

[72] Inventor **Homer J. Shafer**
P.O. Box 83, Mansfield, Ohio 44906
 [21] Appl. No. **680,633**
 [22] Filed **Nov. 6, 1967**
 [45] Patented **Dec. 8, 1970**

3,269,692 8/1966 Shafer II 251/315X
 3,275,025 9/1966 Kowalski 251/315X
 3,367,359 2/1968 Johnson 251/315X

FOREIGN PATENTS

687,567 5/1964 Canada 251/315

Primary Examiner—M. Cary Nelson
Assistant Examiner—Michael O. Sturm
Attorney—Hamilton, Cook, Renner & Kenner

[54] **WELDED BALL VALVE AND METHOD OF MAKING**
6 Claims, 12 Drawing Figs.

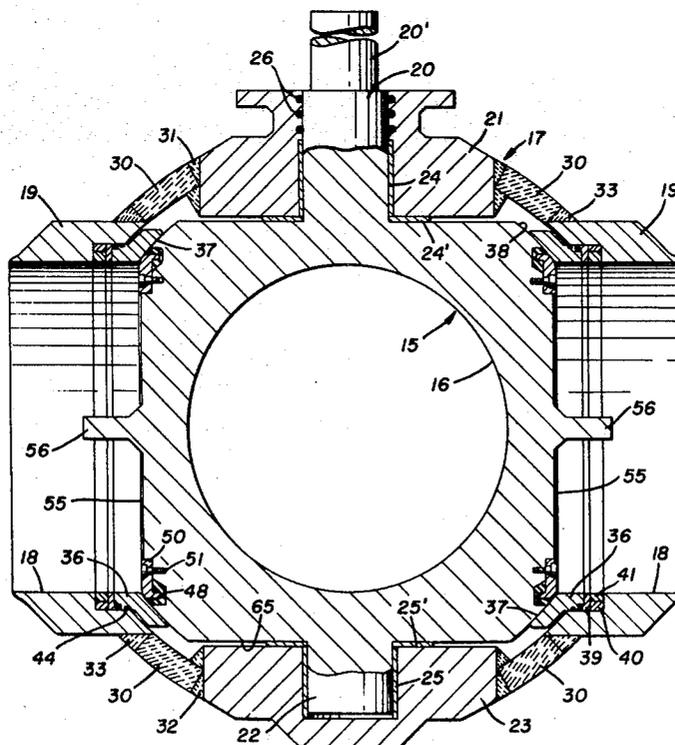
[52] U.S. Cl. **251/309, 251/315**
 [51] Int. Cl. **F16k 5/06**
 [50] Field of Search **251/315, 309, 175, 367**

References Cited

UNITED STATES PATENTS

3,157,190 11/1964 Allen I. 251/315X
 3,195,857 7/1965 Shafer I. 251/315X
 3,235,226 2/1966 Allen II. 251/309

ABSTRACT: A ball valve structure comprising a valve element having an integral stem and a surface formed spherically around the stem axis, mating housing parts welded in a longitudinal plane passing through said stem axis to form a tubular domed housing around the ball with the stem bearing located within and welded to the housing, flow tubes welded in the ends of said tubular housing in accurate alinement with the flow port in the ball and embodying valve seating rings in sealing contact with improved resilient ring seals on the ball, said sealing rings and retaining means therefor insertable through the flow tubes after welding.



