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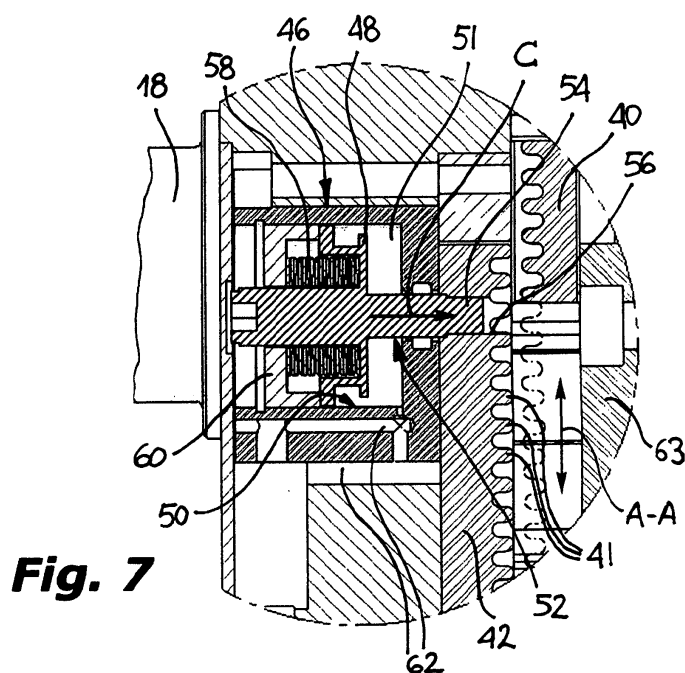
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(54) **Device for stopping the oscillation of the arm of a handling equipment of the swingable lever type**

(57) A handling equipment of the swingable lever type comprises an arm rotationally connected to a shaft (18) that extends from a body (10) of the equipment, and a toggle mechanism (33) interposed between the shaft (18) and one end of an axially slidable stem (34). The sliding of the stem (34) is controlled by pressurized fluid control means so as to cause an angular oscillation of the arm between two predetermined end-of-stroke angular positions. The equipment further comprises a de-

vice for stopping the oscillation of the arm, including a first engagement member (42, 40) fixed to the body (10) and a second engagement member (40) movable together with the stem (the 34), which members (40, 42) have respective reciprocally facing active surfaces adapted to reach a frontal engagement condition as a result of the transverse movement of one of them with respect to the stem (34), when a pressure drop of the fluid fed to said control means takes place, with the aim of stopping the movement of the stem (34).



**Fig. 7**

## Description

**[0001]** The present invention generally refers to handling equipments of the so-called swingable lever type. These equipments comprise a body to which a lever element is externally associated which is susceptible to oscillate between two end-of-stroke angular positions, and the movement of which is controlled by the sliding of a stem actuated by a pressurized fluid control actuator, typically of the pneumatic type, through a toggle mechanism enclosed within the body and operatively connected to an end of the stem.

**[0002]** In a typical application the lever element has the function of an arm supporting an operating unit, such as a working equipment, at its end farther from the body, in which case the handling equipment is called "tilter unit" because allows the operating unit to be tilted between two positions defined by the end-of-stroke angular positions of the arm of the equipment.

**[0003]** More specifically, the invention concerns a stopping device of the type mentioned in the preamble of attached claim 1.

**[0004]** In known equipments of the type defined above, during maintenance operations, or owing to a failure causing a pressure drop in the feeding line of the fluid, an accidental interruption of the pressurized fluid feeding to the control actuator or a reduction of the pressure below a predetermined threshold may occur. In this circumstance the swingable arm of the equipment may lie in an intermediate position between the aforesaid end-of-stroke angular positions. In particular, if the arm supports a heavy apparatus, it may fall back abruptly towards one of the end-of-stroke angular positions, with consequent risks for the integrity of the structure of the equipment and of the corresponding apparatus, as well as for the safety of any operators possibly present near to the equipment.

**[0005]** In order to avoid these drawbacks, a number of devices have been proposed for controlling the movement of the arm of such an equipment, for example for applying a friction force by means of rollers or balls on the outer surface of the stem, or including a plate element with a through-hole crossed by the stem and intended to assume a tilted configuration with respect to the stem in order to stop by interference its axial movement, when a feeding pressure drop below a predetermined threshold takes place.

