SYSTEMS AND RELATED METHODS FOR INSTALLING ~~METHOD FOR~~ OR REPLACING A PROCESS MEASUREMENT INSTRUMENT

BACKGROUND

1. Technical Field

The present disclosure relates to process measuring assemblies and methods for replacing/installing devices/instruments (gauges, transducers, etc.) associated with process measuring assemblies and, more particularly, to process measuring assemblies (e.g., diaphragm seal assemblies or isolation ring assemblies) having couplings that allow a user to replace and/or install process measurement instruments/devices to and/or from the process measuring assemblies, and related methods of use.

2. Background Art

Process measuring assemblies, such as diaphragm seal assemblies and isolation ring assemblies, have innumerable uses in industry. For example, process measuring assemblies can measure a parameter (e.g., pressure) associated with a process (e.g., a process operating under pressure, such as a flow stream process) by utilizing a measurement instrument (gauges, digital gauges, transducers, switches, etc.) mounted with respect to the measuring assembly. Process measuring assemblies are useful in a myriad of different environments (e.g., for commercial and industrial applications).

In general, process measuring assemblies (e.g., diaphragm seal assemblies or isolation ring assemblies) or the like are known. Some exemplary process measuring assemblies and related accessories or the like are described and disclosed in U.S. Pat~~ents~~ Nos. 3,645,139; 4,109,535; 4,192,192; 4,218,926; 4,534,224; 4,763,527; 4,884,452; 5,022,271; 5,708,210 and 7,047,811, the entire contents of each being hereby incorporated by reference in their entireties.

Price competition between the various process measuring assembly manufacturers is a factor in the marketplace. Therefore, a savings in the cost of material, labor and the like by a manufacturer can have a significant effect on that manufacturer's sales, market share and margins. Therefore, a constant need exists among these manufacturers to develop more cost effective manufacturing/operating techniques. Moreover, a constant need exists among process measuring assembly manufacturers to develop assemblies and related accessories that are cost-effective and/or include improved features/structures.

Thus, an interest exists for improved process measuring assemblies/accessories, and

In certain embodiments, the measuring assembly is an isolation ring assembly or the like, and is used as an accessory for pressure measurement in flow stream applications where there are high solids content that might cause clogging of the flow stream and/or piping. As discussed further below in conjunction with the figures, the isolation ring assembly can have an inner flexible ring or member that is mounted substantially flush to the process and prevents clogging of the process/piping. In some embodiments, the measuring assembly includes a flanged metallic ring lined with an inner flexible wall, although the present disclosure is not limited thereto. The inner flexible wall can be mounted flush to the process, which prevents clogging of the process media (e.g., sewage, mining by-products, paper/pulp processing, etc.).

In exemplary embodiments, the measuring assembly is a seal assembly. For example, the measuring assembly can be an isolation ring assembly (e.g., wafer design or bolt-thru design), or an isolation spool assembly (e.g., threaded isolation spool or flanged isolation spool), or it can be a diaphragm seal assembly or the like, as discussed further below. As noted above, exemplary process measuring assemblies or the like are described and disclosed in U.S. Pat. ~~ents~~ Nos. 3,645,139; 4,109,535; 4,192,192; 4,218,926; 4,534,224; 4,763,527; 4,884,452; 5,022,271; 5,708,210 and 7,047,811.

In general and as discussed further below, the process measuring/seal assembly (e.g., diaphragm seal assembly or isolation ring assembly) is configured and dimensioned to provide a means to measure a condition (e.g., pressure) of a process, while protecting the measurement instrument associated with the measuring assembly from harmful process media (e.g., corrosive process media, or media that could freeze or clog, etc.). These issues can have damaging effects, ranging from inaccurate measurements to catastrophic instrument failures.

In general, a measuring/seal assembly can include a housing with a flexible diaphragm/membrane attached (which is exposed to the process), an instrument attached or mounted with respect to the top of the housing, and a fill fluid/media inside which reacts to pressure introduced on or to the diaphragm/membrane. For proper use, and to ensure no damage is done to the assembly when pressurized, it is important to ensure that a proper vacuum fill has been performed so substantially no air bubbles are trapped inside the assembly/system.

