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(71) Applicant: L'AIR LIQUIDE, SOCIETE ANONYME
POUR L'ETUDE ET L'EXPLOITATION DES PRO-
CEDES GEORGES CLAUDE [FR/FR]; 75 Quai d'Or-
say, 75007 Paris (FR).

(72) Inventor; and

(71) Applicant (for US only): BRIGLIA, Alain [FR/CN]; 6
Fuchun Road, Building 3 Unit 1 Room 802, Hangzhou,
Zhejiang 310000 (CN).

(74) Agent: SUNSHINEIP INTELLECTUAL PROPERTY
LAW FIRM; ZHANG, Jasy, Room 2103, Jiaxing Build-
ing, No. 877, Dongfang Road, Pudong New District,
Shanghai 200122 (CN).

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DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
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(54) Title: VALVE ADAPTION FOR TOP ENTRY VALVE IN CRYOGENIC SERVICE

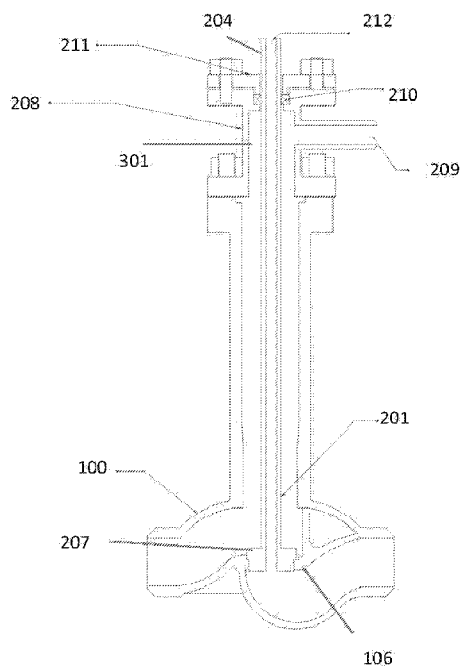


Figure 2

(57) Abstract: An in situ retrofit assembly for a top entry valve includes an annular conduit (100) configured to conform with a seat support (106) at the distal end (207) and a valve body extension (208) with an interior annular region (301). The valve body extension (208) comprises an inlet port (209) fluidically connected to the annular area (301). A gland packing push plate (211) is configured to allow the annular conduit (100) to pass through thereby forming an outlet port (212). This allows the removal of a portion of the fluid from the cold box for downstream processing or manipulation as desired.

VALVE ADAPATION FOR TOP ENTRY VALVE IN CRYOGENIC SERVICE

Background

5 Valves are commonly used in industry to restrict, divert, or blend flows of fluids. In the cryogenic industry, "top entry" valves are commonly used. These top entry valves present the advantage of eliminating flange connections (i.e. between the valve body and the bonnet), which represent a risk of leakage. Consequently, valves of this type eliminate the separate casing typically found in
10 conventional valves, typically filled with mineral wool, thereby allowing for easy access to the valve internals in the case of leakage.

The absence of the separate casing filled with mineral wool implies that the valve and the connecting piping will need to be externally insulated, typically by being immersed with perlite inside the cryogenic cold box. This makes accessing
15 the piping connected to the valve body virtually impossible, except by emptying the cold box of the perlite. This is a time consuming and expensive operation, resulting in an extended plant outages.

In some cases, it can be desirable to access a stream internal to the cold box itself. For example, if the addition of a Helium-Neon enrichment column is
20 envisioned. In the case where a top entry valve is in an appropriate location within the process cycle, the proposed invention would allow the top entry valve to be modified, in situ, to provide an exit and entry port for this process stream.

Summary

25 An in situ retrofit assembly for a top entry valve is provided. The assembly includes a top entry valve body comprising a bonnet, stem, seat ring, seat support, and plug, wherein the bonnet, stem, seat ring, and plug have been removed in situ. An annular conduit with an exterior surface is disposed longitudinally within the top entry valve body. The annular conduit is configured such that the exterior
30 surface of the distal end forms a fluid tight seal with the seat support. A valve body extension is configured to attach to the top entry valve body concentric with the annular conduit. The valve body extension includes an interior annular region, an inlet port fluidically connected to the annular area, and a gland packing configured to seal against the annular conduit. A gland packing push plate is

configured to allow the annular conduit to pass through thereby forming an outlet port.

A method of in situ retrofitting an assembly for a top entry valve, using the above assembly is provided. This includes removing the bonnet, stem, seat ring and plug in situ. It also includes forming a fluid tight seal between the exterior surface of the distal end and the seat support.

Brief Description of the Figures

Figure 1 illustrates a typical top entry valve as known to the prior art..

Figure 2 illustrates one embodiment of the present invention.

