(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 622 331 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **94200679.2**

(22) Date of filing : **16.03.94**

(51) Int. Cl.^{5} : **B66F 9/08,** F15B 15/22

(30) Priority : **19.03.93 IT MI930528**

(43) Date of publication of application :
02.11.94 Bulletin 94/44

(84) Designated Contracting States :
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

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(54) A lifting unit for the forks of lift trucks.

(57) In a unit for lifting the forks of lift trucks using one or more single-acting hydraulic cylinders (19) to lift or lower the forks, in two opposite end-of-travel strokes of the piston (31) of the hydraulic cylinder (19), interception means (37, 34) determine a reduction in the cross-section of the working fluid outflow respectively from a first chamber (44) and from a second chamber (45) of variable volumes inside the hydraulic cylinder (19) ; this brakes the travel of the piston (31) and thus of the actuating rod (33), which is integral with the latter, preventing abrupt stresses being applied to the load on the forks.

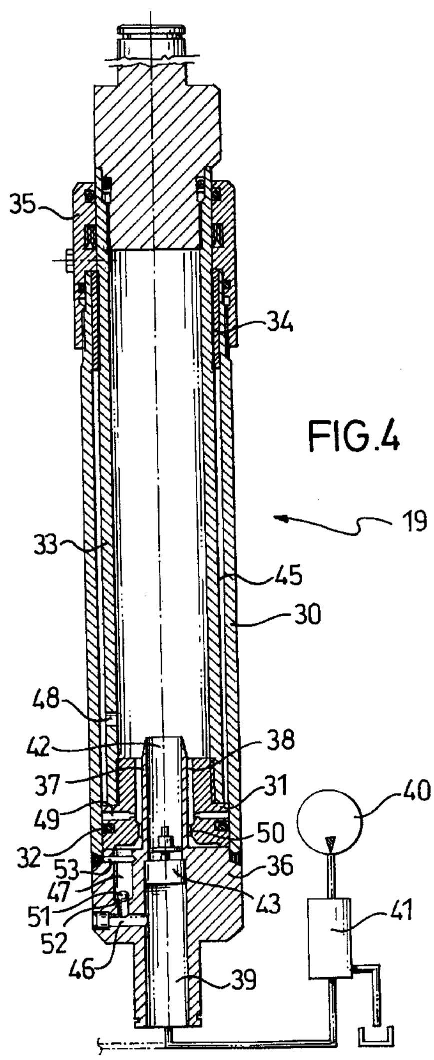

FIG.4

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The subject of the present invention is a unit for lifting the forks of lift trucks.

As is known, lift trucks are provided with a fork lifting unit having at least one single-acting hydraulic cylinder kinematically connected to the forks. The hydraulic cylinder has a cylindrical body in which there is slideably mounted a piston coaxially integral with an actuating rod. In order to lift the forks, the hydraulic cylinder is supplied with working fluid from a pump through a hydraulic distributor such that the actuating rod of the hydraulic cylinder moves the forks upwards. The forks are lowered by gravity, the hydraulic cylinder always being connected for discharge through the hydraulic distributor.

The forks are secured to a plate which slides along a frame during the said lifting and lowering movements. The frame can be of simple construction or telescopic and the number of hydraulic cylinders can vary according to the type of lift truck. Some types of lift trucks with telescopic frames are provided for example with a pair of hydraulic cylinders the action of which causes the forks to rise and the frame to extend simultaneously, by virtue of suitable kinematic components. Other types of lift trucks with telescopic frames are provided with a third hydraulic cylinder in addition to the pair of hydraulic cylinders; in this case, the third hydraulic cylinder lifts the forks when the frame is not extended whilst the pair of hydraulic cylinders merely extend the frame. In all cases, the lowering movement of the forks corresponds to the lifting movement.

During these fork lifting and lowering movements, the hydraulic cylinders reach the end of their travel somewhat abruptly even though the operator usually reduces the inflow and outflow speed of the working fluid in the hydraulic cylinders, acting suitably on the hydraulic distributor, as they reach the end of their travel.

This evidently disturbs the load on the forks with undesirable consequences such as the shifting of the load itself or the movement or even the breaking of elements constituting the load, etc.

The situation is aggravated in cases in which, for example, the operator is distracted and forgets to reduce the inflow and outflow speed of the working fluid in the hydraulic cylinders. In this case, the hydraulic cylinders reach the end of their travel violently, which can have serious consequences such as the dropping of the load, breakage of the load, etc.

The object of the present invention is to overcome the said disadvantages.

This object is achieved by means of a unit for lifting the forks in lift trucks which comprises at least one single-acting hydraulic cylinder kinematically connected to the forks and comprising a cylindrical body in which there slides a piston integral with an actuating rod, the forks being lifted as a result of the hydraulic cylinder being supplied with working fluid and the forks being lowered by gravity with the discharge delivery of the working fluid, characterised in that between the piston and a base of the cylindrical body is defined a first internal chamber communicating with at least one working fluid inflow and outflow duct; in that between the rod and the cylindrical body is defined a second internal chamber opposite the first chamber with respect to the piston and communicating with the first chamber; and in that interception means are provided which, during an end-of-travel stroke of the piston towards the base, determine a narrowing of the cross-section of the fluid outflow from the first chamber to the fluid inflow and outflow duct, and which, during the opposite end stroke, determine a narrowing of the cross-section of the fluid outflow from the second chamber towards the first chamber.

