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(71) Applicant: **FUJI PHOTO FILM CO., LTD.**
210 Nakanuma Minami Ashigara-shi
Kanagawa 250-01(JP)

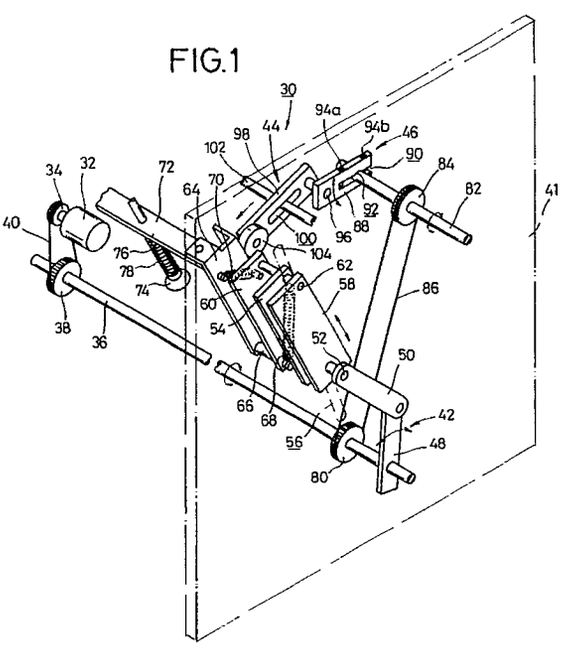
(72) Inventor: **Kagawa, Kazuyuki, c/o FUJI PHOTO EQUIPM. CO. LTD.**
1250 Takematsu
Minamiashigara.shi, Kanagawa-ken,
250-01(JP)

(74) Representative: **Patentanwälte Grünecker, Kinkeldey, Stockmair & Partner**
Maximilianstrasse 58
W-8000 München 22(DE)

(54) Sheet feed mechanism.

(57) A sheet feed mechanism for feeding stacked sheets such as photographic films one by one from a magazine includes a first drive mechanism for moving suction cups toward and away from the stacked sheets in a first direction, and a second drive mechanism for moving the suction cups in a second direction different from the first direction to impart a swinging action to a sheet held by the suction cups. The first and second drive mechanisms are actuated by a single drive source. The first drive mechanism and/or the second drive mechanism is associated with a swinging action adjusting mechanism for adjusting the swinging action to be imparted to the sheet so that plural sheets will not be fed simultaneously but will be fed reliably one by one.

FIG.1



EP 0 415 426 A2

SHEET FEED MECHANISM

BACKGROUND OF THE INVENTION

The present invention relates to a sheet feed mechanism for feeding stacked sheet films, one by one, from a magazine to a cassette, the sheet feed mechanism having means for effecting an adjustable sheet film swinging action.

Many approaches to the exposure of photographic films to images and the subsequent development of the images are known in the art. According to one recent practice, a photographic film is loaded in a cassette, then it is exposed to a radiation image of an object such as a human body, and finally the exposed film is developed by a photographic processor. These steps are effected successively in a bright room.

Actually, unexposed photographic films are supplied one by one from a film magazine to the cassette by a film loading device. The cassette with the exposed film stored therein, or a magazine which temporarily stores exposed films that have been collected from a plurality of cassette, is loaded in a film transfer device, and then the exposed film or films are delivered from the cassette or magazine to an automatic photographic processor.

In the film loading device or the film transfer device, the films stacked in the magazine tend to stick together under electrostatic forces. When the films are taken from the magazine by a sheet feed mechanism, it is necessary to impart a swinging action to each of the films. In case such a swinging action given by the sheet feed mechanism is not adjustable, the films may not be reliably fed one by one from the magazine because of the relative positional relationship between the sheet feed mechanism and the magazine.

There has been proposed a sheet feed mechanism which has a first drive source for moving a suction cup toward and away from a film, and a second drive source for imparting a swinging action to the film which is attracted by the suction cup.

The proposed sheet feed mechanism is however large in size and high in cost since it employs two drive sources.

