(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 October 2011 (06.10.2011)

PCT

(10) International Publication Number
WO 2011/123128 A1

(51) International Patent Classification:
F16K 1/10 (2006.01) *F16K 35/06* (2006.01)
F16K 31/50 (2006.01) *F16K 41/10* (2006.01)

(21) International Application Number:
PCT/US2010/029617

(22) International Filing Date:
1 April 2010 (01.04.2010)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) **Title**: ULTRA HIGH PURITY GAS VALVE WITH BELLOWS ASSEMBLY

(57) **Abstract**: An inline valve (52) for a gas distribution system having a tubular valve chamber (68) for supporting a valve member (72), wherein the inlet and outlet are coaxial with each other and flow enters the valve chamber (68) at a different angle than flow exits the valve chamber. The tubular design reduces 5 raw materials and machining time. Also, the characteristic of the previous in-line design with the machined body, where the inlet and the outlet has a common centerline, is retained, and existing valve internals (e.g., proven valve member designs) can be used. The valve includes a lockout feature (158) for locking the valve in an open position.

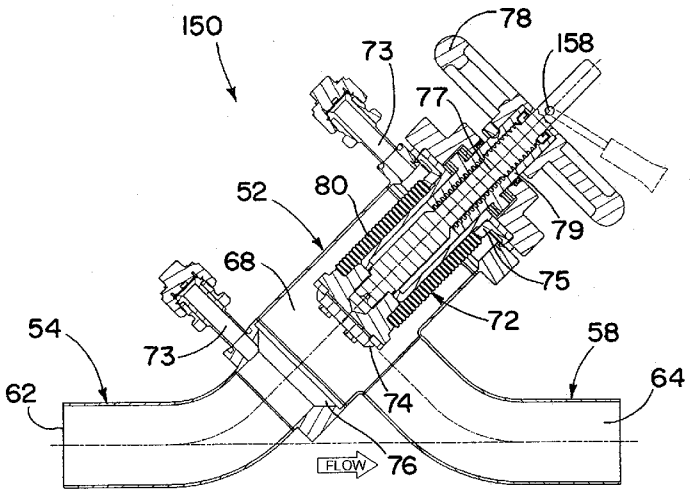


FIG. 5

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ULTRA HIGH PURITY GAS VALVE WITH BELLOWS ASSEMBLY

Field of the Invention

The present invention generally relates to valves and, more particularly, to valves for controlling fluid flow in a gas distribution system.

Background of the Invention

Gas and liquid control systems are used in the semiconductor industry as well as the solar panel manufacturing industry to supply process gases and liquids to semiconductor processing equipment. These systems typically comprise highly finished tubing extending between a supply of the process liquid or gas and the semiconductor/solar processing equipment. The process liquids and gases are forced under pressure through the tubing, and valves are provided in these control systems for opening and closing the fluid passages therethrough and thereby controlling the flow of fluid from the supply to the semiconductor/solar processing equipment.

Conventional valves for such applications are often of a so-called y-shape design having a valve body with a y-shape having an inlet in one arm of the “y”, an outlet in the leg of the “y”, and the other arm of the “y” serving as a valve chamber. In such valves, the inlet and outlet are generally coaxial and are connected via a straight passageway extending through a body of the valve. The valve chamber intersects the straight passageway at an angle, for example 90 or 45 degrees. A valve member is supported in the valve chamber and is movable between an open and closed position to respectively block or permit flow through the passageway from the inlet to the outlet. Such a valve is commonly referred to as an inline valve since the inlet and outlet are coaxial.

The valve bodies of such valves are generally machined from one piece of material, or may be a multi-piece machined body wherein the multiple pieces are joined together, for example by welding. Such valve bodies can be heavy and costly to machine.

Another feature that is often desired is the ability to lock a valve in a given position, for example open or closed, depending on the flow that is controlled by the valve. Such feature is commonly referred to as lock-out/tag-out (LOTO). In

the past, LOTO functionality has been achieved by fitting a valve with various additional components such as interfering members that can be locked together to prevent rotation of an actuating mechanism of the valve. Such LOTO assemblies add additional manufacturing cost, weight and size to the valve assembly.

Summary of the Invention

A valve assembly that provides lock-out/tag-out functionality without the addition of weight and/or size to the valve, and is easily implemented during manufacturing. The valve can be an inline valve for a gas distribution system having a tubular valve chamber for supporting a valve member, wherein the inlet and outlet are coaxial with each other and flow enters the valve chamber at a different angle than flow exits the valve chamber. The valve weight has been decreased between 50% and 80% over existing designs, and the manufacturing costs of the valve have been decreased considerably. By using a tubular design, a reduction in raw material and machine time can be achieved. Also, the characteristic of the previous in-line y-shape machined body design, where the inlet and the outlet has a common centerline, has been retained. Moreover, the valve can utilize existing valve internals (e.g., proven valve member designs).

