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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 4 :		(11) International Publication Number:
B08B 5/02, 9/06	A1	WO 86/ 06986
		(43) International Publication Date: 4 December 1986 (04.12.86)

(21) International Application Number: PCT/US86/01105

(22) International Filing Date: 20 May 1986 (20.05.86)

(31) Priority Application Number: 735,976

(32) Priority Date: 20 May 1985 (20.05.85)

(33) Priority Country: US

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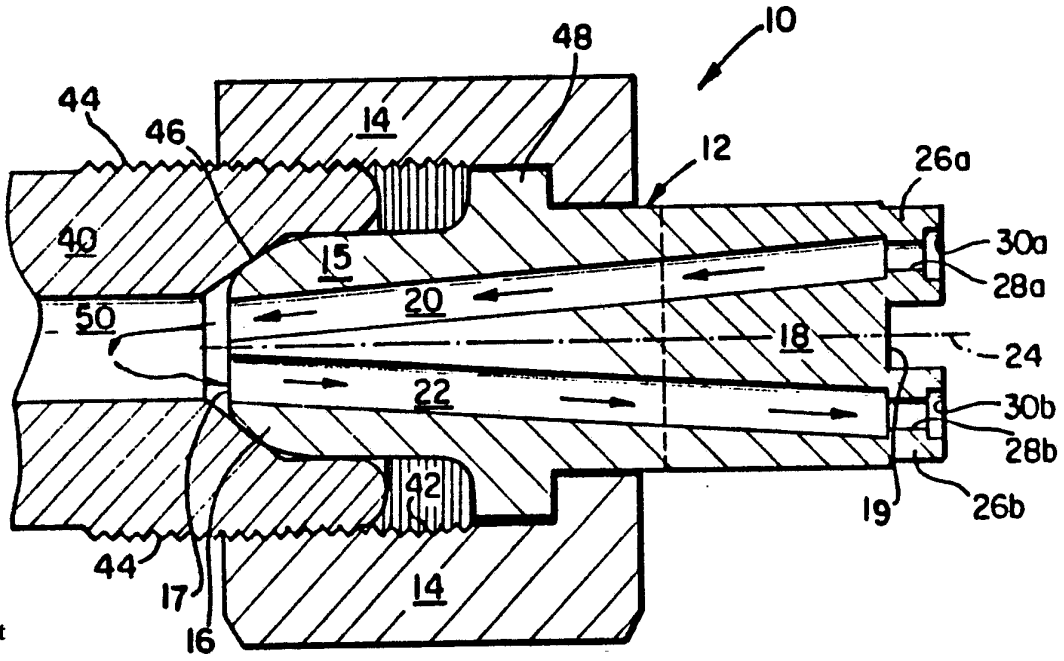
(81) Designated States: BE (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, NL (European patent).

Published
With international search report.

(54) Title: A DEEP PURGE CONNECTOR FOR GAS SUPPLY SYSTEM



(57) Abstract

A gas connector (10) including a nipple element (12) has two boreholes (20, 22) formed in the nipple (12) extending lengthwise therethrough. The boreholes (20, 22) diverge as they extend from the sealing end (15) of the nipple (12) to the connecting end (18). Butt weld protrusions may be formed in the connecting end in commuication with each of the boreholes. The protrusions (26a, 26b) are provided for welding gas tubing (32) to the nipple (12) at the terminal ends of the respective boreholes (20, 22). One of the boreholes is used for transmitting a process gas. The other borehole is used for introducing a purge gas into the gas supply system (100) in which the connector (10) is used. The nipple element (12) may also have its connecting end (18) adapted for connection to other gas conveying assemblies, such as cross-purge assemblies.

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A DEEP PURGE CONNECTOR FOR GAS SUPPLY SYSTEM

Field of the Invention

This invention relates generally to process gas supply systems and more particularly, to a connector useful in purging the process gas from such supply systems.

