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EP 0 460 755 B1

Description

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

These hydraulic control devices are generally known.

In a known hydraulic control device (DE-A-2225397), the 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 thereof 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.

GB-A-847780 describes a hydraulic control device for the vertical movements of the striker weight of a pile driver, comprising: a hydraulic cylinder for driving the striker weight; a control unit located 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, the pump and the reservoir being arranged at a distance from the control unit and forming a part of an aggregate, wherein the control unit comprises a pressure dependent valve actuated by the pressure of the hydraulic fluid, of which the first side is connected to the lifting side of the hydraulic cylinder and to the pressure conduit, and the second side is connected to the pressureless conduit.

This known control device needs three different conduits for connecting the control unit with the aggregate comprising the pump and the reservoir.

The aim of the present invention is to provide such an apparatus wherein the above stated drawbacks are avoided.

This aim is reached in that the pressure dependent valve is an automatic valve having such properties, that it closes automatically, when pressure is applied to the pressure conduit, and that it opens automatically, when the pressure in the pressure conduit falls away.

The automatic action of the valve makes further conduits for transferring control signals unnecessary, so that the number of conduits is reduced. By placing said 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 in the pressure conduit falls away, 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 down 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 pressure dependent 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 valve 23 closes the pressure conduit when the pressure in said conduit falls below a predetermined level. The outflow side of the valve 23 is further connected to a further pressure dependent automatic valve 24 and to the inflow side of a pressure control valve 25. The outflow side of both the automatic valve 24 and the 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 for the vertical movements of the striker weight (11) of a pile driver, comprising:
   - a hydraulic cylinder (7) for driving the striker weight (11);
   - a control unit (6) located in the vicinity of the cylinder (7);
   - a pump (17) connected to the control unit (6) via a pressure conduit (15); and

- a reservoir (21) connected to the control unit via a pressureless conduit (16), the pump (17) and the reservoir (21) being arranged at a distance from the control unit (6) and forming a part of an aggregrate (4), wherein the control unit (6) comprises a pressure dependent valve (24) actuated by the pressure of the hydraulic fluid, of which the first side is connected to the lifting side of the hydraulic cylinder (11) and to the pressure conduit, and the second side is connected to the pressureless conduit,

characterized in that the pressure dependent valve is an automatic valve (24) having such properties, that it closes automatically, when pressure is applied to the pressure conduit (15), and that it opens automatically, when the pressure in the pressure conduit (15) falls away.

2. Hydraulic control device according to claim 1, **characterized in that** the lifting cylinder (7) is double acting and that the second side of the valve (24) is connected to the lowering side of the lifting cylinder (7).

3. Hydraulic control device according to claim 1 or 2, **characterized by** a pressure dependent automatic valve (23) arranged in the control unit (6), which valve (23) is connected between the pressure conduit (15) and the valve (24), which valve (23) closes automatically the pressure conduit (15),when the pressure in said pressure conduit falls below a predetermined level.

4. Hydraulic control device according to claim 1, 2 or 3, **characterized by** a expansion tank (26) incorporated in the control unit (6).

5. Hydraulic control device according to claim 1, 2, 3 or 4, **characterized in that** both sides of the lifting cylinder (7) are short circuited by a pressure limiting valve (25).

6. Hydraulic control device according to one of the preceding claims, **characterized in that** the striker weight (11) is connected to the hydraulic cylinder (7) by means of a slightly elastic coupling (10).

7. Hydraulic control device according to claim 6, **characterized in that** the elastic coupling is formed by a sleeve (16) which is connected to that striker weight (11) and wherein a rod (9) connected to the piston (8) extends and which is otherwise filled with an elastic mass.

