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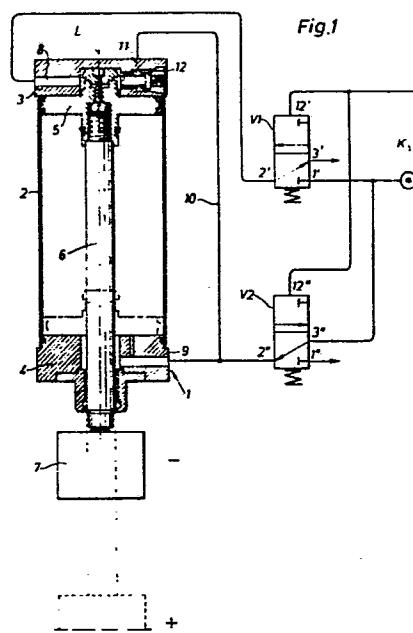
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(54) **Locking device for fluid cylinders.**

(57) The invention relates to a locking device for end position locking of a cylinder piston (5) which is displaceable back and forth between a first and second cylinder end wall (3, 4) in a fluid cylinder (1), comprising at least one locking piston (12), which is movable at an angle to the cylinder axis (L), and which is spring-loaded towards a locking position for engagement with the cylinder piston or a means connected therewith, so that the cylinder piston (5) is locked adjacent to said first cylinder end wall (3). According to the invention, the locking piston (12) is movable to a retracted position by the action of the pressurized fluid exerted on a piston surface on the locking piston in a separate chamber, which communicates (10) with the cylinder chamber situated between the cylinder piston (5) and said second cylinder end wall (4), so that, when the cylinder piston (5) is moved away from said first cylinder end wall (3), the residual pressure of the pressurized fluid in said cylinder chamber keeps the locking piston (12) in its retracted position, whereby the locking piston, due to the spring loading, secures the locking of the cylinder piston (5) only in case of a predetermined pressure drop of the pressurized fluid.

EP 0 032 363 A1



Locking device for fluid cylinders.

The invention relates to a locking device for end position locking of a piston in a fluid cylinder, i.e. a pneumatic or
5 hydraulic actuating cylinder.

In many cases it is desirable to enable the piston to be fixed in a fluid cylinder during transport and mounting operations as well as during final use of the cylinder. By locking the
10 piston with the piston rod in a fully retracted position, the rod is protected during packing and transport operations. When mounting the cylinder, e.g. in a vertical position with a hanging load, it is likewise advantageous to lock the piston in an end position in the cylinder. Moreover, in many cases,
15 in particular for safety reasons, it is essential to provide that the piston is locked automatically in an end position in case of a pressure drop of the operational fluid.

Thus, in connection with electrolytical production of aluminium, a s.c. crust breaker is used, which pierces through a
20 solid crust formed on top of the molten aluminium, so that the solid material is brought down into the molten material and is united therewith. Crust breakers of this kind are preferably suspended in and operated by pneumatic cylinders. In such an
25 environment, the cylinders are exposed to great strain, i.e. by way of high temperatures, risk of damage on connection hoses, etc. Normally, the cylinder piston and the crust breaker attached to the piston rod are held in an upper end position, and the cylinder is intermittently actuated for piercing
30 through the solid material and bringing down the latter into the molten material. Now, it is desirable to provide an automatically operating locking device, which will positively lock the cylinder piston in its upper end position in case of a pressure drop of the pressurized air (e.g. by hose break-
35 age) and, thus, prevent the piston rod and the crust breaker from falling down into the molten material for a relatively

long period and causing contamination and damage to the valuable aluminium molten material.

To provide such a locking device it is close at hand to use
5 one or more locking bars co-operating with the cylinder piston and being movable transversally thereto, said locking bars being spring-loaded towards locking positions and being normally retracted in positions permitting the cylinder piston to freely perform the operational strokes.

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However, for such a locking device, it is rather difficult to prevent wear (since the spring loaded locking bar contacts the cylinder piston or a member connected thereto) or stalling
(in case the locking bar is continuously kept in a retracted
15 position and is brought into a locking position only in case of hose breakage or the like).

