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## (54) An automatic stacking device for piles of sheets.

(57) Automatic stacking device for stacking layers preformed by one or more groups (a, b, c) of sheets, which groups are placed side by side, comprising a motor driven roller plane (1) which brings the layer against a fixed rigid wall (2) so as to avoid that the individual groups of sheets become undone or become displaced obliquely, as well as a group of fixed and movable (4, 6) levelling devices, acting on the four vertical sides of the layer, and automatic controlling means to memorize the number of layers to be laid one over the other and the measures in width at which said roller plane and levelling devices are to work.

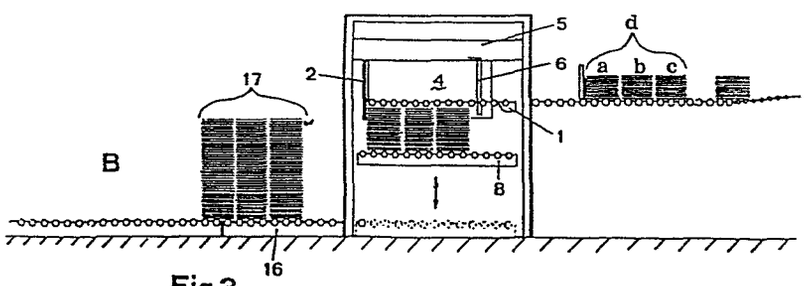


Fig.3

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GIAMPIERO GIUSTI

# An automatic stacking device for piles of sheets.

## Specification

This invention refers to an automatic stacking device for automatically forming piles of sheets by overlaying layers pre-formed by one or more groups of sheets, which groups are placed side by side, said stacking device being apt to be inserted downstream of a preparatory unit of layers of groups of sheets. In order to perform stacking operations, various equipments already known exist which, analyzing them one by one, present however imperfections which the object of this invention obiates; particularly the following should be noted.

1) An apparatus is known for stacking sheets, packages, boxes etc., formed by a sliding plane on which a group of sheets or the like rests, which plane by moving outwards sideways causes the said group to fall on a lifting plane provided with motorized rollers or on the sheets just previously ejected; the lifting plane descends vertically only by the amount of thickness of said group and so on till the pile of the desired height has been formed and then, still automatically, it reaches the level pre-set by a limit switch and performs ejection of the pile through said motorized rollers, after which it rises rapidly till it stops underneath the sliding plane, in order to begin the formation of a new pile.

2) An apparatus is known for stacking sheets of corrugated cardboard, formed by two small sliding planes on which the group of sheets lies, which planes, by moving outwards each respectively from its own side, allow it to fall on a lifting plane which operates in the way already described in the preceding description and however in the way already in use for a plurality of other applications.

The apparatus generally described at points 1) and 2 show the different method of support and ejection of the material to be stacked since on avails itself of a plane which slides away transversally, whereas the other uses two planes, one opposed to the other, which transversally slide out. The above mentioned apparatus differentiate one from the other also in the way through which they perform levelling, since the first was developped for the purpose of stacking a plurality of types of materials and therefore avails itself of a semiautomatic levelling where also the manual intervention of the operator is necessary in order to improve such operation; the second apparatus was devised specifically for corrugated cardboard and avails itself of an automatic levelling, only however on the single group of sheets and when suspended above said planes.

That being said, the device according to this invention improves and adds the following characteristics:

a) It is apt to stack layers preformed by one or more groups of sheets, which groups are placed side by side; it operates through a plane which slides sideways, but on the plane there are motor driven rollers which instead of utilizing only the motion of inertia of the layer fed

by insertion means placed upstream, engage the layer and carry it against a fixed rigid wall so as to avoid that the individual groups of sheets become undone or become displaced obliquely according to the friction differences which may be encountered; furthermore said motor driven rollers ensure a controlled and constant collision against said rigid wall which guarantees a perfect levelling of the front surface of the layer, without the possibility of the individual groups of sheets becoming undone during the travel and displaced obliquely.

b) It operates through a group of fixed and movable levelling devices, placed above and below the roller plane and in any case long enough to act when the layer is resting on the lifting plane or on the layer just previously ejected.

This prerogative allows the layers to be laid one over the other perfectly avoiding the possible displacements of the layers during the passage from the plane or planes to the lifting device so as to form piles which are uniform and have no vertical walls presenting various projections, as happens on the contrary when the levelling of the layer has not taken place during the phase in which it is on the lifting device or on the previously ejected layers.

c) It operates completely in an automatic way with microprocessor controls, it being possible to memorize the number of layers to be laid one over the other before carrying out the ejection of the pile and the measures

in width at which the roller plane and the vertical levelling devices are to work, this through the constant combination with an electronic coder. The main prerogative of the controlling electronic apparatus of the stacking device according to this invention is that by means of a photodiode placed before the input, the removal of the levelling device is controlled in order to allow the insertion even of layers which for abnormal reasons should be oblique or displaced with respect to the normal line of travel. The moving away of the levelling device takes place without leaving the control by the coder, which controls its amount of movement in closure till it causes it to stop always at the programmed measure.