For a better understanding of the invention, a non-limiting embodiment thereof will now be described and is illustrated in the appended drawings, in which:

Figure 1 shows a perspective view of a lift truck provided with a lifting unit according to the invention;

Figures 2 and 3 show perspective views of the movement of the lifting unit of Figure 1;

Figure 4 shows a longitudinal section of a hydraulic cylinder of the lifting unit of Figure 1; and

Figures 5, 6, 7, 8 and 9 show longitudinal sections of the movement of the hydraulic cylinder of Figure 4.

The lift truck in Figure 1, designated 10, comprises a lifting unit 11 which lifts the forks 12 of the lift truck.

The lifting unit 11 comprises a telescopic frame 13 along which a plate 14, integral with the forks 12, is lifted. The frame 13 comprises a pair of fixed outer uprights 15, a pair of movable intermediate uprights 16, and a pair of movable inner uprights 17.

The lifting unit 11 further has a central hydraulic cylinder 18 and a pair of side hydraulic cylinders 19; all these hydraulic cylinders are single-acting. The central hydraulic cylinder 18 is integral with the pair of movable inner uprights 17 and is connected to the fork-bearing plate 14 by means of chains 20 which wind about respective pulleys 21 rotatably supported on a head 22 on which the actuating rod of the said hydraulic cylinder 18 acts. The pair of side hydraulic cylinders 19 is integral with the pair of fixed outer uprights 15 and their actuating rods act on the pair of movable intermediate uprights 16. These uprights 16 are connected to the pair of movable inner uprights 17 by means of chains 23 which wind about respective pulleys 24 rotatably supported on the said pair of uprights 16.

Both the central hydraulic cylinder 18 and the pair of side hydraulic cylinders 19 are supplied with working fluid from a pump by means of a hydraulic distributor.

In order to lift the forks 12, firstly the working fluid acts on the movable portion of the central hydraulic cylinder 18 which, by means of the pulleys 21 and chains 20, lifts the plate 14 with the forks 12 along the pair of inner uprights 17, as shown in Figure 2; during this movement, the fork-bearing plate can evidently be lifted to its maximum at the upper end of the pair of uprights 17. If it is required to lift the fork-bearing plate 14 further, the same working fluid also acts on the movable portion of the pair of hydraulic cylinders 19 which cause the pair of intermediate uprights 16 to slide upwards along the pair of fixed uprights 15 and which, at the same time, cause the pair of inner uprights 17 to slide upwards along the pair of intermediate uprights 16, by means of the pulleys 24 and chains 23, as shown in Figure 3. The fork-bearing plate 14 can thus arrive at the maximum lifted position corresponding to the maximum extension of the frame 13. It can be seen that the fork-bearing plate 14 can be stopped in any intermediate position between its initial, lowered position and its maximum, lifted position. In order to lower the fork-bearing plate 14, the working fluid is discharged and all the components described above move in the opposite direction.

Figure 4 shows one of the two side cylinders 19 in longitudinal section; the other cylinder 19 is identical in all respects. The central cylinder 18 corresponds in structure and function to the cylinder illustrated in Figure 4, and only differs in its dimensions.

The structure of the hydraulic cylinder illustrated in Figure 4 comprises a hollow cylindrical body 30 accommodating a piston 31 in a sliding manner. The piston 31 is coupled with the body 30 in a fluidtight manner by means of a seal 32. A hollow actuating rod 33, sliding inside the body 30, is coaxially integral with the piston 31. A guide bush 34, clamped in position by a lock nut 35, is provided at one end of the body 30, disposed between the rod 33 and the body 30. At the other end, the body 30 has a base 36 from which extends, inside the body 30, a hollow tang 37 for coupling, with clearance, with a shaped axial through hole 38 in the piston 31. This hole 38 opens on one side to the inside of the hollow rod 33, and has a short portion 50 with a diameter slightly greater than the outer diameter of the tang 37, the remaining portion of the hole 38 having a diameter greater than the diameter of such short portion 50. Furthermore, the hole 38 has a lower flaring and the tang 37 has a corresponding flaring of its upper end portion.

A duct 39, connected to the feed pump, indicated 40, by means of the hydraulic distributor, indicated 41, is provided in the base 36. On the interior the hollow tang 37 defines a duct 42 which communicates on one side with the duct 39 by means of a safety valve 43 and on the other side with the interior of the body 30.

During movement of the piston 31, a first internal chamber 44 of variable volume (as can be clearly seen in Figures 5 to 9) is defined between the piston 31 and the base 36, and a second, annular, internal chamber 45 of variable volume is defined between the rod 33 and the body 30. The base 36 also accommodates two ducts 46,47 connected each other and connecting the duct 39 and the first chamber 44. In the duct 47 a check valve is formed, comprising a ball valve member 51, having a diameter smaller than the diameter of the duct 47, which rests on a seat 52 and is retained in the duct 47 by a pin 53 transversely inserted in the duct. The hollow rod 33 has three peripherally equidistant holes 48, of which only one is shown in the drawings; the holes 48 put the second chamber 45 into communication with the interior of the rod 33. The piston 31 has two transversal ducts 49, each of which has a portion of narrow cross-section and communicates on one side with the second chamber 45 via the space between the piston 31 and the body 30 and on the other side with the hole 38 in the piston 31.

The operation of the hydraulic cylinder illustrated in Figure 4 is as follows:

It is assumed in the rest state, that is, the state shown in Figure 4, all the internal parts of the hydraulic cylinder are full of fluid from the hydraulic actuating circuit comprising the pump 40 and the hydraulic distributor 41.

