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Sheesley et al.

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[54] **ACTUATOR OVERRIDE**

[75] Inventors: **John M. Sheesley; Ronald A. Gulick,** both of Houston, Tex.

[73] Assignee: **Research Engineering Company,** Houston, Tex.

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Related U.S. Application Data

[63] Continuation of Ser. No. 865,342, Oct. 10, 1969, abandoned.

[52] **U.S. Cl.** **92/33,** 92/13, 92/138, 91/391

[51] **Int. Cl.** **F01b 9/02,** F15b 13/10

[58] **Field of Search**. 92/33, 31, 138; 91/375 A, 391

[56] **References Cited**

UNITED STATES PATENTS

693,517	2/1902	Halsey	92/33
1,234,882	7/1917	Doble	91/391 R
2,295,288	9/1942	Nardone	92/33
2,360,539	10/1944	Ballard	92/33
2,988,059	6/1961	Wysong, Jr.	91/375 A
3,022,772	2/1962	Zeigler et al	91/375 A
3,217,604	11/1965	Knox	91/391 R
3,614,913	10/1971	Clark	92/138

FOREIGN PATENTS OR APPLICATIONS

549,513	7/1956	Belgium	91/391 R

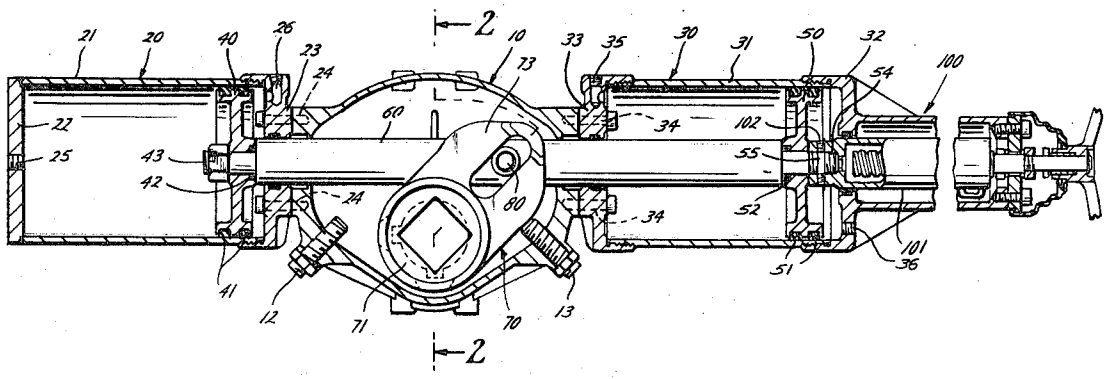
Primary Examiner—Paul E. Maslousky

Attorney, Agent, or Firm—Robert W. B. Dickerson

[57] **ABSTRACT**

An actuating device may comprise: at least one cylinder; means for providing fluid under pressure to the cylinder; a piston mounted in the cylinder for longitudinal sliding motion; a rod attached to the piston for longitudinal motion therewith; a crank member adapted for attachment to apparatus to be actuated; a mechanism connecting the rod and crank member adapted to convert longitudinal motion of the rod to rotary motion of the crank member; and a manual override assembly connected to the rod for displacement of the rod without providing fluid under pressure to the cylinder. The manual override assembly may comprise a ball screw mechanism in which the nut portion may be non-rotatingly attached by a hollow shaft to the end of the rod. The screw shaft of the ball screw mechanism may be mounted coaxially with the rod and rotatingly supported on a support housing adjacent to the cylinder. The end of the screw shaft may be adapted to receive a disengageable handwheel for rotation of the screw shaft and consequent reciprocation of the nut portion and attached rod.

