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(54) Device with synchronous hydraulic jacks.

(57) The invention relates to a device comprising a hydraulic system with a source of hydraulic medium under pressure, a reservoir for the medium, at least two cylinder/piston assemblies (5,6) and a control valve (23) for connecting the source or the reservoir at choice to the cylinders. The cylinders are connected in series and the cylinders are dimensioned such that the effective piston surface in the chambers of the two cylinders, which chambers are directly connected to each other by a connecting conduit (10), is equal. Synchronous operating means comprising position sensors (14,15) generate a signal corresponding with the extended position of each piston, a first correction valve (18) can mutually connect the two connections of the first cylinder/piston assembly (5) in the series connection, a second correction valve (20) can connect the connecting conduit (10) to the reservoir, and wherein control means (13) are arranged connected to the position sensors (14,15) and the correction valves (18,20).

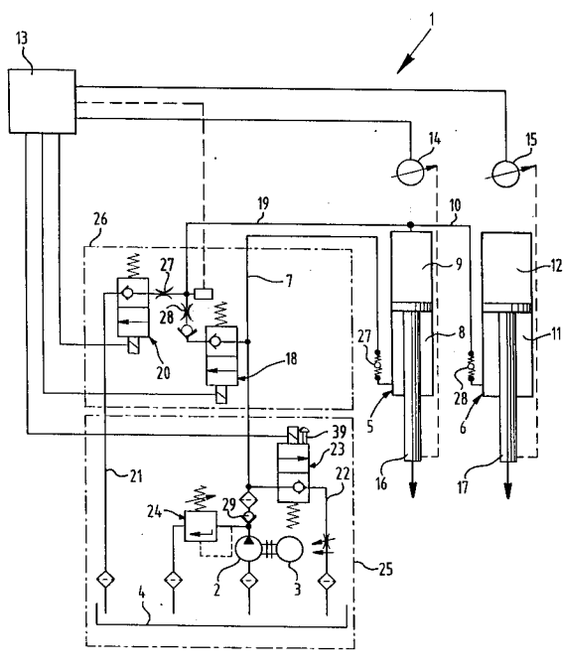

FIG. 1

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The invention relates to a device comprising a hydraulic system with a source of hydraulic medium under pressure, a reservoir for the medium and at least two cylinder/piston assemblies connected in series in a master-slave circuit. In order to obtain a synchronous movement of the pistons synchronous operating means are employed which comprise position sensors generating a signal corresponding with the extended position of each piston. These signals are processed by control means in order to correct a possible non-synchronous position of the pistons by feeding or draining medium.

The invention has for its object to improve such a device as known from the German "Offenlegungsschrift" 3 515 762.

With the device according to the invention as characterized in claim 1 is achieved that a correction can be carried out during both the outward and return stroke of the pistons. In both directions of movement of the pistons the medium pressure in the conduit to the first cylinder/piston assembly in the series connection is higher than in the connecting conduit between the cylinders, so that using the first correction valve medium can be fed into the connecting conduit. With the second correction valve medium can be drained from the connecting conduit.

A particularly favourable embodiment of the device is characterized in claim 2. Hereby the pressure in the feed conduit to the first cylinder/piston assembly is with certainty always higher than in the connecting conduit in the most unfavourable load situation, so that the synchronous operating means can always function reliably.

Another possible embodiment is characterized in claim 3.

With the step of claim 4 is achieved that the correction can take place very uniformly and even undiscernibly. The feed or drain of medium respectively to and from the connecting conduit takes place at a low speed.

According to a further development of the invention the step of claim 5 is applied. When, despite the action of the synchronous operating means, too great a difference occurs in the position of the pistons of the different cylinder/piston assemblies the control means act as safety means preventing the occurrence of a dangerous situation. This step is particularly favourable when the device according to the invention is a vehicle lifting device. The position sensors can herein be connected via vehicle supporting carriers to the piston rods so that when descent of one of the carriers is prevented by an obstacle the device is blocked.

When the step of claim 6 is applied the control means can be embodied in simple manner. For ascent only the pump has to be switched on and for descent only the control valve has to be activated. This prevents different control means having to be operated simultaneously.

With the step of claim 7 a simple and economic structure of the hydraulic system of the device is obtained. Because only one type of valve is employed the holding in stock of spare components is simplified.