The fluid under pressure generated by the pump 40 and delivered to the hydraulic cylinder by means of the hydraulic distributor 41 enters the hollow rod 33, through the ducts 39 and 42, such that it exerts an action on the rod; at the same time, the pressurised fluid passes through the ducts 46 and 47, moving the ball valve member 51 away from the seat 52 and pushing it against the pin 53, and then flows in the chamber 44 such that it also exerts pressure on the piston 31. In this way the piston 31 with the rod 33 moves upwards, as shown in Figures 5 and 6. During this upward travel of the piston 31 and the rod 33, the first chamber 44 increases in volume whilst the second chamber 45 decreases in volume and the fluid in the said chamber 45 flows out of the latter into the rod 33 through the holes 48.

When the holes 48 are obstructed by the guide bush 34, as shown in Figure 7, the fluid in the second chamber 45 is forced to flow from the latter only through the space between the piston 31 and the body 30 and through the transversal ducts 49 and then flows through the hole 38 in the piston 31. This produces a braking effect on the travel of the piston 31 and of the rod 33 during the end stroke of this upward travel.

Downward movement takes place under gravity, the duct 39 being connected for discharge through the distributor 41. The weight on the rod 33 moves the piston 31 downwards, as shown in Figure 8, and the fluid in the body 30 is discharged only through the ducts 42 and 39, since the fluid pressure pushes and keeps the ball valve member 51 against the seat 52 and therefore prevents fluid passage from the duct 47 to the duct 46.

When the hole 38 of the piston 31 opens into the tang 37, as shown in Figure 9, the fluid in the first chamber 44 flows only through the space between the tang 37 and the hole 38 and then discharges through the ducts 42 and 39. Since between the tang 37 and the portion 50 of the hole 38 a narrow cross-section passage is formed, a braking effect is produced on the travel of the piston 31 and of the rod 33 during the end stroke of the downward travel.

The fluidtight seal 32, mounted on the piston 31, prevents any blow-back of fluid between the two chambers 44, 45, such that the fluid is forced to pass through the passages with narrow cross-sections during the said end-of-travel strokes.

The safety valve 43, of known type, operates when the hydraulic circuit connected to the hydraulic cylinder described is broken, preventing the sudden descent of the piston 31 and of the rod 33 by blocking the passage of fluid from the duct 42 to the duct 39.

The other side hydraulic cylinder 19 and the central cylinder 18 are likewise fed from the said pump 40 through the hydraulic distributor 41 and operate in the same manner as described above.

By virtue of the braking action described above, the arrival of the hydraulic cylinder 18 and of the pair of hydraulic cylinders 19 at the respective ends of their upward travel, when the forks 12 are lifted, or downward travel, when the forks are lowered, is particularly smooth such that the load on the forks is not disturbed and the disadvantages mentioned initially are overcome.

It should be noted that this is achieved without substantial alteration of the structure of the hydraulic cylinders and thus without altering their dimensions and weight, hence the obvious advantages.

It should be further noted that such hydraulic cylinders with a braking action are structurally very simple, consisting of few elements, and therefore are really reliable.

At the delivery stage, the ducts 46,47 in addition to the ducts 39,42 ensure a great flow of delivery fluid into the cylinder and therefore a very low loss of pressure. This is a remarkable advantage, since at the delivery stage a high loss of pressure overloads the pump and increases the power consumption of the lift truck. Moreover, when more cylinders are provided hydraulically connected in series, a high loss of pressure may alter the operation sequence of the cylinders.

The check valve formed in the duct 47 is particularly simple and reliable.

The flaring of the tang 37 and of the hole 38 ensures the coupling of such elements.

The shape of the hole 38 and of the ducts 49 is economical from the manufacturing point of view.

It will be appreciated that variants of and / or additions to that which has been described above and illustrated in the drawings are possible.

The actuating unit can comprise any number of hydraulic actuating cylinders, for example one central hydraulic unit alone or only one pair of side hydraulic units, etc.

Hydraulic cylinders of this type can be supplied with working fluid in any suitable manner.

Different arrangements of the various components constituting the hydraulic cylinder are possible. For example, a solid actuating rod can be used instead of a hollow one, providing the appropriate, equivalent hydraulic connections such that the above braking effects are achieved.

One or more main passages and one or more auxiliary passages can be provided, which put the fluid inflow and outflow duct into communication with the first chamber, and this applies also to the communication between the second chamber and the first chamber. Particularly, more auxiliary, delivery passages can be provided such that formed by the ducts 46,47, each with a check valve inside. Passages of this type can be produced in any manner. There can also be more fluid inflow and outflow ducts.

Instead of being integral with the base, the hollow tang can be integral with the piston and, accordingly, the hole with which the tang is coupled is in the base instead of in the piston.

Instead of the pair comprising the tang and the hole and instead of the bush, other equivalent interception means limiting and impeding, respectively, the flow of fluid through the main passages during the end-of-travel strokes of the piston can be provided.

In general, interception means can be provided which reduce the cross-section of the fluid outflow from the first and second chambers during the end-of-travel strokes of the piston and actuating rod. Interception means of this type can also be progressive, for example, on the one hand by suitably shaping the tang and/or the hole, and on the other hand by providing openings for the passage of the fluid disposed such that they are progressively closed by the guide bush.