6 Claims, 4 Drawing Figures



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SHEET 1 OF 2

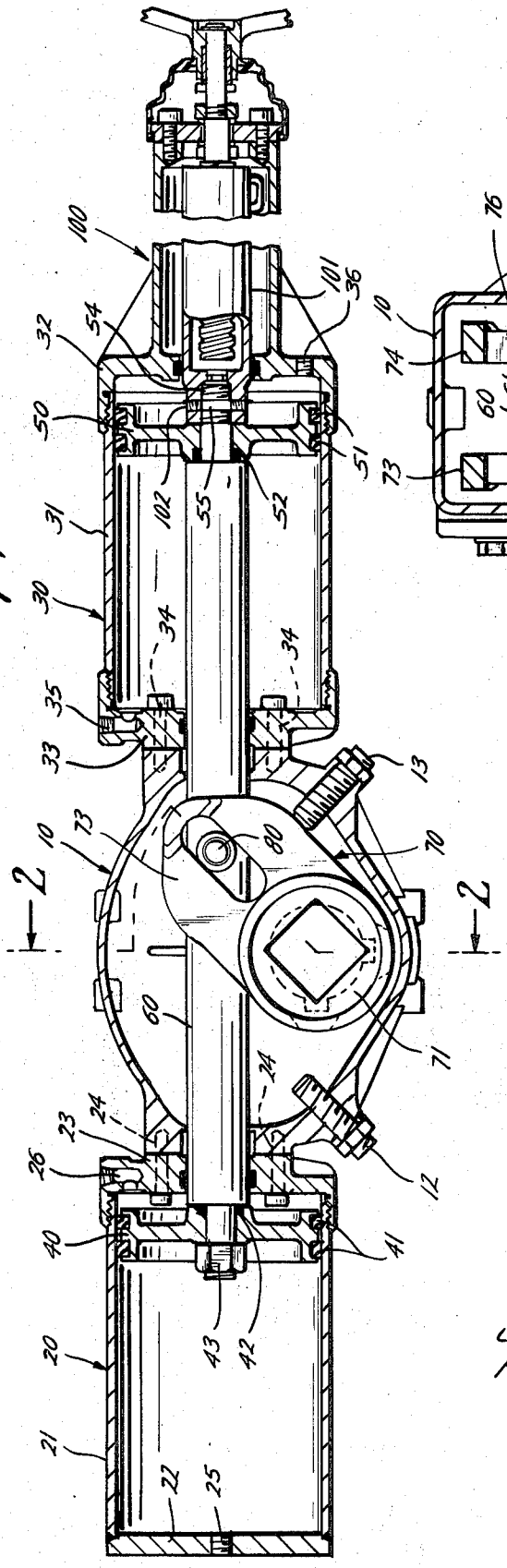


Fig. 1

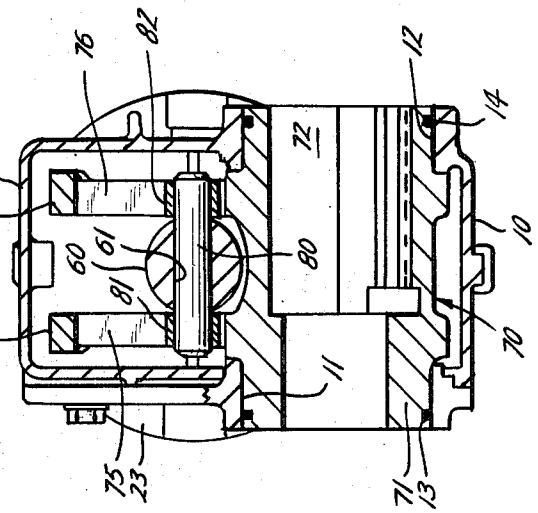


Fig. 2

John M. Sheesley
Ronald A. Gulick
INVENTORS

BY
Bill B Berryhill
ATTORNEY

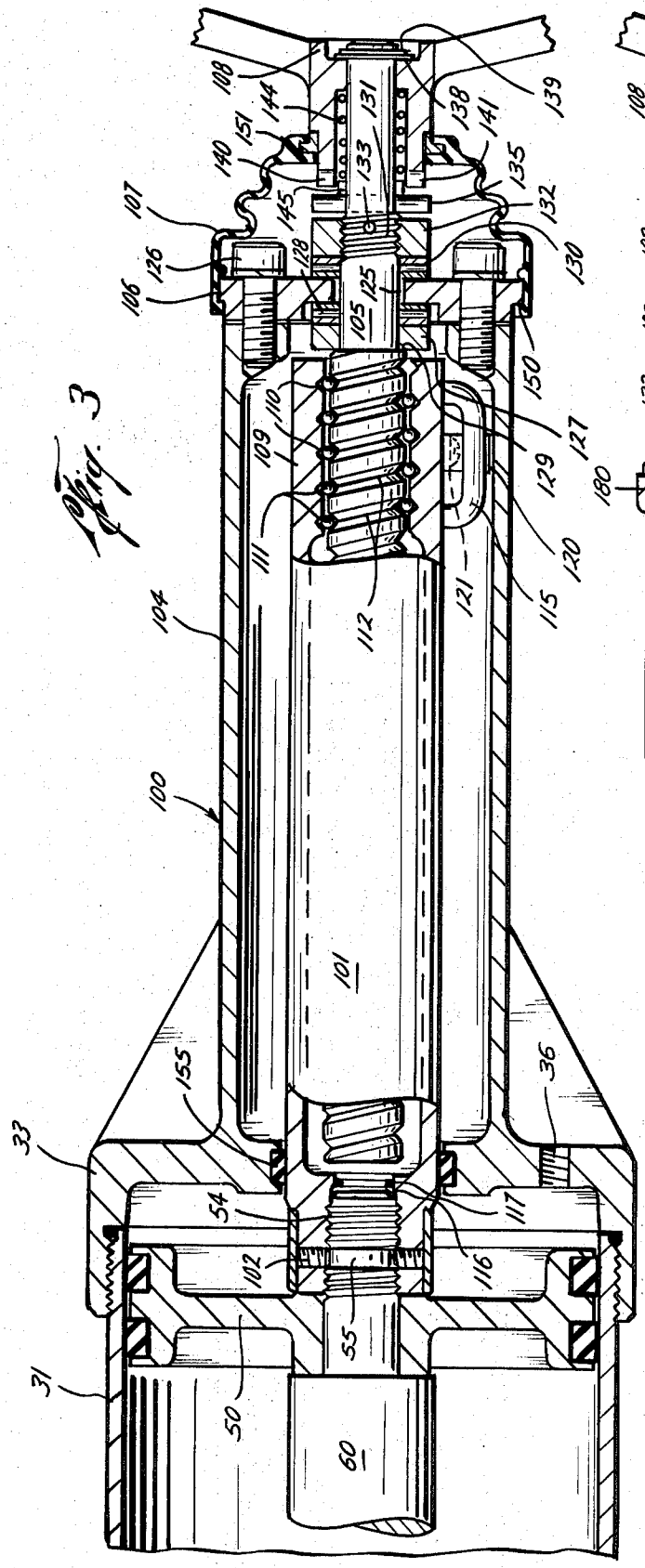


Fig. 3

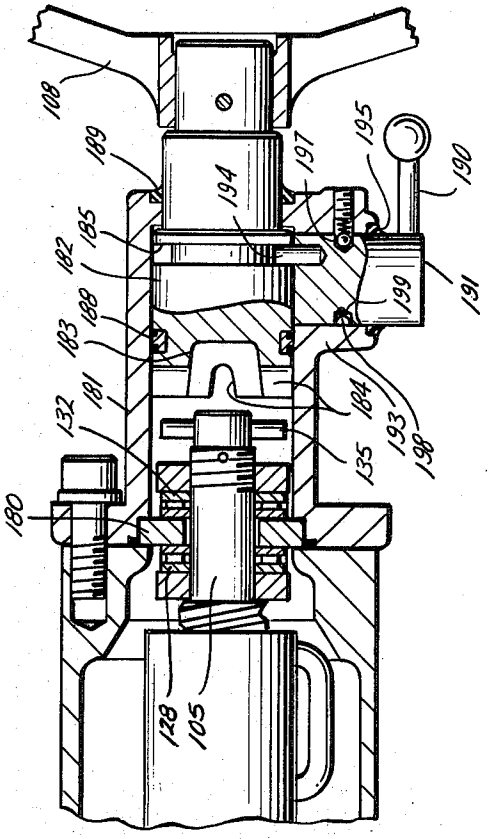


Fig. 4

John M. Sheesley
Ronald A. Gulick
INVENTORS

BY
Bill B Berryhill
ATTORNEY

ACTUATOR OVERRIDE

RELATED APPLICATION

This application is a continuation of application No. 865,342 filed Oct. 10, 1969, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to fluid powered actuators for operating valves. More specifically, it concerns manual override means for actuating the valves independently of fluid operation should fluid power be unavailable.

