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(54) Anti-fall safety device.

(57) A safety device is disclosed for stopping the fall of a carriage (1) slidably mounted to non horizontal guides (3) and suspended by a series of tensile stressed sustaining members (2, 4).

The safety device comprises means (5) capable of detecting a breaking occurring in said series of tensile stressed sustaining members (2, 4). The detecting means (5) are mounted to the carriage (1) and operationally connected to locking means (8) fitted on the carriage and adjacent the guides (3). The locking means (8) are movable from a starting non-operational position close to the guides (3) to a final operational position in which the locking means (8) engage the guides (3), whereby the carriage (1) is stopped from falling.

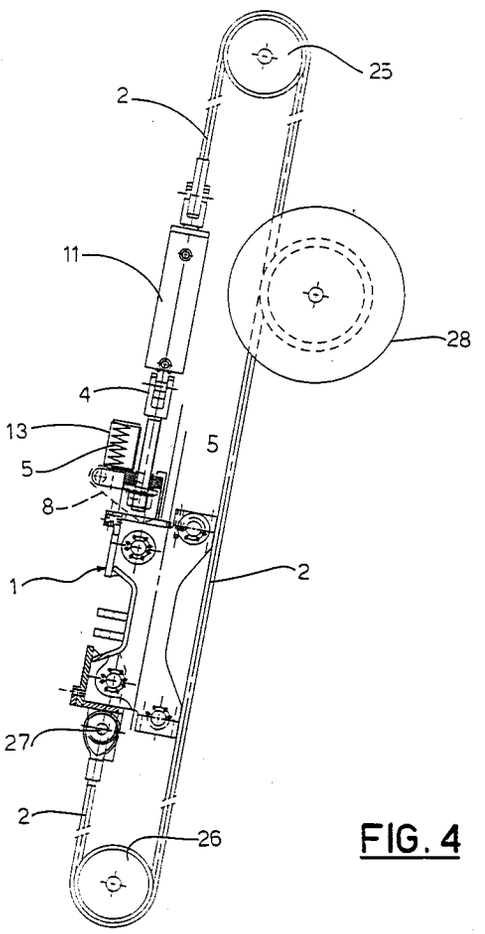

FIG. 4

EP 0 621 223 A2

The present invention pertains to the field of civil or mining engineering works where several kinds of machines are used for soil consolidation, drilling, foundation construction, and the like. More in particular, the present invention refers to an anti-fall safety device for mounting on machines having heavy loads slidably suspended on non-horizontal guides. Should one of the sustaining members break, the load is likely to collapse causing serious damage to people and/or outfits.

Many soil consolidation machines provide a vertical or inclined tower having guides on which a carriage is able to slide sustained by cables or chains. Other outfits that are necessary for the particular function of the machine are mounted on the carriage. Several series-connected members (cables, chains, tension rods, etc.) sustain the carriage in the desired position. Breakdown of one of these members may result in the whole carriage and relevant outfit falling down.

Safety in known machines at present relies only on correct sizing of the carriage sustaining members, but no particular arrangement is provided for accidental breaking of one of such members.

None of the known commercial apparatuses provide carriage sustaining means disposed in parallel, i.e. acting simultaneously, nor safety devices capable of being operated locking the carriage on the tower in case one of the load sustaining members should break.

It is an object of this invention to provide a device capable of increasing safety with outfits having suspended loads slidably mounted on guides.

It is another object of this invention to provide a device that is activated and locks the load on the guides at the precise moment of a breaking occurring in one of the carriage sustaining members.

These and further objects and advantages, which will be more apparent from the ensuing description, are attained according to the invention by a device according to claim 1.

The structural and operational characteristics of two preferred but non-limiting embodiments of a device according to the invention are described hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a schematic front view of a first embodiment of the device of this invention, mounted to a carriage which is slidably engaged on a vertical guide;

Figure 2 is a schematic side view of the device of Figure 1;

Figure 3 is a view, to an enlarged scale, of a detail of Figure 2;

Figure 4 is a schematic side view of a second embodiment of the device, different from the one of Figures 1 and 2; and

Figure 5 is a schematic front view of a third embodiment of the device of this invention.

