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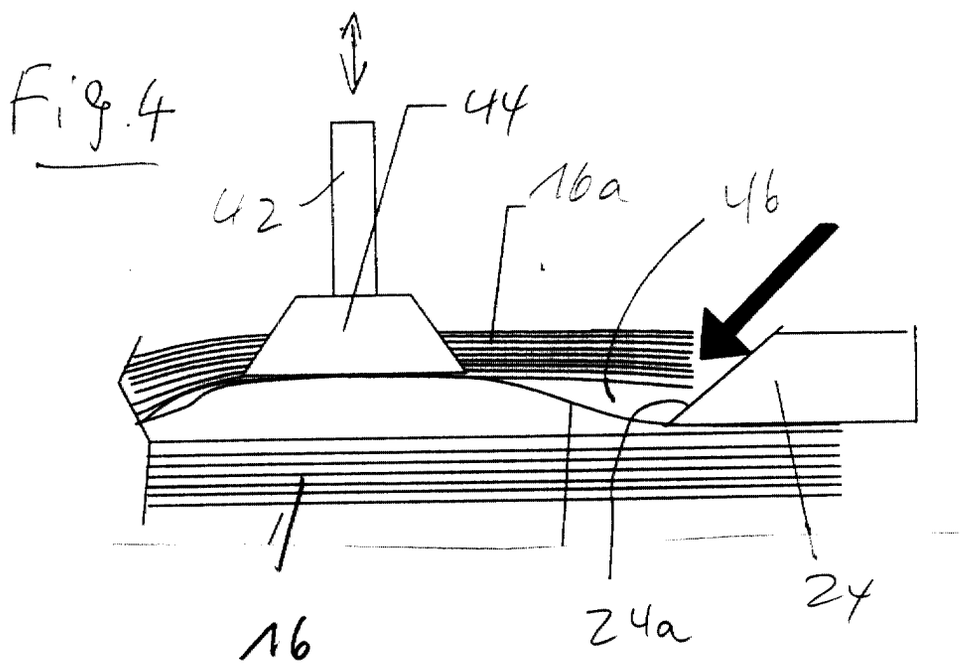
(54) Sheet set feeder

(57) A sheet set feeder is provided for feeding individualized sheet sets from a stack (16) of sheet sets wherein each set is offset-jogged with respect to adjacent sets. A gap (46) is created between the topmost set (16a) and the adjacent set in the stack, and a separator member (24) moves into the gap (46) to engage the topmost set. The separator member (24) is then moved along an edge of the topmost (16a) set to a position midway between the opposed lateral edges of the stack and then advanced in a feed out direction to push out the separated topmost set. The set feeder allows to separate the sets from the top of the stack (16).

Fig. 4



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Description

[0001] The present invention relates to a sheet set feeder for feeding individualized sheet sets from a stack of sheet sets wherein each set is offset-jogged with respect to adjacent sets.

[0002] Digital printers can produce entire sets of sheets for books, booklets, brochures etc. in rapid succession. For the further processing of the sheet sets, they are moved to a finishing machine, e.g. a booklet-maker or a glue-binder. When the sheet sets are stacked for collection and transport, it is common practice to arrange each of them with an offset with respect to the adjacent sets, i.e. the sets are offset-jogged.

[0003] For presenting the sheet sets to a finishing machine, they must be removed one by one from the stack. This can be done manually, but automatic sheet set feeders have also been provided. U.S. Patent Specification No. 5,556,254 shows a sheet set feeder wherein a stack of offset-jogged sheet sets is accommodated in a hopper. Beneath the hopper a shutter mechnism is provided. The shutter mechanism defines an opening that admits passage of individual sheet sets. In this set feeder, the sets are taken from the bottom of the stack. When a malfunction occurs, such as a paper jam within the hopper, all or at least a substantial part of the stack must be removed. This is a difficult task, given the height of the stack that can easily attain half a meter and the consequential weight of the paper to be moved.

[0004] The present invention provides a sheet set feeder that automatically and reliably separates individual sets from the top of a stack. According to the invention, the sheet set feeder comprises a separator member movable between a bottommost sheet of the topmost set and a topmost sheet of a next-to-topmost set to engage the topmost set, and movable in a predefined feed direction after engagement of the topmost set to push the topmost set in the predefined feed direction. Since the separator member acts on the topmost set in the stack, any malfunction in the separating process would occur in the upper portion of the stack, and access to that portion of the stack would be from above, and thus would be easy.

[0005] In the preferred embodiment of the invention, the separator member is movable between two opposed offset-jogged sheet set edges along an edge of the topmost set perpendicular to the offset-jogged edges. In particular, the separator member is movable to a position midway between the opposed offset-jogged edges prior to moving in the feed direction. Thus, separation between successive sets alternatively occurs on opposite sides of the stack, and the separator member always moves to a central position along an edge of the separated set before it pushes the set in the predefined feed direction.

[0006] In a further preferred embodiment of the invention, a lifting member such as suction cup is provided for engaging a topmost sheet of the next-to-topmost set at an offset-jogged edge portion of that sheet, and for locally lifting that sheet at its offset-jogged edge portion, thereby simultaneously partially lifting the uppermost set, locally creating a gap between the two topmost sheet sets. The separator member engages into the gap formed between the two topmost sheet sets, thereby reliably separating the topmost set from the stack.

[0007] The separation of the topmost sheet set preferably occurs always at a constant level. The stack is thus accommodated on a carrier associated with a lifting mechanism to make up for the difference in height after removal of each sheet set. Advantageously, the carrier is a cart, allowing easy transport and loading of a new stack.

