

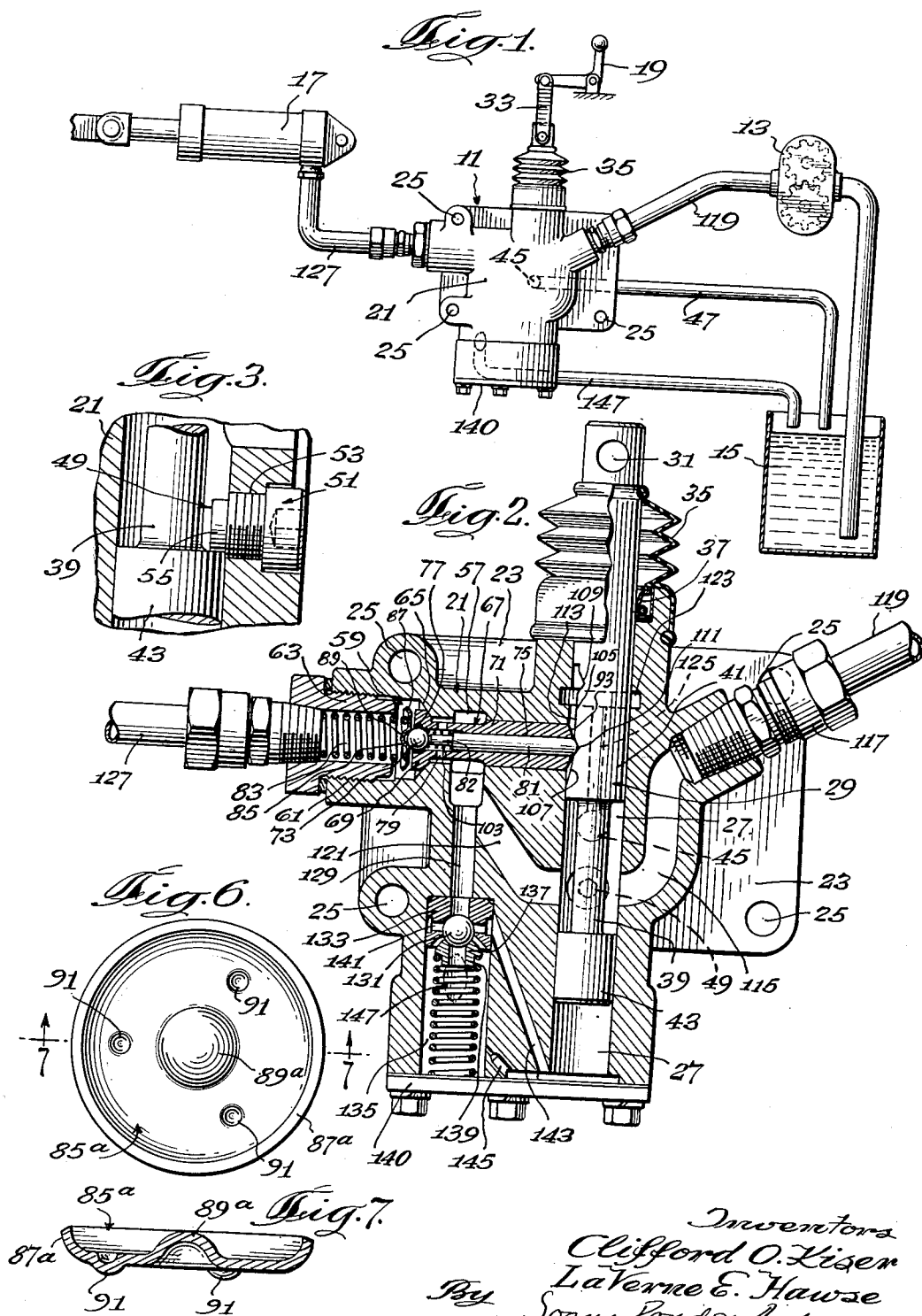
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C. O. KISER ET AL
HYDRAULIC CONTROL VALVE