Referring at first to Figures 1 and 2, numeral 1 indicates overall a conventional carriage suspended by a sustaining cable 2 and provided with rollers 9 for facilitating movement along vertical guide 3. Vertical guide 3 forms part of a tower (not shown) of a soil consolidation or drilling apparatus.

Carriage 1 has the task of supporting special drilling or soil consolidation outfits of the apparatus. For simplicity, said outfits are not described hereinafter as being well known to prior art. However, the outfits are always very heavy mechanical assemblies to which further units and implements such as tools are attached. For example, a bank of drilling rods may be attached to a carriage as illustrated of a drilling tower, the overall weight reached by the carriage/rod bank unit being of several tons.

According to the invention, the sustaining cable 2 is securely attached at 20 to the upper end of a piston 11 for maintaining the cable continuously stretched. The lower end of the piston is pivotally attached to a tension rod 4 that is inserted in a hole 21 (Figure 3) obtained in a horizontal floating plate 6. Plate 6 is vertically slidable relative to the tension rod 4 and carriage 1. In normal working conditions, as shown in Figures 2 and 3, plate 6 is kept steadily at its upper end of stroke, against an abutment 22 integral with carriage 1. At the lower end of tension rod, 4 a screw nut 7 is tightened against the lower face of plate 6, therefore providing safe support of the carriage and its implements to the cable 2.

Moreover, according to the invention, a rigid housing 13 is fixed to the upper portion of carriage 1. The rigid housing 13 contains a plurality of springs 5 biasing the upper face of plate 6. The thrust given by the springs is anyway inferior to the weight of carriage 1 taken alone, so that the floating plate 6 can not be lowered unless a breaking occurs in one of the supporting elements occurs, as specified more in detail hereafter.

Still referring to Figures 1 and 2, the front of plate 6 is fitted with a pair of opposite outwardly projecting side pins 10 aligned on a common horizontal axis. A pair of respective cams 8 are pivotally engaged with a certain slack on pins 10. The back ends 8a of cams 8 are grazing the surface of the guide 3 in normal operational conditions. The cams 8 are centrally hinged and supported by respective horizontal and aligned pins 12, which are supported by couples of bearing ears 23 integral with the carriage 1.

The operation of the device according to the invention is as follows: as long as the tensile force with which screw nut 7 holds the plate 6 at its upper end of stroke prevails on the thrust of springs 5, the anti-fall safety device is not operated. As soon as this condition no longer persists, due to a breaking occurring in the cable 2 or any other member (the piston 11, tension rod 4, screw nut 7) sustaining the weight of the carriage and its attached implements, the springs 5 cause the plate 6 to lower immediately. Consequently. plate 6 pulls the screw nut and the other unloaded supporting members with it. The pins 10, being pulled downward, rotate cams 8 about their hinges 12 causing cam back portions 8a to engage the guides 3 and stopping the fall of the carriage 1 in the position it had at the breaking instant.

Referring to Figure 4, a second embodiment of the device according to the invention provides the sustaining cable 2 forming a closed ring round pulleys 25, 26 located at the upper and lower end portions of guide 3, respectively. One end of the cable 2 is secured to a hooking seat 27 located on the bottom part of carriage 1. Further, the cable 2 is wound around a winch 28 mounted to the back side of the guides, whereby rotation of the winch in either way causes the carriage to move up or down. In this different embodiment also, cable tension is constantly provided by the piston assembly 11.

The embodiment of Figure 4 is ideal for application on machines having tiltable towers for working in sub-horizontal or inclined directions. The stretched cable 2 holds the carriage down from the bottom and prevents the springs 5 from releasing untimely when inclination of the guides produces a lengthwise component of the weight of the carriage (supported by the cable) inferior to the thrust of compressed springs 5.

The safety device shown in Figures 1 to 4 is composed by purely mechanical parts. Figure 5 shows an alternative embodiment of the present invention in which also electrical and hydraulic components are employed.

