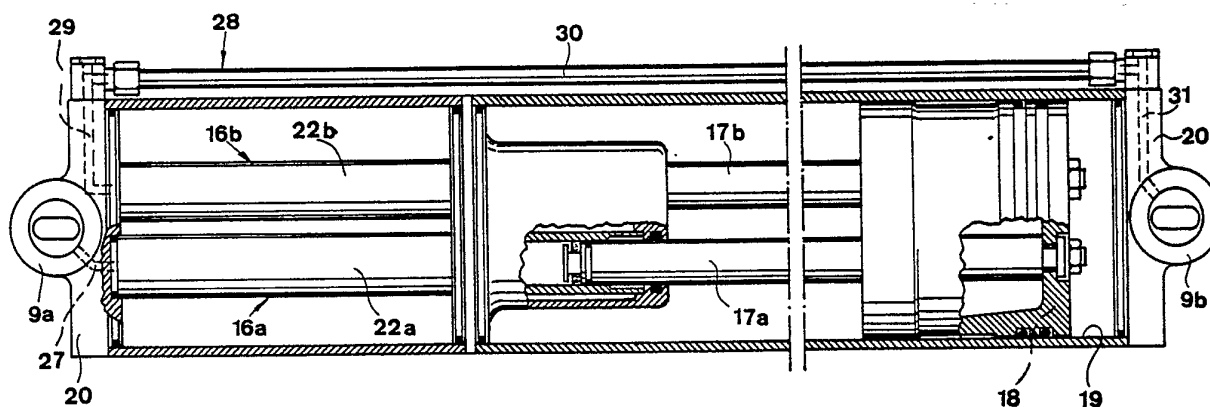


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: A DEVICE FOR SYNCHRONIZED HYDRAULIC FLUID SUPPLY OF TWO OR MORE HYDRAULIC MOTORS



## (57) Abstract

A device for providing a synchronized fluid supply to and fluid evacuation from at least two linear hydraulic motors (9a, 9b) comprises a pumping arrangement including for each of the hydraulic motors a particular hydraulic cylinder pump (16a, 16b) such that each of these pumps fluidly co-operates with only one motor, parts (17a, 17b) comprised in the pumps and adapted to, on movement thereof, cause fluid supply to and fluid evacuation from the motors being interconnected by a linearly movable element (18) of a driving arrangement. The hydraulic pumps have openings which enable communication between the working chambers of the pumps and a hydraulic fluid reservoir when said working chambers are substantially maximal but which are automatically closed off when the volume of the working chambers is reduced.

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A device for synchronized hydraulic fluid supply of two or more hydraulic motors.

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#### FIELD OF INVENTION AND PRIOR ART

This invention is related to a device of the kind defined in the preamble of appendent claim 1. The invention is primarily intended to be applied to a lifting device, e.g. for the lifting of vehicles, wherein the hydraulic cylinder motors are fitted between a support, which is intended to be carried relative to a base, and an elevatable member which is adapted to be directly or indirectly applied to the object to be lifted.

Devices more or less similar to that defined in the preamble of the appendent claim 1 are disclosed in e.g. US A 3 769 881, DE A 2 523 184 and DE A 2 629 579. To the extent that these prior devices are capable of achieving a really synchronous hydraulic fluid supply to the hydraulic cylinder motors, they suffer from the disadvantage that they are relatively complicated. Thus, they require a relatively complex arrangement of control valves etc.

#### SUMMARY OF THE INVENTION

The object of the present invention is to devise a way to achieve a synchronized supply of hydraulic fluid to the cylinder motors and evacuation of fluid therefrom by means of a relatively uncomplicated and accordingly non-expensive device.

This object is obtained in that the hydraulic pumps have openings, which enable, when working chambers of the pumps communicating with the hydraulic cylinder motors are substantially maximal, communication between these working chambers and a hydraulic fluid reservoir but which are automatically closed off from



the working chambers when their volume is reduced. In this way it is obtained that communication between the working chambers and the fluid reservoir is established each time the working chambers have a maximal volume and such communication enables fluid from the reservoir to flow into the working chambers so as to compensate for unequal volumes and in addition air trapped in the hydraulic system may flow out into the reservoir through the openings.

