Sept. 5, 1961 P. VULLIEZ 2,998,957

ARRANGEMENT FOR FITTING A SELF-CENTERING COVER WITHOUT ANY CLEARANCE ON VALVES AND THE LIKE PARTS

Filed Dec. 28, 1959 5 Sheets-Sheet 1

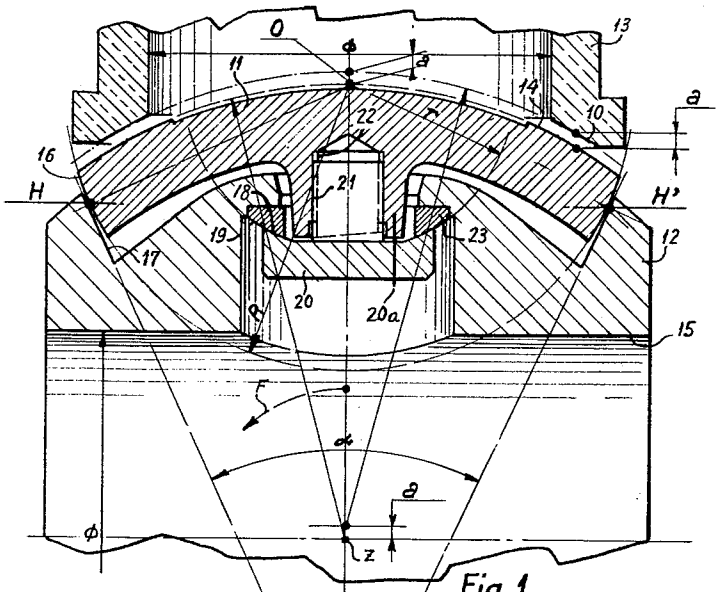


Fig. 1.

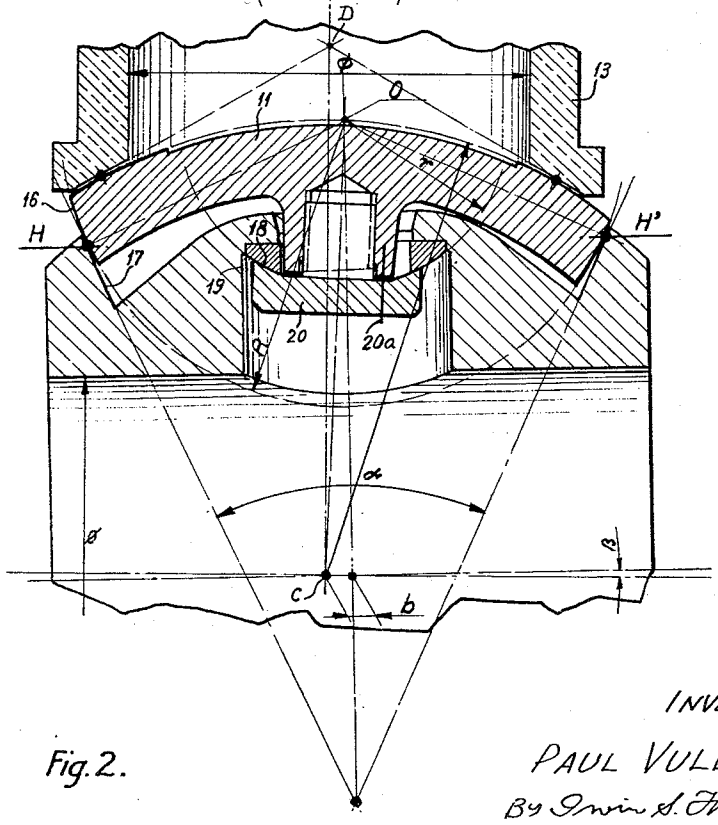


Fig. 2.

INVENTOR

PAUL VULLIEZ

By Irwin S. Thompson

ATTY.

Sept. 5, 1961 P. VULLIEZ 2,998,957

ARRANGEMENT FOR FITTING A SELF-CENTERING COVER WITHOUT ANY CLEARANCE ON VALVES AND THE LIKE PARTS

Filed Dec. 28, 1959 5 Sheets-Sheet 2

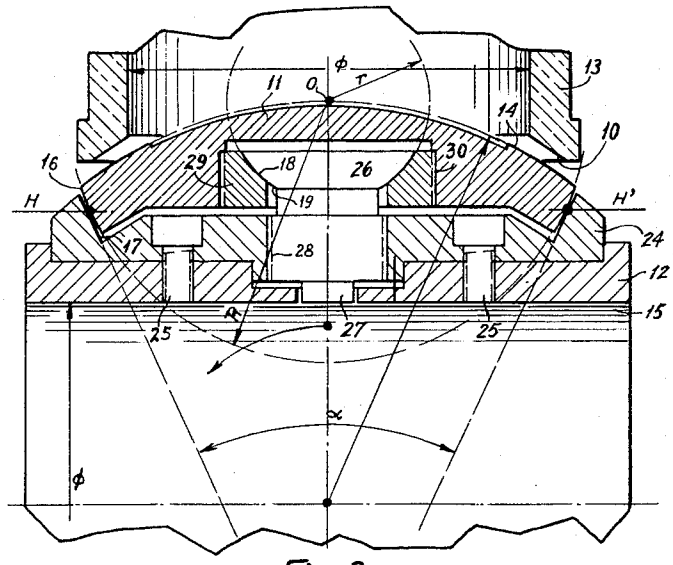


Fig. 3.