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2 Sheets-Sheet 1



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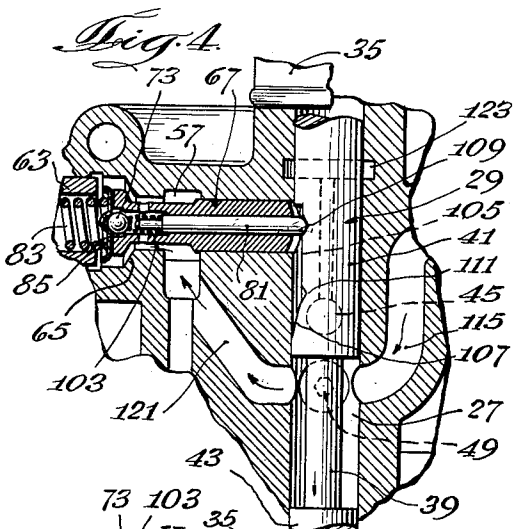
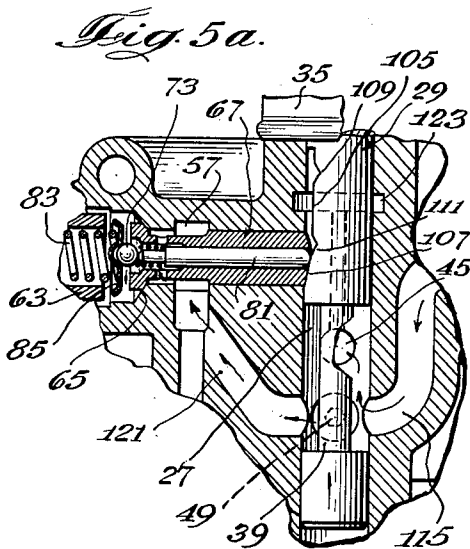
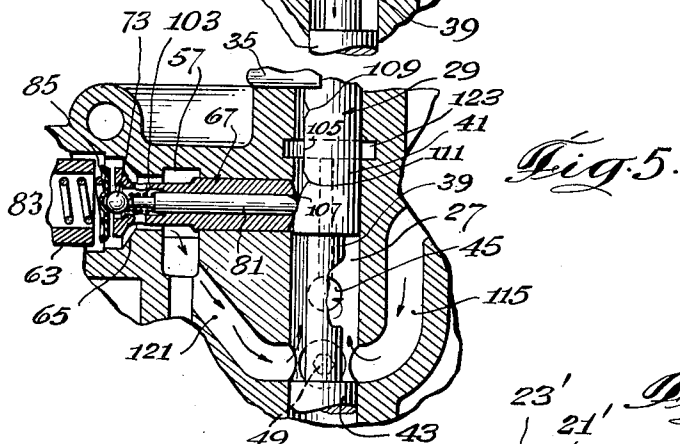
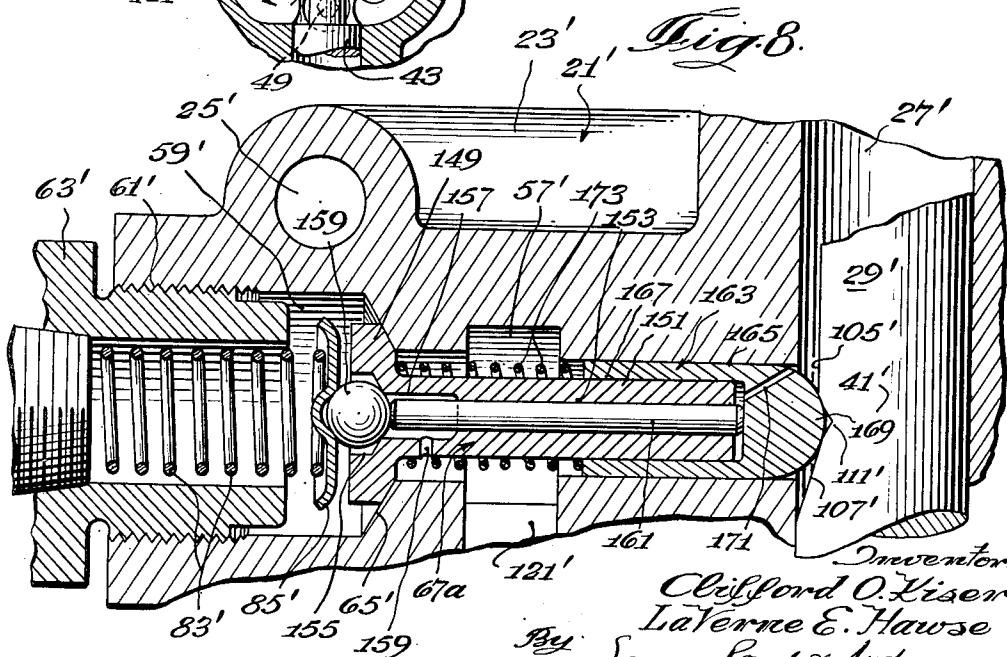
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UNITED STATES PATENT OFFICE

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HYDRAULIC CONTROL VALVE

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10 Claims. (Cl. 137—621)

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The present invention relates to hydraulic control valves and in particular relates to an improved control valve for use in connection with tractors and like implements having auxiliary hydraulically controlled apparatus, as for example, a hydraulic lifting system. The present structure has particular utility in systems which employ hydraulic fluid under extremely high pressures.

Many agricultural type tractors, road scrapers, bulldozers, and like apparatus, are equipped with auxiliary hydraulic systems for accomplishing mechanical adjustments, such as lifting or moving some element which is attached to the implement. In one widely used hydraulic system for this purpose, hydraulic fluid under pressure is supplied by a continuously operating pump which circulates fluid from a sump maintained at normal or atmospheric pressure. The control means used in such systems includes a valve which is operable to apply pressure to the system when it is necessary to raise or to operate the apparatus, which will bleed hydraulic fluid from the hydraulic system and reduce the pressure within that system to lower the apparatus or to operate it in the reverse direction, and which will maintain hydraulic pressure in the system when the operated apparatus is to be held against movement. In addition to the functions set forth above, it is desirable that the control means be automatically operable to disengage the source of hydraulic pressure from the system in the event the hydraulic pressure becomes excessive, or when the apparatus reaches a predetermined position.