The object of the invention is therefore to achieve a generally useful locking device which solves the above-mentioned problems
20 and secures an automatical end position locking of a cylinder piston in case of a predetermined pressure drop of the pressurized fluid without requiring high durability of the parts being in mutual locking engagement or involving any risk of stalling.

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This object is achieved by means of a locking device having the features stated in claim 1. Suitable additional features are defined in the sub-claims 2-6.

30 Thus, owing to the fact that the locking bar operates in response to the pressure in the opposite cylinder chamber, two substantial advantages are obtained. In the first place, during normal operation, any locking engagement is avoided between the locking bar and the cylinder piston, and in the second place,
35 a passive stroke back and forth will be effected by the locking bar for each working stroke, namely when the cylinder piston is at distance from the locking bar. Hereby, the locking bar is kept operative so as to eliminate the risk of stalling. Thus,

the operational reliability is very good.

The invention will be described further below with reference to the drawings illustrating a preferred embodiment of a
5 locking device according to the invention.

Fig. 1 shows schematically a vertically arranged pneumatic cylinder and conduits and valves connected thereto; and

10 Fig. 2 shows in a larger scale a portion of the upper end wall, in which a locking device according to the invention is disposed.

The pneumatic cylinder shown in Fig. 1 comprises, as previously known per se, a cylinder tube 2, two end walls, namely an
15 upper end wall 3 and a lower end wall 4, a piston 5 displaceable between the end walls 3,4 in the cylinder tube, a piston rod 6 connected to the piston 5, said rod extending sealingly through the lower end wall 4 and carrying at its end a load 7
20 (e.g. the crust breaker discussed above), as well as connecting ports 8 and 9 for the supply of pressurized air to the two cylinder chambers situated between the cylinder piston 5 and the end walls 3 and 4, respectively.

25 For the operation of the actuating cylinder by means of pressurized air, the connecting ports 8,9 are connected to each one of two pressure controlled 3-port, 2-position valves V1 and V2, respectively, provided with a return spring (in principal, the valves V1,V2 can be replaced by one directional
30 valve only, namely a 5-port, 2-position valve). A pressurized air source K (main pressure, e.g. 3-8 bar) is connected to the inlet ports 1' and 3", respectively, of the valves, while the outlet ports 2' and 2", respectively, of the valves are connected to connecting ports 8 and 9, respectively, of
35 the actuating cylinder. In the illustrated rest position, wherein the piston is located in its upper end position adjacent to the upper cylinder end wall 3, the pressurized air

source K communicates with the lower cylinder chamber via the valve V2, i.e. the chamber between the cylinder piston 5 and the cylinder end wall 4, whereas the upper cylinder chamber (having a negligible volume in the shown position) communicates with the valve outlet 3' via the connecting port 8 and the outlet port 2' of the valve V1.

If an actuating signal (a certain air pressure) is applied simultaneously on the control ports 12', 12" of the valves, the positions of the valves V1, V2 are reversed, so that the upper cylinder chamber is instead connected to the pressurized fluid source via the ports 2' and 1' of the valve V1, whereas the lower cylinder chamber is connected to the outlet 1" of the valve V2. Hereby, the piston 5 will perform a downward movement, so that the load 7 is lowered from the fully drawn upper position (minus position) to the dashed lower position (plus position). The load is kept in the lower position as long as the actuating signal is applied on the control ports 12' and 12". As soon as the actuating signal ceases, the valves V1 and V2 are reversed, and the piston 5 and the load 7 are returned to the upper end position.

As appears further from Fig. 1, the connecting port 9 of the cylinder 1 communicates with a connecting port 11 in the upper end wall 3 via a conduit or hose 10. Hereby, a locking piston 12 mounted in the end wall 3 is actuated in a way described further below with reference to Fig. 2.