[0008] According to a further advantageous aspect of the invention, the orientation and alignment of the individualized sheet sets can be adapted to the needs of an online connected finishing machine. This is achieved with a combined sheet set rotating and translating device provided downstream of the set separating mechanism. The set rotation and translation device is operated selectively according to the needs, for example to change between portrait and landscape orientation and/or to align the sets with a center axis of the finishing machine.

[0009] Further details of the invention will become apparent from the following description with reference to the drawings. In the drawings:

- Figure 1 is a schematic elevation of a sheet set feeder;
- Figure 2 is a schematic top view of the sheet set feeder;
- Figure 3 shows a sheet set separating mechanism of the set feeder;
- Figure 4 is an enlarged view illustrating the separating process;
- Figure 5 is a schematic sectional view of a sheet lifting mechanism;
- Figure 6 illustrates the separating process in a top view;
- Figure 7 illustrates successive steps of an alignment process for a pair of lateral abutment plates;
- Figure 8 illustrates the operation of a combined sheet set rotator and translator;
- Figure 9 is a schematic elevational view of the sheet rotator and translator; and
- Figure 10 is a flow chart illustrating the operation of the sheet set feeder.

[0010] The sheet set feeder 10 shown in Figure 1 has a housing 12 that accommodates a carrier 14 for a stack 16 of sheet sets, a set separating mechanism 18, a combined set rotator and translator 20 and a set outlet conveyor 22. The set separating mechanism 18 comprises a separator member 24 engaging the top most set in the stack 16. The carrier 14 is a cart with casters 26 that is engaged from beneath by a lifting mechanism 28. The sheet sets in the stack 16 are offset-jogged so that opposed edges of the sheet sets project laterally with respect to corresponding edges of adjacent sheet sets.

[0011] As can be seen more in detail in Figure 3, the carrier 14 is supported by chains 30, 32, running over deflection rollers 34, 36 and engaged by a drive mechanism which is controlled according to the needs so that the topmost set 16a in the stack 16 is always located at the same level. The lateral alignment of the topmost sheet sets is ensured by a pair of opposed abutment members 38, 40 engaging the projecting edges of the uppermost sheet sets in the stack 16. A sheet lifting mechanism is associated with each abutment members 38, 40. As seen in Figure 3, a sheet lifting mechanism 42 has a suction cup 44 in a position above the projecting edge of the topmost sheet in the next-to-topmost sheet set in the stack 16.

[0012] As illustrated in Figure 4, the sheet lifting mechanism with the suction cup 44 is movable vertically, as indicated by a double arrow. When the suction cup 44 is lowered to engage the topmost sheet of the next-to-topmost sheet set in the stack, the sheet lifting mechanism with the suction cup 44 is automatically raised, entraining the uppermost sheet set 16 and creating a gap 46 between the bottom sheet of the uppermost set 16a and the top sheet of the next-to-topmost set. The separator member 24 is shaped as a finger with a tapered edge 24 to facilitate penetration into the gap 46, as also seen in Figure 4. By penetrating into the gap 46, the separator member 24 reliably separates the topmost set 16a from the adjacent set in the stack.

[0013] Details of the sheet lifting mechanism are seen in Figure 5. The suction cup 44 is mounted at the lower edge of a hollow tube 50 mounted for reciprocating upward and downward movement in a cylinder casing 52. The upper end of the hollow tube 50 is connected to a vacuum source. Downward movement of the hollow tube 50 with the suction cup 44 is assisted by a pressure spring 54 accommodated in the casing 52. The pressure spring 54 bears on a plate 56 connected with the hollow tube 50. When the suction cup 44 is lowered into contact with a sheet of paper, it is automatically raised by the action of negative pressure within the hollow tube 50.

[0014] As an alternative to the piston/cylinder arrangement shown in Fig. 5, an electromagnetic solenoid device is used.

[0015] As seen in Figure 6, the separator member 24 is movable along an edge 16b of the uppermost sheet set 16a. In the position illustrated at Figure 6a, the separator member 24 is about to engage beneath the bottom sheet of the uppermost set 16a, as lifted by the suction cup 44. The separator member 24 then moves under the lifted portion of the topmost set 16a, as shown in Figure 4, and is then advanced to a central position along edge 16b, midway between the offset-jogged edges of the sheet sets. To prevent misalignment of the sheets in the topmost set 16a during such movement of the separator member 24, each of the projecting edges of the stacked sets is engaged by a lateral abutment member 38, 40, as more clearly seen in Figure 3. After the separator member 24 has moved to a central position along edge 16b of the topmost set, as seen in Figure 6b, it is moved in a predefined feed direction indicated by an arrow in Figure 6b perpendicularly to edge 16b to push the topmost set in said direction, thereby separating the set from the stack.

[0016] As seen in Figure 6c, the separator member 24 is then moved along edge 16b of the topmost set 16a to the opposite projecting edge to perform a separating function for the next set in the stack, in a manner similar to that for the preceding set. A similar sheet lifting mechanism with a suction cup 44 is associated with the lateral abutment member 38. In Figure 6d, the separator member 24 has moved into a central position along edge 16b, prior to pushing the topmost set from the top of the stack in the predetermined feed direction, as illustrated in Figure 6b.

[0017] For adjustment of the lateral abutment members 38, 40, and for guiding the movement of separator member 24, a common assembly is proposed. As shown in Figure 7, the assembly comprises a horizontal rail 60 mounted in a frame structure, a carriage 62 movably mounted on the rail 60 and carrying the separator member 24, and a pair of sliders 64 mounted for sliding movement on the rail 60. Each slider 64 carries one of the abutment members 38, 40. The sheet lifting mechanisms 42 are attached to the respective abutment members 68, 40. Each slider 64 has a plate 64a of a ferromagnetic material, and carriage 62 has a pair of solenoids 66, each associated with one of the plates 64a.