Claims

1. A lifting unit (11), for the forks (12) of lift trucks (10), having at least one single-acting hydraulic cylinder (18; 19) kinematically connected to the forks (12) and comprising a cylindrical body (30) in which slides a piston (31) which is integral with an actuating rod (33), the forks (12) being lifted as a result of the hydraulic cylinder (18; 19) being supplied with working fluid and the forks (12) be-

ing lowered by gravity, discharging the working fluid, characterised in that between the piston (31) and a base (36) of the cylindrical body (30) is defined a first internal chamber (44) communicating with at least one duct (39) for the inflow and outflow of the working fluid; in that between the rod (33) and the cylindrical body (30) is defined a second internal chamber (45) opposite the first chamber (44) with respect to the piston (31) and communicating with the said first chamber (44); and in that interception means (37,34) are provided which, during an end-of-travel stroke of the piston (31) towards the said base (36), determine a narrowing of the cross-section of the fluid outflow from the first chamber (44) to the fluid inflow and outflow duct (39), and which, during the opposite end stroke, determine a narrowing in the cross-section of the discharge of the fluid outflow from the second chamber (45) to the first chamber (44).

2. A lifting unit according to Claim 1, wherein the first chamber (44) communicates with the fluid inflow and outflow duct (39) through at least one main passage (42) and at least one auxiliary passage (46,47) provided with check valve means (51-53) which prevent the fluid flow from the first chamber (44) to the fluid inflow and outflow duct (39); wherein the second chamber (45) communicates with the first chamber (44) through at least one main passage (48) and at least one narrow auxiliary passage (49); and wherein the said interception means comprise first interception means (37,38) limiting fluid discharging from the first chamber (44) to the fluid inflow and outflow duct (39) through the respective main passage (42) during the said end-of-travel stroke of the piston (31) towards the base (36), and second interception means (34) which prevent the discharge of fluid from the second chamber (45) to the first chamber (44) through the respective main passage (48) during the opposite end-of-travel stroke.

3. A lifting unit according to Claim 2, wherein the actuating rod (33) is hollow; and wherein the first interception means comprise a tang (37) which is integral with the base (36) of the cylindrical body (30), and which is coupled, with clearance, with a through hole (38) in the piston (31) opening on one side into the rod (33), there being accommodated in the tang (37) a duct (42), forming the said main passage relative to the first chamber (44), which communicates on one side with the said fluid inflow and outflow duct (39) and on the other side opens out on the exterior of the tang (37) in the direction of the through hole (38) in the piston (31).

4. A lifting unit according to Claim 3, wherein the through hole (38) has a narrow portion (50) such that a narrow passage is formed between the tang (37) and the hole (38); and wherein the tang (37) and the hole (38) have a corresponding upper and lower flaring respectively.

5. A lifting unit according to Claim 3, wherein the auxiliary passage (46,47) relative to the first chamber (44) is provided in the base (36) of the cylindrical body (30); and wherein the check valve means comprise a ball valve member (51) which rests on a seat (52) of a duct (47) of said auxiliary passage and which is retained in said duct (47) by a pin (53) transversely inserted in the duct (47).

6. A lifting unit according to any of the Claims 2 to 5, wherein the actuating rod (33) is hollow and its interior communicates with the first chamber (44); wherein the said rod (33) has a plurality of through holes (48) each of which forms the said main passage relative to the second chamber (45); and in which the said second interception means comprise a bush (34) which is disposed between the rod (33) and the cylindrical body (30) and which impedes the said through holes (48) during the opposite end-of-travel stroke.

7. A lifting unit according to Claim 6, wherein a plurality of auxiliary passages relative to the second chamber (45) are formed in the piston (31), and comprise through transversal ducts (49) each having a portion with a narrow cross-section and communicating with the second chamber (45) through the space between the piston (31) and the cylindrical body (30).

8. A lifting unit according to any of the preceding Claims, wherein a central hydraulic cylinder (18) kinematically connected to the forks (12) and a pair of side hydraulic cylinders (19) kinematically connected to the central hydraulic cylinder (18) through a telescopic frame (13) are provided.

9. A lifting unit according to any of the Claims 1 to 7, wherein a single hydraulic cylinder kinematically connected to the forks is provided.

10. A lifting unit according to any of the Claims 1 to 7, wherein a pair of side hydraulic cylinders kinematically connected to the forks through a telescopic frame is provided.

