Aug. 3, 1965 J. J. FRY 3,198,033

VALVE ACTUATORS

Filed Feb. 26, 1962 2 Sheets-Sheet 1

Fig. 1

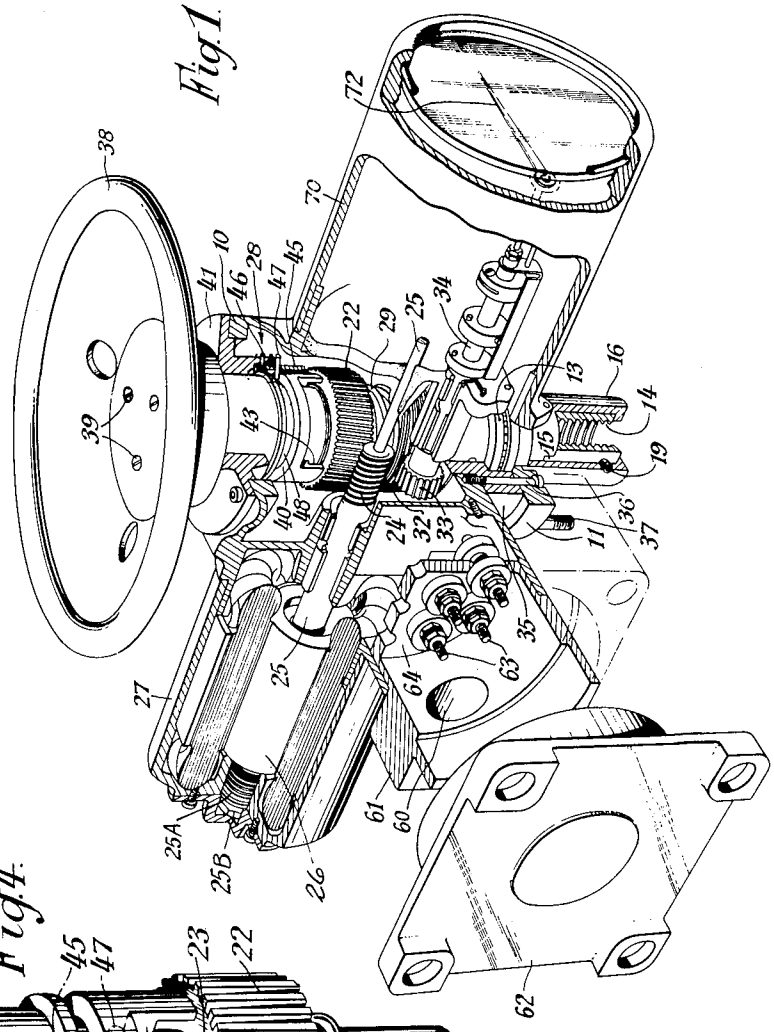
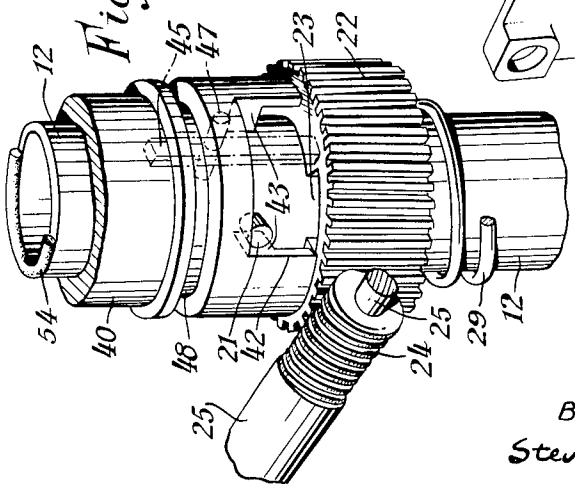