[0018] To adjust one of the abutment members 38, 40, say the abutment member 40 in Figure 7b, the carriage 62 is moved towards the corresponding slider 64 and the corresponding solenoid 66 is energized. Plate 64a of slider 64 is attracted and finally engaged by solenoid 66. Carriage 62 with the slider 64 then moves in the opposite direction until abutment member 40 engages the lateral projecting edges of the uppermost sets in stack 16, as shown in Figure 7c. At this point, solenoid 66 is switched off, and slider 64 with abutment member 40 remains in the thus adjusted position. Next, the adjustment procedure is repeated for abutment member 38, as indicated by an arrow in Figure 7c.

[0019] The combined sheet set rotator and translator is illustrated in Figures 8 and 9. As seen in Figure 8, the basic operation of the set rotator and translator 20 consists in receiving an individualized sheet set 16a from the stack 16 (Figure 8a) rotating the set by 90° (Figure

8b) and shifting the set in a direction perpendicular to the feed direction (Figure 8c) to align the sheet set with the center axis of a downstream finishing machine.

[0020] It should be understood that operation of the rotator and translator 20 is selective, depending on the required orientation and alignment of the sheet sets supplied by the set feeder.

[0021] Details of the combined set rotator and translator 20 are apparent from Figure 9. A sheet set clamp is formed by a pair of clamping jaws 70, 72 opposed to each other in a vertical direction, the upper one 70 being movable up and down under control of an eccenter drive 74 to selectively clamp and release a sheet set 16a received from the set separating mechanism. The clamping jaws 70, 72 are mounted for synchronous rotation about a common vertical axis 76. A pair of pinions 78, 80 are mounted on a common drive shaft 82, in meshing engagement with corresponding peripheral gear teeth on the clamping jaws 70, 72. The entire assembly including the pair of clamping jaws with the associated driving units is mounted on a horizontally movable carriage 84. Carriage 84 is driven with a horizontal reciprocating movement by a chain or belt drive 86 located beneath the carriage 84.

[0022] For automated setup procedures, the set feeder of the present invention is equipped with optical sensors and an electronic control unit. When a cart with a full stack of sheet sets is pushed into the housing 10 of the set feeder, the dimension and position of the sheet sets are automatically detected. The position of the rail 60 with carriage 62 is then adjusted in accordance with a detected edge of the uppermost sheet set. Thereafter, the lateral abutment members 38, 40 are adjusted, as illustrated in Figure 7. Then, the set feeder is ready for operation.

[0023] As illustrated in Figure 10, operation of the set feeder is started at step 100 after completion of the setup procedures. Step 102 is a check whether the last sheet set in the stack has been processed. If the last set has been processed, the lifting mechanism 28 is activated to lower the carrier 14 to its lowermost position, and operation of the set feeder is terminated.

[0024] As long as sheet sets are present on carrier 14, and each time a set has been fed out by the set outlet conveyor 22, the carrier 14 is lifted at step 104. In step 106, the topmost sheet of the next-to-topmost sheet set is lifted by one of the suction cups 44. Simultaneously, in step 108, the suction cup on the opposite side of the stack is raised. In step 110 the gap 46 between the topmost set and the adjacent set in the stack is created. In step 112, the finger of the separator member 24 is moved into the gap 46 and then along the edge of the uppermost set to a central position, with a final pushing movement in the predefined feed direction. In step 114, a flag is checked whether rotation of the set is required. If rotation is required, the set is pushed to the clamp of the set rotator 20 (step 116), and the set is rotated at step 118. After rotation and an optional translation, the set is fed out via the set outlet conveyor 22. If no rotation is required, the set is fed out by the set outlet conveyor 22 in steps 120, 122 and 124. The separator member 24 (referred to as finger in Figure 10) is moved to the opposite side of the stack, and operation is resumed at step 100 for the next set in the stack.

Claims

1. A sheet set feeder for feeding individualized sheet sets from a stack of sheet sets wherein each set is offset-jogged with respect to adjacent sets, comprising a separator member movable between a bottommost sheet of the topmost set and a topmost sheet of a next-to-topmost set to engage the topmost set, and movable in a predefined feed direction after engagement of the topmost set to push the topmost set in said feed direction.

2. The set feeder according to claim 1, wherein said separator member is movable between two opposed offset-jogged sheet set edges along an edge of the topmost set perpendicular to the offset-jogged edges.

3. The set feeder according to claim 2, wherein said separator member is movable to a position midway between said opposed offset-jogged edges prior to moving in said feed direction.

4. The set feeder according to any of the preceding claims, further comprising at least one lifting member for engaging a topmost sheet of the next-to-topmost set at an offset-jogged edge portion of that sheet, and for locally lifting that sheet at said offset-jogged edge portion, thereby simultaneously partially lifting said uppermost set, locally creating a gap between the two topmost sheet sets.

5. The set feeder according to claim 4, wherein said separator member is movable to engage into the gap formed between the two topmost sheet sets.

6. The set feeder according to claim 4 or claim 5, wherein said lifting member comprises a suction cup.

7. The set feeder according to claim 6, wherein said suction cup is carried by a pneumatic piston/cylinder arrangement or by a solenoid device.

8. The set feeder according to any of the preceding claims, wherein said separator member has a tapered edge.

9. The set feeder according to any of the preceding claims, wherein said separator member is rotatable

about a vertical axis.