Referring to Figure 5, when one of the above identified failures occurs, the springs 5 bias a lower floating plate 17 downward. A switch 15, located inside housing 13 and connected to plate 17 causes an electric valve 14 to open via a suitable electric circuit 24 schematically indicated in Figure 5. On either side opposite to guide 3, the anti-fall device comprises respective locking cams 8 hinged in 16 to the carriage and similar to those disclosed with reference to Figure 2. The locking cams of Figure 5 are operated by respective hydraulic spring piston assemblies 19, securely attached to the carriage and fitted with the electric valves 14.

For a better understanding, the cam 8 on the left in Figure 5 is shown in its passive or non-operating position grazing the surface of guide 3, while the cam on the right is illustrated in its active locking position, with its portion 8a engaging the guide.

When the tensile stress in the sustaining members drops, the springs 55 release and bias the floating plate 17 downward. The switch 15 operates both electric valves 14 opening them, whereby the pistons 19 are lowered and rotate cams 8 from the initial non-operational position (shown to the left in Figure 5) to the final working position (on the right in Figure 5) in which the cams engage the tower guides 3. Consequently, falling of the carriage is immediately stopped.

Effective locking of the carriage is provided by cams 8, which are preferably toothed and made of a material that is harder than the one forming the guides 3. Moreover, in the locked position, the weight of the carriage further urges the cams on the guide, thereby further resisting falling.

It is to be understood that the invention is not limited to the two embodiments herein disclosed. A further variant (not shown) of the safety device according to the invention provides an accelerometer as the means for detecting a breaking in the sustaining members instead of the above discussed spring device. The accelerometer is mounted to the carriage and connected to the electric valves that empty pistons 19 for operating them upon detecting a fall of the carriage.

In a further variant embodiment, the fall-detecting device is formed by an electric wire disposed parallel to the sustaining cable and connected to the electric valves 14. When a breaking occurs, also the electric wire breaks and automatically activates the electric valves.

Claims

1. A safety device for stopping the fall of a carriage (1) slidably mounted to non horizontal guides (3) and suspended by a series of tensile stressed sustaining members (2, 4), characterized in that it comprises means (5) capable of detecting a breaking occurring in said series of tensile stressed sustaining members (2, 4); said means (5) being mounted to the carriage (1) and operationally connected to locking means (8) fitted on the carriage and adjacent the guides (3); said locking means (8) being movable from a starting non-operational position close to the guides (3) to a final operational position in which the locking means (8) engage the guides (3), whereby the carriage (1) is stopped from falling.

2. A device according to claim 1, characterised in that said locking means (8) consist of cams, hinged (12, 16) to the carriage.

3. A device according to claim 1, characterised in that said means (5) capable of detecting a breaking occurring in said series of tensile stressed sustaining members consist of means for detecting tensile stress drops in said sustaining members (2, 4).

4. A device according to claims 1 and 3, characterised in that said detecting means (5) comprise a plurality of compressed spring means that end to urge downward a plate (6, 17) suspended to said sustaining members (2, 4).

5. A device according to claim 4, characterised in that said spring means (5) are adjusted so as to move said plate when the tensile stress in said series of sustaining members decreases beyond a predetermined value.

6. A device according to claim 4, characterised in that the plate (6) is pivotally mounted (10) to the cams (8).

7. A device according to claim 4, characterised in that it comprises hydraulic pistons (19) being linked to said locking means (8); said plate (17) being operationally connected to hydraulic piston actuating means (14).

8. A device according to claim 1, characterised in that it comprises straining means (11) mounted to said series of sustaining members (2, 4) for keeping said members (2, 4) under tensile stress in normal operational conditions.

9. A device according to claim 4, characterised in that one end of said sustaining members is a cable (2). one end of the cable being bound to a hooking seat (27) located on the carriage (1), whereby the cable (2) forms a closed ring around pulleys (25, 26) respectively fitted proximate to the upper and lower ends of the guide (3).

10. A device according to claim 9, characterised in that the cable (2) is wound around a winch (28) for moving the carriage (1) upwardly and downwardly.

