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SAFETY DEVICE IN ELECTRICALLY CONTROLLED
VALVES, FITTINGS OR THE LIKE
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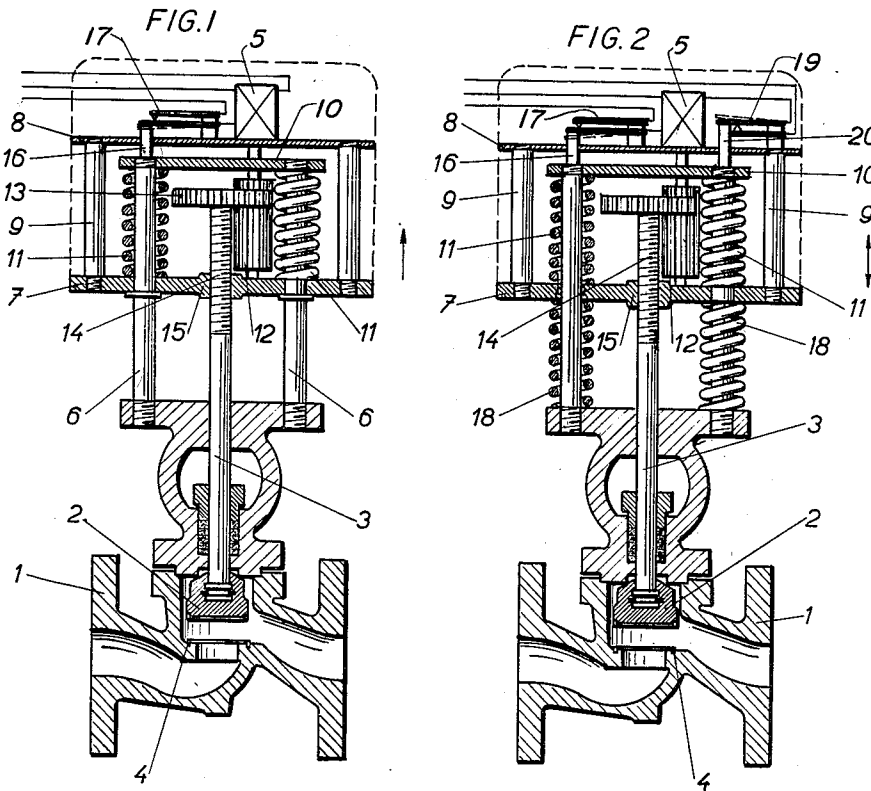
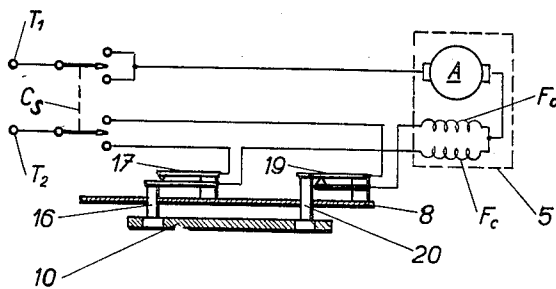


Fig. 3



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SAFETY DEVICE IN ELECTRICALLY CONTROLLED VALVES, FITTINGS OR THE LIKE

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1

This invention relates to electrically operated valves, such as those operated by an associated electric motor, and more particularly, to an improved automatic control for the motor energizing circuit.

Such electric motor operated valves are widely used due to the ease with which they may be controlled, their relatively low cost, their simplicity and reliability, and their adaptability to remote control. Generally, the valves are operated by a geared motor which may rotate a threaded stem through a fixed nut, or vice versa.

However, in order to insure proper closing of the valve, the stopping of the motor must be precisely controlled, as there is usually insufficient "give" in the driving connections to take up any over travel or under travel of the motor.

The present invention is directed to improved torque responsive means for controlling the motor whereby the valve may be firmly closed and firmly held closed independent of any precise stopping of the motor. The torque responsive means may also control the opening of the valve. Preferably, the invention means include one or more motor circuit controllers which are operated by relative movement of the motor support and the valve structure when a predetermined opening or closing torque is applied to the valve stem. The values of the torque may be selected by suitable selection or adjustment of springs controlling such relative movement.

In one embodiment of the invention, the driving motor is mounted on a support movable longitudinally relative to the valve stem and biased toward the valve body by spring means engaging the support and an element secured to the valve body. The valve stem is rotated by the motor and threaded through a nut portion on the support. The support carries a normally open switch included in the valve closing circuit of the motor, and an abutment on the fixed element normally holds this switch closed. As the valve stem meets increased resistance, when the valve is substantially closed, the resulting reaction biases the support outwardly from the valve body, the amount of reaction to effect such movement being determined by the spring strength. As the support moves outwardly, the abutment releases the switch to open, breaking the motor circuit to stop closing movement of the valve stem.

