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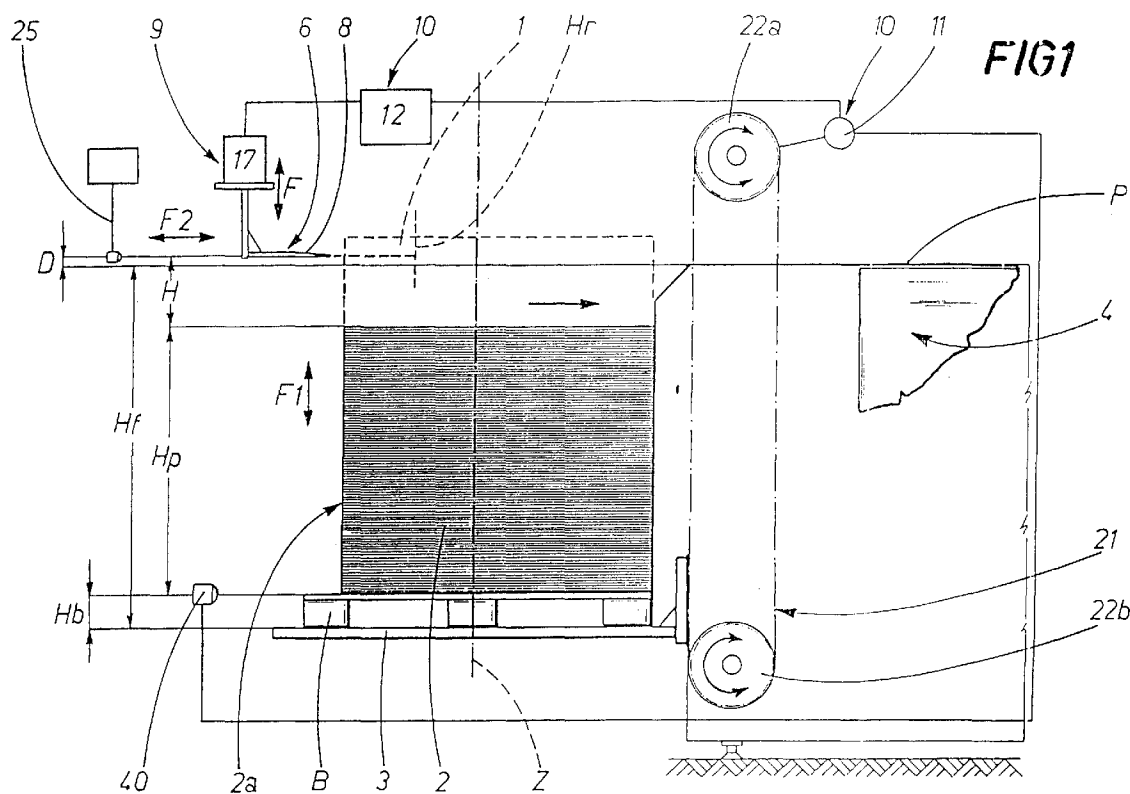
**EUROPEAN PATENT APPLICATION**

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**INVENTION s.n.c.**  
**Via del Cestello, 13**  
**40124 Bologna (IT)**(54) **Device for controlling and adjusting ream pile heights in machines for selecting large loose reams**

(57) A device for size control and adjustment in machines for selection of large reams includes drive means (9), mounted on a control and support unit (7) and acting on a blade (8) that penetrates a sheet pack (2), to adjust, in two directions, the height of the same blade (8) with respect to the control unit (7), thus defining a predeter-

mined theoretical height ( $H_c$ ) of a ream to be selected. The device includes also means (10) for detecting one or more values of the sheet pack (2) height, and for acting on drive means (9) to change the blade (8) position with respect to the control unit (7) in relation to the ream (1) real height ( $H_r$ ).



EP 0 771 749 A1

**Description**

The present invention relates to a device for size control and adjustment in machines for selection of large loose reams.

Selection of the above mentioned large reams, used for sketches, drawings, prints and the like, in the machines aimed at their packaging in separate packs, has always been a big problem.

The sheets to be fed to the packaging machines, coming from the shearing machine, are stacked on a pallet; then, this pallet is placed on an elevator, which automatically raises it toward a packs forming station.

According to another case, similar to the previous one, the machine that prepares the sheet packs, from which the reams are formed, counts the sheets and puts a sign between one sheet and the next one in order to define a ream in relation to the predetermined number of sheets; the sign is nothing but a small piece of paper or something like that, usually colourful, that protrudes from the sheet pack.

