

Oct. 21, 1952

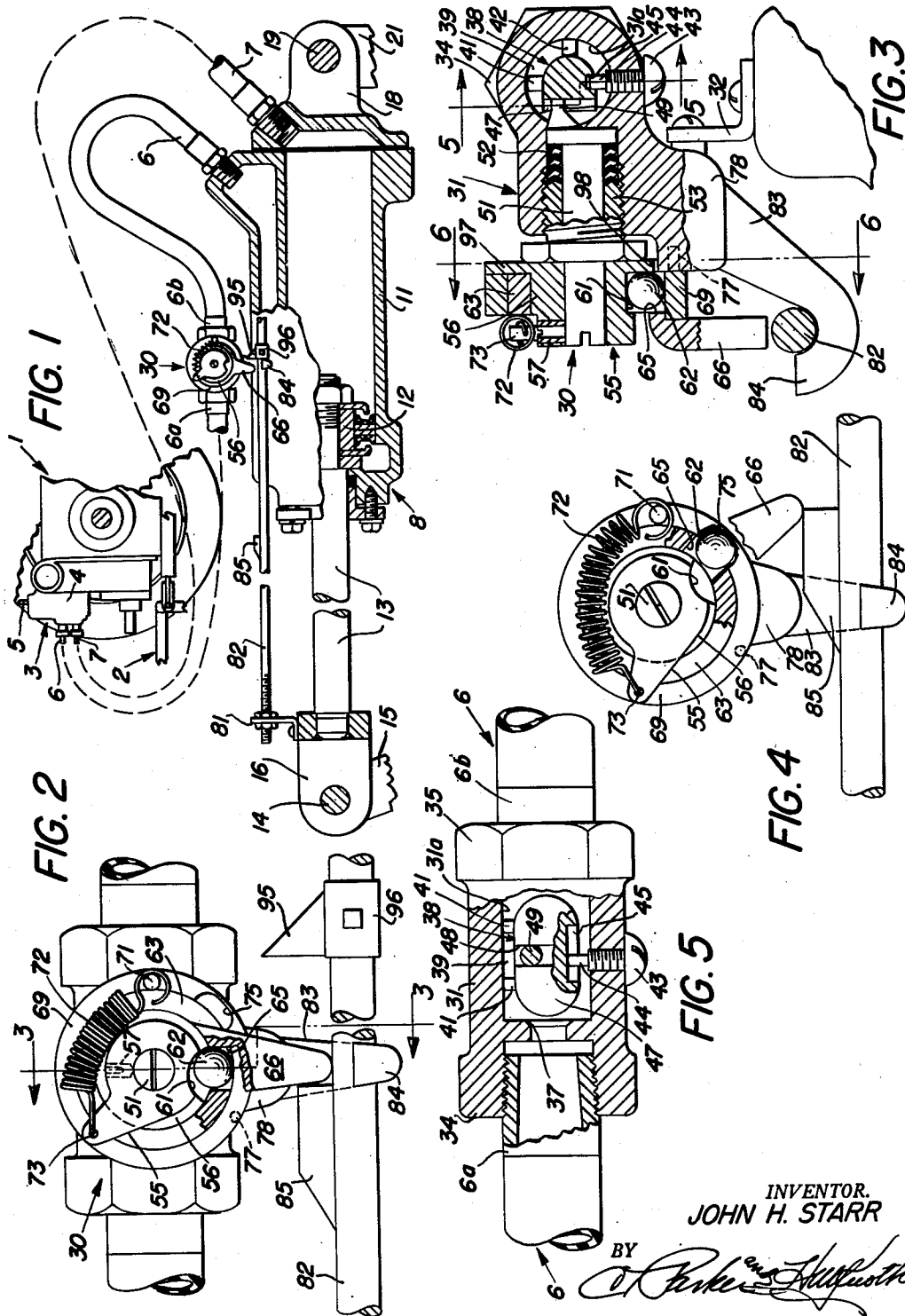
J. H. STARR

2,614,537

MEANS FOR REGULATING STROKE OF FLUID-PRESSURE APPARATUS

Filed June 28, 1950

2 SHEETS—SHEET 1



INVENTOR.
JOHN H. STARR

BY

John H. Starr

ATTORNEYS

UNITED STATES PATENT OFFICE

2,614,537

MEANS FOR REGULATING STROKE OF
FLUID-PRESSURE APPARATUS

John H. Starr, Mayville, Wis., assignor to John
Deere Van Brunt Company, Horicon, Wis., a
corporation of Wisconsin

Application June 28, 1950, Serial No. 170,853

11 Claims. (Cl. 121—38)

1

This application is a continuation-in-part of my co-pending application, Serial No. 634,034, filed December 10, 1945, now abandoned, and the invention herein relates generally to agricultural implements and more particularly to power lift apparatus arranged to raise and lower tools and the like. More specifically, the present invention is particularly adapted for use with hydraulic power lift apparatus in which it is desired to provide means for automatically terminating the raising or lowering action at an adjustable but predetermined point.