Description of Preferred Embodiments

Illustrative embodiments of the invention are described below. While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and are herein described in detail. It should be understood, however, that the description herein of specific embodiments is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

It will of course be appreciated that in the development of any such actual embodiment, numerous implementation-specific decisions must be made to achieve the developer's specific goals, such as compliance with system-related and business-related constraints, which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the art having the benefit of this disclosure.

Turning to Figure 1, a typical top entry valve used for cryogenic service is presented. As the name would suggest, this type of valve allows the internal parts to be accessed through the top, without having to completely remove the valve. A top entry globe valve will have a bonnet (101) which is bolted to the body and is removed to gain access. This valve will also have a valve stem (102) which passes through the bonnet, typically to a hand-wheel or other controlling means,

and transmits linear motion to a valve member, such as the plug (103) of a globe valve. The plug (103) makes contact with the valve seat (104) thereby forming a leak-tight closure that stops the fluid flow through the valve. In order to prevent unwanted fluid leakage through the bonnet, typically a friction tolerant seal, such as packing (105) will be pressed into annular recesses known as glands.

Turning to Figure 2, a top entry valve is shown with the original bonnet, stem, seat ring, and pug removed. These may be removed in situ, without having to remove the valve from the interconnected piping. If this valve is in cryogenic service, it will be imbedded within the cold box with only the top part of the valve body and the bonnet penetrating the cold box and being readily accessible. The rest of the cryogenic valve, will be surrounded by the cryogenic insulation (cryogel, perlite, etc), which would make removal of the valve body itself time consuming and expensive.

Inside the now empty valve body, an annular conduit (201) is introduced. The annular conduit (201) has an exterior surface disposed longitudinally within the top entry valve body (100), in a similar orientation as the valve stem had previously occupied. The annular conduit (201) is configured to conform with the seat support (106) at the distal end (207). The distal end of the annular conduit (201) may be threaded, which will allow it to interface and fit snugly within the seat support (106).

A valve body extension (208) is configured to attach to the top entry valve body (100) concentric with the annular conduit (201). The valve body extension (208) has an interior annular region (301), an inlet port (209) fluidically connected to the annular area (301), and a gland packing (210) configured to seal against the annular conduit (201). The valve body extension (208) has an internal volume (301) that is fluidically connected to the downstream portion of the top entry valve body. Hence, a fluid that is introduced into the inlet port (209) will pass around the annular conduit (201) within the valve body, and then proceed to exit the top entry valve, through a first fluid path.

A gland packing push plate (211) is configured to allow the annular conduit (201) to pass through thereby forming an outlet port (212). The outlet port (212) is fluidically connected to the upstream portion of the top entry valve body. Hence, a fluid that is introduced into the inlet side of the main valve body will pass through

the annular conduit (201) and exit the outlet port (212), through a second fluid path. A gland packing push plate configured to form a fluid tight seal with the gland packing (210).

5 This then allows the removal of a portion of the fluid from the cold box (second fluid path), for downstream processing or manipulation as desired. Then at least a portion of this processed stream, or possibly an entirely unrelated stream, may then be returned to the cold box (first fluid path). The inlet port may be connected to cryogenic service. The outlet port may be connected to
10 cryogenic service.

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What is claimed is:

1. An in situ retrofit assembly for a top entry valve, comprising:

- a top entry valve body (100), comprising a bonnet (101), stem (102),
5 seat ring (104), seat support (106), and plug (103), wherein the bonnet (101), stem (102), seat ring (104), and plug (103) have been removed in situ,
- an annular conduit (201) with a proximal end (204), a distal end (207),
10 and an exterior surface disposed longitudinally within the top entry valve body (100) and configured such that the exterior surface of the distal end (207) forms a fluid tight seal with the seat support (106),
- a valve body extension (208) configured to attach to the top entry valve body (100) concentric with the annular conduit (201), wherein the valve
15 body extension (208) comprises an annular region (301), an inlet port (209) fluidically connected to the annular area (301), and a gland packing (210) configured to seal against the proximal end (204) of the annular conduit (201),
- a gland packing push plate (211) configured to allow the proximal end
20 (204) of the annular conduit (201) to pass through thereby forming an outlet port (212), the gland packing push plate (211) configured to form a fluid tight seal with the gland packing (210).

2. The in situ retrofit assembly for a top entry valve of claim 1, wherein the top
25 entry valve body is installed in cryogenic service.

3. The in situ retrofit assembly for a top entry valve of claim 1, wherein the
inlet port is connected to cryogenic service.

4. The in situ retrofit assembly for a top entry valve of claim 1, wherein the
30 outlet port is connected to cryogenic service.

