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Espenschied et al.

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[54] CONTROL ARRANGEMENT FOR HYDRAULIC MOTORS

[72] Inventors: **Helmut Espenschied**, Buhlertal; **Joseph Sauer**, Schwieberdingen, both of Germany

[73] Assignee: **Robert Bosch GmbH**, Stuttgart, Germany

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **91/31**, 91/48, 91/51, 91/357

[51] **Int. Cl.** **F15b 13/043**, F15b 9/09

[58] **Field of Search** 91/51, 48, 357, 31

[56] **References Cited**

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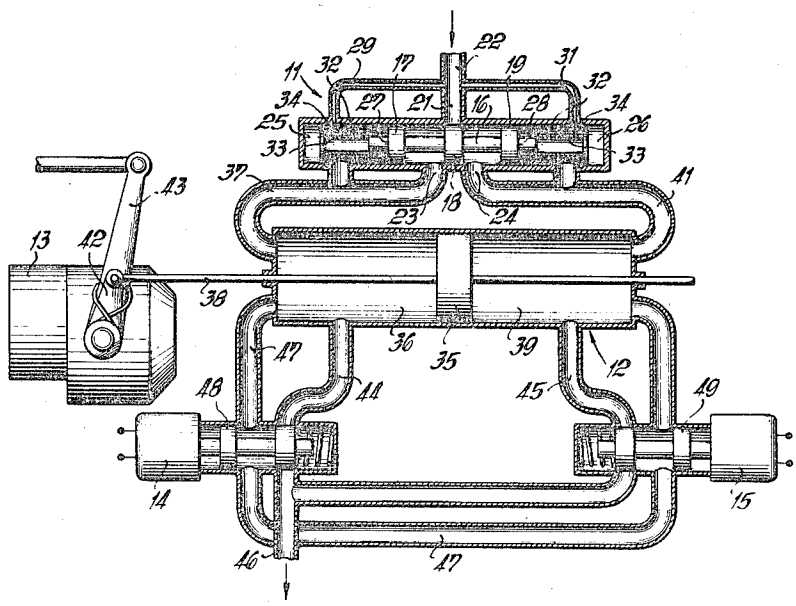
Primary Examiner—Paul E. Maslousky

Attorney—Michael S. Striker

[57] **ABSTRACT**

A hydraulic control arrangement for controlling the operation of a hydraulic motor equipped with a piston which may be subjected on both sides with fluid pressure. A control valve controls the flow of fluid under pressure from the motor to the return flow duct. A directional valve communicates with both sides of the piston of the motor and is actuated by the fluid flow. The control slide of the directional valve is urged, through spring action, into a neutral inoperative position, in which a fluid inflow duct to the directional valve is closed. The control slide connects two ports leading to hydraulically operated devices, with the inflow duct, when in operating positions. Flow chambers at both ends of the control slide communicate with the ports and the inflow duct through throttling passages.

