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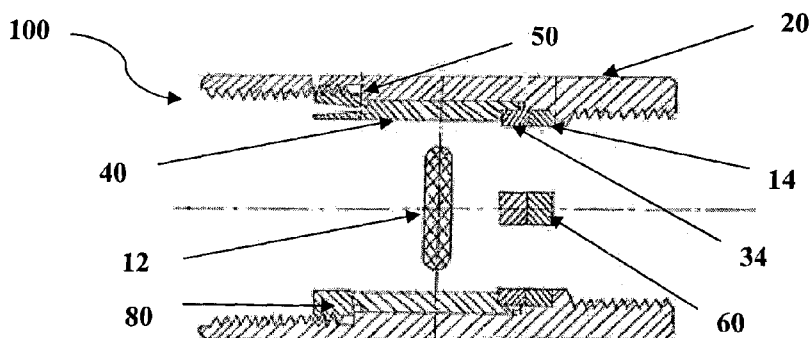


Figure 1b

(57) Abstract: Disclosed is a flow control valve (100). The flow control valve (100) comprises a cylindrical body (20), a piston (40), at least one fluid seal (60), a handle (60) and a nut (90). The flow control valve (100) is connected between an inlet and an outlet of a pipe to control flow of liquid/gases passing there through even at high temperature and pressure. The flow control valve (100) provides good force to the liquid/gas passing there through and provides an equal distribution of the flow at the outlet without resulting in pressure drop.



FLOW CONTROL VALVE

5 Field of the invention

The present invention relates to a valve and more particularly, to a cylindrical circular slice valve for controlling flow of liquid or gas within a pipeline even under high pressure and temperature.

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Background of the invention

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Valves have been used for centuries in many different ways to control the flow of fluids/gases. With the progress of fluid technology especially since the industrial revolution, a great variety of uses have been found for valves. Some of these uses may include pneumatic and motor-driven actuation with controllers that are regulated by a computer. By and large, however, the basic flow design of valves has stayed relatively constant along some of these basic lines as mentioned below.

20

Currently, various types of valves are in use. One such valve is a gate valve. The gate valve also known as lift valves is a valve that opens by lifting a round or rectangular gate/wedge out of the path of the fluid. The gate valve typically contains a circular disc or a slice known as the gate. The circular disc or slice is mounted perpendicular to the pipe containing the fluid/gas. The reciprocal actuation guides the gate up and down into the seat of the valve to either open the flow path for full flow or to close it down.

25

Another valve that is in use is a globe valve. The globe valves are very good at throttling, but with reduced flow capabilities. The path of the fluid through the globe

- 5 valve is tortuous, and as a result, these valves do not allow as much fluid flow for a given size as the other basic valve designs.

Yet another kind of valve in use is a ball valve, which is most popular today. In the ball valve, the valve actuator is connected by a valve stem to a ball inside the valve.

- 10 The ball has a large hole bored inside of it from one side to the other. Rotating the ball allows for this hole to be aligned with the incoming and outgoing flow path. In the closed position, the ball opening is rotated perpendicular to the flow path and completely shuts off the flow of fluid.

- 15 One more type of valve in use presently is a check valve. A typical example of a check valve is a diaphragm check valve which uses a flexing rubber diaphragm positioned to create a normally-closed valve. Pressure on the upstream side must be greater than the pressure on the downstream side by a certain amount, known as the pressure differential, for the check valve to open allowing flow. Once positive
- 20 pressure stops, the diaphragm automatically flexes back to its original closed position. Pressure on the upstream side must be greater than the pressure on the downstream side by a certain amount, known as the pressure differential, for the check valve to open for allowing flow. Once positive pressure stops, the diaphragm automatically flexes back to its original closed position.

25

All the above mentioned valves have disadvantage that they have resistance in the flow because of change in direction of the flow. For example, in the ball valve or the gate valve, the angle of flow is shifted when the valve is not fully open.

- 30 Accordingly, there exists a need to provide a flow controlling device which overcomes the above mentioned drawbacks of the prior art.

5 **Objects of the invention**

An object of the present invention is to provide a flow control valve that controls flow of liquid/gases passing there through even at high temperature and pressure.

