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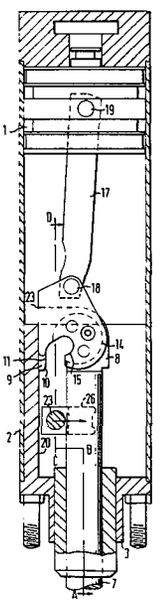
(54) Actuator.

(57) An actuator is provided which comprises a cylinder within which are a piston (1), a piston rod (7) and a mechanical linkage arranged to transmit axial movement of the piston to the piston rod at a relative speed which decreases as the piston nears the end of its travel towards the piston rod. A rigid member constituted by a pivot disc (14) and link plates (16, 16a) is pivoted to the piston rod at a first pivot point. A link (17) is pivoted at a second pivot point (18) to the link plates and at its top end is pivoted to the piston (1). A pin (23) supported in the cylinder at an axial postion intermediate the piston and the piston rod end of the cylinder for transverse sliding movement is pivoted to or pivotally engageable within the disc (14) at a third pivot point. When the piston is at the far end of its travel from the piston rod the second and third pivot points respectively constituted by the pivot (18) and the pin (23) are both on the same side of the piston axis, whereas when the piston moves towards the piston rod, the second pivot point moves to the other side of the piston axis. In a preferred arrangement the pin (23) disengages with the disc (14) when the piston rod is at the far end of its travel.



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ACTUATORS

The present invention relates to an actuator for operation by fluid pressure.

According to the invention there is provided an actuator comprising a cylinder within which are a piston, a piston rod, and a mechanical linkage arranged to transmit axial movement of the piston to the piston rod at a relative speed which decreases as the piston nears the end of its travel towards the piston rod, the linkage including a rigid member pivoted to the piston rod at a first pivot point, a link pivoted at one end to the member at a second pivot point and pivoted at its other end to the piston, a pin supported in the cylinder at an axial position intermediate the piston and the piston rod end of the cylinder for transverse sliding movement and pivoted to or pivotally engageable with the member at a third pivot point, the arrangement being such that when the piston is at the far end of its travel from the piston rod the second and third pivot points are both on one side of the piston axis and as the piston moves towards the piston rod the second pivot point moves to the other side of the piston axis. Preferably the second pivot point is nearer the piston axis than the third pivot point when the piston is at the far end of its travel.

In a preferred construction the rigid member comprises a disc rotatably mounted in a bearing formed in the end of the piston rod, the axis of the bearing being the first pivot point, an arm extending radially from the disc to one side of its axis and carrying the second pivot point

and an aperture eccentrically positioned in the disc to the other side of its axis pivotally engaging or being pivotally engageable with the pin at the third pivot point.

In a further preferred feature the pin is releaseably engageable with the disc at the third pivot point, the end of the piston rod carrying the disc moving axially towards or away from the pin as the piston moves, and the pin entering into engagement with the disc as the disc approaches the end of the pin.

Other features of the invention will be apparent from the accompanying drawings which illustrate, by way of example only, an embodiment of the invention and in which:

Figure 1 is a sectional side elevation of an actuator showing the piston at the top of its stroke;

Figure 2 is a sectional side elevation similar to Figure 1, but showing the piston at the bottom of its stroke;

Figure 3 is a sectional end elevation of part of the actuator with the piston at the top of its stroke the section being taken along lines A-B and C-D of Figure 1; and

Figure 4 is a detail side elevation showing the pin supported in a slideway in a lower end block.

The actuator shown in the drawings employs a toggle mechanism arranged to vary the force amplification throughout the stroke so that near the end of the working stroke when the piston nears the bottom of the cylinder the force amplification is large, whereas during the first part of the working stroke the force amplification is small or even negative. Such an actuator has application to, for example, a punch in which the upper part of the stroke is required only for the purpose of giving clearance to a workpiece to be inserted in and removed from the dies.

Referring now to Figures 1 and 2, a piston 1 is slidable in a cylinder 2 having a lower end block 3 slidably supporting a piston rod 7. The upper end 8 of the piston rod is flattened and of less thickness than the rod

diameter. It includes a bearing whose pivot axis is slightly offset to one side of the axis of the piston rod and a downwardly directed nose 9 on said one side bounding a slot in a lower portion of said bearing. The presence of the offset enables the actuator to give increased power and provide some compensation for side loads on the bearing. The tip of the nose is bevelled to provide a lead-in 10 and its inner face forms a slideway 11 for guiding a pin 23 through the slot in the bearing. A disc 14 pivots in the bearing and has a recess 15 opening to its edge. Overlying the disc 14 and secured to either side thereof are link plates 16 and 16a also formed with recesses corresponding to part of the slideway 11 and recess 15. The ends of the link plates 16 and 16a remote from the recesses are provided with pivot holes. One end of a link member 17 is pivoted to the link plates by means of a pivot pin 18 and the other end thereof is pivoted to the piston 1 by means of a pivot pin 19.

