

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

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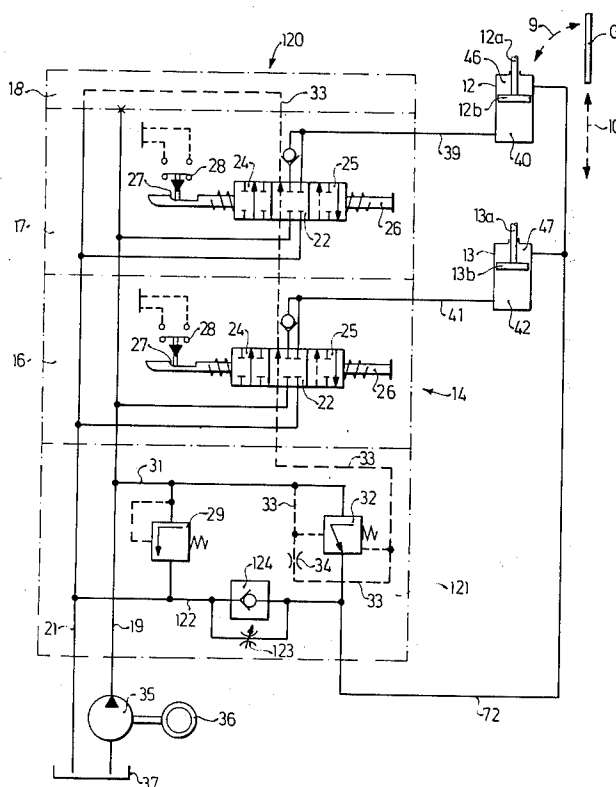
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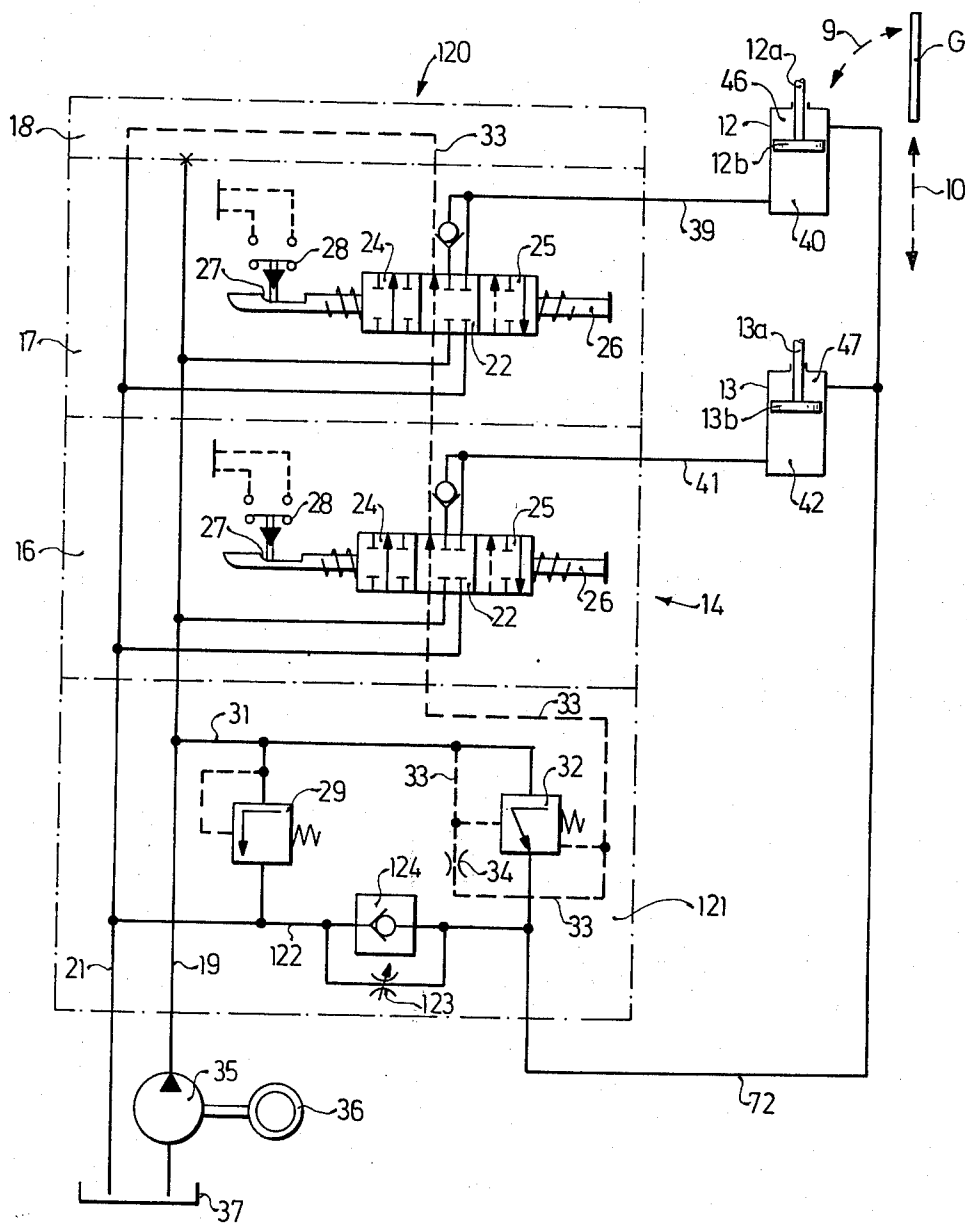
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[57] **ABSTRACT**