SUMMARY OF THE INVENTION

It is a major object of the present invention to provide a sheet feed mechanism which has a single drive source for taking out stacked sheets and swinging the sheets one by one, and means for adjustably imparting a swinging action to the sheets.

Another object of the present invention is to provide a sheet feed mechanism comprising suction means for taking out stacked sheets one by one, first drive means for moving the suction means toward and away from the stacked sheets in a first direction, second drive means for moving the suction means in a second direction different from the first direction to impart a swinging action to a sheet held by the suction means, a single drive source for actuating the first and second drive means in unison with each other, and swinging action adjusting means associated with the first drive means and/or the second drive means, for adjusting the swinging action to be imparted to the sheet.

Still another object of the present invention is to provide the sheet feed mechanism wherein the first drive means comprises a plate movable toward and away from the stacked sheets by the single drive source, and a bracket swingably supported on the plate with a resilient member coupled therebetween, the attracting means being mounted on the bracket, and wherein the second drive means includes a rotatable member held in engagement with the bracket at all times and movable by the single drive source to displace the bracket in the second direction.

Yet another object of the present invention is to provide the sheet feed mechanism wherein the swinging action adjusting means comprises an arm for converting rotational motion from the single drive source into substantially linear reciprocating motion, the second drive means including a shaft rotatable by the single drive source, the arm being positionally adjustably mounted on the shaft.

The above and other objects, features and advantages of the present invention will become more apparent from the following description when taken in conjunction with the accompanying drawings in which a preferred embodiment of the present invention is shown by way of illustrative example.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary perspective view of a sheet feed mechanism according to the present invention;

FIG. 2 is a schematic vertical cross-sectional view of a film loading device which incorporates the sheet feed mechanism shown in FIG. 1;

FIGS. 3(a), 3(b), and 3(c) are side elevational views showing the manner in which sheets are

fed one by one by the sheet feed mechanism according to the present invention; and

FIG. 4 is a schematic vertical cross-sectional view of a sheet delivery device which incorporates a sheet feed mechanism according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 2 shows a film loading device 10 which incorporates a sheet feed mechanism according to the present invention. The film loading device 10 has a housing 12 which includes a magazine loading unit 14 in one upper side thereof and a cassette loading unit 16 disposed below the magazine tray 14. The magazine loading unit 14 holds a magazine 18 which contains a stack of unexposed photographic films F, and the cassette loading unit 16 holds a cassette 22 which has been inverted from an opening 20 defined in the housing 12 through a shutter 19 which can selectively be opened and closed.

A sheet feed mechanism 30 according to the present invention is disposed in an upper portion of the housing 12 near the magazine 18 held in the magazine loading unit 14. As shown in FIG. 1, the sheet feed mechanism 30 has a single rotative drive source 32 which has a rotatable output shaft that supports a sprocket 34. An endless chain 40 is trained around the sprocket 34 and another sprocket 38 which is mounted on a rotatable shaft 36. The rotatable shaft 36 has its opposite ends rotatably supported by respective fixed plates 41 (one shown) which are vertically disposed in the housing 12. First drive means 42 for displacing suction means (described later) toward and away from films F in the magazine 18 are coupled respectively to the opposite ends of the rotatable shaft 36. With each of the opposite ends of the rotatable shaft 36, there are associated a second drive means 44 which imparts a swinging action to a film F which is attracted by the sucking means, and a swinging action adjusting means 46 which adjusts the swinging action imparted to the film F.

Each of the first drive means 42 includes an arm 48 fixed to an end of the rotatable shaft 36 and swingably coupled to one end of a link 50, the other end of which is connected to a guide pin 52. The guide pin 52 is secured to a lower end of a guide plate 54 which is positioned inwardly of one of the fixed plates 41 and extends perpendicularly to the shaft 36. The guide pin 52 extends through an elongate slide groove 56 defined in the fixed plate 41 toward the magazine 18 and also through a slide plate 58 extending parallel to the guide plate 54, and is fitted in the link 50. A pin 62 which is mounted on an upper end of a swing plate 60 parallel to the guide plate 54 is fitted in an upper end of the guide plate 54, and is also inserted through the slide groove 56 and fitted securely into the slide plate 58. A bracket 64 is disposed near the swing plate 60 parallel thereto, and a pin 66 fixedly mounted on a lower end of the bracket 64 is fitted in the swing plate 60 in diagonally opposite relation to the pin 62.

