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(54) Hydraulic pile-driver.

(57) The present invention relates to a hydraulic control device for the falling weight (11) of a pile driving installation, comprising: a hydraulic cylinder (7) for driving the falling weight, a control unit (6) arranged in the vicinity of the cylinder, a pump (17) connected to the control unit via a pressure conduit (15), and a reservoir (21) connected to the control unit via a pressureless conduit (16), wherein the control unit is arranged such that when pressure is applied to the pressure conduit, the pressure in the pressure conduit lifts the weight and when pressure in the pressure conduit falls away the falling weight moves downward.

Because the control unit present at the top of the piling frame thus reacts directly to the pressure in the pressure conduit, the pile-driving process can be controlled from below without transferring signals via extra means for signal transmission such as electrical cables.

The above steps further avoid the use of electrically operated valves at the top of the piling frame. This would in any case also very quickly lead to breakdowns. The invention allows the two conduits necessary for supplying energy, in this case the hydraulic pressure, to be used as signal transmission lines.

According to a preferred embodiment the control unit comprises a valve (24) connected to the lifting side of the cylinder, which valve is closed when pressure is applied to the pressure conduit and which opens when the pressure in the pressure conduit falls away.

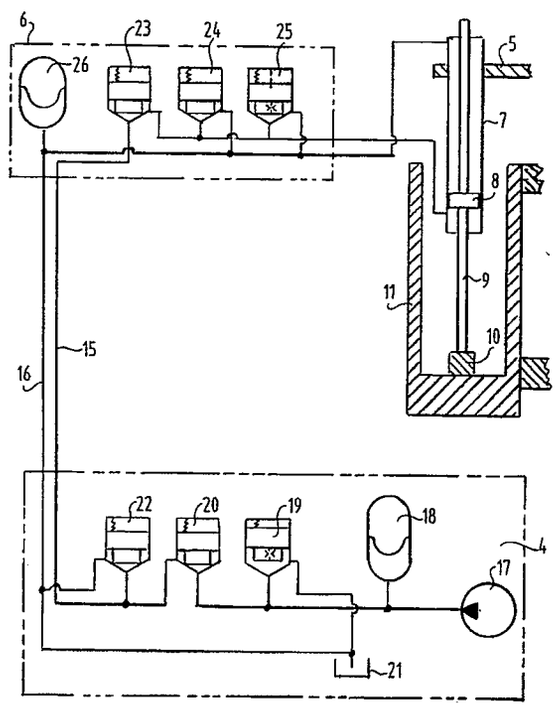

FIG.2

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The present invention relates to a hydraulic control device for the falling weight of a pile driving installation, comprising:

- a hydraulic cylinder for driving the falling weight;
- a control unit arranged in the vicinity of the cylinder;
- a pump connected to the control unit via a pressure conduit; and
- a reservoir connected to the control unit via a pressureless conduit.

Such a hydraulic control device is known from the German patent application number 2225397.

This known hydraulic control device is arranged for the greater part in the vicinity of the hydraulic lifting cylinder for the falling weight or striker weight, and therefore in the vicinity of the striker weight. Since the striker weight is initially situated high in the piling frame and slowly moves downward during further driving of the pile into the ground, the hydraulic cylinder for driving the striker weight will likewise move downward during the course of the pile driving process.

When, as with this known device, the control device is situated substantially in the vicinity of the striker weight this control device will likewise be slowly moved downward during the pile driving process. This control device is moreover subjected to the vibrations and shocks usually prevailing in the upper part of the piling frame as a result of the pile driving.

The consequence hereof is that the control device quickly breaks down.

Apart from the normal conduits for feed and discharge of hydraulic liquids, further lines, for example electrical, are however necessary for transferring control signals for remote control of this control device. In the context of the often rugged surroundings in which pile-driving operations take place and the usually great distance between the control installation and the person controlling the pile-driving device, it is not inconceivable for the control conduits to be damaged.

The object of the present invention is to provide a control device wherein the above stated drawbacks are avoided.

The hydraulic control device according to the invention is distinguished in that the control unit is arranged such that when pressure is applied to the pressure conduit the pressure in the pressure conduit lifts the weight and, when the pressure in the pressure conduit falls away, the falling weight moves downward.

