US 20080231000A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2008/0231000 A1**

(43) **Pub. Date: Sep. 25, 2008**

Xu

(54) **TRAPEZOID-SECTIONAL ANNULAR THERMALLY-ASSISTED SEALING ARRANGEMENT**

(75) Inventor: **Changxiang Xu**, Wenzhou (CN)

Correspondence Address:
MOORE & HANSEN, PLLP
225 SOUTH SIXTH ST
MINNEAPOLIS, MN 55402 (US)

(73) Assignee: **Zhejiang China Valve Co., Ltd**, WSenzhou (CN)

(21) Appl. No.: **12/064,570**

(22) PCT Filed: **Aug. 23, 2006**

(86) PCT No.: **PCT/CN2006/002157**

§ 371 (c)(1),
(2), (4) Date: **Feb. 22, 2008**

(30) **Foreign Application Priority Data**

Aug. 23, 2005 (CN) 200510097905.6

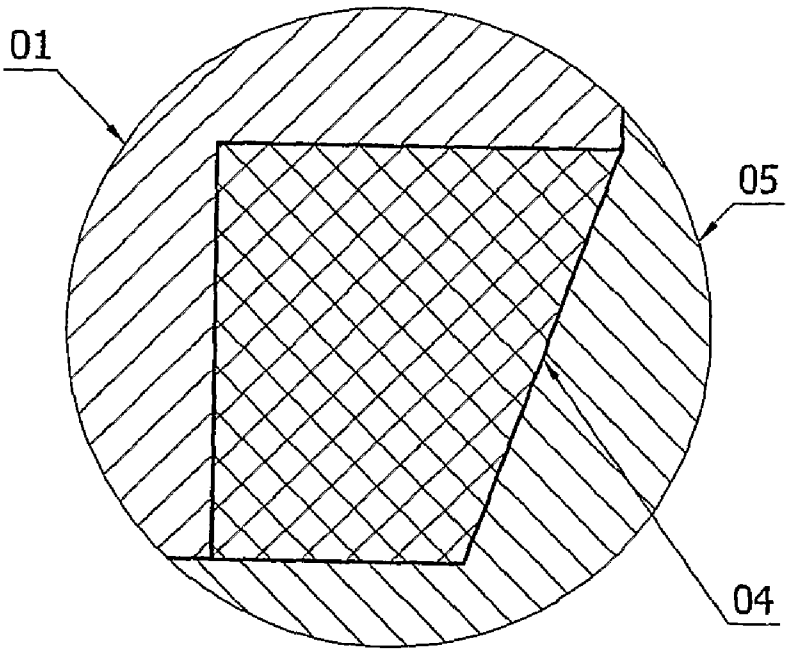
Publication Classification

(51) **Int. Cl.**
F16J 15/10 (2006.01)
F16K 27/06 (2006.01)

(52) **U.S. Cl.** **277/614**

(57) **ABSTRACT**

A trapezoid-sectional annular sealing arrangement, including a trapezoid-sectional annular cavity and gasket or packing used to realize the sealing connection of two fluid-containing members connected by fastening threads or bolts, wherein the said annular gasket or packing is enclosed in the said annular cavity formed by the said two fluid-containing members as joined together by fastening threads or bolts, the said trapezoid is disposed to converge radially and inward, the annular gasket or packing has a sectional area slightly bigger than the sectional area of the annular cavity, and the annular cavity is preferably designed to completely sink into one face of the two end faces to be joined. The sectional area and gyro-radius of the annular gasket with a material thermal expansion coefficient different from the annular cavity will either increase or decrease in response to temperature changes at the same time relative to the annular cavity to enhance or retain the original sealing connection.



