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CONSTANT PRESSURE, CONSTANT FLOW CONTROL VALVE

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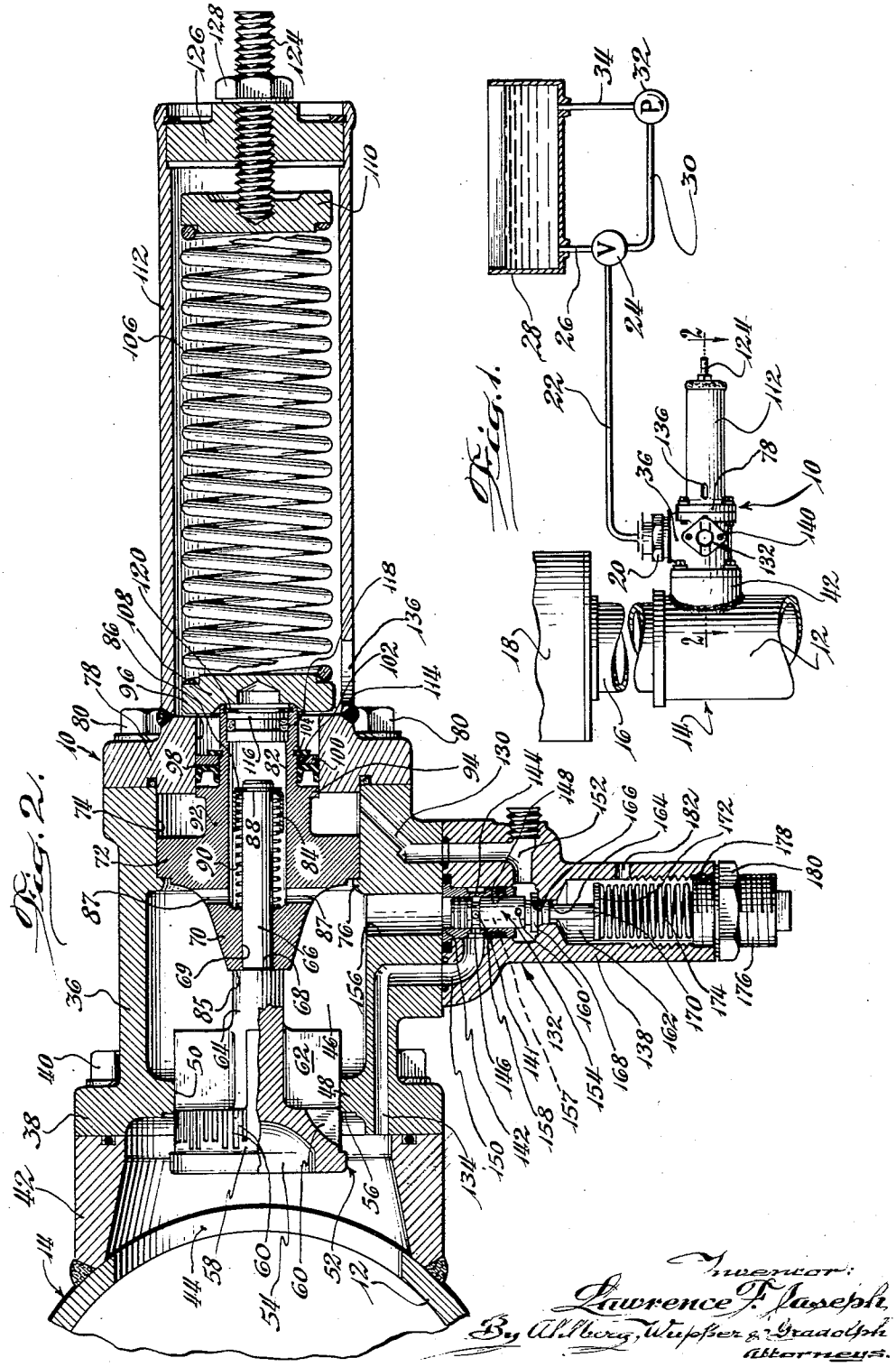


Fig. 1.

Fig. 2.

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CONSTANT PRESSURE, CONSTANT FLOW CONTROL VALVE

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The present invention relates to improvements in control valves, and in particular to a novel speed control and safety stop valve for hydraulically operated lifts and elevators.

Hydraulic elevators of the direct pumped type are equipped with a cylinder-plunger type jack supplied with hydraulic fluid under pressure from a pumping and controlling unit which commonly includes a motor driven hydraulic pump, a check valve, a reservoir, a lowering valve through which hydraulic fluid is vented from the jack to the reservoir, and an electric control circuit. Such pumping and controlling unit is disclosed in Lawrence F. Jaseph Patent No. 2,355,164, dated August 8, 1944, and entitled "Elevator Control." In such installations the elevator is lowered by opening the lowering valve to a predetermined degree, but since the elevator moves downwardly under the force of gravity, there is no provision to hold the speed at the same and a constant rate during the lowering of different weight loads. Furthermore, if accidental rupture of the fluid line between the jack and the lowering valve occurs, the elevator will descend out of control and at a speed substantially, and perhaps dangerously, in excess of the normal speed.

