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Herrmann

[11] **3,864,913**

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[54] **CONTROL APPARATUS FOR HYDRAULIC-LIFT TAIL GATES OF VANS, AND THE LIKE**

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[52] **U.S. Cl.** ..... **60/433,** 60/484, 60/DIG. 2, 91/411 R, 91/414

[51] **Int. Cl.** **F15b 11/08,** F15b 11/16

[58] **Field of Search** ..... 60/433, 477, 484; 91/411 R, 418, 414

[56] **References Cited**

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[57] **ABSTRACT**

The apparatus controls at least one double-acting consumer. A control valve includes at least one valve member movable between first operative, second operative and neutral positions to thereby respectively connect a first fluid-conveying line of the consumer with a supply conduit which is connected to a source of pressurized fluid, with a return conduit which is connected to a tank, and to seal the first line from the conduits. The valve member regulates the flow of fluid in a control conduit for a switch valve. The switch valve has a first port connected to the source of pressurized fluid, a second port connected to a second fluid-conveying line of the consumer, and a third port connected to the return conduit. The switch valve includes at least one valve member normally maintained in a first position establishing communication in the switch valve between the second and third ports thereof and blocking flow through the first port thereof. The valve member of the switch valve is movable under the influence of fluid flow in the control conduit to a second position establishing communication in the switch valve between the first and second ports thereof and blocking flow through the third port thereof.