Patentansprüche

1. Hydraulische Steuerungsvorrichtung für die senkrechten Bewegungen des Hammerklotzes (11) einer Pfahlramme, mit
- einem Hydrozylinder (7) zur Betätigung des Hammerklotzes (11),
- einer sich in der Nähe des Zylinders (7) befindenden Steuereinheit (6),
- einer Pumpe (17), die über eine Druckleitung (15) mit der Steuereinheit (6) verbunden ist, und
- einem Behälter (21), der über eine Rücklaufleitung (16) mit der Steuereinheit (6) verbunden ist, wobei die Pumpe (17) und der Behälter (21) in einiger Entfernung von der Steuereinheit (6) angeordnet sind und einen Teil eines Aggregats (4) bilden und die Steuereinheit (6) ein durch den Druck der Hydraulikflüssigkeit betätigtes, druckabhängiges Ventil (24) umfaßt, dessen erste Seite mit der Hubseite des Hydrozylinders sowie der Druckleitung und dessen zweite Seite mit der Rücklaufleitung verbunden ist,

dadurch gekennzeichnet,

daß als druckabhängiges Ventil ein Selbststeuerventil (24) verwendet wird, das sich automatisch schließt, wenn die Druckleitung (15) unter Druck gesetzt wird, und sich automatisch öffnet, wenn der Druck in der Druckleitung (15) abfällt.

2. Hydraulische Steuerungsvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Hubzylinder (7) ein doppeltwirkender ist, und daß die zweite Seite des Ventils (24) mit der Fallseite des Hubzylinders (7) verbunden ist.

3. Hydraulische Steuerungsvorrichtung nach Anspruch 1 oder 2, gekennzeichnet durch ein in der Steuereinheit (6) angeordnetes druckabhängiges Selbststeuerventil (23), das zwischen der Druckleitung (15) und dem Ventil (24) angebracht ist und automatisch die Druckleitung (15) schließt, wenn der Druck in dieser Druckleitung einen vorgegebenen Pegel unterschreitet.

4. Hydraulische Steuerungsvorrichtung nach Anspruch 1, 2 oder 3, gekennzeichnet durch einen in der Steuereinheit (6) angeordneten Hydrospeicher (26).

5. Hydraulische Steuerungsvorrichtung nach Anspruch 1, 2, 3 oder 4, dadurch gekennzeichnet, daß beide Seiten des Hubzylinders (7) über ein Druckbegrenzungsventil (25) miteinander ver-

bunden sind.

6. Hydraulische Steuerungsvorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß der Hammerklotz (11) mittels einer in geringem Maß elastischen Kupplung (10) mit dem Hydrozylinder (7) verbunden ist.

7. Hydraulische Steuerungsvorrichtung nach Anspruch 6, dadurch gekennzeichnet, daß die elastische Kupplung aus einer mit dem Hammerklotz (11) verbundenen Manschette (16) gebildet ist, durch die eine mit dem Kolben (8) verbundene Stange (9) hindurchragt, wobei die Manschette (16) im übrigen mit einer elastischen Masse gefüllt ist.

Revendications

1. Dispositif hydraulique de commande des déplacements verticaux de la masse de frappe (11) d'un appareil de battage de pieux, comprenant :
   - un vérin hydraulique (7) destiné à déplacer la masse de frappe (11),
   - une unité de commande (6) placée au voisinage du vérin (7),
   - une pompe (17) raccordée à l'unité de commande (6) par un conduit sous pression (15), et
   - un réservoir (21) raccordé à l'unité de commande par un conduit sans pression (16), la pompe (17) et le réservoir (21) étant placés à distance de l'unité de commande (6) et faisant partie d'un ensemble regroupé (4), l'unité de commande (6) comprenant une soupape (24) commandée par la pression du fluide hydraulique , dont le premier côté est raccordé au côté de soulèvement du vérin hydraulique (11) et au conduit sous pression et le second côté est raccordé au conduit sans pression,

   caractérisé en ce que la soupape, dont le fonctionnement dépend de la pression, est une soupape automatique (24) ayant des propriétés telles qu'elle se ferme automatiquement lorsque la pression est appliquée au conduit sous pression (15), et qu'elle s'ouvre automatiquement lorsque la pression disparaît dans le conduit sous pression (15).

2. Dispositif hydraulique de commande selon la revendication 1, caractérisé en ce que le cylindre de levage (7) est à double effet, et le second côté de la soupape (24) est raccordé au côté de descente du vérin de levage (7).

3. Dispositif hydraulique de commande selon la revendication 1 ou 2, caractérisé par une soupape automatique (23) dont le fonctionnement dépend de la pression et qui est placée dans l'unité de commande (6), cette soupape (23) étant raccordée entre le conduit sous pression (15) et la soupape (24), cette soupape (23) fermant automatiquement le conduit sous pression (15) lorsque la pression dans le conduit sous pression tombe au-dessous d'un niveau prédéterminé.

