2061386

A MANUAL OVERRIDE CONTROL FOR A DOUBLE-ACTING ACTUATOR

This invention relates to an apparatus for operating a double-acting fluid or electrically powered actuator, and more particularly to a manual control for mechanically extending or retracting an actuator rod in the event of a failure of the primary fluid or electrical means of controlling the actuator.

Double-acting actuators, either hydraulically or electrically powered, are commonly used to open and close various types of valves employed in the testing, production and shutting down of oil and gas wells in the petroleum industry. In such use the actuator is mounted on the well Christmas tree, and the actuator rod in connected to the valve closure element so that axial movement of the rod between its extended and retracted positions results in opening or closing the valve. The hydraulic or electrical power source is usually at a remote location from the well, especially in the case of offshore or subsea wells, and is connected to the actuator by hydraulic or electrical lines that may extend for a considerable distance. If any of these lines are damaged, or if they sufficiently deteriorate, the actuator very likely will malfunction, resulting in a loss of control of the associated valve which thereby could be locked into

an open position, thus allowing petroleum products to escape, or in a closed position which would prevent testing the well and/or production of petroleum therefrom.

Prior art override controls for such actuators are not entirely satisfactory and a requirement exists for an improved override control.

According to the present invention there is provided a manual override control for operating a double acting actuator having an actuator housing and an actuator rod with a distal end of said rod projecting from one end of said actuator housing and having a pin extending transversely thereof, said override control comprising a generally cylindrical housing having an axially extending passage, a threaded drive nut mounted in said passage, a threaded member threaded to said drive nut, said member having a socket at one end thereof, said socket having a J-slot therein for engagement with said pin on said distal end of the actuator rod, for selectively connecting said socket to said actuator rod, and means for rotating said drive nut to move said threaded member and said socket axially along said passage and to move said actuator rod between an extended and a retracted position when said socket is connected to said actuator rod.

The present invention also provides a manual override control for selectively operating a double-acting actuator, said actuator having an actuator housing and an actuator

rod with a distal end projecting from said actuator housing and having a connector extending transversely therefrom, said control comprising a control housing having an internal passage and a laterally directed aperture, a threaded member having a socket portion at one end thereof for receiving said rod distal end therewithin, means for mounting said threaded member to said control housing for axial movement in said passage, said socket portion having means for releasably engaging said rod distal end connector, a handle member carried by said socket portion and extending laterally through said control housing aperture, means mounting said threaded member and said socket portion in said control housing to facilitate removing said override control from said actuator as a single unit, and means for moving said threaded member in said passage to selectively move said actuator rod relative to said actuator housing when said socket portion has said rod distal end received therein and engaged therewith upon operation of said laterally directed handle member.

Some embodiments of the invention are shown by way of example in the accompanying drawings, in which:-

Figure 1 is a longitudinal section, of one embodiment of a manual override control according to the present invention.

Figure 2 is a vertical section taken along the line 2-2 of Figure 1.

Figure 3 is a side elevation, partially in section, of an end portion of a double acting actuator, showing details of the means for connecting the actuator to the override control

Figures 4 and 5 are side elevations, partially in section, showing details of the operation of the embodiment of Figure 1.

Figure 6 is a side elevation, partially in section and on a reduced scale, of another embodiment of the invention, showing details of the means for connecting the override control to a double-acting actuator while allowing normal hydraulic or electrical control of the actuator.

Figure 7 is a side elevation, partially in section, of another embodiment of the present invention connected to a double-acting actuator. Portions of this view which are identical with the apparatus of Figure 1 have been omitted.

Figure 8 is a view taken along the line 8-8 of Figure 7.

Figure 9 is a view taken along the line 9-9 of

Figure 7.

Figures 10 and 11 are each side elevations, partially in section, of a portion of the embodiment of the invention shown in Figure 7, illustrating the operation of the override control.