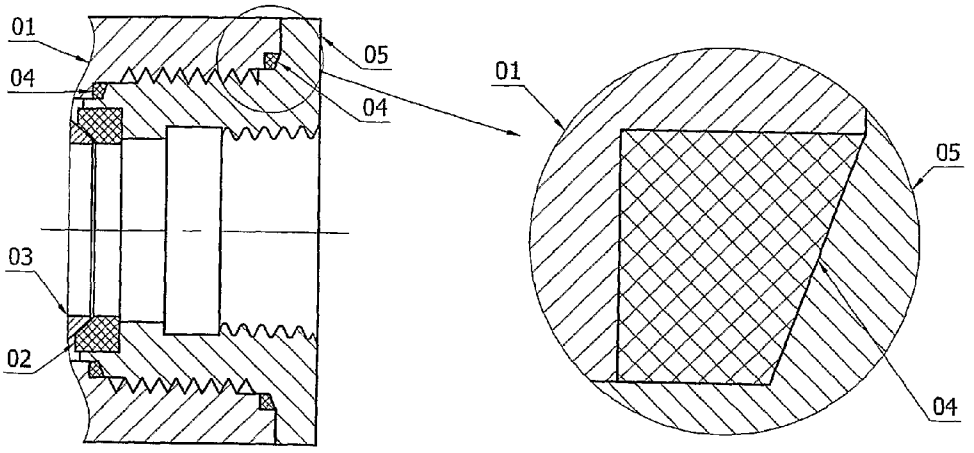

01
04
05
04
03
02
01
05
04

图 1

图 1a

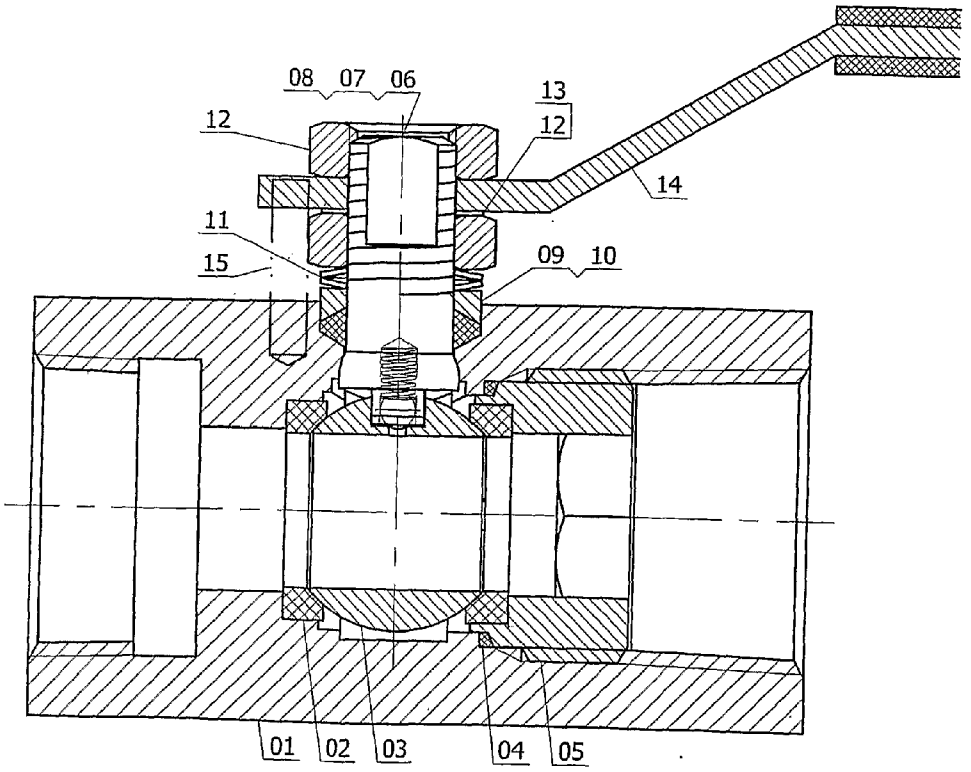

08
07
06
13
12
12
14
11
15
09
10
01
02
03
04
05

图 2

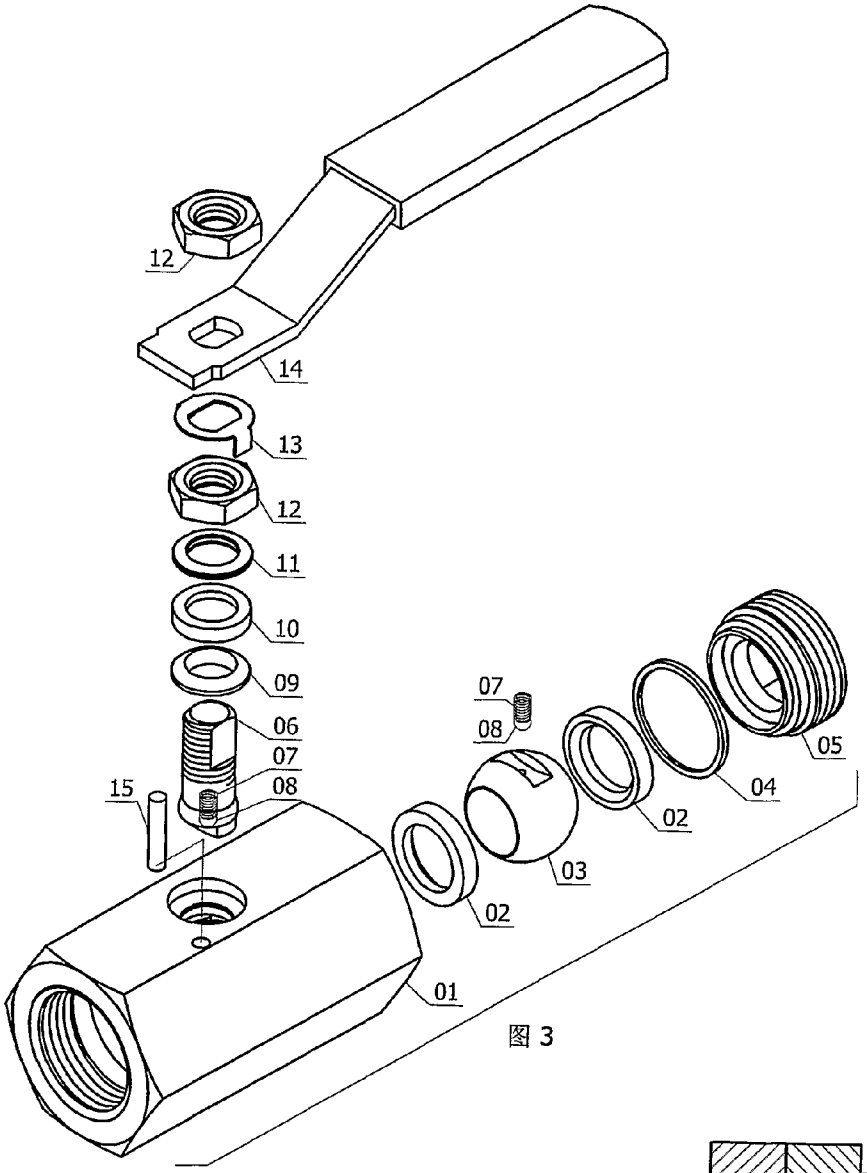


图 3

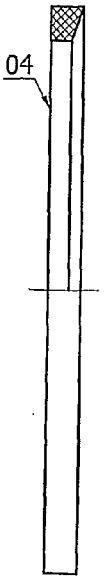


图 4

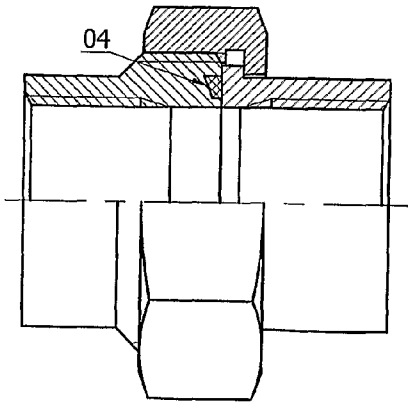


图 5

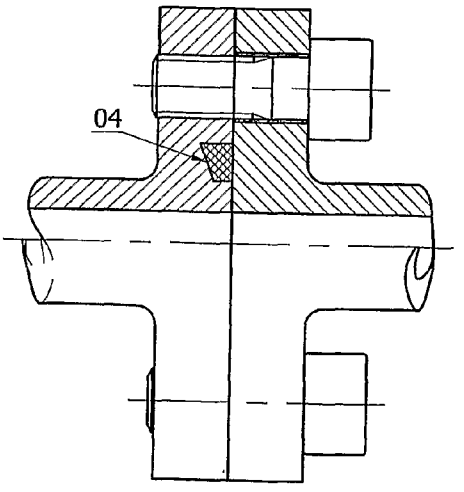


图 6

TRAPEZOID-SECTIONAL ANNULAR THERMALLY-ASSISTED SEALING ARRANGEMENT

TECHNICAL FIELD

[0001] The invention relates generally to fluid seals and more particularly to seals for the connection of two fluid-containing members that is subjected to thermal cycling.

