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(54) **Sheet reversing unit for sheet printing press.**

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DE-A- 2 708 478

(56) References cited :
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US-A- 3 742 847
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Description

Background of the Invention

The present invention relates to a sheet reversing unit for reversing a sheet between printing units for two-side printing.

A printing press which can be selectively used for both single-side printing and two-side printing has been commercially available to satisfy various needs in printing. A printing press of this type (see f.i. US-A 4 448 125) has a sheet reversing unit for reversing a sheet whose one surface has already been printed and then conveying it to the next printing unit for two-side printing.

The two-side printing operation with the printing press comprising this sheet reversing unit will be described with reference to Fig. 3. Two printing units 1 and 2 of the printing press comprise rubber blanket cylinder 3 each of which is in contact with a corresponding plate cylinder (not shown), and impression cylinders 4 and 5 each of which is in contact with the corresponding rubber blanket cylinder 3 and has a diameter twice that of the cylinder 3. Gripper devices 6 and 7 (to be referred to simply as grippers 6 and 7 hereinafter) each consisting of a gripper and a gripper pad are arranged in notches which are formed at a position that equally divides the outer peripheries of the impression cylinders 4 and 5. A reversing cylinder 8 is disposed between the two impression cylinders 4 and 5 so that their peripheral surfaces are brought into contact with each other. A reversing device 11 consisting of a reversing gripper 9 and a suction lever 10 is arranged in a notch formed at a position that equally divides the outer periphery of the reversing cylinder 8. Reference numeral 12 denotes a feeder board for stopping a sheet 13 fed from the sheet feeder and registering the sheet end. Reference numeral 14 denotes a swing device for gripping the sheet 13 on the feeder board 12 to be re-gripped by the gripper 6 of the impression cylinder 4.

With the above arrangement, the sheet 13 gripped by the gripper 6 of the impression cylinder 4 is conveyed while being wound around the peripheral surface of the impression cylinder 4 upon rotation of the impression cylinder 4 in the direction indicated by the arrow in Fig. 3. When the sheet 13 passes through the cylinders 3 and 4, an image transferred from the plate cylinder to the rubber blanket cylinder 3 is transferred to a front surface of the sheet 13, thus performing surface printing. When the impression cylinder 4 is further rotated, and the gripper 6 gripping the sheet 13 has passed the contact point between the two cylinders 4 and 8 and the sheet end of the sheet 13 reaches the contact point between the cylinders 4 and 8, as shown in Fig. 3(b), the suction lever 10 draws the sheet end which causes the reversing gripper 9 to grip it, and the gripper 6 releases the sheet 13. Fig. 3(c) illustrates a state wherein the respective cylinders have been rotated through about 30° from the re-gripping operation. The sheet 13 gripped by the reversing gripper 9 is about to be wound around the reversing cylinder 8 as was wound around the impression cylinder 4 so that its non-printing surface faces the peripheral surface of the reversing cylinder 8. Reference numerals 13A and 13B denote proceding sheets; and 13C and 13D, following sheets. The gripped end of the sheet 13 wound around the reversing cylinder 8 reaches the contact point between the cylinders 8 and 5 upon rotation of the respective cylinders like the sheet 13B, and the sheet 13 is re-gripped from the reversing gripper 9 to the gripper 7. When the respective cylinders are further rotated, the sheet 13 is reversed so that the printed surface faces the peripheral surface of the impression cylinder 5. The sheet 13 is then wound around the impression cylinder 5. Thereafter, in the printing unit 2, the printing operation is performed as in the printing unit 1. In this case, since the sheet 13 is reversed, an image is printed on its back surface.

The two-side printing operation has been described schematically. The arrangement and operation of the reversing unit 11 will be described in more detail with reference to Figs. 4 and 5. Fig. 4 is an enlarged side view of the reversing unit which has passed the contact point with the impression cylinder 5 and is rotated toward the contact point with the impression cylinder 4, and Fig. 5 is an enlarged side view of the reversing unit at the contact point with the impression cylinder 4. In Figs. 4 and 5, a gripper shaft 15 and a hollow suction lever shaft 16 are axially suspended in the notch of the outer peripheral portion of the reversing cylinder 8 and parallel to a cylinder shaft. These shafts 15 and 16 are alternately oscillated in the normal and reverse directions through a predetermined angle at a predetermined timing through the mesh between segment gears which are driven by a cam mechanism arranged on a frame (not shown) and pinions on the shafts 15 and 16. The reversing gripper 9 comprises a gripper holder 17 fixed to the gripper shaft 15 and a pivotal gripper pad holder 18. A gripper 20 for gripping the sheet 13 between itself and a gripper pad 19 fixed to the distal end portion of the gripper pad holder 18 is pivotally mounted on the distal end portion of the gripper pad holder 18. Reference numeral 21 denotes a gripper spring for biasing the gripper pad holder 18 in the closing direction of the gripper 19; and 22, a gripper spring for applying a gripping pressure to the gripper 19. The reversing gripper 9 with the above arrangement is pivoted between positions shown in Figs. 4 and 5 together with the gripper shaft 15 which is reciprocated by the cam mechanism. A roller lever which is swung by the cam mechanism on the frame side (not shown) is fixed to one end of the gripper shaft 15, so as to open and close the gripper 20 at the position shown in Fig. 5. Addi-