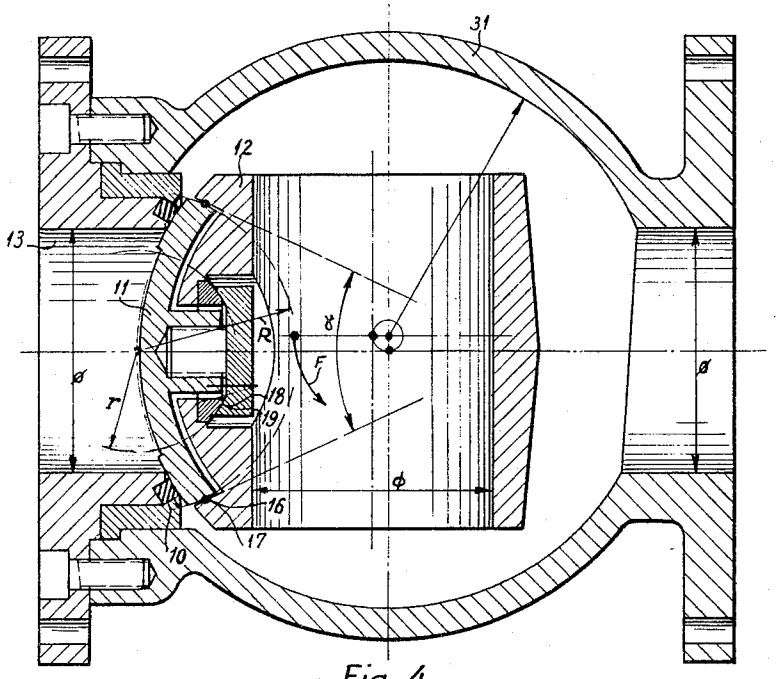


Fig. 4.