15 Claims, 3 Drawing Figures

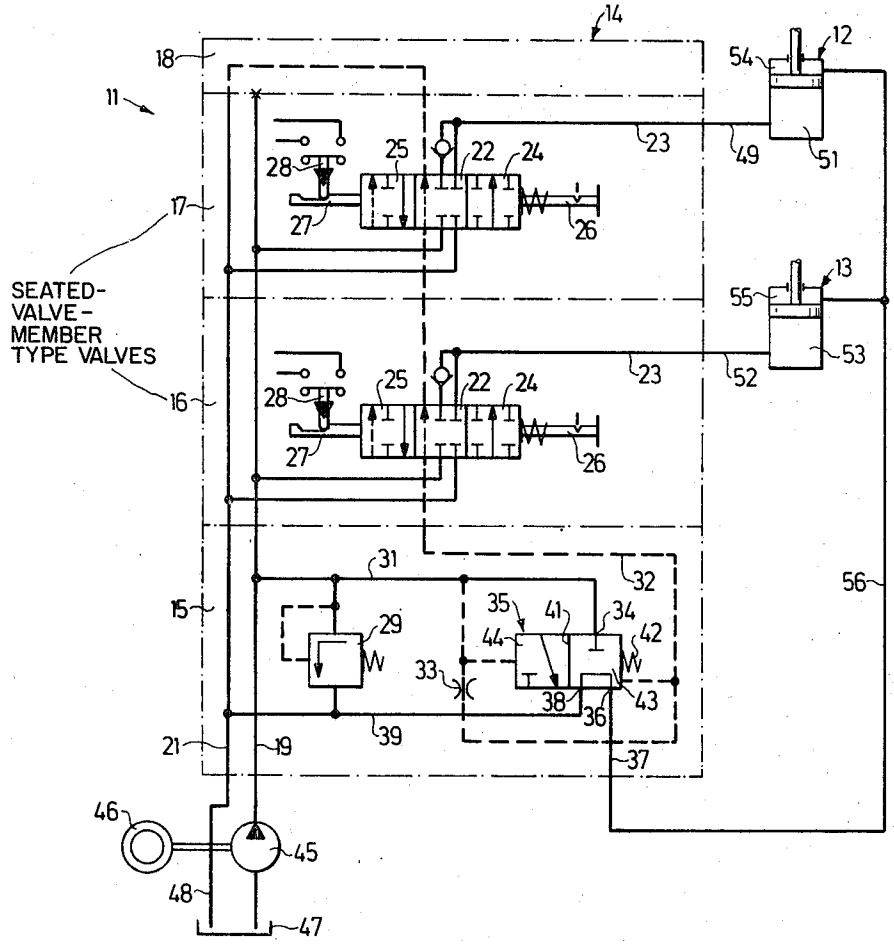
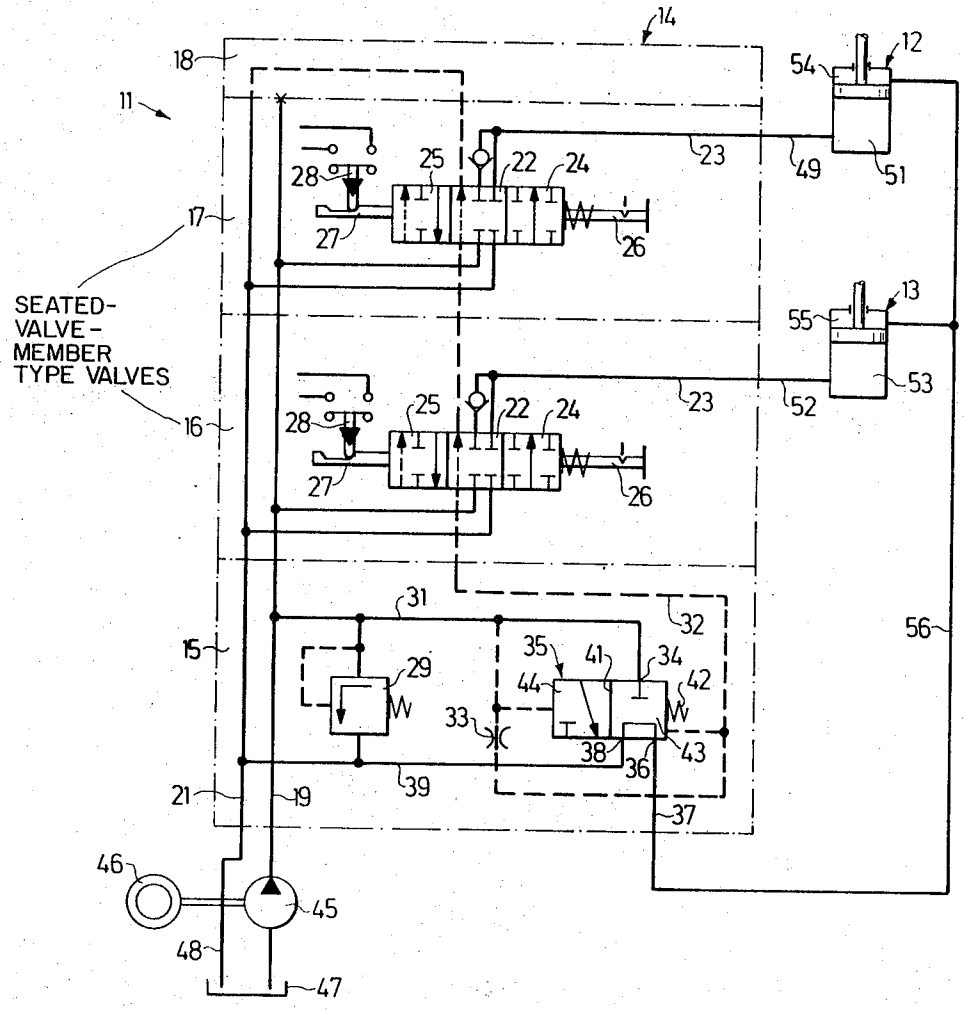


Fig. 1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SEATED-VALVE-MEMBER TYPE VALVES
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Fig. 2

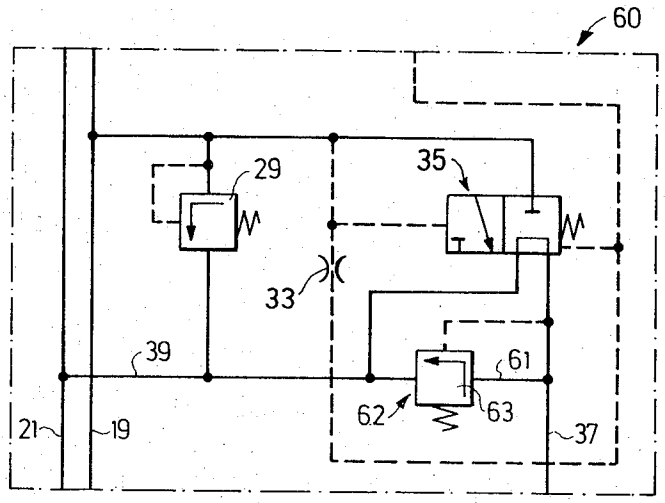
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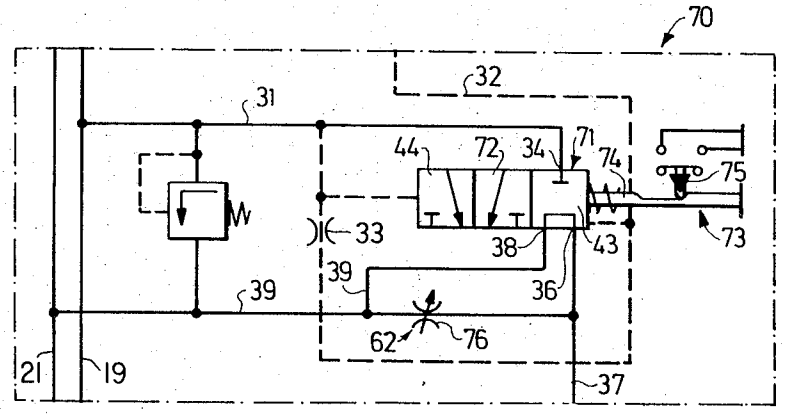
Fig. 3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CONTROL APPARATUS FOR HYDRAULIC-LIFT TAIL GATES OF VANS, AND THE LIKE

