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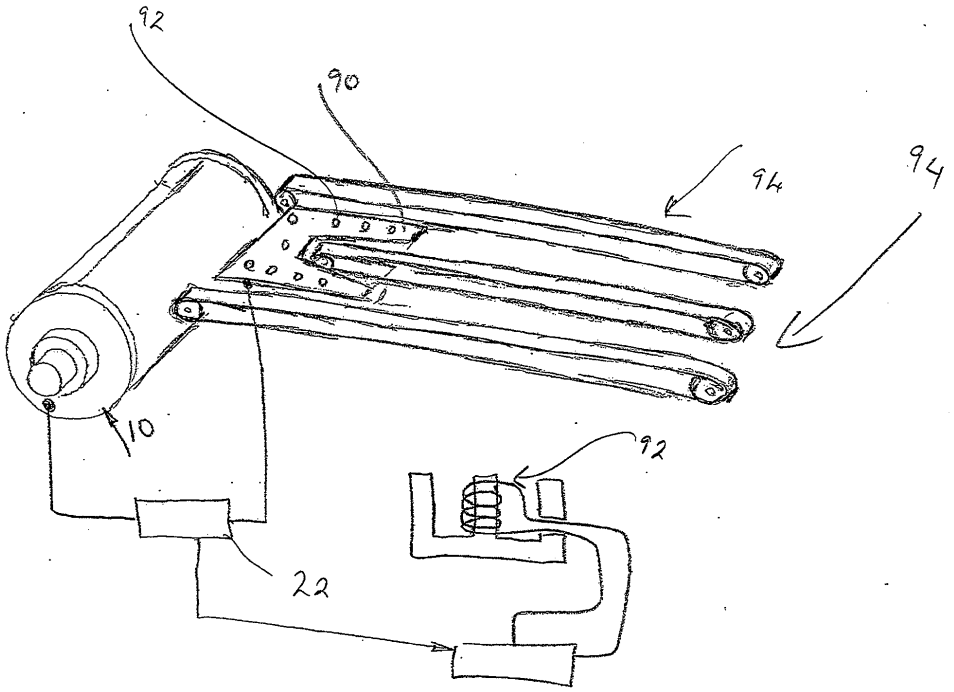
(54) Gripper apparatus for gripping a sheet in a sheet processing apparatus, and sheet processing apparatus incorporating such gripper apparatus

(57) A support table (90) for applying an attractive force to a sheet of material in a sheet processing apparatus is disclosed. The support table comprises a plurality of electromagnets (92) adapted to generate a respective attraction force acting on a sheet of material adjacent thereto when passing through the support table, and a controller (22) adapted to selectively adjust respective attraction forces generated by a plurality of said electromagnets.

FIG.10



EP 2 759 406 A1

Description

[0001] The present invention relates to a gripper apparatus for gripping a sheet of material in a sheet processing apparatus, and relates particularly, but not exclusively, to a gripper apparatus for gripping a sheet of material while feeding the sheet to a printing drum of a sheet printing or coating apparatus for sequentially handling individual sheets of material. The invention also relates to a sheet processing apparatus incorporating such gripper apparatus.

[0002] US 6305285 discloses a known gripping apparatus in the form of a sheet settling system in which a sheet of metal in a high speed sheet printing or coating machine is gripped by an array of suction holes connected to a vacuum chamber when passing over a support surface. The apparatus grips the sheet to assist in accurately locating the sheet relative to a printing or coating component.

[0003] A drawback of this arrangement is illustrated in Figure 12, which shows the force profile 96 provided by a conventional suction arrangement of the type described in US 6305285 as the sheet moves across the support surface. Figure 12 also shows the force profile 96 provided by a conventional sheet settling system using permanent magnets instead of suction. The force generally generated be the sheet settling system starts at a low level because the sheet has only covered a small number of suction openings (or, in the case of an array of permanent magnets, only a small number of magnets) and as the sheet travels forwards through the apparatus, the force applied by the sheet settling system increases. This causes problems in that the sheet is subjected to high levels of friction which can scratch the sheet or cause buckling, instability and deformation, which limits the accuracy of location of the sheet relative to printing or coating components of the sheet processing apparatus.

[0004] Preferred embodiments of the present invention seek to overcome one or more of the above disadvantages of the prior art.

[0005] According to an aspect of the present invention, there is provided a gripper apparatus for applying an attractive force to a sheet of material in a sheet processing apparatus, the gripper apparatus comprising:-

a plurality of attraction devices, wherein each of a plurality of said attraction devices is adapted to generate a respective attraction force acting on a sheet of material adjacent thereto when passing through the gripper apparatus; and

control means adapted to selectively adjust respective said attraction forces generated by a plurality of said attraction devices.

[0006] By providing control means adapted to selectively adjust respective attraction forces generated by a plurality of the attraction devices, this provides the advantage of enabling the force profile provided by the gripper apparatus to be more accurately controlled as the sheet passes through the apparatus. In particular, this enables the force acting on the sheet to be reduced as the sheet is brought into registration with certain components of the sheet processing apparatus, for example a printing or coating component of the sheet handling apparatus. This in turn enables excessive friction on, or buckling or deformation of the sheet to be minimised, as a result of which accuracy of handling and location of the sheet is improved.

[0007] At least one said attraction device may comprise at least one electromagnet.

[0008] At least one said attraction device may produce a respective suction force.

[0009] Said control means may be adapted to selectively actuate a plurality of said attraction devices.

[0010] The apparatus may further comprise support means for supporting a sheet of material thereon, wherein a plurality of said attraction devices are arranged on a side of said support means opposite to said sheet of material in use.

[0011] The apparatus may further comprise transport means for transporting said sheet into engagement with a plurality of said attraction devices.

[0012] Said transport means may comprise at least one conveyor belt.

[0013] The apparatus may further comprise position determining means for determining the position of said sheet of material and providing at least one output signal to said control means to enable adjustment of a plurality of said attraction forces in dependence on a position of said sheet of material.

[0014] According to another aspect of the present invention, there is provided a sheet processing apparatus comprising:-

at least one component adapted to apply material to a surface of a sheet of material; and

at least one gripper apparatus as defined above.

[0015] The sheet processing apparatus may be a sheet printing apparatus.

[0016] The sheet processing apparatus may be a sheet coating apparatus.

[0017] Preferred embodiments of the invention will now be described, by way of example and not in any limitative sense, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic view of a sheet processing apparatus embodying the present invention;

Figure 2 is a plan view of a first embodiment of a sidelay assembly of the apparatus of Figure 1;

Figure 3 is a side view of the sidelay assembly of

Figure 2 viewed in the direction of travel of the sheet;

Figure 4 is a plan view of a sheet gripper assembly of the apparatus of Figure 1;

Figure 5 is a side view of the gripper assembly of Figure 4 viewed in the direction of travel of the sheet;

Figure 6 is a side view of a second embodiment of a sidelay assembly of the apparatus of Figure 1;

Figure 7 is a plan view of the sidelay assembly of Figure 6;

Figure 8 is a schematic side view of a sheet feeding apparatus of the apparatus of Figure 1;

Figure 9 is a detailed view of part of a pusher head of the apparatus of Figure 8;

Figure 10 is a schematic view of part of the apparatus of Figure 1;

Figure 11 is a graph of a force profile provided by a gripping apparatus of the apparatus of Figure 10; and

Figure 12 is a graph of force profiles provided by conventional gripper apparatus.