INVENTOR

PAUL VULLIEZ

By Irwin S. Thompson

ATTY

Sept. 5, 1961 P. VULLIEZ 2,998,957

ARRANGEMENT FOR FITTING A SELF-CENTERING COVER WITHOUT ANY CLEARANCE ON VALVES AND THE LIKE PARTS

Filed Dec. 28, 1959 5 Sheets-Sheet 3

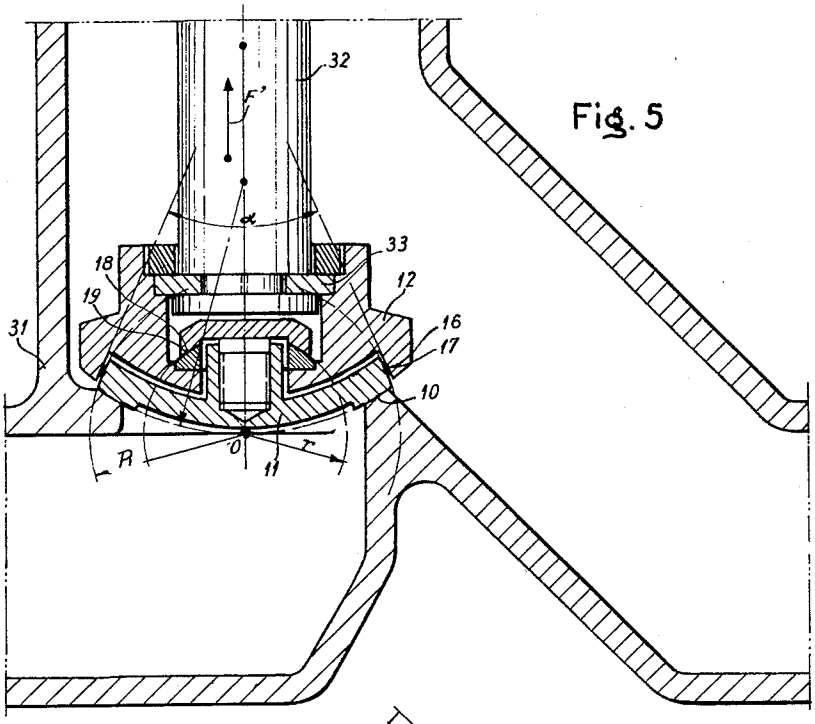


Fig. 5

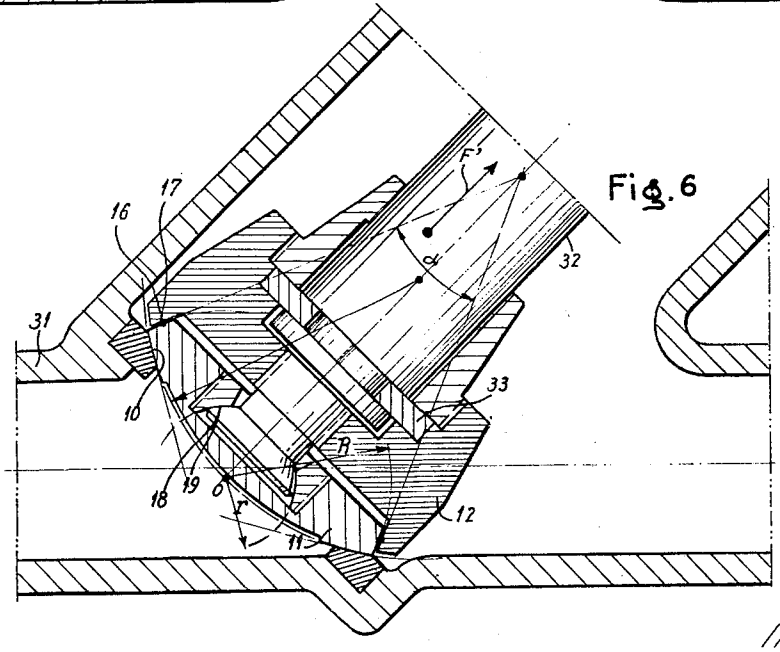


Fig. 6

INVENTOR

PAUL VULLIEZ

By Irwin S. Thompson

ATTY.

Sept. 5, 1961 P. VULLIEZ 2,998,957

ARRANGEMENT FOR FITTING A SELF-CENTERING COVER WITHOUT ANY CLEARANCE ON VALVES AND THE LIKE PARTS

Filed Dec. 28, 1959 5 Sheets-Sheet 4

Fig. 7

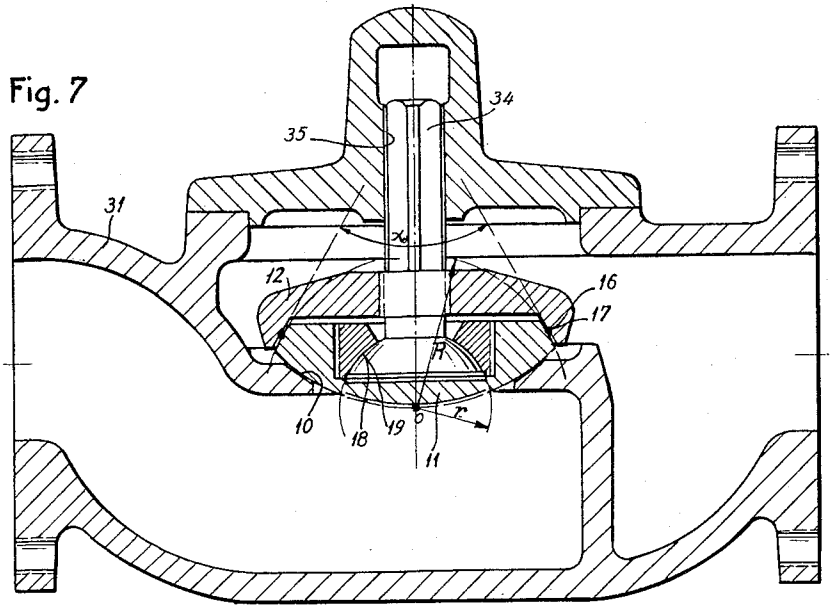
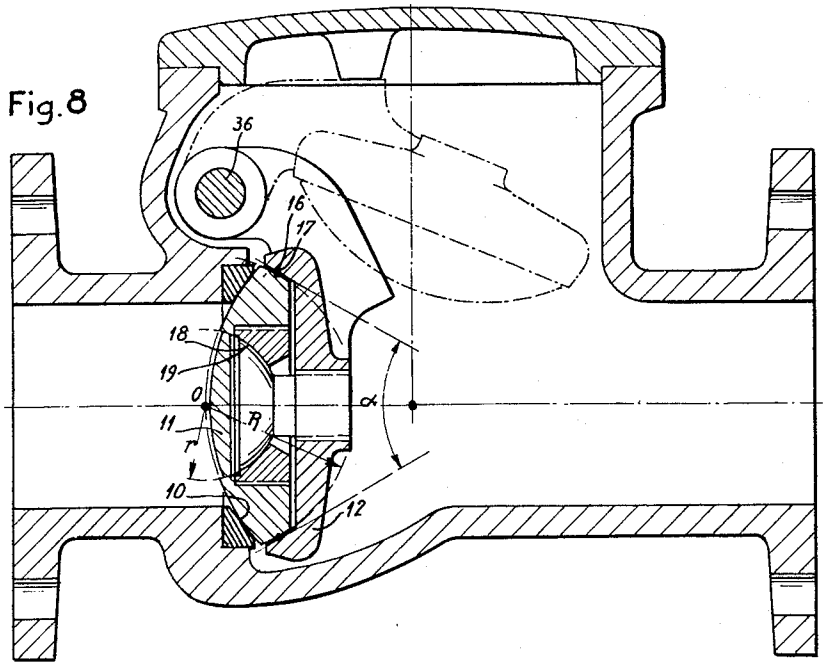


Fig. 8



INVENTOR

PAUL VULLIEZ

By Irwin S. Thompson

ATTY.