The object and general nature of the present invention is the provision of an automatic control valve for hydraulic power lift systems employing piston and cylinder units, the automatic valve being constructed and arranged so that movement of the piston is automatically terminated at a predetermined point, with means providing for moving the piston at will beyond said point, whenever desired or necessary. More particularly, it is a feature of this invention to provide an automatic valve for controlling the action of the hydraulic piston and cylinder unit so that extension of the piston, or the retraction thereof, actuates the control valve whereby the piston is automatically stopped at a predetermined point but may be moved beyond that point whenever necessary. Further, the present invention contemplates an automatic control valve which may be mounted at a distance, or, remotely, from the main control valve, for automatically tripping or releasing the main valve at a predetermined point in the piston travel, with the further feature of providing for movement of the piston beyond said predetermined point merely by a re-actuation of the main valve. These and other objects and advantages of the present invention will be apparent to those skilled in the art after a consideration of the following detailed description, taken in conjunction with the accompanying drawings.

In the drawings:

Figure 1 is a side view of the operating ram or jack unit of the hydraulic power lift piston, with the automatic control valve mounted on the ram or jack unit.

Figure 2 is a side view, on an enlarged scale and partly in section, of the automatic control valve.

Figure 3 is a sectional view taken generally along the line 3—3 of Figure 2.

Figure 4 is a view similar to Figure 2, but showing the control valve unit parts in the positions they occupy at the beginning of the piston-terminating movement.

2

Figure 5 is a sectional view taken generally along the line 5—5 of Figure 3.

Figure 6 is a fragmentary sectional view taken substantially along the line 6—6 of Figure 3.

Figure 7 is a sectional and schematic view including that portion of the fluid pressure circuit including the source of fluid pressure and the main control valve.

Figure 8 is a view similar to Figure 1, but illustrating a different function of the valve unit.

Referring now to the drawings, particularly Figure 1, the present invention has been illustrated as embodied in a tractor propelled outfit including a tractor 1 to the drawbar of which an implement such as a grain drill 2 is hitched. The tractor 1 includes a power lift unit 3 of the type including a valve box 4 enclosing valve mechanism (to be hereinafter described in detail) under the control of a valve lever 5. A pair of hose lines 6 and 7 lead to a double acting hydraulic piston and cylinder unit or motor 8 by means of which power may be applied in either direction. The unit 8 includes a cylinder 11 in which a piston 12 moves in one direction or the other according to whether pressure is delivered to one side or the other, and a piston rod 13 is connected at its inner end to the piston 12 and at its outer end is pivotally connected, as at 14, to a movable implement part, here an arm 15 which is connected with the pressure shaft of the grain drill 2, for example. To this end, the outer end of the piston rod 13 carries an attaching lug 16 which is apertured to receive the pivot connection 14. The opposite end of the unit 8 is apertured to receive a pivot pin 19 by which the cylinder 11 is connected to a bracket 21 or other suitable support on the grain drill, for example. The hydraulic power unit 3 has a valve 101 (Figure 7) by means of which fluid may be delivered under pressure through the hose line 6 and exhausted through the other hose line 7 for moving the piston 12 in one direction, or the valve 101 may be changed to direct fluid under pressure through the hose line 7 and exhausted through the hose line 6 for moving the piston 12 in the other direction. The valve mechanism is also constructed so that, whether the piston 12 is moved in one direction or the other, when an overload is encountered and pressures become too high, the valve mechanism is automatically returned to a neutral position, locking the fluid on both sides of the piston 12, but movement may be resumed at any time after such release of the valve mechanism by operating the latter, provided that the conditions creating the pressure rise are removed or alleviated.

Figure 7 shows schematically and in section a representative type of main control valve for the power lift unit 3. The valve box 4 is provided with a vertical valve cylinder 100 within which the valve 101 is carried for vertical reciprocation. The fluid-pressure circuit includes a high-pressure passage 102 in communication at one end with the valve cylinder 100 and in communication at its other with a source of fluid pressure, such as a pump 103. The pump is associated with a suitable reservoir illustrated schematically at 104. Opposite ends of the valve cylinder 100 are in communication respectively with branch passages 105 and 106 which provide exhaust branches communicating with a main exhaust passage 107 terminating in the reservoir 104.

The control lever 5 for operating the valve 101 is connected to a rockshaft 108 which is journaled in the housing and which has keyed thereto a rockable arm 109. The arm is connected by a link 110 to the upper end of the main control valve 101, so that rocking of the rockshaft 108 in one direction or the other will result in vertical shifting of the valve. The rockshaft 108 also has fixed thereto a plate 111 in which is provided a notch 112. In the neutral position of the parts, as shown, the notch 112 is engaged by a roller 113 forming part of a spring-pressed locking means designated generally by the numeral 114. When the rockshaft 108 is rocked by the lever 5, the result is that the means 114 will be depressed and the roller 113 will ride on one or the other of a pair of flat portions 115 on the plate 111. Opposite end portions of the plate respectively adjacent to the flat portions 115 are provided as lug portions 116, either of which, in cooperation with the spring-pressed means 113-114, presents increased resistance to movement of the lever 5 as such portion approaches the roller 113. This provision is made for indicating to the operator the end of slow-speed operation and the beginning of high-speed operation in either direction. The notch 112 determines the neutral position of the control valve.