- 10 Yet another object of the present invention is to provide the flow control valve that provides good force to the liquid/gas passing there through and equally distributing the flow at the outlet.

Summary of the invention

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Accordingly, the present invention provides a flow control valve. The flow control valve comprises a cylindrical body, a piston, at least one fluid seal, a handle and a nut.

- 20 The cylindrical body is connected between an inlet and an outlet of a pipe for controlling the flow of liquids/gases there through. The cylindrical body includes a connector such as a flange fitted on both ends thereof for fitting into the inlet and the outlet of the pipe. The cylindrical body includes a slit configured centrally thereon and a first disc configured internally therein. The first disc includes at least one cavity
- 25 configured therein. The first disc is an integral part of the cylindrical body formed by a method such as a casting/ machining method. The first disc is fixed on an internal diameter of the cylindrical body by any one of an interference fit method, a welding method and a resin binding method.

- 30 The first disc is selected from any one of a stationary disc and a flying disc. The flying disc includes at least two guide holes configured thereon. The flying disc is adapted to undergo reciprocating movement in response to an in-line fluid pressure.

5 The cylindrical body having the flying disc is designed to include a bridge plate. The bridge plate includes at least two guide pins fixed thereon for allowing the flying disc to undergo reciprocating movement by sliding therein through the at least two holes.

The piston is fitted inside the cylindrical body for moving therein. The piston
10 includes a hole configured centrally thereon and a second disc configured internally therein. The hole is adapted for coinciding with the slit on the cylindrical body. The second disc is configured to rest on the first disc leaving a gap there between. The second disc is an integral part of the piston formed by the method such as the casting/
15 machining method. The second disc is fixed on the internal diameter of the piston by any one of the interference fit method, the welding method and the resin binding method. The first disc and the second disc are flat circular metal discs.

The second disc includes at least one cavity configured therein. The second disc is capable of undergoing a circular movement in response to the movement of the
20 piston resulting in any one of partial alignment, complete alignment and complete misalignment of the at least one cavities with each other for controlling the flow of fluid/gas flowing there through from the inlet to the outlet of the pipe.

The at least one fluid seal is positioned between the internal diameter of the
25 cylindrical body and the second disc of the piston. The handle is adapted for interconnecting the piston with the cylindrical body by passing through the slit on the cylindrical body into the hole of the piston. The handle is capable of being moved by any one of a manual means and an actuator device for moving the piston therewith
30 thereby resulting in the circular movement of the second disc. The nut is adapted for locking the piston inside the cylindrical body. The nut is fixed on top of bearings inside the cylindrical body. The bearings are threadably positioned on top of the piston inside the cylindrical body.

5 Brief description of the drawings

The objectives and advantages of the present invention will become apparent from the following description read in accordance with the accompanying drawings wherein,

10 Figure 1a shows a flow control valve, in accordance with the present invention;

Figure 1b shows a cross-sectional view the flow control valve of figure 1a;

15 Figures 2a, 2b and 2c respectively show a front view, a top view and a bottom view of a piston with an integrated second disc of the flow control valve of figure 1a;

Figure 3 shows a fluid seal of the flow control valve of figure 1a;

20 Figure 4 shows a handle of the flow control valve of figure 1a;

Figure 5 shows a nut of the flow control valve of figure 1a;

25 Figures 6a and 6b respectively show two cavity and four cavity variants of a first/second disc of the flow control valve of figure 1a;

Figure 7a shows a three dimensional view of a stationary disc of the flow control valve of figure 1a;

30 Figure 7b shows a front view of the flying disc of the flow control valve of figure 1a;

- 5 Figure 8a shows a cross-sectional view of the flow control valve having the flying disc as the first disc, in accordance with an alternate embodiment of the present invention;

- Figure 8b shows a magnified view of a guide pin mounted on a bridge plate of the
10 flow control valve of figure 8a;

Figure 8c shows a top view of a cylindrical body with the bridge plate and the guide pins of the flow control valve of figure 8a;

- 15 Figure 9a shows a fully open state of the flow control valve, in accordance with the present invention;

- Figure 9b shows a fully closed state of the flow control valve, in accordance with the present invention; and
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Figure 9c shows a partially open state of the flow control valve, in accordance with the present invention.