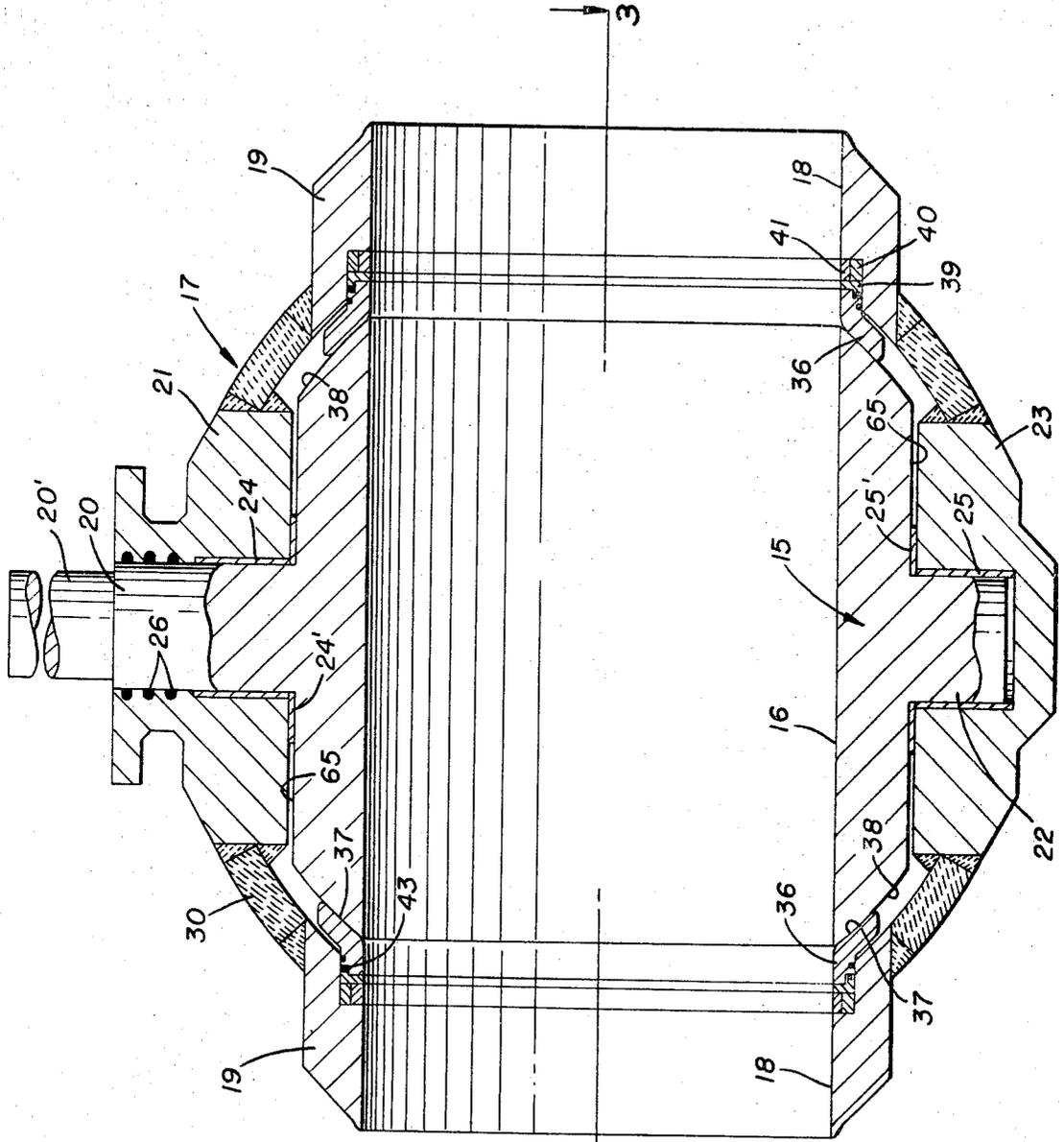


FIG. 2

INVENTOR.
HOMER J. SHAFER
BY *Hamilton & Cook*
ATTORNEYS

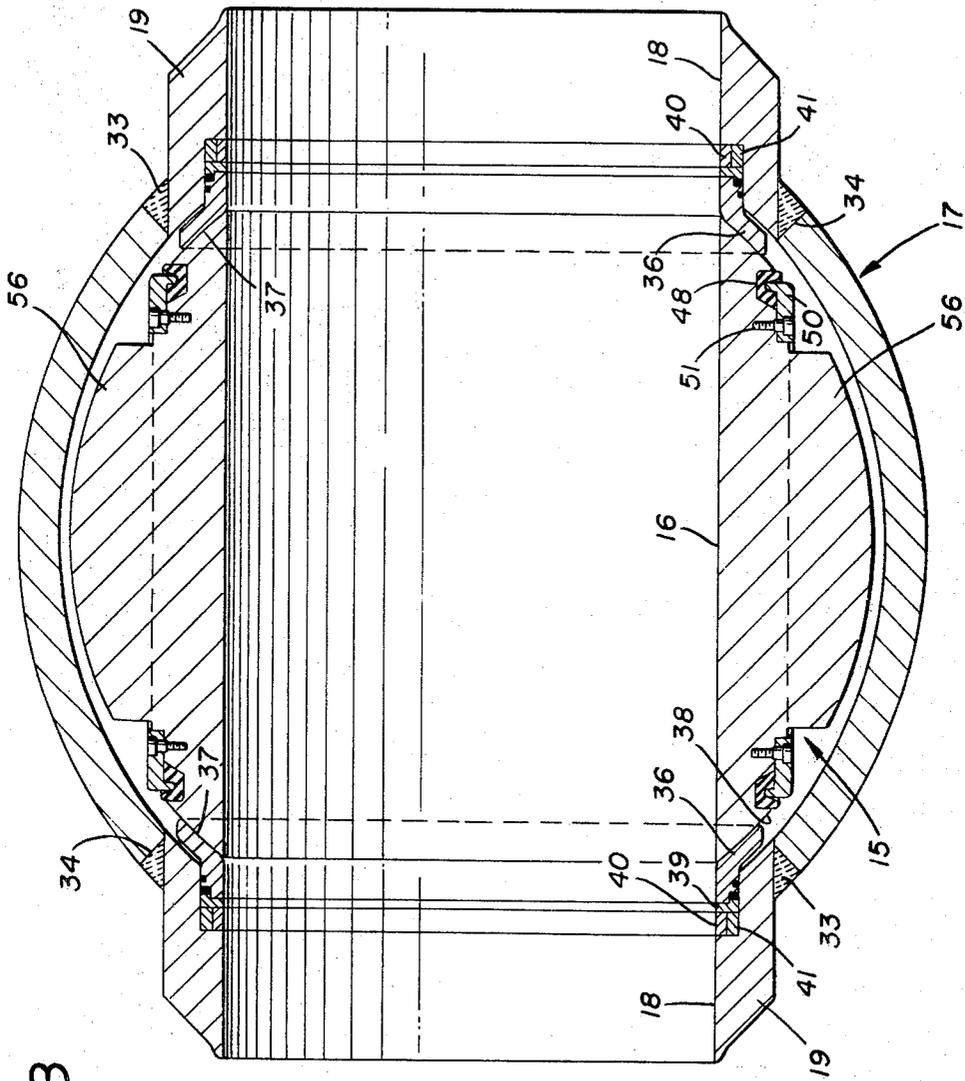


FIG. 3

BY *HOMER J. SHAFER*
Hamilton & Cook
ATTORNEYS

