June 7, 1966 J. R. McGUIRE ETAL 3,254,667

FLOW REGULATOR VALVES

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Fig. 2.

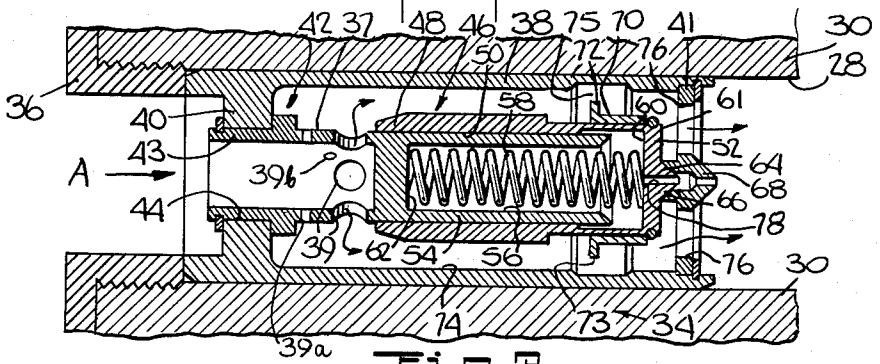
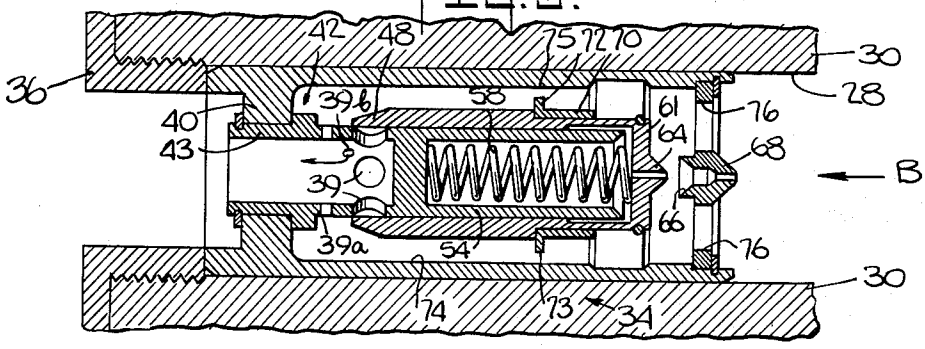



Fig. 3.



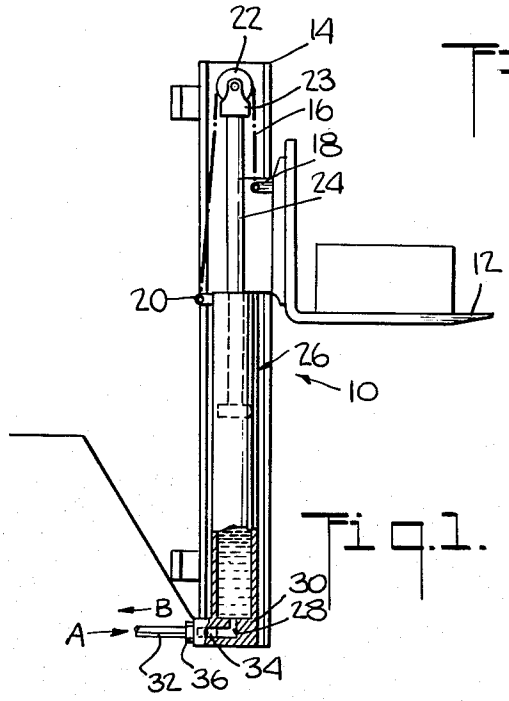
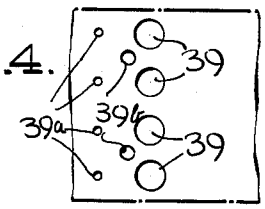




Fig. 1.

Fig. 4.



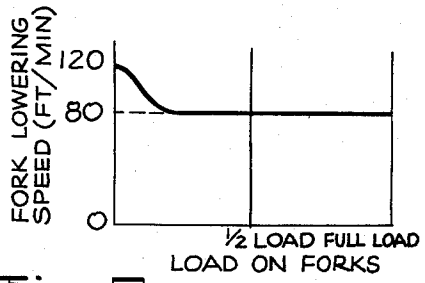




Fig. 5.

