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(54) PUMP HAVING EDGE MOUNTED O-RING SEAL

(57) The present disclosure relates to a fluid pump having a pump housing and an inlet wall portion positioned adjacent the pump housing. The inlet wall portion has an extending portion which extends generally parallel to an inner surface of the pump housing. A motor is housed within the pump housing. An impeller is included which is responsive to the motor. An impeller retainer is disposed adjacent the impeller and includes a radiused corner portion. An O-ring is positioned at the radiused corner portion. The O-ring exerts a force non-perpendicular to the inner surface of the pump housing to form a seal against the inner surface of the pump housing and the extending portion of the inlet wall portion.

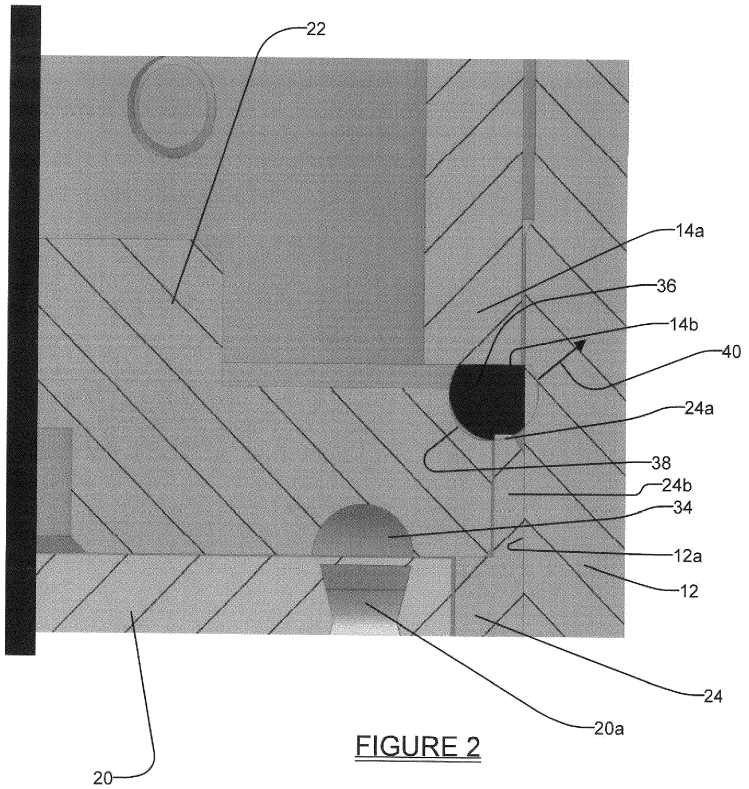


FIGURE 2

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/378,965, filed on August 24, 2016. The entire disclosure of the above application is incorporated herein by reference.

FIELD

[0002] The present disclosure relates to fluid pumps, and more particularly to a fluid pump that includes an edge mounted O-ring seal that significantly improves the pressure that can be generated within the pump without leakage past the O-ring seal.

BACKGROUND

[0003] The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

[0004] O-ring seals are frequently used in various types of pumps to provide a seal between two parallel surfaces, and more typically between two parallel metal surfaces. Typically, such O-rings are used on planar, facing metal surfaces. However, in certain applications where the internal pressures required to pump a fluid, such as a deep groundwater sampling well, are significant, such conventional O-ring implementations are fairly limited in the internal pressure that they can accommodate before allowing a leak to occur.

[0005] The ability to improve the internal pump pressure that a fluid pump, for example a fluid pump used in well bores of groundwater sampling wells, would extend the capability of existing pumps and allow existing pumps to accommodate even higher internal pressures than what is presently possible with conventionally mounted O-ring seals. In particular, the ability to accommodate greater internal pressures would be especially useful in regenerative fluid pumps, which are capable of generating significantly greater internal pressures, and which are used in especially deep well bore extending 100 meters or more below the ground surface.

SUMMARY

[0006] This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

[0007] In one aspect the present disclosure relates to a fluid pump. The fluid pump may comprise a pump housing and an inlet wall portion positioned adjacent the pump housing. The inlet wall portion may include an extending portion extending generally parallel to an inner surface of the pump housing. A motor may be included which is housed within the pump housing. An impeller may be included which is responsive to the motor. An impeller retainer may also be included which is disposed adjacent the impeller and which includes a radiused corner portion. An O-ring may be included which is positioned at the radiused corner portion. The O-ring may exert a force non-perpendicular to the inner surface of the pump housing to form a seal against the inner surface of the pump housing and the extending portion of the inlet wall portion.