Other preferable features of the invention appear from the dependent claims 2-10.

#### SHORT DESCRIPTION OF THE DRAWINGS

A more specific disclosure of an embodiment example of the invention will follow hereinafter with reference to the appended drawings.

In the drawings:

fig 1 is a side view of the device according to the invention;

fig 2 is a partially cut view of the device viewed from above and with certain components removed;

fig 3 is a view similar to fig 2 but in a somewhat larger scale, additional cuts having been made in fig 3 and additional parts removed; and

fig 4 is an enlarged detail view of an end portion of the device.

## DETAILED DISCLOSURE OF A PREFERRED EMBODIMENT

The invention will hereinbelow be described as applied to a lifting device for vehicles. This lifting device comprises a support 1 adapted to be carried by a suitable base. In the example it is indicated that the support 1 via hook shaped carrier members 2 is suspended on upright flanges 3 arranged at the inner margins of surfaces 4 forming driving paths. The support 1 is via the carrying members 2 displaceable along the flanges 3 and in the area between the two flanges 3 there is accordingly an open space, in which on one hand the lifting device and on the other hand an operator may be present. In the view in fig 2 only a portion of the carrying members 2 is illustrated. The carrying members 2 are indicated in fig 2 as having portions received in a fixing member 5, which in turn is bolted, by means of fixing flanges 6 attached thereto, to a housing 7 contained in the support; said housing will be described more in detail hereinbelow. From that stated above it appears that also the fixing flanges 6 indicated in the upper part of fig 2 are intended to be attached to a fixing member similar to the fixing member 5 indicated at the bottom of the figure and that accordingly also such upper fixing member is intended to be carryingly co-ordinated to the carrying members 2. It is of secondary importance for the invention how the support 1 in general is carried and since several known solutions are available for the men skilled in this art no additional disclosure thereof will be given here.

A member 8, which only appears in fig 1, may be lifted and lowered relative to the support 1 by means of two vertically operating hydraulic cylinder motors 9a and 9b. These are arranged at opposite ends of the support 1 and the housing 7 and are formed by piston cylinder mechanisms, the cylinders 10 of which are connected

to the support 1 and the pistons 11 which are connected to the elevatable member 8. In practice, the member 8 may simply be provided with holes 13 for receiving the outer, for instance flat, end portions 12 of the pistons 11. It is desirable in this connection that member 8 is so carried by the pistons 11 that the member 8 cannot be substantially inclined relative to the support 1 about an axis parallel to the longitudinal direction of the support 1 and member 8. The member 8 can in a manner known per se be provided with exchangeable components 14 for a suitable contact with the vehicle to be lifted.

When member 8 is to be lifted, hydraulic fluid is supplied to working chambers 15 in the cylinders 10 so that the pistons 11 move upwardly together with member 8. A pumping arrangement for providing a synchronized supply of fluid to the mechanisms 9a and 9b and fluid evacuation therefrom comprises for each thereof a particular hydraulic cylinder pump 16a and 16b respectively such that each of these pumps fluidly co-operates with only one motor. Parts 17a and 17b comprised in the pumps and adapted to, on movement thereof, cause fluid supply to and fluid evacuation from the piston cylinder mechanisms 9a and 9b are connected to a common movable element 18 of a driving arrangement to impart a unitary movement to the parts 17a and 17b. The element 18 is in the example formed by a piston reciprocatingly movable in a cylinder 19. Said cylinder 19 is formed by the mentioned housing 7, which has a generally circular section and also surrounds the fluid pumps 16a and 16b.

