

EUROPEAN PATENT APPLICATION

Application number: **90300808.4**

Int. Cl.⁵: **B65H 3/08**

Date of filing: **25.01.90**

Priority: **30.01.89 JP 9802/89**
28.04.89 JP 50404/89
28.04.89 JP 50403/89

Date of publication of application:
08.08.90 Bulletin 90/32

Designated Contracting States:
DE FR GB

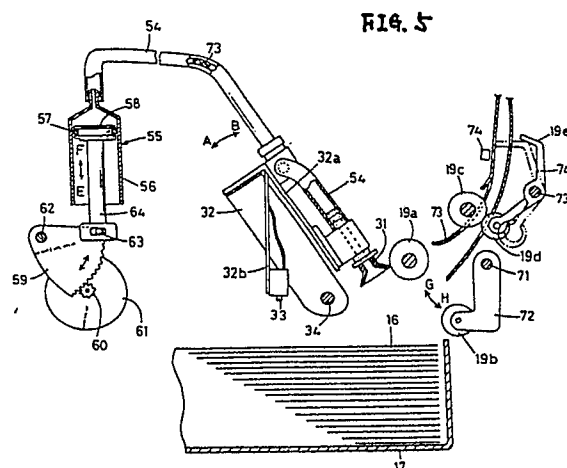
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Sheet feeding mechanism having dust preventing means and method for cleaning the sheet feeding mechanism.

A sheet feeding mechanism having dust preventing means. The sheet feeding mechanism includes a suction cups contactable with a sheet, evacuating means for generating negative pressure within the suction cups and tube means connected between the evacuating means and the suction cups. The dust preventing means includes a filter member disposed within the tube means. The evacuating means includes a cylinder and a piston. The cylinder extends in vertical direction or in horizontal direction. In the latter case, one side end of the cylinder is connected to the tube means and another side end is closed for preventing dusts from being entered therinto, and the cylinder wall is formed with a small bore at lower portion thereof and adjacent the other side. For cleaning the sheet feeding mechanism, positive air stream is generated within the mechanism during idling state thereof.



SHEET FEEDING MECHANISM HAVING DUST PREVENTING MEANS AND METHOD FOR CLEANING THE SHEET FEEDING MECHANISM

BACKGROUND OF INVENTION

The present invention relates to a mechanism for feeding sheet from a sheet cassette in an image recording apparatus such as a copying machine, and more particularly to a mechanism for feeding a developer sheet from a sheet cassette in an image forming machine which employs a photosensitive pressure-sensitive recording sheet for carrying a latent image thereon and transferring a developed image to the developer sheet.

In general, image recording apparatuses such as the copying machines employ continuous photosensitive recording mediums such as a microcapsule sheet and developer sheets used in combination with the photosensitive recording mediums. Developer sheets are stacked in a sheet cassette and usually fed one at a time from the sheet cassette by a semicircular separator roller of rubber. The separator roller and the developer sheets have coefficients of friction different from each other. The separator roller frictionally separates the uppermost developer sheet from the lower stack of developer sheets, and delivers the separated developer sheet to a certain position.

If the developer sheets are stacked such that their reverse sides face up, then the separator roller contacts the reverse side of the uppermost developer sheet. Therefore, when the uppermost developer sheet is fed out of the sheet cassette, the color developer layer on the uppermost developer sheet rubs against the reverse side of the next developer sheet, and the developer material tends to be partly peeled off from the developer sheet. Thus, an image formed on the developer sheet may be damaged where the developer layer has been removed, resulting in poor image quality.

If the developer sheet are stacked such that their developer layers face up, then the separator roller contacts the developer layer on the uppermost developer sheet. Therefore, when the uppermost developer sheet is fed out of the sheet cassette, the separator roller tends to slip on the color layer, which may be partly peeled off. Accordingly, an image on the developer sheet may also be impaired.

Japanese Patent Application Kokai No.55-93744, discloses a sheet feed mechanism which does not employ a frictional separator roller but uses a suction cup for attracting a sheet under a negative pressure and feeding the attracted sheet to a certain position. According to the disclosed sheet feed mechanism, if the negative pressure is

too intensive, the uppermost sheet attracted by the suction cup also attracts the lower sheet or sheets under suction, and hence more than one sheet may be fed out simultaneously. The lower sheet or sheets may also be attracted to and fed with the uppermost sheet due to static electricity developed between sheets. In order to separate sheet from each other, air is ejected between them. If the negative pressure is too small, the attracted sheet may drop off the suction cup due to the applied air. The sheet feed mechanism includes a support base for placing a stack of sheets which is movable up and down. Therefore, the sheet feed mechanism is relatively complex and requires a large amount of energy to be consumed. Another problem is that some stacked sheets are liable to be scattered by the applied air jet. When the support base is lowered with the uppermost sheet being attracted by the suction cup, the suction cup is moved laterally so that the leading end of the sheet can be nipped by a feed roller and a pinch roller. While the suction cup is being moved laterally, however, the attracted sheet may be dropped off from the suction cup. Therefore, the disclosed sheet feed mechanism is not be operated with high reliability.

In order to solve above problems, one sheet feed mechanism is proposed as described in a pending U.S. Patent Application Serial No.377,137 filed July 10, 1989. The proposed sheet feed mechanism will be described below with reference to FIGS. 1 through 4(b) wherein identical parts are denoted by identical reference numerals.

FIG.1 schematically shows a copying machine incorporating a sheet feed mechanism according to an embodiment of that invention. The illustrated copying machine, generally indicated at 1, comprises a photosensitive pressure-sensitive copying machine capable of copying full-color images. The copying machine employs a continuous photosensitive pressure-sensitive recording medium 11 such as a photosensitive microcapsule sheet for recording a latent image thereon, and a developer sheet 16 for receiving a developed color image from the microcapsule sheet. The photosensitive microcapsule sheet 11 and the developer sheet 16 are disclosed in U.S. Patent 4,399,209 and Japanese Patent Application Kokai No.58-88739, for example, and therefore, further description can be neglected.

The copying machine includes an upper panel assembly having an original support stand glass 2 which is movable back and forth and an original support stand glass cover 3 that can be placed over the original support stand glass 2. An original

4 to be copied is put on the original support stand glass 2 which is formed of light transmissive material. The copying machine 1 also has a light source placed in an upper righthand portion thereof below the original support stand glass 2 and comprising a halogen lamp 5a extending in a direction normal to the direction in which the original support stand glass 2 is movable back and forth, and a semicylindrical reflecting mirror 5b disposed in surrounding relation to the halogen lamp 5a. The light source emits a linear-line light toward the lower surface of the original support stand glass 2.

When the original support stand glass 2 moves, the light emitted from the halogen lamp 5a continuously irradiates the entire surface of the original support stand glass 2 from the lefthand to the righthand end thereof (as viewed in FIG.1). The light from the light source passes through the transparent original support stand glass 2, and is then reflected by the original 4 placed on the original support stand glass 2. The original support stand glass cover 3 covers the entire upper surface of the original support stand glass 2 so that the light applied to the original support stand 2 will not leak out from those areas of the original support stand glass 2 which are not covered by the original.

