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71 Applicant: **RIVA CALZONI S.p.A.**, Via Stendhal 34,
I-20144 Milan (IT)

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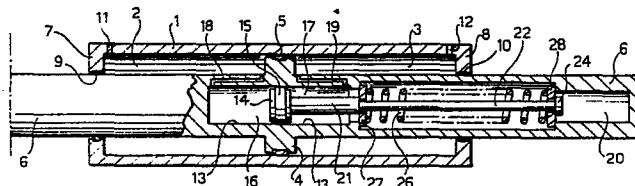
72 Inventor: **Ortelli, Aurelio**, 115, Via Saragozza,
I-40135 Bologna (IT)

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74 Representative: **Perani, Aurelio et al, c/o
JACOBACCI-CASETTA & PERANI S.p.A** 7, Via Visconti di
Modrone, I-20122 Milano (IT)

54 **Overload protection device for a hydraulic cylinder.**

57 A device for protecting a hydraulic cylinder (1) against possible overloading is constituted by an auxiliary hydraulic cylinder (13) in which each working chamber (16, 17) is connected hydraulically by a respective duct (18, 19) to a corresponding working chamber (2, 3) of the protected cylinder (1). The piston rod (21) of the auxiliary cylinder (13) is connected to a spring (26) which yields in a direction opposite the direction of displacement of the rod (21) resulting from the surpassing of a compression force of a value greater than a limit which is predetermined in accordance with the value of the maximum pressure which can be borne by the protected cylinder (1). The device avoids failure of the cylinder (1) and any hydraulic apparatus connected thereto, and also returns the piston rod (6) of the protected cylinder (1) automatically to the initial position from which it was displaced as a consequence of the intervention of the protection device.



Overload protection device for a hydraulic cylinder

The present invention relates to a device for protecting a hydraulic cylinder against overloading which could damage its structure.

As is known, a hydraulic cylinder is normally used for
5 moving an object in a straight line by means of a rod connected to its piston, and for maintaining the object firmly in position at a desired point along its line of movement.

According to the prior art, the object so moved is kept
10 in position by cutting off the two chambers of the cylinder by means of the distributor of the pressurised working fluid, or by means of suitable valves connected in the supply and discharge ducts of the chambers.

If, under these conditions, an external force tries to
15 move the rod of the cylinder, the incompressibility of the working fluid, generally oil, does not allow any movement.

Cases do occur, however, in which the degree of external force applied to the rod of the cylinder is such that
20 the pressures within the cylinder reach values which are unacceptable as regards either the strength of the cylinder itself or the apparatus hydraulically connected thereto.

In order to avoid failure, the prior art makes use
25 of maximum pressure valves connected to the working chambers of the cylinder, which, by opening at a maximum predetermined pressure, allow part of the pressurised fluid to leave one of the chambers.

The intervention of the valves, however, results in a movement of the rod and hence of the object connected to the rod, which leaves its correct position.

Once the external force has ceased, it is thus necessary
5 to act on the hydraulic circuit manually or automatically to return the rod and the object controlled thereby to the initial position where the external disturbing forces occurred.

The problem behind the present invention is thus to
10 provide a protection device for a hydraulic cylinder which avoids the failure of the cylinder and the apparatus hydraulically connected thereto when overloading arises due to any external disturbing forces, and which at the same time allows the rod of the cylinder and hence
15 the object controlled by this rod to be returned automatically to the initial position where the disturbing forces arose.

This problem is solved in accordance with the invention by means of a protection device which is characterised
20 in that it comprises an auxiliary hydraulic cylinder in which each working chamber defined by its piston is in constant hydraulic communication through a respective duct with a corresponding chamber of the hydraulic cylinder to be protected, and in that the rod is
25 connected to a resilient member which yields in a direction opposite the direction of any displacement of the rod itself resulting from the surpassing of a force of predetermined value acting on the piston due to the pressure differential created
30 in the hydraulic cylinder to be protected by the exceeding of the maximum pressure allowable within the cylinder to be protected.

The invention will now be more fully described with reference to an embodiment of the device illustrated in the appended drawings, in which:

Figure 1 is a longitudinal section of a hydraulic cylinder provided with a protection device according to the invention;

Figure 2 is a longitudinal section of the cylinder of Figure 1, to the rod of which is applied an external axial disturbing force acting in one direction;

Figure 3 is a longitudinal section of the cylinder of Figure 1, to the rod of which is applied an external axial disturbing force acting in the opposite direction to that of Figure 2.