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FLOW REGULATOR VALVES

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FIG - 8

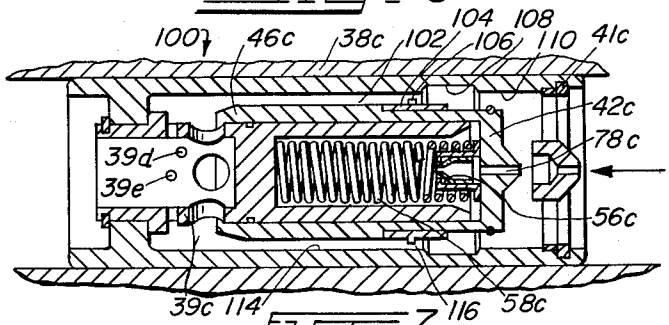



FIG - 7

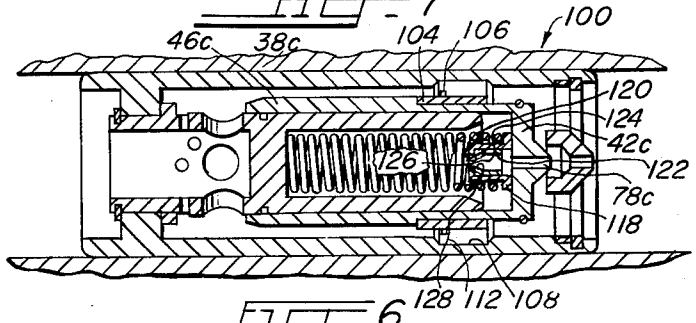
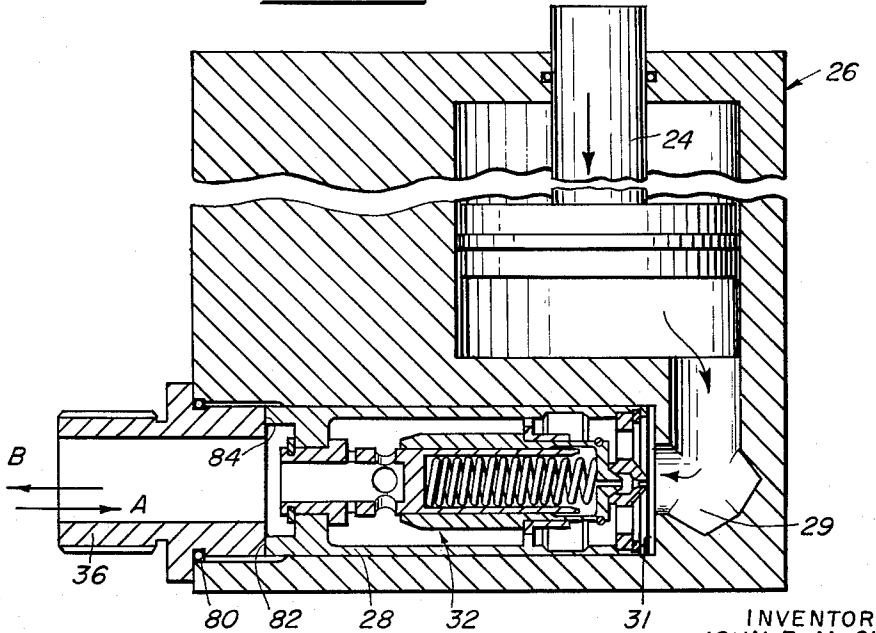



FIG - 6




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3,254,667

# FLOW REGULATOR VALVES

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8 Claims. (Cl. 137—504)

The present invention relates to hydraulic flow regulators and more particularly to a cartridge type pressure compensated flow regulator valve for hydraulic cylinders.

In hydraulic equipment of the type such as fork-lift trucks and the like, the lifting members or "forks" are raised and lowered by means of an hydraulically-actuated pulley system. When suitably actuated by the operator, a piston rod is hydraulically driven in its associated cylinder upwardly or downwardly appropriately moving the forks of the device to raise or lower a load thereon.

Heretofore, a problem with such devices is that the forks tended to move more rapidly downwardly under load. This obviously presented an undesirable and potentially dangerous situation.

Thus, for safety reasons, it is now required that the movement of the hydraulically-actuated lifting members be continuously regulated so that the rate of travel of the lifting members or forks under all load conditions is generally controlled.

Likewise, to ensure proper handling of loads, it is desirable that the movement of such lifting members under load be smooth and uniform. It will be understood that non-uniform or hesitant travel of these lifting forks might result in shifting or even dropping of the load.

To accomplish this in the present invention, there is provided in the hydraulic circuit to the lifting-fork actuating cylinder, a flow regulator valve for regulating the flow of the hydraulic fluid in the hydraulic circuit when the forks are under load. Under no load conditions, there is unrestricted hydraulic flow through the system.

