VALVE SYSTEM FOR HYDRAULIC ELEVATORS

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Fig. 1

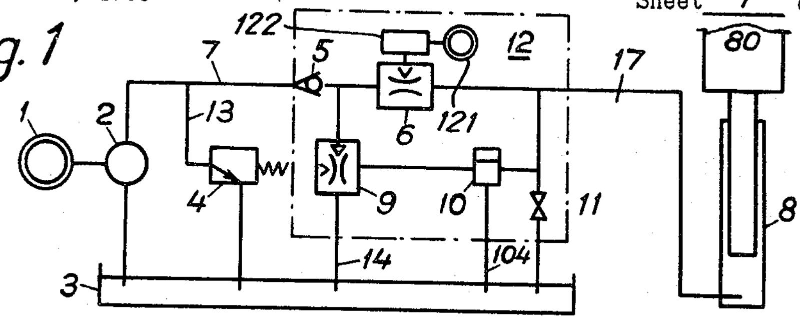

Fig. 2

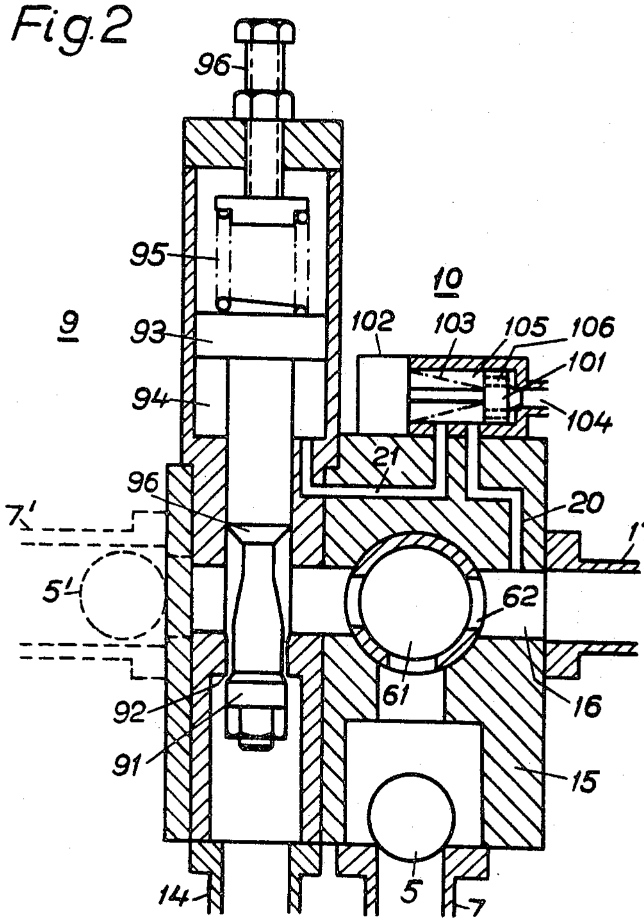

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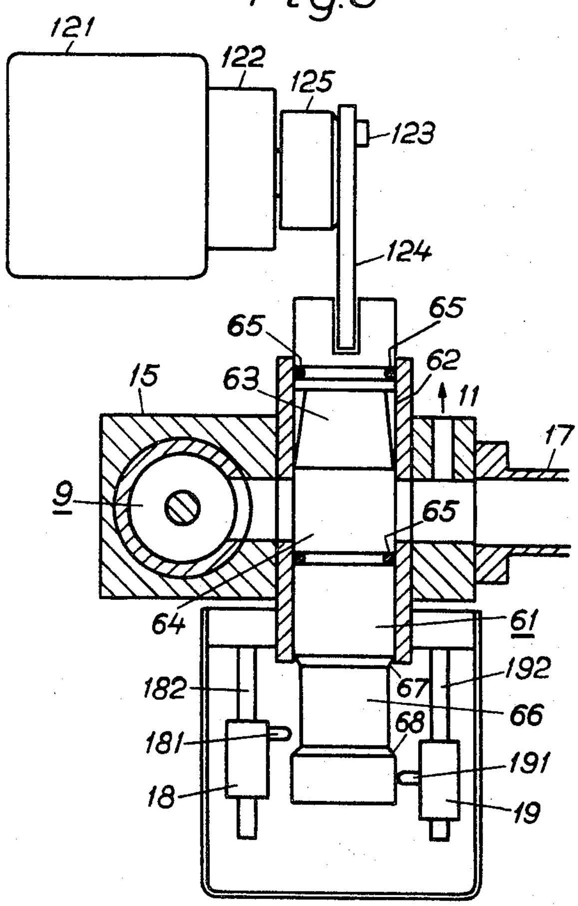
Fig.3