10 Claims, 3 Drawing Figures



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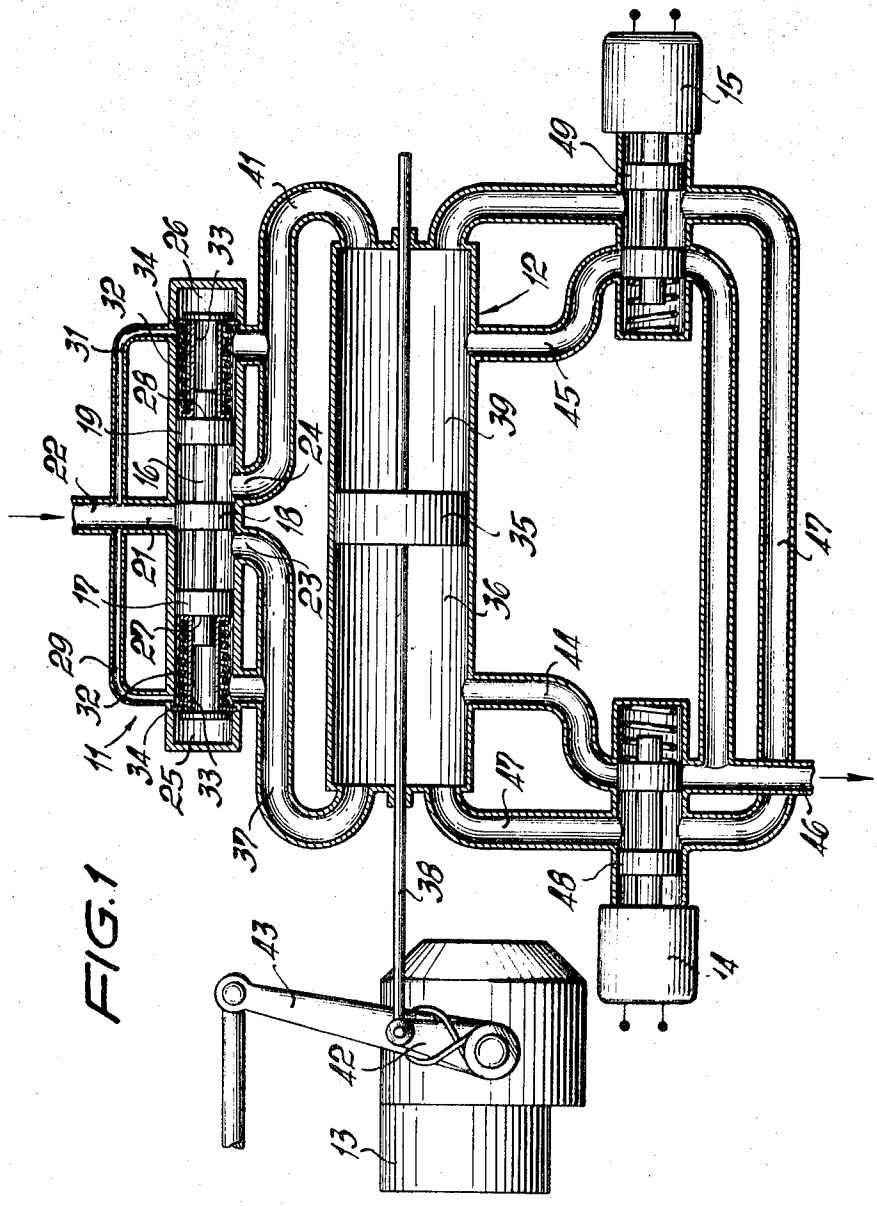


FIG. 1

INVENTORS
Helmut ESPENSCHIED
Josef SAUER
BY
Richard S. Hecker
their ATTORNEY

FIG. 2

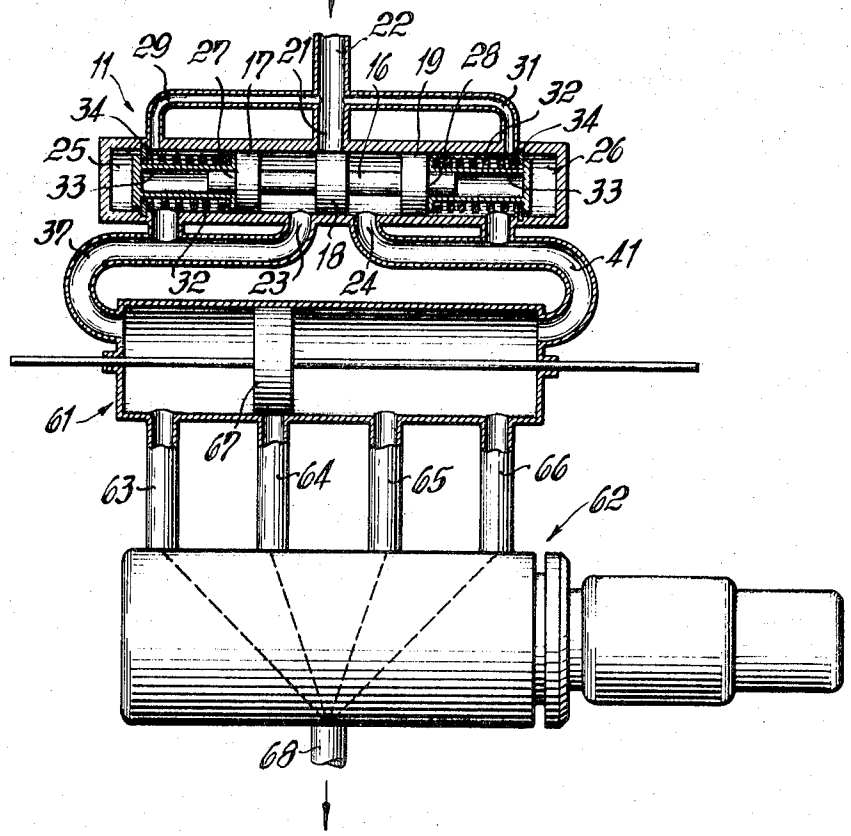
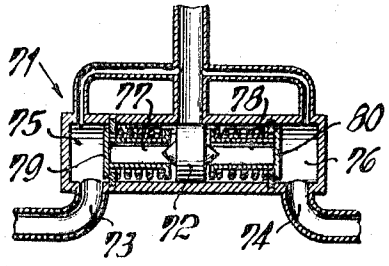