A coil spring 68 extends and is joined between the pin 66 and the guide plate 54, and a coil spring 70 extends and is joined between the bracket 64 and the swing plate 60. Therefore, as viewed from the slide plate 58, the swing plate 60 is normally urged to turn counterclockwise about the pin 62 with respect to the guide plate 54 under the bias of the coil spring 68, and the bracket 64 is normally urged to turn clockwise about the pin 66 with respect to the guide plate 54 under the bias of the coil spring 70.

A relatively long plate 72 is fixed to an upper end of the bracket 64 and extends parallel to the shaft 36. The plate 72 supports a plurality of suction cups 74 (one shown) at spaced intervals. Each of the suction cups 74 is mounted on a lower end of a pipe 76 which is axially slidably supported on the plate 72 with a coil spring 78 interposed therebetween. The other end of the pipe 76 is connected to a vacuum source (not shown).

The second drive means 44 includes a sprocket 80 mounted on the end of the shaft 36 near the arm 48. An endless chain 86 is trained around the sprocket 80 and another sprocket 84 mounted on a shaft 82 which extends parallel to the shaft 36. The swinging action adjusting means 46 comprises an arm 88 fixed to one end of the shaft 82. The arm 88 is of a channel shape with a slot 90 defined therein. The arm 88 also has arcuate grooves 92 opening into the slot 90, the arcuate grooves 92 being partly complementary in shape to the shaft 82. With the shaft 82 received in the arcuate grooves 92, setscrews 94a, 94b are adjustably threaded in the arm 88 one on each side of the shaft 82, fastening the arm 88 to the shaft 82. The angular position of the arm 88 with respect to the shaft 82 can therefore be adjusted by loosing the setscrews 94a, 94b.

A pin 96 is mounted on one end of the arm 88 remote from the shaft 82 and fitted in one end of a swinging arm 98 which is also part of the second drive means 44. The swinging arm 98 has a longitudinally elongate guide groove 100 defined centrally therein, and a fixed shaft 102 parallel the shaft 82 is fitted in the guide groove 100. The other end of the swinging arm 98 supports a rotatable member 104 such as a roller which is held in rolling contact with one end of the bracket 64.

As shown in FIG. 2, a pair of guide plates

110a, 110b and a pair of feed rollers 112 are disposed below the sheet feed mechanism 30. The feed rollers 112 are positioned near and above a horizontal partition 114 in the housing 12. The feed rollers 112 serve to feed a film F into a film insertion slot 116 defined in the partition 114 and extending in a direction normal to the sheet of FIG. 2.

A shutter 118 is mounted on the lower surface of the partition 114 for back and forth movement across the film insertion slot 116 in the directions indicated by the arrows. The shutter 118 is normally urged to move to the right in FIG. 2 by a spring 120. The shutter 118 has a slot 122 similar to the film insertion slot 116 and a downwardly bent engaging member 124 against which the spring 120 is held.

A cassette opening and closing mechanism 130 is disposed below the shutter 118. The cassette opening and closing mechanism 130 includes a rotative drive source 132 with one end of a link 134 mounted on its rotatable shaft. The other end of the link 134 is coupled to one end of an arm 136, the other end of which is linked to an opening and closing member 138. The opening and closing member 138 is swingably supported on a support pin 140 at its lower end, and has a bent engaging portion 142 on its upper portion. The cassette loading unit 16 has a cassette holding member 144 disposed obliquely in confronting relation to the opening and closing member 138. A suction cup 146 connected to a vacuum source (not shown) is supported on the cassette holding member 144.

The cassette 22 which is to be loaded into the cassette loading unit 16 has a cassette case 22a for storing a single film F and a cover 22b which is openable and closable with respect to the cassette case 22a. The cover 22b is shorter than the cassette case 22a in the direction normal to the sheet of FIG. 2. The engaging portion 142 of the opening and closing member 138 can hold the cassette case 22a out of physical interference with the cover 22b.