5. An in situ method to retrofit an assembly in a top entry valve, comprising:

- providing a top entry valve body (100), comprising a bonnet (101), stem (102), seat ring (104), seat support (106), and plug (103),
 - removing the bonnet (101), stem (102), seat ring (104), and plug (103) in situ,
- 5 • providing an annular conduit (201) with a proximal end (204), a distal end (207), and an exterior surface disposed longitudinally within the top entry valve body (100)
 - forming a fluid tight seal between the exterior surface of the distal end (207) and the seat support (106),
- 10 • providing a valve body extension (208) configured to attach to the top entry valve body (100) concentric with the annular conduit (201), wherein the valve body extension (208) comprises an annular region (301), an inlet port (209) fluidically connected to the annular area (301), and a gland packing (210) configured to seal against the proximal end
- 15 (204) of the annular conduit (201),
- providing a gland packing push plate (211) configured to allow the proximal end (204) of the annular conduit (201) to pass through thereby forming an outlet port (212), the gland packing push plate (211) configured to form a fluid tight seal with the gland packing (210).

20

6. The in situ method to retrofit an assembly in a top entry valve of claim 5, wherein the top entry valve body is installed in cryogenic service.

7. The in situ method to retrofit an assembly in a top entry valve of claim 5, wherein the inlet port is connected to cryogenic service.

25

8. The in situ method to retrofit an assembly in a top entry valve of claim 5, wherein the outlet port is connected to cryogenic service.