Because the control unit present at the top of the piling frame thus reacts directly to the pressure in the pressure conduit, making use of this the pile-driving process can be controlled from below without transferring signals via extra means for signal transmission such as electrical cables.

The above steps further avoid the use of electrically operated valves at the top of the piling frame. This would in any case also very quickly lead to breakdowns. For the same reason the use of remote signal transmission using transmitters and receivers is likewise out of the question. Due to the steps according to the invention, the two conduits necessary for supplying energy, in this case the hydraulic pressure, are also used as signal transmission lines.

According to a preferred embodiment the control unit comprises a valve connected to the lifting side of the cylinder, which valve is closed when pressure is applied to the pressure conduit and which opens when the pressure in the pressure conduit falls away. By placing this valve in the control unit such that when pressure is applied this pressure is directly supplied to the lifting side of the piston, the piston will cause the striker weight to move upward. The valve then keeps the discharge closed.

When the pressure falls away in the pressure conduit the valve will open so that the hydraulic liquid then present in the lifting side of the cylinder can flow away via the valve and the striker weight can fall downward with as much free fall as possible, so that an optimal strike on the pile is obtained. Experience has in any case shown that the operation of a striker weight is optimal with as much free fall as possible.

The present invention will be further elucidated with reference to the annexed figures, in which:

Fig. 1 shows a schematic sectional view of a pile driver, wherein the control device according to the present invention is used;

Fig. 2 shows a diagram of an embodiment of the control device according to the present invention; and

Fig. 3 shows a sectional view of the fixing of the piston rod of the device according to the present invention to the striker weight.

Fig. 1 shows a piling frame 1 which is secured by means of wires 2. The piling frame rests on a ground plate 3 on which is mounted an aggregate 4. Arranged in the top of the piling frame is a carrier 5 which is movable along the piling frame by means of means not shown here and on which a control box 6 is arranged.

On the other side of the carrier is attached a hydraulic cylinder 7 wherein a piston 8 is arranged which is connected to the striker weight 11 by means of a piston rod 9 and a coupling 10. In the situation as drawn the striker weight rests on a pile 12 to be driven. The control member 13, which takes a portable form, is connected to the aggregate 4 by means of a cable 14.

The aggregate 4 is further connected to the

control unit 6 by means of both a pressure conduit 15 and a pressureless conduit 16. The diagram of fig. 2 shows how a pump 17 is incorporated in the aggregate 4, the discharge side of which pump is connected to an expansion tank 18. This discharge side of the pump is further connected to a pressure control valve 19, which is also electrically controllable and then acts as short circuit valve, and an electrically controllable valve 20. The outlet side of the valve 19 is connected to a reservoir 21, while the outflow side of the valve 20 is connected to the pressure carrying conduit 15 and to the feed side of a second electrical valve 22. The discharge side of the second electrical valve 22 is connected via a channel to the reservoir 21, as is the pressureless channel 16.

The control unit 6 arranged in the vicinity of the cylinder 7 comprises a first automatic valve 23, the inflow side of which is connected to the pressure conduit 15 and the outflow side of which is connected to the lifting side of the cylinder 7, that is, the chamber of the cylinder 7 which is situated under the piston 8. The outflow side of the third valve 23 is further connected to a second automatic valve 24 and to the inflow side of a second pressure control valve 25. The outflow side of both the second automatic valve 24 and the second pressure control valve 25 is connected to the descent side of the hydraulic cylinder, that is, the chamber located above the piston 8. This side is also connected to a second expansion tank 26 which is otherwise connected to the pressureless conduit 16.

Finally, fig. 3 shows how the piston rod 9 is connected to the striker weight 11 by means of a coupling 10. Arranged on the underside of the piston rod 9 is a bearing 27 through which extends a pin 28. The pin 28 also extends through a sleeve 29 arranged concentrically relative to the underside of the piston rod 9, so that the sleeve 29 is rotatable round a horizontal axis relative to the piston rod 9. Arranged on the underside of the sleeve is a rod 30 which is connected to the sleeve 29 for example by welding. The rod is provided with a number of shoulders 31, 32, 33.

