

[54] **ELECTROPHOTOGRAPHIC APPARATUS FOR COPYING DOCUMENTS OF VARIOUS THICKNESSES**

[72] Inventors: **Takaji Washio**, Toyonaka; **Yasusuke Tohi**, Ikeda; **Tatsuo Aizawa**, Osaka, all of Japan

[73] Assignee: **Mita Industrial Company Limited**, Higashi-ku, Osaka, Japan

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[51] Int. Cl.G03g 15/00

[58] Field of Search.....355/3, 50, 51, 64, 65, 76, 355/82, 89, 99, 109, 8

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Primary Examiner—Samuel S. Matthews

Assistant Examiner—Kenneth C. Hutchison

Attorney—Sherman and Shalloway

[57]

ABSTRACT

An electrostatic copying machine including apparatus for transporting single sheet original documents or books past an exposure station. All originals are transported and supported by a set of drive rollers along a horizontal path at the top of the machine. To transport single sheet originals a set of opposing idler rollers, each extending adjacent to the central portion of a drive roller and biased downward toward that roller, cooperates with the drive rollers. Slightly thicker materials, such as pamphlets, are placed on a rigid transparent platform having a protective light-blocking cover sheet and are driven between the drive rollers and a set of narrow idler rollers which are located adjacent to both ends of the first idler rollers and which contact the edges of the platform. For books and other still thicker originals the top panel of the machine, to which the first idler rollers are attached, is removed so that those rollers do not interfere with the transporting of the book; the book is placed on the rigid carrier as before, with the narrow edge rollers cooperating as before to transport the carrier.

8 Claims, 15 Drawing Figures

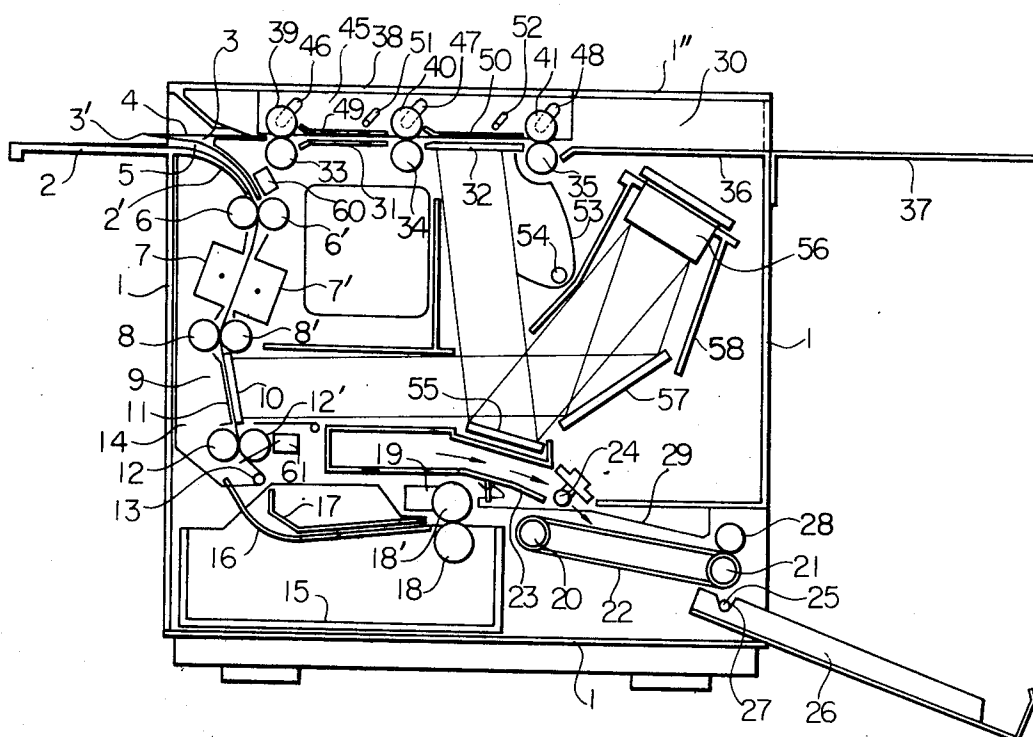
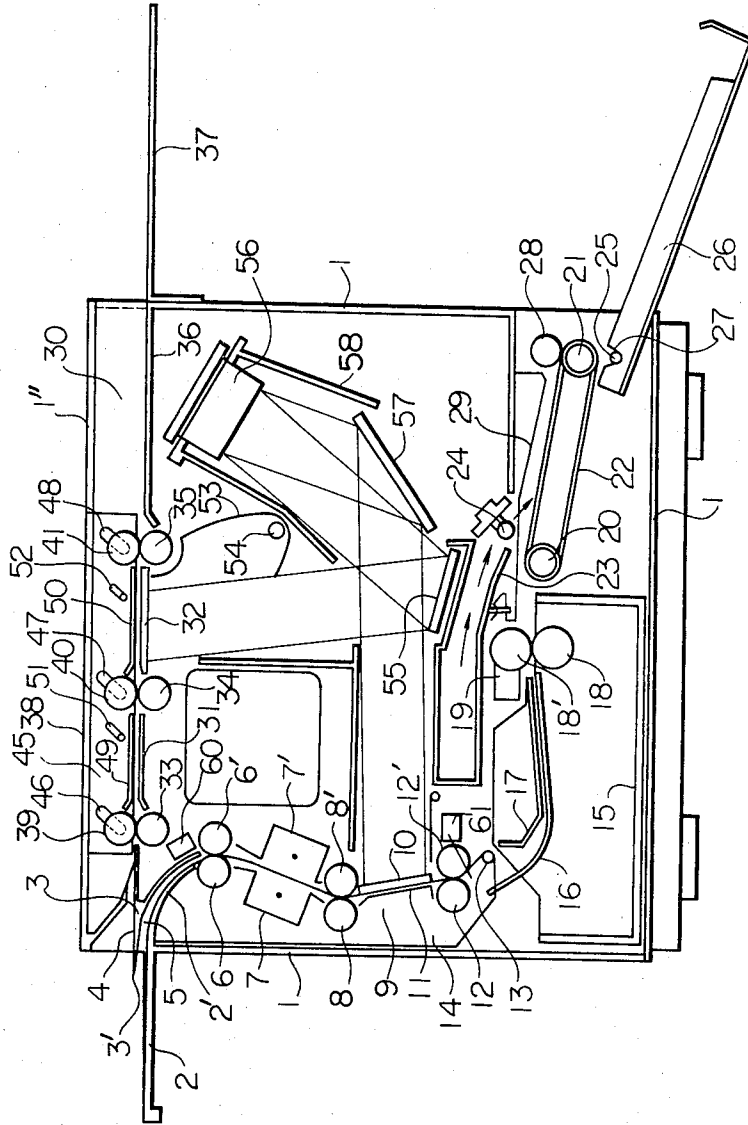