Background of the Invention

Many industries, such as the electronic semi-conductor manufacturing industry, utilize specialty gases which are supplied from a source such as a pressure cylinder, to the particular process. In certain situations, these gases may be highly toxic. Thus, it is important that the system be essentially free of such gases when it is opened to the atmosphere in order to avoid injury to workers. It becomes necessary, therefore, to purge the supply system in order to remove traces of the process gas before the system can be safely opened to the atmosphere, for example when changing pressure cylinders.

Conventional purging systems are not entirely effective because they often leave dead areas where the toxic gases can remain, particularly at the connections to the gas pressure cylinder. One design which sought to overcome this problem utilizes a small piece of tubing inserted through the nipple connector to the gas bottle for directing a stream of purge gas toward the nozzle connection. However, although this does help to eliminate dead areas at the cylinder connection, the design does have some drawbacks. For example,

additional parts and joints are necessary to connect the external tubings, usually called pigtails, to the nipple. Also, there is a possibility of leakage at several points. The size and location of the tubing on the nipple connector render it subject to damage since the nipple connector is frequently disconnected and reconnected. Moreover, this arrangement requires precautionary steps to prevent misconnection of the process gas and purge gas lines to the nipple connector.

In the field of electronic semi-conductor processes, it is necessary to maintain ultrahigh purity of the process gas used. This requires that any connecting devices utilized in the gas supply system be essentially free of minute particles which might enter the gas stream. Thus, an additional desirable feature of a gas purge connector is that it be fabricated in such a way that the opportunity for generation of minute particles in the gas channel be minimized.

Summary of the Invention

A deep purge gas connector according to this invention includes a gas nipple having a sealing end and a connecting end. A pair of boreholes are provided within the gas nipple extending from the sealing end to the connecting end. These boreholes diverge as they extend from the sealing end toward the connecting end. A protrusion is provided at one or both of the locations on the connecting end where the boreholes terminate. These protrusions provide assistance in connecting the process gas and purge gas lines to the gas nipple.

Brief Description of the Drawings

The foregoing summary, as well as the following detailed description of a preferred embodiment of the

present invention, will be better understood when read in conjunction with the appended drawings, in which:

Fig. 1 is a cross-sectional view of a deep purge connector embodying the invention prior to the welding of tubing thereto;

Fig. 2 shows the connecting end of the deep purge connector of Fig. 1;

Fig. 3 is a fragmentary cross-sectional view showing a piece of tubing butt-welded to the deep purge connector of Fig. 1;

Fig. 4 is a cross-sectional view of an alternate deep purge connector embodying the invention; and

Fig. 5 is a diagram of a gas supply system utilizing the deep purge connector according to the invention.

Description of the Preferred Embodiment

Referring now to Fig. 1, there is shown generally a deep purge connector 10. The connector 10 includes a nipple 12 and a nut 14. The nipple 12 has a generally cylindrical sealing end portion 15 having a rounded or semi-spherical end 16, also referred to as a bull nose, and a connecting end portion 18.

A pair of boreholes 20 and 22 are formed within the nipple 12 and extend generally lengthwise from the sealing end face 17 at the rounded end 16 through the connecting end face 19 of connecting end portion 18. The boreholes 20 and 22 diverge from the rounded end 16 at a preselected angle relative to the longitudinal axis 24 of nipple 12. In this manner, the terminals of boreholes 20 and 22 at the end face 19 are spaced farther apart than the terminals at sealing end face 17. It should be noted that the terminals of the two bores in the end face 17 are closely spaced proximate the center of the end face 17.

Means is provided to afford connection of tubes 32 to the boreholes 20 and 22. To this end, a pair of protrusions 26a and 26b are formed on the connecting end portion 18 at the locations where the boreholes 20 and 22 terminate. These protrusions 26a,26b are generally cylindrical as shown in Fig. 2, and in the present instance are arranged with their cylindrical axes parallel to the nipple axis 24. The protrusions 26a and 26b have central bores 28a and 28b respectively, which communicate with the terminals of boreholes 20 and 22, respectively. Additionally, counterbores 30a and 30b are formed in the end surfaces of protrusions 26a and 26b. These counterbores are each sufficiently deep and each have a diameter for snugly receiving a gas tubing end. The bores 28a and 28b correspond in diameter to the interior diameter of the tubes 32, and the counterbores correspond in diameter to the outside diameters of the tubes 32.

