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(54) **VALVE AND STEM SEALING ASSEMBLY**

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CPC ***F16K 5/0694*** (2013.01); ***F16J 15/3236*** (2013.01); ***F16K 5/0657*** (2013.01); ***F16K 5/0689*** (2013.01); ***F16K 41/046*** (2013.01); ***F16K 41/086*** (2013.01)

(58) **Field of Classification Search**
CPC F16K 5/0694; F16K 41/046; F16K 5/0657; F16K 5/0689; F16K 41/086; F16K 15/3236
See application file for complete search history.

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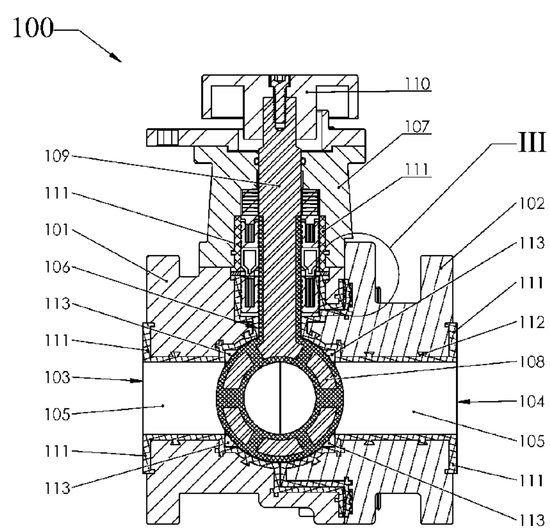
(57) **ABSTRACT**

A valve and stem sealing assembly capable of preventing leakage under demanding environmental and operating conditions. The valve comprises a body and bonnet secured together to house a flow-element, stem, and stem sealing assembly. The body may contain a body joint encapsulated within its liner. The flow-element is positioned between a first port and second port on the valve. The body and bonnet may be configured to eliminate rotational forces from being translated to the bonnet. The stem sealing assembly comprises a primary seal, primary shaft insert, spacer, and force transmitting member. The stem sealing assembly may also comprise a secondary seal and secondary shaft insert. The stem seal assembly is substantially adjacent to the stem, and configured to fit within an annular space or cavity between the stem and the first body half, second body half, and bonnet. The valve may also include a leak detection port.

23 Claims, 6 Drawing Sheets



SECTION I-I

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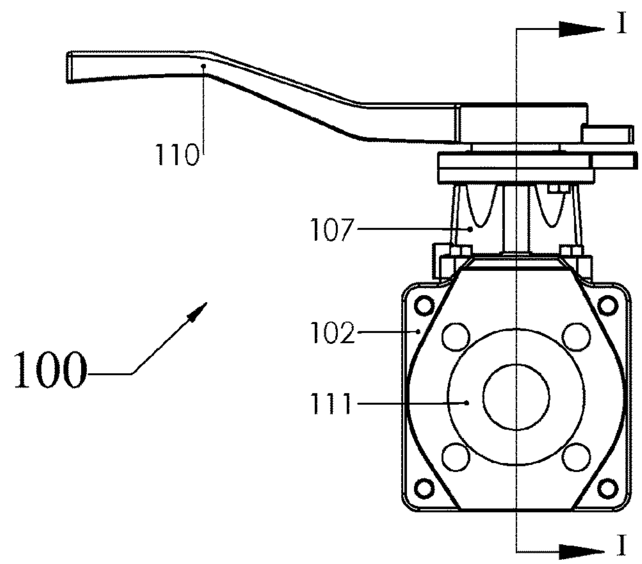
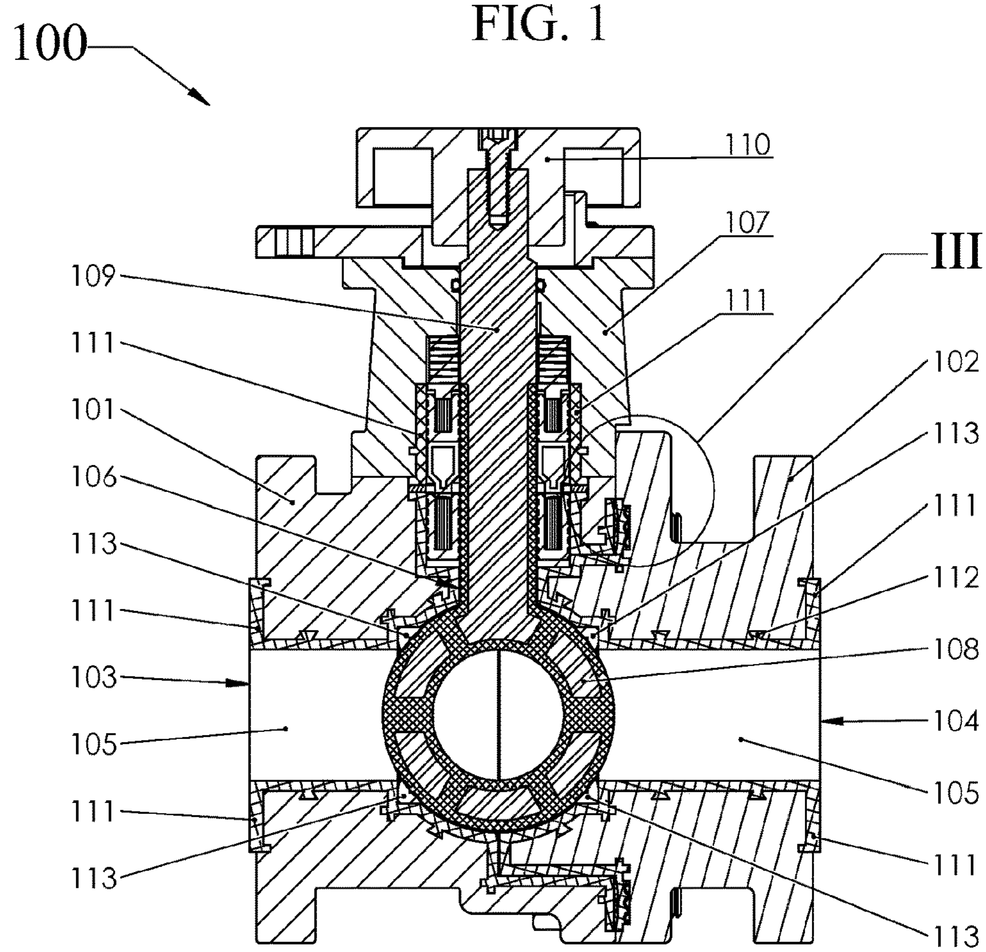