tionally, the suction lever 10 comprises an L-shaped lever 23 which is fixed to the suction lever shaft 16 at a phase different from that of the reversing gripper 9 in the axial direction, and a suction port 24 mounted on one free end portion. The suction port 24 is connected to a suction air source through a hollow portion of the suction lever shaft 16, a rotary valve, and the like. The suction lever 10 is pivoted, between the positions shown in Figs. 4 and 5, together with the suction lever shaft 16 which is reciprocated by the cam mechanism. Note that a stopper 25 projecting from the lever 23 is formed to have the same phase as that of the gripper pad holder 18 in the axial direction.

With the above arrangement, when the reversing unit 11 is located on the upper side of the reversing cylinder 8, the reversing gripper 9 is stopped in position while the stopper 26 abuts against a stopper 27 of the cylinder 8, as shown in Fig. 4. The suction lever 10 is stopped in position while the stopper 25 abuts against the gripper pad holder 18. When the respective cylinders are rotated and the reversing unit 11 reaches the position shown in Fig. 5, only the suction lever 10 is pivoted counterclockwise by the cam mechanism to the position shown in Fig. 5, and then, the reversing gripper 9 is pivoted clockwise by another cam mechanism to the position shown in Fig. 5. Thus, since the stopper 25 is separated from the tail portion of the gripper pad holder 18, the suction lever 10 is again returned to the position shown in Fig. 4, causes the sheet end to be drawn by the suction port 24, and is then pivoted counterclockwise to provide the state shown in Fig. 5. At this time, the gripper shaft 15 is oscillated through a predetermined angle by another cam for opening and closing the gripper, and only the gripper holder 17 is opened and closed, thereby gripping the sheet end between the gripper 20 and the gripper pad 19. When the respective cylinders are further rotated, the gripper opening/closing cam is disabled, and a reversing cam pivots the gripper shaft 15, so that the reversing gripper 9 gripping the sheet end and the suction lever 10 are returned to the positions shown in Fig. 4. In this case, since the suction lever 10 returns the position shown in Fig. 4 slightly after the reversing gripper 9 does, the stopper 24 does not interfere with the tail portion of the gripper pad holder 18. When the reversing gripper 9 and the suction lever 10 are returned to the positions shown in Fig. 4, a cam follower of the cam mechanism for driving them is moved along a downwardly indined surface from a large-diameter portion to a small-diameter portion of the cam surface, and the cam follower is urged against the cam surface by the biasing force of a spring member.

However, in the conventional sheet reversing unit as described above, when the reversing gripper 9 is returned from the position shown in Fig. 5 to the position shown in Fig. 4, the cam follower is moved along the downwardly indined surface while being biased by the spring. When the printing press is operated at high speed, the biasing force of the spring cannot follow the rotation of the cam, and the cam follower floats from the cam surface, resulting in so-called cam skip. This may delay a pivot timing of the reversing gripper. As a result, the suction lever 10 which is pivoted after the reversing gripper 9 catches up with the reversing gripper 9, and the stopper 25 interferes with the tail portion of the gripper pad holder 18, so that the tail portion or its surrounding parts may be damaged. In particular, this phenomenon may often occur when the printing mode is switched from the single-side printing mode to the two-side printing mode for long periods and high-speed printing is performed, resulting in poor reliability.

Summary of the Invention

It is a principal object of the present invention to provide a highly reliable sheet reversing unit for a sheet printing press, which can prevent damage of parts due to their interference during a high-speed printing operation.

In accordance with the invention this object can be obtained by providing the features as stated in the characterizing clause of claim 1.

Further improvements of the invention can be obtained by providing the features as stated within the subclaim.

Brief Description of the Drawings

Figs. 1 and 2 show a sheet reversing unit for a sheet printing press according to an embodiment of the present invention, in which Fig. 1 is a side view showing a portion of a reversing cylinder for explaining the arrangement and operation of the reversing unit, and Fig. 2 is a schematic front view of the reversing cylinder and a reversing gripper driving section; and

Figs. 3(a), 3(b), 3(c) to 6 show a conventional sheet reversing unit of a sheet printing press, in which Figs. 3(a), 3(b), and 3(c) are views for explaining the operation of the reversing unit, Fig. 4 is a side view of the reversing unit in a state before a reversing gripper is pivoted for sheet gripping and after the gripper is returned after sheet gripping, Fig. 5 is a side view of the reversing unit in the sheet gripping state, and Fig. 6 is a side view of the reversing unit in the state wherein the reversing gripper interferes with a suction lever.