Detailed description of the invention

- 25 The foregoing objects of the present invention are accomplished and the problems and shortcomings associated with the prior art, techniques and approaches are overcome by the present invention as described below in the preferred embodiment.

- 30 The present invention provides a flow control valve. The flow control valve controls flow of liquid/gases passing there through even at high temperature and pressure. The

5 flow control valve provides good force to the liquid/gas passing there through and provides an equal distribution of the flow at the outlet.

Referring now figures 1a-9c, a flow control valve (100) (hereinafter the valve (100)) is shown in accordance with the present invention. The valve (100) is connected
10 between an inlet (not shown) and an outlet (not shown) of a pipe (not shown) for controlling the flow of liquids/gases there through. Specifically, the valve (100) is a cylindrical circular slice valve connected to the pipe selected from fuel pipelines, water pipelines, gas pipelines, semisolid fluid pipelines, irrigation pipelines and the like. The valve (100) comprises a cylindrical body (20), a piston (40), at least one
15 fluid seal (50), a handle (60) and a nut (80).

The cylindrical body (20) is adapted to be connected between the inlet and the outlet of the pipe for controlling the flow of liquids/gases there through. Specifically, the cylindrical body (20) is threadably connected between the inlet and the outlet of the
20 pipe by a connector (110) for example a flange. More specifically, the cylindrical body (20) includes threadings (not numbered) configured on an internal diameter (not numbered) on both ends (not numbered) thereof for threadably fitting the connector (110) on both ends thereof.

25 The cylindrical body (20) includes a slit (12) configured centrally thereon and a first disc/slice (14) (herein after 'the first disc (14)') configured internally therein. The slit (12) is configured centrally on the cylindrical body (20) along 'x' axis to occupy only a quarter sector of an arc. Specifically, when the cylindrical body (20) is placed vertically, the slit (12) looks horizontal as shown in figure 8a. In an embodiment, the
30 cylindrical body (20) and the first disc (14) are made of stainless steel or any other suitable material having good strength known in the art.

5 The first disc (14) is selected from any one of a stationary disc (14A) and a flying/
floating disc (14B) and includes at least one cavity (10) configured therein. The
stationary disc (14A) is a non-movable disc while the flying disc (14B) is capable of
undergoing a reciprocating movement while restricting axial/ rotary movement
thereof. The flying disc (14B) undergoes the reciprocating movement in response to
10 an in-line fluid pressure. The flying disc (14B) includes at least two guide holes
(14B0) configured thereon. In case of the flying disc (14B), the cylindrical body (20)
is designed to include a bridge plate (16). The bridge plate (16) includes at least two
guide pins (16B0) fixed thereon for allowing the flying disc (14B) to undergo
reciprocating movement by sliding therein through the at least two holes (14B0). In
15 an embodiment, the bridge plate (16) is a flat integral part of the cylindrical body (20)
(refer figure 8a-8c).

Specifically, the first disc (14) is configured on the internal diameter of the
cylindrical body (20). More specifically, the first disc (14) is capable of being
20 configured as a homogeneous/integral part of the cylindrical body (20) by a method
such as a casting/machining method or is fixed on the cylindrical body (20) by a
method selected from any one of interference fit, welding, resin binding method and
the like. More particularly, the stationary disc (14A) is formed as an integral part of
the cylindrical body (20) by the method such as casting/machining method and the
25 flying disc (14B) is fixed on the bridge plate (16), aligning the at least two guide
holes (14B0) with the at least two guide pins (16B0), so as to allow sliding
movement of the flying disc (14B).

The piston (40) is a hollow type cylinder fitted inside the cylindrical body (20) for
30 moving therein. The piston (40) is capable of undergoing an axial movement inside
the cylindrical body (20). The piston (40) includes a hole (32) configured centrally
thereon and a second disc/slice (34) (herein after 'the second disc (34)') configured

5 internally therein such that when the piston (40) is fitted inside the cylindrical body (20) the hole (32) coincides with the slit (12) and the second disc (34) rests on the first disc (14) leaving a gap (not shown) there between. In an embodiment, there is a gap of 0.5 mm between the first disc (14) and the second disc (34). Specifically, the second disc (34) is configured as a homogeneous/integral part of the piston (40) by
10 the method such as casting/machining method or is fixed on the piston (40) by any one of the interference fit, the welding, the resin binding method and the like.