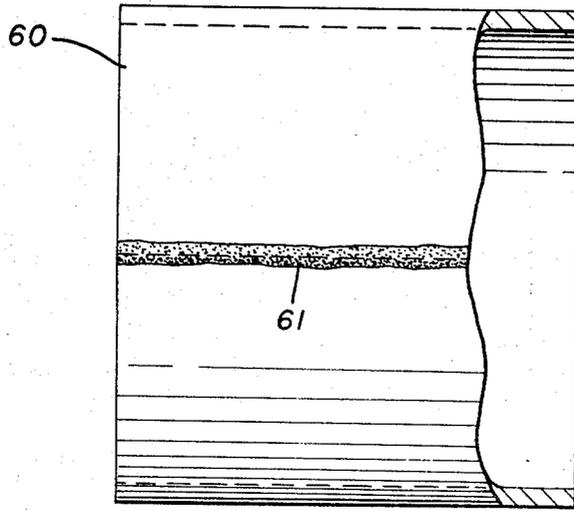


FIG. 4

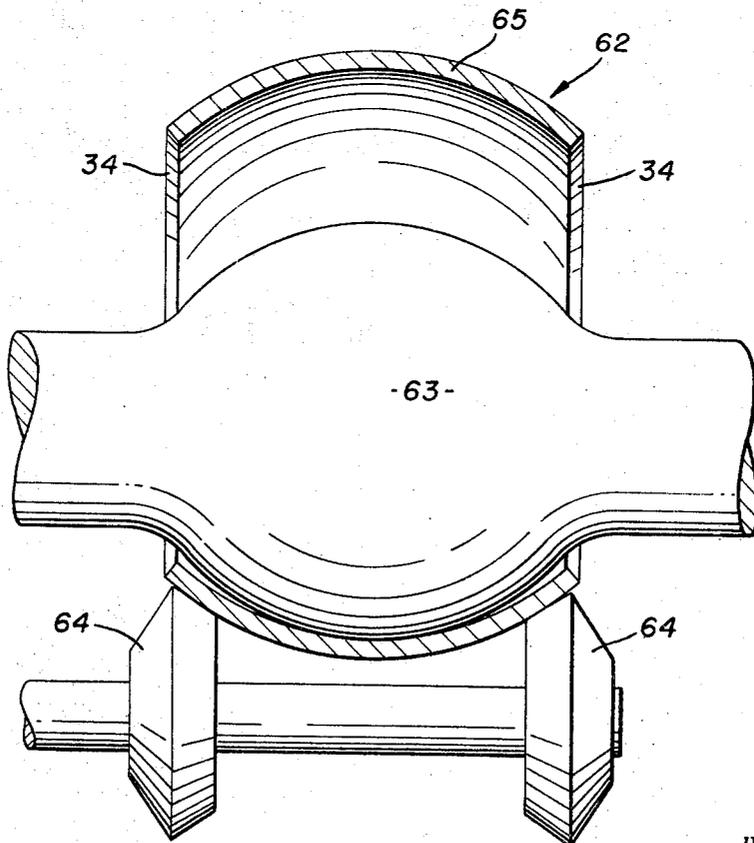


FIG. 5

INVENTOR
HOMER J. SHAFER
BY *Hamilton & Cook*
ATTORNEYS

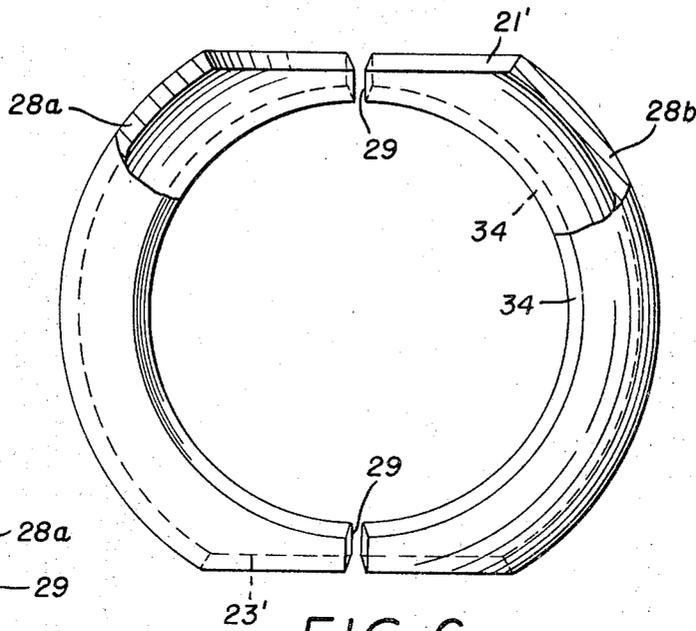