As shown in Fig. 3, the tubing 32 is connected to the protrusion 26 by means of a butt weld 34. Butt weld 34 may be formed by a conventional welding method such as heliarc welding around the circumference of the tubing/protrusion interface. In this manner, the metal of the protrusion is fused together with the metal from the tubing, thereby achieving an integral butt weld. The presence of the protrusions 26 on the end wall limits the mass of the nipple body adjoining the site of the weld and retards the dissipation of heat during the welding operation, thereby enhancing the fusing of the tube end with the socket formed by the counterbore 30. The resulting connection is essentially particle-free since there is an absolute minimum of metal surface contact.

The nut 14 is rotatably engaged with nipple 12, as shown in Fig. 1. Nut 14 is used for fastening the nipple 12 to a gas cylinder valve 40. Nut 14 has internal threads 42 for engaging with like threads 44 on valve 40. By screwing nut 14 onto valve 40, rounded end 16 of nipple 12 is engaged with tapered opening 46 in cylinder valve 40. As the nut 14 is tightened, it presses on shoulder portion 48 of nipple 12, thereby forcing rounded end 16 against the tapered opening 46 and forming a metal-to-metal seal. In this manner, the inner terminals of boreholes 20 and 22 are brought into communication with the cylinder valve orifice 50. In order to avoid twisting nipple 12 during the attachment and disconnection of deep purge connector 10 to the cylinder valve 40, nipple 12 may be provided with flats 52a and 52b in connecting end portion 18 for applying a wrench or other tool.

Referring now to Fig. 4, there is shown an alternate embodiment of the deep purge connector according to the invention. This embodiment is particularly designed for use with valves whose orifice does not accept the rounded nose 16 of the previously described embodiment. A nipple 412 has a flat sealing end 416. A soft (generally plastic) washer 417 is used to assure leak-proof contact between nipple 412 and the cylinder valve 440. A pair of boreholes 420 and 422 divergingly extend from the sealing end 416 to a connecting end 418. It is to be noted that these holes converge at the sealing end 416 within the central opening 419 of washer 417. Protrusions 426a and 426b are formed on connecting end 418 for communication with boreholes 420 and 422, respectively. The boreholes 420 and 422 diverge at a preselected angle from longitudinal axis 424 of nipple 412. A nut 414 is also

provided for attaching nipple 412 to a cylinder valve 440. As nut 414 is tightened on the external fitting, it presses against shoulder 448 causing sealing end 416 to press the soft washer 417 against the flat face 441 of cylinder valve 440, thereby providing a leakproof seal.

A general understanding of the mode of operation of the deep purge connector according to the invention may be had by referring to Fig. 5 in connection with Fig. 1. Fig. 5 shows generally a gas supply system 100 including a compressed gas cylinder 110 containing the process gas. Cylinder 110 is equipped with cylinder valve 112 which has a threaded outlet 113 to which the deep purge connector 10 is connected. A gas service line 114 is connected to the deep purge connector 10 at one of the boreholes as previously described. A purge gas supply line 120 is connected to deep purge connector 10 at the other borehole as previously described. A two-way valve 122 or other valve means is provided in gas service line 114. Valve 122 may be operated to direct the flow of gas from service line 114 either to the process supply line 124 or to a vent line 126.

