

Feb. 11, 1964

P. COGEZ ETAL

3,120,944

MECHANICAL MOVEMENT GATE-VALVE HAVING POSITIVE REDUCTION MEANS

Filed June 22, 1961

3 Sheets-Sheet 1

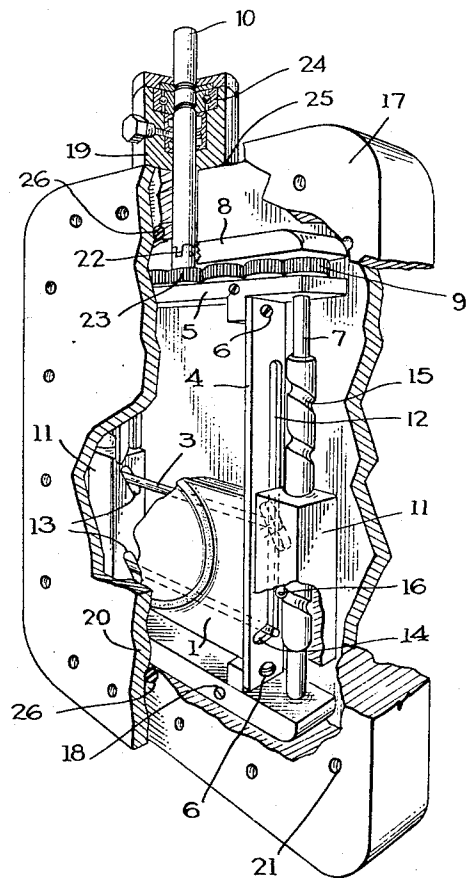


Fig. 1.

Feb. 11, 1964

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3,120,944

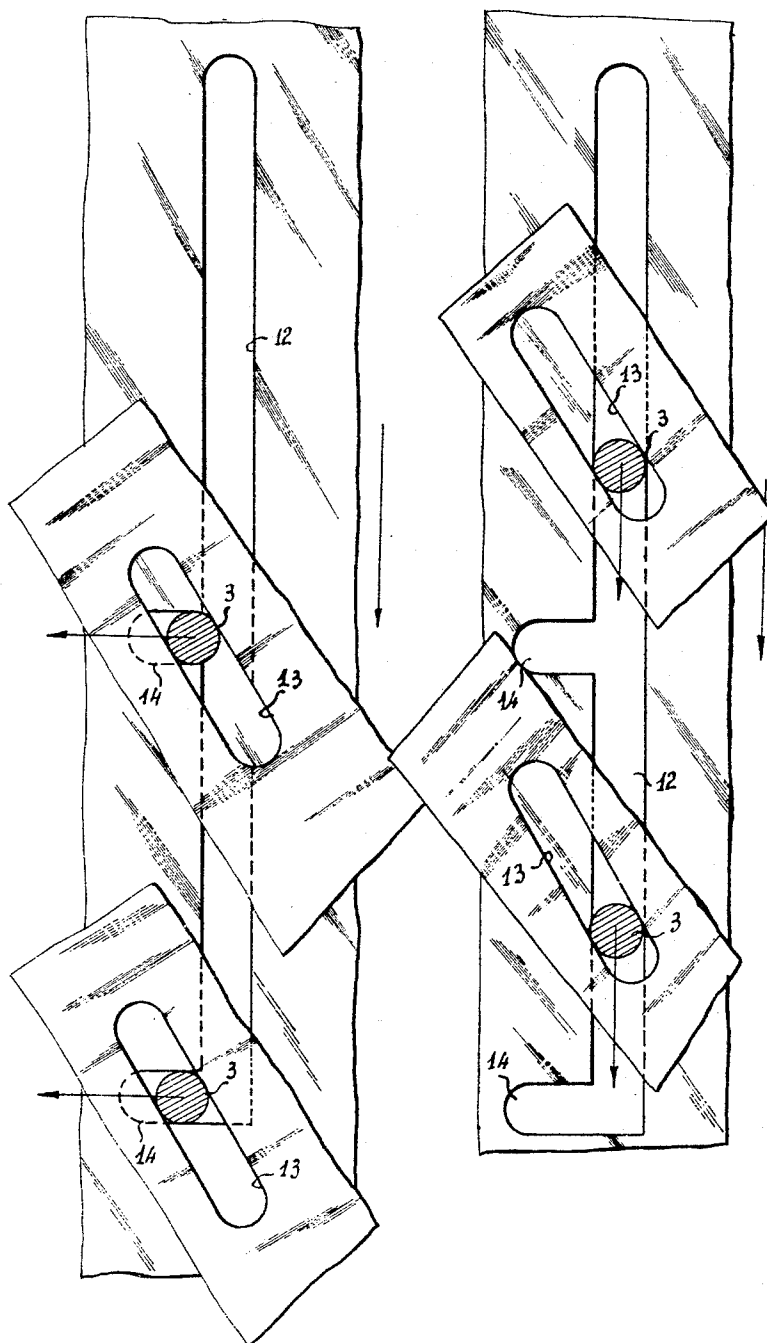
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Filed June 22, 1961