2. Description of the Prior Art

It is well known in the art to provide fluid actuators for operating valves. These actuators are very desirable from the standpoint of ease of operation and adaptability to automatic operation. However, any operation dependent on mechanical or electrical components is subject to malfunctions. Valve actuators are no exception. Fluid actuators may occasionally lose fluid power or malfunction for any one of several reasons well known in the art. Even in some situations not due to malfunction or fluid power loss, it may be desirable to open or close a valve independently of its fluid power.

In order to operate a valve independently of its fluid power, manual override mechanisms have been developed. In the past, however, these manual override mechanisms have been "stacked" on top of, or adjacent to, the fluid actuator. This has resulted in a cumbersome, space consuming and expensive assembly.

SUMMARY OF THE INVENTION

The present invention provides a unique, efficient and compact manual override for use with a fluid operated actuator. The override comprises a ball screw mechanism which is mounted adjacent to a cylinder of the actuator. The screw portion of the mechanism is mounted coaxially with the piston rod of the actuator and is threadingly connected to the rod through ball bearings and a nut in which the ball bearings are confined by internal threads. The nut may be attached to the rod by a coaxial hollow shaft so that on rotation of the screw by a handwheel or such the rod is reciprocated due to the threading make up of the screw and nut. Thus, the valve or other apparatus to which the actuator is attached may be operated even if the fluid pressure to the actuator should fail. Under normal operating conditions the nut is reciprocated back and forth on the screw causing the screw to rotate freely with very little friction loss. This unique coaxial arrangement reduces the space required by "stacked" type overrides.

BRIEF DESCRIPTION OF THE DRAWINGS

other objects and advantages of the invention will become apparent from the description which follows when taken in conjunction with the attached drawings in which:

FIG. 1 is a plan view partially in section of an actuator and override assembly according to a preferred embodiment of the invention;

FIG. 2 is a sectional elevation view of the actuator of FIG. 1 taken on lines 2—2 therein;

FIG. 3 is an enlarged sectional plan view of the override assembly of FIG. 1; and

FIG. 4 is an enlarged sectional plan view of a portion of an override assembly with an alternate handwheel engagement design.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. 1, the valve actuator described herein comprises a body member **10**, cylinders **20** and **30** mounted on opposite sides of body **10**. Cylinder housings **21** and **31** include, at their opposite ends, outer cylinder heads **22** and **32**, respectively, and inner cylinder heads **23** and **33**, respectively. Cylinder head **22** is welded to cylinder housing **21** but the rest of the heads **23, 32, 33** are threaded to their respective housings. Inner cylinder heads **23** and **33** are attached to the body **10** by cap screws **24** and **34**, respectively. Outer cylinder head **32** forms a portion of an override assembly **100** which will be more fully described hereafter.

A piston **40** and **50** is mounted in each cylinder housing **21** and **31**, respectively, for longitudinal sliding movement therein. Each piston is attached to opposite ends of a rod **60** so that they move in unison with the rod, one piston moving toward body **10** while the other moves away from body **10** and vice versa on reciprocation. Piston **40** is attached to rod **60** by nut **43** while piston **50** is attached by internally threaded ball screw nut shaft **101**. Set screws **102** prevent the disengagement of the threaded connection **54** between rod **60** and ball screw nut shaft **101**. The threaded portion of rod **60** is undercut at **55** to prevent galling of the threads. The undercut area **55** could just as easily be located at the end of the rod **60**. Sliding seals **41** and **51** are mounted in annular grooves provided around the periphery of each piston **40, 50**. Annular seals **42, 52** seal the connection between rod **60** and pistons **40, 50**.

Body **10** may be attached by brackets, flanges or the like (not shown) to a valve to be operated by the actuator. Rotatingly mounted within body **10** is a yoke or crank member **70** adapted for attachment to the stem of the valve to be operated. Referring also to FIG. **2**, hub **71** and socket **72** may be provided for this purpose. Hub **71** extends transversely of the body **10** and is rotatably mounted within aligned apertures **11** and **12** in the body **10** and is sealingly engaged in the apertures by means of O-rings **13** and **14**. Yoke **70** is provided with a pair of slotted fingers **73, 74** which extend on either side of rod **60**. A pin **80** mounted in a hole **61**, drilled through rod **60**, extends on either side of rod **60**. The ends of pin **80** are provided with bearing sleeves **81, 82** for sliding engagement with slots **75** and **76** of fingers **73** and **74**.