Sept. 5, 1961 P. VULLIEZ 2,998,957

ARRANGEMENT FOR FITTING A SELF-CENTERING COVER WITHOUT ANY CLEARANCE ON VALVES AND THE LIKE PARTS

Filed Dec. 28, 1959 5 Sheets-Sheet 5

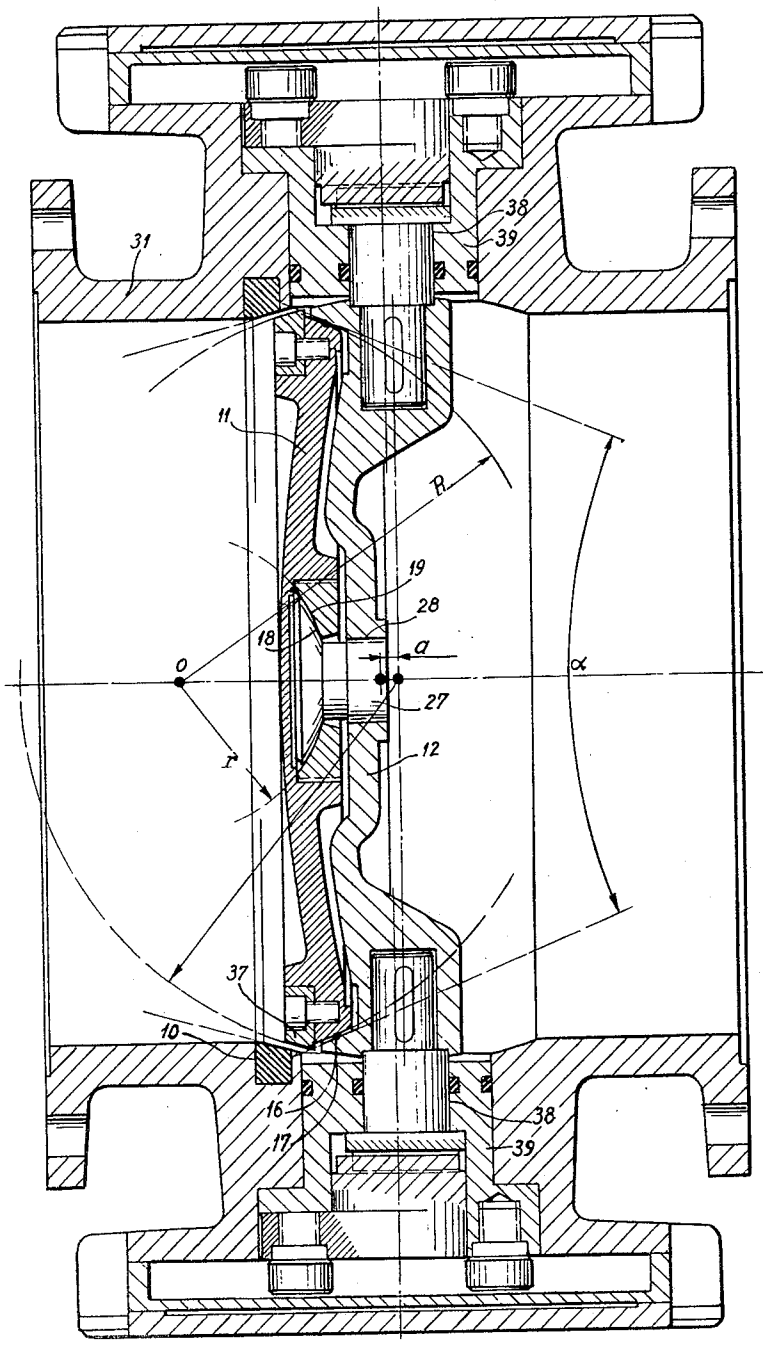


Fig. 9

INVENTOR
PAUL VULLIEZ
By Irwin S. Thompson
ATTY.

United States Patent Office 2,998,957 Patented Sept. 5, 1961

2,998,957

ARRANGEMENT FOR FITTING A SELF-CENTERING COVER WITHOUT ANY CLEARANCE ON VALVES AND THE LIKE PARTS

Paul Vulliez, 48 Route de Rouen,
Pont-Audemer, France

Filed Dec. 28, 1959, Ser. No. 862,369
Claims priority, application France Jan. 26, 1959
6 Claims. (Cl. 251—86)

My invention has for its object improvements in valves or the like parts of the type including a stationary seat, a closing cover or seating unit cooperating with said seat, and a cover-carrying member or core on which said cover is fitted and which is adapted to move between at least one position for which the cover is held at a distance from the seat and a closing position for which the cover is urged against said seat.

