

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 905 067 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

31.03.1999 Bulletin 1999/13

(51) Int. Cl.⁶: B65H 3/08

(21) Application number: 97202786.6

(22) Date of filing: 11.09.1997

(84) Designated Contracting States:

AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE

Designated Extension States:

AL LT LV RO SI

(71) Applicant: W.P. Mechanics N.V.

3850 Nieuwerkerken (BE)

(72) Inventors:

• Maho, Michel

3850 Nieuwerkerken (BE)

• Ramaeckes, Paul

3850 Nieuwerkerken (BE)

(74) Representative:

Quintelier, Claude et al
Gevers & Vander Haeghen,
Patent Attorneys,
Rue de Livourne 7
1060 Brussels (BE)

(54) A method and a device for removing a sheet from a stack of sheets

(57) A method and a device for removing a sheet (17) from a stack (18) of sheets wherein a pulling member (2) is temporarily and removably adhered to said sheet (17) and wherein a pulling force is applied by said pulling member (2) on at least two different points of

said sheet (17), and wherein a pushing force is applied on said sheet (17) on at least one further location situated between said two points.

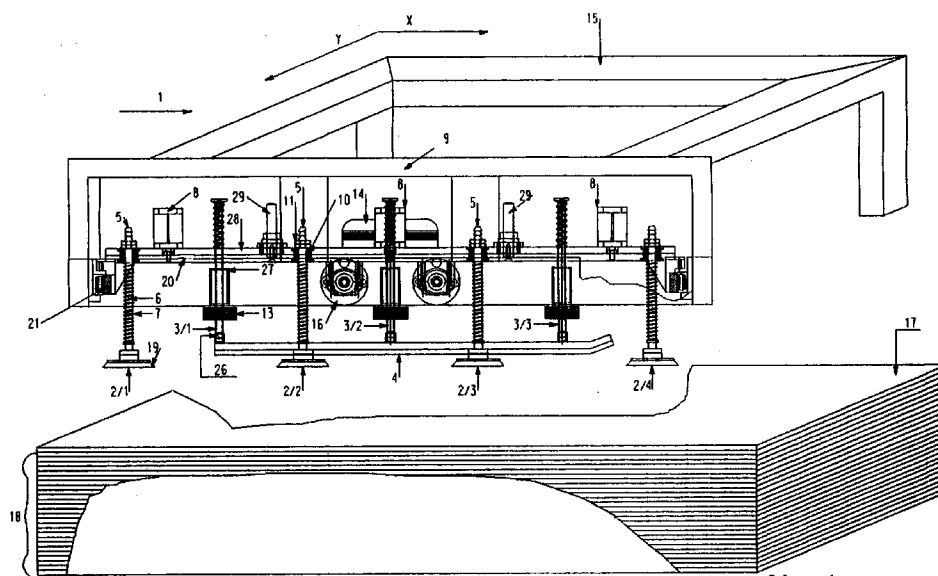


fig 1

EP 0 905 067 A1

Description

[0001] The invention relates to a method for removing a sheet from a stack of sheets wherein a pulling member is temporarily and removably adhered to said sheet and wherein a pulling force is applied by said pulling member on at least two different points of said sheet.

[0002] The invention also relates to a device for removing a sheet from a stack of sheets.

[0003] Such a method and such a device are known in the art. The known method is for example applied in the steel, wood or plastic manufacturing where sheets of steel, as wood or plastic are stacked and have to be removed sheet by sheet from the stack for further processing. The pulling member is brought above the stack and subsequently lowered until it reaches the top sheet of the stack. The pulling member is then temporarily adhered to the top sheet in order to apply a pulling force on the sheet and lift the sheet up from the stack to bring it to a place where it should be processed. Once the sheet is on that place the pulling member is removed from the sheet and brought back to its initial position.

[0004] A drawback of the known method and device is that often more than one sheet is lift up and removed from the stack. Depending on the material of which the sheets are manufactured, electrical charges, remnant magnetism, oil rests etc. causes that the subsequent sheets of the stack stick to each other and do not separate from each other or only after a few seconds when the sheet(s) are already transported. This leads to perturbations in the manufacturing and sometimes to severe damages.

[0005] It is an object to the invention to provide a method and a device enabling to substantially reduce the risk that more than one sheet is lift up from the stack.

