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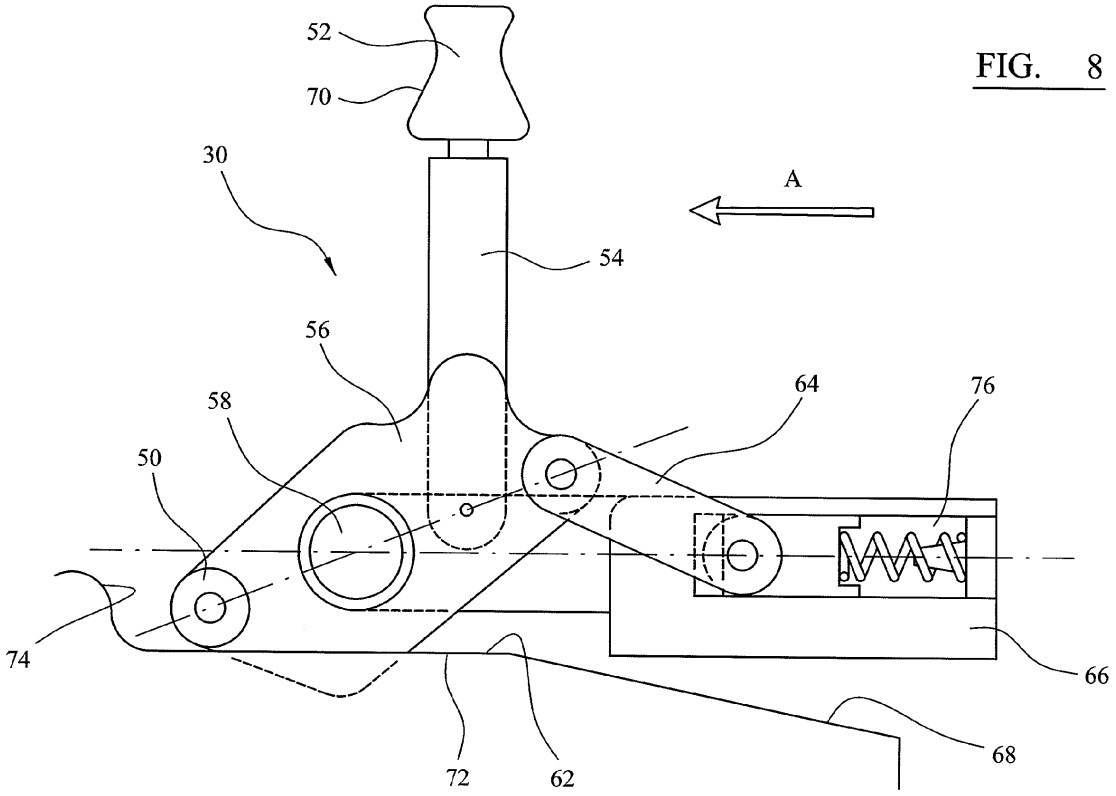
(54) Feeder apparatus for feeding a sheet of material in a sheet processing apparatus, and sheet processing apparatus incorporating such fedder apparatus

(57) A feeder apparatus (30) for feeding a sheet of material in a sheet processing apparatus is disclosed. The feeder apparatus comprises a main body (66) and a pusher head (52) moveably mounted relative to the main body and moveable between a first orientation, in which the pusher head engages a sheet of material to feed the sheet in a sheet processing apparatus, and a second orientation, in which the pusher head allows movement of the sheet relative thereto.

FIG. 8



EP 2 759 501 A1

Description

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

[0002] EP 2008956 discloses an example of a known feeder apparatus for precise feeding of metal sheets in a sheet printing or coating machine in which abutments for limiting movement of a leading edge of a sheet travel around a closed track such that each abutment engages a leading edge of a respective metal sheet to limit its movement in the direction of feeding through the apparatus.

[0003] This arrangement suffers from the drawback that the feeder apparatus is complicated and expensive to construct, and difficult to adjust for varying sheet lengths, since movement of the abutments around the closed track must be synchronised with the movement of the leading edge of the sheet.

[0004] Preferred embodiments of the present invention seek to overcome the above disadvantage of the prior art.

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

support means; and

at least one sheet engaging member moveably mounted relative to said support means and moveable between a first orientation, in which said sheet engaging member engages a sheet of material to feed said sheet in a sheet processing apparatus, and a second orientation, in which said sheet engaging member allows movement of said sheet relative thereto.

[0006] By providing at least one sheet engaging member moveably mounted relative to the support means and moveable between a first orientation, in which the sheet engaging member engages a sheet of material to feed the sheet in a sheet processing apparatus, and a second orientation, in which the sheet engaging member allows movement of said sheet relative thereto, this provides the advantage of providing more efficient operation, since the sheet engaging member can be in contact with the sheet for a larger proportion of the processing cycle when it is not mounted to a closed track with constant speed. This also provides the advantage of making the apparatus easier to control, which in turn enables the apparatus to be more easily adjusted to accommodate different sheet lengths. The advantage is also provided of reducing the complexity and cost of construction of the apparatus.

[0007] The apparatus may further comprise biasing means for biasing at least one said sheet engaging member towards the corresponding said first and/or second orientation.

[0008] This provides the advantage of improving the efficiency and speed of operation of the apparatus.

[0009] At least one said sheet engaging member may be adapted to engage a sheet by means of suction.

[0010] This provides the advantage of enabling the sheet to be fed under tension instead of under compression, which reduces the tendency of the sheet to buckle, especially in the case of very thin sheets. This in turn improves the accuracy of location of the sheet relative to the corresponding component of the sheet processing apparatus which improves the quality of sheet printing in the case of a sheet printing apparatus. This also provides the advantage of enabling the gripper means to only engage the lower (i.e. unprinted or uncoated) surface of the sheet, which in turn eliminates any detrimental effect of the gripper means on print quality.