The stacking device is mainly formed by four groups, and precisely:

a) a motor driven roller plane capable of receiving or containing a complete layer of groups of sheets and of moving out transversally between vertical walls so as to unload the entire layer on a lifting plane or on previously unloaded layers.

b) A group of levelling devices placed over and below the above mentioned plane, capable of acting on the four vertical sides of the layer when it is rested on the lifting device.

c) A lifting plane provided with motor driven rollers and capable of performing partial travels as a function of the individual heights of the layers during the forming

phase of the pile; it is also capable of performing the ejection of the pile through said motor driven rollers and of performing a vertical rising travel at a higher speed than that of the descent and in one unique step.

d) A controlling electronic panel which allows the stacking device to operate in a completely automatic way and, when required for maintenances or emergencies, through electric push button controls in a manual way.

Entering in the constructive and functional details, reference is made to the enclosed schematic drawings, in which:

figure 1 is a front view of the stacking device according to the present invention;

figure 2 is a plan view of said device;

figure 3 is a side view of the stacking device inserted in the line for collecting the sheets, according to two solutions, i.e. solution A: inside a pit; solution B: without a pit;

figure 4 is a side view of the group of guides and controls of a levelling device;

figure 5 is a plan view of another levelling device; and

figure 6 is a side view of the group of guides and controls of still another levelling device.

The stacking device comprises a horizontal table or plane 1 provided with motor driven rollers to receive the layer of groups of sheets and convey it against a vertical rigid fixed wall 2, in order to improve the front levelling; said motor driven roller plane is movable transversally to the direction (arrow F in figure 2) of travel of the layer and is provided with a device (not shown), which, by means of an electric limit switch (not shown) allows its exact positioning with respect to a movable wall 4.

Above the motor driven roller table 1, perpendicularly to the fixed rigid wall 2, two rigid and movable walls 3 and 4 are suspended. The wall 3, during the working cycle, takes up only two distinct positions, forward and backward, by means of the mechanism controlled by pneumatic cylinder 13 (figure 6) and is positioned so as to barely touch the rollers of plane 1.

The wall 4, besides assuming two distinct positions by means of the mechanism controlled by pneumatic cylinder 7 (figure 4), is capable of moving to any whatsoever area which the program of the operating cycle instructs it to, since it is mounted on a frame 5 slidable on guides 11 along which it is moved through an arrangement 12 with rack and pinion geared motor and is positioned at a pre-set measure by means of an electronic coder device (not shown). On frame 5 there is also an arm 6, movable (by not shown driving means) horizontally and parallelly with respect to the wall 4 along the guide 6' and pivoted so as to rotate by 90° on a horizontal plane through the action of a pneumatic cylinder 6"; through such rotation it can move away from wall 4.

Below the table 1 and below the vertical of the moved back position of the wall 3, a fixed wall 10 is mounted, in coincidence of which there is another arm 9, which is like the arm 6 and is movable (by not shown driving means) horizontally and parallelly with respect to wall 10 (on guide 9') and pivoted so as to rotate by 90° on a horizontal plane through the action of a pneumatic cylinder 9"; through such rotation it can move away from the fixed wall 10. A motor driven roller plane 8 is mounted below the table 1; said plane 8 can move vertically like a lifting device, in order to receive the layers, descend from time to time only according to the thickness of the individual layer, for the number of programmed layers, and once said number is reached it continues its descent till it reaches an electric limit switch (not shown) where it stops and causes the motor of its rollers to start for effecting the ejection of the pile. At the stopping and ejecting level, there is a motor driven roller plane 16 apt to receive the pile, which plane, depending on the requirements, may be mounted in a fixed way, i.e. resting on the floor (figure 3, B), or may be a lifting plane in order to bring the pile at optimal heights again (figure 3, A).

The working cycle controlled from a microprocessor and coder electronic panel (not shown) takes place as indicated in the following description. It should be stated first that, every time the cycle begins, horizontal plane 1 is in a stopped forward position, with the front part placed in vicinity of the movable wall 4, which in turn is positioned (by means of 12) at the distance programmed as a function of the length (perpendicularly to the plane of figure 3) of the sheet layer, and in the backward position, controlled by

pneumatic cylinder 7; said sheet layer, in the example of figure 3, consists of three groups a, b, c of sheets, and is bodily designated with d; the movable wall 3 is in the forward position, controlled by the pneumatic cylinder 13; the arms 6 and 9 are positioned and stopped at the input of the stacking device and rotated so as to result in being adjacent with respect to the respective walls 4 and 10; the motor driven roller plane 8 is positioned and stopped at a few mm below the horizontal plane 1 for the first layer and then stopped at a level such that it maintains the upper part of the layer (present on plane 8) at a few mm below the horizontal plane 1, this being possible by the control performed through a photocell (not shown) placed so as to sight in on the area just below the horizontal plane 1.

