April 10, 1945. F. E. SHELLY 2,373,268

THROTTLING VALVE

Filed Dec. 15, 1942

Fig. 1.

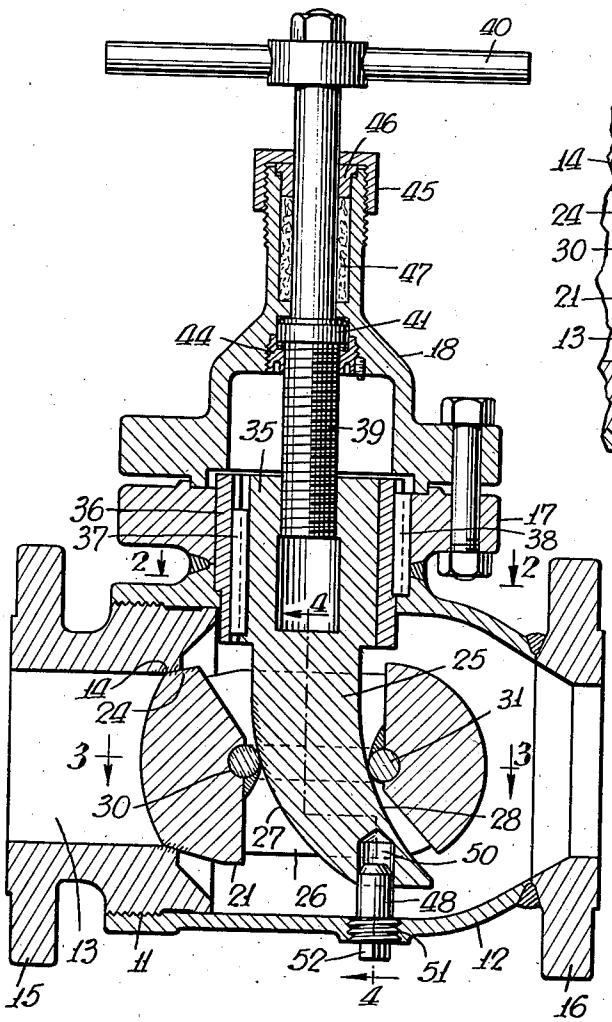


Fig. 3.

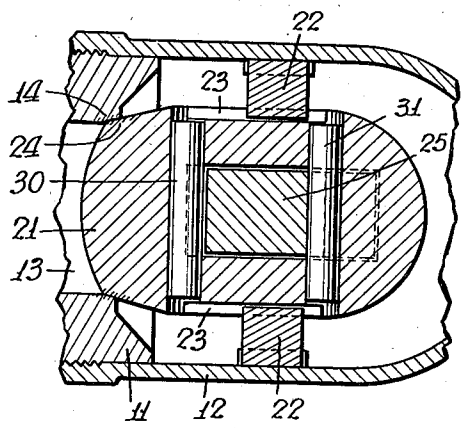


Fig. 4.

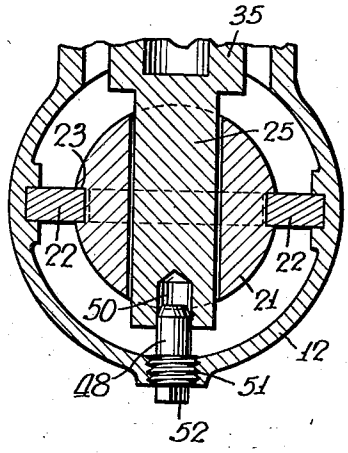
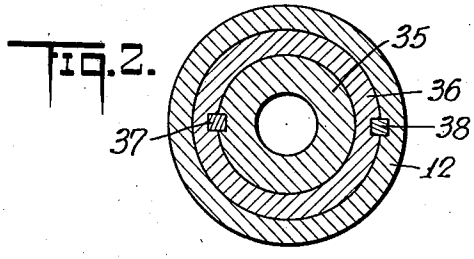


Fig. 2.



INVENTOR
Franklin E. Shelly
BY
Dean Fairbank & Hueck
ATTORNEYS

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THROTTLING VALVE

Franklin E. Shelly, Louisville, Ky., assignor to Tube Turns, Louisville, Ky., a corporation of Kentucky.

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12 Claims. (Cl. 251—39)

This invention relates to what is sometimes referred to as a bullet type of valve, in which the valve member is so mounted in the casing as to be movable endwise in the general direction of the path of flow of the fluid through the valve casing and is so shaped that when moved away from its seat, the fluid flows against one end of the valve member, thence along opposite sides thereof and comes together again at the opposite end of the valve member.

The valve member is desirably streamlined so that there is minimum turbulence in the flow of the fluid from the inlet to the outlet of the valve casing.

