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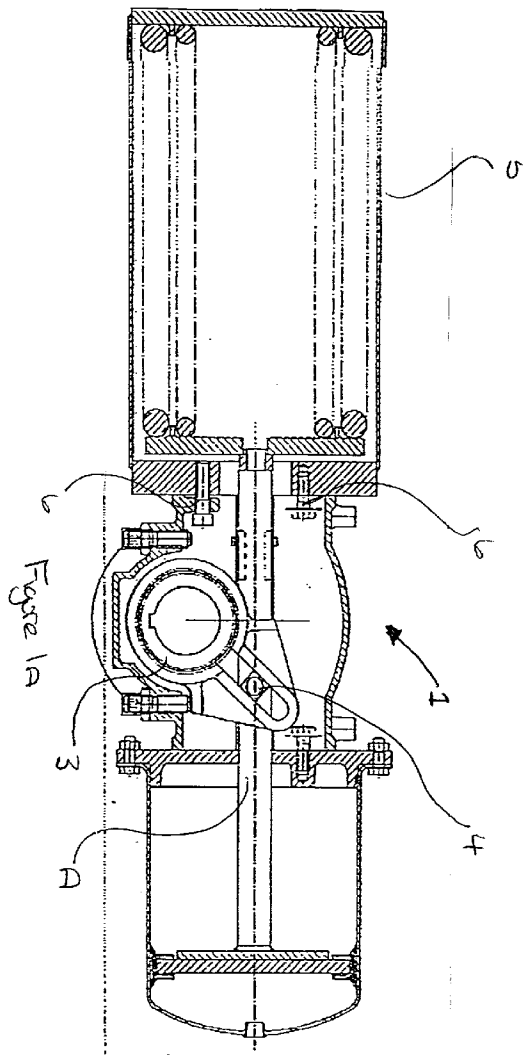
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(54) **Actuator.**

(57) An actuator for converting linear motion into rotational motion comprises a pressure chamber for receiving a working fluid, an actuator housing (1) having a longitudinal slot provided therein, a yoke frame (3) provided within the housing, a shaft (A,B) passing through the longitudinal slot into the yoke frame (3), a thrust pin (4) mounted on the shaft (A,B) within the yoke frame (3), return means (5) for countering working fluid pressure and an override device (7-10) which allows forces stored within the actuator to be released in the event of failure of the actuator.



This invention relates to an actuator and, more particularly, to a valve actuator operated by pneumatic gas or hydraulic means wherein linear motion is converted into angular motion. The "scotch yoke" mechanism for converting linear force and motion by mechanical advantage to a nominal 90 degree maximum rotational force and motion has been used extensively in the valve actuator industry for many years and the present invention aims to provide an improvement of this type of valve actuator.

Valve actuators when powered by pressure sources are required to be manufactured with the customer selected option of a manual override device. This device allows the operator to operate the valve to the required degree of rotation by direct manual means ie without the requirement of the normal external energy source. This function is achieved by various means dependent upon the size of the valve actuator torque force required.

In normal practice, large actuators are manually operated by hydraulic means, intermediate units by a mechanical means, normally a hand wheel and reduction gearing or other means of multiplying the manual input, and smaller units are operated by direct jack screw input. It is generic in the industry that a force of 80 lbs is the maximum human output for force calculations in this work activity.

Of the known devices mentioned above, a hydraulic override system comprises a hand pump capable of generating sufficient thrust to rotate the valve. The system is complex, expensive to manufacture and is used where high forces are necessary.

Manual gearing devices provide manual force multiplication normally by a hand operated wheel connected by means of gearing to the actuator torque producing mechanism. Operation of the hand wheel thus generates rotation of the valve.

A jack screw override comprises a threaded jack shaft that can be fitted directly to the power cylinder of the actuator and by screwing the shaft into the actuator generates longitudinal travel of the piston giving rotation of the valve. This system is available in pressurised or non pressurised versions.

A pressurised system comprises a permanently fitted jack screw applied to the power cylinder. This is a complex arrangement as it is possible for the operator to enter the jack screw into a pressurised cylinder. The system, therefore, must carry large venting/exhaust paths for the pressurised power source, or alternatively the override casings must be designed to withstand the operating pressure. In many cases, actuators in this environment are operated directly by gas, this gas may cause severe corrosive attacks leading to early failure of the gearing.