[0008] In another aspect the present disclosure relates to a fluid pump that may comprise a pump housing and an inlet wall portion. The inlet wall portion may be positioned adjacent the pump housing and may include an extending portion extending generally parallel to an inner surface of the pump housing. A motor may be housed within the pump housing. An impeller may be included which is responsive to the motor. An impeller housing may be included which is positioned within the pump housing for housing the impeller. The impeller housing may include a leg portion projecting therefrom. An impeller retainer may be disposed adjacent the impeller and may include a radiused corner portion. An O-ring may be positioned at the radiused corner portion. The O-ring may have a radius approximately the same as a radius of the radiused corner portion. The O-ring may exert a force non-perpendicular to the inner surface of the pump housing to form a seal against the inner surface of the pump housing.

[0009] In still another aspect the present disclosure relates to a fluid pump that may comprise a pump housing and an inlet wall portion. The inlet wall portion may be positioned adjacent the pump housing and may include an extending portion extending generally parallel to an inner surface of the pump housing. The fluid pump may also include a motor housed within the pump housing, an impeller responsive to the motor, and an impeller housing positioned within the pump housing for housing the impeller. The impeller housing may include a leg portion projecting therefrom parallel to, and adjacent to, the inner surface of the pump housing. An impeller retainer may be disposed adjacent the impeller and may include a radiused corner portion. An O-ring may be included which is positioned at the radiused corner portion. The O-ring may have a radius approximately the same as a radius of the radiused corner portion. The O-ring may exert a force at about a 45 degree angle relative to the inner surface of the pump housing to form a seal against the inner surface of the pump housing.

[0010] In each of the aspects, it is preferred that the O-ring has a radius approximately the same as a radius of the radiused corner portion.

[0011] Preferably, includes an impeller housing positioned within the pump housing for housing the impeller, the impeller housing including a leg portion projecting therefrom.

[0012] Preferably, the O-ring contacts a surface of the leg portion.

[0013] Preferably, the O-ring exerts a force at about a 45 degree angle relative to the inner surface of the pump housing.

[0014] Preferably, the wherein the O-ring simultaneously forms a three way seal including: a first seal between the extending portion of the inlet wall portion and the impeller retainer; a second seal between an upper surface of the leg portion of the impeller housing and the inner wall surface of the pump housing; and a third seal between the inner wall surface of the pump housing and the O-ring.

[0015] Preferably, a minor portion of the O-ring sits in the radiused corner portion.

[0016] Preferably, the O-ring bulges out to exert a force at approximately a 45 degree angle relative to the inner surface of the pump housing.

[0017] Preferably, the O-ring simultaneously forms a three way seal including: a first seal between the extending portion of the inlet wall portion and the impeller retainer; a second seal between an upper surface of the leg portion of the impeller housing and the inner wall surface of the pump housing; and a third seal between the inner wall surface of the pump housing and the O-ring.

[0018] Preferably, only a minor portion of the O-ring is seated in the radiused corner portion of the impeller retainer.

[0019] Preferably, the O-ring simultaneously contacts: the radiused corner portion of the impeller retainer; a surface of the extending portion of the inlet wall portion; an upper surface of the leg portion of the impeller housing; and the inner surface of the pump housing.

[0020] Preferably, the radiused corner portion contacts a minor portion of the O-ring.

[0021] Preferably, the O-ring simultaneously forms a three way seal including: a first seal between the extending portion of the inlet wall portion and the impeller retainer; a second seal between an upper surface of the leg portion of the impeller housing and the inner wall surface of the pump housing; and a third seal between the inner wall surface of the pump housing and the O-ring.

[0022] Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.

Figure 1 is a partial side cross sectional view of a pump in accordance with one embodiment of the present disclosure;

Figure 2 is an enlarged view of a portion of the pump shown in Figure 1 showing in even greater detail an area where an O-ring of the present disclosure is mounted on an edge of one of the pump components; and

Figure 3 illustrate graphs of internal pump pressures achievable using a conventional O-ring and the new edge mounted O-ring construction of the present disclosure.

DETAILED DESCRIPTION

[0024] The following description is merely exemplary in nature and is not intended to limit the present disclosure, application, or uses.