A reflector 5c is positioned on the lefthanded on the side of the light source for applying lights emitted from the halogen lamp 5a to the original highly efficiently. The reflector 5b reflects those emitted lights which are not directed toward the original support glass 2.

The light reflected from the original on the original support stand glass 2 is directed downwardly and the passes through a filter 6 and a lens 7. The filter 6 serves to pass desired wavelengths of light dependent on the sensitivity of a microcapsule sheet 11 for adjusting the colors of a copied image. The lens 7 is mounted on a lens attachment 7a which is slightly adjustable with respect to the path of the light through the filter 6 and the lens 7.

The light converged by the lens 7 is directed 180 degrees back by two reflecting mirrors 8,9 and then focused on the microcapsule sheet 11 held closely against the lower surface of an exposure table 10. The reflecting mirrors 8,9 are mounted on a mirror attachment 8a which is slightly positionally adjustable to vary the length of the light path and the focused condition.

The microcapsule sheet 11 is of a continuously elongated length and is wound around a cartridge reel 12. The sheet 11 is placed in a removable cartridge 12a positioned below the original support stand glass 2. A leading end portion of the microcapsule sheet 11 extends through many rollers and a pressure developing unit 13 toward a takeup reel 15.

More specifically, the microcapsule sheet 11 drawn out of the cartridge 12a from its lower end is fed and guided by a feed roller 14a and a guide roller 14b, and extends beneath the exposure table 10 into the pressure developing unit 13. The microcapsule sheet 11 which has passed through the pressure developing unit 13 is fed by a pair of feed roller 14c, travel past a separator roller 14d and an adjustment roller 14e, and is then wound around the takeup reel 15. The microcapsule sheet 11 discharged from the cartridge 12a remains unexposed by a light-shielding cover 12b before the microcapsule sheet 11 reach the exposure table 10.

The speed at which the microcapsule sheet 11 is fed is controlled so as to be held at a constant level, and remains the same speed at which the original support stand glass 2 is moved. Therefore, a latent image can be formed successively line by line on the microcapsule sheet 11 when it moves past the exposure table 10.

A developer sheet cassette 17 storing a stack of developer sheet 16 is disposed below the pressure developing unit 13. One, at a time, of the developer sheet 16 is taken out of the cassette 17 by a sheet feed mechanism 18 which attracts the developer sheet 16 under suction. The developer sheet 16 which is taken from the cassette 17 is delivered by a feed roller 19a and a pinch roller 19b. After the leading end of the developer sheet 16 is aligned by rollers 19c,19d and a resist gate 19e, the developer sheet 16 is fed into an inlet slot of the pressure developing unit 13.

The microcapsule sheet 11 and the developer sheet 16 are closely held against each other when they are introduced into the pressure developing unit 13. The pressure developing unit 13 includes a small diameter roller 13a and a backup roller 13b. The microcapsule sheet 11 and the developer sheet 16 are sandwiched and pressed together between the small diameter roller 13a and the backup roller 13b. At this time, a microcapsule layer on the microcapsule sheet 11 with the latent image formed thereon and a color developer layer on the developer sheet 16 are held against each other. Those microcapsule in the microcapsule layer which are not exposed are ruptured under pressure, and a developed image is transferred onto the developer sheet 16.

The microcapsule sheet 11 and the developer sheet 16 which have left the pressure developing unit 13 are fed by the roller 14c. Then, the microcapsule sheet 11 is separated from the developer sheet 16 by the separator roller 14d. The microcapsule sheet 11 is directed upwardly, whereas the developer sheet 16 travels straight ahead into a thermal fixing unit 20. The thermal fixing unit is composed a heater roller 20a and feed roller 20b.

After color development on the developer sheet 16 is promoted and the color image is fixed by the heat fixing unit 20, the developer sheet 16 is discharged into a tray 21 with the developed image facing up.

The separated microcapsule sheet 11 travels past the adjustment roller 14e and is wound around the takeup reel 15.

The sheet feed mechanism 18 disclosed in the co-pending U.S. Patent Application will be described in greater detail with reference to FIGS. 2 and 3.

The sheet feed mechanism 18 includes a pair of suction cups 31 mounted on an angularly movable elevator arm 32 by means of an attachment plate 32a. The elevator arm 32 has two pivot shafts 34 (one shown in FIG. 2) rotatably supported on elevator frames 36 vertically movably mounted on machine side plates 35 (one of which is shown in FIG. 2). The pivot shafts 34 about which the suction cups 31 are angularly movable have their central axes lying on a plane which contains the suction surfaces of the suction cups 31. The pivot shafts 34 are positioned behind, or upstream of, the position where the suction cups 31 attract the developer sheet 16, with respect to the direction in which the color developer sheet 16 is fed from the cassette 17.

The suction cups 31 are positioned such that they attract the developer sheet 16 at its relatively forward portion in the direction of feed of the developer sheet 16. An uppermost sheet sensor 33 which may comprise a microswitch, for example, is mounted on the elevator arm 32 by means of an attachment plate 32b extending from and inclined at an angle to the attachment plate 32a. When the attachment plate 32b extends vertically, the sensor 33 and the pivot shafts 34 are disposed in a common horizontal plane.

A motor 37 is mounted on one of the frames 36, and a gear 38 rotatable by the motor 37 is also supported on the frame 36. The gear 38 is held in mesh with a swing gear 39 fixed on the pivot shaft 34. Therefore, when the motor 37 is energized, the elevator arm 32 is angularly moved about the pivot shafts 34 in the directions indicated by the arrows A, B (FIG. 3).

Each of the frames 36 is supported by a vertical guide mechanism (not shown), and can be moved vertically in the direction indicated by the arrow C, D, by a stepper motor 40. Shafts 41, 42 mounted on the machine side plate 35 extend through respective vertical slots 43, 44 defined in the frame 36. Gears 45, 46 fixed to the shafts 41, 42, respectively, are held in mesh with racks 47, 48 defined on edges of the slots 43, 44. A timing belt 51 is trained around pulleys 49, 50 fixed respectively to the shafts 41, 42. A helical gear 52 fixed to

the end of the shaft 41 is held in mesh with a worm gear 53 fixed to the output shaft of the stepper motor 40.

Each of the suction cups 31 has an inner hole defined in its bottom and connected through a flexible tube 54 to an evacuating means 55 mounted on the other machine side plate. The evacuating means 55 includes a cylinder 56, a piston 58 having an O-ring 57 and slidably fitted in the cylinder 56, intermeshing gears 59, 60, and a stepper motor 61. When the stepper motor 61 is energized, the gear 60 mounted on the output shaft of the stepper motor 61 causes the gear 59 to rotate about a shaft 62. A pin 63 is disposed on the gear 60 near an outer peripheral surface thereof and fitted in a slot defined in one end of a piston rod 64 joined to move linearly in the cylinder 56 in the direction indicated by the arrow E, thereby developing a negative pressure in the cylinder 56 which is connected to the tube 54.