FIG. 6

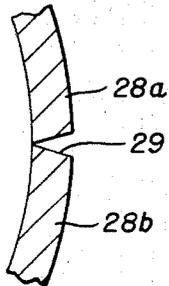


FIG. 10

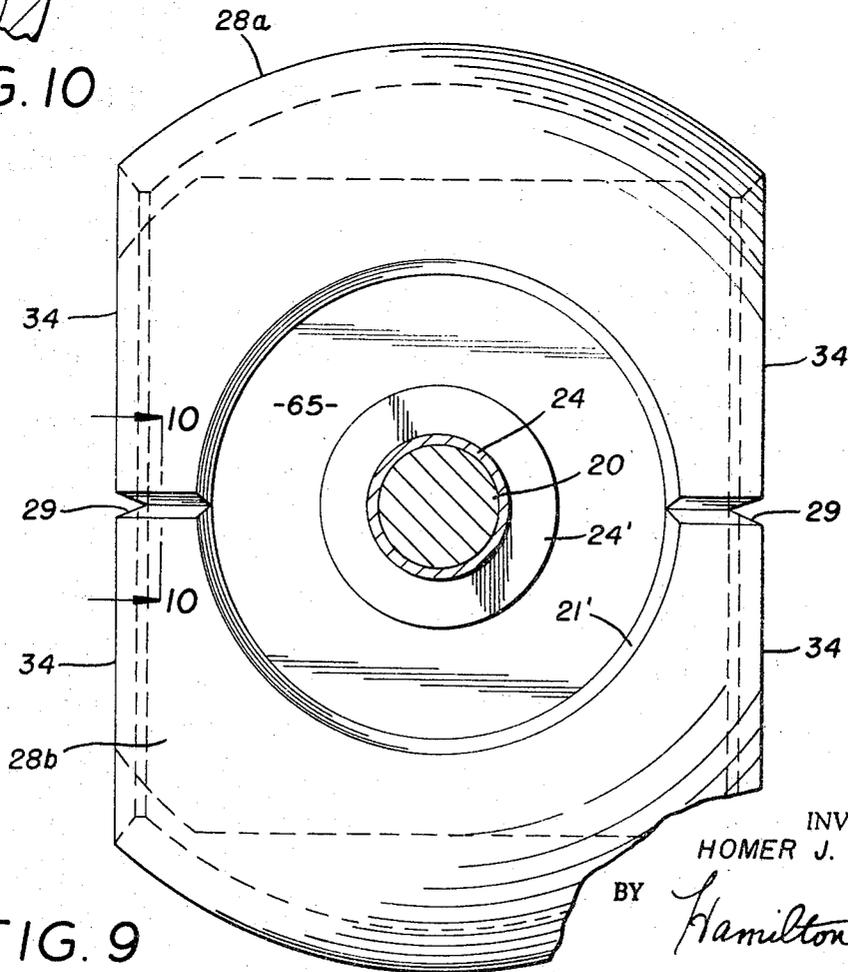


FIG. 9

INVENTOR.
HOMER J. SHAFER

BY *Hamilton & Cook*

ATTORNEYS

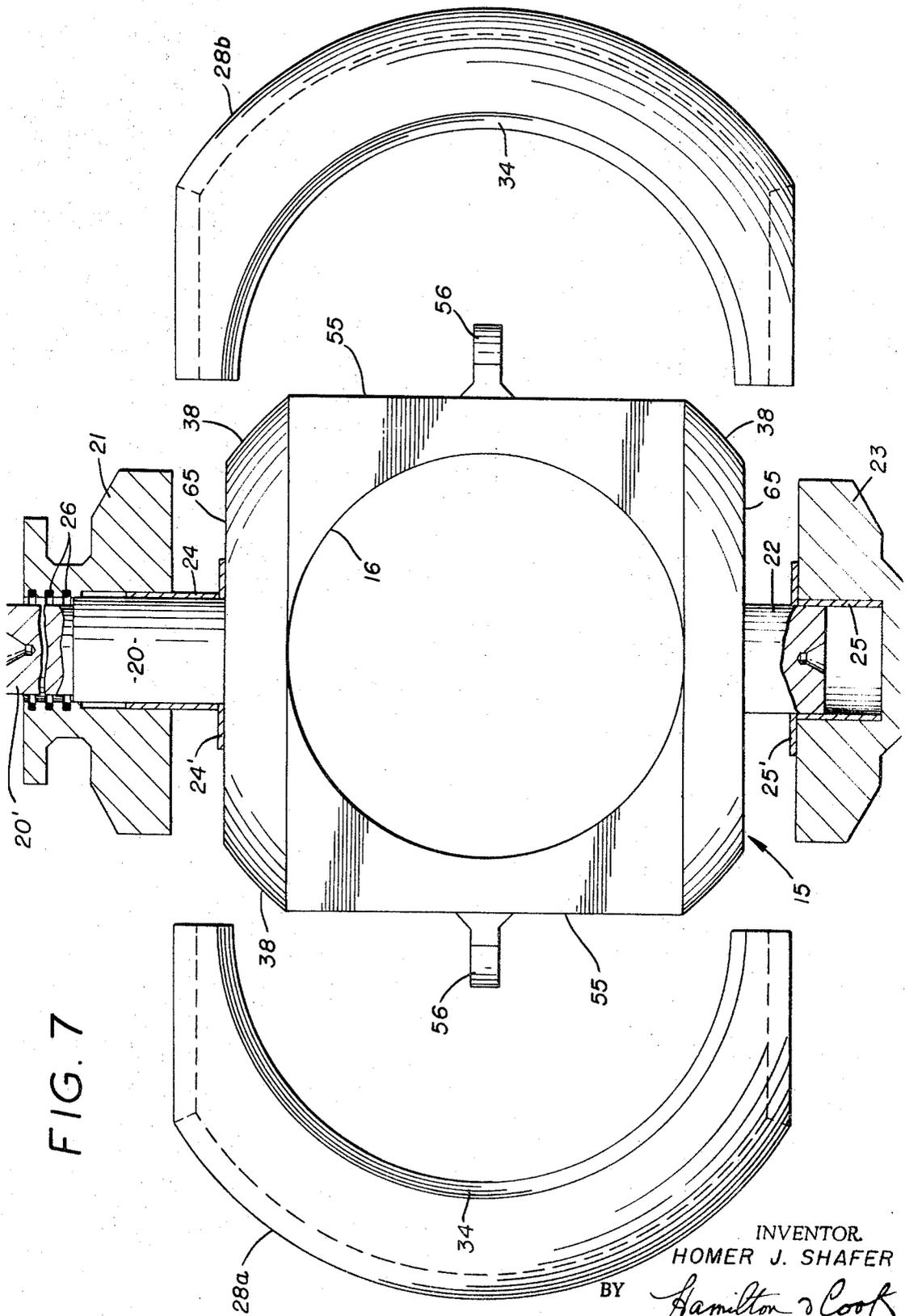