BACKGROUND OF THE INVENTION

The invention relates to a hydraulic control arrangement comprised of at least one valve of the seated-valve-member type serving to control a single-acting user device, which in a neutral position blocks a work conduit leading to a consumer and in two operative positions connects such work conduit selectively to either a fluid supply conduit or to the fluid return conduit and furthermore controls the flow of fluid through a control conduit leading from the fluid supply conduit via the multi-way valve to the return conduit, a switching valve being controlled in dependence upon fluid flow in the control conduit.

A control arrangement is known which makes use of a multi-way valve of the seated-valve-member type usually employed to control a single-acting consumer, and furthermore provided with switch valve control means. A multi-way valve of the seated-valve-member type, in contrast to functionally equivalent valves of the sliding spool type, are charcterized by extremely low oil leakage losses. However, such multi-way valves have the disadvantage that, when employed to control the operation of a double-acting user device, two such multi-way valves must be employed together, with each of the two multi-way valves controlling the flow of fluid through only one of the two work conduits of such double-acting user device. Such a tandem arrangement of multi-way valves of the seated-valve-member type is per se known and has the disadvantage that the construction if expensive and space-consuming. Also, the activating arrangements of such two multi-way valves must be made to cooperate with each other.

SUMMARY OF THE INVENTION

It is accordingly an object of the invention to provide a control arrangement provided with a switch valve and with a least one multi-way valve of the seated-valve-member type, such as are usually employed to control the operation of a single-acting user device, with the control arrangement being of as simple a construction as is possible for the control of a double-acting user device. Furthermore, the control arrangement should be capable of operating as nearly loss-free as possible.

This object, and others which will become more understandable from the following description, can be met according to one advantageous concept of the invention by providing a hydraulic control apparatus for at least one double-acting consumer, such as a hydraulic-lift tail gate arrangement of a truck, moving van, or the like. The apparatus includes at least one control valve comprised of at least one valve member movable between first operative, second operative and neutral positions to thereby respectively connect a first fluid-conveying line of the consumer with a supply conduit which is connected to a source of pressurized fluid, with a return conduit which is connected to a tank, and to seal the first line from the conduits. The valve member regulates the flow of fluid in a control conduit for a switch valve. The switch valve has a first port connected to the source of pressurized fluid, a second port connected to a second fluid-conveying line of the consumer, and a third port connected to the return conduit. The switch valve includes at least one valve member normally maintained in a first position establishing

communication in the switch valve between the second and third ports thereof and blocking flow through the first port thereof. The valve member of the switch valve is movable under the influence of fluid flow in the control conduit to a second position establishing communication in the switch valve between the first and second ports thereof and blocking flow through the third port thereof.

In this manner it becomes possible to employ at low cost and without any special additional modifications multi-way valves of the type customarily employed to control the operation of a single-acting user device to instead control the operation of a double-acting user device, in a manner satisfying stringent requirements as to the seal-tightness of the arrangement. With the concept according to the invention, a suitable control arrangement can be constructed using mass-produced commercially available units. Also, the control arrangement according to the invention is characterized by loss-free operation, because when the user device is to be fed fluid, to actuate the user device in particular direction thereof, the pressure source, such as a pump, of the control arrangement is activated only if the nedd for its operation actually exists.