The lower end block 3 has a vertical slot terminating in a vertical end wall 20 and bounded by side walls 21 and 22. The piston rod 7 and link plates 16 and 16a can move axially in the slot, planar surfaces 23 on the link plates sliding over the upper portion of end wall 20 when the piston is towards the top of its stroke. Formed in side walls 21 and 22 adjacent end wall 20 at an axial position appropriately spaced from the base of the end block 3 are transversely extending slideways which slidably support a pin 23 mounted at its ends on respective trunnion blocks 24 and 25. Figure 4 shows the trunnion block 24 in its slideway 26, the pin 23 being retained by means of circlip 27.

As the piston 1 moves down the cylinder the nose 9 approaches the pin 23 which is initially at the left hand end of the slideway as seen in Figure 1. As the piston descends further the pin 23 moves along the guide surface 11 and into the bearing until it is received within the recess 15. Further downward movement of the piston causes

the disc 14 and link plates 16 and 16a to rotate to the position shown in Figure 2, the pin 23 being trapped within the bearing and being carried around the inner surface thereof. During the downward stroke the pin 23 moves to the right as seen in Figure 1, the movement being denoted by an arrow. Since the pin is free to move transversely but not axially, the net effect is that the piston rod moves very much more slowly during the latter part of its stroke and a large amplification of force is obtained. When the piston moves upwardly the toggle mechanism reverses and the pin 23 disengages with the bearing, its movement being denoted by the arrow in Figure 2.

Various modifications may, of course, be made to the embodiment described herein without departing from the invention. For example, movement of the pin 23 need not be strictly at right angles to the axis of the piston. If the slideway 26 is inclined upwards at an angle to the axis of the piston 1, there is a counteracting movement between the piston and the pin which may be advantageous in some applications. In another possible modification, the actuator may be caused to lock at the end of the working stroke either by means of an over-centre action or by mechanical action. When the line between the centre of the pin 23 and the centre of the bearing moves across a plane parallel to the piston axis, the piston rod is, of course, locked by an over-centre action. It has, however, been found with reference to the present actuator that, provided that the angle between said line and said plane is less than approximately 10 degrees, friction will lock the piston rod notwithstanding that an over-centre action does not quite take place.

The apparatus described above is a further development of that described in the Applicant's earlier British Patent Specification No. 1,401,963 and is of inherently stronger construction. The releaseable pin 23 engages with the bearing more reliably than the apparatus shown in Figure 2 of the said specification and because of the release

feature the present apparatus is not limited to a relatively short working stroke as in the apparatus shown in Figure 3 of the said specification. If, however, only a relatively short working stroke is required the slotted construction of the top of the piston rod may be replaced by a continuous eye with appropriate modification to the shape of the link plates.

While the actuator described herein is primarily intended for pneumatic use, it will be appreciated that the invention also has application to hydraulic actuators, particularly those intended for use at comparatively low hydraulic pressures.

CLAIMS:

1. An actuator comprising a cylinder within which are a piston, a piston rod, and a mechanical linkage arranged to transmit axial movement of the piston to the piston rod at a relative speed which decreases as the piston nears the end of its travel towards the piston rod, the linkage including a rigid member pivoted to the piston rod at a first pivot point, a link pivoted at one end to the member at a second pivot point and pivoted at its other end to the piston, a pin supported in the cylinder at an axial position intermediate the piston and the piston rod end of the cylinder for transverse sliding movement and pivoted to or pivotally engageable with the member at a third pivot point, the arrangement being such that when the piston is at the far end of its travel from the piston rod the second and third pivot points are both on one side of the piston axis and as the piston moves towards the piston rod the second pivot point moves to the other side of the piston axis.

2. A piston according to Claim 1, wherein the rigid member, the piston rod, the link and the pin are arranged so that the second pivot point is nearer to the piston axis than the third pivot point when the piston is at the far end of its travel.

3. An actuator according to Claim 1 or 2, wherein the rigid member comprises a disc rotatably mounted in a bearing formed in the end of the piston rod, the axis of the bearing being the first pivot point, an arm extending radially from the disc to one side of its axis and carrying the second pivot point, and an aperture eccentrically positioned in the disc to the other side of its axis pivotally engaging or being pivotally engageable with the pin at the third pivot point.

