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(54) **Hydraulic system with a double section telescopic piston for the movement of loads in unstable conditions.**

(57) A hydraulic system consisting of a non-limited number of sliding parts having in the last part thereof a double-action telescopic piston for the displacement of loads in unstable conditions in which an initial drive force to totate the hinged load and, afterwards, a breaking or retaining force to avoid the hinged load from falling due to the different position of the centre of gravity with respect to the point of rotation are required.

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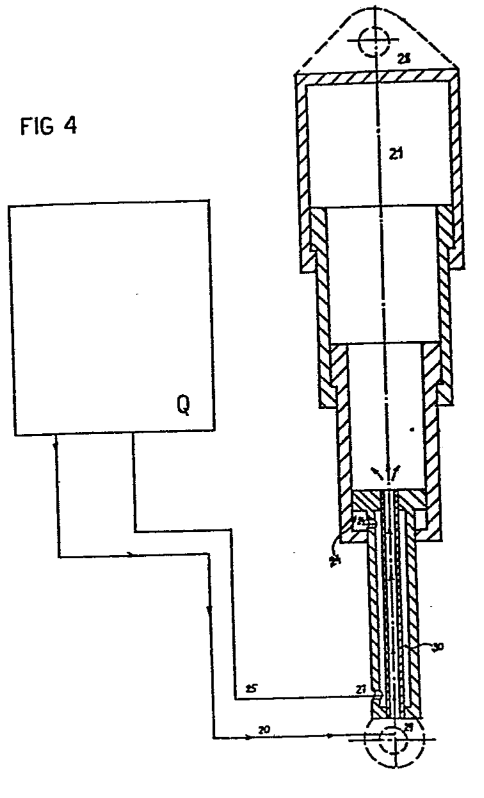
EP 0 055 697 A1

FIG 4



DESCRIPTION

of the invention having the title:
"Hydraulic System with a Double action Telescopic Piston for the Movement of Loads in Unstable Conditions".

This invention refers to an hydraulic system for the rotating displacement of large loads in unstable conditions. In particular it refers to an hydraulic system consisting of a telescopic piston with an unlimited number of sliding sections, on the last of which is mounted a double action piston. The system (of the invention) is in this way capable of pushing the load with an initial drive force such as to start rotation and with a controlled braking or pulling force as soon as the load nears the PMS (point of unstable equilibrium).
The problem of controlled displacement of large loads is presently very important in different technical fields, in particular, in all those in which the transport of objects (loads) of large dimensions is carried out by lorries, platforms on wheels etc.
Usually the technical problem consists of rotating a load, with its lower part fixed to a hinge, from a horizontal position to a vertical position close or beyond the PMS (point of unstable equilibrium).
An operation such as lifting of the movable carriage of a lorry is normally carried out with simple action hydraulic telescopic piston.
In this case, however, the rotation of the carriage must be limited to a position just before the centre of gravity reaches the vertical above the hinge (PMS). A rotation beyond this point is in fact undesirable since it will result in an uncontrolled fall, since the simple action piston due to its nature, is uncapable of exercising controlled pulling action.

In the case of incoherent loads, such as wet sand, the above impossibility renders unloading by gravity very critical, and thus the operator is often forced to exercise sharp up and down movements untill the load is "freed" from the carriage which could not be sufficiently lifted.

The problem becomes completely unsolvable, with a simple action piston, when particular loads (i.e. telescopy towers for telecommunication, vertical axis launchers for missiles,etc) must be lifted from the platform of transport vehicle, or at least from the horizontal position right up to the vertical position with the added difficulty of the hinge for which the fall is not just uncontrollable be ond the PMS position but also impossible to reverse. To this day, to resolve the problem of rotation of particularly heavy and critical loads, several different techniques were used. One technique is that of a crane external to the trailer or lorry, which must manouever with successive translation and lifting movements, to try and generate as near as possible, a trajectory of movement similar to the circumference arc generated by the load in rotation. This operation is very long and difficult to carry out, and even though it is done with much care and precision, there is always an instant of incontrollability which coincides with the instant of direction change of the crane's lifting force, from which abrupt accelerations of the manoeuvre can be generated which could prove harmful to the structure of object being moved.

Another technique adopted is that of using a double-action-non-telescopic piston, which due to its limited extensions (because of their limited dimensions due to installation problems) must be positioned close to the hinge and thus generate very large forces for movement. This results in a overdimensioning of the chassis system (mobile and fixed) which must be capable of supporting very large forces concentrated at the application points of the pistons...

It is obvious that such overdimentioning has a damaging effect on the weight dimensions and on cost of the chassis.

