# United States Patent

**Leopold, Jr. et al.**

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[45] **May 16, 1972**


## [54] GATE VALVE STRUCTURE


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[52] **U.S. Cl.**.....**137/375,** 251/267, 251/326

[51] **Int. Cl.**.....**F16k 27/00,** F16k 31/50, F16k 3/00

[58] **Field of Search**.....137/375; 251/267, 268, 269, 251/326, 328



[56] **References Cited**

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*Primary Examiner*—Henry T. Klinksiek

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[57] **ABSTRACT**

A gate valve structure for use in mains carrying a fluid under high pressure, the fluid being of the type which could possibly cause corrosion to the elements of the gate valve structure including the casing. An improved valve gate member is provided which permits operation from closed to open position and vice versa with a minimum of torque and with maximum holding power in the closed position. The valve gate member is designed so that there is unobstructed communication between the ports of the valve casing to thereby reduce turbulence and currents within the valve structure and thus effectively reduce corrosion deposits and collection of debris within the structure. The valve gate member is a flat and hollow chamber for reception of a valve operating stem and means are provided to completely protect the valve gate member and the track in which it operates from corrosion and possible damage.


**51 Claims, 24 Drawing Figures**

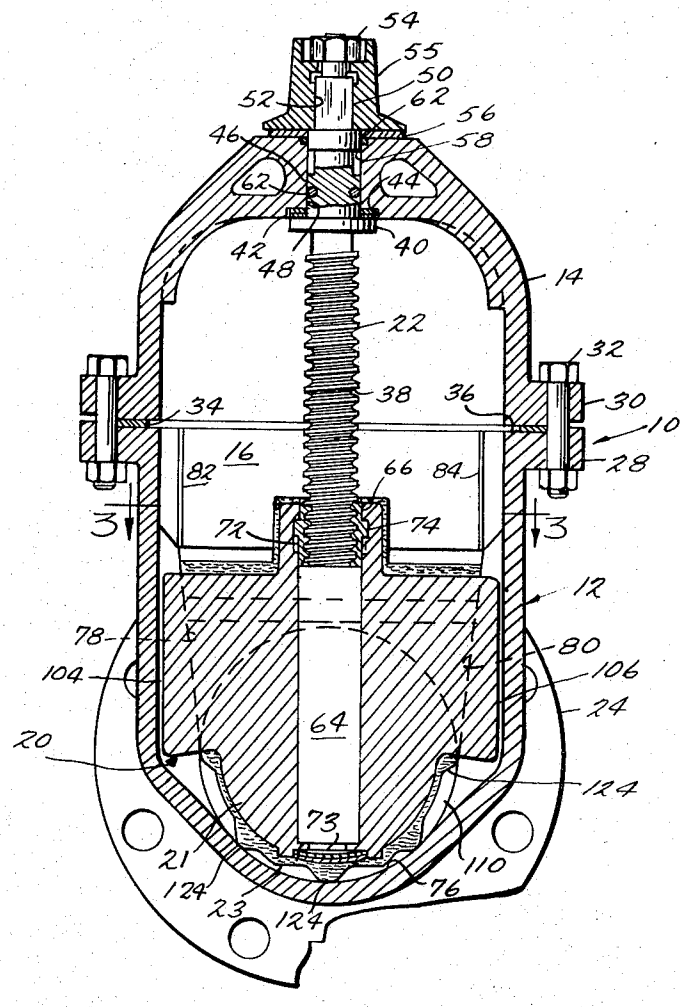

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Fig. 1.

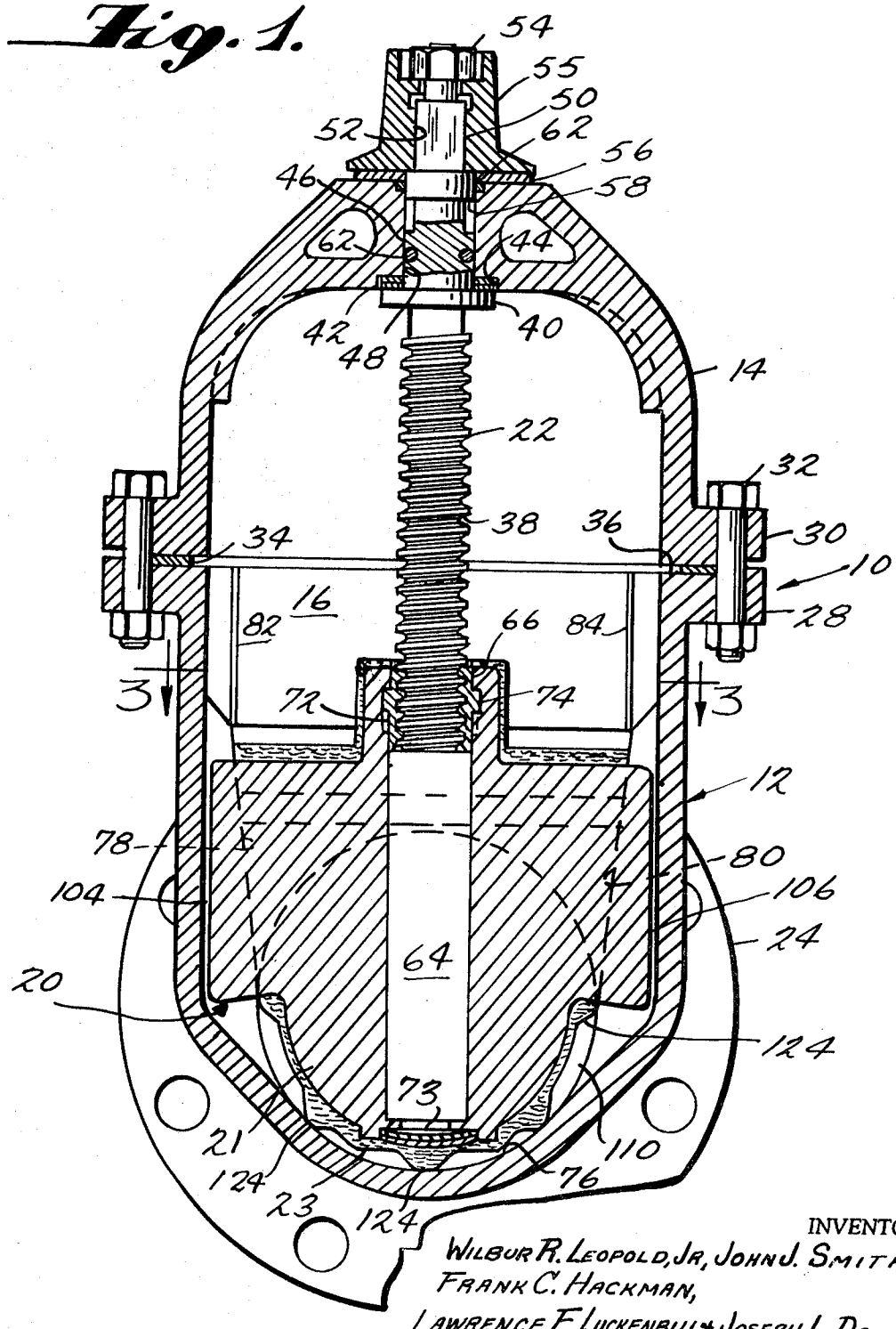


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Fig. 2.

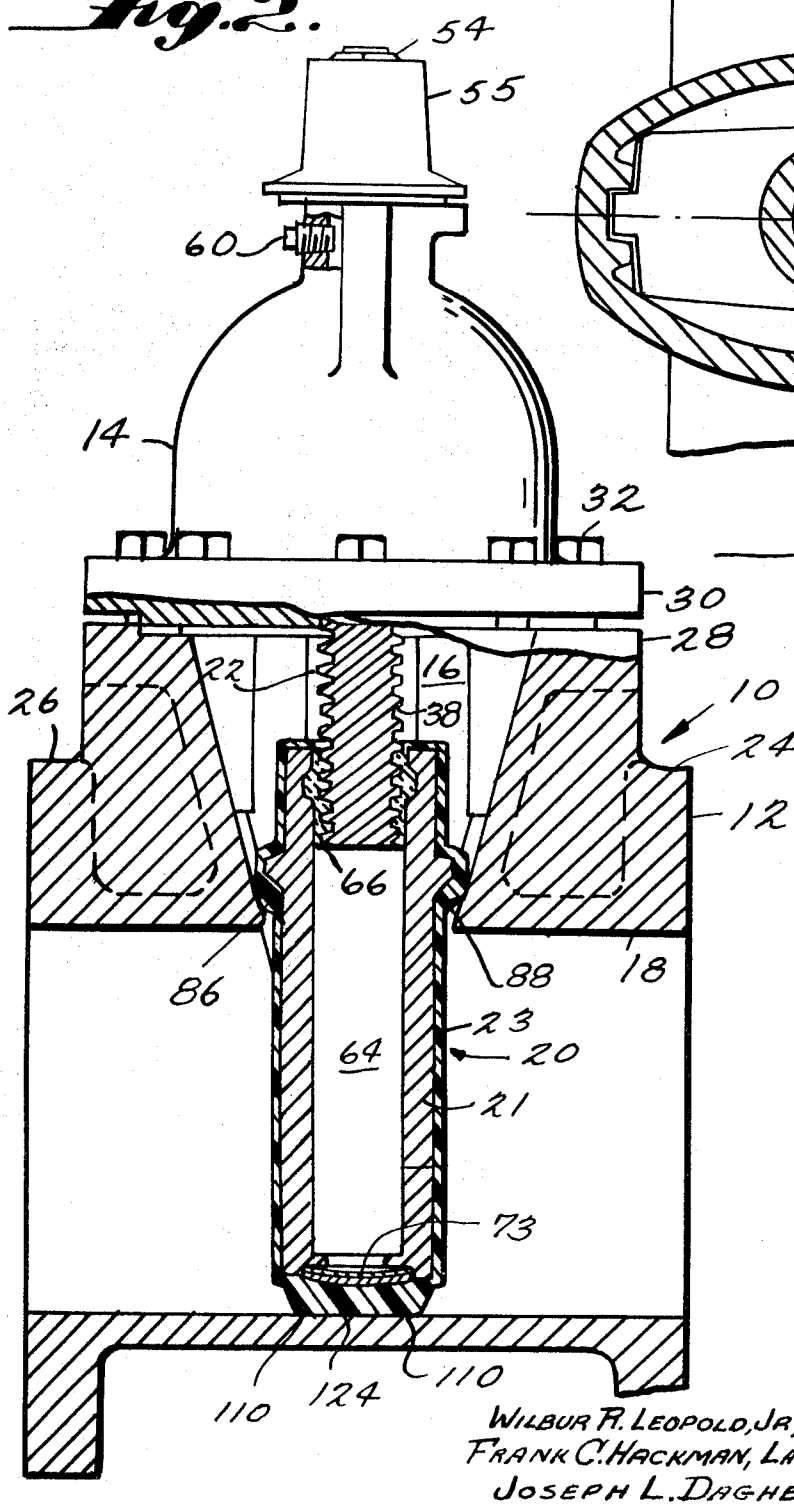


Fig. 3.

