

☐ Description : paged to paged
☒ Claim(s) : paged ..36.. to paged ..31..
☐ Drawing(s) : paged to paged
☐ Abstract : paged to paged

- 1 -

DESCRIPTION

ELECTROPHOTOGRAPHIC COPYING APPARATUS

5 TECHNICAL FIELD

The present invention relates to electrophotographic copying apparatuses such as copying machines.

10 BACKGROUND ART

In recent years, electrophotographic copying apparatuses have been receiving demands for smaller size, saved space and higher speed.

A conventional electrophotographic copying
15 apparatus is explained below in conjunction with the drawings.

In Fig. 6, there is disclosed an electrophotographic copying apparatus which comprises a first unit 111, a second unit 112, a third unit 113 and a
20 control panel 114, wherein the first unit, the second unit and the third unit are stacked one on another, the first unit comprising optical means such as an exposure lamp 115, reflecting mirrors 116 and lenses, the second unit comprising a photosensitive drum 117, developing means 118,
25 cleaning means 119, transfer means 120, fixing means 121

and the like, the third unit comprising sheet feeder means 122, and wherein the second unit and the third unit can be pulled out rightward in the figure, so that the electrophotographic copying apparatus is small-sized and space-saving, while keeping easy in maintenance and jam-processing (Japanese Laid-Open Patent Publication No. 4-371964).

These photosensitive drum, developing means and cleaning means of the electrophotographic copying apparatus are so arranged that a developing roller 124, the photosensitive drum 117 and the cleaning means 119 are integrated into a developing frame 123 as shown in Fig. 7 so as to be used fittable to and removable from the copying apparatus. Reference numeral 125 denotes a drum shaft, 126 denotes a side plate and 127 denotes a development cover 127 (Japanese Patent Publication No. 60-59591).

However, in the above conventional constitution, the first unit comprising optical means is equal in vertical size for all parts, such that the box dimensions of the unit depends on the way how the optical components are placed, with the result that even if useless space is involved, the unit would be stacked on as it is. The second unit is given as an image-formation processing unit, whereas fixing means is also arrayed horizontally besides the photosensitive drum, the developing means and the

cleaning means, such that the unit size is lengthened in the direction of array, inevitably causing the whole apparatus to increase in size. Therefore, because a fed sheet is conveyed along the array of the image-formation processing unit, the conveyance path would become long, 5 resulting in longer copying time.

Furthermore, because the image-formation processing unit including the development frame is weighty, the component members involved are arranged so as to be 10 retained by metallic side plates in order to meet the weighty article and the placement relationship that requires an accurate positioning. Therefore, the whole second unit would be heavy, such that the whole apparatus would also be heavy.

15 The present invention has been accomplished to solve the foregoing issues, and an object of the invention is to provide an electrophotographic copying apparatus which is made more compact and shorter in copying time by disposing its component units vertically, and moreover 20 which is reduced in weight by incorporating a resin frame molding.

DISCLOSURE OF INVENTION

In order to achieve the aforementioned object, an 25 electrophotographic copying apparatus according to the

present invention is characterized in that the electrophotographic copying apparatus comprises: an exposure optical unit including a document plate glass for placing thereon a document to be copied, first reflecting means which is disposed below the document plate glass so as to scan the document placed on the document plate glass, second reflecting means which moves at a speed $1/2$ that of the first reflecting means, and a lens which is designed to project the document scanned by the first and second reflecting means onto a photosensitive drum; an image processing unit including charging means, an exposure slit, developing means, transfer means and cleaning means provided around the photosensitive drum so as to visualize an optical image projected from the lens; a sheet feeder section which is designed to feed a sheet to the transfer means of the image processing unit; and a fixing-and-discharge section which is designed to fix and discharge the sheet onto which the image has been transferred, wherein the sheet feeder section, the image processing unit and the fixing-and-discharge section are arranged generally vertically in this order from below so as to implement an image processing and conveyance unit, and wherein a top portion of the vertically arranged image processing and conveyance unit is located at a place which is below a region of scanning by the first reflecting means of the

exposure optical unit and which is out of a region of scanning by the second reflecting means.

The electrophotographic copying apparatus is also characterized in that the image processing unit is located
5 at a place which is below a region of scanning by the first reflecting means and which is adjacent to the lens and the third reflecting means out of a region of scanning by the second reflecting means.

Further, in the electrophotographic copying
10 apparatus, unit retaining portions which are erected on both sides of one end of a base and each have an engaging portion formed to retain the image processing unit and which have a generally U shape in cross section, and an integral resin frame in which a plurality of pillar
15 portions are disposed on the other end of the base are provided, wherein the image processing unit is mounted to the unit retaining portions of the resin frame, while the exposure optical unit is mounted to upper end portions of the unit retaining portions and upper end portions of the
20 pillar portions in the resin frame.

Also to achieve the aforementioned object, an electrophotographic copying apparatus according to the present invention is characterized in that the electrophotographic copying apparatus comprises: an
25 exposure-optical-system-containing casing containing at

least movable part of an exposure optical system; an apparatus body casing to which a developing unit is removably fitted; a sheet feeder cassette, where the exposure-optical-system-containing casing, the apparatus
5 body casing and the sheet feeder cassette are arranged so as to be stacked from above to below; and an opening/closing casing in which transfer means and fixing means are disposed in a fore of the apparatus body casing, wherein the apparatus body casing has a base, left and
10 right side walls, and front and rear leg walls projected downward from front and rear sides, these members having been integrally molded of resin, and wherein the exposure-optical-system-containing casing is mounted to upper end surfaces of the left and right side walls, a lower end
15 portion of the opening/closing casing is pivotally supported to the front leg wall, and the sheet feeder cassette is insertably and removably accommodated in the guide grooves formed at inner peripheries of the front and rear leg walls.

20 With the above constitution, the image processing unit is arranged into a compact, vertical array so that the sheet conveyance path becomes short. Moreover, the image processing unit can be placed at a location which is below the region where the first reflecting means makes a scan
25 and which is adjacent to the lens and third reflecting

means where the second reflecting means makes no scan, so that dead space of exposure optical units can be effectively utilized for the stacking of the units.

Also, with the use of the resin frame, a support
5 base for each unit can be easily provided, while the weight of the whole apparatus can be reduced.

BRIEF DESCRIPTION OF DRAWINGS

These and other objects and features of the
10 present invention will become apparent from the following description taken in conjunction with the preferred embodiments thereof with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view showing the
15 constitution of an electrophotographic copying apparatus in a first embodiment of the present invention;

Fig. 2 is a perspective view showing the constitution of a resin frame in the first embodiment of the present invention;

20 Fig. 3 is a sectional view showing a constitution in which an exposure optical unit is fitted to the resin frame in the first embodiment of the present invention;

Fig. 4 is a side view for explaining the developing unit;

25 Fig. 5 is a sectional view showing a constitution

in which the sheet conveyor unit is opened;

Fig. 6 is an explanatory view showing constitution of a conventional electrophotographic copying apparatus;

5 Fig. 7 is an exploded perspective view of a conventional developing unit;

Fig. 8 is an overall schematic view in a second embodiment of the present invention;

Fig. 9 is an exploded perspective view thereof;

10 Fig. 10 is a perspective view of its apparatus body casing, as viewed obliquely from above; and

Fig. 11 is a perspective view of its apparatus body casing, as viewed obliquely from below.

15 BEST MODE FOR CARRYING OUT THE INVENTION

Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout the accompanying drawings.

20 A first embodiment of the present invention is described hereinbelow with reference to Figs. 1 to 5.

Fig. 1 shows an electrophotographic copying apparatus having a constitution according to the first embodiment of the invention, the apparatus comprising an
25 exposure optical unit 1, an image processing unit 2 for

forming an image through exposure by the exposure optical unit 1, and a sheet feeder unit 3 for conveying a sheet to this image processing unit 2. These exposure optical unit 1, image processing unit 2, sheet feeder unit 3 may be
5 given either integrally or separately. In particular, the sheet feeder unit 3 is made up of a plurality of different sheet feeder cassettes 3a stacked in different sheet sizes.

The exposure optical unit 1 comprises: first reflecting means implemented by a lamp 5 and a first
10 reflecting mirror 6 which are moved under a platen glass 4 to scan a document; second reflecting means 7 implemented by second reflecting mirrors 7a, 7b which move at a speed ratio of 1/2 relative to the first reflecting means; a lens 8 for projecting a scanned document image onto the
15 photosensitive drum; third reflecting means implemented by a third reflecting mirror 9 which is so arranged that the document image that has passed through the lens is bent downward so as to be led to the photosensitive drum; and the like. It is noted that reference numeral 10 denotes
20 reflecting mirrors which are interveniently provided to project onto the photosensitive drum 11 the document image derived from the third reflecting mirror 9.

The image processing unit 2, which has a photosensitive drum 11 as well as charging means 12, a side
25 eraser 13, an exposure slit 14, developing means 15,

transfer means 16, cleaning means 17 and the like disposed therearound, forms a toner image on the photosensitive drum 11 by common electrophotographic method in correspondence to a document image obtained through exposure, and
5 transfers the toner image onto the sheet that has been fed up. Before the transfer section where the photosensitive drum and the transfer means are opposed to each other, are disposed a pair of registration rollers 21 for stopping a sheet 20, at its leading end, that is fed one by one by a
10 feed roller 18 and a separation roller 19 of the sheet feeder unit 3, and for registering the sheet end and adjusting the timing at which the sheet is fed in. In turn, after the transfer section, are provided a fixing device 22 for performing a fixing process on the sheet 20
15 after the transfer, and a pair of discharge rollers 23 for discharging the sheet fed out from the fixing device 22.

The sheet conveyor system of these components is provided in a unit construction which is openable/closable at a boundary of the sheet conveyance system so that jam
20 processing can be easily attained.

The sheet feeder unit 3 is made up of a sheet feeder cassette 24 in which a different size of sheets 20 are accommodated, and a sheet path 25. Stacking this sheet feeder unit in various sheet sizes makes it possible to
25 implement sheet feeding ready for the various sheet sizes.