The apparatus controls at least one double-acting hydraulic consumer, such as a hydraulic-lift end gate of a moving van, or the like. The apparatus 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 fluid-conveying line of the consumer from the supply and return conduits. The valve member of the control valve also controls the flow of fluid in a control conduit for a switchover valve which opens in response to fluid flow in the control conduit to provide a path for the flow of pressurized fluid from the supply conduit into a second fluid-conveying line of the consumer. A pressure-regulating unit is connected between the outlet of the switchover valve and the tank, and is operative for regulating the pressure of fluid in the second fluid-conveying line of the double-acting consumer. The pressure-regulating unit is provided in the form of a flow restrictor connected between the outlet of the switchover valve and the tank and a check valve connected parallel to the flow restrictor with such an orientation as to permit flow of fluid from the tank into the second fluid-conveying line of the double-acting consumer.

5 Claims, 1 Drawing Figure





HYDRAULIC CONTROL APPARATUS FOR HYDRAULIC-LIFT END GATES OF MOVING VANS AND THE LIKE

BACKGROUND OF THE INVENTION

An arrangement for the control of a double-acting hydraulic consumer is disclosed in commonly owned U.S. Pat. application Ser. No. 395,372 of Walter Herrmann et al., filed on Sept. 7, 1973, and now U.S. Pat. No. 3,854,289. That arrangement makes use of a control valve having at least one valve member movable between first operative, second operative and neutral positions to thereby respectively connect a first fluid-conveying line of a 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 fluid-conveying line of the consumer from the supply and return conduits. The at least one valve member of the control valve controls the flow of fluid in a control conduit for a switchover valve which opens in response to fluid flow in the control conduit to provide a path for the flow of pressurized fluid from the supply conduit into a second fluid-conveying line of the double-acting consumer. In the arrangement being referred to, pressure-regulating means is connected between the outlet of the switchover valve and the tank and is operative for regulating the pressure of fluid in the second fluid-conveying line of the double-acting consumer, and specifically is operative for keeping the pressure furnished to the second fluid-conveying line of the double-acting consumer lower than the pressure furnished to the first fluid-conveying line of the double-acting consumer.

In the arrangement being referred to, the pressure-regulating means was provided in the form of a pressure-limiting valve connected between the outlet of the switchover valve and the tank and operative for limiting the pressure in the second fluid-conveying line of the double-acting consumer to a predetermined value.

Provision of such a pressure-limiting valve connected between the outlet of the switchover valve and the tank does reliably limit the pressure in the second fluid-conveying line of the double-acting consumer. However, the use of a pressure-limiting valve is relatively expensive, particularly in the context of a hydraulic control apparatus of relatively simple construction and comprised of only a few valves.

SUMMARY OF THE INVENTION

It is the general object of the invention to provide a hydraulic control apparatus similar to the apparatus referred to above, but of simpler and less expensive construction.

More particularly, it is an object of the invention to provide a hydraulic control apparatus similar to the apparatus referred to above, but using simpler and less expensive means in place of the pressure-limiting valve referred to above.

Still more particularly, it is an object of the invention to provide a hydraulic control apparatus similar to the apparatus referred to above, but using instead of the pressure-limiting valve referred to above different means having an inherent operation different from the operation of a conventional pressure-limiting valve, but acting, when used in the specific context discussed above, in a manner which is sufficiently analogous to the action of a conventional pressure-limiting valve.