The bottom part of the rod 30 extends inside a sleeve 34 which is closed off on both sides by covers 35, 36 through which the rod 30 extends. The space between the rod 30 and the sleeve 34 which is enclosed by the covers 35, 36 is occupied by a slightly elastic mass 38. This mass 38 transfers the forces acting in the vertical direction between the rod 30 and the sleeve 34 so that a slightly elastic coupling is obtained, wherein due to the properties of the slightly elastic material a certain damping is obtained which has the effect of improving the service life of the various components. The sleeve 37 is further connected on its underside to the striker weight 11. On the left in fig. 3 can also be seen a part of the guiding of the striker weight 11. This guiding does not form any part of the present application and will not be discussed further.

The operation of the device according to the present invention will now be described.

For the pile-driving, a pressure will first have to be built up in the expansion tank 18 by means of the pump 17. The pump 17 obtains its hydraulic liquid from the reservoir 21. In the neutral position in which pile driving does not take place the pressure control valve 19 is open so that through the throttle action of this valve the pressure built up by the pump 17 is throttled and only a small amount of liquid flows through the valve to the reservoir 21.

The valves 20 and 22 are here closed. No pressure is thus created on the pressure conduit 15, so that the piston 8 remains in the cylinder 7 in its lowest position.

When the operator wants to perform a stroke with the pile-driver, he will close the pressure control valve 19 and open the electro-magnetically controlled valve 20 using the electrical remote control. The liquid present in the conduit 15 thus comes under pressure wherein the automatic valve 23 is opened by the action of the pressure and the hydraulic liquid flows through the valve 23 to the bottom chamber of the lifting cylinder 8 and the striker weight 11 is moved upward. The liquid situated in the top chamber is herein pressed away to the expansion tank 26 and to the pressureless conduit 16, via which conduit the liquid finally arrives in the reservoir 21. During this operation the valves 24 and 25 remain closed.

This process is continued until the operator closes the valve 20 by means of the remote control and the pressure built up by the pump 17 is collected in the expansion tank 18. As a result thereof the pressure conduit 15 becomes pressureless whereby the valve 24 is opened and the liquid present in the bottom chamber of the cylinder 7 flows to the top chamber via the valve 24. The striker weight can thus fall freely. The pressure control valve 25 otherwise serves the purpose of not allowing the pressure in the bottom chamber of the cylinder 7 to rise excessively; when a determined limit value is exceeded the pressure control valve 25 will partially open so that the pressure inside the cylinder 7 is compensated.

Claims

1. Hydraulic control device of a falling weight of a pile driver, comprising:
   - a hydraulic cylinder for driving the falling weight;
   - a control unit arranged in the vicinity of

the cylinder;
- a pump connected to the control unit via a pressure conduit; and
- a reservoir connected to the control unit via a pressureless conduit;

characterized in that the control unit is arranged such that when pressure is applied to the pressure conduit, the pressure in the pressure conduit lifts the weight and when pressure in the pressure conduit falls away the falling weight moves downward.

2. Hydraulic control device as claimed in claim 1, **characterized in that** the control unit comprises a valve connected to the lifting side of the cylinder which valve is closed when pressure is applied to the pressure conduit and which opens when the pressure in the pressure conduit falls away.

3. Hydraulic control device as claimed in claim 2, **characterized in that** the cylinder is double-acting and that the valve reacting to the falling away of the pressure is arranged between both sides of the cylinder.

4. Hydraulic control device as claimed in claim 2 or 3, **characterized by** a second pressure dependent valve arranged in the control unit, which valve is connected between the pressure conduit and the first pressure dependent valve, which second valve closes the pressure conduit when the pressure in said conduit falls below a predetermined level.

5. Hydraulic control device as claimed in claim 2, 3 or 4, **characterized by** a expansion tank incorporated in the control unit.

6. Hydraulic control device as claimed in the claims 2, 3, 4 or 5, **characterized in that** both sides of the lifting cylinder are short circuited by a pressure limiting valve.

7. Hydraulic control device as claimed in any of the preceding claims, **characterized in that** the pump and the reservoir are arranged at a distance from the control unit, form a part of an aggregate and are connected to the control unit via the pressure conduit and the pressureless conduit.

8. Hydraulic control device as claimed in any of the preceding claims, **characterized in that** the striker weight is connected to the hydraulic cylinder by means of a slightly elastic coupling.