The problems associated with the techniques presently adopted to obtain the displacement of large loads in unstable conditions can therefore be summarized by the following points.

a) the volume available for housing the hydraulic lifting system is rather limited;

b) the trajectory, and in general the kinematics of the movement from the horizontal to the vertical position necessarily implies, at a certain stage in the manoueore, the control of the applied force to the load, and its inversion from a drive force to a retaining or braking force, to avoid the uncontrolled fall of the load.

Utili ation of present double- action telescopic piston is very critical in as much that these systems are cumbersome and thus contradicts the need of containing the volume alloted to such a system.

Utilisation of present simple- action telescopic pistons even though satisfying the condition of minimal volume of the system, does not allow to control with sufficient safety the inversion of the driving force, and thus as soon as the point of unstable equilibrium is reached (PMS), the shift in centre of gravity causes an uncontrolled fall of the load, since a retaining or braking force to avoid this situation is not available. The hydraulic system constituting the object of the present invention solves in a simple manner the problems mentioned above, by means of a double- action piston which is housed in the last sliding section of the telescopic arrangement.

The piston in the overall assembly remains very compact and behaves, for the first half of the movement up to the point just before inversion of the driving force, as a simple- action telescope, whereas in the second half of the movement it behaves as a double- action piston which by generating a controlled counter-pressure, controls the movement of the load, by generatiny a retaining or braking force, just near to the point of unstable equilibrium (PMS).

The aim of the present invention is that of realising an hydraulic system consisting of a telescopic piston with several sliding sections to the last of which is mounted a double- action piston which allows, as well as limiting the dimentions to that of a normal hydraulic system with a simple action telescopic piston, the control of movements and thus the displacement of the load, in the vicinity of the point of unstable equilibrium.

The hydraulic system of this invention, is now described in more detail with the help of the enclosed diagrams in which:

Figure 1, illustrates schematically, by the three phases a, b and c, the stages of the displacement of an ideal load by means of an ideal hydraulic system,

Figure 2 schematically illustrates the hydraulic system of the present invention

Figure 3 to 7 schematically illustrate the different phases through which the controlled action of the hydraulic system of the present invention developes.

With reference to fig.1 a, an ideal load "2"n driven by a piston 1 and fixed at point C by a hinge is illustrated. The force F is such as to oppose the weight force P of the load, in fact it exceeds P and moves the load so as to bring about its displacement.

Figure 1 b illustrates the position when the load has reached the point of unstable equilibrium (PMF). This condition of the weight force P, indicated by "X", passes the fixed point C of the hinge. Just after this situation the drive force F necessary for lifting, and thus for the displacement of the load, must be counter balanced by a retaining force R.

Figure 1 c illustrates the retaining situation by means of the force R which keeps the load in equilibrium. It is necessary to point out that the most delicate part of the displacement is that in which the drive force F is substituted, in a controlled manner, by the retaining force R which avoids sharp movements or whatsmore falling of the load.

In figure 2 a typical realisation of the hydraulic system of the present invention is schematically illustrated. The telescopic piston 1 shown has three sliding sections in the last of which is mounted a double-action piston supplied with two chambers 24 and 30 which are infact necessary to attain the double effect. The simple-action sliding sections make use of the single chamber 21. These chambers are obviously utilised for the letting-in and out the compressed oil fed by means of pipeline 25.

The introduction of the compressed oil, or the exit of the returning oil passes through channel 31 and valve 27 respectively. The dotted lines illustrate, purely for an indicative purpose, two devices for the eventual mounting of the piston to the load to be displaced and mounting to the sustaing plane, as indicated by 28 and 29.

Finally Q indicates, for explanitory purpose, the apparatus for controlling the oil pressure in the pipelines 20 and 25, which can be realised in a very conventional way.

Figure 2 illustrates the hydraulic system in its initial position in which the sliding sections are all closed, and the oil is in a rest condition in all the chambers.

During operation, the oil in pipeline 20 is put under pressure and introduced into chamber 21, which on expanding causes of the simple-action sliding sections to lengthen until the end-stops 23 are reached, and thus stopping the lengthening of the telescopic piston (fig. 3).

At this point the action of the double-action piston begins. The oil in pipeline 25, by means of valve 27, is put in counterpressure and is then, so to say, squeezed out from chamber 24, by means of valve 26 and chamber 30.

This causes futher lengthening of the telescopic piston (fig. 4).

At this point, and here the control action which can be exercised on the displacement of the load in the vicinity of unstable equilibrium (PMS) can be noted, by changing the direction of the oil pressure in pipeline 25, a direction change in the force generated by the telescopic piston is attained. In fact putting the oil under pressure in this pipeline, forcing it into chamber 24 by means of valve 27, chamber 30 and valve 26, produces the expansion of said chamber.

Note that in this phase, pipelines 25 and 20 constitute the forward and return of the oil's counterpressure respectively (fig.5).