The yoke and pin mechanism just described translates the longitudinal movement of pistons **40** and **50** into rotary movement which is transmitted to the stem of a valve by yoke **70**. The mechanism shown is primarily for plug valves and similar valves which are operated by no more than about 90 degree rotation of the stem. However, it could be adapted for other type valves.

So far, with the exception of override assembly **100** and the attachment of ball screw nut shaft **101** to rod **60**, the actuator described is similar in many respects to other fluid operated actuators. Pressure is introduced on one side of pistons **40** and **50** through ports **25** and **35**, respectively, to rotate yoke **70** in one direction to move a valve to which it is attached from a first position to a second position. Then pressure is introduced to the opposite side of pistons **40** and **50** through

ports 26 and 36, respectively, to rotate yoke 70 in the opposite direction for returning the valve to its first position. Stop screws 12, 13 through body 10 provide adjustable stops whereby the rotation of yoke 70 may be limited.

Should fluid power fail and it become necessary to manually operate the valve to which the actuator is attached, it may be done so through override assembly 100 which is more clearly shown in FIG. 3. The override assembly 100 comprises outer cylinder head 33, cylindrical housing 104, ball screw nut shaft 101, ball screw shaft 105, retainer plate 106, boot 107, and handwheel 108.

As previously described, ball screw nut shaft 101 is attached at one end by threaded connection 54 to rod 60. Set screws 102 bearing against the undercut area 55 on rod 60 prevent disengagement of the connection. This connection also holds piston 50 on rod 60. A plug 116 and an 0-ring 117 is placed at the end of rod 60 in sealing engagement with nut shaft 101 to prevent pressure leakage into housing 104. The other end of nut shaft 101 provides a nut portion 109 with internal thread grooves 110 for receiving ball bearings 111. Ball screw shaft 105 has external thread grooves 112 also for receiving ball bearings 111. An external tube 115 communicating with internal thread grooves 110 through radial holes (not shown) drilled through the side of the nut portion 109 permits cycling of ball bearings and is well known in ball screw mechanisms. The return tube 115 is held in place by a retainer clip 120 and screw 121. As is well known in the art, as the ball screw shaft 105, telescopically received in the hollow bore of nut shaft 101, rotates relative to nut portion 109 nut shaft 101 and screw shaft 105 move longitudinally relative to each other and ball bearings 110 are fed through one end of tube 115 returning through the other end to threaded grooves 110 and 112.

Ball screw shaft 105 is mounted in an aperture 125 in retainer place 106. Retainer plate 106 is attached to the end of housing 104 by cap screws 126. A collar 127 and thrust plate 128 are mounted adjacent to retainer plate 106 and bearing against shoulder 129 of screw shaft 105 internally of housing 104. A bearing 130 is mounted on the other side of retainer plate 106. Screw shaft 105 is threaded at 131 to receive a locking nut 132 which is held in place by a locking pin 133.

A handwheel drive pin 135 is tightly fitted into a hole drilled transversely in shaft 105. Handwheel 108 is mounted on the end of shaft 105 and prevented from coming off by retainer washer 138 and retainer 139. The inner face of the hub of handwheel 108 is provided with aligned radial slots 140 and 141 having a width slightly greater than the diameter of pin 135 for engagement therewith. Normally handwheel 108 is biased out of engagement with pin 135 by spring 144 bearing against spring retainer sleeve 145. Spring 144 must be depressed by pushing on handwheel 108 in order to rotate shaft 105 through the engagement of drive pin 135 and drive slots 140, 141. Protective boot 107 is held in place by the flange lip 150 on retainer plate 106 and retainer ring 151.