Such similarity of action can exist notwithstanding viscosity-and volume-dependent pressure oscillations.

These objects, and others which will become more understandable from the following description of a preferred embodiment, can be met according to one advantageous concept of the invention by replacing the pressure-limiting valve referred to above with a parallel combination of a simple flow restrictor and a simple check valve, this parallel combination being connected between the outlet of the switchover valve and the tank, and the check valve having such an orientation as to permit free flow of fluid from the tank through the check valve and into the second fluid-conveying line of the double-acting consumer device.

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

The single FIGURE depicts an exemplary embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The single FIGURE illustrates a hydraulic control apparatus 120 for two discrete consumers in the form of cylinders 12, 13 which impart various movements to the end gate G of a truck, station wagon or an analogous automotive vehicle. The cylinder 12 is of the double-acting type and serves to pivot the gate G between open and closed positions (arrow 9), and the cylinder 13 is a double-acting hydraulic jack which can raise the gate G (arrow 10) from a lower end position in which the gate is ready to be pivoted to its closed position. The gate G ordinarily descends under its own weight when the control apparatus 120 allows fluid to escape from the lower chamber 42 of the cylinder 13.

The control apparatus 120 comprises a block-shaped housing 14 which includes a connecting unit 121 adapted to be secured to the dashboard or to another part of the vehicle, an end unit 18, and two identical control valves 16, 17, here shown in the form of directional control valves. The valves 16 and 17 may be constructed as shown in FIG. 5 of commonly owned U.S. Pat. application Ser. No. 395,372 of Hermann et al., filed Sept. 7, 1973, now U.S. Pat. No. 3,854,289, the disclosure of which is incorporated herein by reference.

The control valves 16, 17 are connected in parallel between a supply conduit 19 for pressurized oil or another hydraulic fluid and a return conduit 21 for hydraulic fluid. The valve members of each of the control valves 16, 17 are movable between central or neutral positions 22 (which are established by suitable resilient biasing means) and two operative positions 24, 25. When in the neutral positions 22, the valve members of the control valve 17 seal the conduits 19, 21 from a first fluid-conveying line or consumer line 39 which is connected with the lower chamber 40 of the cylinder 12. When in the neutral position 22, the valve members of the control valve 16 seal the conduits 19, 21 from a first fluid-conveying line or consumer line 41 which is con-

connected with the lower chamber 42 of the cylinder 13. When in the first operative position 24, the valve members of the control valves 16, 17 respectively connect the supply conduit 19 with the consumer lines 41, 39. When in the second operative positions 25, the valve members of the control valves 16, 17 respectively connect the return conduit 21 with the consumer lines 41, 39. The valve members of the control valves 16, 17 are movable by discrete mechanical actuating means 26, and each actuating means 26 comprises a cam or trip 27 for a normally open limit switch 28. When a limit switch 28 is closed (in the first operative positions 24 of the respective valve members), an electric motor 36 or an analogous prime mover drives a pump 35 which constitutes a source of pressurized hydraulic fluid.

The connecting unit 121 supports or embodies a pressure relief valve 29 which opens automatically when the pressure of fluid in the supply conduit 19 rises to a predetermined maximum permissible value and then allows pressurized fluid to flow from the supply conduit 19 into the return conduit 21 and from there into a reservoir or tank 37. Furthermore, the connecting unit 121 supports or comprises a conventional switchover valve 32 which is connected to the supply conduit 19 by a bypass conduit 31. A control conduit 33 connects the bypass conduit 31 with the return conduit 21, and the flow of fluid therein is regulated by the control valves 16 and 17. A portion of the control conduit 33 extends through the unit 18 of the housing 14. When the control conduit 33 is allowed by control valves 16 and 17 to convey fluid from the conduit 31 to the conduit 21, the flow of fluid in control conduit 33 maintains the switchover valve 32 in open position. Specifically, the illustrated compression spring normally biases the valve member of switchover valve 32 to valve-closing position. When a flow of fluid is established in control conduit 33, the pressure difference across restrictor 34 results in a net force opposing the biasing force of the compression spring and moving the valve member of valve 32 to open position.