The expansion of chamber 24, for the particular double-action piston configuration, generates a shortening of the piston, permitting the system to solicitate the load with a retaining or braking force for controlling the displacement of the load in the vicinity of the unstable equilibrium point (fig. 6).

Finally , figure 7 illustrates the telescopic piston on returning to its rest position, when the oil in chamber 21 is withdrawn through pipeline 20.

The hydraulic system of the present invention hasbeen described with particular reference to a prefered method of realisation which must not be considered restrictive.

It is in fact obvious that various modifications can be made, as for example the number of sliding sections or to the profiles of the end-stops of the same sliding sections, without deviating from the principles and aims of the present invention as indicated by the following claims.

C L A I M S

1. Hydraulic system for displacing large loads in unstable conditions consisting of a telescopic piston including a set of sliding sections the last which is a double-action piston capable of generating in a controlled way a drive force and a retaining force in the vicinity of the unstable equilibrium point belonging to the displacement trajectory of the load.

2. Hydraulic system as in claim 1 characterized by the fact that the double-action piston utilizes a sliding section having a double action chamber, whose filling with hydraulic fluid causes the contraction of the sliding section and consequently the generation of a retaining or braking force, and whose emptying causes the expansion of the sliding section and consequently the generation of a drive force.

3. Hydraulic system as in claim 2 characterized by the fact that the said double-action chamber is made up of the internal wall of the last-but-one sliding section and by the external wall of the last sliding section; the last sliding section possessing a first valve on the internal wall, which puts the double-action chamber in communication with the second auxiliary chamber which constitutes part of the last sliding section, utilized for feeding the hydraulic fluid in the second auxiliary chamber of the sliding section.

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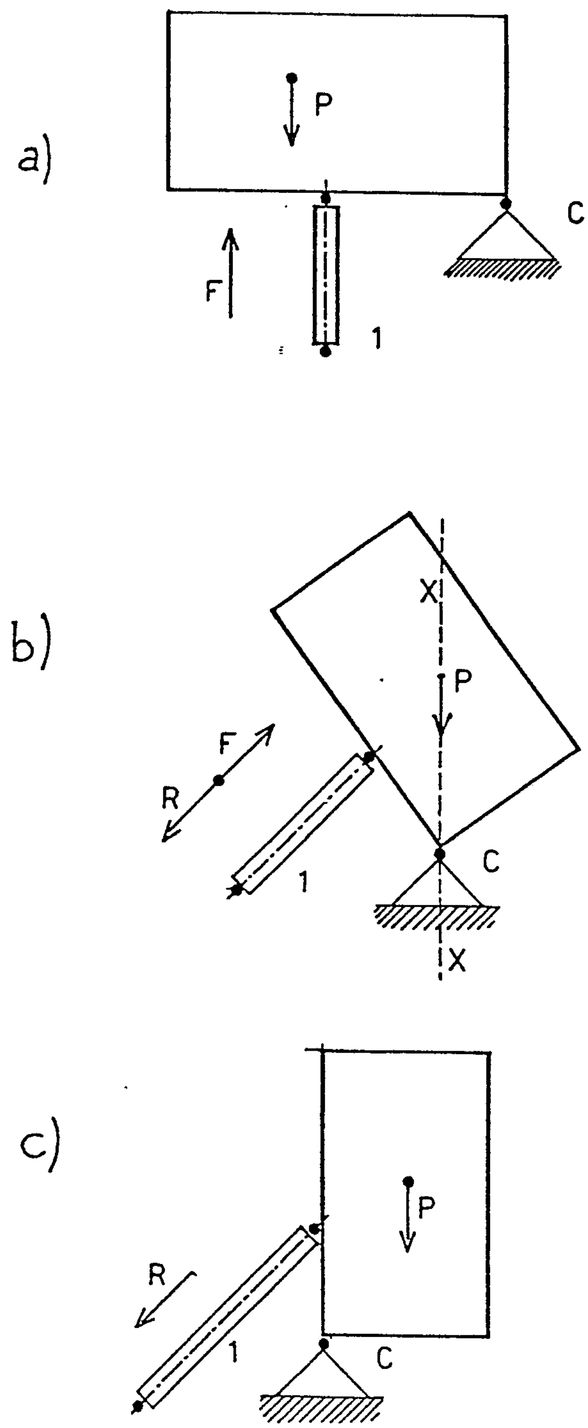