FIG. 7

INVENTOR
HOMER J. SHAFER

BY *Hamilton & Cook*

ATTORNEYS

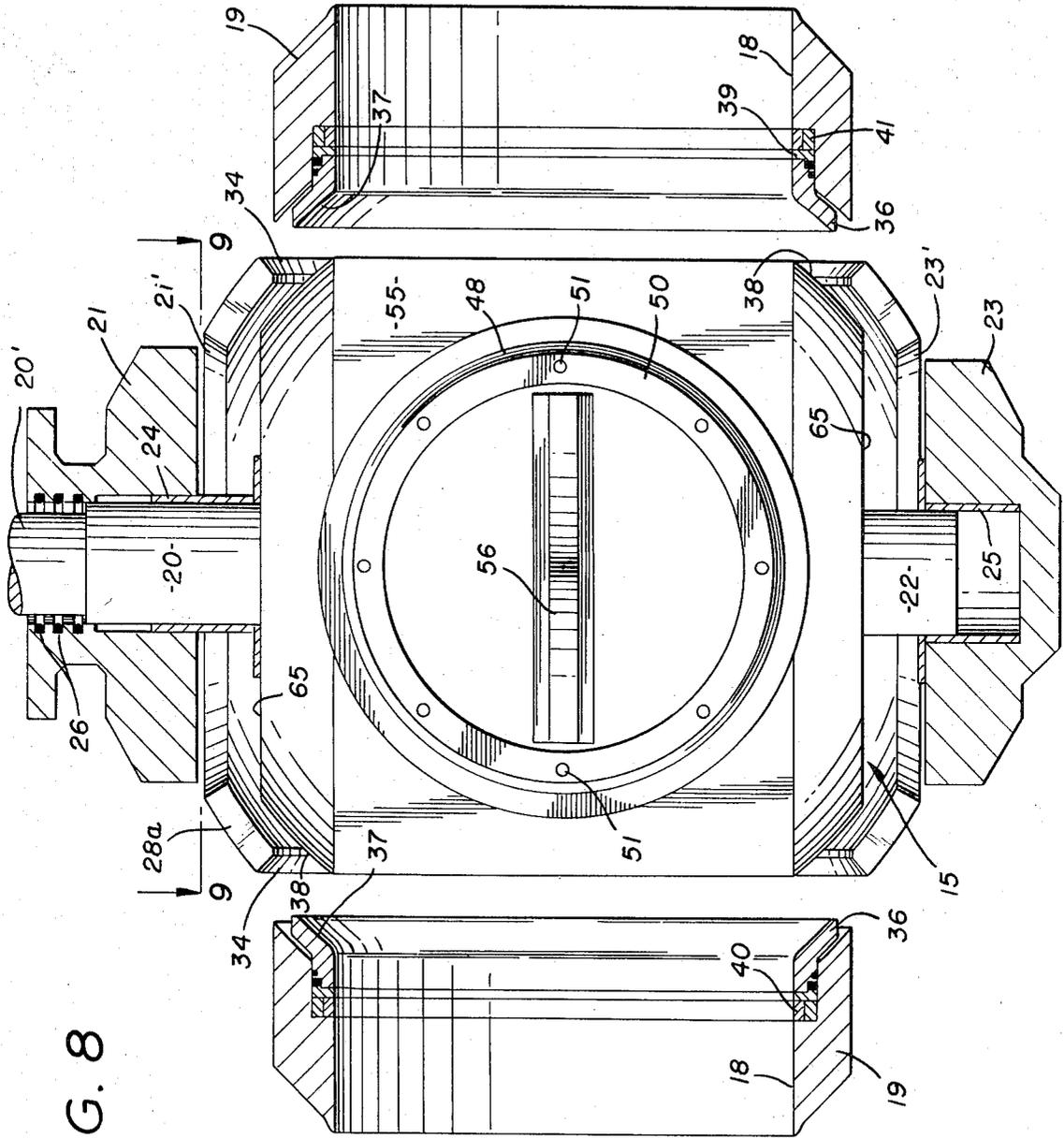
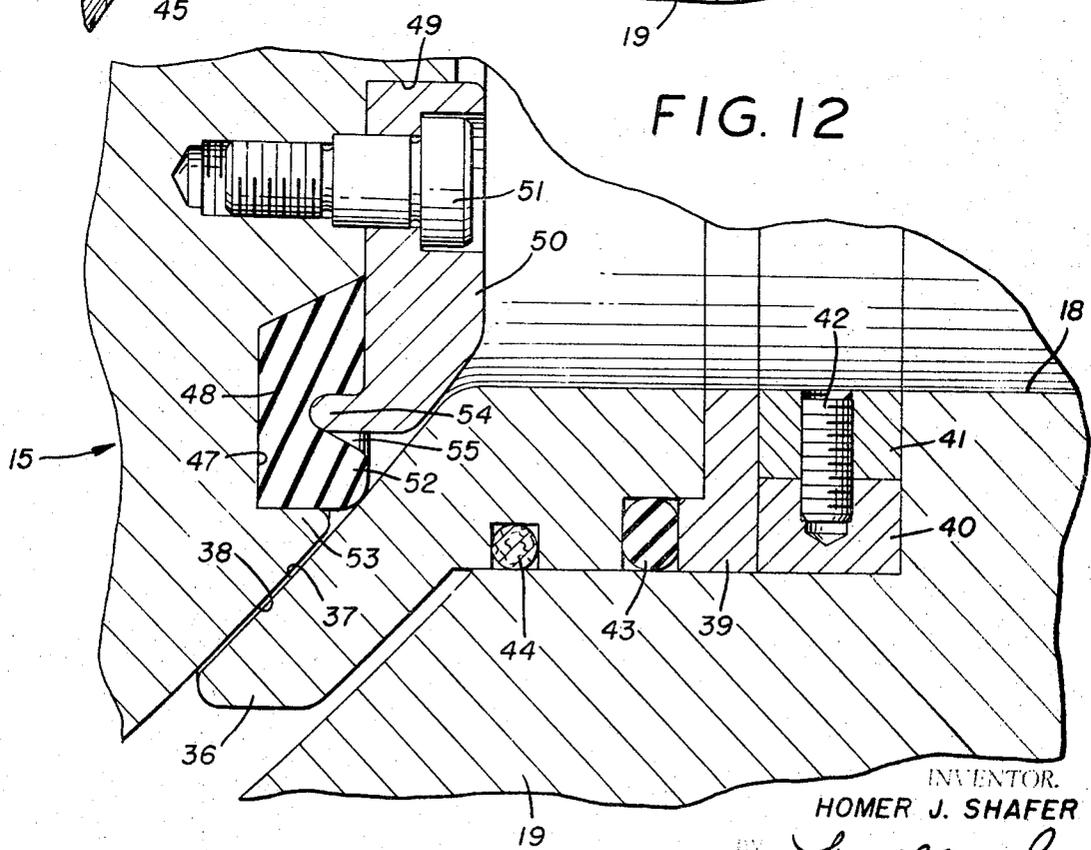
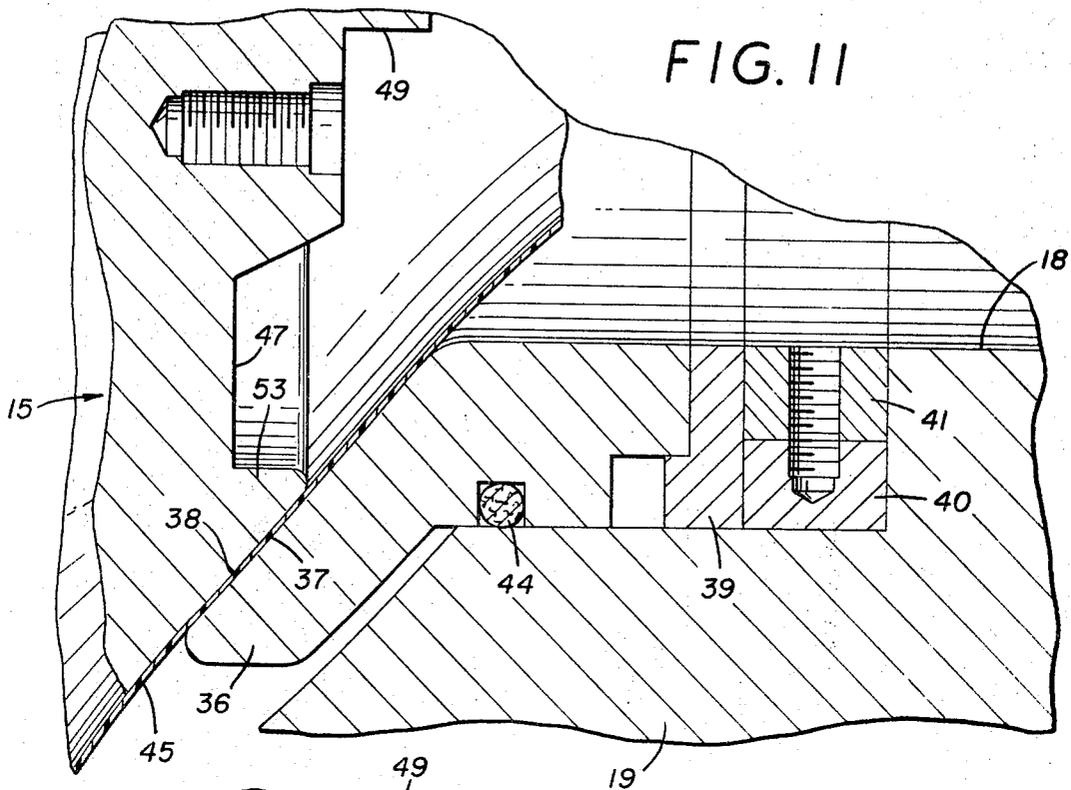