The valve of the present invention is characterized by the provision of a pair of relatively-movable internal valve control members within an outer housing. The first valve member is generally cylindrical and provided with a plurality of radially-disposed port members adjacent the connection of the valve member to the hydraulic inlet to the device. The second valve control member is likewise generally cylindrical and concentrically disposed about the first member and mounted for sliding movement along the first valve control member. Spring means is provided for normally positioning the second valve control member so that the ports in the first member are unrestricted. In this manner hydraulic fluid can flow freely into and through the valve to the lifting fork actuating cylinder to lift the forks to load-engaging position.

However, when the fluid is forced in the opposite direction as the forks are lowered with a load thereon, the fluid, flowing in the opposite direction, moves through an orifice formed between a flange element on the second or outer valve member and the inner surface of the housing. This causes a pressure differential in the fluid moving therepast and urges the outer member along the inner valve member against the action of the spring. The outer valve member continues its travel along the inner member gradually closing off the ports in the second member and throttling the flow of fluid therethrough.

To ensure continuous and smoothly regulated downward movement of the lifting forks, radially-opposed bleeder ports are provided in the inner valve member. These bleeder ports are generally smaller in diameter than the primary ports of the valve and are located adjacent the connection of the inner valve member to the valve housing. As the primary or main ports are covered by the moving outer valve member, the flow of the fluid



through the bleeder ports increases, making the throttling operation a gradual one to ensure smooth downward movement of the lifting forks and load.

In addition, the outer valve member is so dimensioned and the bleeder ports so positioned that such bleeder ports are always unrestricted. This feature permits control of the lifting forks and load at all times during descent and likewise assists in returning the outer valve member to its original non-operative position when the fluid flow in the unregulated direction is resumed.

In like manner, there is also provided additional or secondary ports associated with the main ports for assisting the main ports during rapid or instantaneous actuation of the valve when a high pressure differential is present. The secondary ports are also operative to assist in making the throttling operation a gradual, even one.

In addition, to prevent uneven valve operation, there is provided dash-pot means on the movable valve member which dampens the back-and-forth movement of the movable member, thereby preventing rapid on-and-off throttling of the fluid flow therethrough and ensuring smooth downward movement of the associated lifting forks and load.

In one form of the invention, the valve is adapted to ensure uniform downward movement of the forks under all load conditions. In another form of the invention, the valve is adapted to permit rapid descent of the forks under no-load conditions thereby decreasing the time of loading operation. However, when the forks are descending under load, then the valve is adapted to control the downward descent of the forks and load at a uniform rate.

It is therefore the object of the present invention to provide in an hydraulic system, a pressure compensated hydraulic flow regulator which permits free fluid in one direction while regulating flow in the opposite direction in such system.

Another object of the invention is to provide in an hydraulically-actuated lifting device, an hydraulic system including a pressure compensated hydraulic flow regulator for controlling the hydraulic fluid flow through such system regardless of the load on the lifting device.

A further object of the invention is to provide in an hydraulically-actuated lifting device, an hydraulic system including a control valve having a pair of relatively-movable internal valve members responsive to movement of the fluid in the system in one direction to permit free flow thereof through the system and responsive to movement of the fluid in the system in the other direction to regulate such fluid flow.

An added object of the invention is to provide, in a pressure compensated hydraulic flow regulator valve, an inner stationary valve member having parts therein for fluid flow through the valve, and a movable outer valve member, concentrically disposed about the inner member, and responsive to the flow of fluid through the valve in a predetermined direction for advancing along the inner member to a position covering the parts to thereby interrupt the flow of fluid therethrough in the predetermined direction.

It is likewise an object of the invention to provide, in a pressure-compensated hydraulic flow regulator valve, a pair of relatively-movable inner and outer valve members with the inner member having a plurality of main parts for the prime flow of fluid through the valve, the main ports being constructed and arranged to be closed by the outer valve when the fluid flow through the valve is in a given direction and bleeder ports in the inner member and disposed in spaced relationship to the main ports for accommodating an auxiliary unrestricted flow of fluid through the valve at all times.

Another object of the invention is to provide in an hydraulically-actuated lifting device, a pressure-compensated hydraulic flow regulator valve for controlling the operation of such lifting device wherein the valve permits uniform downward movement of the lifting members of such lifting device under all load conditions.

A further object of the invention is to provide, in an hydraulically-actuated lifting device, a pressure-compensated hydraulic flow regulator valve for controlling the operation of such lifting device wherein the valve permits rapid downward movement of the lifting members of such lifting device under no-load conditions while controlling the downward descent thereof at a uniform rate under load.