The control valve of the present invention is effective to overcome both of these difficulties. It will minimize the speed variations during lowering regardless of the loading on the elevator. With a pipe line rupture during either raising or lowering of the elevator opening a substantially larger passage than offered by the lowering valve, during a normal lowering movement, to permit downward overspeed of the elevator, complete shutoff of fluid flow from the jack will be obtained to bring the elevator to a halt. When fully shut off by overspeed in this manner, the control valve may be automatically reset for normal operation of the apparatus by the restoration of operating pressure to raise the elevator.

In order to obtain the maximum benefit from the control valve of the present invention, it is preferred that it be installed at the juncture of the fluid line with the jack, and it actually forms a convenient connection between the fluid line and the jack.

It is a principal object of the present invention to provide a new and improved control valve for hydraulically operated elevators, which will regulate the descending speed of the elevator regardless of the load, thereby providing a substantially constant speed, the rate of which is determined by the setting of the lowering valve.

It is another object to provide a new and improved control valve for hydraulically operated elevators, which stops the elevator descent when its speed becomes excessive due to any of a number of factors, including pressure failure in the line between the jack and the lowering valve.

Another object is to provide a new and improved control valve which will bring the elevator to a halt upon rupture of the fluid supply line.

Another object is to provide a new and improved control valve having the foregoing characteristics, which can be restored to service merely by restoring the normal operating pressure in the fluid flow line.

A further object is to provide a new and improved control valve having the foregoing characteristics, which can be restored to service merely by operating the elevator in the ascending direction to bring the fluid supply line to fluid operating pressure.

Still another object is to provide a novel control valve for hydraulically operated elevators, which is fully automatic in its operations of maintaining constant the speed of the elevator in the descending direction, and bringing the elevator to a halt when that speed becomes excessive due to pressure failure.

A further object is to provide a new and improved control valve which, with slight modifications, can be used only as a speed control or regulating device, or as a safety device.

A further object is to provide a new and improved speed control and safety valve for hydraulically operated elevators, which may be used with presently available pumping and controlling units.

Other objects and advantages will become apparent from the following description taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a diagrammatic view of the hydraulic portion of a controlling and pumping unit, showing the control valve of the present invention installed at the junction between the fluid line and the jack; and

Fig. 2 is a cross-sectional view, on a greatly enlarged scale, taken substantially along the line 2—2 of Fig. 1, showing the control valve in medial cross section with the valve components in the position which they would normally occupy when lowering an empty elevator car at maximum speed setting of the lowering valve.

The control valve of the present invention, indicated generally by the reference character **10**, is mounted on the cylinder **12** of a jack **14** having a piston **16** reciprocable in the cylinder, and carrying at its upper end an elevator car or cage **18** of conventional construction. The control valve **10** has a port **20** which is connected to a fluid line **22** leading from a combined lowering and direction controlling valve **24**, one port of which is connected by a conduit **26** directly to the reservoir or tank **28** and the other port of which is connected by conduit **30** to the outlet from a motor driven pump **32** which receives fluid from the reservoir **28** through a conduit **34**. Either the outlet from the pump **32** or the valve **24** is provided with a check valve (not shown) to prevent reverse flow of hydraulic liquid through the conduit **30** and pump **32**.

When it is desired to raise the elevator, fluid is pumped from the tank **28** by the pump **32** through the conduit **30**, valve **24**, conduit **22**, valve **10**, and into the cylinder **12**. When it is desired to lower the elevator **18**, the lowering valve **24** is set for a particular descending speed rate and fluid is expelled by the weight of the elevator cage **18**, its load and piston **16** from the cylinder **12** through the control valve **10**, conduit **22**, valve **24**, and conduit **26** to the tank **28**. The descent of the elevator should be at a rate of speed determined by the setting of the lowering valve, but it has been found that the speed will vary substantially in accordance with the weight or load of the elevator car **18**, its contents, and the plunger **16** unless governed by the control valve **10**, which will maintain the descending speed substantially constant and at the rate dictated by the setting of the lowering valve **24**, regardless of whether the elevator **18** is empty or is loaded to capacity.

While the control valve is of the reversible flow type, that is, fluid may flow through it in either of two direc-

tions, it functions automatically as a control or safety valve only when the fluid flows through it from the jack 14 toward the reservoir 28 or the pump 32. This flow direction obtains when the lowering valve 24 is open or when there is a rupture in the line communicating the jack with the reservoir or pump. In the latter case there is a sudden loss of line pressure which allows the elevator cage to descend, and obviously the rupture may occur at any time during the operation of the elevator control system. In view of this, the following description will consider the normal operating condition of the valve 10 to exist when the elevator cage 18 is descending and the hydraulic fluid is flowing from the jack cylinder 12 either under a normal descent or under an emergency descent caused by a failure in the hydraulic system downstream from the jack.

The control valve 10 has a main valve body 36 provided at one end with a flange 38 secured by cap screws or bolts 40 to an adapter 42 welded to the wall of the cylinder 12, and encompassing an opening 44 therein. The control valve 10 is thus mounted directly on the jack cylinder 12 so that its maximum safety features can be utilized, and any failure of the system between the control valve 10 and the lowering valve 24 will cause the control valve 10 to bring the elevator 18 to a halt.