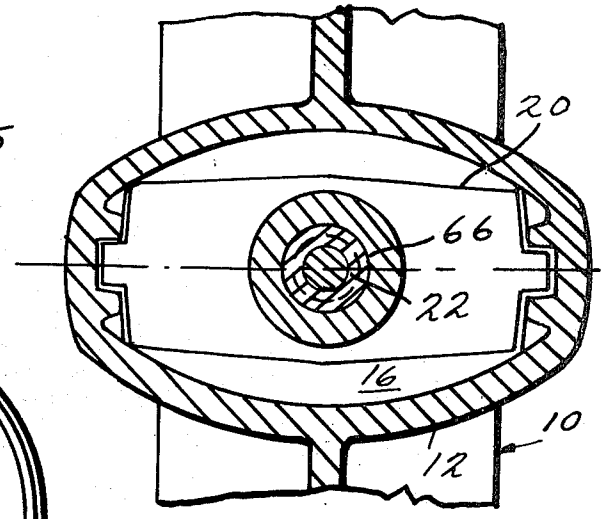


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Fig. 4.

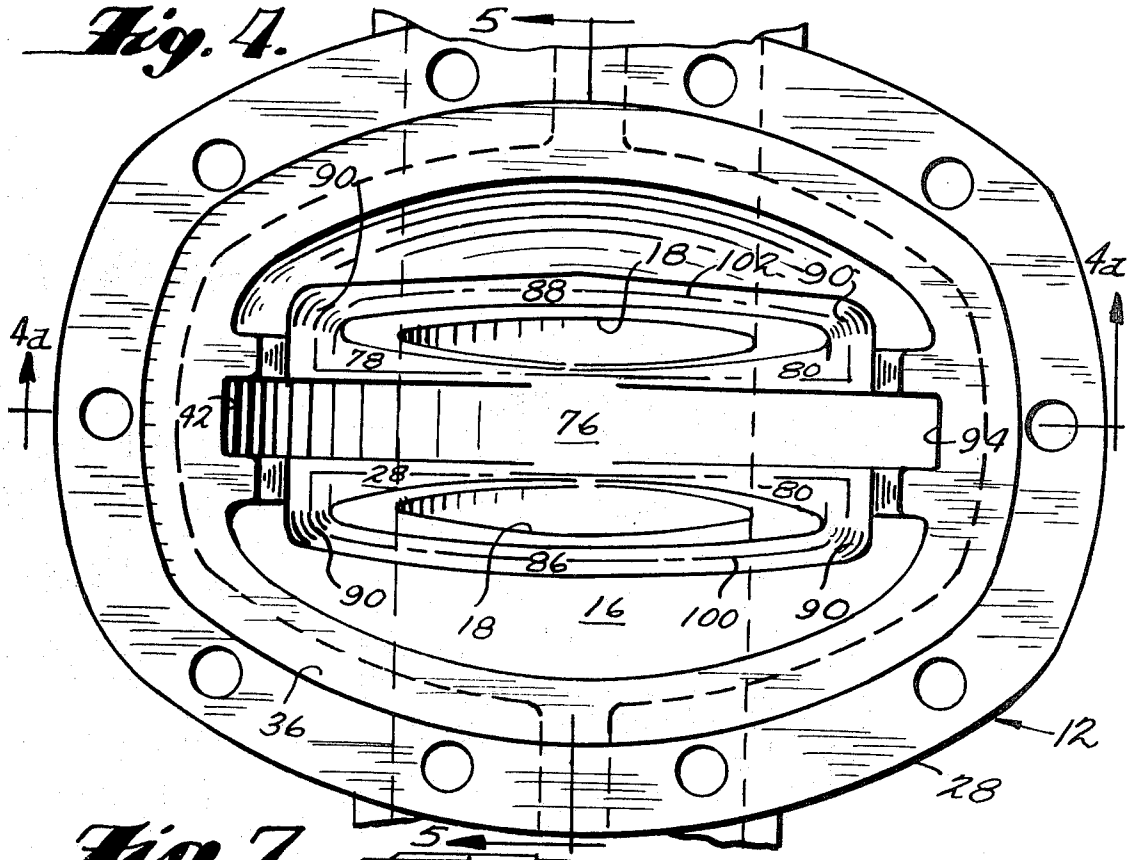
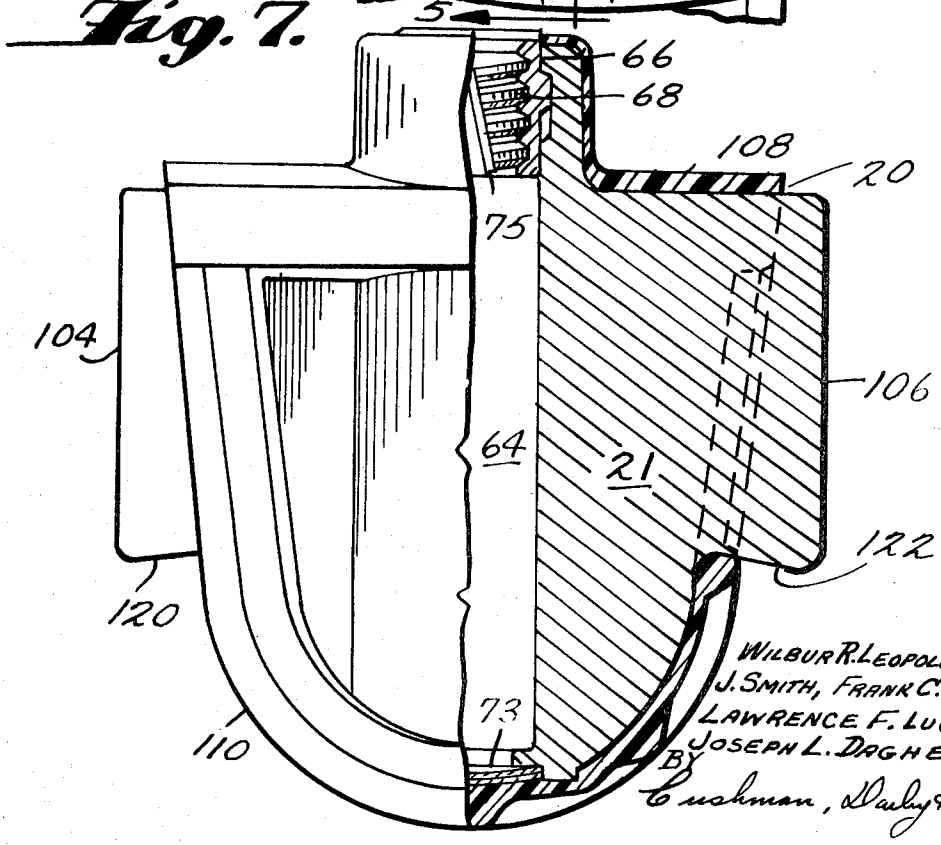



Fig. 7.

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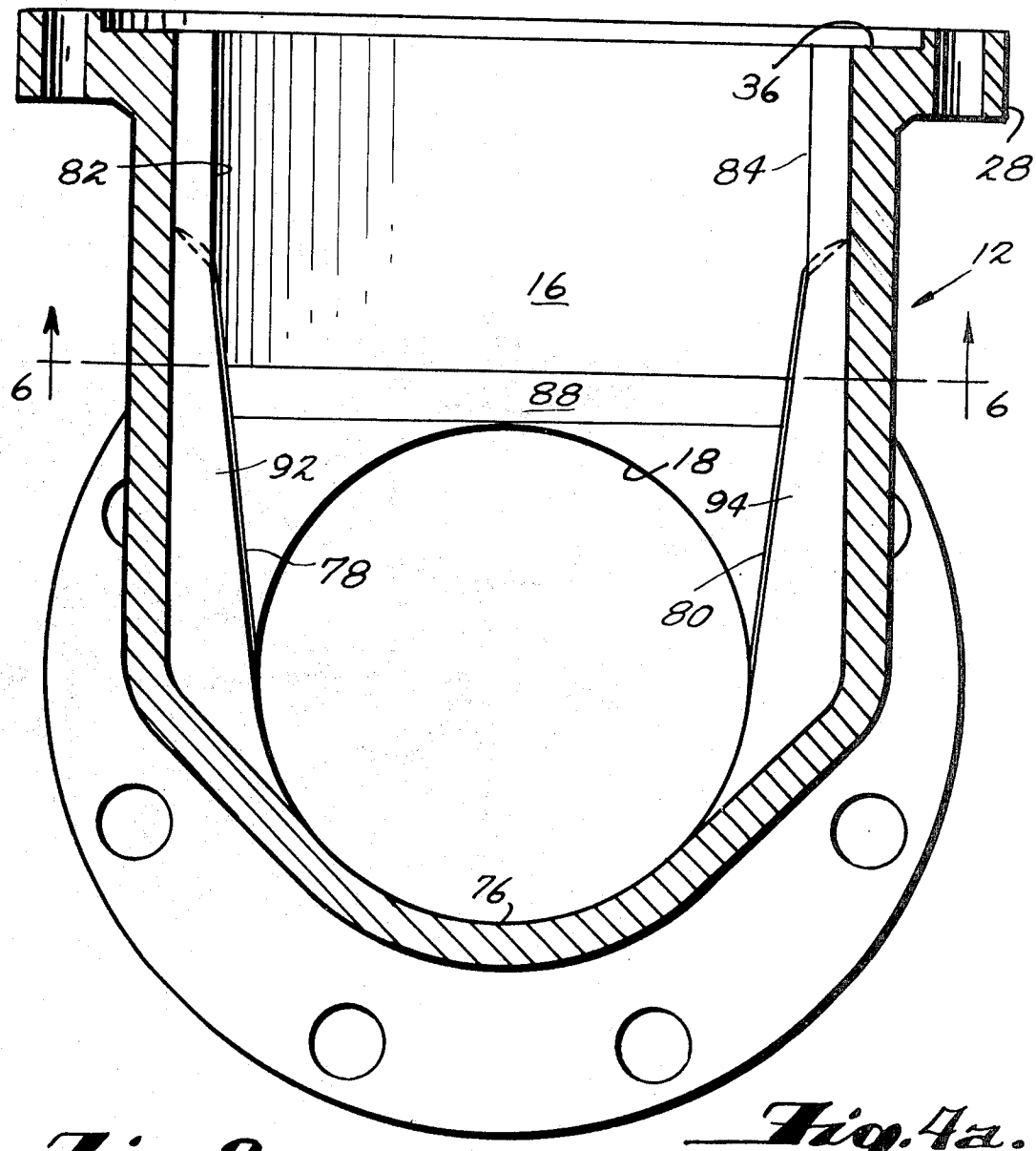
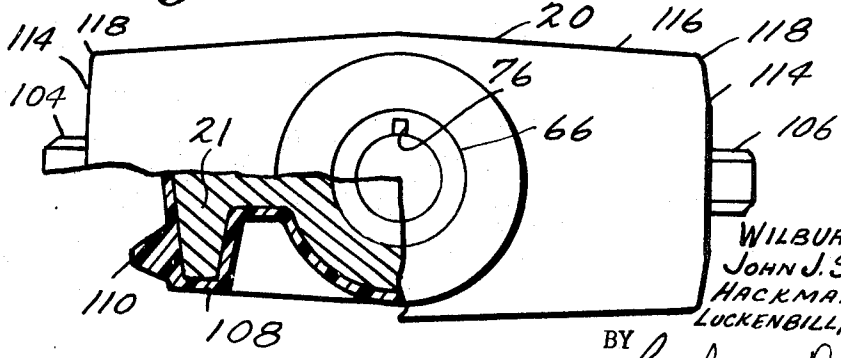