[0018] Referring to Figure 1, a sheet processing apparatus 2 such as a sheet printing apparatus or a sheet coating apparatus embodying the present invention applies ink or coating material to a metal sheet 4 at a gap 6 between a blanket cylinder 8 and an impression cylinder 10. Registration of a leading edge 14 of the sheet 4 with the impression cylinder 10 is achieved by means of a pair of frontlay devices 16 with accompanying grippers (not shown) which co-operate with respective notches 18 in the impression cylinder 10 to limit forward travel in the direction of arrow A of the sheet 4 and move with the impression cylinder 10 to cause registration of the leading edge 14 of the sheet 4 with the cylinder 10.

[0019] At the same time, a sidelay assembly 20 moves in synchronisation with the frontlay devices 16 by means of a controller 22 and provides a stop for limiting movement of the side edge 24 of the sheet 4 in a direction transverse to arrow A, while moving with the sheet along a support 26 in the direction of arrow A. The sheet 4 is fed to the gap 6 between the rollers 8, 10 by means of a suitable feeder apparatus 28, 30 (Figures 6 to 9). In addition, movement of the sheet 4 can be controlled by means of a gripper apparatus in the form of a feeder table 90 (Figure 10) comprising an array of electromagnets 92 which can be controlled by the controller 22 to vary the force applied to the sheet 4.

[0020] Referring to Figures 2 and 3, the sidelay assembly 20 comprises a pair of spaced apart reference pins 32 rotatably mounted to a support plate 34 having an inclined surface 36 adjacent the pins 32 facing the side edge 24 of the sheet 4. The support plate 34 is pivotably mounted to a support shaft 38 which is in turn attached to a carriage 40 (Figure 1) for movement along axes parallel and perpendicular to arrow A in Figure 1 to enable the sidelay assembly 20 to approach a desired position in a direction perpendicular to arrow A while at the same time moving with the sheet 4 in the direction of arrow A such that the component of movement of the sidelay assembly 20 relative to the sheet 4 in the direction of arrow A is substantially zero. As the pins 32 come into contact with the side edge 24 of the sheet 4, the support plate 34 can pivot about the support shaft 38 to accommodate deviations in rectangularity of the sheet 4 without imparting reaction torque to the sheet 4.

[0021] Referring to Figures 4 and 5, a gripper assembly 42 is positioned between the two reference pins 32 for gripping the side edge 24 of the sheet 4 when the sheet 4 reaches its desired sidelay position in a direction perpendicular to arrow A. The gripper assembly 42 comprises a two axis actuator 44 for opening and closing upper 46 and lower 48 jaws, and moving the upper 46 and lower 48 jaws into engagement with the edge 24 of the sheet 4 in the direction of arrow B shown in Figure 5. A spring 50 biases the jaws 46, 48 away from the sheet 4 so that when the sheet 4 engages the reference pins 32, a small preload against the pins 32 is ensured. The gripper assembly 42 pulls the sheet 4 into registration with the reference pins 32, and a further gripper assembly (not shown) on the opposite side of the sheet 4 pulls the sheet 4 in the opposite direction with a smaller force than the gripper assembly 42 shown in Figures 4 and 5 to place the sheet 4 under tension to ensure it is stable and flat across its width. This minimises any tendency of the sheet 4 to buckle and therefore improves accuracy of registration of the sheet 4 in the gap 6 between the rollers 8, 10. The controller 22 ensures that the jaws 46, 48 of the sidelay gripper assembly 42 open and the gripper assembly 42 is retracted after the frontlay grippers (not shown) have closed, and the sidelay grippers 42 then start their return path in preparation for the next sheet 4. A further actuator 51 assists in disengaging lower jaw 48 from sheet 4.

[0022] Referring to Figures 8 and 9, a feeder apparatus 30 for urging the sheet 4 in the direction of arrow A comprises a pusher head 52 mounted via a pusher arm 54 to a lever 56 pivotally mounted about a pivot 58 and carrying a cam follower wheel 60 which engages a cam surface 62. The lever 56 is pivotally connected at its end remote from the cam follower wheel 60 with a connector 64 which is slidably located at its other end in a main body 66. The main body 66 moves in the direction of arrow A with the cam follower wheel 60 in engagement with the cam surface 62 such that the cam follower wheel 60 moves up a first inclined surface 68 of the cam surface 62 to raise the pusher arm 54 and pusher head 52 into the plane of the sheet 4 to engage a rear edge of the sheet 4 while moving forwards in the direction of arrow A.

[0023] Referring to Figure 9, the pusher head 52 has a curved profile 70 such that it gradually engages the trailing edge of the sheet 4 to reduce forces applied to the sheet 4 to minimise the tendency of the sheet 4 to buckle. The main body 66 is urged further in the direction of arrow A so that the cam follower wheel 60 moves along a second inclined surface 72 of the cam surface 62, the second inclined surface 72 being less steep than the first inclined surface 68, to cause the pusher head 52 to further urge the sheet 4 in the direction of arrow A. The cam follower wheel 60 then engages a third inclined surface 74 of the cam surface 62, the third inclined surface 74 being steeper than the first 68 and second 72 inclined surfaces, which causes the lever 56 to pivot clockwise about the pivot 58 which causes the connector 64 to rotate anticlockwise against the action of compression spring 76 to lower the pusher arm 54 and pusher head 52 away from the plane of the sheet 4. This allows the main body 66 to then be retracted in the direction opposite to arrow A to prepare for engagement with the trailing edge of the next sheet 4. The arrangement shown in Figures 8 and 9 has the advantage over a feeding apparatus mounted to a continuous track in that a larger proportion of the cycle of movement of the feeder apparatus can occur with the pusher head 52 in engagement with the sheet 4, thereby improving efficiency of operation of the feeder apparatus.