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ABSTRACT OF THE DISCLOSURE

A hydraulic elevator controlled system includes a circuit connecting pump to a hydraulic cylinder; included in this circuit are first a branch containing an overflow (bypass) valve; then a non-return (check) valve; then a branch containing a load controlled lowering valve and then a control valve operated by a control motor.

The present invention relates to a valve system for a hydraulic elevator inserted in a pressure conduit between a liquid pump and the lifting cylinder of the elevator.

When constructing valve systems for hydraulic elevators, the following conditions and aims must be borne in mind. Smooth starting and stopping is desirable both on the way up and down so that the system must comprise some sort of control valve. Further, there must be no undesired movement when the elevator is stationary and, especially, no undesired lowering, which means that the valves in the system must be absolutely tight. Further, for the upward movement the pump device of the elevator should be able to start independently of the control system itself and the valve system should therefore contain an overflow valve of some sort.

There is already a great number of known constructions which fulfill these requirements and desires but most of these known constructions contain either rather many or relatively complicated valve components, since attempts have been made to combine several functions in the various valves so that particularly the demand for tightness is difficult to fulfill without complicating the valves. It is extremely difficult to make a simple adjustable valve which also fulfills the demand for tightness.

A valve system according to the present invention is remarkable since the number of valves is small although each valve has only one function, thus making the construction of the various valves simple. A valve system according to the the invention is characterised in that it comprises an overflow valve in a branch of the pressure conduit between the pump and the lift cylinder, a non-return or check valve, a lowering valve in another branch of the pressure conduit and a control valve controlled by an operating device which provides a certain desired opening and shutting time for said control valve. These valves are connected in the pressure conduit in the mentioned sequence. In this way a minimum number of valves is achieved, impart the same control valve is used for both the upward and the downward movement. Most important is, however, the fact that the sealing function rests only on the non-return valve and the lowering valve so that the tightness requirements of the control valve are moderate and this valve may therefore have a simple construction. Furthermore, the non-return valve and lowering valve as well as the control valve are always filled with oil under pressure so the risk of air bubbles in the hydraulic system is very small, which is a great advantage for the same operation of the elevator. The simple design

of the different valves also means that they can be built together in a common housing.

The invention will be further described with reference to the accompanying drawing where FIGURE 1 shows a diagram of a valve system according to the invention while FIGURES 2 and 3 show different views of an embodiment of a combined valve aggregate according to the invention.

FIGURE 1 shows a motor **1** which drives a pump **2** which pumps oil from a liquid container **3** into a pressure conduit **7**. In a branch **13** of this pressure conduit is arranged an overflow valve **4** from which the oil can flow back to the liquid container when the pump starts. In the pressure conduit **7** a non-return valve **5** is arranged and after this a lowering valve **9** in a branch **14**. After this branch comes a control valve **6** with an operating device **12** and from this control valve a pressure conduit **17** leads further to the lifting cylinder **8** of the elevator car **80**. The The lowering valve **9** is suitably controlled with the help of the pressure from the lifting cylinder **8** supplied to the lowering valve through a pilot valve **10**. The system may also be provided with a manual drop valve **11**.

For upwards movement the motor **1** is started and the pump **2** then pumps oil through the overflow valve **4** which is a single spring-loaded over-pressure valve. When the operating device **12**, which suitably consists of a motor **121** with mechanical gearing **122**, opens the control valve **6** the oil will flow through the non-return valve **5** and as the control valve opens the oil flow will increase in the pressure conduit **17** to the lifting cylinder **8** and the elevator car **80** is accelerated to full speed. When the elevator approaches the desired stopping level, the operating device **12** receives an impulse and the control valve **6** slowly closes so that the elevator approaches the stopping level with gradually decreasing speed and stops at the desired position. Thereafter, the motor **1** and the pump **2** are stopped.