In certain valves of this type which have been proposed, the valve member is provided with a chamber intermediate of its ends and in which there is mounted a cam or eccentric connected to a spindle or shaft, so that by rotating the spindle through 180°, the valve may be moved to and from closed position. Where the valve is large and the fluid pressure is high, a great deal of power is required to operate the valve. Furthermore, when the valve member is midway of its limits of travel, the cam or eccentric bears on the valve member at a point nearer to one side than to the other, so that non-axial stresses are exerted on the valve member resulting in unequal strain and wear on the guides of the valve member.

To operate the valve member by swinging a lever having a free end projecting into an opening in the valve member is even less satisfactory, particularly where large sizes and high pressures are involved.

In carrying out my invention I overcome the objections to all prior constructions of this type and with which I am familiar, by providing an improved construction which gives a low pressure drop, is easily and positively operated, and applies operating pressure at the same point centrally of the valve member in all operating positions of said member.

In carrying out my invention I provide the valve member with a transverse passage intermediate of its ends and reciprocate the valve member by the longitudinal movement of a cam member extending into or through said passage.

As a further feature of my invention, the cam surface is preferably a curved one so that for equal increments of movement of the operating members, there will be progressively greater increments of movement of the valve member as it moves away from its seat and progressively smaller increments of movement as it moves towards its seat.

As a further feature, the passages in the valve member and the cam member are so designed that they have substantially line contact midway between opposite sides of the valve member.

Although in some constructions where the fluid pressures dealt with are low, the reciprocating cam member may be guided at only the end from which it is operated, I preferably provide, as a further feature of my invention, a guide at the opposite end of the cam member. This guide may be in continuous engagement with the cam member but preferably comes into operation only when the valve member reaches a position reasonably close to its seat and when the force required to seat the valve against the fluid pressure is far greater than that for moving the valve when it is in mid-position or in fully opened position.

For operating the cam member, there is provided, as a further feature of the invention, a rotatable operating member in substantial alinement with the path of movement of the cam member and held against longitudinal movement and well packed in respect to the valve casing. The operating member and the cam member have threaded engagement so that by rotating the operating member, the cam member may be reciprocated in a direction preferably at right angles to the direction of movement of the valve member.

Various other objects, features and advantages of the invention will be apparent from the following particular description, and from an inspection of the accompanying drawing, in which

Fig. 1 is a longitudinal section through a valve embodying the present invention; and

Figs. 2, 3 and 4 are sections taken on lines 2—2, 3—3 and 4—4 of Fig. 1, respectively.

In the specific embodiment of the invention shown in the drawing, there is provided a valve casing desirably made of two sections 11 and 12 having a flow passage 13. They may be connected by screw threads, by welding, or in any other suitable manner. One of these casing sections 11 is formed with a conical seat 14 concentric with the flow passage 13, and may have a flange 15 or other means for connection to a supply line. The other casing section 12 may have a similar flange 16 or other means for connecting to a delivery line. It may also have a flange 17 for facilitating the attachment of the bonnet or cap holding the valve stem. These parts may be of forgings welded together.

In the flow passage 13 is a valve member 21 in the form of a bullet suitably streamlined to reduce to a minimum, turbulence in the flow around the valve member. It is guided for axial movement in the line of flow in any suitable manner, as for instance by means of a pair of guides 22, disposed between the casing section 12 and the valve member 21 and disposed in opposed grooves of both. They may tightly fit in the grooves of the casing section and have a sliding fit in the grooves of said valve member. The streamlining contour of the valve member may be determined in accordance with the character and velocity of the fluid to be controlled and the relative size of the valve and the passage around it. As shown, it is generally ellipsoidal in contour with its ends convexedly and bluntly curved. One of these ends is formed with a conical section 24 for engagement with the seat 14. This conical section 24 and seat 14 are desirably surface hardened to withstand erosion and wear.

To move the valve member 21 axially, I provide as an important feature of the construction, a cam member 25 extending into a transverse passage 26 in said valve member and having its opposite sides presenting cam surfaces 27 and 28. These cam surfaces have cam follower engagement with the valve member 21 substantially in the axial plane of said member, which is at right angles to the direction of movement of the cam member. It is highly desirable that the portions of the valve member engaging the cam be wear resistant. This is facilitated by the use of a pair of parallel cylindrical rods 30 and 31 which may be hardened steel or softer steel surface hardened, and mounted in opposed grooves in opposite sides of the passage through the valve member. They may have a driving fit in the grooves or may be rotatable, but preferably they are secured by welding at one or at opposite sides. These two contact rods 30 and 31 are so disposed that their axes lie in the central axial plane of the valve member 21 and of the flow passage 13, and the two cam surfaces 27 and 28 are so designed as to engage one or the other or both of said rods at all times substantially along straight lines in said plane, so that the cam pressure is always applied in said plane and the forces are transmitted equally to the two guides 22. Although both cam surfaces may be surface hardened, it is more important that the cam 27 be surface hardened, as it is the one toward the valve seat and subject to the greater pressure.