In a radial recess or bore 13 in the cylinder end wall 3 a sleeve 14 is inserted to perform a guiding means for the above-mentioned locking piston 12. Radially outside of the guide sleeve 14 and the locking piston 12, an end plug 15 is screwed therein. The end plug 15 is provided with a central, through opening 16, in which a filter 17 is inserted between an inner O-ring 18 and an outer locking ring (a s.c. Seeger ring). The through opening 16 of the end plug 15 has internally (i.e. to the left in Fig. 2) a wider portion, the shoulder

surface 20 of which forms a seat for a pressure spring 21, which urges the locking piston 12 towards the axis L of the cylinder (dashed), so that in the shown position an internal locking tongue 22 on the locking piston 12 is brought into locking engagement with a member connected to the cylinder piston 5, namely a locking flange 23 which is centrally fixed by means of a screw 24 to a neck 25 protruding axially from the cylinder piston 5. The upper edge 26 of the locking flange 23 is bevelled obliquely, and the lower edge 27 of the locking tongue 22 has a corresponding bevel, though not as steep, so that the locking flange 23 can be displaced upwards so as to cause the locking piston 12 to move (towards the right in Fig. 2) against the action of the spring 21, e.g. before transport of the cylinder 1 or in connection with the suspension of a load 7 at the end of the piston rod 6 (see Fig. 1) before connecting the pressurized air.

In order to prevent the locking piston 12 from rotating about its axis, a guide pin 28 is inserted into the wall of the guide sleeve 14. The guide pin 28 protrudes into a longitudinal groove 29' in the upper portion of the locking piston. The above-mentioned connecting port 11, communicating with the connecting port 9, is connected to a chamber 29 inside the guide sleeve 14, said chamber 29 being limited on the one hand by an annular shoulder surface 30 of the guide sleeve 14 and on the other hand by an annular piston surface 31 on a widened portion 32 of the locking piston 12. Annular sealings 33 and 34, respectively, of a s.c. sliding-O-ring type ensure that the chamber 29 is kept pressure separated from the upper cylinder chamber of the cylinder 1 as well as the ambient air.

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The locking device operates in the following way: In the rest position according to Fig. 1, the lower cylinder chamber and the separate chamber 29 communicate with the pressurized air source K, and therefore the locking piston is located in its right hand position not shown in Fig. 2, because the spring 21 is dimensioned so as to be overcome by the pressure exerted by

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the pressurized air on the piston surface 31. Now, when an actuating signal is applied to the control ports 12', 12" of the valves V1, V2, whereby the valves are reversed, the full main pressure is quickly obtained in the upper cylinder chamber of the cylinder 1, since this cylinder chamber has a very small volume. The lower cylinder chamber, however, has a rather large volume and will therefore be emptied relatively slow via the outlet port 9 and the outlet 1".

10 When the pressure difference between the upper and the lower cylinder chambers reaches a certain value, e.g. 0,5-1 bar, the cylinder piston 5 starts its downward movement. At this moment, however, the lower cylinder chamber and the chamber 29 communicating therewith still have a remaining counter
15 pressure of e.g. 2-3 bar, and therefore the locking piston 12 is held in its retracted position to the right. Only when the remaining pressure in the last-mentioned chamber has been reduced to a predetermined value, e.g. approximately 1,6 bar, the spring 21 has the power to displace the locking piston 12
20 to its left end position. At this time, however, the cylinder piston 5 and its locking flange 23 have already sunk far down into the cylinder 1, normally all the way down to the lower end position (dashed in Fig. 1). As long as the actuating signal is applied on the valves, the piston 5 and, consequently,
25 the load 7 as well remain in this lower end position.

As soon as the actuating signal ceases, the valves V1, V2 are reversed again, whereby the lower cylinder chamber and the separate chamber 29 (now having a rather small volume) quickly
30 reach the air source main pressure of 3-8 bar. Hereby, the locking piston 12 immediately returns to its retracted right hand position, whereas the cylinder piston 5 together with its load 7 somewhat later reach their upper position 12 (the rest position according to Fig. 1, wherein the locking piston, as mentioned
35 above, is located in its right hand position).