Description of the Preferred Embodiment

An embodiment of the present invention will now be described with reference to Figs. 1 and 2. The same reference numerals in Figs. 1 and 2 denote the

same parts as in Figs. 3 to 6, and a detailed description thereof will be omitted. A reversing cylinder 8 is axially supported by right and left frames 30 of the printing press. A gripper shaft 15 is supported by two bearers 8b to be axially suspended in an outer peripheral notch 8a of the reversing cylinder 8. A reversing gripper 9 consisting of a gripper holder 17 whose shaft is fixed and a pivotal gripper base holder 18 is axially mounted on the gripper shaft 15. A gear shaft 31 which receives a clockwise pivotal force in Fig. 1 from a torsion bar (not shown) is axially supported by the two bearers 8b of the reversing cylinder 8, and a segment gear 33 which meshes with a pinion 32 on the gripper shaft 15 is fixed to a projecting portion of the gear shaft 31. Reference numeral 34 denotes a reversing cam which is fixed to the frames 30 adjacent to the contact portion between the reversing cylinder 8 and an impression cylinder 4. The reversing cam 34 has small- and large-diameter portions concentrical with the reversing cylinder 8 and a cam surface consisting of upwardly and downwardly inclined surfaces therebetween. A cam follower 35 which is pivotally mounted on the segment gear 33 is urged against the cam surface by the biasing force of the torsion bar. When the reversing cylinder 8 is rotated and the cam follower 35 is brought into contact with the small-diameter portion of the reversing cam 34, the reversing gripper 9 is located at a position indicated on the upper portion of the reversing cylinder 8 in Fig. 1 (a position described with reference to Fig. 4). When the cam follower 35 is moved along the upwardly inclined surface and is brought into contact with the large-diameter portion, the reversing gripper 9 is pivoted and is located at a position shown in the right side portion of the reversing cylinder 8 in Fig. 1 (a position described with reference to Fig. 5). When the reversing cylinder 8 is further rotated from this position, and the cam follower 35 is moved along the downwardly inclined surface of the reversing cam 34, the reversing gripper 9 is pivoted and is then returned to the position indicated in the lower portion of the reversing cylinder 8 shown in Fig. 1.

Although omitted from Fig. 2, a suction lever shaft 16 is axially suspended in the notch 8a of the reversing cylinder 8 to be parallel to the gripper shaft 15. The suction lever 10 is axially mounted on the shaft 16. A gear shaft 36 to which a clockwise pivotal force in Fig. 1 is applied by a torsion bar (not shown) is axially supported between the bearers 8b of the reversing cylinder 8. A segment gear 38 which meshes with a pinion 37 on the suction lever shaft 16 is fixed to the gear shaft 36. Reference numeral 39 denotes a suction lever cam which is fixed to the frames 30 that are adjacent to the contact portion between the reversing cylinder 8 and the impression cylinder 4. The cam 39 has small- and large-diameter portions concentrical with the reversing cylinder 8 and a cam surface consisting of upwardly and downwardly inclined surfaces therebetween. A cam follower 40 which is pivotally mounted on the segment gear 38 is urged against the cam surface by the biasing force of the torsion bar. When the reversing cylinder 8 is rotated and the cam follower 40 is brought into contact with the small-diameter portion of the suction lever cam 39, the suction lever 10 is located at a position indicated in the upper portion of the reversing cylinder 8 in Fig. 1 (a position described with reference to Fig. 4). When the cam follower 40 is moved along the upwardly inclined surface of the suction lever cam 39 and is brought into contact with the large-diameter portion, the suction lever 10 is pivoted and is located at a position indicated in a right side portion of the reversing cylinder 8 (a position described with reference to Fig. 5). When the reversing cylinder 8 is further rotated from this position, the cam follower 40 is moved along the downwardly inclined surface of the suction lever cam 39, and the suction lever 10 is pivoted to be located at a position indicated in the lower portion of the reversing cylinder 8 in Fig. 1.

Although not shown in detail in Fig. 1, a cam lever 41 is axially mounted on the projection of the gripper shaft 15 on the side of the pinion 32, and a gripper opening/closing cam 42 as an arcuated partial cam is formed on the frame 30 on this side to be concentrical with the impression cylinder 4, and is fixed in position to have the contact position between the cylinders 4 and 8 as its center. A cam follower 43 which is pivotally mounted on the cam lever 41 is brought into contact with the gripper opening/closing cam 42. During the contact, when the cam follower 43 goes beyond the projecting portion of the gripper opening/closing cam 42, the gripper 20 is opened and closed. After the gripper 20 is closed by means of the cam 42, since the cam follower 43 is separated from the cam 42, the cam lever 41 swings upon pivotal movement of the gripper shaft 15 by means of the reversing cam 34.