3 Sheets-Sheet 2

Fig. 3

Fig. 2



Feb. 11, 1964

P. COGEZ ETAL

3,120,944

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3 Sheets-Sheet 3

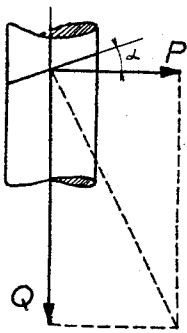


Fig. 4

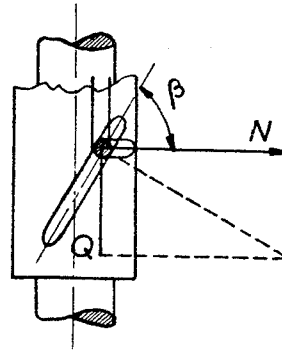


Fig. 5

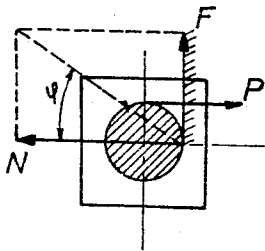


Fig. 6

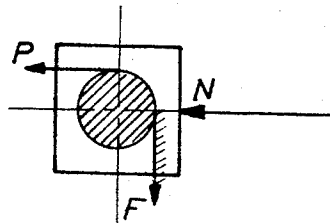


Fig. 7

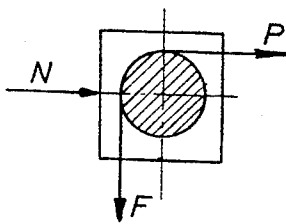


Fig. 8

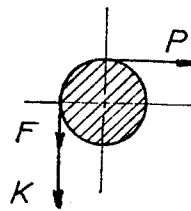


Fig. 9

1

3,120,944

MECHANICAL MOVEMENT GATE-VALVE HAVING POSITIVE REDUCTION MEANS

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4 Claims. (Cl. 251-158)

The present invention relates to gate-valves of the type in which closure takes place by two successive movements of the valve plate:

a translatory movement of the valve plate in its general median plane, known as the approach movement, which ends when the valve plate is disposed completely in front of the orifice to be closed;

a translatory movement of the valve plate transversely of its general median plane for applying it to and holding it in a sealed manner against the edge of the orifice to be shut.

In known gate-valves of this type, the translatory movement of the valve plate in its general median plane is controlled by a translatory motion device, whereas the transverse translatory movement for locating the valve plate on its seat is controlled by a rotary device. With this arrangement, prior gate-valves of the kind in question have various disadvantages which render them cumbersome or inappropriate for certain uses.

In particular, these gate-valves are of large dimensions with respect to the diameter of the orifice to be closed; their thickness, namely their dimension measured perpendicular to the plane of the valve plate, is generally very large, such that, if it is necessary to pass a sample through the gate-valve, its passage is difficult to control. There is, in this case, great interest in diminishing the thickness of the gate-valve as a whole.

The present invention has the particular object of overcoming this disadvantage.

According to the present invention, a gate-valve is provided of the kind in which the valve plate can undergo translatory movement parallel to its general median plane and translatory movement perpendicular to such plane in order to become located on its seat, which comprises guide means for guiding the valve plate in a first plane parallel to its general median plane and in a second plane transversely of the first and valve plate actuating means comprising an axially-displaceable screw-threaded nut for controlling successive displacements of the valve plate.

Preferably, the guide means comprises at least one support provided on the valve plate and at least one guide member with which the valve plate support co-operates.

Preferably, the valve plate actuating means comprises at least one groove provided thereon and at least one screw angularly coupled with a rotary mechanism located externally of the valve plate, the groove and the screw thread being connected by at least one ball and the unit comprising the screw, ball and nut serving to transform rotational movement of the screw into axial translatory movement of the nut.

In order that the invention may be readily understandable to those skilled in the art, an embodiment thereof is described below, by way of example, in conjunction with the accompanying drawings, in which:

FIG. 1 is a view in perspective of the gate-valve assembly, partly broken away and partly in section;

FIGS. 2 and 3 show diagrammatically the relative dispositions of the slide apertures, the camming slopes of the blocks and the support rods of the valve plate;

FIGS. 4 to 9 are explanatory operative diagrams of the control of the valve plate.