FIG 1

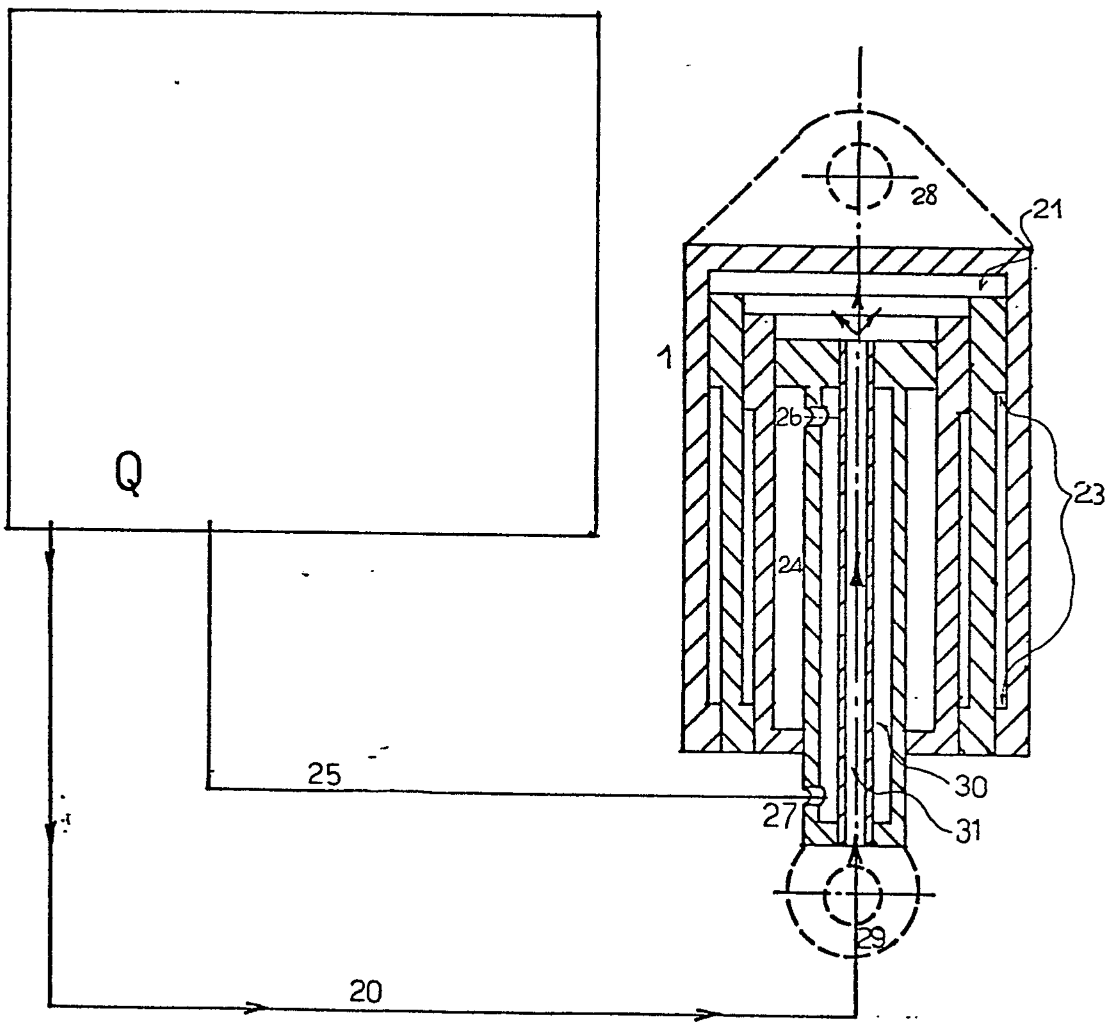


FIG 2

FIG 3