Reference numeral 26 denotes a manual feed tray, and 27 denotes a discharge tray.

The exposure scanning of the document is started by the first reflecting means of the lamp 5 and the first reflecting mirror 6, beginning with the left end in Fig. 1. When this occurs, the second reflecting means 7 composed of the second reflecting mirrors 7a, 7b starts to move from a right proximate position of the lens 8 away from the first reflecting means. At the time when the exposure scanning process is completed, the first reflecting means and the second reflecting means come to a state of proximity to each other at the right end.

The exposure optical unit 1 is constituted of one part smaller in vertical size and the other part larger, in the front and rear along the scanning direction. The region on the left side of Fig. 1 where only the first reflecting means scans has a smaller vertical size, while the region on the right side where both the first reflecting means and the second reflecting means scan needs to include a region for optical axes of reflection, with lenses also disposed, thus being larger in the vertical size. Besides, the exposure optical unit 1 is formed into a box shape having a step gap in the vertical size, its bottom surface and side surfaces being made of metal plates, with the platen glass 4 placed thereon. Further,

at the bottom surface portion, fourth reflecting mirrors 10 are disposed within the casing, so that an optical image that has passed through the lens 8 and been bent by the third reflecting mirror 9 will be bent generally horizontal by the fourth reflecting mirrors 10 and led to the exposure slit 14 of the photosensitive drum 11. Although this casing is fitted to the bottom surface of the exposure optical unit 1, the casing may also be provided integrally with the exposure optical unit or provided so as to be removable.

The image processing unit 2 is constituted so as to be removably retained to the resin frame made from a resin material such as glass-containing polycarbonate.

The resin frame is so constructed, as shown in Fig. 2, that side walls 29 are vertically erected on both sides of one end of a base 28 while a plurality of pillar members 30 are disposed at the other end, where these members are integrally resin molded. Reference numeral 31 denotes engaging holes formed in the side walls 29, serving each as a unit retaining portion for engaging and retaining the image processing unit 2. Whereas the resin frame is molded into a generally U shape in cross section, legs 32 may be molded integrally as required. Reference numerals 33a to 33d denote gas grooves, which will be described later. The exposure optical unit 1, as shown in Fig. 3, is

placed and fixed on upper end portions of the side walls 29 serving each as a unit retaining portion for the resin frame as well as on upper end portions of the plurality of pillar members 30.

5 The resin frame is now explained in detail with reference to Fig. 2. The frame to be used in the electrophotographic copying apparatus of the first embodiment of the invention is made by integral molding of resin, where for the molding of such a resin structure that
10 is relatively large sized and that requires precision of the fitting portions of various units and the like, a molding process with gas assist is employed instead of the conventional molding process in which the whole frame is formed into thick walls by using low foaming material.
15 This is intended to provide a constitution of non-uniform sections in which portions requiring strength and precision are of thicker walls, where the portions of non-uniform sections are made hollow so that inert gases such as nitrogen, carbon dioxide gas and air will be supplied to
20 thereby ensure the strength and precision.

The concrete arrangement for applying the molding process with gas assist to the resin frame integrally made from ABS resin, polystyrene or other thermoplastic resins is as follows.

25 First, in order to mold the unit retaining

portion having a generally U-shaped cross section for retaining the image processing unit, gas grooves 33a are provided by forming hollow portions that serves as passages for inert gas along the erection boundary portions between the base 28 and the side walls 29. Also, in order to improve the dimensional accuracy of the upper end portions of the side walls 29, to which the exposure optical unit 1 is to be fitted, gas grooves 33b are formed so as to be branched and extended from the gas grooves 33a in a longitudinally generally center portion of scanning course of the optical system. This gas groove 33b, if provided vertical in proximity to the engaging portion 31 formed in each unit retaining portion, serves also as a reinforcement of the engaging portion for retaining the image processing unit.

Further, gas grooves 33c are formed also in the plurality of pillar members 30 disposed at the other end of the base 28. The gas grooves may be provided either singly or by being branched and extended from the gas grooves 33a. When the legs 32 are integrally molded into the resin frame, gas grooves 33d are formed also at the boundary portions between the base 28 and the legs 32 in the same way as described above.

As described above, by providing gas grooves and their branched and extended portions in the molding process

of the resin frame, the precision of the unit fitting portions on the peripheries can be ensured with the feed of inert gas, while the strength can be increased with the hollow structure.

5 In the image processing unit 2, among others, the developing device 15, the photosensitive drum 11 and the cleaning means 17 constitute a developing unit, as they are disposed generally vertically in this order, which is to be fitted from the left hand in Fig. 2 to the engaging
10 portions 31 provided in the unit retaining portions with generally U-shaped cross sections of the resin frame. With the developing unit fitted, an optical image projected from the exposure optical system is applied onto the surface of the photosensitive drum 11 through the exposure slit 14.

15 The developing unit is made up integrally from lower frame 34 and upper frame 35 as shown in Fig. 4, where the lower frame 34 is equipped with a magnet roll 36 and agitating blades 37 so that the developer within the developing device 15 will be agitated and turned, by which
20 development is carried out in the developing section. Designated by numeral 38 is a mounting screw.

 The photosensitive drum 11 and the cleaning means 17 are provided in the upper frame 35, where the photosensitive drum 11 is so arranged that a drum shaft 40
25 is retained by a drum retainer 39 formed in the upper frame

35. The frames, which are made from ABS or other resin material, are to be fitted by making use of elasticity of the resin material. The photosensitive drum 11 can be fitted to the upper frame 35 by turning the upper frame 35 upside down and fitting the upper frame 35 to the photosensitive drum 11 from above.

Next, the retained drum shaft 40 is fitted by inserting a support pin 44 to a hole 43 provided in the lower frame 34 from outside of the frame, by which the drum side is retained at a specified position and set to a regular position with the cleaning means 17 and a toner receptor 41 pressed against the photosensitive drum 11.

Also in this upper frame 35, the toner receptor 41 and a recovery screw 42 are provided as well.

The recovery screw 42 is rotated with rotation of the photosensitive drum 11 so as to send out recovered toner on this side of the drawing, as viewed in the figure, and discharge into a separate recovery container.

The resin frame is equipped with an unshown hinge at the lower end, and a sheet conveyor unit 45 serving also as a cover is fitted so as to be openable and closable about this hinge as shown in Fig. 5. The sheet conveyor unit 45 is equipped with transfer means 16 implemented by a corona charger and the fixing device 22 implemented by a heat roller, so that a sheet fed up from below, onto which

a toner image formed on the photosensitive drum 11 will be transferred by the transfer means 16 and fixed by the fixing device 22 with heat and pressure, will then be discharged by the discharge roller 23.

5 Next, a second embodiment of the present invention is described with reference to Figs. 8 to 11.

Referring to Figs. 8 and 9, reference numeral 51 denotes an exposure-optical-system-containing casing, which comprises a platen glass 4, a lamp 5, a first reflecting
10 mirror 6, second reflecting means 7, a projection lens 8 and a third reflecting mirror 9, as described based on Fig. 1, and which is formed into the same configuration and structure as the casing of the exposure optical unit 1 shown in Figs. 1 and 3. Numeral 52 denotes an apparatus
15 body casing, which internally contains a fourth reflecting mirror 10 and a sheet feed roller 18 as described based on Fig. 1 and to which a developing unit 53 comprising a photosensitive drum 11, charging means 12, a side eraser 13, an exposure slit 14, developing means 16, cleaning
20 means 17 and the like is removably fitted. Designated by numeral 54 is an opening/closing casing, which comprises a registration roller 21, transfer means 16, a fixing device 22 and discharge rollers 23 as described based on Figs. 1 and 5. Numeral 55 denotes a sheet feeder cassette.

25 The exposure-optical-system-containing casing 51,

in which at least movable part of the exposure optical system is contained, the apparatus body casing 52 and the sheet feeder cassette 55 are placed so as to be stacked from above to below, while an opening/closing casing 54 is placed in the fore of the apparatus body casing 52. The apparatus body casing 52, as shown in Figs. 9 to 11, has a base 56 (equivalent to the base 28 in Fig. 2), left and right side walls 57a, 57b, and front leg wall 59 and rear leg wall 60 (equivalent to the legs 32 in Fig. 2) projected downward from the front and rear sides), these component members being integrally resin molded. The exposure-optical-system-containing casing 51 is fitted to the upper end surfaces of the left and right side walls 57a, 57b, and lower end portion of the opening/closing casing 54 is pivotally supported to the front leg wall 59 by a hinge 61 (see Fig. 8). Also, the sheet feeder cassette 55 is insertably and removably fitted to guide grooves 62, 62 formed at inner peripheries of the front and rear leg walls 59, 60.

The base 56 of the apparatus body casing 52 has a multiplicity of reinforcing ribs 63 integrally formed on its upper and lower surfaces in a lattice shape, thus ensuring the rigidity while weight reduction is designed. The left side wall 57a is formed into a hollow wall member 64a over its about 2/3 range on the front side, a front end

portion of which is a high wall portion 65a of a much taller hollow pillar shape, and a rear end portion of which is a hollow pillar portion 66a. The left side wall 57a also has a hollow pillar member 67a at its rear end
5 portion. The right side wall 57b is formed into a hollow wall member 64b over its about 2/3 range on the front side, front end portion of which is a high wall portion 65b of a much taller hollow pillar shape, and a rear end portion of which is a hollow pillar portion 66b. The right side wall
10 57b also has a hollow pillar member 67b at its rear end portion.

As shown in Fig. 11, the front leg wall 59 of the apparatus body casing 52 has a plurality of hollow pillar portions 59a, both left and right ends of which are
15 integrally coupled with downward projections 59b, 59c of the high wall portions 65a, 65b. Likewise, the rear leg portion 60 has a plurality of hollow pillar portions 60a, both left and right ends of which are integrally coupled with downward projections 60b, 60c of the hollow pillar
20 members 67a, 67b.