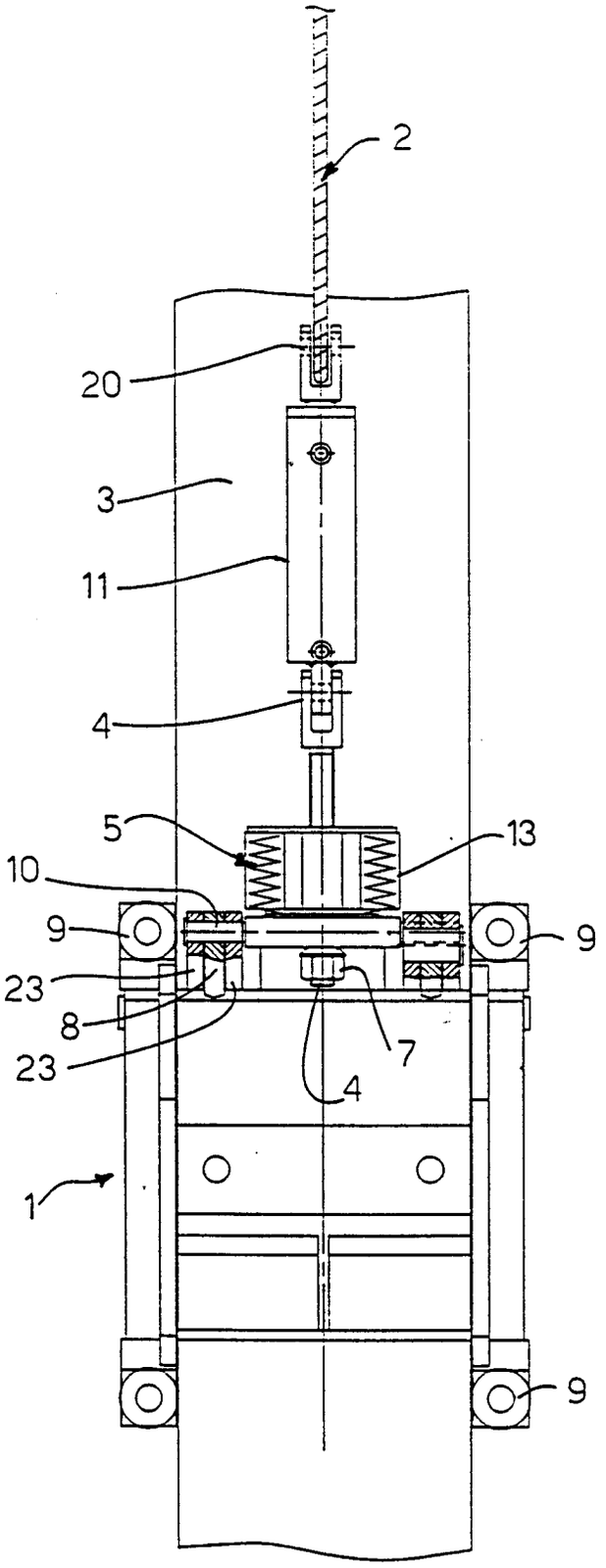

FIG.1