The cam follower 43 pivotally mounted on the cam lever 41 which swings upon pivotal movement of the gripper shaft 15 travels as shown in Fig. 1. More specifically, as described above, the reversing gripper 9 which has passed the opposing position with the impression cylinder 4 is pivoted counterclockwise together with the gripper shaft 15 since the cam follower 35 is moved along the downwardly inclined surface of the reversing cam 34, and the cam lever 41 integral with the gripper shaft 15 swings. Then, these movements are synthesized with the peripheral movement of the gripper shaft 15 upon rotation of the reversing cylinder 8, and the cam follower 43 is moved along a V-shaped path. A regulating cam 44 for preventing the cam follower 43 from falling outside the normal travel path is fixed to the frame 30 at a position outside the travel path of the cam follower 43. More specifically, the regulating cam 44 comprises a cam surface 44a which contacts with the cam follower 43 to have a very small gap therebetween.

Even if the cam follower 35 that moves along the downwardly inclined surface of the reversing cam 34 remains floating from the cam surface due to its inertia, since the pivotal movement of the gripper shaft 15 is regulated by the cam follower 43 held in contact with the regulating cam 44, the reversing gripper 9 is accurately moved along the cam surface of the reversing cam 34, and the pivotal timing will not be delayed.

The operation of the sheet reversing unit with the above arrangement will be described below. When the reversing cylinder 8 is rotated from a state wherein the reversing unit 11 is located on the upper side of the reversing cylinder 8 and reaches the opposing point with the impression cylinder 4, the cam follower 40 is moved from the large-diameter portion to the small-diameter portion of the suction lever cam 39, and the suction lever 10 is pivoted counterclockwise. Thereafter, the cam follower 35 is moved along the upwardly inclined surface of the reversing cam 34, and the reversing gripper 9 is pivoted clockwise. The cam follower 40 then goes beyond the projecting portion of the suction lever cam 39, so that the suction lever 10 is swingably pivoted, thereby drawing the sheet end of the sheet 13 to move it to the sheet gripping position. The reversing gripper unit indicated by reference numeral 11A in Fig. 1 represents this state. At this position, the cam follower 43 enters the gripper opening/closing cam 42 and passes its large-diameter portion, and then the gripper 20 is opened and closed to grip the sheet end. When the reversing cylinder 8 is kept rotated from this state, the cam follower 35 is moved to the small-diameter portion of the reversing cam 34, and the reversing gripper 9 is pivoted counterclockwise. After some movement, the cam follower 40 is moved to the large-diameter portion of the suction lever cam 39, and the suction lever 10 is pivoted slightly later than the reversing gripper 9. Upon pivotal movement of the reversing gripper 9, the cam follower 35 is moved along the downwardly inclined surface of the reversing cam 34, so that the cam follower 35 tends to float from the cam surface due to its inertia during high-speed rotation. However, in this unit, when the cam follower 43 separated from the gripper opening/closing cam 42 is moved while being in contact with the cam surface of the regulating cam 44, the pivotal movement of the gripper shaft 15 is regulated, and the cam follower 35 is moved while being urged against the cam surface without floating. Thus, the pivotal movement of the reversing gripper 9 will not be delayed from the normal movement. Therefore, as shown in Fig. 6, the stopper 25 of the suction lever 10 which is pivoted after the reversing gripper 9 will not interfere with the tail portion of the gripper base holder 18.

As described above, before gripping the sheet 13, the reversing gripper 9 and the suction lever 10 are moved to prevent interference between the stopper 25 and gripper base holder 18. In this case, since the cam follower 35 is moved along the upwardly inclined surface of the reversing cam 34, the cam follower 35 does not float from the cam surface, and there is no fear of interference between the stopper 25 and the gripper base holder 18.

As can be seen from the above description, in a sheet reversing unit for a sheet printing press, a cam lever which is brought into contact with a cam surface of a cam mechanism for opening/closing a gripper of a reversing gripper device is fixed to a pivot shaft to which the reversing gripper device is fixed. A regulating cam having a cam surface which contacts a cam follower so as not to fall outside a normal moving path is provided outside the moving path of the cam follower which is pivoted together with the pivot shaft after a sheet is gripped. When a reversing gripper and a suction lever are pivoted to be returned to their original positions after the sheet is gripped, a gripper shaft together with the cam follower whose movement is regulated is accurately moved along the cam surface of a cam mechanism for pivoting the reversing gripper, and the pivotal movement of the reversing gripper will not be delayed. Therefore, the reversing gripper and the suction lever will not interfere with each other, and damage to these and surrounding parts can be prevented, thereby improving reliability.

Claims

1. Sheet reversing unit (11) for a sheet printing press, being arranged in the area of a rotating reversing cylinder (8), located between two impression cylinders (4, 5); comprising
   - a suction member (10) activated by a first cam mechanism (39, 40) for catching the rear end of a sheet (13) to be printed from both sides as soon as the same reaches the contact point to the preceeding cylinder (4),
   - a reversing gripper device (9) arranged adjacent to said suction member (10) being activated by a second cam mechanism (42, 43) for gripping the rear end of the sheet (13) caught by the suction member (10), as well as
   - a third cam mechanism (34, 35) for rotating the pivot shaft (15) of the reversing gripper device (9) and for transfering the gripped rear end of the sheet (13) as new front end to the following cylinder (5),

   whereby the cam follower (43) of the second cam mechanism (42, 43) is pivoted together with the pivo t shaft (15) of the reversing gripper device (9) following the gripping of the sheet (13) **characterized**, in that on the frame (30) of the printing press at a position outside the normal travel path

of the cam follower (43) of the second cam mechanism (42, 43) there is mounted a stationary regulating cam (44) having a cam surface (44a) which during rotation of the pivot shaft (15) of the sheet holding reversing gripper (9) contacts the cam follower (43) of the second cam mechanism (42, 43) so as not to permit any deviation of said cam follower (43) from its normal path due to inertia during high speed printing operations.