**[0006]** However, these known control devices are usually not very reliable and accurate since their operation suffers from the wear of the components. Moreover, they are not very easy to use since, in the more general case, they allow the movement of the stem to be stopped only in one of its movement directions, and therefore they must be doubled in number whenever it is desired to stop the movement of the stem in both directions of movement.

**[0007]** Another known device which is adapted to prevent the violent fall of the arm in case of an anomaly in

feeding the pressurized fluid to the control actuator, is the subject of European patent application EP-1 300 625 in the name of the same Applicant. The device of this application comprises stopping means that include a rotatable worm member engaging an axial cavity of the stem and having a head provided with an axial toothing facing on a corresponding toothing of a movable element axially associated to the bottom of the actuator. In the case of a reduction of the pressure in the circuit for feeding fluid to the actuator, elastic means apply a thrust on the axially movable element, thereby bringing the aforesaid toothings in mutual engagement in order to stop the movement of the stem and therefore the oscillation of the arm. Although highly effective in its operation, this known solution turns out to be generally expensive and complex to be manufactured.

**[0008]** The main object of the present invention is to propose a stopping device for an handling equipment of the swingable lever type, which automatically acts when an anomaly takes place in the feeding of the pressurized fluid to the actuator in order to stop the angular movement of the arm of the equipment, and which is effective in its operation and relatively simple and inexpensive to be manufactured.

**[0009]** This object is attained by virtue to a stopping device having the features mentioned in the attached claims.

**[0010]** According to a feature of the invention, the device comprises a first engagement member axially fixed to the body and a second engagement member movable together with the stem, such engagement members having respective reciprocally facing active surfaces adapted to reach a frontal engagement condition as a result of the transverse movement of one of them with respect to the stem, when a pressure drop of the fluid fed to said control means takes place, with the aim of stopping the movement of the stem.

**[0011]** By virtue of such a feature, the stopping device of the invention is characterized by a simple structure allowing a quick and effective stop of the swingable arm of the equipment when an anomaly takes place in the feeding of the control means. Moreover, the device is small sized thus allowing its application to the normally used equipments with few structural modifications, and involving limited production costs.

**[0012]** According to a preferred feature of the invention, the engagement formations are teeth, so that each engagement member consists of a rack. In this manner the engagement formations can be made in a simple and economic manner.

**[0013]** According to another preferred feature of the invention, the teeth of each rack are round-topped teeth and have substantially parallel flanks.

**[0014]** Further features and advantages of the invention will become more clear from the following detailed description, given by way of a non-limitative example only, and referred to the attached drawings in which:

figure 1 is a side elevation view of the body of an handling equipment provided with a stopping device according to the invention,  
 figure 2 is a front elevation view partially sectioned along line II-II of figure 1,  
 figures 3 and 4 are perspective views of the two half-shells of the body of the handling equipment in the open condition, respectively,  
 figure 5 is a side elevation view of the half-shell, from the side of arrow V of figure 4,  
 figure 6 is a schematic perspective view of two main elements of the stopping device of the invention, which in use condition are respectively associated to the half-shell of figure 3 and to the stem of the equipment, and  
 figure 7 is an enlarged, front elevation view of a detail indicated by arrow VII in figure 1.

**[0015]** With reference to the figures, the body of a handling equipment of the swingable lever type is indicated by 10, and comprises a pair of half-shells 12 and 14 fittable to one another by means of screws or similar removable connecting means (not shown).

**[0016]** The two half-shells 12 and 14, in their mutual fitted condition, define an inner cavity in which a crank 16 is arranged, from which crank a pair of appendages extend axially and define a shaft 18 having opposite end portions 20 and 22 protruding from the sides of the body 10. Each portion 20 and 22 of the shaft 18 has a pair of diametrically opposite flats 20a, 22a provided for rotationally fixing branches of an arm or lever (not shown because known per se) on the shaft 18. Such arm can be used for supporting a working apparatus, in the case of an handling equipment employed as a tilter device.

**[0017]** The crank 16 has a fork-shaped portion comprising a pair of parallel arms 24 extending inside the cavity of the body 10, whose ends opposite to the shaft 18 are articulated at 26 to a first end of a connecting rod 28 through a pin. The second end of the connecting rod 28 is in turn articulated at 30 to a fork element 32 by means of a pin, which fork element is articulated to the upper end (with reference to the drawings) of a stem 34 whose top portion is only shown in the drawings.