Fig. 4a.

Fig. 8.

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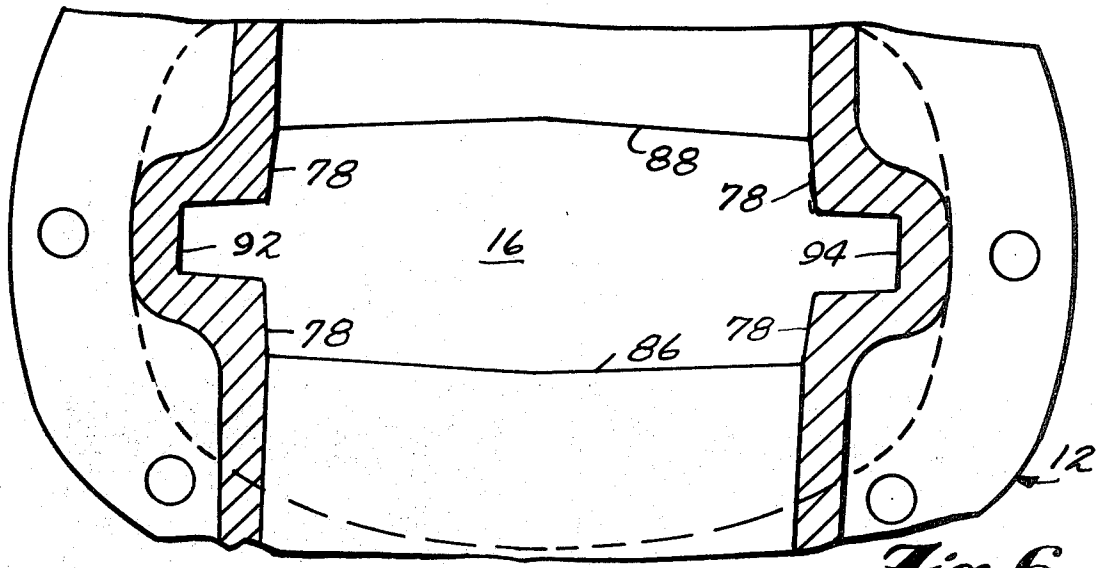


Fig. 6.

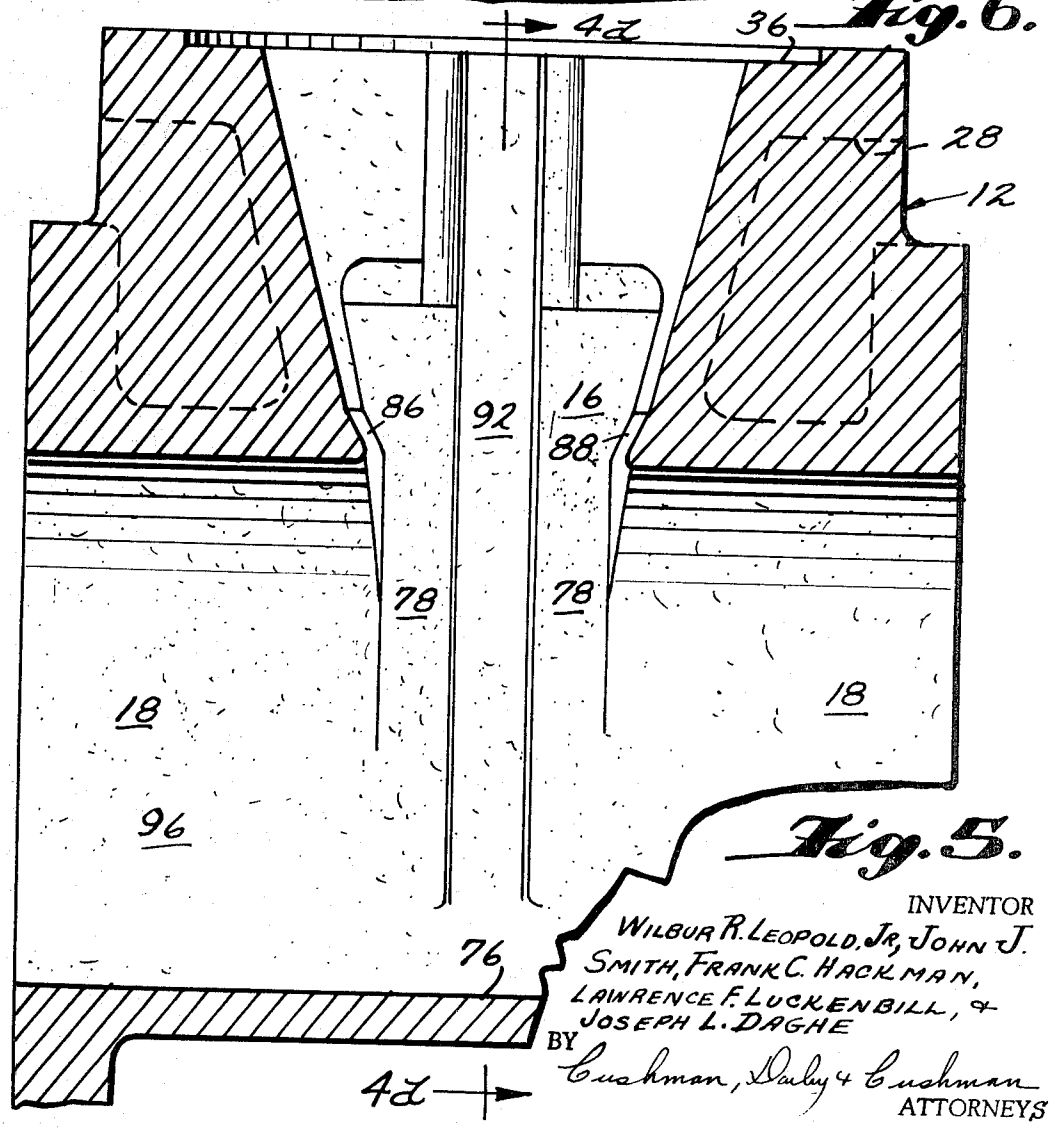


Fig. 5.

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Fig. 9.

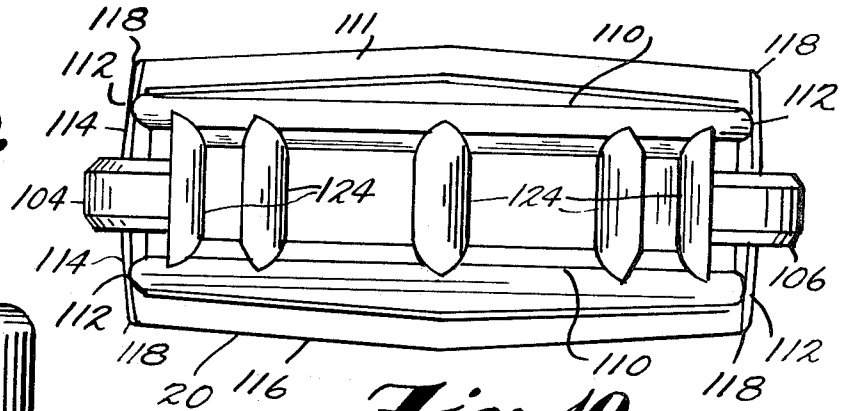


Fig. 10.

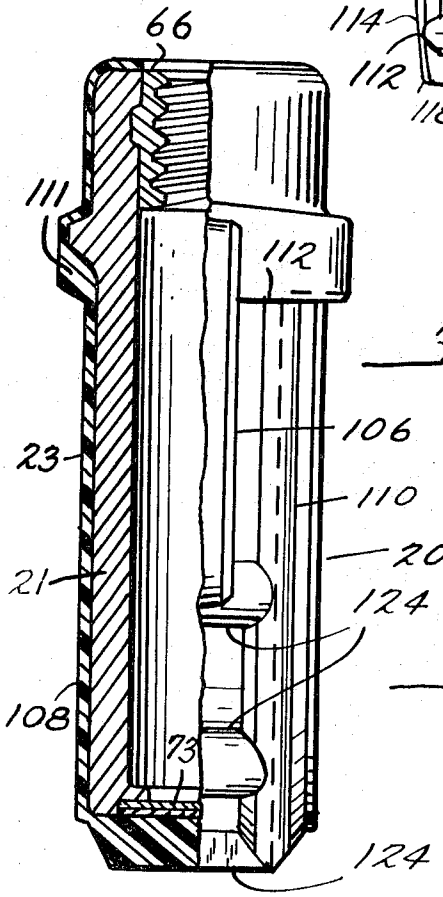


Fig. 11.