A non-pressurised system normally requires the removal of a plug from the cylinder outer end plate. Once removed, the aforementioned threaded hexagon ended or similarly configured jack screw is fitted

to the correspondingly threaded boss in the cylinder end plate. Rotation of the jack screw generates valve rotation by creating a thrust to the actuator piston assembly ie directly replacing the normal pressure power source. The weakness of the system is that the plug must be removed from the cylinder this is a dangerous practice and is not considered suitable or fit for this purpose.

The present invention aims to overcome or at least mitigate the problems associated with the known devices discussed above.

According to one aspect of the present invention there is provided an actuator for converting linear motion into rotational motion comprising a pressure chamber for receiving a working fluid, an actuator housing having a longitudinal slot provided therein, a yoke frame provided within the housing, a shaft passing through the longitudinal slot into the yoke frame, a thrust pin mounted on the shaft within the yoke frame, return means for countering working fluid pressure and an override device which allows forces stored within the actuator to be released in the event of failure of the actuator.

Advantageously, the shaft is longitudinally slidable within the slot.

Conveniently, the return means comprises a spring within a spring module mounted on the housing of the actuator and operatively connected to the shaft.

Preferably, the override device comprises a safety device wherein hooks are provided on the spring module and corresponding apertures are provided on the housing to cooperate with the hooks.

Advantageously, the override device comprises a hand wheel or a wrench drive for manual actuation of the actuator.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a schematic view of an actuator according to one aspect of the present invention; Figure 1A is a sectional view of the actuator according to one aspect of the present invention; Figure 1B is a cross-sectional view of the actuator of Figure 1A;

Figure 2 is a schematic view of a spring cartridge module of the actuator of Figure 1;

Figure 3 is a further schematic view of the spring cartridge module of Figure 1;

Figure 4 is a side view of the plate face of the module of Figure 2;

Figure 5 is a view of the plate face of Figure 4 in an un-locked condition, and

Figure 6 is a view of the plate face of Figure 4 in a locked condition.

Turning to the figures there is shown an actuator having a housing 1 which is provided with a machined longitudinal rectangular hollow section 2 therein. A yoke frame 3 of a known type is slidably received

within the longitudinal hollow section. The yoke frame 3 may bear directly within the housing 1 or alternatively may incorporate bearings to the slide surfaces between the yoke frame 3 and the housing 1. Furthermore, the yoke frame 3 may be formed of one or two plates as shown by the dotted lines in Figure 1.

A pair of shafts A, B are slidably received within the hollow rectangular section. The shafts, one of which is shown in Figure 1A are connected to the piston of the actuator and are moved longitudinally within the rectangular section by fluid pressure within the pressure chamber of the actuator. The shafts bear in the longitudinal slot and are in contact with the bearing surfaces at all times. This ensures that the actuator is subjected to very low bearing stresses due to the relatively large area of the shafts in contact with the bearing surfaces.

Within the yoke frame 3 there is provided a thrust pin 4 which is located to co-operate with the yoke arm of the yoke frame. The thrust pin 4 is located in a transverse bore through the shafts A and B and may for example be a pin and block arrangement. This arrangement is the means for producing rotary output motion from the actuator.

A spring cartridge module 5 is joined to the actuator housing 1 by fasteners or screwed tie bars 6. A screwed shaft 7 (not shown in Figure 1A) is located longitudinally at the end plate of the spring cartridge. The shaft 7 may rotate but cannot travel in a longitudinal axis. The shaft 7 may rotate on a low friction device such as a needle ball/bearing thrust disc or other similar low friction bearing 8. The shaft 7 may be rotated externally of the plate by means of a hand wheel 9 or other type of wrench drive 10. Options requiring an output thrust greater than that generated by direct manual operation (Eg 80 lbs force applied to a hand wheel 9 or wrench limited in size due to product and/or industry acceptable wheel or wrench envelope) will incorporate an external device such as a gear chain belt or other such device and may be operated by an input shaft with its axis either longitudinal or at any angle to the actuator longitudinal axis.