FIG. 8

INVENTOR
HOMER J. SHAFER
BY *Hamilton & Cook*
ATTORNEYS



INVENTOR.
HOMER J. SHAFER

BY *Hamilton & Cook*

ATTORNEYS

WELDED BALL VALVE AND METHOD OF MAKING

BACKGROUND OF THE INVENTION

Certain prior welded ball valves having sealing assemblies, which are inserted into the flow tubes after the body is welded, include retainer rings or thimbles which are screwed or otherwise secured in the flow tubes to hold resilient sealing rings against the ball surface. This type of construction is shown in my U.S. Pat. No. 2,890,017, and requires extra parts to hold the sealing rings accurately in place and increasing the outer dimensions of the valve to accommodate the seating ring assemblies.

Other prior welded constructions have provided for seals mounted in the ball surface and removable with their retaining means through the flow ports, as disclosed in my U.S. Pat. No. 3,155,368, but the valve body consists of a central tube welded between two flow tubes, so that a trunnion type of ball valve having an integral stem and trunnion cannot be inserted into the central tube; the stem and trunnion must be separate parts inserted from the exterior through the central tube. A ball valve having an integral stem and trunnion is advantageous because it can be cast or formed in one piece with the stem and trunnion accurately located on the axis of rotation at right angles to the flow axis, does not require the stem and trunnion to be accurately fitted into the ball, and the spherical surface of the ball can be accurately machined about the stem or rotating axis.

Another prior welded construction using a ball valve having an integral stem and trunnion is disclosed in U.S. Pat. No. 3,157,190. In this construction two mating tubular domed housing parts are welded together continuously from one end to the other on a plane passing through the flow axis at right angles to the stem axis, and transversely aligned holes are formed in the housing parts for the stem and trunnion bearings to be welded therein. This required an excessive amount of welding tending to cause distortion of the body and misalignment of the flow tubes.

Moreover, the seals in this construction are provided by seating rings abutting the spherical surface of the ball, which require a very expensive machining operation to obtain a highly polished spherical surface.

It is an object of the present invention to provide an improved welded ball valve construction which has reduced cost of manufacture and improved alignment of the parts.

Another object is to provide an improved and economical welded ball valve construction and method of making the same.

A further object is to provide an improved welded ball valve construction having the stem bearing within the housing for absorbing stress directly with minimal bending moment on the stem.

A still further object is to provide an improved welded ball valve construction requiring a minimum amount of finish machining of the ball surface.

Still another object is to provide an improved welded ball construction having improved sealing means mounted on the ball and insertable and removable through the flowways of the housing.

These and other objects are attained by the improved construction and method disclosed in the accompanying drawings and hereinafter described in detail. Variations and modifications in structure and method are intended to be within the scope of the appended claims.

SUMMARY OF THE INVENTION

The invention comprises a ball valve having a valve element with an integral stem and trunnion around which a tubular valve body is assembled by welding the longitudinal edges of two halves together in a plane passing through the stem and trunnion axis and the body flow axis, said stem and trunnion having bearings welded in said body in line with and intersecting said longitudinal welds and mounting said valve element for rotation between flowway open and closing positions, the

ends of the body having flow tubes welded thereto with interior seating rings conforming to the valve element and abutting resilient sealing rings on the ball insertable through the flow tubes after welding and having radially outer annular legs abutting the seating rings at predetermined angles, the radially inner annular portions of said sealing rings being held by retaining means insertable through said flow tubes after welding.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view on the flow axis of a preferred embodiment of the improved welded ball valve, showing the valve element in full closed position.

FIG. 2 is a similar view showing the valve element in full open position.

FIG. 3 is a horizontal sectional view on line 3-3 of FIG. 2.

FIG. 4 is an elevational view on a reduced scale, partly in section, of a cylindrical tube from which the valve body is formed.

FIG. 5 is a sectional view showing the manner of forming the cylindrical tube into a tube having an outwardly convex or domed wall.

FIG. 6 is a view showing the tube of FIG. 5 provided with two opposite bearing holes on an axis perpendicular to and intersecting the tube axis, and cut vertically along the tube axis to form two mating parts.