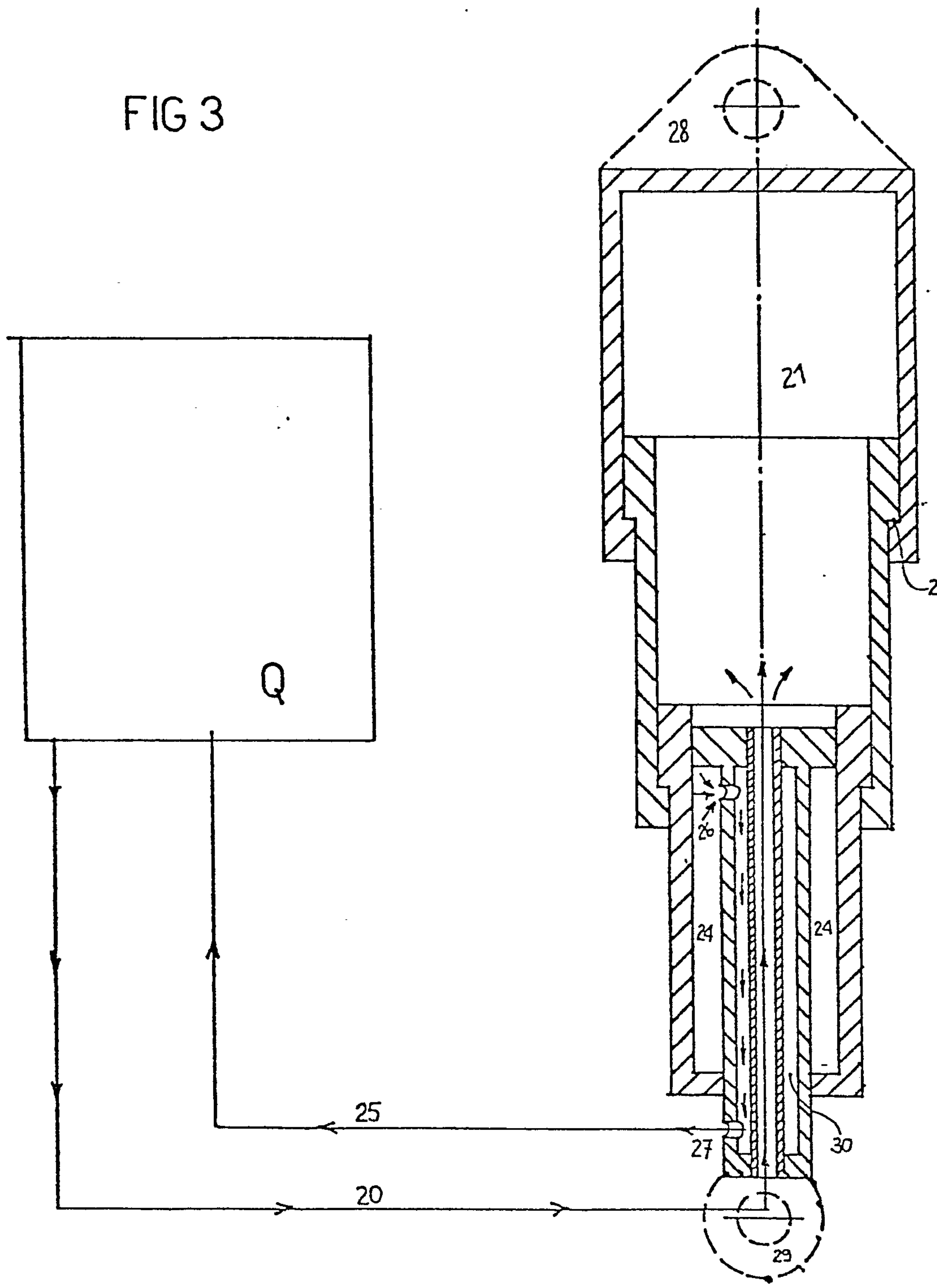


FIG 4