With reference to the drawings, a conventional hydraulic cylinder 1 has its interior divided into working chambers 2, 3 by a piston 4 which slides in a straight line within the cylinder 1. A conventional sealing ring 5 is located on the piston 4.

In a conventional manner, the piston 4 is rigid with a rod 6 which, in the example illustrated, is of the type which projects from both ends 7, 8 of the cylinder 1 through respective apertures provided with conventional seals 9, 10.

The working chambers 2, 3 are provided with respective ducts 11, 12 for alternating hydraulic connection to a source of pressurised fluid, generally oil, and to a discharge vessel, not illustrated, through a distributor, also not illustrated since it is conventional.

In accordance with the invention, in a preferred embodiment, the rod 6 has a cylindrical cavity 13 within which is slidable a piston 14 with a seal 15. This piston divides the cylindrical cavity 13 into
5 two working chambers 16, 17. The whole thus constitutes an auxiliary hydraulic cylinder. A duct 18 effects a constant hydraulic connection between the chamber 16 and the chamber 2 of the cylinder 1 to be protected, while a second duct 19 effects a constant hydraulic connection
10 between the chamber 17 and the working chamber 3 of the cylinder 1.

The rod 6 of the cylinder 1 also has a cylindrical cavity 20 coaxial with the cavity 13. This cavity 20, in the preferred embodiment shown in the drawings, communicates
15 hydraulically with the working chamber 17 of the auxiliary hydraulic cylinder. A rod 21 is connected to the piston 14 and, in the embodiment illustrated, projects only from the side facing the chamber 17.

This rod 21 is extended by a coaxial section 22 which
20 extends longitudinally within the cavity 20 of the side 6. At the junction between the rod 21 and its extension 22 there is an annular shoulder 23, while at the free end within the cavity 20 there is a head 24 defining an annular shoulder 25 facing the shoulder 23.

25 A helical spring 26 is mounted on the extension 22 and will yield only on the surpassing of a predetermined compression value, the spring being located between two annular elements 27, 28 which, when the spring 26 is not operative, bear against the shoulders 23, 25 of the
30 extension rod 22, respectively. The latter may

slide freely axially of the said annular elements 27, 28.

The cavity 20 of the rod 6 is provided, in its turn, with two opposing annular projections 29, 30 against which the annular elements 27, 28 engage when the spring 26 is in its non-operative condition.

The operation of the device is as follows.

Supposing that an external disturbing force F_2 greater than the maximum force F_1 envisaged for the normal operation of the cylinder 1 arises and acts on the rod 6 of the cylinder 1 to be protected, while the rod 6 is retained in a predetermined position by means of the conventional blocking of the ducts 11, 12, there occurs an increase in the pressure differential between the chambers 2, 3 in the cylinder 1.

This same increased pressure differential also occurs between the chambers 16, 17 of the auxiliary cylinder 13, which are in constant communication with the chambers 2, 3 of the cylinder 1 to be protected by means of the ducts 18, 19, respectively.

As a consequence of the increase in the pressure differential, the piston 14 is moved towards the left, as seen in Figure 2, in that the spring 26, the predetermined load limit being surpassed, yields and is compressed towards the left between the annular elements 27, 28, the element 27 being retained against the projection 29 of the cavity 20.

Under these conditions, some of the working fluid present in the chamber 3 flows into the chamber 17 of the auxiliary cylinder, allowing the piston 4 of the protected cylinder 1 to move towards the right, again as seen in Figure 2, avoiding any failure.

Simultaneously, some of the fluid moved by the piston 14 in the chamber 16 flows into the chamber 2 of the protected cylinder which, its volume being increased, is able to receive it. Clearly, the volumes displaced in the two directions are equal. When the disturbing force F_2 ceases and the force less than or equal to the maximum force F_1 envisaged for the normal operation is restored, the spring 26 expands and returns to the initial condition between projections 29, 30 in the cavity 20.

The piston 14 is thus returned to its initial position and, with the return of the previously-displaced hydraulic fluid to the chamber 3 of the cylinder 1, the piston 4 is also returned automatically to the initial position.

Thus, the object (not illustrated) controlled by the rod 6 of the cylinder 1 is also automatically re-positioned exactly in its initial position.

An entirely similar operation occurs again when a disturbing force F_3 acts on the rod 6 in the opposite direction from the force F_2 .