It is also an object of the invention to provide a pressure compensated hydraulic flow regulator having a pair of relatively-movable internal valve members responsive to the flow of fluid therethrough to permit free fluid flow in one given direction and to regulate fluid flow therethrough in the opposite direction and dash-pot means associated with the valve members for controlling the relative movement of said valve members to insure proper regulation of the fluid flow through the regulator.

Further objects and advantages of the invention will be obvious herefrom or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The foregoing general description and the following detailed description are exemplary and explanatory, but are not restrictive of the invention.

Of the drawings illustrating by way of example preferred embodiments of the invention and wherein like numerals designate like parts:

FIG. 1 is a schematic view of a lifting device provided with a regulator of the present invention;

FIG. 2 is a side elevation partly in section showing one form of the regulator unit of the present invention in position for unrestricted hydraulic fluid flow;

FIG. 3 is an illustration of the unit of FIG. 2 in position to restrict the flow of fluid therethrough;

FIG. 4 is a developed view of a portion of the inner regulator control member of the regulator of FIGS. 1 and 2 showing the relationship of the main fluid ports, the secondary ports and the auxiliary bleeder ports;

FIG. 5 is a graph of fork lowering speed versus load on forks for the lifting forks of a conventional fork lift truck embodying either one of the typical regulators of the present invention;

FIG. 6 is an enlarged view somewhat schematic, of a typical installation of a regulator of the present invention;

FIG. 7 is a side elevation, partly in section, showing another form of regulator unit of the present invention in position for unrestricted hydraulic fluid flow; and

FIG. 8 is an illustration of the unit of FIG. 7 in position to restrict fluid flow therethrough.

Referring to FIG. 1 there is schematically illustrated a lifting device, designated generally at **10**, provided with the preferred embodiment of the present invention. For illustration purposes only, device **10** is shown as a conventional "fork-lift" truck, although it will be understood that other suitable lifting devices can utilize the present invention.

As shown in FIG. 1, device **10** includes lifting elements or forks **12** (only one of which is shown) which are slidably mounted for vertical travel along standards **14** of the device **10**. To move forks **12** up and down along standards **14**, there is provided lifting means including a flexible tensile member **16** secured at one end to a bracket **18** on the lifting forks **12** and at its other end to a fixed abutment **20** on the device **10**. Between bracket **18** and abutment **20**, tensile member passes around a sheave **22** or the like rotatably mounted on the free end **23** of the piston rod **24** of an hydraulic cylinder **26**, vertically supported on device **10** as shown in FIG. 1. The lowermost



end of cylinder **26** remote from piston **24** communicates with an hydraulic conduit **32** through internal bores **28** and **29** leading to a source of supply of hydraulic fluid (not shown) and means (not shown) for causing flow of the fluid on demand through the conduit **32**. (See FIG. 6.)

In operation, when fluid is pumped through conduit **32** into bores **28** and **29** in the direction of arrow A, FIGS. 1, 2 and 6, such fluid entering cylinder **26** extends rod **24** thereof. This movement of rod **24**, through sheave **22** and tensile member **16**, effects the upward movement of forks **12**. It will be understood that movement of fluid out of cylinder **24** and through bores **28** and **29** and conduit **32** in direction B, FIGS. 1, 3 and 6 effects lowering of forks **12**.

To regulate the flow of hydraulic fluid moving through conduit **32** and bores **28** and **29** to and from cylinder **24**, there is provided a cartridge-like regulator unit, designated generally **32** disposed in bore **28** adjacent the connection thereto of conduit **32** through fitting **36**.

Unit **34** shown best in FIGS. 2 and 3, comprises an outer cylindrical housing **38** dimensioned to fit snugly in bore **28**. Housing **38** has an end wall **40** adjacent the end of unit **34** contiguous fitting **36** while the other end of housing **38** within bore **28** is provided with a foraminous stop member **41** for reasons more fully set forth hereinbelow.

Unit **34** also includes a first control member **42** of generally sleeve-like configuration within housing **38**. One end **43** of member **42** is accommodated in an associated recess **44** in end wall **40** such that conduit **32** communicates with the interior of housing **38** through the open end **43** of member **42**. In turn, to permit communication between the interior of housing **38** and the interior of member **42**, member **42** is provided with a plurality of radially-disposed main ports or openings **39** through the wall **37** thereof. Likewise, there are a plurality of bleeder ports **39***a* and secondary ports **39***b* which also provide communication between the interior of member **42** and housing **38** for purposes more in detail set forth hereinbelow.