Fig. 4



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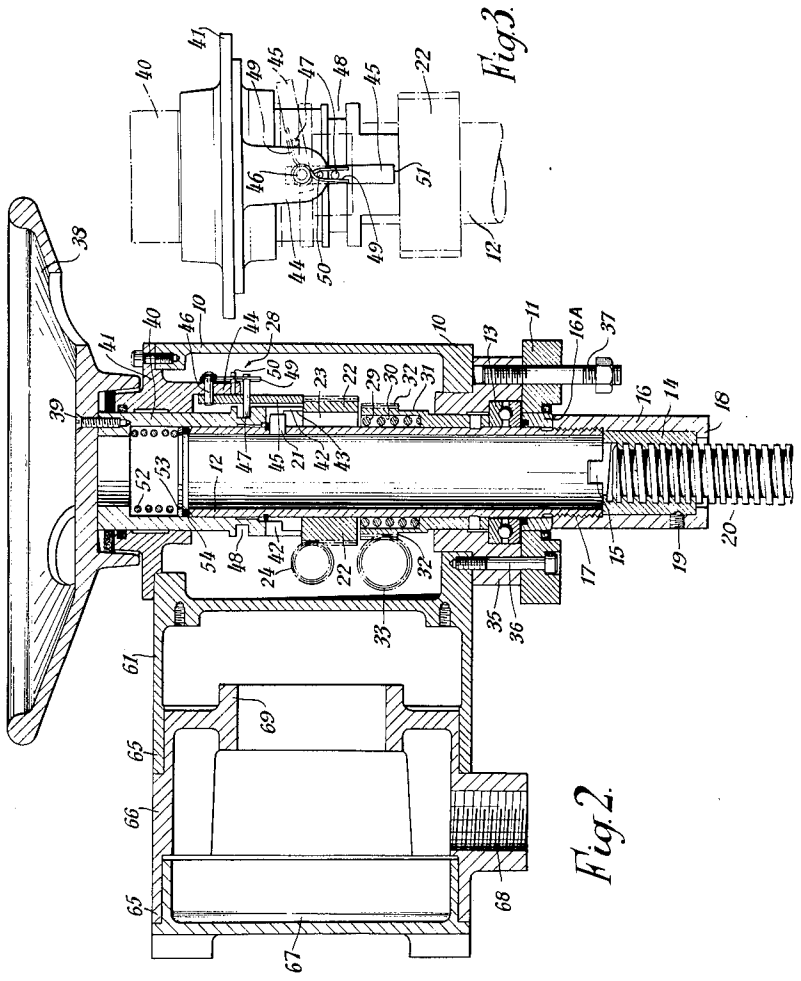


Fig. 3.

Fig. 2.

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United States Patent Office

3,198,033
Patented Aug. 3, 1965

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3,198,033

VALVE ACTUATORS

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Filed Feb. 26, 1962, Ser. No. 175,769
Claims priority, application Great Britain, Feb. 28, 1961, 7,344/61
11 Claims. (Cl. 74—625)

This invention relates to actuating mechanisms and more particularly to valve actuating mechanisms of the kind incorporating a drive mechanism by which the valve may be selectively operated either manually, i.e., by rotation of the customary handwheel, or by power means such as an electric motor.

In known arrangements of such valve actuating mechanisms a clutch member is provided which is movable axially by a hand lever in one direction to couple the output shaft or valve spindle to a handwheel for manual operation. The clutch member is automatically moved in the opposite direction to reset the actuator for power operation upon energisation of the electric motor which causes the disengagement of retaining means normally holding the clutch member in driving engagement with the handwheel.

A valve actuating mechanism of the kind described above forms the subject matter of our prior British patent specification No. 842,581, filed July 27, 1960.

The object of the present invention is to provide an improved and greatly simplified drive mechanism of the kind set out above and in which the manual operation is controlled directly by the handwheel.

According to the invention there is provided a valve actuator comprising an output shaft or spindle for actuating the valve and carrying a key or like driving member which is normally engaged by a power valve operating means, wherein a manual valve operating means is movable to engage said driving member and to disengage said power valve operating means therefrom, said manual valve operating means being held in engagement with said driving member by retaining means which are released when the power means is operated to allow the power means to re-engage said driving member and to disengage said manual valve operating means therefrom.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a general perspective view of a valve actuator constructed in accordance with the invention;

FIGURE 2 is a sectional elevation through the actuator of FIGURE 1 but in which the casing has been modified to show an alternative arrangement for the input of the electrical leads;

FIGURE 3 is a front elevation of the retaining means for maintaining the manual operation of the actuator in response to actuation of the handwheel; and

FIGURE 4 is an isometric illustration of the operating parts of the actuator in their position for manual operation.