The override thrust and locating components may be sealed against environmental ingress by a suitable arrangement. A locking device may be fitted to prevent uncontrolled rotation of the override screw.

The inner end of the screwed shaft 7 enters through the yoke frame 3 and screws into a second thrust nut 4', the nut being held captive to prevent rotation with the yoke frame 3. The nut 4' is prevented from unscrewing off the end of the shaft 7 by a circlip, split pin 11 or roll pin.

The spring cartridge module 5 incorporates stored energy mainly by means of compressed springs 12 or alternatively other force imparting means could be constructed within the assembly.

A safety device is connected to the abutting faces of the spring cartridge module 5 and actuator housing

1. The safety device comprises a retention device such that failure or removal of the retaining fasteners whilst spring force is being generated would result in the spring cartridge being retained by the safety device to the actuator housing.

The end face 13 of the housing 1 incorporates two or more through holes 14 which are accessible from the internal side of the housing end face. The spring cartridge module front mounting plate face incorporates 2 or more hook shaped devices 15. The tip of each of the hook shaped devices 15 terminates in a spigot 16 with a diameter such that a clearance entry to the hole 14 in the actuator end face is possible.

The assembly of the unit permits the retaining devices to enter into the actuator housing 1 and be rotated to a position in which the retaining fasteners 14,16 are aligned. In this alignment the hook part 15 of the safety device is located with slight clearance immediately above the inner face entry of the hole 14 through the housing end face.

The principle of operation of the device is that for normal actuator operation ie by pressure source, the override mechanism remains in the park position, as shown in Figure 5 the device incorporating lost longitudinal motion by allowing the internal end of the rectangular thrust face of the yoke frame 3 to travel slidably along the non rotating override screw shaft 7. Rotation of the hand wheel 9, wrench drive or other rotational input device by the operator causes the override thrust nut 4' to screw up the shaft 7 abutting the inner end of the scotch yoke frame 3 and causes the actuator to rotate.

In the process of actuator rotation, a spring force is compressed opposing the actuator rotation being generated by rotation of the hand wheel 9. Reverse rotation of the manual override screw turning device allows the compressed spring force to be released causing actuator rotation.

Failure or removal of the normal retaining means of the spring cartridge module 5 with stored energy present would result in the cartridge moving outwards from the actuator housing 1. During this action the spigots 16 provided on the hooks 15 of the safety device enter the holes 14 thus retaining the spring cartridge in position. A further safety benefit is that disengagement of this device is not possible by rotation alone.

The device as described is used for a single acting device however this may be changed to a double acting device by the application of a force imparting means applying push or pull forces to either one or other end of the yoke frame 3.

The advantages of this devices are that the device is lightweight and extremely simple to construct,. It cannot slip from engagement and there is an extremely low risk of seizure. There is no connection to any pressurized source therefore no removal of plugs is necessary and no danger to the operator should

the actuator be allowed to operate by pressure source during the manual override operation.

It is to be understood that although the preferred embodiment of the present invention has been described as having a spring retention module and an override safety device, an embodiment of the invention is envisaged without the spring retention device.

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Claims

1. An actuator for converting linear motion into rotational motion comprising a pressure chamber for receiving a working fluid, an actuator housing having a longitudinal slot provided therein, a yoke frame provided within the housing, a shaft passing through the longitudinal slot into the yoke frame, a thrust pin mounted on the shaft within the yoke frame, return means for countering working fluid pressure and an override device remote from the pressure chamber which allows forces stored within the actuator to be released in the event of failure of the actuator.
2. An actuator according to claim 1 wherein the shaft is longitudinally slidable within the slot.
3. An actuator according to claim 1 or 2, wherein the return means comprises a spring within a module mounted on the housing of the actuator and operatively connected to the shaft.
4. An actuator according to claim 3, wherein the override device comprises a safety device wherein hooks are provided on the spring module and corresponding apertures are provided on the housing to cooperate with the hooks.
5. An actuator according to any one of the preceding claims, wherein the override device comprises a hand wheel or a wrench drive for manual actuation of the actuator.