FIG. 1



SECTION I-I
FIG. 2

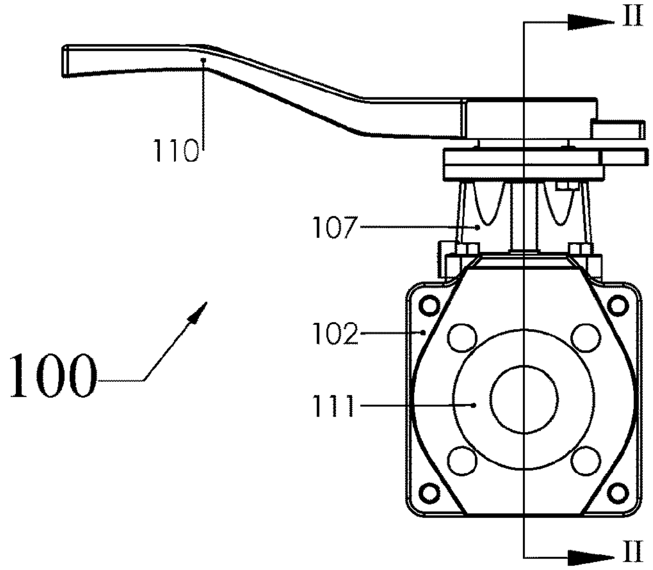
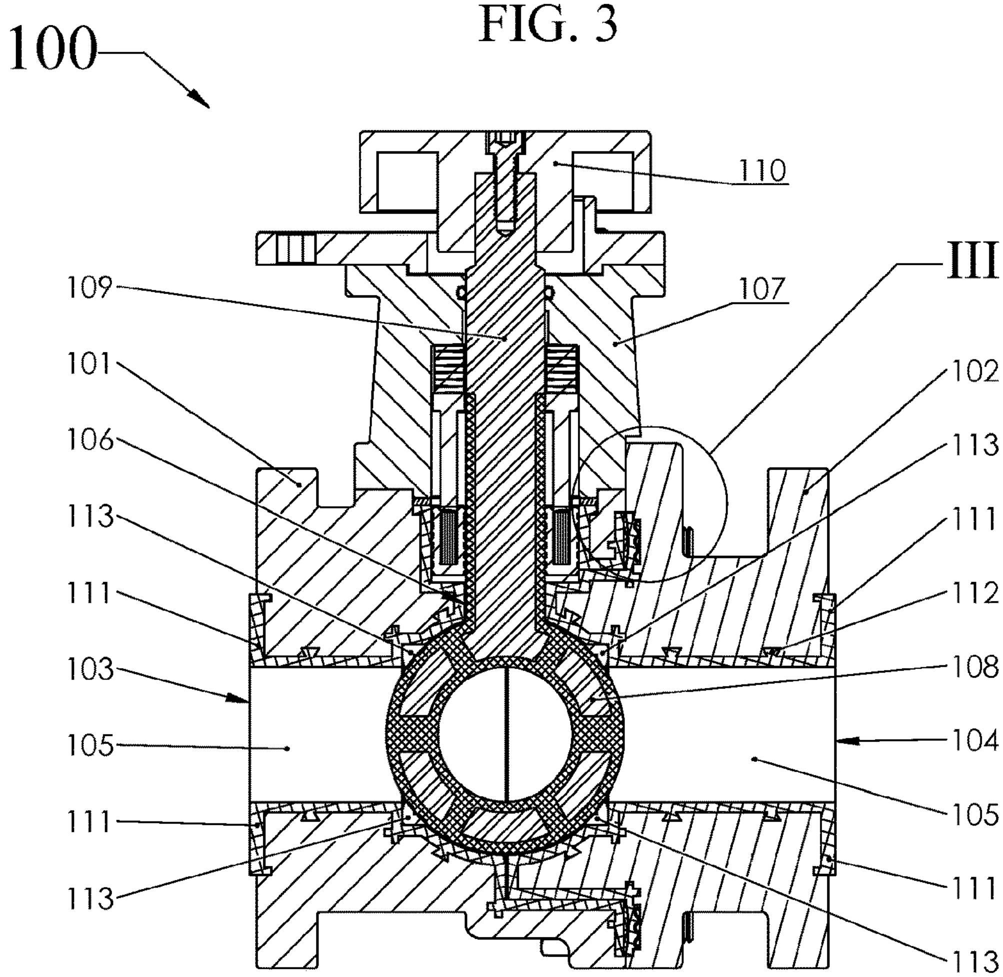
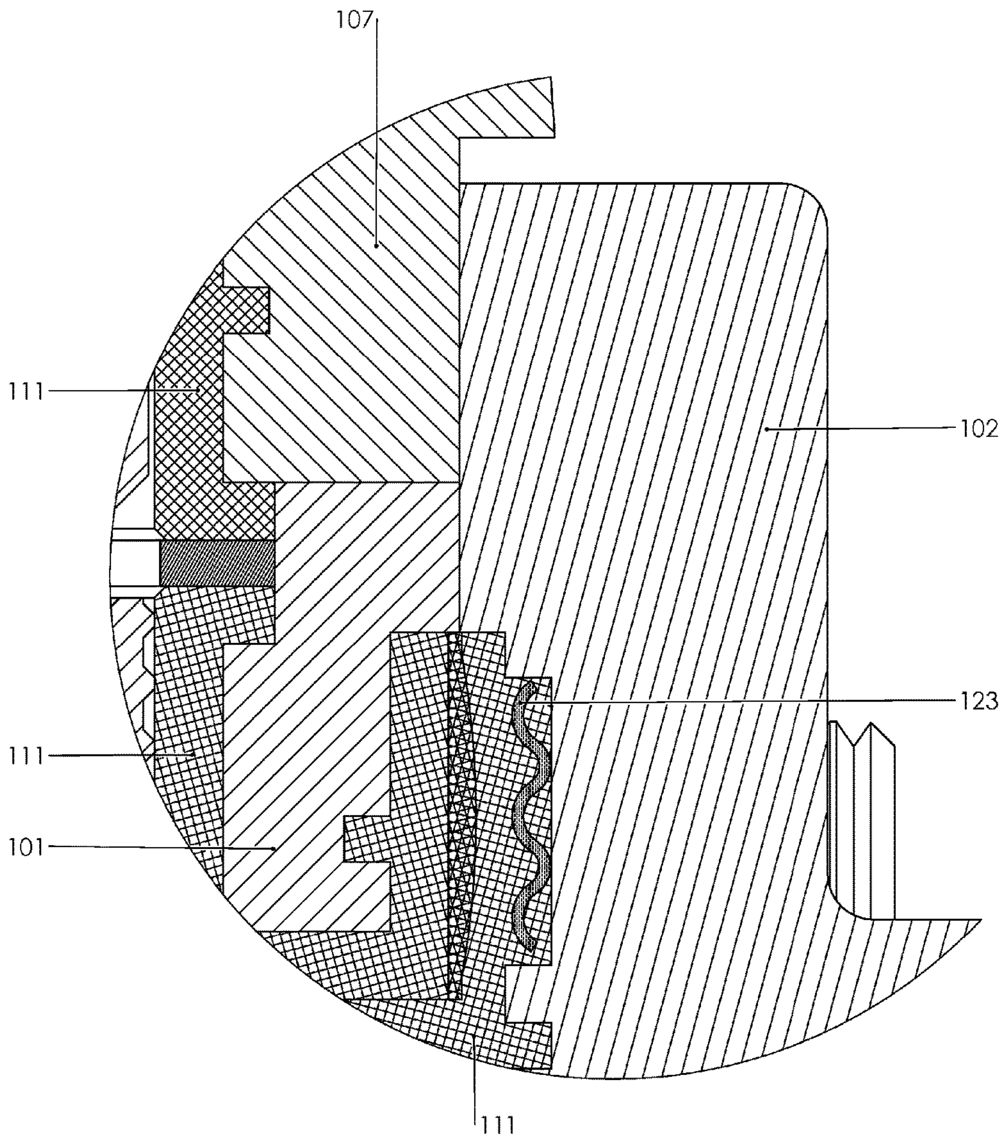