10. The set feeder according to any of the preceding claims, and comprising a carrier accommodating said stack of sheet sets.

11. The set feeder according to claim 10, wherein said carrier is movable vertically to lift said stack in compensation for each sheet set separated from the stack.

12. The set feeder according to claim 10 or claim 11, wherein said carrier is a cart that is movable between the set feeder and a sheet stacker.

13. The set feeder according to claim 11 and claim 12, further comprising a lifting mechanism releasably engaging the cart.

14. The set feeder according to any of the preceding claims, further comprising a feeder outlet for individualized sheet sets and a sheet set rotator upstream of said feeder outlet, the sheet set rotator having a vertical axis of rotation.

15. The set feeder according to claim 14, wherein the sheet set rotator is selectively operable to either rotate a sheet set by 90° or pass a sheet set without rotation.

16. The set feeder according to claim 14 or claim 15, wherein the sheet set rotator comprises a pair of clamping jaws mounted for rotation about a common vertical axis and coupled in synchronism to a common rotary drive.

17. The set feeder according to claim 16, wherein at least one of said clamping jaws is mounted for vertical movement in opposite directions.

18. The set feeder according to claim 16, wherein at least one of said clamping jaws is resiliently mounted on a platen.

19. The set feeder according to any of claims 14 to 18, wherein said sheet set rotator is combined with a sheet set translator adapted to move a sheet set in a direction transverse to said predefined feed direction.

20. The set feeder according to any of the preceding claims, further comprising a pair of lateral abutment members each associated with one of the two opposed offset-jogged edges of the topmost sheet sets in the stack.

21. The set feeder according to claim 20, wherein at least one of said abutment members is adjustably movable into engagement with associated sheet edges.

22. The set feeder according to any of the preceding claims, and further comprising a frame, a horizontally extending guide rail mounted on said frame, and a carriage movably mounted on said guide rail and carrying said separator member.

23. The set feeder according to claims 20, 21 and 22, wherein said lateral abutment members are adjustably mounted on said guide rail.

24. The set feeder according to claim 23, wherein each lateral abutment member carries an associated lifting member for engaging a topmost sheet of the next-to-topmost set at an adjacent offset-jogged edge portion of that sheet.

25. The set feeder according to claim 23 or claim 24, wherein said lateral abutment members are adapted to be temporarily coupled to said carriage for movement therewith into engagement with associated sheet edges.