FIG. 7 is an exploded elevational view, partly in section, showing the manner of assembling the two parts of FIG. 6 around a ball valve element having integral axially aligned stem and trunnion shafts with trunnions partly journaled thereon.

FIG. 8 is an exploded sectional view at right angles to FIG. 7, showing the flow tubes embodying seating ring assemblies in juxtaposition to the ends of a body part.

FIG. 9 is a plan view on line 9-9 of FIG. 8.

FIG. 10 is a partial sectional view on line 10-10 of FIG. 9.

FIG. 11 is an enlarged partial section of the seating ring assembly and ball showing the manner of holding a predetermined clearance during welding.

FIG. 12 is a similar view after welding with the sealing rings inserted.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIGS. 1 and 2, the ball valve element indicated generally at 15 has a flowway 16, and axis of which in the full open position of FIG. 2 coincides with the flow axis of the valve body indicated generally at 17. The flowway 16 is the same diameter as the flow ports 18 in the flow tubes 19 joined to the ends of the valve body 17, which ports are in turn the same diameter as the inner diameter of the pipe line in which the valve is connected, so that full flow through the valve is accomplished.

The ball valve element 15 has diametrically opposite trunnions integral with the ball and on the vertical rotating axis of the ball, which axis is at right angles to the flow axis. The upper trunnion 20 is the valve stem and is journaled in a trunnion bearing 21, and the lower trunnion 22 is journaled in a trunnion bearing 23. The trunnion bearings are circular and are welded into circular holes 21' and 23' in the valve body (see also FIGS. 8 and 9). Bearing sleeves 24 and 25 are interposed between the trunnions 20 and 22 and their bearings 21 and 23, respectively, and the sleeves have annular flanges 24' and 25' between the trunnions and the ball.

The trunnion bearings 21 and 22 extend a substantial distance into and are wholly within the valve body 17, so as to absorb stress imparted to the ball by line pressure wholly within the body with minimal bending moment applied to the stem. As shown in the drawings the opposite surfaces of the ball adjacent to the trunnion bearings 21 and 23 are substantially flattened or reduced from spherical shape where the bearings extend inwardly from the body. Above the upper trunnion bearing 21 a reduced portion of the stem 20' projects upwardly for attachment to suitable means for operating the

valve. O-ring seals 26 are provided around the stem 20 within the bearing 21.

As best shown in FIGS. 6-9, the body is formed of two mating halves 28a and 28b which are joined together by welding in a vertical plane extending longitudinally of the body and passing through the stem axis and the flow axis. The joint between the two parts 28a and 28b is indicated at 29 in FIGS. 6 and 9, and the longitudinal weldment at the joint is indicated at 30 in FIGS. 1 and 2. The weldment 30 connects with or intersects the circular weldments 31 and 32 between the body and the trunnion bearings 21 and 22, respectively, and also intersects the circular weldments 33 which connect the flow tubes 19 to the ends 34 of the body parts. Thus the total longitudinal weldment comprises the four short sections 30.

The flow tubes 19 have mounted in their inner ends seating ring assemblies each comprising a seating ring 36, having a spherical inner surface 37 for conforming to the spherical outer surface 38 on the ball 15, a backup ring 39, and spacing and retaining rings 40 and 41, as best seen in FIGS. 11 and 12. The retaining ring 40 is preferably split or in removable sections, and the ring 41 is a split ring having overlapping ends. The headless setscrew 42 secures the overlapping ends of ring 41 to one of the sections of ring 40.

By removing the retaining rings 40 and 41 the backup ring 39 may be retracted into the space normally occupied by rings 40 and 41, to allow insertion and removal of the O-ring 43 therein when the seating ring 36 is in place. The ring 44 is an asbestos wiper ring. Thus, the flow tubes 19 may be welded to the valve body with the seating ring assemblies in position without the O-ring 44, and with plastic shim material 45 between the seating rings and the ball to establish a predetermined clearance there between, as shown in FIG. 11. The shim material may be plastic sheet material such as a tetrafluorocarbon material known as "TEFLON" which will withstand welding heat. After the welding operation, the plastic shim material 45 is removed and the O-ring 43 inserted in the manner previously described. Obviously, the asbestos wiper ring is not affected by the heat of welding. The parts are then in the position of FIG. 12.

As best shown in FIGS. 11 and 12, the ball 15 is provided on its closed sides with annular grooves 47 to receive and mount annular sealing rings 48 in the ball. The sealing rings 48 are preferably of suitably soft elastomeric rubber or plastic material. The grooves 47 preferably extend radially partially under the seating rings 36 and partially within the flow ports 18, so that the sealing rings can be inserted and removed through the flow tubes.

The annular grooves 47 merge into radially inner annular grooves 49 for receiving retaining rings 50 which overlap the seating rings 48 and extend radially under the seating rings 36 at a slight clearance therefrom equivalent to the clearance between the spherical surfaces 37 and 38 on the seating rings and the ball, respectively. Such clearance may be on the order of 20 to 25 thousandths of an inch. The retaining rings 50 are made in three or more abutting sections held in place by screws 51 so that they can be inserted or removed through the flow ports when the sealing rings 48 are inserted or removed.

The design of the sealing rings 48 is substantially V-shaped or chevron-shaped in cross section, with the outer annular leg 52 confined and directed by the outer annular wall 53 of groove 47 in a direction parallel to the flow axis of the valve, and at substantially 45° to the seating surface 37 of seating ring 36. The annular gripping flange 54 of retaining ring 50 engages in an annular groove formed medially in seating ring 48, and provides a limited amount of flexing space between the flange 54 and the leg 52 of the sealing ring, as indicated at 55.

The exposed end of leg 52 seals against seating surface 37 when the line pressure is acting toward the grooved side of the seating ring 48, and flexes in space 55 to relieve cavity pressure when the pressure is in the opposite direction. The amount of flexing space is much less than in prior constructions where the sealing leg was directed substantially perpendicularly to the seating surface, so that the sealing leg flexes

only a minimal amount when breaking away from the seating surface 37 during opening and closing of the valve and thus greatly reduces wear on the ring, and enables using a relatively soft material for the sealing rings which gives a tighter seal against the ball surface than a harder material.