The sheet feed mechanism 30 according to the present invention and the film loading device 10 which incorporates the sheet feed mechanism 30 are basically constructed as described above. Operation of the sheet feed mechanism 30 and the film loading device 10 will now be described below.

The magazine 18 which stores a stack of unexposed photographic films F is placed in the magazine loading unit 14, and the cassette 22 is loaded through the opening 20 into the cassette loading unit 16, after which the shutter 19 is closed. Then, a shutter (not shown) in the magazine 18 is removed to open the magazine 18 in the housing 12, and thereafter the sheet feed mechanism 30 is actuated.

More specifically, the rotative drive source 32 is energized to cause the sprocket 34, the chain 40, and the sprocket 38 to rotate the shaft 36 about its own axis in a predetermined direction. The arm 48 on one end of the shaft 36 and the link 50 coupled thereto move the slide plate 58 and the guide plate 54 in unison toward the magazine 18 (see FIG. 1). Therefore, the suction cups 74 are caused by the swing plate 60 and the bracket 64, which are connected to the slide plate 58 and the guide plate 54, to contact an uppermost film F in the magazine 18 (see FIG. 3(a)). The vacuum source (not shown) is actuated to enable the suction cups 74 to suck the film F under vacuum, and then the bracket 64 is lifted by continued rotation of the rotative drive source 32.

The arm 88 operatively coupled to the shaft 36 is rotated to cause the swinging arm 98 to press the rotatable member 104 against the bracket 64 in a direction different from the direction in which the bracket 64 is moved back and forth by the first drive means 42, while the swinging arm 98 is being guided by the guide groove 100 and the fixed shaft 102. Therefore, the bracket 64 as it moved upwardly at this time is angularly moved about the pin 66 in the direction indicated by the arrow in FIG. 3(b) against the tension of the coil spring 70. At the same time, the swing plate 60 is angularly displaced about the pin 62 under the resiliency of the coil spring 68. Consequently, the position of the pin 66 about which the bracket 64 swings varies thereby to give the film F sucked by the suction cups 74 a swinging action along a desired path.

Upon continued energization of the rotative drive source 32, the bracket 64 is elevated by the first drive means 42, and the swinging arm 98 is displaced away from the bracket 64. The bracket 64 is swung in a direction opposite to the previous direction in which the swinging action is imparted, so that the suction cups 74 are angularly moved toward the guide plates 110a, 110b (see FIG. 3(c). The film F attracted by the suction cups 74 is thus removed from within the magazine 18, and when the suction source connected to the suction cups 74 is inactivated, the film F is fed by gravity along the guide plates 110a, 110b toward the feed rollers 112.

In the cassette loading unit 16, the cassette 22 is opened by the cassette opening and closing mechanism 130. More specifically, as shown in FIG. 2, the cover 22b of the cassette 22 is positioned on the cassette holding member 144 under a vacuum developed by the suction cup 146, and the cassette case 22a is engaged by the engaging portion 142 of the opening and closing member 138. When the rotative drive source 132 is energized, the link 134 is turned to cause the arm 136 to pull the opening and closing member 138

together with the cassette case 22a away from the cover 22b.

When the opening and closing member 138 swings about the support pin 140, the distal end of the opening and closing member 138 engages the engaging member 124 of the shutter 118 and moves the shutter 118 to the left (FIG. 2) against the bias of the spring 120. When the opening and closing member 138 is stopped in a predetermined angular position, the slot 122 in the shutter 118 is held in registry with the film insertion slot 116 in the partition 114. The film F is now fed by the feed rollers 112 through the slots 116, 122 and then drops between the cassette case 22a and the cover 22b.

Then, the rotative drive source 132 is energized to cause the arm 136 to swing the cassette case 22a toward the cover 22b, thereby closing the cassette 22. The film F is thus stored in the cassette 22 while being shielded from light. The shutter 118 is moved to the right (FIG. 2) under the resiliency of the spring 120, thus closing the film insertion slot 116. When the vacuum source connected to the suction cup 146 is inactivated and the shutter 19 is opened, the cassette 22 can be removed from the cassette loading unit 16. At this time, no extraneous light enters the upper chamber in the housing 12 where the magazine 18 is loaded.