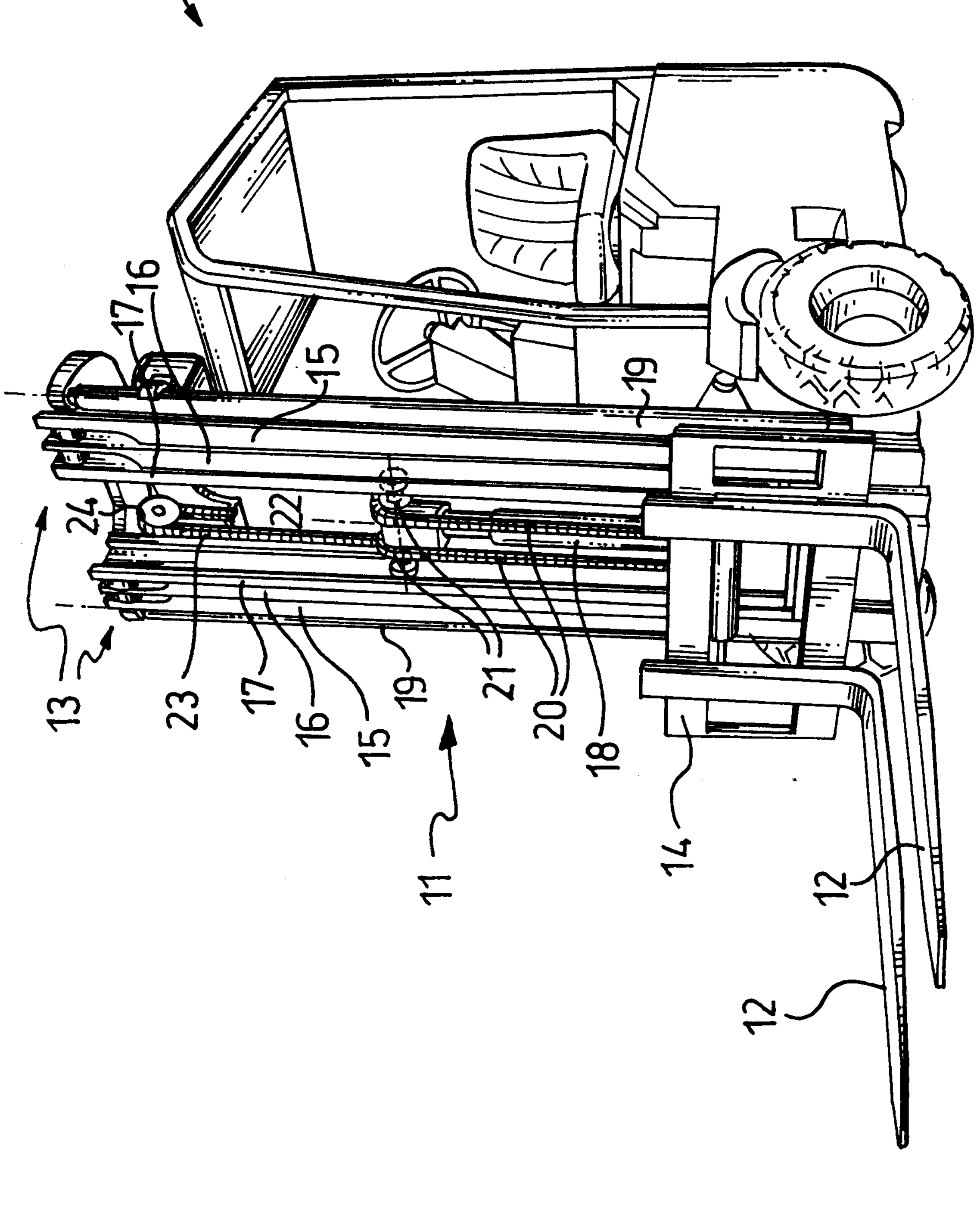

FIG.1

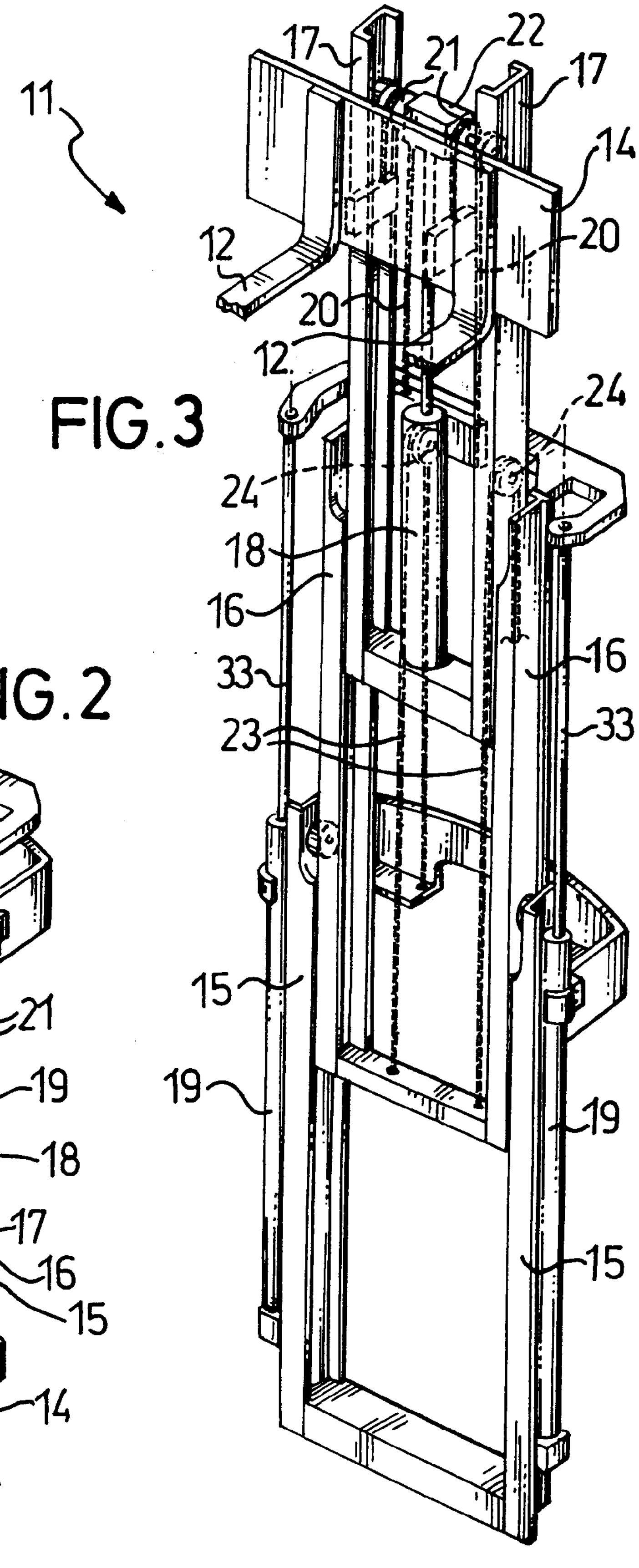
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FIG.3