4. An actuator according to any preceding claim, wherein the pin is releasably engageable with the disc at the third pivot point, the end of the piston rod carrying the disc moving axially towards or away from the pin as the piston moves, and the pin entering into engagement with the disc as the disc approaches the end of the pin.

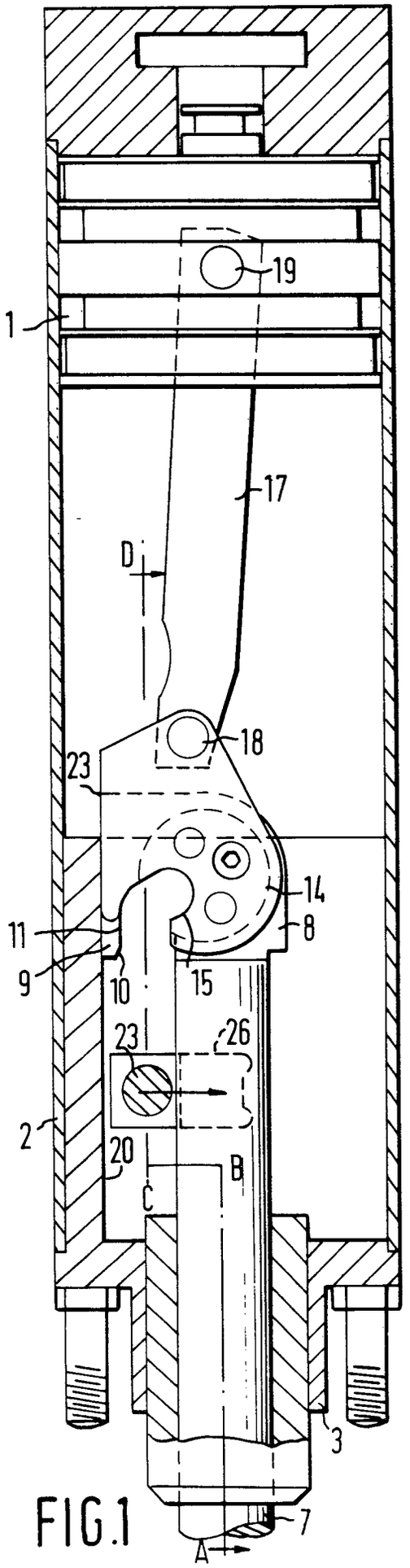
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FIG.1

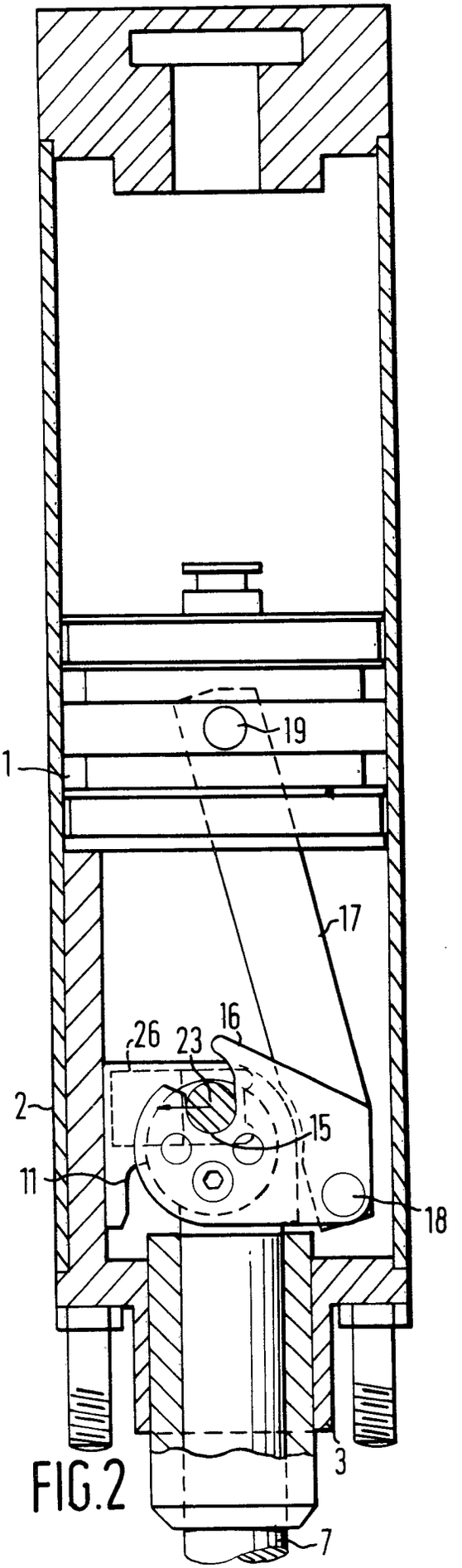
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FIG.2