Figure 12 is a side elevation, partially in section, of another embodiment of the override control of the present invention connected to a double-acting actuator. Portions of this view which are identical with the apparatus of Figure 1 have been omitted.

Figure 13 is a view taken along the line 13-13 of Figure 12.

Figure 14 is a view taken along the line 14-14 of Figure 12.

Figure 15 is a side elevation of a portion of the embodiment shown in Figure 12, illustrating operation of the override control.

Figure 16 is a side elevation of a portion of the embodiment shown in Figure 12, illustrating details of the connection of various internal parts.

A manual override control for a double-acting hydraulic or electrically powered valve actuator according to one embodiment comprises an elongate outer control housing 11 (Figs. 1, 2, 4 and 5), with an axial passage 12 (Fig. 1) extending therethrough and having internal screw threads 13 for connecting the housing to a double-acting actuator 17 (Figs. 3-5). The right end portion of the actuator 17 (Fig. 3) includes external screw threads 18 onto which the housing 11 is threaded and then

locked in position by a plurality of set screws 19.

A pair of annular bearing support members 23, 24 are mounted in the right end portion of the passage 12 (Fig. 1) and are retained in position by a pair of shearable set screws 25 each extending through a threaded hole 29 in the housing 11 and into members 23,24. An annular drive nut 30, having a radial outward flange 31 and a threaded bore 32, is rotatably mounted with the flange 31 between a radial inward flange 36 on the support member 23 and a radial inward flange 37 on the support member 24. A plurality of needle or other rollable bearing means 38a is positioned between the flanges 31 and 36, and another plurality of similar needle roller bearings 38b is positioned between the flanges 31 and 37.

A screw-type threaded member 42, having a cylindrical threaded shank 43 rotatably mounted in the threaded bore 32 of the drive nut 30, includes an enlarged socket portion 44 having a pair of J-slots 48,49 therein. A handle 50 (Figs. 1, 2, 4 and 5), threaded or otherwise connected to the outer surface of the socket portion 44, extends radially outward from the socket portion through a slot 51 (Figs. 1 and 2) in the side of the housing 11, with the upper and lower ends of the slot 51 defined by the edges 51a,51b respectively. The socket portion 44 is adapted to slip over an actuator rod 54 (Figs. 3-5) extending axially outward from the end of the actuator 17. A pin 55, mounted transversely through a bore 56 (Fig. 3) in the actuator rod 54 and secured in place by set screw 60 mounted in a threaded axial bore 61, slides into the J-slots 48,49 (Figs. 1, 2, 4 and 5) when the socket portion

44 (Figs. 1, 2, 4 and 5) is positioned about the actuator rod 54.

A cylindrical protective cap 62 (Fig. 1), threaded to the outer end of the drive nut 30, seals out dirt, dust and protects the threaded shank 43 from damage. A handwheel 66 (Fig. 1) is mounted around the protective cap 62 (Fig. 1) and secured to the drive nut 30 by one or more set screws 67, each of which extends through a threaded hole 68 in a wheel flange 72 and into a bore 73 in the drive nut 30, to facilitate rotation of the drive nut.

The threaded member 42 and the socket portion 44 move axially toward the actuator rod 54 when the handwheel 66, as viewed in Figure 2, is rotated counterclockwise. The action of gravity on the handle 50 and friction between the threaded bore 32 of the drive nut 30 and the threaded shank 43 causes the handle 50 to ride along the lower slot edge 51b as the handwheel 66 is rotated counterclockwise, thereby aligning the entrance to the J-slots 48,49 with the pin 55 (Figs. 2-5) and causing the pin 55 to move into position in these slots (Fig. 5) as the socket member moves near the actuator 17. When the handle 50 is moved upward, i.e., clockwise (Fig. 2), against the upper edge 51a of the housing slot 51, the pin 55 (Fig. 4) moves into the notch 48b of the J-slot. When the pin 55 is in notch 48b a clockwise rotation of the handwheel 66 (Fig. 2) moves the threaded member 42 and the socket portion 44 away from the actuator 17, thereby pulling the actuator rod out of the actuator 17 into the rod's extended position.