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 depicts a first embodiment of the invention;

FIG. 2 depicts a portion of a second embodiment of the invention; and

FIG. 3 depicts a portion of a third embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a control arrangement, generally designated by reference numeral **11**. The control arrangement **11** is operative for controlling the operation of two cylinder-and-piston units generally designated **12** and **13**.

The first hydraulic cylinder-and-piston unit **12** is operative for controlling the swinging up and down of a (non-illustrated) hydraulic-lift tail gate of a truck, i.e., for controlling the swinging or pivoting down of the hydraulic-lift tail gate to an approximately horizontal orientation and for controlling the swinging up of the hydraulic-lift tail gate to an approximately vertical orientation.

The second hydraulic cylinder-and-piston unit **13** is operative for controlling the raising and lowering of the hydraulic-lift tail gate, in a vertical sense. For example, the hydraulic-lift tail gate will initially be in closed position, with a vertical orientation, perhaps closing off the rear opening of the cargo compartment of a truck. Firstly, the tail gate will be made to swing downwardly to an approximately horizontal orientation, and the tail gate will be at a horizontal level substantially flush with the floor of the truck cargo compartment. Thus, cargo in the cargo compartment can be slid or rolled onto the horizontally extending tail gate. The tail gate is then

lowered in vertical direction to for example the streel level, so that the cargo can be slide or rolled off the tail gate onto the street surface. This done, the tail gate is then for example caused to rise while maintaining a horizontal orientation, and is thereafter caused to swing upwards back to its initial or closed position.

The control arrangement **11** of FIG. **1** includes a valve block **14** comprised of a connecting unit **15**, a first multi-way valve unit **16**, a second multi-way valve unit **17** and an end unit **18**. The multi-way valves **16**, 17 are identical and of the seated-valve-member type, as opposed to the sliding-spool type; that is, the blocking of flow effected by valves **16**, **17**, when they do block flow, results from the abutment of a valve member against a valve seat (seated-valve-member type) as opposed to the blocking off of a port by a sliding spool (sliding-spool type). The important difference between valves of the seated-valve-member and sliding-spool types is that the latter type is characterized by a seal-tightness which is far inferior to the seal-tightness of the seated-valve-member type. Valves **16** and **17** may for example be of the type disclosed in German Offenlegungschrift 1,507,164, especially in FIG. **6** thereof. A specific construction for the valves **16** and **17** is shown in FIG. **5** of copending and commonly owned U.S. Pat. application 395,327, filed Sept. 7, 1973, of Walter Herrmann et al., the disclosure of which is incorporated herein by reference.

The four-port three-position valves **16** and **17** are connected in parallel with each other to a pressure fluid supply conduit **19** and to a return conduit **21**. Each multi-way valve **16**, **17** has a spring-maintained neutral position **22** in which it blocks the respective user conduit **23**. Each valve **16**, **17** has a first operative position **24** in which it connects the respective user conduit **23** to the supply conduit **19**, and a second operative position **25** in which it connects the respective user conduit **23** to the return conduit **21**.

Furthermore, each multi-way valve **16**, **17** is provided with a mechanical activating arrangement **26** provided with an associated switching cam surface **27** and a limit switch **28**. In the connecting unit **15** there is arranged a hydraulic fuse for the supply conduit **19**, in the form of a pressure-limiting valve **29**. A control conduit **32** leads from a conduit **31**, which latter is connected to supply conduit **19**, to a flow restrictor **33**, to the valve **16**, to the valve **17**, to the end unit **18** and there into the return conduit **21**.

The conduit **31** leads to a first port **34** of a switch valve **35**, the second port **36** of which is connected with a second work conduit **37**. The third port **38** is connected to the retun conduit **21** via a conduit **39**. The switch valve **35** is provided with a blocking member **41**, schematically depicted in FIG. **1**. The illustrated biasing spring **42** acts upon the blocking member **41** in such a manner as to normally maintain the switch valve in the position **43** thereof, in which inlet port **43** is blocked and the second port **36** is connected with the third port **38**. The two dashed lines leading from control line **32** to the left and right sides of valve **35**, respectively, represent the fact that the blocking member **41** is subjected to the pressure prevailing in the respective two portions of the control conduit **32**. Because of provision of the restrictor **33**, the pressure upstream of the restrictor **33** may exceed the pressure downstream of the restrictor **33** to such an extend as to overcome the biasing force of biasing spring **42** and move the valve member **41** of switch valve **35** to its second position **44**, in which it connects the first port **34** with the second port **36** and blocks the third port **38**.