Cooperating with first control member **42** is a second control member **46**, likewise of generally sleeve-like or cylindrical configuration and concentrically-disposed about the outer surface **48** of member **42** with the inner surface **50** of member **46** in continuous relationship with surface **48** as shown in FIGS. 2 and 3.

Means are provided for normally maintaining members **42** and **46** in the relative positions shown in FIG. 2. These means include a bottom wall **52** on member **46** adjacent stop **41** of housing **38**, wall **52** thereby forming a closure for the interior of member **46**. Likewise, the body portion **54** of member **42** has formed therein an open-end, generally cylindrical recess **56**. Balance spring member **58** is positioned in recess **56** with one thereof bearing against the inner face **60** of bottom wall **52** while the other end of spring **58** bears against the closed end **62** of recess **56**. Spring **58**, thus normally urges members **42** and **46** into their positions shown in FIG. 2.

With member **46** in position shown in FIG. 2, a seating element **64** formed on the outer face **61** of bottom wall **52** is received in an accommodating recess **66** in the seat portion **68** of stop **41**. (See FIG. 2.)

To move member **46** along member **42** from nonoperative position (FIG. 2) to operative position (FIG. 3) there is provided orifice means comprising an annular member **70** slidably disposed about the outer periphery of member **46**. Member **70** in turn is provided with a transverse flange or shoulder **72** whose outer edge **73** is spaced from the inside wall **74** of housing **38** to form therebetween an annular constriction or orifice **75**, whose effect and operation will hereinafter be set forth in detail.

With the hydraulic fluid flowing from conduit **32** toward bore **28** in the direction or arrow A, FIGS. 1 and 2, when forks **12** are ascending, the fluid enters regular

34 through the open end 43 of member 42. With fluid flow in this direction, member 46 under the urging of spring 58 is retained in non-operative position shown in FIG. 2 permitting unrestricted flow of fluid from member 42 through ports 39 into the interior of housing 38 and out through openings 76 in stop 41 into bore 28 and hence to cylinder 26, extending rod 24 thereof to raise forks 12 of device 10.

When, however, the direction of fluid flow is in the direction of arrow B, FIGS. 1 and 3, the hydraulic fluid entering housing 38 through opening 76 and 78 passes through orifice 75 as it travels through regulator 34. As the fluid moves through orifice 75 it experiences a pressure drop causing a pressure differential acting on flange 72 with the fluid on the left side of flange 72 as viewed in FIG. 3 exerting a greater pressure on flange 72 than is exerted on the opposite side thereof, thus effecting movement of member 46 along stationary member 42 toward operative port-closing position shown in FIG. 3, thereby interrupting the flow of fluid through ports 39 into conduit 32.

However, it will be understood that sudden and complete interruption of fluid flow through regulator 34 causes sudden and complete stoppage of forks 12 with a load thereon. To prevent such sudden stoppage and to always ensure some flow of fluid, there are provided the bleeder ports 39*a* which are so positioned in wall 37 of member 42 that, even with member 46 in full, operative position shown in FIG. 3, bleeder ports 39*a* are unrestricted, permitting some flow of fluid therethrough and ensuring smooth, continuous descent of forks 12. Bleeder ports 39*a* also have the effect of increasing the total area of fluid exits in member 42 such that as main ports 39 are closed by member 46, the fluid can continue to exit through ports 39*a* making for a gradual interruption of fluid flow. In addition, these bleeder ports 39*a* provide some fluid communication in the system to ensure instantaneous response of the cylinder and forks. In like manner, secondary ports 39*b* are provided in wall 37 of member 42. Secondary ports 39*b* are effective in throttling fluid flow at times of high pressure differentials across orifice 75; that is, under sudden, heavy load conditions. The secondary ports 39*b* are positioned in wall 37 between main ports 39 and bleeder ports 39*a* and are so located that only when movable valve member 46 reaches its maximum travel does it completely block the secondary ports 39*b*. Thus, member 46 is required to travel additional distance "*d*" to accomplish complete throttling. This assists in making the valve dynamically stable because of the longer throttling time, ensuring smooth, continuous regulated descent of forks 12 rather than potentially hazardous stop-and-start hesitant descent if fluid flow through valve 32 where alternately rapidly throttled and unthrottled.