In FIG. 4, an alternative handwheel engaging design is shown. Shaft 155 is shortened somewhat and the retainer plate 106 of FIG, 3 is replaced by retainer ring 180 and handwheel mounting cylinder 181. Drive pin 135 is fitted in a hole in shaft 105 as in FIG. 3 also. The handwheel shaft 182 has a hollow end portion 183 which is provided with slots 184 for engagement with drive pin 135 on the longitudinal movement of handwheel shaft 182 to the left (as shown in FIG. 4). In order to move handwheel shaft 182 from the disengaged position shown to the engaged position, an operating lever 190 and shaft 191 are provided. Shaft 191 is rotatingly mounted in a cylindrical housing projection 193 on the side of cylinder 181 with its axis perpendicular to the axis of handwheel shaft 182. Shaft 191 is rotatingly held in place by a ball 197 and groove 198 arrangement. Ball 197 rides in groove 198 until shaft 191 reaches one of two (180°) apart terminal positions where the ball 97 drops into a slightly deeper hole 199, indicating the proper terminal position of either full engagement or complete disengagement. Handwheel shaft 182 is provided with an annular groove 185 for engagement with an eccentrically centered pin 194 on operating shaft 191. When lever 190 is in the position shown the handwheel 108 and shaft 182 are in the completely disengaged position. By manually grasping lever 190 and rotating operating shaft 191 one hundred and eighty degrees, so that lever 190 points in the opposite direction, the eccentric pin 194 causes shaft 182 to move into full engagement with drive pin 135. A pressure seal 188 is provided around handwheel shaft 182 sealing against pressure within the actuator unit. Weather seals 189 and 195 are provided around handwheel shaft 182 and operating shaft 191, respectively. This design is very desirable since the engaged or disengaged position of shaft 182 is readily ascertainable by looking at the position of lever 190.

Another important distinction of the alternate handwheel design of FIG. 4 resides in the fact that seal 155 (see FIG. 3) may be removed, relying on seal 188 to prevent pressure loss into the atmosphere. Thus, a dynamic or sliding seal 155 is replaced by a static seal 188. This is, of course, desirable for several reasons, including less seal wear and greater reliability in general. Furthermore, it eliminates the necessity of precision machining of nut shaft 101.

Referring now to all drawings, in normal operation fluid pressure is applied to cylinders 20 and 30 to the proper sides of pistons 40 and 50 causing rod 60 to reciprocate and yoke or crank member 70 to rotate, operating the valve to which the actuator is attached. During this reciprocation of rod 60 nut shaft 101 is also reciprocated causing shaft 105 to rotate harmlessly within housing 104. Very little power is consumed in this motion since the shaft rides on ball bearings. Annular seal 155 in sealing engagement with head 33 and nut shaft 101 prevent pressure leakage. In the alternate design of FIG. 4, the seal 188 serves this purpose. Nut shaft 101 does not rotate since it is fixed to shaft 60. Therefore, screw shaft 105 is caused to harmlessly rotate during this reciprocation.

If for any reason, fluid operating pressure is lost the manual override assembly 100 may be employed to reciprocate rod 60 and rotate yoke 70. This is done simply by engaging drive pin 135 with handwheel drive slots 140 and 141. Then rotation of handwheel 108 will cause screw shaft 105 to rotate. The cooperation of nut portion 109, grooves 110, 111, and ball bearings 112 cause shaft 101 to reciprocate This in turn, causes rod 60 to reciprocate rotating yoke 70 and the stem of the valve to which the actuator is attached.

Override assembly housing 104, nut shaft 101 and ball screw shaft 105 are all mounted coaxially with rod

60. The override assembly 100 and actuator are thus combined in a unique economical compact unit arrangement to provide emergency means for manually operating a valve to which the actuator is attached. Although the actuator described herein utilizes dual pistons, the override assembly could just as easily be adapted to a single piston actuator. With a single piston actuator cylinder 20 might be removed or cylinder 30 might be replaced by the override assembly 100 for a more balanced appearance. It is also apparent that the override assembly 100 could be adapted for use with an actuator in which the piston slides on one or more stationary rods such as the actuators shown in U. S. Pat. No. 3,104,592. In such a case the ball screw nut and motion translating mechanism might be connected directly to the piston. It is also quite apparent that the actuator and override mechanism could be used with other equipment where translation of longitudinal motion to rotary motion is desired.