Current practice provides that it is not uncommon for a measurement instrument (e.g., gauge) to fail or fall out of its calibration specification, at which point it needs replacing. Typically, when a measurement instrument is replaced, it is important to ensure the entire

systems/methods of the present disclosure also provide users with significant operational, manufacturing and/or commercial advantages as a result.

As discussed further below, an exemplary dry-break coupling of the present disclosure (e.g., a flush-face dry-break hydraulic quick connect/disconnect coupling available from Parker Snap-tite, Series 71 or the like) includes plumbing connections, and its valve, which has a seal on both sides, is designed to provide sufficient flow while maintaining a low pressure drop when disconnected, as well as preventing fluid loss and air inclusion. It is noted that the coupling can be used in hydraulic or chemical service where cleanliness is required, or applications where spillage cannot be tolerated due to the high value of the fluid or environmental regulations.

Some other advantageous benefits of the systems/methods of the present disclosure include, without limitation: (i) utilizing the exemplary couplings and related methods with respect to a wide range of measuring/seal assemblies, and allowing users to interchange measurement instruments between various types of measuring/seal assemblies, (ii) allowing the measurement instrument to be rotated 360 degrees by hand for viewing and measurement taking needs, (iii) existing measurement instruments can be replaced by any other suitable type of instrument with a similar internal volume, (iv) measurement instruments can be removed/attached several times without concern of fluid loss or accuracy impediment, and/or (v) exemplary sleeve-lock features (discussed below) of the couplings prevent unintentional removal of the measurement instruments.

As will be appreciated, the advantageous abilities/features of the systems/methods of the present disclosure combined with the importance of proper field serviceability in the measuring assembly (diaphragm seal) market are very valuable.

Referring now to the drawings, like parts are marked throughout the specification and drawings with the same reference numerals, respectively. Drawing figures are not necessarily to scale and in certain views, parts may have been exaggerated for purposes of clarity.

As shown in FIGS. 1-3, there is illustrated a measuring assembly 10 depicting an embodiment of the present disclosure. In general, measuring assembly 10 (or 100, below) is a seal/isolator assembly (e.g., diaphragm seal assembly or isolation ring assembly), and is configured and dimensioned to provide a means to measure a condition (e.g., pressure) of a process (e.g., via fill ~~fluid/~~or sensing media 22, diaphragm/membrane 20, and instrument 12 – discussed below), while protecting the measurement instrument 12 associated with the measuring assembly 10 from harmful process media (e.g., corrosive process media, or media that could

freeze or clog, etc.). These issues can have damaging effects, ranging from inaccurate measurements to catastrophic instrument 12 failures.

In general, a measuring/seal assembly 10, 100 includes a housing 18, 118 with a flexible diaphragm/membrane/member 20 attached or mounted therewith (which is exposed to the process/piping), a measurement instrument 12, 12', 112 attached or mounted with respect to the measuring assembly 10 (e.g., to the top of the housing 18, 118), and a fill ~~fluid/~~or sensing media 22 (e.g., sensing fluid) inside (of the assembly 10) which reacts to pressure introduced on the diaphragm/membrane 20 (via the process/piping). In exemplary embodiments and for proper use, and to ensure substantially no damage is done to the assembly 10, 100 when pressurized, it is important to ensure that a proper vacuum fill has been performed so substantially no air bubbles are trapped inside the assembly/system 10, 100. ~~Pressure~~Fill or sensing media 22 (e.g., pressure-conveyance media~~ 22~~) may be composed of glycerin, silicone, or any other appropriate fluid or the like for conveying pressure.

It is noted that measurement instrument 12, 12', 112 can take a variety of forms (mechanical gauges 12, 12', digital gauges 112, transducers, switches, etc.). In certain embodiments, measurement instrument 12, 12', 112 is a pressure measurement instrument or the like. It is noted that measurement instruments 12, 12' and/or 112 are not the only measurement instruments that could be used in accordance with the principles of the present disclosure, as will be readily apparent to persons skilled in the art from the description provided herein.

In general and as shown in FIGS. 1-14, measurement instrument 12 (or 12', 112) is configured and dimensioned to be mounted with respect to measuring assembly 10 (or 100), via coupling assembly 14. Coupling assembly 14 typically includes a first coupling member 15, and a second coupling member 16, as discussed further below.

