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(71) Applicant: **Matsui. Akio**
16-19 Fukumitsu-Minamimachi
Gifu-Shi Gifu-Ken(JP)

(72) Inventor: **Matsui. Akio**
16-19 Fukumitsu-Minamimachi
Gifu-Shi Gifu-Ken(JP)

(74) Representative: **Huntingford, David Ian et al,**
W.P. THOMPSON & CO. Coopers Building Church Street
Liverpool L1 3AB(GB)

(54) Cylinder locking device.

(57) A cylinder locking device for a fluid pressure cylinder in which two brake members (6, 7) are formed by dividing axially into two a thick cylinder having outer and inner circumferences in eccentric relation, the division being made in the region of maximum thickness and the region of minimum thickness. A piston rod (5) of a fluid pressure cylinder (1) is slidably fitted within the inner circumferential portion of the nearly semi-cylindrical brake members (6, 7). Support members (8, 9) rotatably support the outer circumferential portions of the two brake members (6, 7). A spring (14) is arranged to bias the brake members (6, 7) in a direction to lock the piston rod (5), and an actuator (20) can rotate the brake members (6, 7) in a direction to release them from their locking condition against the biasing force of the spring (14).

Fig.1

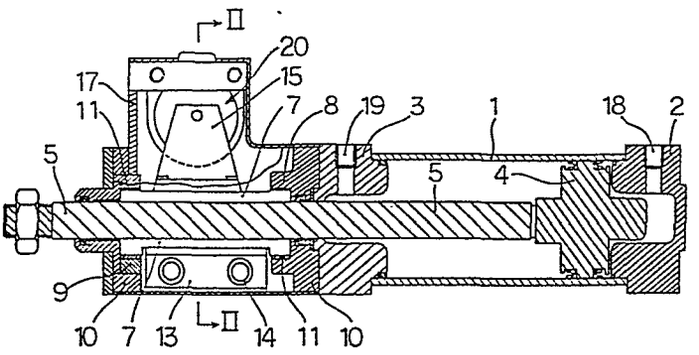
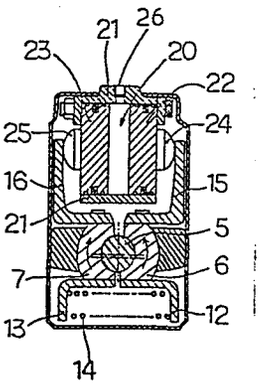


Fig.2



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DESCRIPTION

CYLINDER LOCKING DEVICE

The invention relates to a cylinder locking device for locking the piston rod of a fluid pressure cylinder at an arbitrary position, and more specifically to a cylinder locking device which can lock the piston rod automatically and securely in the event of a fault in a fluid pressure source.

The present inventors have already proposed in Japanese patent application NO. 192272/1982 a cylinder locking device of a simple mechanical type which enables the piston rod of a fluid pressure cylinder to be securely locked at an arbitrary position.

In the latter cylinder locking device, a thick-walled cylinder, having outer and inner circumferential surfaces in eccentric relation, is divided in two in the region of maximum thickness and the region of minimum thickness in the axial direction to form two thick semi-cylindrical brake members, and the piston rod of a fluid pressure cylinder is slidably fitted within the inner circumferential portion of the two semi-cylindrical brake members, these brake members being rotatably fitted in a housing, and the two brake members being rotatable in opposite directions to each other whereby to lock the piston rod therebetween.

The cylinder locking device as described above can lock the piston rod using a relatively small force and without producing shearing or rotational forces on the piston rod. In order for the device to be useful widely in practice, however, a mechanism to operate the semi-cylindrical brake members automatically is required and so far no such mechanism has been available.

In order to increase the utility of the above-described cylinder locking device, an object of the present invention is to provide a cylinder locking device which can lock the piston rod of a fluid pressure cylinder automatically and which will reliably and safely lock the piston rod in the even that a fluid pressure source or a power source is

turned off for any reason.

In accordance with the present invention, there is provided a locking device for the piston of a fluid pressure cylinder, comprising two nearly semi-cylindrical brake members formed in effect from a thick-walled cylinder, whose outer and inner circumferential surfaces are in eccentric relation, and which is divided in two in the axial direction in the regions of maximum and minimum thickness of the cylinder, and support members for rotatably supporting outer peripheral portions of the two brake members, with a piston rod of the fluid pressure cylinder slidably fitted within the inner circumferential portions of the brake members, such that said piston rod can be locked by relative angular displacement of the two brake members in opposite directions, characterized by a spring which is arranged to bias the two brake members in a direction to lock the piston rod, and an actuator for selectively rotating the brake members against the biasing force of the spring in a direction to release the locking action of the brake members on the piston rod.