Heretofore control means of the character described has been unduly complicated and has included a multiplicity of expensive and delicate valves which frequently become clogged or out of adjustment. In addition, while the movement of the control lever of prior valves into a predetermined control position effects the movement of the hydraulically actuated apparatus, the operation of such valves has required careful attention by the operator during an adjusting operation. Therefore, the object of the present invention is to provide a hydraulic control valve which is simple in construction, which is economical to manufacture, which is positive in action, and which is free from the operating difficulties which are inherent in the prior structures. Other objects and advantages of the invention will be made apparent by reference to the following description and the accompanying drawings of one preferred embodiment thereof.

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In the drawings:

Fig. 1 is a diagrammatic view of a hydraulic system having a control valve in accordance with the invention;

Fig. 2 is an enlarged elevational view, partially in section, of the control valve illustrated in Fig. 1;

Fig. 3 is a fragmentary view of the stop for the control piston which constitutes a part of the control valve illustrated in Fig. 2;

Fig. 4 is a sectional view of the control valve mechanism in one of the control positions;

Fig. 5 is a sectional view of the control valve mechanism in another of the control positions;

Fig. 5a is a sectional view of the control valve mechanism as it is moved toward the position illustrated in Fig. 5 from the position illustrated in Fig. 2;

Fig. 6 is a plan view of a modified ball valve guide for use in the structure illustrated in the preceding figures;

Fig. 7 is a view taken on line 7—7 in Fig. 6; and

Fig. 8 is a sectional view of a modified control valve mechanism.

The control valve illustrated at 11 in Fig. 1 is connected into a hydraulic system of the general type used on agricultural tractors or the like. The illustrated system includes, in addition to the control valve 11, a continuously operating, gear type pump 13, a sump 15 for hydraulic fluid, a hydraulic power translation unit for accomplishing the desired work such as the ram 17, and a control handle or lever 19 which is moved by the operator of the apparatus to effect the energization of the hydraulic ram 17. Suitable fluid conduits are provided to connect the sump 15, the pump 13, the control valve 11, and the hydraulic ram 17.

The control valve 11 includes a housing 21 of cast metal or the like which has been cored and machined to provide various openings and passageways as will be hereinafter described. A unitary, supporting flange 23 may be cast integrally with the housing 21, as illustrated, and the flange 23 may be drilled with holes 25 for attaching the control valve 11 to a suitable mounting bracket on the tractor.

A vertically extending passageway 27 is provided in the housing 21 to form a guideway for a sliding valve or control rod 29. The control rod or control member passageway 27 is conveniently cylindrical in shape and is machined to close tolerances so that a liquid tight seal will be formed between the control rod 29 and the walls of the passageway 27.

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The control rod 29, which fits within the control-rod passageway 27, is adapted to be moved longitudinally of the passageway between determined limits into a plurality of control positions. Downward movement of the control rod in the passageway to the lowermost position or first control position is adapted to connect the source of pressure fluid to the operated apparatus (Fig. 4); movement of the control rod upwardly to a position intermediate the upper and lower limits, the second or neutral control position, connects the source of pressure fluid to the sump (Fig. 2); and, movement to the uppermost position, the third control position (Figs. 5 and 5a), is operable to bleed pressure fluid from the ram system to effect lowering of the apparatus. The third control position, in effect, is two control positions; as the control-rod 29 approaches the third position illustrated in Fig. 5, that rod is operable to unseat an auxiliary valve means (Fig. 5a) which tends to reduce the pressure within the ram system to a point at which further interconnection may be accomplished. This constitutes one of the important features of the invention. In order to accomplish such movement, the upper end of the rod 29 is provided with an opening 31, and a connecting link 33, which extends to the control lever 19, is pivotally attached in this opening (Fig. 1). In order to prevent dirt and other foreign materials from becoming lodged around the control rod 29, a resilient bellows 35 is disposed between the upper end of the rod 29 and the housing 21. A yieldable washer 37 is engaged against the rod 29 as it enters the housing 21 to insure the exclusion of these foreign materials in the event that the bellows 35 become torn or damaged.

The control rod 29 is fabricated from a piece of cylindrical stock and has a portion of reduced diameter 39 adjacent its lower end. The portion of reduced diameter 39 forms a stem which divides the control rod 29 into an upper control piston 41 and a lower control piston 43. As the control rod 29 is moved up and down by the control lever 19, the upper control piston 41 opens and closes a by-pass or outlet port 45 in the passageway 27, the outlet port 45 being connected by a first passageway or conduit 47 (Fig. 1) to the sump. A stop 49 (Figs. 2 and 3) which extends into the passageway 27 is provided in the wall of the passageway 27, below the by-pass or outlet port 45. The stop 49 limits the movement of the control rod 29 to the length of the connecting stem 39, and defines the lowermost and the uppermost positions of the control rod, the first and the third control positions, respectively.

The stop 49 is particularly illustrated in Fig. 3 and comprises a set screw 51 which extends into the control passageway 27 through a tapped opening 53 in the housing 21. The set screw 51 is provided with a rounded, machined projection 55 at its inner end which is adapted to extend within the passageway 27 to engage the pistons 41 and 43.