The cassette 22 with the unexposed film F stored is then loaded into a radiation image photographing apparatus in which the film F is exposed to an image of a desired object.

The sheet feed mechanism 30 according to the present invention has the first drive means 42 for moving the suction cups 74 toward and away from the film F in the magazine 18, and the second drive means 44 for tilting the bracket 64 in a certain direction to impart a swinging action to the film F which is held by the suction cups 74, the first and second drive means 42, 44 being driven by the single rotative drive source 32. Therefore, the sheet feed mechanism 30 is lower in cost and takes up a smaller space than the conventional sheet feed mechanism which employs two rotative sources associated respectively with first and second drive means (see FIG. 1).

The second drive means 44 is associated with the swinging action adjusting means 46. The angular position of the arm 88 with respect to the shaft 82 can easily be varied by loosening the setscrews 94a, 94b, adjusting the angular position of the arm 88 with respect to the shaft 82, and then tightening the setscrews 94a, 94b to fasten the arm 88 to the shaft 82. In this manner, the position where the bracket 64 is tilted by the rotatable member 104 can be changed with respect to the magazine 18, and hence the swinging action of the film F held by the suction cups 74 can be modified. Consequently, the swinging action of the film F can easily be adjusted in a manner to prevent a plurality of films from being fed simultaneously from the magazine 18. The arm 88 and the shaft 82 may also be arranged such that their relative position can be adjusted in addition to the adjustability of the angular position of the arm 88 with respect to the shaft 82.

The arm 48 of the first drive means 42 may be replaced with the swinging adjusting means 46. Therefore, insofar as the swinging action adjusting means 46 is associated with at least one of the first and second drive means 42, 44, the flying action imparted to the film F can be adjusted.

A film delivery device which incorporates a sheet feed mechanism according to the present invention will be described below with reference to FIG. 4.

As shown in FIG. 4, the film delivery device, generally denoted at 200, has a cassette loading unit (not shown), in an upper corner thereof, for receiving a cassette which stores an exposed film, and a magazine loading unit 202 disposed below the cassette loading unit. The sheet feed mechanism, denoted at 30a, which is identical to the sheet feed mechanism 30 shown in FIGS. 1 and 2, is positioned near the magazine loading unit 202. Those parts of the sheet feed mechanism 30a which are identical to those of the sheet feed mechanism 30 are designated by identical reference numerals, and will not be described in detail. A pair of guide plates 204a, 204b is positioned below the sheet feed mechanism 30a, and a feed device 206 is disposed near ends of the guide plates 204a, 204b. The feed device 206 comprises belts, roller pairs, and guide plates, and is directed upwardly in the film delivery device 200. The feed device 206 has an upper end directed to a film outlet slot 208 defined in an upper end of the sheet delivery device 200 opposite to the cassette loading unit. The film outlet slot 208 communicates with a film inlet slot 212 of an automatic photographic processor 210 located adjacent to the sheet delivery device 200. The automatic photographic processor 210 has a pair of feed rollers 214 disposed therein near the film inlet slot 212.

In operation, a magazine 216 which stores a plurality of exposed films F1 is inserted into the magazine loading unit 202. After a shutter (not shown) is pulled from the magazine 216, the sheet feed mechanism 30a is actuated. Operation of the sheet feed mechanism 30a will not be described in detail here as it is the same as that of the sheet feed mechanism 30.

A film F1 which has been taken out of the magazine 216 is fed to the feed device 206 through the guide plates 204a, 204b, and then

delivered upwardly by the feed device 206. The film F1 is finally fed from the film outlet slot 208 into the automatic photographic processor 210 through the film inlet slot 212. In the automatic photographic processor 210, the film F1 is supplied to a feed path (not shown) by the feed rollers 214 and then processed for image development, fixing, washing, and drying.