Fig.1

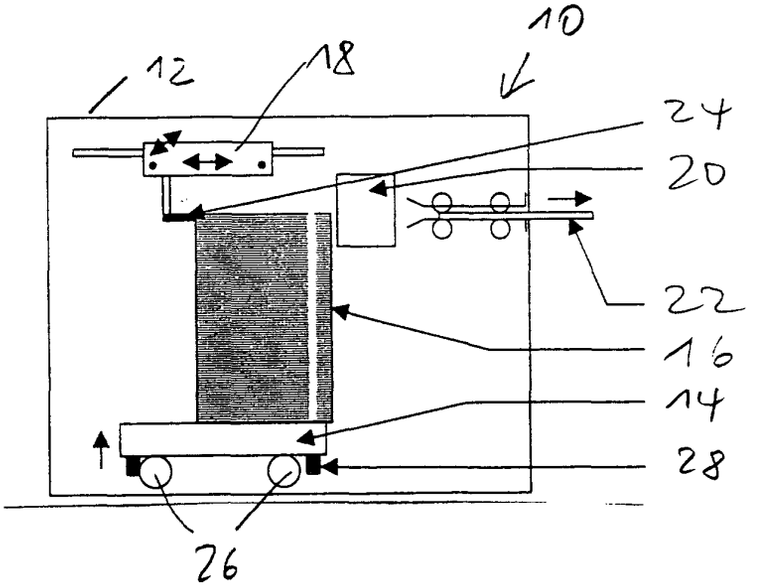


Fig.2

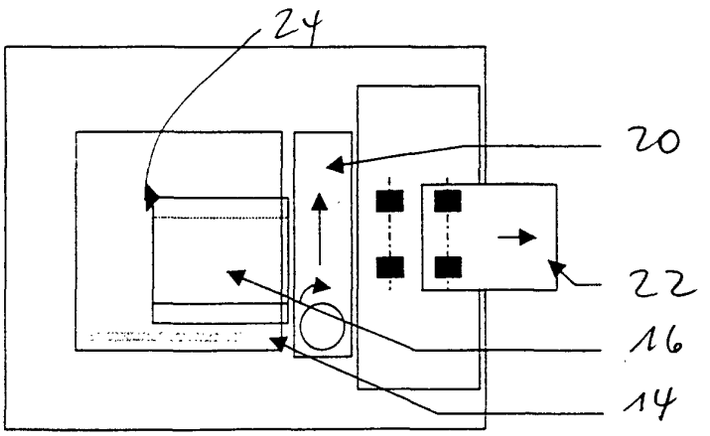


Fig.3

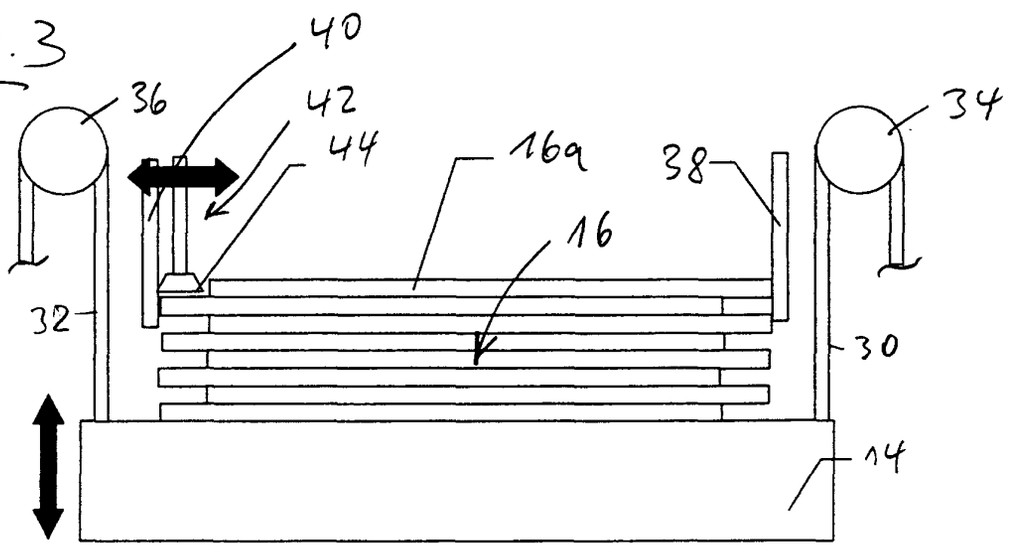


Fig.4

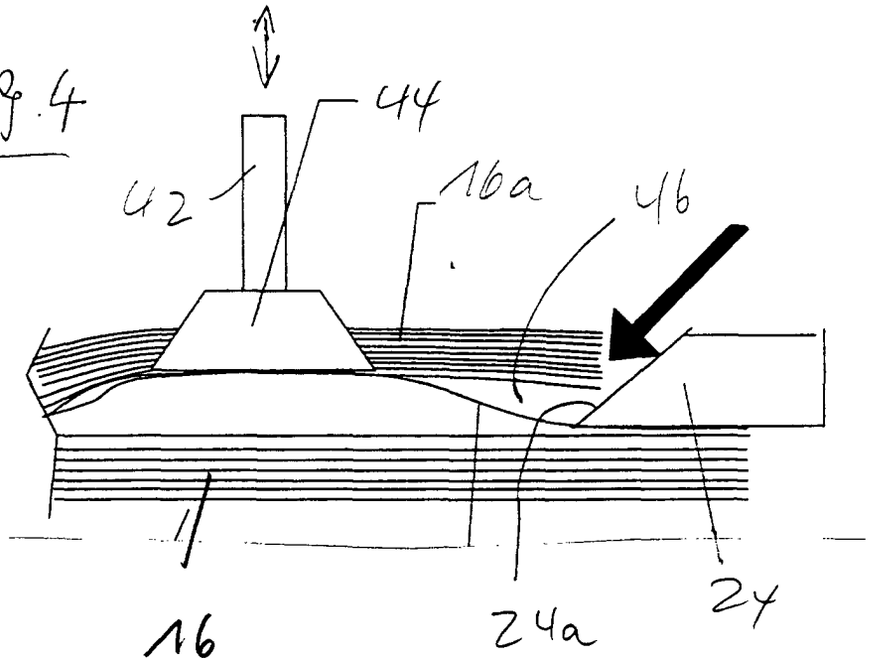


Fig.5