The locking device described above has the following advantages:

- During normal service conditions, no locking engagement between the locking piston 12 and the cylinder piston 5 will ever occur, and therefore the wear is reduced to a minimum;
- 5 - Each time the cylinder piston 5 performs an actuating stroke, the locking piston is displaced passively back and forth, and therefore the locking piston is kept operative so that risk of stalling is small;
- When the air pressure disappears (and only then), e.g.
10 due to a hose breakage in the main conduit from the pressurized air source or in one of the conduits which are integrated with the cylinder-valve-system, the locking piston 12, by the action of the spring 21, will be quickly displaced to its left end position into lock-
15 ing engagement with the locking flange 23 connected to the cylinder piston 5;
- The area of the piston surface 31 of the locking piston 12 and the spring force 21 can easily be so dimensioned that a good safety margine is obtained for the desired
20 functions for a given load and a given main pressure of the pressurized air source;
- The cylinder piston 5 can be fixedly held in its end position during transport and, moreover, the mounting of the cylinder unit is facilitated, especially in a
25 vertical positon, in that the cylinder piston is locked in a retracted position.

The inventive locking device can be modified in many ways within the scope of the inventive idea defined in claim 1.

30 Thus, one or more locking pistons can be mounted at each end of the cylinder. Moroeover, the locking piston can co-operate with the piston rod instead of the locking flange 23. Nor is the orientation of the cylinder essential to the invention, though several advantages are gained by the illustrated
35 vertical orientation. The actuating cylinder may be single-

acting (by means of a return spring or by way of a load) or double-acting (as described). Finally, the pressurized fluid may be constituted by either oil or gas (air).

C L A I M S

1. A locking device for end position locking of a cylinder piston (5), which is displaceable back and forth between a first and a second cylinder end wall (3,4) in a fluid cylinder (1), comprising at least one locking piston (12), which is movable at an angle to the cylinder axis (L) and which is spring-loaded (21) towards a locking position for engagement with the cylinder piston or a means (23) connected therewith, so that the cylinder piston (5) is locked adjacent to said first cylinder end wall (3), characterized in that the locking piston (12) is operable towards a retracted position by the action of the pressurized fluid exerted on a piston surface (31) on the locking piston in a separate chamber (29), which communicates (10) with the cylinder chamber situated between the cylinder piston (5) and said second cylinder end wall (4), so that, when the cylinder piston (5) is moved away from said first cylinder end wall (3), the residual pressure of the pressurized fluid in said cylinder chamber keeps the locking piston (12) in its retracted position, whereby the locking piston, due to the spring loading, secures the locking of the cylinder piston (5) only in case of a predetermined pressure drop of the pressurized fluid.
2. A locking device as set forth in claim 1, characterized in that the locking piston (12) is slidably mounted in a recess (13) in said first cylinder end wall (3), said separate chamber (29) forming a part of said recess.
3. A locking device as set forth in claim 2, characterized in that the recess (13) is situated in a peripheral part of the cylinder end wall (3), wherein the locking piston (12) in its locking position extends inwardly and engages with said means (23) connected to the cylinder piston (5,25).

4. A locking device as set forth in claim 3, characterized in that said means (23) is arranged on a cylinder piston neck (25), which is displaceable into a central cavity in the cylinder end wall (3).

5. A locking device as set forth in anyone of claims 1-4, characterized in that said cylinder chamber (between 5 and 4) and said separate chamber (29) are jointly connected to a pressurized fluid source (K) via a two-positional valve (V2), which in one of its positions connects said chambers to the pressurized fluid source and in its other position connects said chambers to an outlet (1").

6. A locking device as set forth in claim 5, characterized in that the spring force (21) exerted on the locking piston (12) is dimensioned in such a way that the spring force balances the pressurized fluid pressure exerted on the piston surface (31) of the locking piston at a pressure exceeding the outlet pressure but lying below the pressure of the pressurized fluid source (K).