The sheet feed mechanism according to the present invention offers the following advantages:

Since the first drive means for moving the sucking means toward and away from stacked sheets and the second drive means for imparting a swinging action to a sheet are actuated by the single drive source, the number of drive sources is reduced to half that of drive sources used in the conventional sheet feed mechanism, the sheet feed mechanism has a reduced space requirement, and can be manufactured inexpensively.

Inasmuch as at least one of the first and second drive means is associated with the swinging action adjusting means, the swinging action to be imparted to a sheet can easily be adjusted so that a plurality of sheets are prevented from being fed simultaneously but can be fed one by one reliably.

Although a certain preferred embodiment has been shown and described, it should be understood that many changes and modifications may be made therein without departing from the scope of the appended claims.

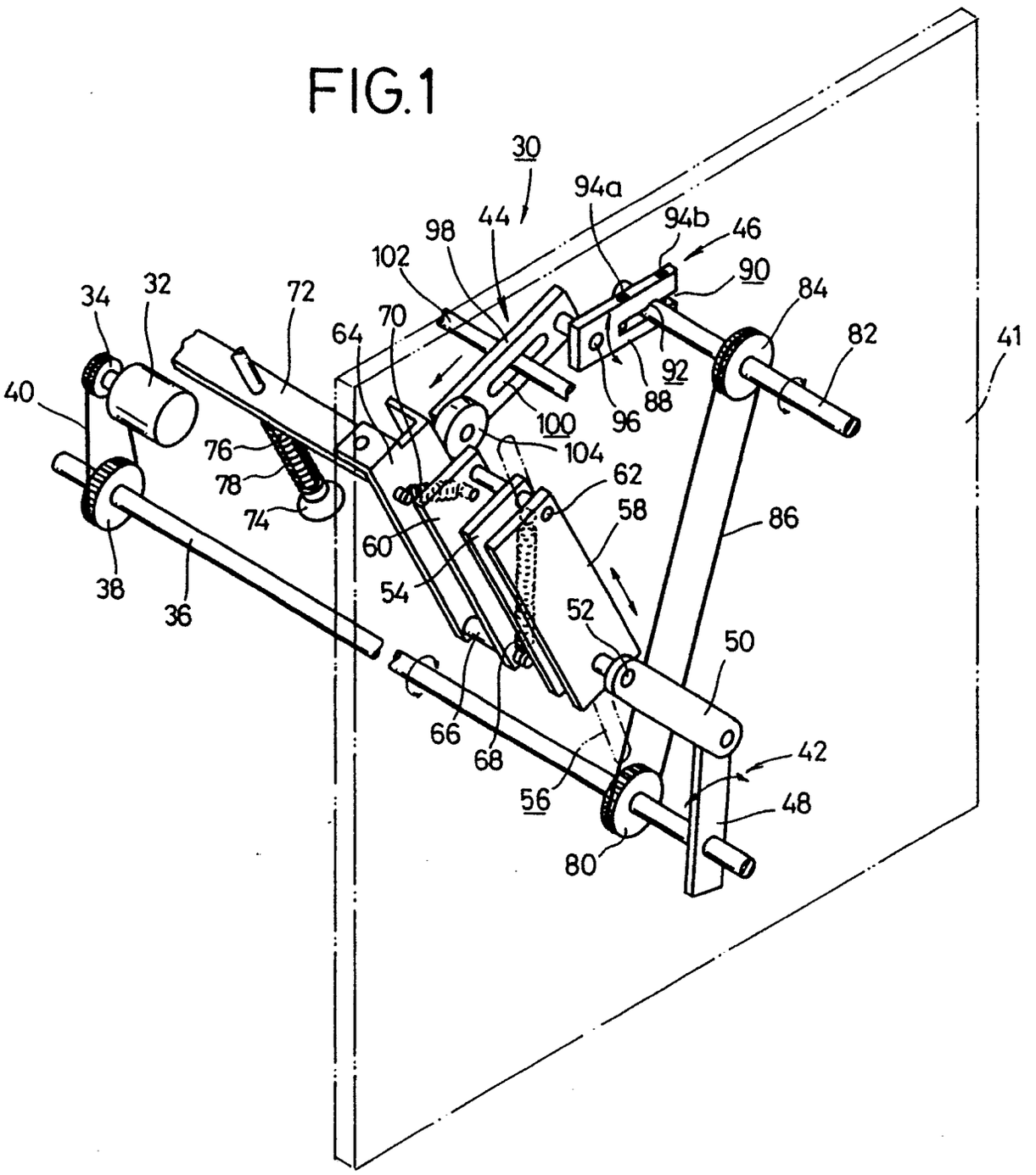
Claims

1. A sheet feed mechanism comprising:
suction means for taking out stacked sheets one by one;
first drive means for moving said suction means toward and away from the stacked sheets in a first direction;
second drive means for moving said suction means in a second direction different from said first direction to impart a swinging action to a sheet held by said suction means;
a single drive source for actuating said first and second drive means in unison with each other; and