To disengage the socket portion 44 from the actuator rod 54 the handwheel 66 is again rotated counterclockwise (Fig. 2) until the pin 55 (Fig. 4) moves axially away from the notch 48b. The handle 50 (Fig. 2) is then rotated counterclockwise until it rests against the slot edge 51b and the pin 55 moves into the J-slot adjacent the notch 48a. The handle 50 is held against the slot edge 51b while the handwheel is then rotated clockwise to move the socket portion 44 away from the actuator 17 and move the pin 55 out of the J-slots 48,49.

Hydraulic or electrical operation of the actuator can be resumed when repairs are completed on the primary control system. If the human operator should forget to disconnect the socket portion 44 from the actuator rod 54 before such primary control operation of the actuator is resumed, axial movement of the actuator rod causes corresponding axial movement of the threaded member 42 and of the bearing support members 23,24, thus shearing the set screws 25 (Figs. 1 and 2) and allowing further unrestricted axial movement of the actuator rod.

A second embodiment of the present invention is illustrated in Figures 7-11. This embodiment differs from that of Figures 1-5 by the inclusion of a different means for connecting the actuator rod to the threaded member of the override control. A threaded member 42a includes a socket portion 44a with a cylindrical inner member 78 having an outwardly extending annular flange 79 (Figs. 7 and 10) at the right end, and having a plurality of tapered radial extending holes 80 circumferentially positioned around the left end portion. A plurality of

spherical balls 84, each positioned on one of the tapered holes 80, are too large to move through the radially inward end of the holes 80, but can move in and out of the radially outward end of the holes. A cylindrical sleeve 85, slidably mounted around the left end of the portion of the inner member 78 (Figs. 7, 10 and 11), includes an annular inner groove 86 having a tapered surface 90 between a larger diameter portion 91 and a smaller diameter portion 92. When the small diameter portion 92 of the groove is adjacent the balls 84 (Figs. 7 and 11) the balls are pressed into the holes 80 with a portion of each ball protruding through the radially inward end of its hole 80. The sleeve 85 is biased away from the radial flange 79 of the inner member 78 by a compression spring 97 having one end bearing against the flange 79 and having the other end bearing against the end of the sleeve 85. A handle 50a is mounted in a threaded bore 98 (Figs. 7 and 11) in the sleeve 85 and extends radially outward through an axially extending slot 102 in the housing 11a. A pin 103 (Figs. 7-11) is mounted in a threaded bore 104 in the inner element 78 and extends radially outward through an L-shaped slot 108 in the sleeve 85 and through an axially extending slot 109 in the housing 11a.

The socket portion 44a of the override control is moved in an axial direction in the housing 11a by rotating the handwheel 66 as was described hereinbefore with the first embodiment of the present invention. As the socket 44a moves axially toward the actuator rod 54a (Fig. 7) the handle 50a is held against the edge 102a (Figs. 7 and 9) of the slot 102, causing the rod 103 to

extend through the portion 108a (Fig. 8) of the slot 108 and causing the groove 92 (Fig. 7) to retain the balls 84 at the radially inward portion of the holes 80. To allow the socket 44a to move on to the actuator rod 54a, the handle is moved clockwise (Fig. 9) against the edge 102b of the slot 102 and the handle is also moved axially toward the actuator 17a causing the sleeve 85 to slide along the inner member 78 to the position shown in Figure 10 and with the pin 103 at position 108b in the L-shaped slot 108 (Fig. 8). The balls 84 are forced radially outward by a cam surface 110 (Figs. 7 and 10) as the socket 44a moves toward the left and around the actuator rod 54a. Further axial movement of the socket 44a toward the actuator 17a allows the balls 84 to move into a groove 114 (Figs. 7, 10 and 11). When the handle 50a is moved counterclockwise against the edge of the slot and the spring 97 is compressed, the sleeve 85 moves to the right (Fig. 11) with the pin 103 at position 108a of the slot 108, causing the tapered surface 90 of the groove 86 to press the balls 84 into the actuator rod groove 114 and to lock the socket 44a securely to the actuator rod 54a. Rotating the handwheel 66 moves the actuator rod 54a to either the extended or retracted position as desired.