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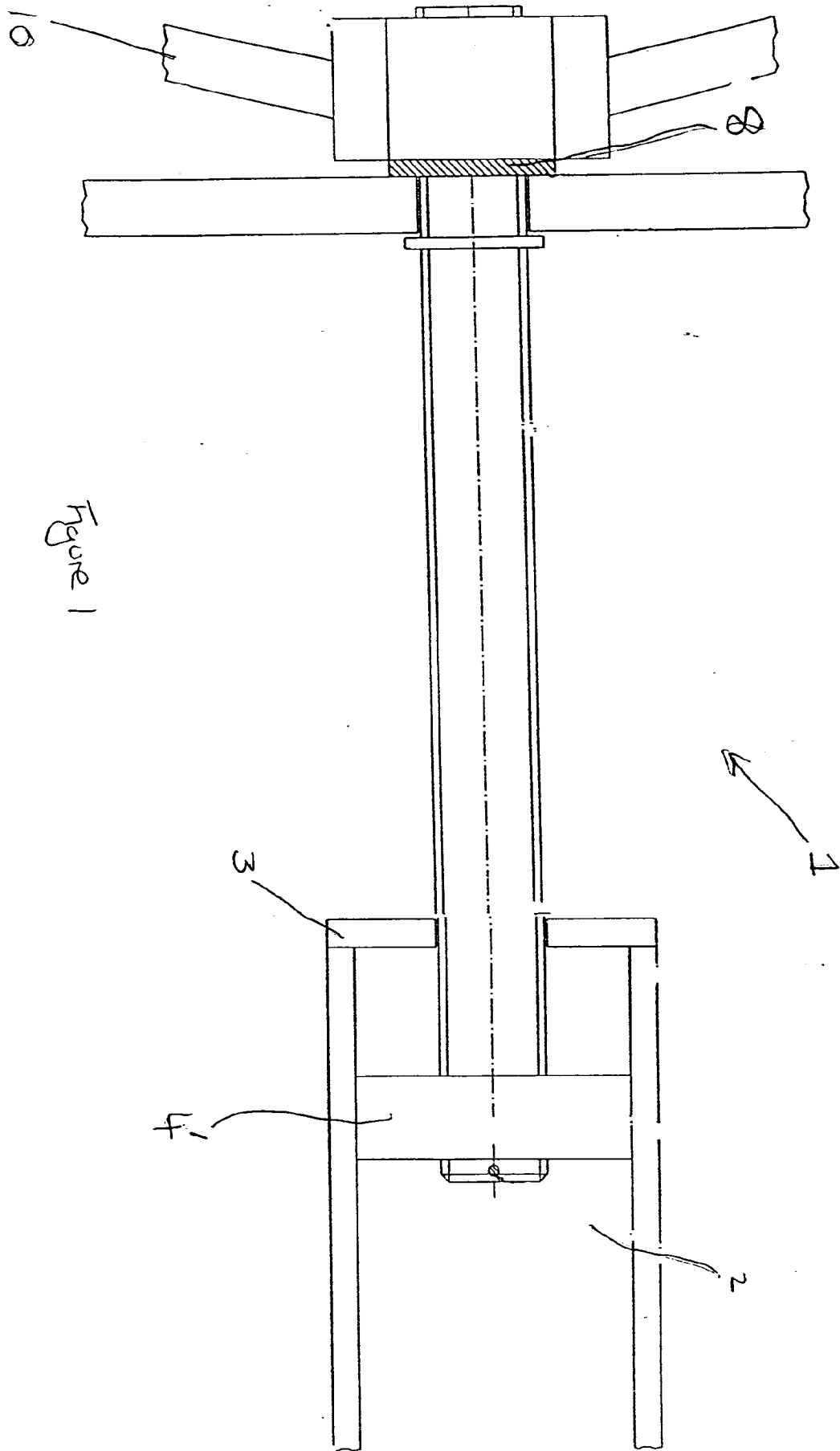