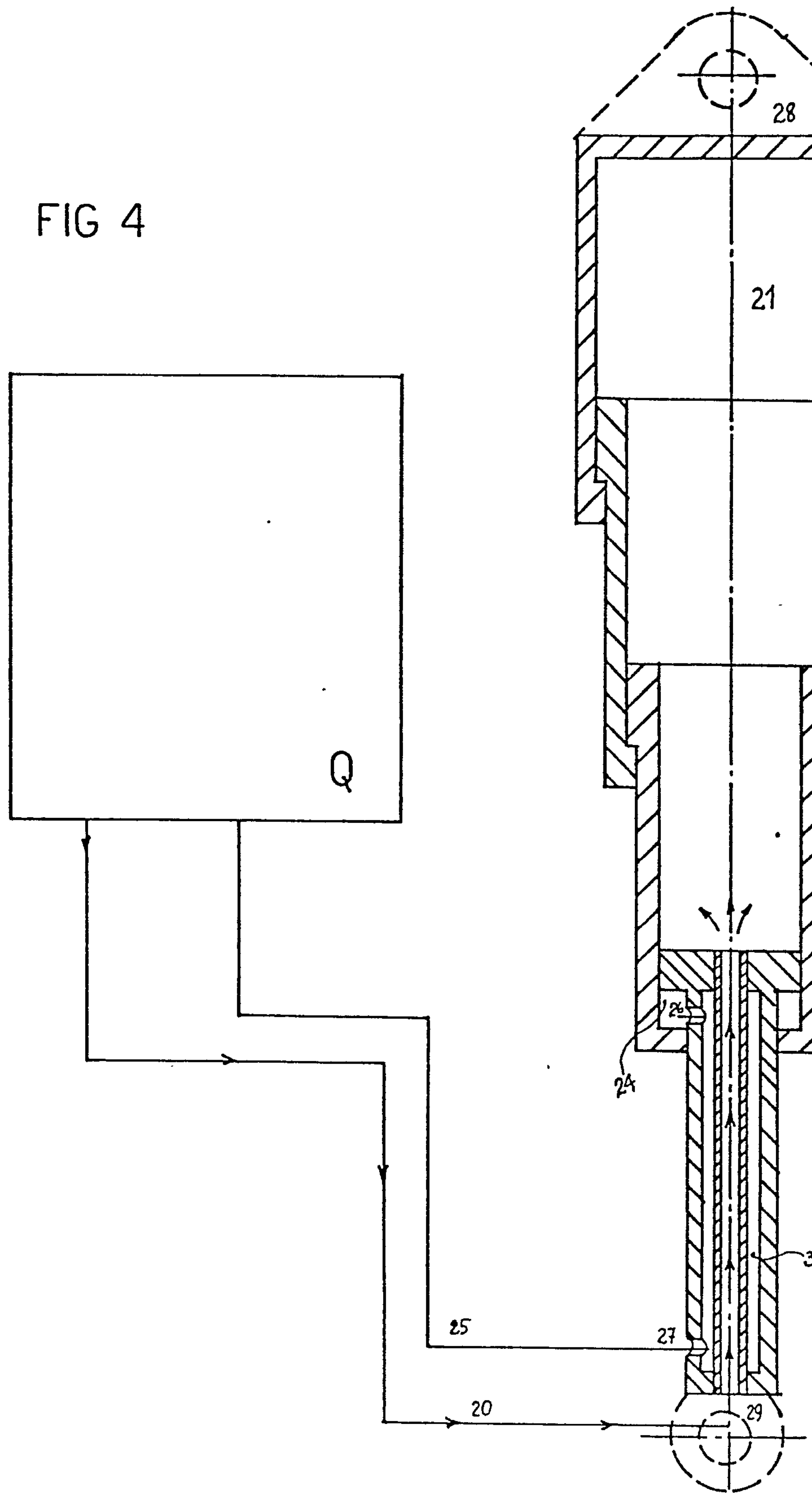


FIG 5

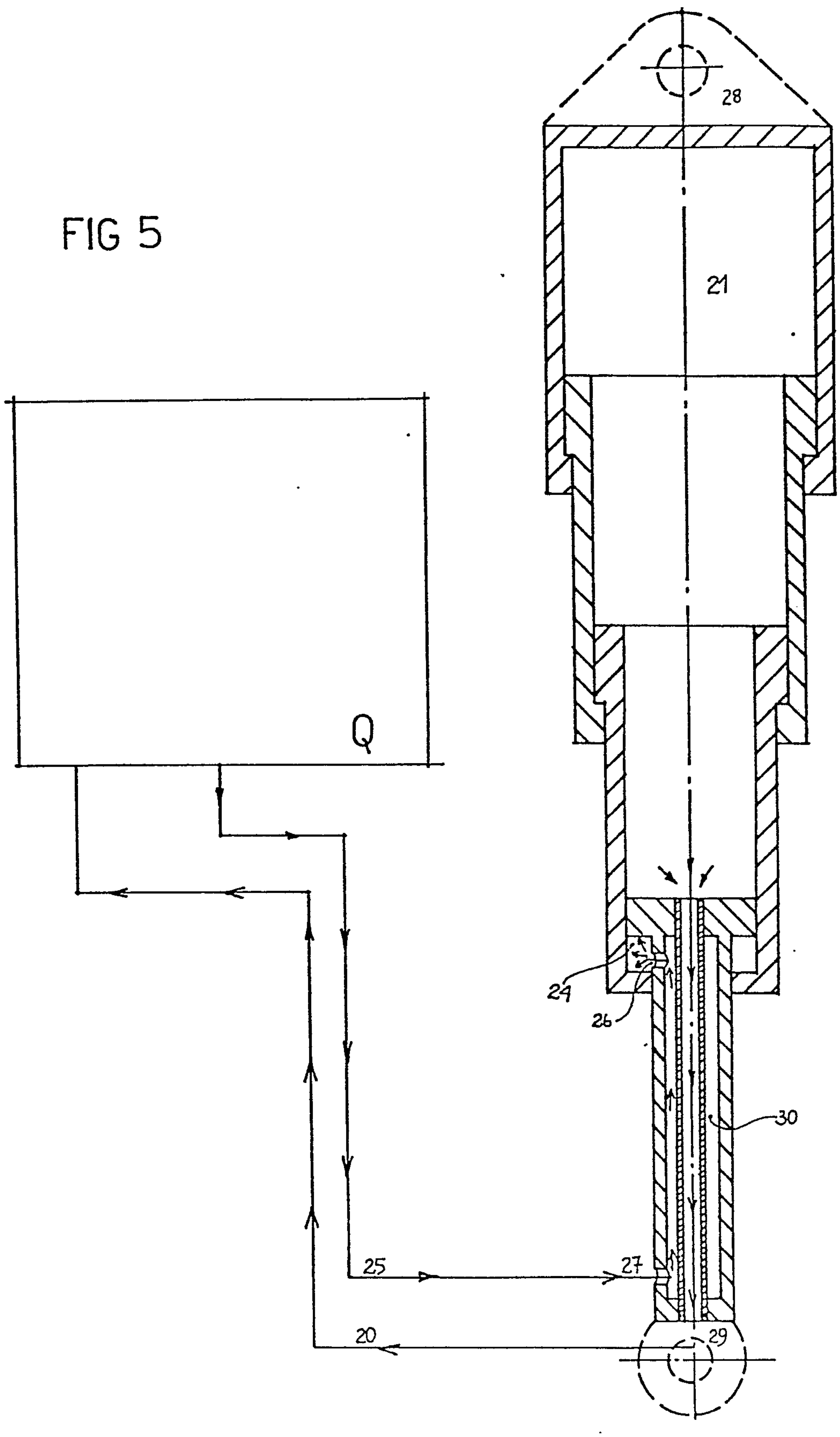