The piston cylinder mechanisms 9a and 9b are arranged at the opposite ends of housing 7. More specifically, the cylinders 10 of the mechanisms are formed in pieces constituting gables of housing 7. The housing has bet-

ween the gables 20 the character of a tube, the ends of which are received in localizing seats 21 (see fig 4) in the gables 20. A suitable number of pull rods 22 extend between the gables 20 of the housing externally of the tubular portion of the housing and have at their ends nuts enabling tightening of the gables in a direction towards each other. There are suitable sealing members in connection with the seats 21 for sealing the space within the housing relative to the surrounding. Each of the two hydraulic pumps 16a, 16b is formed by the piston 17a and 17b respectively connected to the piston 18 and by a cylinder 22a and 22b respectively receiving said piston. These two cylinders are disposed side by side and extend in the longitudinal direction of housing 7, i.e. generally parallel to the direction of movement of piston 18.

Each of the pumps 16a and 16b has an opening 23, which when the working chamber of the pump in question is substantially maximal as in fig 4 enables communication between the working chamber 24 and a fluid reservoir 25 but which is automatically closed off from the working chamber 24 when the piston 17a moves in a direction for reduction of the volume of the working chamber. The opening 23 is liberated for communication with working chamber 24 and closed off from such communication respectively by means of piston 17a, more specifically a sealing 26 provided at the outer end thereof. The opening 23 can be arranged in such a portion of the cylinder tube 22a and 22b respectively which has a larger internal diameter than the rest of the cylinder tube and the outer diameter of the sealing 26 when it has expanded maximally in a radial direction. Thus, there appears between the outer surface of sealing 26 and the area of the inner side of the cylinder tube 22a surrounding the opening 23 a gap allowing a free communication between the working chamber 24 and reservoir 25 as soon as the piston 17a

and 17b respectively is retracted so far that sealing 26 is located in the expanded end area of cylinder tube 22a. As an alternative or complement thereto, the device may be such that the sealing 26, when the working chamber 24 is maximal, is located retracted so far that communication may occur between working chamber 24 and reservoir 25 although sealing 26 tends to abut radially outwardly also against the inner side of the portion of the cylinder tube 22a having a larger internal diameter than the rest of the cylinder tube. Thus, the invention is based upon the principle that communication between the working chamber 24 and reservoir 25 in each pump 16a, 16b shall occur when the working chamber 24 is maximal and accordingly the piston 11 lowered to a maximum. Such an embodiment has the result that some leakage past the sealings of mechanisms 9a and 9b on each maximal expansion of the working chambers 24 in the pump 16a and 16b is compensated by some flow of fluid into the working chambers. When the pistons 17a and 17b subsequently are again moved forwardly while reducing the volume of working chambers 24, the sealings 26 will relatively immediately pass the opening 23 and close off communication between working chamber 24 and reservoir 25. The sealing 26 shall in each case have such design that it effectively seals between the piston 17a and 17b respectively and the portion of the cylinder tube 22a and 22b respectively which has a smaller diameter than the portion in the area of the opening 23.

Said opening 23 is, in order to automatically allow possible air to flow out of the fluid containing system formed by the mechanism 9a and 9b respectively, pump 22a and 22b respectively and conduits therebetween, intended to be located at the highest fluid level in this system. Furthermore, the system should be so designed that no air retaining pockets occur. The object of this construction is to avoid irregular movements



of pistons 11 due to occurrence of easily compressible air in the fluid system. Air may e.g. enter the system on lowering of the pistons 11 without load since the expansion of working chambers 24 when there is some jamming of the pistons 11 and some clearance in the sealings in the mechanisms 9a and 9b may cause air to be drawn past these sealings and into the working chambers of mechanisms 9a and 9b. Since according to the invention the opening 23 is the highest point in each of the fluid systems formed by the mechanisms 9a and 9b respectively, the pump 16a and 16b respectively and conduits therebetween and there are no air retaining pockets, such air will tend to flow upwardly from the working chamber of the mechanism 9a and 9b respectively via the conduit 27, 28 in question and pass into the respective working chamber 24 so as to pass out through the opening 23 when the same is liberated and reach the atmosphere above the fluid level in the reservoir 25, which preferably via a connection located above the fluid level and provided with an air filter communicates with the atmosphere outside housing 7. The reservoir has for the rest at a suitable location a fluid refill opening.