[0024] Referring to Figures 6 and 7, a second embodiment of a sidelay assembly 20 is shown. The sidelay assembly 20 has a pair of reference pins 32 for engaging a side edge 24 of the sheet 4, the reference pins 32 being rotatably mounted to a support plate 34 which is in turn pivotably connected to carriage 40 by means of a support pin 36. A sheet feeding apparatus 28 includes a suction gripper 78 mounted to the carriage 40 and having a suction head 80 for gripping the underside of the edge 24 of the sheet 4 by means of suction. As the sheet 4 approaches the sidelay assembly 20 and the carriage 40 carrying the reference pins 32 approaches the side edge 24 of the sheet 4 under the action of two-axis actuator 82, the suction head 80 extends sideways underneath the path of travel of the sheet 4. The suction head 80 is then moved upwards towards the underside of the sheet 4 and suction switched on. The sheet 4 is then pulled into registration against the reference pins 32. A similar suction operated gripper (not shown) arranged on the opposite side of the sheet 4 pulls the sheet 4 with a lower force than that applied by the sidelay assembly 20 shown in Figures 6 and 7, to bring the sheet 4 into tension to ensure stability across its width. When the front lay grippers (not shown) have engaged the leading edge 14 of the sheet 4, the suction applied to suction head 80 is switched off, thereby releasing the sheet 4 from the feeding apparatus 28. The carriage 40 then retracts and starts its return path to engage the side edge 24 of the next sheet 4. The arrangement of Figures 6 and 7 provides the advantage that since it grips the bottom surface of the sheet 4, it has no effect on the printing area on the top surface of the sheet 4, which enables it to be used if there is no margin for a non-printed area. The arrangement of Figures 6 and 7 can also be constructed in a more compact and lightweight manner while also making the mechanism simpler by removing the need for actuation of a mechanical gripper. Also, any additional degree of freedom in the direction of arrow A can be compensated for the servo tracking performance by means of the flexible nature of a bellowed suction head 80.

[0025] Referring to Figure 10, a support table 90 for the sheet 4 has an array of electromagnets 92 which can be activated to grip the sheet 4, the electromagnetic force being varied by means of selective switching of the electromagnets by means of the controller 22. The support table 90 further includes a conveyor comprising a series of generally parallel conveyor belts 94 on which the sheet 4 rests and is urged by the conveyor belts 94 into engagement with the electromagnets 92 of the support table. As the sheet 4 slides over the support table 90, the controller 22 selectively switches on the electromagnets 92 to cause an initial increase in attractive force on the sheet 4 as the sheet comes into engagement with the support table 90, and then decreases the attractive force on the sheet 4 as the sheet 4 approaches roller 10 to provide a force profile 93 as shown in Figure 11. This contrasts with the force profile 96 as shown in Figure 12 for a conventional vacuum support table and force profile 98 for a conventional magnetic support table, which has the disadvantage that the increase in force as the sheet 4 approaches roller 10 can give rise to excessive friction acting on and buckling or deformation of the sheet 4, which has a detrimental effect on the accuracy of location of the sheet 4 relative to the roller 10.

[0026] It will be appreciated by persons skilled in the art that the above embodiments have been described by way of example only and not in any limitative sense, and that various alterations and modifications are possible without departure from the scope of the invention as defined by the appended claims. For example, the support table 90 can use an array of suction devices in addition to, or as an alternative to, the electromagnets 92.

Claims

1. A gripper apparatus for applying an attractive force to a sheet of material in a sheet processing apparatus, the gripper apparatus comprising:-
   a plurality of attraction devices, wherein each of a plurality of said attraction devices is adapted to generate a respective attraction force acting on a sheet of material adjacent thereto when passing through the gripper apparatus; and
   control means adapted to selectively adjust respective said attraction forces generated by a plurality of said attraction devices.

2. An apparatus according to claim 1, wherein at least

one said attraction device comprises at least one electromagnet.

3. An apparatus according to claim 1 or 2, wherein at least one said attraction device produces a respective suction force.

4. An apparatus according to any one of the preceding claims, wherein said control means is adapted to selectively actuate a plurality of said attraction devices.

5. An apparatus according to any one of the preceding claims, further comprising support means for supporting a sheet of material thereon, wherein a plurality of said attraction devices are arranged on a side of said support means opposite to said sheet of material in use.

6. An apparatus according to any one of the preceding claims, further comprising transport means for transporting said sheet into engagement with a plurality of said attraction devices.

7. An apparatus according to claim 6, wherein said transport means comprises at least one conveyor belt.

8. An apparatus according to any one of the preceding claims, further comprising position determining means for determining the position of said sheet of material and providing at least one output signal to said control means to enable adjustment of a plurality of said attraction forces in dependence on a position of said sheet of material.

9. A sheet processing apparatus comprising:-
at least one component adapted to apply material to a surface of a sheet of material; and
at least one gripper apparatus according to any one of the preceding claims.