A third embodiment of the present invention is disclosed in Figures 12-15. This embodiment differs from those of Figures 1-5 and 7-11 by the inclusion of a different means for connecting the actuator rod to the threaded member of the override control. A socket portion 44b of the third embodiment includes a cylindrical outer sleeve 120 (Figs. 12 and 15) threaded to an end portion 121

of the member 42b and having an axially extending bore 122. A cylindrical inner sleeve 126, having a radially outward flange 127 at one end thereof and a sloping cam surface 128 at the other end, is slidably mounted for axial movement in the bore 122. An annular tapered retainer sleeve 132, having a radially inward flange 133, is mounted between the left end of the end portion 121 and a shoulder 134 on the outer sleeve 120. The inner sleeve 126 is biased toward the right against the threaded member 42b (Figs. 12 and 15) by a helical compression spring 138 positioned between the retainer sleeve 132 and the flange 127. A handle 50b, mounted in a threaded bore 98b in the sleeve 126 and extending radially outward through a slot 159 in the member 42b and through a slot 139 in the housing 11b, facilitates sliding the inner sleeve axially in the bore 122. A pin 103b, projecting through a slot 109b in the housing 11b and mounted in a threaded bore 104b in the sleeve 121, prevents rotation of the sleeve inside the housing 11b.

A plurality of latching dogs 140 (Figs. 12, 14 and 15) are spaced around an actuator rod 54b between the inner sleeve 126 and the retainer sleeve 132, with each of the dogs pivoted about an axis A at the right end thereof. An annular plate 144 (Figs. 12, 15 and 16) is connected to the left end of inner sleeve 126 by a plurality of tie rods 145 (Figs. 13, 14 and 16) each having one end thereof mounted in a threaded bore 146 (Fig. 16) in the end of the inner sleeve 126, and having the other end thereof secured to the plate 144 by a plurality of screws 147 each extending through a bore 155 in the plate 144 and threaded into a

bore 156 in one of the rods 145. A plurality of screws 150, each fixed in a threaded bore 151 to the plate 144 (Figs. 12 and 15), slidably extend through holes 152 in a radially inward extending flange 120a in the sleeve 120, and thence into the area adjacent the latching dogs 140.

In order to connect the socket portion 44b of the manual override control to an actuator rod 54b, the handle 50b and the sleeve 126 are moved toward the left (Fig. 12) causing the inner sleeve 126 to spread the latching dogs 140 radially outward, and the handwheel 66 (Figs. 1 and 7) rotated as described hereinbefore to move the socket portion 44b toward the actuator 17b (Fig. 12). As the handle 50b and the sleeve 126 are moved from a "locked" position shown in Figure 12 toward an "unlocked" position shown in Figure 15 the cam surface 128 on the sleeve 126 moves over a cam surface 157 on the dogs 140, forcing each of the latching dogs 140 to pivot radially outward to an unlocked position. As the inner sleeve 126 moves toward the unlocked position, the tie rods 145 move the plate 144 and the screws 150 toward the left (Figs. 14 and 15) to pull the screws 150 away from the latching dogs 140.