**[0018]** In a per se known manner, the stem 34 is axially slidably mounted in the body 10 in the direction transverse to the shaft 18, and its sliding is controlled by fluid control means, usually constituted by a double or single action cylinder (not shown in the drawings because known per se) connected to the base of the body 10. In the more common case, the cylinder that controls the sliding of the stem 34 is a pneumatic cylinder having a chamber in which a piston rigidly connected to the stem 34 is sealingly and slidably mounted. In this chamber, compressed air is fed at least at one side of the piston, in order to cause the reciprocating movement of the stem 34.

**[0019]** The unit including the crank 16, the connecting rod 28 and the fork element 32 constitutes a toggle ar-

ticulation mechanism, indicated 33 as a whole, the function of which is to make irreversible the position of the crank 16 and the shaft 18 which correspond to the maximum extension of the stem 34, as shown in figures 3 to 5.

**[0020]** The sliding of the stem 34 controlled by the corresponding control means through the toggle articulation mechanism 33, causes an angular oscillation of the end portions 20 and 22 of the shaft 18 between two predetermined end-of-stroke angular positions, and therefore an oscillation of the arm fixed to the shaft 18 as well as of the relative equipment supported by the arm.

**[0021]** A bracket element 36 is connected close to the upper end of the stem 34, for example by means of a fixing pin 38. An engagement member 40 is fixed to the bracket element 36 so as to be axially movable together with the stem 34. The member 40 has an active surface provided with engagement formations that extend transverse to the stem 34 and preferably comprise a series of teeth 41, as a result of which the element 40 is constituted by a rack.

**[0022]** A further engagement member 42 is fixed axially to the body 10 and has an active surface facing on the teeth 41 of the rack 40. The member 42 having an elongate shape is housed in a corresponding hollow seat 43 adjacent to an axial edge of the half-shell 12. Its active surface is provided with engagement formations preferably in form of teeth 41 that project in the direction transverse to the stem 34 and have a profile corresponding to those of the member 40, as result of which also the member 42 is preferably constituted by a rack.

**[0023]** The profile of the teeth 41 of the racks 40 and 42 is conveniently of the type having substantially parallel flanks and a rounded top.

**[0024]** The rack 42 has an axial extension substantially equal to the full stroke of the stem 34 and is mounted transversely translatably with respect to the stem 34, and therefore to the rack 40. The rack 40 conveniently has a smaller axial extension than the rack 42.

**[0025]** The possibility of movement of the two racks 40 and 42 is schematically shown in figure 6. In particular, the rack 40 is susceptible to move along an axial direction A-A parallel to the stem 34, while the rack 42 can translate along a direction B-B transverse to the stem 34.

**[0026]** In order to allow the rack 42 to move transversely to the stem 34, a transverse guide pin 44 is provided, which passes through the wall of the half-shell 12 with an axial clearance. The pin 44 has a normally threaded free end 44a adapted to engage a central threaded portion of the rack 42, in order to guide and bound the movement of the rack 42 with respect to the body 10. At the side opposite to the end 44a, the pin 44 is provided with a head projecting outside of the body 10 for being driven, typically by means of a tool such as a spanner or a screwdriver, in order to allow the fine tuning of the maximum translation of the rack 42 towards the rack 40.

**[0027]** The translation of the rack 42 towards the rack 40 is controlled by at least one actuator 46, a pair of equal actuators 46 being preferably provided at the same dis-

tance but on opposite sides with respect to the pin 44.

**[0028]** Each actuator 46 comprises an auxiliary piston 48 slidably mounted in a cylindrical seat 50 formed in the wall of the half-shell 12, which seat defines a chamber 51 on the side facing towards the rack 42. To each piston 48 a coaxial rod 52 is connected rigidly, the free end of which, on the side adjacent to the rack 42, has a threaded portion 54 engaging a corresponding thread of a transverse hole 56 of the rack 42. In this manner, an axial movement of the rods 52 of the actuators 46 determines a corresponding movement of the rack 42 with respect to the body 10 and the rack 40, thanks to the axial clearance of the pin 44.

**[0029]** Elastic thrust means 58, preferably consisting of a pack of Belleville washers for compactness reasons, are coaxially mounted on each auxiliary piston 48 in such a manner that a first end of them rests against the surface of the piston 48 opposite to the chamber 51, while the other end rests against a removable cover 60, normally fixed to the body 10 of the equipment.