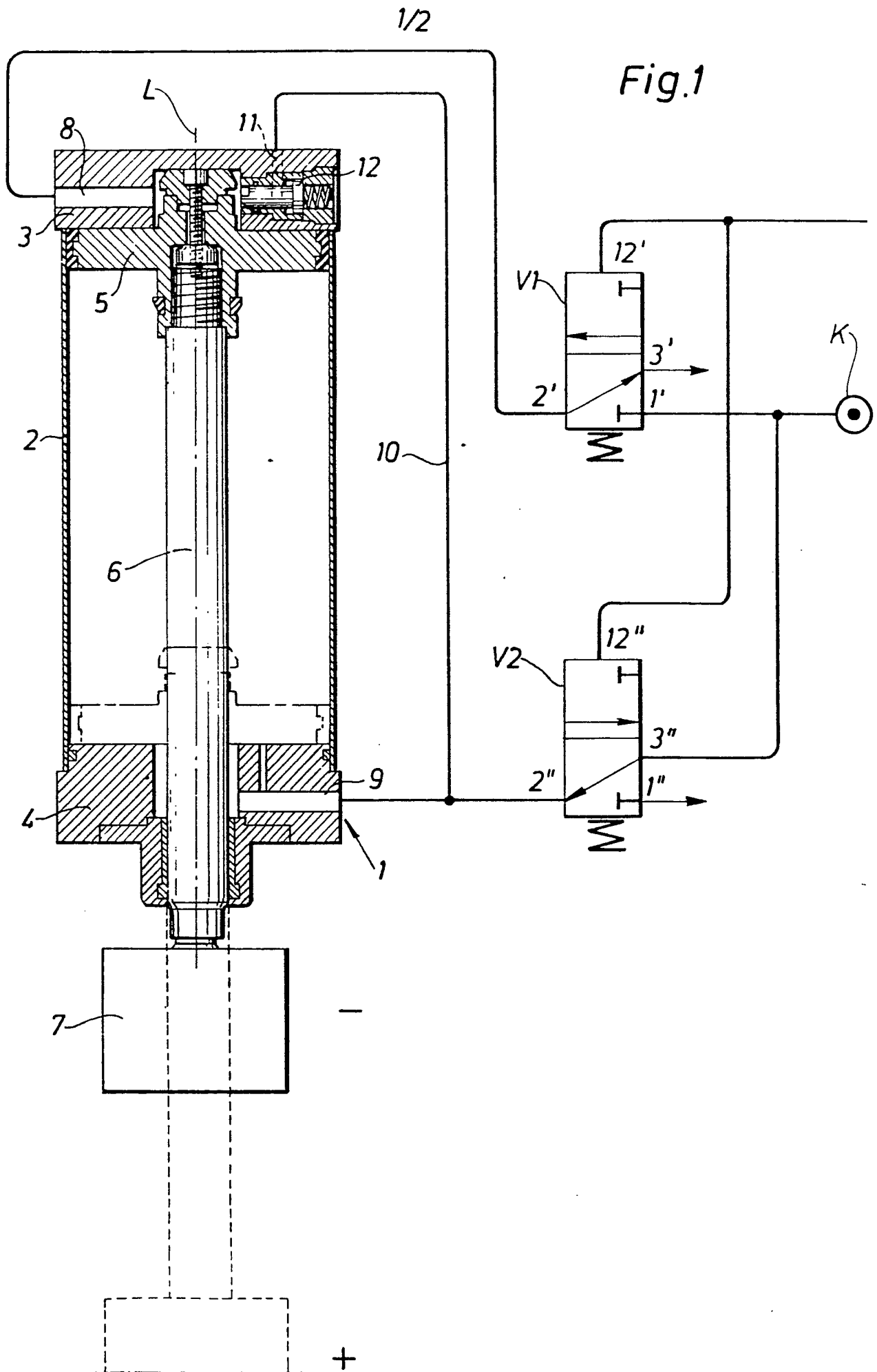
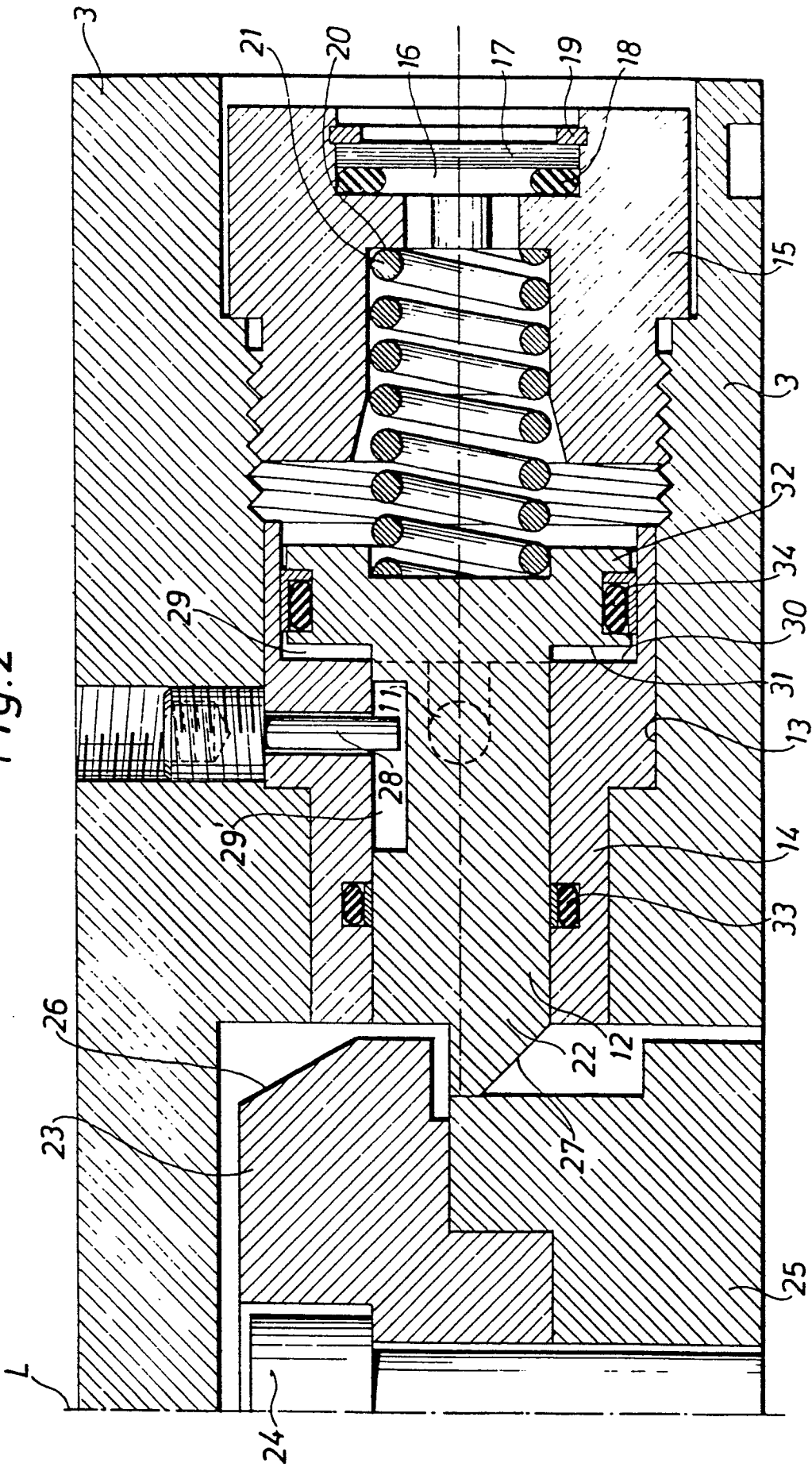