[0011] The apparatus may further comprise pneumatic means for moving at least one said sheet engaging member between the corresponding said first and second orientations.

[0012] The apparatus may further comprise electromagnetic means for moving at least one said sheet engaging member between the corresponding said first and second orientations.

[0013] The apparatus may comprise cam means on at least one of said sheet engaging member and said support means, and cam follower means on the other of said sheet engaging member and said support means and adapted to cooperate with said cam means to move at least one said sheet engaging member between the corresponding said first and second orientations.

[0014] At least one said sheet engaging member may comprise a respective first member adapted to engage said sheet and a respective second member pivotally connected to said cam means or said cam follower means mounted thereto.

[0015] At least one said sheet engaging member may further comprise at least one respective third member for moving said cam means relative to said cam follower means.

[0016] At least one said sheet engaging member may be adapted to abut said sheet.

[0017] At least one said sheet engaging member may include a respective engagement surface adapted to move relative to said sheet when in engagement therewith.

[0018] This provides the advantage of providing more gradual engagement of the sheet engaging member with the sheet, which in turn reduces forces on the sheet tending to cause buckling of the sheet.

[0019] 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 feeder apparatus as defined above.

[0020] The sheet processing apparatus may be a printing apparatus.

[0021] The sheet processing apparatus may be a coating apparatus.

[0022] The apparatus may comprise a plurality of said feeder apparatus for sequential feeding of the sheet.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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.

[0032] 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 feeder apparatus for feeding a sheet of material in a sheet processing apparatus, the feeder apparatus comprising:- support means; and
at least one sheet engaging member moveably mounted relative to said support means and moveable between a first orientation, in which said sheet engaging member engages a sheet of material to feed said sheet in a sheet processing apparatus, and a second orientation, in which said sheet engaging member allows movement of said sheet relative thereto.

2. An apparatus according to claim 1, further comprising biasing means for biasing at least one said sheet engaging member towards the corresponding said first and/or second orientation.

3. An apparatus according to claim 1 or 2, wherein at least one said sheet engaging member is adapted to engage a sheet by means of suction.

4. An apparatus according to any one of the preceding claims, further comprising pneumatic means for moving at least one said sheet engaging member between the corresponding said first and second orientations.

5. An apparatus according to any one of the preceding claims, further comprising electromagnetic means for moving at least one said sheet engaging member between the corresponding said first and second orientations.

6. An apparatus according to any one of the preceding claims, further comprising cam means on at least one of said sheet engaging member and said support means, and cam follower means on the other of said sheet engaging member and said support means and adapted to cooperate with said cam means to move at least one said sheet engaging member between the corresponding said first and second orientations.

7. An apparatus according to claim 6, wherein at least one said sheet engaging member comprises a respective first member adapted to engage said sheet and a respective second member pivotally connected to said cam means or said cam follower means mounted thereto.

8. An apparatus according to claim 7, wherein at least one said sheet engaging member further comprises at least one respective third member for moving said cam means relative to said cam follower means.

9. An apparatus according to any one of the preceding claims, wherein at least one said sheet engaging member is adapted to abut said sheet.

10. An apparatus according to claim 9, wherein at least one said sheet engaging member includes a respective engagement surface adapted to move relative to said sheet when in engagement therewith.

11. 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 feeder apparatus according to any one of the preceding claims.

12. An apparatus according to claim 11, wherein the sheet processing apparatus is a printing apparatus.

13. An apparatus according to claim 11 or 12, wherein the sheet processing apparatus is a coating apparatus.

14. An apparatus according to any one of claims 11 to 13, comprising a plurality of said feeder apparatus for sequential feeding of the sheet.