A left-and-right pair of grounding protrusions 68a, 68b are integrally formed on the lower surface of the front leg wall 59 on both end portions thereof, and one grounding protrusion 68c is integrally formed in a center
25 of the lower surface of the rear leg wall 60, so that the

apparatus body casing 52 will be supported at three points by the grounding surface. Also, a left-and-right pair of auxiliary grounding protrusions 69a, 69b slightly smaller in protruding amount than the grounding protrusions 68a, 68b, 68c are integrally formed at positions in proximity to both end portions of the lower surface of the rear leg wall 60. In this way, supporting at three points the apparatus body casing 52, which is an integrally molded product of resin, makes it possible to solve the issue of unstable grounding due to distortions during the resin molding process. Still, providing a left-and-right pair of auxiliary grounding protrusions 69a, 69b makes it possible that even when external force largely acts on the apparatus body casing 52, the apparatus body casing 52 would result in only a slight tilt and recover the stability.

This embodiment also employs the resin molding process with gas assist, as in the first embodiment, to ensure the rigidity and strength of the apparatus body casing 52. Hatched portions 70a to 70h in Fig. 11 are gas grooves formed by this molding process. As apparent from the sectional view of a place indicated by P in Fig. 11, each of the gas grooves 70a to 70h comprises a passage q through which inert gas passes in the molding process, and a peripheral wall portion r formed around this passage, so that, for example at the place P, one corner portion of the

hollow pillar member 67a is reinforced from inside, and therefore that the whole hollow pillar member 67a is reinforced. Referring to Fig. 11, 70a, 70a denote gas grooves which reinforce the high wall portions 65a, 65b; 5 70b, 70b denote gas grooves which reinforce center portions of the hollow wall members 64a, 64b (the gas groove which reinforces the center portion of the hollow wall member 64a located on this side of Fig. 11 is not shown); 70c, 70c denote gas grooves which reinforce the hollow pillar 10 portions 66a, 66b (the gas groove which reinforces the hollow pillar portion 66a located on this side of Fig. 11 is not shown); 70d, 70d denote gas grooves which reinforce the hollow pillar members 67a, 67b; 70e denotes a gas groove which is provided at a boundary portion between the 15 base 56 and the left side wall 57a to reinforce this boundary portion; 70f denotes a gas groove which is provided at a boundary portion between the base 56 and the right side wall 57b to reinforce this boundary portion; 70g denotes a gas groove which is provided at a boundary 20 portion between the base 56 and the front leg wall 59 to reinforce this boundary portion; and 70h denotes a gas groove which is provided at a boundary portion between the base 56 and the rear leg wall 60 to reinforce this boundary portion.

25 As shown above, the apparatus body casing 52 has

the reinforcing ribs 63 formed on the base 56, the left and right side walls 57a, 57b and the front and rear leg walls 59, 60 composed of a plurality of hollow pillared portions 65a, 65b, 66a, 66b, 67a, 67b, 59a, 59b, 59c, 60a, 60b, 60c, and moreover the gas grooves 70a to 70h. Thus, the apparatus body casing 52, although being an integrally molded product of resin, has enough rigidity and strength to keep its shape sufficiently even if the exposure-optical-system-containing casing 51, which is a weighty article, is placed thereon and a multiplicity of internal components are equipped therein.

In addition, in this embodiment, as shown in Fig. 10, in conjunction with the fact that the apparatus body casing 52 is formed from resin to have electrically insulating property, a high-voltage power supply board 71 is directly mounted to the right side wall 57b. Thus, the need of interposing some insulating member between the high-voltage power supply board and the side wall, which would be involved in the case of conventional metallic casings, can be eliminated in this embodiment.

As described in detail above, in the present invention, the sheet feeder section, the image processing unit and the fixing-and-discharge section are arranged generally vertically in this order from below to constitute an image processing and conveyance unit, in such a way that

the top of the vertically arranged image processing and conveyance unit is located in a region which is below the region of scanning by the first reflecting means of the exposure optical unit and which is out of the scanning by
5 the second reflecting means. Thus, the whole apparatus can be made compact.

This arrangement also allows completed copies to be discharged nearby the document placed for copying, so that an electrophotographic copying apparatus which is easy
10 to confirm the performance of copying and convenient to use can be offered. Moreover, with the vertical arrangement of the image processing and conveyance unit, the electrophotographic copying apparatus is reduced in the conveyance distance of sheets, as compared with
15 conventional copying apparatuses in which the sheet is conveyed horizontally, so that the electrophotographic copying apparatus can be reduced in the time taken from the copying start until the copying completion.

Furthermore, the integral resin frame is formed
20 into a construction with non-uniform sections of thick walls requiring strength and precision as well as into a hollow construction so that the molding process with gas assist can be applied to the resin frame. Therefore, as compared with conventional molding process by using low-
25 foaming material, a resin frame having a greater effect of

weight reduction can be made, each unit becomes easy to mount, and an electrophotographic copying apparatus of high precision as a whole can be realized. Further, the gas grooves make the resin material better in fluidity during the molding process, so that the injection pressure of resin can be reduced, that distortions due to residual stress of injection remaining in the resin frame, which is a molded product, can be prevented, and that the dimensional accuracy can be enhanced. Moreover, both the molding machine and the molding dies can be downsized by virtue of the reduction in injection pressure. In the case where the apparatus body casing is supported at three points, the issue of unstable grounding due to distortions during the resin molding process can be solved. Further, the high-voltage power supply board can be mounted directly to the side wall of the apparatus body casing which is integrally molded of resin, so that the construction can be simplified, and like this, a variety of functional effects can be obtained.

Although the present invention has been fully described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. Such changes and modifications are to be understood as included within the

- 25 -

scope of the present invention as defined by the appended claims unless they depart therefrom.



- 26 -

CLAIMS

1. An electrophotographic copying apparatus characterized by comprising: an exposure optical unit including a document plate glass for placing thereon a document to be copied, first reflecting means which is disposed below the document plate glass so as to scan the document placed on the document plate glass, second reflecting means which moves at a speed $1/2$ that of the first reflecting means, and a lens which is designed to project the document scanned by the first and second reflecting means onto a photosensitive drum; an image processing unit including charging means, an exposure slit, developing means, transfer means and cleaning means provided around the photosensitive drum so as to visualize an optical image projected from the lens; a sheet feeder section which is designed to feed a sheet to the transfer means of the image processing unit; and a fixing-and-discharge section which is designed to fix and discharge the sheet onto which the image has been transferred, wherein the sheet feeder section, the image processing unit and the fixing-and-discharge section are arranged generally vertically in this order from below so as to implement an image processing and conveyance unit, and wherein a top portion of the vertically arranged image processing and conveyance unit is located at a place which is below a

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- 27 -

region of scanning by the first reflecting means of the exposure optical unit and which is out of a region of scanning by the second reflecting means.

2. An electrophotographic copying apparatus
5 characterized by comprising: an exposure optical unit including a document plate glass for placing thereon a document to be copied, first reflecting means which is disposed below the document plate glass so as to scan the document placed on the document plate glass, second
10 reflecting means which moves at a speed $1/2$ that of the first and second reflecting means, a lens which is designed to project the document scanned by the first and second reflecting means onto a photosensitive drum, and third reflecting means designed to bend downward a document image
15 that has passed through the lens and thereby lead the image to the photosensitive drum; and an image processing unit designed to visualize and transfer onto a sheet the projected document image and thereby create a copy, wherein the image processing unit is located at a place which is
20 below a region of scanning by the first reflecting means and which is adjacent to the lens and the third reflecting means out of a region of scanning by the second reflecting means, and wherein the first and second reflecting means start a scan in a positional relation that the image
25 processing unit is arranged as described above and that the

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- 28 -

first and second reflecting means are away from each other, and terminate the scan in a positional relation that the first and second reflecting means are close to each other.

3. An electrophotographic copying apparatus
5 characterized by comprising: an exposure optical unit including a document plate glass for placing thereon a document to be copied, and an optical system which is disposed below the document plate glass and which scans and exposes to light the document placed on the document plate
10 glass; an image processing unit which is disposed below one end portion of the exposure optical unit and which conveys a sheet generally vertically from below to above to create a copied image; unit retaining portions which are erected on both sides of one end of a base and each have an
15 engaging portion formed to retain the image processing unit and which have a generally U shape in cross section; and an integral resin frame in which a plurality of pillar portions are disposed on the other end of the base, wherein the image processing unit is mounted to the unit retaining
20 portions of the resin frame, while the exposure optical unit is mounted to upper end portions of the unit retaining portions and upper end portions of the pillar portions in the resin frame.

4. The electrophotographic copying apparatus
25 according to Claim 3, characterized in that gas grooves

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- 29 -

having in their interior passages of inert gas for molding with gas assist are provided at boundary portions between the unit retaining portions each having a generally U-shaped cross section of the resin frame and the base.

5 5. The electrophotographic copying apparatus according to Claim 3, characterized in that a gas groove is branched and extended vertically in proximity to the engaging portion formed in the unit retaining portions having generally U shape in cross section of the resin
10 frame, the gas groove being provided at a boundary portion between the unit retaining portions and the base, and having in its interior a passage of inert gas for molding with gas assist.

6. The electrophotographic copying apparatus
15 according to Claim 3, characterized in that leg portions are provided so as to be integrally extended from the base in a direction opposite to the unit retaining portions each having a generally U shape in cross section of the resin frame, and gas grooves having in their interior passages of
20 inert gas for molding with gas assist are provided at boundary portions between the base and the leg portions.

7. The electrophotographic copying apparatus according to Claim 3, characterized in that gas grooves having in their interior passages of inert gas for molding
25 with gas assist are provided at boundary portions between

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- 30 -

the unit retaining portion each having a generally U shape in cross section of the resin frame and the base, and the gas grooves are branched and extended into a plurality of pillar portions disposed at the other end of the base.