In this respect, it should be noted that the control valve 101 and its association with the remainder of the circuit is of the type providing both high-speed and low-speed operation for the motor or unit 8. The manner in which these results are accomplished appears below. For the present, it will suffice to note that the operator may move the control lever in either direction to shift the valve 101 in either direction to an extent measured by departure of the roller 113 from the notch 112 and engagement by the roller 113 of one or the other of the lug portions 116, depending upon the direction in which the rockshaft 108 is rocked.

The means for automatically returning the valve 101 to the neutral position shown in Figure 7 includes a second plate 117 fixed to the rockshaft 108. This plate is provided at its left hand end with an arcuate portion 118 which terminates in a pair of cut-off portions 119. In the neutral positions of the parts, and during operation thereof within a certain range, the arcuate portion 118 is in constant engagement with a roller 120 provided on one arm of a pivoted bell crank 121. This bell crank is pivoted at 122 on a portion of the housing 4. The other arm of the bell crank is associated with pressure-relief means including a vertical rod 123 which extends downwardly in a bore 124 in the housing 4. The bore 124 intersects the horizontal portion of the main exhaust or low-pressure passage 107. The lower

end of the rod 123 is headed and carries thereon a washer 125 between which and the upper portion of the housing in which the bore 124 terminates is disposed a compression spring 126. The action of this spring is such as to maintain the engagement of the roller 120 with the arcuate portion 118 on the plate 117. The extent of the arc 118 is so proportioned with respect to the components of the plate 111 that the roller 120 does not depart from the arc as long as rocking of the rockshaft 108 is confined to a range in which the roller 113 does not pass either of the lug portions 116. In short, the roller 120 remains in engagement with the arcuate portion 118 when the valve mechanism is in its neutral position or when it has been shifted to either of its slow-speed positions.

The housing 4 is provided with a passage or bore 128 which is coaxial with the bore 124 and which intersects both the exhaust passage 107 and the lower horizontal portion of the high-pressure passage 102. At its lower end, the bore 128 is provided with a valve seat 129 on which is seated a valve 130 which normally closes the passage or bore against the entrance of fluid from the high-pressure passage 102. A fairly heavy coiled compression spring 131 seats against the valve 130 and against an annular shoulder 132 provided in the bore 128. Above the shoulder 132, the bore 128 carries a valve body 133 which normally rests on the shoulder 132 and which has a reduced portion 134 apertured at 135 in communication with an axial passage or bore 136. This axial passage communicates with the lower portion of the bore 128.

The spring 131 is sufficiently strong to hold the valve 130 closed except against an abnormal or excess rise in pressure in the system. During normal operation of the system, the parts occupy the positions illustrated in Figure 7. Hence, there is no interaction between the valve body 133 and the spring-pressed rod 123 for the bell crank 121.

As previously stated, as long as the rockshaft 108 is rocked during slow-speed operation of the system, the roller 120 remains in engagement with the arcuate portion 118 on the plate 117. However, should the control lever 5 be moved to its maximum position in either direction, thus increasing the angle of rocking of the rockshaft 108, the roller 120 will depart from the arc 118 and will engage one or the other of the notches or cut-off portions 119. This action results in temporarily and yieldably locking the rockshaft 108 in one or the other of the high-speed positions, inasmuch as the spring-loaded rod 123, bell crank 121, and roller 120 provide a releasable tripping mechanism. The operator may, of course, overcome the action of this tripping mechanism and may restore the control lever to its neutral or to either of its other or slow-speed operating positions.

The importance of the present invention is emphasized when used with mechanism of the type just described, inasmuch as the valve mechanism embodies a control valve which may be temporarily held in one of its operating positions by means which is responsive to an increase in pressure in the system to restore the valve to neutral. Accordingly, the operator, without further attention, may move the control lever to its maximum position and after the fluid-pressure system accomplishes the desired result, the control lever will be automatically returned to neutral. In prior known systems,

it is customary to provide on the motor unit a pair of interengageable stops, one being on or represented by the cylinder and the other being on the piston. The stops could be set for the desired range of movement and when they engage, further relative movement between the cylinder and piston would be impossible and there would be thereby created a condition of excess pressure in the system such as to cause the control lever to move or return to neutral. Such an arrangement is desirable in many cases but has the disadvantage that the interengageable stops must be manually adjusted each time it is desired to increase the range through which the motor parts are movable. As will be brought out hereinafter, the present invention provides an improvement in which further movement of the motor parts beyond a predetermined range is made possible automatically.

Referring now again to the valve mechanism shown in Figure 7, it will be seen that the hose lines 6 and 7 are in communication with the cylindrical valve chamber 100 by means of ports 137 and 138, respectively. These ports are controlled respectively by spring-loaded check valves 139 and 140, these valves controlling passages 141 and 142, respectively.