At present, the reams are selected by automatic machines, see e.g. US Patent No. 5.244.340 and Patent Application No. IT-B094A 000371, both of the same Applicant, that select the reams by a sensor unit which checks the flatness of the free surface of a sheet pack, and which moves vertically.

The unit supports and operates a blade that defines the ream thickness by its vertical adjustment with respect to the unit.

This blade can both move horizontally away from and toward the ream until it penetrates therein, and rotate so as to obtain a gap between the pre-selected ream and the pack sufficient to allow transfer means to penetrate the same ream.

These transfer means include a servomechanism equipped with a couple of horizontal blades, arranged parallel to each other and near the edge of the sheet pack.

These blades are supported by a carriage, sliding on a horizontal guide so that they can slide parallel to a longitudinal dimension of the sheet pack and penetrate therein. The blades can be adjusted vertically.

After having penetrated the pre-selected ream, the blades feed it to the packaging station. Therefore, this solution guarantees that elevation and transfer are effected with precise and reliable operation.

However, the ream size is still to be changed manually by an operator, who must raise and lower the blade with respect to the sensor unit by releasing and then locking the blade to its support.

Therefore, this operation is slower than other non-production operations, but above all the definition of the new size cannot be precise and inevitably depends on the experience of the operator's.

Moreover, the distance between blade and head is adjusted at a constant value (for a unique size, obviously) and does not take into consideration other variable parameters, such as the ream thickness, that changes in relation to the different position of the sheets in the pack.

In other words, the thickness of a ream selected at the top of the pack is different from the height of a ream, having the same number of sheets, situated on the bottom of the pack. This is due to the fact that in the bottom ream less air is trapped between one sheet and another, because of the weight of the rest of the pack placed thereover.

In order to solve this problem, the Applicant has designed and set up a device for controlling and adjusting the blade position during the size change over. This device can be applied to the above mentioned machines for selection of large loose reams and allows a rapid, automatic and precise change of the blade vertical position in relation to the new size of reams to be selected, with or without references or signs.

For the same purpose, the Applicant has also conceived and defined, through practical tests and experiments, an algorithm that take into consideration also variables connected with different vertical positions of the sheet ream in the pack, with a corresponding correction of the blade vertical position executed in real time.

Technical characteristics of the present invention, according to the above mentioned objects, will be better understood from the content of claims, given below, and the advantages of the same invention will become more evident from the following, detailed description, with reference to the attached drawings, which represent a merely illustrative and non limitative embodiment, in which:

- Figure 1 shows a schematic side view of the device for size control and adjustment, being the subject of the present invention, applied to a machine for selection of large reams;
- Figure 2 shows a side view of the device, shown in Fig. 1, with a particular in enlarged scale and with some parts removed in order to highlight others;
- Figures 3 and 3a show a schematic side view and a front view of a different embodiment of the device, being the subject of the present invention, in particular for selection with signs;
- Figure 4 shows a fragmentary front view of a different kind of sheet pack to be selected, in particular a pack provided with printed signs;
- Figure 5 shows a graph which represents an algorithmic correction system inserted in a computer and correction unit provided in the device being the subject of the present invention.

According to the attached drawings, and with particular reference to figure 1, the subject device allows to control and adjust ream size in machines for selection of large loose reams 1, formed from a pack 2 of stacked sheets.

This pack 2 rests on a table 3 which moves in two opposite directions along a vertical axis Z and is situated upstream of a station 4 for packaging reams separated from the pack 2.

The table 3 may include a driving system, equipped with a couple of close-loop chains 21 mounted on respective couples of sprockets 22a and 22b. The working runs of the chains support, in a cantilevered fashion, the movable table 3, that carries a pallet B and the respective sheet pack 2.

Figure 2 shows means 5 for moving a ream 1 selected by selection means 6, toward the above mentioned packaging station 4. The moving means 5 (represented only schematically and by a broken line, since they are of known type and do not strictly form part of the present invention) include plates 23 supported by a cross piece 24 that moves away from and toward the packaging station 4.

The selection means 6 include a unit 7 which goes in abutment onto the free surface of the pack 2 and supports a blade 8 for defining the height of the ream 1.

The blade 8 moves along with the unit 7 near an edge 2a of the pack 2 and also along a path parallel to the free surface of the sheet pack 2. The vertical position of the blade 8 can be adjusted by the control unit 7 in two vertical directions to set a predetermined distance, indicated with  $H_c$ , which substantially defines the height  $H_r$  of the ream to be selected.