4. Dispositif hydraulique de commande selon la revendication 1, 2 ou 3, caractérisé par un réservoir de dilatation (26) incorporé à l'unité de commande (6).

5. Dispositif hydraulique de commande selon la revendication 1, 2, 3 ou 4, caractérisé en ce que les deux côtés du vérin de levage (7) sont mis en court-circuit par une soupape de limitation de pression (25).

6. Dispositif hydraulique de commande selon l'une des revendications précédentes, caractérisé en ce que la masse de frappe (11) est raccordée au vérin hydraulique (7) par un accouplement légèrement élastique (10).

7. Dispositif hydraulique de commande selon la revendication 6, caractérisé en ce que l'accouplement élastique est formé par un manchon (16) qui est raccordé à la masse de frappe (11) et dans lequel passe une tige (9) raccordée au piston (8) et qui est par ailleurs remplie d'une masse élastique.

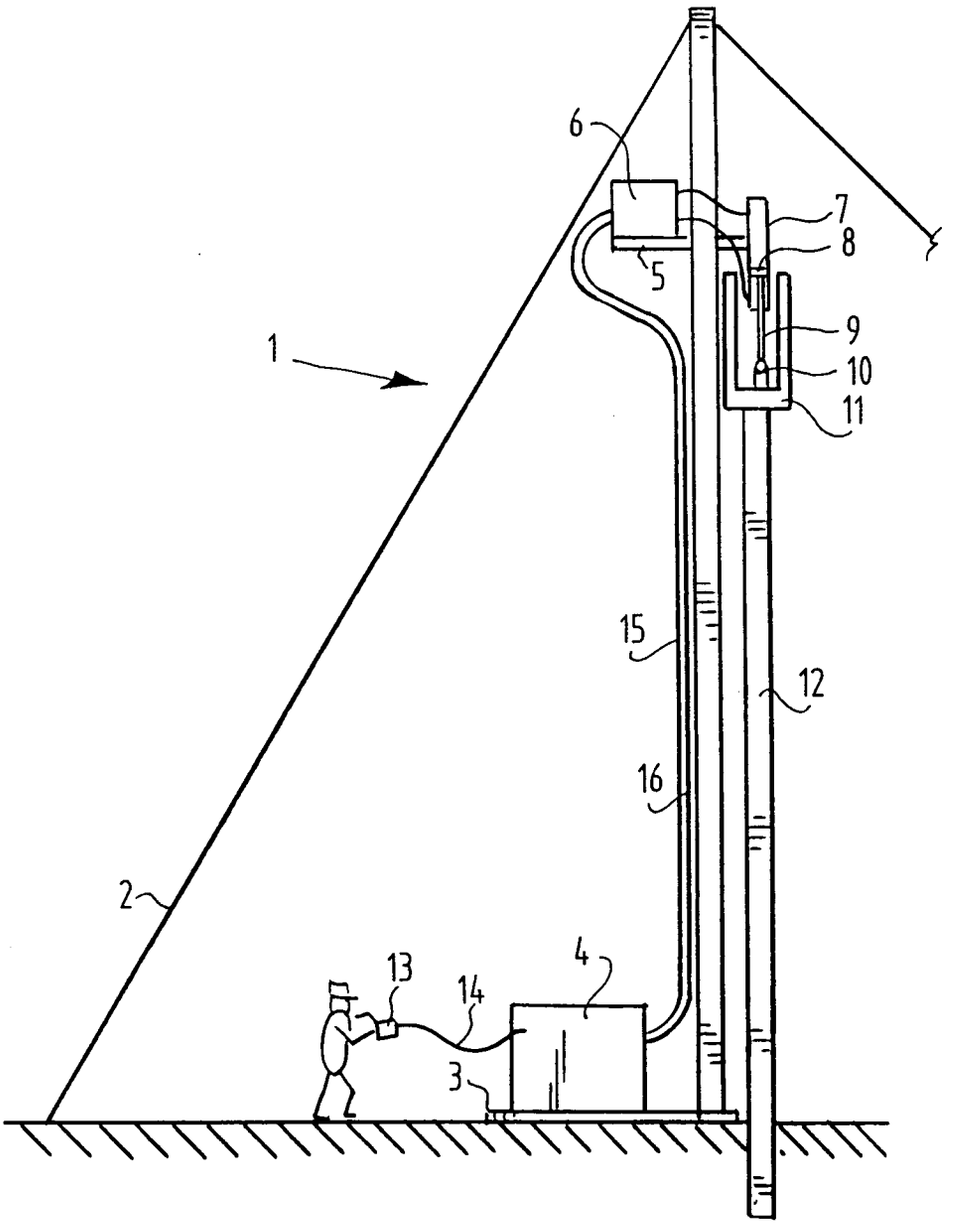


FIG.1

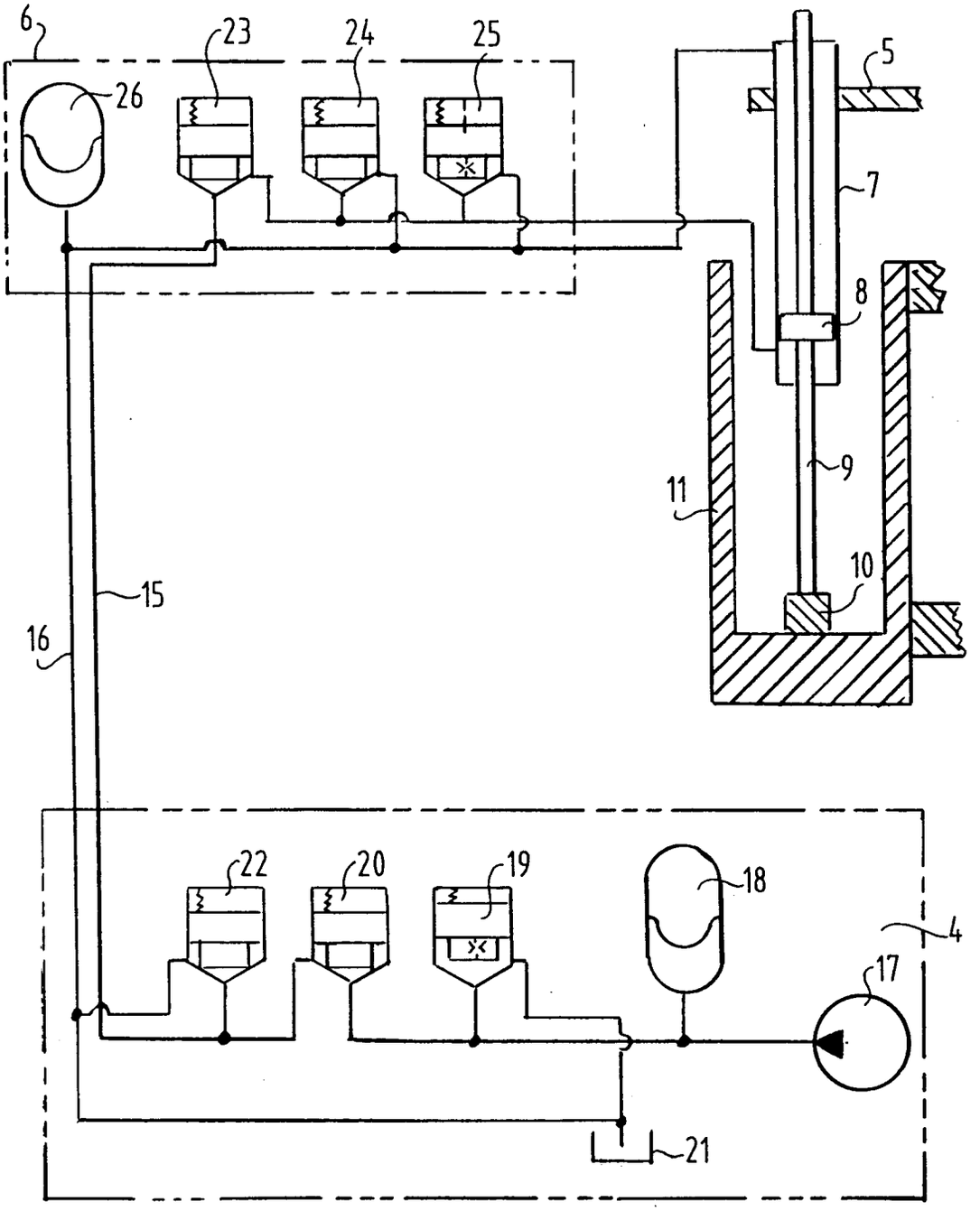


FIG.2

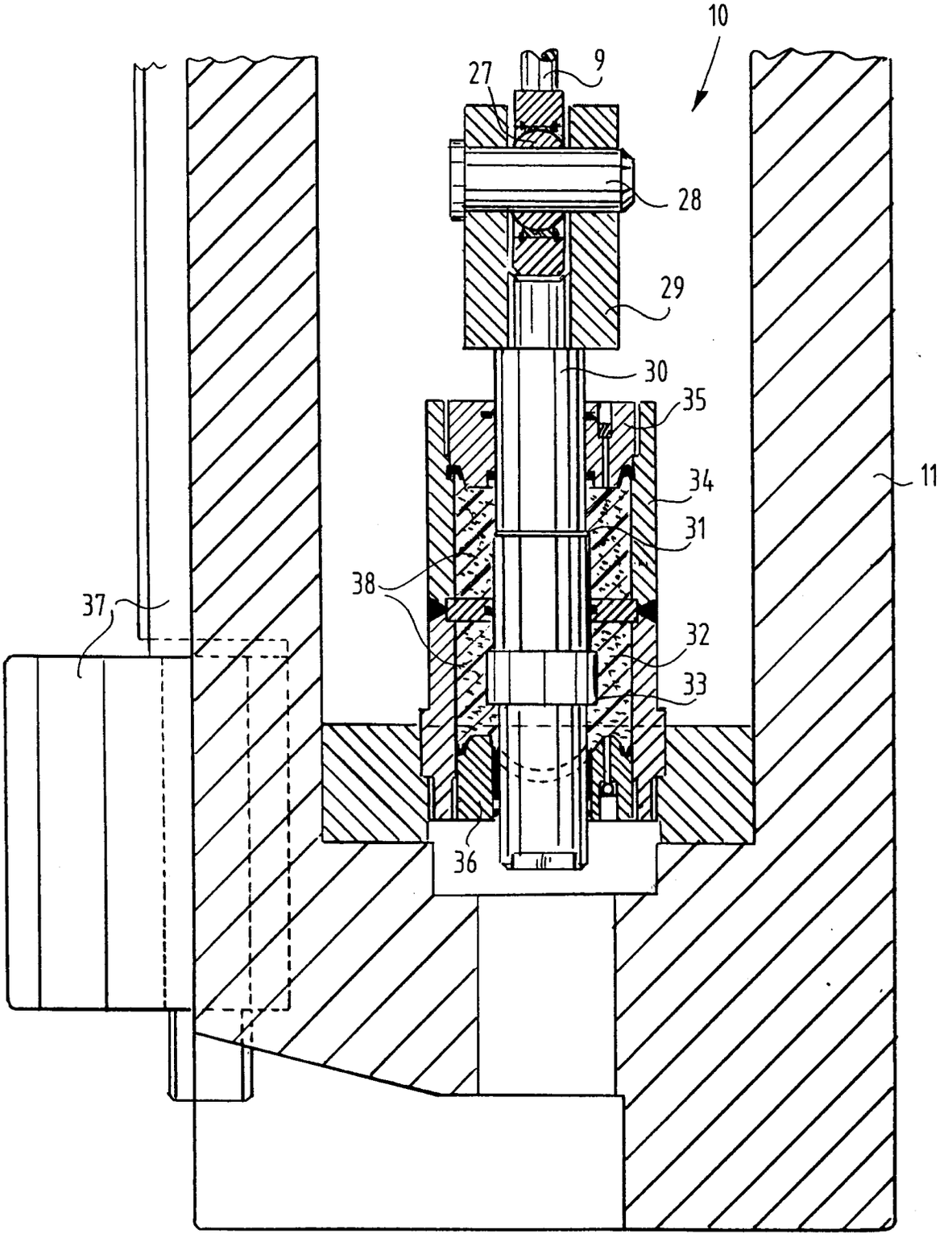


FIG.3