**[0030]** In the chambers 51 of the actuators 46 the same pressurized fluid is admitted to the control means of the equipment, through ducts indicated generally by 62. In the case of a plurality of actuators 46, as in the embodiment shown in the figures, or of a different number of actuators 46, the actuators 46 are put in communication with one another by means of feeding ducts allowing the pressurized fluid to reach the corresponding chambers 51 simultaneously.

**[0031]** Behind the back surface of the rack 40 opposite to its active surface provided with teeth 41, an elongate counter plate 63 is fixed to the half-shell 14, typically by means of screws, which plate is separated by a small distance from the back surface of the rack 40. On the surface of the plate 63 facing towards the rack 40 a series of friction elements 64 is provided, which friction elements are realized for example by means of rough linear formations arranged transverse to the extension of the plate 63. The function of the plate 63 will become more clear in the following.

**[0032]** In operation of the equipment, the pressurized fluid fed to the control means of the equipment causes, thanks to the toggle mechanism 28, the reciprocating axial movement of the stem 34 that in turn causes the rotation of the shaft 18 between a pair of predetermined end-of-stroke angular positions, and therefore the oscillation movement of an arm rotationally fixed to the shaft 18 as well as of any equipments possibly supported by it.

**[0033]** The same fluid, which is fed to the chambers 51 through ducts 62, applies a pressure on the auxiliary pistons which tends to keep the pistons 48 in a position spaced from the stem 34, against the elastic action of the washers 58 of the actuators 46. Owing to the thrust exerted by the actuators 46, the rack 42 remains separated from the rack 40.

**[0034]** Of course, the load of the washers 58 of the actuators 46 is calculated in such a manner that the rack 42 remains spaced from the rack 40 when the pressure

of the fluid in the chambers 51 is greater than a predetermined threshold.

**[0035]** If the pressure of the fluid in the chamber 51 of the actuators 46 drops below the aforesaid predetermined threshold, for example owing to a failure interrupting the supply of pressurized fluid to the equipment, or during operations of maintenance, the elastic action of the washers 58 causes the movement of the rods 52 towards the stem 34, and therefore the movement of the rack 42 towards the rack 40, in the direction indicated by arrow C in figure 6. In this situation, the teeth 41 of the rack 42 engage frontally the teeth 41 of the rack 40 causing the stroke of the stem 34 to stop and therefore the movement of oscillation of the arm fixed to the shaft 18 to stop.

**[0036]** As a result of the transverse translation of the rack 42 and the engagement of its teeth with those of the rack 40, the rack 40 is subject only to a small transverse movement until its back surface rests against the plate 63, in such a manner that the rack 40 and the corresponding bracket element 36 are subject only to a limited bending load, and the sliding movement of the rack 40 is further slowed down owing to the engagement of its back surface with the friction elements 64 of the plate 62.