A valve chamber or branch passageway 57 is bored in the upper portion of the housing 21, and this chamber communicates with and extends radially outwardly from the upper portion of the control-rod passageway 27, above the by-pass outlet 45, to the sump 15. The outer end of the valve chamber 57 opens into an enlarged recess or counterbore 59 extending inwardly from the outer surface of the housing 21. The recess 59 is provided with a threaded portion 61 for receiving a connecting bushing 63. The inner end

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of the enlarged recess 59 is provided with a valve seat 65, and a poppet-type valve 67 of special construction positioned within the valve chamber 57, is adapted to engage the seat 65.

The poppet valve 67 includes a head 69 and a stem 71, and in addition, the valve 67 is provided with means for permitting pressure fluid to flow from one side of the valve to the other side of the valve under predetermined conditions when the valve is engaged against its seat 65. The means for permitting pressure fluid to flow through the valve 67 includes a two-member valve which includes a sealing member 73, and an operating member 81. In the illustrated embodiment of the invention the sealing member 73 is the ball valve which is seated in the valve head 69. In this connection, the valve stem 71 is provided with an axially extending passageway 75 which has a counterbored portion 77 at the valve head 69. The shoulder formed between the counter bore 77 and the axially extending passageway 75 provides a seat for the ball valve 73. A plurality of radially extending apertures 79 interconnect the passageway 75, adjacent the ball valve 73, with the valve chamber 57 so that pressure fluid can flow between the chamber 57 and the recess 59 when the ball valve 73 is unseated. The unseating of the ball valve 73 is effected by the operating member or rod 81 which is slidably supported within the passageway 75 in the valve stem 71. In this connection, one end of the operating rod 81 is provided with a portion of reduced diameter 82 which engages the ball 73 while the other end of the member 81 engages the upper control piston 41 of the control rod 29, as illustrated in Figures 2, 5 and 5a.

The bore of the valve chamber 57 is considerably larger than the diameter of the valve stem 71 at its outer end; this permits hydraulic fluid within the valve chamber 57 to pass around the stem into the enlarged recess 59 whenever the valve 67 is displaced from its seat. The poppet valve 67 and the ball valve 73 are both biased into the closed position by a coiled spring 83 which acts between the ball valve 73 in the head of the valve 67 and the bushing 63. The spring 83 may be adjustably tensioned by changing the position of the bushing 63 relative to the threaded portion 61 of the enlarged recess 59. In order to aid in maintaining the alignment of the valve 67 and the spring 83 during operation, and to assure that the ball valve 73 is held within the counterbore 77, a thrust plate 85 is provided intermediate the spring 83 and the ball 73. The thrust plate 85 comprises a circular piece of sheet metal or the like which may be fabricated with outwardly dished outer flange 87 for engaging the spring 83, and an inwardly dished central portion 89 which is adapted to be seated upon the ball 73.

A modified construction for the thrust plate is illustrated in Figures 6 and 7. In the modified structure the thrust plate 85a is provided with an outwardly dished flange 87a for engaging the spring 83 and an inwardly dished central portion 89a for seating against the ball 73. In addition, a plurality of knobs 91 are formed in the surface of the thrust plate 85 which is adapted to be placed adjacent the head of the valve 67. The knobs 91 are proportioned to clear the valve head 79 when the thrust plate 85a is parallel to the valve head 69. In the event that the spring 83 exerts an unbalanced biasing force on the ball valve 73, the knobs or projections 91 contact the head of the valve 67 and thereby limit angular movement between the thrust plate 85a and the valve

head 67. While the modified thrust plate 35a is provided with three projecting knobs 91, it will be understood that the number of projections and the general shape of the thrust plate may be varied depending upon operating conditions.

The innermost end of the valve stem 71 is rounded as illustrated at 93 (Figs. 2, 4, 5, and 5a) and is proportioned to extend a short distance into the control passageway 27. The inner end of the valve stem is slidably supported within the valve chamber 57 and is proportioned to closely engage the walls of the valve chamber to provide a substantially liquid tight seal between the outer portion of the valve chamber 57 and the control-rod passageway 27.

The ball operating member 81 is biased in the direction of the control rod 29 by a coil spring 103 which acts between the ball valve 73 and the shoulder formed by the portion of reduced diameter 82 at the outer end of the ball operating member 81. However, as will hereinafter appear, an additional force is applied to the ball operating member 81 whenever the hydraulic fluid within the valve chamber 57 is under pressure. This provides an additional biasing force for engaging the member 81 against control rod 29 and is an important feature of the invention. The spring 103 is proportioned to exert a smaller force than the spring 83 which biases the poppet valve 67 and the ball valve 73 into the closed position and, therefore, in the absence of pressure within the valve chamber 57, the valve 67 will normally be engaged against its seat 65.

The surface of the control rod 29 which engages the operating member 81 is provided with an irregular cam surface or groove 105 which is adapted to coact with the ball operating member 81 and the valve stem 71. The shape of the surface or groove 105 is such that vertical movement of the control rod 29 to the third or uppermost control position effects horizontal outward movement of the valve stem 71 and the ball operating member 81. In this connection, the groove 105 tapers outwardly at its lower end to form a ramp 107 which tends to force the ball operating member 81 and the valve stem 71 outwardly when the rod 27 is lifted toward its upper position. The lengths of the operating member 81 and the valve stem 71 are proportioned so that the initial movement of the ramp 107 causes the operating member 81 to be forced outwardly to unseat the ball valve 73 (Fig. 5a). This tends to reduce the pressure in the recess 57 and permits further movement of the ramp 107 to readily unseat the poppet type valve 67 (Fig. 5).