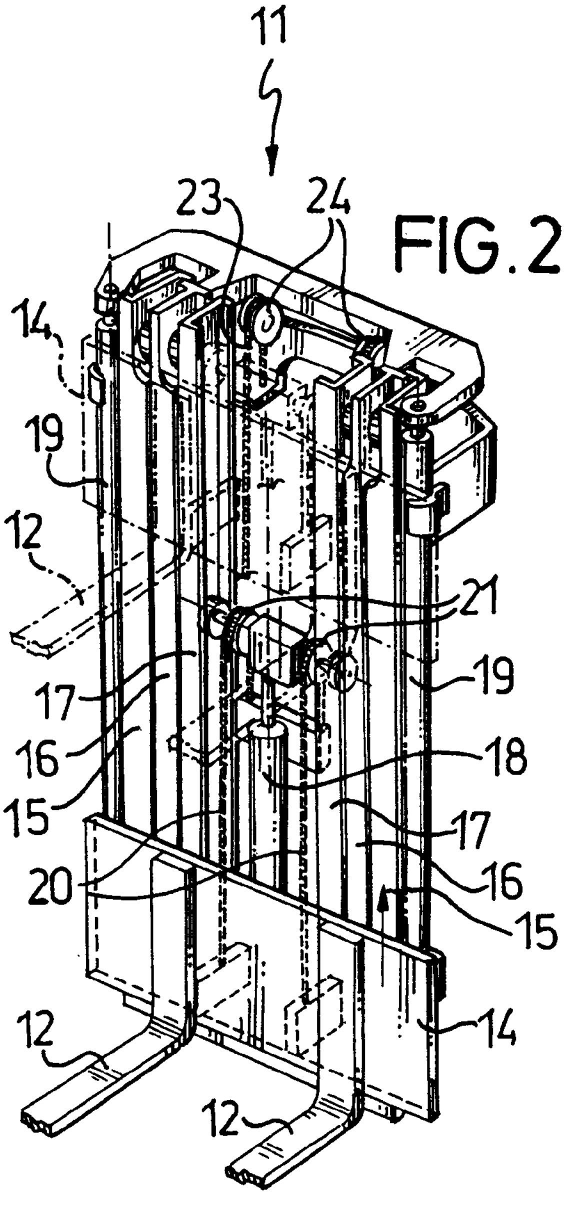
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FIG.2