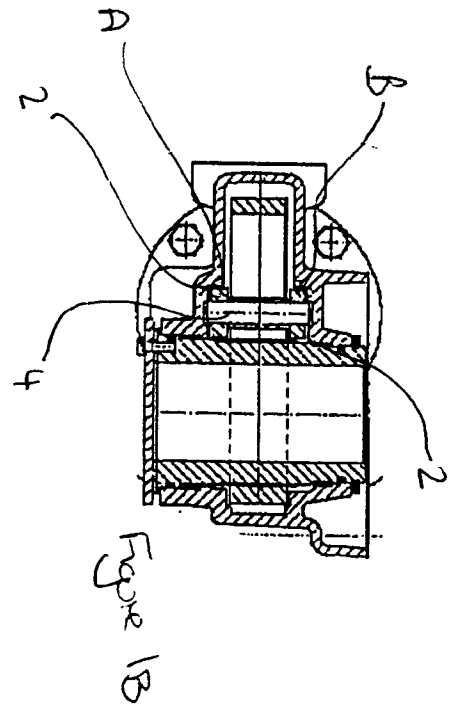
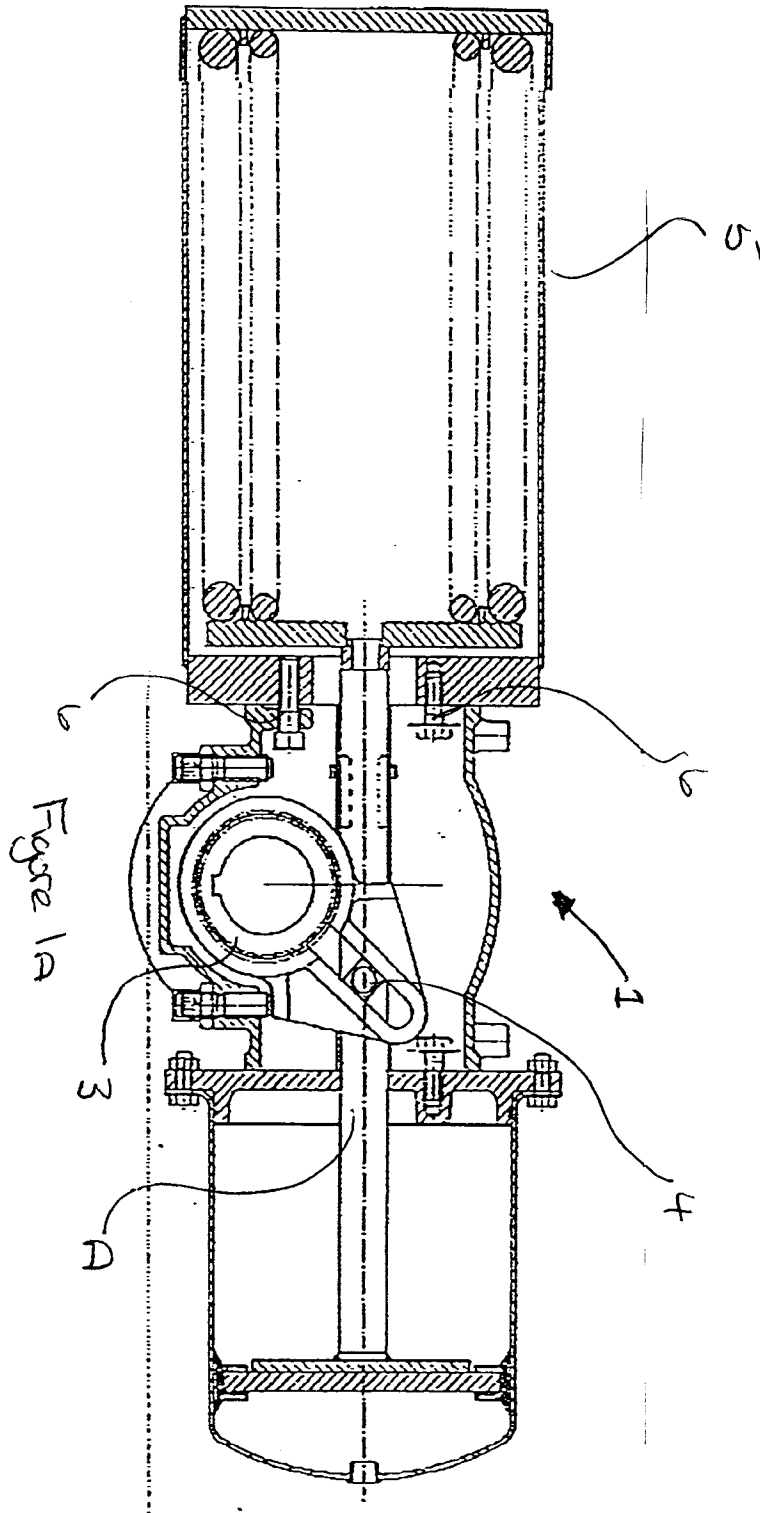