A depression or V-shaped cut 109 is provided at the upper end of the control rod groove 105 to permit the operating member 81 to move inwardly towards the center of the control passageway when the control rod 29 is moved into the first control position (Fig. 4) to latch the rod 29 in that position and a second V-shaped cut 111 is provided at the base of the ramp 107 to engage the operating member 81 when the control rod 29 is in the second or neutral control position (Fig. 2). A generally flat portion 113 extends between the V-shaped cuts 109 and 111.

An inlet or second passageway 115 for hydraulic fluid extends from the control-rod passageway 27, adjacent the control-rod stop 49, to a connection 117 which is coupled to the outlet opening on the gear pump 13 by a conduit 119. In order to conduct hydraulic fluid from the inlet or second passageway 115 to the valve chamber or branch passageway 57, a third passageway or

channel 121 is provided; this connects the control passageway 27, at a position adjacent the stop 49, with the branch passageway or valve chamber 57.

An annular opening 123 is provided in the housing 21 around the control passageway 27 for collecting any fluid which might leak between the control rod 29 and the walls of the control passageway 27. The opening 123 is connected to the by-pass outlet 45 by a passageway 125. In addition to preventing fluid from leaking out of the top of the control valve, the annular opening 123 which is connected to the sump 15, makes possible a pressure differential across the valve stem 71 and the operating member 81 when pressure fluid is admitted to the valve chamber 57. The pressure differential between the sump 15 and the fluid in the valve chamber 57 acts upon the exposed area of the operating member 81 to force the inner end of the operating member 81 against the control rod 29 with a force equal to the product of the pressure differential and the area of the member 81.

During operation, when it is desired to supply hydraulic pressure to the ram 17, the control rod 29 is moved into the first, or operating, control position (Fig. 4), that is the rod 29 is depressed until the by-pass outlet 45 to the sump 15 is closed by the upper control piston 41 and the ball operating member 81 moves into the depression 109 at the upper portion of the grooved section of the control rod 29. Pressure immediately builds up within the passageways in the housing and in the valve chamber 57. This pressure displaces the poppet valve 67 from its seat 65 so that fluid under pressure flows around the head of the valve 67 into the enlarged recess 59. The fluid then flows to the hydraulic ram 17 through a conduit 127.

After the ball valve 73 has been opened and a portion of the high pressure fluid within the ram system has been conducted to the sump 15 through the counter bore 77, the apertures 79, and the passageways 121 and 27, the larger, poppet valve 67 may be raised to permit greater flow. Further upward movement of the control rod 29 and the ramp 107 effects engagement between the valve stem 71 and the ramp 107 thereby unseating the valve 67. This permits the hydraulic fluid in the ram to return to the sump 15 through the channel 121 and the control-rod passageway 27. The ball valve 73 has a relatively small area exposed to the pressure fluid within the hydraulic ram system so that it requires a relatively small force to unseat the ball. This feature of the invention is of particular value in high pressure hydraulic systems, but the incorporation of an auxiliary valve means in a low or medium pressure system results in easier operation and closer control.

In order to effect the automatic disengagement of the hydraulic ram 17 or other power translating apparatus from the source of pressure fluid in the event that the pressure becomes excessive, a safety shut-off is provided in the lower portion of the housing 21 (Fig. 2). In the illustrated structure the safety shut-off communicates with the valve chamber 57 through a passageway 129. The safety shut-off includes a ball 131 which is held in a suitable seat 133 at the end of a passageway 135 by means of a ball follower 137 and a follower spring 139 which bear against a plate 149 which seals the lower end of the passageways 135 and 27. An annular channel 141 extends between the ball 131 and the seat

133, and this channel is connected to the lower portion of the control-rod passageway 27 by a drilled hole 143. The lower portion of the passageway 135, which contains the safety shut-off mechanism, also communicates with the lower end of the control rod passageway 27 through an opening 145 of lesser cross section than the passageway 143. The passageway 135 for the safety shut-off mechanism is connected to the sump 15 through a suitable conduit 147.

When the pressure within the valve chamber 57 becomes excessive, the safety ball 131 is moved downwardly against the pressure of the follower spring 139, so as to permit pressure fluid to flow through the annular channel 141 and the passageway 143 into the lower portion of the control-rod passageway 27. This fluid builds up a pressure which acts upon the lower end of the control rod 29 with sufficient force to move the rod upwardly into the neutral or second control position (the by-pass port 45 then being uncovered). After the control rod 29 has moved to the second control position, the pressure within the housing 21 is relieved since the fluid flows directly to the sump 15. Upon the next downward movement of the control rod 29 to effect the operation of the apparatus, the fluid remaining in the lower portion of the control-rod passageway 27 will flow outwardly through the passageway 145 and through the conduit 147 to the sump. The differing sizes of the passageways 143 and 145 determine the amount of pressure which is produced in the lower portion of the control-rod passageway when the ball 131 is unseated, the smaller the cross-sectional area of the passageway 145 relative to the cross-sectional area of the passageway 143, the greater the pressure within the lower portion of the control-rod passageway 27.