As shown in FIGS. 1-3, exemplary measuring assembly takes the form of an isolation ring assembly 10 (e.g., pressure monitoring isolating assembly). Assembly 10 is configured and dimensioned to measure/monitor the pressure of fluid in a process/pipeline, and to minimize the risk of losing fill or sensing media 22 (e.g., pressure sensing fluid~~ 22~~) when an attached instrument 12 (e.g., pressure gauge) is removed therefrom or attached thereto. In general, assembly 10 is configured and dimensioned to measure/monitor the flow of fluid through a process/pipeline at a desired position along the pipeline/process.

In exemplary embodiments, assembly 10 includes an annular housing 18 that is adapted to be positioned between two flanges of a pipeline and connected thereto. A flexible ring 20 (e.g., a rubber ring or the like) is received in the housing 18. The flexible ring 20 has

an inner diameter substantially equal to the diameter of the pipeline. A chamber is formed in the annular housing 18. The chamber is filled with a fill or sensing media 22 (e.g., sensing fluid~~/media 22~~) and has a measurement instrument 12 (e.g., pressure gauge) associated therewith. As process media/fluid travels through the pipeline and between the annular housing 18, fluid is forced against the flexible element/member 20, which in turn places pressure on the ~~fluid/~~fill or sensing media 22 in the chamber of the assembly 10. The instrument 12 is used to take a reading of this pressure.

In general, the measuring assembly 10 isolates the instrument 12 from the fluid that passes through the process/pipeline. Such isolation is important as the composition, temperature or pressure of the fluid can permanently damage the instrument 12. The advantageous assemblies 10, 100 of the present disclosure are configured and dimensioned to prevent the fill or sensing ~~fluid~~media 22 from being sprayed out of its associated chamber when the pressure gauge 12 is removed from the assemblies 10, 100.

As shown in FIGS. 12-13, an alternative measuring assembly 100 takes the form of a diaphragm seal assembly 100. Similar to assembly 10, assembly 100 is configured and dimensioned to measure/monitor the pressure of fluid in a process/pipeline, and to minimize the risk of losing ~~pressure~~fill or sensing ~~fluid~~media 22 when an attached instrument 12, 12', 112 (e.g., pressure gauge) is removed therefrom or attached thereto. In general, assembly 100 is configured and dimensioned to measure/monitor the flow of fluid through a process/pipeline at a desired position along the pipeline/process. In general and as noted above, assembly 100 includes a housing 118 with a flexible diaphragm/membrane/member (obscured) attached or mounted therewith (which is exposed to the process/piping), a measurement instrument 12, 12', 112 attached or mounted with respect to the measuring assembly 100 (e.g., to the top of the housing 118), and a fill ~~fluid/~~or sensing media 22 (e.g., sensing fluid/media) inside (of the assembly 100) which reacts to pressure introduced on the diaphragm/membrane via the process/piping. In exemplary embodiments, assembly 100 typically includes a coupling device that is configured to couple assembly 100 to a process having a media for which the pressure is to be measured and to relay pressure of the process media to ~~pressure conveyance~~fill or sensing media 22. For example, the coupling device can be a sanitary-type seal and include a diaphragm (obscured) that deforms in response to pressure exerted by the process media. The process media may be a liquid, a gas, or a combination thereof.

The deformation of the diaphragm due to the external pressure affects the pressure of ~~pressure conveyance~~fill or sensing media 22. The coupling device may be of any appropriate size for coupling assembly 100 to the process, and can be fabricated from stainless steel, plastic,

rubber, composite, and/or any other appropriate material. In general, the coupling device may be any appropriate apparatus for coupling a pressure measurement assembly 100 to a process/system having a substance for which pressure is to be measured and for communicating the substance's pressure to a ~~pressure-conveyance~~fill or sensing media 22. Instrument 12, 112 couples (via coupling assembly 14) to housing 118 and receives a portion of ~~pressure-conveyance~~fill or sensing media 22 for measuring purposes, and outputs the measurement readings via a display or the like.

In alternative embodiments, FIGS. 4-6 depict a measuring assembly 10 having a needle valve 24, and a coupling assembly 14. For example, measuring assembly 10 can include a needle valve 24 mounted with respect to the housing 18, and a second coupling member 16 mounted with respect to the needle valve. First coupling member 15 (mounted with respect to instrument 12) is configured to releasable couple to second coupling member 16, as described above and below. In exemplary embodiments, coupling assembly 14 functions as the removal/installation assembly for instrument 12, and the needle valve 24 can function as a throttling device (e.g., to minimize process spikes which can potentially damage the instrument 12).

