 3 and the cartridge casing 4 are reconciled property. In the embodiment actually produced, the diameter of the photosensitive drum 1 was 30 mm; and the drum gear 3 had the module of 0.8 and the twist angle of 10 degrees in the counter-clockwise direction, with satisfactory results.

In the foregoing embodiment, the process cartridge detachably mountable into the main assembly contains the photosensitive drum 1, the corona discharger 10, the developing device 12 and the cleaning device 13. As other examples to which the present invention is applicable, the process cartridge may

contain the photosensitive drum 1, the corona dis-
charger 10 and the cleaning device 13, as shown in
Figure 5. The process cartridge may contain the
photosensitive drum 1, the discharger 10 and the
5 developing device 12 as shown in Figure 6. The process
cartridge main contain the photosensitive drum 1 and
the cleaning device 13 or the developing device 12, as
shown in Figure 7 or Figure 8. As an additional
example, the process cartridge may contain the photo-
10 sensitive drum 1, the discharger 10, the developing
device 12 and the transfer discharger 16, as shown in
Figure 9.

As described in the foregoing, according to
the present invention, the process cartridge is
15 automatically positioned to a reference position by a
force imparted to the photosensitive drum by simply
applying the driving force to the photosensitive
member, so that the image forming operation can be
effected with the process cartridge positioned
20 correctly at the predetermined position during the
image forming operation. Also, when the photosensitive
drum is driven the process cartridge is moved to the
predetermined reference position, and therefore, the
process cartridge and the photosensitive drum in the
25 process cartridge are placed in a designed position.
Also, even if the diameter of the photosensitive drum
is reduced, it is not necessary to reduce the

dimensions of the gear teeth, so that a high quality image can be provided even in a small size apparatus without deteriorating the durability thereof.

While the invention has been described with
5 reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.

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The claims defining the invention are as follows:

1. A process cartridge detachably mounted to an image forming apparatus, comprising:

a rotatable photosensitive member;

5 helical gear operatively coupled to said photosensitive member and adapted to receive driving force from the image forming apparatus when mounted thereto to drive said photosensitive member and to urge said photosensitive member in the direction of its rotational axis with the driving force received from the image forming apparatus;

10 process means contributable to repetitive formation of an image on said photosensitive member; and

supporting means for supporting as a unit said photosensitive member and said process means.

15 2. A process cartridge detachably mountable to an image forming apparatus, comprising:

a rotatable photosensitive member;

20 a helical gear operatively coupled to said photosensitive member and adapted to receive driving force from the image forming apparatus when mounted thereto to drive said photosensitive member, said helical gear being disposed adjacent one longitudinal end of said photosensitive member and being twisted in such a direction that when it receives the driving force from the image forming apparatus said helical gear urges said photosensitive member toward a side of said process cartridge;

25 process means contributable to repetitive formation of an image on said photosensitive member; and

supporting means for supporting as a unit said photosensitive member and said process means.

30 3. A cartridge according to claim 2, wherein said helical gear has a module of 0.5 - 1.5, and has a twist angle, with respect to its rotational axis, of 5 - 30 degrees.

4. A cartridge according to claim 3, wherein the module is 0.8, and the twist angle is 10 degrees.

35 5. A cartridge according to claim 2, wherein said process cartridge is insertable into the image forming apparatus in a direction of a rotational axis of said photosensitive member, and said side is a leading side when said process cartridge is inserted into the image forming apparatus.

6. A cartridge according to claim 1, further comprising a portion for abutment to a frame of the image forming apparatus to position said process



cartridge therein.

7. A cartridge according to claim 6, wherein said portion of said cartridge is adjacent to the helical gear.

8. A process cartridge detachably mountable to an image forming apparatus, comprising:

a rotatable photosensitive member;

a helical gear operatively coupled to said photosensitive member and adapted to receive driving force from the image forming apparatus when mounted thereto to drive said photosensitive member, said helical gear being disposed adjacent one longitudinal end of said photosensitive member and being twisted in such a direction that when it receives the driving force from the image forming apparatus said helical gear urges said photosensitive member toward a side of said process cartridge;

process means contributable to repetitive formation of an image on said photosensitive member; and

supporting means for supporting as a unit said photosensitive member and said process means, said supporting means having a positioning portion for engagement with a positioning portion of the image forming apparatus interrelatedly with mounting of said process cartridge into the image forming apparatus.

9. A cartridge according to claim 8, wherein said positioning portion of said supporting means includes means for defining an opening.

10. A cartridge according to claim 9, wherein the opening is coaxial with the rotational axis of said photosensitive member.