Accordingly, a valve assembly comprises a valve body, a valve stem supported in the body for longitudinal movement, and a valve member connected to the valve stem, the valve member movable by the valve stem between open and closed positions for respectively permitting and blocking flow through the valve body, wherein the valve stem has a portion thereof that protrudes from the valve body when the valve is in an open position, the protruding portion of the valve stem including a hole for receiving a lockout member for preventing movement of the valve stem to a position corresponding to a closed position of the valve member.

The valve body may further comprise a tubular body extending axially along a central body longitudinal axis between a body first end and a body second end, the body having a body radial axis and a body medial opening disposed along the body radial axis between the body first and second ends; a tubular first port extending axially along a central first port longitudinal axis to a

first port end having a first port end axis disposed at a first angle relative to the first port longitudinal axis, the first port end being joined in fluid communication to the body first end with the first port end axis being generally coaxially aligned with the central body longitudinal axis; and a tubular second port extending axially along a central second port longitudinal axis to a second port end having a second port end axis disposed at a second angle relative to the second port longitudinal axis, the second port end being joined in fluid communication to the body medial opening with the first and second port longitudinal axes being generally coaxially aligned.

The first and second port longitudinal axes can be disposed at an angle of about 45° relative to the body longitudinal axis. The second port end axis can be disposed generally orthogonal to the body longitudinal axis. The valve assembly may further comprise a valve seat disposed within the body about the body first end. The body can be cylindrical and the valve seat can extend radially inwardly from an interior surface of the body. At least one of the tubular ports can be welded to the tubular body. The body can be generally cylindrical and can have an axially extending bore opening to the first and second ends of the body, wherein the second end of the body is adapted to receive a valve member. The body can include at least one purge port for purging excess pressure from the body. The body can be machined, and flow can enter the body at a different angle than flow exits the body. The valve member can be a bellows-type valve.

The valve assembly can further comprise a hand wheel coupled to the valve member, whereby rotation of the hand wheel in a first direction moves the valve member to the open position, and rotation of the hand wheel in a second direction moves the valve member to the closed position. The assembly can also include the lockout member installed in the hole. The lockout member can be a tag or a lock, for example.

In accordance with another aspect, a method of locking out a valve assembly, such as set forth above, comprises the steps of moving the valve assembly to an open position, and installing a lockout member in the hole of the valve stem.

Further features of the invention will become apparent from the following detailed description when considered in conjunction with the drawings.

Brief Description of the Drawings

Fig. 1 is a cross-sectional view of a prior art valve body for an inline valve assembly.

Fig. 2 is a cross-sectional view of an exemplary valve assembly in accordance with the invention.

Fig. 3 is an enlarged portion of Fig. 2.

Fig. 4 is a cross-sectional view of the valve body of the valve assembly of Fig. 3, with the valve member removed.

Fig. 5 is a cross-sectional view of another exemplary valve assembly including a lock-out/tag-out feature in accordance with the invention.

Detailed Description

Referring to the attached drawings, Fig. 1 shows an exemplary prior art valve body 10 of previous bulk gas valves used in gas delivery systems. The body 10 is a single piece machined steel body having a general y-shape, with an inlet 12 in one arm of the "y", an outlet 14 in the leg of the "y", and the other arm of the "y" serving as a valve chamber 16. The inlet 12 and outlet 14 are connected via passageway 18. The valve chamber 16 intersects the passageway 18 at an angle, and a valve member (not shown) can be supported in the valve chamber 16 for blocking or permitting flow through the passageway 18 from the inlet 12 to the outlet 14. As will be appreciated, the valve body 10 is an in-line design, where the inlet 12 and the outlet 14 have a common centerline and flow enters and exits the valve body along such centerline.

Turning to Figs. 2-4, an exemplary inline valve assembly in accordance with the invention is illustrated and indicated generally by reference numeral 50. The valve assembly 50 includes a generally tubular body 52 extending axially along a central body longitudinal axis A_L. An inlet port tube 54 and an outlet port tube 58 are secured to the body 52 in a suitable manner, such as by welding, for example. The inlet port tube 54 has an inlet port end 62 opposite its other end that is secured to the body 52, and the outlet tube 58 has an outlet port end 64 opposite its other end that is secured to the body 52. The inlet port end 62 and the outlet port end 64 of each port tube are generally coaxially aligned along a

port end axis A_P. Of course, either port tube 54 or 58 can function as an inlet or outlet depending on the direction of flow through the valve.