FIG. 3



INVENTORS
Helmut ESPENSCHIED
Josef SAUER
BY
their ATTORNEY

CONTROL ARRANGEMENT FOR HYDRAULIC MOTORS

BACKGROUND OF THE INVENTION

The present invention resides in a control arrangement for a hydraulic motor with a piston head which is controlled and actuated on both sides, and with valves controlling the return flow from the hydraulic motor.

A control device for a double-acting hydraulic motor is known in the art, in which the motor can assume two operating positions, and is centered or takes a central position by being subjected to pressure. The chambers on both sides of the operating piston in this conventional device, are always in communication with a pressure source through two 3/2 directional valves, when the operating piston is in its central position. These two chambers on both sides of the operating piston are alternatingly relieved to a return flow, in the operating position of the pistons. This control arrangement does not make possible any intermediate positions of the operating piston, and involves particularly complex construction as a result of centering the operating piston through fluid means.

Another control arrangement for a hydraulic motor with operating pistons subjected on both sides to fluid under pressure, is known in the art. In such conventional unit, the operating piston controls itself three ports at the hydraulic motor, and thereby also assumes only three positions. The port corresponding to the particular position of the operating piston is connected, in this arrangement, to a vacuum source through a rotational slide valve, whereas one of the remaining ports is connected with the atmosphere. In view of simultaneous control of inflow and return flow of the hydraulic motor through the rotational slide valve, a complex control slide is required. This conventional arrangement known in the art, is not adaptable to rapid switching processes.

Accordingly, it is the object of the present invention to provide a control unit for a hydraulic motor which may be displaced or positioned by any desired amount. It is also an object of the present invention to provide such a control unit which is simple in construction and possesses substantially short response times.

The object of the present invention is achieved through the arrangement in which fluid under pressure is applied to both sides of the operating piston from an inflow for controlling purposes. A directional valve is provided, furthermore, which is actuated by the controlling fluid under pressure. The direction valve has a control slide which closes or shuts an inflow port, when in its neutral position. The control slide, furthermore, has operating positions in which it connects the inflow port with one of two ports of hydraulically operated devices. On both frontal sides of the control slide, chambers are provided which communicate with the designated port of the hydraulically operated device, and through a throttling passage with the inflow port.

In this manner, the control unit, in accordance with the present invention, can possess short response times, in addition to being simple in construction. The arrangement of the present invention, furthermore, makes possible precise positioning of the operating piston.

SUMMARY OF THE INVENTION

A hydraulic control arrangement for use in conjunction with a hydraulic motor. The motor has a piston which may be subjected to fluid pressure on both sides thereof. A return flow duct communicates with the motor through return flow passages and controlling valves located within the passages. A directional valve communicates with both sides of the piston for the purpose of controlling fluid flow to these sides of the piston. The directional valve has a control slide which is urged into a neutral central position through spring action, whereas in the operative position of the control slide, a fluid inflow duct communicates with the directional valve. In the operating positions of the control slide, furthermore, two fluid flow ports are connectable to the fluid inflow duct through the control slide. Fluid chambers on both sides of the control slide communicates with the ports and the fluid inflow duct, through throttling passages. A switching valve may connect a plurality of return flow ports from the motor to the return flow duct.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a sectional view, in simplified schematic form, of the hydraulic control arrangement, in accordance with the present invention; of a hydraulic motor for an injection pump;

FIG. 2 is a sectional view, in simplified schematic form, of another embodiment of the control arrangement shown in FIG. 1;

FIG. 3 is a sectional view through a directional valve used in conjunction with the control arrangement of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, the control arrangement of FIG. 1 consists essentially of a directional valve 11 which is actuated for the purpose of controlling the fluid under pressure, a double-acting hydraulic motor 12 for actuating an injection pump 13, and two electromagnetically actuated valves 14 and 15.