11. A cartridge according to claim 8, wherein the image forming apparatus is an electrophotographic copying apparatus.

12. An image forming apparatus, comprising:

a process cartridge including a rotatable photosensitive member, a helical gear operatively coupled to said photosensitive member and adapted to receive driving force from the image forming apparatus when mounted thereto to drive said photosensitive member and to urge said photosensitive member in the direction of its rotational axis with the driving force received from the image forming apparatus, process means contributable to repetitive formation of an image on said photosensitive member, and supporting means for supporting as a unit said photosensitive member and said process means;

means for detachably holding said process cartridge; and

a second helical gear, which is provided in the image forming



apparatus, meshed with the first mentioned helical gear to drive said photosensitive member.

13. An image forming apparatus, comprising:

5 a process cartridge including a rotatable photosensitive member, a helical gear operatively coupled to said photosensitive member, process means contributable to repetitive formation of an image on said photosensitive member, and supporting means for supporting as a unit said photosensitive member and said process means;

means for detachably holding said process cartridge; and

10 a second helical gear which is provided in the image forming apparatus meshed with the first mentioned helical gear to drive said photosensitive member;

15 wherein said helical gears are twisted in such directions that when said photosensitive member is driven said photosensitive member is urged toward a side of said process cartridge where said first helical gear is provided.

14. An apparatus according to claim 13, wherein said helical gear has a module of 0.5 - 1.5, and has a twist angle, with respect to its rotational axis, of 5 - 30 degrees.

20 15. An apparatus according to claim 14, wherein the module is 0.8, and the twist angle is 10 degrees.

16. An image forming apparatus, comprising:

25 a process cartridge including a rotatable photosensitive member, a helical gear operatively coupled to said photosensitive member and adapted to receive driving force from the image forming apparatus when mounted thereto to drive said photosensitive member and to urge said photosensitive member in the direction of its rotational axis with the driving force received from the image forming apparatus, process means contributable to repetitive formation of an image on said photosensitive member, supporting means for supporting as a unit said photosensitive member and said process means, said supporting means having a positioning portion for positioning said process cartridge;

means for detachably holding said process cartridge;

35 a second helical gear, which is provided in the image forming apparatus meshed with said first mentioned helical gear of said process cartridge to drive said photosensitive member; and

a second positioning portion for engagement with said first mentioned positioning portion of said process cartridge, said second positioning



portion being fixed in a frame of said image forming apparatus.

17. An apparatus according to claim 16, wherein said first and second positioning portions are engageable interrelatedly with mounting of said process cartridge into said image forming apparatus.

5 18. An apparatus according to claim 16, wherein said first positioning portion includes means for defining an opening in a casing of said process cartridge which functions as said supporting means, and wherein said second positioning portion includes a pin.

10 19. An apparatus according to claim 17, wherein said process cartridge is insertable into the image forming apparatus in a direction of a rotational axis of said photosensitive member, and wherein said first helical gear is provided adjacent a side which is a leading side when said process cartridge is inserted into the image forming apparatus.

15 20. An apparatus according to claim 17, wherein said helical gear has a module of 0.5 - 1.5, and has a twist angle, with respect to its rotational axis, of 5 - 30 degrees.

21. An apparatus according to claim 20, wherein the module is 0.8, and the twist angle is 10 degrees.

20 22. An apparatus according to claim 17, wherein said image forming apparatus is an electrophotographic copying apparatus.

23. A cartridge according to claim 2 or 8, wherein said photosensitive member is urged toward a side where the helical gear for receiving the driving force from the image forming apparatus.

25 24. An apparatus according to claim 12, further comprising a positioning surface for abutment with a portion of the process cartridge.

25 25. An apparatus according to claim 24, wherein the positioning surface of the image forming apparatus is adjacent the second helical gear.

30 26. A cartridge according to claim 1, wherein said helical gear has an opening engaging with a shaft, of said image forming apparatus, for providing a rotational center of a said photosensitive member.

30 27. An apparatus according to claim 12, further comprising a shaft for providing a rotational center of said photosensitive member, said shaft being engageable with an opening of the helical gear of said process cartridge.

35 28. A cartridge or apparatus according to claim 1, 2, 8, 12, 13 or 16 wherein said process cartridge contains charging means, developing means and cleaning means as the process cartridge.

29. A process cartridge detachably mountable to an image forming



apparatus as hereinbefore particularly described with reference to what is shown in Fig. 1.

30. A process cartridge detachably mountable to an image forming apparatus as hereinbefore particularly described with reference to what is shown in Figs. 1 to 4.

31. A process cartridge detachably mountable to an image forming apparatus as hereinbefore particularly described with reference to what is shown in Fig. 5.

32. A process cartridge detachably mountable to an image forming apparatus as hereinbefore particularly described with reference to what is shown in Fig. 6.

33. A process cartridge detachably mountable to an image forming apparatus as hereinbefore particularly described with reference to what is shown in Fig. 7.