Instead of operating the apparatus in the manner described in the foregoing, the operator may energize the hydraulic system by moving the control rod 29 to the first of lower position (Fig. 4). As before pointed out, this closes the by-pass outlet 45 to the sump 15 and causes pressure to build up within the valve chamber 57. When this pressure equals the pressure within the operating portion of the system, the valve 67 lifts, and fluid is pumped into the ram 17 or other operating unit. The hydraulic ram unit may be permitted to reach its limit of movement whereupon excessive pressure can build up within the system and the safety shut-off mechanism, which has been described, will be displaced from its seat and the fluid flowing therearound will cause a pressure within the lower portion of the control-rod passageway which will move the control rod 29 back to the neutral position. So long as there is hydraulic fluid flowing around the valve 67, the pressure in the third passageway or channel is elevated relative to the pressure in the sump 15, and the pressure differential thus formed across the operating member 81 acts to force that member against the control rod 27 thereby to resiliently latch the control rod in the first control position. If it is desired to operate the apparatus in the reverse direction, the control rod is raised by the operator until the ramp 107 on the control rod 29 operating member 81 and the valve stem 71 outwardly an amount sufficient to unseat the valves 73 and 67, respectively. This bleeds pressure fluid back through the valves to the sump 15.

In the event that it is desired to increase the locking force exerted on the control rod 29 in response to the fluid pressure within the valve

chamber 57, the construction of the valve 67 may be readily modified to present a greater area to the hydraulic fluid within the valve chamber 57. A modified valve structure 67a of this type is shown in Fig. 8. In Fig. 8 the various elements which are the same as the corresponding elements which have been described in the foregoing will be given the same reference numeral as the corresponding element with the addition of the symbol "prime" (').

The valve 67a includes a head 149 and a stem 151, stem 151 being provided with an axially extending passageway 153 as illustrated. The passageway 153 is provided with a pair of counter-bored portions 155 and 157 adjacent the valve head 149. A plurality of radially extending apertures 159 interconnect the counterbore 157 and the valve chamber 57' so that pressure fluid can flow between the chamber 57' and the recess 59'. The shoulder formed by the counterbores 155 and 157 provides a seat for a ball valve 159. The unseating of the ball valve 159 is effected by a ball operating member or rod 161 which is slidably supported within the passageway 153 within the valve stem 151. In this connection, one end of the rod 161 engages the ball 159 and the other end of the rod 161 extends a short distance beyond the end of the valve stem 151 as illustrated in Fig. 8. The valve 67a and the ball valve 159 are both biased into the closed position by the coil spring 63' which acts between the ball valve 159 in the head of the valve 67a and a bushing 63'.

The inner end of the valve stem 151 is supported within a combined guideway and detent assembly 163 which is operable to support and to guide the valve stem 151 and to exert a locking action upon the control rod 29' at all times when the fluid within the valve chamber 57' is at a pressure higher than that of the sump. The detent assembly 163 includes a locking plunger 165 which has one end hollowed out to form a well 167 which is proportioned to receive the inner end of the valve stem 151.

The locking plunger 165 is slidably supported within the valve chamber 57' and is proportioned to closely engage the walls of that chamber to provide a substantially liquid tight seal between the outer portion of the valve chamber 57' and the control rod passageway 27'. The inner end of the locking plunger 165 is machined to provide a rounded portion 169 which is adapted to engage the control rod 29'. In order to avoid fluid locks between the bottom of the well 167 and the base of the valve stem 151 a passageway 171 is provided intermediate the well 167 and the control passageway 27'. A spring 173 is provided intermediate the plunger 165 and the valve head 149, as illustrated, to bias the plunger 165 against the control rod 29' at all times when the valve 67a is in the closed position. The spring 173 exerts a smaller force than the spring 83' so that the valve 67a will normally remain in the closed position.

The lengths of the member 161 and the valve stem 151 are proportioned so that initial outward movement of the plunger 165 will cause the base of the well 167 to first force the operating rod member 161 outwardly to unseat the ball valve 159. This tends to reduce the pressure in the recess 59' thereby permitting outward movement of the plunger 165 with a minimum force to unseat the valve 67a.

As will be seen from examination of the illustrated structure, a pressure differential between the valve chamber 57' and the control passage-

way 27' will be operable to apply a fairly substantial locking force to the control rod 29'. The pressure differential is applied to the area of the operating member 161 and to the exposed annular shoulder of the locking plunger 165, which has an area determined by the differences in diameter of the locking plunger 165 and the valve stem 151. Thus the control rod 29' is effectively locked in the operative position when pressure is built up in the valve chamber 57' even though the pressure exerted by the spring 173 is greatly reduced.

One of the important features of the invention lies in the provision of the member which exerts a force on the operating member 81 so as to resiliently engage the control rod 29' in the desired position. This force is proportional to the pressure differential between the valve chamber and the control passageway and is therefore substantially independent of spring pressure when the valve 67 is open, the second control position. The force exerted by the spring tends to latch the control rod in its position in the second and third control positions. This arrangement, in effect, releasably locks the control rod in the desired operating position until it is moved to another position by the operator or by the action of the safety shut-off. Thus, when the operator wishes to operate the hydraulic system, it is necessary for him merely to move the control lever to the operating position, and he can rely on the latching means to hold the lever in that position.