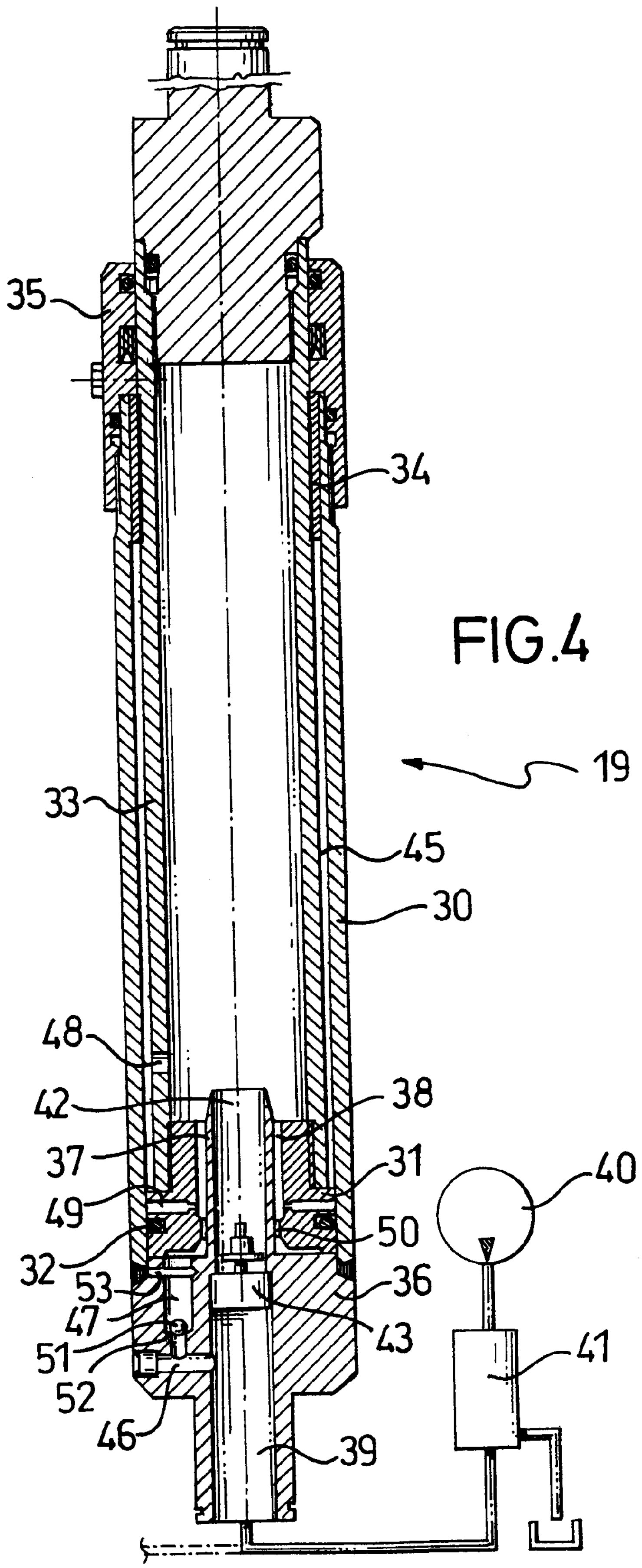

FIG.4

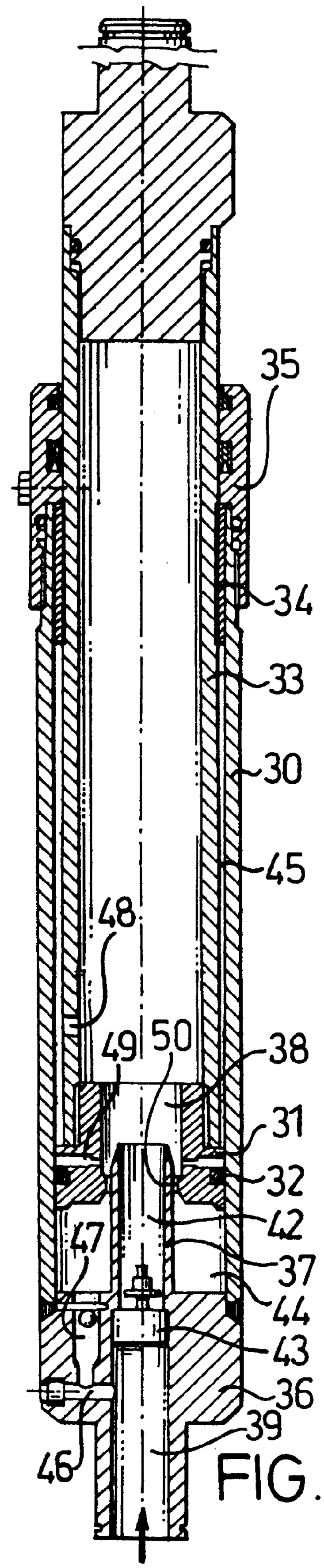

FIG.5

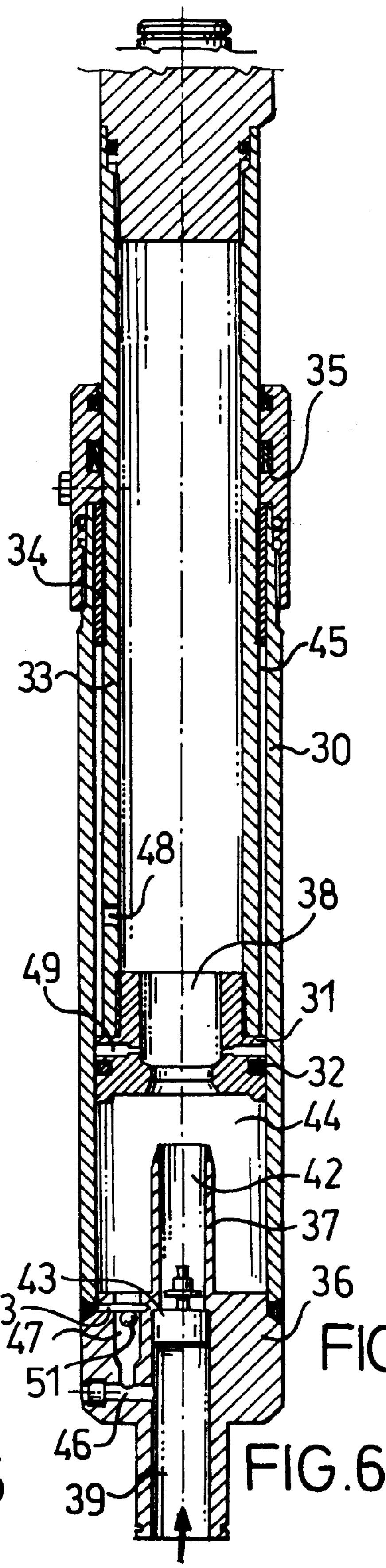

FIG.6

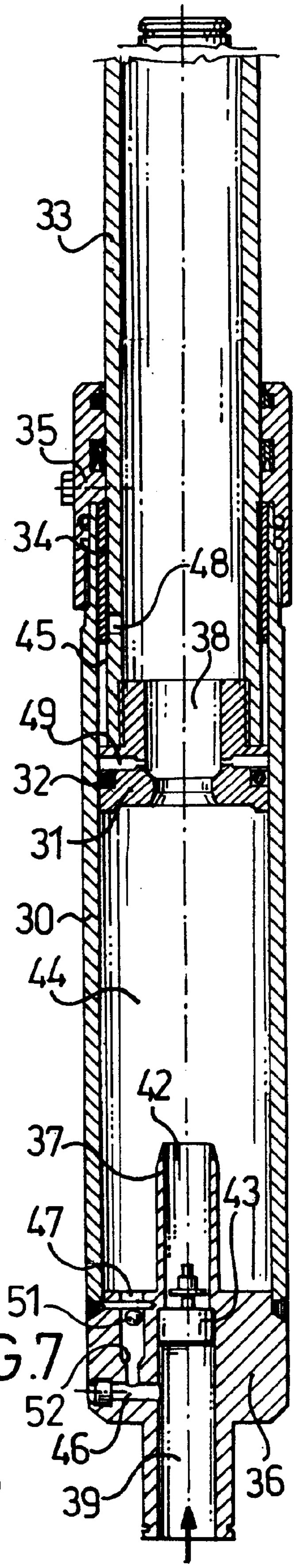

FIG.7

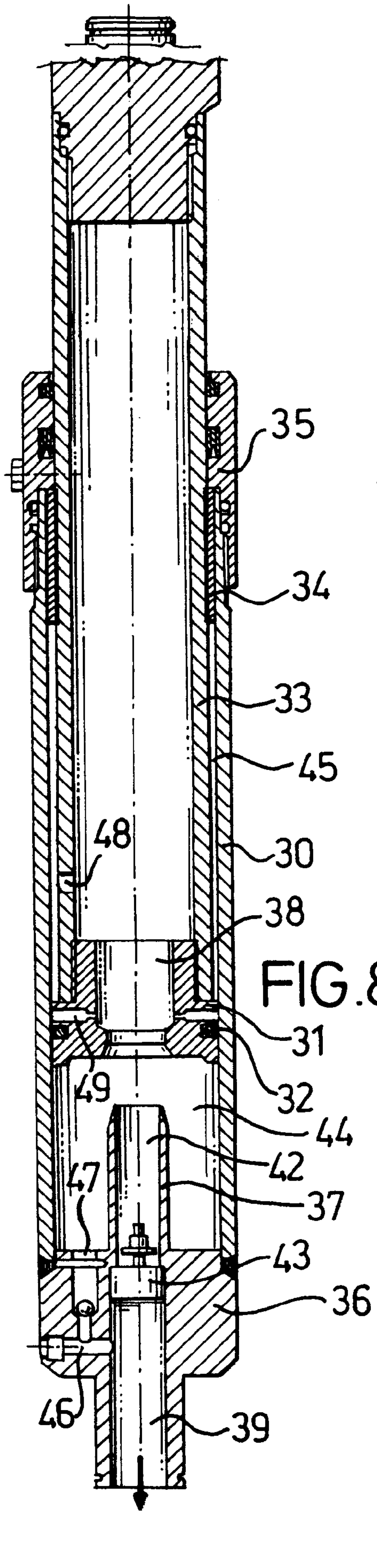

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FIG.8

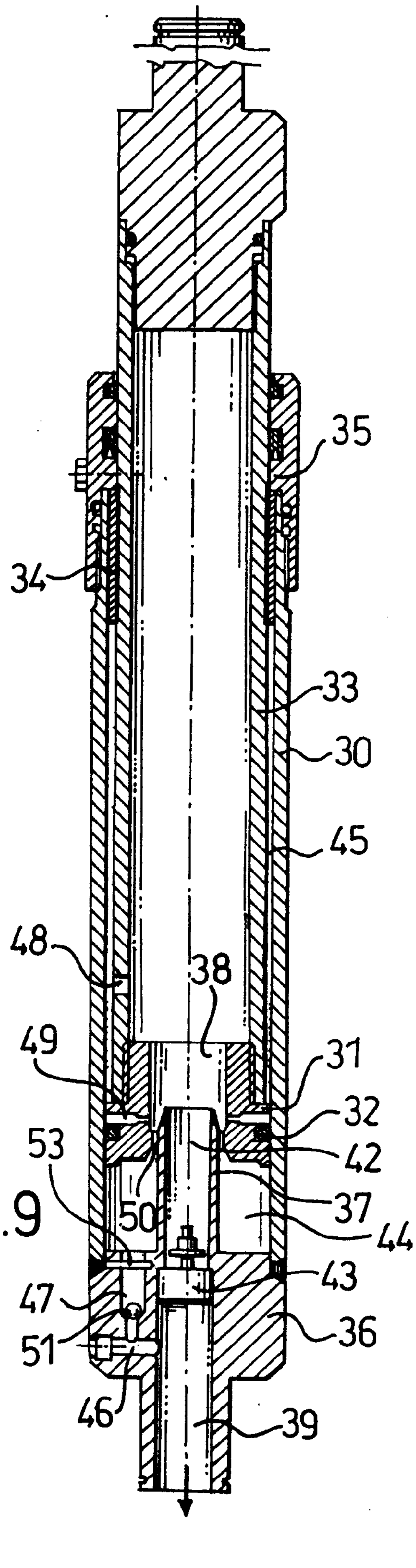

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FIG.9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 20 0679

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.5)
X	DE-A-36 06 515 (K. K. TOYODA JIDOSHOKKI SEISAKUSHO)	1,2,6	B66F9/08 F15B15/22
Y	* page 20, paragraph 2 - page 16, paragraph 2 *	3,8-10	
A		7	

Y	EP-A-0 080 579 (WABCO)	3	
A	* page 3, line 9 - page 7, line 16 *	1,2,5	

Y	EP-A-0 102 514 (TOWMOTOR CORPORATION) * page 3, line 2 - line 34 * * page 5, line 3 - line 26 *	8-10	

A	US-A-4 006 666 (MURRAY)		

A	FR-A-1 414 638 (APPALETTE)		

A	FR-A-2 024 747 (LATI)		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)
B66F F15B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	9 August 1994	Van den Berghe, E

CATEGORY OF CITED DOCUMENTS

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