For downward movement the lowering valve **9** is first opened with the help of the pilot valve **10**, after which the operating device **12** slowly opens the control valve **6** and the elevator starts slowly in downward direction. When the elevator approaches the desired stopping level the operating device **12** receives an impulse to close the control valve and the speed gradually decreases until the elevator stops at the desired level. Since both the non-return valve **5** and the lowering valve **9** are extremely simple valves with sufficient tightness, it is seen that the demand for tightness in the control valve **6** is rather small since a small leakage in the control valve does not influence the correct operation of the elevator.

A simple embodiment of the control valve **6** is shown in FIGURES 2 and 3 which also show how the valves **5**, **6**, **9** and **10** which are placed within the dotted line in FIGURE 1 may suitably be built together to a common aggregate. The reference numbers used in FIGURE 1 are also used in FIGURES 2 and 3.

FIGURES 2 and 3 show how the valve **6** is made as a slide valve comprising a slide **61** arranged in a cylinder **62** arranged perpendicular to the pressure conduit **17**. The slide **61** consists of a cylindrical part **64** and a conical part **63**. At the ends of the active part of the slide **61** sealing rings **65** are arranged to ensure that oil does not run out between the cylinder **62** and the ends of the slide. Further the cylindrical part **64** is made with such a diameter that it slides easily in the cylinder **62**. Such a sliding fit is not sufficiently tight to prevent oil under pressure from the lifting cylinder **8** from leaking through the control valve, but this does not matter as a sealing is obtained by the non-return valve **5** and the drop valve **9**. This is a great advantage when manufacturing the slide valve since the slide **61** and the cylinder **62** can then be manufactured with relatively large tolerance in relation to each other and a certain wear on the slide valve may be permitted.

The operating device **12** for the slide valve consists of an electric motor **121** with gearing **122** and a disc **125** with a crank pin **123** and connecting rod **124** which at its lower end is attached to the slide **61**. At its lower end the slide is provided with an extension **66** having a diameter less than that of the slide cylinder **64** and at the ends of the narrower part of this extension are conical surfaces **67** and **68**. By means of these surfaces it is possible to control operating contacts **18** and **19** which have contact-fingers **181** and **191** resting on the surface of the projection **66**.

When the elevator is to be started the motor **121** is started and the slide **61** is moved slowly downwards. The operating contacts **18, 19** are at first inoperative. When the slide **61** reaches its lowest position the coincal surface **67** will press on the contact finger **181** thus breaking the current to the motor **121** with the contact **18** and the slide stops. When the elevator approaches the desired stopping level, the motor **121** is started again and the slide is pulled upwards towards closing position. Before the slide reaches its upper position the surface **68** will press on the contact finger **191** and the contact **19** breaks the motor current. The slide valve **6** is thus not completely closed and the elevator continues with low speed until the correct position is reached, after which the valve **6** is completely closed. In this way the control valve **6** also acts as a precision adjustment valve without involving extra stages in construction.

The contacts **18** and **19** are adjustable on supporting arms **182** and **192** respectively so that the correct position of the contacts in relation to the movement of the slide can be obtained. Further operating contacts corresponding to **18** and **19** may be arranged, for example to control the lift during the precision adjustment interval. When the control valve closes as the elevator approaches the desired level, therefore, the contact **19** will first break the current to the operating motor **121**. Just before the stopping position the operating motor is started again and when the control valve reaches closed position the operating motor is stopped by the surface **68** operating a contact, not shown, of the same type as contact **19**. No extra precision adjustment valve is thus required according to the invention.

FIGURE 2 shows how the three valves **5, 6** and **9** are suitably built together in a common housing **15** provided with a T-bore **16**. It is seen that the slide valve **6** is arranged in the middle of this T-bore and that such a positioning of this slide valve would be rather inconvenient from the manufacturing point of view if the demands for tightness in the slide valve were great. The pressure conduit **17** leading to the lifting cylinder **8** is connected to the right-hand branch of the T-bore.

In the lower branch of the T-bore the non-return valve **5** is arranged at the junction of the pressure conduit **7** from the pump. The non-return valve may, for example, be a simple ball-valve with a ball which seals against a seat.