Referring now to the drawings and in particular to FIGURES 1 and 2, it will be seen that the actuator comprises a main casing 10 which is positioned substantially vertically. The lower part of the casing 10 is provided with a closure plate 11 which has an outlet therein for

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the lower end of the main hollow output shaft 12 which extends vertically in the main casing as shown in FIGURE 2. The output shaft 12 is rotatably mounted in the casing in suitable bearings, a lower bearing being shown at 13. The bearing 13 is a thrust bearing capable of receiving thrust in response to movement of the output shaft in either direction. As shown the lower end of the output shaft 12 drivably engages a rotatable nut 14 by means of keyed connections 15 so that the nut is connected to the shaft 12 for rotation therewith. The nut 14 is mounted within the outer sleeve 16 which is internally screw-threaded at 17 and mounted on the output shaft 12 and is rotatable with the output shaft and the nut. The lower end of the sleeve 16 is formed with an inwardly directed flange 18 which holds the nut 14 in driving engagement with the shaft 12, the assembly being completed by a locking screw 19. An output shaft or a rising valve spindle 20 is externally screw-threaded at its upper end and is mounted in the nut member 14 so that the rotation of the nut member by the output shaft 12 will produce axial movement of the valve spindle 20 in one direction or the other depending upon the direction of rotation of the nut member. The thrust due to movement of the spindle 20 is transmitted through sleeve 16 to collar 16A. It is to be noted that the positioning of the nut 14 externally of the actuator casing permits among other advantages the provision of an increased spindle capacity for a given size of the actuator.

The output shaft 12 is provided at its upper end with one or more projecting keys or like driving members one of which is shown by the reference 21. Normally, the driving key 21 is maintained in a driving engagement with a transmission worm wheel which is slidable axially on the outside of the shaft 12 and which is formed with an annular slot 23 which engages over the driving key 21. The worm wheel 22 is at all times in engagement with a worm 24 which is mounted on the driving shaft 25 of a reversible electric motor 26 which is mounted in a horizontally located casing 27 extending from the main casing 10. A pack of Belleville washers 25A retained on shaft 25 by nut 25B permits axial movement of shaft 25 in either direction in response to a predetermined torque due to resistance to movement of the valve. This axial movement of shaft 25 is utilized to operate torque switches in a control unit as will be described.

During power operation by the electric motor 26 the worm 24 will be in driving engagement with the lower portion of the wormwheel 22 so that the drive from the motor 26 will be transmitted to the output shaft 12 through the driving key or keys 21 to operate the spindle 20. In FIGURE 2 of the drawings the wormwheel 22 is shown in its lowermost position in which it is disengaged from the driving key 21. The wormwheel 22 is held in this position by a retaining means shown generally by the reference 28 and which will be hereinafter described. When the retaining means is disengaged from the wormwheel 22, the wormwheel is moved upwardly into driving engagement with the key 21 by means of a heavy spring 29 which is mounted in an internal annular slot 30 in a lower sleeve 31 secured to the output shaft 12 for rotation therewith. The sleeve 31 is provided with a second worm 32 which drives a wormwheel 33 mounted on a shaft 34 which is thereby rotated during operation of the output shaft and which is adapted to drive ancillary equipment, such as limit control switches, as will be hereinafter de-

scribed. The lower end of the sleeve **31** seats on the upper surface of the bearing **13** which, as shown in FIGURE 2, is mounted in a member **35** which is secured in position between the lower end of the casing **10** and the closure plate **11** by connecting members **36**. Attachment bolts **37** for a lower casing around the spindle **20** are provided as shown in FIGURE 2.