BACKGROUND ART

[0002] All the fluid-containing members need to be connected or enclosed to withstand a pressure. The connections shall complete the two kinds of sealing and fastening tasks, and are often realized by welding, threading, flanging, flaring, swaging etc. The sealing arrangement is different as the connecting or fastening method differs. The weld connection completes sealing and fastening at the same time by weld metal. The connection by jointing threads where pressure tight joints are made on the threads completes its sealing and fastening by the same threads. The connection by fastening threads where pressure tight joints are not made on the threads completes its fastening by threads or bolts disposed around the flow path, and its sealing by annular sealing gaskets or packing disposed between the end faces to be joined. The annular sealing gasket is often made of non-metal, and sometimes compressed into a metal cavity which is enclosed by the connecting components in order to meet a higher requirement. The non-metal and metal often have a thermal expansion coefficient very different from each other, and create problems with the seal integrity when subjected to thermal cycling. U.S. Pat. No. 6,837,482 disclosed a diamond-shaped cross-sectional thermally-assisted sealing arrangement to try to make use of material thermal expansion to enhance sealing connection. However, the patent could not disclose a complete principle of thermally-assisted sealing cavities, and misunderstood that any annular non-metal packing would simply move radially relative to its containing metal cavity into one of the converging end portions of the diamond-shaped cavity to enhance the sealing connection in response to temperature changes. As it is, it is not so simple. As well known, any differences in thermal expansion or contraction coefficients will cause the sectional area and gyro-radius of the said annular gasket to either increase or decrease in response to temperature changes at the same time relative to the cavity enclosing the annular gasket, regardless of whether the coefficient of the annular gasket material is greater or less than the gasket-containing cavity material. That the annular packing increases in sectional areas and gyro-radii relative to its containing cavity means that more packing material is to be compressed into a smaller cavity, and so any shape of cavities does not create sealing problems provided the tensile strength of packing material is lower than the strength of cavity material. However, when the annular packing decreases in sectional areas and gyro-radii relative to its containing cavity, the annular packing whose gyro-radius is decreasing shall be strong enough for contracting into a radially inward converging portion of the cavity to compensate the decreasing sectional area of the annular packing, that is to say, the annular packing shall have enough tensile strength for carrying out such a compensation.

[0003] As for the diamond-shaped design of U.S. Pat. No. 6,837,482, the first, the annular packing has to move diagonally or not radially relative to its containing cavity to provide a thermally-assisted compensating seal in response to temperature changes, whereas the packing-expanding or contracting force is radial; that is to say, the force diagonally moving the annular packing is only a component of the radial packing-expanding or contracting power. In another words, the diamond-shaped design of U.S. Pat. No. 6,837,482 cannot fully utilize the thermal expansion or contraction force of the annular packing relative to its cavity to perform the thermally-assisted compensating seal and is not yet an ideal design.

[0004] The second, the diamond-shaped cavity shall be made of two halves separately in two end face to be joined; if not, for example, if the diamond-shaped cavity is designed to completely sink into one face of the two butt end faces and the other end face is fully plain, the annular packing in its containing cavity will be diagonally away from and cause leakage along the plain face when the annular packing moves inward to its diagonal corner in response to temperature changes. It is well known that it is the most simple for user's connection designs and the most convenient for user's application for the packing-containing cavity to be designed completely at the manufacturer's product end. However, it is very difficult for the design to be machined with a complete diamond-shaped cavity at one end even if there would be no leakage problem with the diamond-shaped design. Therefore it may be said that the diamond-shaped design of U.S. Pat. No. 6,837,482 is neither ideal nor practical.

[0005] The last, U.S. Pat. No. 6,837,482 incorrectly taught that any forms of air and jell in the diamond-shaped cavity could move along its sectional diagonal and provide a thermally-assisted compensating seal in response to temperature changes. Actually it is impossible because any gas or jell free in a container can not expand or contract or move along a certain direction excluding gravity direction in response to temperature changes; that is to say, U.S. Pat. No. 6,837,482 may cause an incorrect application without reliability.

[0006] Valves, as the controlling unit for fluid conveying, have a valving member, such as the ball in ball valves, the gate in gate valves, etc. The valving member is installed in a flow path, and has an open position, which allows media to flow through the valve, and a closed position, which prevents media from flowing through the valve. The shifting of the two positions of the valving member in its seat is realized by a stem extending out of the valve. The installing or fixing of the valving member and its seats in the valve flow path relates to the sealing connection realized by annular sealing gaskets or packing disposed around the flow path and between the end faces to be joined, and relates to one of the three basic fastening connections realized by fastening threads or bolts, one is by bolted flanges, another, by threaded flanges or threaded upset ends, and the other, by threaded unupset ends.