We claim:

1. In a valve actuating device having at least one cylinder and means for providing fluid under pressure to said cylinder, an oscillating member adapted for attachment to a valve stem, means connecting said piston and said oscillating member adapted to convert longitudinal movement of said piston to oscillating movement to said oscillating member; the improvement comprising:

a manual override assembly for longitudinal displacement of said piston without requiring the provision of fluid under pressure to said cylinder, said override assembly including:

a ball screw mechanism having a nut with internal thread grooves for receiving ball bearings and an externally threaded shaft threadingly engageable with said nut through said ball bearings, said nut being affixed to said piston;

said shaft being mounted on stationary support means for rotation only, whereby rotation of said shaft effects said longitudinal displacement of said piston;

manually operable shaft rotating means and means for releasably engageing said shaft rotating means and said shaft, said linking engaging means means including

means for moving said rotating means toward a first position away from said piston wherein said shaft and said rotating means are not engaged, and means for permitting said rotating means to engage said sahft on said rotating means being moved to a second position closer to said piston than said first position.

2. An actuating device as set forth in claim 1 characterized in that said rotating means comprises a handwheel operatively movable in and out of driving engagement with said shaft.

3. An actuating device comprising: a body member adapted for attachment to apparatus to be actuated; at least one cylinder adjacent to said member; a piston longitudinally slidably disposed in said cylinder; a rod connected to one end to said piston for longitudinal slidable motion therewith, said rod projecting through an aperture in one end of said cylinder into said body member; a crank member having a hub oscillatably mounted in said body member and having means for engaging said rod within said body member; and means for admitting fluid under pressure to at least one end of said cylinder whereby longitudinal movement of said rod and piston may be translated to oscillating movement of said crank hub; manual override means for reciprocating said piston and said rod without providing fluid under pressure to said cylinder, said override means comprising:

Nut means coaxially affixed to said rod; a screw shaft coaxially aligned with said rod and mounted adjacent said cylinder for nonreciprocating rotational motion; threaded means connecting said nut and said screw whereby said shaft may be rotated to reciprocate said rod and said piston; and

manually operable screw rotating means positionable adjacent one end of said screw shaft in at least first and second positions, and linking means for drivingly engaging said rotating means to said shaft when said rotating means is in said first position and for permitting said shaft to rotate without resulting rotation of said rotating means when said rotating means is in said second position.

4. An actuating device as set forth in claim 3, said rotating means including a manually operated handwheel mounted coaxially with said screw shaft, said handwheel being adapted for engagement with the one end of said screw shaft on longitudinal movement of said handwheel toward said screw shaft for rotation of said screw shaft on manual rotation of said handwheel, a portion of said handwheel having an annular groove thereabout,pin means engaging said groove and eccentrically mounted for rotation about an axis perpendicular to said screw shaft axis, and operating means associated with said pin for rotating said pin about said perpendicular axis for longitudinal movement of said handwheel into and out of engagement with said screw shaft.

5. An actuating device as set forth in claim 3, said rotating means including a manually operated handwheel mounted coaxially with said screw shaft, said handwheel having a first position adapted for driving engagement with the one end of said screw shaft for rotation of said screw shaft on manual rotation of said handwheel, and means for moving said handwheel to a second position of disengagement with said screw shaft.

6. An actuating device comprising: a body housing; cylinders mounted at opposite sides of said housing on a common axis; means for admitting fluid under pressure to each of said cylinders; a piston longitudinally slidably disposed in each of said cylinders; a rod connected at each end to one of said pistons for longitudinal slidable motion therewith, said rod passing through the ends of said cylinders into said body for reciprocating movement therein; an oscillatable member mounted within said body and adapted for attachment to apparatus to be actuated; means within said body connecting said rod and said oscillatable member adapted to convert said reciprocating movement of said rod to oscillating movement of said oscillatable member; an override assembly for reciprocating said rod without providing fluid under pressure to said cylinder, said override assembly comprising:

a hollow shaft non-rotatingly attached to said rod coaxially therewith and having internal grooves therein;

an externally threaded shaft in coaxial threaded engagement with said hollow shaft through ball bearings confined by said internal thread grooves, said externally threaded shaft being mounted for nonre-

ciprocating rotational movement on support means adjacent to one of said cylinders; and

manually operable rotating means positioned adjacent said support means, and linking means for releasably linking said rotating means to said exteriorly threaded shaft wherein when said members are linked, rotation of said rotating means causes rotation of said threaded shaft, but when such members are not linked, said threaded shaft may rotate without commensurate rotation of said rotating means.

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