9. Hydraulic control device as claimed in claim 8, **characterized in that** the elastic coupling is formed by a sleeve which is connected to that striker weight and wherein a rod connected to the piston rod extends and which is otherwise filled with an elastic mass.

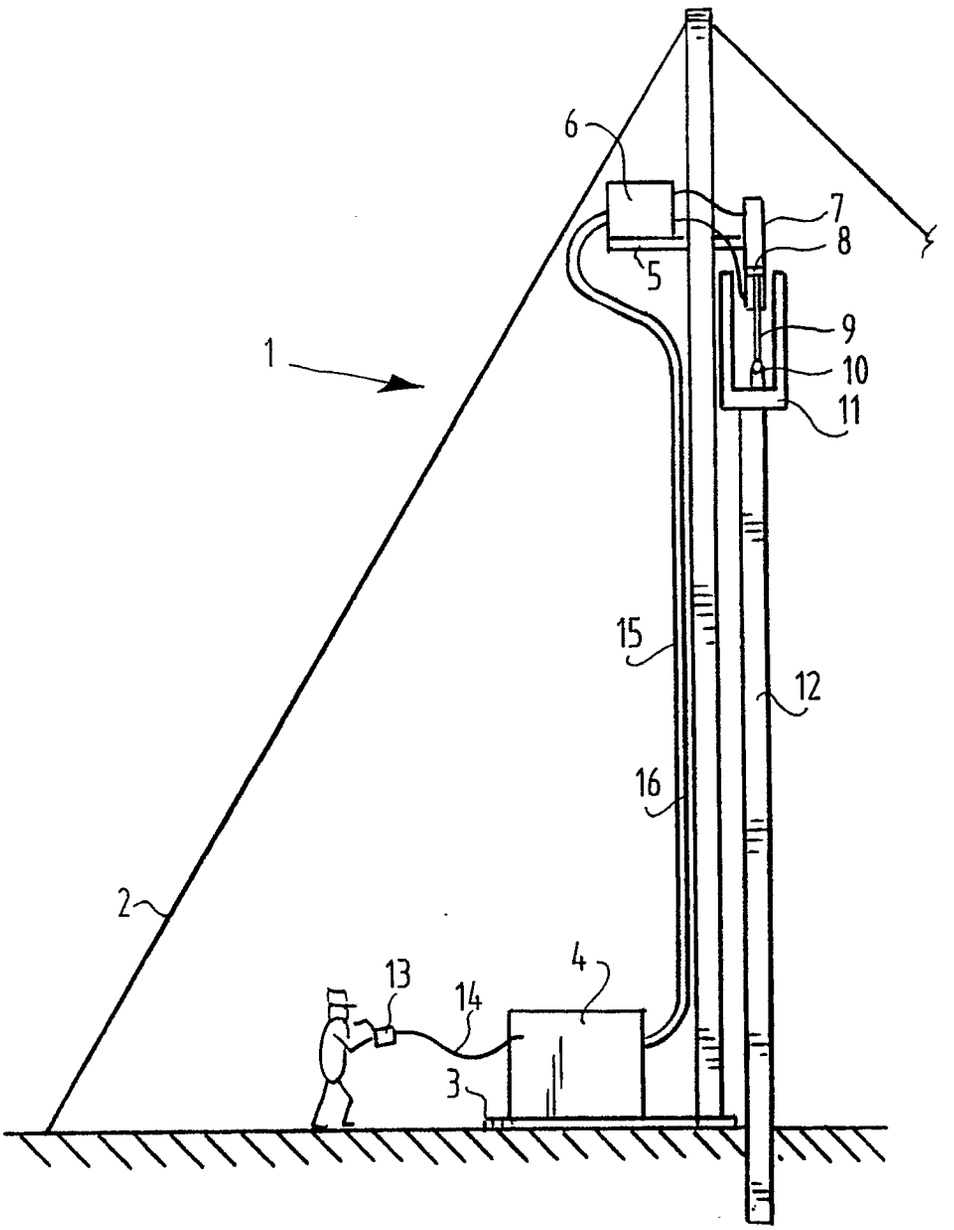

FIG.1

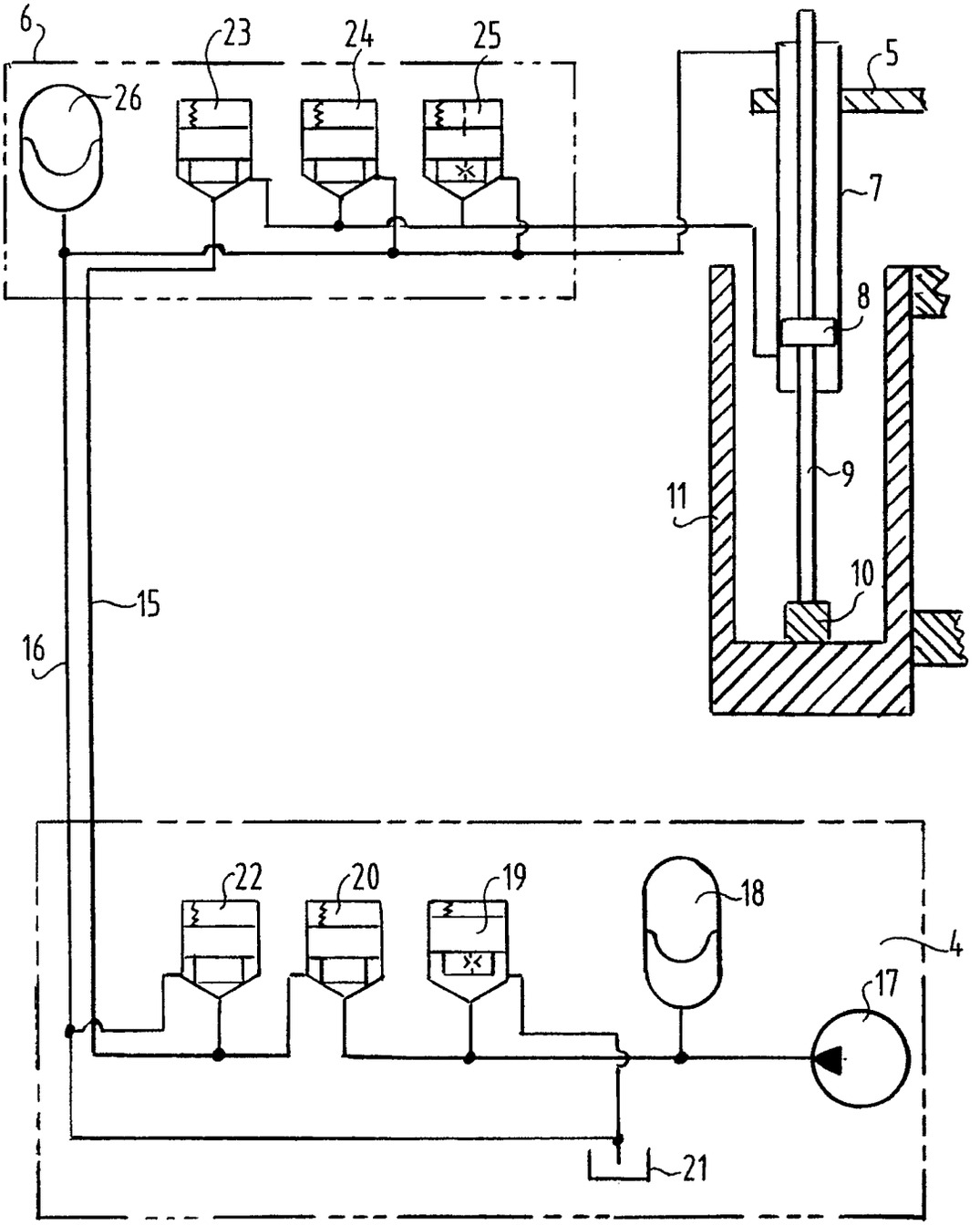

FIG.2