10. An apparatus according to claim 9, wherein the sheet processing apparatus is a sheet printing apparatus.

11. An apparatus according to claim 9 or 10, wherein the sheet processing apparatus is a sheet coating apparatus.

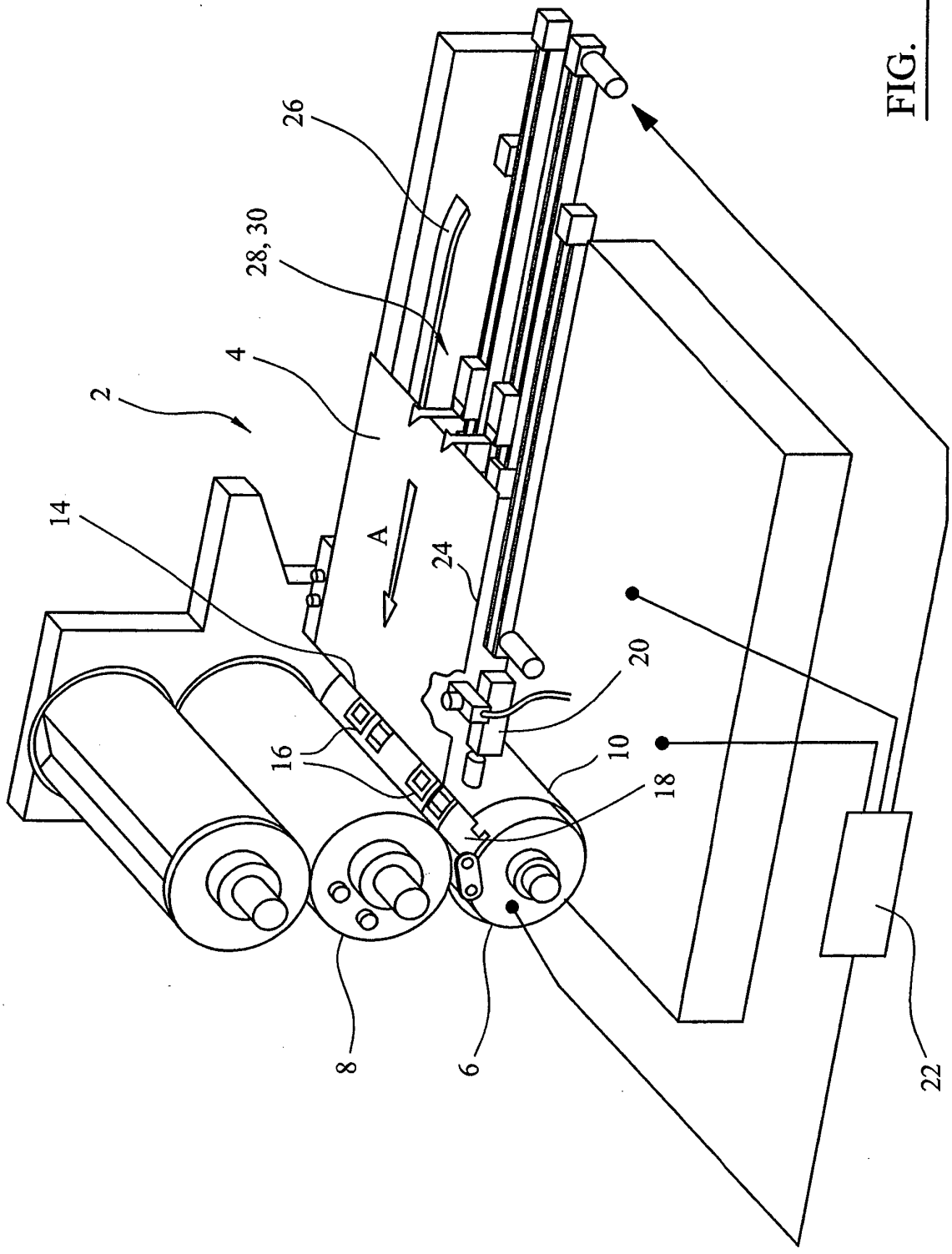


FIG. 1

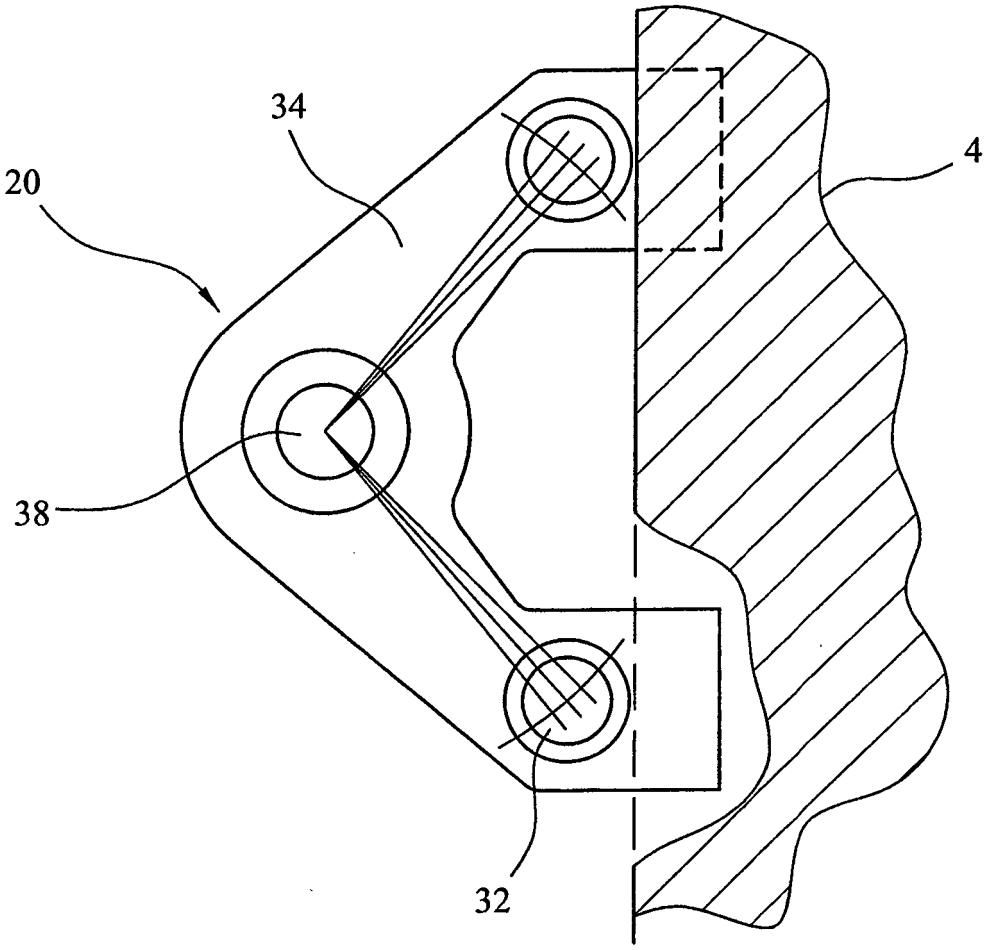


FIG. 2

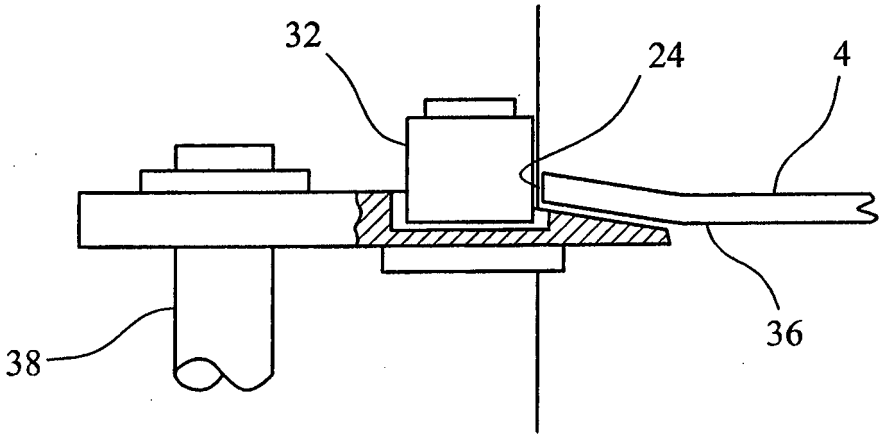


FIG. 3

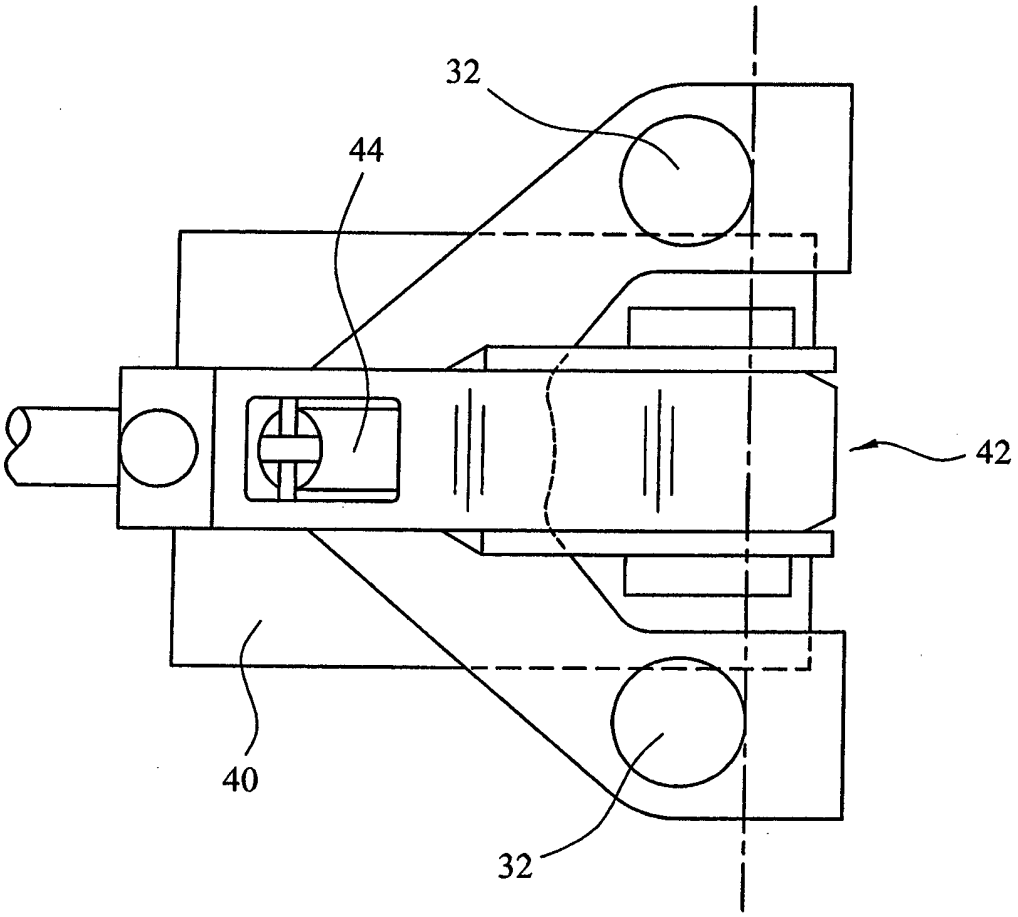