It has been found that the steps of claim 8 can result in an economically favourable embodiment. The position sensors embodied in accordance with this embodiment can be manufactured at relatively low cost so that the whole device can be embodied very economically.

A very favourable embodiment of the device is characterized in claim 9. The piston rods of the cylinder/piston assemblies are continuously tension loaded during operation so that driving only has to take place in the lifting device. The descending movement can take place under the weight of the movable parts of the device. Because only one pressure conduit is required here, the hydraulic system becomes exceptionally simple so that compared with the usual construction for such vehicle lifting devices, wherein the vehicle lifting members are mutually connected by chains or the like, a considerable simplification is realized.

With the preferred step of claim 10 is achieved that the piston rods can only be tension loaded and never pressure loaded, whereby they do not have to be dimensioned for buckling, which enables a slim-line embodiment.

The invention will be further elucidated in the following description with reference to the annexed figures.

Figure 1 shows a hydraulic diagram of a device according to a first embodiment of the invention.

Figure 2 shows a hydraulic diagram corresponding with figure 1 of a second embodiment.

Figure 3 is a perspective view of a vehicle lifting device embodied as a device according to the invention.

The device 1 shown in figure 1 comprises a hydraulic system with a pump 2 which can be driven by an electric motor 3. The pump 2 draws up hydraulic oil out of a reservoir 4 and can press it into a pressure conduit 7. The latter is connected to a series connection of two cylinder/piston assemblies 5, 6. Conduit 7 is connected to the first chamber 8 of cylinder 5 in the series connection. The second chamber 9 of cylinder 5 is connected via a connecting conduit 10 to the first chamber 11 of second cylinder 6. In this embodiment the second chamber 12 of this cylinder is not incorporated in the hydraulic circuit since piston rods 16, 17 of respectively cylinder 5 and 6 are tension loaded. The downward stroke of piston rod 17 can be effected by this tension loading in a manner to be

further described. The second chamber 12 can in simple manner be in open communication with the environment or in communication with the oil reservoir.

It will be apparent that if the pump 2 presses oil under pressure in conduit 7 to the first chamber 8 of cylinder 5, oil is forced out of the second chamber 9 of this cylinder which flows via connecting conduit 10 to the first chamber 11 of cylinder 6. The effective piston surface in chamber 9 is equal to that in chamber 11 so that the piston rods 16, 17 will hereby operate synchronously. In order to ensure that the effective piston surface in chamber 9 equals that in chamber 11 the active diameter of cylinder 6 must equal the root of the sum of the square of the active diameter of cylinder 5 and the square of the diameter of the piston rod 17.

By switching on motor 3 the piston rods 16 and 17 will thus move upward as seen in figure 1. After motor 3 has been switched off the piston rods 16 and 17 remain in the position reached, wherein the pressure in conduit 7 is maintained by the action of the non-return valve 29. This situation persists until the valve 23 is activated, which opens a connection of conduit 7 to the drain conduit 22 to the reservoir 4. As a result of the downward load of piston rods 16 and 17 the oil flows out of the first chamber 11 of cylinder 6 to the second chamber 9 of cylinder 5 and out of the first chamber 8 of cylinder 5 through the conduit 7 to reservoir 4.

In addition to the synchronous operation of piston rods 16 and 17 achieved in this manner the device comprises synchronous operating means which ensure that the mutual position of the piston rods 16 and 17 remains the same within narrow limits. These control means comprise position sensors which are formed in this embodiment by potentiometers 14 and 15. These potentiometers are connected to the respective piston rods 16 and 17 so that the rotational position of these potentiometers 14, 15 has a fixed relation to the extended position of piston rod 16 and 17.