The supply conduit **19** is supplied with pressure fluid from a pump **45**. Pump **45** is driven by an electromotor **46** and pumps pressure medium up from a tank **47**. A conduit **48** connects the return conduit **21** with the tank **47**. A first work conduit **49** connects the user conduit **23** of the valve **17** with the lower cylinder chamber **51** of the pivoting-controlling unit **12**. A first work conduit **52** connects the user conduit **23** of the valve **16** with the corresponding chamber **53** of the lifting unit **13**. The cylinder chambers **54**, **55** of the cylinder-and-piston units **12**, **13** are connected to a common second work conduit **37**.

The operation of the arrangement depicted in FIG. **1** is as follows:

It is initially assumed that the hydraulic-lift tail gate is in the closed position, i.e., in the position it assumes after being raised in vertical direction and then swung upwardly to the earlier defined closed position thereof.

To cause the tail gate to swing down to a horizontal orientation, the valve **17** is made to assume its second operative position **25**. In this position the switching cam surface **27** does not cause the switch member **28** to move such a distance as to bridge the respectively associated electrical contacts, which when bridged serve to energize the pump drive motor **46**. Accordingly, the pump **45** does not operate and no pressure fluid flows through the control conduit **32**. As a result, no fluid force opposes the biasing force of spring **42** and the valve **35** remains in its first position **43**. Accordingly, the chamber **54** of cylinder **12** is connected with the return conduit **21**, via the second work conduit **56**, the switch valve **35** and the conduit **39**. The hydraulic-lift tail gate can accordingly swing downwards of its own weight, and as a result pressure fluid will be expelled from the chamber **51** and flow through the work conduit **49** and the valve **17** to the return conduit **21**. Simultaneously, pressure fluid in the tank **47** will be sucked up into chamber **54** via conduit **39**, switch valve **25** and conduit **56**.

It is should happen that the truck provided with the hydraulic-lift tail gate is parked on an inclined road surface with such an orientation that the weight of the tail gate tends to maintain the tail gate in closed position, instead of tending to cause it to swing down to open position, then the piston of the cylinder **12** remains in its initial position, even though the valve **17** is in its second operative position **25**. The switching cam surface **27** on the control slide of the multi-way valve **17** is advantageously so constructed that it will operate the limit switch **28** only after a delay. That is, the person activating the hydraulic-lift tail gate will first attempt to cause the tail gate to swing open under its own weight, by simply moving the valve **17** to its second work position **25**, using the manually operable activator **26**. However, in the event the tail gate does not swing down of its own weight, then the person activating the tail gate will move the activator **26** of the valve **17** all the way to the rightmost end position thereof, causing the switch member **28** to bridge the associated pair of electrical contacts and energize the motor **46**. As a result, the pump **45** pumps pressure fluid through the supply conduit **19**, the pressure achieved in the supply conduit **19** being limited by provision of the pressure-limiting valve **29**. A smaller flow of fluid is established along a parallel

path through the control conduit 32 to the return conduit 21, since the control conduit 32 is not blocked when the valve 16 is in the neutral position 22 and is not blocked when the valve 17 is in the second operative position 25 thereof. The pressure difference which develops upstream and downstream of the restrictor 33 opposes the biasing force of spring 42 and moves the valve member 41 of switch valve 35 to the second position 44 thereof. As a result, pressure fluid can flow from the supply conduit 19, through the conduit 31, through the switch valve 35 and through the second work conduit 56 into the chamber 54 of the unit 12, so as to develop a force positively forcing the tail gate to swing down to open position. The pressure-limiting valve 29 limits the magnitude of the available pressure.

To cause the tail gate to swing upwards back to closed position, the activator 26 of multi-way valve 17 is moved leftwards to its first operative position 24. As a result, the cam surface 27 pushes switch 28 closed, turning the motor 46 on immediately. The pump supplies pressure fluid through the supply conduit 19, through the multi-way valve 17 and through the first work conduit 49 into the chamber 51 of the unit 12. When the valve 17 is in the first working position 24, the control conduit 32 is blocked; as a result, the switch valve 41 assumes its first position 43. Consequently, pressure fluid can freely flow out of the chamber 54 of the cylinder 12 through the second work conduit 56, through the switch valve 41, through the conduit 39 and into the return conduit 21.