The valve body 36 is formed with a main cavity or chamber 46 communicating freely with the port 20 and bounded by a wall 48 at the end of the body 36 adjacent the cylinder 12. The chamber 46 communicates with the cylinder 12 through a smoothly bored orifice, opening or aperture 50 in the wall 48, and in which a valve member 52 is reciprocably mounted. The valve member 52 is provided or formed with an enlarged head 54 on the cylinder or upstream side of the aperture 50 to prevent its passing completely therethrough toward the chamber 46, and which when the valve is closed, bears against a valve seat 56 surrounding the opening 50. That portion of the valve member 52, which normally remains in or slides in the opening 50, is formed with a plurality of fluid flow restricting slots 60 of varying depth. The narrow slots 60 reduce the capacity of the opening 50 to about 40% of its completely unobstructed size and also reduce the turbulence of hydraulic fluid under pressure flowing in either direction through the opening. The valve member 52 is provided with a plurality of guide wings 62, preferably three, which center the valve in the opening when it is moved to its fully open position by the reverse flow of fluid from the cavity 46 to the cylinder 12 during the upward movement of the elevator.

The valve member 52 is formed with an integral axial shank 64 and stem 66 of reduced diameter to provide a shoulder 68 between the stem 66 and shank 64. The stem 66 is slidable in a bore 69 in a guiding portion 70 of a piston 72 reciprocable in a cylinder 74 formed in the guide body 36 and coaxial with the opening 50. The piston 72 has its movement in the leftward direction or toward the cavity 46 limited by a shoulder 76 and the opposite end of the cylinder 74 is closed by a cap 78 secured to the valve body by bolts or cap screws 80. The stem 66 projects into an enlarged axial counterbore 82 in the piston 72, and is fitted at its outer end with a cup 84 held thereon by a split ring 86 in a stem groove 88, with the open end of the cup facing inwardly of the stem. A light spring 90 confined between the base of the cup 84 and the inner end of the bore 82 in the piston 72 urges the stem and valve member 52 toward the piston 72 so that the shoulder 68 normally abuts the outer end 84 of the guide portion 70. The cup 84 limits the movement of the stem 66 outwardly of the piston, that is, in the direction of the valve opening or to the left as seen in Fig. 2. Dashpot action of the stem 66 in the axial bores 69 and 82 is prevented by transverse passages 87 in the guide 70 connecting the bore 82 and chamber 46.

The piston 72 is formed opposite the guide 70 with an integral stem portion 92 and piston 94 of smaller diameter than the piston 72, the latter being reciprocable in a cylinder 96 formed in the cap 78. The piston 94 is sealed against the cylinder 96 by a resilient cup shaped sealing member 98 held in place by a washer 100 and a split retaining ring 102 seated in an annular groove 104 in the outer end of the piston stem 92.

The piston 72 is biased in the valve opening direction by a relatively strong or heavy spring 106 having a low rate, so that its force will vary as little as possible over the travel of the piston 72, and which is confined between a pair of spring keepers 108 and 110 within a cylindrical housing 112 having its inner end welded to the cap 78 at 114. The spring keeper 108 bears against the outer end of piston stem 92, and the bore 82 within the piston 72 and stem 92 is closed by a plug 116, gasket 118, and split retaining ring 120 seated in an annular groove 122 in the bore 82. The keeper 110 bears against the inner end of a bolt 124 extending through a tapped cap 126 closing the outer end of the housing and by means of which the pressure exerted by the spring 106 can be adjusted. A lock nut 128 maintains the bolt 124 in its adjusted position, which should be that at which the force exerted by the spring will not quite move piston 72 against the hydraulic pressure produced by the weight of an empty elevator car 18.

The space in the cylinder 74 between the piston 72 and the piston 94 and the cap 78 communicates with the interior of the jack cylinder 12 through a passageway 130, pilot or safety valve 132, and a passageway 134, the passageways 130 and 134 being bored or cored in the valve body 36. So long as the valve 132 establishes communication between the passageways 130 and 134, jack cylinder fluid pressure exists in the cylinder 74. The area of the piston 72 is very nearly equal to the sum of the areas of the piston 94 and the effective area of the valve seat 56, so that the pressure on the head 54 of the valve member 52 is completely balanced by equal pressure on the exposed equal differential piston areas in the cylinder 74. The head of the piston 94 is exposed to atmospheric pressure through the open end of the cylinder 96 and a port 136 in the housing 112. Thus when the valve 132 permits communication between the jack cylinder 12 and valve cylinder 74, jack pressure has no influence on the position of the valve member 52.