5 8. An electrophotographic copying apparatus characterized by comprising: an exposure-optical-system-containing casing containing at least movable part of an exposure optical system; an apparatus body casing to which a developing unit is removably fitted; a sheet feeder
10 cassette, where the exposure-optical-system-containing casing, the apparatus body casing and the sheet feeder cassette are arranged so as to be stacked from above to below; and an opening/closing casing in which transfer means and fixing means are disposed in a fore of the
15 apparatus body casing, wherein the apparatus body casing has a base, left and right side walls, and front and rear leg walls projected downward from front and rear sides, these members having been integrally molded of resin, and wherein the exposure-optical-system-containing casing is
20 mounted to upper end surfaces of the left and right side walls, a lower end portion of the opening/closing casing is pivotally supported to the front leg wall, and the sheet feeder cassette is insertably and removably accommodated in the guide groove formed at inner peripheries of the front
25 and rear leg walls.

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- 31 -

9. The electrophotographic copying apparatus according to Claim 8, characterized in that the left and right side walls and front and rear leg walls of the apparatus body casing each have a plurality of hollow
5 pillar portions, and the base has a multiplicity of reinforcing ribs.

10. The electrophotographic copying apparatus according to Claim 8 or 9, characterized in that a left-
10 and-right pair of grounding protrusions are formed in a lower surface of one leg wall out of the front and rear leg walls, while one grounding protrusion is formed in a center of a lower surface of the other leg wall, and wherein the apparatus body casing is supported at three points by the grounding surface.

15 11. The electrophotographic copying apparatus according to Claim 10, characterized in that auxiliary grounding protrusions slightly smaller in protruding amount than the grounding protrusions are provided on both sides of the grounding protrusion in the lower surface of the
20 other leg wall.

12. The electrophotographic copying apparatus according to Claim 8 or 9, characterized in that a high-voltage power supply board is mounted directly on one side wall of the apparatus body casing.

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ABSTRACT

In an electrophotographic copying apparatus, component units are disposed in a vertical arrangement in order that the electrophotographic copying apparatus can be
5 made more compact, lighter in weight and shorter in copying time.

An image processing and conveyance unit has a sheet feeder unit 3, an image processing unit 2 and a fixing-and-discharge section 22 placed generally vertically
10 in this order from below. A developing unit of an image processing unit is retained by a unit retaining portion formed into a generally U shaped in cross section and erected on both sides of one end of a base, and by a resin frame having pillar portions integrally formed at the other
15 end. An exposure optical unit 1 is fitted to upper end portion of the resin frame, and the image processing and conveyance unit is so arranged that its top portion is located in a place out of the region of scanning by the second reflecting means of the exposure optical unit.
20 Thus, the whole apparatus can be made compact and shorter in the conveyance distance of sheets.