Patentansprüche

1. Bogen-Wendeeinheit (11) für eine Bogendruckmaschine, welche im Bereich des Wendezylinders (8) zwischen zwei Gegendruckzylindern (4, 5) angeordnet ist, bestehend aus
   - einem von einem ersten Nockenmechanismus (39, 40) aktivierten Saugelement (10) zum Erfassen des rückwärtigen Endes eines Papierblattes (13), welches von beiden Seiten bedruckt wird, sobald dasselbe die Kontaktstelle des vorangegangenen Zylinders (4) erreicht,
   - einem in der Nähe des Saugelementes (10) angeordneten, von einem zweiten Nockenmechanismus (42, 43) aktivierten Wendegreiferelement (9) zum Erfassen des rückwärtigen Endes eines von dem Saugelement (10) erfaßten Papierblattes (13), sowie
   - einem dritten Nockenmechanismus (34, 35) zum Rotieren der Greiferwelle (15) des Wendegreiferelements (9) und zum Überführen des erfaßten rückwärtigen Endes des Papierblattes (13) als neues vorderes Ende zu dem folgenden Zylinder (5) ,

   wobei ein Nockenfolger (43) des zweiten Nockenmechanismuses (42, 43) zusammen mit der Greiferwelle (15) des Wendegreiferelements (9) nach dem Erfassen des Papierblattes (13) verschwenkt wird,
   dadurch gekennzeichnet,
   daß auf einem Rahmen (30) der Druckmaschine in einer Position außerhalb des normalen Bewegungspfads des Nockenfolgers (43) des zweiten Nockenmechanismuses (42, 43) ein stationärer Einstellnocken (44) mit einer Steuerfläche (44a) montiert ist, welcher während der Rotation der Greiferwelle (15) des Blattwendegreifers (9) den Nockenfolger (43) des zweiten Nockenmechanismuses (42, 43) derart berührt, daß kein Abheben des Nockenfolgers (43) von seinem normalen Pfad während Druckvorgängen mit hoher Geschwindigkeit aufgrund von Trägheit zustande kommt.

Revendications

1. Unité de retournement de feuille (11) pour une machine à impression de feuilles disposée dans la zone d'un cylindre de retournement rotatif (8) disposé entre deux cylindres d'impression (4, 5), comprenant :
   - un élément d'aspiration (10) actionné par un premier mécanisme à came (39, 40) pour saisir l'extrémité arrière d'une feuille (13) à imprimer à partir des deux côtés dès que cette feuille atteint le point de contact avec le cylindre précédent (4),
   - un moyen de saisie de retournement (9) disposé au voisinage dudit élément d'aspiration (10) qui est actionné par un second mécanisme à came (42, 43) pour saisir l'extrémité arrière de la feuille (13) saisie par l'élément d'aspiration (10), aussi bien que,
   - un troisième mécanisme à came (34, 35) pour faire tourner l'axe de pivotement (15) du moyen de saisie de retournement (9) et pour transférer la partie arrière saisie de la feuille (13) en tant que nouvelle extrémité de telle sorte que le suiveur de came (43) du second mécanisme à came (42, 43) pivote en même temps que l'arbre de pivotement (15) du moyen de saisie de retournement (9) à la suite de la saisie de la feuille (13) caractérisée en ce que sur le châssis (30) de la presse à imprimer, en une position qui se trouve à l'extérieur du trajet normal de déplacement du suiveur de came (43) du second mécanisme à came (42, 43), se trouve montée une came stationnaire de régulation (44) qui comporte une surface de came (44a) qui, au cours de la rotation de l'arbre de pivotement (15) du moyen de saisie de retournement et de maintien de feuille (9), vient au contact avec le suiveur de came (43) du second mécanisme à came (42, 43) de façon à ne permettre aucun écart dudit suiveur de came (43) par rapport à son trajet normal en raison de l'inertie pendant des opérations d'impression à grande vitesse.