The main control valve 101 is provided with upper and lower tapered portions 143 and 144, respectively, which are engageable with stems 145 and 146 respectively on the check valves 139 and 140. When the control valve 101 is in its neutral position as shown, fluid from the high-pressure passage 102 may circulate freely back through the exhaust branches 105 and 106 to the reservoir 104. When the control lever 5 is moved in a counterclockwise direction, as shown in Figure 7, the rockshaft 108 is likewise rocked in that direction, thus raising the valve 101. If the valve 101 is raised only partly, according to engagement of the roller 113 with the left hand lug portion 116, the tapered portion 143 engages the stem 145 and partially opens the upper check valve 139 in the port 137 for the hose line 6. The pressure in the lower portion of the valve chamber 100 rises and forces open the check valve 140 so that fluid under pressure is transmitted through the hose line 7 to the left hand end of the cylinder in Figure 1, thus forcing the piston 12 toward the right, as viewed in Figure 1. The partial opening of the check valve 139 restricts the fluid being exhausted, and thus gives slow-speed operation. Had the control lever been moved completely in a counterclockwise direction, the valve 101 would be moved upwardly to its maximum extent and the check valve 139 would be opened to its maximum extent, thus giving high-speed operation.

Opposite movement of the piston 12 in the cylinder 11 may be accomplished at either of the speeds mentioned by rocking of the rockshaft 108 in the opposite direction by the control lever 5. In either case of high-speed operation, it will be seen that the control valve 101 is temporarily and releasably locked in position by the tripping mechanism comprising the plate 117, roller 120 and spring-loaded bell crank 121. Should there occur any condition resulting in an abnormal increase in pressure in the system, the valve 130 would open against the loading of the spring 131, thus admitting fluid to the lower portion of the bore 128. This fluid would force the valve body 133 upwardly, which would be followed by communication of the passage 135-136 with the exhaust passage 107 and engagement of the

headed end of the rod 123 by the upper portion of the upwardly moving valve body 133. Hence, not only would excess pressure be by-passed through the passage 107 to the reservoir 104, but the bell crank 121 would be rocked in a counterclockwise direction and would release the roller 120 from one or the other of the notches or cut-off portions 119. The spring pressure in the means 114 would be sufficient to cause the rockshaft 108 to rock in such direction and through such range as to effect return of the valve 101 to its neutral position. As will be seen from what is described below, it is an important feature of the invention to utilize the characteristics of a fluid-pressure system of this type in achieving automatic control of stop or limit means in association with the system.

The present invention has particularly to do with an automatic control valve for an installation as described above, the automatic control valve preferably being incorporated in one of the above mentioned hose lines, such as hose line 6, and the construction is such that the automatic control valve serves automatically to stop the movement of the piston after it reaches an adjustable but predetermined point by momentarily locking the fluid in the unit 8 against movement, whereupon the main control valve 101 is automatically returned to a neutral position, after which the automatic control valve automatically returns to an open position thereby providing for a further movement of the piston, if such further movement is desired, by a second actuation of the valve lever 5 on the tractor. A mechanism of this kind is particularly useful in grain drills. For example, the automatic control valve, which will be described below in detail, may be adjusted to provide for lowering the furrow openers to plant at the desired depth, but occasions may arise where, as in passing over very hard ground or the like, it may be desirable to apply additional pressure to the furrow openers for forcing them downwardly in order to maintain the desired depth of operation, it being understood that in a grain drill the furrow openers are normally held in operating position through pressure springs, whereby any one or more furrow openers may move upwardly against the spring pressure applied thereto so as to accommodate the passage of the implement over uneven ground surfaces. However, when a hard spot is encountered and it is desired to maintain a substantially constant depth of planting, as is customary, it is necessary to apply additional pressure against the springs. Therefore, where an automatic valve of some kind is adapted to lock the piston 12 in some position of adjustment to provide for normal conditions, it is necessary to extend the piston of the hydraulic unit an additional amount in order to apply additional pressure through the pressure springs for maintaining a substantially constant depth of planting under the conditions of hard ground or the like assumed.

An automatic control valve mechanism, such as was referred to above, is shown in detail in Figures 2 to 6. Referring now to these figures, it will be seen that the automatic control valve, indicated in its entirety by the reference numeral 30, comprises a valve body 31 mounted in any suitable position on the cylinder 11 by a bracket 32 and provided with a pair of oppositely extending inlet and outlet sections 34 and 35 which are preferably tapped to receive hose connections 6a and 6b by which the unit 30 may be