The known valves of said type do not satisfy completely the essential conditions of a both durable and good fluid tightness.

My invention has for its object an arrangement incorporating a cover for valves or the like parts of the type disclosed, which allows ensuring the desired conditions of fluidtightness for the valve, which fluidtightness is both durable and of a high grade, the cover engaging its seat in perfect manner under all circumstances.

According to my invention, the cover is guided without any clearance with reference to the cover-carrying member throughout any spherical movement round a predetermined center, as provided by two rotula connections operating in opposite directions and having said center as a common center.

More accurately, the cover is fitted on the associated parts, by means of a first bearing provided on the cover, a first cooperating bearing formed on the cover-carrying member and adapted to engage said first bearing, said first bearings forming a first rotula bearing round the common center and adapted to be operative during the movement of the valve towards its seat. The cover is further provided with a second bearing cooperating with a second bearing formed on the cover-carrying member and adapted to engage said second bearing of the cover, said second bearings forming a second rotula connection round the common center, so as to be operative in the direction for which the valve moves away from its seat. Preferably, the first rotula connection has a diameter which is larger than the second rotula connection and it is arranged at the periphery of the cover in the vicinity of the area in which the latter engages its seat. The surface of said cover facing the seat is preferably part-spherical and cooperates with a part-spherical seat of an equal curvature or with a frusto-conical seat. The operative closing surface of the cover may also lie in a plane surface, so as to engage a flat seat or a seat, the curvature of which is tangent to the plane of the cover.

My invention provides thus for an automatic self-centering of the cover over the member carrying it, without any axial clearance.

A valve arrangement according to the present invention is more particularly characterized in that it comprises a stationary valve seat having a fluid passageway therethrough, a movable valve core for controlling fluid flow through said passageway, a seating unit having a seating area cooperating with said seat, a cup-shaped depression in said core having an internal edge, said seating unit having its periphery girdled by said depression edge, said periphery and edge forming a first rotula-like connection between said seating unit and said core, a second rotula-like connection between said seating unit and said core having the same center as and being of

smaller radius than the said first connection, said center being located in front of said depression edge, both first and second connections forming a universal mounting connecting the seating unit to the core for moving the seating unit in opposite directions of movement toward and away from the seat upon such corresponding movement of the valve core.

Such an arrangement provides performances as follows:

(1) an excellent peripheral support giving high resistance against heavy pressures if any;

(2) complete sheltering of the sub-face of the seating unit, thus avoiding any beating and oscillations under the fluid action;

(3) small thickness of the structure;

(4) easy tooling and assembling;

(5) structure impervious to any particle in suspension in the fluid so that such particles cannot penetrate between moving members and cannot impede free motions thereof;

(6) impossibility of jamming of the rotula-like connections.

The movement of the cover towards its seat provides a first contact between said cover and seat. As the nearing movement continues, the cover rocks round the rotulas carrying it, up to the moment at which the desired contacting area is entirely obtained with the seat. It is then possible to produce the locking stress adapted to close the valve, without producing any friction between the seat and the cover. Before the final closing, the seat is subjected only to the negligible stress required for the rocking of the flap valve or the like cover-carrying member.

Said arrangement allows correcting at the moment of the nearing movement any defect in alignment ascribable to machining errors, or else, to a wear due to protracted operation. It allows also executing a nearing movement of a member such as a valve plug carrying its cover in a plane which is not parallel with the plane of the seat, as is the case when the plug is controlled, so as to close through a pendular movement.

The final contact between the cover and the seat is always provided along a geometrically ideal surface, as a consequence of the rocking movement of the cover with only slight friction of the latter with reference to the rotulas, until said ideal contact is actually obtained. For its closed position, the center of curvature of the outer surface of the cover returns always onto the axis of the pipe passing through the apex of the frusto-conical seat surface.

It should be remarked that, in addition of the advantage of an automatic self-centering, the double rotula cover is stable under load and does not vibrate and does not beat. This advantageous property due to the absence of any axial clearance and to the peripheral contact of the cover with its seat prevents any action of fluid on its inner surface.

Furthermore, as a consequence of the fitting of the peripheral rotula in the frusto-conical bore carrying it, the cover has a considerable bearing rigidity, so that it does not risk being deformed under the action of closing pressure. During the nearing and rotary movements of the valve, the cover remains perfectly stationary with reference to the member carrying it. The central rotula cooperates with its bearing surface, so as to allow the movements to be executed whatever may be the direction of action of the pressure.

These properties are such that my improved double rotula cover is specially adapted for ensuring fluidtightness between two metal surfaces, whereby the surface condition of the seat and of the cover remains unaltered as a consequence of the absence of friction.

When the cover and the seat are made of different

materials, fluidtightness is also obtained under optimum conditions with the double rotula cover.