The consumer line 39 admits pressurized hydraulic fluid to the lower chamber 40 of the cylinder 12 when the piston rod 12a is to pivot the gate G to its closed position. The upper chamber 46 of the cylinder 12 then discharges fluid by way of a second fluid-conveying or working line which is connected to an additional conduit 72. The latter is connectable to the bypass conduit 31 by the switchover valve 32. The upper chamber 47 of the cylinder 13 is likewise connected to the additional conduit 72. The chamber 47 discharges fluid when the chamber 42 of the cylinder 13 receives pressurized fluid for the purpose of moving the gate G from the lower to the upper end position.

The operation of the illustrated control arrangement is as follows:

It will initially be assumed that the end gate G is in the elevated and closed position, with the pistons 12b and 13b accordingly in their respective upper positions.

Firstly, it is desired to cause the end gate G to pivot downwardly to assume an approximately horizontal orientation. This can be effected in either one of two different ways.

As the first possibility, the end gate G can be caused to swing downwards under its own weight. To effect this, the actuator 26 of valve 17 is moved leftwards, causing the one or more valve members in valve 17 to assume the second operative position 25. In this valve

position, the fluid-conveying line 39 of the cylinder 12 is made to communicate with the return conduit 21, and fluid will be expelled from lower cylinder chamber 40, as piston 12b descends under the weight of the end gate G. As the piston 12b descends and expels fluid from chamber 40, the upper chamber 46 of cylinder 13 will become filled with fluid drawn up from tank 37 by the force of simple suction via conduit 21, conduit 122, check valve 124 and also to some extent restrictor 123, and via conduit 72. Under these circumstances, the valve members of valve 17 will be in second operative position 25 and those of valve 16 in the neutral position 22, and accordingly flow of fluid through control conduit 33 will not be blocked. However, there is in fact no flow of fluid through control conduit 33, because the pump 35 has not been activated, there being no need for activation of the pump when the end gate G is made to swing downwards simply under its own weight. With no flow of fluid through control conduit 33, no pressure difference will develop across restrictor 34, and accordingly no net pressure opposing the force of biasing spring will open switchover valve 32. Therefore, switchover valve 32 will remain closed if the end gate G is made to swing down solely under its own weight.

It may happen that downward swinging of the end gate G solely under its own weight, in the manner just described, will not be possible. For example, if the van provided with the hydraulic-lift end gate G is parked on a downward incline, the end gate G may be so disposed that its own weight will tend to maintain it in closed position, instead of causing it to swing downwards as would be the case if the van were parked on a horizontal surface or on an upward incline. To effect the desired downward swinging of the end gate G under such circumstances, the following must be done:

The actuator 26 of valve 17 will be pushed in leftwards direction, as just described, to thereby move the valve members of valve 17 to the second operative position 25 thereof. If, because of the just-mentioned inclination of the van, the end gate G does not swing downwards, then the actuator 26 is pushed leftwards a further distance. This causes switch 28 to be pushed by camming surface 27 towards the respective pair of electrical contacts. When these electrical contacts are bridged, the electromotor 36 becomes energized, and the pump 35 begins to pump fluid into the supply conduit 19, accordingly.

As a result, pressurized fluid begins to flow through supply conduit 19, through bypass conduit 31 and along control conduit 33, back to tank 37 via return conduit 21. The flow of fluid through control conduit 33 creates a pressure difference across flow restrictor 34. This pressure difference opposes the biasing force of compression spring 42 and moves the valve member of switchover valve 32 to the valve-opening position. As a result, the pressure created by operation of pump 35 is communicated to some extent to cylinder chamber 46, via bypass conduit 31, switchover valve 32 and fluid-conveying line 72. It will be noted that the pressure in conduit 72 and accordingly in cylinder chamber 46 will be limited by provision of the return-flow conduit 122 which connects the outlet port of valve 32 to the return conduit 21. However, the pressure in line 72 will not fall to zero, because the restrictor 123 in conduit 122 evidently does not permit unthrottled flow of fluid to tank 37. On the other hand, the diversion of

fluid to tank 37 via the restrictor 123 and conduit 122 causes the pressure in line 72 to be lower than the pressure associated with the pressure-limiting valve 29. This lowering of the pressure in line 72 in this manner is appropriate, because evidently only a relatively small force is required to cause the end gate G to swing downwards, the required force being considerably lower than the force required to cause the end gate G to swing upwards. In any event, the end gate G does swing downwards, not solely because of its own weight but instead because of the positive pressure pushing piston 12b downwards.