FIG.1

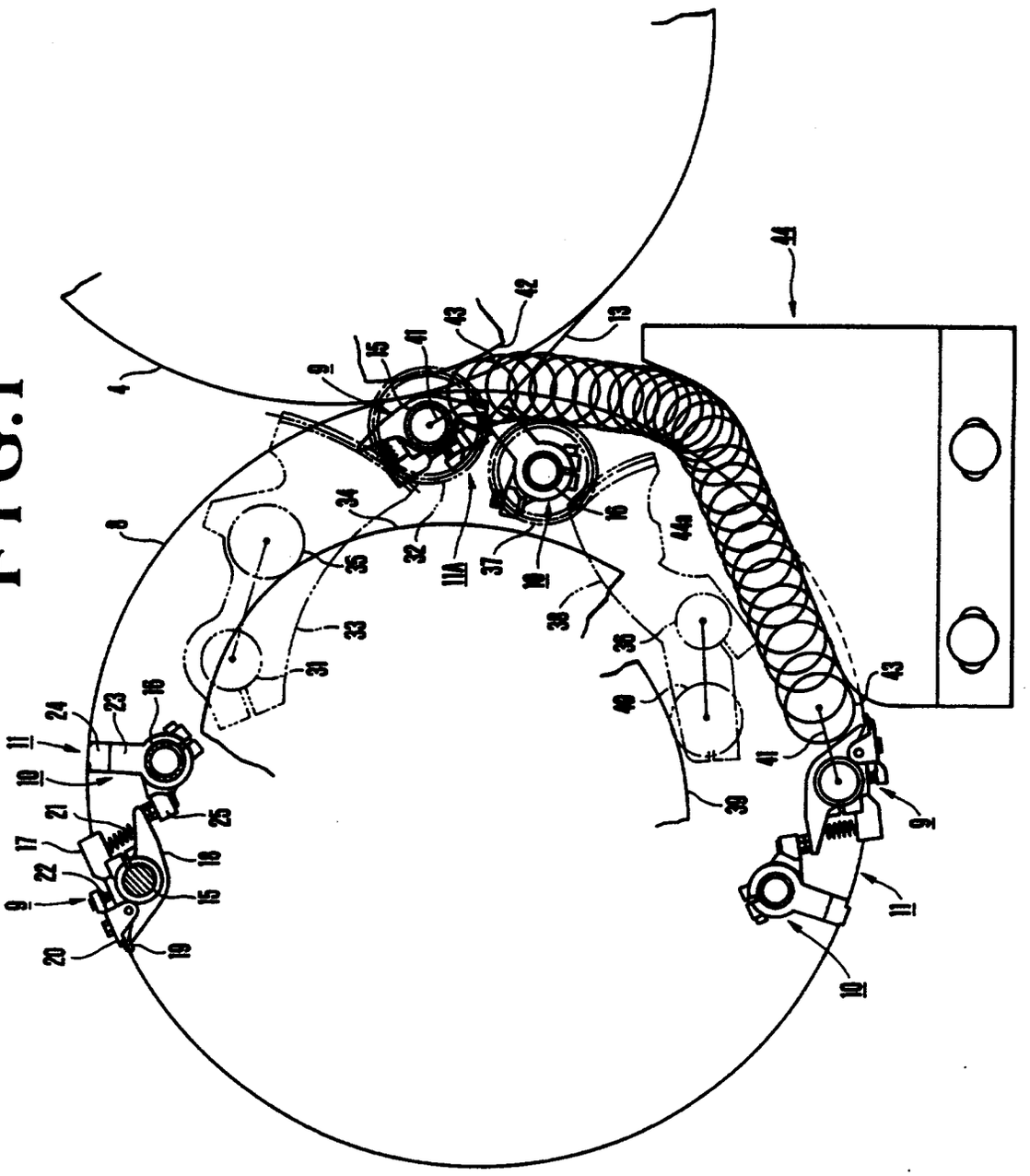
4
8
9
11
11A
11B
13
15
16
17
18
19
20
21
22
23
24
25
31
32
33
34
35
36
37
38
39
40
41
42
43
44
44a