[0025] Referring to Figure 1, a pump 10 is shown in accordance with one embodiment of the present disclosure is shown. The pump 10 is a regenerative pump constructed in large part in accordance with the description provided in co-pending U.S. Non-Provisional Application Serial No. 15/100,904, filed June 1, 2016 (16783-000123-US-NPB), the entire disclosure of which is hereby incorporated by reference into the present disclosure. The pump 10 of the present disclosure differs only from the pump shown in co-pending U.S. Application Serial No. 15/100,904 in the seal that is provided adjacent to a regenerative pump impeller, as will be described below in detail.

[0026] With continued reference to Figure 1, the pump 10 generally includes a tubular metal pump housing 12 having a housing end wall 14 with fluid inlet ports 15. Within the pump housing 12 is a motor 16, which may be a DC or AC powered motor, having an output shaft 18. The following discussion will reference a DC motor, but it will be appreciated that the pump 10 is equally well suited to use with AC or DC motors.

[0027] The output shaft 18 of the DC motor 16 drives an impeller 20 via a connection to an impeller retainer 22. The impeller 20 is disposed between the impeller retainer 22 and an impeller housing 24. An outlet end cap 26 is disposed at an opposite end of the pump housing 12 and includes a discharge bore 28 through which fluid which has entered the pump 10 is pumped out from the pump. A suitable hose (not shown) may be coupled to the discharge bore 28 through which the fluid may be pumped up a wellbore within which the pump 10 is positioned to a collection tank or reservoir. A conduit 30 forms a means for making an electrical connection with the DC motor 16 to power the DC motor. A circuit board 32 is also positioned within the pump housing 12 for assisting in controlling the DC motor 16 and controlling overall operation of the pump 10.

[0028] Referring to Figure 2, the circled area labelled 2 in Figure 1 is shown in highly enlarged form. The impeller retainer 22 includes a supply channel 34 formed therein, and the impeller 20 includes a channel 20a which communicates with the supply channel 34 and is used to pump fluid to a discharge channel (not visible in Figure 2) in the impeller housing 24. Disposed at a corner of the impeller retainer 22 and impeller housing 24 interface is an O-ring 36 which seals the interface area between these two components. The O-ring 36 is supported in a new edge mounted configuration that provides significantly improved pump performance by enabling a signif-

icantly increased internal pressure that can be accommodated by the pump 10.

[0029] The edge mounting of the O-ring 36 is accomplished by providing a radiused edge 38 on an upper peripheral corner of the impeller retainer 22. The O-ring 36 is only partially seated within the radiused edge 38. The radius of curvature of the radiused edge 38 is preferably about the same as, and more preferably exactly the same as, the radius of the O-ring 36. The housing end wall 14 includes an extending portion 14a having a flat surface 14b which makes contact with the O-ring 36 and helps to cause a controlled deformation of the O-ring 36. The O-ring 36 is also contacted by an upper flat surface 24a of a leg 24b of the impeller housing 24. The contact of the O-ring 36 with the flat surface 14b of the extending portion 14a, as well as the upper flat surface 24a of the impeller housing leg 24b and the radiused edge 38 all cooperate to cause the O-ring to be deformed in a controlled manner so as to bulge out along directional arrow 40. Directional arrow 40 extends generally at about a 45 degree angle relative to the pump housing 12. The 45 degree angle of the bulge provides a first vector component which pushes upwardly against the flat surface 14b of the extending portion 14a of the housing end wall 14, while simultaneously pushing outwardly along a horizontal vector against an inner wall surface 12a of the pump housing 12. This enables three sealing surfaces to be simultaneously created with the single O-ring 36: a first seal between the flat surface 14b and the impeller retainer 22; a second seal between the upper surface 24a of the impeller housing 24 and the inner wall surface 12a of the housing 12; and a third seal between the inside wall surface 12a and the right side of the O-ring 36.

[0030] The edge supported O-ring 36 shown in Figures 1 and 2 enables significantly higher internal pump pressures to be handled which would not be possible with a conventional O-ring mounting. Figure 3 illustrates the significantly increased pressures that the O-ring 36 enables relative to a conventional O-ring seal. In Figure 3 the graph 42 represents the pressures achievable using the O-ring 36, while graph 44 represents the pressures achievable by a conventional O-ring seal.

[0031] The edge-mounted O-ring 36 of the present pump 10 described herein does not require additional component parts to be included in the pump, nor does it require extensive modifications to the internal components of the pump. The edge mounted O-ring 36 construction also does not require significant modifications to the assembly procedure for assembling the pump 10, nor does it add appreciably to the overall cost or complexity of the pump 10. The significantly increased pressures that the pump 10 can accommodate enable the pump to be used to pump liquids at depths that would have heretofore been impossible to pump from with a conventional O-ring sealing construction.