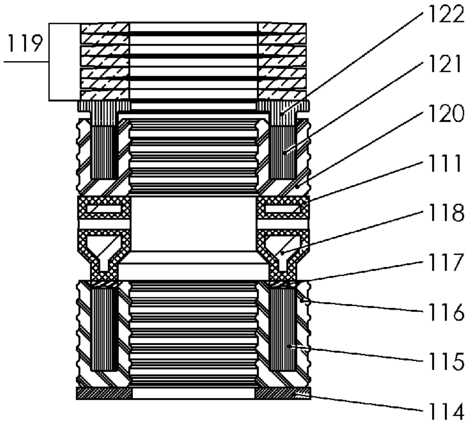
FIG. 3



SECTION II-II
FIG. 4



DETAIL III
FIG. 5



SECTION IV-IV
FIG. 7

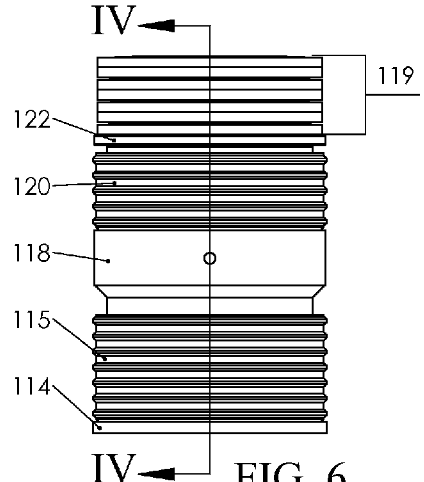


FIG. 6

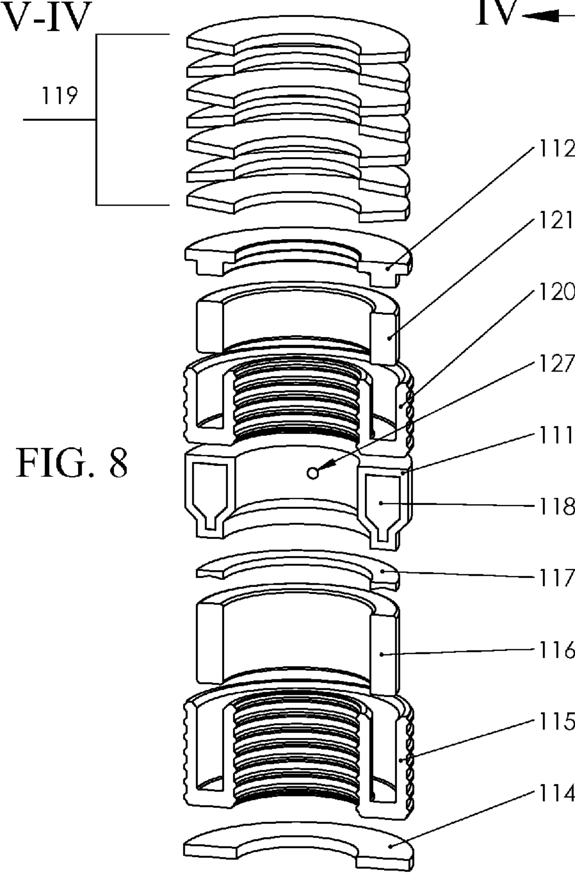
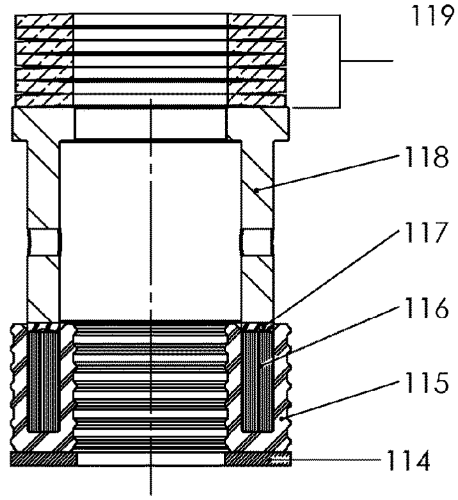


FIG. 8



SECTION V-V
FIG. 10

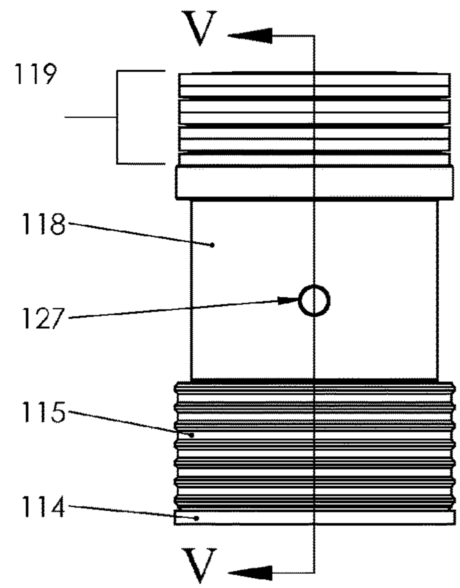
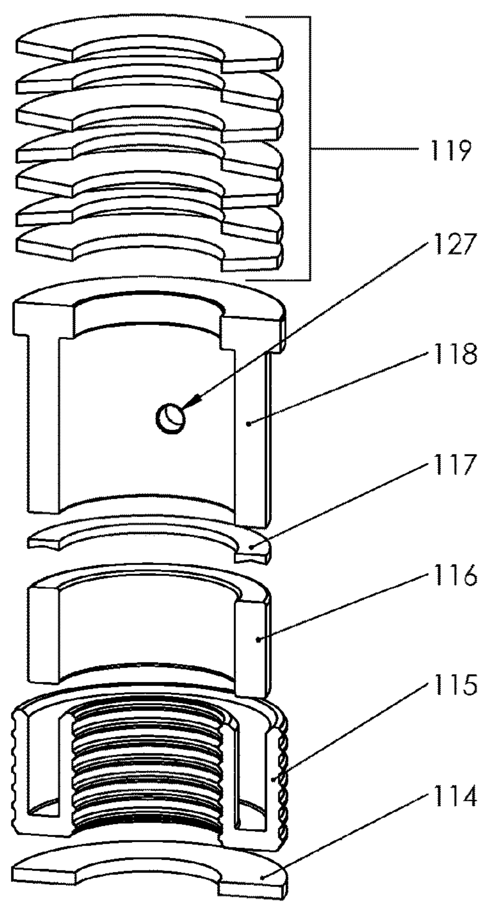


FIG. 9

FIG. 11



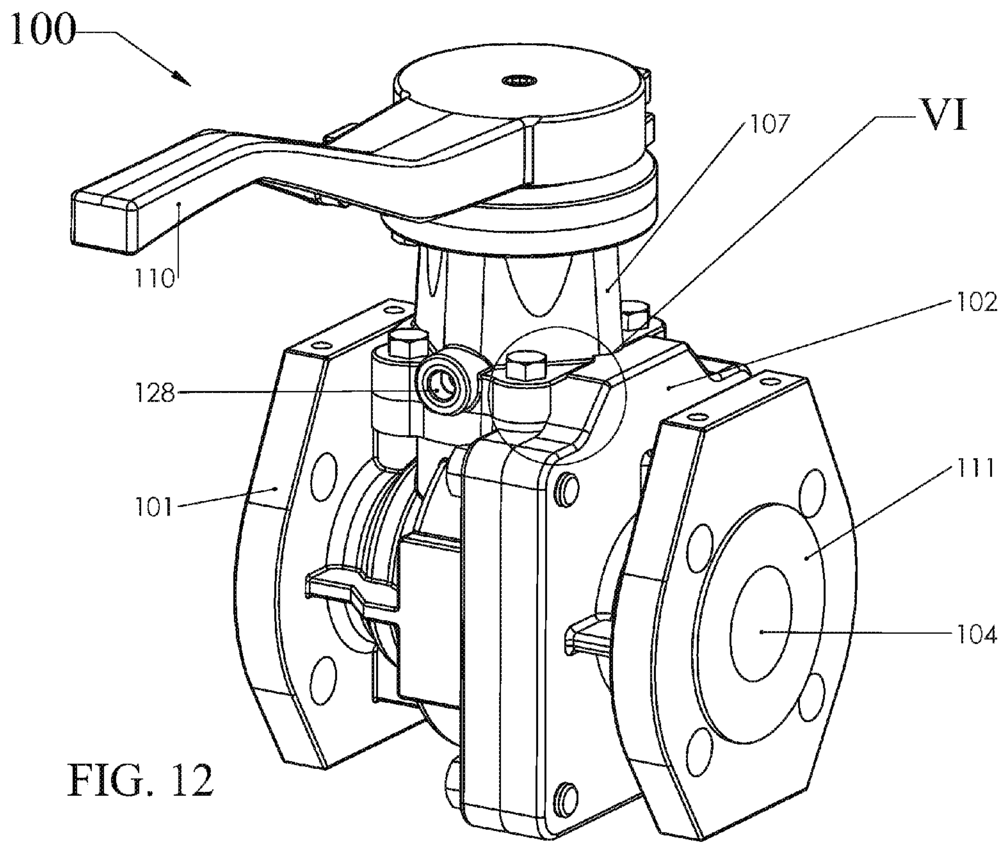
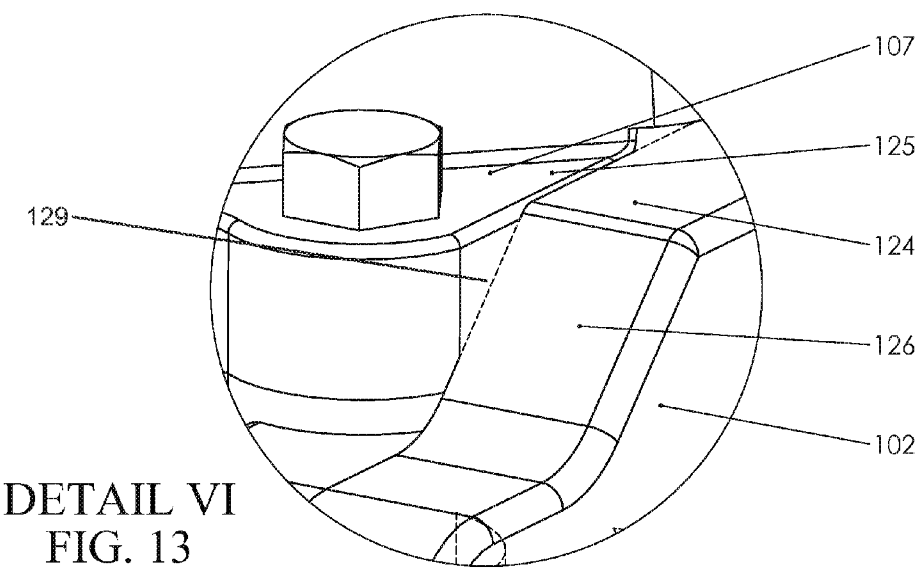