The tubular body 52 includes a valve chamber 68 in which a valve member 72 is supported. Purge ports 73 are provided for relieving excess pressure from the valve. The valve member 72 is a bellows-type valve member having a seal member 74 adapted for sealing against a valve seat 76 within the valve chamber 68 to restrict flow through the body 52 from the inlet port end 62 of the inlet port tube 54 to the outlet port end 64 of the outlet port tube 58. As will be appreciated, the seal member 74 is movable between open and closed positions to respectively block or permit flow.

As best seen in Fig. 3, the seal member 74 is moveable between the closed position (shown), and an open position (not shown) whereat fluid can flow from the inlet port 62 to the outlet port 64. In this regard, the seal member 74 is mounted to a plug 82 which is connected to a threaded shaft 77 of the valve member 72 that is supported within the body 52 for longitudinal movement when a driver 79 is rotated by turning a hand wheel 78. A bellows 80 is connected via welding or the like between the plug 82 and a bellows adapter upper 75 and isolates the shaft 77 from the valve chamber 68 to prevent leakage of fluid. The seal member74, which can be an elastomeric seal or the like, can be provided on the plug 82 for sealing the interface between the seal member 74 and the valve seat 76. The bellows 80 can be made from Inconel 625 and can vary in thickness/number of plies depending on the size of the bellows. The dynamic seal can be a PCTFE and can be replaced if necessary. Although a bellows-type valve member is shown, other types of valve members can be used without departing from the scope of the invention. In fact, a wide variety of existing, proven valve members can be utilized with the valve body making it highly versatile.

Turning to Fig. 4, the valve body 52 is shown in cross-section with the valve member 72 removed therefrom. The tubular body 52 extends axially along central body longitudinal axis A_L. The inlet port end 62 and the outlet port end 64 of respective port tubes 54 and 58 are generally coaxially aligned along axis A_P. As will be appreciated, the inlet port tube 54 and outlet port tube 58 are attached to the body 52 at generally right angles with respect to respective

openings in the valve body 52. In the illustrated embodiment, the inlet port tube 54 is attached about an opening in an axial end face of the body 52, while the outlet port tube 58 is attached to the side of the body 52 around a medial opening disposed along a body radial axis (which may be generally orthogonal or otherwise angled relative to the body longitudinal axis) between the body first and second ends. As will be appreciated, fluid can flow from the inlet port end 62 of the inlet port tube 54 through the valve body 52 to the outlet port 64 of the outlet port tube 58. A 45 degree inlet port tube and 45 degree outlet port tube in the illustrated embodiment results in the in-line valve body design. While the inlet and outlet ports 62 and 64 are coaxial thereby facilitating inline installation, the valve body 52 is generally cylindrical and has a single axially extending throughbore forming the valve chamber 68 and opening to axial ends of the body 52. The inlet port tube 54 is secured to the body at the first end, while the second end is adapted to receive a valve member 72 as shown in Fig. 2. The valve member 72 can be secured to the body 52 in any suitable fashion, such as with bolt, or may be screwed into the body 52, for example.

The valve body 52 can be lighter than the prior art design by as much as 50% to 80%. Manufacturing costs can also be decreased considerably since machining the intersecting bores of the prior art design of Fig. 1 is no longer required. The new design therefore also simplifies manufacturing. Also, by using a tubular design, a reduction in raw materials can be achieved. The decrease in weight makes the valve easier to install in the field, and easier to handle in general. Valve performance can also be improved by increasing the ply material thickness/number of layers in the bellows design.

Turning now to Fig. 5, another exemplary embodiment of the valve assembly is illustrated and generally indicated by reference numeral 150. The valve assembly 150 is generally identical to the valve assembly 50 described previously, except for the provision of a throughbore 158 in the threaded shaft 77 for providing lock-out/tag-out functionality.

As illustrated, the valve assembly 150 is in the full open position whereby fluid can flow from the inlet 62 to the outlet 64 via the valve body 52. The threaded shaft 77 (sometimes referred to as a valve stem) in this position is withdrawn from the valve body 52 such that the upper end of the shaft 77

protrudes from the valve body 52 so as to permit access to the throughbore 158 for installing a lock 162, or a tag (not shown).

As will be appreciated, once the lock 162 is installed in the throughbore 158 as shown, the threaded shaft 77 is restricted from longitudinal movement towards the closed position (for example, to the position shown in Fig. 2), since the lock shackle and/or body would interfere with the valve body 52 as the shaft 77 is drawn into the valve body 52. Thus, the throughbore 158 provides lock-out/tag-out (LOTO) functionality for the valve 150 when in the full open position.