The blade 8 is adjusted by drive means 9 which are connected to the same blade and situated on the control unit 7. The drive means 9 move the blade 8 in two opposite directions (see Arrow F of Fig. 2) so as to change the height of the blade with respect to the control unit 7.

Therefore, the drive means 9 define the above mentioned, predetermined theoretical height  $H_c$  of the ream 1 to be selected. These drive means 9 may include e.g. a motor 17, such as a step motor or another similar one, supported by a vertical rod schematically shown at 18 and connected with the control unit 7.

The motor 17 drives a threaded rod 19 set in screw engagement with a threaded bushing 20, with which the blade 8 is made integral. Thus, the blade 8 can change its height in two opposite directions since this mechanism provides movement therefor.

According to a different embodiment, not shown since it does not change the substance of the invention, the motor is fixed to the lower surface of the blade, in the region of the blade rear border, and the threaded rod extends upwards and pass through a threaded bushing made integral with the support unit 7.

When the motor is operated, the threaded rod turns and moves the blade, along with the motor, vertically due to its screw engagement with the bushing. A handwheel is keyed to the upper end of the threaded rod so that the blade may also be moved manually during size change over.

Means 10 for detecting one or more values of the sheet pack 2 height, act on the motor 17 and change the blade 8 position with respect to the control unit 7 in relation to the ream 1 real height  $H_r$ .

In other words, these detecting means 10 check, in real time, the change of the sheet pack 2 height, as this pack gets thinner and thinner due to separation of the reams brought to the packaging station 4.

In fact, there is in practice a difference between the reams defined at the bottom of the pack 2 and the ones defined at its upper part; the weight of the sheets of the pack upper part reduces air trapped between the sheets as they become nearer to the bottom of the pack. This results in the reams height difference, increasing with the pack 2 height.

Therefore, in order to leave the number of sheets in a selected ream 1 unchanged, the means 10 for detecting one or more values of the sheet pack 2 height are used. These means 10 include a unit 11, for calculating and measuring the pack 2 height, constituted by e.g. an encoder connected for rotation to one of the above mentioned sprockets 22a or 22b.

Outlet of this encoder 11 is connected with a computer and processing unit 12, e.g. a PLC, which operates in real time to control the motor 17 so as to change the height of the blade 8 with respect to the control unit 7.

The computer unit 12 is equipped with an algorithmic correction program AS, which can be linear, hyperbolic or other, depending on the type of the sheet pack selection and, consequently, on the correction to be made on the blade.

In the illustrated case, this algorithmic system AS is linear and set up properly for this purpose in accordance with the type of conformation and structure of the sheets pack 2.

Fig. 5 shows the algorithm function plotted in a X-Y axes diagram, in which the pack 2 height is reported on the X-axis and the correction values  $\pm \Delta x$  result from the Y-axis.

According to the corrections obtained by this algorithmic system AS, the blade 8 is displaced to select a height resulting from either the sum  $H_r + \Delta x$ , when the blade enters upper part of the pack 2, or the subtraction  $H_r - \Delta x$ , when the blade 8 enters the terminal part of the sheet pack 2.

These adjustments of the blade 8 are possible only if the computer unit is always updated on the sheets pack 2 height. These data are supplied by the above mentioned encoder 11. The following heights will be detected, for example:

- the height between the movable table 3, when it is located in a position for pack 2 replacement, and a machine

- plane P coplanar with the packaging station 4 (which height must be 2000 mm as indicated with Hf in Fig. 1);
- the height Hb between the said pallet B and the effective height H measured by the encoder 11 from the moment in which the pack 2 is placed on the movable table 3, until its raising stop determined by detection of the pack top by a photocell 25 situated in front of the same pack near the blade 8 (see again Fig. 1) at a height D, predetermined in the beginning (usually slightly bigger than the height of the machine plane P).

As it is apparent, H is the variable that is updated each time and sent to the computer unit 12 by the encoder 11 each time it is necessary to correct the blade 8 position.

Beginning from these data, the computer unit 12 defines the effective height Hp of the pack 2, which in the illustrated example is given by  $H_p = 2000 + D - H - H_b$ .

If the computer unit 12 has this data in real time and constantly, it will make the corrections as mentioned above and illustrated in Fig. 5.