[0006] A method according to the present invention, is therefor characterised in that a pushing force is applied on said sheet on at least one further location situated between said two points, by applying a pushing force a compression strain is induced in the upper layer of the sheet, whereas the pulling force exerted on both sides of the point where the pushing force is applied, induces a tensile strain in the under layer of the sheet. So for two subsequent sheets of the stack the under layer of the top sheet will feel a tensile strain and the upper layer of the subsequent sheet will feel a compression strain. These opposite forces on two adjacent sides will cause the subsequent sheets to detach from each other, so that only one sheet will be removed from the stack.

[0007] A first preferred embodiment of a method according to the invention is characterised in that a gas burst is projected on a lateral side of said stack which lateral side is substantially perpendicular to a surface on which said pulling force is applied. The projection of a gas burst further improves the detachment of stacked sheets which would stick together.

[0008] A second preferred embodiment of a method according to the present invention is characterised in that said pushing force is applied over the distance of a line situated between said two points. The pushing force is in such a manner applied over the whole distance of the line which enables to increase the compression force applied on the upper layer of the sheet.

[0009] A preferred embodiment of a device according to the present invention is characterised in that said pulling and said pushing elements are load adjustably mounted, and in particular that said pulling elements and said pushing elements are connected to a same support bar. This enables to adjust the pulling and pushing member at a predetermined preload value and enables in particular the use of a same motor for controlling both the pushing and pulling element 1.

[0010] A further preferred embodiment of a device according to the present invention is characterised in that said pulling elements and said pushing elements are provided with a pulling respectively a pushing head mounted at an extremity of said pulling respectively said pushing element facing said sheet, said pushing heads being mounted offset in a direction away from said sheet with respect to said pulling heads. In such a manner first the pulling member contacts the sheet and then the pushing member when the device is used for removing a sheet. The pulling elements can thus be adjusted before the pushing elements start to exert their pushing force.

[0011] The invention will now be described in more details by means of the annexed drawings illustrating a preferred embodiment of a device according to the present invention.

[0012] In the drawings :

Figure 1 shows a general view of a preferred embodiment of a device according to the invention; Figure 2 shows a gas blower in combination with a pulling element as part of a device according to the invention;

Figure 3 illustrates the bending of a sheet upon application of a pulling and a pushing force exerted by a device according to the invention; and Figure 4 illustrates on an enlarged scale two successive sheets of a stack bent by application of the forces exerted by the device according to the invention.

[0013] In the drawings a same reference sign has been assigned to a same or analogous element.

[0014] The device 1 for removing a sheet 17 from a stack 18 of sheets illustrated in figure 1 comprises a pulling member 2 having at least two pulling elements (2-1, 2-2, 2-3, 2-4,-). The pulling elements are mounted to a support member 9 which can be moved on a frame 15 by means for example of a set of wheels 16 enabling an X-Y movement of the support member 9. In such a manner the support member can adjust the position of

the pulling member 2 with respect to the stack 18 and transport the sheets from the stack to a place where further manufacturing will take place.

[0015] The sheets on the stack can be for example made of steel, wood, plastic,... Preferably the sheets are thin, i.e. less than 1,5 cm whereas the problem of subsequent sheets on a stack sticking together due to electrical charges, adhesion, remnant magnetism, oil rests etc., is more important with thin sheets.

[0016] In the illustrated embodiment 2-i ($i = 1, 2, \dots$) comprises a cup 19 mounted on a tube 6 which is resiliently mounted by means of a bearing 10 on a support bar 20 which is part of the support member 9. A spring 7 is wrapped around the tube and a preload is given to that spring by means of the bolts 11. The tube 6 ends in a connecting mouth 5 to which a vacuum pump (not shown) is connectable. The vacuum pump enables to suck the air in the tube and between the cup and the sheet 17 when the cup is placed on the sheet. In such a manner the cup and thus the pulling member is temporarily adhered to the sheet. The cup is removed from the sheet by letting air flow into the tube.

[0017] It will be clear that the present invention is not limited to a pneumatic pulling element 2 as just described. Other alternatives are possible depending on the material of which the sheets are made. For example for steel sheets magnetic cups could be used and the tube 6 could be replaced by a rod. The adhesion of the cup to the steel sheet could then be realised by inducing an electrical current in a coil in order to apply a magnetic field in the cup which would attract the steel sheet. A hydraulic solution using oil or water pressure could also be applied instead of a spring 7 to give a preload to the pulling elements.