Significantly, the LOTO feature is facilitated by the throughbore 158 and, unlike other LOTO valves no additional parts are needed thereby resulting in ease of manufacturing. In fact, as compared to a non-LOTO version of the valve, the only additional component would be a lock or tag, for example.

Although the invention has been shown and described with respect to a certain preferred embodiment or embodiments, it is obvious that equivalent alterations and modifications will occur to others skilled in the art upon the reading and understanding of this specification and the annexed drawings. In particular regard to the various functions performed by the above described elements (components, assemblies, devices, compositions, etc.), the terms (including a reference to a "means") used to describe such elements are intended to correspond, unless otherwise indicated, to any element which performs the specified function of the described element (i.e., that is functionally equivalent), even though not structurally equivalent to the disclosed structure which performs the function in the herein illustrated exemplary embodiment or embodiments of the invention. In addition, while a particular feature of the invention may have been described above with respect to only one or more of several illustrated embodiments, such feature may be combined with one or more other features of the other embodiments, as may be desired and advantageous for any given or particular application.

What is claimed is:

1. A valve assembly comprising:

a valve body;

a valve stem supported in the body for longitudinal movement; and

a valve member connected to the valve stem, the valve member movable by the valve stem between open and closed positions for respectively permitting and blocking flow through the valve body;

wherein the valve stem has a portion thereof that protrudes from the valve body when the valve is in an open position, the protruding portion of the valve stem including a hole for receiving a lockout member for preventing movement of the valve stem to a position corresponding to a closed position of the valve member.

2. A valve assembly as set forth in claim 1, wherein the valve body further comprises:

a tubular body extending axially along a central body longitudinal axis between a body first end and a body second end, the body having a body radial axis and a body medial opening disposed along the body radial axis between the body first and second ends;

a tubular first port extending axially along a central first port longitudinal axis to a first port end having a first port end axis disposed at a first angle relative to the first port longitudinal axis, the first port end being joined in fluid communication to the body first end with the first port end axis being generally coaxially aligned with the central body longitudinal axis; and

a tubular second port extending axially along a central second port longitudinal axis to a second port end having a second port end axis disposed at a second angle relative to the second port longitudinal axis, the second port end being joined in fluid communication to the body medial opening with the first and second port longitudinal axes being generally coaxially aligned.

3. A valve assembly as set forth in any one of claim 1-2, wherein the first and second port longitudinal axes are disposed at an angle of about 45° relative to the body longitudinal axis.

4. A valve assembly as set forth in any one of claims 1-3, wherein the second port end axis is disposed generally orthogonal to the body longitudinal axis.

5. A valve assembly as set forth in any one of claims 1-4, further comprising: a valve seat disposed within the body about the body first end.

6. A valve assembly as set forth in any one of claims 1-5, wherein the body is cylindrical and the valve seat extends radially inwardly from an interior surface of the body.

7. A valve assembly as set forth in any one of claims 1-6, wherein at least one of the tubular ports are welded to the tubular body.

8. A valve assembly as set forth in any one of claims 1-7, wherein the body is generally cylindrical and has an axially extending bore opening to the first and second ends of the body, wherein the second end of the body is adapted to receive a valve member.

9. A valve assembly as set forth in any one of claims 1-8, wherein the body includes at least one purge port for purging excess pressure from the body.

10. A valve assembly as set forth in any one of claims 1-9, wherein the body is machined.

11. A valve assembly as set forth in any one of claims 1-10, wherein flow enters the body at a different angle than flow exits the body.

12. A valve assembly as set forth in any one of claims 1-11, wherein the valve member is a bellows-type valve.

13. A valve assembly as set forth in any one of claims 1-12, wherein the valve assembly further comprises a hand wheel coupled to the valve member, whereby rotation of the hand wheel in a first direction moves the valve member to the open position, and rotation of the hand wheel in a second direction moves the valve member to the closed position.

13. A valve assembly as set forth in any one of claims 1-13, further comprising the lockout member installed in the hole.

14. A valve assembly as set forth in any one of claims 1-14, wherein the lockout member is at least one of a tag or a lock.

15. A method of locking out a valve assembly as set forth in any one of claims 1-14 comprising the steps of moving the valve assembly to an open position, and installing a lockout member in the hole of the valve stem.