In this case, the piston 14 of the auxiliary cylinder 13 moves towards the right, as seen in Figure 3, and the spring 26 is compressed between the annular elements 27, 28, with the latter bearing against the projection 30 of the cavity 20.

Although the invention has been described with reference to a preferred embodiment in which the auxiliary cylinder is formed within a cavity in the rod of the cylinder to be protected and the resiliently yielding member constituted by the spring 26 is also housed within a coaxial cavity in the same rod of the cylinder to be protected,

the auxiliary cylinder and its resiliently yielding member may clearly also be formed separately from the rod of the cylinder to be protected without departing from the scope of the invention.

- 5 The basic advantage of the device according to the invention is that of achieving suitable protection against possible overloading and, at the same time, returning the rod of the cylinder to be protected automatically to the initial position where the
- 10 overloading occurred, without having recourse to special operations.

Moreover, in accordance with the preferred embodiment of the invention, there is also achieved the advantage that the structural compactness of the protection device

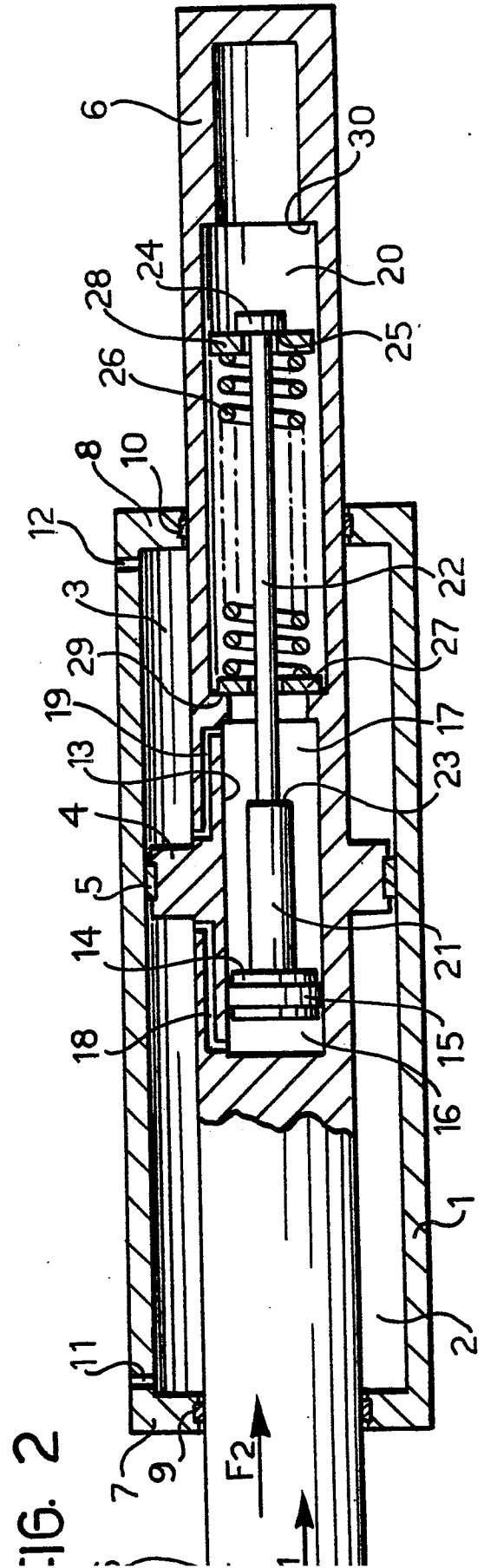
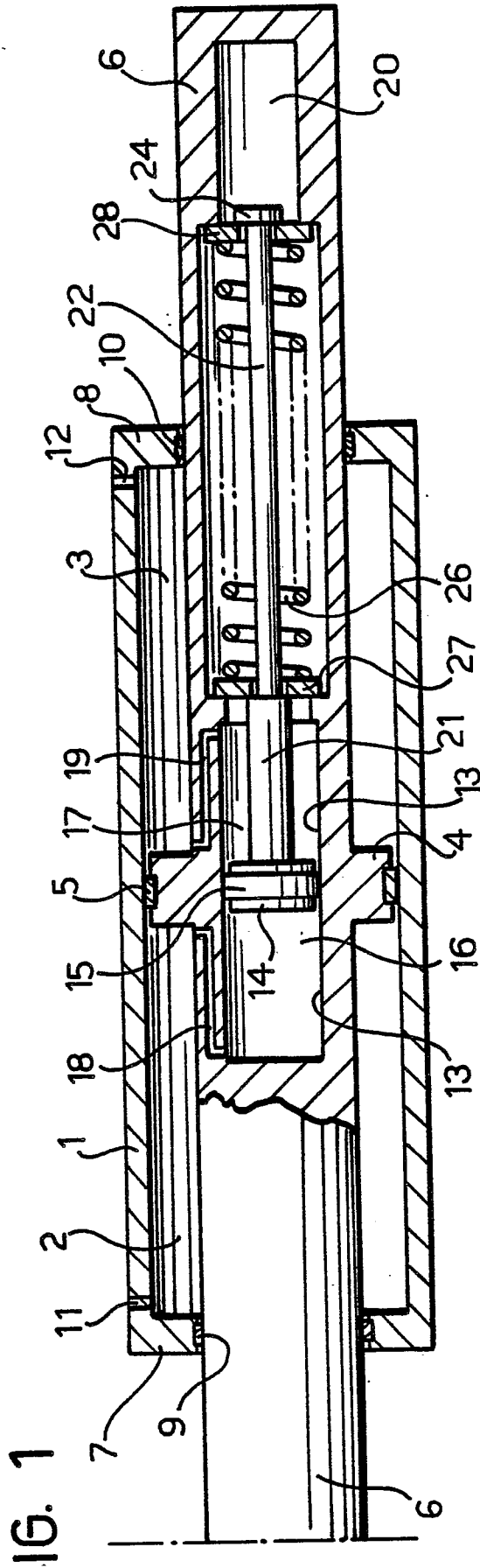
15 renders it more efficient.