[0018] At least one motor 8 is mounted on the support bar 20, to which the pulling member is mounted. The motor is either an electrical, hydraulic or pneumatic motor, and enables a lift up and a lowering of the pulling member 2. In order to enable this vertical movement of the support bar 20, the latter is mounted on a guiding rail 21.

[0019] A pushing member 3 comprising at least one pushing element 3-1, 3-2, 3-3,... is also mounted on the support member 9. Each pushing member comprises a pushing head 26 mounted at the extremity of a rod 27 around which a spring 12 is wrapped between the other extremity of the rod and a further support bar 28 through which the rod 27 passes and which is part of the support member 9. A set screw 13 enables to set the pushing element at a calibrated height with respect to the extremity of the cup 19 facing the sheet 17, in such a manner that at rest the pushing head 26 is offset from the cup 19 in a direction away from the sheet 17.

[0020] A further motor 29 is mounted to the further support bar 28 and enables the pushing member to exert a pushing force on the sheets.

[0021] In the embodiment shown at figure 1, the pushing heads 26 are connected among each other by

means of a connection bar 4. Preferably this connection bar comprises a curved end in order not to disturb the bending of the sheets as will be described hereinafter. The presence of such a connection bar is however optional and enables to exert a uniform pushing force over the whole length of the bar.

[0022] According to an alternative embodiment, the pulling member 2 and the pushing member 3 are mounted on a same support bar, to which a motor is connected. In this case, bending of the plate can be obtained by providing in said pushing member a spring having a higher preload than the spring 7 from the pulling member.

[0023] Another optional feature shown by the embodiment of figure 1 is the presence of a vibration element 14 mounted on the further support bar 28 and provided for inducing a vibration force via the pushing elements 3-j ($j = 1, 2, \dots$) into the sheets.

[0024] In the embodiment shown in figure 2 the device according to the present invention further comprises a gas blower 22 connected via a duct 30 to a gas source 24. A control valve 25 having an input for receiving a control signal 23 is mounted on the duct 30. Upon receipt of the control signal generated by a control unit (not shown) the control valve 25 is opened so that a gas burst is exhausted via the blower 22. The blower 22 is mounted on a lateral side of the stack, substantially perpendicular to the axis z of the pulling member 2. Therefore the blower blows the gas burst between the successive sheets of the stack so as to detach them from each other.

[0025] When a sheet 17 has to be removed from the stack 18, the pulling member 2 is brought towards the stack by a movement of the support member 9. The motor 8 now causes the pulling elements 2 to move towards the sheet 17 until the cups 19 contact the sheet. Subsequently, the cups are temporarily adhered to the sheet by, according to the preferred embodiment, applying a suction force via the mouths 5 on the cups 19. As the pushing members are offset from the cups, they are at this stage not yet in contact with the sheet.

[0026] As illustrated in figure 1 and 3 the pushing elements 3 are each time mounted between two successive pulling elements 2. Once the cups 19 are adhered to the sheet 17, the pushing elements 3 are moved by means of the motor 29 towards the sheet so that the pushing head or the connection bar 4 contacts the sheet.

[0027] The motor 8 now starts to apply a force F_1 on the support bar 20 so as to raise the bar 20 and the pulling elements 2 attached thereon. This causes the force F_1 to be applied on the cups and thus on the sheet 17. The motor 29 now causes a force F_2 of opposite direction with respect to F_1 wherein $F_2 > F_1$. The force F_2 is applied on the sheet 17 via the pushing elements 3-j. As is illustrated in figures 3 and 4 the application of the force F_1 on both extremities of the sheets causes the latter to be bent according to a cosh function. The force

F_1 , thus induces a tensile strain F_4 , F_4' in the under layer of sheet 17, where F_4 and F_4' have opposite directions. The force F_2 applied approximately in the middle between two points where the force F , is applied, due the positioning of the pulling and pushing members, causes an induction of a compression force F_3 and F_3' in the upper layer of the sheet 17. F_3 and F_3' also being of opposite direction. The force F_3 and F_3' thus causes a compression of the upper layer of the sheet, whereas F_4 and F_4' causes an extension of the under layer of the sheet. So at a point P between two successive sheets opposite force are exerted since the under layer of sheet 17-1 feels the force F_4 and F_4' whereas the upper layer of sheet 17-2 feels the force F_3 and F_3' . These opposite forces cause the cohesion forces between two successive sheets of the stack to be disrupted so that the two successive sheets will detach from each other and only the upper sheet will be removed. Due to the applied force F_1 and F_2 and their resulting components F_3 , F_3' , F_4 and F_4' a shifting force is induced between successive sheets causing the sheets to be bent according to cosh function.