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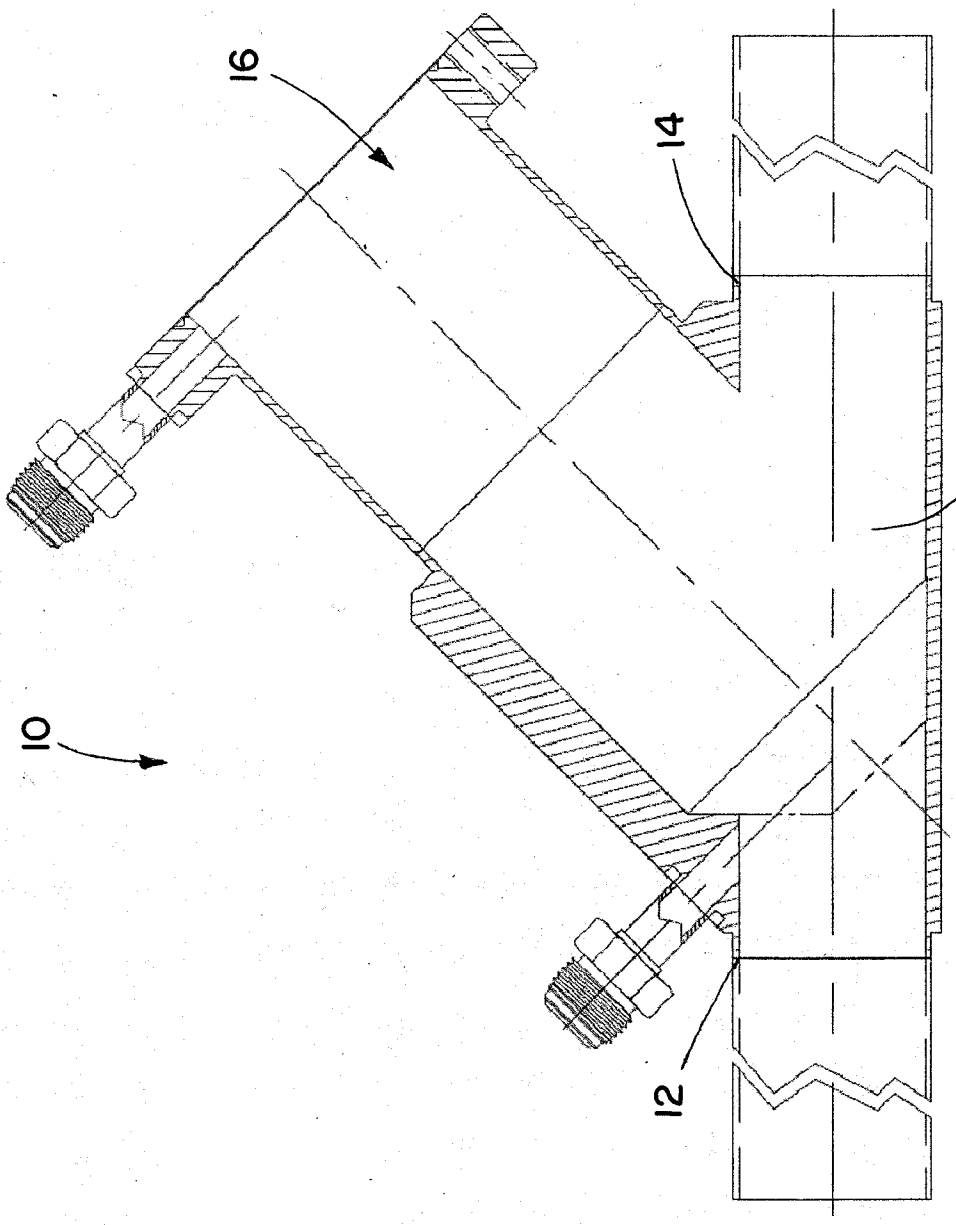


FIG. 1
(Prior Art)