For operating the cam member 25, the latter is provided at one end with a shank portion 35 guided for axial slide movement in a sleeve 36 and held against rotation by a key 37. The sleeve 36 may be held against rotation in the casing section 12 by a key 38. Threaded into this shank 35 and extending axially thereof is a valve stem 39 passing through the bore of the valve bonnet 18 and having a suitable operating member such as a handle 40 at its outer end. The stem 39 is held against axial movement in any suitable or conventional manner, as for instance, by a collar 41 retained between an annular shoulder in the valve bonnet 18 and a locking ring 44 threaded into said bonnet 18. Around the stem 39 there is any suitable stuffing box shown as comprising a collar 45 threaded on the neck of the bonnet 18 and bearing against a bushing 46 seated on a packing ring 47 encircling said stem.

As the cam member 25 is moved downwardly from an open valve position by rotation of the handle 40, the cam surface 27 bearing against the contact rod 30, moves the valve member 21 to the left towards valve closure position shown in Fig. 1. As the valve member 21 moves towards seating engagement with the valve seat 14, the fluid pressure on said valve member 21 transmitted to the lower section of the cam member 25 increases. Thus the valve may be forced to its seat and against high head pressure, by the minimum force applied at the operating member.

In some cases the cam surfaces 27 and 28 may be straight, parallel, and at the desired angle to direction of movement of the cam member, so that there will be equal endwise movement of the valve for equal endwise movement of the cam, but as a further feature of the improved construction the surfaces are curved and converge so that for equal endwise movement of the cam there will be progressively shorter movements, as the valve approaches its seat.

To effect complete closure of the valve, the cam member 25 must bear with substantial force against the valve member 21. The loading, therefore, of the cam member resulting from fluid pressure and valve seating reaction is at a maximum in closed position of the valve. With the cam member 25 supported only at one end as a cantilever, the bending movements on said cam member resulting from this loading may, in some cases, be excessive.

To relieve the strain on the upper support of the cam member 25 when the valve member 21 approaches closed position, I provide as an important feature, an abutment or guide for the lower end of said cam member opposite to the guided shank 35. This may continuously engage the cam member or engage it only when the valve member is near the end of its movement toward and to the seat. This abutment or guide is shown in the form of a pin 48 having a section 51 threaded through the wall of the casing section 12. The pin acts as a guide for the cam member, as for instance by fitting into a hole 50 at the end of the cam member 25. The outer end section 52 of the pin may be shaped to receive a suitable turning tool. This abutment or guiding and bracing pin 48 may be tapered at its outer end to facilitate its entry into the hole 50, if the pin is short enough so that it serves as an abutment only during a portion of the movement of the valve member 21. The pin is shown as circular in cross section but may be of any cross section shape as will offer the least resistance to the flow of fluid past it.

As many changes can be made in the above apparatus, and many apparently widely different embodiments of this invention can be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

Applicant's valve has the advantage of both the conventional gate valve and the conventional globe valve without the disadvantage of either. A gate valve will give positive shut-off, but cannot be used very satisfactorily for throttling. On the other hand, throttling can be secured with a globe valve, but it is not very effective from the standpoint of positive shut-off. With applicant's valve, positive shut-off can be secured and also very effective throttling.

Another advantage, more particularly with relation to applicant's particular type of wedge cam, is that this cam provides a stronger construction

than the usual rotatable cams such as have been proposed in prior art. Moreover, with the conventional rotatable cam, it is difficult to secure locking of the cam member, since the cam supporting element is not threaded, and this usually results in the necessity for additional locking means such as worm gearing. On the other hand, with applicant's type of cam, the advantages of a non-rising stem valve are secured; the threads on the stem being effective to lock the cam in any desired position.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A valve having a casing defining a flow passage and presenting a seat substantially concentric with said passage, a valve plug in said casing guided for movement towards or away from said seat along the axis of the seat, and having a recess intermediate its ends transversely of its path of movement, a cam extending into said recess and having engagement with said plug, means for moving said cam in a direction transversely of the path of movement of said plug to effect movement of said plug along said path, and means carried by said casing and independent of said valve plug for guiding said cam and for positively preventing rotation of said cam on its longitudinal axis during said movement.

2. A valve having a casing defining a flow passage and presenting a seat, a bullet type of valve member in said casing and guided for endwise movement towards or away from said seat, a cam member in said casing and in engagement with said valve member, means for moving said cam member in a direction at right angles to the direction of movement of said valve member to move said valve member while maintaining said cam member in follower engagement with said valve member, and a guide independent of said cam member carried by said casing and engaging said valve member for preventing rotation of said valve member about its longitudinal axis.