[0028] The displacement d obtained by shifting the successive plates equals :

$$d = \frac{\pi t \operatorname{tg}^{-1} \frac{b}{a}}{2\pi}$$

wherein :

- t is the sheet thickness;
- b is the height difference as shown in figure 3;
- a is the distance between the axes z and q of the pulling and pushing elements.

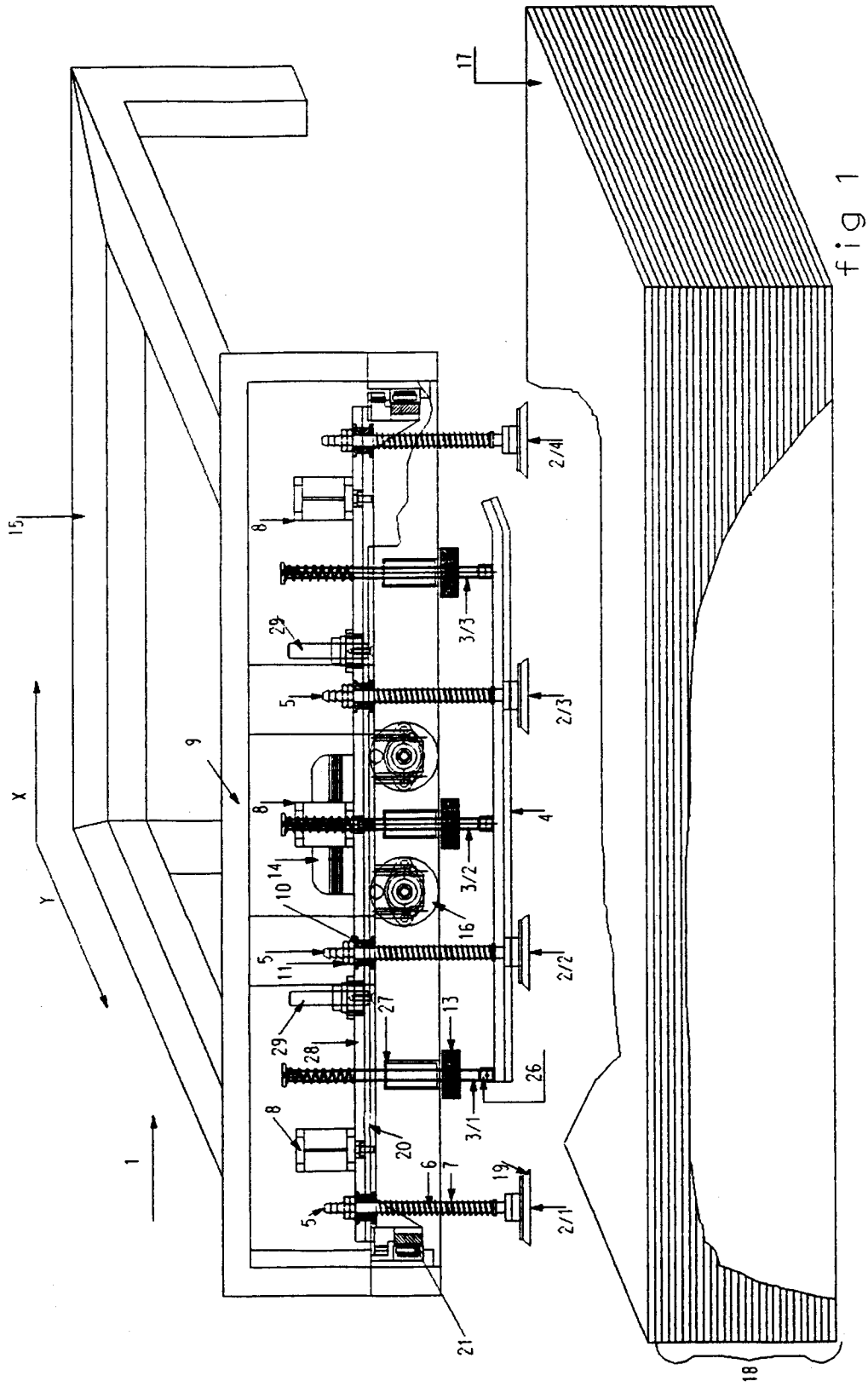
[0029] The detachment of two successive sheets can further be improved by inducing, by means of the vibration element 14, and the pushing element 3 a vibration force into the sheet through the intermediary of the support bar 20 and/or 28.