It should be remarked that the bearings of the central and peripheral rotulas may be machined, so as to show a frusto-conical or spherical surface. It is possible, for instance, to provide advantageously a frusto-conical bearing for the peripheral rotula and a spherical bearing for the central rotula.

I will now describe, by way of example, various embodiments of my invention, as illustrated in the accompanying drawings, wherein:

FIG. 1 is diagrammatic longitudinal sectional view of a part-spherical cover fitted through a dual rotula on the member carrying it, the cover being shown as spaced with reference to its seat.

FIG. 2 is similar to FIG. 1, but therein the member carrying the cover shows defects such that, in its closed position, it is misaligned, both angularly and linearly with reference to the axis of the seat, said FIG. 2 showing how my improved arrangement brings a remedy to such defects.

FIG. 3 is a longitudinal sectional view of a modified embodiment.

FIG. 4 is a sectional plan view of an arrangement including a part-spherical cover according to my invention, wherein the seat is provided with an inserted bearing element.

FIG. 5 relates to an application of my invention to a valve with a straight seat.

FIG. 6 relates to an application of my invention to a valve with a sloping seat.

FIG. 7 relates to an application of my invention to a flap valve of a horizontal type.

FIG. 8 relates to an application of my invention to a flap valve of the beating type.

FIG. 9 is a sectional view of a throttle valve, the cover of which includes a dual rotula cover and is adapted to assume two movements.

Turning first to FIG. 1 illustrating an embodiment of my improved valve, **10** designates the stationary seat of the valve, **11** the closing cover or seating unit cooperating with the seat **10** and **12** the core carrying the cover **11**. In the example illustrated in FIG. 1, the seat **10** is provided at the end of a pipe element **13**, the inner diameter of which is designated as Φ. The seat **10** is frusto-conical, but it may, as well, be part-spherical and it is adapted to be engaged by the outer annular part-spherical seating area **14** of the cover **11**. The core member or plug **12** carrying the cover is mounted so as to be capable of moving between one or more positions, for which the area **14** of the cover **11** is spaced with reference to the seat **10** and a closed position, for which the area **14** of the cover **11** engages said seat **10**. In the example illustrated, the member **12** is constituted by a plug provided with a central passageway **15**, the diameter of which is equal to the diameter Φ of the pipe **13**, which is aligned with the pipe **13** for the fully open position of the valve. The member **12** carrying the cover may, for instance, be capable of rotating round an axis Z perpendicular to the plane of FIG. 1 through an angle equal to 90° between the position illustrated and the open position in the direction of the arrow F, said member being also capable of executing a small translational movement *a* in parallelism with the axis of the pipe **13**, so as to pass from the position illustrated into its closed position; any suitable control system may be provided for shifting the plug **12** carrying the cover between its open and closed positions.

According to the invention, the fitting of the cover **11** on the plug **12** includes a first bearing surface **16** for the cover, associated with a first cooperating bearing **17** on the plug **12**, adapted to engage said cover bearing **16**, so as to form therewith a first rotula connection **16—17** having a well-defined center **0**, which first connection is operative in the direction of a nearing movement of the cover towards the seat **10**. A second connection is provided by a second bearing **18** formed on the cover near its medial part and by a cooperating second bearing **19** on the plug **12**, said second bearings **18** and **19** being adapted to interengage so as to form a second rotula connection having the same center **0**, which second connection is operative when the cover moves away from the seat **10**. Thus, the two connections **16—17** and **18—19** ensure a guiding without any clearance of the cover **11** with reference to the plug **12** during any rotary movement round said common axis O.

The first bearing **16** on the cover **11** is provided at the periphery of the latter and is machined over a part-spherical surface having a radius R and a center at the point **0**, while the cooperating bearing **17** on the plug **12** associated with said bearing **16** forms for the latter a machined recess of a frusto-conical shape in the plug **12**, the contact being obtained along the circumference of a circle extending in a plane H—H', which is invariable with reference to the plug **12** (FIGS. 1 and 2). The second bearing **18** formed on the cover **11** is arranged centrally and is machined along a part-spherical concave surface, the radius of which is equal to *r* and is smaller than R, the center of said last-mentioned surface being at the above-mentioned point **0**. Said second bearing **18** is defined by a member **20** screwed at **21** into a tapping **22** in the cover **11**, so as to allow, on the one hand, an easy assembly and dismantling of the plug and cover system **11—12** and, on the other hand, adjusting the tightening stress between the bearings **16—17** and **18—19**, with a view to obtaining an easy fit without any clearance. After adjustment, the screw **20** is locked in position on the cover **11** through a pin **20***a* or the like suitable locking or braking means. The second cooperating bearing **19** on the plug **12**, associated with the bearing **18** on the cover, is machined so as to form a part-spherical convex surface having its center at **0**, with a radius *r* formed on a shoe **23** fitted in the plug **12**.