In the embodiment shown, the valve plate is consti-

2

tuted by a rectangular plate 1, one of the faces of which carries a toroidal or like sealing joint 2, such as a metal-plastic sealing member which ensures the fluid-tightness of the closure when the valve plate is held on its seat as described below. The control members of the valve plate, in this embodiment, are constituted by the ends, projecting from the lateral faces of the valve plate, of rods 3 located in and fixed to the latter, perpendicular to its lateral faces.

The valve plate 1 is mounted between two slides constituted by flat plates 4 in contact with these lateral faces and, in consequence, parallel thereto. The slides 4 are supported at their ends by cross-heads 5 to which they are rigidly fixed by screws 6, for example. The slides 4 and the cross-heads 5 constitute a skeleton which forms a frame for the valve plate and for all the parts of its control mechanism. The ends of threaded control rods 7, disposed parallel to the slides 4, are suitably mounted in the cross-heads 5 and the upper cross-head, in combination with a backing plate 8, supports a gear train 9, the end gear wheels of which are keyed to the rods 7, whereas the central gear wheel 23 is keyed to a rotary shaft 10, the intermediate gear wheels being freely mounted. This gear train is arranged so that, by rotating the shaft 10, the two rods 7 rotate in the same sense and through the same angle.

The nuts mounted on the threaded rods for controlling displacement of the valve plate 1 are constituted by blocks 11 which are each in contact with one of the external faces of the slides 4, along which they can be displaced without rotating.

In accordance with an important preferred feature of the invention and of the present embodiment thereof, the ends of the rods 3 or valve plate control members engage both in slots 12 in the slides 4 and in apertures 13 formed in the inner faces of the blocks 11. The slot 12 in each slide 4 is rectilinear over all its length and includes two transverse notches 14, the distance apart of which is equal to the spacing of the rods 3. The apertures 13 in the inner faces of the blocks 11 are also rectilinear, but are inclined to the general direction of the slot 12.

It is to be noted that the rods 3 can be located in the slots 12 with some play and, if there is also play in the apertures 13, the valve plate 1 thus has without inconvenience a certain transverse floating action. Also, the depth of the notches 14 is advantageously substantially greater than the minimum which they should have in order to permit the valve plate 1 to be displaced transversely into its closed position on its seat.

Preferably, the threaded rods 7 are each constituted by a cylindrical member in which a helical groove 15 is cut, the pitch of which is determined by the considerations detailed below, and which connects a rod 7 to its associated block 11 by means of one or more balls 16 lodged in recesses in the block 11 and in the groove 15.

The valve plate 1 and its control mechanism thus constitute a unit which can be mounted in a valve-body 17 to which it is fixed as by means of screws 18; the rotary shaft 10 is lodged in a hole in the body 17 and is connected, by way of a rotary screw connection 22, with the driving gear wheel 23 of the gear train 9, fluid-tightness between the shaft 10 and the interior of the valve-body 17 being provided by suitable seal-rings 24 or packings disposed in a stuffing-box 19 fixed to the valve-body 17. Fluid-tightness between the stuffing-box 19 and the valve-body 17 is provided by a gasket 25. The valve-body is completed by a plate 20 fixed by screws located in holes 21 and provided on its external face, like the valve-body 17, with appropriate connections to the enclosures between which communication is to be controlled by the valve plate 1. The seat of the valve plate 1, against which the seal-ring 2 is compressed when the valve plate is held

in the closing position, is provided on the internal face of the plate 20. Fluid-tightness between the plate 20 and the valve-body 17 is provided by a seal-ring 26.

Operation of the valve control mechanisms is as follows (FIGS. 1, 2 and 3):

In order to close the gate-valve, assumed to be open with the valve plate 1 in its high position with respect to the slides 4, the shaft 10 is rotated in the appropriate sense so that the blocks 11 are simultaneously displaced from top to bottom while carrying the valve plate 1, by means of the rods 3, which follows the direction prescribed by the slots 12 in the slides 4.

In this displacement, the valve plate 1 and its seal-ring 2 do not make contact with the internal faces of the valve-body 17 and the plate 20, the valve plate 1 being able to float transversely, as indicated above.

At the end of the travel (FIG. 3), the lower rod 3 abuts the bottom of the slot 12 and the valve plate 1, thus restrained, can no longer follow the displacement of the blocks 11, the inclined apertures 13 of which, via one of their sides, exert a camming action for urging the rods 3 into the transverse notches 14 and applying the valve plate against its seat while compressing the seal-ring 2. Removal of the valve plate and its displacement to return it to the high position are effected by carrying out the operations described in the reverse order.