Potentiometers 14 and 15 are connected to control means 13. These detect when the position sensors 14, 15 have a mutually differing position, which means that piston rods 16 and 17 have a mutually differing position. In the case the piston rod 17 lies in a lower position than piston rod 16, for instance because hydraulic oil has leaked out of the closed system of chamber 9, connecting conduit 10 and chamber 11, the control unit 13 will actuate opening of a first correction valve 18. A connection is hereby effected between conduit 7 and connecting conduit 10, or between the first chamber 8 and second chamber 9 of cylinder 5. Since as a result of the downward load on piston rod 16 the pressure in chamber 8 is at all times higher than that in chamber 9, which is further reinforced in that the effective piston surface of chamber 8 is smaller than that of chamber 9, hydraulic oil will flow via the opened valve 18 out of conduit 7 via the valve 18 and conduit 19 to connecting conduit 10. The amount of oil in the system of chamber 9, connecting conduit 10 and chamber 11 hereby increases so that the non-synchronous position is compensated. The flow speed through conduit 19 is limited by the restriction 28 so that the position correction takes place uniformly and even undiscernibly. The position sensors 14 and 15 detect as soon as a synchronous position is once again reached, whereafter the control unit 13 closes valve 18. In the opposite case wherein piston rod 16 has a lower position than piston rod 17 and too much oil is therefore present in the system of chamber 9, connecting conduit 10 and chamber 11 that in the normal situation is closed, the control unit 13 will actuate opening of the second correction valve 20 whereby a connection is formed from connecting conduit 10 via conduit 19, valve 20 and conduit 21 to the reservoir 4. Due to the drain-off of oil the piston rod 17 descends to the level of that of piston rod 16, which is detected by position sensors 14 and 15. Restriction 27 also provides herein a limited flow rate of medium out of the connecting conduit 10 so that the correction in this direction likewise proceeds smoothly and even undiscernibly. As shown in the figure, separate restrictions 27 and 28 are used for both correction flows in order to achieve an optimum adjustment. At normal operating pressures the restriction 27 will have to be narrower than restriction 28 since the pressure difference over restriction 27 is greater than that over restriction 28. In a simplified embodiment it is possible to suffice with one restriction in the conduit 19 which forms an optimum for both correction situations. As soon as a synchronous position has been reached the control unit 13 will close valve 20 once again.

As can be seen in figure 1, the hydraulic system can be constructed from a per se known pump unit 25 which in addition to the above described elements also has an overpressure valve 24. This pump unit 25 is connected via two hydraulic connections to a valve block 26 in which are arranged the valves 18 and 20. Control unit 13 comprises a comparator which is self-evident to a skilled person and which at a determined minimal voltage difference between the output signal of potentiometers 14 and 15 in the one direction generates a control signal for the valve 18 and at a minimal voltage difference in the other direction generates a control signal for the valve 20. The control signal for the "descent" valve 23 is generated in usual manner when a pressure switch (not shown) is pressed in. The control valve 23 can, as shown, be provided with an additional hand control 39 so that

in the case of power breakdown the device can be set in a rest position by hand. As shown in figure 1, safety valves 27, 28 respectively are also arranged in conduit 7 and in connecting conduit 10 which close the connection as soon as too high a flow speed occurs, for instance as a result of conduit breakage.

It will be apparent that the signal of the position sensors 14 and 15 can also be used for other purposes. The whole system can for instance be switched off if a position difference above a determined value is detected.

When a first value is exceeded the descend option is preferably switched off first. When a second, greater value is exceeded, the whole system is then switched off. A non-synchronous position caused because during descent the vehicle or a supporting arm of the bridge comes into contact with an obstacle such as a support can then be restored rapidly by switching the bridge to lift.

Figure 2 shows a circuit similar to that of figure 1 wherein corresponding components are designated with the same reference numerals. In the circuit of figure 2 two cylinder/piston assemblies 30, 31 are likewise present. The piston rods 32, 33 respectively hereof are however not tension but pressure loaded. In this case the conduit 7 must of course be connected to chamber 34 of cylinder 30 which lies on the other side of piston rod 32. The second chamber 35 of cylinder 30 is connected via connecting conduit 37 to the first chamber 36 of cylinder 31.

When now the diameter of piston rod 32 amounts to less than half the diameter of the piston, that is, than the effective diameter of cylinder 34, the pressure in the chamber 34 will be higher at an equal load of piston rods 32 and 33 than that in the closed system of chamber 35, connecting conduit 37 and chamber 36. Supplementing the oil in this closed system can then take place in simple manner, using the same circuit as shown in figure 1, by means of the first correction valve 18. In situations with variable loads between the piston rods 32 and 33 supplementing can optionally take place using a source of medium under a higher pressure. This can for instance be realized by incorporating a reducing valve in the portion of the conduit 7 between the valve 18 and cylinder 30. A greater pressure then prevails at the position of valve 18 than in the chamber 34.