With the end gate G now swung down to open position, the end gate will for example be flush with the floor of the cargo compartment of the van, to permit cargo to be rolled or slid onto the horizontal end gate. Further movement of the piston 12b is not now required, and accordingly the valve members of valve 17 will be returned to their neutral positions 22.

The cargo having been rolled or slid onto the end gate, it will now be desired to lower the end gate to the street level, for example, so that the cargo can be rolled or slid off the end gate and onto the street. To accomplish such lowering of the end gate, the actuator 26 of valve 16 will be moved in leftwards direction, to move the valve members of valve 16 to the second operative position 25. This establishes communication between compartment 42 of cylinder 13 and the return conduit 21. Accordingly, the end gate G descends under its own weight and under the weight of any supported cargo, lowering piston 13b and expelling pressure fluid from compartment 42. The lowering of piston 13b solely as a result of the weight of the end gate and any supported cargo is exactly analogous to the lowering of piston 12b solely under the weight of the end gate, as described above. Accordingly, it will simply be noted that when the end gate is lowered in this manner, the switch 28 associated with valve 17 will not activate the pump motor 36, and the switchover valve 32 will be closed. As the piston 13b descends, the upper compartment 47 of cylinder 13 becomes filled with pressure fluid sucked up from tank 37 via return conduit 21, conduit 122, check valve 124 and to some extent restrictor 123, and via conduit 72.

Under some circumstances, it may happen that the lowering of the horizontally disposed end gate under its own weight plus the weight of any supported cargo will not be satisfactory. It may be desired that an additional force push down the end gate towards the street level, for example to cause the end gate to lie as flat as possible on soft and uneven ground. To accomplish this, the following is done.

After the actuator 26 of valve 16 has been moved in leftwards direction, to move the valve members of valve 16 to position 25, the actuator 26 is pushed a small additional distance, to cause the camming surface 27 to push switch 28 into engagement with the respective pair of electrical contacts. This energizes the pump motor 36, and the pump 35 will pump pressure fluid from the tank 37 into the supply conduit 19. Pressure will be communicated to bypass conduit 31, but will be limited to the value associated with pressure-limiting valve 29. Fluid will flow through control conduit 33, creating the aforescribed pressure drop across restrictor 34, which opens valve 32. As a result, pressure fluid will flow from bypass conduit 31 through valve 32 and conduit 72 into the upper chamber 47 of cylinder

13, positively forcing the piston 13a downwards. The connection of the outlet port of valve 32 to the return conduit 21 via restrictor 123 and conduit 122 makes for a pressure in line 72 and chamber 47 which is lower than the pressure established by pressure-limiting valve 29 in bypass conduit 31. This is appropriate, because maximum fluid pressure would not be required for the lowering of the end gate G, even in the situation where the weight of the end gate plus any cargo is not sufficient for a particular situation.

Once the horizontally oriented end gate G has been lowered to ground level, the actuator 26 will be moved rightwards to cause the valve members of valve 16 to assume the neutral position 22, inasmuch as further movement of piston 13b will not be required or desired at this time.

After the cargo on the end gate has been rolled or slid off the end gate and onto the street, it may be desired to roll or slide different cargo from the street onto the end gate. This done, it will be desired to raise the end gate to a level flush with the floor of the cargo compartment of the van, so that the new cargo can be rolled or slid onto the floor of such cargo compartment. To do this, the following is done:

Activator 26 of valve 16 will be moved in rightwards direction, to move the valve members of valve 16 to first operative position 24. The camming surface 27 of the activator 26 will immediately effect closing of switch 28 and energization of the pump motor 36. Pressure fluid will be pumped through supply conduit 19 and the check valve associated with valve 16, and through consumer line 41 into compartment 42 of cylinder 13, raising piston 13b and accordingly raising the end gate G.

When the valve members of valve 16 are in position 24, fluid flow through control conduit 33 is blocked, and accordingly switchover valve 32 remains blocked. Accordingly, the pressure of fluid in supply conduit 19 will be limited only by the action of the pressure-limiting valve 29.

As the piston 13b is pushed upwards in this manner, the fluid in the upper cylinder chamber 47 will be expelled through conduit 72, restrictor 123 and conduit 122, into the return conduit 21 leading to the tank 37.