Fig. 1



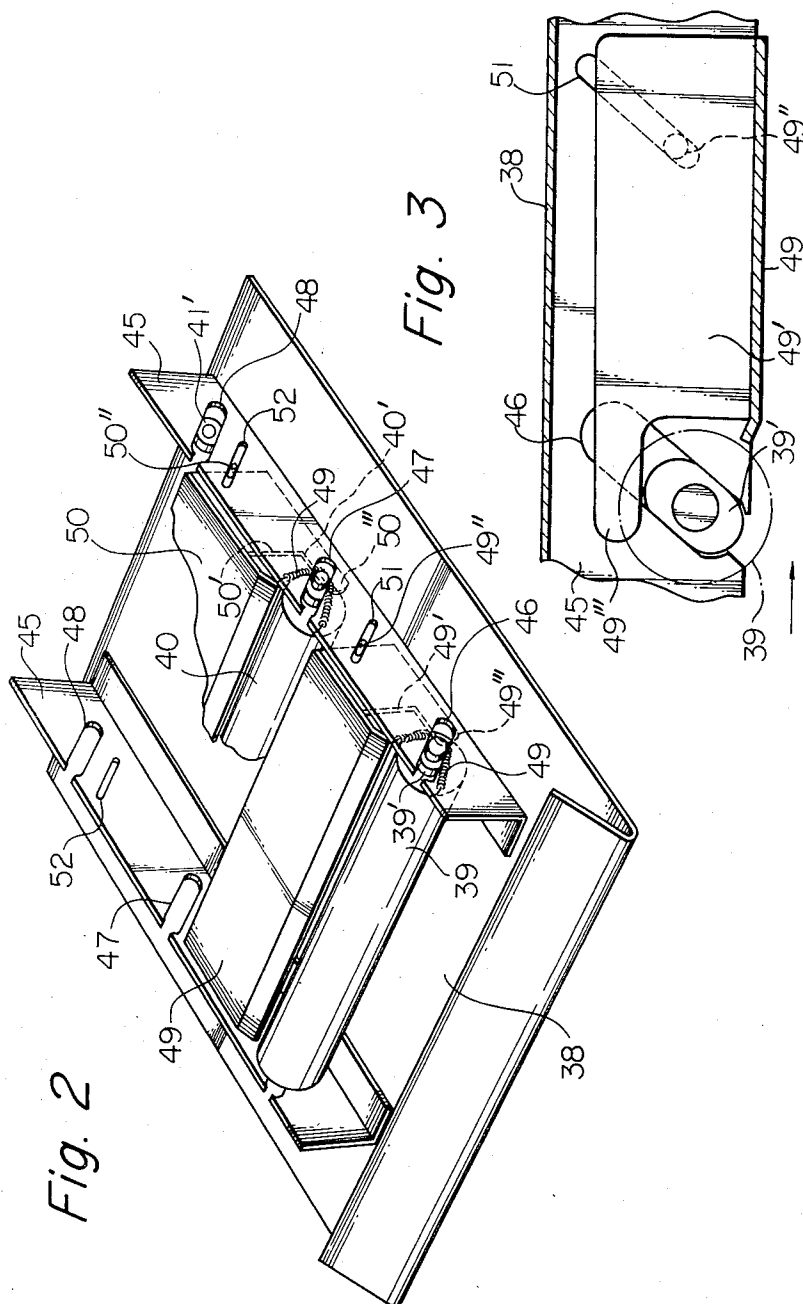


Fig. 4

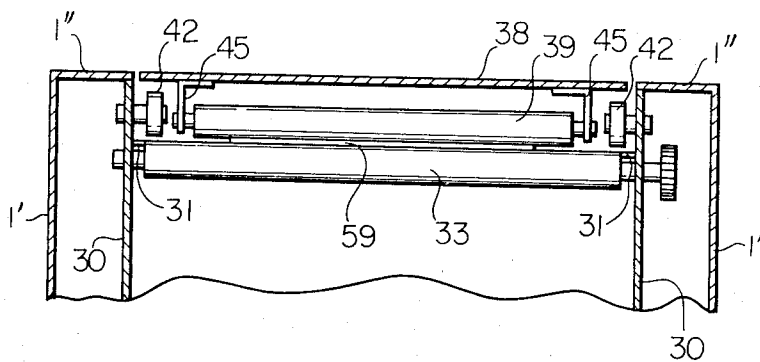


Fig. 5

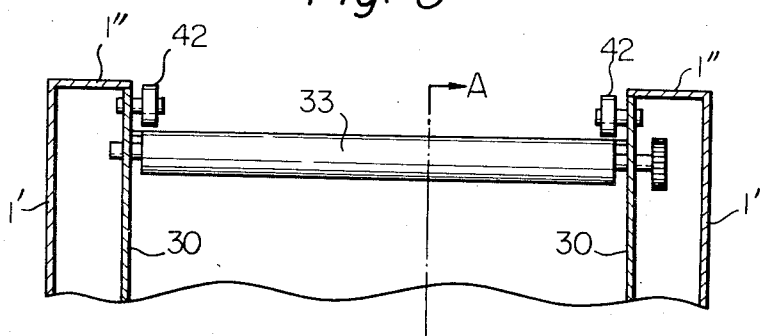


Fig. 6

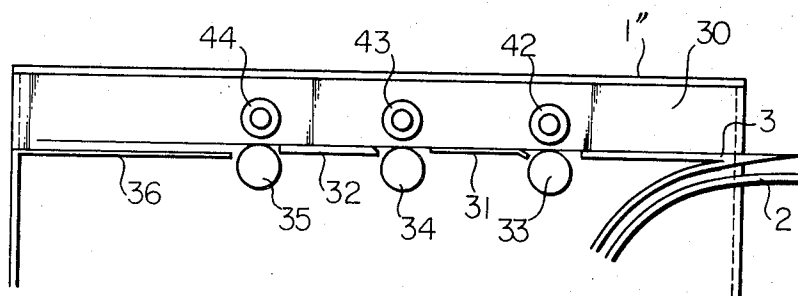


Fig. 7

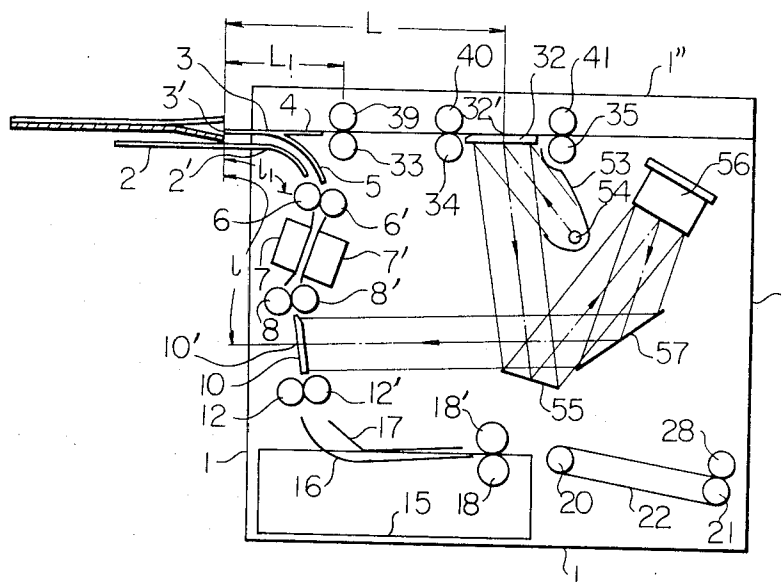


Fig. 9

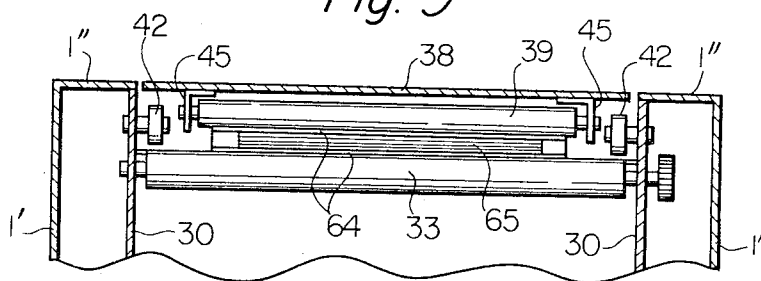


Fig. 11

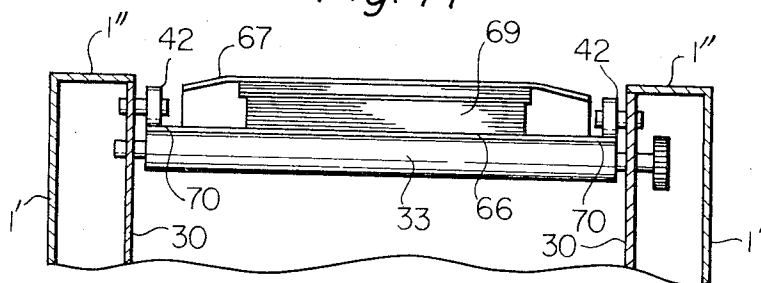


Fig. 8A

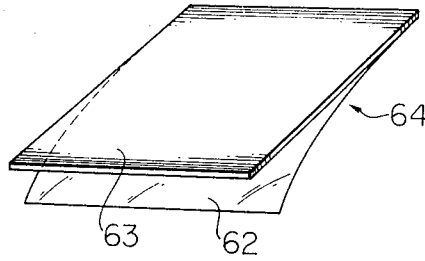


Fig. 8B

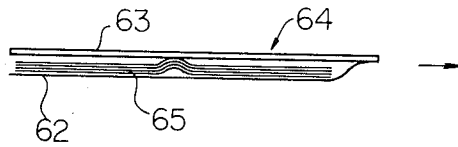


Fig. 8C

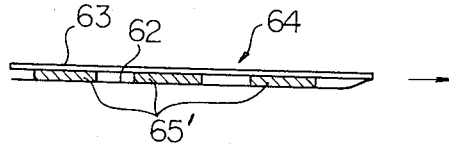


Fig. 10A

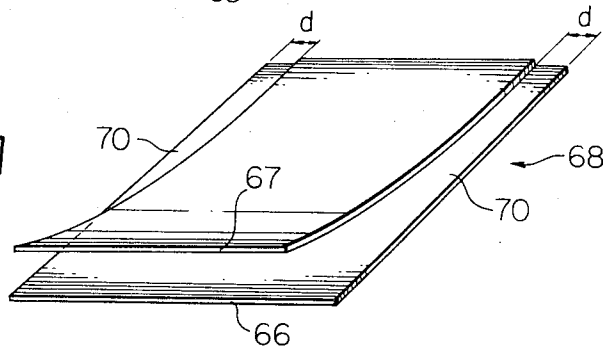


Fig. 10B

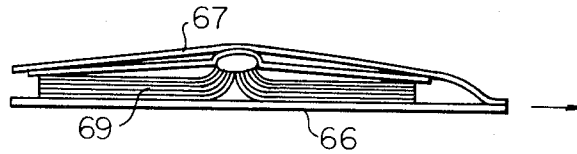
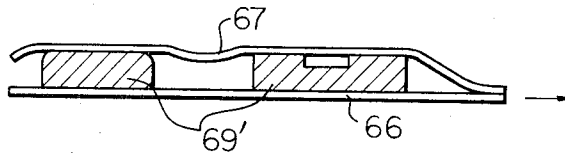


Fig. 10C



ELECTROPHOTOGRAPHIC APPARATUS FOR COPYING DOCUMENTS OF VARIOUS THICKNESSES

This invention relates to an electrophotographic copying apparatus, and more specifically to an electrophotographic copying apparatus of simplified structure for use in many ways including a transfer passage adapted to support and transfer a thin sheet-like original or a relatively thick original of uniform thickness and a transfer passage adapted to support and transfer a thick book or other solid material carrying it on a transparent thin plate.

As is well known, according to the electrophotographic copying method, a copying paper having a photoconductive coating layer is charged, for instance, by corona discharge; and image of the original is formed on the charged copying paper by an appropriate exposing mechanism, thereby forming an electrostatic latent image; thereafter, the exposed, latent image-carrying copying paper is developed with a liquid or solid toner having charged coloring particles, and fixed, as required.