The cycle begins at the arrival from upstream apparatus, at intervals of time greater than the total time of the cycle of the stacking device, of a complete layer, formed by one or more groups of sheets. Such a layer, upon entering the stacking device, darkens a photodiode (not shown) placed at the input, which controls the starting of the motor driven rollers of the table 1. The layer enters completely the stacking device and, being pushed by the motor driven rollers of the table 1, collides and therefore levels against wall 2, where a photodiode (not shown) controls the stopping of the rollers; then the movable wall 4 is moved (by cylinder 7) towards the layer and a photocell (not shown), placed on the wall 4, when it sees the initial part of the layer, controls the sliding out of table 1; in this way the layer rests on the wall 3, and wall 4 ends its travel, stopping at the pre-set measure, which is equivalent to the length of the layer.

As soon as table 1 has moved completely out from beneath the layer, and therefore has caused it to rest on the lifting plane 8, wall 3 (by cylinder 13) moves back into the position where it is aligned with wall 10, while the movable arms 6 and 9 are shifted at the rear wall of the layer, reading the exactness of the stopping position through a direct reflexion photocell (not shown) and stop, and then through rotation by 90° (by means of 6" and 9", respectively) they level the layer pushing it towards the fixed wall 2; at the same time the wall 4, by means of its pneumatic cylinder 7, pushes the layer towards walls 3 and 10.

After a time set by an electronic timer (not shown), the wall 4 and the arms 6 and 9 move away from the layer and the lifting plane 8 descends vertically only by the thickness of the individual layer; in fact, said photocell placed to sight in underneath the table 1, as soon as returned in light, controls the stopping of the lifting plane 8 and the simultaneous return motion of table 1, which goes to stop into the position of beginning of the cycle, ready to receive a new layer.

The above mentioned cycle repeats for the programmed number of times, which correspond to the number of layers which are to be overlaid on the lifting plane 8, in order to reach the height of pile which it is intended to obtain; once the last layer has been unloaded, the lifting device 8 continues its descent till it stops at an electric limit switch (not shown) placed so as to cause a mating of the level of the roller plane 8 with the level of the roller plane 16.

When said limit switch is engaged, the rollers of device 8 are started and perform the ejection; a photocell (not shown) placed at the exit, when darkened by the pile, controls the starting of the rollers of the roller plane 16; in figure 3 the pile so ejected is designated with 17. When said photocell sees the light again, (this indicating that the pile has been completely unloaded), it controls the rising again of the plane 8, at a speed which is remarkably greater than that of descent, since plane 8 is now unloaded, till it stops at an electric limit switch (not shown) placed so as to cause the plane 8 to stop at a few millimeters beneath the table 1, ready to receive a new layer and begin the formation of a new pile.

It is obvious that numerous variations and modifications may be brought to the above described exemplifying form of embodiment of the invention, without departing from its scope; it is intended that all such variations and modifications fall within the field of the invention itself.

## Claims

1. An automatic stacking device for piles of sheets, characterized by the fact that for stacking layers preformed by one or more groups of sheets, which groups are placed side by side, for the formation of piles of sheets of programmable height, it comprises: a horizontal plane (1) sideways movable transversally to the direction in which said layers are fed to said plane by upstream feeding means, and provided with motor driven rollers; a fixed vertical rigid wall (2); levelling means for the sides of the layer to be stacked; and automatic electronic means for controlling the operation of the stacking device, in which device said motor driven rollers instead of utilizing only the motion of inertia of the fed layer, engage the layer and bring it against said fixed rigid wall, so as to avoid that the individual groups of sheets become undone or become displaced obliquely according to the differences in friction which may be encountered, as well as causing a controlled and constant collision against said rigid wall which ensures a perfect levelling of the front surface of the layer, without the possibility of the individual groups of sheets becoming undone during the travel and displaced obliquely.

2. The automatic stacking device according to claim 1, characterized by the fact that said levelling means are placed above and below said roller plane (1) and comprise two fixed (2, 10) and four movable (3, 4, 6, 9) levelling devices, said levelling devices acting on some of the vertical sides of the layer during its feeding to said

plane and during the subsequent sliding away of the plane to unload the layer on an underlying lifting device (8), and acting on all four vertical sides of the layer when it is resting on said lifting device or over the layer previously unloaded on this lifting device.

3. The automatic stacking device according to claim 1 or 2, characterized by the fact that said electronic means comprise microprocessor, coder and photodiode means, it being thus also possible to memorize the number of layers to be laid one over the other before performing the ejection of the pile, and the measures in width at which said roller plane and said levelling means are to work.