## Claims

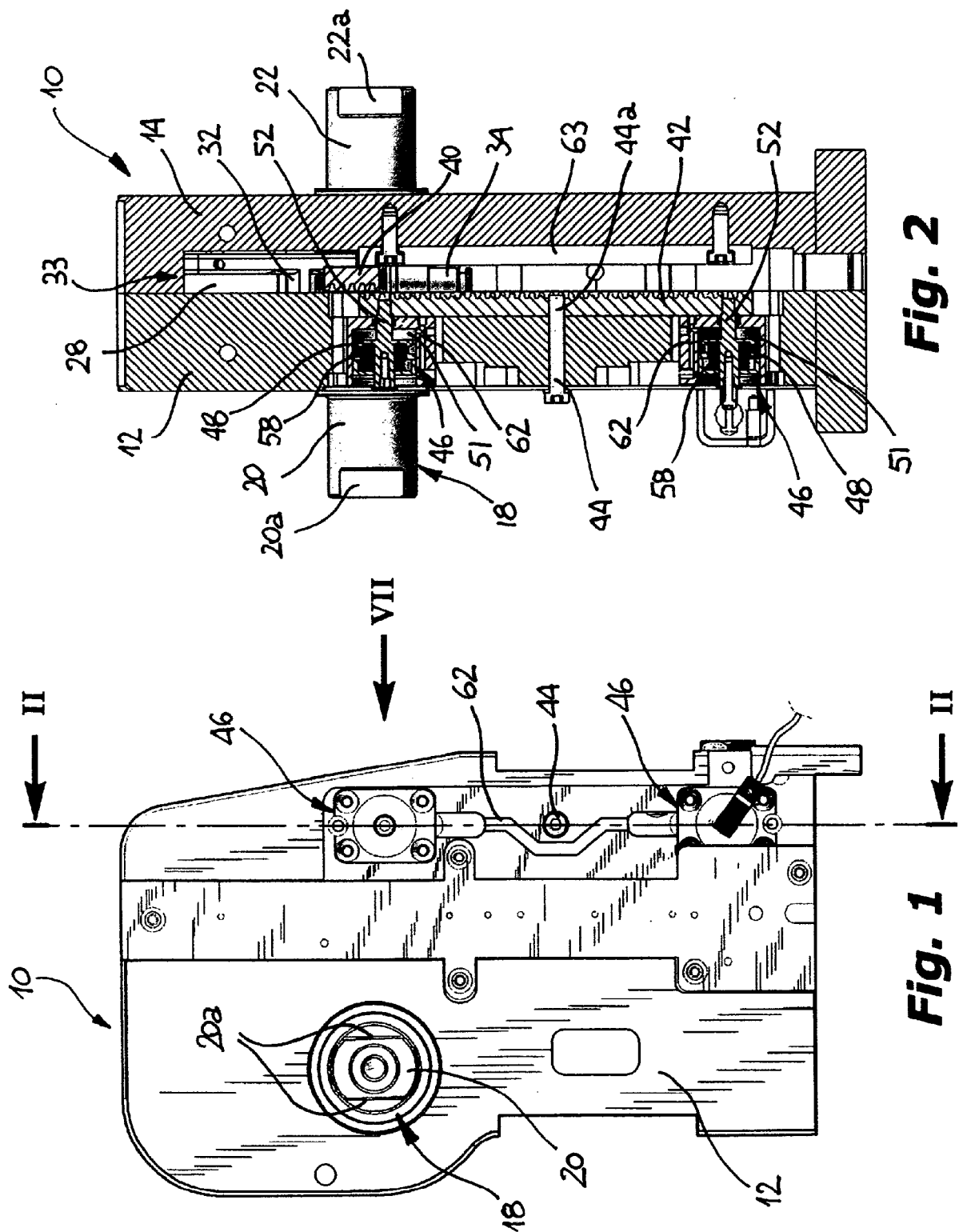
1. Device for stopping the oscillation of the arm of a handling equipment of the swingable lever type, in which the arm is rotatably connected to a shaft (18) which extends from a body (10) of the equipment, the body enclosing a toggle mechanism (33) operatively interposed between the shaft (18) and one end of a stem (34) axially slidable in a direction transverse to the shaft (18), the stem (34) being controlled by under pressure fluid control means associated with the body (10), whereby sliding of the stem (34) gives rise to an angular oscillation of the arm between two predetermined end-of-stroke angular positions, **characterized in that** the device comprises a first engagement member (42) axially fixed to the body (10), and a second engagement member (40) movable together with the stem (34), said engagement members (40, 42) having respective reciprocally facing active surfaces adapted to reach a frontal engagement condition as a result of the transverse movement of one of them with respect to the stem (34), when a pressure drop of the fluid fed to said control means takes place, with the aim of stopping the movement of the stem (34).
2. Device according to claim 1, **characterized in that** the facing surfaces of said engagement members (40, 42) are provided with projecting engagement formations (41) of a corresponding shape.
3. Device according to claim 2, **characterized in that**

said engagement formations are teeth (41), so that each engagement member consists of a rack (40, 42).

4. Device according to claim 3, **characterized in that** the teeth (41) of each rack (40, 42) are round-topped teeth and have substantially parallel flanks. 5
5. Device according to any one of claims 1 to 4, **characterized in that** the first engagement member (42) is adapted to translate transverse to the body (10) of the equipment towards the second engagement member (40), and **in that** translation of the first engagement member (42) is controlled by at least an actuator (46) which can be driven as a result of a reduction of the pressure of the fluid operating said control means below a predetermined threshold, the second engagement member (40) being rigidly connected to the stem (34). 10  
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6. Device according to claim 5, **characterized in that** the extension of the first engagement member (42) is substantially equal to the axial stroke of the stem (34). 25
7. Device according to claim 6, **characterized in that** the axial extension of the second engagement member (40) is smaller than that of the first engagement member (42). 30
8. Device according to any one of claims 5 to 7, **characterized in that** the transverse movement of the first engagement member (42) is guided by a guide pin (44) associated with the body (10), which extends transverse to the stem (34). 35
9. Device according to claim 8, **characterized in that** the movement of the first engagement member (42) is controlled by a pair of actuators (46) arranged at opposite sides with respect to said guide pin (44). 40
10. Device according to any one of claims 5 to 9, **characterized in that** each actuator (44) comprises an auxiliary piston (48) slidable in a cylindrical seat (50) defining a chamber (51) in which the same fluid fed to the equipment control means is admitted, said piston (48) having a rod (52) connected to the first engagement member (42) so that, when the fluid is fed to said chamber (51) with a sufficient pressure, the auxiliary piston (48) reaches a position spaced from the second engagement member (40), against the action of elastic thrust means (58) biasing the auxiliary piston (48) towards to the second engagement element (40). 45  
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11. Device according to claim 10, **characterized in that** said elastic thrust means consist of a pack of Belleville washers arranged coaxially to the relevant