Another of the important features of the invention lies in the provision of the small-area, two-member valve in the head of the main, spring-pressed valve. This arrangement enables the operator to easily control a hydraulic system which employs high pressure fluid and to more accurately control the operation of both high and low pressure systems.

Various features of the invention are set forth in the appended claims.

We claim:

1. In a control valve of the class described, the combination of a housing, a fluid inlet passageway in said housing which is adapted to be connected to a source of pressure fluid, a fluid outlet passageway in said housing which is adapted to be connected to a sump, a passageway in said housing which is adapted to be connected to a power translating means, and means for effecting the interconnection of said passageways in a predetermined sequence including a valve and a control member, said control member being movable to a plurality of control positions to effect such interconnection, and a control member latching means movably mounted in said housing and adapted to engage said control member, said latching means being operably associated with said passageway adapted to be connected to said power translating means, said latching means being operably responsive to the fluid pressure in said last named passageway for causing said latching means to engage said control member.

2. In a control valve of the class described, the combination of a housing, a fluid inlet passageway in said housing which is adapted to be connected to a source of pressure fluid, a fluid outlet passageway in said housing which is adapted to be connected to a sump, a passageway in said housing which is adapted to be connected to a power translating means, and a control member and a spring pressed valve having a sealing member and an operating member for interconnecting

said passageways in a predetermined sequence, said control member being movable to a plurality of control positions to effect such interconnection, said operating member being movably mounted in said housing and adapted to engage said control member, said operating member being operably associated with said passageway adapted to be connected to said power translating means, said operating member being operably responsive to the fluid pressure in said last named passageway for causing said operating member to engage said control member.

3. In a control valve of the class described, the combination of a housing, a fluid inlet passageway in said housing which is adapted to be connected to a source of pressure fluid, a fluid outlet passageway in said housing which is adapted to be connected to a sump, a passageway in said housing which is adapted to be connected to a power translating means, and a control member and a valve having a sealing member and an operating member for interconnecting said passageways in a predetermined sequence, said control member being movable to a plurality of control positions to effect such interconnection, said sealing member being biased towards the closed position by a spring and said operating member being disposed intermediate said sealing member and said control member, said operating member being biased towards said control member by a second spring which acts between said sealing member and said operating member, said second spring exerting a smaller force than the spring for biasing said sealing member towards the closed position, said operating member being operable when said control member is in one of said positions to latch said control member in that position, and which is operable to unseat said sealing member when said control member is in another position.

4. In a control valve for use in a hydraulically controlled system of the class described, the combination of a housing, a fluid inlet passageway in said housing which is adapted to be connected to a source of pressure fluid, a fluid outlet passageway in said housing which is adapted to be connected to a sump, and a third passageway in said housing which is adapted to be connected with the hydraulically controlled system with which said control valve is used, a control member, a control-member passageway in said housing for receiving said control member, said control member being movable to a plurality of control positions for effecting the interconnection of said passageways in a predetermined sequence, a valve for controlling the flow of fluid to and from the hydraulic system from said third passageway, and a second valve having a lesser area than said first valve also interconnecting said third passageway and said hydraulic system, said second valve including a sealing member and an operating member, movement of said control member to one control position being operable to successively unseat said second valve and said first valve, at least a portion of said operating member being exposed to pressure fluid in said third passageway so that said operating member is engaged against said control member in response to pressure within said third passageway.

5. In a control valve for use in a hydraulically controlled system of the class described, the combination of a housing, a fluid inlet passageway in said housing which is adapted to be connected to a source of pressure fluid, a fluid outlet passageway in said housing which is adapted to be con-

connected to a sump, and a third passageway in said housing which is adapted to be connected with the hydraulically controlled system with which said control valve is used, a control member, a control-member passageway in said housing for receiving said control member, said control member being movable to a plurality of control positions for effecting the interconnection of said passageways in a predetermined sequence, a poppet-type valve having a head and a stem for controlling the flow of fluid to and from the hydraulic system from said third passageway, a passageway extending the length of said poppet valve and communicating at the head of said poppet valve with the hydraulically controlled system, a second valve having a sealing member which is disposed adjacent the end of the passageway in said poppet valve which communicates with the controlled hydraulic system and an operating member which is disposed intermediate said sealing member and said control member, movement of said control member to one control position being operable to successively unseat said second valve and said first valve, at least a portion of said operating member being exposed to pressure fluid in said third passageway so that said operating member is engaged against said control member in response to pressure within said third passageway.