34. A process cartridge detachably mountable to an image forming apparatus as hereinbefore particularly described with reference to what is shown in Fig. 8.

35. A process cartridge detachably mountable to an image forming apparatus as hereinbefore particularly described with reference to what is shown in Fig. 9.

DATED this TWELFTH day of DECEMBER 1989

Canon Kabushiki Kaisha

Patent Attorneys for the Applicant

SPRUSON & FERGUSON



gr/144z

U.S. PATENT OFFICE

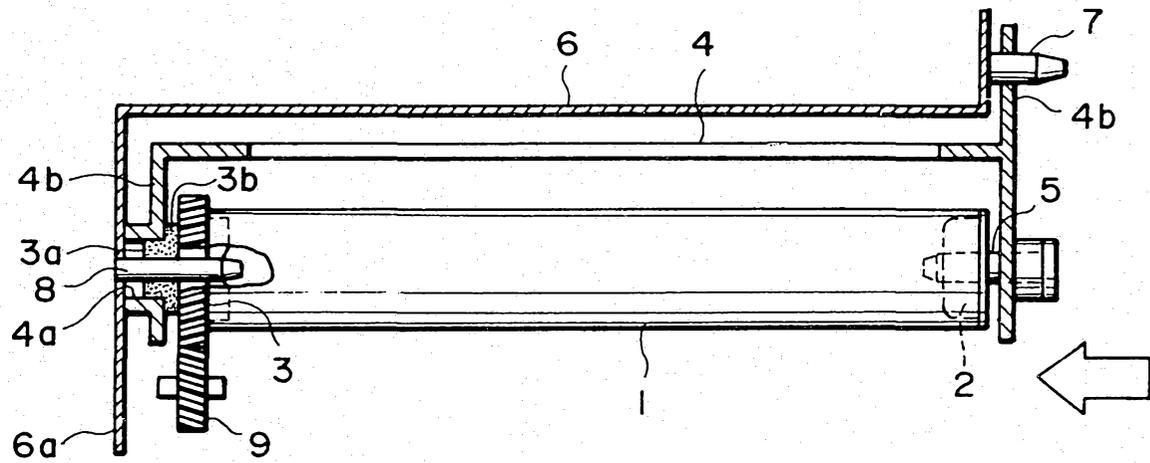