Fig.2



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EUROPEAN SEARCH REPORT

Application number

EP 80 85 0194.4

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	<u>US - A - 3 359 862</u> (J.L. MODRICH) * claims 1 to 3; fig. 1, 2, 4, 6 * ---	1-5	F 15 B 15/26 F 16 J 10/02
X	<u>US - A - 3 889 576</u> (H.I. SHEFFER et al.) * claim 1; fig. 1 to 3 * ---	1-4	
	<u>DE - A - 1 751 159</u> (R. GEIGER PRÄZISIONS-DREH- UND FRÄSTEILE) * claim 1, page 8, lines 1 to 3; fig. 1 * ---	1-3,6	TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
A	<u>DE - A - 2 146 592</u> (WESTINGHOUSE BREMSEN- UND APPARATEBAU) ---		F 15 B 15/00 F 16 J 10/00
A	<u>DE - U - 7 715 334</u> (LIEBHERR-AERO- TECHNIK) ---		
A	<u>US - A - 3 033 171</u> (J.H. ENGELBRECHT et al.) ---		
A	<u>US - A - 3 397 620</u> (D.M. SKELTON et al.) ----		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
☒ The present search report has been drawn up for all claims			☐ member of the same patent family, corresponding document
Place of search		Date of completion of the search	Examiner
Berlin		23-03-1981	MASSALSKI