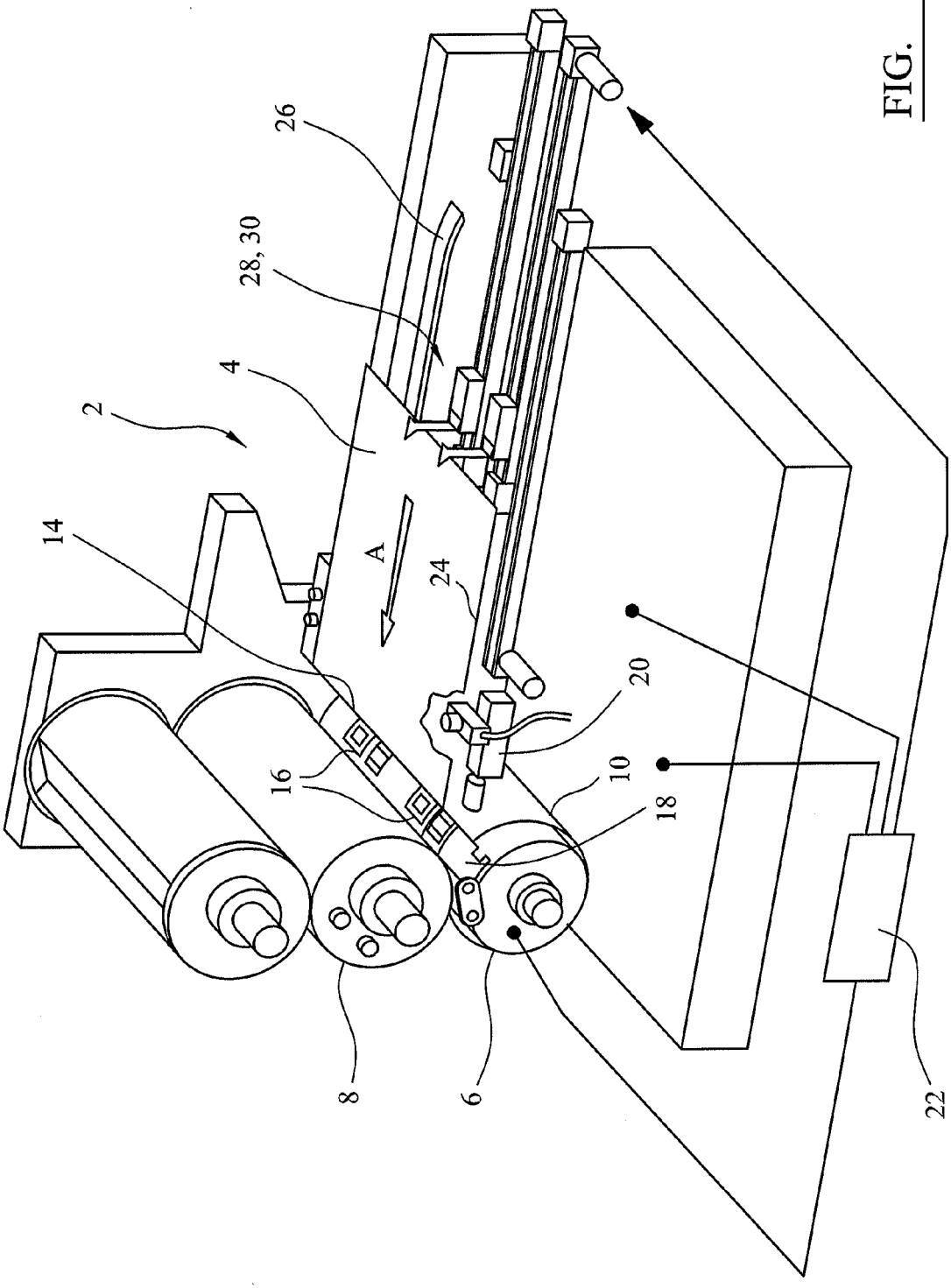


FIG. 1

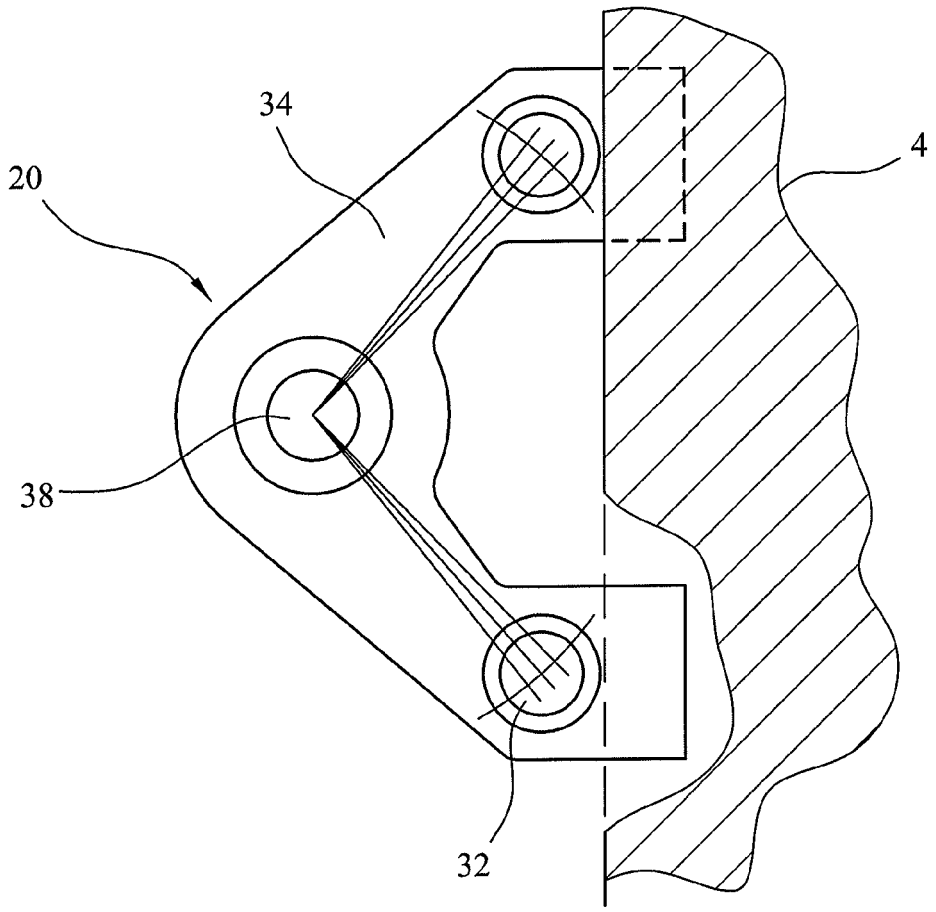