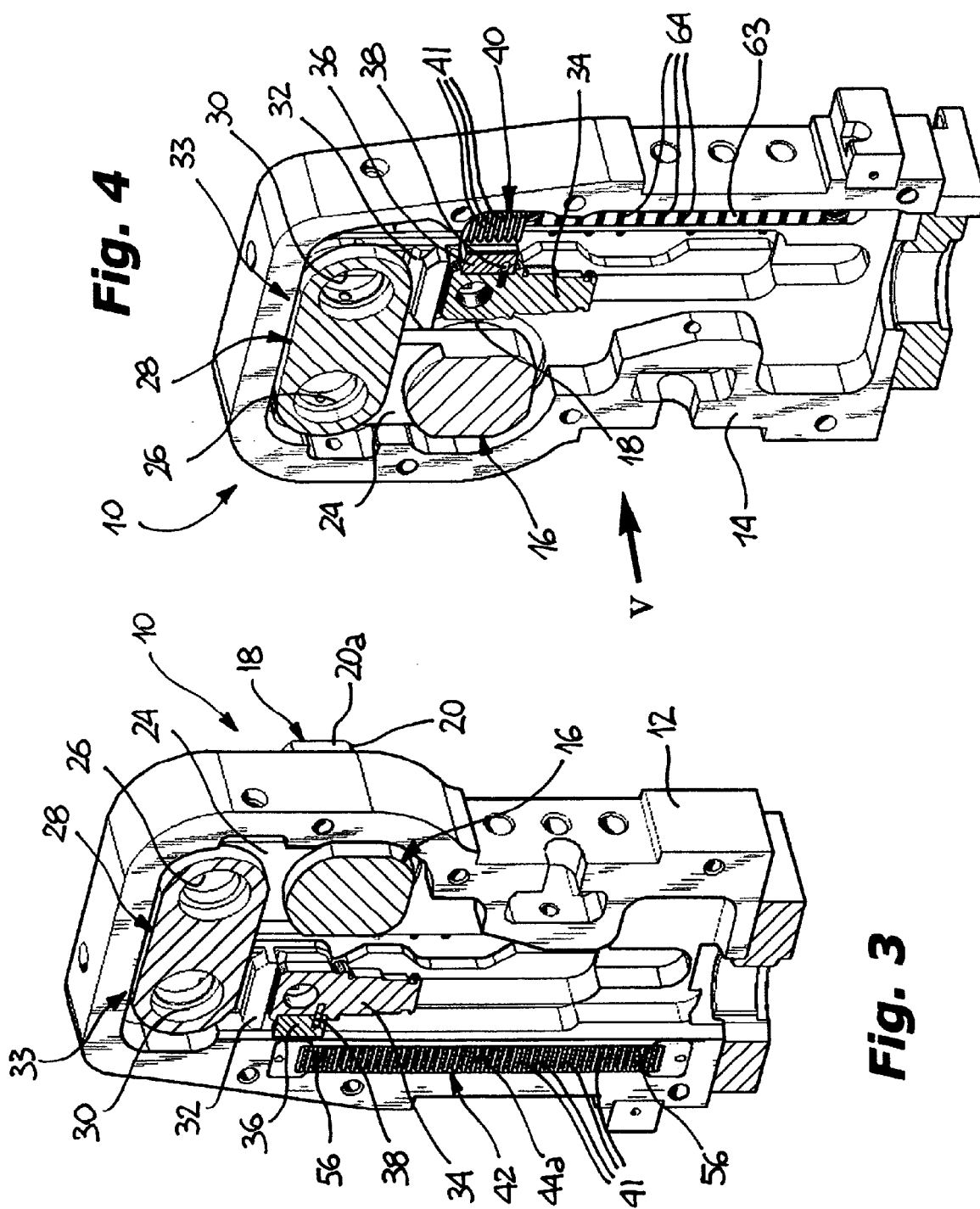
auxiliary piston (48).