The cylinder 56 has an open end through which the piston rod 64 extends. The open end of the cylinder 56 is preferably directed downwardly so that dust will not be deposited in the cylinder 56 and grease for lubricating the inner surface of the cylinder 56 will not flow through the tube 54 toward the sheets 16. If the open end of the cylinder 56 is directed upwardly, then it should be closed by a cover to prevent foreign matter such as dust and dirt from entering the cylinder 56.

The feed roller 19a, which is shown as a plurality of feed rollers 19a in FIG. 2, is disposed upwardly of the leading ends of the developer sheets 16 stacked in the cassette 17. The pinch roller 19b is movable toward and away from the feed roller 19a and rotatably supported on the distal ends of swing arm 72 (one shown in FIG. 3) which are angularly movable about a shaft 71 in the directions indicated by the arrow G, H. The swing arm 72 are angularly moved by a drive source (not shown) each time a developer sheet 16 is to be fed out of the cassette 17, for thereby moving the pinch roller 19b toward and away from the feed roller 19a. A guide member 73 is disposed downstream of the roller 19a, 19b with respect to the direction of feed of the developer sheets 16, the guide member 73 defining a sheet feed path. The roller 19c, 19d and the resist gate 19e are also disposed downstream of the rollers 19a, 19b. The resist gate 19e includes one end of a lever 74 rotatable about a shaft 73. The roller 19d is supported on another end of the lever 74. The roller 19d and the resist gate 19e are angularly movable alternatively between the solid-line position and the two-dot-and-dash-line position in FIG. 3.

Operation of the sheet feed mechanism 18 thus constructed will be described below with reference to FIGS. 2, 3, and 4(a) through 4(d).

It is assumed that the frames 36 are first disposed in a home position. In response to a sheet feed signal from the controller of the copying machine 1, the stepper motor 40 is energized, and its rotation is transmitted through the worm gear 53 and the helical gear 52 to the shaft 41 to rotate the gear 45 in the clockwise direction in FIG.2. At the same time, the gear 46 on the shaft 42 is rotated in the clockwise direction through the pulley 49, the timing belt 51, and the pulley 50. As the gear 45, 46 are in mesh with the respective racks 47, 48, the frame 36 is moved downwardly in the direction indicated by the arrow D. Upon the downwardly movement of the frame 36, the attachment platen 32b is in its vertical position as shown in FIGS.3 and 4(a), and the sensor 33 can first detect the uppermost sheet surface in the cassette 17.

When the sensor 33 detects the uppermost sheet surface, the stepper motor 40 is deenergized to stop the downward movement of the frame 36. Then, the stepper motor 37 is energized, and its rotation is transmitted to the gear 38, 39 to rotate the shafts 34 about their own axes. The suction cups 31 are then moved downwardly along an arcuate path until they are held against the uppermost color developer sheet 16 as shown in FIG.4 (b).

Then, the motor 61 is energized to move the piston 58 in the direction indicated by the arrow E. A negative pressure is developed in each of the suction cups 31 to enable the suction cups 31 to attract the uppermost developer sheet 16.

With the suction cups 31 attracting the uppermost developer sheet 16, the stepper motor 37 is reversed to turn the arm 32 through a predetermined angle about the shaft 34 in the direction indicated by the arrow A until the arm 32 assumes the position shown in FIG. 4(c). At this time, the arm 32 is not turned about the suction cups 31, but is turned about the shafts 34 positioned behind the suction cups 31. Therefore, the suction cups 31 also turned about the shafts 34. The suction cups 31 attracts the uppermost developer sheet 16 under suction and lifts the leading end position of the developer sheet 16 off the next developer sheet 16. At this time, the uppermost developer sheet 16 is separated from the lower sheet 16 because of the stiffness of the upper developer sheet 16. Even if the negative pressure developed in the suction cups 31 is relatively small in pressure, the suction cups 31 can separate the upper most sheet 16 since it is simply lifted off the lower developer sheet 16 without frictional engagement therewith. If the suction cups 31 were not turned but were operated only to attract the developer sheet 16, two or more developer sheets would be fed out at the same time when an electrostatic force acting on these sheets is greater than the weight of the

developer sheet 16. Since the suction cups 31 are actually turned about the shafts 34, however, two or more developer sheets are prevented from being fed out together. An experiment conducted on the sheet feed mechanism 18 indicated that the uppermost sheet 16 could sufficiently be separated from the lower developer sheet 16 by the suction cups 31 when the arm 32 was turned through about 30 degrees. After the uppermost developer sheet 16 has been separated, the stepper motor 40 is reversed to elevate the frames 36 and hence the elevator arm 32 in the direction indicated by the arrow C up to the position shown in FIG.4(a) in which the leading end of the developer sheet 16 is positioned directly below the feed roller 19a.

Then, the pinch roller 19b is swung about its own axis in the direction indicated by the arrow G to pinch or nip the leading end of the developer sheet 16 between the pinch roller 19b (indicated by the two-dot-and-dash line) and feed roller 19a. Thereafter, the motor 61 of the evacuating means 55 is reversed to move the piston 58 in the direction of the arrow F. The negative pressure in the suction cups 31 is eliminated, and the developer sheet 16 is released from the suction cups 31.

The stepper motor 40 is further energized to lift the frames 36 and the arm 32 by a certain distance to avoid engagement or interference between the suction cups 31 and the developer sheet 16 as is fed along.

Through the above operation, the uppermost one of the stacked developer sheets 16 is separated and delivered into the sheet feed path. In an initial stage of the sheet feeding operation, the roller 19d and the resist gate 19e are in the two-dot-and-dash position shown in FIG. 3, and hence the roller 19c, 19d are spaced from each other. The developer sheet 16 is fed by the feed roller 19a and the pinch roller 19b until its leading end is engaged by the resist gate 19e, whereupon the leading end of the developer sheet 16 is properly aligned and corrected out of the any skewed condition. Then, the lever 74 is turned to displace the roller 19d against the roller 19c and pull the resist gate 19e out of the sheet feed path. The developer sheet 16 is now fed along the sheet feed toward the pressure developing unit.

The sheet feeding mechanism 18 described in the U.S. Application has a simple construction, and the sheet is surely delivered from the sheet cassette without any damage to the sheet. The sheet feeding mechanism 18 is incorporated into an image recording apparatus or a copying machine which employs voluminous papers as recording mediums. In such circumstances, dusts or fibrous particles are released from the paper sheets. Further, in the image recording apparatus or the copying machine, heat is released in its interior. There-

fore, external air is normally introduced into its interior by means of a fan etc. in order to cool internal components.

In this case, ambient dusts may also be introduced into the interior together with the external air. Accordingly, such dusts are also introduced into the sheet feeding mechanism 18. If the latter is the case, dusts may be entered into the flexible tube 54 of the sheet feeding mechanism due to aspiration of the evacuating means 55. Therefore, the tube 54 may be choked up with the dusts. Further, dusts may be adhered to the suction cup 31, so that intimate contact between the suction cup 31 and the sheet 16 may be degraded, to thus degrade separation and absorption efficiency of the evacuating means 55.