Claims:

1. Device for protecting a hydraulic cylinder (1) against overloading, characterised in that it comprises an auxiliary hydraulic cylinder in which each working chamber (16, 17) defined by its piston (14) is in constant hydraulic communication through a respective duct (18, 19) with a corresponding working chamber (2, 3) of the hydraulic cylinder (1) to be protected, and in that the rod (21) of said piston (14) is connected to a resilient member (26) which yields in a direction opposite the direction of any displacement of the rod (21) itself resulting from the force acting on the piston (14) due to the pressure differential in the hydraulic cylinder (1) to be protected surpassing a predetermined value due to the pressure within the cylinder (1) to be protected exceeding its maximum allowable value.
2. Protection device according to Claim 1, characterised in that the auxiliary hydraulic cylinder (13) and the resiliently yielding member (26) connected to its piston rod (21) are housed within respective parts of a longitudinal cavity (13, 20) in the piston rod (6) of the hydraulic cylinder (1) to be protected.
3. Protection device according to Claim 2, characterised in that the auxiliary hydraulic cylinder is constituted by a cylindrical portion of the inner wall of the longitudinal cavity (13) in the piston rod (6) of the cylinder (1) to be protected.
4. Protection device according to Claim 1, characterised in that the resiliently yielding member is constituted by a spring (26) which can yield to a compression force of a value predetermined in dependence on the value of the maximum pressure allowed within the hydraulic cylinder (1) to be protected, the spring (26) being mounted coaxially on an extension (22) of the rod (21) of the

piston (14) of said auxiliary cylinder (13) between two annular end elements (27, 28) slidably mounted on the said rod extension (22) between two end shoulders (23, 25) thereof, the annular elements (27, 28) bearing against respective opposing annular projections (29, 30) on the inner wall of the axial cavity (13) in the rod (6) of the cylinder (1) to be protected when the spring (26) is in its non-operative condition.

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EUROPEAN SEARCH REPORT

0103549

Application number

EP 83 83 0172

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. ³)
X	FR-A-1 555 347 (ROBERT BOSCH) * Whole document *	1-4	F 15 B 15/20
X	US-A-4 007 667 (ELIAS) * Whole document *	1, 2, 4	
X	OELHYDRAULIK UND PNEUMATIK, vol. 6, no. 10, October 1962, page 379, Mainz, DE. "Schwenktrieb"	1, 4	
A	FR-A-2 414 130 (POREL)		
A	WO-A-8 103 527 (LEPPÄLÄ)		
A	FR-A-1 347 730 (GRATZMÜLLER)		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11-11-1983	Examiner BENZE W.E.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : 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			