Many of the known electrophotographic copying machines include a transfer mechanism for feeding the original to an exposing zone and another transfer mechanism provided independently of the original-transfer mechanism for feeding an electrophotographic copying material to a charging zone, an exposing zone, and a developing zone. The original-transfer mechanism consists of a reciprocating table which carries a thin sheet-like original, a book or other solid materials and reciprocates on the exposing area. Or the construction is such that the original-carrying table is fixed, and a copying paper is exposed while being stopped. The first-mentioned type requires a special drive mechanism to reciprocate the original-carrying table, and it is inevitable that the apparatus occupies a larger area. This type of electrophotographic copying apparatus further requires the provision of a special control mechanism since a step of passing the original through an original-exposing zone and a step of passing an electrophotographic copying paper through a copying paper-exposing zone must be carried out in a timely manner.

The latter type requires a special mechanism of stopping the copying paper in a flat state at a predetermined position. When the stopping, full-frame exposing method is used, a large space is needed for a lens having a wide angle of view and an optical system. The use of the transferring, slit exposing method will obviate these difficulties, but a special mechanism for moving the optical system without vibrations and a special mechanism for regulating and coordinating the transfer, stopping, exposing, and a further transfer of the copying paper are required.

German Patent Publication (DAS) 1,278,817 discloses an electrophotographic copying apparatus including an exposing device, a developing device and a paper feed device in conjunction with a control device, said apparatus comprising a transparent plate on the upper surface of a housing for exposing the original, drive feed rollers extending beyond the upper surface of the housing and located before and after the transparent plate, and a back pressure roller capable of pressure-contacting with said feed roller and provided in a

frame removable from the upper surface of the housing. In this apparatus, a tin sheet-like original is fed only in one direction through a space between the feed rollers and the back-pressure roller. A thick original such as a book is conveyed to an original-exposing area by means of the drive feed rollers after removing the frame supporting the back-pressure roller from the upper surface of the housing. However, to drive the original by the drive feed rollers relying only on the contact pressure of the original caused by its own weight becomes the cause of deviation of the original from a normal transfer path or of a disordered timing between the original-exposing step and the copying paper-exposing step. Moreover, fragments of solid materials and materials having uneven surfaces cannot be transferred by this method.

This apparatus is simplified in that it does not require a special mechanism for reciprocating the original on an original-exposing zone. But it requires the provision of a special control device for regulating and coordinating the timing of a step of feeding a copying paper from the paper feed mechanism to the copying paper exposing zone and a step of feeding the original to the original-exposing zone, and adds to the complication of the apparatus as a whole.

An object of the present invention is to provide an electrophotographic copying apparatus including a transfer passage for supporting and transferring a thin sheet-like original or a relatively thick original or uniform thickness and another transfer passage for transferring a thick book or other solid materials on a transparent thin plate, wherein a step of exposing the original and a step of exposing a copying paper can be carried out always in a timely fashion merely by superposing the original and the copying paper and transferring them selectively through the respective passages.

Another object of the present invention is to provide an electrophotographic copying apparatus which carries out a step of exposing the original and a step of exposing the electrophotographic copying paper always in a timely fashion and therefore does not require any control device to regulate and coordinate the timing.

Still another object of the present invention is to provide an electrophotographic copying apparatus of simplified structure which occupies a relatively small space for installation, and is usable for many purposes.

According to the present invention, there is provided an electrophotographic copying apparatus including a charging mechanism for charging an electrophotographic copying paper, an exposing mechanism for projecting an image of the original on the charged copying paper, a developing mechanism for developing the exposed copying paper, a transfer mechanism for transferring the copying paper successively to said mechanisms, and an original-transferring mechanism for transferring the original to the exposing mechanism, said original transferring mechanism comprising a pair of opposing side plates spaced inwardly from the sides of a housing and extending downwardly from the upper surface of the housing, a guide plate defining the lower side of the passage for the original and secured to said side plates at intervals from the upper surface to the lower part of said housing, a transparent plate for exposing the original constituting a part of the lower side of said original passage, a plurality of drive rollers

rotatably journaled onto the side plates for transferring the original along said original passage, follow-up rollers suspended from a removable ceiling plate on the upper surface of the housing so as to move up and down and urge the original against the drive rollers, and bearing rollers for holding and transferring the transparent thin plate provided at the sides of said follow-up rollers and secured rotatably to the side plates; said transfer mechanism having an original-transferring passage whose lower side is defined by the drive rollers, guide plate and transparent plate for exposing the original and whose upper side is defined by the follow-up rollers and a transfer passage for an original-transferring transparent thin plate whose lower side is defined by the drive rollers and whose upper side is defined by the bearing rollers.

The apparatus of the present invention will be described in detail with reference to the accompanying drawings in which:

FIG. 1 is a side elevation in selection for illustrating the arrangement of the mechanisms of the apparatus;

FIG. 2 is a perspective view showing the structures of the follow-up rollers provided on the ceiling plate of the housing and those of support members for supporting an original guiding and pressing plate;

FIG. 3 is an enlarged, partly-broken-away side elevation for illustrating the state wherein the follow-up rollers and the original guiding and pressing plate are supported by the support member of the housing ceiling plate;

FIG. 4 is a partly-broken-away, front elevation illustrating the transfer passage for supporting and transferring a thin sheet-like original and showing the relative positions of the drive rollers and the follow-up rollers;

FIG. 5 is a partly-broken-away front elevation illustrating the transfer passage for the original-transferring transparent thin plate in a state where the ceiling plate of the housing is removed, and showing the relative positions of the drive rollers and the bearing rollers;

FIG. 6 is a side, sectional view taken along the line A of FIG. 5;

FIG. 7 is a view illustrating the relative positions of the transparent plate for exposing the original and the transparent plate for exposing the copying paper, the optical connection of both of said transparent plates, and the relative positions of a pair of the original feeding rollers and a pair of the copying paper feeding rollers;

FIG. 8A is a perspective view of a sheet carrier for use in feeding a somewhat thick or piece-like original between the drive rollers and the follow-up rollers; FIG. 8B and FIG. 8C are side elevations showing a somewhat thick original and a piece-like original each held by the sheet carrier;

FIG. 9 is a partly-broken-away front elevation showing the relative positions of the drive rollers and the follow-up rollers when a relatively thick original is supported and transferred;

FIG. 10A is a perspective view of a transparent thin plate for supporting and transferring a thick original such as a book and other solid material;

FIG. 10B and FIG. 10C are a side elevation showing the original transferring transparent thin plate on which a thick original or solid material is placed; and

FIG. 11 is a partly-broken-away front elevation illustrating the transfer passage for supporting and transferring a thick original and showing the relative positions of the drive rollers, original-transferring transparent thin plate and the bearing rollers.