The directional valve 11 has an axial slide 16 which is centered through spring action, and has three head-shaped sliding sections 17, 18 and 19. The middle slide section 18 blocks a port 21, in the neutral position of the axial or longitudinal slide 16. The port 21 serves as an entrance for a flow 22. The slide section 18, furthermore, isolates a chamber 23 from another chamber 24, when in the neutral position of the longitudinal slide 16. Two chambers 25 and 26 on both frontal sides 27 and 28 of the axial slider 16, communicate with the chambers 23 and 24 respectively. Lines 29 and 31 shaped to form throttling elements, furthermore, connect the chambers 25 and 26, respectively, with the inflow 22. A conventional return arrangement is, moreover, situated within the chambers 25 and 26, and consists essentially of prestressed springs 32, sleeves 33, and supporting rings 34 secured to the housing.

The hydraulic motor 12 has an operating head 35 communicating on one side, with an actuating space of chamber 36 which communicates, in turn with the port 23 through a line 37. This port 23 is associated with the first hydraulically operated device. The other actuating side of the operating head 35 faces the chamber 39 which communicates with the second port 24 of the first hydraulically operated device, through a line 41. The piston rod 38 is linked to a lever 42 of the injection pump 13. The lever 42 is coupled through a spring to a one-armed lever 43, so that they are both oriented along the same axis. The lever 43 is loosely held and is actuated through a conventional driving pedal, not shown.

From both chambers 36 and 39 of the hydraulic motor 12, lines 44 and 45 lead to a return flow 46. The chambers 36 and 39, furthermore, are interconnected through a line 47 which passes around the return flow line 46. A first electromagnetically actuated valve 14 is situated in the line 44 between the actuating chamber 36 and the return flow line 46. A similar electromagnetically actuated valve 15 is situated in the line 45 between the chamber 39 and the return flow line 46. Each electromagnetically actuated valve 14 and 15 possesses a piston slide 48 and 49, respectively, which is spring loaded on one side. Through these piston slides 48 and 49, these electromagnetically actuated valves 14 and 15 also influence the flow line 47 which passes around the return flow line 46. In the initial position of the piston slide 48 and 49, as shown in the drawing, the line 44 and 45 are cut off from the return flow line 46, whereas the flow line 47 is opened.

In operation, the pressure in the inflow channel 22 is derived from a pressure source, and is applied to the directional valve 11, when in its neutral position, through the throttling lines 29 and 31. The pressure is applied to both frontal sides 27 and 28 of the axial or longitudinal slide 16. Through the two lines 37 and 41, the pressure also builds up simultaneously at both sides of the operating head 35 which does not function as a differential piston. Since the electromagnetic valves 14 and 15 retain the flow line 47 open, when they are not actuated, the operating piston 35 can follow the position corresponding to that assumed by the driving pedal.

Through actuation of the electromagnetic valve 14, the line 47 becomes closed, and the line 44 becomes connected with the return line 46. The pressure drop appearing in the chamber 36, is also applied to the longitudinal or axial slide 16 within the chamber 25, through the line 37. As a result, a connection is established between the inflow port 21 to the second port 24 of the hydraulically operated device.

Fluid under pressure consequently flows from the inflow 22 through the directional valve 11 and into the line 41. After passing through the line 41, the fluid under pressure flows into the chamber 39 of the hydraulic motor 12 and forces the operating piston 35 towards the left, provided that the piston 35 has initially assumed the position illustrated in FIG. 1 of the drawing. When the piston 35 is positioned at the left abutment position, it becomes then moved towards the right through actuation of the electromagnetically energized valve 14.

When the electromagnetically actuated valve 14 closes the connection to the return flow line 46, the inflow pressure is rapidly built up again within the chambers 36 and 25, and the axial or longitudinal slide 16 assumes subsequently its neutral position through the return arrangement. In this neutral position of the axial slide 16, the inflow channel 22 is blocked or cut off.

By actuating the electromagnetic valve 15, the operating piston 35 is displaced in a corresponding reverse manner and in the opposite direction, depending upon its initial position.

Through corresponding means in the flow line 47, the displacement motion of the operating piston or head 35 can be damped in one or both directions, when the electromagnetically operated valves 14 and 15 are not actuated.