Figure 3 shows an application of the invention as vehicle lifting device. This vehicle lifting device 40 comprises two columns 41 and 42 in which carriages 45, 46 respectively are guided for vertical displacement. These carriages 45, 46 carry at their bottom end vehicle lifting members 43 and 44 respectively. Carriages 45, 46 with lifting members 43, 44 are moved up and downward in the columns 41, 42 by means of hydraulic cylinder/piston assemblies 47, 48. These cylinders 47 and 48 correspond with the cylinders 5 and 6 of figure 1. Cylinder 48 therefore has a greater diameter than cylinder 47 in order to obtain the described ratio. Cylinders 47 and 48 are "suspended" in the top of the columns 41, 42. The respective piston rods 49, 50 extend downward and engage through the carriages 45, 46 onto supports 51, 52 close to the underside of carriages 45, 46. The supports 51, 52 are embodied such that piston rods 49, 50 can protrude therethrough. The piston rods bear on their bottom end a stop with which they engage on the underside onto the supports 51, 52. When the lifting members 43, 44 are thus loaded vertically downward during normal operation, for instance because a vehicle is placed thereon, they move together with the piston rods. If a vehicle lifting member 43, 44 were to be obstructed in its downward movement, for instance because a support or the like has been left thereunder, the piston rods can slide through the openings in the supports 51, 52 so that these piston rods are not pressure loaded and are therefore not under buckling load.

Mounted in the top of each column 41, 42 is a potentiometer, whereof the potentiometer 53 in column 41 is shown. This potentiometer 53 carries on its shaft a wire drum on which is wound a wire. The wire drum is continuously loaded in winding direction by a wind-up spring. The wire 54 is connected to a support 55 of carriage 45. The potentiometer 53 and that in column 42 correspond with the potentiometers 14 and 15 of figure 1. As soon as a height difference occurs in the lifting members 43, 44 this is therefore detected by the potentiometers and oil is added or drained in the above described manner to correct the difference.

If one of the vehicle lifting members 43, 44 is obstructed in its downward movement in the above described manner this will immediately be detected by the potentiometers and an attempt will be made to perform a correction by adding or draining oil. Since the piston rods can slide through the opening in supports 51, 52 relative to the carriages, this correction will not provide the desired result and at a given moment the potentiometers will detect a difference set above a determined limit value. The control device is then embodied such that when this maximum permissible difference is exceeded the whole device is switched off. A safe operation of the vehicle lifting device 40 is thus obtained.

As shown in figure 3, a fine construction is obtained with the invention. The usual chain or cable transmission between carriages 45 and 46 is not present. There is a minimum number of moving parts so that servicing of a lifting device 40 as shown in figure 3 is minimal.

The invention is of course also applicable to other vehicle lifting devices, for instance four-column lifting devices, and in general to other devices wherein synchronous operation of piston rods of hydraulic cylinder/piston assemblies is desired.

Claims

1. Device comprising a hydraulic system with a source of hydraulic medium under pressure, a reservoir for the medium, at least two cylinder/piston assemblies, a control valve for connecting the source or the reservoir at choice to the cylinders, wherein the cylinders are connected in series, the cylinders are dimensioned such that the effective piston surface in the chambers of the two cylinders, which chambers are directly connected to each other by a connecting conduit, is equal, and synchronous operating means comprising position sensors generating a signal corresponding with the extended position of each piston, a first correction valve which can mutually connect the two connections of the first cylinder/piston assembly in the series connection, a second correction valve which can connect the connecting conduit to the reservoir and control means connected to the position sensors and the correction valves.

2. Device as claimed in claim 1, wherein the cylinder/piston assemblies are mounted such that the piston rods thereof are continuously tension loaded in the operating situation.

3. Device as claimed in claim 1, wherein the cylinder/piston assemblies are mounted such that the piston rods thereof are continuously pressure loaded in the operating situation, wherein the diameter of the piston rod of the first assembly in the series connection amounts to less than half the diameter of the piston.

4. Device as claimed in any of the foregoing claims, wherein restrictions are arranged in conduit portions connected to the correction valves.

5. Device as claimed in any of the foregoing claims, wherein
the control means are embodied such that these prevent the operation of the device when the difference between the signals of the position sensors exceeds a threshold value.

6. Device as claimed in any of the foregoing claims, comprising a continuous pressure conduit from the output of the pump to the series connection of cylinder/piston assemblies, wherein the control valve is a closing valve arranged in a conduit leading to the reservoir and branched from this pressure conduit.