When it is desired to purge the gas supply system, cylinder valve 112 is first closed off, thereby shutting off the supply of process gas to the system. Next, purge gas is allowed to flow through the supply line 120 into a borehole 20 of deep purge connector 10. Two-way valve 122 is operated to direct the flow of gas into vent line 126. The purge gas flows through borehole 20, as indicated by the arrows in Fig. 1, into the valve orifice 50 and then out through borehole 22, sweeping any residual process gas along with it. It

should be noted that the terminals of boreholes 20 and 22 are spaced apart in the end face 17 but are sufficiently close together to open directly into the orifice 50. In other words, a circle circumscribing the terminals in the end face 17 is smaller than the contact diameter between the rounded end 16 of nipple 12 and the tapered opening 46 of cylinder valve 40 so that the purging gas introduced through the borehole 20 must enter the orifice 50 of the cylinder valve 40 before it can exit through the borehole 22, thereby forcing the gas out and enhancing the purging process. Borehole 22 is in communication with supply line 114. Thus, the purging gas is directed down the supply line 114 through valve 122, and is exhausted to a suitable purifier or collector through vent line 126. In this manner, the entire gas supply system from valve 112 through gas supply line 114 may be purged, without leaving any unpurged areas in the vicinity of cylinder valve 112.

From the foregoing description and the accompanying drawings, it can be seen that the present invention provides a novel apparatus for deep purging a gas supply system. The apparatus is simple to manufacture and is fabricated in a way which minimizes the generation of particles which could be introduced into the process gas stream. Additionally, there are only two joints required to connect the pigtails to the nipple and no additional parts are required to make up the assembly.

It will be recognized by those skilled in the art that changes or modifications may be made to the above-described embodiment without departing from the broad, inventive concepts of the invention. For

example, a cross-purge assembly could be employed for interconnecting the process gas supply line 114, the purge gas supply line 120 and the vent line 126, at the connecting end portion 18 of nipple 12 to facilitate the purging procedure. Such cross-purge assemblies include purge and vent ports which are perpendicular to a main gas supply port. Cross-purge assemblies of this type are produced by Matheson Gas Products, of East Rutherford, New Jersey.

It is understood, therefore, that the invention is not limited to the particular embodiments which are disclosed, but is intended to cover all modifications and changes which are within the scope and spirit of the invention as defined in the appended claims.

What is claimed is:

1. For use with a gas supply system having a gas vessel equipped with a cylinder valve, a supply line for supplying the gas from the vessel to a process, means to supply purging gas to the supply line when the cylinder valve is closed, and means in said supply line to divert the purging gas away from the process to a vent, an improved deep purge connector disposed between said cylinder valve and said supply line and connected to said purging gas supply means, said connector comprising:

an elongated nipple having a sealing end confronting said cylinder valve and a connecting end;

sealing means providing a sealed connection between said nipple and said valve;

said nipple having a pair of boreholes extending throughout the length of said nipple;

said boreholes terminating at the sealing end in closely-spaced relation proximate the center of said sealing end, and diverging toward the connecting end and terminating in said connecting end;

said supply line being connected to one of said boreholes; and

said purging gas supply means being connected to the other of said boreholes.

2. A deep purge connector as recited in Claim 1 wherein said connecting end has at least one protrusion surrounding the terminal of one of the boreholes in the connecting end, said protrusion having a central bore therethrough communicating with the associated borehole.

3. A deep purge connector as recited in Claim 1 wherein said connecting end has a protrusion surrounding the terminal of each borehole in the connecting end and each protrusion has a central bore communicating with the associated borehole and a counterbore.

4. A deep purge connector comprising:

an elongated nipple element having a sealing end, a connecting end, a longitudinal axis, and a pair of boreholes divergingly extending through said nipple element from the sealing end to the connecting end;

first connecting means for connecting one of the boreholes to a purge gas supply line; and

second connecting means for connecting the other borehole to a process gas supply line.

5. A deep purge connector as recited in claim 4 wherein the boreholes each diverge at a preselected angle from the longitudinal axis as they extend from the sealing end of said nipple element.