The common center **0** is selected above the contact line H—H' of the bearing **16** with the corresponding cooperating bearing **17**. The center **0** may be advantageously located, as illustrated in FIG. 1, i.e. at the apex of the spherical cap defined by the cover **11**. This arrangement is by no means to be considered as limiting the invention. To obtain a proper execution, the center **0** should be selected so as to give the hollow frusto-conical member, having an apical angle α, which defines the cooperating bearing **17** inside which the peripheral bearing **16** is held, a value which prevents any wedging, while avoiding any too flat curvature of the central rotula **18—19**. This double favorable condition is obtained when the center **0** lies above the line H—H'.

The mounting of the cover with the dual rotula **16—17** and **18—19** according to my invention allows a free oscillation of the cover in all directions, whereby its self-centering is obtained with reference to the frusto-conical seat **10** of the valve body, without any axial clearance and without any objectionable friction on the seat. At each closing operation, the cover **11** selects its circular contacting line with the seat **10**, whereby the structure is independent of any clearance due to machining. I obtain thus an excellent and durable fluid tightness as a consequence of the absence of any objectionable contact friction.

Among other advantages, said arrangement allows also: cutting out the beating of the cover when operating under load; making the operation of the cover independent of the direction of application of pressure; retaining a good rigidity for the cover through its peripheral bearing on the plug.

It will be remarked, furthermore, that the closing of the valve is performed under excellent conditions, even if the nearing movement of the plug **12** towards the seat **10** is no longer aligned with the axis of said seat **10**. As apparent more particularly from inspec-

tion of FIG. 2, the double rotula connection **16—17** and **18—19** allows cutting out any objectionable result of a lack of alignment, both angularly, as shown by the angular shifting β and linearly, as shown by the lateral shifting *b*. At the moment of the final closing contact, the center C of curvature of the outer spherical surface of the cover returns onto the axis of the pipe **13** passing through the apex D of the frustoconical seat **10**. It will be readily ascertained that the lack of alignment has been exaggeratedly shown in FIG. 2, such a lack of alignment never reaching in practice the amplitude illustrated, which shows merely, on a very exaggerated scale, the possibilities of centering of the cover **11** even under the most difficult conditions.

It should also be remarked that for the preceding reasons and also for an easier reading of the drawings, the proportions given to the various parts illustrated in FIGS. 1 and 2 are more in conformity with the requirements of a diagrammatic illustration than with those of a true scale drawing for industrial execution. In contradistinction, the following FIGS. 3 to 9 relating to applications of my invention to various types of pipes are in conformity with a true showing of an industrial embodiment.

Referring first to FIG. 3, the arrangement is similar to that described with reference to FIG. 1, but the frustoconical machined surface **17** engaged by the peripheral part-spherical bearing **16** of the cover **11** is provided, in the case of FIG. 3, on an intermediate supporting plate **24**, which is secured through screws **25** to the plug **12**. The second bearing **19** cooperating with the cover remains, as precedingly, at the center of the arrangement, but it is formed on the part-spherical underside of the head **26** of a screw **27** screwed at **28** into the intermediate plate **24**. The bearing **18** on the cover cooperating with the bearing **19** is formed on a shoe **29** screwed at **30** into a tapping of the cover **11** and locked in the latter. The adjustment providing an easy fit is obtained through the screwing of the screw **27** into the intermediate plate. The arrangement illustrated in FIG. 3 provides the advantage of allowing the metal used for the double rotula to be selected as desired. For instance, the plug **12** may be made of cast iron, while the plate **24** and the cover **11** are made of sulfinused stainless steel, bronze or the like metal.

It should be remarked that the arrangement of FIG. 3 may be executed without any intermediate supporting plate **24** as in the case of arrangements according to FIGS. 6 to 9.

Turning now to FIG. 4 showing an application of the invention to the so-called spherical quarter of revolution valve, the latter includes a body **31** and FIG. 4 shows again the pipe **13**, the seat **10** formed, in the case illustrated, by a ring fitted at the end of the pipe and made of the so-called Teflon or the like plastic material providing a low coefficient of friction, while **11** designates, as precedingly, the cover, **12** the plug and **16—17** and **18—19** the two rotula connections.

The plug **12** may be controlled, so as to provide a single movement, i.e. a nearing movement towards the seat **10** accompanying the rotation of the plug **12**. The reason of the presence of the low friction lining **10**, as described, resides in the necessity of reducing the friction arising at the moment of the contact between the seat and the cover. Obviously, the lining **10** may be arranged on the cover **11**, instead of being inserted in the seat. The plug may also be controlled so as to execute a dual movement, so that the nearing movement of the cover **11** may be independent of the rotary movement of the plug **12**, the double rotula system **16—17** and **18—19** cutting out any friction on the seat. In such a case, the lining may be omitted.

The double rotula system **16—17** and **18—19** is of particular interest for the valves of the type illustrated in FIG. 4, since such valves are thus capable of supporting the action of pressure in either direction, while the opening movement is furthered by the absence of any axial clearance and by the proper engagement between the cover **11** and the plug **12**, as provided by the peripheral rotula **16—17**.