If the dusts are entered into the cylinder 56 of the evacuating means 55, the O-ring 57 of the piston 58 may be impaired, which may reduce service life of the evacuating means.

It is, therefore, an object of the present invention to provide a sheet feed mechanism capable of preventing dusts from being entered into evacuating means.

Another object of the invention is to provide a method for positively discharging dusts accumulated within the flexible tube or the suction cups toward outside of the sheet feed mechanism.

These and other objects of the present invention will be attained by providing a sheet feeding mechanism for feeding an uppermost sheet of a sheet stack stacked in a sheet cassette, the sheet having a leading end with respect to a sheet feed path, the sheet feeding mechanism comprising suction cup means movable into and out of contact with the uppermost sheet in the sheet cassette, evacuating means for developing a negative pressure in the suction cup means to enable the suction cup means to attract the uppermost sheet, tube means connecting the suction cup means and one end of the evacuating means, lifting means for lifting the suction cup means with the uppermost sheet being attracted thereto, nipping means for nipping the leading end of the attracted and lifted uppermost sheet and delivering the uppermost sheet into the sheet feed path, and dust preventing means positioned near or in the evacuating means for preventing dust from being entered into the evacuating means.

In another aspect of the invention there is provided a method for cleaning a sheet feeding mechanism which feeds an uppermost sheet of a sheet stack stacked in a sheet cassette, the sheet having a leading end with respect to a sheet feed path, the sheet feeding mechanism including suction cup means movable into and out of contact with the uppermost sheet in the sheet cassette, evacuating means for developing a negative pres-

sure in the suction cup means to enable the suction cup means to attract the uppermost sheet, tube means connecting the suction cup means and one end of the evacuating means, the evacuating means including a cylinder, a piston provided movable within the cylinder and a drive means connected to the piston for reciprocally moving the piston, the method comprising the steps of: energizing the drive means when the suction cup means is out of contact with the uppermost sheet for reciprocating the piston, thereby generating an air stream, and discharging dusts accumulated within at least one of the tube means and the suction means by the air stream.

In still another aspect of this invention, there is provided a sheet feeding method for feeding an uppermost sheet of a sheet stack stacked in a sheet cassette, the sheet having a leading end with respect to a sheet feed path, the sheet feeding mechanism including suction cup means movable into and out of contact with the uppermost sheet in the sheet cassette, evacuating means for developing a negative pressure in the suction cup means to enable the suction cup means to attract the uppermost sheet, tube means connecting the suction cup means and one end of the evacuating means, the evacuating means including a cylinder, a piston provided movable within the cylinder and a drive means connected to the piston for reciprocally moving the piston, the sheet feeding method comprising the steps of energizing the drive means for moving the piston when the suction cup means is out of contact with the uppermost sheet, thereby generating an air stream, discharging dusts accumulated within at least one of the tube means and the suction means by the air stream moving the suction cup means to allow the suction cup means to be brought into contact with the uppermost sheet, again energizing the drive means for moving the piston, to thereby generate negative pressure, to thus attract the uppermost sheet to the suction cup, lifting the suction cup means which attracts the uppermost sheet, and moving the suction cup means toward the sheet feed path for introducing the uppermost sheet thereinto.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG.1 is a schematic vertical cross-sectional view showing a copying machine incorporating a sheet feed mechanism, according to an embodiment of an invention disclosed in a pending U.S. Patent Application;

FIG.2 is an enlarged fragmentary perspective view showing the sheet feed mechanism described

in the pending application;

FIG.3 is a side elevational view, partly cut away, showing the sheet feed mechanism described in the pending application;

FIG.4(a) through 4(d) are sectional side elevational view showing a sequence of operation in the sheet feed mechanism described in the pending application;

FIG.5 is a side elevational view, partly cut away, showing a sheet feed device having dust preventing means according to a first embodiment of the present invention; and

FIG.6 is a side elevational view, partly cut away, showing a sheet feed device having dust preventing means according to a second embodiment of the present invention.

Embodiments of the present invention will be described below with reference to FIGS. 5 and 6, wherein like parts and components are designated by the same reference numerals and characters as those shown in FIGS. 1 thru 4(d) for eliminating a duplicating description.

FIG.5 shows a sheet feed mechanism according to a first embodiment of the present invention. Apparently, the sheet feed mechanism according to the first embodiment is applied to an image recording apparatus or a copying machine as described above.

A suction cup 31 has an inner hole defined in its bottom and connected through a flexible tube 54 to an evacuating means 55 mounted on another side frame (not shown). The evacuating means 55 includes a cylinder 56, a piston 58 having an O-ring 57 and slidably fitted in the cylinder 56, intermeshing gears 59, 60, and a stepper motor 61 having an output shaft. The intermeshing gear 59 has one end pivotally supported by a pivot shaft 62, and has another end adjacent its gear portion provided with a pin 63. The piston 58 is connected to a piston rod 64 whose distal end is formed with a slot. The pin 63 is provided engageable with the slot. When the stepper motor 61 is energized, the gear 60 mounted on the output shaft of the stepper motor 61 permits the gear 59 to rotate about the shaft 62. Therefore, the gear 59 causes the piston 58 to move linearly in the cylinder 56 by way of the pin 63 and the slot in the direction indicated by an arrow E, thereby developing a negative pressure in the cylinder 56 which is connected to the tube 54.

In the first embodiment, a filter 73 is provided in the tube 54 for purifying the air intaken into an interior of the suction cup 31 and the tube 54 by the evacuating means 55, so that dust such as paper powders in the intaken air is trapped by the filter 73. Therefore, the filter 73 prevents the dusts from reaching an interior of the evacuating means, and accordingly, dusts are not involved at a sliding portion of the piston 58. As a result, prolonged

service life of the evacuating means 55 would be obtainable. If great amount of dusts are accumulated at the filter 73, the filter 73 together with the tube 54 are replaced by a new filter and the tube. Consequently, inherent filtering function can be obtained.

FIG. 6 shows a sheet feed mechanism according to another embodiment of the present invention. In the first embodiment shown in Fig. 5, the cylinder 56 of the evacuating means 55 extends in vertical direction similar to the cylinder 56 of the above described copending U.S. Patent Application. Further, a lower end of the cylinder 56 is fully opened to an atmosphere. On the other hand, in the second embodiment, the cylinder 56' extends in horizontal direction, and relevant end portion of the cylinder 56' is closed by an end plate 56'A.

More specifically, the cylinder 56' has one end connected to a tube 54 and has another end covered with the end plate 56'A. The cylinder 56' is supported by a side frame (not shown) with maintaining its horizontal orientation. Further, a hole 65 is bored at a lower portion of a cylindrical wall of the cylinder 56' and at a position adjacent the end plate 56'A for discharging air when a piston 58 is moved in a direction E.

Similar to the first embodiment, when the stepper motor 61 is energized, the gear 59 causes the piston 58 to move linearly in the cylinder 56 in the direction indicated by the arrow E, thereby developing a negative pressure in the cylinder 56 which is connected to the tube 54.