7. Device as claimed in any of the foregoing claims, wherein the control valve and the correction valves are identical valves.

8. Device as claimed in any of the foregoing claims, wherein the position sensors comprise potentiometers, a shaft of which carries a wire drum and an end of a wire wound onto the wire drums is connected to an element fixedly connected to the respective piston rods, while the wire drum is continuously loaded in winding direction by a wind-up spring.

9. Device as claimed in any of the foregoing claims, being a vehicle lifting device comprising at least two columns having vehicle lifting members mounted thereon for vertical displacement, wherein in each column a cylinder/piston assembly is mounted in suspended manner with the respective vehicle lifting member hanging from the downward protruding piston rod thereof.

10. Device as claimed in claim 9, wherein the piston rod bears a stop engaging in upward direction and the piston rod is slidable downward with the stop relative to the vehicle lifting member.

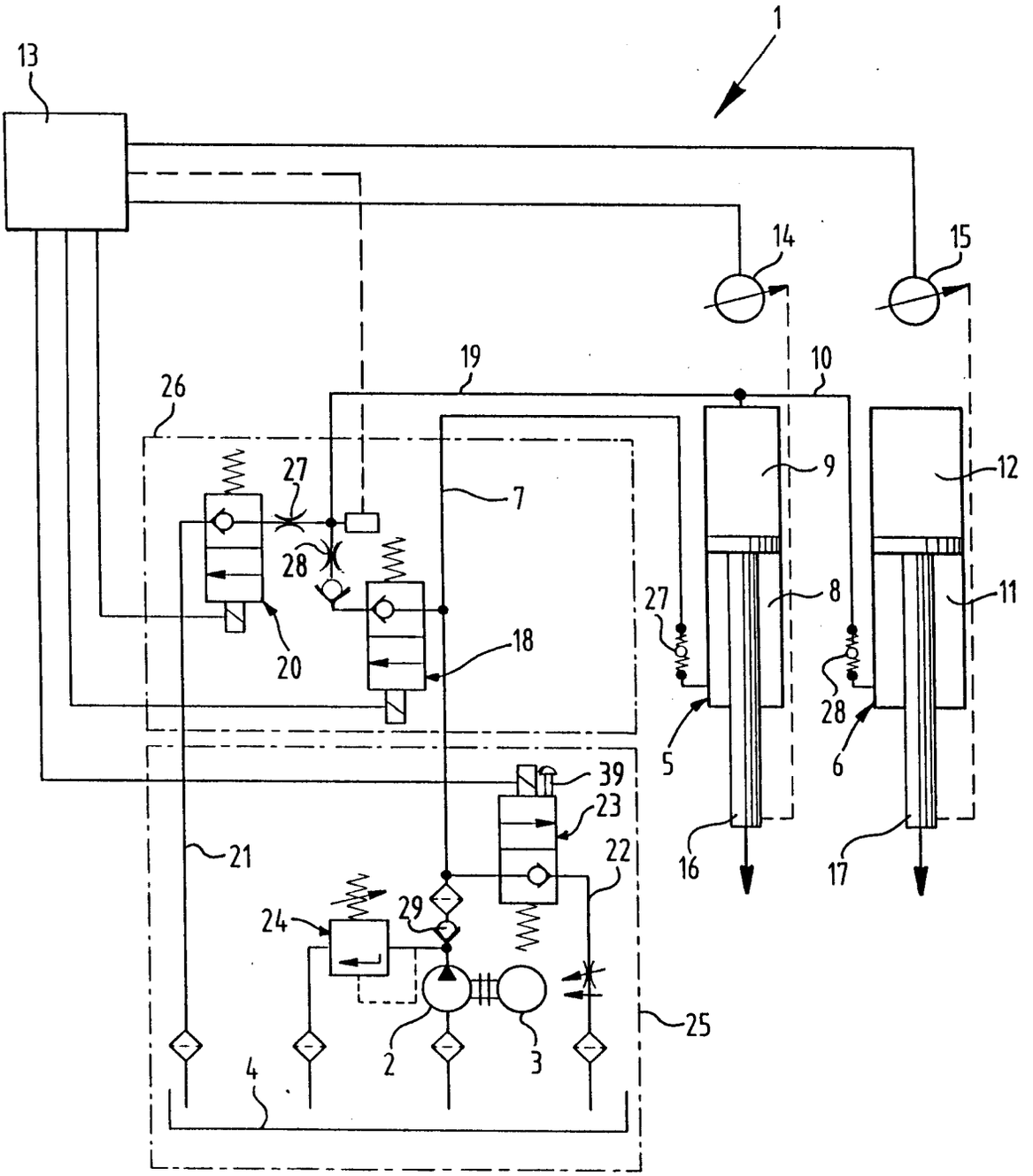
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FIG. 1