The pressure in the pipe line 22 and main valve cavity 46 acts on the valve member 52 in valve opening direction and on the piston 72, tending to move it in such direction as to permit the valve 52 to close, but since the difference in the effective areas of the valve member 52 and the piston 72 is exactly equal to the effective area of the piston 94, the net effect is that the line pressure in the main valve cavity 46 acts to move the pistons 72 and 94 in the direction of valve closing over an area equal to the effective area of the piston 94. This pressure in the main valve cavity 46 is resisted by compression of the heavy spring 106, which when compressed sufficiently will permit the pistons 72 and 94 to move in such direction as to permit the pressure in the jack cylinder 12 and the light spring 90 to close the valve 52.

The pilot or safety valve 132 is housed in a valve body 138 secured by suitable bolts or cap screws 140 to the valve body 36. The valve body 138 is formed with a central bore 141 fitted with a valve cylinder sleeve 142 having an external circumferential groove 144 and ports 146 which communicate cylinder 148 in the sleeve 142 with a passage 150 in the valve body 138 which communicates directly with the passage 134. The central bore 141 communicates with the passage 130 through an angular passage 152 formed in the valve body 138. A piston type valve member 154 is slidable in the valve cylinder 148 and has a head exposed to the fluid pressure in the main valve cavity 146 through a passageway 156 formed in the valve body 36. The piston valve

member 154 has an axial bore 157 and communicating lateral ports 158 and 160 by which the axial bore 157 communicates respectively with the passageways 150 and 152. Thus when the piston valve member 154 is in the position shown in Fig. 2, communication between the jack cylinder 12 and the space within the cylinder 74 is established through the following path: passageways 134 and 150, ports 146 and 158, axial bore 157, port 160, and passageways 152 and 130.

The central bore 141 and the valve cylinder 148 communicate with a spring chamber 162 in the valve body 138 through a port 164 formed with a valve seat 166, the port normally being closed by a valve cap 168 screwed into the end of the piston valve member 154 opposite its head. The effective area of the seat 166 is precisely equal to the area of the head of the piston valve member 154.

The valve cap 168 is formed with a stem 170 projecting through the port 164 and having a washer 172 at its outer end adapted to bear against a spring 174, the compression of which may be adjusted by a relatively large diameter screw 176 threaded into the tapped outer end 178 of the spring chamber 162. A lock nut 180 maintains the screw in its adjusted position which should be that at which the force of the spring 174 is less than the hydraulic pressure on the head of the piston valve member 154 obtained during lowering of the elevator, as determined by the adjustment of the screw 124. The spring chamber 162 is vented to the atmosphere through a drain port 182.

When the system is idle with the elevator at its lower position having come there after a descent, the valves 24 and 10 will be closed and the fluid in the system will only be that necessary to sustain the weight of the elevator and the load carried during the last descent. With the hydraulic pressure produced by the weight of the empty cage 18 alone present in the cavity 46, the piston 72 will have been moved to its extreme outward position, contacting the inner face of the cap 78, since the spring 106 will have been adjusted by the screw 124 so that its force will be just less than enough to prevent such full travel of the piston 72.

When the hydraulic pump 32 is run to raise the elevator, the hydraulic pressure in the line 30, 22 and in the valve chamber 46 rises to open the valve member 52, and as the total areas of the slots 60 in the valve member 52 will normally be inadequate to pass the full flow of liquid in the reverse or toward the jack 14 direction without a substantial pressure drop, the valve 52 will open fully, leaving only the guide wings 62 within the opening 50, compressing the spring 90 and with the valve movement limited by contact of the cup 84 against the bottom of the axial bore 82. When the pump is stopped and its check valve closes, the fluid flow from the pump 32 to the jack cylinder 12 will stop and the spring 90 will return the valve 52 to its fully closed position.

When the elevator is to be lowered, the jack cylinder 12 is vented to the reservoir 28 through the control valve 10, conduit 22, lowering valve 24 and conduit 26. The rate of descending speed is determined by the setting of the lowering valve 24. In those elevator installations not incorporating the control valve 10, the actual speed of descent of the elevator depends upon the load imposed on the elevator, heavier loads producing faster speeds through an increase in the volumetric rate of fluid flow from the jack cylinder 12 to the reservoir 28. The control valve 10, however, automatically regulates this fluid flow from the jack cylinder 12 to the reservoir in accordance with the setting of the lowering valve 24.

When the lowering valve 24 is opened fluid under pressure flows from the valve chamber 46 to the reservoir 28, and, a fall in pressure in the cavity 46 results. Since the fluid pressure in the jack cylinder 12 has no effect on the valve position under normal conditions, the spring 106 moves the piston 72 and valve member 52 in the valve opening direction to permit hydraulic fluid to flow from the jack cylinder 12. As the fluid is throttled by the restriction through the partially uncovered slots 60 there is a drop in its pressure, and the spring 106 will move the valve member 52 in the opening direction until the pressure in the chamber 46 equals the pressure exerted by the spring at its adjusted setting. The proper setting is that obtained when an empty car 18 is descending at the maximum speed setting of the lowering valve 24, and the control valve components are shown in this position in Fig. 2.

Thus, the valve 52 when properly set automatically throttles the normal flow of hydraulic fluid through the port or opening 50 to produce a substantially fixed pressure in the valve chamber 46 during lowering of the elevator cage 18. Since this fixed pressure is transmitted through the conduit 22 to the lowering valve 24, that rate of flow of liquid determined by the setting of the valve 24 is always produced, and, consequently, the rate of descent is maintained substantially uniform or constant and determined solely by the setting of the valve 24.