incorporated in the hose line 6. As best shown in Figure 5, the valve body 31 has an axial bore 31^a at one end of which is a valve seat 37 which is normally open but which may be closed by a longitudinally shiftable plug 38. The valve plug 38 is supported in the valve chamber 39 in the casing 31 by any suitable means providing for free movement, such as pins or lugs 41 and 42. The plug 38 is prevented from turning about its longitudinal axis by means of a screw pin 43, the inner end 44 of which extends into a longitudinally extending groove 45 formed on one side of the valve plug 38. The laterally outer face 47 of the valve plug 38 is flat and has a groove 48 therein extending normal to the axis of the valve. The groove 48 receives a lug 49 which is formed on the inner end of a valve operating shaft 51 that extends outwardly through one side of the valve body 31, being sealed by a suitable packing 52. The lug 49 is eccentric with respect to the shaft 51. Rotating the shaft 51 in one direction or the other will shift the valve plug 38 longitudinally to move the latter toward or away from the valve seat 37. The packing 52 is compressed by a packing gland 53 of usual construction. The shaft 51 extends outwardly and at its outer end receives an arm 55, the central hub section 56 of which is locked adjustably to the shaft by a socket screw 57 or other suitable means. At one side, the hub section 56 is provided with a notch 61 into which a ball 62 may extend. A ring member 63 surrounds the hub section 56 and has a through opening 65 formed therein. An operating arm 66 is carried by or formed on the ring 63, and surrounding the ring 63 is a second ring or collar 69 carrying a pin 71. A spring 72 is connected at one end to the pin 71 and at the other end to the arm 55, as indicated at 73 in Figures 2 and 4. The outer ring 69 is formed with a ball receiving recess or notch 75, and the ball 62, together with the through opening 65 and the notches 61 and 75, are so proportioned that the ball may lie either in the opening 65 and notch 75 or in the opening 65 and notch 61, as shown respectively in Figures 4 and 2. On its side opposite the arms 55 and 66 the ring 69 carries a pin 77 which bears against an extended portion 78 of the valve body 31. The pin 77 in bearing against the valve casing 31 prevents clockwise movement of the ring 69 beyond that shown in Figure 6 (counterclockwise movement beyond that shown in Figure 2). Since the spring 72 is anchored at 71 to the outer ring 69 the spring 72 is effective to hold the arm 55 in the position shown in Figure 2, urging the arm 55 in a clockwise direction (Figure 2) which acts through the pin 49 (Figure 5) to hold the valve 38 in its open position, thereby permitting a free flow of fluid through the hose line 6 in either direction.

In order to provide a stop against which the spring 72 may act in holding the valve 38 in its open position, a plate 97, preferably formed integral with the collar 56, is cut out at 98 to accommodate movement of the pin 77 on the collar 69, one edge 99 of the cut out 98 being engageable with the adjacent portion of the valve casing extension 78 (Figure 6) and thus stopping the clockwise movement of the valve arm 55 under the influence of the spring 72 and holding the valve 38 in its open position as the arm 66 is returned from the position of Figure 4 to that of Figure 2.

According to the present invention, the valve 38 is momentarily closed by movement of the

arm 66 in a counterclockwise direction (Figure 2), and this is accomplished in the following manner. A bracket 81 is fixed to the outer end of the piston rod 13 and is apertured to receive the outer end of a control rod 82, preferably secured to the bracket 81 in a selected position by suitable means such as a pair of lock nuts or the like. The inner end of the control rod 82 is supported for fore and aft movement in a bracket 83 that is formed on or secured to the extended portion 78 of the valve body 31. The bracket 83 has a curved section 84 forming a saddle to receive the control rod 82. The member 83 thus disposes the control rod 82 close to the arm 66, as best shown in Figure 3. The control rod 82 is provided with a lug 85 thereon. The lug 85 is so constructed and arranged that when the piston 12 is forced inwardly of the cylinder 11, as by operating the tractor power lift unit 3 to force fluid through the hose 6 and valve 30 to the outer end of the cylinder 11, fluid from the inner end of the cylinder flowing through the hose line 7 and back to the valve box 4, the control rod 82 is moved toward the right (Figure 1). Movement of the rod 82 to the right (Figure 1) causes the lug 85 to approach the arm 66 and during the further inward movement of the piston 12 and the corresponding further movement of the rod 82, the lug 85 swings the arm 66 out of the position shown in Figure 2 toward the position shown in Figure 4. As will be seen from Figure 2, where the ball 62 is disposed in the notch 61 and the aperture 65, the ball 62 serves as an operating connection between the members 63 and 55 so that, as the arm 66 is swung in a counterclockwise direction from the position of Figure 2 to that of Figure 4, the ball is moved up against the right-hand edge of the notch 61, whereupon further movement of the arm 66 swings the spring biased arm 55 in a counterclockwise direction. Since the arm 55 is secured to the shaft, the valve 38 is shifted to the left, or toward its closed position, imposing a restriction or stoppage in the line 6 to an extent sufficient to cause such rise in fluid pressure as will actuate the relief valve 133, following which the valve 101 is returned to neutral. At the same time, as the two members 63 and 55 have moved together in a counterclockwise direction, the ball 62 drops into the notch 75 at about the point where the lug 85 starts to pass under the arm 66. When the ball 62 drops into the notch 75, it clears the notch 61, whereupon the tensioned spring 72 now acts to return the arm 55—and the valve 38—to the position shown in Figure 2, which opens the valve 38 (Figure 5), the arm 66, however, remaining in the position of Figure 4. Thus, when the piston structure 12, 13 reaches a given position, depending upon the adjustment of the rod 82 in the bracket 81, the control valve 30 is momentarily closed. This closing of the valve 38 occupies only a short space of time but is sufficient to cause the valve mechanism 3 on the tractor to trip, locking the hydraulic unit 8 against further movement. However, since the valve 38 opens almost immediately, all that it is necessary to do to further retract the piston is to direct more fluid under pressure through the hose line 6.