Exemplary coupling assembly 14 takes the form of a dry-break coupling assembly 14, and includes a first dry-break coupling member 15, and a second dry-break coupling member 16, although the present disclosure is not limited thereto. Rather, it is noted that coupling assembly 14 can take a variety of forms.

As discussed further below and as shown in FIGS. 7-9 and 14, exemplary dry-break coupling assembly 14 (e.g., a flush-face dry-break hydraulic quick connect/disconnect coupling assembly 14, available from Parker Snap-tite, Series 71 or the like) includes plumbing connections, and its valve, which has a seal on both sides, is designed to provide sufficient flow while maintaining a low pressure drop when disconnected, as well as preventing fluid loss and air inclusion. It is noted that the coupling assembly 14 can be used in hydraulic or chemical service where cleanliness is required, or applications where spillage cannot be tolerated due to the high value of the fluid or environmental regulations.

In general, second coupling member 16 is plumbed inline with measuring assembly 10, and first coupling member 15 is plumbed inline with instrument 12. In exemplary embodiments, coupling assembly 14 allows the instrument 12 to be removed under pressure without losing ~~fill/sensing fluid/~~ fill or sensing media 22 (e.g., fill/sensing fluid) in either the measuring assembly 10 or the instrument 12 (FIG. 1). For example, when first coupling member 15 is mounted to second coupling member 16 (FIG. 2), a user can thereafter remove first coupling member 15 from

the second coupling member 16 under pressure without losing fill~~/~~ or sensing ~~fluid/~~media 22 in either the measuring assembly 10 or the instrument 12 (FIG. 1). It is noted that after first coupling member 15 and instrument 12 is removed from member 16/measuring assembly 10, a user can then replace instrument 12/member 15 with another instrument 12, 12', 112. Replacement instrument 12, 12', 112 can be pre-charged to a pre-determined pressure level. For example, replacement instrument 12, 12', 112 can be pre-charged to substantially the same pressure of the previous/removed measurement instrument 12 prior to its removal from assembly 10.

As such, the improved systems/methods of the present disclosure provide for the robust ability to remove a measurement instrument 12, 12', 112 while the process is under pressure (e.g., around 300 psi maximum), and can provide a replacement measurement instrument 12, 12', 112 that is not only pre-filled with the proper ~~fluid/~~fill or sensing media 22, but also "pre-charged" to a desired level (e.g., to substantially the same pressure at which the previous instrument 12, 12', 112 was removed). This thereby substantially eliminates the possibility of improper fills and/or installations of measurement instruments 12, 12', 112 to assembly 10 (or 100), which can cause fluid loss and/or air inclusion that lead to accuracy errors or seal damage. These added benefits of the systems/methods of the present disclosure also provide users with significant operational, manufacturing and/or commercial advantages as a result.

Some other advantageous benefits of the systems/methods of the present disclosure include, without limitation: (i) utilizing the exemplary couplings 14 and related methods with respect to a wide range of measuring/seal assemblies 10, 100, and allowing users to interchange measurement instruments 12, 12', 112 between various types of measuring/seal assemblies 10, 100, (ii) allowing the measurement instrument 12, 12', 112 to be rotated 360 degrees by hand for viewing and measurement taking needs, (iii) existing measurement instruments 12, 12', 112 can be replaced by any other suitable type of instrument 12, 12', 112 with a similar internal volume, (iv) measurement instruments 12, 12', 112 can be removed/attached several times without concern of fluid loss or accuracy impediment, and/or (v) exemplary sleeve-lock features (discussed below) of the couplings 14, 15, 16 prevent unintentional removal of the measurement instruments 12, 12', 112.

It is noted that coupling assembly 14 can be utilized on a wide variety of measuring/seal assemblies 10, 100 (e.g., an isolation ring assembly, such as a wafer design or a bolt-thru design, or an isolation spool assembly, such as a threaded isolation spool or a flanged isolation spool), or a diaphragm seal assembly or the like), and can be utilized on a wide variety of measuring instruments 12, 12', 112 (e.g., mechanical gauges 12, 12', digital

gauges 112, transducers, switches, etc.).