FIG.2

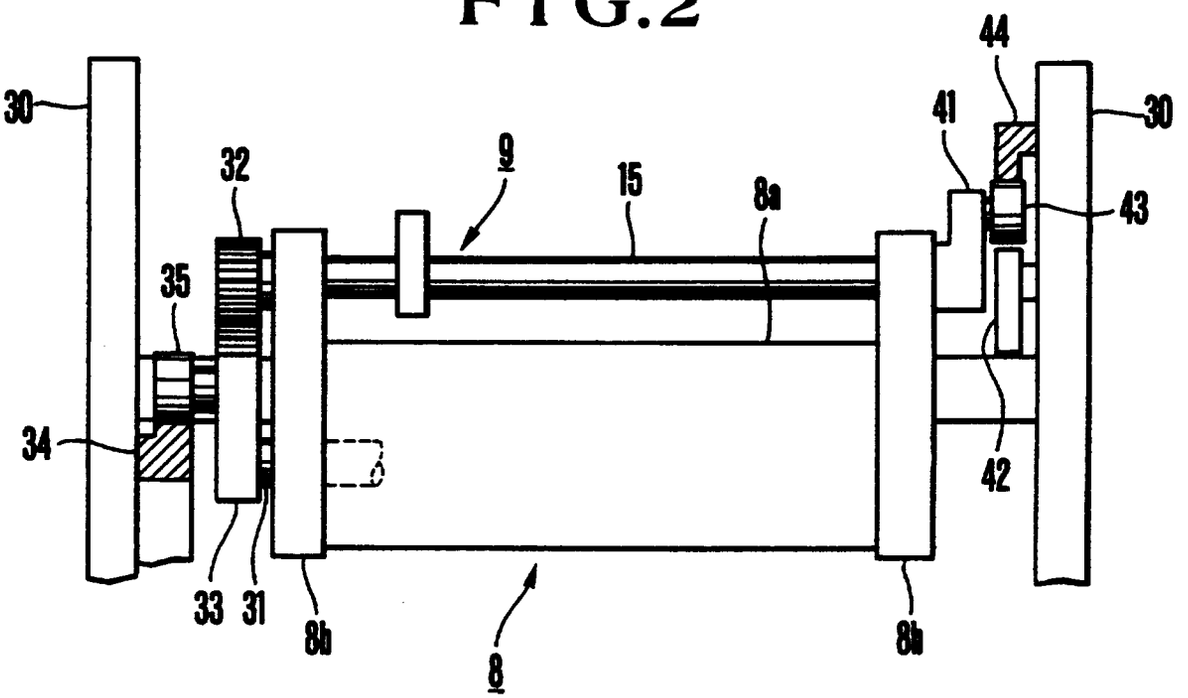

FIG.3 (a)

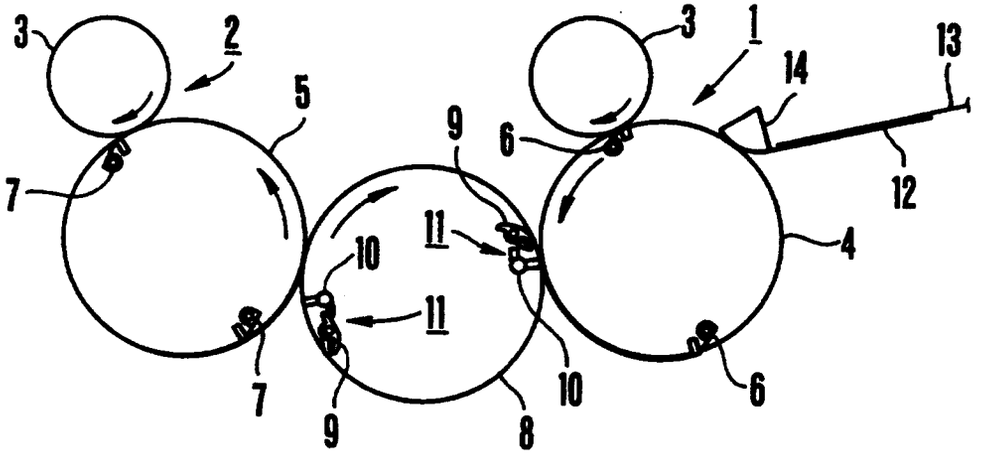

FIG.3 (b)

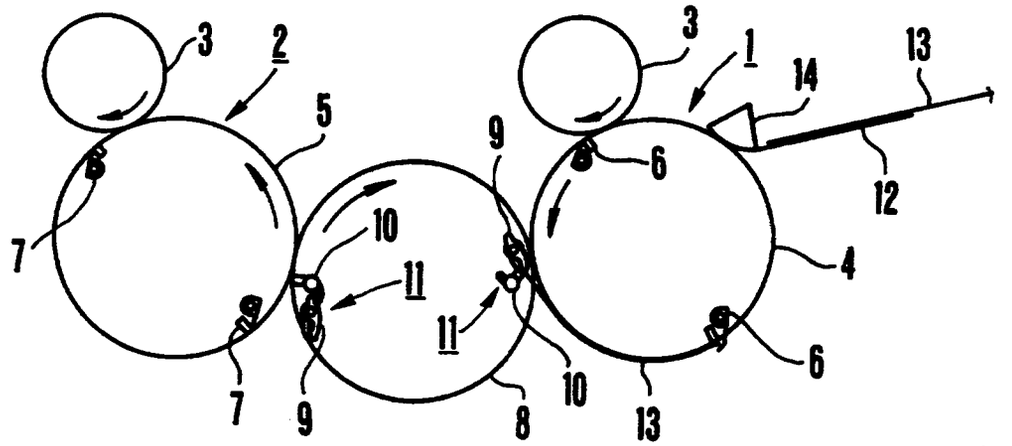

FIG.3 (c)