Claims

1. A method for removing a sheet from a stack of sheets wherein a pulling member is temporarily and removably adhered to said sheet and wherein a pulling force is applied by said pulling member on at least two different points of said sheet, characterised in that a pushing force is applied on said sheet on at least one further location situated between said two points.
2. A method as claimed in claim 1, characterised in that a gas burst is projected on a lateral side of said stack which lateral side is substantially perpendicular to a surface on which said pulling force is

applied.

3. A method as claimed in claim 1 or 2, characterised in that said pushing force is applied over the distance of a line situated between said two points.
4. A device for removing a sheet from a stack of sheets, said device comprising a pulling member having at least two pulling elements provided to be temporarily and removably adhered to one of said sheets and for applying a pulling force to said sheet on which it is temporarily adhered, characterised in that said device further comprises a pushing member having at least one pushing element mounted in a space between two successive pulling elements and provided for exerting a pushing force on said sheet.
5. A device as claimed in claim 4, characterised in that said pushing member comprises at least two pushing elements, each pushing element being provided with a pushing head mounted at an extremity of said pushing element facing said sheet, said extremities being connected among each other with a connection bar.
6. A device as claimed in claim 4 or 5, characterised in that said pulling and said pushing elements are load adjustably mounted, and in particular that said pulling elements and said pushing elements are connected to a same support bar.
7. A device as claimed in claim 4, characterised in that said pulling elements and said pushing elements are provided with a pulling respectively a pushing head mounted at an extremity of said pulling respectively said pushing element facing said sheet, said pushing heads being mounted offset in a direction away from said sheet with respect to said pulling heads.
8. A device as claimed in anyone of the claims 4 to 7, characterised in that it comprises a gas blower provided for projecting a gas burst on a lateral side of said stack.
9. A device as claimed in anyone of the claims 4 to 8, characterised in that it comprises a vibration element provided for applying a vibration force to the sheet.