FIG. 1

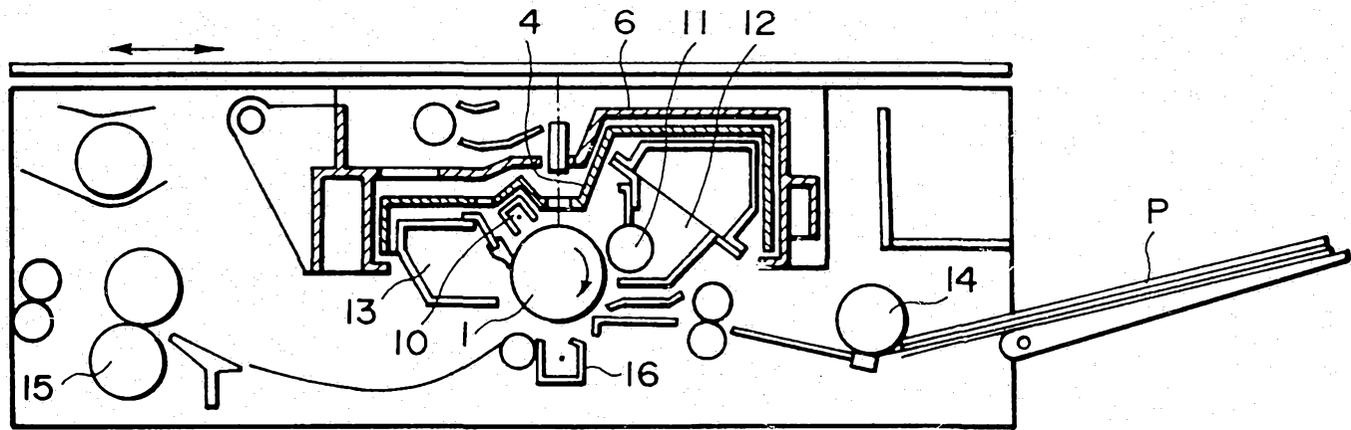


FIG. 2

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74602/87

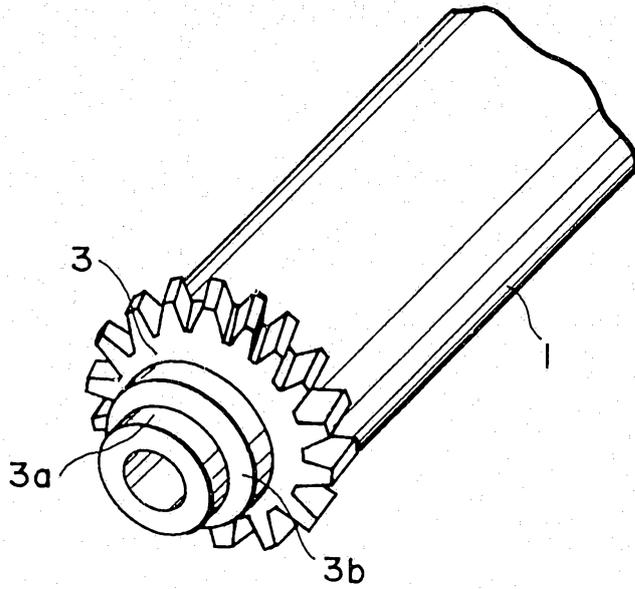


FIG. 3

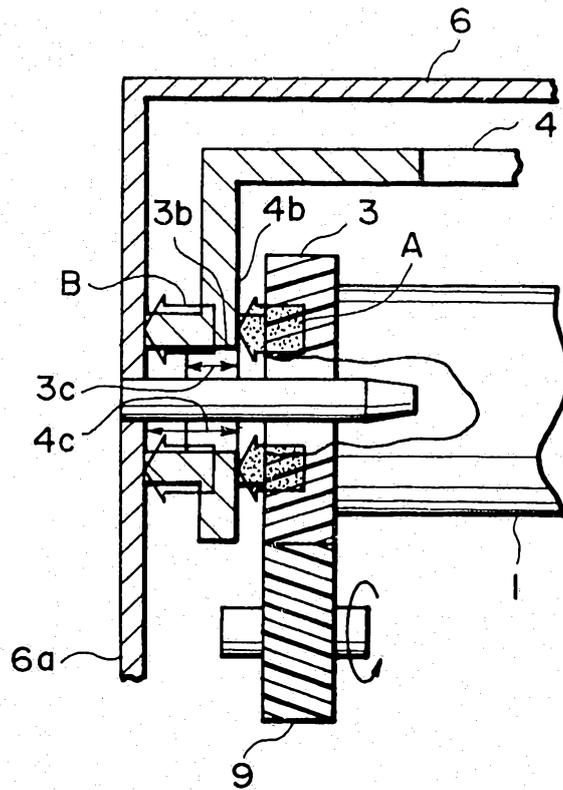


FIG. 4

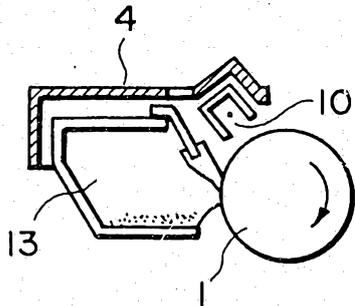


FIG. 5

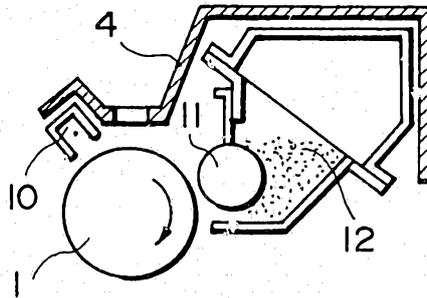


FIG. 6

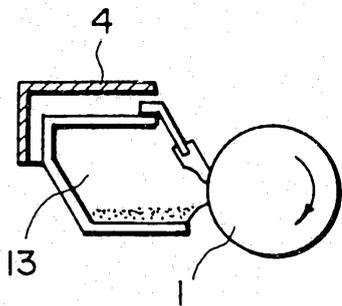


FIG. 7

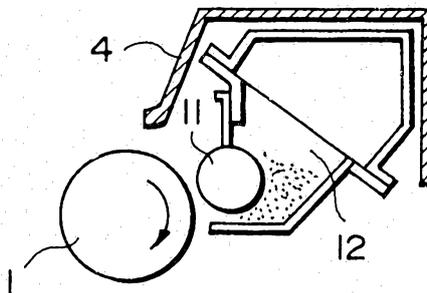


FIG. 8

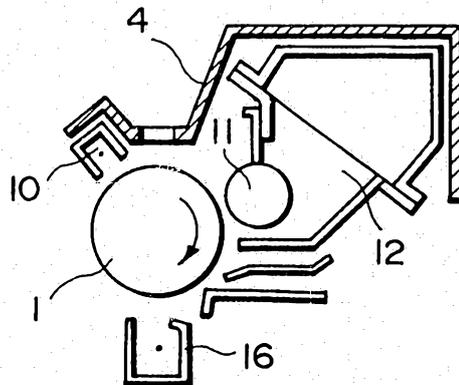


FIG. 9