These corrections can be algebraically summed up in the following expression:

$$H_p = 2000x + 1000,$$

from which it is deduced that

$$x = \frac{(H_p - 1000)}{2000} = \frac{(1000 + D - H - H_b)}{2000} = \left[ \frac{(1000 - H - H_b)}{2000} \right] + \frac{D}{2000}$$

Thus, through this type of formula, given as a simple example to better explain the device operation, the PLC can calculate each time the value of the variable corresponding to the blade 8 movement constantly detected by the encoder 11, with respect to the previous position assumed with respect to the unit 7.

Then this value is set in relation with the value H in order to take into consideration the reduction of the pack 2 height.

Consequently, the value Hr of the ream 1 to be selected is corrected, by introducing a correction value correlated with the change of the ream 1 thickness in relation to its vertical position in the pack 2.

Obviously, this correction is theoretical and connected with the algorithm as described above.

The just explained solution may be used also for the selection, in which the sheets pack 2 is provided with a plurality of signs 13, regularly spaced apart and each inserted partly in the pack 2 and partly protruding from it.

These signs 13 act as visual references for the bases of the reams 1 to be selected. In this case (see fig. 3), the control unit 7 is provided with a stationary vertical bar 14, which extends under the blade 8 and folds the sign 13 downward in direction of the edge 2a of the pack 2, as the same pack is raised by the movable table 3.

The detecting means 10 include a photocell 15, situated beside the blade 8 and coplanar therewith. The photocell is connected directly with the motor 17, so as to perform possible changes of the blade 8 vertical position in relation to the position of the folded sign 13 front part, since also in this case the thickness of different reams 1 changes in relation to their position in the pack 2.

Likewise (see Fig. 4), if the sheets pack 2 is provided with prints 16, printed in a contrasting colour on the front of the edge 2a of the pack 2 and regularly spaced apart so as to define a reference for the base of the ream 1 to be selected, the detecting means 10 include only the said photocell 15, coplanar with the blade 8 and connected directly with the motor 17, so as to change the blade 8 vertical position in relation to the position of the print 16.

Therefore, as can be deduced from the above description, this device carries out control and adjustment operations in the following way, beginning from a situation, in which the movable table 3 is situated in the lowest point of the selection station, so as to make it possible for a pack 2 of sheets, without signs 13 or prints 16, to enter the same station.

As soon as the new pack 2 is placed on the raising table 3, the zero setting of the encoder 11 begins, due to the signal of a photocell 40 situated in the region of the raising table 3 in a wait position for the pack 2.

After the encoder 11 has been reset, the photocell 25 is moved to the height D, just above the machine plane P, and the blade 8 is displaced to the theoretical height Hc of a ream 1, defined with respect to the control unit 7.

At this point, the table 3 is operated and raises the pack 2 (see arrow F1 of Fig. 1) until this latter is detected by the photocell 25, stopping the upward movement of the table 3.

In this situation, it is possible for the computer unit 12 to calculate the actual size Hp of the pack, on the basis of the height H, that is known from the encoder 11. Thus, also the correction value for the blade 8 vertical position can be calculated by the computer unit 12, which has stored in its memory the other data (pallet height, machine plane distance, etc.).

The computer unit 12 activates the motor 17, which moves the blade 8 away from the unit 7 (see arrow F of Fig.

2). Afterwards, according to the procedure, the blade 8 begins to select the reams 1 moving horizontally into the sheets pack 2 (see arrow F2 of Figure 1 ) to penetrate therein.

Every time the pack 2 height is reduced, the unit 12 corrects the blade 8 vertical position, so as to keep the selected reams 1 identical, until the pack 2 height is smaller or equal to the ream 1 height, i.e.  $H_p \leq H_r$ .

This situation is detected by the encoder 11 and provokes disablement of blade 8 operation meanwhile enabling downward movement for the raising table 3, so as to substitute the empty pallet B with a new pack 2 to be selected.

If the sheets packs 2 are provided with signs 13 of prints 16, the blade 8 position is corrected directly by the photocell 15, which, reading the position of the signs 13 or of the prints 16, acts directly on the motor 17 to adjust the blade 8 position.

Therefore, this device fully achieves the objects, by means of a simple and practical structure and a high level of selection reliability. Small dimensions of the control elements unit permit to provide it with all the elements that allow to make selection with or without the signs, thus making the selection device adaptable to all necessities.

So conceived invention can be modified in many ways, still remaining within the scope of the invention. Moreover, all the details can be substituted by technically equivalent ones.