[0032] While various embodiments have been described, those skilled in the art will recognize modifications or variations which might be made without departing from the present disclosure. The examples illustrate the various embodiments and are not intended to limit the present disclosure. Therefore, the description and claims should be interpreted liberally with only such limitation as is necessary in view of the pertinent prior art.

Claims

1. A fluid pump (10) comprising:

a pump housing (12);
an inlet wall portion (14) positioned adjacent the pump housing and including an extending portion (14a) extending generally parallel to an inner surface of the pump housing;
a motor (16) housed within the pump housing;
an impeller (20) responsive to the motor;
an impeller retainer (24) disposed adjacent the impeller and including a radiused corner portion; and
an O-ring (36) positioned at the radiused corner portion,
the O-ring exerting a force non-perpendicular to the inner surface of the pump housing to form a seal against an inner surface (12a) of the pump housing

2. The fluid pump of claim 1, wherein the O-ring also forms a seal against the extending portion of the inlet wall portion.

3. The fluid pump of claim 1 or claim 2, wherein the O-ring has a radius approximately the same as a radius of the radiused corner portion.

4. The fluid pump of any one of the preceding claims, further including an impeller housing (24) positioned within the pump housing for housing the impeller, the impeller housing including a leg portion (24b) projecting therefrom.

5. The fluid pump of claim 4, the leg portion projecting parallel to and adjacent to the inner surface of the pump housing.

6. The fluid pump of claim 4 or claim 5, wherein the O-ring contacts a surface of the leg portion.

7. The fluid pump of any one of the preceding claims, wherein the O-ring exerts a force at about a 45 degree angle relative to the inner surface of the pump housing.

8. The fluid pump of claim 7, wherein the O-ring bulges out to exert the force at approximately a 45 degree angle relative to the inner surface of the pump housing.

9. The fluid pump of any one of the preceding claims, wherein a minor portion of the O-ring sits in the radiused corner portion.

10. The fluid pump of any one of the preceding claims, wherein the radiused corner portion contacts a minor portion of the O-ring.

11. The fluid pump of any one of the preceding claims, wherein the O-ring simultaneously forms a three way seal including:

a first seal between the extending portion of the inlet wall portion and the impeller retainer;
a second seal between an upper surface of the leg portion of the impeller housing and the inner wall surface of the pump housing; and
a third seal between the inner wall surface of the pump housing and the O-ring.

12. The fluid pump of any one of the preceding claims, wherein the O-ring simultaneously contacts:

the radiused corner portion of the impeller retainer;
a surface of the extending portion of the inlet wall portion;
an upper surface of the leg portion of the impeller housing; and
the inner surface of the pump housing.