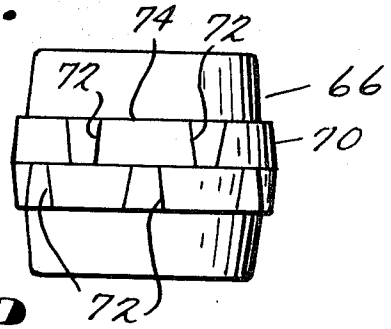


Fig. 12.

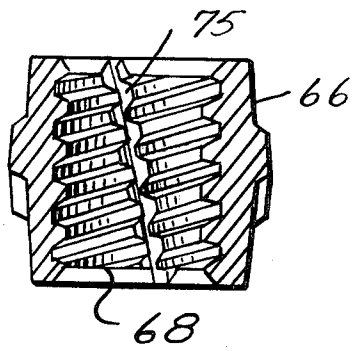


Fig. 13.

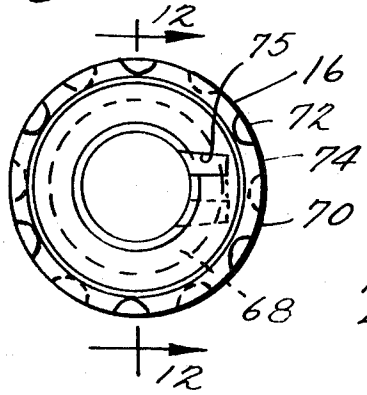


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Fig. 15.

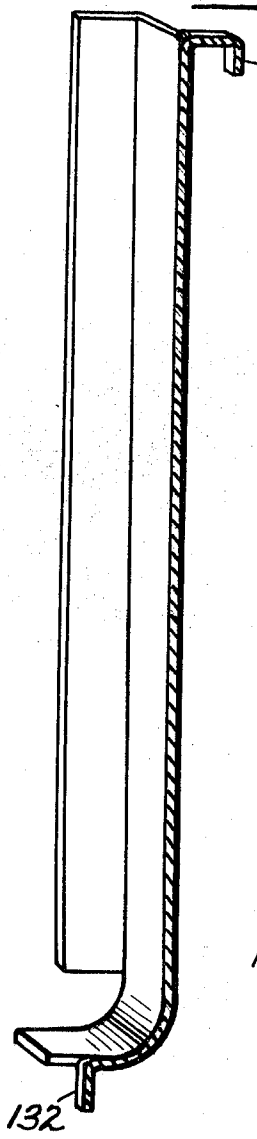



Fig. 14.

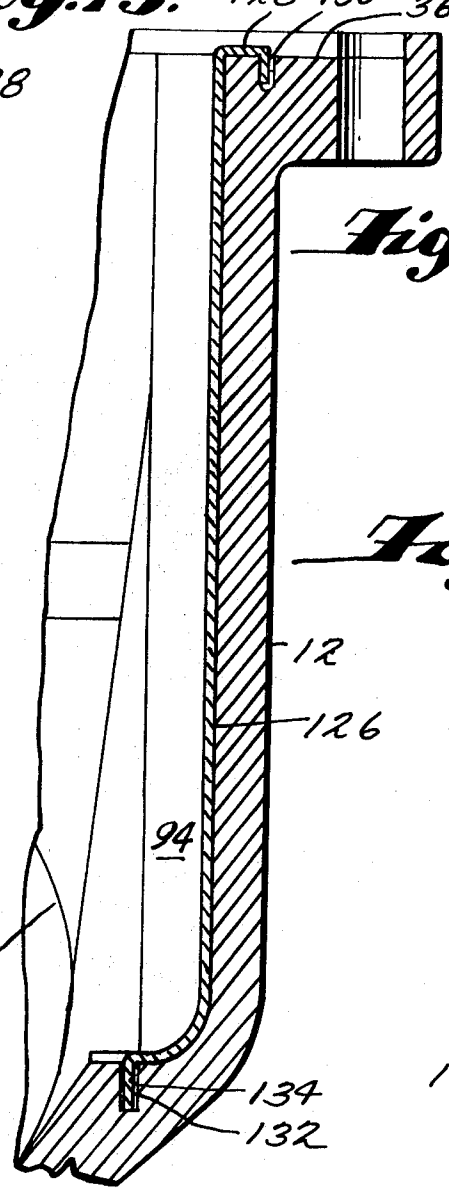



Fig. 17.

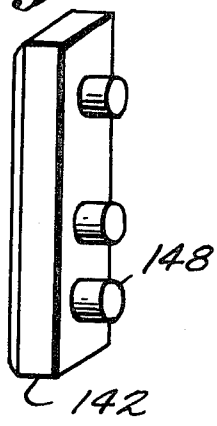
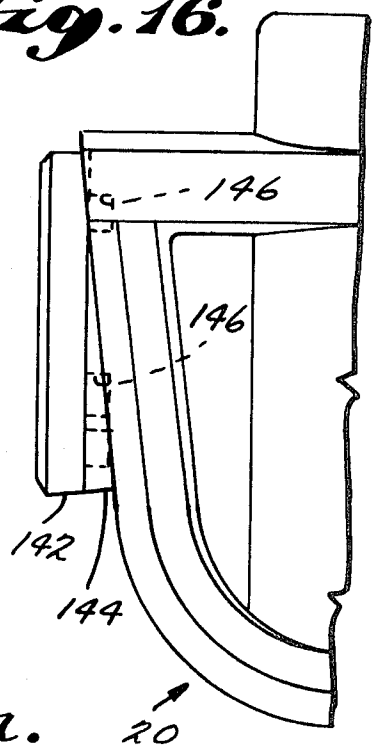



Fig. 16.

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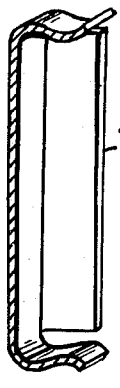
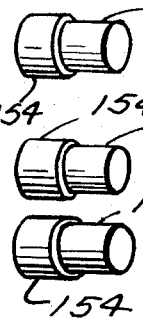



Fig. 17a.

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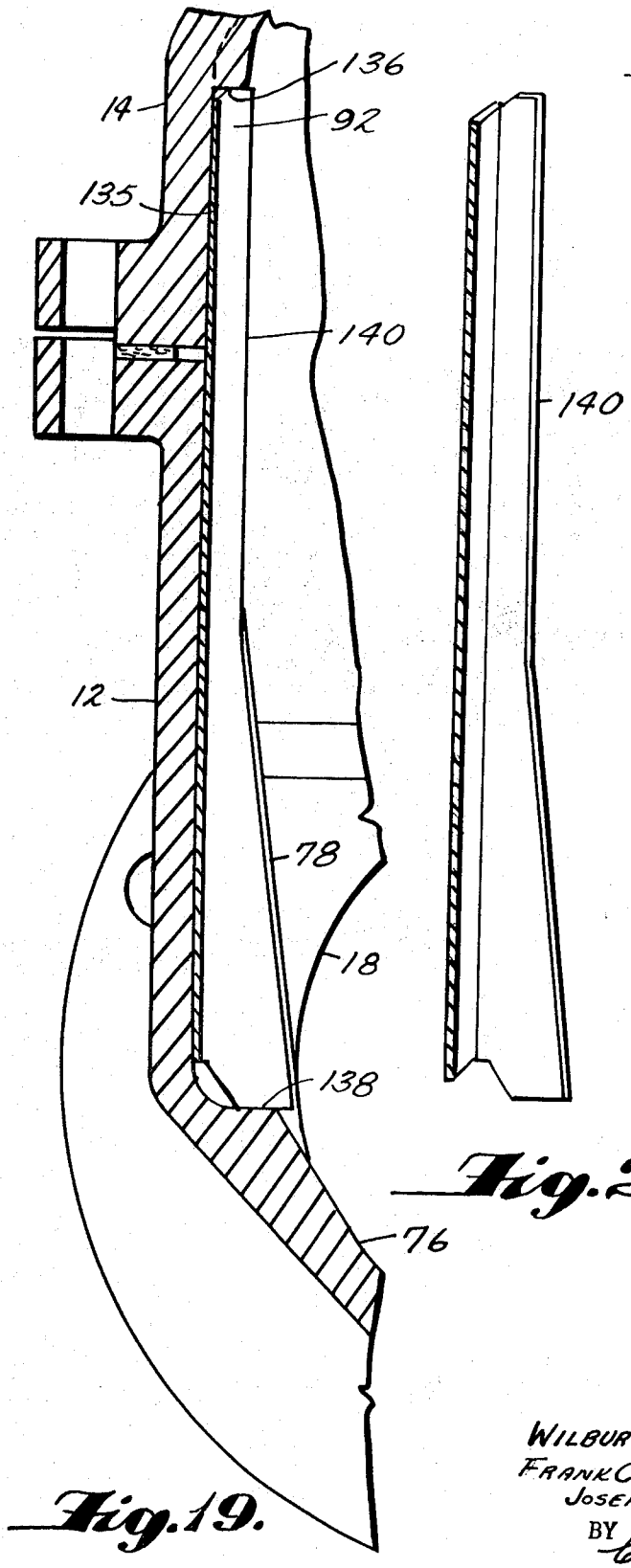



Fig. 19.




Fig. 20.

Fig. 21.

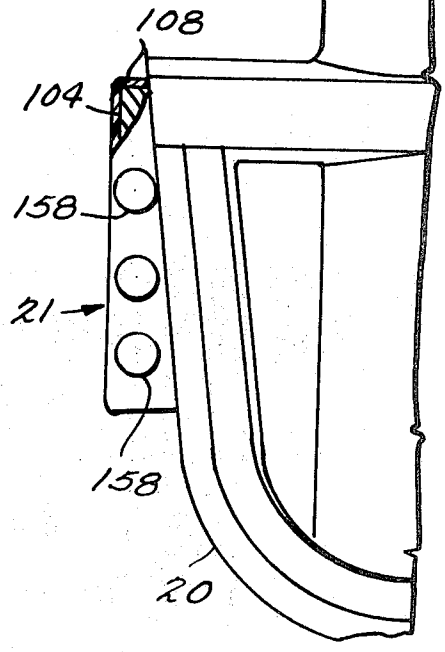
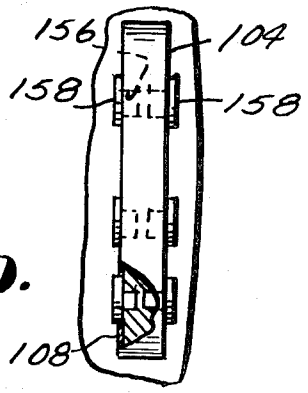



Fig. 22.