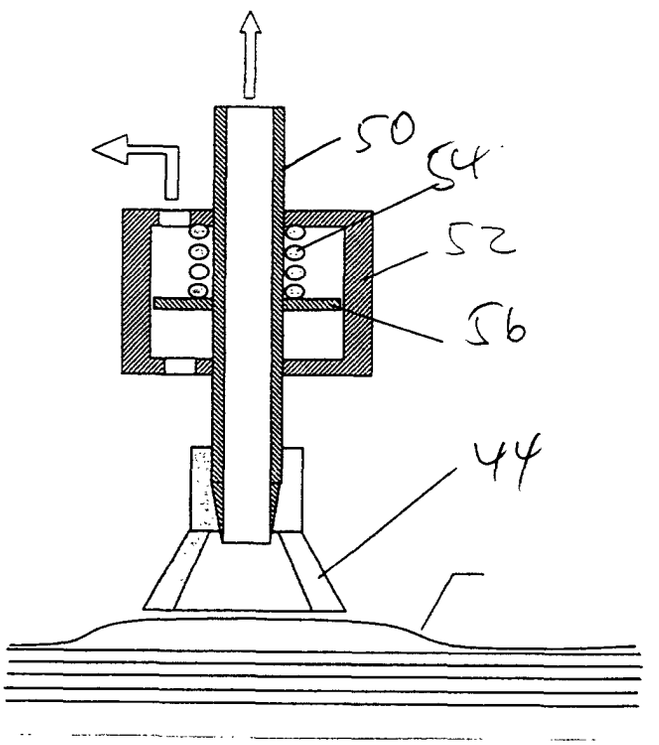


Fig. 2

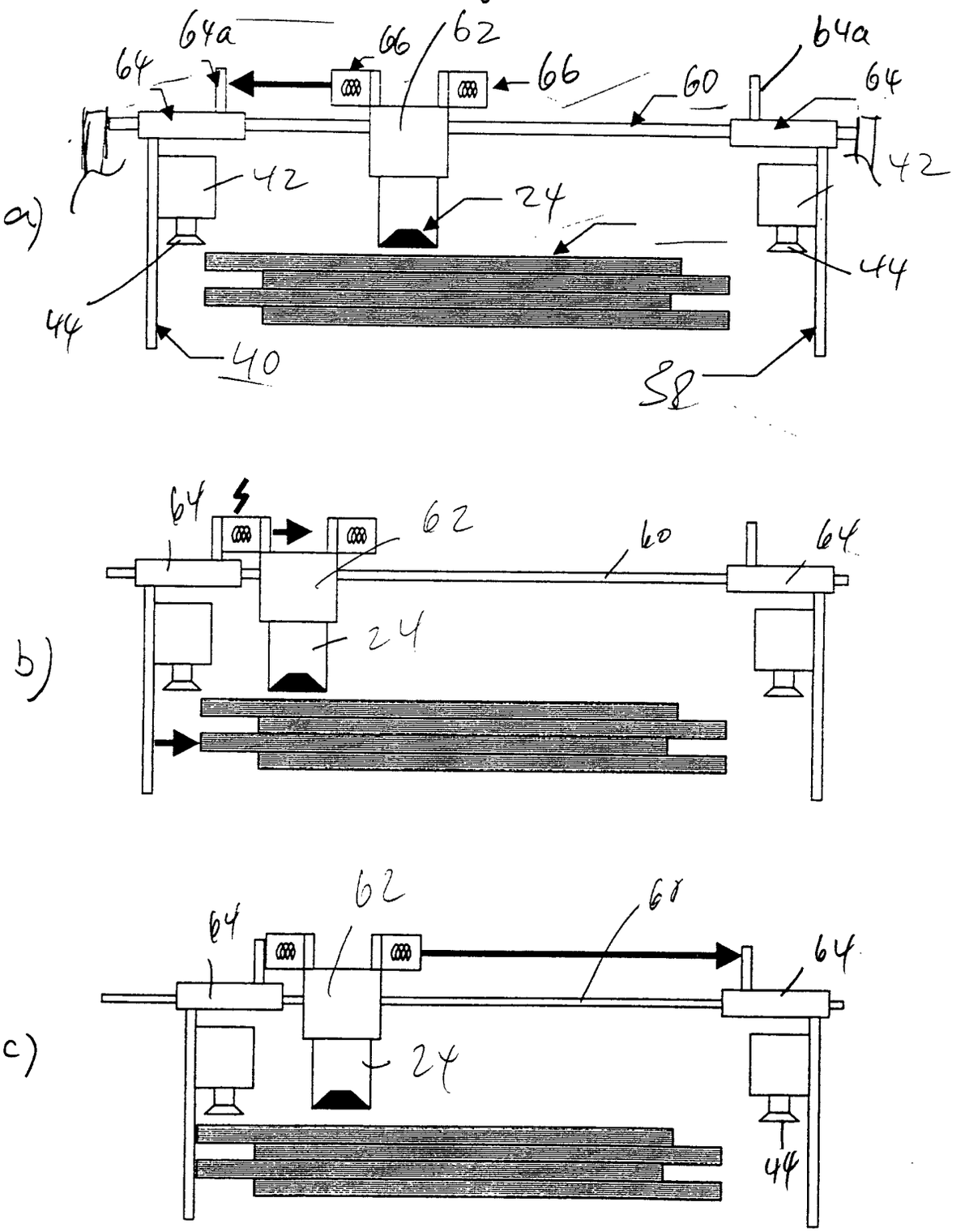
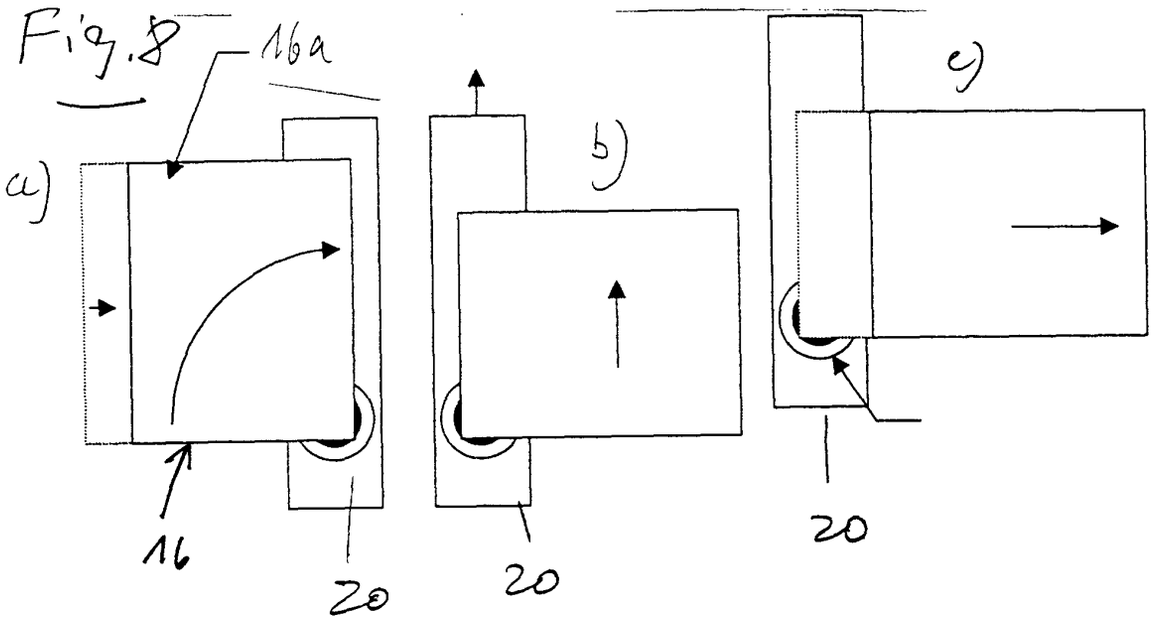

a)
64a
64
66
62
66
60
64a
64
42
42
24
44
44
40
58
b)
64
62
60
64
24
c)
64
62
61
64
24
44