FIG. 12



DETAIL VI
FIG. 13

VALVE AND STEM SEALING ASSEMBLY

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

CROSS-REFERENCE TO RELATED APPLICATION

[Not applicable]

The present application is a reissue application of U.S. Pat. No. 8,910,921.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

THE NAMES OF THE PARTIES TO A JOINT RESEARCH AGREEMENT

Not applicable.

INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC

Not applicable.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present disclosure relates to means, for regulating flow of a fluid through a passage, either by closing the passage or restricting it by a definite predetermined motion of the flow-element, and more particularly to devices wherein the valve stem and/or actuator is particularly associated with means to pack or seal it to prevent leakage of fluid between the inside and outside of the valve body.

2. Description of Related Art

Valves are mechanical devices that are frequently utilized to regulate the flow of fluids, gases and slurries over a wide range of temperatures and pressures. Valves are used in a variety of applications, particularly industrial applications (e.g. refining, chemical, petrochemical, pharmaceutical, etc.), and several different types of valves have been developed to meet the broad range of industrial applications. Examples include ball valves, plug valves, butterfly valves, gate valves, check valves, globe valves, diaphragm, and so forth. Valves may be operated manually by hand or operated mechanically with pneumatic, hydraulic, or electric actuators.

Most valves are provided with a passage containing a flow-element that is positioned within the passage. The flow-element regulates the flow of a fluid, gas or slurry through the passage either by closing the passage or restricting it by a definite predetermined motion of the flow-element. The flow-element has an open position, which allows a fluid, gas or slurry to flow through the passage, and a closed position that prevents a fluid, gas or slurry from flowing through the passage. Examples of flow-elements include, but are not limited to, the ball in a ball valve, the disc in a butterfly valve, and so forth. The flow-element is typically connected to a stem, which actuates the flow-element, either manually or mechanically, between the open position and closed position. Many ball valves are provided with a bonnet, which is fastened to the body of the valve, to secure the flow element and stem in place as well as any sealing or packing means. During operations, a valve stem is frequently moved between the open position and closed position, which may expose the bonnet to rotational stress and loosen the bonnet over time. A loose valve bonnet may cause a fluid, gas or slurry leakage from the valve, which is very undesirable for reasons more fully set forth below.

Valve stems are usually associated with a means to pack or seal it to prevent leakage of fluid between the inside and outside of the valve body. A common means to prevent leakage around the valve stem is a stem seal. However, due to demanding environmental and operating conditions, valve seals are prone to leakage. For example, valves may be exposed to wide and rapid temperature changes, i.e. thermal cycling, causing its seals to contract and expand rapidly, which may degrade the seal over time. In addition, valve seals are sometimes exposed high temperature environments, such as those experienced in fire conditions, which may consume many seal materials.

Other factors that may impact the reliability of a valve seal include vibrations and rotational forces. For example, during operations, a stem seal is frequently exposed to rotational forces as a valve is moved between its open and closed position, which can degrade the integrity of the seal over time causing the valve to leak. Additionally, valves are frequently exposed to high pressure operating conditions and pressure drops, which cause vibrations that may degrade the seal.

A valve body may be constructed from two separate body halves which are secured together by flanged face connections on its corresponding faces. The two separate body halves can have a liner on flanged connections. Frequently, when the liner between these two separate body halves is stressed and/or compressed, it tends to cold flow (expedited at higher temperatures), which diminishes the integrity of the seal. With inadequate sealing pressure on the liner a leak path will be made.

Any leakage is very undesirable since it undermines the ability of the valve to control fluid or slurry flow. Moreover, in recent years, environmental regulations have placed a greater emphasis on reducing leaks and other fugitive emissions from valves in industrial settings by imposing fines and other penalties on facilities that exceed allowable levels. Therefore, in light of the foregoing, a need exists for a more robust valve and stem sealing assembly capable of preventing leakage under demanding environmental and operating conditions.

Furthermore, leaks and/or fugitive emissions from valves are usually identified during field inspections by operations personnel. Field inspections often cannot identify a degrading seal until the valve has already begun to leak. As a result, a valve may leak for a prolonged period of time before it is noticed possibly subjecting personnel to exposure to a hazardous material and/or the facility to fines and other penalties. Therefore, in light of the foregoing, a need exists for a more robust valve and sealing assembly capable of detecting a leak and/or fugitive emission before it is released into the environment.

BRIEF SUMMARY OF THE INVENTION

An object of this invention is to provide a more robust valve and stem sealing assembly capable of preventing leakage under demanding environmental and operating conditions. A further object of this invention is to provide a valve and stem sealing assembly capable of detecting a leak before it is released into the environment. Still a further object of this invention is to provide a valve and stem sealing assembly that prevents a bonnet from turning and loosening during operations. Additional objects and advantages of this invention shall become apparent in the ensuing descriptions of the invention.

Accordingly, a valve and stem sealing assembly in accordance with this invention are provided that are capable of preventing leakage under demanding environmental and operating conditions. The valve comprises a body and bonnet secured together to house a flow-element, stem, and stem sealing assembly. The body may contain a body joint encapsulated within its liner. The flow-element is positioned between a first port and second port on the valve. The body and bonnet may be configured to eliminate rotational forces from being translated to the bonnet. The stem sealing assembly comprises a primary seal, primary shaft insert, spacer, and force transmitting member. The stem sealing assembly may also comprise a secondary seal and secondary shaft insert. The stem seal assembly is substantially adjacent to the stem, and configured to fit within an annular space or cavity between the stem and the first body half, second body half, and bonnet. The valve may also include a leak detection port.

The foregoing broadly outlines the features and technical advantages of the present invention in order for the following detailed description of the invention to be understood. Additional features and advantages of the invention will be described hereinafter which form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and specific embodiments disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention.

It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims. The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages will be better understood from the following description when considered in connection with the accompanying Figures. It is to be expressly understood, however, that each of the Figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present invention.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

FIG. **1** is a side view of an embodiment of a valve in accordance with this invention.

FIG. **2** is a cross-sectional view of the embodiment of the valve in FIG. **1**.

FIG. **3** is a side view of an alternate embodiment of a valve in accordance with this invention.

FIG. **4** is a cross-sectional view of the embodiment of the valve in FIG. **3**.

FIG. **5** is a close-up detail view of a body joint in the embodiment of the valve in FIG. **2** and FIG. **4**.

FIG. **6** is a side view of a stem sealing assembly in accordance with this invention illustrated in FIG. **2**.

FIG. **7** is a cross-sectional view of the stem sealing assembly shown in FIG. **6**.

FIG. **8** is an exploded view of the stem sealing assembly shown in FIG. **7**.

FIG. **9** is a side view of an alternative embodiment of a stem sealing assembly in accordance with this invention in the embodiment of the valve illustrated in FIG. **4**.