A second lug 95 is adjustably fixed on the control rod 82 in such a position that when the piston rod 13 is again moved towards its outermost position (Figure 1) the lug 95 engages the arm 66 and moves it from its position shown in Figure 4 to the position shown in Figure 2. This

restores the connection 61-62-65 so that the control valve 30 is again conditioned to stop the piston 12 at a predetermined but adjustable point in its inward movement, thus tripping the tractor valve mechanism, but in which further inward movement of the piston 12 may be made as desired. The lug 95 must be positioned so that, when the arm 66 is restored to the position shown in Figures 1 and 2 from the position shown in Figure 4, the piston rod is at its outer limit of movement, as shown in Figure 1, irrespective of the position of the rod 82 in the bracket 81. To secure this relation the lug 95 is positioned adjustably on the rod 82 in any suitable way, as by a set screw collar 96, whereby the control valve is readily adapted to different power cylinders, variations in the length of stroke, and/or variations in the implement tool means.

If desired, both of the lugs 85 and 96 may be mounted on set screw collars or otherwise made adjustable along the control rod 82.

In the modified functioning of the valve 30 as shown in Figure 8, the valve 30 is installed in the line 7, so that fluid flow while the piston is being retracted is from right to left instead of from left to right as in the case of Figure 1. In other words, fluid flow at the time actuation of the valve 30 is to occur is in the direction of closing movement of the valve 38.

Hence, just before the lug 85 approaches the point at which it is ready to pass under the arm 66 (Figure 4), and the ball 62 is about ready to drop into the notch 75, a rapidly accelerated throttling action occurs in the hydraulic valve unit 30 as the valve 38 closely approaches but is still physically separated a small amount from the seat 37. This momentary throttling action establishes a momentary but relatively substantial pressure difference on opposite sides of the valve 38, being greater on the right or upstream side of the valve (Figure 5) than on the left or downstream side, and causes the valve 38 to be drawn sharply toward its seat 37 with a snap action against the tension of the spring 72. This momentarily shuts off flow through the hose line 6 (and also the hose line 6) and hence the valve mechanism 3 on the tractor is automatically tripped, returning the valve 101 to neutral. The slight movement of the valve 38, pin 51 and arm 55 as the valve 38 is snapped against its seat 37 by the aforesaid throttling action and the resulting momentary relaxation of pressure between the ball 62 and notch 61 causes the ball 62 to move immediately into the notch 75.

The condition of the system at the time the valve 38 closes in that both check valves 139 and 140 close as the main valve 101 returns to neutral, and it may appear that fluid in the line 7 between the right hand side of the "closed" valve 38 and the cylinder 11 will be trapped at such pressure as to prevent the spring 72 from opening the valve 38. But it must be remembered that the action is almost instantaneous and the valve 38 need not close perfectly and completely in order to establish a sufficient restriction in the line 7 to bring about a pressure rise capable of actuating the relief valve 133. The point is that it is neither necessary nor desirable for the valve 38 to seal tight against the seat 37. It merely has to throttle the oil at this point sufficiently to build up pressure in the line 6 to a point where the relief valve operates to return the control valve 101 to its neutral position. With a very slight leakage between the valve 38 and seat 37, pressure will be balanced throughout

the full length of the line 7 from the check valve 140 to the cylinder 11. The valve 38 is, therefore, in hydraulic balance and even a very slight tension of the spring 72 results in returning the valve 38 to neutral as soon as the ball 62 drops into the notch 75.

What actually occurs is the flow of fluid at this point becomes less than the pump discharge with the result that the fluid pumped in excess of the flow between the valve 38 and its seat 37 is discharged through the relief valve causing the valve 101 to return to its neutral position, which in turn closes both check valves 139 and 140. As a result, the pressure in the line 7 including the valve 30 equalizes all points between the check valve 140 and the cylinder 11.

While I have shown and described above the preferred structure in which the principles of the present invention have been incorporated, it is to be understood that my invention is not to be limited to the particular details shown and described above, but that, in fact, widely different means may be employed in the practice of the broader aspects of my invention.

What I claim, therefore, and desire to secure by Letters Patent is:

1. In an agricultural implement having a part movable back and forth between different positions and a fluid motor unit connected to move said part, a valve controlling the flow of fluid to and from said unit, means biasing said valve for movement into an open position, a control member having a detachable connection with said valve, means acting through said control member for closing said valve when the part reaches a given position, and means operative when said part reaches said position for disconnecting said control member from said valve.