The working chamber 24 within the cylinder 22a communicates with the working chamber of mechanism 9a via the conduit 27, which is formed by a passage through the gable 20 comprising mechanism 9a as appears from fig 3 and 4. Communication between working chamber 24 in cylinder tube 22b and the working chamber in the piston cylinder mechanism 9b occurs as mentioned via conduit 28. This conduit is combined by a passage 29 in the gable 20 to the left in fig 3, a tube 30 communicating with this passage and located externally of housing 7 and a passage 31 formed in the gable located to the right in fig 3. Analogous to that previously described, the passages 29 and 31, the tube 30 and the working chamber in mechanism 9b are always loca-

ted lower than the opening 23 in the cylinder tube 22b.

The interior of housing 7 is by means of a partition member 32 divided into two spaces, namely a first space 33, in which piston 18 is received, and a second space forming fluid reservoir 25. The partition member 32 is penetrated by cylinders 22a, 22b and/or pistons 17a, 17b of the hydraulic pumps and forms means to radially support these cylinders and/or pistons. In the example there are members sealing directly between the partition member 32 and the respective pistons 17a and 17b to avoid hydraulic fluid to enter the space 33. The partition member 32 is fixed as to its position in housing 7 by having a flange 34, which is clamped between two members 35 taking part in forming the tubular portion of the housing. Between these members and the partition member there are sealing members. The cylinder tubes 22a and 22b are fixed as to their position by having their one ends received in seats formed in the gable 20 comprising mechanism 9a and by having their second ends received in seats formed in partition member 32.

The cylinder tubes 22a and 22b and the pistons 17a, 17b extend horizontally in substantially the same plane.

It is preferred to use pressurized air as means to move piston 18 in its cylinder chamber 19. As diagrammatically indicated in fig 2 there is valve means 36, by means of which the pressurized air supply to cylinder chamber 19 via a conduit 37 preferably at least partially formed in the gable 20 can be controlled. A conduit 38 may be present for evacuating air from space 33. This conduit 38 can for the rest be used for pressurized air supply to space 33 so that pressurized air assisted return movement of piston 18 is obtained,

the pump 16a and 16b thereby causing such a suction effect that pistons 11 forcibly will move downwardly in cylinders 10 also in absence of appreciable load on pistons 11.

When using the device according to the invention, control means 36 is adjusted for pressurized air supply to cylinder chamber 19, which causes movement of piston 18 to the left in the figures. This causes fluid present in pumps 16a, 16b to be forced into the working chambers of piston cylinder mechanisms 9a and 9b via conduits 27, 28 so that accordingly pistons 11 move synchronously and uniformly while raising the lifting member 8. For lowering of pistons 11, cylinder chamber 19 is depressurized, possibly in combination with pressurization of space 33, so that piston 18 moves to the right in the figures and working chambers 24 decrease their volume. When pistons 17a and 17b have reached the position in fig 4, communication between working chambers 24 and reservoir 25 is opened so that possible air may enter out of working chambers 24 and instead fluid be filled into working chambers 24. It is preferable that the control arrangement for the lifting device is designed so that when the lifting device is operated in a direction for lowering, a complete lowering movement occurs, which accordingly cannot be reversed by the operator before the position according to fig 4 has been reached. In this way a frequently occurring elimination of air from the fluid system is guaranteed and simultaneously fluid is filled into the working chambers 24.

#### POSSIBLE MODIFICATIONS OF THE INVENTION

The invention has hereinabove been primarily described as applied in connection with a lifting device, i.e. a device wherein the pistons 11 move vertically. There is, however, no hindrance for the invention to be app-

lied also as a power exerting device with horizontal or other directions of movement of the pistons 11. It has been illustrated in the example that pistons 11 exert lifting forces on a member 8 bridging the pistons. If desired the member 8 can of course be eliminated and pistons 11 designed so as to exert forces directly on various objects. Although it as a rule is desirable that pistons 11 move with the same speed there may be applications, wherein it is desired to maintain a predetermined movement relation between the pistons but wherein the speed of the pistons may be different. Such a case could be obtained by designing the working chambers 24 of pumps 16a and 16b with different volume or by designing the working chambers in piston cylinder mechanisms 9a and 9b with different volume.