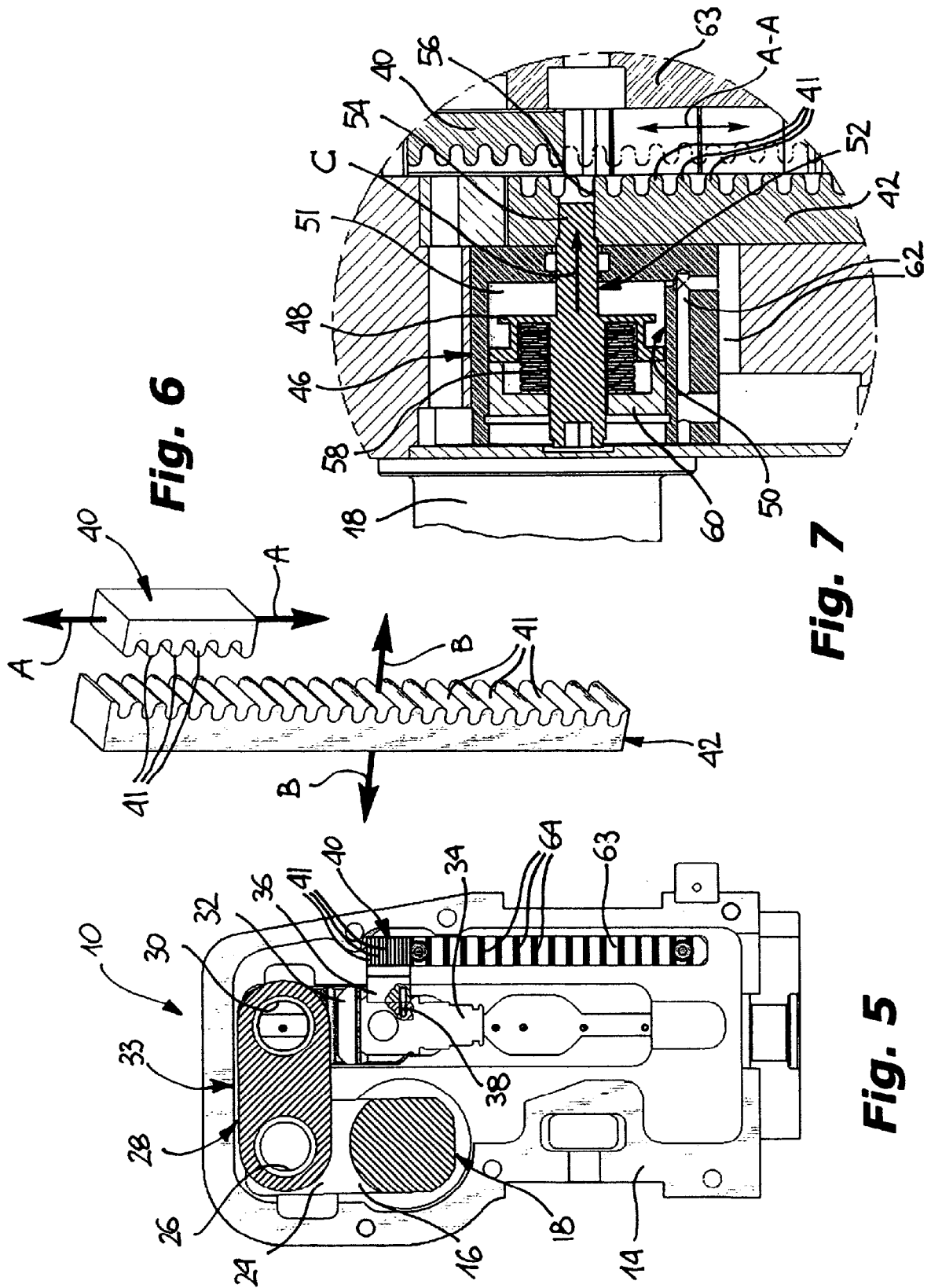
12. Device according to claim 11, **characterized in that** the pack of Belleville washers (58) of each actuator (46) rests against a respective removable cover (60) adapted to be fixed to the body (10) of the equipment.
13. Device according to any one of claims 1 to 12, **characterized in that** it comprises an elongated counter plate (63) adjacent and usually spaced from the surface of the second engagement member (40) opposite to the active surface thereof, which has a series of friction elements (64) on its surface facing the second engagement member (40).