FIG. 2

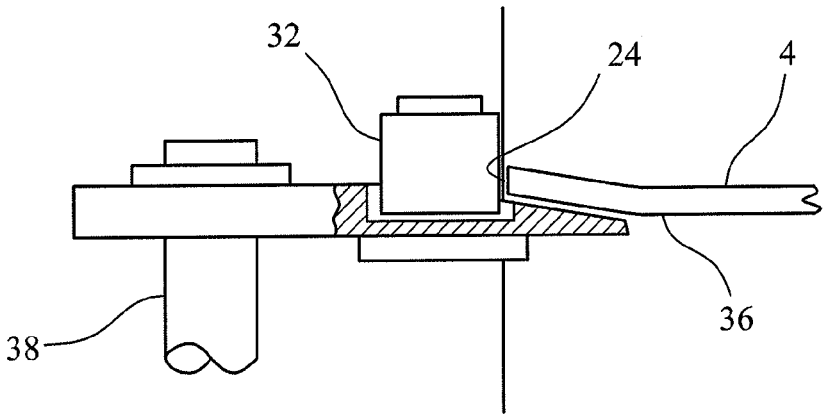


FIG. 3

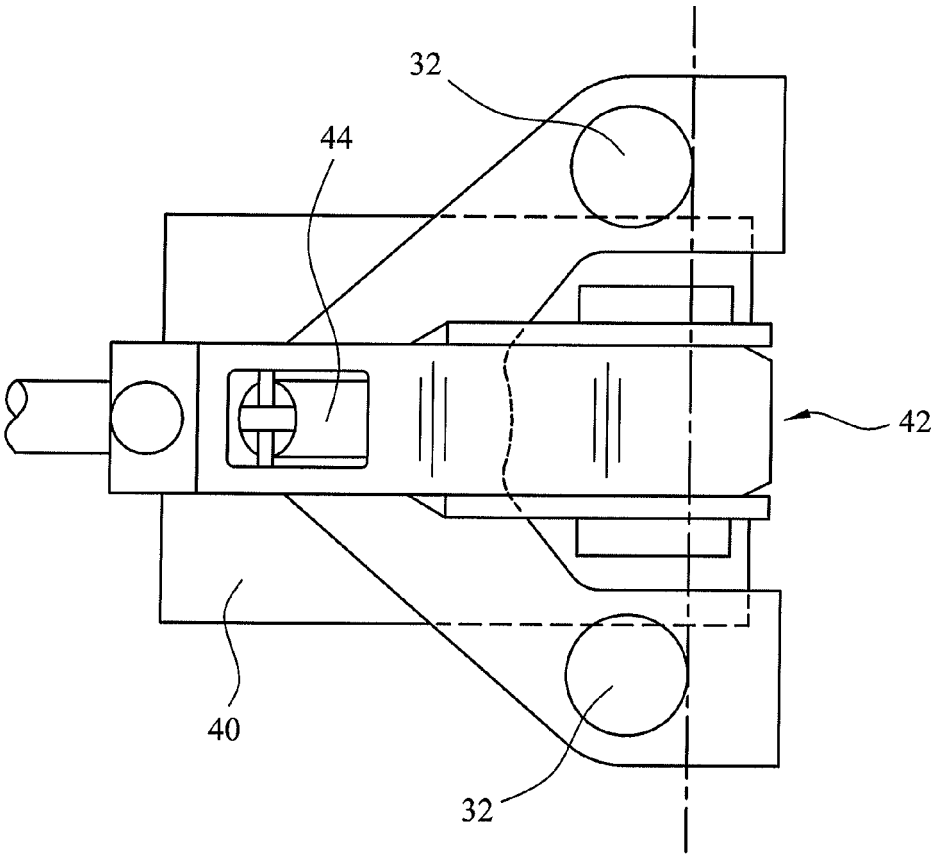