The cylinder-and-piston unit 13 can be controlled by the first multi-way valve 16 in a manner analogous to the manner in which the unit 12 is controlled by the second multi-way valve 17, just discussed. The multi-way valve 16 has a first operative position 24 for effecting raising of the tail gate in vertical direction and has a second working or operative position 25 for effecting lowering of the tail gate in vertical direction. When the tail gate is to be raised in vertical direction, the pump 45 is always turned on as a result of activation of the switch 28 of the valve 17. The lowering of the tail gate in vertical direction occurs almost always in consequence of the tail gate's own weight, and accordingly in such circumstances the pump 45 need not be caused to operate. However, if necessary, the pump 45 can be activated. The cylinder-and-piston unit 13 is a double-acting unit precisely for such reason, and furthermore to make it possible for the tail gate to be positively pressed down against the surface of a loading ramp, for example.

In consequence of the parallel connection of the two cylinder-and-piston units 12 and 13, the unit 13 can raise the hydraulic-lift tail gate in vertical direction while the unit 12 simultaneously causes the tail gate to swing upwardly towards closed position. Likewise, the tail gate can be caused to simultaneously swing down towards a horizontal orientation while being lowered in vertical direction, for example to street level.

FIG. 2 shows an end unit 60, which could replace the connecting unit 15 of FIG. 1, to form a second embodiment of the invention. To the extent that the unit 60 of FIG. 2 is comprised of components identical in structure and function to those in unit 15 of FIG. 1, such components are designated in FIG. 2 by the same reference numerals as in FIG. 1. Unit 60 of FIG. 2 differs from unit 15 of FIG. 1 in the following respects: A conduit 61 connects the second work conduit 37 and the conduit 39. Provided in conduit 61 is a means 62 for controlling the fluid pressure, here constructed in the form of an adjustable pressure-limiting valve 63. Alternatively, the means 62 could for example be constructed as an adjustable restrictor.

The operation of a control arrangement in which the unit 60 of FIG. 2 replaces the unit 15 of FIG. 1, differs from the operation of the FIG. 1 embodiment, in that the pressure of fluid flowing into the chambers 54 and 55 of the cylinder-and-piston units 12 and 13 is set by the pressure-limiting valve 63. Since swinging down and lowering of the tail gate requires a lesser force than is needed for raising the tail gate and for causing it to swing upwards, the pressure-limiting valve 63 can be set for a correspondingly lower pressure. This results in a reduced energy-consumption requirement.

The means 62 for controlling the fluid pressure can also be provided in the form of an adjustable restrictor, as mentioned before, if the viscosity and the pressure oscillations in the fluid flow are acceptable. The control arrangement according to FIG. 2 is particularly well suited for the control of a hydraulic-lift tail gate because of its low-loss operation and because of the employment of two different work pressures.

FIG. 3 shows a connection unit 70 which can be substituted for the connection unit 15 of FIG. 1 to form a third embodiment of the control system according to the invention. Identical components in unit 70 of FIG. 3 and in unit 60 of FIG. 2 are denoted by the same reference numerals. Unit 70 of FIG. 3 differs from unit 60 of FIG. 2 in the following respects: A switch valve 71 connects the conduits 31, 37 and 39. The switch valve 71, in addition to the first position 43 and second position 44, has an intermediate third position 72. In the third position 72, the first port 34 is connected with the third port 38, and the second port 36 is blocked. Furthermore, the switch valve 71 is provided with a manual activating arrangement 73 having a switching cam surface 74 and an associated end switch 75, the switch 75 when closed serving to energize the pump motor. The means 62 for controlling the pressure of the fluid medium is here provided in the form of an adjustable restrictor 76.

The operation of the FIG. 3 embodiment differs from the operation of the FIG. 2 embodiment in the following respect: When the multi-way valves 16 and 17 are in their neutral positions 22 a so-called neutral circulation of fluid is possible, i.e., the pump 45 pumps the largest part of the pressure fluid through the supply conduit 19, through the switch 71, through the conduit 39 in unthrottled manner, and then into the return-flow conduit 21. A smaller flow of fluid through the control conduit 32 serves to maintain the switch valve 71 in its third position 72. If the tail gate is to be positively lowered or swung down, i.e., because the tail is so disposed that its own weight will not result in such movement, then the manual activating arrangement 73 brings the switch valve 71 into its second position 44, and the pump 45 will simultaneously be activated in consequence of the automatic closing of switch 75.

The embodiment of FIG. 3 can be resorted to when a continuously operating pump is anyway present so that such a neutral fluid circulation would be advantageous.