In the electrophotographic copying apparatus of the invention as shown in FIG. 1, a table 2 is provided on the front surface of a frame 1, and a separating and guiding plate 3 is provided at a small distance from the table 2 so as to separate superposed original and electrophotographic copying paper and feed them to the respective transfer passages. The separating and guiding plate 3 has a plane upper surface 4 for guiding the original and a curved under surface 5 for guiding the copying paper downwards. The back part 2' of the table 2 is curved along the under surface 5 of the separating and guiding plate, and a transfer passage for the copying paper is formed between the under surface 5 of the separating and guiding plate and the back part 2'. In proximity to the back end of the under surface 5, a pair of copying paper feed rollers 6 and 6' are provided, and a charging mechanism 7 of the known type is located near the feed rollers. The charging mechanism 7 may, for instance, be a corona discharge electrode, or there may be a pair of charging mechanisms 7 and 7' on both sides of the copying paper passage. A pair of copying paper feed rollers 8 and 8' are disposed on the discharge side of the charging mechanism 7, and in proximity to the feed rollers 8 and 8', a copying paper-exposing area 9 is provided. The copying paper-exposing area 9 may consist of an exposing transparent plate 10 inside for exposing the copying paper and a guiding and pressing plate 11 near said transparent plate. Close to the discharge side of the copying paper exposing area 9 are disposed a pair of copying paper feed rollers 12 and 12'. The tables 2 and 2', the copying paper feed rollers 6, 8 and 12, the charging mechanism 7, and the guiding and pressing plate 11 may be fitted to a swingable frame 14 supported pivotally by a pin 13. This makes it possible to open and inspect the transfer passage for the copying paper.

At the bottom of the frame 1 is placed a tank 15 for accommodating a developing solution, and a developing dish 16 is disposed in the upper portion of the tank 15. A developing area is formed between the developing dish 16 and an upper dish 17 spaced by a small distance from the dish 16. Both the developing dish 16 and the upper dish 17 are opened underneath the copying paper feed rollers 12 and 12', and the copying paper is delivered to the developing area by means of the feed rollers 12 and 12'. The developing solution within the tank 15 is fed to the developing area through the upper dish 17 by means of a pump (not shown). On the discharge side of the developing area, a pair of squeezing rollers 18 and 18' are installed to return excessive developing solution adhering to the copying paper to the tank 15. A cleaner 19 comes in abutment with the squeezing roller 18' so as to sweep the toner particles adhering to the roller 18'. The developing dish 16, upper dish 17, and squeezing roller 18 may be secured to the tank 15, whereby they can be withdrawn from the apparatus for inspection together with the developing tank 15.

A front pulley or sprocket 20 is provided on the discharge side of the squeezing rollers 18 and 18', and a back pulley or sprocket 21 is provided on the rear side of the frame 1. A belt or chain 22 runs up between the pulleys or sprockets 20 and 21 to transfer a copying paper. A hot air feed duct 23 and a heater 24 are disposed near the front pulley or sprocket 20 so as to dry or fix the developed copying paper on the belt or chain 22. A pin 25 is located beneath the back pulley or sprocket 21, and a copying paper receiver 26 which, when not used, can be stored within the apparatus or removed is fixed by the engagement between a notch 27 and a pin 25. A copying paper delivery roller 28 is provided on the upper side of the back pulley or sprocket 21. In order to place a copying paper along the belt or chain 22, a guide 29 consisting, for instance, of wire is provided near the belt of chain 22.

In the above described transferring mechanism, when the developed copying paper is situated in front of the belt or chain 22, hot air impinges against the upper surface of the copying paper, and the copying paper can be effectively dried or fixed. On the other hand, when the copying paper reaches the back of the belt or chain 22, hot air blows against the back surface of the copying paper through spaces of the belt or chain and lifts it, thereby making it possible to transfer the copying paper smoothly to the copying paper receiver 26.

The combination, as described above, of the charging mechanism, exposing mechanism, developing mechanism and drying and fixing mechanism is one preferred embodiment of the electrophotographic copying apparatus of the present invention, and any optional combination known per se can be used.

One of the critical features of the apparatus of the invention is that the original-transferring mechanism includes two transfer passages, one for supporting and transferring a thin sheet-like original or a relatively thick original of uniform thickness, and the other for transferring a thick book and other solid material on a transparent thin plate.

To ensure this construction, a pair of opposing plates 30 spaced from the side surfaces 1' of the housing to its inside and extending downwardly from the upper surface 1'' of the housing are provided as shown in FIGS. 1, 4 and 6, and a guide plate 31 defining the underside of the original passage is fitted in said side plates 30 at a position spaced apart downwardly from the upper surface 1'' of the housing. The guide plate 31 is substantially on the same plane as the upper surface 4 of the separating and guiding plate 3, and on this same horizontal plane is disposed a transparent plate 32 for exposing the original so as to form a part of the underside of the original passage.

A plurality of drive rollers 33, 34 and 35 are rotatably mounted on said side plates 30 to transfer the original along this substantially horizontal original passage. The first drive roller 33 for transferring the original is interposed between the rear end of the upper surface 4 of the separating and guiding plate 3 and the front end of the guide plate 31; the second drive roller 34 is provided between the rear end of the guide plate 31 and the front end of the transparent plate 32; and the drive roller 35 is located in proximity to the rear end of the transparent plate 32. For ensuring a smooth

transfer of the original on the transparent plate 32, the upper ends of the drive rollers 33, 34 and 35 should preferably be on substantially the same surface as the horizontal plane including the transparent plate 32. On the discharge side of the drive roller 35 is provided a guide plate 36 at the rear end of which is installed an original receiver 37 in a horizontal relation with the guide plate 36. It is preferred that the guide plate 36 be provided slightly underneath the horizontal plane including the transparent plate 32.

In the apparatus of the present invention shown in FIG. 1, three drive rollers are disposed in a spaced relationship. The number of drive rollers is not limited to three, but the same effect can be achieved with two or four rollers or more, for instance. Follow-up rollers 39, 40 and 41 are suspended from a removable ceiling plate 38 on the upper surface 1'' of the housing so as to move up and down and urge the original against the drive rollers 33, 34 and 35. To the sides of the follow-up rollers 39, 40 and 41 and the side plates 30 are rotatably secured bearing rollers 42, 43 and 44 for holding and transferring the transparent thin plate that supports and transfers the original.