When the end gate has been raised to a level flush with the cargo compartment floor, the activator will be moved in leftwards direction to restore the valve members of valve 16 to neutral position 22, since further movement of piston 13b will not be required or desired at this time. Operation of the pump 35 will cease. The cargo supported on the horizontally disposed end gate will be rolled or slid into the cargo compartment of the van.

Finally, it will be desired to cause the end gate, now horizontally disposed at the level of the cargo compartment floor, to swing upwards to its closed position. To accomplish this, the activator 26 of valve 17 is moved rightwards, to move the valve members of valve 17 to the first operative position 24. The cam surface 27 of the activator 26 of valve 17 immediately closes the respective switch 28 and energizes the pump motor 36. Pressure fluid is pumped into the lower cylinder chamber 40 via supply conduit 19, valve 17 and consumer line 39, forcing piston 12b upwards. When the end gate G reaches its closed position, the activator 26 of valve 17 is moved rightwards, to move the valve members of

valve 17 back to neutral position 22, simultaneously terminating operation of pump 35.

This is the complete cycle of operation of the illustrated arrangement. However, it is noted that it would of course be possible to alternatively effect lowering of the end gate simultaneously with the downward swinging thereof, and to effect raising of the end gate simultaneously with the upward swinging thereof, in which case the two activators 26 could be operated in unison.

An important advantage of the illustrated arrangement is the use of the parallel combination of the flow restrictor 123 and the check valve 124. When pressure fluid is pumped via line 72 into one of the upper cylinder chambers 46, 47, the provision of the restrictor 123 reduces the working pressure, relative to the pressure employed to raise the pistons 12b and 13b. In this sense the restrictor 123 performs to some extent the function of a pressure-limiting valve. However, it will be appreciated by persons skilled in the art that the use of a simple flow restrictor 123 in this context, instead of a pressure-limiting valve, is considerably more simple and economical, reducing both the initial and maintenance cost of the arrangement. The provision of the check valve 124 permits fluid to be sucked up from tank 37 into the upper cylinder chambers 46, 47 without short-circuiting the flow of fluid through line 72 when the pump 35 is pumping fluid through conduit 72 into one of the upper cylinder chambers 46, 47. Such short-circuiting would be effected if the necessary flow path for sucking up of fluid from tank 37 into chambers 46, 47 were provided in the form of a simple conduit, instead of check valve 124. If a simple conduit were employed, then it would be necessary to control the flow of fluid in such conduit by some means responsive to the different positions of valves 16, 17 and furthermore responsive to operation and non-operation of pump 35. Evidently, such control means would be far more complicated than the simple check valve 124. The use of the simple check valve 124, in the context depicted, permits the sucking of fluid into the upper cylinder chambers 46, 47 when the tail gate descends or swings down solely under its own weight, without in any way interfering with the operation of the illustrated control apparatus when the control apparatus is performing in any of the other four modes described above.

It may be desired to vary the pressure associated with pumping of fluid into the upper cylinder chambers 46, 47 via conduit 72. For this purpose, the flow restrictor 123 can either be made adjustable or else be constructed as a removable unit readily replaceable by a flow restrictor having different characteristics.

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 circuits and constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a control apparatus for a hy-

draulic-lift end gate of a moving 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 of the type 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 of said control valve controls the flow of fluid in a control conduit for a switchover valve which opens in response to fluid flow in said control conduit to provide a path for the flow of pressurized fluid from said supply conduit into a second fluid-conveying line of said consumer, and wherein pressure-regulating means is connected between the outlet of said switchover valve and said tank and is operative for regulating the pressure of fluid in said second fluid-conveying line of said consumer, the improvement consisting in that said pressure-regulating means comprises a flow restrictor connected between the outlet of said switchover valve and said tank and a check valve connected in parallel to said flow restrictor with such an orientation as to permit flow of fluid from said tank into said second fluid-conveying line of said consumer.

2. The apparatus defined in claim 1, wherein said pressure-regulating means consists of said flow restrictor and said check valve.

3. The apparatus defined in claim 1, wherein said apparatus further includes a pressure-limiting valve connected between said supply conduit and said tank for limiting the pressure of fluid in said supply conduit, and wherein the inlet of said switchover valve is connected to and receives fluid from said supply conduit.

4. The apparatus defined in claim 3, wherein said pressure-limiting valve and said flow restrictor and said check valve are incorporated in a common housing provided as a module.

5. The apparatus as defined in claim 1, wherein said flow restrictor is an adjustable flow restrictor.

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