To automatically open the motor circuit during a valve opening movement, a normally closed switch is mounted on the movable support and included in the valve opening motor circuit. Whereas, in the first embodiment, fixed abutment

2

means limit inward movement of the support, in the second embodiment, springs limit such movement. The spring and switch arrangement for controlling valve closing is the same. An abutment on the fixed element engages the normally open switch so that, when a predetermined resistance to valve opening movement is developed, the reaction through the valve stem effects inward movement of the movable support. The last mentioned abutment thereupon opens the normally closed switch to break the valve opening circuit of the motor.

With the foregoing in mind, it is an object of the present invention to provide torque responsive means controlling operation of an electric motor operated valve.

Another object is to provide torque responsive means controlling both opening and closing movements of the valve.

These, and other objects, advantages and novel features of the present invention will be apparent from the following description and the accompanying drawing. In the drawing:

Fig. 1 is a partially schematic sectional view through an electric motor operated valve embodying the invention.

Fig. 2 is a view similar to Fig. 1 illustrating another embodiment of the invention.

Fig. 3 is a schematic wiring diagram illustrating a typical motor and energizing circuits therefor, as used in the embodiment of Fig. 2.

Referring to Fig. 1, a valve body 1 is illustrated as having a valve 2 on a rotatable stem 3 and arranged to cooperate with a valve seat 4, stem 3 being rotated by a geared electric motor 5. Posts 6 secured to the valve body slidably support and guide an inner movable plate 7 fixedly secured to an outer motor supporting plate 8 by staybolts or posts 9, posts 6 having collars limiting inward movement of the movable support formed by interconnected plates 7 and 8.

A fixed element, such as a plate 10 is secured to the outer ends of posts 6, and coil springs 11 surround the posts between plates 7 and 10, abutting one of these plates at each end. Springs 11 bias the movable motor support inwardly. Motor 5 has an elongated driving pinion 12 arranged between plates 7 and 10 and meshing with a pinion 13 on the outer end of stem 3. The stem has a threaded portion 14 extending through a threaded enlargement 15 on plate 7. One post 6 has an extension 16 extending through plate 8 and engaging a normally open switch 17 included in the valve closing circuit of motor 5.

3

Motor 5 is shown as having three leads, for exemplary purposes only, one lead being common and the other two each controlling opening or closing movement of the motor, respectively. This arrangement may be used with a motor of the type having two reversely arranged fields and a common armature, one field controlling each direction of motor rotation. However, the motor energizing circuit is schematic or exemplary only, and the number of leads will depend on the type of reversible motor employed.

The described arrangement operates in the following manner. When the valve closing circuit of motor 5 is energized, stem 3 is rotated in a direction to move valve 2 toward seat 4. As the valve engages the valve seat, the resulting reaction transmitted to nut 15 by stem 3 tends to move the support 7, 8, 9 outwardly. This outward movement is resisted by springs 11, which may be selected or adjusted to not permit such upward movement until a predetermined force is exerted to press valve 2 against its seat. When such predetermined force is exceeded, movable support 7, 8, 9 moves outwardly relative to fixed element 10, springs 11 being compressed between plates 7 and 10. As plate 8 moves outwardly, extension 16 remains fixed so that it disengages switch 17, carried by plate 8, and this switch opens to break the valve closing circuit of motor 5.

In the arrangement of Fig. 2, an additional switch, and cooperating torque responsive operating means, are provided to break the valve opening circuit of motor 5 when there is a predetermined resistance to opening movement of stem 3. The means for breaking the valve closing motor circuit is the same as in Fig. 1.

Referring to Fig. 2, the collars on posts 6 are omitted and each of these posts is embraced by a coil spring 18 set between valve body 1 and lower plate 7. Springs 18 resist inward movement of the motor support, and may be selected or adjusted to permit such inward movement only when the valve opening torque on valve stem 3 exceeds a preset value. A normally closed switch 19 is provided in the valve opening circuit of motor 5, and is arranged to be opened by an extension 20 of the other post 9, extension 20 projecting through movable plate 8 into operative relation with switch 19.

When motor 5 is energized in a valve opening direction, stem 3 rotates through nut 15, the valve body and movable support remaining relatively fixed until the torque on stem 3 exceeds a preset value, as when valve 2 reaches its outer limit of movement or an obstruction to valve opening movement is encountered. When the torque increases beyond this value, the reaction of stem 3 on nut 15 moves plate 7, and attached plate 8 inwardly. As extension 20 remains fixed relative to the valve body, inward movement of plate 8 carrying switch 19 thus effects opening of switch 19 by extension 20. The valve opening motor circuit is thus broken.

The valve closing control operation is the same as described for Fig. 1, as springs 18 perform the function of the collars on posts 6 (Fig. 1) in limiting inward movement of the movable motor support, except as described above. The springs 11 act to resist outward movement of plate 7 in the same manner as described.

A typical motor and control circuits, for the embodiment of Fig. 2, are shown in Fig. 3. Motor 5 is illustrated as having an armature A commonly connected to a valve opening field F_o and

4

a valve closing field F_c , the two fields being reversely directed for opposite rotations of the motor. A control switch CS is shown operable, in either position, to connect armature A to power terminal T₁. In one position of switch CS, field F_o is connected to terminal T₂ through normally open switch 17. In the other switch position, opening field F_o is connected to terminal T₂ through normally closed switch 19.