2. The combination with a fluid motor having relatively movable motor members and a conduit connected therewith, of an automatic control valve disposed in said conduit and including a valve closure, means for normally holding said closure in an open position, arm means detachably connected with said closure and adapted when moved in one direction and when connected with said closure for moving the latter into a closed position, means movable by relative movement of said motor members for operation on and including a part adapted to engage and move said arm means for shifting said closure into its closed position, said part being positioned to move beyond said arm means at the point where the latter shifts said closure into its closed position, means for disengaging said arm means when it is moved by said part into its position closing said valve, whereby said valve is sequentially closed and then opened, and means for shifting said arm means into a position providing for its reconnection with said valve closure.

3. The invention set forth in claim 2, further characterized in that said means for restoring the arm means comprises a part movable with said piston when the latter is shifted in a direction opposite to that in which said part is shifted when operating said arm means to close said valve closure.

4. The combination with a double-acting hydraulic motor unit having relatively movable motor members and a fluid conduit connected therewith, of an automatic control valve incorporated in said conduit and comprising a valve body, a valve closure movable therein, means for normally holding said closure in an open position, arm means detachably connected with said

closure and adapted when connected thereto to shift said closure into a closed position, means for disconnecting said arm means from said closure at the point where the latter substantially reaches its closed position, means movable by relative movement of said motor members in one direction for shifting said arm means to cause said closure to be closed when the motor members are moved relatively in said one direction to a given point in their range of movement, and means operated by relative movement of the motor members in the other direction for shifting said arm means into a position in which it is reconnected with said valve closure.

5. In an agricultural implement of the type having a part adapted to be adjusted by power, the combination of a power unit including valve mechanism automatically returnable to a neutral position upon the occurrence of excessive pressure in the system, a double-acting hydraulic power unit including a fluid chamber and a motor member movable therein, a pair of fluid conduits leading from said valve mechanism to opposite ends of said chamber to conduct fluid to and from opposite sides of said motor member, a control valve unit in one of said conduits and including a valve and a valve seat, movement of the motor member in one direction being accompanied by a flow of fluid through said one conduit in a direction past said valve toward and through said seat, and means actuated by movement of said motor member in said one direction to shift said valve toward said valve seat in the direction of said fluid flow, whereby as said valve is moved to a position closely approaching said valve seat the resulting throttling action on the fluid flow establishes a pressure differential on opposite sides of the valve which results in a completion of the movement of the valve to its closed position and thereby effecting the return to neutral of said power unit valve mechanism.

6. In an agricultural machine including a part to be shifted by power, the combination of a source of hydraulic power including valve mechanism automatically returnable to a neutral position upon the occurrence of an abnormal pressure in the system, a hydraulic motor having relatively movable members connected with said part, a conduit extending between said unit and said valve mechanism and accommodating a flow of fluid in one direction between said unit and said valve mechanism when the motor members are moved relatively, means including a valve and valve seat interposed in said conduit and arranged so that said valve is movable in said one direction with said fluid flow toward said seat, and valve operating means connected with said valve and one motor member for causing movement of the latter to move said valve in said one direction toward said seat to a point sufficiently close to said seat so as to throttle the fluid flow and create sufficient pressure differential on opposite sides of said seat to complete the closing of said valve against said seat independent of further movement of said one motor member and thereby to increase the pressure in said system to return said valve mechanism to its neutral position.

7. For an implement of the type having a part adjustable in different directions by fluid-pressure apparatus including a fluid motor having relatively movable parts operative to adjust the implement part selectively in any of the aforesaid directions, a source of fluid pressure, a fluid-pres-

sure-transmitting circuit including the fluid-pressure source and the motor and a manually operated main control valve for regulating the flow of fluid pressure between the source and the motor, the improvement comprising: second valve means in the circuit, separate from the main valve and effective to open the circuit so that the main control valve may regulate the circuit for the transmission of fluid pressure at a predetermined rate between the source and the motor to effect operation of the motor for adjusting the implement part in one direction, or to positively close the circuit, apart from manual regulation of the circuit by the main control valve, for completely discontinuing transmission of fluid pressure to the motor; means engageable by one of the aforesaid parts and in controlling association with the second valve means and operative automatically in response to a predetermined extent of said one-direction operation of the motor to effect closing of the second valve, and means energized by closing movement of the second valve and automatically effective immediately subsequent to closing of the second valve for automatically reopening the second valve to condition the circuit for subsequent manual regulation by the main control valve to transmit fluid to the motor at the aforesaid rate for subsequent operation of the motor to adjust said part further in said one direction and beyond the aforesaid predetermined extent.