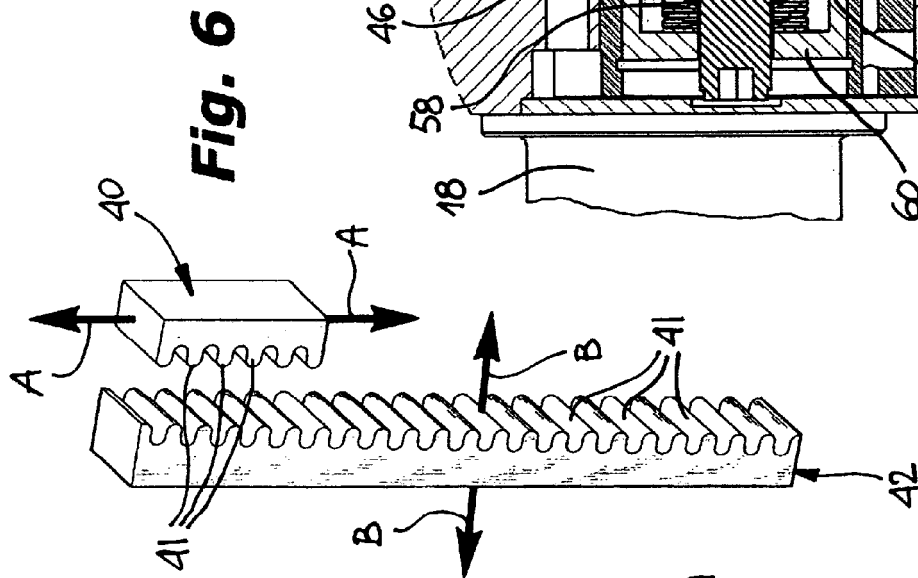
**Fig. 2**

**Fig. 1**

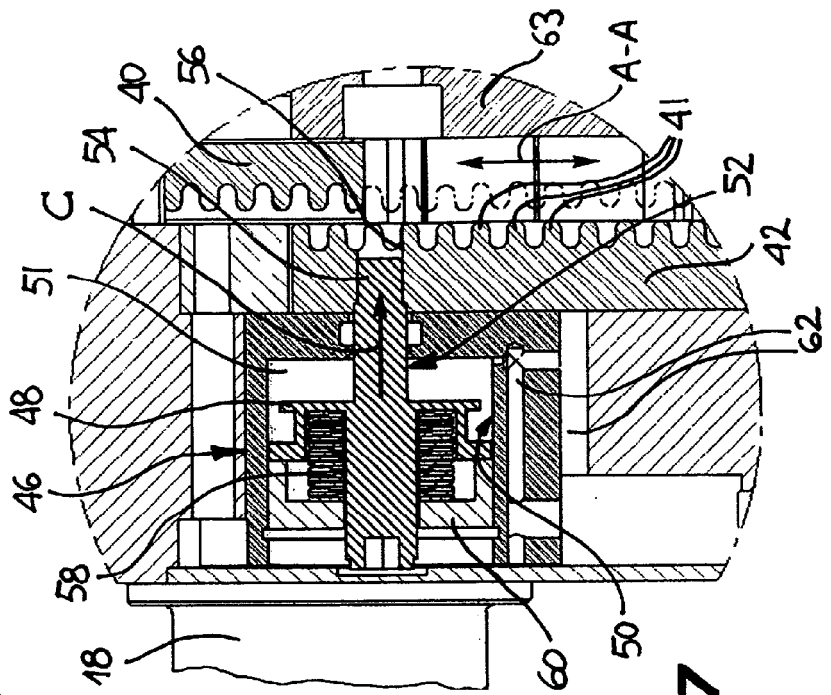




**Fig. 5**



**Fig. 6**



**Fig. 7**



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Application Number  
EP 09 01 2622

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                           |                                                                                                                                                  |                                                                                                                                                                                                                                                                                       |                                            |
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| Place of search<br><b>Munich</b>                                                                                                                                                                                                                              |                                                                                                                                                  | Date of completion of the search<br><b>9 March 2010</b>                                                                                                                                                                                                                               | Examiner<br><b>Kühn, Thomas</b>            |
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