The manual operation of the actuator is performed by a handwheel **38** which is mounted coaxially about the output shaft **12**. The handwheel **38** is fixed by screws **39** to the top of a hollow shaft or transmission sleeve **40** which extends into a closure plate **41** at the top of the casing **10**. The lower end of the sleeve **40** snugly surrounds the top of the output shaft **12** and is movable rotatably and axially relatively thereto. The lower end of the sleeve **40** is formed with a skirt or flanged portion **42** the lower edge of which is positioned to engage the top surface of the wormwheel **22**. The skirt portion **42** is cut away to form two diametrally opposite annular slots **43** one of which is shown in FIGURE 1 and which are adapted to receive the driving keys **21** on the output shaft **12**.

As previously mentioned the wormwheel **22** is normally held in driving engagement with the keys **21** by means of the spring **29**. To operate the actuator manually the operator merely depresses the handwheel **38** downwardly so that the skirt portion **42** of its sleeve **40** engages the wormwheel **22** to move the wormwheel downwardly against the action of spring **29** until it is disengaged from the driving key or keys **21**. Further downward movement of the handwheel **38** now drivably engages the slots **43** in the skirt portion **42** of the sleeve **40** with the keys **21** on the output shaft **12**. This position is as shown in FIGURES 2 and 4 of the drawings where it will be seen that the handwheel sleeve is in driving engagement with the keys **21** while the wormwheel **22** is in its lowermost inoperative position. It is to be noted that the worm **24** on the motor shaft **25** is still in driving engagement with the wormwheel **22**.

In order to maintain the actuator in its manually operable condition there is provided retaining means which, as previously mentioned, is indicated generally by the reference numeral **28**. The retaining means is mounted on an extension **44** depending from the top closure plate **41** of the casing **10**. The retaining means comprises a latch device which engages with the top of the wormwheel **22** to hold the wormwheel in its lowermost inoperative position. The latch device comprises a pawl **45** which is pivotally mounted on a pin **46** in the extension **44**. The pawl **45** carries a lower guide pin **47** which extends through the pawl **45** and has its inner end located within an annular groove **48** in the handwheel sleeve **40**. The pivot pin **46** also carries a spring **49** the ends of which are crossed and are located one on each side of the outer portion of the guide pin **47**. A stop pin **50** is mounted in the extension **44** and extends between the two arms of the spring **49**. It is to be noted that the lower end of the pawl **45** has a flat surface **51** of rectangular section for engaging the upper surface of the wormwheel **22**.

Normally, the handwheel **38** is held in its inoperative, uppermost position by means of a spring **52** which is located within the sleeve **40** and rests on a washer **53** which rests on a rubber sealing ring **54** on top of the output shaft **12**. In its uppermost position the sleeve **40** is shown in chain lines in FIGURE 3 and it will be seen that the guide pin **47** has been moved upwardly by reason of its engagement with the lower surface of the slot **48**. This movement has tensioned the adjacent arm of the spring **49** so that when the handwheel is depressed the spring **49** will progressively return the pawl **45** to its operative vertical position as shown in full lines in FIGURE 3. When the handwheel **38** has been fully depressed the pawl **45** is vertical as shown and is positioned above the wormwheel **22**. By releasing the handwheel **38** the

wormwheel **22** will move upwardly to engage the flat lower surface **51** of the pawl **45**, thus holding the arrangement in its manual condition as the handwheel can now be freely operated to rotate the output shaft **12**. In this condition the guide pin **47** engages the lower surface of the slot **48** to prevent the return of the handwheel to its inoperative position under the action of the spring **52**. (FIGURE 2).

When the electric motor is energised for power operation of the actuator, the wormwheel **22** will immediately rotate in one direction or the other depending on the direction of rotation of the motor. The rotation of the wormwheel **22** immediately causes the pawl **45** to be moved sideways about the pivot pin **46** in one direction or the other as seen in FIGURE 3. The wormwheel is now free to move upwardly under the action of the spring **29** and this movement assists the upward movement of the handwheel **38** under the action of its own spring **52**. As the handwheel sleeve **40** moves upwardly it draws the guide pin **47** with it in its slot **48** thus moving the pawl **45** to its inoperative position as shown in chain lines in FIGURE 3.