FIG. 4

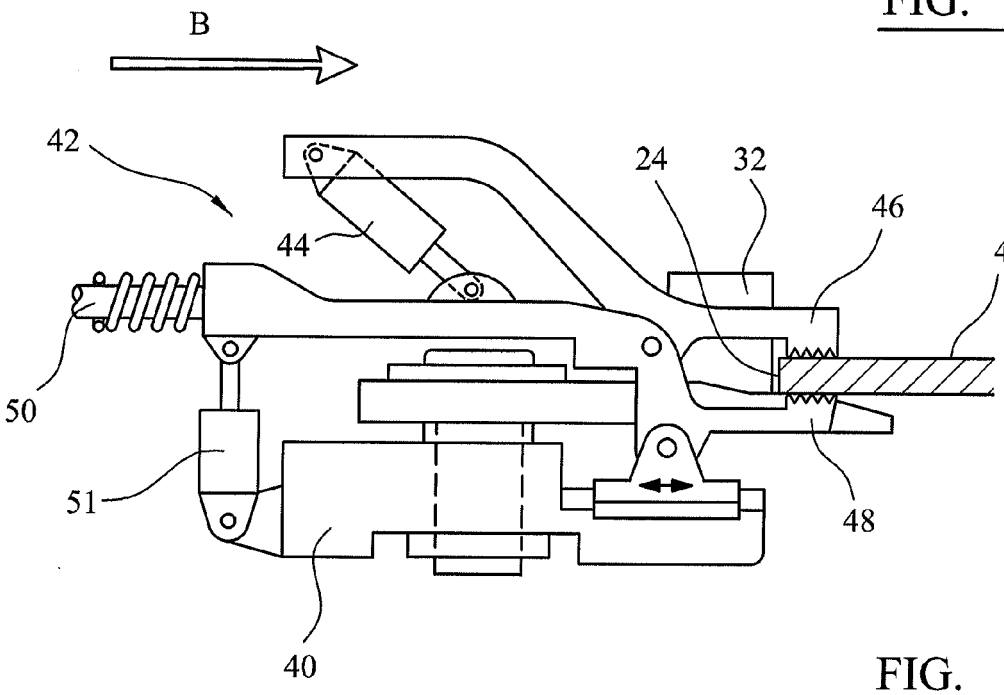


FIG. 5

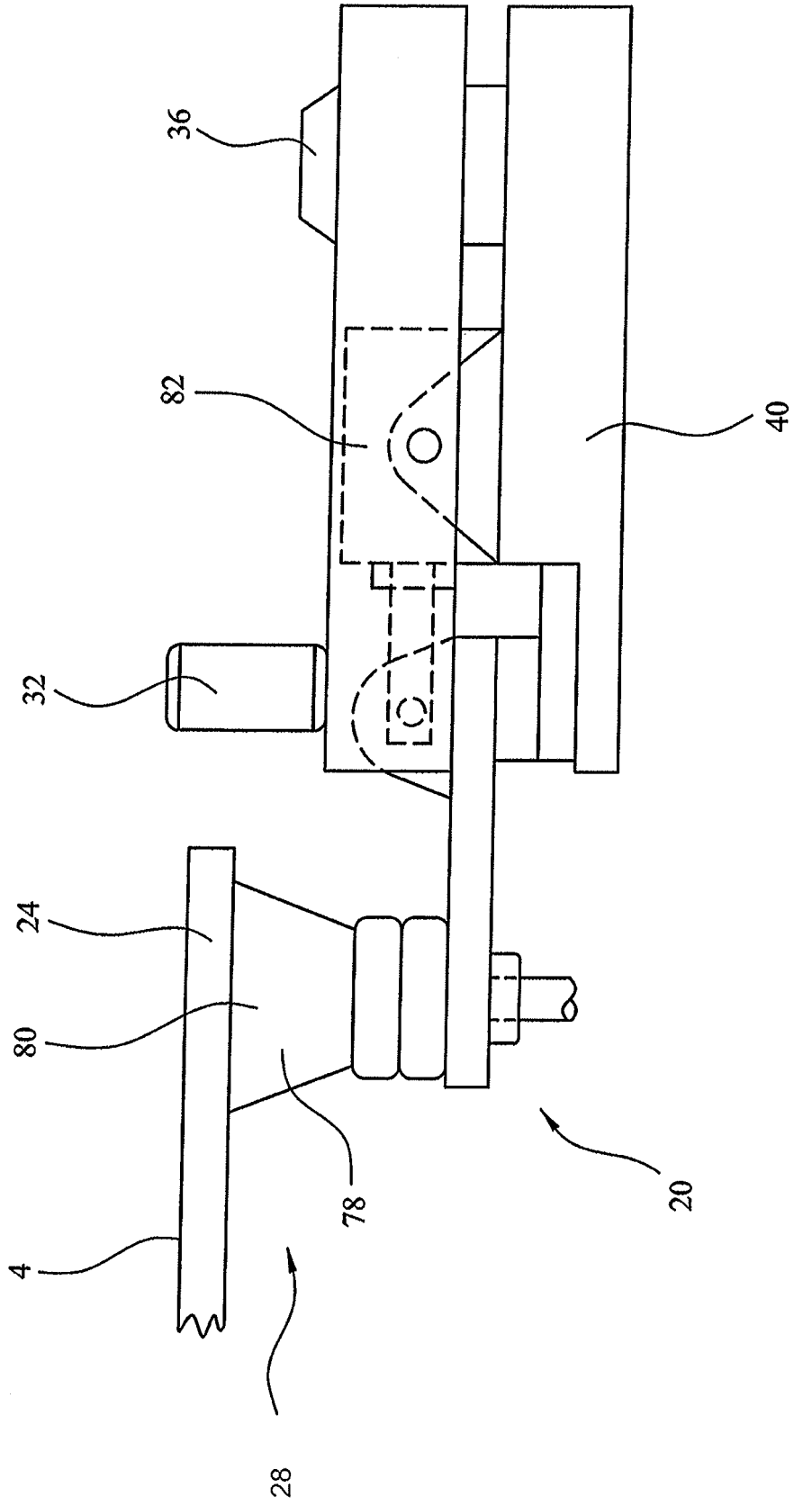