It has been disclosed that a pneumatic driving motor 18, 19 is used for driving pistons 17a and 17b. It is of course possible within the scope of the invention to move piston 18 also by means of hydraulic fluid. For the rest it would be conceivable to use other means than a fluid motor for moving pistons 17a and 17b; an element interconnecting pistons 17a and 17b could be driven by a screw or chain transmission or other mechanical arrangement. Furthermore, it would be conceivable to carry out driving by means of a linear electrical motor. Also other modifications of the device are conceivable within the scope of the invention.

Claims

1. A device for providing, with the assistance of a pumping arrangement, a synchronized supply of hydraulic fluid to two or more hydraulic cylinder motors (9a, 9b) and evacuation of hydraulic fluid therefrom, said pumping arrangement comprising for each of the hydraulic cylinder motors a particular hydraulic cylinder pump (16a, 16b) such that each of these pumps fluidly cooperates with only one motor (9a, 9b), parts (17a, 17b) comprised in the pumps and adapted to, on movement thereof, cause hydraulic fluid supply to and evacuation from the motors being interconnected by means of a movable element (18) of a driving arrangement for imparting a unitary movement to said parts, characterized in that the hydraulic pumps (16a, 16b) have openings (23), which enable, when working chambers (24) of the pumps communicating with the hydraulic cylinder motors (9a, 9b) are substantially maximal, communication between these working chambers and a hydraulic fluid reservoir (25) but which are automatically closed off from the working chambers when their volume is reduced.

2. A device according to claim 1, characterized in that the movable parts (17a, 17b) of the pumps are adapted to open and close respectively the openings (23) in that the latter are arranged in the cylinders (22a, 22b) of the hydraulic pumps.

3. A device according to claim 1, characterized in that said openings (23), in order to automatically allow passage of possible air out of the hydraulic fluid containing systems formed by the hydraulic cylinder motors (9a, 9b), hydraulic pumps (16a, 16b) and conduits (27, 28) therebetween, are intended to be located at the highest hydraulic fluid level in the systems.

4. A device according to claim 1, characterized in that the interior of a housing (7) is by means of a partition member (32) divided into two spaces, namely a first space, in which the movable element (18) of the driving arrangement is received, and a second space, which is intended to function as said hydraulic fluid reservoir (25).

5. A device according to claim 4, characterized in that the partition member (32) is penetrated by the cylinders and/or pistons of the hydraulic pumps and forms means to radially support these cylinders and/or pistons.

6. A device according to claim 1, characterized in that the driving arrangement comprises a fluid cylinder driving motor (18, 19).

7. A device according to claim 6, characterized in that the hydraulic pumps (16a, 16b) are arranged within a longitudinal housing (7), at the ends of which the hydraulic cylinder motors (9a, 9b) are arranged.

8. A device according to claim 6, characterized in that the hydraulic pumps (16a, 16b) are arranged within a longish housing (7), which forms the cylinder of the driving motor of the driving arrangement.

9. A device according to claim 7, characterized in that the cylinders (10) of the hydraulic cylinder motors are formed in pieces forming gables (20) of the housing.

10. A device according to claim 7 or 8, characterized in that each of the hydraulic pumps (16a, 16b) is formed by said movable part (17a, 17b), which is formed by a piston connected to the movable

element of the driving arrangement, and a cylinder (22a, 22b) receiving the piston and extending in the longitudinal direction of the housing.