Fig. 1

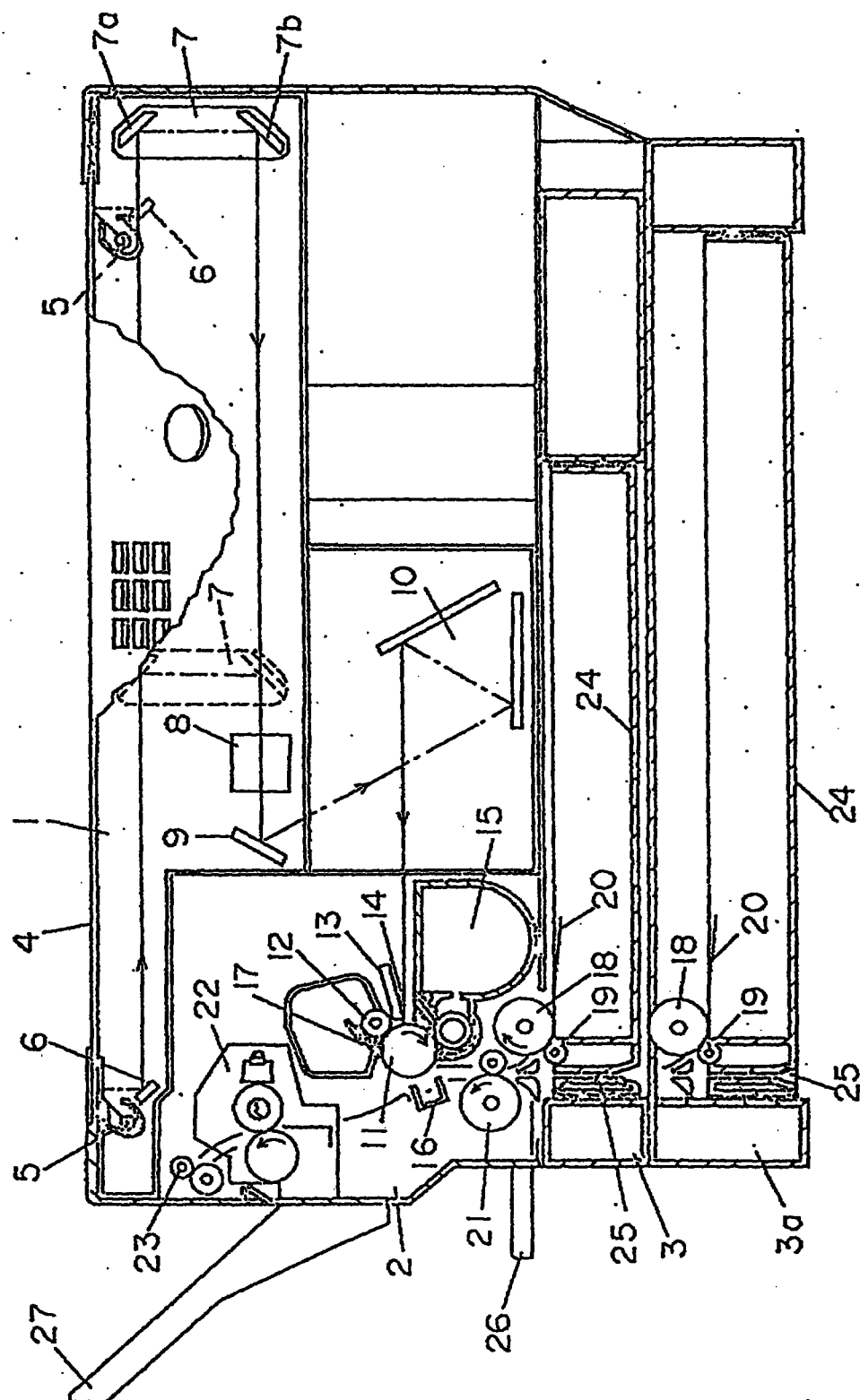


Fig. 2

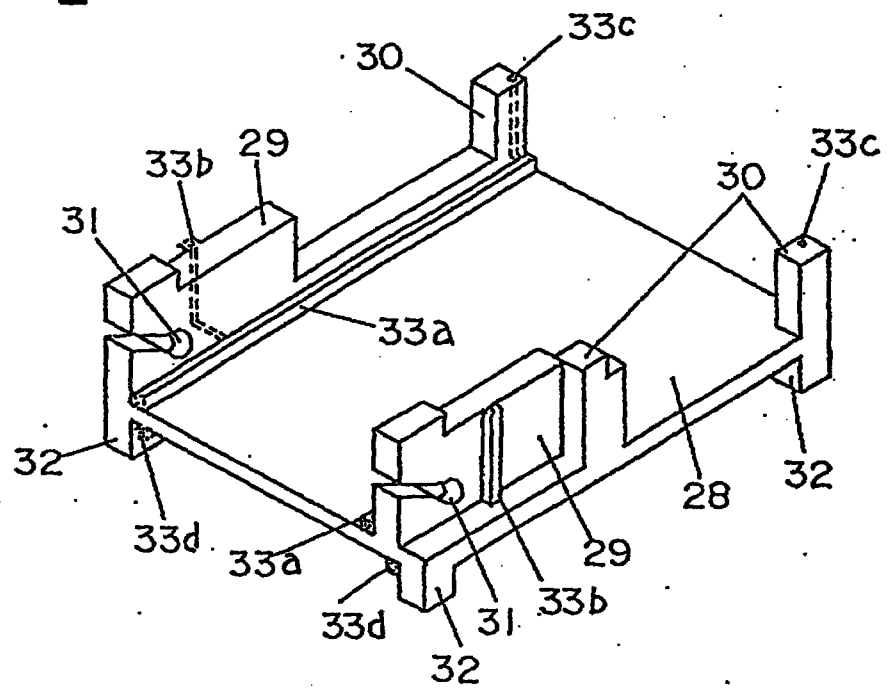


Fig. 3

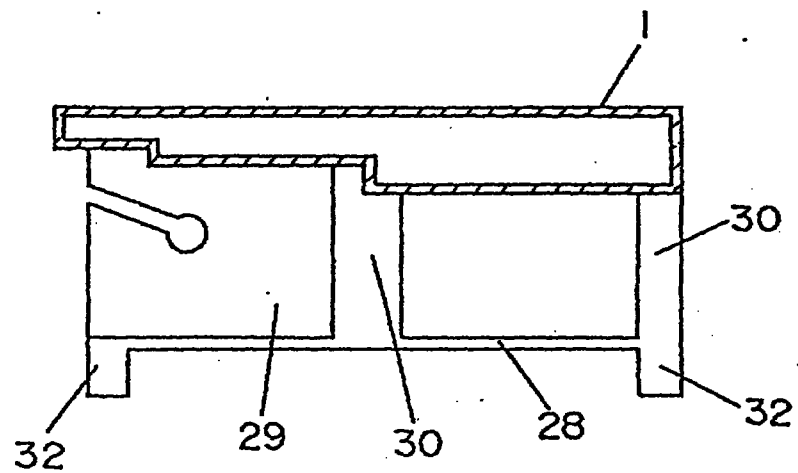


Fig. 4

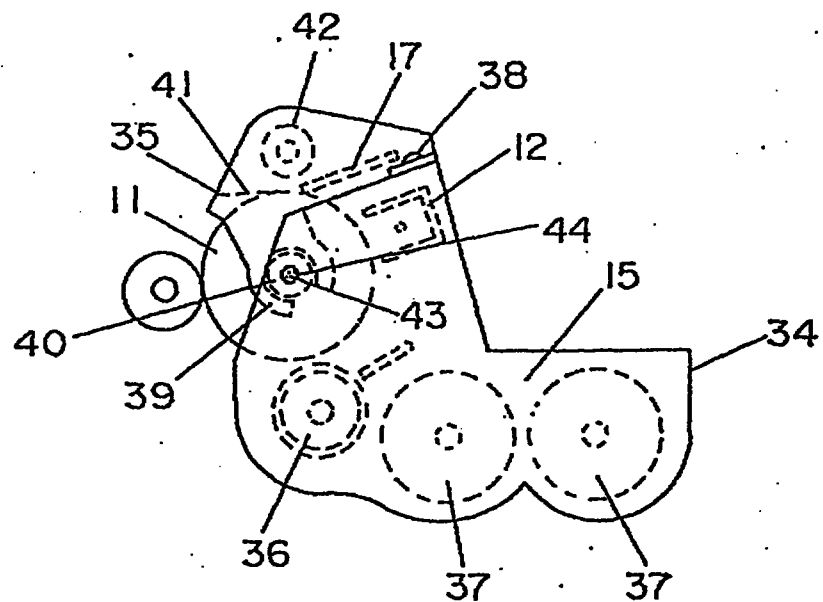


Fig. 5

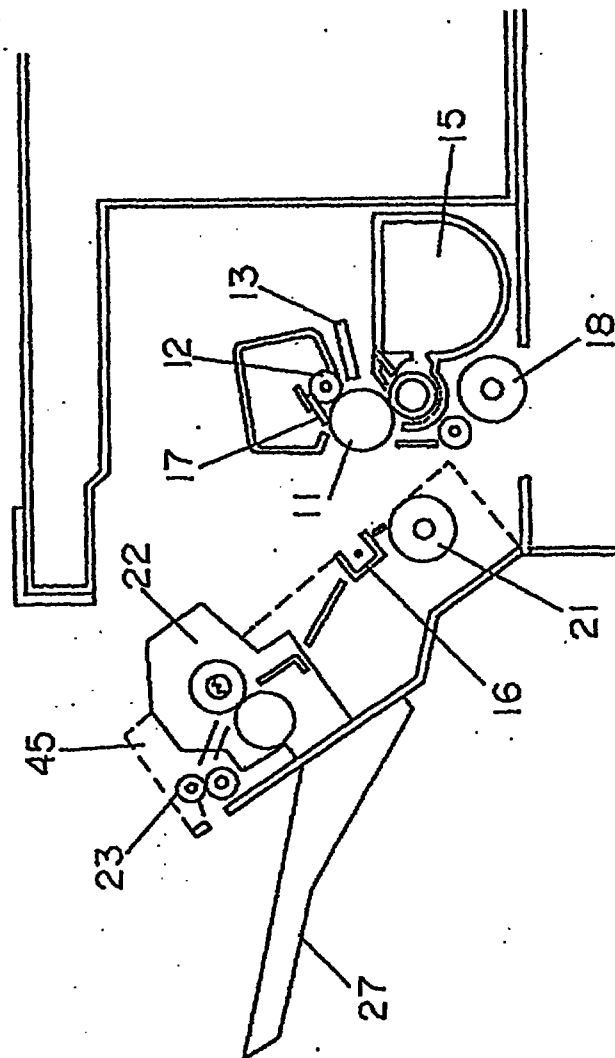


Fig. 6