6. In combination in a control valve for use in a hydraulically controlled system of the class described, a housing, a control member, a control-member passageway in said housing for receiving said control member, said control member being movable to a plurality of control positions, an inlet passageway in said housing which communicates with said control-member passageway and which is adapted to be connected to a source of pressure fluid, and a third passageway in said housing which is adapted to be connected with the hydraulically controlled system with which said control valve is used, said third passageway communicating with said control member passageway and said control member passageway having a branch which also communicates with said third passageway, a poppet-type valve having a head and a stem, the stem of said poppet valve extending within the branch of said control-member passageway, a passageway extending the length of the stem of said poppet valve and communicating at the head of said poppet valve with the hydraulically controlled system, a second valve disposed in the stem of said poppet valve passageway at the end thereof adjacent the head of said poppet valve, conduit means interconnecting said third passageway and the passageway within the stem of said poppet valve, an operating member for said second valve in the passageway in the stem of said poppet valve, said operating member being proportioned to extend beyond the end of said stem, movement of said control member between predetermined positions being operable to successively move said operating member and the stem of said poppet valve thereby first unseating said second valve and finally unseating said first valve, and at least a portion of said operating member being exposed to pressure fluid in said third passageway so that said operating member is engaged against said control member in response to pressure within said third passageway.

7. In combination in a control valve for use in a hydraulically controlled system of the class described, a housing, a control member, a control-member passageway in said housing for receiving

said control member, said control member being movable to a plurality of control positions, an inlet passageway in said housing which communicates with said control-member passageway and which is adapted to be connected to a source of pressure fluid, and a third passageway in said housing which is adapted to be connected with the hydraulically controlled system with which said control valve is used, said third passageway communicating with said control-member passageway and said control-member passageway having a branch which also communicates with said third passageway, a poppet-type valve having a head and a stem for interconnecting said third passageway and the hydraulically controlled system, the stem of said poppet valve extending within the branch of said control-member passageway, a second valve, a seat for said second valve in the head of said poppet valve, an operating member for said second valve, a passageway through the stem of said poppet valve for said operating member, the end of said operating-member passageway adjacent the seat for said second valve being enlarged and communicating with said third passageway, a spring intermediate said second valve and said operating member for urging said operating member against said control member, means biasing said poppet valve and said second valve into the closed position, movement of said control member between predetermined positions being operable to successively move said operating member and the stem of said poppet valve thereby unseating said second valve and said poppet valve respectively, and at least a portion of said operating member being exposed to pressure fluid in said third passageway so that said operating member is engaged against said control member in response to the pressure within said third passageway.

8. In combination in a control valve for use in a hydraulically controlled system of the class described, a housing, a control member, a control-member passageway in said housing for receiving said control member, said control member being movable to a plurality of control positions, an inlet passageway in said housing which communicates with said control-member passageway and which is adapted to be connected to a source of pressure fluid, and a third passageway in said housing which is adapted to be connected with the hydraulically controlled system with which said control valve is used, said third passageway communicating with said control-member passageway and said control-member passageway having a branch which also communicates with said third passageway, a poppet-type valve having a head and a stem for interconnecting said third passageway and the hydraulically controlled system, the stem of said poppet valve extending within the branch of said control-member passageway, a detent mechanism associated with the stem of said poppet valve and being disposed intermediate said control member and the stem of said poppet valve, a second valve, a seat in the head of said poppet valve, an operating member for said second valve, a passageway through the stem of said poppet valve for receiving said operating-member, the end of said operating-member passageway which is adjacent said valve seat being enlarged and communicating with said third passageway, said detent mechanism including a plunger which is slidably supported within said branch passageway and which is adapted to slidably support and to guide the stem of said

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poppet valve, said operating member extending beyond the end of the stem of said poppet valve to coact with said plunger, resilient means acting upon said second valve for biasing said second valve and said poppet valve into the closed position, movement of said control member between predetermined positions being operable to move said plunger to successively act upon said operating member and the stem of said poppet valve to thereby unseat said second valve and said poppet valve respectively, and at least a portion of said plunger and said operating member being exposed to pressure fluid in said third passageway so that said detent mechanism is engaged against said control member in response to the pressure within said third passageway.

9. In combination in a control valve for use in a hydraulically controlled system of the class described, a housing, a control member, a control-member passageway in said housing for receiving said control member, said control member being movable to a plurality of control positions, an inlet passageway in said housing which communicates with said control-member passageway and which is adapted to be connected to a source of pressure fluid, and a third passageway in said housing which is adapted to be connected with the hydraulically controlled system with which said control valve is used, said third passageway communicating with said control-member passageway and said control-member passageway having a branch which also communicates with said third passageway, a poppet-type valve having a head and a stem for interconnecting said third passageway and the hydraulically controlled system, the stem of said poppet valve extending within said branch passageway, a ball valve, a seat in the head of said poppet valve for said ball valve, an operating member for said ball valve, an operating-member passageway through the stem of said poppet valve for receiving said operating member, the end of said operating-

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member passageway which is adjacent the seat for said ball valve being enlarged and communicating with said third passageway, said operating member being slidably supported within said operating-member passageway, a spring biasing said operating member towards said control member, said operating member for said ball valve being proportioned to extend beyond the end of the stem of said poppet valve to coact with said control member, resilient means acting upon said ball valve for biasing said ball valve and said poppet valve into the closed position, movement of said control member between predetermined positions being operable to move, successively, said operating member and the stem of said poppet valve to thereby unseat said ball valve and said poppet valve respectively, and at least a portion of said operating member being exposed to pressure fluid in said third passageway so that said operating member is engaged against said control member in response to the pressure within said third passageway.

10. A control valve as set forth in claim 2 having a resilient member mounted in said housing, said resilient member being positioned between and engaging said sealing member and said operating member and being adapted to cause said operating member to engage said control member.

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