When the handle 50b reaches the unlocked position at the end 158 of the slot 139 (Figs. 12 and 15), the handle 50b should be moved (by hand) out of a notch 159a and the left end of the slot 159, allowing the spring 138 to move the inner sleeve 126 against the threaded member 42b. The sleeve 126 and the tie rod 145 move the plate 144 and the screws 150 toward the right, causing a cam surface 162 on the screw 150 to slide over a cam surface

163 on the latching dogs 140 to pivot the latching dogs radially inward and force a radial inward flange 140a of the dogs into a groove 164 to lock the dogs 140 to the actuator rod 54b.

The socket portion 44b of the override control can be quickly disconnected from the actuator 17b by moving the handle 50b toward the left causing the inner sleeve 126 to move the latching dogs 140 out of the groove 164 in the actuator rod 54b. The handwheel (Figs. 1 and 7) can be rotated to move the socket portion 44b of the override control away from the actuator rod, and hydraulic or electrical operation of the actuator can be resumed when the hydraulic or electrical system is functioning properly.

A fourth embodiment of the present invention is illustrated in Figure 6. This embodiment differs from that of Figures 1-5 by the inclusion of means for permanently connecting the actuator rod 54c to the threaded member 42c of the override control, and means for slidably mounting a drive nut 30c in the override control housing 11c. A bearing support member 23c, having a radially inwardly extending flange 36c at the left end thereof, is mounted in a passage 12c and retained in position by a pair of shearable set screws 25 each of which is threaded into a bore 171 in the outer housing 11c and extends into a bore 172 in the support member 23c. The annular drive nut 30c, having a radial outward flange 31c and a threaded bore 32c, is rotatably mounted with the flange 31c between a pair of annular bearing rings 173a,173b. A plurality of needle roller bearings or other bearing means 38c are mounted between the flange 31c and the bearing ring 173a, and

another plurality of similar needle roller bearings 38d are mounted between the flange 31c and the bearing ring 173b. The bearing rings 173a,173b are retained in position by a pair of annular retainer rings 177a,177b mounted in a pair of annular grooves 178a,178b respectively.

An annular sleeve 179, threaded to the right end of the bearing support, limits the axial travel of the bearing ring 173b and the drive nut 30c. The drive nut 30c, the bearing rings 173a,173b and the roller bearings 38c,38d are all slidably mounted in a passage 183 and are axially movable in the passage with the bearing ring 173a, 173b and the nut flange 31c movable in the space between the threaded sleeve 179 and the radial flange 36c of the bearing support 23c. An annular seal 184 between the drive nut 30c and a shoulder 185 of the threaded sleeve seals out foreign matter from the passage 183, and a protective cap 189 threaded to the end of the drive nut 30c seals out foreign matter from the end of the drive nut. The handwheel 66 is connected to the drive nut 30c by one or more set screws 67 each extending through a threaded hole 68 in the wheel flange 72 and secured to a bore 90 in the drive nut 30c, to facilitate rotation of the drive nut.

When the handwheel is rotated counterclockwise (as viewed in the direction of the arrow B) the drive nut 30c, the bearing rings 173a,173b and the bearings 38c,38d move to the left (Fig. 6) until the bearing ring 173a contacts the radial flange 36c. Further counterclockwise rotation of the handwheel moves the threaded member 42c and the actuator rod 54c toward the right (Fig. 6),

moving the rod 54c into the extended position. A clockwise rotation of the handwheel moves the bearing rings 173a, 173b and drive nut 30c to the right in the passage 183 while the actuator rod 54c remains extended. When the bearing ring 173b moves to a position near the threaded sleeve, hydraulic operation of the repaired actuator can be resumed with the bearing rings 173a,173b and the flange 31c of the drive nut movable axially back and forth in the passage 183 between the flange 36c and the threaded sleeve 179.

To manually move the actuator rod 54c (Fig. 6) of a disabled actuator from an extended position to a retracted position, the handwheel 66 is rotated clockwise until the bearing ring 173b contacts the threaded sleeve 179. Further clockwise rotation of the handwheel 66 and the drive nut 30c moves the threaded member 42c and the actuator rod 54c to the left toward the retracted position. Reversing the rotation of the handwheel moves the bearing ring 173a to a position near the flange 36c and allows operation of a repaired actuator with the bearing rings 173a,173b and the flange 31c of the drive nut movable in the passage 183.