FIG. **10** is a cross-sectional view of the alternative embodiment of the stem sealing assembly shown in FIG. **9**.

FIG. **11** is an exploded view of the alternative embodiment of the stem sealing assembly shown in FIG. **10**.

FIG. **12** is a perspective view of a valve in accordance with this invention.

FIG. **13** is a close-up detail view of an anti-rotational bonnet and body interface in accordance with this invention.

DETAILED DESCRIPTION OF THE INVENTION

An embodiment of a valve in accordance with this invention is shown generally in FIG. **1** and FIG. **2** at **100**. An alternative embodiment of a valve in accordance with this invention is illustrated generally in FIG. **3** and FIG. **4** at **100**, and discussed in further detail below. The valve **100** comprises a valve body. The valve body may be single body, three piece body, split body, top entry, or welded. In a preferred embodiment, the valve body may be formed by a first body half **101** and a second body half **102** secured together. The first body half **101** may have a flanged connection face that secures to a corresponding flanged connection face on the second body half **102**. The first body half **101** and second body half **102** may be secured together by any conventional means such as a threaded, bolted, welded joint, and so forth. The first body half **101** and second body half **102** may be constructed from any suitable material such as carbon steel, stainless steel, nickel alloys, and so forth. As one of ordinary skill in the art appreciates, all materials used in the construction of the valve and sealing assembly elements are selected according to the varying types of applications. The materials are chosen to optimize functional reliability, fluid compatibility, service life and cost.

The first body half **101** and second body half **102** may have a liner **111**. The liner **111** may be on flanged faces of the first body half **101** and second body half **102**. A seal between the first body half **101** and second body half **102** is created by contact between the liner **111** on the flanged faces both body halves. In a preferred embodiment, the first body half **101** and second body half **102** may be bolted together and constructed from carbon steel and coated with an epoxy paint to prevent corrosion. The bolted connection provides the force necessary to create the seal between the first body half **101** and second body half **102**.

As shown in FIG. **2**, FIG. **4** and FIG. **5**, the valve **100** may have a body joint **123** configured to maintain adequate sealing pressure and sealing integrity between the first body half **101** and the second body half **102** thereby reducing the likelihood of a leak path, particularly when a piping system is stressed, compressed, misaligned, or subjected to vibrations or thermal cycling. The body joint **123** provides rigidity or almost “memory” to the liner **111**. The body joint **123** may be an annular disc or spring with several ridges or waves, which extend between the inner and outer circumference of the body joint **123**. The body joint **123** is dynamically loaded and energized, and may be encapsulated within a liner **111**. In a preferred embodiment, the body joint **123** is located on the flanged face connection of the second body half **102**, and encapsulated by the liner **111**. The body joint **123** may be preferably located where the flanged faces are connected together, e.g. at the connection points between the first body half **101** and second body half **102**.

The valve **100** has a first port **103** and a second port **104** with a passage **105**, which is configured to flow a media (fluid, gas or slurry), extending between the first port **103** and second port **104**. The valve **100** also has a stem port **106** that extends between the inside and outside of the valve **100**. The valve **100** further comprises a bonnet **107**. The bonnet **107** acts as a cover on the first body half **101** and second body half **102**, and is typically cast or forged of the same material as the first body half **101** and second body half **102**. The bonnet **107** may be secured to the first body half **101** and second body half **102** by any conventional means such as a threaded, bolted, welded joint, and so forth.

As shown in FIG. **2** and FIG. **4**, a flow-element **108** is positioned between the first port **103** and second port **104**. The flow-element **108** may be connected to a stem **109**, which actuates the flow-element **108**, either manually or mechanically, between an open position and a closed position. Alternatively, to eliminate hysteresis and prevent lining damage associated with traditional two-piece designs, the flow-element **108** and stem **109** may be fabricated as a single-piece design. The stem **109** extends through the stem port **106**, and is connected to an actuator **110**. In a preferred embodiment, the actuator **110** may be a manually actuated handle or lever; however, the actuator **110** may also be any conventional means such as pneumatic, hydraulic, electric actuators, and so forth. The flow-element **108** is preferably a full port ball, but it may be any conventional means capable of closing or restricting the passage **105** when it is moved between the open position and closed position. Examples include, but are not limited to, a V-port ball, standard ball, and so forth.

The valve may be provided with a liner **111** to prevent corrosion. The liner **111** is preferably substantially uniformly thick and secured to the surface of the valve **100**. The liner **111** may be secured to any surface of the valve **100**, but is preferably secured to surfaces that will be exposed to the media. For example, a liner **111** may be secured to the surfaces of the first body half **101** and second body half **102** that define the passage **105**. The liner **111** may also be secured to the surfaces of the flow-element **108**, and stem **109**.

The liner **111** may be secured to the valve **100** by any conventional means. In a preferred embodiment, the liner is secured to the first body half **101**, second body half **102**, and bonnet **107** by a series of dovetail groves and interlocking holes **112** on body of the valve, which facilitate the handling of process pressure, vacuum, thermal cycling, and temperature cycling. As one of ordinary skill in the art appreciates, the liner **111** material may be selected based on the application of the valve. In corrosive applications (e.g. chlorine, hydrochloric acid, etc.), the liner **111** may be constructed from a fluoropolymer and thermoplastic material such as fluorinated ethylene propylene (FEP), perfluoroalkoxy (PFA), polyvinylidenefluoride (PVDF), and so forth.

Internal seats **113** are interposed between the flow element **113** and the valve body. The internal seats **113** are configured and designed to prevent leakage within the valve **100**. In a preferred embodiment, the internal seats **113** are positioned between the void space between the flow element **108** and the first body half **101** and second body half **102**. The material of construction of the internal seats **113** is largely dependent on the temperature, pressure, and type of media flowing through the valve **100**. As one of ordinary skill in the art appreciates, the internal seats **113** are preferably constructed from any material capable of resisting the effects of chemical attack, absorption, swelling, cold flow, and permeation with respect to a media. Suitable materials include, but are not limited to, fluoroplastic materials such as polytetrafluoroethylene (PTFE), fluorinated ethylene propylene (FEP), perfluoroalkoxy (PFA), polyvinylidenefluoride (PVDF), and so forth.

The valve **100** further comprises a stem seal assembly as shown in FIG. **2**. FIG. **4** illustrates a valve **100** with an alternate embodiment of a stem seal assembly. The stem seal assembly is utilized to prevent leakage of a media from the inside to the outside of the valve **100**. The stem seal assembly is substantially adjacent to the stem **109**. In a preferred embodiment, the stem seal assembly is configured to fit within an annular space defined by the area between the stem **109** and the first body half **101**, second body half **102**, and bonnet **103**. Alternatively, if the first body half **101**, second body half **102**, and bonnet **103** are provided with a liner, the stem seal assembly may be configured to fit within an annular space defined by the area between the stem **109** and liner **111**.

An embodiment of a stem seal assembly shown in FIG. **2** is illustrated in FIG. **6**, FIG. **7**, and FIG. **8**. The stem seal assembly is a dynamic sealing system that has the advantages of being virtually maintenance free and requiring no adjustment in the field. The stem seal assembly may also serve as a bearing and assist with reducing lateral forces that may be placed on the flow-element **108** and stem **109**. The stem seal assembly comprises a bottom gasket **114**, a primary seal **115**, primary shaft insert **116**, seal **117**, spacer **118**, secondary seal **120**, secondary shaft insert **121**, support ring **122**, and force transmitting member **119**. The secondary seal **120** and secondary shaft insert **122** provide a backup seal if the primary seal **115** is compromised.

The bottom gasket **114** is seated in the bottom of the annular space. The bottom gasket **114** may have an interface on its top surface configured to substantially mate with the bottom surface of the primary seal **115**. In a preferred embodiment, to prevent the passage of a media, the outer circumference of the bottom gasket **114** is configured to substantially fit with the valve stem, and the inner circumference of the bottom gasket **114** is configured to substantially fit with the valve body or valve body liner **111**. The bottom gasket **114** may be constructed from any material resistant to the media passing through the valve. Suitable materials include but are not limited to a thermoplastic or fluoroplastic material such as polytetrafluoroethylene (PTFE) or other suitable material.