6. A deep purge connector as recited in claim 5 wherein said first connecting means comprises:

a cylindrical protrusion having a central borehole therethrough in communication with a borehole in said nipple element, said protrusion also having a counterbore coaxial with the central borehole, said counterbore having a depth and diameter sufficient for receiving a tubing end.

7. In a gas purge connector of the type having a nipple, said nipple including a sealing end, a connecting end, a longitudinal axis, and a pair of

boreholes extending lengthwise through said nipple, the improvement wherein:

the boreholes terminate at the connecting end, and at the sealing end, and diverge as they extend from the sealing end to the connecting end; and the connecting end includes means for permitting butt welding tubing to the nipple at each of the locations where the boreholes terminate in the connecting end wall to enable each borehole to communicate with a tubing end.

8. A deep purge connector as recited in Claim 7 wherein said butt welding means comprises:

a pair of cylindrical protrusions having a cylindrical axis parallel to said longitudinal axis of the nipple, each protrusion having a central bore therethrough communicating with one of said boreholes in said nipple element, said protrusions each also having a counterbore coaxial with the central bore, said counterbore having a depth and diameter sufficient for receiving a tubing end, the central bore having a diameter corresponding to the inner diameter of the tubing and the counterbore having a diameter corresponding to the outside diameter of said tubing.

9. A deep purge connector as recited in Claim 8 including a tubing element mounted in each of said counterbores, the ends of said tubing elements being welded to said protrusion so as to integrally unite said tubing elements with the nipple.

10. A deep purge connector comprising:

a nipple element having an elongated, generally cylindrical shape, said nipple element

including a sealing end portion and a connecting end portion, said nipple element having a longitudinal axis and a pair of boreholes divergingly extending through said nipple element from the sealing end portion to the connecting end portion;

fastening means rotatably and sealingly engaging said nipple element adjacent to the sealing end portion such that the sealing end may be connected to a cylinder valve; and

protruding means on the connecting end portion for permitting butt-welding of a gas conduit to the connecting end of said nipple element at each of the locations where the boreholes emerge through the connecting end portion of said nipple element, such that each borehole communicates with a separate gas conduit.