It has been noted previously that the effective areas of the piston 72 and the piston 94 acted on by fluid under pressure in the cylinder 74 differ by the effective area of the valve member 52 which is exposed to the same pressure, namely the jack cylinder pressure, and that pressure has no influence on the position of the pistons 72 and 94. And whenever during lowering of the cage 18, the pressure in the valve chamber 46 exceeds that corresponding to the setting of the spring 106, the piston 72 and valve member 52 move in the valve closing direction to establish equilibrium between chamber pressure and spring compression and vice versa. It is, therefore, the throttling effect of the valve member 52 and the valve positioning by the spring 106 to produce a substantially constant or uniform pressure in the chamber 46 that produces the substantially constant fluid flow and even descent of the elevator at any rate of speed for which the lowering valve 24 may be set.

When the elevator is to be stopped the lowering valve 24 will be operated to closed position and this operation is accomplished gradually. The reduced flow of fluid through the valve slits 60 and opening 50 into the valve chamber 46 will decrease the throttling pressure drop through the slits 60 and the pressure will rise in the valve chamber 46, moving the piston 72 and valve member 52 against the force of the spring 106 in the valve closing direction. When the lowering valve 24 has reached its fully closed position, the valve member 52 will also be fully closed and the elevator will be halted because the fluid flow has stopped.

During the normal operation of the control valve 10 in maintaining the rate of fluid flow from the jack cylinder 12 constant and in accordance with the setting of the lowering valve 24, the pilot or safety valve 132 is held in the position shown in Fig. 2 by pressure in the chamber 46 with the valve cap 168 closing the port or passageway 164. Should there be a loss of pressure in the system which arises from a bursting of the line 22 or some other cause which transmits this loss of pressure to the valve chamber 46, the spring 174 moves the piston valve member 154 upwardly lifting the valve cap 168 from its seat 166 to open the port 164. The cylinder 74 is vented to the atmosphere and drains through the passageways 130 and 152, port 164, spring chamber 162 and drain hole 182. This movement of the piston valve member 154 also cuts off communication between the jack cylinder 12 and the control valve cylinder 74 so that the drained fluid will not be replaced. Since there is only atmospheric pressure in the cylinder 74 and the pressure acting on the valve member 52 exceeds the force of the spring 106, the valve 52 will be closed fully and promptly, bringing the elevator to a stop. This action will take place whether there is a normal or reverse flow of fluid through the valve

10 immediately preceding the fault causing the loss of pressure in the chamber 46 or downstream of the orifice 50.

It should be noted that this same action is obtained if the lowering speed is adjusted to a value in excess of the capacity of the valve 52 at the largest opening obtainable by inward motion of the piston 72, so that the pressure from chamber 46 exerted on the piston 154 will be less than that exerted by the spring 174 on the piston valve member 154. This offers a means of checking the performance of the safety feature of the novel control valve by an elevator inspector without actually breaching the pipe line 22.

The control valve is restored to normal operation by setting the valve 24 to the "up" or elevator raising position and operating the pump 32 to establish normal operating pressure in the line 22 and chamber 46. This pressure created by the reverse flow of hydraulic fluid moves the piston valve member 154 downwardly to reestablish communication between the jack cylinder 12 and the control valve cylinder 74 and to close the port 164. Hence, it is not necessary to make any adjustments at the control valve itself in order to restore the system to operation after a test by an elevator inspector or after correcting the cause of pressure failure in the system.

It was noted previously that the pressure in the balance chamber or cylinder space 74 was exactly equal to that in the jack cylinder 12 when the control valve is functioning properly. From this it would seem to appear that exact regulation is impossible, since at high jack pressures the valve 52 must be nearly closed during lowering, compressing the spring 106 to its maximum degree, thereby raising its force and requiring a high pressure in the valve cavity 46 to effect a balance. This rise in pressure in the valve cavity 46—with a consequent rise in speed of descent of the cage 18—is overcome by leakage from the cylinder 74 past the piston 72 to the cavity or chamber 46. The leakage is possible because the piston 72 does not fluid tightly seal against the wall of cylinder 74, and it increases linearly with the pressure excess in the jack cylinder 12 since the leak is through a narrow clearance (too small to be shown in the drawing) between the piston 72 and the cylinder 74. This leakage would not result in a fall of pressure in the cylinder 74 except that the passage through the pilot valve 132 is somewhat restricted, and the pressure in the cylinder 74 may be reduced sufficiently to reduce the valve opening force exerted on the piston 72 as much as the force of the spring increases.

The same result may be obtained without making use of the pressure drop across the pilot valve 132, by making the effective area of the piston 72 slightly larger than the sum of the effective areas of the valve seat 56 and the balance cylinder 94. If this is done the effect of the leakage must be avoided, either by packing the piston 72 against the wall of the cylinder 74 or by making inlet passage to the cylinder 74 through the pilot valve generous in size.