The primary seal **115** is seated in the annular space above the bottom gasket **114**. The primary seal **115** is seated on the top surface of the bottom gasket **114**. In a preferred embodiment, the bottom surface of the primary seal **115** is configured to substantially mate with the top surface of the bottom gasket **114**, and sits on top of the top surface of the bottom gasket **114**. The primary seal **115** may have a cavity between the inner circumference and outer circumference of the primary seal **115**. The cavity is preferably sized and configured to receive the primary shaft insert **116**. In a preferred embodiment, the cavity is a U-cup shape. As shown in FIG. **8**, the cavity extends between the inner and outer circumference of the primary seal **115** and from the top to the bottom of the primary seal **115**. The outer and inner circumference of the primary seal **115** may have a plurality of ribs. The ribs on the inner and outer circumference of the primary seal **115** enact a seal with the walls of the annular space. Alternatively, if the first body half **101**, second body half **102**, and bonnet **103** are provided with a liner, the primary seal **115** creates a seal with the walls of the annular space defined as the area between the stem **109** and liner **111**. The primary seal **115** may be constructed from any material resistant to the media passing through the valve **100**. Suitable materials include but are not limited to thermoplastic or fluoroplastic materials such as polytetrafluoroethylene (PTFE), fluorinated ethylene propylene (FEP), perfluoroalkoxy (PFA), polyvinylidenefluoride (PVDF), and so forth.

The primary shaft insert **116** is seated in the annular space above the bottom gasket **114**, and is sized and configured to fit within the cavity of the primary seal **115**. In a preferred embodiment, the primary shaft insert **116** fits within a cavity that is U-cup shape as shown in FIG. **8**. The U-cup design of the primary seal **115** and primary shaft insert **116** allows looser tolerances for these elements than typical packing systems because these elements have the ability to expand radially when subjected to an axial load thereby filling any voids caused by loose tolerances and fit. The primary shaft insert **116** may be constructed from any material capable of expanding radially when subjected to an axial load. Suitable materials include but are not limited to a synthetic rubber and fluoropolymer elastomer such as Viton, or other suitable material.

Located above the primary seal **115** and primary shaft insert **116** is a seal **117**, which is seated in the annular space. In a preferred embodiment, the seal **117** may be a vee seal. The seal **117** sits on the top surface of the primary seal **115** and primary shaft insert **116**. The seal **117** may be constructed from any material resistant to the media passing through the valve. Suitable materials include but are not limited to thermoplastic or fluoroplastic materials such as polytetrafluoroethylene (PTFE), fluorinated ethylene propylene (FEP), perfluoroalkoxy (PFA), polyvinylidenefluoride (PVDF), and so forth.

A spacer **118** sits on top of the seal **117**. The spacer **118** sits within the annular space above the seal **117**. The spacer **118** is configured to align with the leakoff connection **128** on the bonnet **107**. In a preferred embodiment, the spacer **118** may be a lantern ring with an aperture **127** configured to align with the leakoff connection **128**. The spacer **118** may be constructed from any material sufficiently resistant to the media passing through the valve. Suitable materials include metals such as stainless steel. In a preferred embodiment, the spacer **118** may have a liner **111**. As one of ordinary skill in the art appreciates, the liner **111** material may be selected based on the application of the valve. For example, in corrosive applications, the liner **111** may be constructed from a fluoropolymer and thermoplastic material such as fluorinated ethylene propylene (FEP), perfluoroalkoxy (PFA), polyvinylidenefluoride (PVDF), and so forth.

The secondary seal **120** is seated in the annular space above the spacer **118**. The secondary seal **120** is seated on the top surface of the spacer **118**. The secondary seal **120** may have a cavity between the inner circumference and outer circumference of the secondary seal **120**. The cavity is preferably sized and configured to receive the secondary shaft insert **121**. In a preferred embodiment, the cavity is a U-cup shape. As shown in FIG. **8**, the cavity extends between the inner and outer circumference of the secondary seal **115** and from the top to the bottom of the secondary seal **115**. The outer and inner circumference of the secondary seal **115** may have a plurality of ribs. The ribs on the inner and outer circumference of the secondary seal **115** enact a seal with the walls of the annular space. Alternatively, if the first body half **101**, second body half **102**, and bonnet **103** are provided with a liner, the secondary seal **120** creates a seal with the walls of the annular space defined as the area between the stem **109** and liner **111**. The secondary seal **120** may be constructed from any material resistant to the media passing through the valve **100**. Suitable materials include but are not limited to thermoplastic or fluoroplastic materials such as polytetrafluoroethylene (PTFE), fluorinated ethylene propylene (FEP), perfluoroalkoxy (PFA), polyvinylidenefluoride (PVDF), and so forth.

The secondary shaft insert **121** is seated in the annular space above the seal **117**, and is sized and configured to fit within the cavity of the secondary seal **120**. In a preferred embodiment, the secondary shaft insert **121** fits within a cavity that is U-cup shape. The U-cup design of the secondary seal **120** and secondary shaft insert **121** allows looser tolerances for these elements than typical packing systems because these elements have the ability to expand radially when subjected to an axial load thereby filling any voids caused by loose tolerances and fit. The secondary shaft insert **121** may be constructed from any material capable of expanding radially when subjected to an axial load. Suitable materials include but are not limited to a synthetic rubber and fluoropolymer elastomer such as Viton, or other suitable material.

Located above the secondary seal **120** and secondary shaft insert **121** is a support ring **122**. In a preferred embodiment, the support ring **122** may be a stainless steel Belleville support ring. Within the annular space above the support ring **122**, a force transmitting member **119** is seated on top of the support ring **122**. The force transmitting member **119** may be a spring washer such as a Belleville spring washer. The force transmitting member **119** is configured to transfer an axial load to the primary shaft insert **116** and secondary shaft insert **121**. The primary shaft insert **116** and secondary shaft insert **121** then transfer the load radially creating a seal force along the cavity between the area defined by inner circumference and outer circumference of the primary seal **115** and secondary seal **120**. The primary seal **115** and secondary seal **120** are then pushed outward creating a seal with the walls of the annular space. Alternatively, if the first body half **101**, second body half **102**, and bonnet **103** are provided with a liner, the primary seal **115** and secondary seal **120** create a seal with the walls of the annular space defined as the area between the stem **109** and liner **111**.

An embodiment of a stem seal assembly shown in FIG. **4** is illustrated in FIG. **9**, FIG. **10** and FIG. **11**. The stem seal assembly comprises a bottom gasket **114**, primary seal **115**, primary shaft insert **116**, seal **117**, spacer **118**, and force transmitting member **119**. The bottom gasket **114** is seated in the bottom of the annular space. The bottom gasket **114** may have an interface on its top surface configured to substantially mate with the bottom surface of the primary seal **115**. In a preferred embodiment, to prevent the passage of a media, the outer circumference of the bottom gasket **114** is configured to substantially fit with the valve stem **109**, and the inner circumference of the bottom gasket **114** is configured to substantially fit with the valve body or liner **111**. The bottom gasket **114** may be constructed from any material resistant to the media passing through the valve **100**. Suitable materials include but are not limited to a thermoplastic or fluoroplastic material such as polytetrafluoroethylene (PTFE) or other suitable material.

The primary seal **115** is seated in the annular space above the bottom gasket **114**. The primary seal **115** is seated on the top surface of the bottom gasket **114**. In a preferred embodiment, the bottom surface of the primary seal **115** is configured to substantially mate with the top surface of the bottom gasket **114**, and sits on top of the top surface of the bottom gasket **114**. The primary seal **115** may have a cavity between the inner circumference and outer circumference of the primary seal **115**. The cavity is preferably sized and configured to receive the primary shaft insert **116**. In a preferred embodiment, the cavity is a U-cup shape. As shown in FIG. **11**, the cavity extends between the inner and outer circumference of the primary seal **115** and from the top to the bottom of the primary seal **115**. The outer and inner circumference of the primary seal **115** may have a plurality of ribs. The ribs on the inner and outer circumference of the primary seal **115** enact a seal with the walls of the annular space. Alternatively, if the first body half **101**, second body half **102**, and bonnet **103** are provided with a liner, the primary seal **115** and secondary seal **120** create a seal with the walls of the annular space defined as the area between the stem **109** and liner **111**. The primary seal **115** may be constructed from any material resistant to the media passing through the valve. Suitable materials include but are not limited to thermoplastic or fluoroplastic materials such as polytetrafluoroethylene (PTFE), fluorinated ethylene propylene (FEP), perfluoroalkoxy (PFA), polyvinylidenefluoride (PVDF), and so forth.