FIG. 5 shows the application of my invention including the dual rotula **16—17** and **18—19** to a straight-stemmed valve and FIG. 6 shows its application to a valve engaging a sloping seat. In both cases, the plug **12** provided with the frusto-conical recess **17** engaged by the peripheral rotula **16** of the cover moves in unison with the latter only for the translational movement in the direction F', while it is independent of the rotation of the control stem **32**, as provided by the two half-rings **33** inserted between said parts. In such applications, the fluidtightness remains excellent, in spite of the clearances and misalignments produced through the wear of the control stem **32**. The seat may be provided on the valve body **31**, as in the case of FIG. 5, or on an insert on the latter, as in the case of FIG. 6.

FIG. 7 illustrates the application of my invention including a cover **11** provided with a dual rotula **16—17** and **18—19** to a flap valve of the horizontal rising type. In such a case, the fluidtightness remains independent of the clearance of the stem **34** inside the recess **35** housing it inside the body **31**.

FIG. 8 also shows the application, according to my invention, of a cover **11** with a dual rotula **16—17** and **18—19** to a flap valve of a beating type. As in the case of FIG. 7, the frequency of operation of such types of valves leads to a speedy wear of their guiding or securing means. With the dual rotula cover, such a wear, for instance that of the pivot **36**, has no action on the fluidtightness of the arrangement, wherein self-centering is always ensured.

I will now describe the arrangement illustrated in FIG. 9, relating to the case of a throttle valve provided with a cover or cap **11** with a dual rotula **16—17** and **18—19**, the closing being operated in two stages. The incorporation of the dual rotula **16—17** and **18—19** appears clearly from inspection of FIG. 9 showing the cover **11** with its inserted fluidtight packing ring **37**. Said cover **11** rests, through its peripheral rotula **16**, inside the frustoconical bore **17** formed in the central plug **12** revolvably mounted in the trunnions **38**. The central bearings **18** and **19** engage each other with an easy fit obtained through adjustment, as provided by the fitting and braking or locking of the screw **27** screwed at **28** into the plug **12**. FIG. 9 also shows how the proper selection of the center **0** ensures an excellent cooperation between the rotulas **16—17** and **18—19**, said center **0** lying underneath the apex of the spherical cap forming the cover **11**. To allow an easy rotation of the plug and cover system **12—11** inside the valve body **31**, the seat **10** is formed on a cone, the apical angle of which is much smaller than in the case of the embodiments illustrated in FIGS. 1 and 3.

The closing in two stages of the throttle valve illustrated in FIG. 9 may be controlled in the following manner: During the first stage, the annular members **39**, the rotation of which controls the translational movement of the plug, are stationary and the trunnions **38** rock together through 90°, so as to set the cover **11** into radial registry with its seat **10**. During the second stage, the trunnions **38** are held fast against rotation, while the annular members **39** produce the nearing movement through a common pivoting motion. The bores for the trunnions **38** in the annular members **39** are out of center and, consequently, the rotation of the latter makes the system **38—12—11** move nearer the seat **10**, whereupon the cover **11** engages fluidtightly the latter.

As precedingly, the part played by the dual rotula **16—17** and **18—19** allows urging, without any friction, the cover **11** onto its seat **10**, which ensures an excellent and durable fluidtightness.

What I claim is:

1. A valve arrangement comprising a stationary valve seat having a fluid passageway therethrough, a movable valve core for controlling fluid flow through said passageway, a seating unit having a seating area cooperating with said seat, a cup-shaped depression in said core having an internal edge, said seating unit having its periphery girdled by said depression edge, said periphery and edge forming a first rotula-like connection between said seating unit and said core, a second rotula-like connection between said seating unit and said core having the same center as and being of smaller radius than the said first connection, said center being located in front of said depression edge, both first and second connections forming a universal mounting connecting the seating unit to the core for moving the seating unit in opposite directions of movement toward and away from the seat upon such corresponding movement of the valve core.

2. A valve arrangement as claimed in claim 1 wherein said seating area is located in front of said depression edge and said center is located in front of said seating area.

3. A valve arrangement as claimed in claim 1 wherein said unit comprises a seating head and a rear member screwed in said head, said member forming one bearing of said second connection.

4. A valve arrangement as claimed in claim 1, wherein said unit comprises a seating head and a rear member screwed in said head, said member forming one bearing of said second connection, and said core comprises a plate member and a central member screwed through said plate member, said central member forming another bearing of said second connection cooperating with said one bearing.

5. A valve arrangement as claimed in claim 1, further comprising a threaded member screwed in one of the said unit and core and forming one bearing of said second connection, said member having a thread radius smaller than the first connection radius.

6. A valve arrangement as claimed in claim 1, further comprising a member screwed in one of the said unit and core and forming one bearing of said second conection, and locking means for preventing said member from unscrewing.

References Cited in the file of this patent

UNITED STATES PATENTS

373,522	Giles	Nov. 22, 1887
2,710,163	Mueller	June 7, 1955

FOREIGN PATENTS

550,238	Belgium	Aug. 31, 1956