swinging action adjusting means associated with said first drive means and/or said second drive means, for adjusting the swinging action to be imparted to the sheet.

2. A sheet feed mechanism according to claim 1, wherein said first drive means comprises:
a plate movable toward and away from the stacked sheets by said single drive source; and
a bracket swingably supported on said plate with a resilient member coupled therebetween, said suction means being mounted on said bracket; and
wherein said second drive means includes:
a rotatable member held in engagement with said bracket at all times and movable by said single drive source to displace said bracket in said second direotion.

3. A sheet feed mechanism according to claim 1, wherein said swinging action adjusting means comprises an arm for converting rotational motion from said single drive source into substantially linear reciprocating motion, said second drive means including a shaft rotatable by said single drive source, said arm being positionally adjustably mounted on said shaft.

FIG.1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94b
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98
102
90
84
82
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34
32
72
70
64
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88
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104
40
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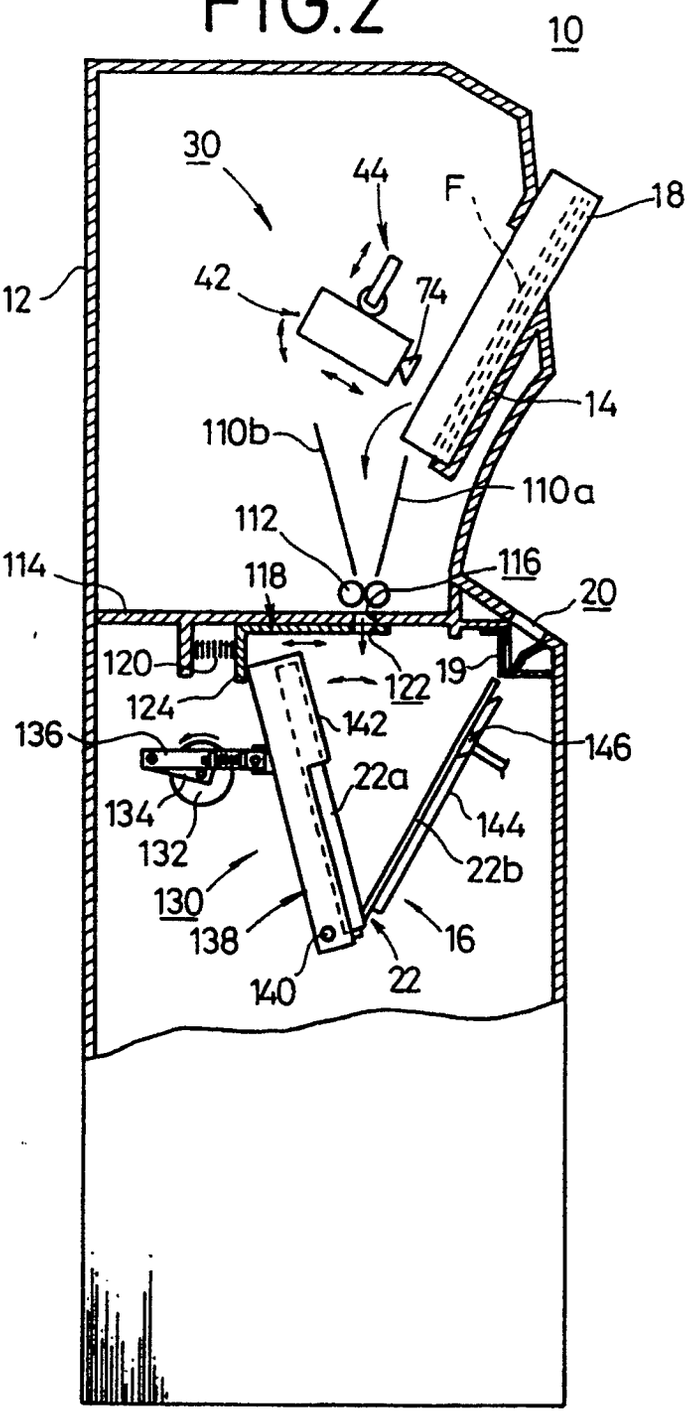
56
48
80