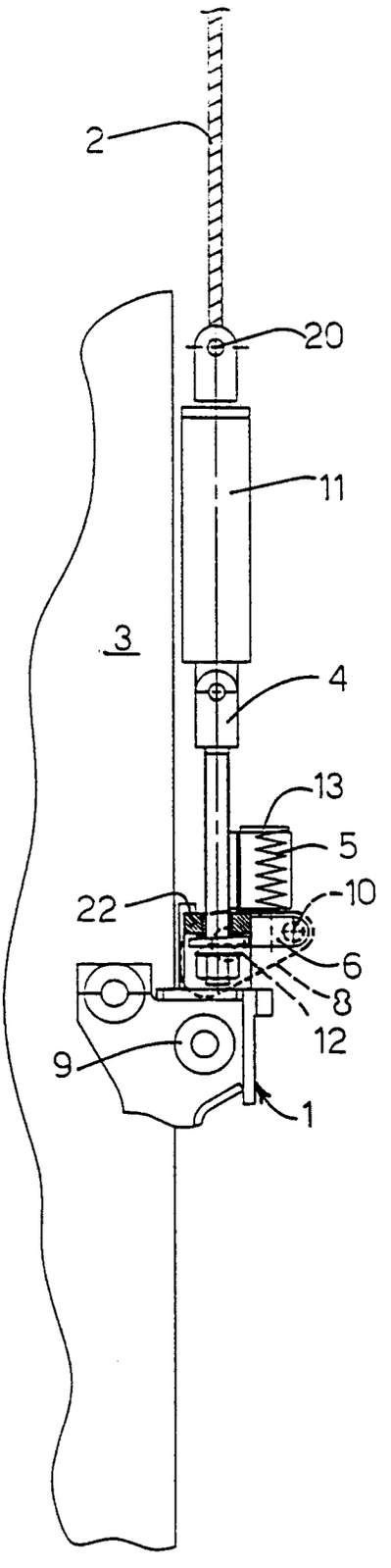

FIG.2

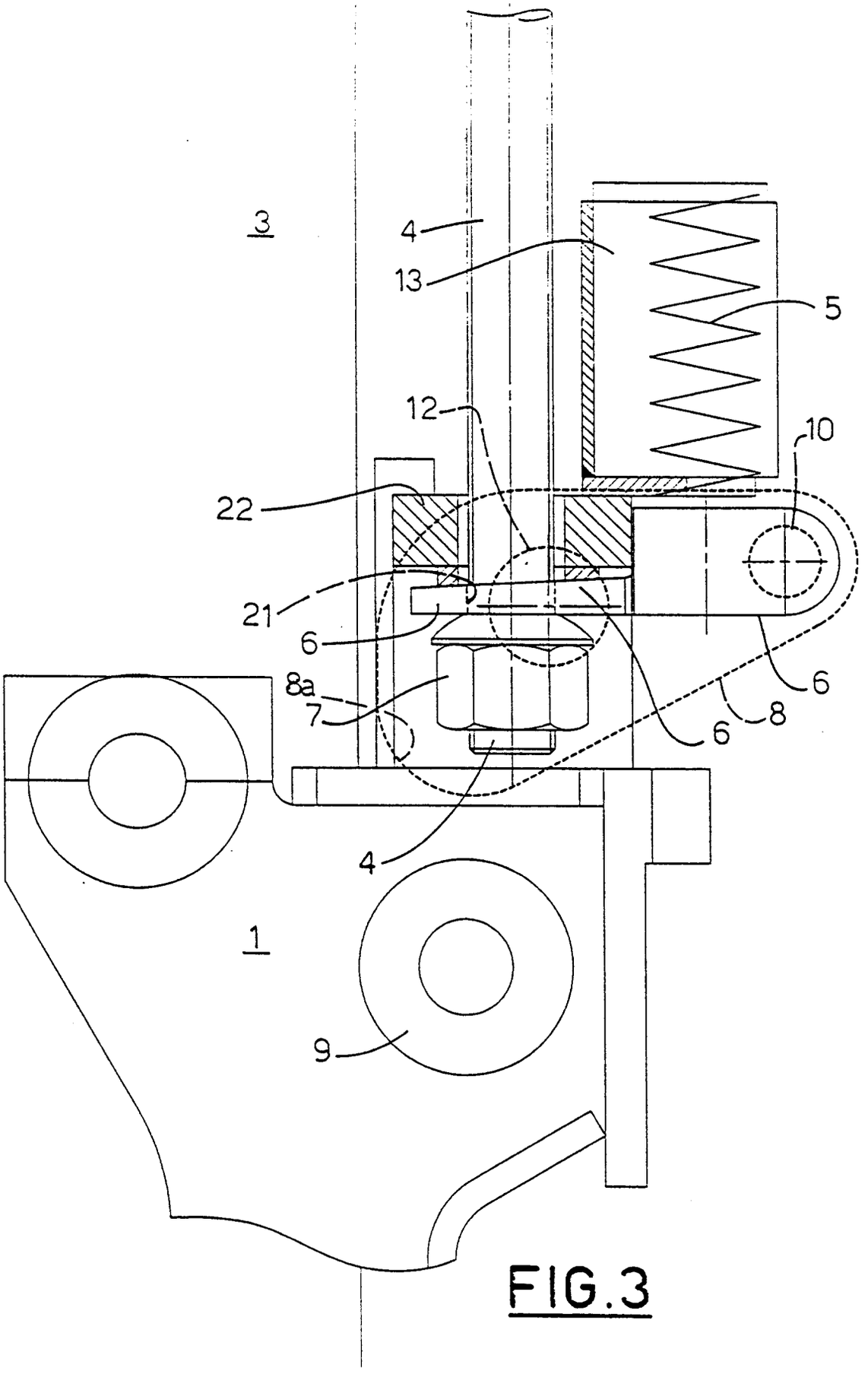