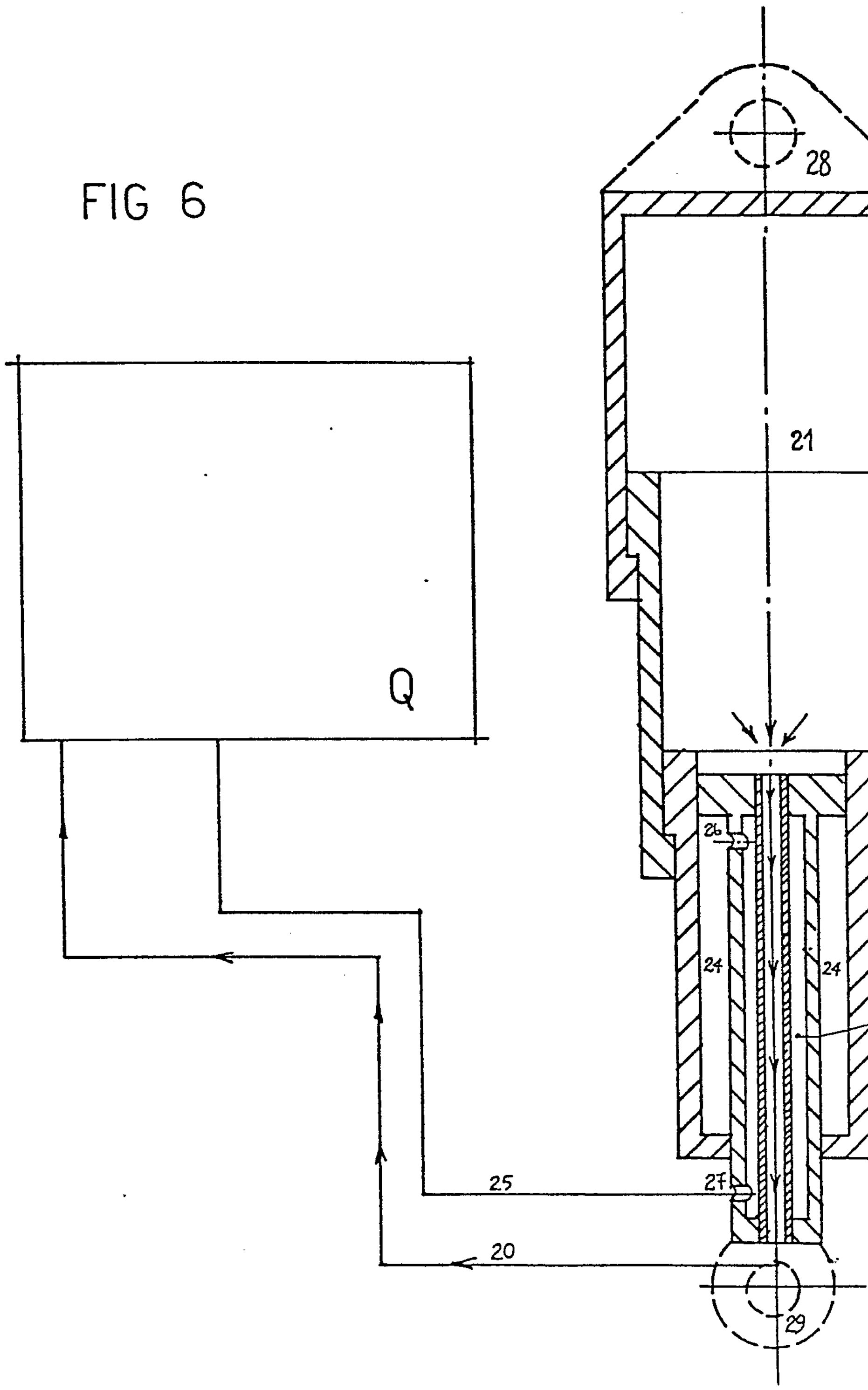