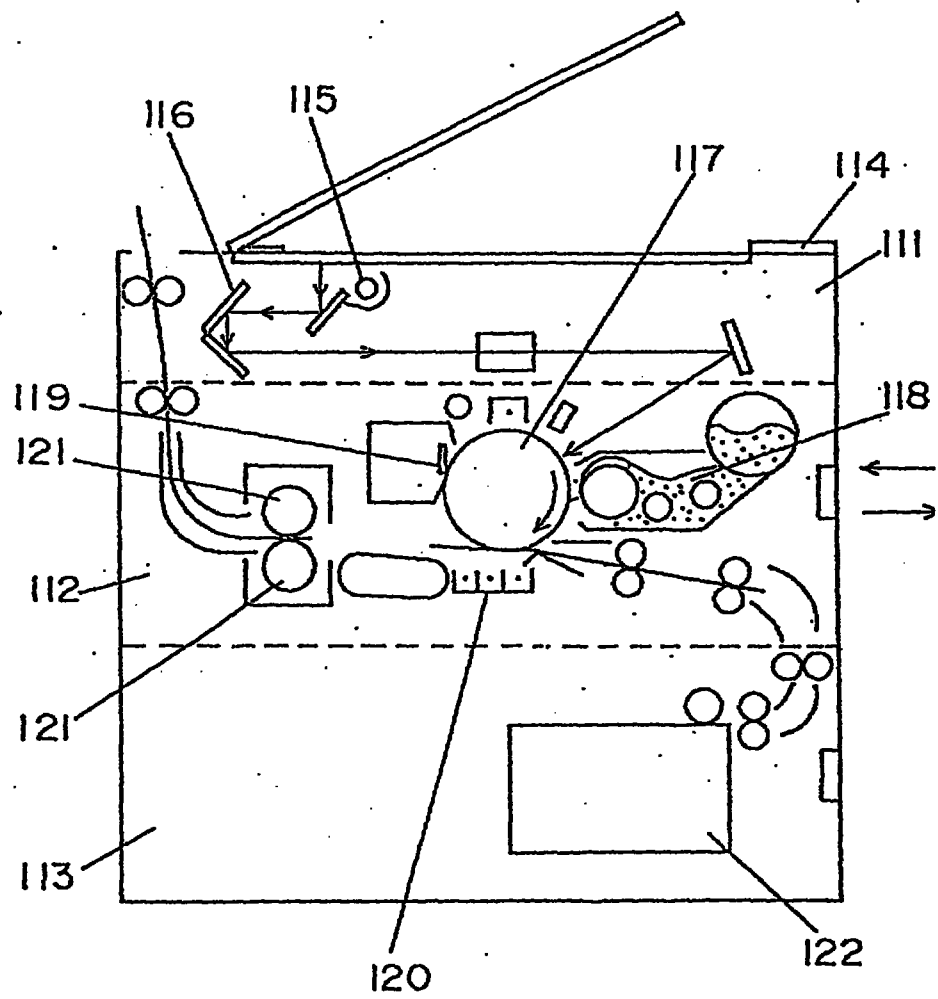


Fig. 7

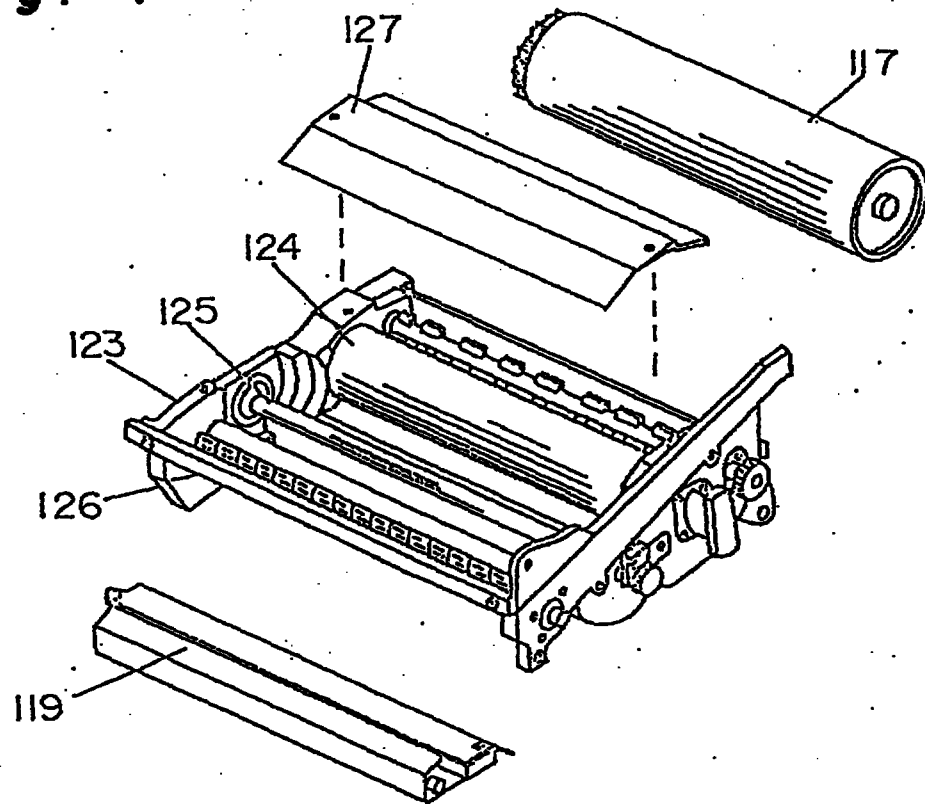


Fig. 8

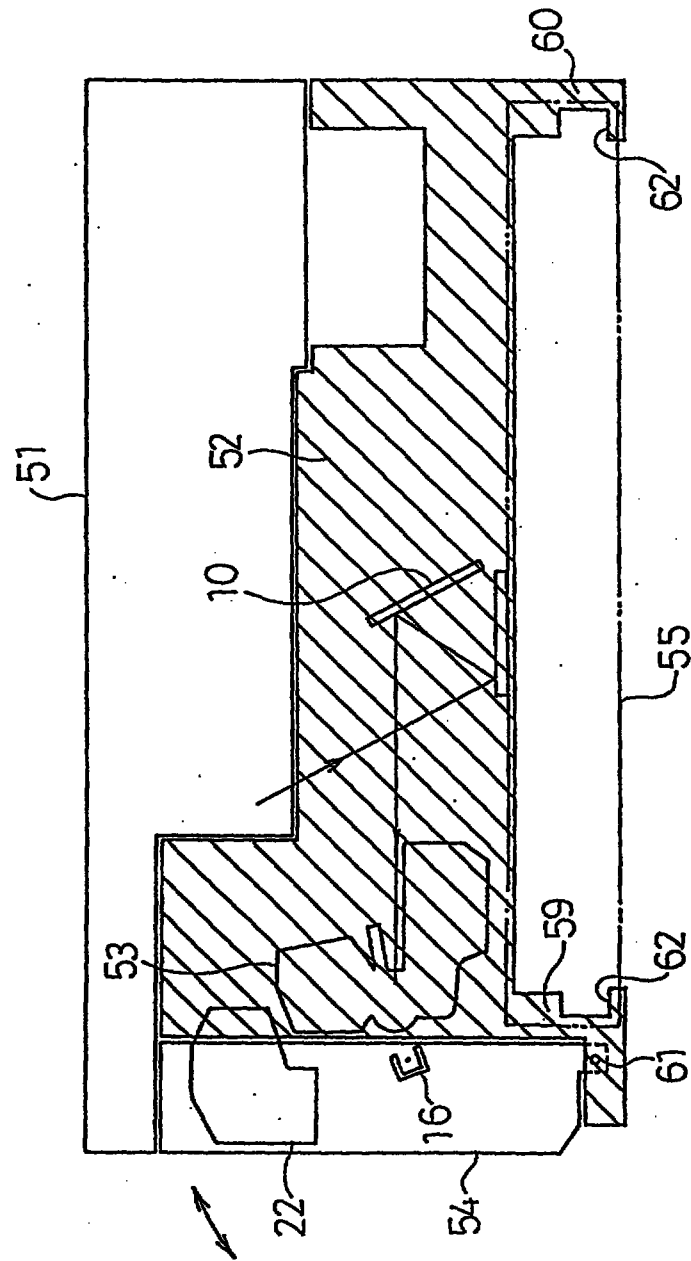


Fig. 9

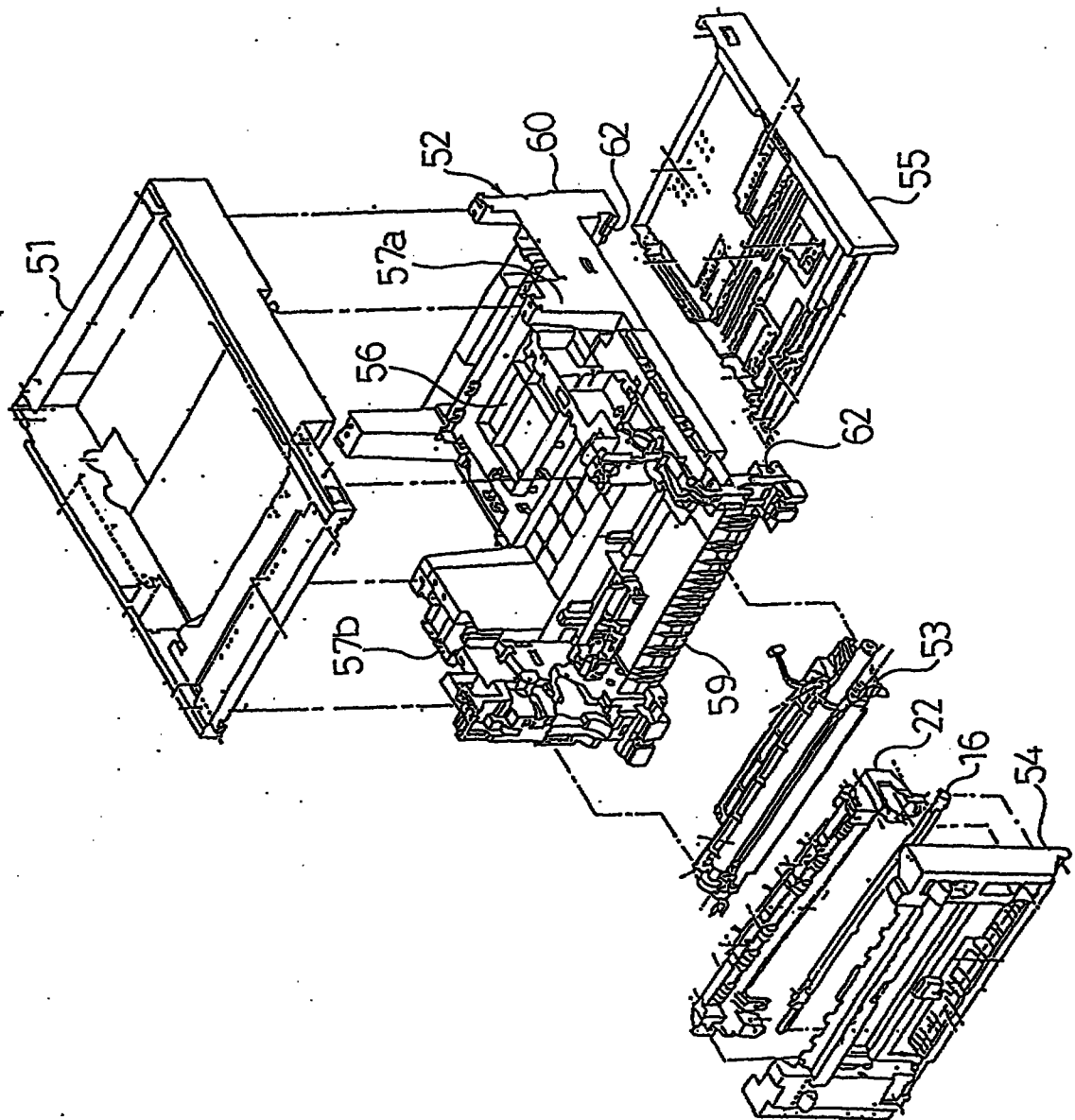


Fig. 10

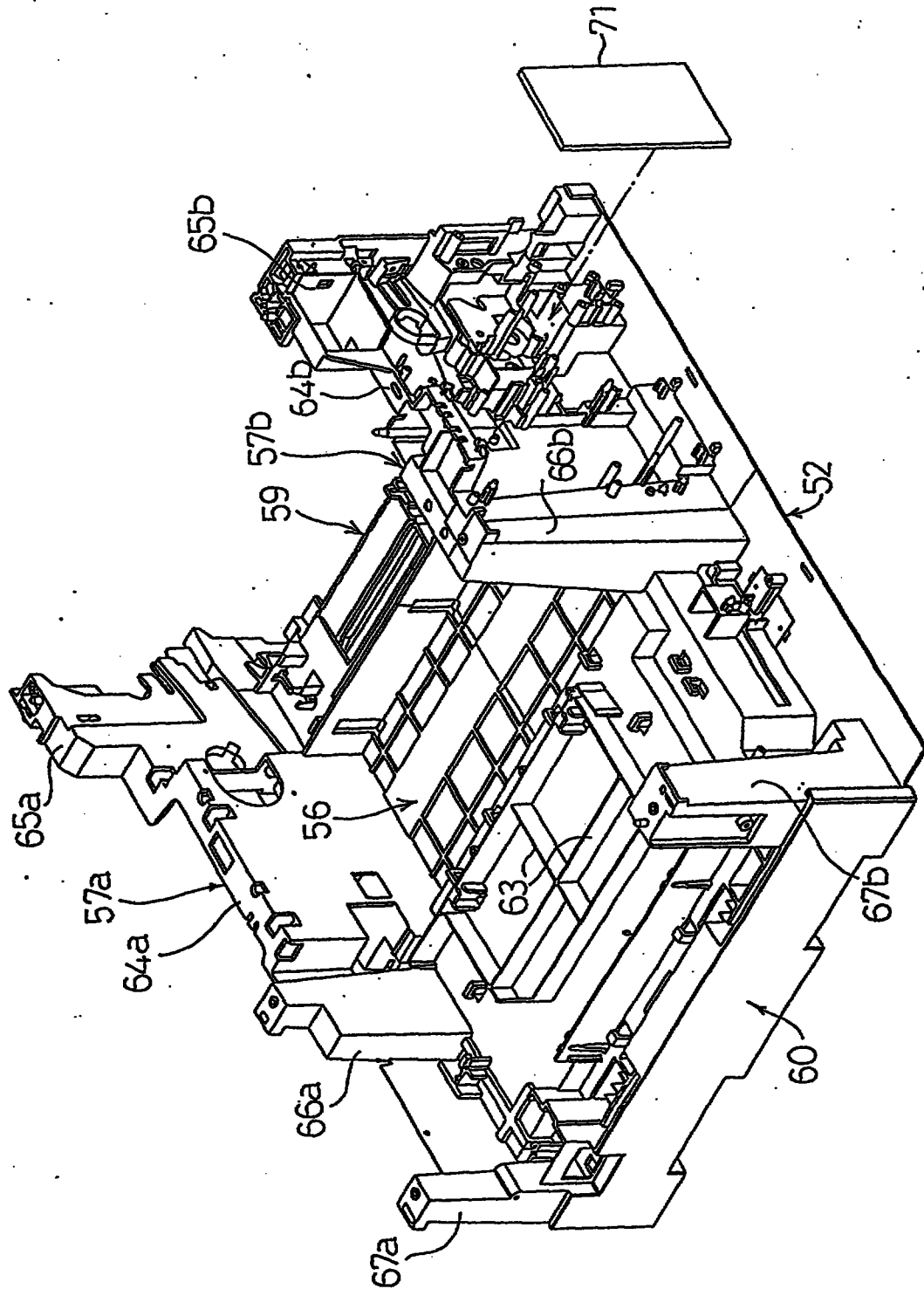
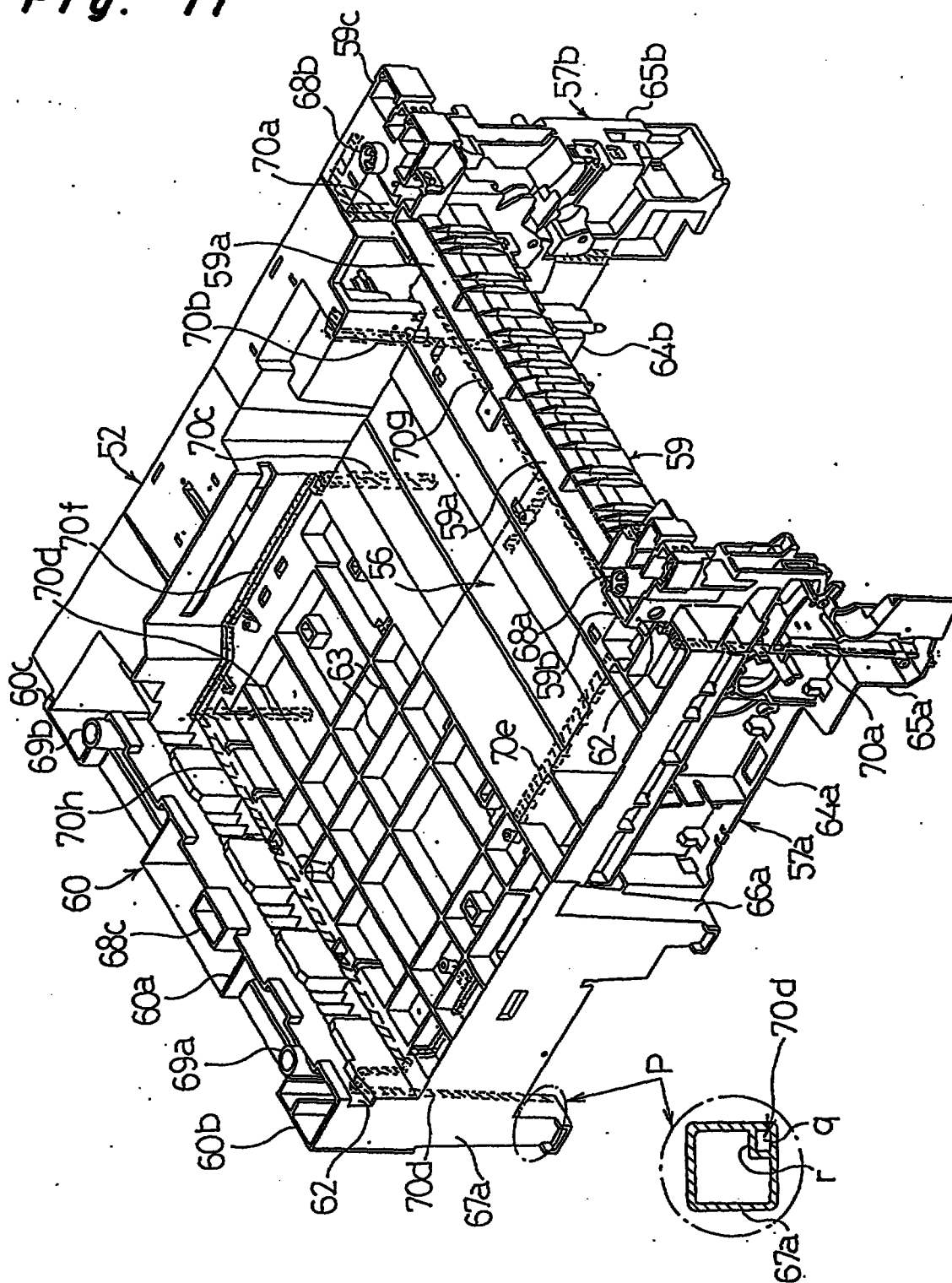