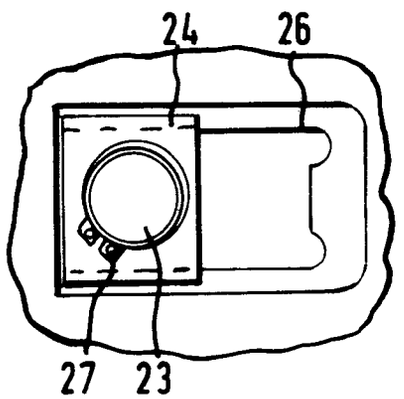

FIG.4

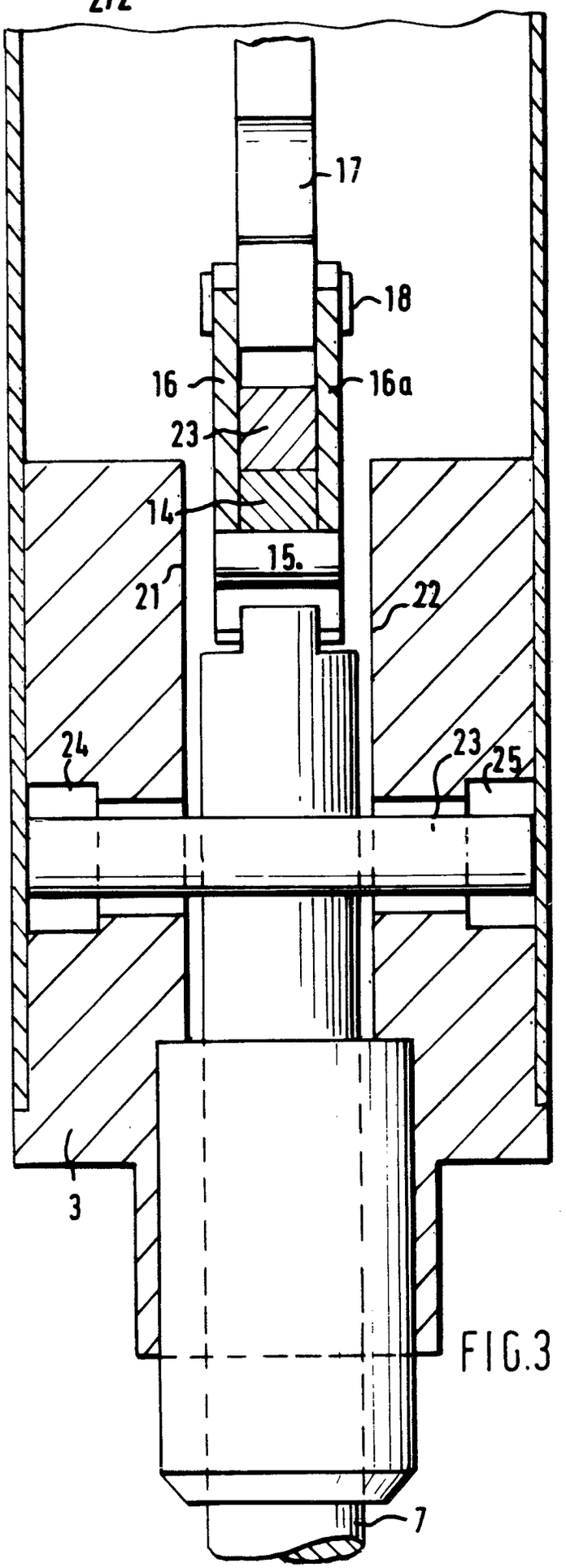

FIG.3

European Patent Office

EUROPEAN SEARCH REPORT

0024276
Application number
EP 79 30 1648

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
D	GB - A - 1 401 963 (TOURDELOS) * Page 2, lines 51-103; figures 2,3 * -- DE - A - 2 253 732 (BREMS) * Page 22, line 1 to page 26, line 17 * ----	1,2,3 1

CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)

F 15 B 15/20
15/02
F 16 H 21/44

TECHNICAL FIELDS SEARCHED (Int.Cl. ³)

F 15 B
F 16 H
B 30 B

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28-03-1980	KNOPS

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