## Claims

1. Device for size control and adjustment in machines for selection of large loose reams (1), which machines operate beginning from a pack of sheets (2) stacked on a table (3) which moves along a vertical axis (Z) and located upstream of a station (4) in which the same reams are packaged, the said device being associated with means (5) for moving the said reams (1) toward the said packaging station (4), and ream selection means (6);

the said selection means (6) including a control and support unit (7) which goes in abutment onto a free surface of the said pack (2);

a blade (8) supported by said control and support unit (7) for defining the height of said ream (1), said blade (8) being moved both vertically, along with the said control and support unit (7) near an edge (2a) of the said pack (2), and horizontally on a plane parallel to the free surface of the sheet pack (2), so that the said blade (8) can be adjusted in two directions by the said control and support unit (7) to set a predetermined distance ( $H_c$ ) therebetween, this distance defining the actual height ( $H_r$ ) of the said ream (1) to be selected;

the device being characterised in that it includes:

- drive means (9), connected with the said blade (8) and mounted on the said control and support unit (7), for determining, with a two directions movement, vertical position of the same blade with respect to the said control and support unit (7), to define the predetermined theoretical height ( $H_c$ ) of said ream (1) to be selected;
- means (10) for detecting one or more values of the sheet pack (2) height, and for operating said drive means (9) to change the blade (8) vertical position with respect to the said control and support unit (7) in relation to the ream (1) actual height ( $H_r$ ).

2. Device, according to claim 1, characterised in that said means (10) for detecting one or more values of the sheet pack (2) height, include at least one member (11), for calculating the sheet pack (2) height, this member (11) being connected with the said movable table (3), and a computer and processing unit (12), connected in its turn to the said drive means (9) for controlling thereof in real time, this unit (12) being equipped with an algorithmic program (AS) for correction of the said position of the blade (8) in relation to the sheet pack (2) height.

3. Device, according to claim 2, characterised in that the said algorithmic correction program (AS) includes a linear function.

4. Device, according to claim 1, in which the sheets pack (2) is provided with a plurality of signs (13), regularly spaced apart and placed each one partly in the pack (2) and partly protruding therefrom, to define references for the bases of the reams (1) to be selected, characterised in that the said control and support unit (7) is provided with a vertical stationary bar (14), extending under the said blade (8) and folding the sign (13) downward in direction of the said edge (2a) of the pack (2), and in that the detecting means (10) include a photocell (15), situated beside and coplanar with the blade (8), and connected directly with the said drive means (9) so as to change the blade (8) position in relation to the position of the folded sign (13) front part.

5. Device, according to claim 1, in which the sheets pack (2) is provided with prints (16) made in a contrasting colour on the front of the edge (2a) of the pack (2) and regularly spaced apart so as to define references for the bases

of the reams (1) to be selected, characterised in that the said detecting means (10) include a photocell (15), situated beside and coplanar with the blade (8), and connected directly with the said drive means (9) so as to change the blade (8) position in relation to the position of the said prints (16) front part.

- 5     **6.** Device, according to claim 1, characterised in that the said drive means (9) include a motor (17) supported by a vertical rod (18) connected with the said control and support unit (7), said motor (17) driving a threaded rod (19) set in screw engagement with a threaded bushing (20) with which the said blade (8) is integral, so as to change the height of the said blade (8) in two opposite directions.
- 10    **7.** Device, according to claim 1, characterised in that the said drive means (9) include a motor (17) fixed to the lower surface of the said blade (8), in the region of the blade rear border, with said motor (17) driving a threaded rod extending upwards and passing through a threaded bushing made integral with the control and support unit (7), so that the height of the said blade (8) is changed in two opposite directions, when the motor is operated, due to screw engagement between said threaded rod and said bushing.