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# GATE VALVE STRUCTURE

The present invention relates to an improved gate valve structure and, more particularly, to an improved valve gate member having an improved seating arrangement within the valve casing, an improved operating mechanism for such a gate member, and an improved means of protecting the various parts from corrosion and debris so that the valve structure has an extended life.

Heretofore gate valve structures provided with a reciprocating valve gate member for blocking flow of a through-bore of a valve casing required a specially designed valve casing having a circular valve seat around the through-bore. Usually, this valve seat was placed on the downstream side of the valve gate member so that the pressure of the fluid in the main, such as a water main of a water distribution system, would assist in the sealing. In some instances, the valve seat was also placed on the upstream side as well as the downstream side of the gate member. The circular seat required the valve casing to have a dished out portion or well along the bottom of the through-bore to receive the lower portion of the gate member, and thus, when the valve gate member was opened, eddy currents were set up therein, this resulting in lime deposits and dirt and sludge deposits settling in the dished out bottom or well. Such an arrangement of valve seat for cooperating with the valve gate member often times made operation of the valve structure difficult both in closing the valve and opening the valve. For example, if lime or dirt deposits collected around the valve seat while the valve was open, there was interference when efforts were made to completely close the valve gate member of the valve, and too much torque would be placed on the valve gate member in an effort to make a full seal. By having the valve seat arranged to cooperate with the valve gate member throughout on a force line of sealing parallel to the axis of the flow of fluid through the valve or the axis of the through-bore, the torque necessary to open the valve was also quite high because in effect there had to be a "shearing" type separation between the gate member and its seat.

Over and above these aforementioned disadvantages, the provision of an entirely curved concentric valve seat and a cooperating surface on the valve gate member necessitated expensive and difficult manufacturing techniques.

Prior gate valve structures were not in the complete sense corrosive-resistant. The ears or guides on the valve gate member traveled in grooves or tracks on the valve casing which were exposed to the corrosive action of the fluid and thus were subject to extensive wear and subsequent malfunctions after periods of use. Additionally, where the valve gate member had a valve operating stem chamber therein, means were not provided to protect the valve gate member from a "pumping action" caused by the valve stem entering the chamber and so no means was provided for compensating for dirt or debris entering such chamber and possibly causing the binding of the threads between the stem and the valve gate member.

## SUMMARY OF THE INVENTION

The gate valve structure of the present invention is primarily utilized in large mains carrying fluid under high pressure, such as water mains in city and country water distribution systems. While the gate valve structure of the present invention is primarily for use with very large diameter water mains, the same may also be utilized in smaller water mains and in other fluid distribution systems such as chemicals, steam, gas, oil and the like wherein the fluid is under high pressure and may have a possible corrosive action.

A valve casing is provided having a completely unobstructed through-bore and a generally flat valve gate member, which has a hollow valve stem receiving chamber arranged to reciprocate across the through-bore to block the flow of fluid therethrough. The valve gate member is provided with a plastically deformable corrosive-resistant covering such as rubber, a rubber-like product, lead, plastic, asbestos, aluminum or the like, and a portion of this covering is arranged to seal on a force line of seal normal to the axis of flow whereas another portion of the covering seals on a generally straight line across the casing but still on a force line transverse of the axis of flow, the arrangement permitting ease of manufacture for both the valve casing and the valve gate member as a completely curved seat is eliminated. The arrangement is such that the gate valve structure of the present invention will hold approximately twice the pressure of a conventional curved seat gate valve structure with a lesser amount of holding torque. For example, a 12 inch diameter valve made according to the present invention when inserted into a main where the test line pressure is 400 p.s.i., the total pressure on the valve gate member is approximately 40,000 lbs. To maintain a seal, it is necessary to have 600 p.s.i. to 700 p.s.i. on the sealing area, and this can be obtained easily by a minimum of torque applied through the operating mechanism. To open such a valve, there is no "shearing effect" to overcome as the valve seat and gate member separate transverse of the line of flow of the fluid and thus the total pressure on the gate member has little effect on operation.



The particular arrangement of valve seat in the valve casing permits better elastic deformation of the contacting plastically deformable material of the covering of the valve gate member and thus, more positive sealing results. Further, the arrangement of the valve seat in the casing eliminates "bottoming" of the valve gate member preliminarily of the seating of the remainder of the gate member, and consequently, a sufficient minimum torque may be used to provide for complete stoppage of flow of fluid when the valve is in the closed position.

The entire external area of the valve gate member is provided with means to protect the gate member from corrosion in either the open or the closed position. Additionally, the interior of the valve casing, including the bonnet, may be provided with a corrosive-resistant coating such as an epoxy resin, and the trackways for the ears of the valve gate member are protected from damage to this coating by easily replaceable protective inserts provided in the trackways.

## DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view through the gate valve structure of the present invention, taken in a plane transverse of the through-bore of the same, and illustrating the valve gate member in the closed position;

FIG. 2 is a vertical sectional view partly in elevation of the gate valve structure of FIG. 1, the vertical sectional view being taken in a plane parallel to the axis of the through-bore;

FIG. 3 is a sectional view of the gate valve structure of FIG. 1 taken substantially on the line 3—3 of FIG. 1;

FIG. 4 is an enlarged plan view of the lower body member of the valve casing looking down into the valve chamber and the opening to the through-bore;

FIG. 4A is a vertical sectional view through the lower body member of the valve casing, the view being taken on the line 4*a*—4*a* of FIG. 4.

FIG. 5 is a sectional view of the lower body member of the valve casing taken on the line 5—5 of FIG. 4, a portion of the view being broken away;

FIG. 6 is a fragmentary sectional view of the lower body member of the valve casing taken substantially on the line 6—6 of FIG. 4A and illustrating the guideways or tracks for the valve gate member;

FIG. 7 is an enlarged vertical sectional view, partly in side elevation, of the valve gate member of the gate valve structure of FIG. 1, the view looking at the gate member from a direction along the axis of the through-bore of the valve casing when positioned therein;

FIG. 8 is a top plan view, partly in section, of the valve gate member of FIG. 7;

FIG. 9 is an end elevation, partly in vertical section, of the valve gate member of FIG. 7;

FIG. 10 is a bottom plan view of the valve gate member of FIG. 7;

FIG. 11 is an enlarged side elevational view of the annular bushing inserted into the valve gate member when the valve gate member is cast;

FIG. 12 is a vertical sectional view through the annular bushing of FIG. 11;

FIG. 13 is a top plan view of the annular bushing of FIG. 11;

FIG. 14 is an enlarged fragmentary vertical sectional view through the guideway for the valve gate member in the bottom body member of the valve casing and illustrating one modification of providing a detachable corrosive-resistant insert member to protect the guideway;

FIG. 15 is a fragmentary perspective view of the insert member of FIG. 14;

FIG. 16 illustrates a fragmentary side elevation of a modified valve gate member having a replaceable corrosive-resistant ears;

FIG. 17 is a perspective view of the replaceable ear for the valve gate member of FIG. 16;

FIG. 17A is a perspective view of roller-pin elements utilized in place of the ears of FIG. 16 and functioning as ears;

FIG. 18 is a fragmentary perspective view of a corrosive-resistant cover member which may be snapped or otherwise secured to the ears of the valve gate member shown in FIG. 7;

FIG. 19 is an enlarged fragmentary vertical sectional view through the valve casing and illustrating a trackway or guide for the valve gate member extending from the body member to the bonnet member and provided with a modified form of corrosive-resistant insert;

FIG. 20 is a fragmentary perspective view of the insert used in the modification shown in FIG. 19;

FIG. 21 is a view similar to FIG. 16 but illustrating a further modified means of protecting the ears of the valve gate member; and

FIG. 22 is a fragmentary end elevational view of the valve gate member of FIG. 21 looking in the direction of the arrow 21.

## DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings wherein like character and reference numerals represent like and similar parts, the gate valve structure of the present invention is generally illustrated in FIGS. 1 through 3 inclusive. In more detail, a valve casing generally designated at 10 includes a body member 12 and a detachable bonnet member 14. The bonnet member 14, together with the body member 12, define a valve chamber 16 open at its lower end to a through-bore 18 in the body member. A valve gate or disc member 20 cooperating with a valve operating stem 22 is arranged to move in the chamber 16 between a position across and closing the through-bore 18 to an open position where the through-bore 18 is unobstructed and there can be smooth flow of fluid through the valve structure. Of course, there can be intermediate positions where the valve structure is throttled.

The body member 12 of the valve casing 10 is, as mentioned above, provided with the through-bore 18, the through-bore terminating in end flanges 24 and 26, respectively. The flanges 24 and 26 are adapted to be bolted to corresponding flanges of two sections of a fluid main, not shown. Of course, means other than flanges 24 and 26 may be provided for connecting the valve body member 12 to the main. An upwardly facing flange 28 is provided on the body member 12 and is arranged to receive a downwardly facing flange 30 provided on the bonnet member 14. As shown in FIGS. 1 and 2, nut and bolt means 32 are utilized to secure the body member 12 to the bonnet member 14, there being positioned a gasket 34 therebetween. The gasket 34 is received within a counterbore or groove 36 in the upwardly facing surface of flange 28, and thus, there can be no outward flow of the gasket from line pressure in the chamber 16 when the valve structure is in the open position.