Fig. 11



REFERENCE NUMERALS

1: exposure optical unit, 2: image processing unit, 3: sheet feeder unit, 5: lamp, 6: first reflecting mirror, 7a, 7b: second reflecting mirror, 9: third reflecting mirror, 11: photosensitive drum, 15: developing device, 16: transfer charger, 17: cleaning means, 20: sheet, 22: fixing device, 23: discharge roller, 28: base, 29: side wall, 30: pillar member, 31: engaging hole, 33a - 33d: gas groove, 34: lower frame, 35: upper frame, 45: sheet conveyor unit, 52: apparatus body casing, 53: developing unit, 54: opening/closing casing, 55: sheet feeder cassette, 56: base, 57a, 57b: side wall, 59, 60: leg wall, 62: guide groove, 63: reinforcing rib, 65a, 65b, 66a, 66b, 67a, 67b, 59a, 59b, 59c, 60a, 60b, 60c: hollow pillar portion, 68a, 68b, 68c: grounding protrusion, 69a, 69b: auxiliary grounding protrusion, 70a - 70h: gas groove, 71: high-voltage power supply board.



REPLACED SHEETS SG

☐ Description : paged to paged
☒ Claim(s) : paged 36 to paged 39
☐ Drawing(s) : paged to paged
☐ Abstract : paged to paged

- 26 -

CLAIMS

1. An electrophotographic copying apparatus comprising:

a document plate glass (4) for placing thereon a
5 document to be copied;

an exposure optical unit (1) including: first
reflecting means (5, 6) which are disposed below the
document plate glass and which are designed to scan the
document placed on the document plate glass by moving from
10 one end side to the other end side of the document plate
glass; second reflecting means (7) which is placed in such
a region ranging from below a generally central portion of
the document plate glass to below the other end side of the
document plate glass as will not hinder the first
15 reflecting means from scanning and which moves at a speed
1/2 that of the first reflecting means; a lens (8) which is
designed to project the document scanned by the first and
second reflecting means onto a photosensitive drum (11);
and third reflecting mirror (9) which is designed to bend
20 downward a document image that has passed through the lens
and thereby lead the image to the photosensitive drum;

an image processing unit (2) including charging
means (12), an exposure slit (14), developing means (15),
transfer means (16) and cleaning means (17) provided around
25 the photosensitive drum so as to visualize an optical image

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- 27 -

projected from the lens and to copy the image onto a sheet;

a sheet feeder section (3) which is designed to feed a sheet to the transfer means of the image processing unit; and

5 a fixing-and-discharge section (23) designed to fix and discharge the sheet which has been discharged from the image processing unit and onto which the document image has been transferred,

wherein an image processing and conveyance unit
10 is constituted up by placing the image processing unit above one end of a sheet feeder cassette (24) of the sheet feeder section so that sheets will be fed to the transfer means of the image processing unit one by one from the sheet feeder section upward and generally vertically to the
15 surfaces of sheets accommodated in the sheet feeder cassette, and by placing the fixing-and-discharge section further above the image processing unit so that the sheet discharged upward from the image processing unit will be fixed and discharged;

20 a top portion of the image processing and conveyance unit is located at a place which is below a region of scanning by the first reflecting means of the exposure optical unit and out of a region of scanning by the second reflecting means and which is adjacent to the
25 third reflecting means so that the sheet will be discharged

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- 28 -

from the image processing and conveyance unit to a proximity to the document placed on the document plate glass;

the first and second reflecting means start a
5 scan in a positional relation that the image processing unit is arranged as described above and that the first and second reflecting means are away from each other on one end side and a center side of the document plate glass, and terminate the scan at a scanning end point on the other end
10 side of the document plate glass in a positional relation that the first and second reflecting means are close to each other;

the electrophotographic copying apparatus further comprises: unit retaining portions which are erected on
15 both sides of one end of a base (28) and each have an engaging portion (31) formed to retain the image processing unit and which have a generally U shape in cross section; and an integral resin frame in which a plurality of pillar portions (30) are disposed on the other end of the base;

20 gas grooves (33a) having in their interior thereof passages of inert gas for molding with gas assist provided at boundary portions between the unit retaining portions each having a generally U shape in cross section of the resin frame and the base, while gas grooves (33c)
25 are extendedly provided so that the aforementioned gas

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- 29 -

grooves are branched to the plurality of pillar portions (30) disposed at the other end of the base, and the unit retainer portions and the pillar portions have upper end portions, respectively, molded with higher dimensional accuracy than the other portions by molding the unit retainer portions and the pillar portions thicker in walls than the other portions and hollow and by feeding therein inert gas with use of the gas grooves during molding processes;

10 and wherein the image processing unit is mounted to the unit retaining portions of the resin frame, while the exposure optical unit is mounted to upper end portions of the unit retaining portions and upper end portions of the pillar portions in the resin frame.

15 2. The electrophotographic copying apparatus according to Claim 1, wherein gas grooves (33b) are branched and extended vertically in proximity to the engaging portions (31) formed in the unit retaining portions each having a generally U shape in cross section
20 of the resin frame, the gas grooves being provided at boundary portions between the unit retaining portion and the base (28), and having in their interior passages of inert gas for molding with gas assist.

3. The electrophotographic copying apparatus
25 according to Claim 1 or 2, wherein leg portions (32) are

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- 30 -

provided so as to be integrally extended from the base (28) in a direction opposite to the unit retaining portions each having a generally U shape in cross section of the resin frame, and gas grooves (33d) having in their interior
5 passages of inert gas for molding with gas assist are provided at boundary portions between the base and the leg portions.

4. The electrophotographic copying apparatus according to Claim 1, wherein an exposure-optical-system-
10 containing casing (51) containing at least a movable part of the exposure optical unit, an apparatus body casing (52) to which the image processing unit is removably fitted, and a sheet feeder cassette (55) are arranged so as to be stacked from above to below;

15 the electrophotographic copying apparatus further comprising an opening/closing casing (54) in which the transfer means (16) and the fixing-and-discharge section (22) are disposed in a fore of the apparatus body casing;

the apparatus body casing has a base (56), left
20 and right side walls (57a, 57b), and front and rear leg walls (59, 60) projected downward from front and rear sides, these members having been integrally molded of resin;

the exposure-optical-system-containing casing is
25 mounted to upper end surfaces of the left and right side

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- 31 -

walls;

a lower end portion of the opening/closing casing is pivotally supported to the front leg wall;

and wherein the sheet feeder cassette is insertably and removably accommodated in gas grooves (62) formed at inner peripheries of the front and rear leg walls.