The invention is described further hereinafter, by way of example only, with reference to the accompanying drawings, wherein:

Fig. 1 is a sectional side view of one embodiment of a cylinder locking device in accordance with the present invention installed to a fluid pressure cylinder; and

Fig. 2 is a sectional end view taken on the line II-II in Fig. 1.

The fluid pressure cylinder of Fig. 1 comprises a cylinder tube or wall 1, a cylinder head 2 and a cylinder cover 3, tightened and fixed at both ends of the cylinder tube 1 by one or more tie rods (not shown), a piston 4 fitted within the cylinder tube 1, and a piston rod 5 passing through the centre of the cylinder cover 3 and fixed at its base end to the piston 4. A cylinder locking device is installed on the cylinder cover 3 and surrounds the outer circumference of the piston rod 5. Numerals 6 and 7 designate nearly semi-

cylindrical brake members arranged to embrace an outer circumferential portion of the piston rod 5.

The brake members 6, 7 are formed by taking a thick-walled cylinder which is arranged to have outer and inner circumferences which are in eccentric relation and dividing this cylinder into two about an axial plane which passes through the maximum thickness portion and the minimum thickness portion of the cylinder. The two axial ends of both outer circumferential portions of the brake members 6, 7 are rotatably supported by support members 8, 9, respectively. The support member 8 serves also as a housing on one end of the cylinder cover 3. The piston rod 5 passes through the centre of the support member 8, a bearing metal being positioned at the support region. The support member 9 includes a bearing metal fitted to the inside of a housing 10, an end portion of the housing 10 slidably supporting the piston rod 5. Bushes 11 made of fluororesin as its starting material are interposed at the positions where the support members 8,9 rotatably support the brake members 6,7, whereby to decrease the sliding friction. As shown in Fig. 2, the nearly semi-cylindrical brake members 6, 7 have a respective circumferential space between each pair of opposing regions so that both members 6, 7 can be mutually rotated to some extent. In the course of such rotation the centre of the circle including the outer circumference of the brake members 6, 7 is shifted slightly downwards relative to the centre of the inner circumference thereof, i.e. relative to the central axis of the piston rod 5. Consequently, when the brake members 6, 7 are rotated in a direction to open the lower portion thereof as directed by the arrows in Fig. 2, the brake members 6, 7 are rotated in the support members 8, 9 for the outer circumference thereof and the piston rod 5 within the members 8, 9 is gripped from both sides and locked.

Brackets 12, 13 having an L-shaped cross-section are fixed to lower portions of the two brake members 6, 7 and a

coil spring 14 for biasing the brackets 12, 13 apart is hooked in a compressed state between the brackets 12, 13. The brake members 6, 7 are normally biased by the coil spring 14 into their position in which they lock the piston rod 5.

Further L-shaped arms 15, 16 are fixed in opposition to each other on upper portions of the brake members 6, 7. A fluid pressure actuator 20 is arranged between the two arms 15, 16 and is fixed to a mounting plate 17 mounted on an upper portion of the housing 10. The fluid pressure actuator 20 comprises a cylinder 21, two pistons 22, 23 spaced from each other and fitted inside the cylinder 21, and pressure projections 24, 25 located on the outside of the two pistons 22, 23 for pushing the two arms 15, 16 apart. When fluid pressure is applied between the pistons 22 and 23, they are moved outwards, thereby urging the upper portions of the arms 15, 16 apart, which in turn rotate the brake members 6, 7 in a direction counter to the arrows in Fig. 2 to release the piston rod 5.

Operation of the above-described cylinder locking device is as follows.

In normal operation, the piston 4 of the fluid pressure cylinder, and with it the piston rod 5, can be moved to the left in Fig. 1 by fluid pressure supplied via a port 18. Movement of the piston and piston rod 5 to the right is obtained by fluid pressure supplied via a port 19.

In the operating state of the piston rod 5 shown in Fig. 2, the fluid pressure actuator 20 is energised to hold the upper portions of the arms 15, 16 apart whereby the brake members 6, 7 are in the non-braking state. In other words, when fluid pressure is applied to a port 26 of the fluid pressure actuator 20, both pistons 22, 23 are moved outwards so as to urge the upper portions of the arms 15, 16 apart by way of the projections 24, 25. The two brake members 6, 7, whose outer circumferential portion is supported in the support members 8, 9, and thus rotated against the biasing

force of the coil springs 14 so as to open the circumferential gap between the uppers portions of the brake members and to close the circumferential gap between the lower portions of those members.