Since the hole 65 is bored downwardly and the cylinder 56' is substantially hermetically sealed by the end plate 56'A except the hole 65, dust is hardly entered into the interior of the cylinder 56'. Therefore, prolonged service life of the evacuating means 55 is obtained. Further, since the cylinder 56' extends in horizontal direction and the tube 54 is connected to the one end of the cylinder 56' at a radially center portion thereof, grease for lubrication purpose would not flow out of the cylinder toward the tube 54. Accordingly, sheet contamination with the grease can be obviated.

In the second embodiment various modifications may be conceivable. For example, a filter member 73 shown in the first embodiment can be assembled into the flexible tube 54 for further avoiding dust sucking into the interior of the cylinder through the suction means 31. Furthermore, a filter may be attached to an open end of the hole 65 of the cylinder 56' for completely avoiding dust sucking into the interior of the cylinder 56'.

Next, in the present invention, positive discharge of the dusts out of the sheet feed mechanism 18 is attainable prior to the sheet feeding operation or at an instance in which dusts are considered to be attached to the interior of the tube

54 or the suction cups 31. In the latter case, such dust discharge may be conducted after predetermined numbers of copying are carried out. That is, in an idling state of the sheet feed mechanism, i.e., in a state where the suction cups 31 are separated from the sheet, a motor 61 (Fig. 3) is energized for reciprocatingly moving the piston 58 in directions E and F in order to produce an air stream within the flexible tube 54 and the suction cups 31, to thereby positively discharge paper fibrous chips or dusts out of the tube or the suction cups.

According to this idling operation, i.e., positive dust discharging operation, dusts attached to the tube etc. can be removed therefrom. Therefore, probability in dust entry into the evacuation means can be reduced. Further, since the dust attached to the suction cups can also be removed by the positive discharge, intimate contact between the suction cups and the sheet can be provided, to thereby ensure sheet feeding operation.

Further, this idling operation can be applied to the above described first and second embodiments of this invention. That is, upon energization of the motor 61 (Fig. 5), the piston 58 is reciprocally moved within the cylinder 56' to generate an air stream within the tube 54 and within the cylinder 56'. Therefore, dusts accumulated to the filter 73 as well as to the flexible tube 54 can be blown by the air stream and is discharged to the atmosphere. Therefore, service life of the filter can also be prolonged.

Furthermore, in order to positively discharge the dusts accumulated within the flexible tube 54 or the filter 73, moving speed of the piston 58 may be changed. That is, moving speed of the piston in the direction F is arranged to be higher than that in the direction E so as to produce positive air stream having high velocity directing to F direction.

The above described cleaning method or idling operation is not limited to the copying machine described above, but is available to other types of image recording apparatus using photosensitive pressure sensitive recording medium. Further, various modifications may be effected to the sheet feed mechanism per se. For example, crank-mechanism may be available in the evacuating means 55. Furthermore, numbers of the suction cups 31 can be changed in accordance with the size and weight of the sheets to be fed.

While the invention has been described in detail and with reference to specific embodiments thereof, it would be apparent to those skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope of the invention.

Claims

1. A sheet feeding mechanism for feeding an uppermost sheet of a sheet stack stacked in a sheet cassette, the sheet having a leading end with respect to a sheet feed path, the sheet feeding mechanism comprising;
 - suction cup means movable into and out of contact with the uppermost sheet in the sheet cassette;
 - evacuating means for developing a negative pressure in the suction cup means to enable the suction cup means to attract the uppermost sheet;
 - tube means connecting the suction cup means and one end of the evacuating means;
 - lifting means for lifting the suction cup means with the uppermost sheet being attracted thereto;
 - nipping means for nipping the leading end of the attracted and lifted uppermost sheet and delivering the uppermost sheet into the sheet feed path; and
 - dust preventing means positioned near the evacuating means for preventing dust from entering into the evacuating means.
2. The sheet feeding mechanism according to claim 1, wherein the evacuating means comprises a cylinder, a piston movably provided within the cylinder, and piston driving means connected to the piston for reciprocally moving the piston, the cylinder having one end connected to the tube means.
3. The sheet feeding mechanism according to claim 1 or 2, wherein the dust preventing means is positioned in the tube means.
4. The sheet feeding mechanism according to claim 3, wherein the dust preventing means comprises filter means.
5. The sheet feeding mechanism according to claim 2, wherein the cylinder extends in horizontal direction.
6. The sheet feeding mechanism according to claim 5, wherein the dust preventing means comprises an end plate covering another end of the cylinder, the cylinder having a cylindrical wall formed with a hole positioned near the end plate and at a lower portion of the cylindrical wall.
7. The sheet feeding mechanism according to claim 6, wherein the dust preventing means further comprises a first filter means positioned within the tube means.
8. The sheet feeding mechanism according to claim 7, wherein the dust preventing means further comprises a second filter means positioned at the hole.
9. A method for cleaning a sheet feeding mechanism which feeds an uppermost sheet of a sheet stack stacked in a sheet cassette, the sheet having a leading end with respect to a sheet feed path, the sheet feeding mechanism including suction cup means movable into and out of contact with the uppermost sheet in the sheet cassette,

evacuating means for developing a negative pressure in the suction cup means to enable the suction cup means to attract the uppermost sheet, tube means connecting the suction cup means and one end of the evacuating means, the evacuating

means including a cylinder, a piston provided movable within the cylinder and a drive means connected to the piston for reciprocally moving the piston, the method comprising the steps of:

energizing the drive means when the suction cup means is out of contact with the uppermost sheet for reciprocating the piston, thereby generating an air stream, and

discharging dust accumulated within at least one of the tube means and the suction means by the air stream.

10. The method according to claim 9 wherein the energizing step is conducted prior to the sheet feeding operation.

11. The method according to claim 9 or 10 wherein the energizing step is conducted after a predetermined number of copying operations are carried out.

12. The method according to claim 9 10 or 11 wherein the piston is movable in one direction for generating the negative pressure in the suction cup and is movable in opposite direction, the moving speed of the piston in the opposite direction being faster than that in the one direction.

13. A sheet feeding method for feeding an uppermost sheet of a sheet stack stacked in a sheet cassette, the sheet having a leading end with respect to a sheet feed path, the method using suction cup means movable into and out of contact with the uppermost sheet in the sheet cassette, evacuating means for developing a negative pressure in the suction cup means to enable the suction cup means to attract the uppermost sheet, tube means connecting the suction cup means and one end of the evacuating means, the evacuating means including a cylinder, a piston provided movable within the cylinder and a drive means connected to the piston for reciprocally moving the piston, the sheet feeding method comprising the steps of:

energizing the drive means for moving the piston when the suction cup means is out of contact with the uppermost sheet, thereby generating an air stream;

discharging dust accumulated within at least one of the tube means and the suction means by the air stream;

moving the suction cup means to allow the suction cup means to be brought into contact with the uppermost sheet;

again energizing the drive means for moving the piston, to thereby generate negative pressure, to thus attract the uppermost sheet to the suction cup;

lifting the suction cup means which attracts the uppermost sheet; and

moving the suction cup means toward the sheet feed path for introducing the uppermost sheet thereinto.