For the embodiment of Fig. 1, switch 19 is omitted and field F_o connected directly to the corresponding contact terminal of switch CS.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the invention principles thereto, it should be understood that the invention may be otherwise embodied without departing from such principles.

I claim:

1. An electrically operated valve assembly comprising, in combination, a valve body having a valve seat; a stem movably mounted in said body and carrying a valve cooperable with said seat; an electrically operable driving device operatively connected to said stem to move the latter; energizing circuits connected to said device to energize the latter in valve opening and valve closing directions; an element mounted in fixed relation on said body; a support for said electric device mounted for movement inwardly and outwardly relative to said body, said support being interengaged with said stem to convert the said movement by said driving device to movement relative to the body to open and close said valve and to absorb the reaction of said stem during operation of said valve; a normally open switch mounted on said movable support and connected in the valve closing energizing circuit of said device; an operator fixed to said element and arranged to engage said switch and bias the same to a closed position when said support is in its innermost position, said operator releasing said switch to open upon outward movement of said support; and means associated with said element and said support and constructed and arranged to bias said support inwardly relative to said element to position said support to effect engagement of said operator with said switch to maintain said switch closed, said means providing for outward movement of said support when the reaction of said stem on said support during the closing movement of said valve exceeds a preset value; whereby, when said device operates said stem in a valve closing direction and the stem reaction exceeds such preset value, said support will move outwardly so that said operator will disengage said switch and deenergize said device.

2. An electrically operated valve assembly comprising in combination a valve body having a valve seat; a stem movably mounted in said body and carrying a valve cooperable with said seat; an electric motor operatively connected to said stem to move the latter; energizing circuits connected to said device to energize the latter in valve opening and valve closing directions; an element mounted in fixed relation on said body; a support for said electric motor mounted for movement inwardly and outwardly relative to said body; said stem being threadedly engaged with said support to convert the said movement by said electric motor to movement relative to the body to open and close said valve; a first normally open switch mounted on said movable support and connected in the valve closing energizing circuit of said motor; a first operator

fixed to said element and arranged to engage said switch and bias the same to closed position when said support is in a given position, said operator releasing said switch to open upon outward movement of said support from said given position; first means associated with said element and said support and constructed and arranged to bias said support inwardly relative to said element to position said support to said given position to effect engagement of said operator with said switch to maintain said switch closed; said first means providing for outward movement of said support during closing movement of said valve when the reaction of said stem on said support exceeds a preset value; whereby, when said motor rotates said stem in a valve closing direction and the stem reaction exceeds such preset value, said support will move outwardly so that said first fixed operator will disengage said switch to open to deenergize said motor; a second normally closed switch mounted on said support and connected in the valve opening energizing circuit of said motor; a second operator fixed to said element and positioned to engage and open said second switch when said support is in said given position; said second operator releasing said second switch to close when said support moves outwardly from said given position, and second means associated with said element and said support and constructed and arranged to bias said support outwardly relative to said element to said given position, said second means providing for inward movement of said support from said given position when the reaction of said stem on said support during opening movement of said valve exceeds a predetermined value; whereby, when said motor rotates said stem in a valve opening direction and the stem reaction exceeds such predetermined value, said support will move inwardly so that said second fixed operator will engage said second switch to open the latter to deenergize said motor.

3. A valve assembly as claimed in claim 2 in which said first means comprises coil springs.

4. A valve assembly as claimed in claim 2 in which said first and second means comprise coil springs.

5. A valve assembly as claimed in claim 2 in which said fixed element is secured on posts mounted on said body and acting as guides for said support, said first means comprises coil springs surrounding said posts; and said operator comprises an extension of one of said posts.

6. A valve assembly as claimed in claim 2 in which said fixed element is secured on posts

mounted on said body and acting as guides for said support, said first and second means comprise coil springs surrounding said posts, and said operators comprise extensions of a pair of said posts.

7. An electrically operated valve assembly comprising, in combination, a valve body having a valve seat; a stem movably mounted in said body and carrying a valve cooperable with said seat; an electric motor operatively connected to said stem to move the latter; energizing circuits connected to said motor to energize the latter in valve opening and valve closing directions; an element mounted in fixed relation on said body; a support for said electric motor mounted for movement inwardly and outwardly relative to said body, said support being interengaged with said stem to convert the said movement by said driving device to movement relative to the body to open and close said valve and to absorb the reaction of said stem during operation of said valve; a normally open switch mounted on said movable support and connected in the valve closing energizing circuit of said motor; an operator fixed to said element and arranged to engage said switch and bias the same to a closed position when said support is in its innermost position, said operator releasing said switch to open upon outward movement of said support; and means associated with said element and said support and constructed and arranged to bias said support inwardly relative to said element to position said support to effect engagement of said operator with said switch to maintain said switch closed; said means providing for outward movement of said support when the reaction of said stem on said support during closing movement of said valve exceeds a preset value; whereby, when said motor operates said stem in a valve closing direction and the stem reaction exceeds such preset value, said support will move outwardly so that said operator will disengage said switch and deenergize said motor.

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