FIG.3

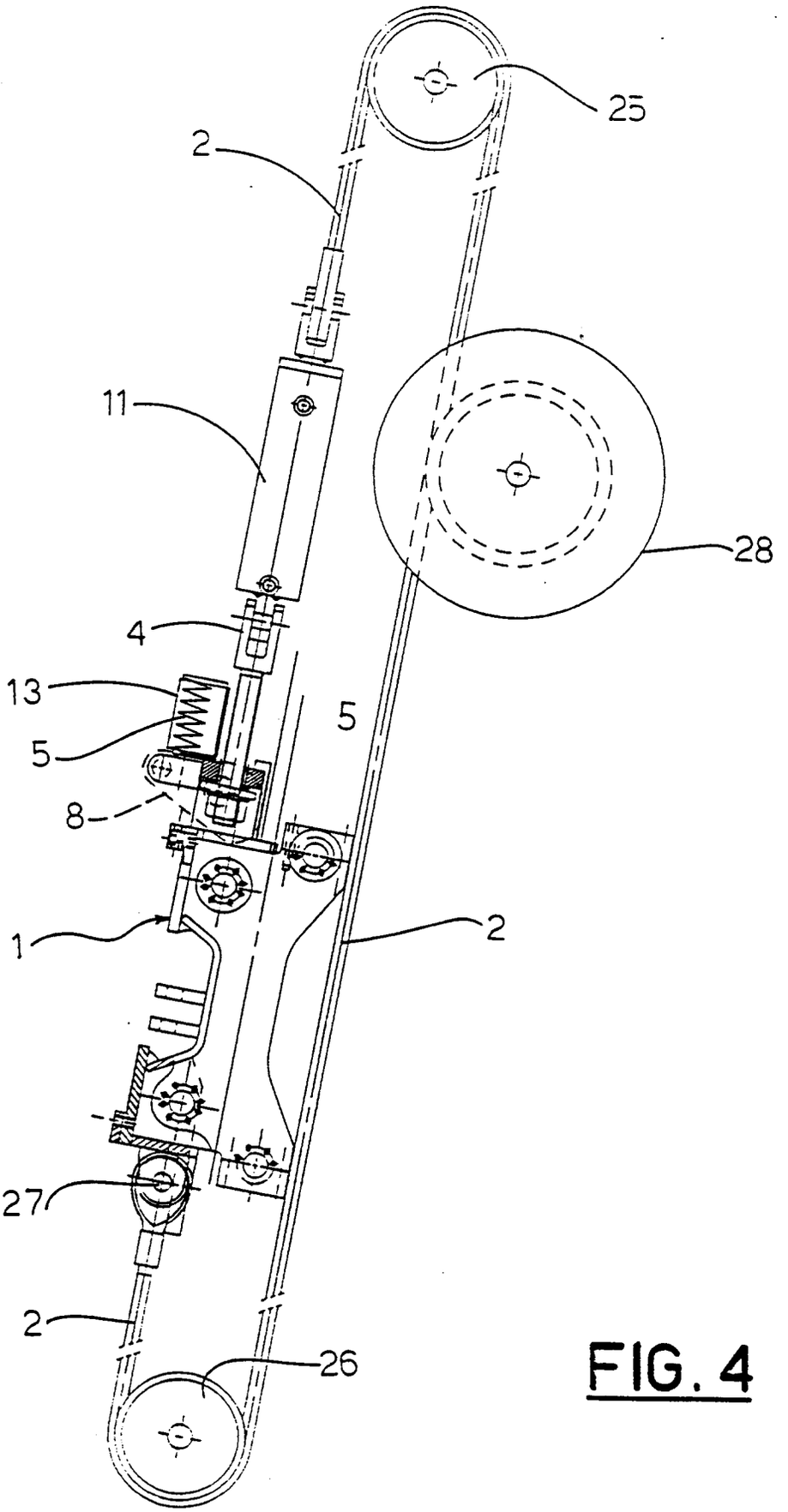