8. For an implement of the type having a part adjustable in a certain direction by fluid-pressure apparatus including a fluid motor having relatively movable parts operable to adjust the implement part selectively in said direction, a source of fluid pressure, a fluid-pressure-transmitting circuit including the fluid-pressure source and the motor and a main control valve for regulating the flow of fluid pressure between the source and the motor, the improvement comprising: second valve means in the circuit, separate from the main valve and effective to establish a first condition of circuit-control, in which the circuit transmits fluid pressure between the source and the motor to effect operation of the motor for adjusting the implement part in said direction, or a second condition of circuit-control for discontinuing operation of the motor, actuating means engageable by one of the aforesaid parts and in controlling association with the second valve means and operative automatically in response to a predetermined extent of said one-direction operation of the motor to effect the aforesaid second circuit-control condition of the second valve; and means connected with the circuit and effective subsequent to the occurrence of said second circuit-control condition of the second valve means for automatically conditioning the circuit for continued operation of the motor to adjust said part further in said direction beyond the aforesaid predetermined extent, and said actuating means including cooperating elements having provision for overrunning after actuation of the second valve so that continued operation of the motor may be had without affecting said second valve.

9. In an agricultural implement of the type having a part adapted to be adjusted by power, a fluid-pressure system comprising: the combination of a power unit including valve mechanism automatically returnable from a manually set activating position to a neutral position upon the occurrence of excess pressure in the system, a fluid-pressure motor having means

for connection with the implement tool means and having a fluid-transmitting connection with the power unit, a control valve in said fluid-transmitting connection and having a first actuating element, means including a second actuating element operated by actuation of said motor to a predetermined extent for engagement with the first actuating element to close said control valve to an extent sufficient to create a condition resulting in excess pressure in the system and thus to stop the motor by effecting the return to neutral of said valve mechanism, releasable means operated by actuation of said motor to said predetermined extent to store energy for causing re-opening of said control valve so that subsequent setting of the valve mechanism in its activating position will cause actuation of the motor beyond said predetermined extent, and said actuating elements being separable after closing and re-opening of the control valve to accommodate overrunning of one element by the other as the motor is actuated beyond said predetermined extent.

10. In an agricultural implement having a part adapted to be adjusted by power, the combination of a fluid-pressure power unit including valve mechanism for controlling the transmission of fluid under pressure to and from said power unit and including means responsive to an abnormal increase in pressure for returning the valve mechanism from a manually set activating position to a neutral position in which such fluid transmission is discontinued, a fluid-pressure motor having motor members movable relatively through a given range and adapted to be connected with said implement part for adjusting said part, fluid-transmitting means extending from said motor to said valve mechanism, a valve in said fluid-transmitting means having a fluid-flow restricting phase and biased for change to an open phase accommodating relatively free transmission of fluid through said fluid-transmitting means, a first actuating element connected to the biased valve and a second actuating element connected with one of the motor members and cooperative with the first actuating element to change said biased valve to its fluid-flow restricting phase when said motor members move relatively to a given position within said range so as to cause said valve mechanism of said power unit to be returned to its neutral position, said first actuating element including a releasable connection with said biased valve operative to release said biased valve for subsequent return to its open phase to provide for subsequent manual setting of the valve mechanism in its activating position to effect operation of said motor beyond said given position, and said actuating elements having provision for the overrunning of one by the other as the motor is operated beyond said given position.

11. For an implement of the type including a supporting part and an implement part connected thereto for movement with respect thereto in at least one direction: fluid-pressure apparatus comprising a fluid motor having first and sec-

ond parts provided with means for connection respectively to the implement and supporting parts and arranged for movement of one relative to the other in at least one direction to move the implement part as aforesaid; a source of fluid pressure having high and low sides; a fluid-pressure circuit connected to and including the fluid-pressure source and the motor for transmitting fluid pressure between the motor and the source; a control valve in the circuit selectively movable to a neutral position to cut out the circuit between the source and the motor or to an active position for establishing the circuit; pressure-relief means in the circuit operative in response to abnormal fluid pressure in the circuit for by-passing the motor and diverting the fluid pressure to the low side of the fluid-pressure source; means connected between the pressure-relief means and the control valve for returning the control valve from its active position to its neutral position in response to actuation of said pressure-relief means; means including a second valve in the circuit actuatable from a first position conditioning the circuit for the supply of fluid to the motor at normal pressures, to a second position restricting said circuit to an extent sufficient to cause an excess of pressure therein effective to operate the pressure-relief means; actuating means operative in response to a predetermined extent of movement of one motor part relative to the other in said direction for actuating the second valve means from its first position to its second position and hence to effect return of the control valve to neutral via operation of said pressure-relief means; means operative in response to actuation of said second valve means to its second position for conditioning the circuit for the subsequent transmission of fluid between the motor and said source so that re-positioning of the control valve to its active position is effective to again initiate operation of the motor whereby relative movement of said parts in said direction may be resumed; and said actuating means including cooperative elements having provision for overrunning relative to the second valve means after actuation of said second valve means to its second position so that said second valve means is unaffected by subsequent operation of the motor in said direction.

JOHN H. STARR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,223,792	Muir	Dec. 3, 1940
2,243,364	Trautman	May 27, 1941

FOREIGN PATENTS

Number	Country	Date
527,171	Great Britain	Oct. 3, 1940
327,386	Germany	Oct. 11, 1920