The gate valve structure of the present invention as illustrated in FIGS. 1 and 2 is being provided with the valve operating stem 22 which is of the non-rising type, but it will be appreciated that certain aspects of the gate valve structure of the present invention could be modified for use with a rising stem type of valve. In more detail, the valve stem 22 is exteriorly threaded as indicated at 38 and is provided at its upper end with an annular flange 40 that bears against at least one anti-friction washer 42 positioned in a counterbore 44 of the bonnet member 14. The portion 46 of the valve operating stem 22 extends through a bore 48 of bonnet member 14 and projects therefrom as indicated at an end portion 50. The projecting end portion 50 is non-circular in cross-section and may be tapered outwardly. An operating nut 55 having a non-circular recess 52 therein, complementary to the non-circular end portion 50, fits over the end portion 50 and is held thereon by a nut 54 threaded onto the extreme outer end of end portion 50. A suitable anti-friction washer 56 is provided between the operating nut 55 and the bonnet member 14.

In order to support the valve stem 22 for rotation but prevent the same from moving vertically downwardly, the valve stem is provided with an annular groove 58 on the portion 46 within the bore 48, the groove 58 being arranged to receive the end of a hold plug 60 threaded into a bore through the bonnet member wall. Of course, the flange 40 prevents upward or outward movement of the valve operating stem 22. Suitable O-ring seals 62 are provided between the end portion 46 of the valve stem 22 and the bore 48 in the bonnet member 14.

The valve gate member 20 is hollow and thus provided with a chamber 64 for receiving the valve stem 22 as the gate member is moved out of the through-bore 18 into the valve receiving chamber 16. In more detail, the valve gate member 20 is provided with a body 21 having a deformable covering 23 thereon. A more detailed description of the covering 23 and its relation to the invention will follow in the specification. The body 21 is manufactured by casting the same from iron, and at the time of casting an annular brass bushing 66 is positioned in the mold and integrally cast into the body 21 of the gate member 20 at the upper end of the chamber 64. The annular bushing 66, as best shown in FIGS. 11 through 13, is provided with interior threads 68 for receiving the exterior threads 38 of the valve stem 22, the threads 68 being machined in the bushing after casting of the body 21. It will be noted by particular reference to FIG. 11 the exterior of the bushing is provided with an annular shoulder 70 having a plurality of spaced recesses 72 around the same so as to define lug-like elements 74 therebetween. The lug-like elements 74 projecting radially from the annular bushing 66 functions as means to prevent relative rotation between the bushing 66 and the cast body 21 of the gate member 20.

The end of the valve stem receiving chamber 64 opposite to the end carrying the annular bushing 66 is closed by means of a blow-out plug 73 which functions not only as a blow-out plug but also as a freeze plug should liquid get into the chamber 64 and freeze and a means to fill the hole left in the bottom of the body 21 caused by the core support during casting or molding and, thus, normally protects the inside of the body 21 from line fluid. In order to prevent the blow-out plug from blowing out during normal operation of the valve structure when the valve operating stem 22 is rotated to raise the gate member 20 to the open position, the annular bushing 66 is provided with an spiral groove 75 (FIGS. 12 and 13) extending co-axial of the bushing's axis and having a depth slightly greater than the root-diameter of the thread 68. Thus, when the valve operating stem 22 is rotated and the gate member 20 rises thereon, the end of the valve stem cannot act as a piston in the valve receiving chamber 64 as this relieves pressure build-up within the chamber 64. Additionally, the spiral groove 75 extending across the threads 68 also functions to permit any dirt or sludge on the exterior threads 38 or the interior threads 68 to be discharged therefrom and, thus, functions as cleaning means. This cleaning function normally becomes necessary when the gate valve structure is used to throttle and the gate member 20 is left in the partially opened position for a long time and sand, sludge or other dirt collects in the chamber 64.

Sudden opening of the gate member **20** to the full position will not damage the same.

Referring now specifically to FIGS. **4**, **4A**, **5** and **6**, there is disclosed in detail the body member **12** of the valve casing **10** which forms with the bonnet member **14** the valve chamber **16** in which the valve gate member **20** operates. The body member **12** is preferably manufactured of cast iron, although other materials, such as ductile iron, steel, brass and the like, depending upon whether the fluid of the main is water, chemicals, gas, oil or the like, may be used. Likewise, the material for the bonnet **14** depends on the fluid of the particular system. If cast iron is used, the valve seat is provided during casting or molding, although it may be machined finished. As will be noted by reference to the figures mentioned above, a portion of the valve chamber **16** within the body member **12** is defined by a curved bottom wall **76** which provides a smooth continuation of the bottom of the through-bore **18**. Extending upwardly from the bottom wall **76** are oppositely disposed planar side walls **78** and **80**, these walls joining the bottom wall **76** on a tangent thereto and diverging upwardly away from each other at a predetermined included angle in the order of 14°. The side walls **78** and **80** merge into straight vertical side wall portions **82** and **84**, respectively, the side walls **82** and **84** terminating at the open upper end of the body member. As will be noted in FIG. **4**, the upper open end of the chamber **16** in the body member **12** is generally rectangular in cross-section in a plane parallel to the axis of the through-bore **18** and the side walls **78** and **80** are joined at their upper portions by end walls **86** and **88**, which are oppositely disposed to each other and which extend generally transverse of the through-bore. The transverse end walls **86** and **88** diverge outwardly in an upwardly direction. At each of the points of junction of the side walls **78** and **80** with the transverse end walls **86** and **88**, the joining surfaces as indicated at **90** are provided with a predetermined radius. The function of these curved surfaces **90** will be described later when discussing the seating arrangement of the valve gate member **16** when blocking flow through the through-bore **18**.

Oppositely disposed guideways or tracks **92** and **94** extend from the flanged end of the body member downwardly in the side walls **82** and **84**, then into the side walls **78** and **80**, respectively, and terminate at the upper portion of the bottom wall **76** by merging smoothly into the same. The function of the guideways **92** and **94** will be explained in more detail later in the specification.

The valve structure of the present invention is intended for use in water distribution systems and other fluid systems where corrosion or rusting may take place. In order to fully protect the valve structure, the entire interior of the through-bore **18** and the chamber **16** in the body member **12**, and well as in the portion of the chamber formed by the bonnet member **14**, may be covered by a non-corrosive coating **96** represented diagrammatically by the speckled portion shown only in FIG. **5**. This non-corrosive coating **96** may be a fluidized bed coating, a galvanized coating, an epoxy resin coating or a dry film lubricant coating, depending upon the type of fluid distribution system in which the valve structure is to be used. In some instances, the entire interior of the body member **12** and bonnet member **14** may be coated, whereas in other instances, depending upon the type of fluid in the fluid system, it may only be necessary to coat those portions of the body member **12** within the valve chamber **16**. In any event, the coating may cover the track or guideways **92** and **94** to protect the same, and when it does cover such guideways, it must be protected from moving parts of the valve gate member **20**, as will be explained in more detail later in the specification.

The valve seat for the valve gate member **20** is defined by at least one continuous valve seating surface **100** shown in dash-dot lines on FIG. **4**, and it will be noted that this seating surface **100** extends completely around the through-bore **18** and is defined by the bottom wall **76**, side walls **78** and **80**, curved surfaces **90** and one transversely extending wall **86**. Preferably, a second valve seating surface **102** is defined on the other side of the guideways **92** and **94** by the bottom wall **76**, side walls **78** and **80**, curved surfaces **90**, and the other transversely extending wall **88**. A more detailed discussion of the cooperation of the valve seating surfaces **100** and **102** will be discussed later when the valve member **20** is described in detail.

Referring now to FIGS. **7**, **8**, **9** and **10**, the valve gate member **20** of the present invention is shown in detail and is provided with the generally flat cast body **21** which in front elevation is generally shaped similarly to the seating surfaces **100** and **102**. In side elevation, as shown in FIG. **9**, it is generally rectangular in shape, and, of course, during casting the valve stem receiving chamber **64** is formed and the nut or bushing **66** is cast integral therewith. In the modification shown in FIGS. **7** through **9**, inclusive, oppositely disposed and projecting ears **104** and **106** are integral with the body **21**, the ears being provided for cooperating with the guideways **92** and **94**, respectively. As is well-known in the art, the ears **104** and **106** ride in the guideways or tracks **92** and **94** and prevent the gate member **20** from rotating when the valve stem **22** is rotated, and thus, only reciprocating movement is imparted to the gate member.

The gate member **20** is provided with the covering **23** made of a plastically deformable material such as any elastomeric material. Preferably, the covering **23** is made of rubber or a rubber-like material, but it may be made of plastics, lead, asbestos, soft aluminum and the like. The covering **23** is molded all over the body **20** with the exception of the surface area of the ears **104** and **106**, and as a molding convenience, it has a minimum one-sixteenth of an inch thickness. Of course, if desired, the ears **104** and **106** may be covered with the covering **23**. As is now evident, the covering **23** has a two-fold function, first to provide corrosion protection for the body member, and second, to provide sealing areas for the sealing surfaces **100** and **102**. The sealing areas which are arranged to engage the seating surfaces **100** and **102** are provided with a bead-like rib **110**, there being one-bead-like rib for engaging the curved bottom wall **76** and the side walls **78** and **80** on either side of the guideways **92** and **94**. The bead-like ribs **110** merge into an upper thickened portion **111** of the covering **23** as indicated at **112** in FIGS. **9** and **10**, the thickened portion **111** providing a continuation of the sealing area for engaging the side walls along a longitudinal line, the curved surfaces **90**, and the transverse walls **100** and **102**. In other words, the bead-like ribs **110** have a curved bottom portion complementary to the bottom wall **76** and then they diverge upwardly and outwardly at a predetermined included angle, with them then merging smoothly into the thickened portion **111** at **112**, and thus, the thickened portion **111** has a longitudinally extending surface **114** which has a juncture with a transversely extending surface **116**. The juncture between each of the longitudinally extending surfaces **114** and the transversely extending surfaces **116** is a curved surface **118** of predetermined radius less than the predetermined radius of the curved surface **90**. This arrangement, upon closing of the gate member **20**, permits the deformable material to flow so that a completely tight seal can be obtained around the curved surfaces.