Since the centre of the circle which includes the outer circumference of the brake members 6,7 is shifted downwards relative to the centre of the inner circumference, i.e. from the centre of the circular section of the piston rod 5, a small gap is produced between the brake members 6, 7 and the piston rod 5 and the brake is thereby released.

On the other hand, if the fluid pressure applied to the fluid pressure actuator 20 is decreased, either delibrately in order to effect locking of the piston rod 5 or as a result of a fault, the brake members 6, 7 are caused to be rotated in the direction of the arrows in Fig. 2 and lock the piston rod 5 automatically. In other words, if fluid pressure within the fluid pressure actuator 20 is removed for any reason, the force necessary to push the pistons 22, 23 apart disappears whereby the biasing force of the coil spring 14 acting on the brake members 6, 7 causes them to rotate within the inner circumference of the support members 8, 9 so that the circumferential gap between the upper portions of the brake members 6, 7 is opened. Since the centre of the inner cirumference of the support members 8, 9, i.e., the centre the circle including the outer circumference of the brake members 6, 7, is shifted from the centre of the inner circumference of the brake members 6, 7, i.e., the centre of the circular section of the piston rod 5, the piston rod 5 is graspsed by the brake members 6, 7 from both sides and thereby locked. The piston rod 5 can thus be locked without being subjected to shearing or rotational forces.

As an alternative, an electromagnetic actuator may be used in place of the fluid pressure actuator 20.

According to the cylinder locking device of the invention described above, since the piston rod is grapsed by the two

nearly semi-cylinderical brake members, it can be locked by a mechanical brake of simple structure without producing shearing or rotational forces, whereby the piston rod or the bearing parts therefor is prevented from deformation or abrasion and the piston rod can be stopped securely and reliably. Furthermore, since the brake members are normally biased in the locking direction by the spring, even if the fluid pressure source or the power source of the actuator is suddenly turned off as a result of a fault, the piston rod is immediately locked by the biasing force of the spring and safety is secured.

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CLAIMS

1. A locking device for the piston (4) of a fluid pressure cylinder (1) comprising two nearly semi-cylindrical brake members (6, 7) formed in effect from a thick-walled cylinder, whose outer and inner circumferential surfaces are in eccentric relation, and which is divided in two in the axial direction in the regions of maximum and minimum thickness of the cylinder, and support members (8, 9) for rotatably supporting outer peripheral portions of the two brake members (6, 7) with a piston rod (5) of the fluid pressure cylinder (1) slidably fitted within the inner circumferential portions of the brake members (6, 7), such that said piston rod (5) can be locked by relative angular displacement of the two brake members (6, 7) in opposite directions, characterized by a spring (14) which is arranged to bias the two brake members (6, 7) in a direction to lock the piston rod (5), and an actuator (20) for selectively rotating the brake members (6, 7) against the biasing force of the spring (14) in a direction to release the locking action of the brake members (6, 7) on the piston rod.

2. A cylinder locking device as claimed in claim 1, wherein bushes (11) made of fluororesin material are disposed at support portions of the support members (8, 9) for rotatably supporting the brake members (6, 7).

3. A cylinder locking device as claimed in claim 1 or 2, wherein the spring (14) comprises a coil spring arranged between two brackets (12, 13) fixed to the two brake members.

4. A cylinder locking device as claimed in claim 3, wherein the coil spring (14) biases said two brackets (12, 13) apart such as to rotate said brake members (6, 7) in said support members (8, 9) in said direction to release the locking action on the piston rod.

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Fig.2

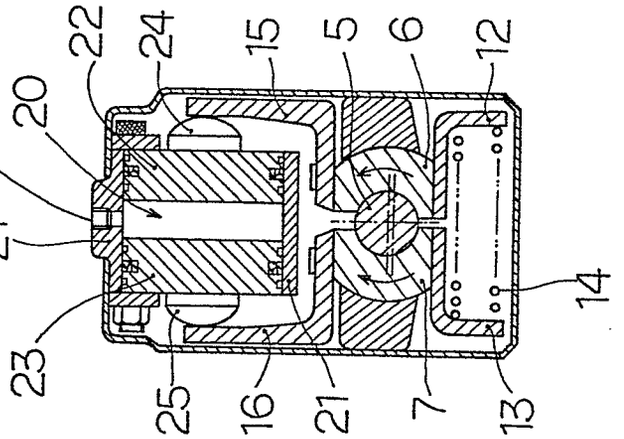

Fig.1