Fig. 8


16a
a)
b)
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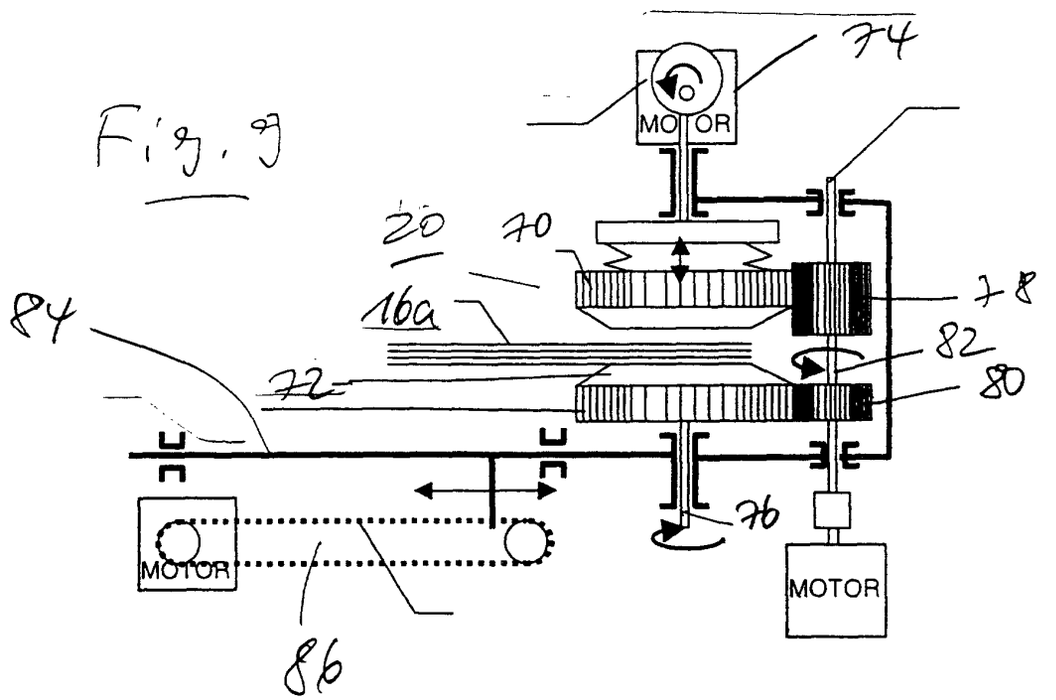
16
20
20
20

Fig. 9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16a
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82
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72
80
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86