The control valve 10 may be modified slightly to use it solely as a speed control device. To do this it is necessary to omit the pilot valve 132 and to connect the passageway 134 directly to the passageway 130, and the passageway 156 is of course omitted or plugged.

The control valve 10 may also be used solely as a safety device. In this arrangement the spring 106 and spring housing 112 are omitted, as are the piston 94 and cylinder 96. The cap 78 is made solid to become the head for the cylinder 74 and jack pressure is applied to the entire face of the piston 72 in the cylinder 74. The control valve elements are then normally biased to the position shown in Fig. 2, the position in which an empty elevator cage 18 is lowered at maximum speed setting of the lowering valve 24, and when there is a loss of pressure in the chamber 46 the pilot valve 132 will operate as previously described to vent the cylinder 74 and the pressure on the head of the valve member 52 will close this valve, bringing the elevator to a halt.

From the foregoing description it is clear that the advantages claimed for this control valve are fully attained, and that it will operate to maintain the descending speed of an elevator constant at the rate determined by the setting of the lowering valve, and will bring the elevator to a halt should there be a pressure failure in the system communicable to the control valve 10.

While preferred embodiments of the control valve constituting this invention have been shown and described, it will be apparent that further modifications and variations thereof may be made without departing from the underlying principles of the invention. It is, therefore, desired by the following claims to include within the scope of the invention all such variations and modifications by which substantially the results of this invention may be obtained through the use of the same or equivalent means.

What is claimed as new and desired to be secured by United States Letters Patent is:

1. A control valve for regulating the rate of flow of a fluid under pressure through an orifice comprising means forming a valve cavity downstream of and communicating with the orifice and having an opening therefrom, a throttling valve member in the orifice and movable therein to various positions from fully closed to fully open to control the rate of flow of fluid into said cavity, valve member positioning means connected to said valve member and sensitive to fluid pressure downstream of the orifice and in said cavity to adjust the throttling effect of said valve member, said valve member having offsetting areas acted upon by upstream fluid pressure so that the upstream fluid pressure does not affect the position of the valve member thereby to maintain the downstream fluid pressure in said cavity substantially constant, and second means sensitive to a fall in the downstream fluid pressure below a predetermined value to render ineffective said valve member positioning means, thereby to permit higher pressure upstream of the orifice to close said valve member in the orifice to stop fluid flow therethrough.

2. A control valve for regulating the rate of flow of a fluid under pressure through an orifice comprising means forming a valve cavity downstream of and communicating with the orifice and having an opening therefrom, a throttling valve member in the orifice and biased in closing direction by fluid pressure upstream of the orifice and movable therein to various positions to control the rate of flow of fluid through the orifice and into said cavity, and valve member positioning means connected to said valve member and sensitive to fluid pressure downstream of the orifice and in said cavity to adjust the throttling effect of said valve member, thereby to maintain the downstream fluid pressure in said cavity substantially constant, said last named means including means to compensate for the effect of upstream fluid pressure acting on said valve member.

3. A control valve for regulating the rate of flow of a fluid under pressure through an orifice comprising means forming a valve cavity downstream of and communicating with the orifice and having an opening therefrom, a throttling valve member in the orifice and movable therein to various positions to control the rate of flow of fluid into said cavity, and valve member positioning means connected to said valve member and sensitive to fluid pressure downstream of the orifice and in said cavity to adjust the throttling effect of said valve member, thereby to maintain the downstream fluid pressure in said cavity substantially constant, said last named means comprising a pair of interconnected opposed differential area piston-cylinder means, a passageway connecting said piston-cylinder means with a point of the orifice to receive fluid under pressure therefrom so that the upstream fluid pressure normally does not affect the position of said valve member, and biasing means biasing said valve member to open position.

4. A control valve for regulating the rate of flow of a fluid under pressure through an orifice comprising means forming a valve cavity communicating with the orifice and having an opening therefrom, a throttling valve member in the orifice and movable to various positions to control the rate of flow of fluid into said cavity, a first cylinder having one end communicating with said cavity, a piston slidable therein, a second cylinder communicating with the second end of said first cylinder, a piston slidable in said second cylinder and connected to said first cylinder piston so that said pistons move together, said pistons having a difference in areas equal to the effective area of said throttling valve member, a passageway connecting said cylinders between said pistons to receive fluid under pressure from that side of the orifice opposite said cavity, lost motion means connecting said valve member to said pistons, and loading means biasing said pistons and said valve member to open position, whereby the fluid pressure in said cavity is maintained substantially constant and at a value determined by said loading means.

5. A valve for controlling the flow of a fluid under pressure through an orifice comprising means forming a valve cavity downstream of and communicating with the orifice and having an opening therefrom, a valve member movable in the orifice to control the flow of fluid into said cavity, valve member positioning means connected to said valve member, means communicating fluid under pressure from upstream of the orifice to said valve member positioning means to move said valve member toward open position, and means sensitive to a fall in fluid pressure downstream of the orifice in said cavity below a predetermined value to interrupt the communication of fluid under pressure to said valve member positioning means thereby to permit higher pressure upstream of the orifice to move said valve member to closed position.