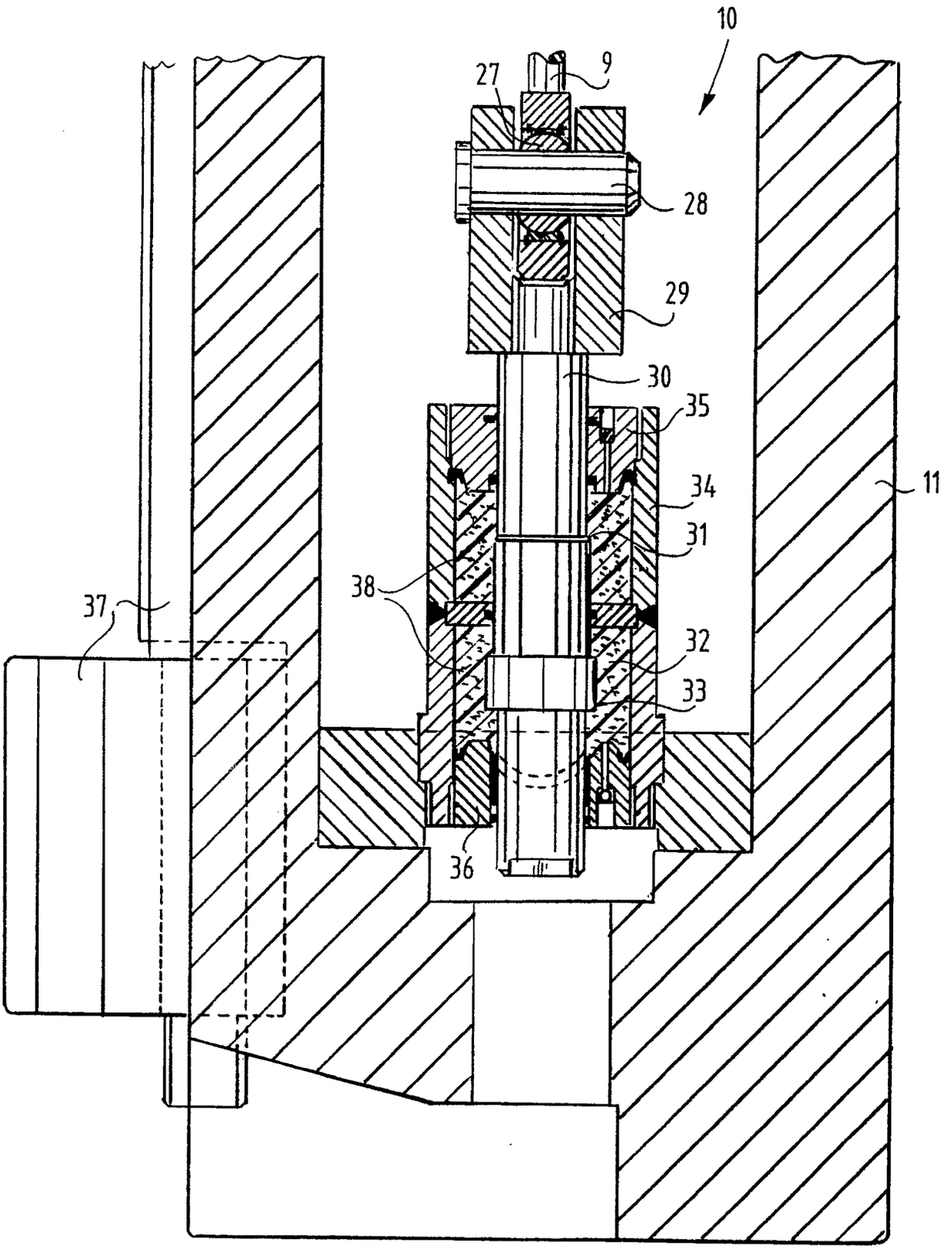

FIG.3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 20 1351

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	GB-A-8 477 80 (AUBERGER) * page 1, line 25 - page 2, line 33 * *figure *	1,2,7	E 02 D 7/10 E 02 D 13/10
A	PATENT ABSTRACTS OF JAPAN vol. 10, no. 40 (M-454)(2097) February 18, 1986 & JP-A-60 192 026 (HITACHI) September 30, 1985 * the whole document *	3-6	
A	US-A-3 446 293 (GUILD) * column 1, line 50 - line 60 * * column 5, line 11 - line 50 * * figure 10 *	8,9	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

E 02 D

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	05 September 91	KERGUENO J.P.D.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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