FIG.2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F
18
12
42
74
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110a
112
114
118
116
20
120
19
122
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142
136
146
22a
134
144
132
22b
130
138
16
140
22

FIG.3(c)

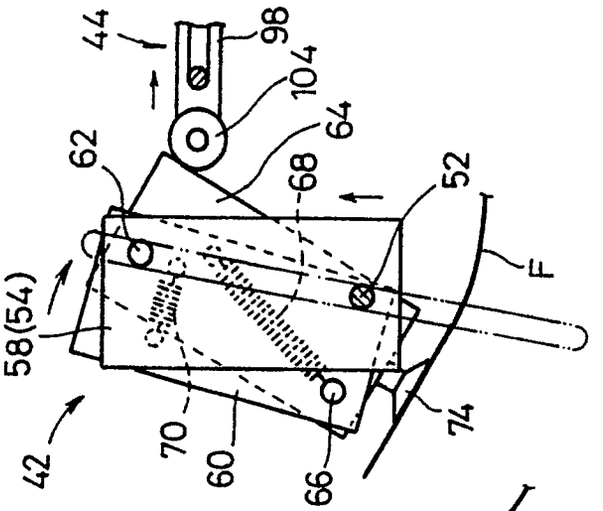

FIG.3(b)

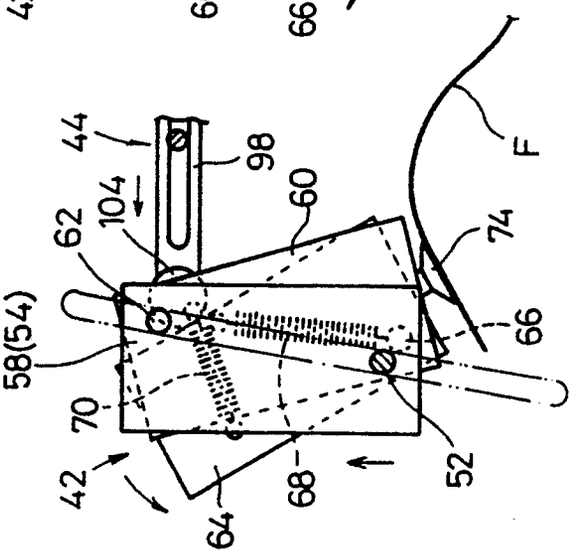

FIG.3(a)

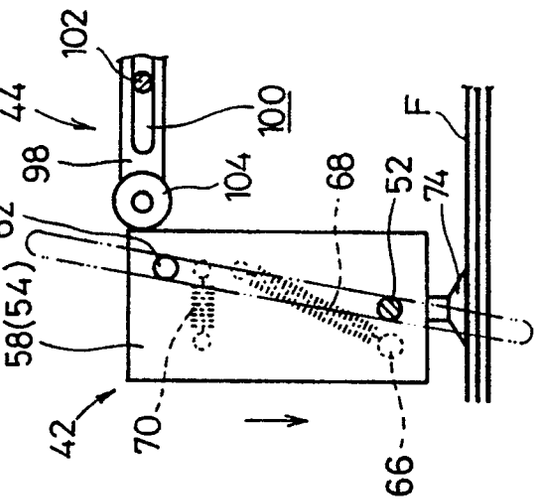

FIG.4