4. The automatic stacking device according to claim 3, characterized by the fact that said photodiode is placed before the input of the stacking device and controls the moving away of levelling means (4) so as to allow the entrance even of layers which for abnormal reasons should be placed obliquely or displaced with respect to the normal line of travel, the moving away of said levelling means (4) taking place without leaving the control by said coder which controls its amount of movement in closure till it causes it to stop always at the programmed measure.

5. The automatic stacking device as essentially herein-before described and illustrated with reference to the enclosed drawings.

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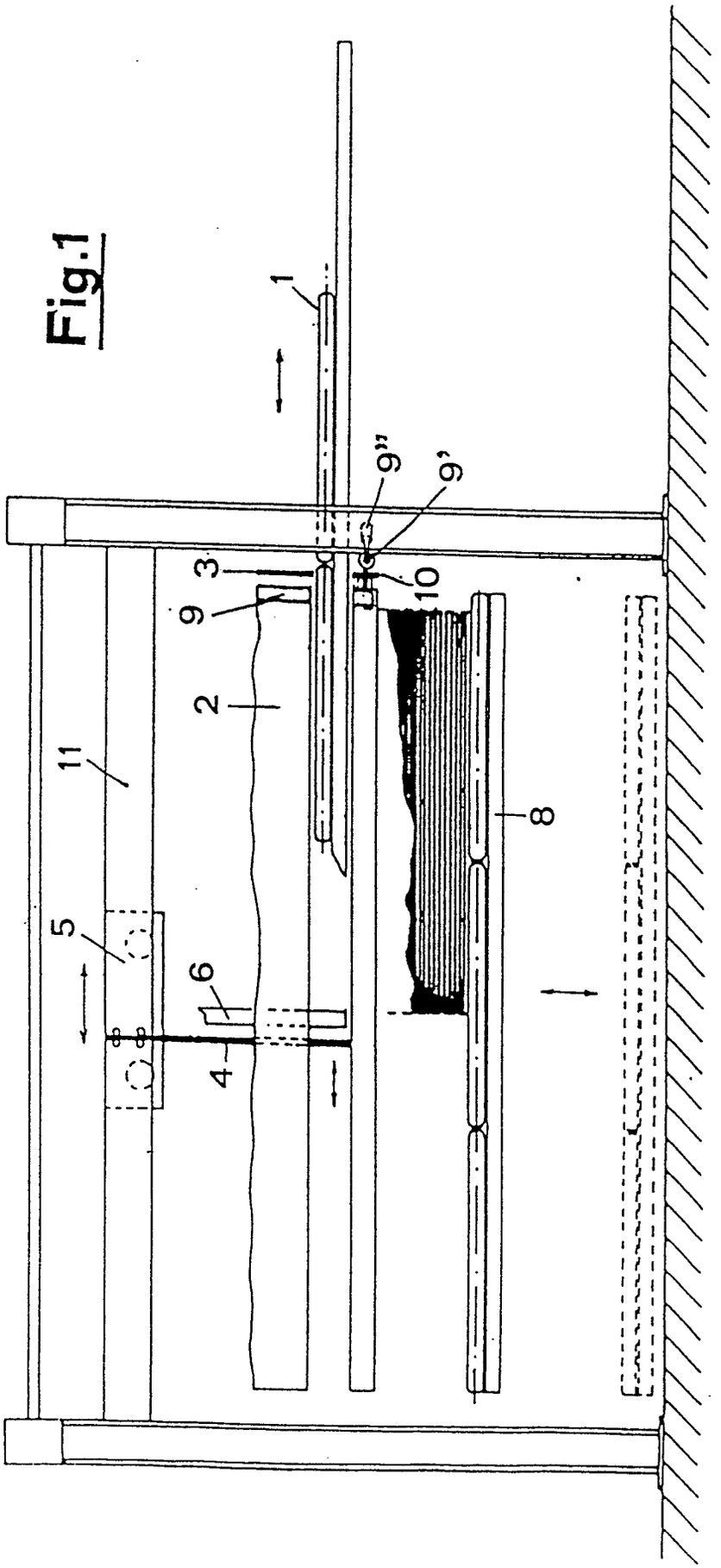
Fig.1