As shown in FIGS. 3 and 6-9, exemplary coupling assembly 14 is shown. FIG. 7 depicts coupling assembly 14 disengaged, with the first coupling member 15 (e.g., the male member 15) and the second coupling member 16 (e.g., the female member 16) being sealed individually with O-ring 26 (member 15) and O-rings 27 (member 16). It is noted that O-ring 26 and/or O-rings 27 can include or be associated with back-up rings or the like (e.g., Teflon back-up rings).

As shown in FIGS. 8-9, as the first coupling member 15 (e.g., the male member 15) is pressed/engaged onto/into the second coupling member 16 (e.g., the female member 16), each of the inner plungers 28, 29 begin to depress. Before any of the seals of rings 27 are broken, a mating seal is created on the outer diameter of the plunger 29 (e.g., secondary brass female plunger 29) via ring 26 (FIG. 8).

As shown in FIG. 9, in the final (engaged/coupled) position, the plunger 29 has been depressed enough to expose the communication hole/passage 30, allowing ~~fluid/~~fill or sensing media 22 (from the assembly 10) therethrough, and to instrument 12 for measuring purposes. A relief in the first coupling member 15 allows the outer sleeve 31 of the second coupling member 16 to spring upwards (toward member 15), thereby shifting the ball bearings 32 inward to releasably lock member 15 to member 16. As such, exemplary outer sleeve 31 prevents unintentional removal of the measurement instruments 12, 12', 112 from assembly 10, 100. In exemplary embodiments, assembled coupling 14 prevents unintentional removal of the measurement instruments 12, 12', 112 from assembly 10, 100 by including an external cut in the sleeve 31 which, when aligned with a ball in the body 16, allows the sleeve 31 to be pulled down and released; but when the sleeve 31 is rotated and the cut is no longer aligned with the ball it cannot be pulled down for release.

As such, the present disclosure provides for a highly advantageous method for installing or replacing a process measurement instrument 12, 12', 112 including: operating a process under pressure; providing a first measurement instrument 12, 12', 112 mounted with respect to a measuring assembly 10, 100 positioned for measuring a parameter associated with the process; removing the first measurement instrument 12, 12', 112 from the measuring assembly 10, 100 while the process operates under pressure; replacing the first measurement instrument 12, 12', 112 with a second measurement instrument 12, 12', 112 while the process operates under pressure by installing and mounting the second measurement instrument 12, 12', 112 with respect to the measuring assembly 10, 100; wherein the first measurement instrument 12, 12', 112 includes a first coupling 15 that allows a user to remove the first

measurement instrument 12, 12', 112 from the measuring assembly 10, 100 while the process operates under pressure without substantial loss of fill or sensing ~~fluid/~~media 22 (e.g., fill or sensing fluid) from the first measurement instrument 12, 12', 112; wherein the second measurement instrument 12, 12', 112 includes a second coupling 15 that allows a user to replace the first measurement instrument 12, 12', 112 by mounting the second measurement instrument 12, 12', 112 with respect to the measuring assembly 10, 100 while the process operates under pressure, the second measurement instrument 12, 12', 112: (i) containing pre-filled fill or sensing ~~fluid/~~media 22 configured to react to pressure of the process, and (ii) pre-charged to a pre-determined pressure level.

In certain embodiments, the first and second couplings 15 are dry-break couplings or the like (e.g., safe quick release dry-break couplings). In exemplary embodiments, the measuring assembly 10, 100 includes a third coupling 16 that allows the user to: (i) couple the first coupling 15 to the third coupling 16 to mount the first measurement instrument 12, 12', 112 with respect to the measuring assembly 10, 100, or (ii) couple the second coupling 15 to the third coupling 16 to mount the second measurement instrument 12, 12', 112 with respect to the measuring assembly 10, 100. In example embodiments, the coupling 16 is a dry-break coupling or the like.

It is noted that the second measurement instrument 12, 12', 112 can be pre-charged to a pre-determined pressure level prior to installing/mounting the second measurement instrument 12, 12', 112. For example and in certain embodiments, the second measurement instrument 12, 12', 112 can be pre-charged to substantially the same pressure of the first measurement instrument 12, 12', 112 (as mounted, and during its operation) prior to removing the first instrument 12, 12', 112 and prior to installing the second measurement instrument 12, 12', 112. The first and second measurement instruments 12, 12', 112 can be pressure measurement instruments (e.g., gauges, digital gauges, transducers, switches, etc.).