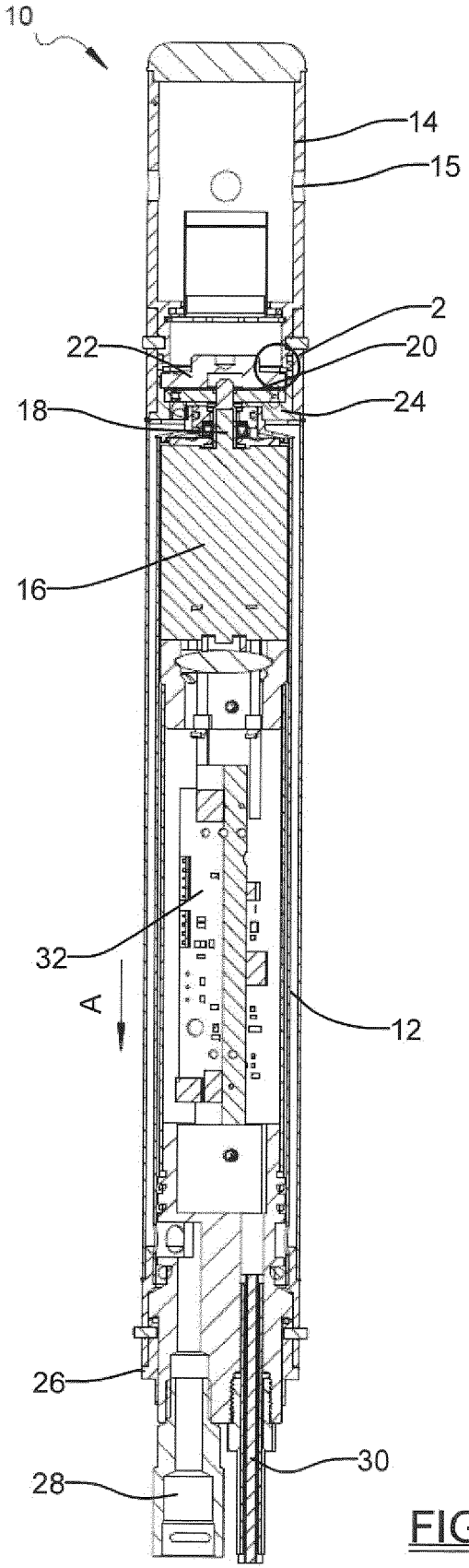


FIGURE 1

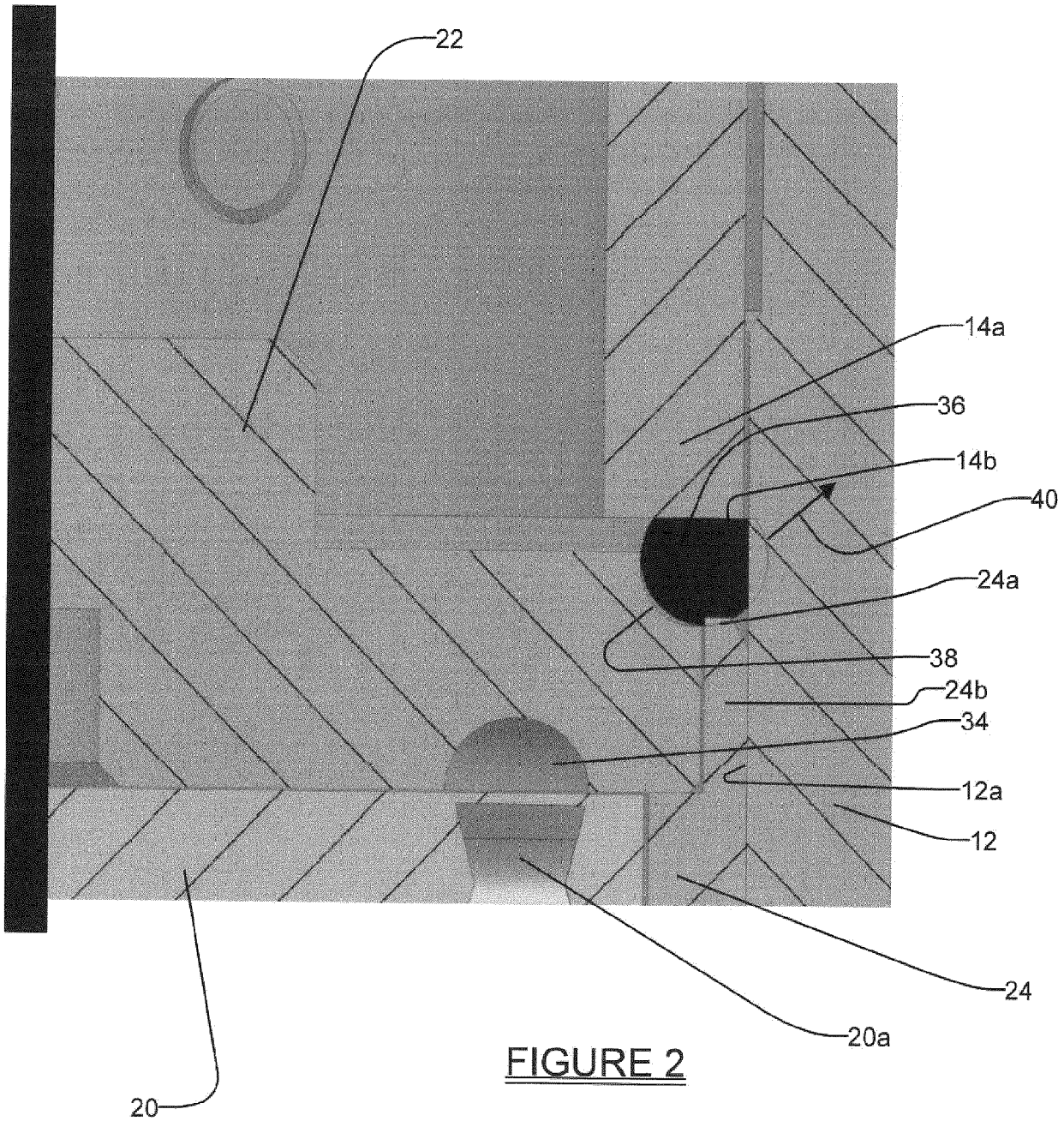


FIGURE 2

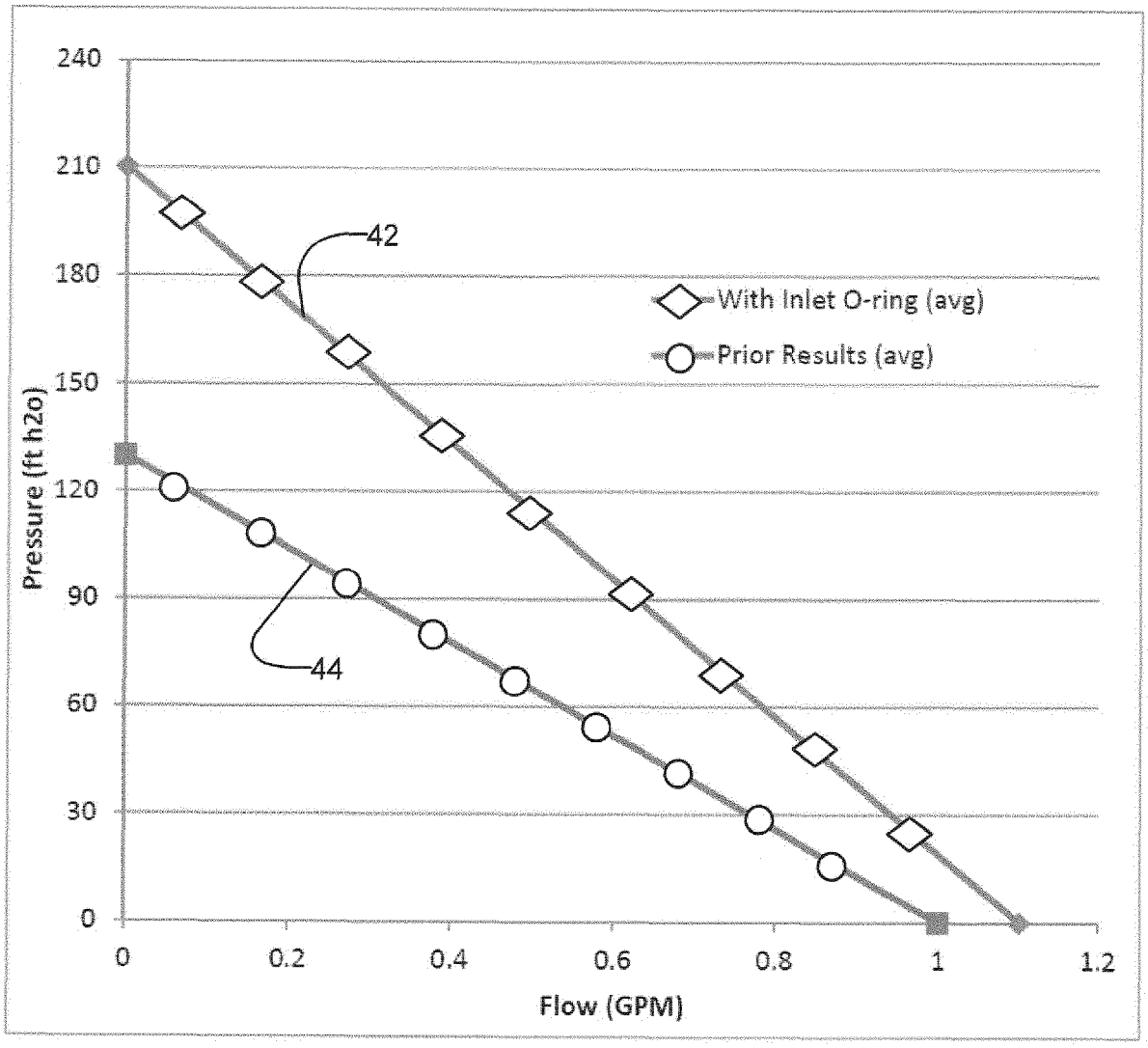

240
210
180
150
120
90
60
30
0
Pressure (ft h2o)
0
0.2
0.4
0.6
0.8
1
1.2
Flow (GPM)
42
44
With Inlet O-ring (avg)
Prior Results (avg)

FIGURE 3

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EUROPEAN SEARCH REPORT

Application Number
EP 17 18 6912

DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	12 January 2018	Oliveira, Damien

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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