FIG. 4

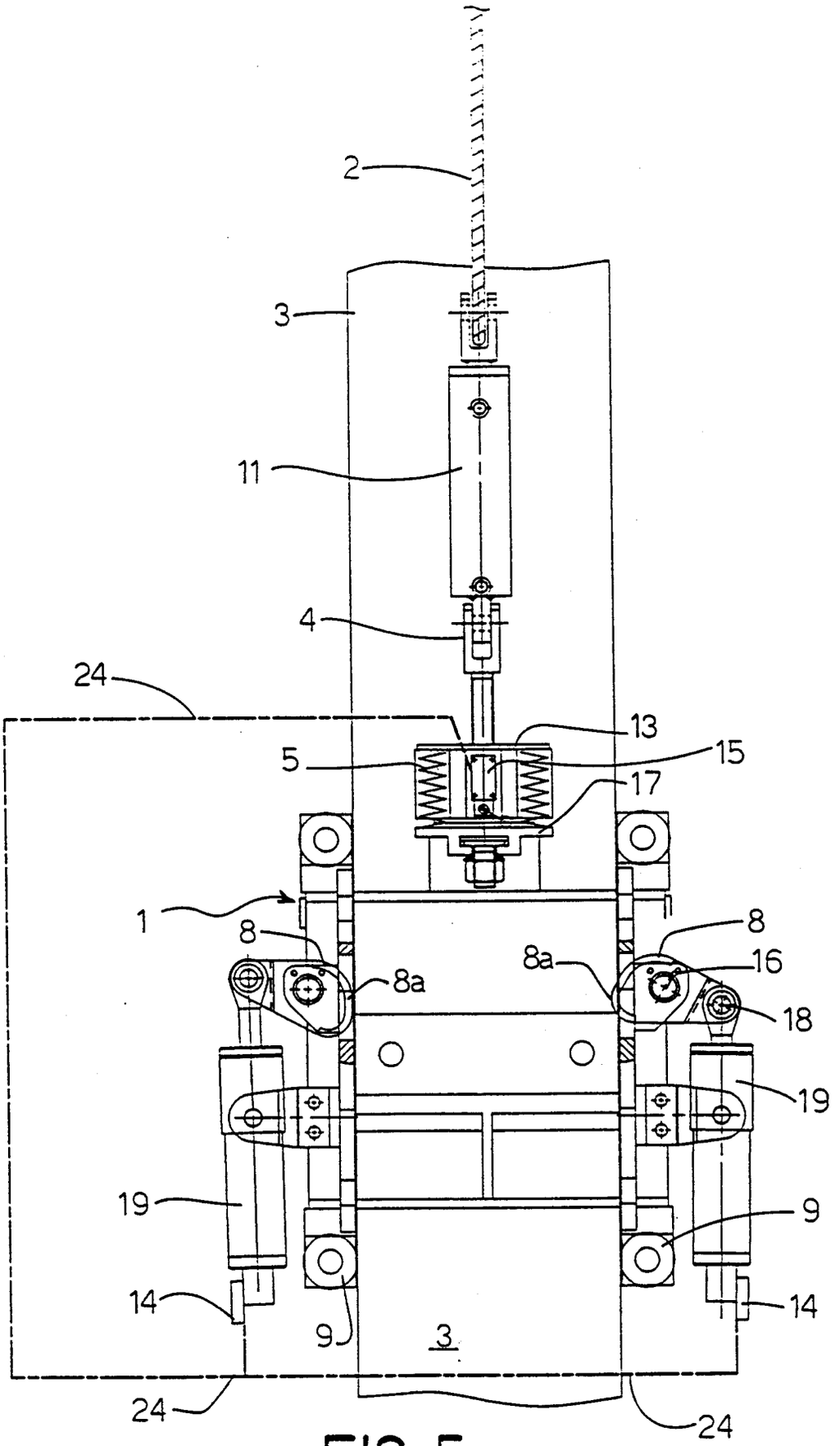

FIG.5