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FIG. 1

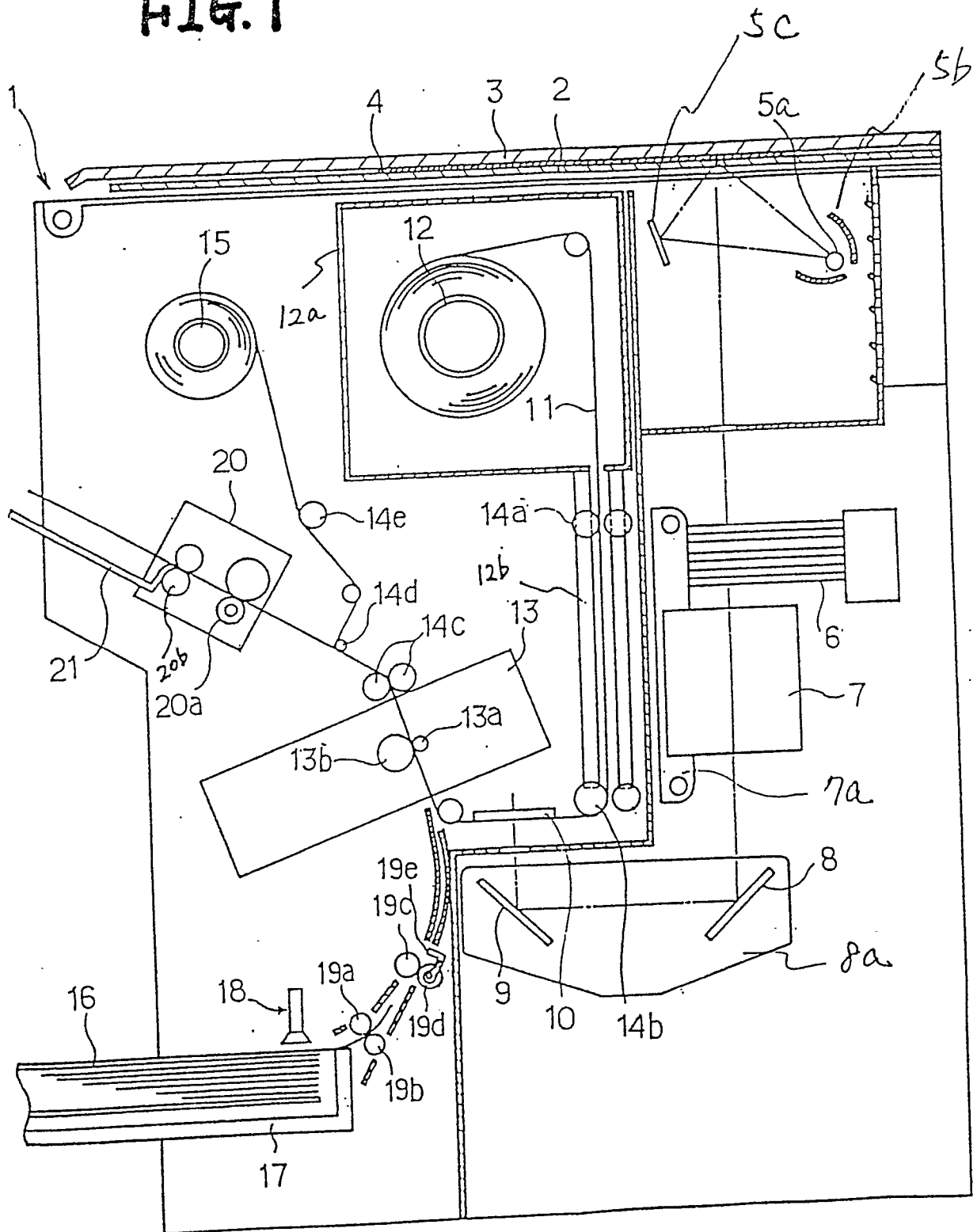


FIG. 2

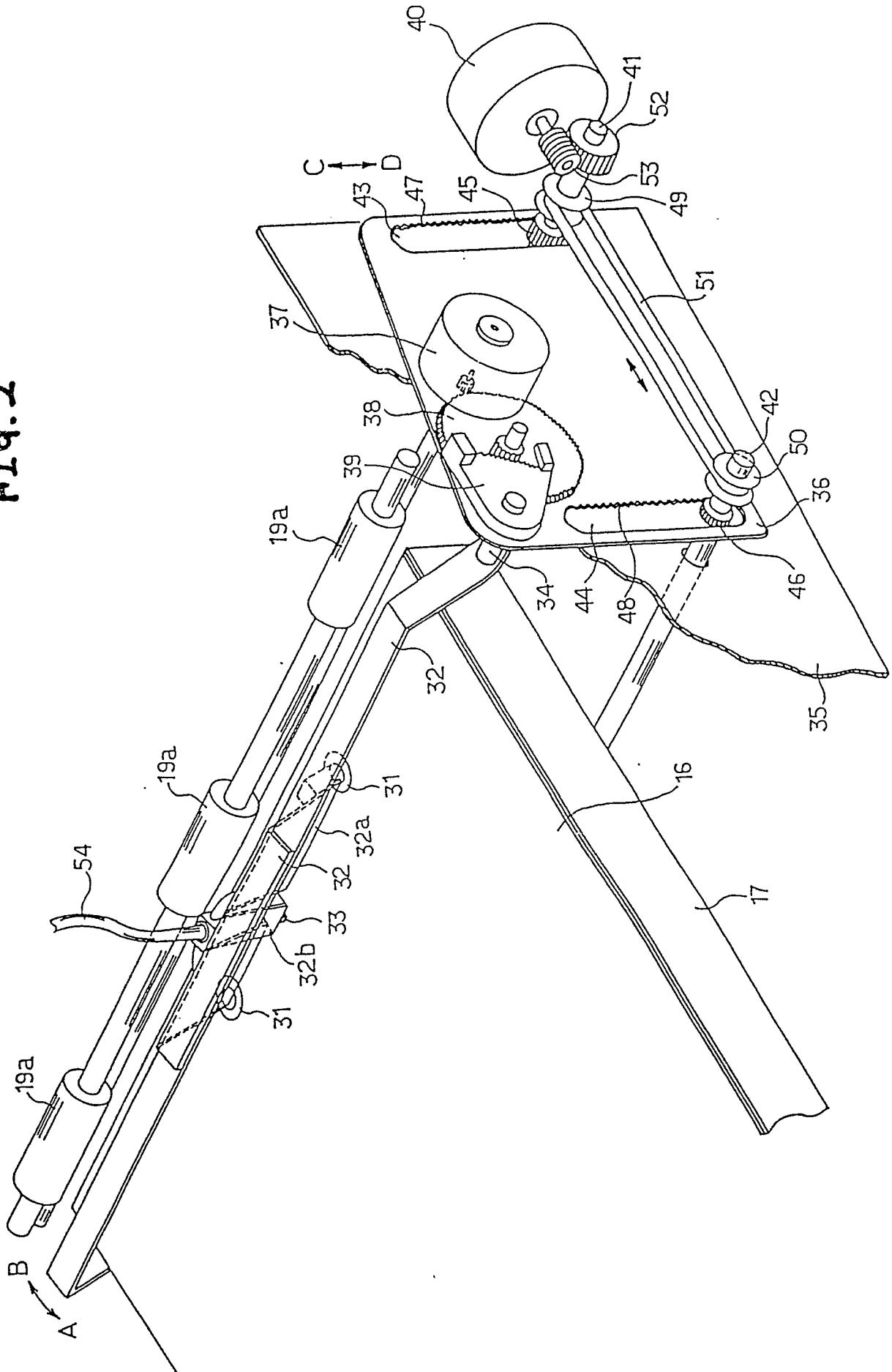