The primary shaft insert **116** is seated in the annular space above the bottom gasket **114**, and is sized and configured to fit within the cavity of the primary seal **115**. In a preferred embodiment, the primary shaft insert **116** fits within a cavity that is U-cup shape. The U-cup design of the primary seal **115** and primary shaft insert **116** allows looser tolerances for these elements than typical packing systems because these elements have the ability to expand radially when subjected to an axial load thereby filling any voids caused by loose tolerances and fit. The primary shaft insert **116** may be constructed from any material capable of expanding radially when subjected to an axial load. Suitable materials include but are not limited to a synthetic rubber and fluoropolymer elastomer such as Viton, or other suitable material.

Located above the primary seal **115** and primary shaft insert **116** is a seal **117**, which is seated in the annular space. In a preferred embodiment, the seal **117** may be a vee seal. The seal **117** sits on the top surface of the primary seal and primary shaft insert. The seal **117** may be constructed from any material resistant to the media passing through the valve. Suitable materials include but are not limited to thermoplastic or fluoroplastic materials such as polytetrafluoroethylene (PTFE), fluorinated ethylene propylene (FEP), perfluoroalkoxy (PFA), polyvinylidenefluoride (PVDF), and so forth.

A spacer **118** sits on top of the seal **117**. The spacer **118** sits within the annular space above the seal **117**. The spacer **118** is configured to align with the leakoff connection **128** on the bonnet **107**. In a preferred embodiment, the spacer **118** may be a lantern ring with an aperture **127** configured to align with the leakoff connection **128**. The spacer **118** may be constructed from any material sufficiently resistant to the media passing through the valve. Suitable materials include metals such as stainless steel. Within the annular space above the spacer **118**, a force transmitting member **119** is seated on top of the surface of the spacer **118**. The force transmitting member **119** may be a spring washer such as a Belleville spring washer. The force transmitting member **119** is configured to transfer an axial load to the primary shaft insert **116**. The primary shaft insert **116** then transfers the load radially creating a seal force along the cavity between the area defined by inner circumference and outer circumference of the primary seal **115**. The primary seal **115** is then pushed outward creating a seal with the walls of the annular space. Alternatively, if the first body half **101**, second body half **102**, and bonnet **103** are provided with a liner, the primary seal **115** creates a seal with the walls of the annular space defined as the area between the stem **109** and liner **111**.

The valve **100** may include a leak detection port that extends from the leakoff connection **128** on the outside of the valve to an annulus above the primary seal **115**. In a preferred embodiment, the leak detection port extends from the outside of the valve to an annulus between the primary seal **115** and secondary seal **120**. The leak detection port is utilized to detect whether any leakage occurs around the sealing assembly.

As shown in FIG. **12** and FIG. **13**, the interface between the bonnet **107** and valve body is configured to eliminate rotational forces from being translated to the bonnet **107**. In a preferred embodiment, a flanged bolted connection on the bonnet **107** secures the bonnet **107** to the valve body. The top edge of the flanged connection **125** on the bonnet **107** may be substantially flat. When the bonnet **107** is secured to the body, the top edge of the flanged connection **125** on the bonnet **107** is preferably substantially flush with the top edge **124** of the second body half lip **126** creating a substantially flat planar surface between the top edge of the flanged connection **125** on the bonnet **107** and the top edge of the second body half lip **126**. In addition, a notched interface **129** between the bonnet **107** and second body half **102** eliminates rotational forces from being translated to the bonnet **107** bolts, which maintains the sealing integrity of the seal between the body **101** and the bonnet **107**, i.e. the bonnet **107** is prevented from turning accidentally during operation. As one of ordinary skill in the art appreciates, to prevent rotation during operation, the top edge **124** of the lip **126** of the second body half **102** need only be tall enough to provide enough resistance to counteract the force from the bonnet **107**. For example, to prevent bonnet **107** rotation, the top edge **124** of the lip **126** of the second body half **102** may be higher than the top edge of the flanged connection **125** on the bonnet **107**.

In a preferred embodiment, during assembly of a valve, the first body half **101** is bolted together with the second body half **102**. A seal is created between the first body half **101** and second body half **102** between the liner **111** on the flanged faces both body halves. As shown in FIG. **2**, FIG. **4** and FIG. **5**, the valve **100** has a body joint **123** configured to maintain the sealing integrity between the first body half **101** and the second body half **102**. The body joint is located on flanged connection of the second body half **102** and encapsulated by the liner **111**. The body joint **123** provides rigidity or almost “memory” to the liner **111**. When the first body half is bolted to the second body half a sealing force is created, which dynamically loads and energizes the body joint **123**. The energized body joint **123** maintains adequate sealing pressure and sealing integrity between the first body half **101** and the second body half **102** thereby reducing the likelihood of a leak path, particularly when a piping system is stressed, compressed, misaligned, or subjected to vibrations. As shown in FIG. **5**, the body joint **123** is located at the connection points between the first body half **101** and second body half **102**, e.g. the body joint **123** is located around the bolt connection point between the first body half **101** and second body half **102** and encapsulated in the liner **111** on the second body half **102**.

The sealing assembly encompasses the stem **109**. As the spring washer **119** is loaded, it transfers transfer an axial load to the primary shaft insert **116** and secondary shaft insert **121**. The primary shaft insert **116** and secondary shaft insert **121** then transfer the load radially creating a seal force along the cavity between the area defined by inner circumference and outer circumference of the primary seal **115** and secondary seal **120**. The primary seal **115** and secondary seal **120** are then pushed outward creating a seal with the walls of the annular space defined as the area between the stem **109** and the first body half **101**, second body half **102**, and bonnet **103**. Alternatively, if the first body half **101**, second body half **102**, and bonnet **103** are provided with a liner, the primary seal **115** and secondary seal **120** create a seal with the walls of the annular space defined as the area between the stem **109** and liner **111**. The bonnet **107** is bolted to the first body half and second body half. The bonnet **107** acts as a cover for the first body half **101** and second body half **102** and is configured to secure the sealing assembly.

Any reference to patents, documents and other writings contained herein shall not be construed as an admission as to their status with respect to being or not being prior art. Although the present invention and its advantages have been described in detail, it is understood that the array of features and embodiments taught herein may be combined and rearranged in a large number of additional combinations not directly disclosed, as will be apparent to one having ordinary skill in the art.

Moreover, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the invention as defined by the following claims. There are, of course, other alternate embodiments, which are obvious from the foregoing descriptions of the invention, which are intended to be included within the scope of the invention, as defined by the following claims.

What is claimed is:

1. A valve comprising:

a. a body having a first port and a second port with a passage configured to flow a media extending between said first port and said second port, wherein said body has a flow-element positioned between said first port and said second port;

b. a stem secured to said flow-element and an actuator, wherein said stem extends through a stem port located on said body and is configured to actuate said flow-element;

c. a bonnet secured to said body; and,

d. a sealing assembly substantially adjacent to said stem and configured to fit within an annular space between said stem, said body, and said bonnet, said sealing assembly comprising:

i. a primary seal having a cavity between its inner and outer circumference, wherein said cavity comprises at least two sidewalls that are substantially orthogonal to a bottom wall;

ii. a primary shaft insert configured to fit within said cavity of said primary seal;

iii. a sealing element located above said primary seal;

iv. a bottom gasket;

v. a spacer seated on said sealing element; and,

vi. a force transmitting member configured to transfer an axial load to said primary shaft insert, wherein said primary shaft insert is configured to transfer said axial load radially to said primary seal creating at least one seal with the walls of said annular space.