Referring now to FIGURE 1 the electrical leads for the actuator extend through an aperture **60** in a part **61** of the main casing **10** which is closed by a plate **62**. The leads are connected to contacts **63** in a partition **64**. In a modified arrangement as shown in FIGURE 2, the part **61** of the casing **10** is formed with a flange **65** for receiving extension sections **66** whereby the casing may be extended as desired. Each extension section **66** is provided with a similar flange **65** for receiving a further section or a closure plate **67**. An aperture **68** is provided in one section for receiving the electrical leads and this section may be provided with a central bush **69** in which there is provided a central plug in which the contacts are embedded. Such an arrangement may be required to meet flameproof or other requirements.

As previously mentioned the lower shaft **34** driven by the worm **33** extends into a further horizontally located casing **70** extending outwardly from the main casing **10**. This shaft is adapted to operate ancillary equipment such as limit control switches forming part of the electrical control unit. The motor shaft **25** also extends into casing **70** to operate torque switches also forming part of the electrical control unit for the motor. The control shafts **25** and **34** may operate any suitable control unit, and one such unit forms the subject matter of our copending United States patent application No. 197,183, filed May 21, 1962. The actual control unit forms no part of the present invention and is not, therefore, described herein in detail. As shown, the casing **70** may be provided with a visual indicator in the form of a pointer **72** which is operable by the control unit to give an indication of the position of the spindle **20** and its associated valve.

It will be appreciated that the actuator construction has been greatly simplified in order to provide for easy manual operation. A clutch member as such is not provided as in the previously mentioned arrangement and the mechanism ensures that the valve cannot be operated simultaneously by both the manual and power devices.

I claim:

1. A valve actuator comprising an output shaft for actuating a valve in operable engagement therewith, driving means disposed on said output shaft, power operating means including an electric motor provided with a driving shaft having a worm mounted thereon, a worm wheel axially movable on said output shaft for normally engaging said driving means and coupling said motor therewith, said worm drivingly engaging said worm wheel, manual valve operating means movable to engage said driving means and to disengage said power operating means therefrom, and retaining means to hold said manual valve operating means in engagement with said driving means, said retaining means releasing said manual

valve operating means from engagement with said driving means upon operation of said power operating means so that said power operating means engages said driving means.

2. A valve actuator comprising an output shaft for actuating a valve in operable engagement therewith, driving means disposed on said output shaft, power operating means for normally engaging said driving means, said power operating means including an electric motor having a driving shaft, a worm and a wormwheel, said worm mounted on said driving shaft and said wormwheel axially movable on said output shaft and having an annular slot for engaging said driving means, said worm drivingly engaging said wormwheel, manual valve operating means movable to engage said driving means and to disengage said power operating means thereform, and retaining means to hold said manual valve operating means in engagement with said driving means, said retaining means releasing said manual valve operating means from engagement with said driving means upon operation of said power operating means so that said power operating means engages said driving means.

3. A valve actuator comprising an output shaft for actuating a valve in operable engagement therewith, driving means disposed on said output shaft, power operating means for normally engaging said driving means, said power operating means including an electric motor and having a driving shaft, a worm and a wormwheel, said worm mounted on said driving shaft and said wormwheel axially movable on said output shaft for engaging said driving means, said worm drivingly engaging said wormwheel, resilient means to urge said wormwheel into driving engagement with said driving means, manual valve operating means movable to engage said driving means and to disengage said power operating means therefrom, and retaining means to hold said manual valve operating means in engagement with said driving means, said retaining means releasing said manual valve operating means from engagement with said driving means upon operation of said power operating means so that said power operating means engages said driving means.