The present disclosure will be further described with respect to the following examples; however, the scope of the disclosure is not limited thereby. The following examples illustrate the improved systems/methods of the present disclosure of installing/replacing process measurement instruments to/from process measurement assemblies (e.g., to/from diaphragm seal assemblies or isolation ring assemblies). More particularly, the following examples illustrate the advantageous process measurement assemblies of the present disclosure having couplings that allow a user to replace/install process measurement instruments/devices to/from the process measurement assemblies, and related methods of use.

What is claimed is:

CLAIMS

1. A method for replacing a process measurement instrument comprising:

operating a process under pressure;

providing a first measurement instrument mounted with respect to a measuring assembly positioned for measuring a parameter associated with the process;

removing the first measurement instrument from the measuring assembly while the process operates under pressure;

replacing the first measurement instrument with a second measurement instrument while the process operates under pressure by installing and mounting the second measurement instrument with respect to the measuring assembly;

wherein the first measurement instrument includes a first coupling that allows a user to remove the first measurement instrument from the measuring assembly while the process operates under pressure without substantial loss of fill or sensing media from the first measurement instrument;

wherein the second measurement instrument includes a second coupling that allows the user to replace the first measurement instrument by mounting the second measurement instrument with respect to the measuring assembly while the process operates under pressure, the second measurement instrument: (i) containing pre-filled sensing media configured to react to pressure of the process, and (ii) pre-charged to a pre-determined pressure level.

2. The method of claim 1, wherein the second measurement instrument is pre-charged to substantially the same pressure of the first measurement instrument prior to installing the second measurement instrument.

3. The method of claim 1, wherein the first and second measurement instruments are pressure measurement instruments.

4. The method of claim 1, wherein the first and second measurement instruments are selected from the group consisting of gauges, digital gauges, transducers and switches.

5. The method of claim 1, wherein the first and second couplings are dry-break couplings.

6. The method of claim 5, wherein the measuring assembly includes a third coupling that allows the user to: (i) couple the first coupling to the third coupling to mount the first measurement instrument with respect to the measuring assembly, or (ii) couple the second coupling to the third coupling to mount the second measurement instrument with respect to the measuring assembly; and

wherein the third coupling is a dry-break coupling.

~~6.~~ 7. The method of claim 1, wherein the fill or sensing fluid of the first measurement instrument is configured to react to pressure of the process when the first

measurement instrument is mounted with respect to the measuring assembly.

~~7.~~8. The method of claim 1, wherein the measuring assembly is a seal assembly.

~~8.~~9. The method of claim 1, wherein the measuring assembly is an isolation ring assembly or an isolation spool assembly.

~~9.~~10. The method of claim 1, wherein the measuring assembly is a diaphragm seal assembly.

~~10.~~11. The method of claim 1, wherein the process operating under pressure is a flow stream process, the flow stream process having a solids content.

~~11. The method of claim 5, wherein the measuring assembly includes a third coupling that allows the user to: (i) couple the first coupling to the third coupling to mount the first measurement instrument with respect to the measuring assembly, or (ii) couple the second coupling to the third coupling to mount the second measurement instrument with respect to the measuring assembly; and~~

~~wherein the third coupling is a dry-break coupling.~~

12. The method of claim 1, wherein the fill or sensing media is a sensing fluid; and

wherein the pre-filled sensing media is a sensing fluid.

13. The method of claim 1 further comprising a needle valve mounted with respect to the measuring assembly, and a third coupling mounted with respect to the needle valve; and

wherein the third coupling allows the user to: (i) couple the first coupling to the third coupling to mount the first measurement instrument with respect to the measuring assembly, or (ii) couple the second coupling to the third coupling to mount the second measurement instrument with respect to the measuring assembly.

14. The method of claim 1, wherein the fill or sensing media includes glycerin or silicone.

15. The method of claim 1, wherein the measuring assembly includes a housing with a flexible member exposed to the process, the housing containing fill or sensing media; and

wherein the fill or sensing media of the housing is configured to react to pressure introduced to the flexible member.