Fig. 3

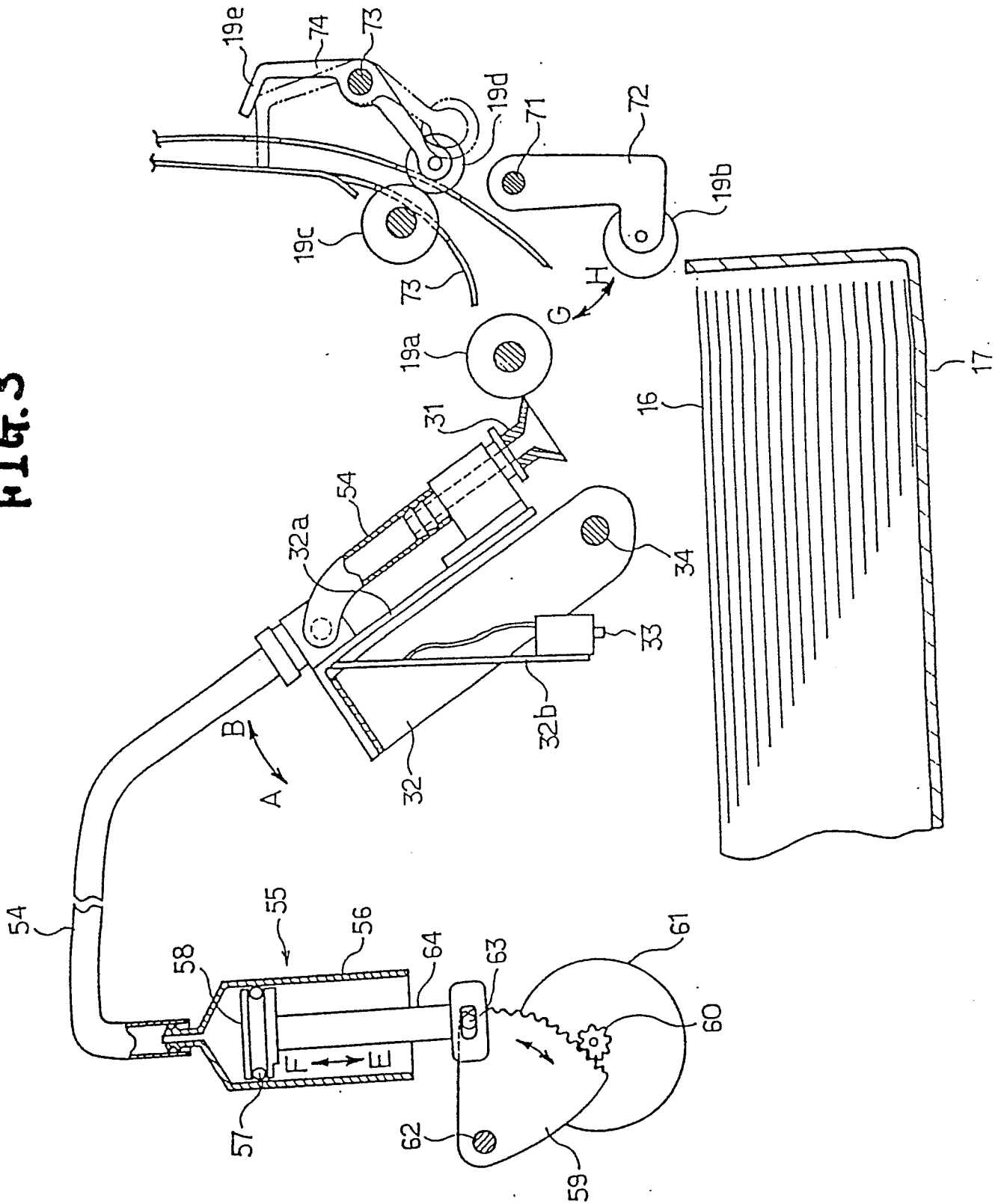


FIG. 4 (a)

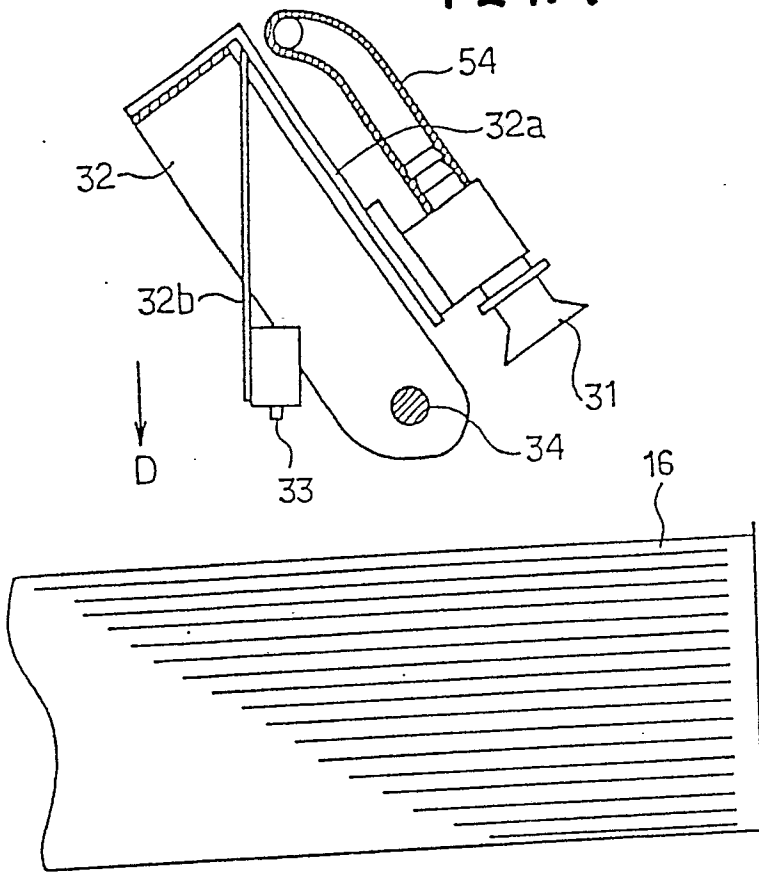


FIG. 4 (b)