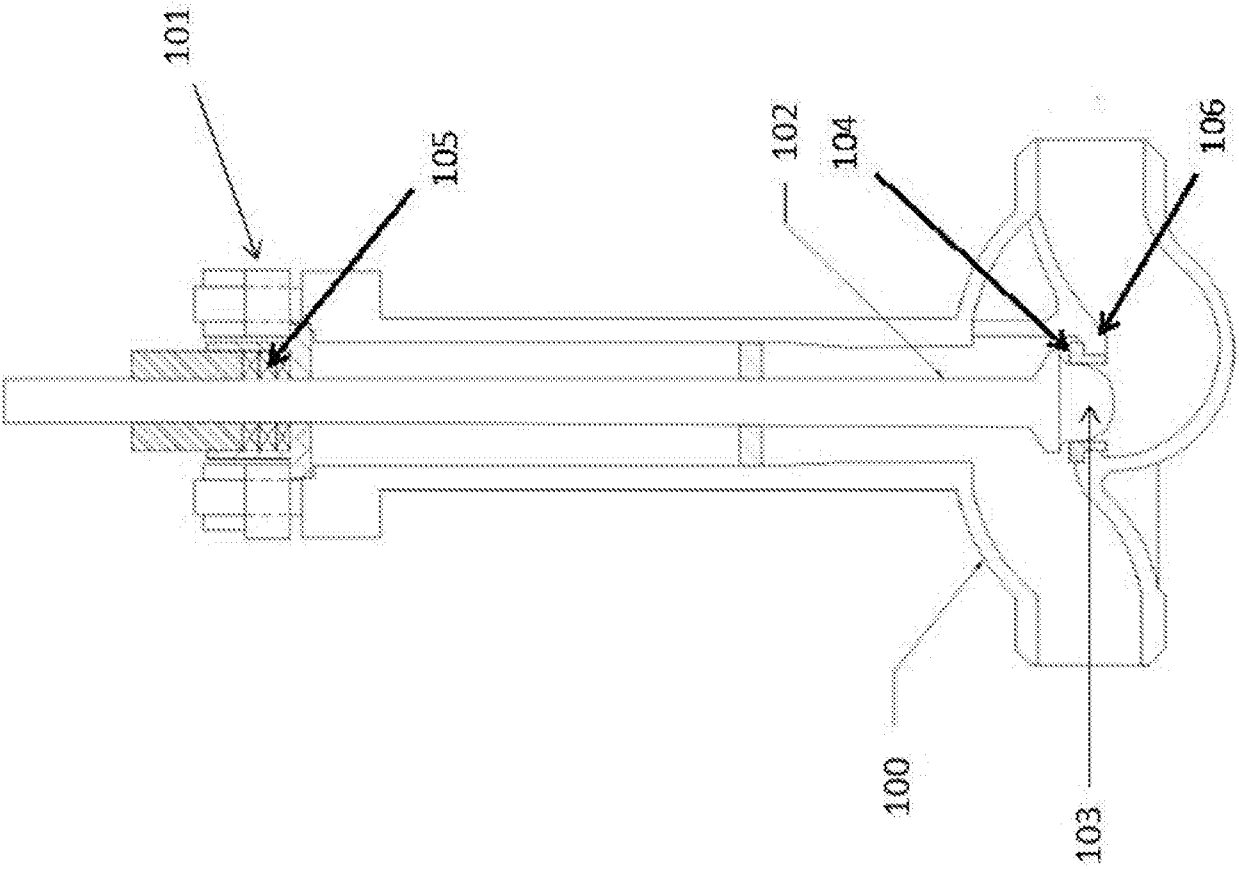


Figure 1
Prior Art

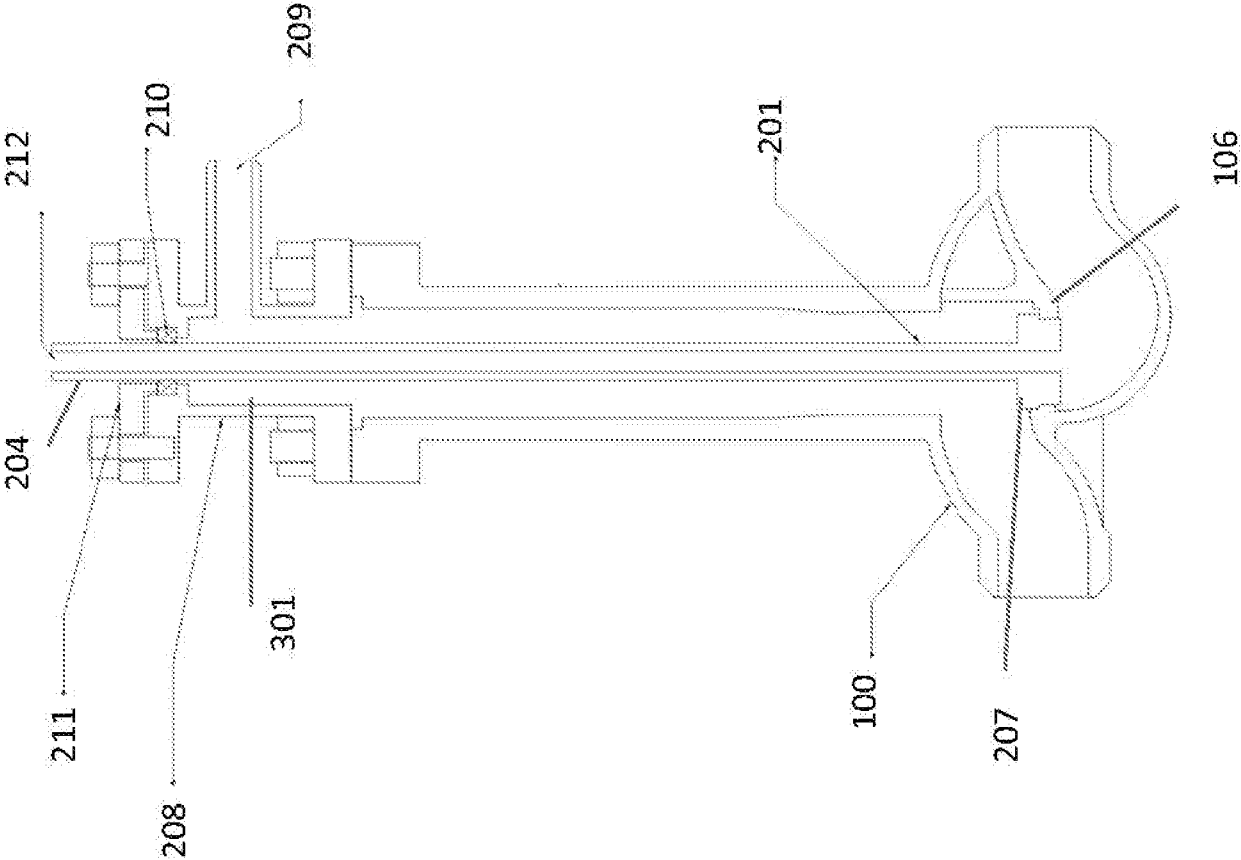


Figure 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/094207

A. CLASSIFICATION OF SUBJECT MATTER

F16K 3/12(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16K; F17C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, DWPI: valve, entry, top, plug, conduit, seal+, packing, cryogenic

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5013009 A (GODDARD VALVE CORP) 07 May 1991 (1991-05-07) see column 2, line 2 to column 4, line 31, figures 1 to 3	1-8
A	US 4285498 A (ICI LTD) 25 August 1981 (1981-08-25) see the whole document	1-8
A	US 4815692 A (LOISEAU GERARDET AL.) 28 March 1989 (1989-03-28) see the whole document	1-8
A	WO 2014021509 A1 (SAMJIN JMC CO LTD) 06 February 2014 (2014-02-06) see the whole document	1-8
A	US 4641681 A (NIPPON BALL VALVE) 10 February 1987 (1987-02-10) see the whole document	1-8
A	EP 1936255 A1 (AIR LIQUIDE) 25 June 2008 (2008-06-25) see the whole document	1-8
A	US 6098674 A (AIR LIQUIDE) 08 August 2000 (2000-08-08) see the whole document	1-8

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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STATE INTELLECTUAL PROPERTY OFFICE OF THE
P.R.CHINA
6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing
100088, China

YU, Hanzheng

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Information on patent family members

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Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
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