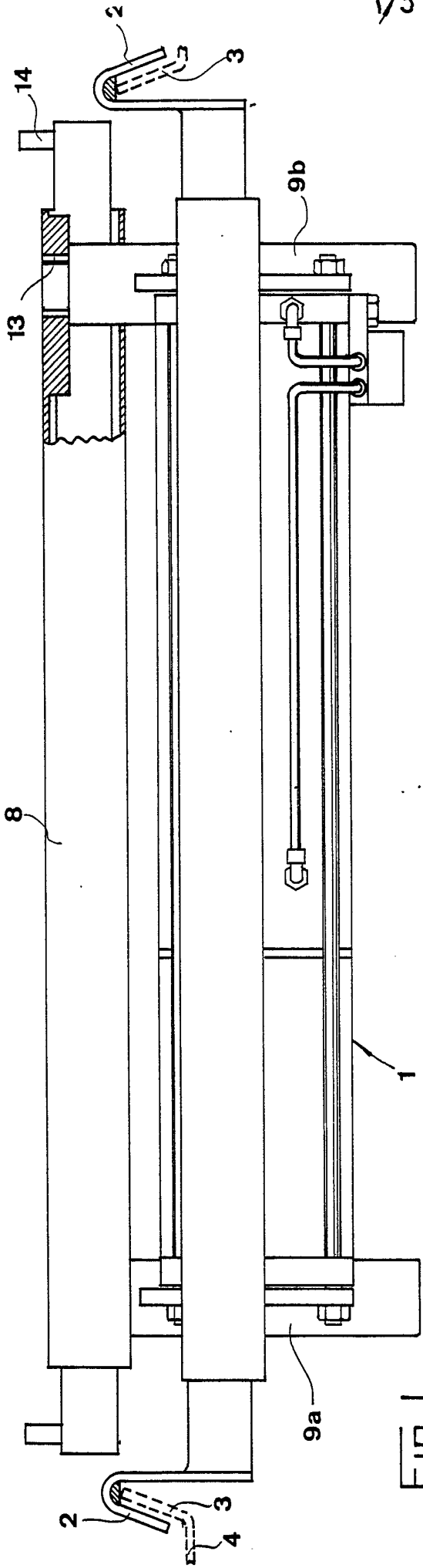


FIG 1

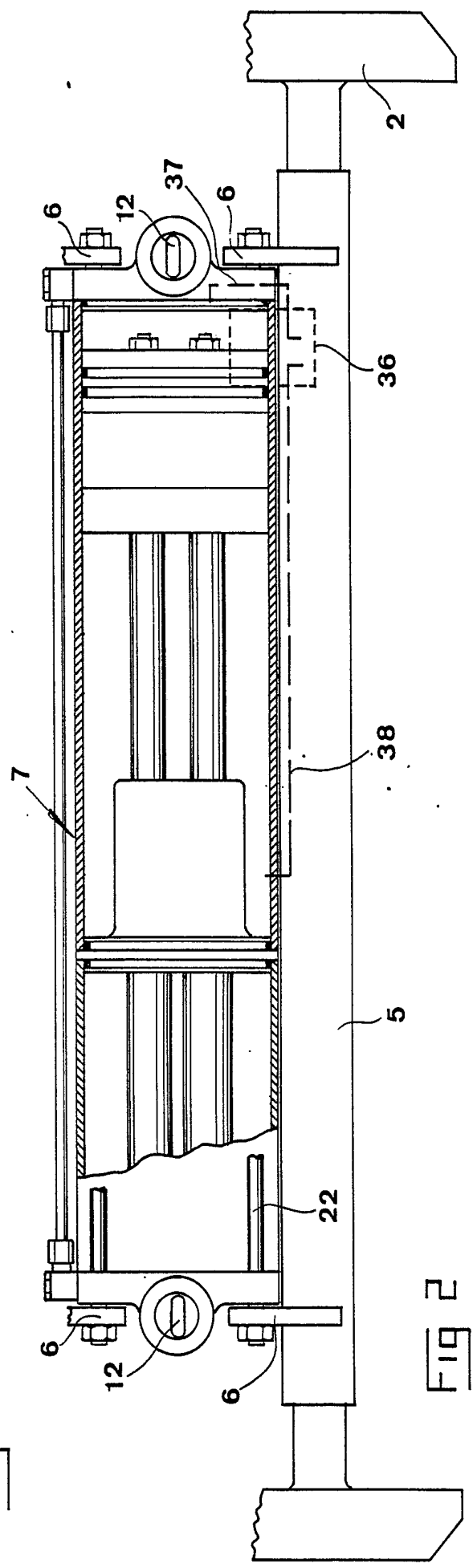


FIG 2



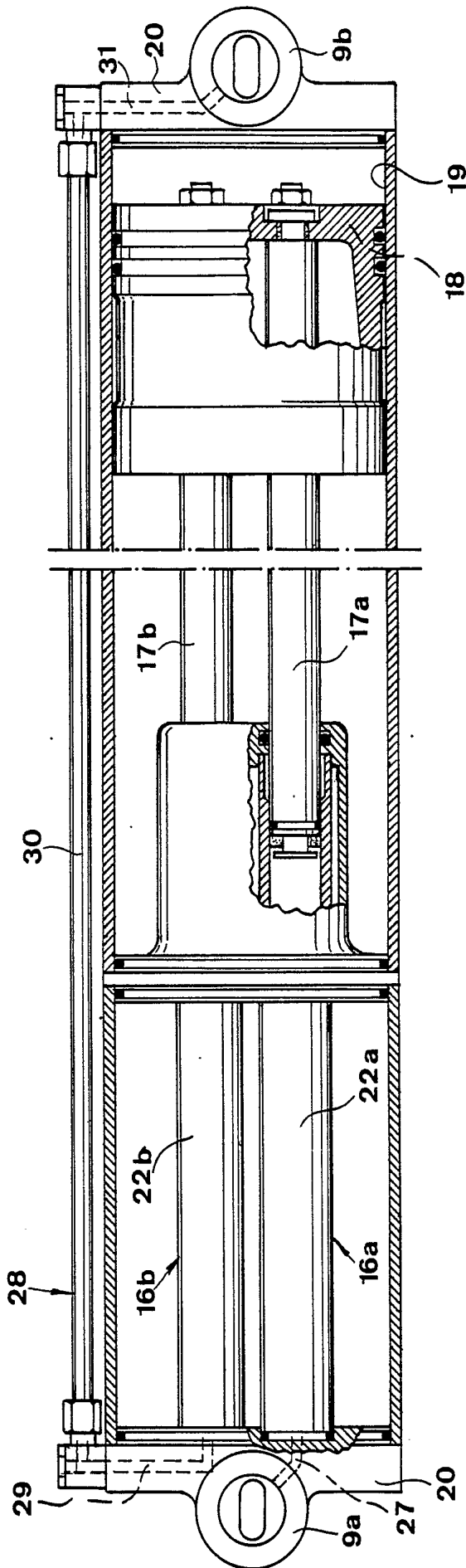


FIG 3

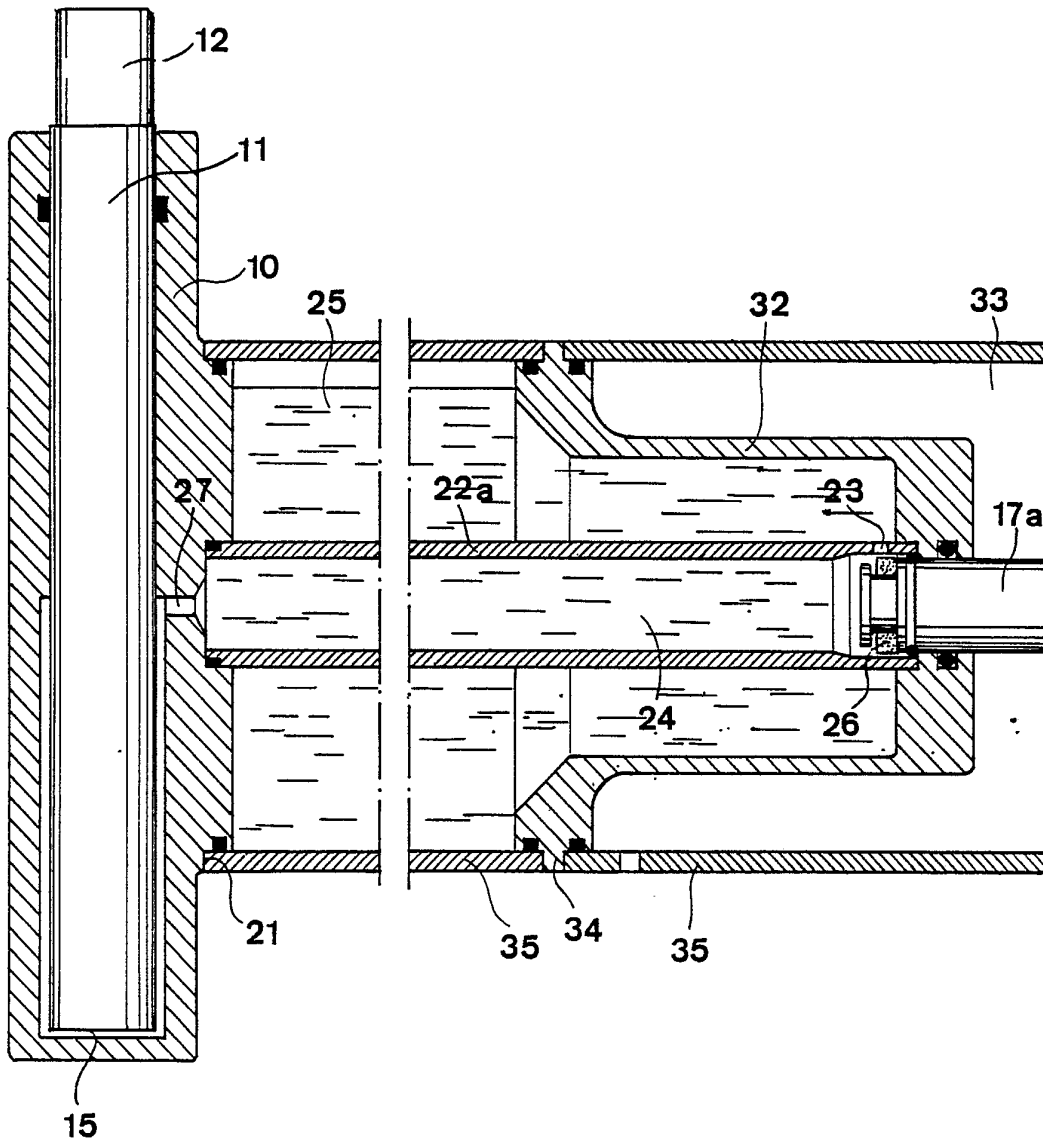
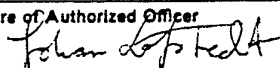


Fig 4

# INTERNATIONAL SEARCH REPORT

International Application No **PCT/SE86/00079**

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC <sup>4</sup>		
F 15 B 11/22 // B 66 F 7/20		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
<b>Classification System</b>	<b>Classification Symbols</b>	
IPC 4	F 15 B 7/00, 11/16, /22, 13/06, /09, 15/00, /02, 18/00; B 66 F 3/24, /46, 7/16, /20	
US Cl	60:698, 716, 719, 720: 91/170-174 .../...	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
SE, NO, DK, FI classes as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b>		
<b>Category <sup>9</sup></b>	<b>Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup></b>	<b>Relevant to Claim No. <sup>13</sup></b>
A	DE, A1, 2 523 184 (E ADAMI) 16 December 1976	
A	DE, A1, 2 629 574 (HYDROSTANDARD GmbH & CO KG) 5 January 1978	
A	US, A, 3 769 881 (KATASHI AOKI) 6 November 1973	
<p><sup>10</sup> * Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
1986-04-18	1986-05-13	
International Searching Authority	Signature of Authorized Officer	
Swedish Patent Office	 Johan Löfstedt	

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II

Fields Searched (cont)

411, 412, 508;

92: 61, 76;254: 89, 93V.  OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE <sup>1</sup>

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1.  Claim numbers..... because they relate to subject matter not required to be searched by this Authority, namely:
2.  Claim numbers..... because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3.  Claim numbers..... because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI.  OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING <sup>2</sup>

This International Searching Authority found multiple inventions in this international application as follows:

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4.  As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

## Remark on Protest

- The additional search fees were accompanied by applicant's protest.
- No protest accompanied the payment of additional search fees.