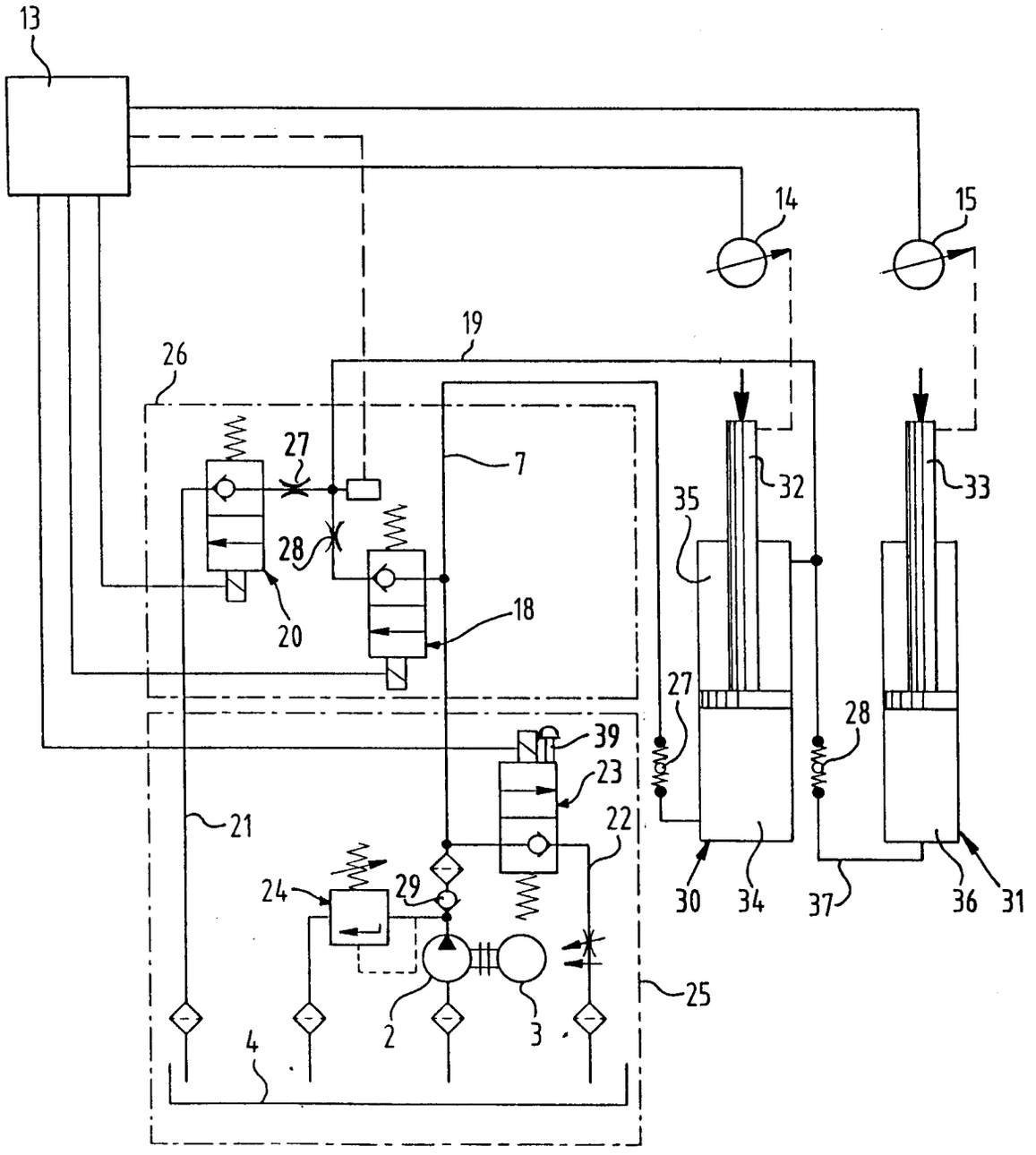
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FIG. 2