The control unit shown in FIG. 2, serves for the purpose of controlling a motor vehicle drive, and differs from the control unit shown in FIG. 1, through a different hydraulic motor 61 and a switching valve 62. The directional valve 11 is identical to that used for the arrangement of FIG. 1. Identical parts of this valve, consequently, are denoted with identical reference numerals.

In the embodiment of FIG. 2, four return flow lines 63, 64, 65 and 66 are provided at the hydraulic motor 61, next to the two ports for the lines 37 and 41 from the directional valve 11. The four return flow lines are spaced from each other. An operating piston 67 of the hydraulic motor 61, can open and close each one of these return flow lines 63 to 66. From the return flow lines 63 to 66, lines lead to the switching valve 62. The latter has a slide which is actuated through a stepping magnetic device, not further shown, so as to selectively connect one of these return flow lines 63 to 66 to a return flow duct 68.

In the control unit of FIG. 2, the operating piston 67 which is always subjected to pressure on both sides, is always displaced by the switching valve 62 in a direction to that one of the return flow ports 63 to 66 which is relieved to the return flow duct 68. Shortly before arriving into its designated position, the operating piston 67 becomes braked or decelerated through the application of opposing pressure. The functional operation of the directional valve 11 is, thereby, identical to that of this device in the control arrangement of FIG. 1.

FIG. 3 shows the cross-sectional view of an embodiment of a directional valve 71 actuated and controlled through fluid under pressure. This directional valve 71 differs from the directional valve 11 of FIG. 1, essentially through a shorter control piston or head 72, and the arrangement of a first and second port 73 and 74, respectively, of hydraulically operated devices. Chamber 75 and 76 receive or contain a return device. These chambers 75 and 76 are on both sides of the control head or piston 72, and passages or channels 77 and 78 form sleeves 79 and 80 of the return device.

The functional operation of the direction valve 71 corresponds to that of the directional valve 11. When one side of the control piston head 72 becomes relieved, fluid under pressure flows from the inflow channel 22, through the passage which lies on the other side of the control piston head 72 and to one port of a hydraulically operated device. The fluid then flows further to the hydraulic motor.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a hydraulic motor control arrangement, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

We claim:

1. A control arrangement for a neutral motor comprising, in combination, a hydraulic motor comprising a cylinder and a piston subjectable to pressure on both sides of said piston; return flow means from said motor; control valve means for controlling flow from said motor to said return flow means; directional valve means communicating with both sides of said piston for controlling fluid flow to said sides of said piston, said fluid flow actuating said piston; control slide means in said directional valve means and having a neutraul inoperative position and operating positions; fluid inflow means communicating with said directional valve means and closed when said control slide means is in said neutral inoperative position; two fluid flow ports connectable to said fluid inflow means through said control slide means in said operating positions of said control slide means; and chamber means on both end sides of said control slide means and communicating with said ports and said fluid inflow means.

2. The control arrangement as defined in claim 1 including throttling means between said chamber means and said fluid inflow means.

3. The control arrangement as defined in claim 1 including spring means acting on said control slide means and urging said control slide means into said neutral inoperative position.

4. The control arrangement as defined in claim 1, wherein SAID RETURN FLOW MEANS COMPRISES A plurality of controllable return flow ports communicating with said cylinder of said hydraulic motor and being spaced in axial direction of said cylinder from each other, and a return flow duct, said control valve means being arranged between said return flow ports and said return flow duct for connecting said return flow ports individually with said return flow duct.

5. The control arrangement as defined in claim 4 wherein said control valve means comprises an electromagnetically actuated valve.

6. The control arrangement as defined in claim 1 including flow line means connecting both sides of said piston of said motor; and said control valve means comprising auxiliary valve means in said flow line means for controlling fluid flow from said motor to said return flow means.

7. The control arrangement as defined in claim 6 wherein said auxiliary valve means has an initial position wherein said return flow means is closed and said flow line means is opened, said return flow means being opened and said flow line means being closed when said auxiliary valve means is in an operative position, said initial position being an inoperative position.

8. The control arrangement as defined in claim 7 including throttling means in said inflow means.

9. The control arrangement as defined in claim 8 wherein said throttling means throttles fluid flow in at least one direction.

10. The control arrangement as defined in claim 7 wherein said auxiliary valve means comprises electromagnetically actuated valve means with displaceable slide means.

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