In FIG. 2 which shows the ceiling plate 38 in an up-side-down condition, supporting members 45 are installed on the underside of the ceiling plate 38. The supporting members have upwardly inclined long shaft holes 46, 47 and 48 to which the follow-up rollers 38, 40 and 41 are fitted through bearings 39', 40' and 41' for movement within the holes. The bearings 39', 40' and 41' are urged against the undersides of the holes by means of a suitable elastic member such as a coil spring 49, whereby the follow-up rollers 39, 40 and 41 are urged against the drive rollers 33, 34 and 35 respectively. The ceiling plate 38 of the housing is removably fixed to the housing 1'' by means of a known mechanism.

Another characteristic feature of the present invention is that as shown in FIGS. 2 and 3, the follow-up rollers 39, 40 and 41 are secured to the long shaft holes 46, 47 and 48 which are upwardly inclined against the transferring direction of the original. Even when a relatively thick original having a uniform thickness of about 1/4 inch, such as pamphlets, periodicals or newspapers, is fed between the drive rollers and the follow-up rollers, this construction permits the formation of a space for passage of the original by a rapid escape of the follow-up rollers upwards, without an excessive resistance due to the drive rollers and the follow-up rollers. Thus, a smooth support and transfer of the original becomes possible. The use of a sheet carrier which will be described later ensures a more smooth transfer of the original.

In the present invention, it is preferable that an original guiding and pressing plate 49 be provided between the follow-up rollers 39 and 40 so as to move up and down; while an original guiding and pressing plate 50, between the follow-up rollers 40 and 41 so as to move up and down, and the follow-up rollers 39, 40 and 41 and the original guiding and pressing plates 49 and 50 define the upper side of the original transferring passage. To achieve this end, long pin holes 51 and 52 are provided in the supporting members 45 in parallel with the long shaft holes 46, 47 and 48, as illustrated in FIGS. 2 and 3. The original guiding and pressing plates

49 and 50 have side plates 49' and 50' respectively. The side plates 49' and 50' include pins 49'' and 50'' fitting in said long pin holes 51 and 52 respectively, and supporting members 49''' and 50''' supported by bearings 39' and 40' of the follow-up rollers 39 and 40 and moving up and down together with the bearings 39' and 40'. Thus, the original guiding and pressing plates 49 and 50 make it easy for the original to pass through the original feed rollers 34, 40 and 35, 41, and the plate 50 makes it possible to bring the original into intimate contact with the transparent plate 32. Even when a relatively thick original is fed, the original guiding and pressing plates 49 and 50 escape easily without any resistance incident to the escape of the follow-up rollers 39, 40 and 41 since the front ends of the plates 49 and 50 are supported on the bearings 39' and 40' fitted by means of the supporting members 49''' and 50''' in a manner freely movable within the long shaft holes described above. The rear ends of the plates 49 and 50 are supported by the pins 49'' and 50'' freely movable in the long pin holes 51 and 52 provided in parallel with said long shaft holes. Hence, with the movement of the original, the rear ends of the plates 49 and 50 can also escape readily without any resistance.

Referring to FIGS. 5 and 6, bearing rollers 42, 43 and 44 secured to the side plates 30 for supporting and transferring a thick original such as a book and a solid material onto the transparent plate 32 for exposing the original go in pair with the drive rollers 33, 34 and 35, and form a passage for transferring the transparent thin plate for supporting and transferring the original. The bearing rollers 42, 43 and 44 and the driver rollers 33, 34 and 35 are provided through a small space for passage of the original supporting and transferring transparent thin plate. It is preferred that this small space be within the focal depth of the optical system employed. For instance, the practical focal depth in taking a photograph at a magnification of 1:1 using in-mirror lens ($F=5.6$ and $f=180$ mm) consisting of three lenses and a mirror in between is within ± 1.5 mm. It is thus possible to form a clear reproduced image without regulating the focus of the optical system both when the original is fed between the drive rollers and the follow-up rollers and when the ceiling plate including the follow-up rollers and so on is removed, and the original is carried on the transparent thin plate. Instead of providing the bearing rollers 42, 43, and 44 at a small distance from the drive rollers 33, 34 and 35, at least the peripheral surfaces of the bearings rollers 42, 43 and 44 may be constructed of an elastic material such as rubber or an elastic porous material so as to permit the intrusion of end portions of both sides of the transparent thin plate for supporting and transferring the original, between the bearing rollers 42, 43 and 44 and the drive rollers 33, 34 and 35. Or it is possible to secure the bearing rollers 42, 43 and 44 to the side plates 30 through an elastic member so as to move up and down, as shown in FIG. 2 with respect to the follow-up rollers. Or the bearing rollers may be provided in the side plates so that their positions can be freely regulated by a means known per se.

In the present invention, the original exposing transparent plate 32 is connected with the exposing transparent plate 10 for exposing the copying paper by an appropriate optical system. In the preferred embodi-

ment of the invention shown in FIGS. 1 and 7, light from a light source 54 of a halogen-sealed incandescent lamp, for instance, accommodated in a reflex mirror 53 is irradiated onto the original on the transparent plate 32, and a part of the refractive light is projected against an in-mirror lens 56 via a reflex mirror 55. The refractive light from the in-mirror lens 56 is again reflected on a reflex mirror 57, and projected onto the copying paper through the copying paper-exposing transparent plate 10. In the above-described optical system, a light-shielding plates 58 forming an optical path is provided. In the optical system used in the apparatus of the present invention, refractive light from the original is conducted to the in-mirror lens 56 through the plane reflex mirror 55, and the refractive light from the in-mirror lens 56 is projected onto the copying paper through the other plane reflex mirror 57, thereby making it possible to reduce the volume of the optical system considerably.

Any other optical system known in the art can be used instead of one described above.

Still another important feature of the apparatus of the present invention is that the distance L between the tip 3' of the separating and guiding plate 3 and center 32' of the original-exposing area is made equal to the distance l between the tip 3' of the separating and guiding plate to the center 10' of the copying paper-exposing area. Thus, as the original-exposing area and the copying paper-exposing area is provided, a step or exposing the original and a step or exposing the copying paper can be carried out always with a completely synchronized timing by feeding superposed original and copying paper of any kind through the separating and guiding plate 3 into the respective transfer passages. Accordingly, the apparatus of the present invention does not require any control mechanism to regulate and coordinate the timing of the original exposing step and the copying paper-exposing step.