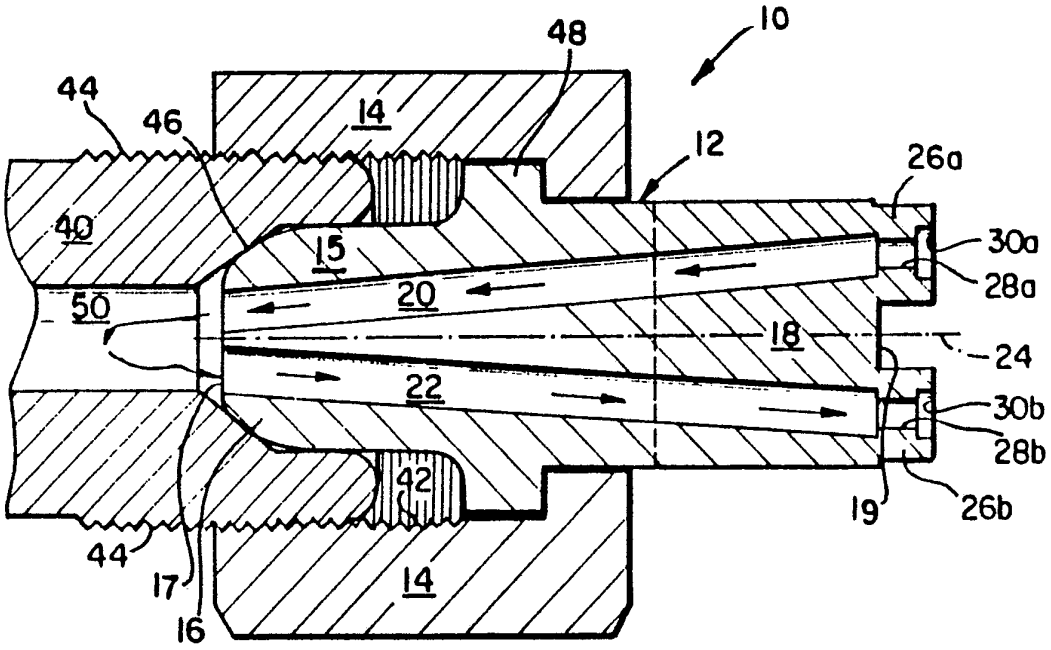


FIG. 1

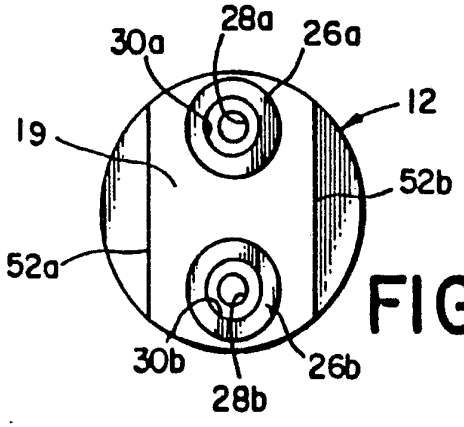


FIG. 2

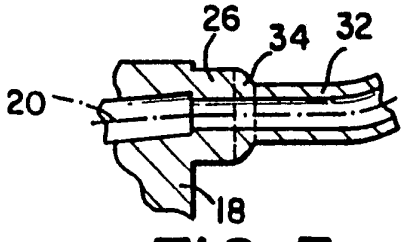
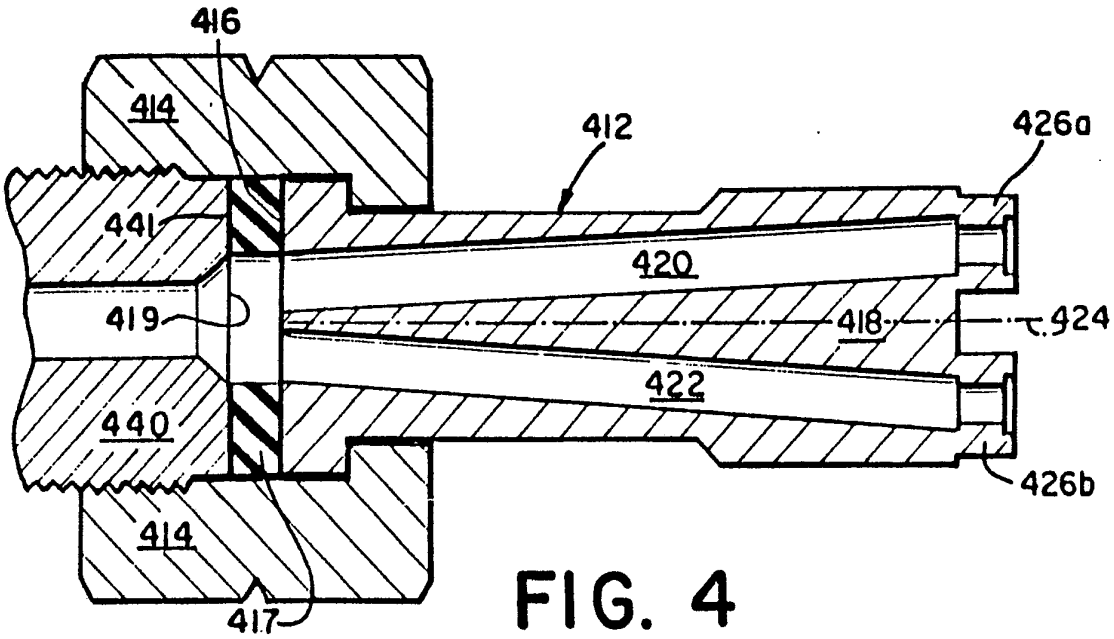


FIG. 3


416
414
412
426a
441
420
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422
440
414
426b
417