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 hydraulic and constructions differing from the type described above.

While the invention has been illustrated and described as embodied in a hydraulic control arrangement for controlling both the swinging movement and pushing vertical movement of a hydraulic-lift tail gate of a van or the like, 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:

1. In a hydraulic control apparatus for at least one double-acting consumer wherein at least one control valve includes at least one valve member movable between first operative, second operative and neutral positions to thereby respectively connect a first fluid-conveying line of said consumer with a supply conduit which is connected to a source of pressurized fluid, with a return conduit which is connected to a tank, and to seal said first line from said conduits, and wherein said valve member regulates the flow of fluid in a control conduit for a switch valve, the improvement which consists in said switch valve having a first port connected to said source of pressurized fluid, a second port connected to a second fluid-conveying line of said consumer, and a third port connected to said return conduit, and wherein said switch valve includes at least one valve member normally maintained in a first position establishing communication in said switch valve between said second and third ports and blocking flow through said first port and movable under the influence of fluid flow in said control conduit to a second position establishing communication in said switch valve between said first and second ports and blocking flow through said third port.

2. An apparatus as defined in claim **1**, and further including pressure-controlling means having a first port connected to said return conduit and to said third port of said switch valve and having a second port connected to said second fluid-conveying line of said consumer and to said second port of said switch valve.

3. An apparatus as defined in claim **2**, wherein said pressure-controlling means comprises a flow restrictor having two ports constituting said first and second ports of said pressure-controlling means.

4. An apparatus as defined in claim **3**, wherein said flow restrictor is adjustable.

5. An apparatus as defined in claim **2**, wherein said pressure-controlling means comprises a pressure-limiting valve having two ports constituting said first and second ports of said pressure-controlling means.

6. An apparatus as defined in claim **1**, and further including a pressure-limiting valve connected to said supply conduit for limiting the pressure therein.

7. An apparatus as defined in claim **1**, wherein said switch valve is provided with biasing means for maintaining said at least one valve member of said switch valve in said first position thereof, and further including a flow restrictor in said control conduit for developing a pressure difference upstream and downstream of said flow restrictor in response to the establishment of flow through said control conduit, and connected to said control conduit upstream and downstream of said flow restrictor and operative in response to development of said pressure difference for applying to said at least one valve member of said switch valve a force opposing the force of said biasing means and moving said valve member of said switch valve to said second position thereof.

8. An apparatus as defined in claim **1**, wherein said at least one valve member of said switch valve has an intermediate third position in which it establishes fluid communication in said switch valve between the first and third ports of the latter and in which it blocks fluid flow through said second port of said switch valve.

9. An apparatus as defined in claim **8**, wherein said source of pressurized fluid includes a pump operative for pumping fluid into said supply line, and wherein said switch valve is further provided with activating means for initiating operation of said pump when said at least one valve member of said switch valve is moved into said second position thereof.

10. An apparatus as defined in claim **1**, and further including an additional control valve in addition to said first-mentioned control valve, and an additional consumer in addition to said first-mentioned consumer, and wherein said additional control valve includes at least one valve member movable between first operative, second operative and neutral positions to thereby respectively connect a respective first fluid-conveying line of said additional consumer with said supply conduit, with said return conduit and to seal said respective first line of said additional consumer from said supply and return conduits, and wherein said valve member of said additional control valve regulates the flow of fluid in said control conduit in cooperation with the regulation of fluid in said control conduit by said valve member of said first-mentioned control valve, and wherein said additional consumer has a respective second fluid-conveying line connected to said second port of said switch valve.

11. An apparatus as defined in claim **1**, wherein said source of pressurized fluid includes a pump operative for pumping fluid into said supply line, and wherein said control valve is further provided with activating means for initiating operation of said pump in automatic response to movement of said valve member of said control valve into one of said operative positions thereof.

12. An apparatus as defined in claim **11**, wherein said activating means comprises means operative for initiating operation of said pump in automatic response to movement of said valve member of said control valve into said first operative position thereof.

13. An apparatus as defined in claim **12**, wherein said activating means comprises means operative for selectively initiating operation of said pump when said valve member of said control valve is in said second operative position thereof.

14. An apparatus as defined in claim **1**, wherein said consumer is a hydraulic-lift tail gate arrangement.

15. An apparatus as defined in claim **1**, wherein said control valve is of the seated-valve-member type.

* * * * *