The considerations below, which are given in relation to FIGS. 4 to 9, will explain, apart from purely kinematic features of the valve control mechanisms, the mechanical conditions which determine the characteristics of the screw-threaded members and the camming apertures which actuate the support rods.

If P (FIG. 4) is the tangential force applied to the screw, the thread of which is inclined at an angle α , and Q is the axial translatable force which results:

$$P = \tan \alpha \cdot Q$$

The apertures or cam slots in the blocks (FIG. 5), the inclination of which is β , apply to the valve plate a transverse force $N = Q \cdot \tan \beta$, where:

$$P = N \cdot \frac{\tan \alpha}{\tan \beta}$$

If $\tan \phi = f$ is the coefficient of friction of the blocks on the screws, a frictional force F (FIG. 6) equal to Nf opposes P and:

$$F = P \cdot \frac{\tan \beta}{\tan \alpha} \cdot f$$

If K is the tangential force to be applied to the axis to overcome other friction in the control mechanism, it is necessary to apply a force $(P+K)$ to the screw to obtain the force P .

With the gate-valve closed, if a force N is applied to the valve plate at the side of the seal (FIG. 7) or at the opposite side (FIG. 8), this force exerts two couples on the screw:

A couple of force P , which tends to rotate the screw;

A frictional couple of force F , which opposes the first couple (FIG. 8).

In order that the screw shall rotate, it is necessary to overcome the force F plus the force K (FIG. 9) and the conditions of irreversibility are consequently:

$$F + K > P$$

or

$$F + K - P > 0$$

or

$$K + P \left(\frac{\tan \beta}{\tan \alpha} \cdot f - 1 \right) > 0$$

By appropriately selecting α , β and f , it can be seen

that, for small P , N can be large and the opening force small.

$$\text{If } \frac{\tan \alpha}{\tan \beta} \rightarrow f, \text{ this force} \rightarrow K$$

The gate-valve of the invention has in particular, the following advantages:

(a) The translatable movements of the valve plate, parallel and perpendicular to its general median plane, and its maintenance on its seat, are derived from a single external rotary mechanism, which, particularly, greatly simplifies the problem of remote control;

(b) The total length of the gate-valve is materially reduced in comparison with that of gate-valves of the same general type, the kinematics of control being such that it eliminates the problem of exact guidance of the valve plate in its "approach" translatable movement;

(c) The sealing joint provided on the valve plate or on the valve-body around the orifice to be closed does not make sliding contact with fixed or movable walls; on closing and on opening, it only undergoes relative displacement in a direction perpendicular to its general plane;

(d) The valve plate is self-locking on its seat, in the closed position, and the preponderant force transversely of the valve plate, due to the relative pressures in the enclosures on either side of the orifice to be closed, can readily be exerted either on one face or on the other of the valve plate;

(e) Operation of the gate-valve is independent of its position or of its orientation in space;

(f) Its thickness can be of the order of 50 mm. for a diameter of 200 mm. of the orifice to be closed.

What we claim is:

1. In a gate valve, a valve plate, a valve seat and means for moving said valve plate parallel to its general median plane and then for moving said valve plate perpendicular to said plane into engagement with said seat comprising parallel slides engaging opposite sides of said plate, rectilinear slots in said slides, rods supporting said plate and engaging in said slots, transverse notches in said slots for said rods, a threaded control rod parallel and adjacent to each of said slides, a control nut mounted on each of said threaded rods and engaging the adjacent one of said slides, an aperture in each of said nuts for each of said rods and means for rotating said threaded control rods simultaneously.

2. In a gate valve as described in claim 1, at least one ball mounted in each of said nuts engaging in the thread of the associated one of said threaded rods.

3. In a gate valve as described in claim 1, said plate being rectangular and said apertures forming cams co-operating with said notches for seating and unseating said plate.

4. A gate valve as described in claim 1 including cross-heads connecting said slides, said threaded rods being mounted for rotation in said cross-heads, a gear train rotatably mounted on one of said cross-heads for rotation of said threaded rods and a rotatable shaft for rotating said gear train.

References Cited in the file of this patent

UNITED STATES PATENTS

547,817	Stone	Oct. 15, 1895
1,057,226	Delano	Mar. 25, 1913
1,213,764	Elliott	Jan. 23, 1917
1,779,637	Phillips	Oct. 28, 1930
1,985,078	Collison	Dec. 18, 1934
2,198,639	Stines	Apr. 30, 1940
2,203,399	Wheatley	June 4, 1940