It will be understood that the flow of fluid through valve regulator 32 in the restricted direction of arrow B is, in part, controlled by balance spring 58. Balance spring 58 is selected to maintain a predetermined flow pressure differential across orifice 75. When the pressure differential exceeds the resilient spring force of spring 58 member 46 throttles flow of fluid through member 32. The flow rate remains constant since member 46 is moved into and out of throttling position by spring 58 as the pressure differential changes due to the throttling, spring 58 thereby being operative to assist in maintaining a constant, predetermined flow rate through the regulator 32.

When the fluid flow in the system is again reversed into the direction A, member 46, as explained hereinabove, is returned to non-operative position shown in FIG. 2 and unrestricted fluid flow through regulator 34 is resumed.

To assist in eliminating bouncy or hesistant movement of fork 12 by sudden throttling of fluid flow through the regulator 32, means is provided for cushioning or controlling the movement of member 46. This means includes a dash-pot orifice 78 formed in wall 52 at the seating element 64. Orifice 78 communicates the closed recess 56 with the interior of housing 38. Thus, when installed, recess 56, as well as the interior of housing 38 are filled with hydraulic fluid. When, member 46 starts to move toward operative, throttling position shown in FIG. 3 the fluid within closed recess 56 is compressed and forced out of recess 56 through the relatively-small orifice 78. Since the compressed fluid within recess 56 cannot escape quickly through orifice 78, a back-pressure is developed against the movement of member 46 toward operative position, causing member 46 to move smoothly into the throttling area. In like manner, when member 46 is moved away from the throttling area adjacent ports 39 and 39*b*, some back-pressure develops to thus ensure smooth movement of member 46 into and out of operative throttling position and thus assist in eliminating too rapid opening and closing of the valve and thereby preclude bouncy or hesitant downward movement of forks 12.

As shown best in FIG. 6, there is provided with the regulator of the present invention a novel method of sealing the cartridge valve installation which eliminates the need of auxiliary sealing member; such as, packings, rings and the like. As described hereinabove, regulator 32 is seated snugly in bore 28 between the fitting 36 and face 31 of bore 28 communicating with reduced-diameter angular bore 29.

Fitting 36 is a conventional SAE-type hydraulic fitting secured in the open end of bore 28 and sealed thereagainst by a sealing element 80 in known manner. The annular end portion of housing 38 is machined to form a sealing surface adapted to fit flush against the cooperating end 84 of fitting 36 within bore 28. When fluid is flowing through bore 28 under pressure in the regulated direction of arrow B, FIG. 6, the cooperating surfaces 82 and 84 of housing 38 and fitting 36 are urged by the fluid flow into sealing engagement, the greater the fluid pressure the greater the sealing action between surfaces 82 and 84. With surfaces 82 and 84 thus in sealing contact, no fluid leakage from within bore 28 can occur, thus eliminating any need for sealing elements between members 32 and 36.

FIGS. 7 and 8 disclose a modified form of the present invention wherein, when the lifting forks are descending under no load or relatively light loads, the regulator, designated generally 100, permits such lightly loaded forks to descend at a higher speed than when under comparatively heavy load. This feature substantially reduces material handling time and costs.

The installation and general operation of regulator 100 is substantially similar to regulator unit 34 with like parts designated by like numerals with the suffix "*c*".

Thus, regulator 100 includes a cylindrical housing 38*c*, a stationary member 42*c* having main ports 39*c*, secondary ports 39*e* and bleeder ports 39*d*; a movable member 46*c*; balance spring 58*c*; foraminous stop 41*c*; dash-pot opening 78*c*; all similar in construction and operation to corresponding members 38, 42, 46, 58, 41 and 78 of unit 34 illustrated in FIGS. 1–4 and 6.

To move member 46*c* along member 42*c* into throttling position as described heretofore when the lifting elements associated with regulator 100 are descending under load, the outer surface 102 of member 46*c* is provided with an annular member 104 having a flange or shoulder 106 transversely formed thereon.

As shown in FIG. 7, when member 46*c* is in non-throttling position, flange 106 is normally disposed within an annular recess 108 formed in the inner wall 110 of housing 38*c*. In this position an orifice 112 is defined by the outer periphery of flange 106 and the inner face of recess 108.

As member 46*c* approaches full operative throttling position as shown in FIG. 8, flange 106 on member 104 is moved out of recess 108 into spaced relationship with generally uniformly-cylindrical inner wall section 114 of

housing 38c. In this area, an orifice 116 is defined by the outer periphery of flange 106 and the section 114. Since orifice 116 is smaller than orifice 112, the pressure differential across orifice 116 is greater then the pressure differential across orifice 112. Thus, regulator 100 is operative to permit relatively rapid descent of its associated lifting members when under relatively light loads and the flange 106 is within recess 108 with a relatively low pressure differential across orifice 112 balanced by spring 58c, while permitting only uniform descent of such lifting members under heavy load and flange 106 is adjacent wall section 114 with a relatively higher pressure differential across orifice 116.