6. A valve for controlling the flow of fluid under pressure through an orifice, comprising means forming a valve cavity downstream of and communicating with the orifice and having an outlet therefrom, a valve member movable in the orifice to control the flow of fluid into said valve cavity, valve member positioning means connected to said valve member, said last named means including a cylinder and a piston reciprocable therein, said piston being connected to said valve member, a passageway connecting said cylinder on the head side of said piston with the fluid under pressure upstream of the orifice whereby the fluid under pressure in said cylinder acts on said piston to move said valve member to open position, a drain port, a valve controlling fluid flow through said passageway and said drain port, means biasing said valve to passageway closing and drain port opening position, and means sensitive to fluid pressure downstream of the orifice in said cavity and acting in opposition to said biasing means to hold said valve in passageway opening and drain port closing position as long as the downstream pressure remains above a predetermined value, whereby a fall in downstream fluid pressure below said predetermined value permits said biasing means to close said passageway and open said drain port, said cylinder then emptying through said drain port and higher pressure upstream of the orifice moving said valve member to closed position.

7. In a hydraulic elevator control system having a jack cylinder, a cage supporting plunger reciprocable therein, and a lowering valve adapted to receive hydraulic fluid under pressure from the jack cylinder to regulate the rate of speed of elevator descent, a reverse flow control valve comprising in combination a control valve body adapted to be mounted on the jack cylinder and having a valve cavity therein, a constantly open port in said valve body adapted to be connected to the lowering valve, an opening in said valve body upstream of said valve cavity and adapted to communicate with the jack cylinder and through which hydraulic fluid flows in a first direction into said valve cavity, a throttling valve member slidable in said opening and movable to various positions therein to control the rate of fluid flow in said first direction into said cavity, said throttling valve member having an effective area exposed to fluid under pressure upstream of said valve opening tending to move said throttling valve toward closed position, means forming a first cylinder having one end communicating with said valve cavity, a piston slidable therein, means forming a second cylinder communicating freely with the second end of said first cylinder, a piston slidable in said second cylinder and connected to said first cylinder piston so that said pistons move together, said pistons having a difference in areas equal to the effective area of said throttling valve member, a passageway connecting said cylinders between said pistons with a point upstream of said valve opening, lost motion means connecting said valve member to said pistons and including means biasing said throttling valve member to closed position so that fluid may flow under pressure in a second and reverse direction through said control valve, loading means biasing said pistons and said throttling valve member to open position, whereby the fluid pressure in and the fluid flow through said valve cavity in said first direction is maintained substantially constant, means forming a pilot valve cylinder having one end open to said valve cavity, a drain port, a valve plunger in said pilot valve cylinder and normally closing said drain port, means biasing said valve plunger to open said drain port, and said valve plunger lying across said passageway and having a passage therethrough which maintains said passageway open when said drain port is closed and closes said passageway when said drain port is open, said cylinders draining through said drain port when fluid pressure in said cavity falls below a predetermined value whereby fluid under pressure upstream of said valve opening closes said throttling valve member.

8. In a hydraulic elevator control system having a jack cylinder, a cage supporting plunger reciprocable therein, and a lowering valve adapted to receive hydraulic fluid under pressure from the jack cylinder to regulate the rate of speed of elevator descent, a control valve comprising in combination a control valve body adapted to be mounted on the jack cylinder and having a valve cavity therein, a constantly open port in said valve body adapted to be connected to the lowering valve, an opening in said valve body upstream of said valve cavity and through which hydraulic fluid flows into said valve cavity, a throttling valve member slidable in said opening and movable to various positions therein to control the rate of fluid flow into said cavity, said throttling valve member having an effective area exposed to fluid under pressure upstream of said valve opening tending to move said throttling valve toward closed position, means forming a first cylinder having one end communicating with said valve cavity, a piston slidable therein, means forming a second cylinder communicating freely with the second end of said first cylinder, a piston slidable in said second cylinder and connected to said first cylinder piston so that said pistons move together, said pistons having a difference in areas equal to the effective area of said throttling valve member, a passageway connecting said cylinders between said pistons with a point upsteram of said valve opening, means connecting said valve member to said pistons, loading means biasing said pistons and said throttling valve member to open position, whereby the fluid pressure in and the fluid flow through said valve cavity is maintained substantially constant.

9. In a hydraulic elevator control system having a jack cylinder, a cage supporting plunger reciprocable therein, and a lowering valve adapted to receive hydraulic fluid under pressure from the jack cylinder to regulate the rate of speed of elevator descent, a control valve

comprising a control valve body adapted to be mounted on the jack cylinder and having a valve cavity therein, a constantly open port in said valve body adapted to be connected to the lowering valve, an opening in said valve body upstream of said valve cavity and through which hydraulic fluid flows into said valve cavity, a valve member slidable in said opening and controlling the flow of fluid into said cavity, said valve member having an effective area exposed to fluid under pressure upstream of said valve opening tending to move said valve member toward closed position, means forming a cylinder having one end communicating with said valve cavity, a piston slidable therein, said piston having an area greater than the effective area of said valve member, a passageway connecting said cylinder at the head of said piston with a point upstream of the valve opening, means connecting said valve member to said piston, means forming a safety valve cylinder having one end open to said valve cavity, a drain port adapted to receive fluid from said cylinder, a valve plunger in said pilot valve cylinder and normally closing said drain port, means biasing said valve plunger to open said drain port, and said valve plunger lying across said passageway and having a passage therethrough which maintains said passageway open when said drain port is closed and closes said passageway when said drain port is open, said cylinder draining through said drain port when fluid pressure in said cavity falls below a predetermined value whereby fluid under pressure upstream of said valve opening closes said valve member.