3. A valve having a casing defining a flow passage and presenting a seat, a valve member, means guiding said valve member for movement axially towards or away from said seat and operative to prevent rotation of the valve member about its longitudinal axis, a cam engaging said valve member substantially in an axial plane of the valve member, operating means for moving said cam endwise through said valve member to move the latter towards and away from said seat, and separate and independent guiding means carried by said casing for guiding said cam and for preventing rotation of said cam about its axis of endwise movement.

4. A valve having a casing presenting a seat, a valve member in said casing and having guided axial movement towards or away from said seat, said valve member having a passage extending transversely of its path of movement, said passage presenting opposed curved surfaces intermediate of the ends thereof, disposed transversely of the passage and extending transversely of the direction of movement of said valve member, and disposed in an axial plane of the valve member, a cam extending into said passage and having cam surfaces on opposite sides thereof facing the direction of movement of said valve member and having cam follower engagement with said curved surfaces in said passage, and means for moving said cam endwise through said passage while maintaining follower contact with said valve member in said plane to move said valve member axially towards or away from said seat.

5. A valve having a casing presenting a seat, a valve member in said casing guided for movement towards or away from said seat, an operating member movable endwise in a direction at right angles to the direction of movement of said valve member, and means for moving said valve member at progressively increasing rate away from said seat, and at progressively decreasing rate towards said seat for equal increments of endwise movement of said operating member.

6. A valve having a casing presenting a seat, a valve member in said casing guided for movement towards or away from said seat, a longitudinally movable operating member, and a transmission between said operating member and said valve member for moving said valve member towards or away from said seat upon endwise actuation of said operating member, said transmission including means for progressively increasing the mechanical advantage of the power transmitted to said valve member from said operating member as said valve member is moved towards said seat and for progressively decreasing said mechanical advantage as said valve member is moved away from said seat.

7. A valve having a casing presenting a seat, a valve member in said casing guided for movement towards or away from said seat, an endwise movable cam member having a convexedly curved cam surface in follower engagement with said valve member for forcing said valve member towards said seat as said cam member is moved in a direction at right angles to the path of movement of said valve member, and an operating member for moving said cam member, whereby said valve member is moved at progressively decreasing rate towards said seat for equal increments of movement of said operating member.

8. A valve having a casing presenting a seat, a valve member guided for movement towards or away from said seat, a cam member having a concavely curved cam surface in follower engagement with said valve member for forcing said valve member away from said seat as said cam member is moved in a direction at an angle to the direction of movement of said valve member, and an operating member for moving said cam member, whereby said valve member is moved at progressively increasing rate away from said seat for equal increments of movement of said operating member.

9. A valve having a casing defining a flow passage and presenting a seat concentric with said flow passage, a valve plug in said casing guided for movement towards or away from said seat substantially along the axis of the seat, a cam member having on its side facing the seat a convexedly curved cam surface and on the opposite side a concavely curved surface, said surfaces being in follower engagement with said valve plug to force said plug towards or away from said seat as said cam member is moved at an angle to the path of movement of said valve plug, and an operating member for moving said cam member, whereby said valve plug is moved at progressively increasing rate away from said seat and progressively increasing rate towards said seat for equal increments of movement of said operating member.

10. A valve having a casing defining a flow passage, and presenting a seat, a valve member in said casing guided for movement towards or away from said seat, a cam member having an overhanging unsupported section, and having a hole

at the free end of said unsupported cam section, means for moving said cam member longitudinally to operate said valve member towards or away from said seat, and a pin connected to said casing and disposed in the path of movement of said hole, said pin entering said hole with a snug slide fit as said cam member approaches the limit of its valve closure position, whereby said cam section is supported by said pin against the reaction of said valve member.

11. A valve having a casing presenting a seat, a valve member in said casing guided for movement towards or away from said seat, a cam member having follower engagement with said valve member to move said valve member towards or away from said seat as said cam member is moved longitudinally, means slidably connecting said cam member and said casing and preventing rotation of said cam member, a valve stem supported by said casing and having threaded engagement with said cam member, means for holding said stem against endwise movement whereby said cam member is moved longitudinally upon rotation of said stem, and a packing in said casing and around said stem.

12. A valve having a casing defining a flow passage and presenting a seat, a valve member movable endwise toward and from the seat, a cam member having a cam surface for engaging said valve member to move the latter toward and from said seat, said cam member being movable in an endwise direction substantially at right angles to the direction of movement of said valve member, a guide on said casing and engaging said cam member for preventing rotation of the latter during said endwise movement, and a separate guide on said casing and engaging said valve member to prevent rotation of the latter about the axis of its endwise movement.

FRANKLIN E. SHELLY.