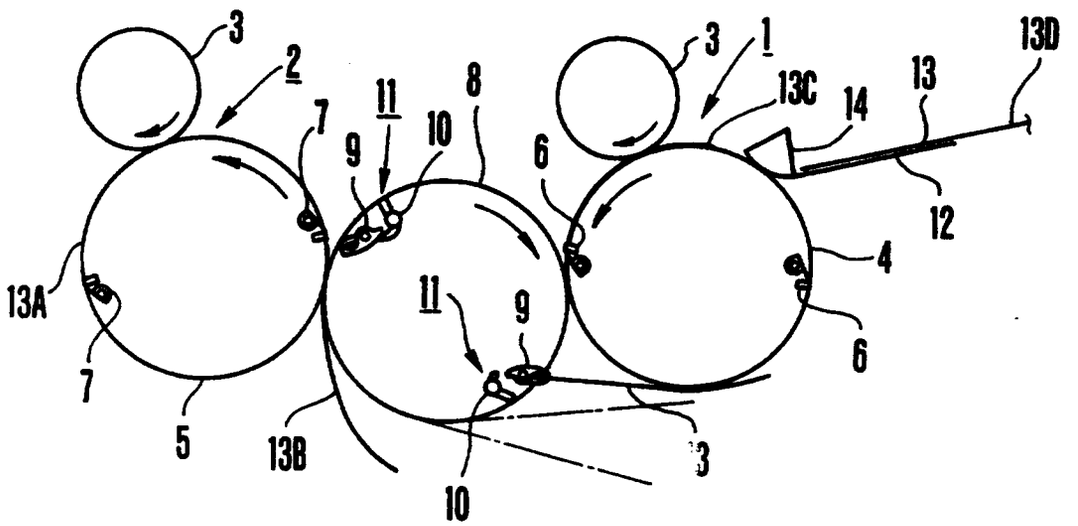

FIG.4

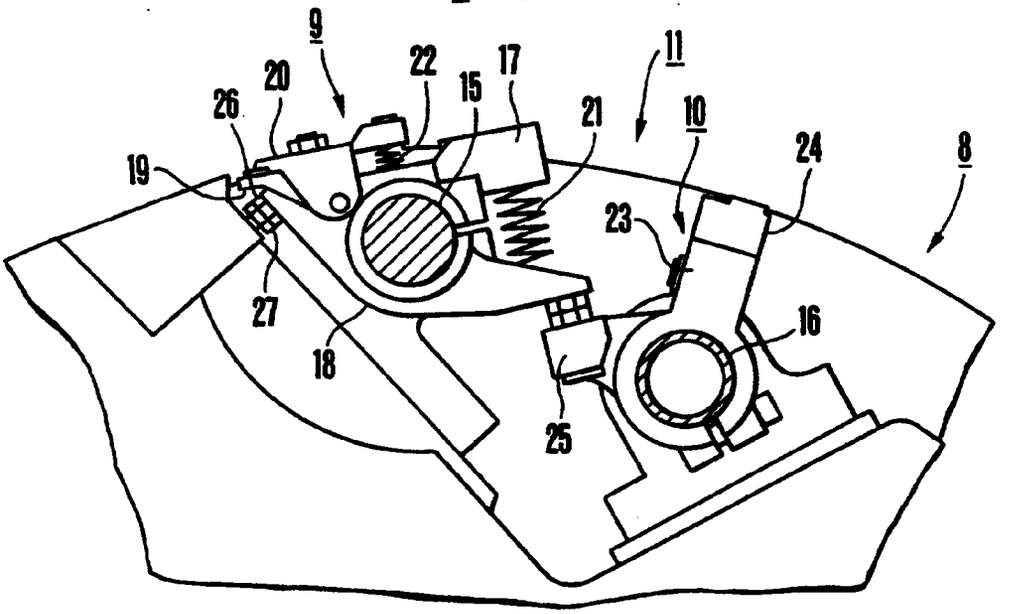

FIG.5

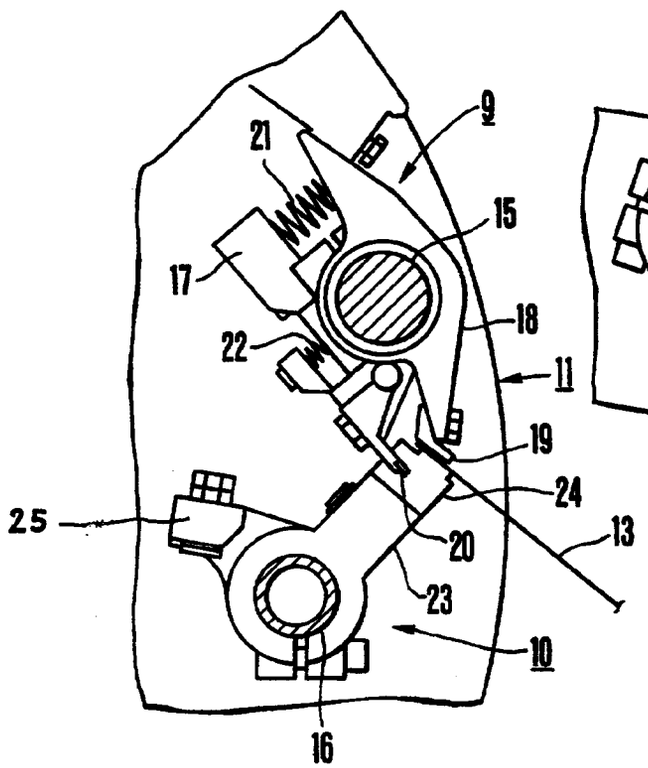

FIG.6