10. A control valve for regulating the rate of flow of fluid under pressure through an orifice, comprising means forming a valve cavity downstream of and communicating with the orifice and having an opening therefrom, a throttling valve member in the orifice and movable to various positions therein to control the rate of flow of fluid through the orifice and into said cavity, and valve member positioning means connected to said valve member and sensitive to fluid pressure downstream of the orifice and in said cavity to adjust the throttling and pressure drop effect of said valve member, thereby to maintain the fluid pressure in said cavity substantially constant, said last named means comprising a pair of interconnected opposed differential area piston-cylinder means acted upon by downstream pressure fluid in said cavity, a passageway having a fluid flow restriction therein connecting said piston-cylinder means with a point upstream of the orifice to receive fluid under pressure therefrom to cause said piston-cylinder means to tend to move said valve member in valve opening direction, and compressible spring means biasing said valve member to open position, whereby excessive pressure upstream of the orifice tending to cause said piston-cylinder means to open said valve member to increase pressure in said cavity is offset by leakage from said piston-cylinder means into said valve cavity and a pressure drop across said restriction substantially equal to the gain in force exerted by said spring means due to compression thereof as said valve member is moved to a highly throttling position.

11. A control valve for regulating the rate of flow of fluid under pressure through an orifice, comprising means forming a valve cavity downstream of the orifice and communicating with the orifice and having an opening therefrom, a throttling valve member in the orifice and movable therein to various positions to control the rate of flow of fluid through said orifice and into said cavity, and valve member positioning means connected to said valve member and sensitive to downstream fluid pressure in said cavity to adjust the throttling and pressure drop effect of said valve member, thereby to maintain the fluid pressure in said cavity substantially constant at a predetermined valve, said last named means comprising a pair of interconnected opposed differential area piston-cylinder means acted upon by downstream pressure fluid in said cavity, a passageway connecting said piston-cylinder means with a point upstream of the orifice to receive fluid under pressure therefrom to cause said piston-cylinder means to tend to move said valve member in valve opening direction, compressible spring means biasing said valve member to open position, and said valve member positioning means including means to compensate for excessively high pressure upstream of the orifice tending to cause opening of said valve member sufficiently to reduce the throttling effect of said valve member and permit rise of pressure downstream of the orifice above said predetermined value.

12. A control valve for regulating the rate of flow of fluid under pressure through an orifice, comprising means forming a valve cavity downstream of and communicating with the orifice and having an opening therefrom, a throttling valve member in the orifice and movable to various positions therein to control the rate of flow of fluid into said cavity, said valve member having an effective area exposed to fluid under pressure upstream of the orifice tending to close said valve member, a first cylinder having one end communicating with said cavity, a piston slidable therein, a second cylinder communicating with the second end of said first cylinder, a piston slidable in said second cylinder and connected to said first cylinder piston so that said pistons move together, said pistons having a difference in area equal to the effective area of said throttling valve member, means connecting said valve member to said pistons, a passageway having a fluid flow restriction therein connecting said cylinders between said pistons to receive fluid under pressure from a point upstream of the orifice to cause said interconnected pistons to tend to move said valve member in valve opening direction, and compressible spring means biasing said valve member to open position, whereby excessive pressure upstream of the orifice tending to cause said pistons to open said valve member and increase the pressure downstream of the orifice is offset by leakage from said first cylinder into said valve cavity and a pressure drop across said restriction substantially equal to the gain in force exerted by said spring means due to compression thereof as said valve member is moved to a highly throttling position.

13. A control valve for regulating the rate of flow of fluid under pressure through an orifice, comprising means forming a valve cavity downstream of and communicating with the orifice and having an opening therefrom, a throttling valve member in the orifice and movable to various positions therein to control the rate of flow of fluid into said cavity, said valve member having an effective area exposed to fluid under pressure upstream of the orifice tending to close said valve member, a first cylinder having one end communicating with said cavity, a piston slidable therein, a second and smaller diameter cylinder communicating with the second end of said first cylinder, a piston slidable in said second cylinder and connected to said first cylinder piston so that said pistons move together, said pistons having a difference in areas slightly greater than the effective area of said throttling valve member, means connecting said valve member to said pistons, a passageway connecting said cylinders between said pistons to receive fluid under pressure from a point upstream of the orifice to cause said interconnected pistons to tend to move said valve member in valve opening direction, and compressible spring means biasing said valve member to open position, whereby the fluid pressure in said cavity is maintained substantially constant and at a value determined by said biasing spring even though the pressure upstream of the orifice opposite said cavity shall become excessively high.

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