5 The electrophotographic copying apparatus according to Claim 4, wherein the left and right side walls and front and rear leg walls of the apparatus body casing each have a plurality of hollow pillar portions (67a, 67b), and the base has a multiplicity of reinforcing ribs (63).

10 6. The electrophotographic copying apparatus according to Claim 4 or 5, wherein a left-and-right pair of grounding protrusions (68a, 68b) are formed in a lower surface of one leg wall out of the front and rear leg walls;

one grounding protrusion (68c) is formed in a center of a lower surface of the other leg wall;

20 and wherein the apparatus body casing is supported at three points by the grounding surface.

7. The electrophotographic copying apparatus according to Claim 6, wherein auxiliary grounding protrusions (69a, 69b) slightly smaller in protruding amount than the grounding protrusions are provided on both

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- 32 -

sides of the grounding protrusion in the lower surface of the other leg wall.

8. The electrophotographic copying apparatus according to any one of Claims 4 to 7, wherein a high-
5 voltage power supply board (71) is mounted directly on one side wall of the apparatus body casing.

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REPLACEMENT SHEETS		SG
☐	Description : paged to paged	
☒	Claim(s) : paged 36 to paged 33	
☐	Drawing(s) : paged to paged	
☐	Abstract : paged to paged	
DATE OF RECEIPT		13 NOV 1998

26

Substitute sheet
11 November 1998



CLAIMS

1. An electrophotographic copying apparatus comprising:

5 a document plate glass (4) for placing thereon a document to be copied;

an exposure optical unit (1) including: first reflecting means (5, 6) which are disposed below the document plate glass and which are designed to scan the document placed on the document plate glass by moving from one end side to the other end side of the document plate glass; second reflecting means (7) which is placed in such a region ranging from below a generally central portion of the document plate glass to below the other end side of the document plate glass as will not hinder the first reflecting means from scanning and which moves at a speed 1/2 that of the first reflecting means; a lens (8) which is designed to project the document scanned by the first and second reflecting means onto a photosensitive drum (11); and third reflecting mirror (9) which is designed to bend downward a document image that has passed through the lens and thereby lead the image to the photosensitive drum;

25 an image processing unit (2) including charging means (12), an exposure slit (14), developing means (15), transfer means (16) and cleaning means (17) provided around the photosensitive drum so as to visualize an optical image

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Date: 13 NOV 1998



projected from the lens and to copy the image onto a sheet;
a sheet feeder section (3) which is designed to
feed a sheet to the transfer means of the image processing
unit; and

5 a fixing-and-discharge section (23) designed to
fix and discharge the sheet which has been discharged from
the image processing unit and onto which the document image
has been transferred,

wherein an image processing and conveyance unit
10 is constituted up by placing the image processing unit
above one end of a sheet feeder cassette (24) of the sheet
feeder section so that sheets will be fed to the transfer
means of the image processing unit one by one from the
sheet feeder section upward and generally vertically to the
15 surfaces of sheets accommodated in the sheet feeder
cassette, and by placing the fixing-and-discharge section
further above the image processing unit so that the sheet
discharged upward from the image processing unit will be
fixed and discharged;

20 a top portion of the image processing and
conveyance unit is located at a place which is below a
region of scanning by the first reflecting means of the
exposure optical unit and out of a region of scanning by
the second reflecting means and which is adjacent to the
25 third reflecting means so that the sheet will be discharged

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Date: 13 NOV 1998



from the image processing and conveyance unit to a proximity to the document placed on the document plate glass;

5 the first and second reflecting means start a scan in a positional relation that the image processing unit is arranged as described above and that the first and second reflecting means are away from each other on one end side and a center side of the document plate glass, and terminate the scan at a scanning end point on the other end
10 side of the document plate glass in a positional relation that the first and second reflecting means are close to each other;

the electrophotographic copying apparatus further comprises: unit retaining portions which are erected on
15 both sides of one end of a base (28) and each have an engaging portion (31) formed to retain the image processing unit and which have a generally U shape in cross section; and an integral resin frame in which a plurality of pillar portions (30) are disposed on the other end of the base;

20 gas grooves (33a) having in their interior thereof passages of inert gas for molding with gas assist provided at boundary portions between the unit retaining portions each having a generally U shape in cross section of the resin frame and the base, while gas grooves (33c)
25 are extendedly provided so that the aforementioned gas

This is the replacement sheet

Date: 13 NOV 1998



grooves are branched to the plurality of pillar portions (30) disposed at the other end of the base, and the unit retaining portions and the pillar portions have upper end portions, respectively, molded with higher dimensional accuracy than the other portions by molding the unit retainer portions and the pillar portions thicker in walls than the other portions and hollow and by feeding therein inert gas with use of the gas grooves during molding processes;

10 and wherein the image processing unit is mounted to the unit retaining portions of the resin frame, while the exposure optical unit is mounted to upper end portions of the unit retaining portions and upper end portions of the pillar portions in the resin frame.

15 2. The electrophotographic copying apparatus according to Claim 1, wherein gas grooves (33b) are branched and extended vertically in proximity to the engaging portions (31) formed in the unit retaining portions each having a generally U shape in cross section
20 of the resin frame, the gas grooves being provided at boundary portions between the unit retaining portions and the base (28), and having in their interior passages of inert gas for molding with gas assist.

3. The electrophotographic copying apparatus
25 according to Claim 1 or 2, wherein leg portions (32) are

This is the replacement sheet

Date: 13 NOV 1998



provided so as to be integrally extended from the base (28) in a direction opposite to the unit retaining portions each having a generally U shape in cross section of the resin frame, and gas grooves (33d) having in their interior passages of inert gas for molding with gas assist are provided at boundary portions between the base and the leg portions.

4. The electrophotographic copying apparatus according to Claim 1, wherein an exposure-optical-system-containing casing (51) containing at least a movable part of the exposure optical unit, an apparatus body casing (52) to which the image processing unit is removably fitted, and a sheet feeder cassette (55) are arranged so as to be stacked from above to below;

15 the electrophotographic copying apparatus further comprising an opening/closing casing (54) in which the transfer means (16) and the fixing-and-discharge section (22) are disposed in a fore of the apparatus body casing;

20 the apparatus body casing has a base (56), left and right side walls (57a, 57b), and front and rear leg walls (59, 60) projected downward from front and rear sides, these members having been integrally molded of resin;

25 the exposure-optical-system-containing casing is mounted to upper end surfaces of the left and right side walls;

This is the replacement sheet

Date: 13 NOV 1998



a lower end portion of the opening/closing casing is pivotally supported to the front leg wall;

and wherein the sheet feeder cassette is insertably and removably accommodated in gas grooves (62) formed at inner peripheries of the front and rear leg walls.

5 The electrophotographic copying apparatus according to Claim 4, wherein the left and right side walls and front and rear leg walls of the apparatus body casing each have a plurality of hollow pillar portions (67a, 67b), and the base has a multiplicity of reinforcing ribs (63).

10 The electrophotographic copying apparatus according to Claim 4 or 5, wherein a left-and-right pair of grounding protrusions (68a, 68b) are formed in a lower surface of one leg wall out of the front and rear leg walls;

15 one grounding protrusion (68c) is formed in a center of a lower surface of the other leg wall;

and wherein the apparatus body casing is supported at three points by the grounding surface.

20 The electrophotographic copying apparatus according to Claim 6, wherein auxiliary grounding protrusions (69a, 69b) slightly smaller in protruding amount than the grounding protrusions are provided on both sides of the grounding protrusion in the lower surface of

25 the other leg wall.

This is the replacement sheet

Date: 13 NOV 1998



8. The electrophotographic copying apparatus according to any one of Claims 4 to 7, wherein a high-voltage power supply board (71) is mounted directly on one side wall of the apparatus body casing.

5 9. The electrophotographic copying apparatus according to any one of Claims 4 to 8,

wherein the apparatus body casing (52) has gas grooves (70a to 70h) each of which comprises a passage (q) through which inert gas passes in molding with gas assist, and a
10 peripheral wall portion (r) formed around this passage (q), so that one corner portion of the hollow pillar member (67a) is reinforced from inside, and therefore that the whole hollow pillar member (67a) is reinforced,

the left side wall (57a) is formed into a hollow wall
15 member (64a) over its about 2/3 range on its front side, a front end portion of which is a high wall portion (65a) of a much taller hollow pillar shape, and a rear end portion of which is a hollow pillar portion (66a), the left side wall (57a) also has a hollow pillar member (67a) at its
20 rear end portion,

the right side wall (57b) is formed into a hollow wall member (64b) over its about 2/3 range on its front side, a front end portion of which is a high wall portion (65b) of a much taller hollow pillar shape, and a rear end portion
25 of which is a hollow pillar portion (66b), the right side

This is the replacement sheet
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Date: 13 NOV 1998



wall (57b) also has a hollow pillar member (67b) at its rear end portion,

the gas grooves (70a) reinforces the high wall portions (65a, 65b), the gas grooves (70b) reinforces center portions of the hollow wall members (64a, 64b); the gas grooves (70c) reinforces the hollow pillar portions (66a, 66b), the gas grooves (70d) reinforces the hollow pillar members (67a, 67b), the gas groove (70e) is provided at a boundary portion between the base (56) and the left side wall (57a) to reinforce this boundary portion, the gas groove (70f) is provided at a boundary portion between the base (56) and the right side wall (57b) to reinforce this boundary portion, the gas groove (70g) is provided at a boundary portion between the base (56) and the front leg wall (59) to reinforce this boundary portion, and the gas groove (70h) is provided at a boundary portion between the base (56) and the rear leg wall (60) to reinforce this boundary portion.