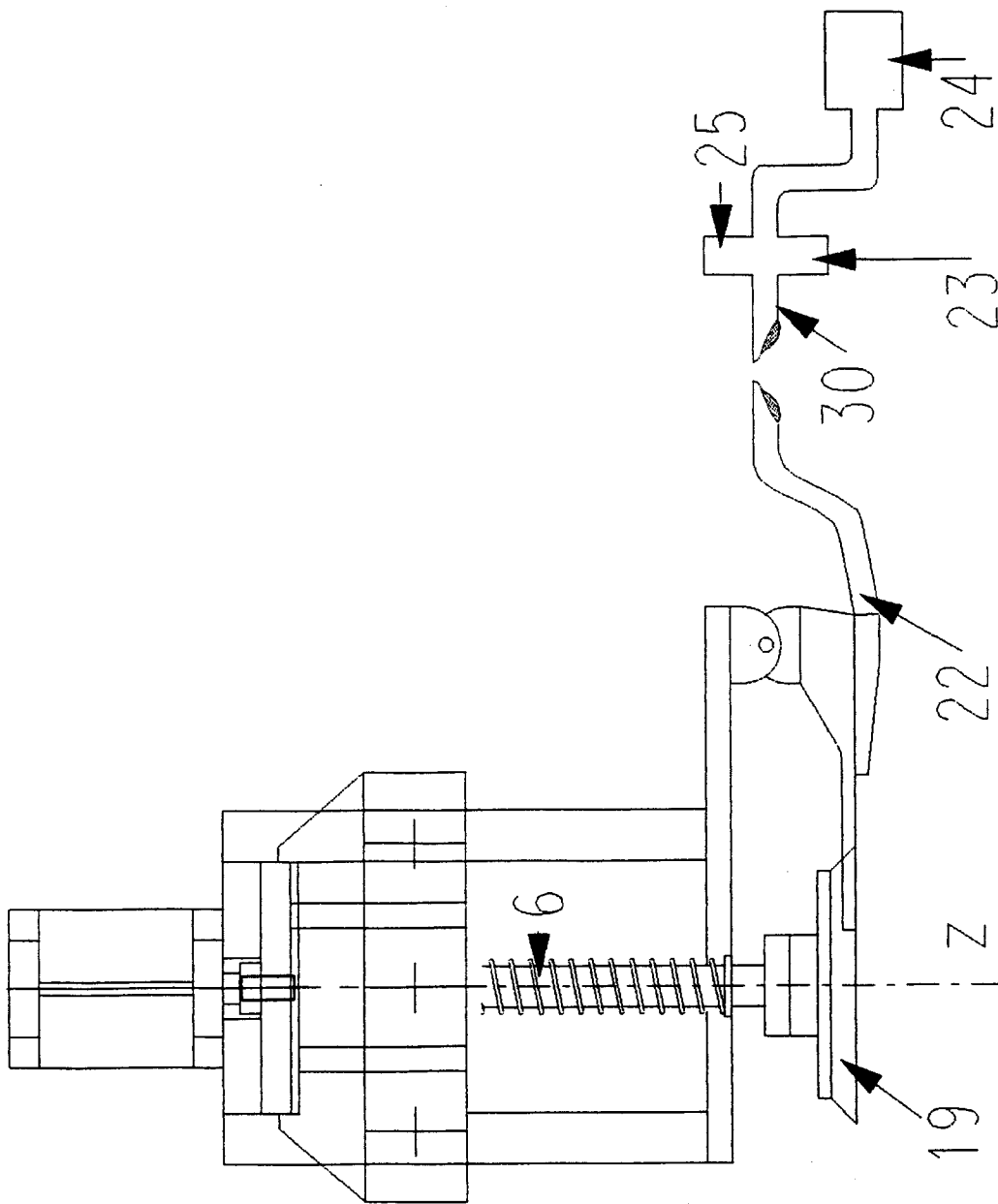


fig 2

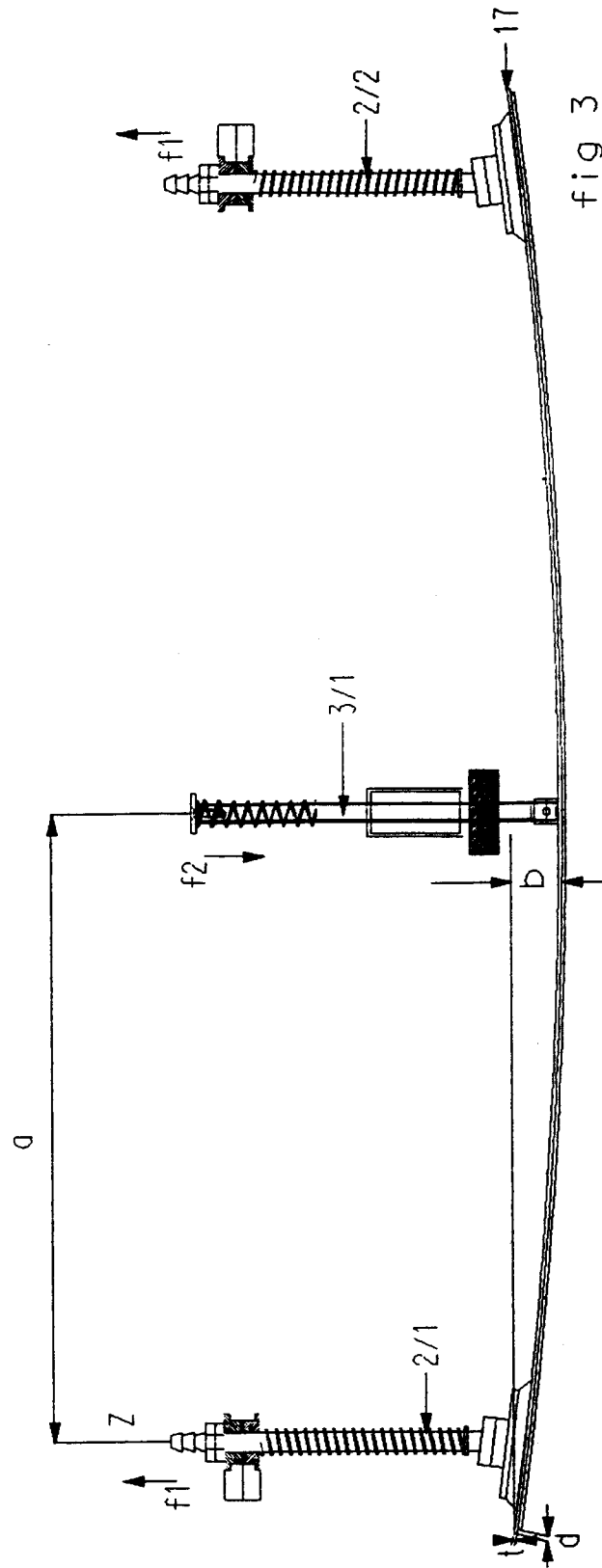


fig 3

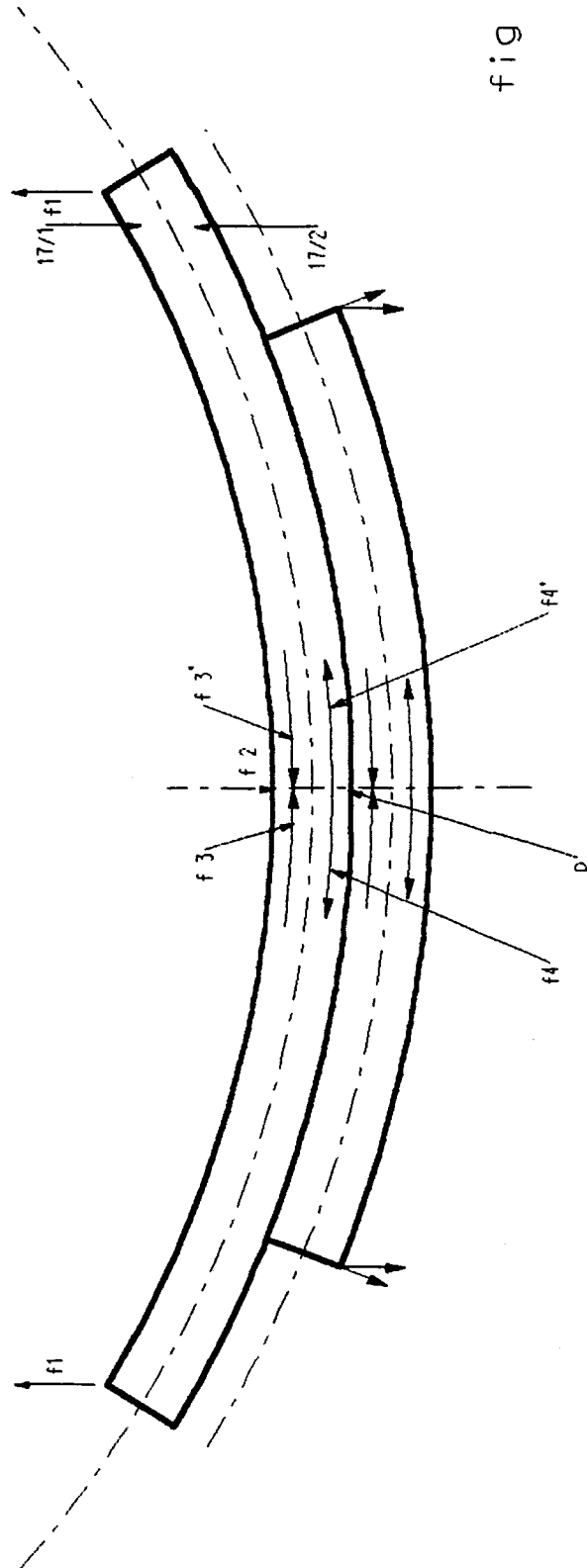


fig 4



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 20 2786

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	DE 40 02 324 A (BAYERISCHE MOTOREN WERKE AG)	1,3-7	B65H3/08
Y	* the whole document *	2,8,9	
Y	---		
Y	DE 31 36 544 A (TRUMPF GMBH & CO)	2,8	
A	* page 3, line 17 - page 4, line 6; figure *	1,4	
Y	---		
Y	PATENT ABSTRACTS OF JAPAN vol. 006, no. 048 (M-119), 27 March 1982 & JP 56 161240 A (MATSUSHITA ELECTRIC WORKS LTD), 11 December 1981,	9	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B65H
A	* abstract *	1,4	
X	---		
X	DE 22 56 793 A (PILOT MAN-NEN-HITSU K.K.) * page 5, line 17 - page 12, line 8; figures 4-8 *	1,4,6,7	
X	---		
X	EP 0 086 280 A (CAR VENTOMATIC S.P.A.) * page 3, line 16 - page 4, line 12; figures 1,3 *	1,4,6	
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
BERLIN		23 January 1998	David, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)