4. A valve actuator comprising an output shaft for actuating a valve in operable engagement therewith, driving means disposed on said output shaft, power operating means for normally engaging said driving means, said power operating means including an electric motor having a driving shaft, a worm and a wormwheel, said worm mounted on said driving shaft and said wormwheel axially movable on said output shaft for engaging said driving means, said worm drivingly engaging said wormwheel, manual valve operating means including a handwheel having a sleeve movable relatively to the output shaft to engage said driving means and engageable with the adjacent upper surface of said wormwheel for disengaging said wormwheel from said driving means, and retaining means to hold said manual valve operating means in engagement with said driving means, said retaining means releasing said manual valve operating means from engagement with said driving means upon operation of said power operating means so that said power operating means engages said driving means.

5. An actuator as claimed in claim 4, wherein the handwheel sleeve is formed with at least one slot providing a driving connection with said driving means on the output shaft.

6. An actautor as claimed in claim 5, wherein the retaining means comprises a pivoted pawl engageable with the upper surface of the wormwheel of the power operating means, said pawl having spring means for holding said pawl in engagement with the upper surface of the wormwheel until the wormwheel is rotated by said electric motor.

7. An actuator as claimed in claim 6, wherein the pawl is provided with a guide pin one end of which is located in an annular groove formed in the handwheel sleeve for controlling the movement of the pawl as the sleeve is moved to its operative position by depression of the handwheel.

8. A valve actuator comprising an output shaft for actuating a valve in operable engagement therewith, driving means disposed on said output shaft a threaded valve spindle mounted coaxially with said output shaft, a rotatable nut threadedly engaging said valve spindle and fixed in axially adjacent relationship to that end of said output shaft which is directed toward said valve, power operating means normally engaging said driving means, manual valve operating means movable to engage said driving means and to disengage said power operating means therefrom, and retaining means to hold said manual valve operating means in engagement with said driving means, said retaining means releasing said manual valve operating means from engagement with said driving means upon operation of said power operating means so that said power operating means engages said driving means.

9. A valve actuator comprising an output shaft for actuating a valve in operable engagement therewith, a driving means disposed on said output shaft, power operating means normally engaging said driving means, said power operating means including a wormwheel and a worm in driving engagement therewith, drive shaft means mounting the worm at one end and connected to a motive means, said motive means surrounding said drive shaft means and adapted to drive same into rotation, casing means carrying said motive means, torque spring means disposed between said casing means and the other end of said drive shaft means to provide axial movement of said drive shaft means in either a forward or backward direction with respect to said casing and motive means, said drive shaft means having an extension engaging said casing means at a position intermediate its length so that said worm means is virtually on an unsupported portion of said drive shaft means, power operating means normally engaging said driving means, manual valve operating means movable to engage said driving means and to disengage said power operating means therefrom, and retaining means to hold said manual valve operating means in engagement with said driving means, said retaining means releasing said manual valve operating means from engagement with said driving means upon operation of said power operating means so that said power operating means engages said driving means.

10. A valve actuator comprising an output shaft for actuating a valve in operable engagement therewith, driving means on said output shaft, transmission means having a first and a second member surrounding said output shaft in the neighborhood of said driving means, and being movable with respect to the main axis of said output shaft between a first and a second end position, power operating means normally engaging said driving means through said first member in said first end position, manual valve operating means movable in the direction of said main axis to move said gear means along said output shaft, to disengage said first member and consequently said power operating means from said driving means and to engage said driving means through said second member to said manual means in said second end position, and retaining means to hold said manual valve operating means in engagement with said driving means, said retaining means releasing said manual valve operating means from engagement with said driving means upon operation of said power operating means so that said first and said second members are returned into said first end position and said power operating means engages said driving means through said first member.

11. A device for actuating a valve spindle of a valve member, comprising: a casing for housing and mounting various parts of said device, an output shaft rotatably

mounted in said casing and having an end portion thereof extending outwardly from said casing, a drive nut having a threaded portion for threadedly engaging a threaded valve spindle, said nut being coaxially and rotatably engaged with said end portion and being located outwardly of said casing, said nut being disengageable from said shaft and removable from the remainder of said actuator, retaining means outwardly of said casing for holding said nut in engagement with said shaft end portion, said retaining means being releasable to permit said nut to be disengaged from said shaft and thereby removed from the remainder of said actuator without opening said casing.

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