Figure 1



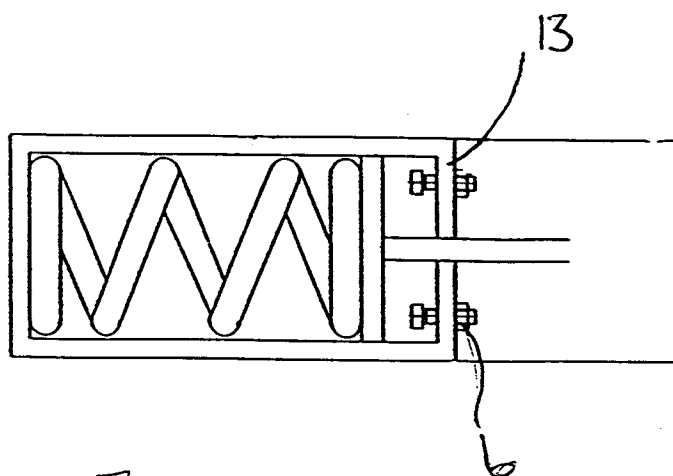


Figure 2

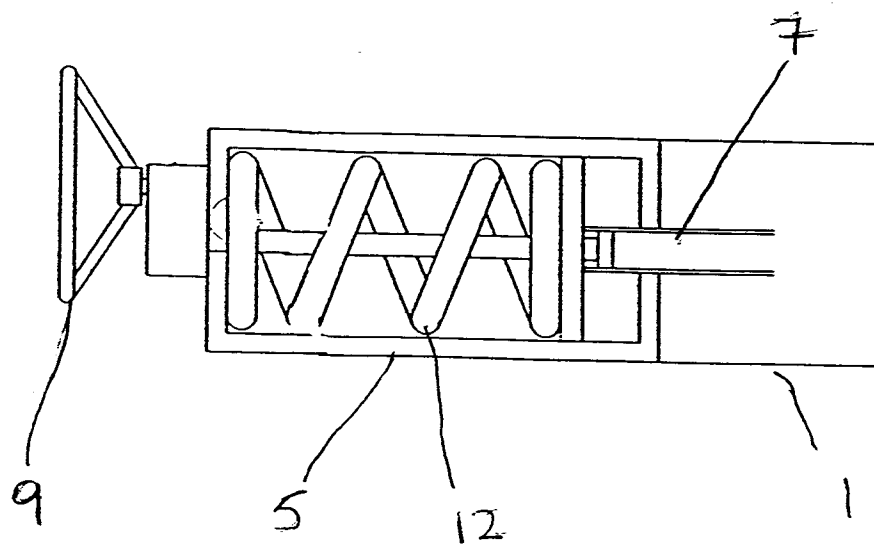


Figure 3

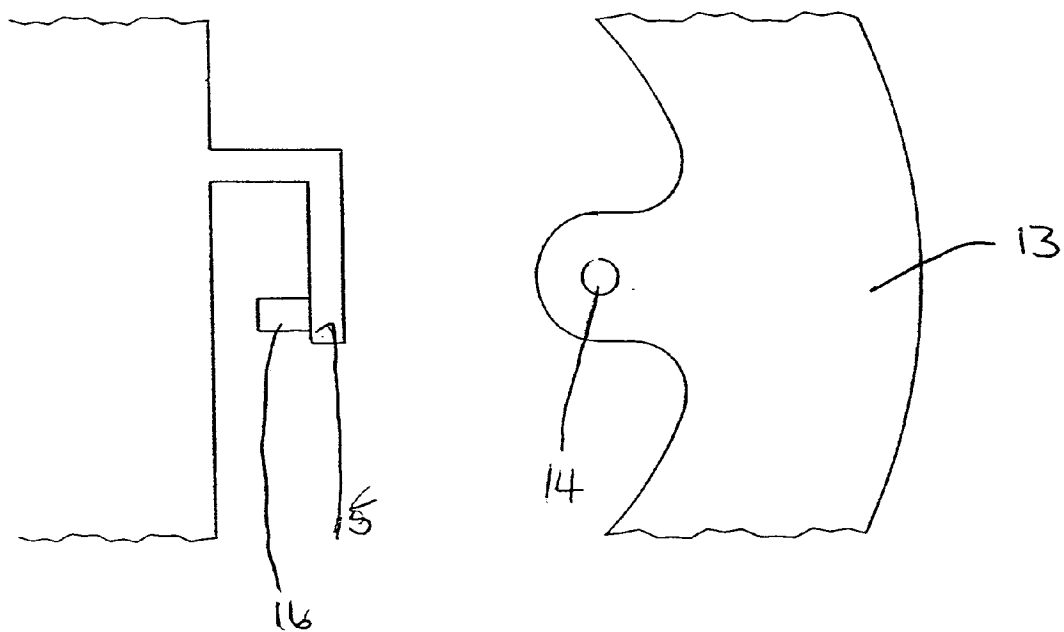


Figure 4

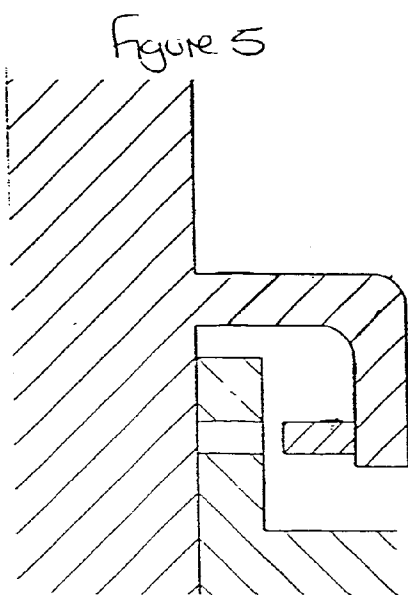


Figure 5

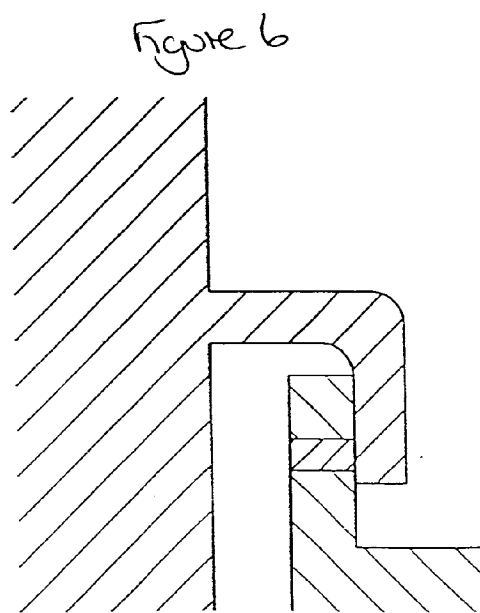


Figure 6



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 30 3449

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.5)
Y	US-A-3 801 062 (ARN ET AL.) * claim 1; figure 1 * ---	1-3,5	F15B15/08 F16K31/143
Y	EP-A-0 023 120 (ROTORK CONTROLS) * page 3, line 17 - page 4, line 14; figure 1 * ---	1-3,5	
A	DE-A-2 508 683 (YAZAKI) * page 8, last paragraph; figure 2 * ---	1,3,5	
A	DE-B-1 171 685 (KARL ADAMS) * claim 4; figures 1,2 * ---	1,5	
A	DE-U-6 800 971 (SÜDDEUTSCHE ARMATURENFABRIK) * page 2, paragraph 2; claim 1; figure 1 * -----	1,5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F15B F16K
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 12 AUGUST 1993	Examiner THOMAS C.
CATEGORY OF CITED DOCUMENTS		I : 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	
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