Fig.6

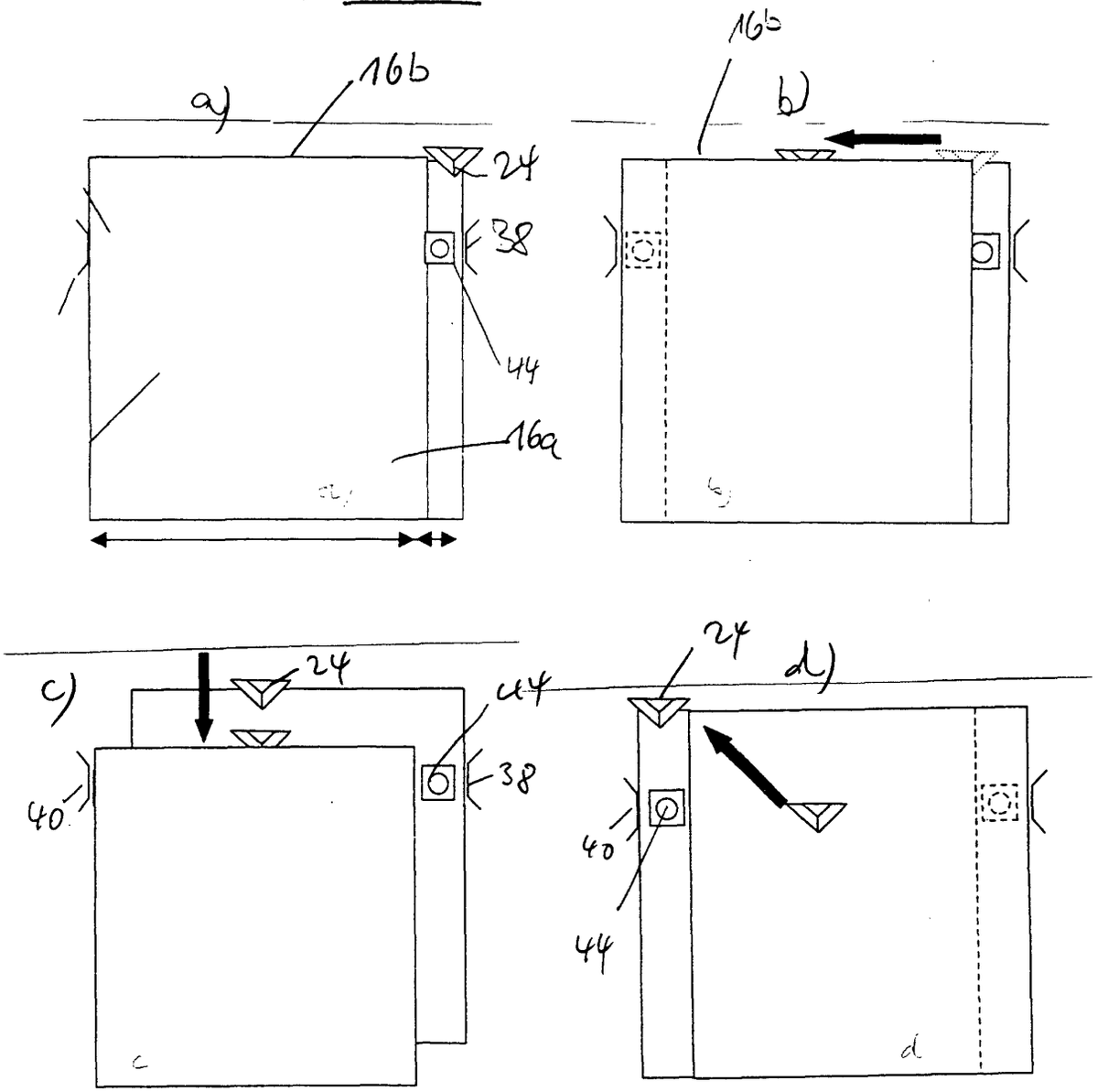
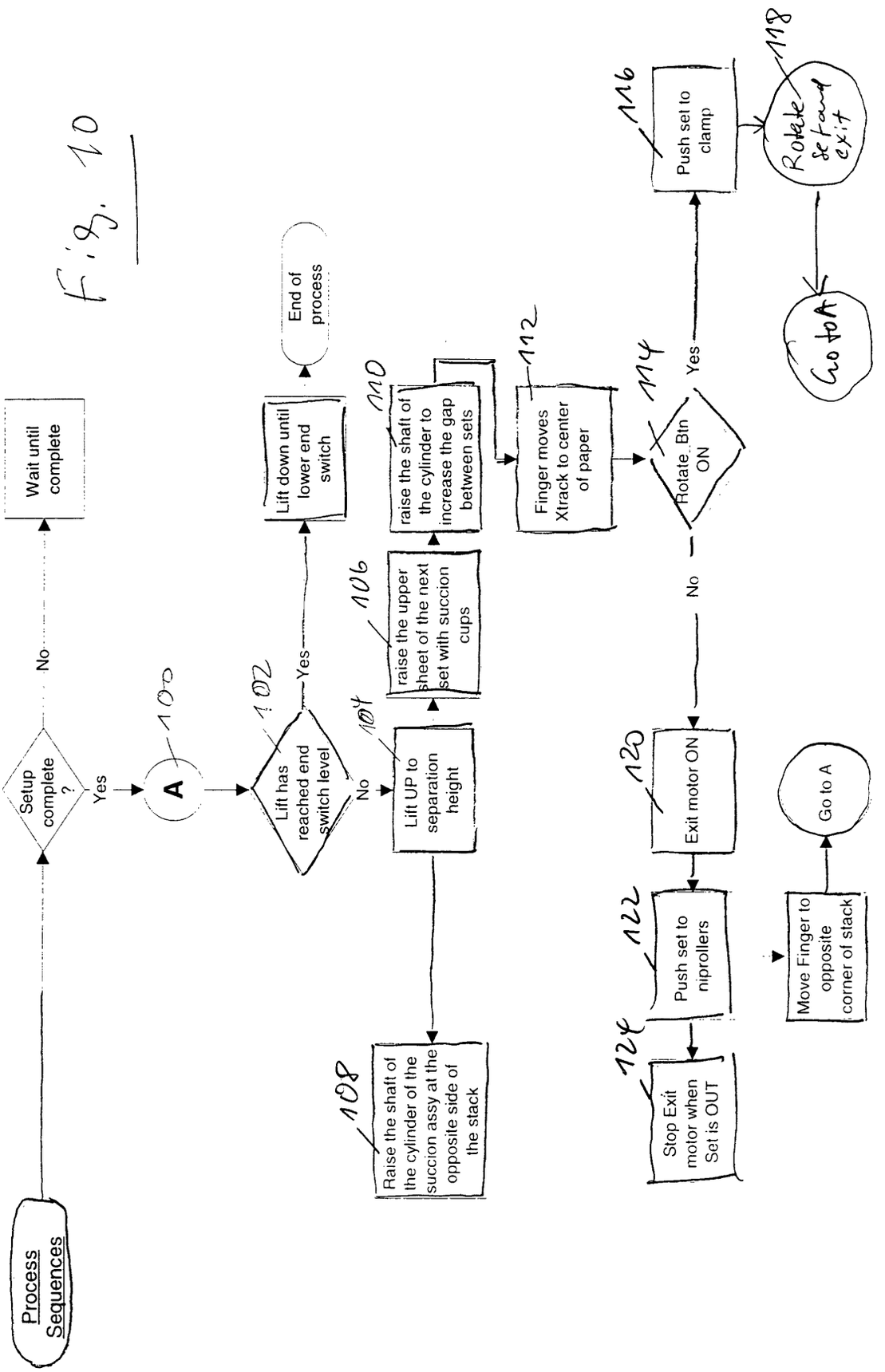


Fig. 10


Process Sequences
Setup complete ?
No
Yes
Wait until complete
A
100
Lift has reached end switch level
102
Yes
Lift down until lower end switch
End of process
No
104
Lift UP to separation height
Raise the shaft of the cylinder of the succion assy at the opposite side of the stack
108
raise the upper sheet of the next set with succion cups
106
raise the shaft of the cylinder to increase the gap between sets
110
Finger moves Xtrack to center of paper
112
Rotate_Btn ON
114
Yes
No
Push set to clamp
116
Rotate & Feed & exit
118
Go to A
Exit motor ON
120
Push set to niprollers
122
Stop Exit motor when Set is OUT
124
Move Finger to opposite corner of stack
Go to A

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EUROPEAN SEARCH REPORT

Application Number
EP 00 10 3362

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 July 2000	Haaken, W

CATEGORY OF CITED DOCUMENTS

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