It is mentioned above that the bead-like ribs **110** extend upwardly and diverge at a predetermined included angle and this included angle is less than the included angle between the side walls **78** and **80**, and this is purposely arranged in this manner so that the side portions of the bead-like ribs **110** engage the side walls **78** and **80** when the gate member **20** is being closed just before the bottom wall **76** is engaged. Such a sloping arrangement permits the gate member **20** to be moved further to insure proper sealing between the side portion of the bead-like ribs **110** of gate member **20** and the side walls **78** and **80** without the danger of the gate member prematurely "bottoming" on the bottom wall **76**. In other words, necessary compression can be applied to the bead-like ribs **110** progressively upwardly by the side walls **78** and **80** and then by the bottom wall **76**. This arrangement permits a minimum of

operating torque to be used to obtain a maximum of sealing pressure. Additionally, all seal areas between the gate member **20** and the seating surfaces **100** and **102** are normal to the gate member's travel or tapered with respect to the gate member's travel, and thus, produce required seat leads with a minimum of operating torque. There is no sliding frictional contact between the gate member **20** and the seating surfaces **100** and **102**, thus, eliminating a "shearing" sliding type of separation or engagement, and consequently, eliminating wear and high operating torques.

It has been found that for best results the predetermined included angle between the ribs **110** should vary for different size valves with the included angle between the body side walls **78** and **80** being constant and vice versa. For example, when the included angle between the side walls is 14°, then the included angle between the ribs **110** of gate member **20** for different size valves is as follows:

| Size of Valve | Included Angle on Gate Member |
|---|---|
| 2 inch | 10° – 44′ |
| 3 inch | 11° – 44′ |
| 4 inch | 12° – 16′ |
| 6 inch | 12° – 50′ |
| 8 inch | 13° – 8′ |
| 10 inch | 13° – 18′ |
| 12 inch | 13° – 26′ |

The ears **104** and **106** which ride in the guideways or tracks **92** and **94** have their lower ends **120** and **122** which face the curved bottom wall **76** extending at a back angle to the gate member, the back angle for each of these ends **120** and **122** being in the order of 6° with a plane extending normal to the axis of the gate member. When the gate member **20** is open for a long period of time often deposits of sludge or dirt build up in the guideways **92** and **94**, and this would present a problem in obtaining full closure of the valve gate member **20** if it were not for the "cow catcher" effect produced by the ends **120** and **122** of the ears **104** and **106**. By providing a substantial back angle on each of the ends **120** and **122** of the ears **104** and **106**, respectively, the ends **120** and **122** will scrape any build-up of dirt or sludge from the guideways **92** and **94**, and it will be deposited into the main so that the ears can have their complete travel downwardly in the guideways.

When the covering **23** for the valve gate member **20** is made of rubber it has been found advantageous to have the rubber in a hardness range of 60–70 durometers. Preferably, the rubber covering **108** is molded directly to the body **21**, although it may be applied by other means. It will be noted by reference to FIGS. **9** and **10**, the bead-like ribs **110** are separated longitudinally of each other by a plurality of peripherally spaced, longitudinally extending bead-like ribs **124**, and the purpose of these longitudinally extending ribs **124** is to provide ease in manufacture when molding and to provide additional resistance to rubber blow-down when the gate member **20** is in the closed position. The ribs **124** are provided during molding by sprue passages in the mold and add more rubber strength to the covering **23**. This substantially reduces the causes of tearing of rubber from the body member **21**, particularly under high velocity conditions of flow of the fluid existing at or near closure of the gate member **20** across the through-bore **18**. Additionally, the bead-like ribs **124** transmit the holding power from the upstream bead-like rib **110** to the downstream bead-like rib **110**, and thus, make the downstream bead-like rib **110** function similar to the upstream bead-like rib **110** so it, too, can assist in providing a better sealing means when the valve structure has the gate member **20** in the closed position.

As mentioned earlier in the specification, certain valve structures require better protection on the interior of the same from corrosion by the fluids used. In this respect, the interior of the valve casing **10** can be provided with the corrosive-resistant coating **96** (FIG. **5**), this coating being applied to the guideways **92** and **94**. Care must be taken to protect the coating **96** in the area guideways **92** and **94** from wear caused by movement of the ears **104** and **106** therein, and this may be accomplished by providing an insert **126** (FIGS. **14** and **15**) within the guideways. Preferably, the insert **126** is made from stainless steel so it, too, will be corrosive-resistant, although it can be made of a plastic, and it is detachably retained in the guideways **92** and **94** so that when it becomes worn it can be easily replaced by removal of the bonnet member **14** without damage to the coating **96**. The insert **126** shown in FIGS. **14** and **15** has a length substantially equal to the length of the guideways **92** and **94** in the body member, and it is provided with a tab **128** at its upper end which is folded back and extends down a short distance into an aperture **130** provided in the gasket recess **36**. Insert **126** is provided at its lower end with a downwardly extending tab **132** which is arranged to fit into a recess **134** provided in the end of the guideways **92** and **94**. The insert **126** is U-shaped in cross-section and closely covers the walls of the guideways **92** and **94** to protect the same. When the bonnet member **14** is applied to the body member **12**, the flange **30** of the bonnet member will retain the tab **132** in position, and thus, the insert is prevented from moving longitudinally in the guideway, and it also cannot move transverse of the guideway as the tab **132** orients the same.

Referring now to FIGS. **19** and **20**, there is disclosed a slight modification of the insert for the guideways **92** and **94**. In this modification the guideways **92** and **94** are arranged to extend upwardly into the bonnet member **14** as indicated at **135**, the same terminating in a shoulder **136**, whereas the lower ends of the guideways **92** and **94** terminate in an oppositely disposed shoulder **138** in the body member **12**. An insert **140**, U-shaped in cross-section and made from stainless steel or other non-corrosive material and having an over-all length substantially equal to the distance between the opposed shoulders **136** and **138**, is placed into the guideway with the ends of the insert abutting the shoulders. Such an arrangement prevents the insert **140** from moving longitudinally in the guideways and, of course, the ears **104** and **106** bearing against the bottom wall of the insert **140** would prevent the same from moving transversely out of the guideways.

As shown in FIGS. **1** and **7**, the ears **104** and **106** project out of the covering **108**. As also mentioned earlier in the specification, these ears **104** and **106** may be covered with the covering **23** to protect the same against corrosion where the particular valve structure is to be used with corrosive fluids.

If it is desired, the ears **104** and **106** may be made as detachable ears **142**, and the body member **21** may be cast with a boss **144** thereon having suitable holes **146** for receiving pins **148** projecting from the ears (see FIGS. **16** and **17**). The ears **142** in this case would be made of stainless steel so as to be corrosive-resistant and should they ever become damaged, then they could be easily replaced without having to replace the entire gate member **20**.

Referring to FIG. **17A**, there are shown pin elements **152** having rollers **154** on their outer ends. These pin elements **152** could be inserted into the holes **146** in the boss **144** of the gate member **20** shown in FIG. **16**, and the rollers would function as ears instead of the single integral ear member **142**.

In FIG. **18** there is disclosed a stainless steel clip-on cover member **150** for clipping over the cast ears **104** and **106** of the gate member **20** of FIGS. **1** and **7**. This clip-on cover member **150**, being made of stainless steel, is corrosive-resistant and could be easily replaced but yet would protect the ears **104** and **106** projecting from the body member **21** of the gate member **20** from fluid flowing through the valve structure. The clip-on cover member **150** could be made of other corrosive-resistant materials, for example, plastics, bronze or the like. Also, it will be appreciated that instead of having the cover member **150** clip on, it could be mechanically attached, such as by screws, rivets or the like.

Referring now to FIGS. 21 and 22, there is disclosed the gate member 20 having ears 104 and 106 covered with the rubber covering 108 that also covers the rest of the gate member. In this type of an arrangement the ears 104 would have holes 156 drilled therethrough, the holes receiving, at opposite ends thereof, stainless steel pins 158, the pins projecting from the covering to act as guides for the ears in the guideways. The pins 158 would be press-fit into the holes so that they could be replaced, if desired. Additionally, the pins 158 could be inserted into the ears prior to application of the covering and, thus, could be utilized to properly position the body member 21 during application of the covering.

The terminology used throughout this specification is for the purpose of description and not limitation of the invention, the scope of the invention being defined in the appended claims.

What is claimed is:

1. A gate valve structure for use in mains carrying a fluid, said gate valve structure comprising: a valve casing having a through-bore with spaced axially aligned ports and a valve chamber intermediate the ports and providing unobstructed communication between the ports, said valve chamber being defined by a curved bottom wall providing a continuation of the bottom of the through-bore, oppositely disposed planar side walls diverging upwardly from said curved bottom wall at a predetermined included angle, and an upper open end generally rectangular in cross-section parallel to the axis of the through-bore, said upper open end being defined by upper portions of said divergent side walls and by divergent oppositely disposed walls extending generally transverse of the through-bore, said bottom wall, divergent side walls and at least one of said transversely extending walls providing a continuous surface defining a valve seat; and a generally flat valve gate member movable through the upper open end of said valve chamber to a closed position blocking said through-bore, said gate member having a covering on the exterior thereof made of a deformable material, said gate member having a configuration in elevation substantially similar to the cross-sectional configuration of said valve chamber transverse of said through-bore and having a seating surface provided by its covering complementary to the continuous surface defining said valve seat in said casing, said seating surface including at least a bead-like rib on a portion of gate member's periphery having a curved bottom portion and diverging side portions, the diverging side portions of said bead-like rib having a predetermined included angle slightly less than said predetermined included angle of the side walls of said valve chamber, whereby contact occurs initially between the diverging side portions of said bead-like rib and the planar side walls of said chamber to ensure adequate compression therebetween at least at the time adequate sealing is obtained between the curved bottom portion of said bead-like rib and the curved bottom wall of said chamber.

2. A gate valve structure as claimed in claim 1 in which said deformable material is elastomeric.

3. A gate valve structure as claimed in claim 1 in which said elastomeric material is rubber.

4. A gate valve structure as claimed in claim 3 wherein there are two bead-like ribs on the portion of said gate member's periphery having the curved bottom portion and diverging side portions, one of said ribs being upstream of the other said ribs, said covering being provided with longitudinally extending ribs interconnecting said two bead-like ribs for transmitting holding power when said gate member is seated from the upstream rib to the downstream rib.

5. A gate valve structure as claimed in claim 1 in which the included angle between said oppositely disposed planar side walls of said valve chamber is in the order of 14° and in which the included angle between the diverging side portions of said bead-like rib increases as size of the valve structure increases.

6. A gate valve structure as claimed in claim 1 in which said upper portions of said divergent side walls have junctures with said divergent oppositely disposed walls of a predetermined radius and wherein a portion of the complementary seating surface of said valve gate member has a substantially straight surface extending transversely of a plane through the axis of the through-bore for seating with one of the divergent oppositely disposed walls and longitudinally extending surfaces for seating with the upper portions of the divergent side walls of said valve chamber, said transversely extending surface having junctures with said longitudinally extending surfaces which have a radius less than said predetermined radius whereby the deformable material may have areas to flow during seating.