FIG. 4

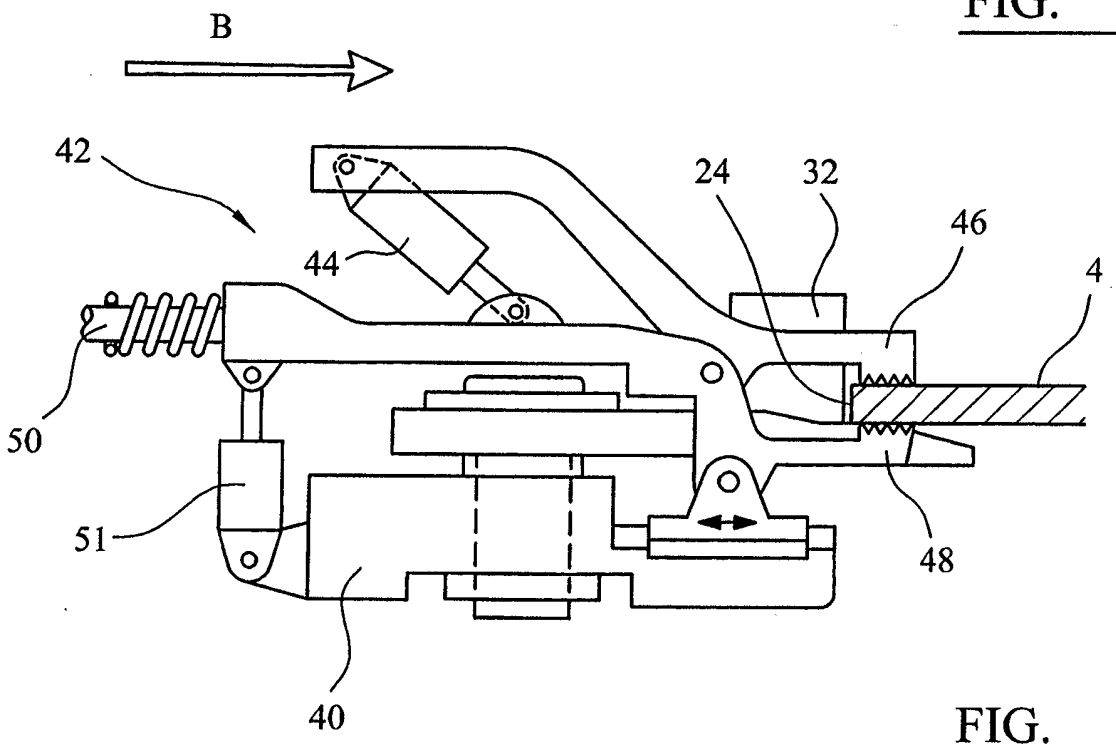


FIG. 5

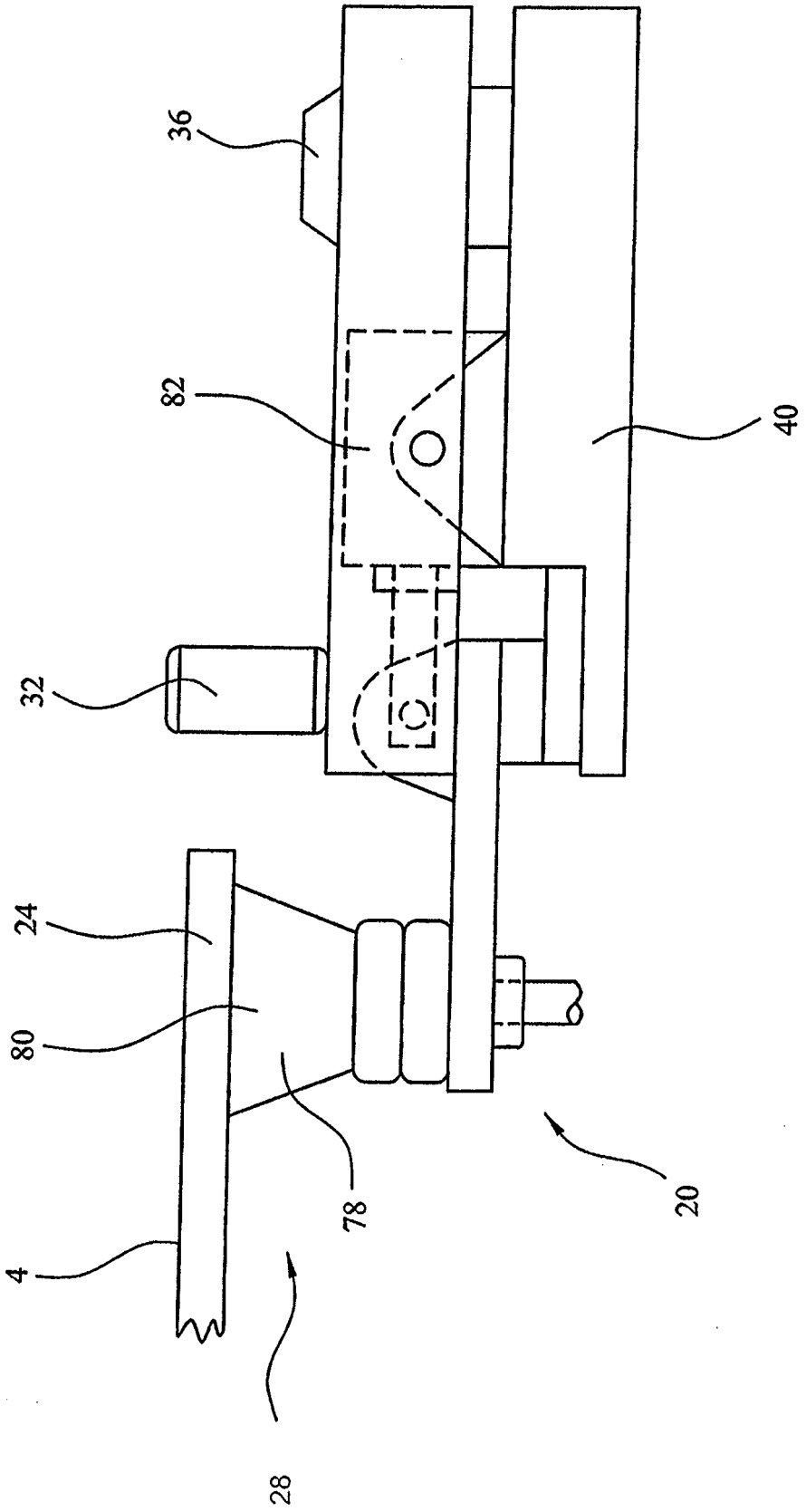


FIG. 6

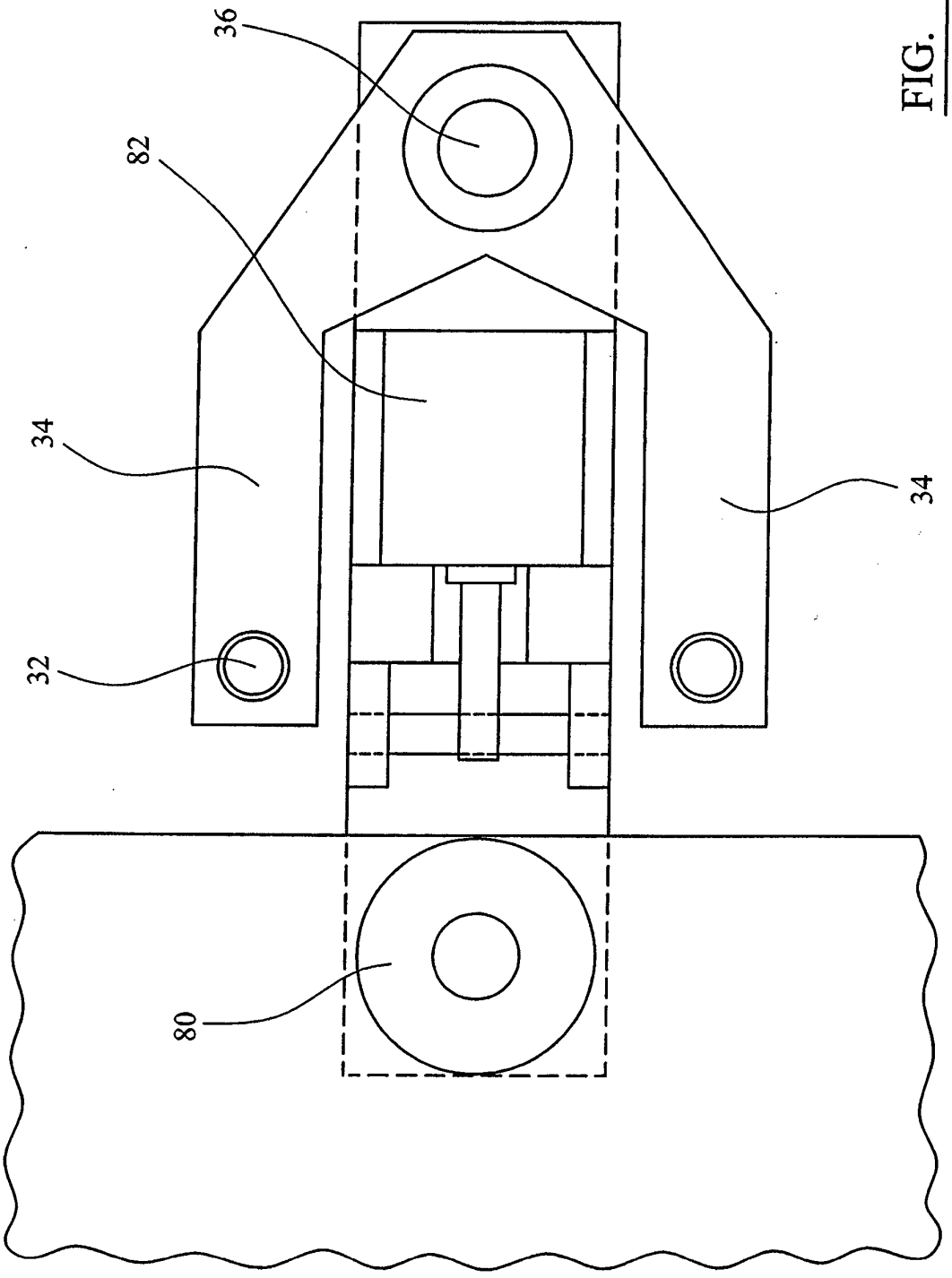
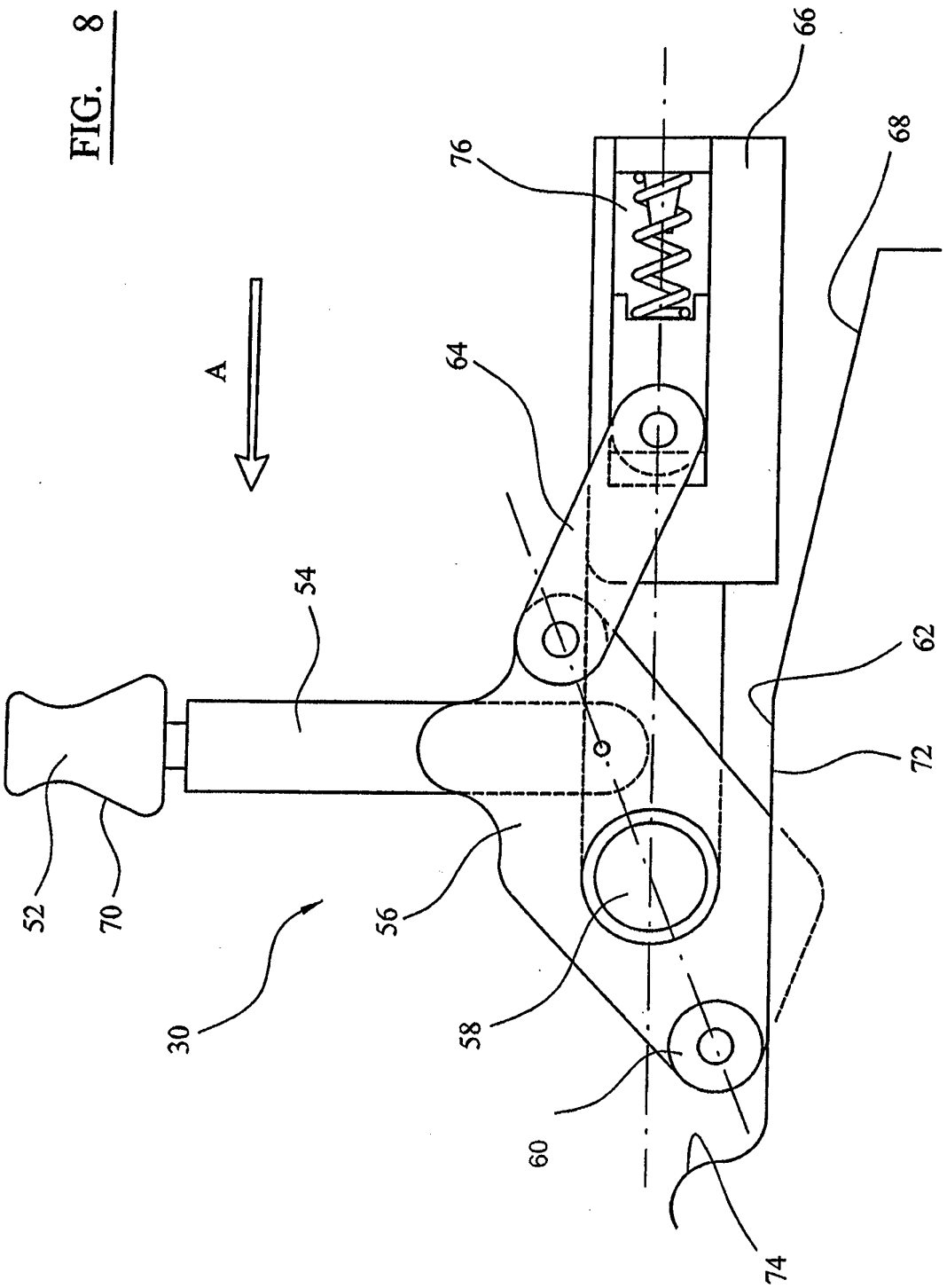