Novel dash-pot means is provided with this embodiment of the invention due to its variable pressure differential feature which includes a cap 118 seated within recess 56c against bottom wall 32c of member 46c. Cap 118 includes an opening 120 aligned with orifice 78c and communicating the inside of cap 118 with the remainder of recess 56c. Cap 118 also includes an inner member 122 having a conical surface 124 with an opening 126 therein aligned with opening 120 but of a smaller diameter than orifice 78c. Surface 124 also includes a plurality of additional openings 128 angularly related to opening 126 and orifice 78c but of a diameter generally equal to that of orifice 78c.

In operation, fluid with recess 56c compressed therein by movement of member 46c into operative position exists through openings 120, 126 and orifice 78c. Since opening 126 is smaller than orifice 78c additional dampening is realized with this construction than with the employment of orifice 78c alone.

Likewise, when member 46c returns to non-operative position, fluid entering recess 56c must pass through orifice 78c and then smaller opening 126, thereby controlling such return movement of member 46c. It will be understood that openings 128 operate to partially relieve the back pressure and admit fluid therepast.

Turning to FIG. 5, there is shown typical performance graphs for both modifications of the present invention. As will be noted, the dashed line represents the typical performance of a regulator of FIGS. 1–4 wherein the regulator is adapted to regulate the rate of descent of its associated forks to eighty feet per minute under all load conditions.

The solid line represents the typical performance of a regulator of FIGS. 7–8 wherein the regulator is adapted to permit descent of the forks at 120 feet per minute under no-load condition. The modified regulator is operative to permit less rapid fork descent under small loads until at about one-quarter load on the forks, the operating and regulating characteristics of both modifications are the same.

Thus there is disclosed a novel, improved, cartridge style pressure compensated regulator for an hydraulic system which permits unrestricted fluid flow therethrough in one direction with restricting flow of fluid in the other direction to ensure smooth, controlled operation of an associated hydraulic cylinder, with one embodiment providing uniform control under any and all load conditions while another embodiment permits variable control under varying load conditions.

We claim:

1. An hydraulic flow regulator comprising in combination an outer housing having means for securing said regulator in an hydraulic system, a first control element, means mounting said element within said housing, access means for accommodating the passage of hydraulic fluid into and out of said first control element, ports in said first control element for accommodating the passage of hydraulic fluid therethrough into and out of said housing, a second control element within said housing, means mounting said second control element for movement relative to said first control element from non-operative position remote from said ports to operative port-closing position, means normally maintaining said second element in non-operative position remote from said ports in said first element for free flow of hydraulic fluid through said regulator, and means for moving said second control element relative to said first control element from non-operative to operative position when the flow of hydraulic fluid is in a selected direction through said regulator whereby fluid flow through said ports is restricted and from operative to non-operative position when the fluid flow is in the opposite direction from said selected direction through said regulator such that passage of fluid through said regulator is restricted in said selection direction and unrestricted in said opposite direction, said last mentioned means comprising a flanged element mounted on said second control element for limited free movement therealong in the direction of movement of said second control element, said flanged element in one limiting position of free movement cooperating with said housing to allow free flow of fluid thereby, and in another limiting position of free movement, cooperating with said housing to define a restrictive orifice.

2. An hydraulic flow regulator comprising in combination an outer housing having means for securing said regulator in an hydraulic system for passage of the hydraulic fluid therethrough, a first control element, means mounting said element to said housing, access means for accommodating the passage of hydraulic fluid into and out of said first control element, main ports in said first control element for accommodating the passage of hydraulic fluid therethrough into and out of said housing, a second control element within said housing, means mounting said second control element for sliding movement relative to said first control element from non-operative position remote from said ports to operative port-closing position, means normally biasing said second element into non-operative position remote from said ports in said first element for free flow of hydraulic fluid through said regulator, and means on said second element for moving said second control element relative to said first control element from non-operative to operative position when the flow of hydraulic fluid is in a selected direction through said regulator whereby fluid flow through said ports is interrupted and from operative to non-operative position when the fluid flow is in the opposite direction from said selected direction through said regulator such that passage of fluid through said regulator is restricted in said selection direction and unrestricted in said opposite direction, said last mentioned means comprising a flanged element mounted on said second control element for limited free movement therealong in the direction of movement of said second control element, said housing further having a recess formed in an inner wall thereof, said recess bridging said flanged element for permitting oil to flow past said flanged element with minimal resistance in one position of said flanged element, the housing wall adjacent said recess cooperating with said flanged element to define a restrictive orifice.