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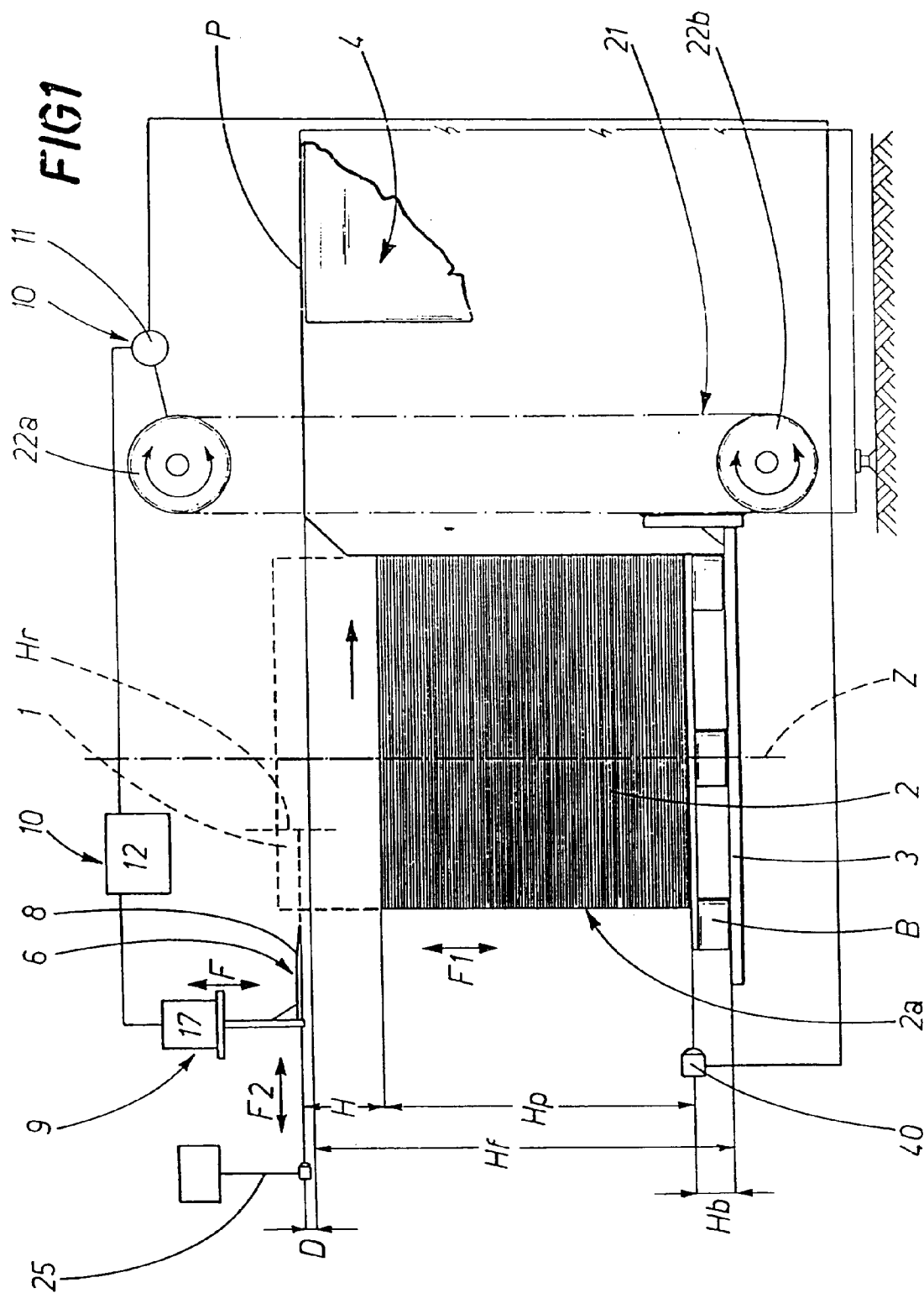
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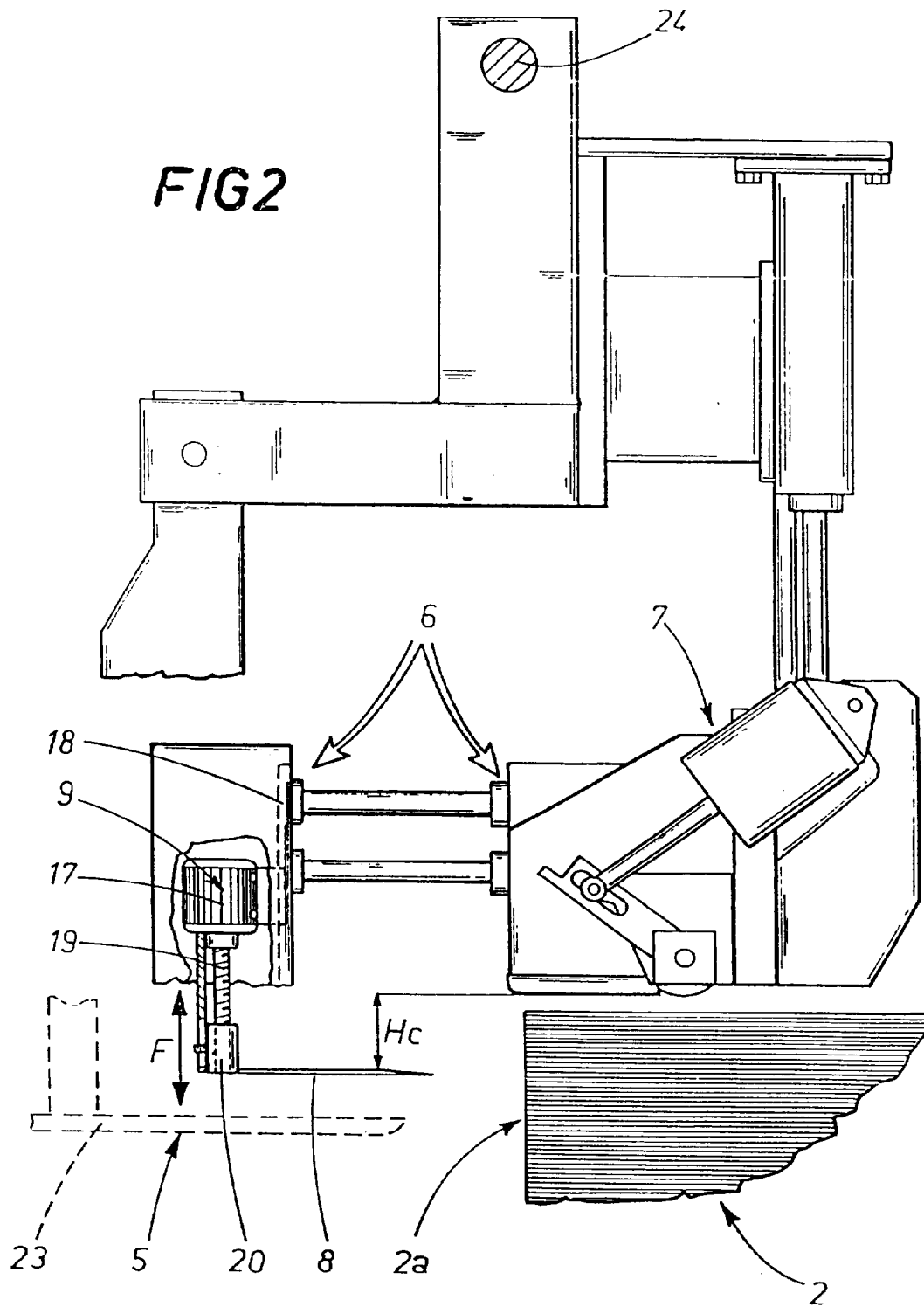
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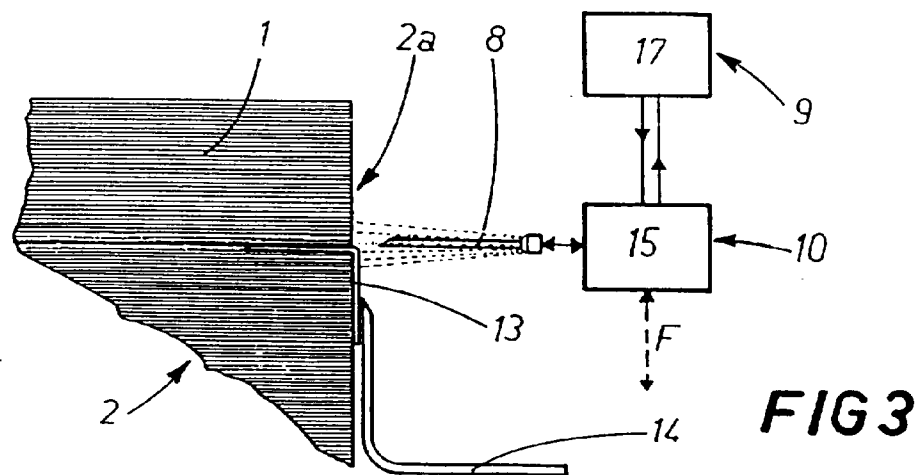
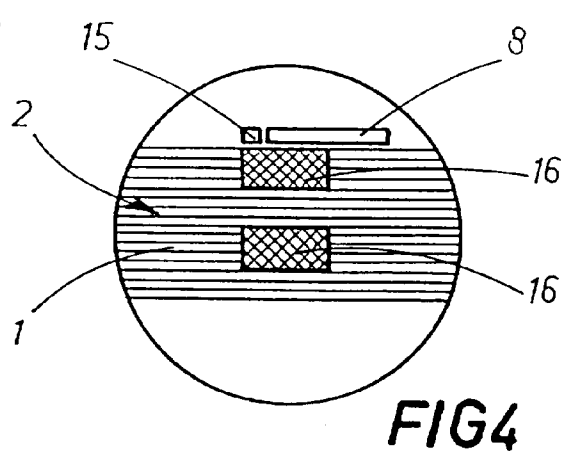
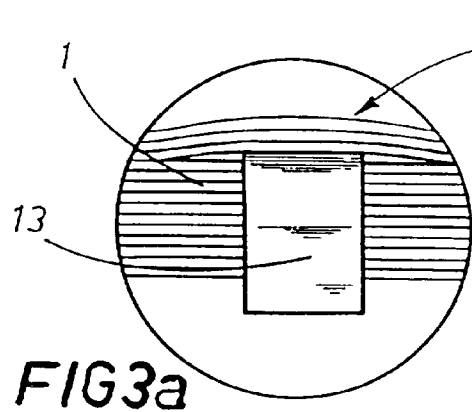
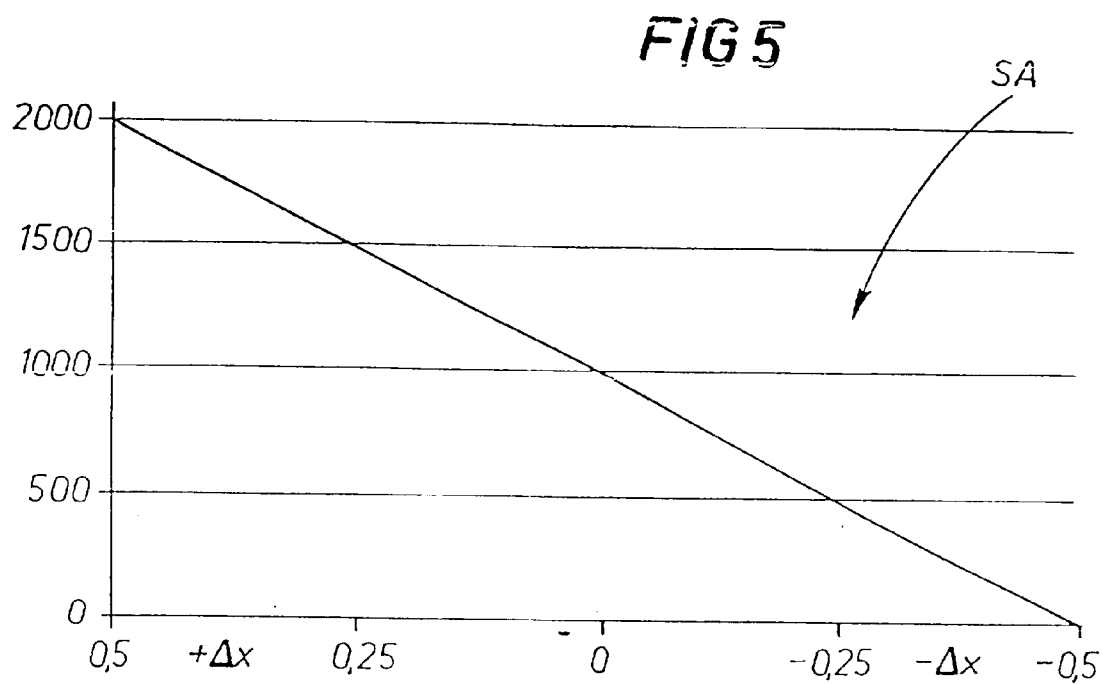
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# EUROPEAN SEARCH REPORT

Application Number  
EP 96 83 0539

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	WO 95 21785 A (NISSEN ALF PETER) 17 August 1995	1-3,6,7	B65H3/32
Y	* page 4, line 16 - page 6, line 16; figure 1 *	4,5	
Y	--- EP 0 147 319 A (KANZAKI PAPER MFG CO LTD) 3 July 1985 * the whole document *	4	
Y	--- PATENT ABSTRACTS OF JAPAN vol. 017, no. 580 (M-1500), 21 October 1993 & JP 05 170354 A (FUJI PHOTO FILM CO LTD), 9 July 1993, * abstract *	5	
D,A	--- US 5 244 340 A (PIZZI FAUSTO ET AL) 14 September 1993 -----	1-7	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B65H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 20 February 1997	Examiner Henningsen, O
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