FIG. 4

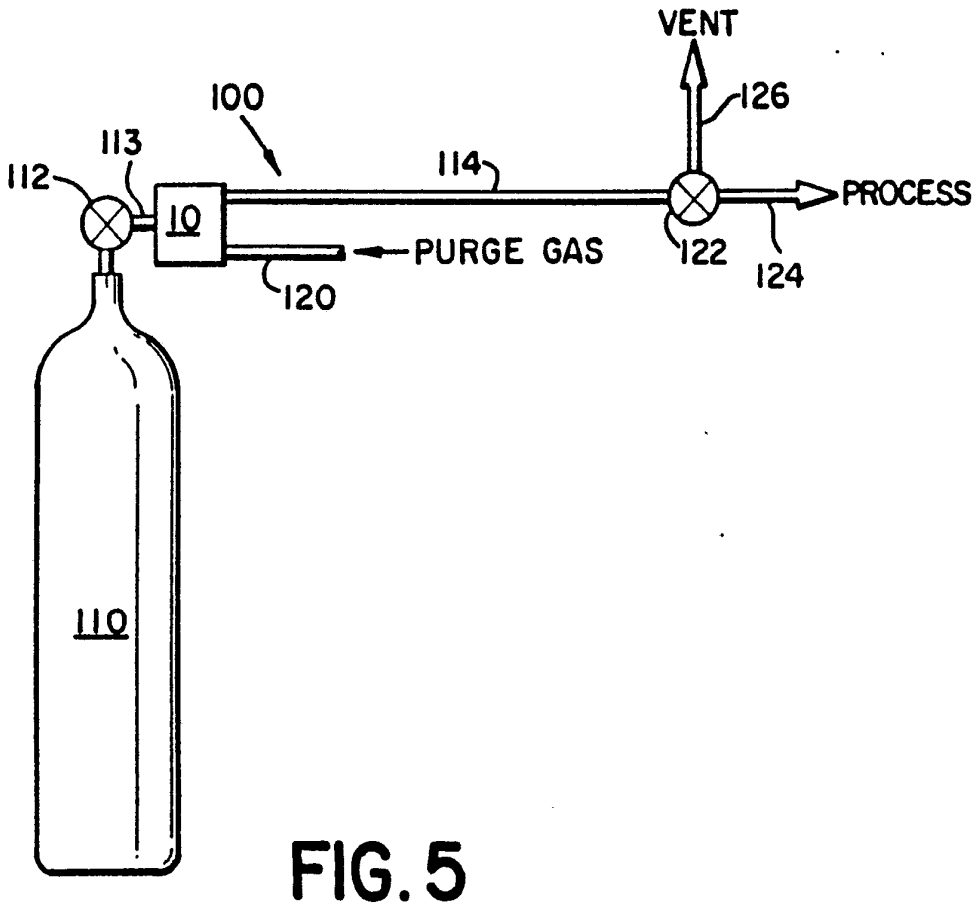
VENT
126
100
113
112
114
PROCESS
10
PURGE GAS
122
124
120
110

FIG. 5

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 86/01105

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

INT. CL. [4] B08B 5/02, 9/06
US. CL. 137/602,240;285/137R,286

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	137/238,240,602 285/155,137R,285,286

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	US, A, 2,570,525 (Collison) 9 October 1951	
A	US, A, 4,133,347 (Mercer) 9 January 1979	
A	US, A, 4,316,624 (Davlin) 23 February 1982	
Y	US, A, 4,383,547 (Lorenz et al) 17 May 1983 See Col. 3, lines 53-69, Col. 4, line 64 to Col. 5, line 2	1-3, 6-10
A	US, A, 4,169,486 (Otteman et al) 2 October 1979	
X Y	US, A, 3,898,861 (McMillan) 12 August 1975 See Fig. 6	4-5 1-3, 6-10

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
25 June 1986	14 JUL 1986
International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	Stephen M. Hepperle

Form PCT/ISA/210 (second sheet) (October 1981)