FIG. 6

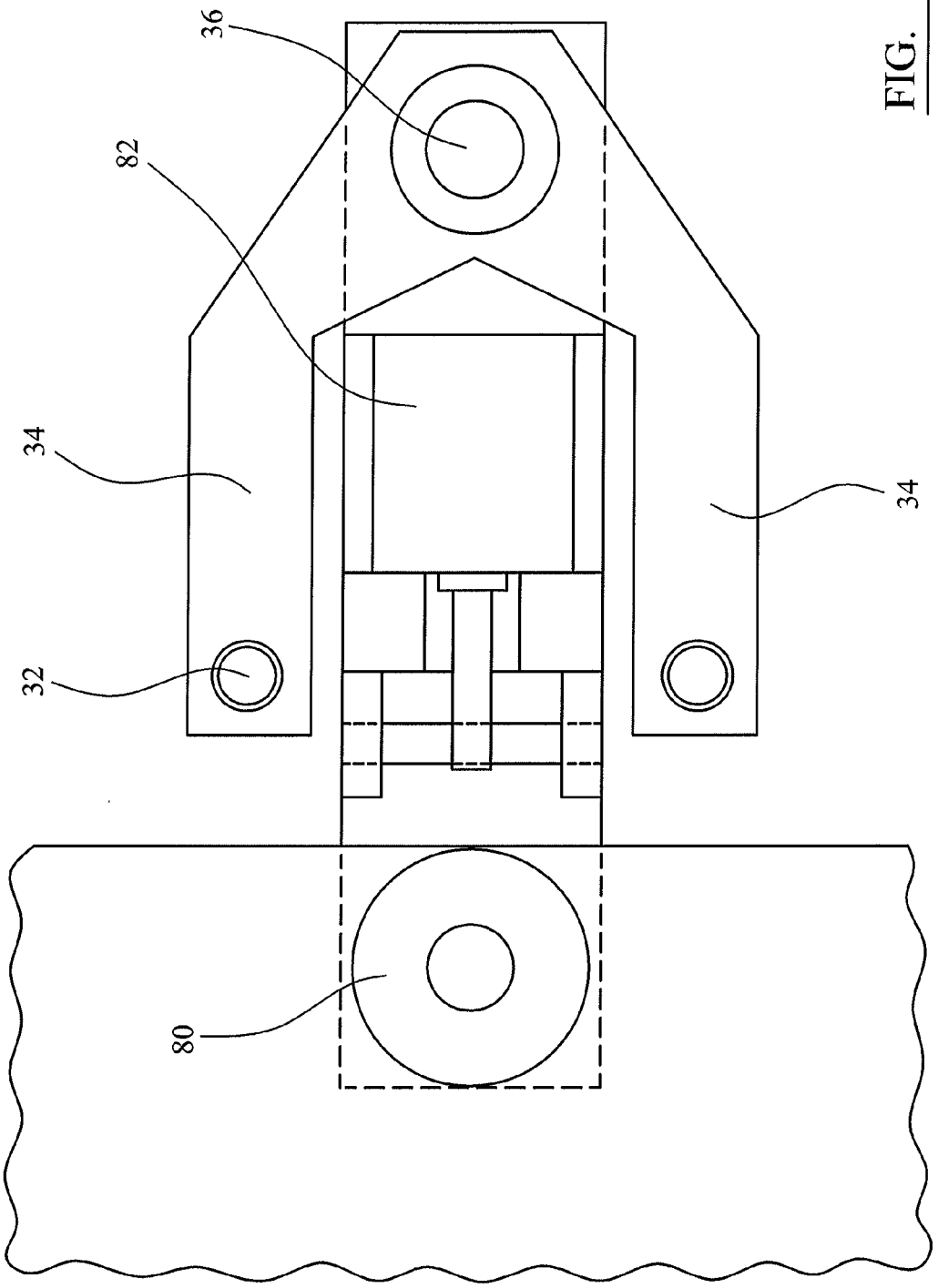
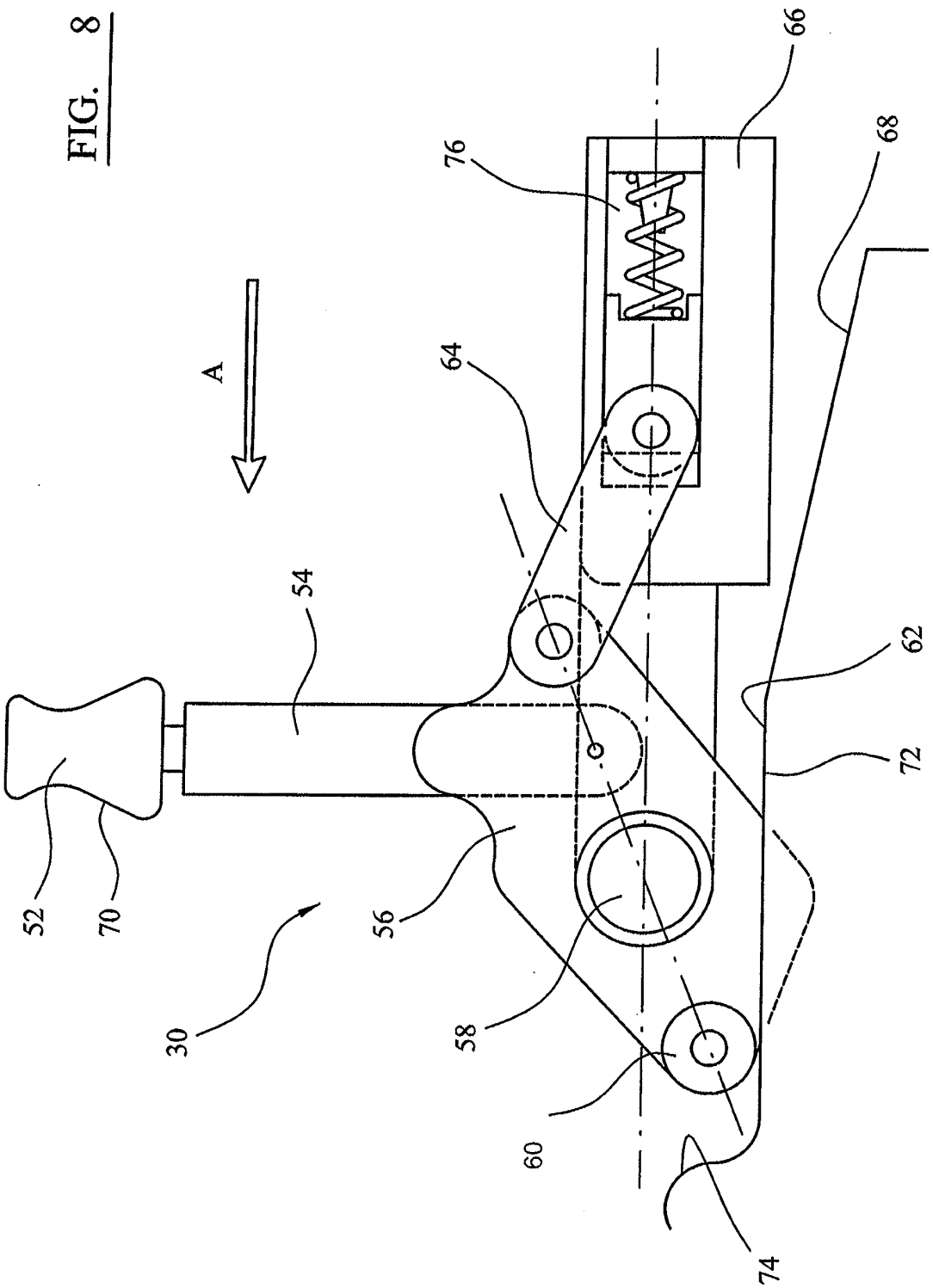