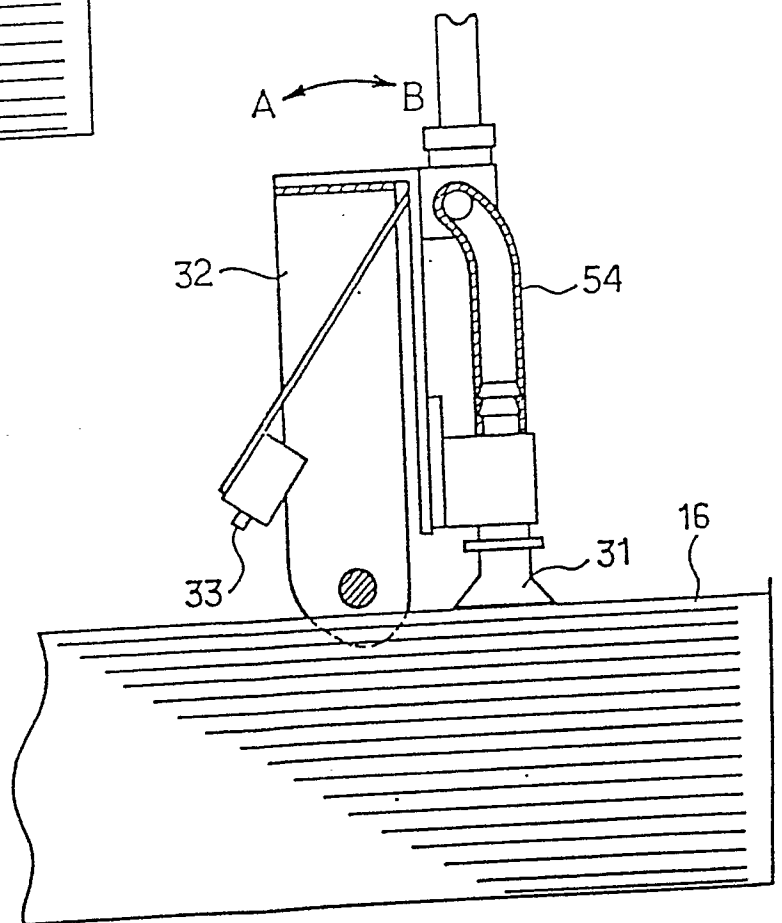


FIG. 4(c)

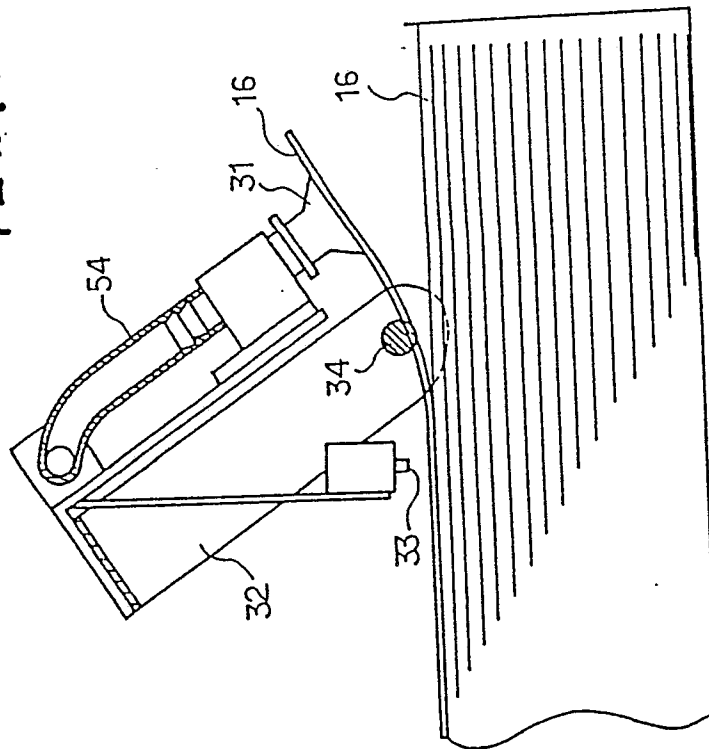


FIG. 4(d)

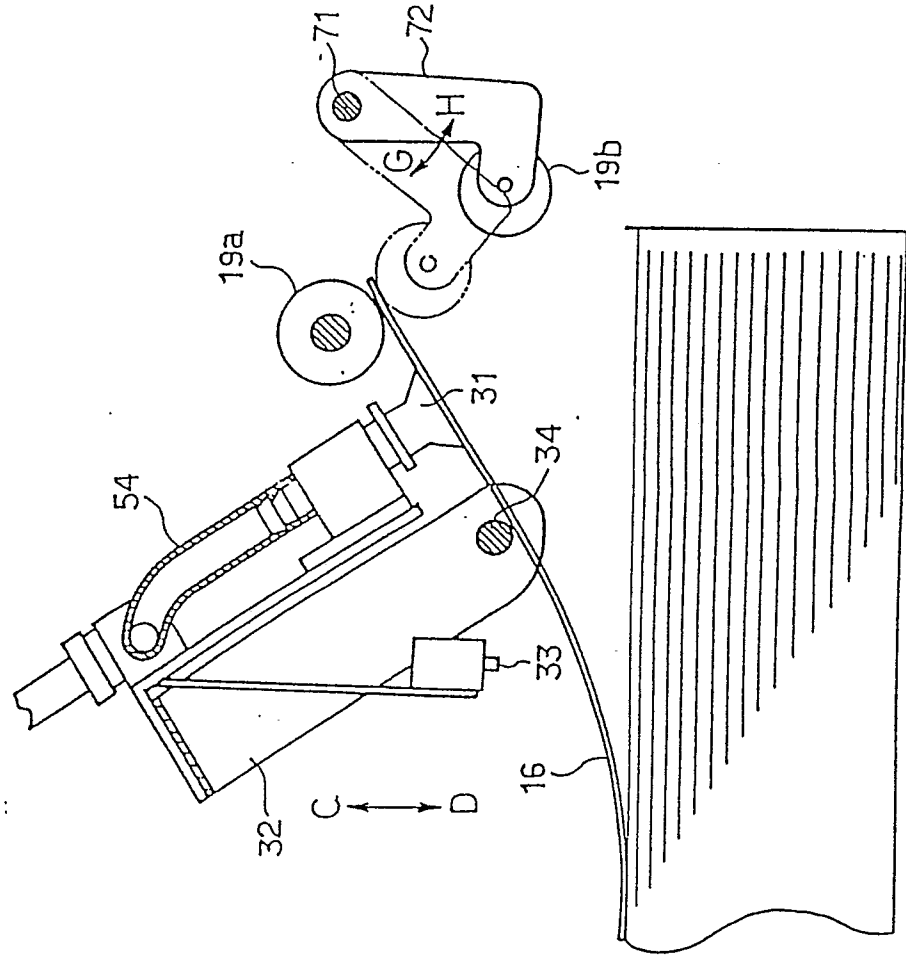


FIG. 5