7. A gate valve structure as claimed in claim 1 in which said oppositely disposed side walls of said valve chamber are provided with opposed vertically extending guideways and in which said gate member is provided with oppositely disposed ears extending from the sides thereof and arranged to slide in said guideways, said ears having the lower ends thereof extending at a back angle to the gate member whereby dirt or sludge in said guideways is scraped therefrom when said gate member is moved towards the closed position.

8. A gate valve structure as claimed in claim 7 in which the interior of the through-bore and the valve chamber including the guideways is coated with a corrosive-resistant coating and including means to protect said corrosive-resistant coating in an area of said guideways whereby the ears of said gate member are prevented from contacting said coating.

9. A gate valve structure as claimed in claim 8 in which said means includes a insert member carried in each of said guideways and defining a track for said ears.

10. A gate valve structure as claimed in claim 9 in which said insert member is made from stainless steel.

11. A gate valve structure as claimed in claim 9 including means to detachably retain each insert member in the respective guideway.

12. A gate valve structure as claimed in claim 11 in which said valve casing includes a body member having the valve chamber therein and a bonnet detachably connected to said body member and in which said means to retain each insert in the respective guideway includes a tab at one end of the insert extending between said body member and said bonnet and a second tab at the other end of said insert fitting into a hole at the lower end of the respective guideway.

13. A gate valve structure as claimed in claim 11 in which said valve casing includes a body member having the valve chamber therein and a bonnet detachably connected to said body member and in which said means to retain each insert in the respective guideway includes providing each guideway with oppositely disposed end shoulders and in which each insert has a length substantially equal to a distance between said shoulders of said guideway, the ends of the insert abutting said shoulders.

14. A gate valve structure as claimed in claim 7 in which said gate member includes a body made of cast iron and in which said deformable material of said covering is corrosive-resistant; and means for protecting said ears against corrosion.

15. A gate valve structure as claimed in claim 14 in which said last-mentioned means includes providing detachable corrosive-resistant covers for said ears made from stainless steel.

16. A gate valve structure as claimed in claim 14 in which said ears of said gate member are detachable from the body of the same, said ears being made from a corrosion-resistant material.

17. A gate valve structure as claimed in claim 16 in which said corrosive-resistant material of said detachable ears is stainless steel.

18. A gate valve structure as claimed in claim 16 in which the corrosive resistant material of said detachable ears is bronze.

19. A gate valve structure as claimed in claim 16 in which said ears comprise a plurality of pins extending from the sides of the gate member, each of said pins having a roller for riding in the guideways and each of said pins being received in holes provided in the body of said gate member.

20. A gate valve structure as claimed in claim 14 in which said means for protecting said ears against corrosion includes a covering of corrosive-resistant material thereon, said ears being provided with a plurality of stainless steel pins projecting therefrom and providing bearing surfaces to slide in said guideways.

21. A gate valve structure as claimed in claim 1 in which said oppositely disposed side walls of said valve chamber are provided with opposed vertically extending guideways and in which said gate member includes a body having oppositely disposed ears extending from its sides and arranged to slide in said guideways, said body having a valve stem receiving chamber therein open to the exterior of the gate member by a bore, an annular bushing having interior threads, said annular bushing being carried in the bore of said gate member, and said gate valve structure further including a non-rising rotatable valve stem having exterior threads and which is received in the interior threads of said bushing.

22. A gate valve structure as claimed in claim 21 in which said bushing is provided with a spiral groove extending axially from one end to the other end of said bushing for relieving pressure build-up inside the chamber in said gate member and/or discharge of dirt and sludge from the interior threads of said bushing and the exterior threads of said non-rising valve stem.

23. A gate valve structure as claimed in claim 22 in which said body of said gate member is cast and said bushing is positioned in said bore during casting and has means on its exterior to prevent relative rotation between the bushing and the body.

24. A gate valve structure as claimed in claim 23 in which said bushing is made of brass.

25. A gate valve structure as claimed in claim 22 in which said body of said gate member is provided with a blow-out plug between said valve stem receiving chamber and the exterior of the body.

26. In a gate valve structure: a valve casing comprising a body member having a through-bore for the flow of fluid and seat means surrounding the through-bore, a bonnet member fixedly attached to said body member and defining therewith a chamber opening to the through-bore; a valve gate member movable between a blocking position across said through-bore and against said seat means to an open position within said chamber of said valve casing, said gate member having a pair of oppositely disposed ears projecting from its sides to guide the same during movement, a pair of oppositely disposed groove-like guideways within said valve casing and extending from said through-bore into said chamber, said guideways providing a track for receiving said ears; and replaceable means carried in each of said guideways for protecting the same from contact with said ears when said gate member is moved.

27. A gate valve structure as claimed in claim 26 in which at least said guideways are coated with a corrosive-resistant coating to protect the same from fluid flowing through said valve structure.

28. A gate valve structure as claimed in claim 27 in which said through-bore and said chamber within said casing are coated with a corrosive-resistant coating.

29. A gate valve structure as claimed in claim 27 in which said means to protect said guideways from contact with said ears are insert members carried in said guideways.

30. A gate valve structure as claimed in claim 29 in which said insert members are made from stainless steel and are complementary in shape to said guideways, each of said insert members being provided with a tab at one end thereof extending between said body member and said bonnet member and a second tab at the other end thereof fitting into a hole at the lower end of the respective guideway whereby said insert members are prevented from longitudinal movement with respect to said guideways.

31. A gate valve structure as claimed in claim 29 in which said guideways have a predetermined length with a shoulder at each end thereof and wherein said insert members are made of stainless steel and complementary in shape to said guideways and have substantially the same length whereby they are prevented from moving longitudinally with respect to said guideways.

32. In a gate valve structure having a non-rising valve stem, an improved gate member comprising: a body having a valve stem receiving chamber closed at one end and open at the other end to the exterior of the gate member by a bore, an annular bushing having interior threads for threadedly receiving the non-rising valve stem, said annular bushing being fixedly supported in the bore of said gate member, and a spiral groove co-axial of and extending from one end to the other end of said bushing across said interior threads for relieving pressure build-up inside the chamber and/or for discharging dirt and sludge from said threads.

33. An improved gate valve member as claimed in claim 32 in which said body of said gate member is cast and in which said bushing is provided with lug-like elements on its exterior and is positioned in the bore during casting, said lug-like elements preventing relative rotation between the bushing and the body.

34. An improved gate valve member as claimed in claim 33 in which said bushing is made of brass.

35. An improved gate valve member as claimed in claim 33 in which said closed end of said valve stem receiving chamber is provided with a blow-out plug.

36. An improved gate valve member as claimed in claim 35 in which the exterior of said body is provided with an elastomeric coating.

37. In a gate valve structure: a valve casing comprising a body member having a through-bore for the the flow of fluid and seat means surrounding the through-bore, and a bonnet member fixedly attached to said body member and defining therewith a chamber opening into the through-bore; a valve gate member movable between a blocking position across said through-bore and against said seat means to an open position within said chamber, said gate member having a pair of oppositely disposed ears projecting from its side to guide the same during movement, a pair of oppositely disposed groove-like guideways within said valve casing and extending from said through-bore into said chamber, said guideways providing a track for receiving said ears, said ears having at least their ends facing the through-bore extending at a back angle to the gate member whereby dirt and/or sludge in said guideways is scraped therefrom when said gate member is moved towards the closed position.

38. A gate valve structure as claimed in claim 37 in which said back angle for each of said ends is in the order of 6° with a plane extending normal to the axis of the gate member.

39. In a gate valve structure: a valve casing comprising a body member having a through-bore for the flow of fluid and seat means surrounding the through-bore, and a bonnet member fixedly attached to said body member and defining therewith a chamber opening into the through-bore; a valve gate member movable between a blocking position across said through-bore and against said seat means to an open position with said chamber, said gate member including a body made of cast iron and covered with a corrosive-resistant deformable material, said body having oppositely disposed ears projecting from its side to guide the same during movement; a pair of oppositely disposed groove-like guideways within said valve casing and extending from said through-bore to said chamber, said guideways providing a track for receiving said ears; and means for protecting said ears against corrosion.

40. A gate valve structure as claimed in claim 39 in which said protecting means includes providing detachable corrosive-resistant covers for said ears made from stainless steel.

41. A gate valve structure as claimed in claim 39 in which said ears of said gate member are detachable from the body of the same, said ears being made from a corrosive-resistant material.

42. A gate valve structure as claimed in claim 41 in which said corrosive-resistant material of said detachable ears is stainless steel.

43. A gate valve structure as claimed in claim 41 in which said corrosive-resistant material of said detachable ears is bronze.

44. A gate valve structure as claimed in claim 41 in which said ears comprise a plurality of pins extending from the sides of the body of the gate member, each of said pins having a roller for riding in said guideways and each of said pins being received in holes provided in the body of said gate member.

45. A gate valve structure as claimed in claim 39 in which said means for protecting said ears against corrosion includes a covering of corrosive-resistant material thereon, said ears being provided with a plurality of stainless steel pins projecting therefrom and providing bearing surfaces to slide in said guideways.

46. A great valve structure as claimed in claim 39 including at least a corrosive-resistant coating provided on said guideways, and detachable means to protect said coating from actual contact with said ears.

47. A gate valve structure as claimed in claim 46 in which said coating protecting means includes an insert member carried in each of said guideways and which define the track for said ears.

48. A gate valve structure as claimed in claim 47 in which each of said insert members is made from stainless steel.

49. A gate valve structure as claimed in claim 47 including means to detachably retain said each of said insert members in their respective guideways.

50. A gate valve structure as claimed in claim 49 in which said valve casing in which seat means to retain each of said inserts in their respective guideways includes a tab at one end of the insert extending between said body member and said bonnet to prevent longitudinal movement within the particular guideway and a second tab at the other end of said insert fitting into a hole at the lower end of the particular guideway to prevent lateral movement of said insert.

51. A gate valve structure as claimed in claim 49 in which said means to retain each insert in the respective guideway includes providing each guideway with oppositely disposed end shoulders and in which each insert has a length substantially equal to a distance between said shoulders of said guideway, the ends of the insert abutting said shoulders.

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