It is preferable that in the apparatus of the present invention, the distance L_1 between the tip 3' of the separating and guiding plate to the original feed rollers 39 provided on the rear end of the plane portion 4 of the separating and guiding plate should be made equal to the distance l_1 between the tip 3' of the separating and guiding plate and the copying paper feed rollers 6 and 6' provided on the rear end of the downwardly curved portion 5 of the separating and guiding plate. The provision of the original feed rollers 39 and the copying paper feed rollers 6 and 6' in this manner makes it possible to transfer the original and the copying paper through the respective passages while maintaining the relative positions of the original and the copying paper as they are superposed.

As described hereinabove, the passage for transferring the original whose lower side is defined by the drive rollers 33, 34 and 35, the guide plate 31 and the transparent plate 32 for exposing the original and whose upper side is defined by the follow-up rollers 39, 40 and 41 and the guide and pressing rollers 49 and 50 and the passage for transferring a transparent plate adapted to support and transfer the original, which passage is defined at its underside by the drive rollers 33, 34 and 35 at its upper side by the bearing rollers 42, 43 and 44 are provided. Irrespective of the kind of the

original used, a step of exposing the original and a step of exposing the copying paper are always preferred with a synchronized timing.

The operation of the apparatus used in copying will now be described.

As shown in FIG. 4, when a thin sheet-like original 59 is used, a copying paper is laid on the original 59. Both are fed into the apparatus from the separating and guiding plate 3 so that the original 59 is positioned on the plane portion 4 and the copying paper in a passage between the curved portion 5 and the rear end 2' of the table. When the front end of the original reaches the original feed rollers 33 and 39, it is nipped by the rollers 33 and 39 and driven through a space between the guiding plate 31 and the guiding and pressing plate 49. It is further nipped by the feed rollers 34 and 40, and conveyed into an original exposing zone consisting of the transparent plate 32 and the guiding and pressing plate 50. In the meantime, the copying paper inserted between the curved portion 5 and the rear end 2' of the table is driven by being nipped with the feed rollers 6 and 6', and is uniformly charged through a passage within the charging mechanisms 7 and 7'. It is further driven by being nipped with the feed rollers 8 and 8', and fed into a copying paper-exposing zone consisting of the transparent plate 10 for exposing the copying paper and the guiding and pressing plate 11. Refractive light from the original 59 is projected onto the copying paper through the optical systems 32, 55, 56, 57 and 10 to form an electrostatic latent image on a photoconductive layer of the copying paper. The copying paper which has passed the copying paper-exposing zone is nipped with the feed rollers 12 and 12', fed into a developing passage between the developing dish 16 and the upper dish 17, and developed. The developed copying paper is squeezed free of excessive developing solution by being nipped with the squeezing rollers 18 and 18', placed on the belt or chain 22, dried or fixed, and discharged into the copying paper receiver 26 by being nipped with the belt or chain 21 on the delivery roller 28. On the other hand, the original which has passed through the original-exposing area is nipped with the feeding rollers 35 and 41, and discharged into the original receiver 37 through the guide plate 36. As illustrated in FIG. 1, only when the copying paper is in the passage for transferring the copying paper, the charging mechanisms 7 and 7' and the light source 54 are actuated. Hence, it is possible to provide a switch 60 actuable with paper in a passage between the lower curved portion 5 of the separating and guiding plate and the rear end 2' of the table, and a switch 61 actuable with paper in proximity to the copying paper feed rollers 12 and 12'. When the switch 60 is actuated by a known electrical circuit, the charging mechanisms 7 and 7' and the light source 54 are on, and by the actuation of the switch 61, the charging mechanisms 7 and 7' and the light source 54 are off.

A pamphlet or a relatively thin original can be fed through a transferring passage defined by the drive rollers 33, 34 and 35 and the follow-up rollers 39, 40 and 41 since the follow-up rollers 39, 40 and 41 are capable of escaping upwards within the long shaft holes 46, 47 and 48.

As shown in FIG. 8A, it is preferable to use a sheet carrier 64 consisting of a flexible transparent thin plate

62 and a white opaque backing thin plate and having one end closed, and insert the original 65 in the transparent thin plate 62 so that as shown in FIG. 8B, the surface to be copied of the original faces the thin plate 62. In the copying operation, the sheet carrier 64 with the original 65 inserted therein is superposed on a copying paper, and fed by the aid of the separating and guiding plate through the respective transfer passages, in the same way as in the case of copying a thin sheet-like original. When the sheet carrier 64 comes in collision with the original feeding follow-up roller 39, the bearing 39' of the follow-up roller 39 moves obliquely upwards within the long shaft hole 46, whereby the follow-up roller 39 escapes upwards, and the sheet carrier 64 moves within the original transferring passage while being nipped with the follow-up roller 39 and the drive roller 33. This state is shown in FIG. 9.

The use of such a sheet feeder makes it possible to feed piece-like originals 65' in the manner as shown in FIG. 8C, into the original transfer passage.

When a thick book or solid material is used as the original, a transparent thin plate for supporting and transferring the original is employed. In this case, the ceiling plate 38 of the housing which supports the follow-up rollers 39, 40 and 41 and the guiding and pressing plates 49 and 50 is removed as shown in FIGS. 5 and 6.

As illustrated in FIGS. 10A, it is preferable to use a carrier 68 consisting of a transparent tin plate 66 for supporting and transferring the original and pliable backing member 67 having a width narrower by the distance d for holding with the bearing rollers and being secured to the plate 66 at one end. When a book 69 is the original to be copied, a page to be copied of the book is placed on the transparent thin plate face to face, and the book 69 is held down by the backing member 67 to prevent the book from being deviated in position. This is shown in FIG. 10B. As illustrated in FIG. 10C, when a solid material 69' is used as the original, it is held between the transparent thin plate 66 and the backing member 67. In this state, a copying paper is laid on the underside of the transparent thin plate 66, and both are separated from each other by means of the separating and guiding plate 3 so that the transparent thin plate 66 for supporting the original is fed onto the upper surface 4 of the separating and guiding plate 3 and the copying paper, into a passage between the lower curved portion 5 of the separating and guiding plate and the rear portion 2' of the table. Thus, as shown in FIG. 11, the transparent thin plate 66 is nipped at its both side edges 70 by the drive roller 33 and the bearing roller 42, and moves through a transfer passage whose upper side is defined by the bearing rollers 42, 43 and 44 and whose underside is defined by the drive rollers 33, 34 and 35. The original 69 is transferred smoothly on the original-exposing area. Thus, according to the apparatus of the present invention, books or solid materials are supported by the transparent thin plate, and transferred by being held with the bearing rollers and the drive rollers. Consequently, it is possible to prevent slippage from the transfer system or deviation of the original.