During opening and closing, the sealing ring on the pressure side is subjected to the greatest wear as it starts to move over the seating surface during opening and closing, because the line pressure tends to bulge the sealing leg 52 out from its supporting wall 53. However, the present construction provides for minimal wear on the sealing leg as it comes across the seating surface because the leg is fully supported or backed-up by the wall 53 except at the very tip of the sealing leg which is exposed.

As indicated in FIG. 7, the ends of the stem shaft 20 and trunnion shaft 22 are provided with centering recesses which are used to chuck the ball for machining the spherical surfaces 18 thereon about the rotating axis of the ball. This provides for simply and accurately obtaining a truly spherical surface on the ball, as distinguished from the prior practice of using the ends of the ball flowway 16 to chuck the ball for the machining operation. Moreover, the use of the plastic shim material 45 to provide a predetermined clearance between the ball surface and the seating surfaces allows the use of spherical surfaces on the ball which do not need to be highly polished, as is the case where the metal ball surface contacts a metal seating surface.

Preferably, the ball is provided on its closed sides 55 with guide ribs 56, which are machined to have spherical outer surfaces at the same time that the spherical surface 38 are machined.

The improved method of making and assembling the valve body around the ball comprises first providing a hollow cylinder of proper length and wall thickness to form the body. The cylinder may be formed from a flat sheet with the edges seam welded together, as shown in FIG. 4 in which the cylinder 60 has a longitudinal welded joint 61.

The next step is to radially outwardly bulge the cylinder wall to form a tubular convexly bulged housing indicated as a whole at 62. This may be done, as shown in FIG. 5, by hot rolling the cylinder between an inner convex roller 63 and outer tapered supporting rollers 64 at the ends of the cylinder. The wall of tube 60 is thus bowed outwardly between the ends while drawing the ends slightly inwardly to form the convexly bulged tube 62 having a wall 65 of substantially uniform thickness with opposite ends 34.

The next step is to form the two diametrically opposite circular bearing holes 21' and 23' medially of and at right angles to the ends 34, and then to cut the tube 62 longitudinally on a plane passing through the flow axis (the axis of ends 34) and the stem axis (the axis of the bearing openings 21' and 23'), thereby making the two halves 28a and 28b with the joint surfaces 29 (see FIG. 6). The holes 21' and 23' and the cut 29 may be done by a cutting torch.

Referring to FIGS. 7 and 8, the bearing sleeves 24 and 25 are then applied to the stem and trunnion 20 and 22 of the spherically machined ball, the trunnion bearings 21 and 23 fitted thereover, and the two body parts brought together around the ball with the joints 29 in abutment. With the parts 28a and 28b suitably held in abutting position, as seen in FIG. 9, the trunnion bearings 21 and 23 are moved wholly within the bearing holes 21' and 23' until the bearings are seated against the bearing sleeve flanges 24' and 25' which in turn abut the end faces 65 of the ball. With the parts held in this position, the circular weldments 31 and 32 between the bearings 21 and 23 and their respective holes and the intersecting longitudinal welds 30 in the joints 29 are made.

Next, the flow tubes 19 with the seating ring assemblies therein (without O-rings 43) are moved into the end openings 34 until the seating rings 36 conform to the ball in closed position with the plastic shim material interposed between the abutting surfaces 37 and 38, as shown in FIG. 11. In this position the circular weldments 33 between the flow tubes and the ends of the body are made.

After the welding operation the ball is rotated to the fully open position to facilitate removing the shim material, and then rotated back to closed position, and the sealing rings 48, retainer rings 50 and O-rings 43 inserted through the flow ports 18 into position.

Because the ball surfaces have been accurately machined around the rotating axis of the ball, the seating surfaces of the seating rings conform accurately to the spherical surfaces on the ball with the predetermined clearance therebetween established by the shim material during welding, and highly polishing the ball and seating surfaces is not required. Thus, the improved ball valve is inexpensive to construct and assemble and has accurate alignment of parts, while permitting easy removal and replacement of its sealing rings.

I claim:

1. A ball valve structure having a ball valve element and a surrounding completely welded tubular body having a longitudinal flowway, said valve element having a flowway and a transversely aligned stem, a bearing around said stem mounting the valve for rotation between flowway opening and closing positions, flow tubes welded to the ends of said tubular body and having inner diameters equal to the diameter of the flowway in the ball valve element, said body comprising solely two domed parts having longitudinal edges welded together in a plane, said body flowway axis and said stem axis lying in said plane said stem bearing extending inwardly of the body and being located wholly within and welded to said body.

2. A ball valve structure as defined in claim 1 in which the ball valve element has a transversely aligned integral stem and trunnion, and bearings around said stem and trunnion extending inwardly of the body and located wholly within and welded

to said body.

3. A ball valve structure as defined in claim 1 in which the flow tubes have interior annular seating surfaces, and resilient sealing rings insertable through the flow tubes are mounted on the closed sides of the ball element.

4. A ball valve structure as defined in claim 3 in which the sealing rings have inner annular portions and outer annular legs abutting said seating surfaces at the ends of said legs, and retaining means are provided securing said inner annular portions to said ball.

5. A ball valve structure as defined in claim 4 in which the ball has annular grooves receiving the sealing rings and the radially outer wall of each groove abuts substantially the entire outer surface of the annular leg therein, and the retaining means permits radially inward flexing of said leg.

6. A ball valve structure having a ball valve element and a surrounding completely welded tubular body having a longitudinal flowway, said valve element having a flowway and a transversely aligned stem, a bearing around said stem mounting the valve for rotation between flowway opening and closing positions, the surface of the valve element adjacent to the stem bearing being somewhat flattened, flow tubes welded to the ends of said tubular body and having inner diameters equal to the diameter of the flowway in the ball valve element, said body comprising solely two domed parts having longitudinal edges welded together in a plane, said body flowway axis and said stem axis lying in said plane, said stem bearing extending inwardly of the body toward said flattened surface of the valve element and being located wholly within and welded to said body.

35

40

45

50

55

60

65

70

75