FIG. 7

FIG. 8



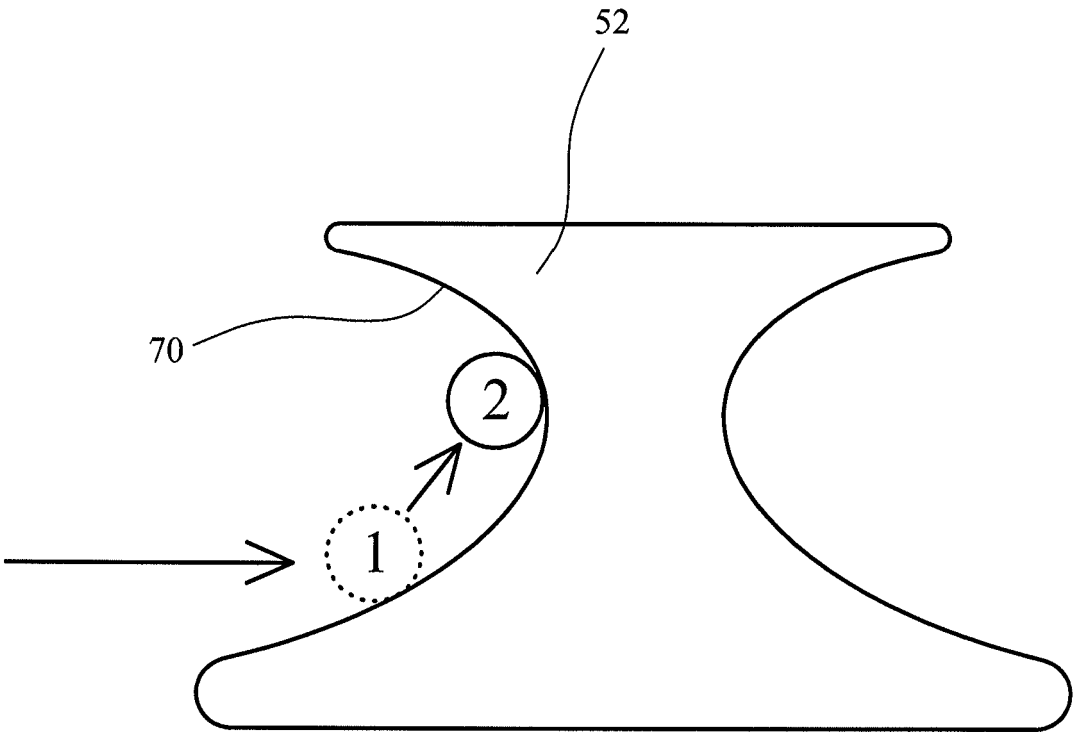


FIG. 9

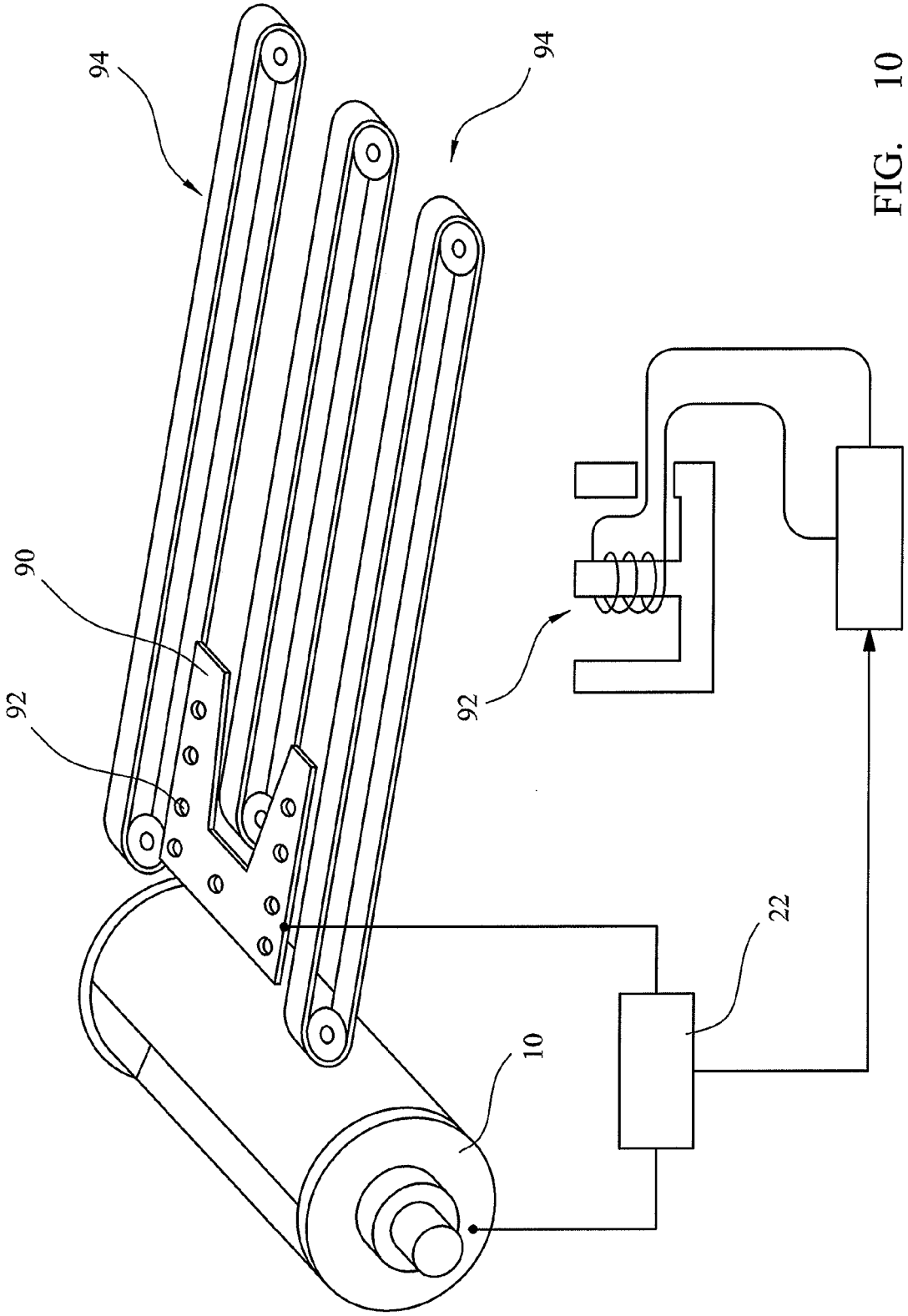


FIG. 10

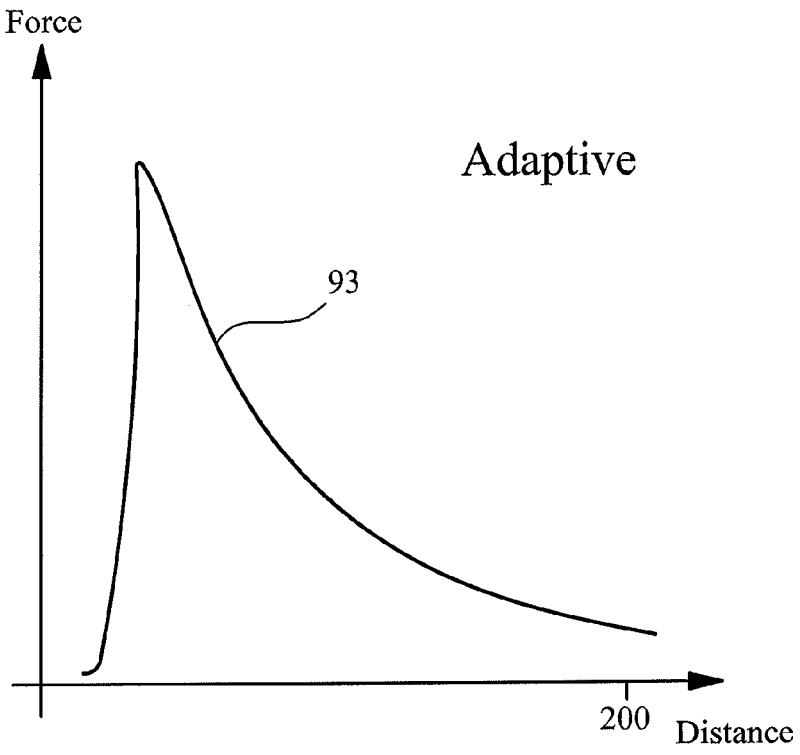

Force
Adaptive
93
200
Distance

FIG. 11

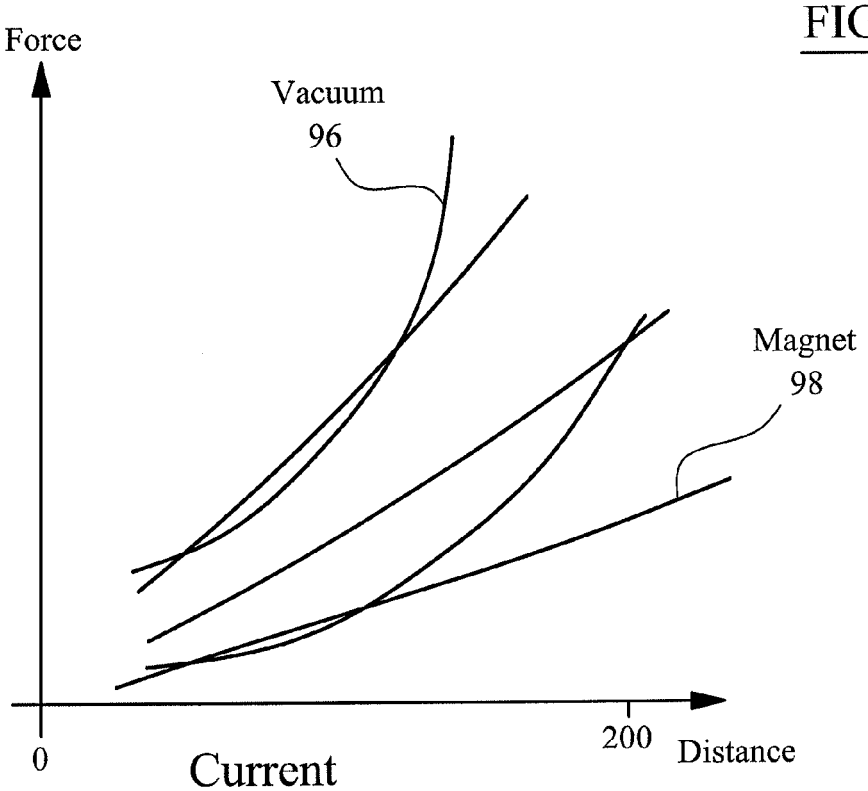

Force
Vacuum
96
Magnet
98
0
200
Distance
Current
State of Art

FIG. 12

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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 2367

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 June 2013	Henningsen, Ole

CATEGORY OF CITED DOCUMENTS

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