DISCLOSURE OF THE INVENTION

[0007] The object of the invention is to provide an improved thermally-assisted sealing arrangement for the connection of two fluid-containing members connected by fastening threads or bolts.

[0008] The thermally assisted sealing arrangement of the invention is a trapezoid-sectional annular sealing arrangement, including a trapezoid-sectional annular cavity and gasket or packing used to realize the sealing connection of two fluid-containing members connected by fastening threads or bolts. The said trapezoid-sectional annular gasket or packing, generally with a sectional area slightly bigger than the sectional area of the said cavity, is enclosed in the said cavity

formed by the said two fluid-containing members as joined together by fastening threads or bolts, and the said trapezoid is disposed to converge radially and inward. The said trapezoid-sectional annular cavity is preferably designed to completely sink into one face of the two end faces to be joined. When the thermal expansion coefficients of materials used for the annular cavity and the annular gasket are different from each other, the sectional area and gyro-radius of the annular gasket will either increase or decrease in response to temperature changes at the same time relative to the cavity containing the annular gasket, regardless of whether the coefficient of the annular gasket material is greater or less than the gasket-containing cavity material. That the annular packing increases in sectional areas and gyro-radii relative to its containing cavity means that more packing material is to be compressed into a smaller cavity, and so any shape of cavities does not create sealing problems provided the tensile strength of packing material is lower than the strength of cavity material. However, when the annular packing decreases in sectional areas and gyro-radii relative to its containing cavity, the annular packing whose gyro-radius is decreasing shall be strong enough for contracting into a radially inward converging portion of the cavity to compensate the decreasing sectional area of the annular packing, that is to say, the annular packing shall have enough tensile strength for carrying out such a compensation.

[0009] One embodiment of the thermally assisted sealing arrangement is that the said trapezoid-sectional annular cavity is made of metal, and the said annular packing or gasket is made of non-metal, such as PTFE (Polytetrafluoroethylene) and the like. Another embodiment of the thermally assisted sealing arrangement is that it is disposed between two flange end faces to be connected, where the flanges are connected by either bolts or threads. Another embodiment of the thermally assisted sealing arrangement is that it is disposed on the end face of either externally threaded parts or internally threaded parts, where the male and female threads fasten the two fluid-containing parts together by engagement. Another embodiment of the thermally assisted sealing arrangement is that it is used to realize the sealing connection of valve bodies or valve flow paths, where the fastening connection is realized by threads or flanges.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a partial cross-sectional view of a two-body type ball valve whose body is joined together by fastening threads, including two trapezoid-sectional annular sealing arrangements in accordance with the invention.

[0011] FIG. **1***a* is a partially enlarged view of the trapezoid-sectional annular sealing arrangement of FIG. **1**.

[0012] FIG. **2** is a complete one-body type ball valve including a trapezoid-sectional annular sealing arrangement in accordance with the invention, shown in cross-sectional elevation.

[0013] FIG. **3** is a disassembled perspective view of FIG. **2**.

[0014] FIG. **4** is a trapezoid-sectional annular sealing gasket taken out of the cavity in accordance with the invention, shown in partially cross-sectional elevation.

[0015] FIG. **5** is a pipe union joined together by threaded flanges including a trapezoid-sectional annular sealing arrangement in accordance with the invention, shown in partially cross-sectional elevation.

[0016] FIG. **6** is another pipe union joined together by bolted flanges including a trapezoid-sectional annular sealing arrangement in accordance with the invention, shown in partially cross-sectional elevation.

BEST MODE OF CARRYING OUT THE PRESENT INVENTION

[0017] One embodied application and disposition of the trapezoid-sectional annular sealing arrangement in the connection of two fluid-containing members can be found in the flow controlling path of the two-body type ball valve shown in FIG. **1**. The flow controlling path is formed of a ball **03** and two seats **02** fixed in a body **01** by an end cap **05** engaged into the body by fastening threads. There are two trapezoid-sectional annular cavities of gaskets **04** separately enclosed at the end of the externally threaded end cap and at the mouth of internally threaded opening when the end cap are engaged into the body. FIG. **1***a* is a partially enlarged view of the trapezoid-sectional annular sealing arrangement in FIG. **1**. That the annular gasket increases in sectional areas and gyro-radii relative to its enclosing cavity in response to temperature changes means that more gasket material, such as PTFE, will be compressed into a smaller metal cavity to enhance the sealing, which means any shape of cavities does not create sealing problems. As the annular gasket decreases in sectional areas and gyro-radii relative to its enclosing cavity, the decreasing annular gasket will radially inward contract into a smaller portion of its cavity as its gyro-radius decreases so as to compensate its decreasing area and to keep the sealing integrity of the connection (see FIG. **1***a*), provided the annular gasket has enough tensile strength.