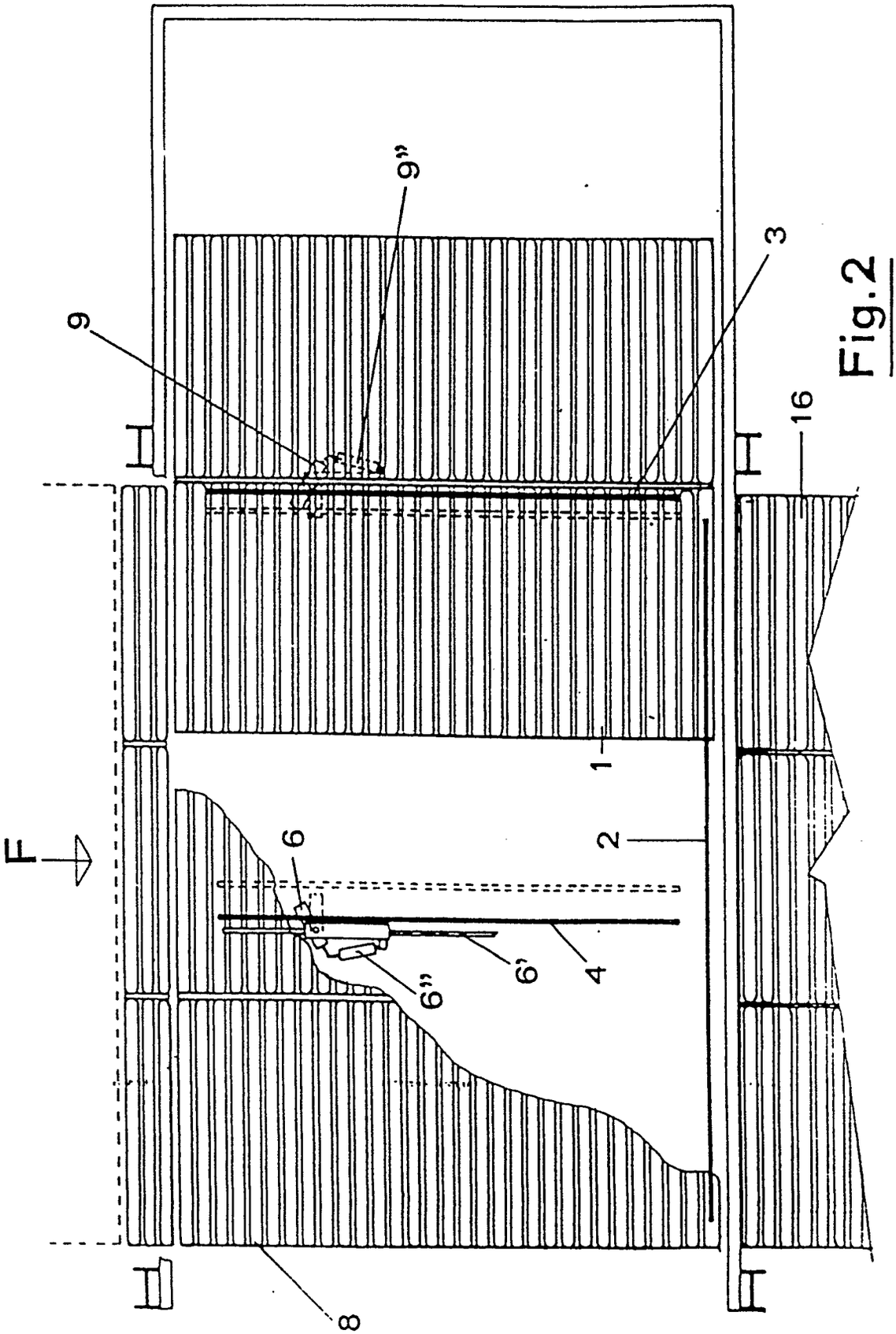



Fig.2

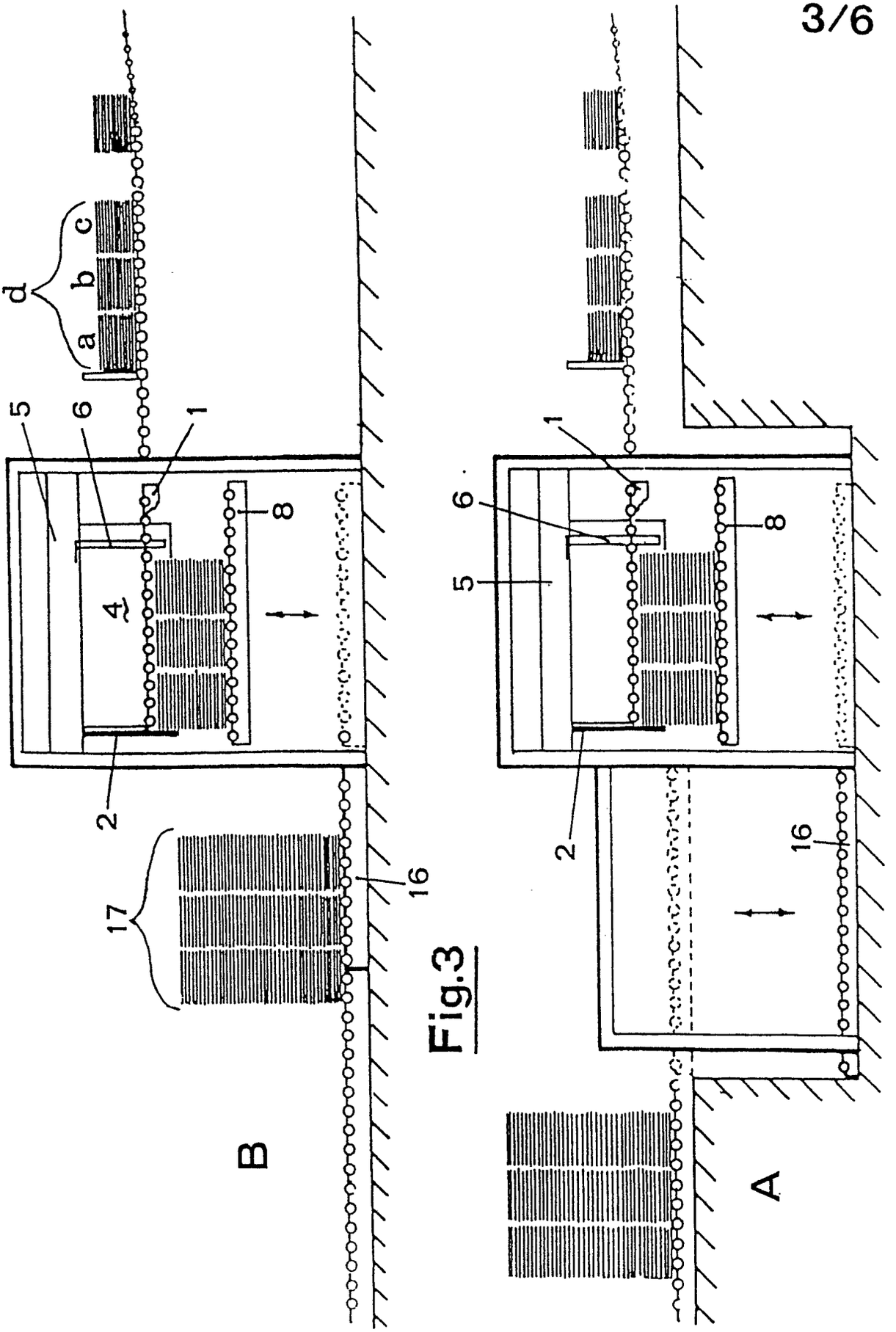



Fig.3

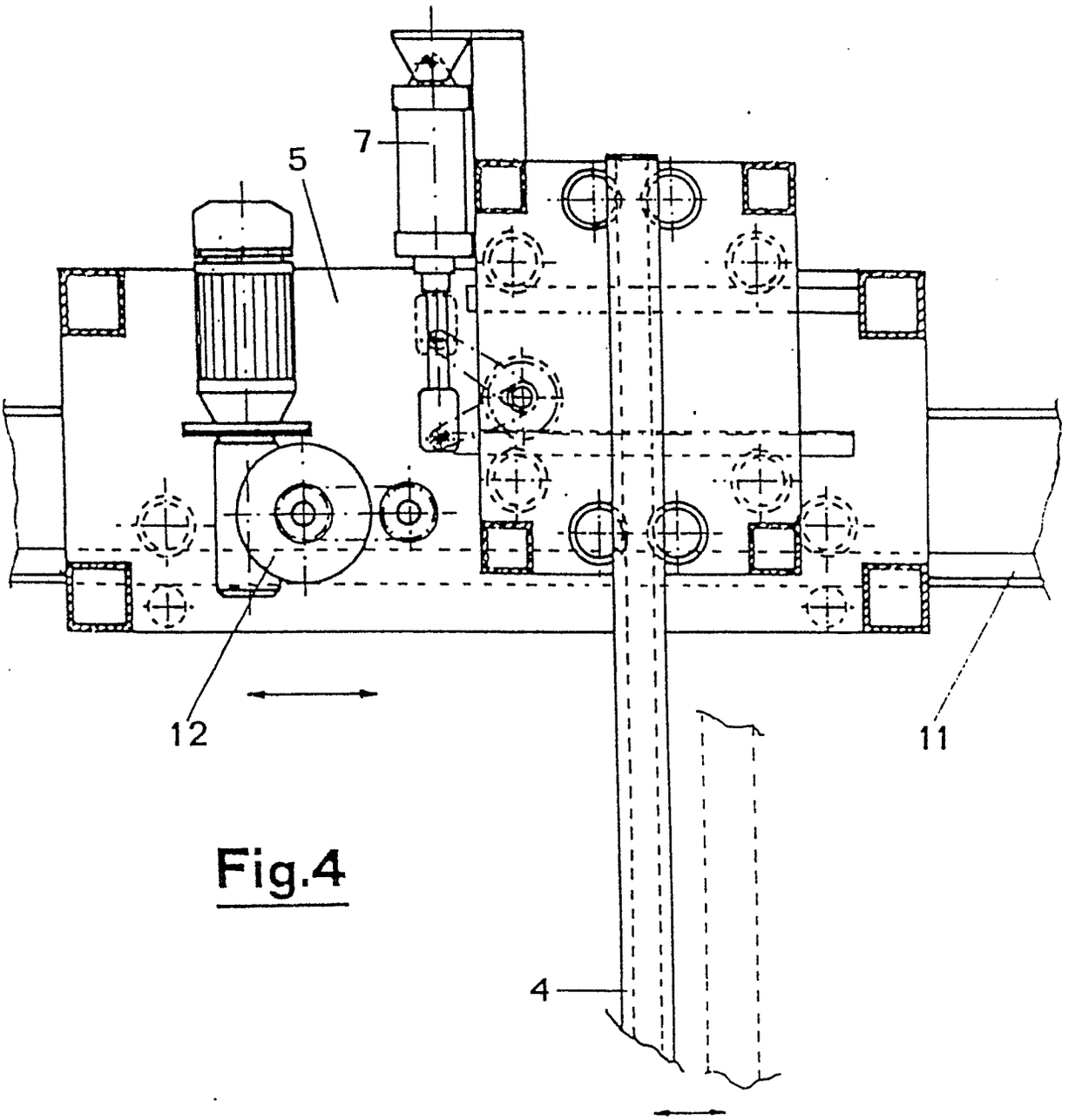



Fig.4

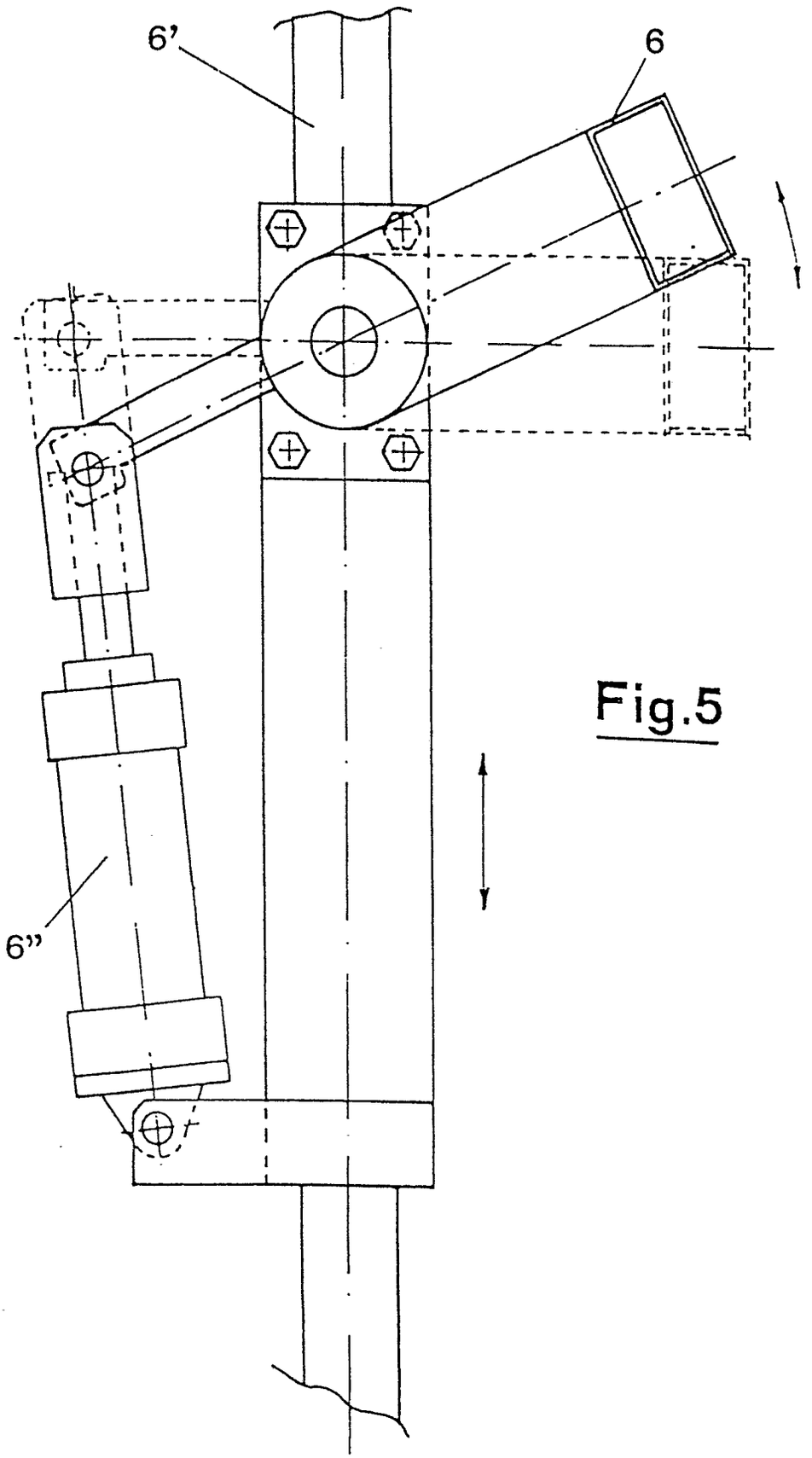



Fig.5

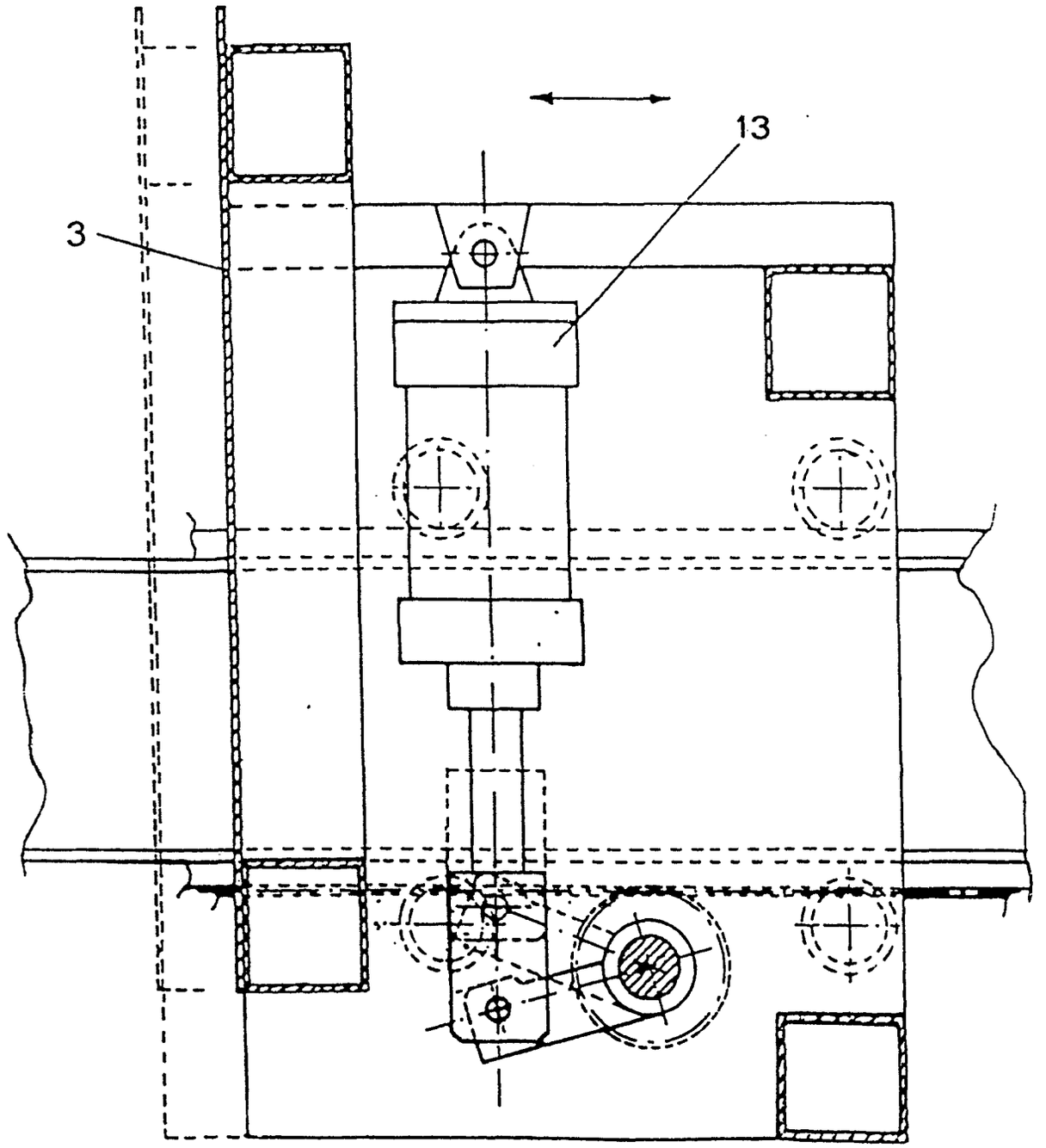



Fig.6

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# EUROPEAN SEARCH REPORT

Application number
EP 82830134.1

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim |
|---|---|---|
| A | FR - A1 - 2 277 727 (AMPAG AUTOMATISCHE VERPACKUNGSMASCHINEN G.M.B.H. & CO. KG.)<br>* Totality *<br>---- | 1 |

CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)

B 65 H 29/38

TECHNICAL FIELDS SEARCHED (Int.Cl. ³)

B 65 H 29/00
B 65 H 31/00
B 65 H 33/00
B 65 H 39/00
B 65 H 43/00

CATEGORY OF CITED DOCUMENTS

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E: earlier patent document, but published on, or after the filing date
D: document cited in the application
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X The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| VIENNA | 18-08-1982 | WIDHALM |

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