If a human operator should forget to move the bearing rings173a,173b away from either the flange 36c or the threaded sleeve 179 before hydraulic operation is resumed, movement of the actuator rod 54c may force the bearing rings 173a,173b against either the flange 36c or the sleeve 179 providing an axial force on the bearing support member 23c which will shear the screws 25 and permit hydraulic operation of the actuator 17c.

The present invention provides means for selectively connecting a manual override control to a hydraulic or electric actuator to operate the actuator in the event of a failure of the normal hydraulic or electric control system. The manual override can be quickly connected to the actuator in an emergency and can be quickly disconnected when normal operation is restored.

CLAIMS

1. A manual override control for operating a double acting actuator having an actuator housing and an actuator rod with a distal end of said rod projecting from one end of said actuator housing and having a pin extending transversely thereof, said override control comprising a generally cylindrical housing having an axially extending passage, a threaded drive nut mounted in said passage, a threaded member threaded to said drive nut, said member having a socket at one end thereof, said socket having a J-slot therein for engagement with said pin on said distal end of the actuator rod, for selectively connecting said socket to said actuator rod, and means for rotating said drive nut to move said threaded member and said socket axially along said passage and to move said actuator rod between an extended and a retracted position when said socket is connected to said actuator rod.

2. A manual override control as defined in claim 1 including a plurality of bearing means mounted between said cylindrical housing and said threaded drive nut.

3. A manual override control as defined in claim 1 including a handwheel secured to said drive nut to rotate said nut as said handwheel is rotated.

4. A manual override control as defined in claim 1 including a handle connected to said socket to facilitate moving said socket to bring said J-slot into or out of engagement with the pin on said actuator rod.

5. A manual override control for selectively operating a double-acting actuator, said actuator having an actuator housing and an actuator rod with a distal end projecting from said actuator housing and having a connector extending transversely therefrom, said control comprising a control housing having an internal passage and a laterally directed aperture, a threaded member having a socket portion at one end thereof for receiving said rod distal end therewithin, means for mounting said threaded member to said control housing for axial movement in said passage, said socket portion having means for releasably engaging said rod distal end connector, a handle member carried by said socket portion and extending laterally through said control housing aperture, means mounting said threaded member and said socket portion in said control housing to facilitate removing said override control from said actuator as a single unit, and means for moving said threaded member in said passage to selectively move said actuator rod relative to said actuator housing when said socket portion has rod distal end received therein and engaged therewith upon operation of said laterally directed handle member.

* C L M S *

(32)

6. A manual override control as defined in claim 5 wherein said laterally directed connector is a transversely extending pin secured to said rod, said engaging means of said socket portion includes a J-slot therein for cooperative engagement with said pin, and said socket portion is mounted for rotation by said handle member for effecting said cooperative engagement.

7. A manual override control as defined in claim 5 wherein said engaging means of said socket portion comprises a series of locking balls mounted for radial movement therein, and further includes a sleeve mounted on said socket portion for axial shifting movement by said handle member and having cam surfaces for shifting said balls into said groove, for locking engagement with a groove extending around said rod distal end.

8. A manual override as defined in claim 5 wherein said engaging means of said socket portion includes a series of locking dogs mounted for pivotal movement therein, and further includes a sleeve mounted on said socket portion for axial shifting movement by said handle member and having a cam surface for pivoting said dogs into and from said groove, for locking engagement with a groove extending around said rod distal end.

9. A manual override control substantially as herein-before described with reference to the accompanying drawings.

The text of the specification has been reproduced by photocopying the applicants original typescript. It may contain a few amendments which are difficult to read. The original typescript containing these amendments may be inspected on the premises of the Patent Office