[0018] What is shown in FIGS. **2** and **3** is the same ball valve, a one-body type ball valve. In these two drawings, each like reference numeral indicates the same component. In the ball valve, there is a flow controlling path assembly and a stem sealing assembly. The flow controlling path is formed of a ball **03** and two seats **02** fixed in a body **01** by an insert **05** engaged into the body by fastening threads. As the externally threaded insert **05** is engaged into the internally threaded body, a trapezoid-sectional annular gasket **04** is enclosed in the annular cavity formed by the engagement at the end of the insert **05** to provide a thermally assisted sealing arrangement for the connection. The ball **03** with a through hole is captured between the seats **02**, and can be turned by a stem **06** with a handle **14** or an actuator to provide a fully open position, a partially open position and a fully closed position for flow control. The stem sealing assembly includes a triangle-sectional bushing used as stem cylinder seals and a ball wedge/spherical seat mating used as stem shoulder seals. The triangular bushing **09** is clamped around the stem **06** against the bushing seat at the stem exit on the body **01** by a gland **10**, Belleville washers **11** and a nut **12** engaged with the stem to provide a cylinder seal for the stem. The ball wedge/spherical seat mating is formed of a ball wedge shoulder of the stem **06** and a spherical seat at the stem entrance on the body **01**. As the triangular bushing **09** is clamped against its seat, the ball wedge shoulder is pulled against its spherical seat to provide a shoulder seal for the stem.

[0019] FIG. **5** shows a pipe union joined together by threaded flanges and FIG. **6** shows another pipe union joined together by bolted flanges, which both include a trapezoid-sectional cavity of annular packing or gaskets between the two butt end faces. The cavity shown in these two pipe unions is caved only in one end face, with the other end face com-

pletely plain, but actually it can be enclosed by two halves of cavities or two internally shaped surfaces sinking in the two faces.

[0020] The trapezoid-sectional annular gasket shown in FIG. **4** is the same as the one indicated by the like reference numeral **04** in the other drawings, which has been taken out of its cavity and shown in partially cross-sectional elevation.

[0021] As a matter of fact, the trapezoid-sectional annular sealing arrangement can be used as the thermally assisted seal in any connections of two fluid-containing members connected by bolted flanges (FIG. **6**), threaded flanges (FIG. **5**) and fastening threads (FIGS. **1** and **2**).

What is claimed is:

1. A trapezoid-sectional annular sealing arrangement, including a trapezoid-sectional annular cavity and gasket or packing used to realize the sealing connection of two fluid-containing members connected by fastening threads or bolts, wherein the said annular gasket or packing is enclosed in the said annular cavity formed by the said two fluid-containing members as joined together by fastening threads or bolts, and the said trapezoid is disposed to converge radially and inward.

2. A trapezoid-sectional annular sealing arrangement in accordance with claim **1**, wherein the said annular gasket or packing has a sectional area slightly bigger than the sectional area of the said annular cavity.

3. A trapezoid-sectional annular sealing arrangement in accordance with claim **1**, wherein the said annular cavity is preferably designed to completely sink into one face of the two end faces to be joined.

4. A trapezoid-sectional annular sealing arrangement in accordance with claim **1**, wherein the said annular cavity and gasket or packing is disposed around the flow path and between the two flange faces to be joined by bolts or threads.

5. A trapezoid-sectional annular sealing arrangement in accordance with claim **1**, wherein the said annular cavity and gasket or packing is disposed around the flow path and at the end of either externally or internally threaded fluid-containing parts to be joined by fastening threads.

6. A trapezoid-sectional annular sealing arrangement in accordance with claim **1**, wherein the said annular cavity and gasket or packing is disposed around the flow path to realize the sealing connection of valve bodies to be joined by threads or flanges.

* * * * *