FIG 6



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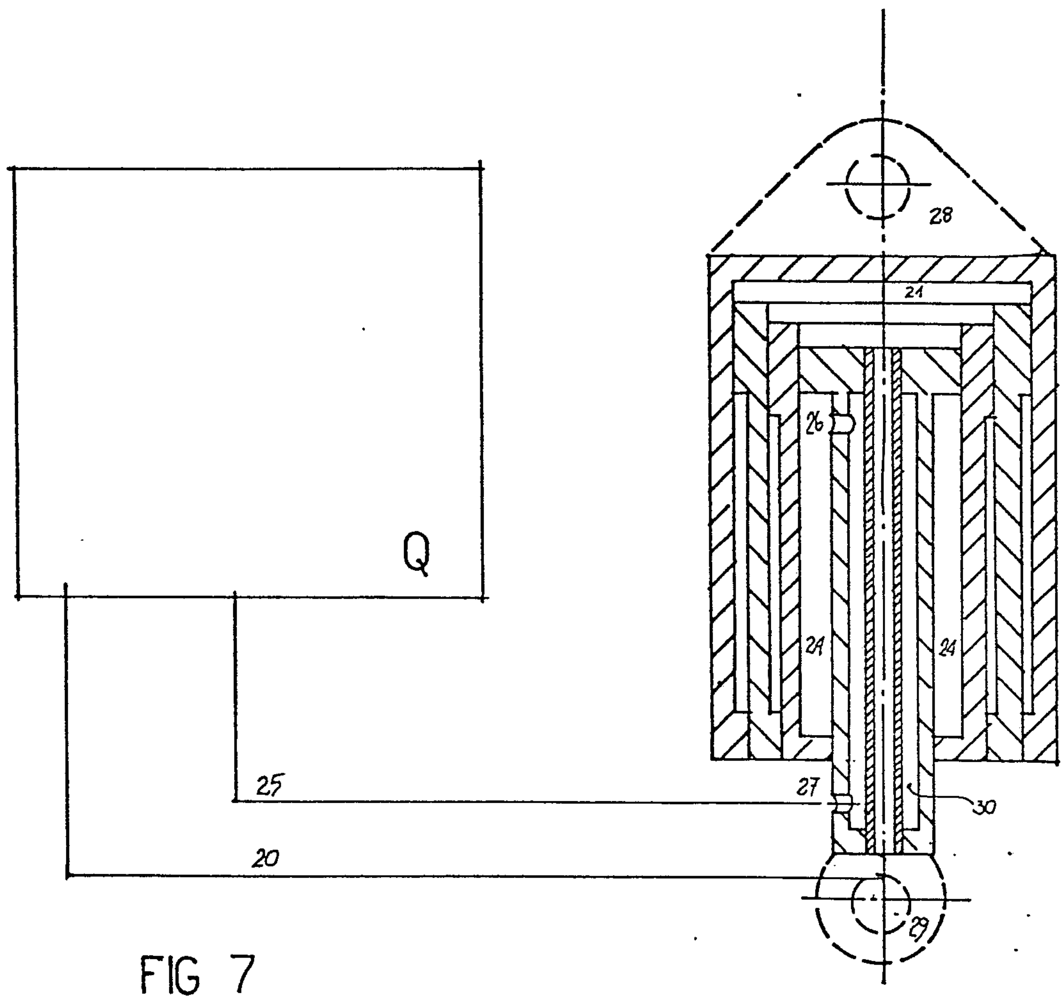

FIG 7

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EUROPEAN SEARCH REPORT

Application number
EP 81 83 0251

Category	DOCUMENTS CONSIDERED TO BE RELEVANT Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X	US - A - 3 415 169 (NADDELL) * Column 3, lines 50-57; figures 1-7 * --	1-3	F 15 B 15/16
X	US - A - 2 517 153 (WOOD) * Column 2, lines 49-55; column 2, lines 1-38; column 9, claim 1; figures 1-4 * --	1-3	
A	US - A - 3 956 970 (KUPIEK)		TECHNICAL FIELDS SEARCHED (Int.Cl. 3)
A	DE - C - 929 148 (MEILLER)		F 15 B
A	GB - A - 1 526 563 (DAVY-LOEWY)		
A	FR - A - 2 129 936 (BENALU)		
A	US - A - 3 603 207 (PARRETT) ----		

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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A: technological background
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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

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29-03-1982	VAN DEN BERGHE

EPO Form 1503.1 06.78