3. The regulator as defined in claim 2 including bleeder ports in said first control element, said bleeder ports being of smaller diameter than main ports and in spaced relationship therewith to accommodate minor flow of fluid through said regulator when said second control element is in operative port-closing position.

4. An hydraulic flow regulator comprising in combination an outer housing having means for securing said regulator in an hydraulic system for passage of hydraulic fluid therethrough an inner tubular member disposed within said housing, means mounting said inner member at one end of said housing with the exterior of said housing in communication with the interior of said inner member to provide an access for accommodating the passage of hydraulic fluid into and out of said first inner member, ports in said inner member for accommodating the passage of hydraulic fluid therethrough into and out of said housing, an outer tubular member concentrically

disposed about said inner member within said housing, means mounting said outer member for movement relative to said inner member from non-operative position remote from said ports to operative port-closing position, spring means normally urging said outer member into non-operative position remote from said ports in said inner member for free flow of hydraulic fluid through said regulator, and means for moving said outer member relative to said inner member from non-operative to operative position when the flow of hydraulic fluid is in a selected direction through said regulator whereby fluid flow through said ports is interrupted and from operative to non-operative position when the fluid flow is in the opposite direction from said selected direction through said regulator such that passage of fluid through said regulator is restricted in said selection direction and unrestricted in said opposite direction, said last mentioned means comprising a sleeve like element mounted on said outer tubular member for limited free movement along its length, said sleeve like element having a radially extending flange portion, said flanged portion in one limiting position of free movement cooperating with said housing to allow free movement of fluid thereby, and in another limiting position of free movement, cooperating with said housing to define a restrictive orifice.

5. In an hydraulically-actuated lifting device comprising an hydraulic cylinder for operating the lifting element of said device, an hydraulic system for actuating said cylinder to move said lifting element including an hydraulic flow regulator for said system comprising in combination an outer housing having means for securing said regulator in said hydraulic system for controlling passage of hydraulic fluid therethrough, an inner tubular member disposed within said housing, means mounting said inner member in one end of said housing with the exterior of said housing in communication with the interior of said inner member to provide an access for accommodating the passage of hydraulic fluid into and out of said first inner member, ports in said inner member for accommodating the passage of hydraulic fluid therethrough into and out of said housing and to and from said cylinder, an outer tubular member concentrically disposed about said inner member within said housing, means mounting said outer member for slidable movement along said inner member from non-operative position remote from said ports to operative port-closing position, balance spring means normally urging said outer member into non-operative position remote from said ports in said inner member for free flow of hydraulic fluid through said regulator, orifice forming means adjacent the outer surface of said outer member for moving said outer member relative to said inner member against said balance spring means from non-operative to operative position when the flow of hydraulic fluid is in a selected direction through said regulator whereby fluid flow through said ports is substantially interrupted and from operative to non-operative position when the fluid flow is in the opposite direction from said selected direction through said regulator such that passage of fluid through said regulator is restricted in said selection direction and unrestricted in said opposite direction whereby the movement of said lifting element is controlled, said orifice forming means comprising a sleeve like element mounted on said outer tubular member for limited free movement along its length, said sleeve like element having a radially extending flanged portion and said housing further being formed with an annular recess in an inner wall thereof, said recess serving to bridge said flange portion for permitting oil flow past said flange portion with minimal resistance in one position thereof, the inner housing wall adjacent said recess cooperating with said flanged portion to define a restricted orifice.

6. The mechanism of claim 5 including secondary ports and bleeder ports in said inner member, said secondary and bleeder ports being of a smaller diameter than said main ports and in spaced relationship therewith, said secondary ports being operative to increase fluid flow when said main ports are suddenly closed by said outer member thereby increasing the flow time of said fluid to ensure smooth movement of said associated lifting element, said bleeder ports being operative to accommodate a minor flow of fluid therethrough at all times to ensure smooth uniform movement of said element.

7. The mechanism of claim 5 including dash-pot means associated with said movable outer member and operative to oppose movement of said outer member whereby rapid movement into and out of operative position by said outer member is prevented.

8. The mechanism of claim 5 wherein the free movement of said flanged portion in the direction of the operative position of said outer member is limited to a position adjacent said annular recess with the outer member in non-operative position, said annular recess having a uniform inner surface whereby a variable flow of hydraulic fluid thereby occurs as said outer member moves into and out of operative position.

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