FIG. 7

FIG. 8



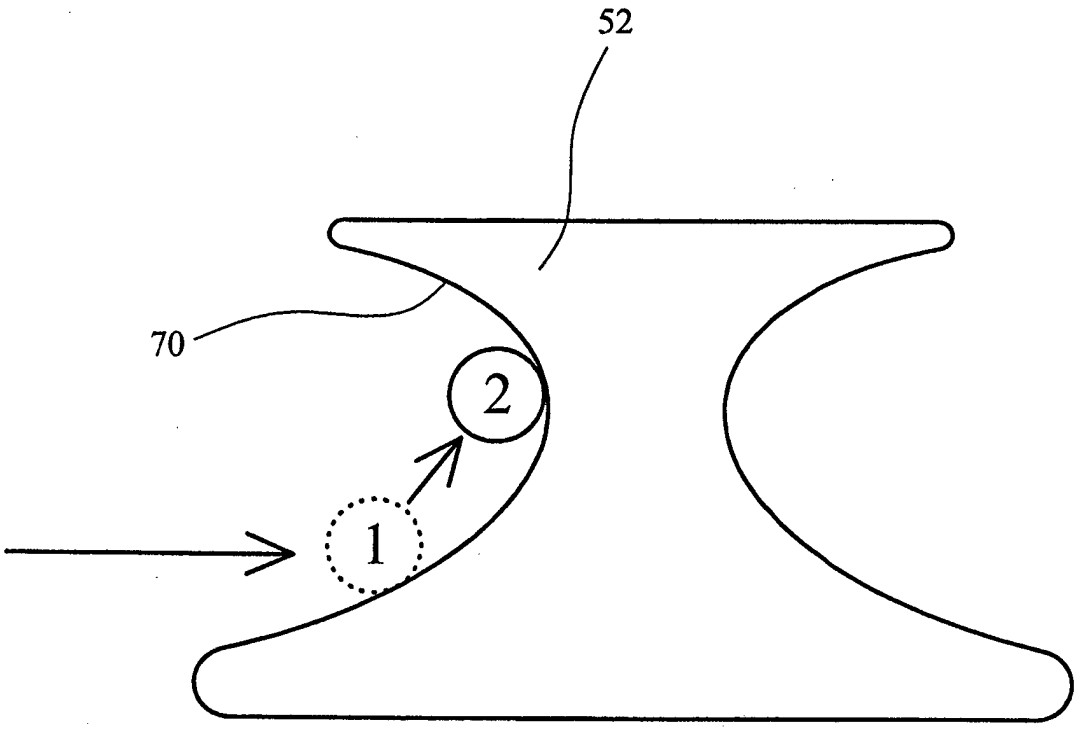


FIG. 9

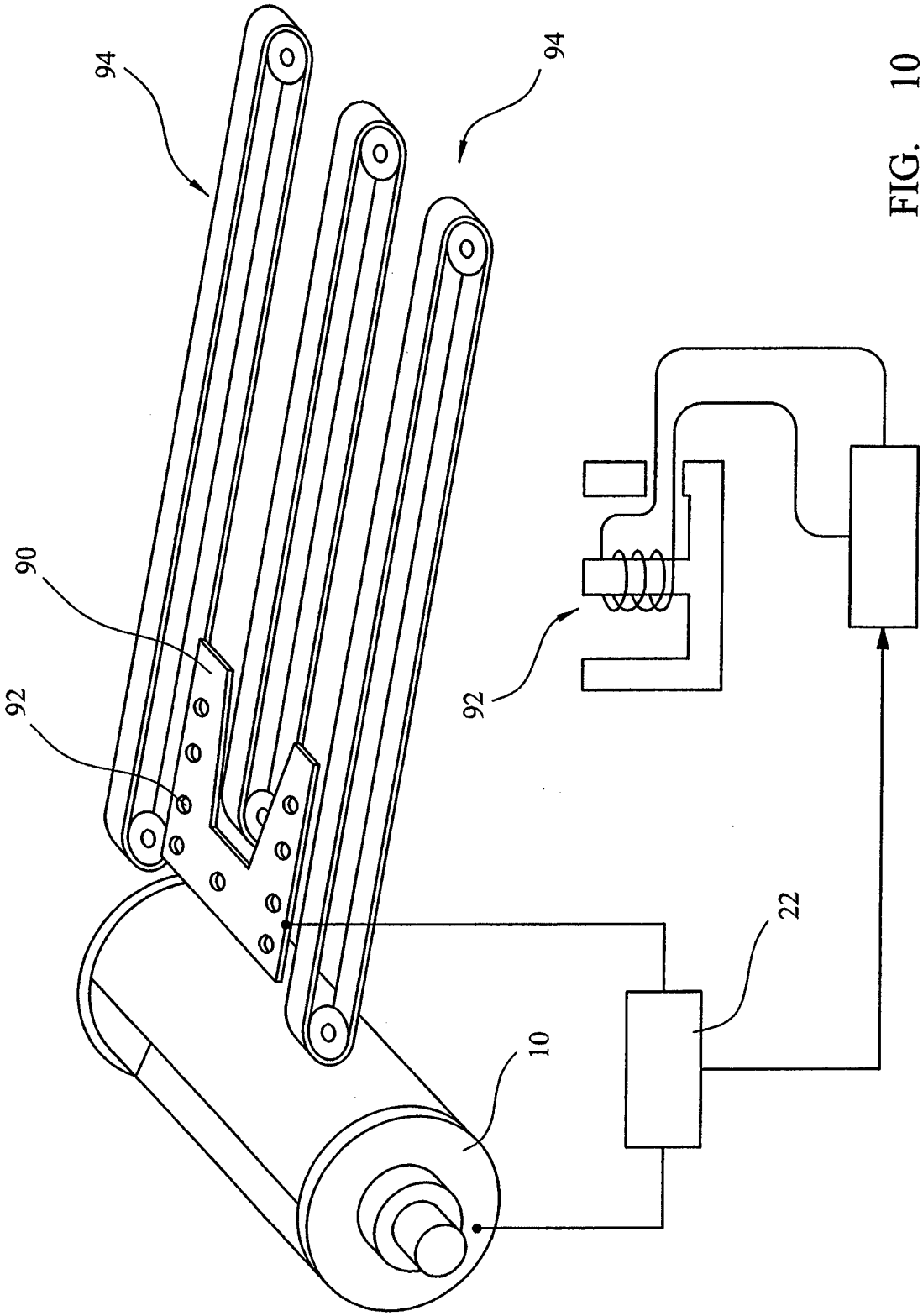


FIG. 10

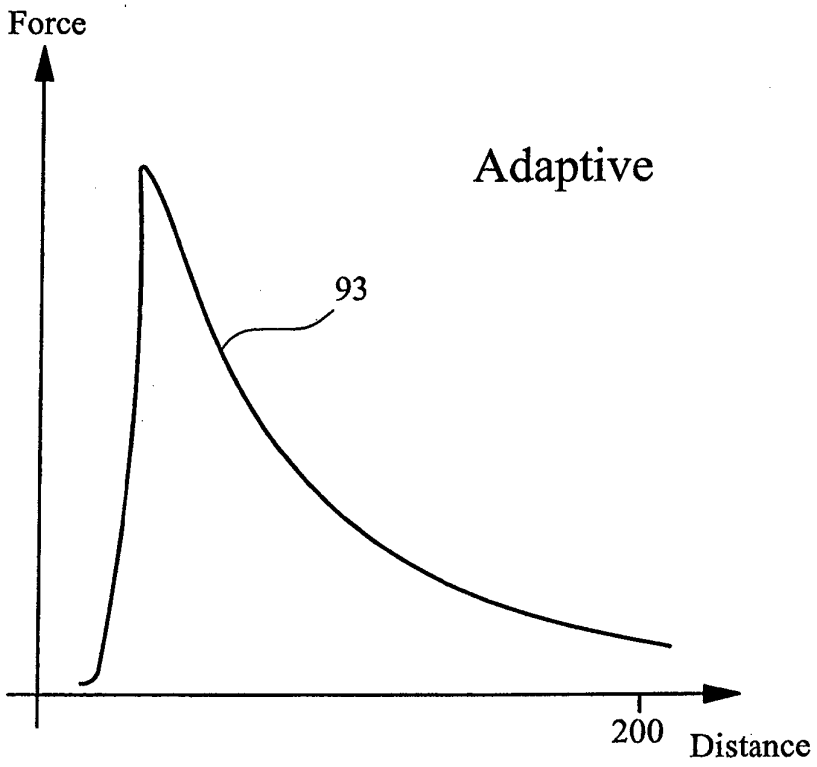

Force
Adaptive
93
200
Distance

FIG. 11

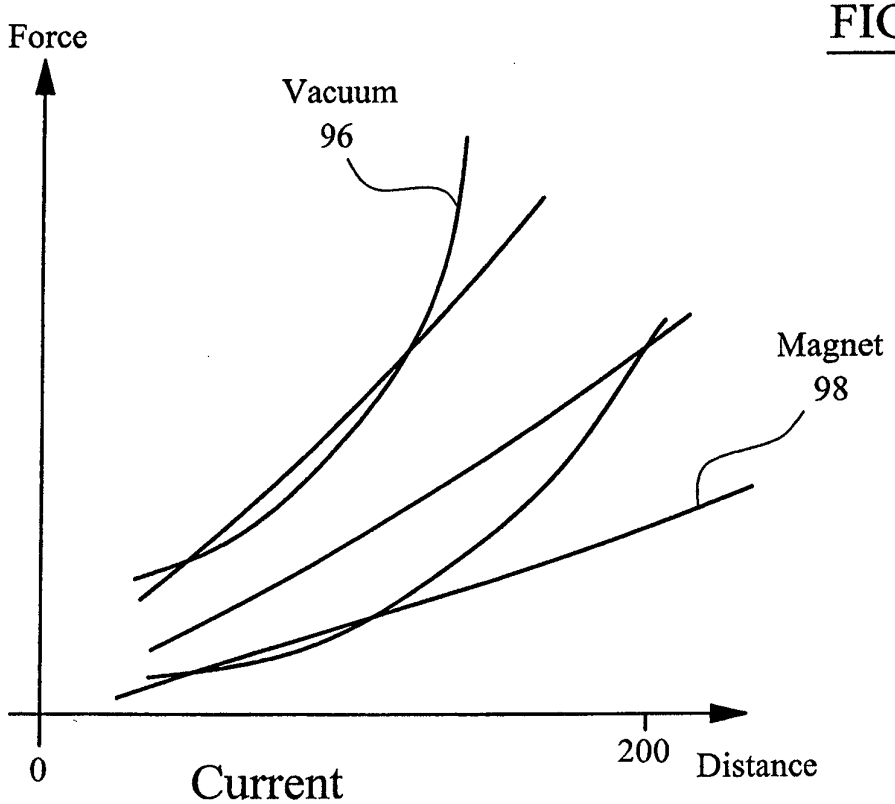

Force
Vacuum
96
Magnet
98
0
200
Distance
Current
State of Art

FIG. 12

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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 2369

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 103 15 192 A1 (HEIDELBERGER DRUCKMASCH AG [DE]) 6 November 2003 (2003-11-06) * abstract * * paragraphs [0006] - [0010], [0015] - [0016], [0022] - [0028] * * figures 1-3 *	1,3-5, 8-10	INV. B41F21/00 B41F21/12 B41F21/14
X,D	US 6 305 285 B1 (STEVEN ANDREW [GB]) 23 October 2001 (2001-10-23) * abstract * * column 2, line 4 - column 3, line 53 * * figure 1 *	1-5,9-11	
X	DE 198 04 120 A1 (ROLAND MAN DRUCKMASCH [DE]) 5 August 1999 (1999-08-05) * abstract * * column 1, line 45 - column 4, line 14 * * figure 1 *	1,3-10	
A	DE 10 2010 064064 A1 (MANROLAND AG [DE]) 28 June 2012 (2012-06-28) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (IPC)
B41F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 May 2013	Bellofiore, Vincenzo

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16-05-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 10315192 A1	06-11-2003	DE 10315192 A1	06-11-2003
		JP 4146275 B2	10-09-2008
		JP 2003341883 A	03-12-2003
		US 2004065995 A1	08-04-2004
US 6305285 B1	23-10-2001	NONE	
DE 19804120 A1	05-08-1999	NONE	
DE 102010064064 A1	28-06-2012	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6305285 B **[0002] [0003]**