2. The valve of claim **1**, wherein said primary seal has a plurality of ribs located on the inner and outer circumference of said primary seal, wherein said ribs are configured to enact at least one seal with the walls of said annular space.

3. The valve of claim **2**, wherein said cavity is a U-cup shape extending between the inner and outer circumference of the primary seal and from the top to the bottom of the primary seal.

4. The valve of claim **1**, wherein said valve has a resistant liner secured to the surface of the valve.

5. The valve of claim **4**, wherein said liner is secured to the surface of said valve by a series of dovetail groves and interlocking holes.

6. The valve of claim **1**, wherein said body further comprises a first body half secured to a second body half, wherein a body joint is encapsulated within a liner on said body and located where said first body half is secured to said second body half.

7. The valve of claim **6**, wherein said body joint has several ridges extending between the inner and outer circumference of said body joint capable of energizing when subject to a force.

8. The valve of claim **1**, wherein said sealing assembly further comprises:

a. a secondary seal seated above said spacer, wherein said secondary seal has a cavity between its inner circumference and outer circumference and a plurality of ribs located on its inner and outer circumference, wherein said ribs are configured to enact at east one seal with the walls of said annular space; and,

b. a secondary shaft insert seated above said spacer, wherein said secondary shaft insert is configured to fit within said cavity of said secondary seal and to transfer said axial load from said force transmitting radially to said secondary seal creating at least one seal with the walls of said annular space.

9. The valve of claim **1**, wherein a notched interface is provided between said bonnet and said body, said interface configured to eliminate rotational forces from being translated to the bonnet.

10. The valve of claim **1**, wherein said spacer has an aperture and aligns with a leakoff connection on said valve.

11. The valve of claim **1**, wherein said primary shaft insert substantially fills said cavity of said primary seal.

12. The valve of claim **1**, wherein said primary shaft insert completely fills said cavity of said primary seal.

13. A stem seal assembly for a valve configured to fit within an annular space surrounding a valve stem, said stem seal assembly comprising:

a. a primary seal, wherein said primary seal has a cavity between its inner circumference and outer circumference, wherein said cavity comprises at least two sidewalls that are substantially orthogonal to a bottom wall;

b. a primary shaft insert configured to fit into said primary seal cavity;

c. a sealing element located above said primary seal;

d. a bottom gasket;

e. a spacer seated on said sealing element; and,

f. a force transmitting member seated above said primary seal and configured to transfer an axial load to said primary shaft insert, wherein said primary shaft insert is configured to transfer said axial load radially to said primary seal creating a seal with the walls of said annular space.

14. The stem seal assembly of claim **13** wherein said primary seal has a plurality of ribs located on the inner and outer circumference of said primary seal, wherein said ribs are configured to enact a seal with the walls of said annular space.

15. The stem seal assembly of claim **14** wherein said spacer has an aperture configured to align with a leakoff connection on said valve.

16. A stem seal assembly for a valve configured to fit within an annular space surrounding a valve stem, said stem seal assembly comprising:

a. a primary seal, wherein said primary seal has a U-cup shaped cavity between its inner circumference and outer circumference, wherein said cavity extends between the inner and outer circumference of the primary seal and from the top to the bottom of the primary seal;

b. a primary shaft insert configured to fit into said primary seal cavity;

c. a sealing element located above said primary seal;

d. a bottom gasket;

e. a secondary seal seated above said primary seal, wherein said secondary seal has a U-cup shaped cavity between its inner circumference and outer circumference, wherein said cavity extends between the inner and outer circumference of said secondary seal and from the top to the bottom of said secondary seal;

f. a secondary shaft insert seated above said primary seal and configured to fit into said secondary seal cavity;

g. a spacer located between said primary seal and said secondary seal; and,

h. a force transmitting member seated above said secondary seal and configured to transfer an axial load to said primary shaft insert and said secondary shaft insert, wherein said primary shaft insert is configured to transfer said axial load radially to said primary seal creating a seal with the walls of said annular space, wherein said secondary shaft insert is configured to transfer said axial load radially to said secondary seal creating a seal with the walls of said annular space.

17. The stem seal assembly of claim **16**, wherein a plurality of ribs are located on the inner and outer circumference of said primary seal and secondary seal, wherein said ribs are configured to enact a seal with the walls of said annular space.

18. The stem seal assembly of claim **17**, wherein said spacer has an aperture configured to align with a leakoff connection on said valve.

19. A valve comprising:

a. a body having:

i. a first port and a second port with a passage configured to flow a media extending between said first port and said second port, wherein said body has a flow-element positioned between said first port and said second port; and

ii. a first body half secured to a second body half, wherein a body joint is encapsulated in a liner on said body and located where said first body half is secured to said second body half; wherein said body joint has several ridges extending between the inner and outer circumference of said body joint and capable of energizing when subject to a force;

b. a stem secured to said flow-element and an actuator, wherein said stem extends through a stem port located on said body and is configured to actuate said flow-element;

c. a bonnet secured to said body; and,

d. a sealing assembly substantially adjacent to said stem and configured to fit within an annular space, said sealing assembly comprising:

i. a primary seal having a U-cup shaped cavity between its inner and outer circumference, wherein said primary seal has a plurality of ribs located on its inner and outer circumference that are configured to enact a seal with the walls of said annular space;

ii. a primary shaft insert configured to fit within said cavity of said primary seal;

iii. a sealing element located above said primary seal;

iv. a bottom gasket;

v. a spacer seated on said sealing element; and,

vi. a force transmitting member configured to transfer an axial load to said primary shaft insert, wherein said primary shaft insert is configured to transfer said axial load radially to said primary seal creating a seal with the walls of said annular space.

20. The valve of claim **19**, wherein said sealing assembly further comprises:

a. a secondary seal seated above said spacer, wherein said secondary seal has a cavity between its inner circumference and outer circumference and a plurality of ribs located on its inner and outer circumference, wherein said ribs are configured to enact a seal with the walls of said annular space; and,

b. a secondary shaft insert seated above said spacer, wherein said secondary shaft insert is configured to fit within said cavity of said secondary seal and to transfer said axial load from said force transmitting radially to said secondary seal creating a seal with the walls of said annular space.

21. The valve of claim **19**, wherein a notched interface is provided between said bonnet and said body, said interface configured to eliminate the translation of rotational forces to the bonnet.

22. A valve comprising:

a. a body having:

i. a first port and a second port with a passage configured to flow a media extending between said first port and said second port, wherein said body has a flow-element positioned between said first port and said second port; and

ii. a first body half secured to a second body half, wherein a body joint is encapsulated in a liner on said body and located where said first body half is secured to said second body half; wherein said body joint has several ridges extending between the inner and outer circumference of said body joint and capable of energizing when subject to a force;

b. a stem secured to said flow-element and an actuator, wherein said stem extends through a stem port located on said body and is configured to actuate said flow-element;

c. a bonnet secured to said body; and

d. a sealing assembly substantially adjacent to said stem and configured to fit within an annular space, said sealing assembly comprising:

i. a primary seal having a U-cup shaped cavity between its inner and outer circumference, wherein said primary seal has a plurality of ribs located on its inner and outer circumference that are configured to enact a seal with the walls of said annular space;

ii. a primary shaft insert configured to fit within said cavity of said primary seal;

iii. a spacer located above said primary seal; and

iv. a force transmitting member configure to transfer an axial load to said primary shaft insert, wherein said primary shaft insert is configured to transfer said axial load radially to said primary seal creating a seal with the walls of said annular space, wherein a notched interface is provided between said bonnet and said body, said interface configured to eliminate the translation of rotational forces to the bonnet.

23. The valve of claim 22, wherein said sealing assembly further comprises:

a. a secondary seal seated above said spacer, wherein said secondary seal has a cavity between its inner *circumference and outer circumference configured to receive said secondary shaft insert and a plurality of ribs located on its inner and outer circumference, wherein said ribs are configured to enact a seal with the wall of said annular space; and*

b. a secondary shaft insert seated above said spacer, wherein said secondary shaft is configured to fit within said cavity of said secondary seal and to transfer said axial load from said force transmitting radially to said secondary seal creating a seal with the walls of said annular space.

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