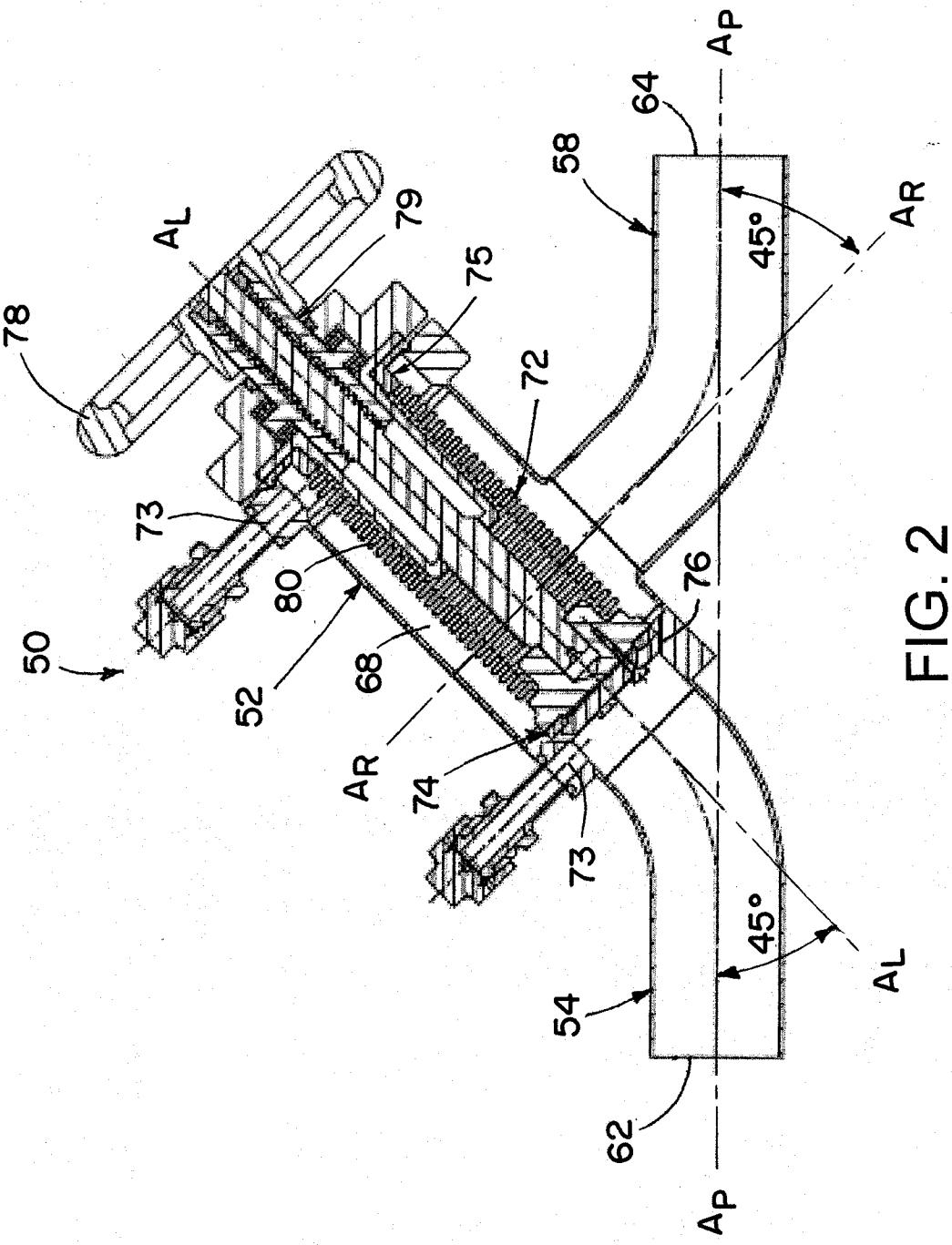


FIG. 2

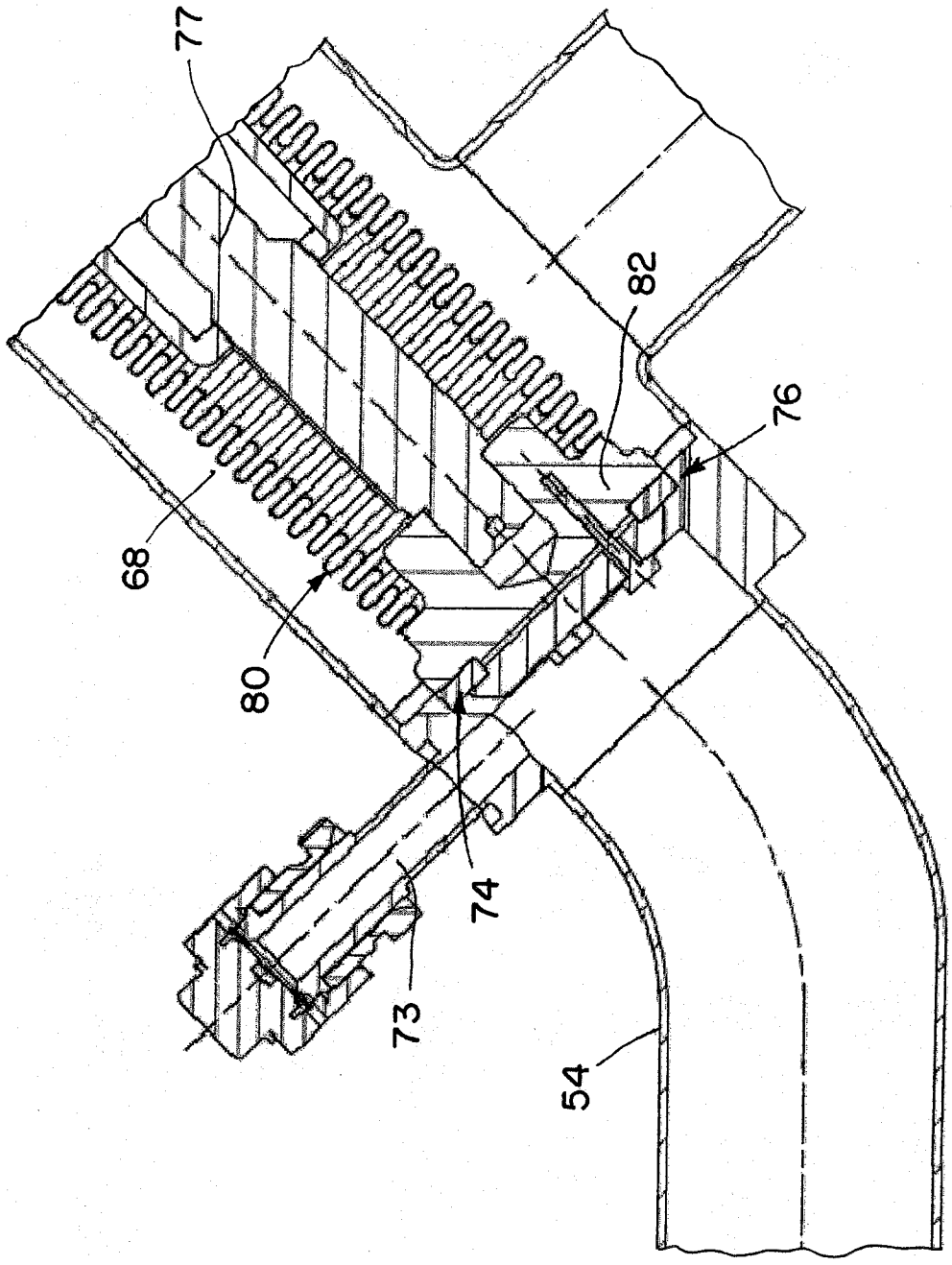


FIG. 3

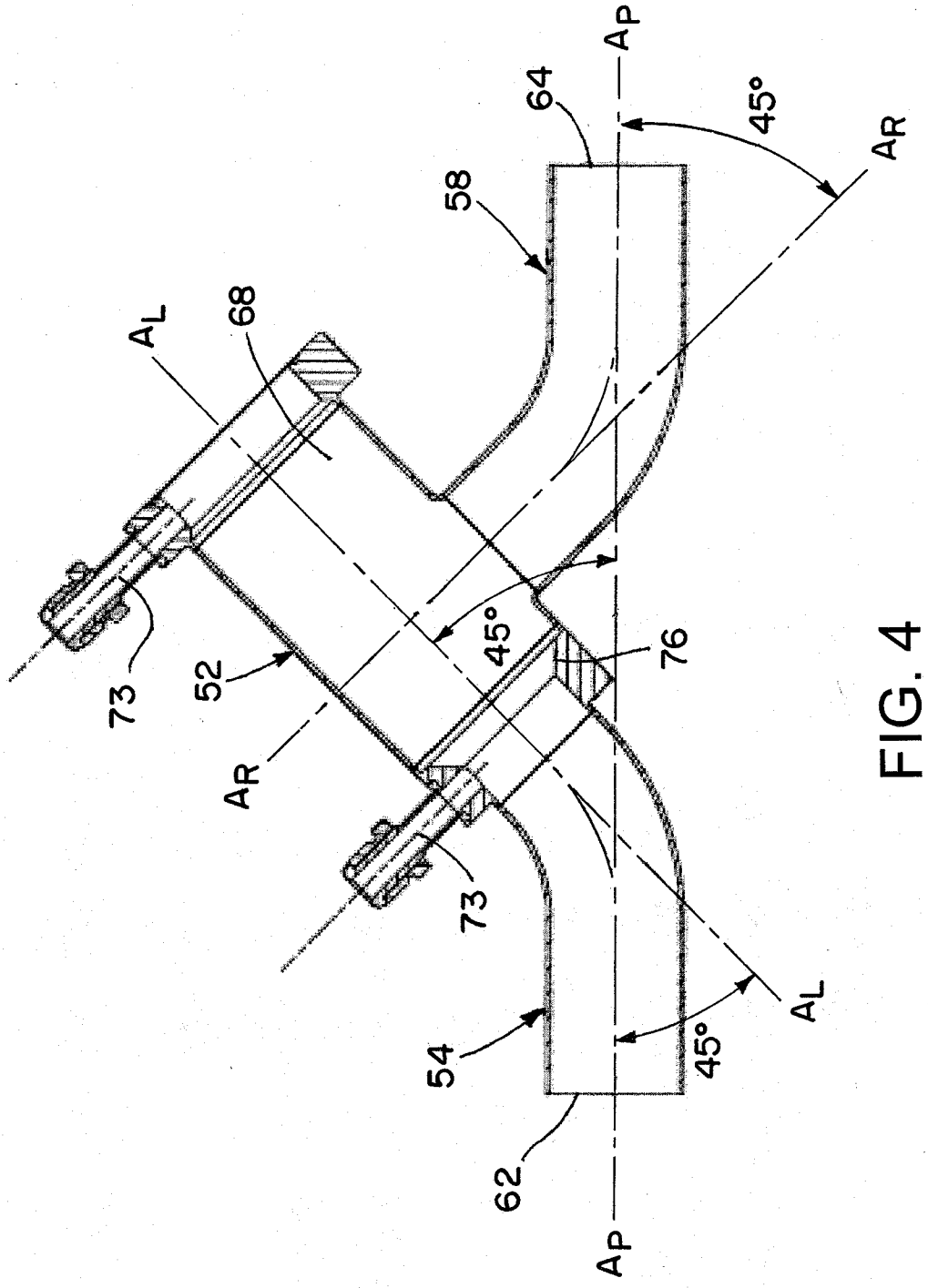


FIG. 4

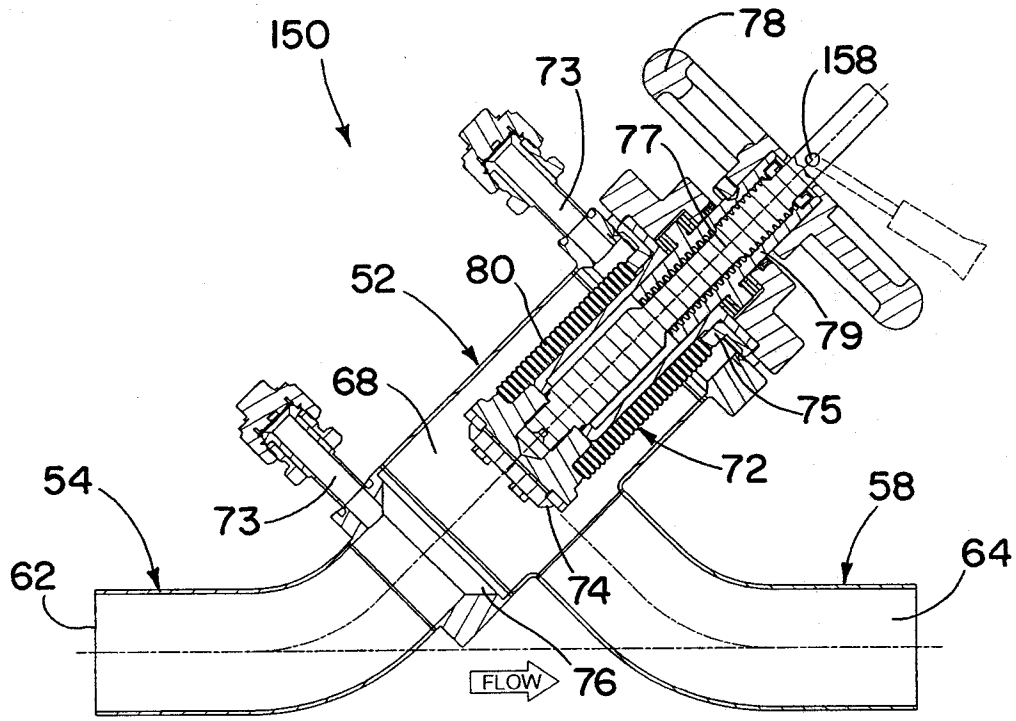


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/029617

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16K1/10 F16K31/50 F16K35/06 F16K41/10
ADD.

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

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 practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y A	DE 299 06 644 U1 (IBEG MASCH & GERAETEBAU [DE]) 22 July 1999 (1999-07-22) figure 1	12 2

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
9 March 2011	17/03/2011

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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