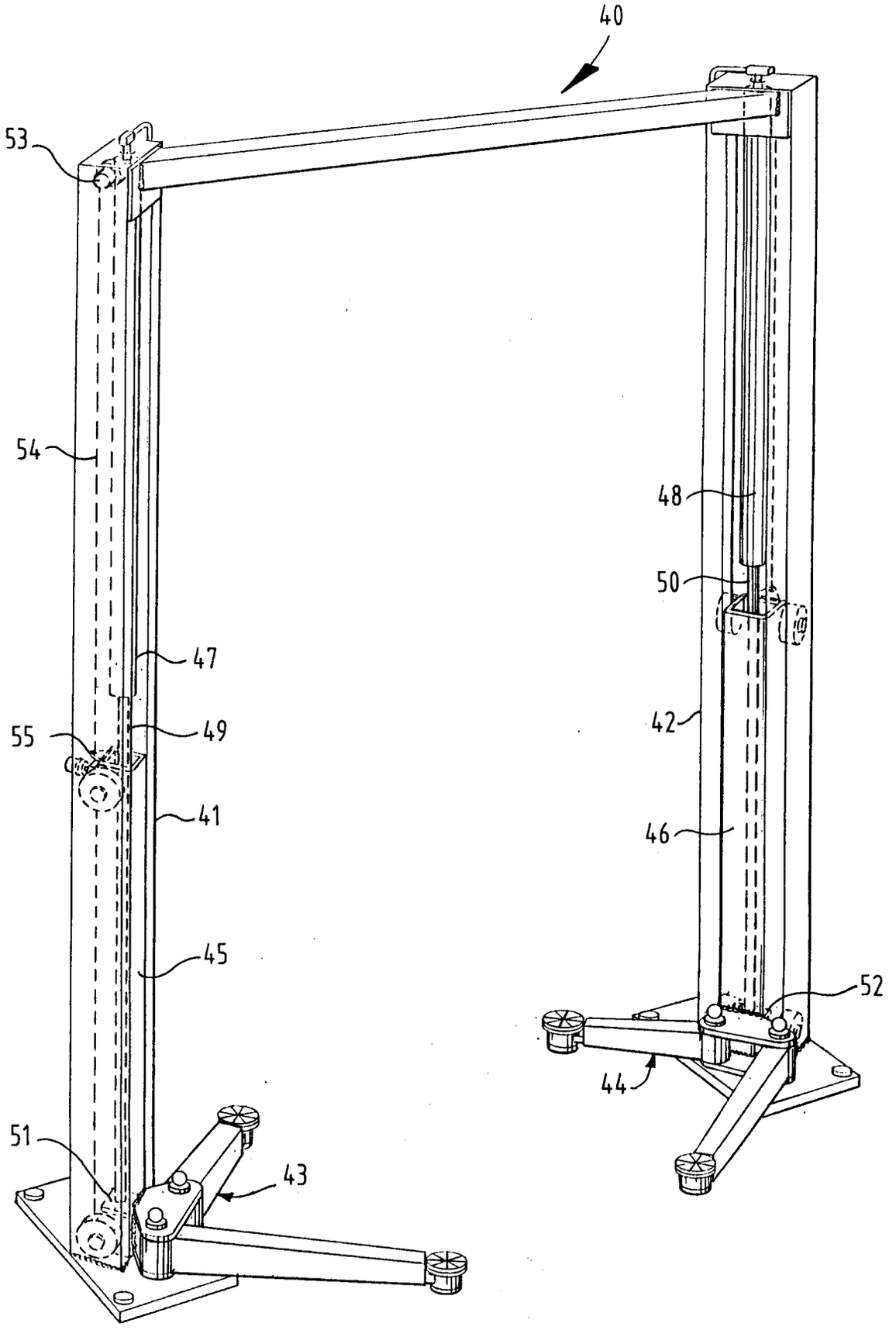

FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 20 1068

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)
D,X	DE-A-3 515 762 (ZIPPO) * the whole document * ---	1-3,5,6	F15B11/22 B66F7/20
A	DE-A-3 439 292 (NUSSBAUM) * the whole document * -----	1-3,9	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F15B
B66F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02 JULY 1993	KNOPS J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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