In the left-hand branch of the T-bore the drop valve **9** is arranged comprising the actual lowering valve consisting of a valve cone **91** resting against a seat **92**. On the valve spindle for the lowering valve is arranged a piston **93** in a pressure cylinder **94**. When the elevator is stationary or moving upwards this pressure cylinder is under pressure from the pressure conduit **17** through bores **20** and **21** in the housing **15**. These bores open into a chamber **105** in a pilot valve **10** comprising a valve cone **101** controlled by an electro-magnetic control device **102** and loaded by a spring **103**. On the downwards movement the valve cone **101** is opened by the electro-magnetic operating device **102** against the pressure of the spring **103**. The bore **20** is throttled somewhat by the valve cone **101** and the oil from the cylinder **94** escapes through the bore **21**, holes **106**, in the cone or piston **101** and return conduit **104** from the pilot valve. The spring **95** will then press the piston **93** downwards, thus opening the valve cone **91** of the lowering valve. When the operating device **12** afterwards opens the slide valve **6** the oil from the pressure conduit **17** will flow out through the lowering valve.

FIGURE 2 also shows how the lowering valve **9** may suitably comprise a constant-flow valve by making the valve spindle for the drop valve with varying thickness. For this purpose the valve spindle is provided with a coincal collar **96**, the outer diameter of which exceeds the diameter of the valve seat **92**. Depending on the load in the elevator the pressure from the pressure conduit **17** will influence the valve surface **96** with a pressure which, to a lesser or greater extent, counteracts the pressure from the spring **95**. In this way the opening between the valve cone **91** and the valve seat **92** will be decreased with increased load in the elevator car, and the product of the oil pressure and opening area in the lowering valve will be kept more or less constant so that a more or less constant downward speed is obtained for the elevator regardless of the load in the elevator.

Furthermore, in FIGURE 2 has been indicated with dotted lines how the non-return valve **5** instead of being arranged in a lower branch of the T-bore, can be arranged at the left-hand end of a through-running bore in the valve housing **15**. The valve ball and pressure conduit from the pump have been designated **5'** and **7'** respectively. In certain cases this may provide a simplified embodiment of the valve housing **15** which is an advantage from the manufacturing point of view. Which embodiment is to be preferred, however, depends mostly on the arrangement of the other components in the system.

I claim:

1. In a hydraulic elevator comprising a liquid pump and a hydraulic lift cylinder; a pressure conduit connecting said liquid pump to said lift cylinder; a liquid tank at the input side of said pump; a valve system for said hydraulic elevator in said pressure conduit; said valve system comprising nearest to said pump a first branch connected to said pressure conduit and leading to said liquid tank; an overflow valve in said first branch; a non-return valve in said pressure conduit after said first branch; a second branch connected to said pressure conduit after said non-return valve and leading to said liquid tank; a lowering valve in said second branch; a control valve in said pressure conduit after said second branch; operating means for said control valve; said operating means opening or closing said control valve with a certain, predetermined speed.

2. A valve system as claimed in claim **1**; said control valve being formed like a slide valve comprising a cylinder arranged perpendicular to said pressure conduit and a slide arranged in said cylinder; said slide comprising a cylindrical part fitting into said cylinder and a conical part co-axial to said cylindrical part; said slide being movable in the longitudinal direction of said cylinder and connected to said operating means.

3. A valve system as claimed in claim **2**; a common housing for said non-return valve, said control valve and said lowering valve; said housing provided with a T-bore; said control valve arranged in the middle of said T-bore; said non-return valve, said lowering valve and a connection from said control valve to said lift cylinder being arranged each at its own branch of said T-bore.

4. A valve system as claimed in claim **2**; a common housing for said non-return valve, said control valve and said lowering valve; said housing provided with a T-bore; said non-return valve and said control valve arranged each at its own end of the straight part of said T-bore; said lowering valve arranged in a branch of said T-bore.

5. A valve system as claimed in claim **2**; said slide provided with an extension outside said cylinder; control means for said operating device; said control means arranged in connection with said extension.

6. A valve system as claimed in claim **1**; said lowering valve being a constant flow valve.

7. A valve system as claimed in claim **1**; said operating means being arranged for opening and closing operation of said control valve; said closing operation being a two stage operation; the first of said two stages corresponding to a closing interval from a fully open control valve to a nearly closed control valve; the second of said two stages corresponding to an interval from a nearly closed control valve to a fully closed control valve.

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