While the preferred embodiments of the present invention have been described above, it is to be understood that various modifications and changes can be

made without departing from the spirit of the present invention.

What is claimed is:

1. In electrophotographic copying apparatus including a charging mechanism for charging an electrophotographic copying paper, an exposing mechanism including an optical system for projecting an image of the original on the charged copying paper, a developing mechanism for developing the exposed copying paper, a transfer mechanism for transferring the copying paper successively to the charging, exposing and developing mechanism and a housing enclosing the charging, exposing and developing mechanisms and having opposing sides and an upper surface; an original transferring mechanism for transferring the original to the exposing mechanism comprising a pair of opposing side plates spaced inwardly from said opposing sides of said housing and extending downwardly from said upper surface of said housing; a guide plate defining a lower side of a transferring passage for the original and secured to said side plates spaced from said upper surface of said housing; a transparent plate for exposing the original constituting a part of said lower side of said original transferring passage; a plurality of drive rollers rotatably journaled in said side plates for transferring the original along said original transferring passage; a removable ceiling plate aligned with said upper surface of said housing; a plurality of follow-up rollers suspended from said ceiling plate so as to move up and down and urge the original against said drive rollers; and a plurality of bearing rollers disposed at the sides of said follow-up rollers and secured rotatably to said side plates; said lower side of said original transferring passage being defined by said drive rollers, said guide plate and said transparent plate for exposing the original and an upper side of said original transferring passage being defined by said follow-up rollers; a transfer passage for an original-transferring transparent thin plate having a lower side defined by said drive rollers and an upper side defined by said bearing rollers, supporting members fixed in opposition to the underside of said ceiling plate of said housing, said supporting members having a plurality of long shaft holes inclined upwardly along the original-transfer direction and long pin holes in parallel with said shaft holes; said follow-up rollers being journaled in said long shaft holes so that said follow-up rollers are movable in said long shaft holes; a plate for guiding and pressing the original being positioned between said follow-up rollers to be movable up and down; said original guiding and pressing plate having side plates, said plates including a supporting part supported by said follow-up rollers and moving up and down together with the bearings and pins received in said long pin holes.

2. An apparatus according to claim 1 wherein a passage for transferring the original and a passage for transferring the electrophotographic copying paper are provided independently from each other; a separating and guiding plate is provided at the inlet of said two transfer passages to separate the superposed original and copying paper from each other and feed them into the respective transfer passage; and the original-transfer passage is generally horizontal and planar.

3. An apparatus according to claim 2 wherein the distance between the tip of said separating and guiding

plate in the original transfer passage to the center of an original-exposing area is equal to the distance between the tip of the separating and guiding plate in the copying paper-transfer passage to the center of a copying paper exposing area, and wherein a transparent plate forming said original exposing area and a transparent plate forming said copying paper exposing area are connected by an optical system.

4. An apparatus according to claim 2 wherein said separating and guiding plate has a planar top surface for guiding the original and a downwardly curved undersurface for guiding the copying paper; a pair of original feed rollers are disposed in proximity to the rear end of said top surface and a pair of copying paper feed rollers are disposed in proximity to the rear end of said undersurface; and said original feed rollers and said copying paper feed rollers are disposed at equal distances from the tip of said separating and guiding plate.

5. An apparatus according to claim 1 wherein the exposing system includes an optical system, said bearing rollers and said drive rollers are provided with a space therebetween for holding and transferring said transparent thin plate, said transparent thin plate having a thickness within the focal depth of said optical system.

6. In electrophotographic copying apparatus including a charging mechanism for charging an electrophotographic copying paper, an exposing mechanism including an optical system for projecting an image of the original on the charged copying paper, a developing mechanism for developing the exposed copying paper, a transfer mechanism for transferring the copying paper successively to the charging, exposing and developing mechanism and a housing enclosing the charging, exposing and developing mechanisms and having opposing sides and an upper surface; an original transferring mechanism for transferring the original to the exposing mechanism comprising a pair of opposing side plates spaced inwardly from said opposing sides of said housing and extending downwardly from said upper surface of said housing; a guide plate defining a lower side of a transferring passage for the original and secured to said side plates spaced from said upper surface of said housing; a transparent plate for exposing the original constituting a part of said lower side of said original transferring passage; a plurality of drive rollers rotatably journaled in said side plates for transferring the original along said original transferring passage; a removable ceiling plate aligned with said upper surface of said housing; a plurality of follow-up rollers suspended from said ceiling plate so as to move up and down and urge the original against said drive rollers; and a plurality of bearing rollers disposed at the sides of said follow-up rollers and secured rotatably to said side plates; said lower side of said original transferring passage being defined by said drive rollers, said guide plate and said transparent plate for exposing the original and an upper side of said original transferring passage being defined by said follow-up rollers; a transfer passage for an original-transferring transparent thin plate having a lower side defined by said drive rollers and an upper side defined by said bearing rollers, said passages for transferring the original and a passage for transferring the electrophotographic copying paper being provided independently from each other; a

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separating and guiding plate being disposed to separate the superposed original and copying paper from each other and feed them into the respective transfer passages; and said original-transfer passages being generally horizontal and planar; said separating and guiding plate having a planar top surface for guiding the original and a downwardly curved undersurface for guiding the copying paper; a pair of original feed rollers disposed in proximity to the rear end of said planar top surface; a pair of copying paper feed rollers disposed in proximity to the rear end of said undersurface; said original feed rollers and said copying paper feed rollers disposed at equal distances from the tip of the separating and guiding plate; said bearing rollers and said drive rollers being spaced for holding and transferring said transparent thin plate; said transparent thin plate having a thickness within the focal depth of the optical system; said original transferring mechanism including opposed supporting members fixed to the underside of said ceiling plate of said housing, said supporting members having long shaft holes inclined upwardly along

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the original-transferring direction, and said follow-up rollers being journaled in said long shaft holes of said supporting members so as to move therein.

7. An apparatus according to claim 6 wherein said supporting members have long pin holes disposed in parallel with said shaft holes; and said original guiding and pressing plate has side plates, said side plates including a supporting part supported by bearings of said follow-up rollers and moving up and down together with the bearings and pins received in said long pin holes.

8. An apparatus according to claim 7 wherein said original transferring mechanism includes a plate for guiding and pressing the original secured to said ceiling plate of said housing at a position between said follow-up rollers in a manner movable up and down, said follow-up rollers and said guiding and pressing plate defining said upper side of the passage for transferring the original.

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