The second disc (34) includes at least one cavity (30) configured therein corresponding to the at least one cavity (10) on the first disc (14). Specifically, the
15 first disc (14) and the second disc (34) are flat circular metal discs having same number of cavities for controlling the flow of fluids/gases flowing there through in a precise manner. In an embodiment, the valve (100) with the discs (14, 34) having only one cavity is employed where an equal distribution of flow at the outlet is not required and in such cases the cavity is not covering more than 50% of the disc
20 radially. In another embodiment, the valve (100) when used in a factory for example a paper factory where a lot of fluid is to be handled in a peculiar manner without dropping rate of flow and pressure includes the discs (14, 34) having multiple cavities such as two and four cavities spaced equidistantly as shown 6a and 6b. The multiple cavities may also vary in shape and size/s depending on the flow
25 requirement and the end use.

The second disc (34) is capable of undergoing a circular movement in response to the movement of the piston (40). Thus, the movement of the second disc (34) is restricted to the movement of the piston (40). Due to the circular movement, the second disc
30 (34) slides over the first disc (14) resulting in any one of partial alignment, complete alignment and complete misalignment of the at least one cavities (10, 30) with each other for controlling the flow of fluid/gas flowing there through from the inlet to the

5 outlet of the pipe. The gap between the discs (14, 34) facilitates easy movement of the second disc (34). When the at least one cavities (10, 30) are completely aligned, the valve (100) is in a fully open state (refer figure 9a) to allow fluid/gas to flow at a controlled rate and when the at least one cavities (10, 30) are completely misaligned, the valve (100) is in a fully closed state (refer figure 9b) to prevent fluid/gas to flow
10 thus controlling the fluid/gas flow. When the at least one cavities (10, 30) are partially aligned, the valve (100) is in a partially open state as shown in figure 9c.

The cylindrical body (20) and the piston (40) include the at least one fluid seal (50) (herein after 'the fluid seal (50)') sandwiched there between to prevent leakage of
15 fluids/gases therefrom. Specifically, the fluid seal (50) is positioned between the internal diameter of the cylindrical body (20) and the second disc (34) of the piston (40). In an embodiment, the fluid seal (50) is selected from any one of 'O' Ring, flat ring, 'U' cup seal and the like and is made of a material selected from any one of graphite, synthetic, resin bonded and any other suitable material known in the art
20 depending on application.

The handle (60) is adapted for interconnecting the piston (40) with the cylindrical body (20) by passing through the slit (12) on the cylindrical body (20) into the hole (32) of the piston (40). Specifically, the handle (60) is threadably fitted into the hole
25 (32) of the piston (40) by passing through the slit (12) on the cylindrical body (20). However, it is understood that the handle (60) can be fitted in any other suitable ways known in the art. The handle (60) is capable of moved by any one of a manual means (not shown) and an actuator device (not shown) for moving the piston (40) therewith thereby resulting in the circular movement of the second disc (34). In an
30 embodiment, the handle (60) is capable of being attached or replaced with a probe (not shown) or an actuator (not shown) for automation with an automated controller

5 (not shown). The valve (100) is capable of being controlled precisely with the probe on the handle (60).

The axial load of the piston (40) is taken care by bearings (70) for example thrust bearings. The bearings (70) are threadably positioned on top of the piston (40) inside the cylindrical body (20).

10

The nut (80), also known as pressure nut or lock nut is fixed on top of bearings (70) inside the cylindrical body (20). The nut (80) is adapted for locking the piston (40) inside the cylindrical body (20) thereby maintaining the location of the piston (40) inside the cylindrical body (20). Specifically, the nut (80) includes a round ring
 15 threading (not numbered) on an outer diameter (not numbered) thereof for threadably fixing inside the cylindrical body (20) at a correct pressure. The facing of the nut (80) has fine finishing and includes a taper hole (not numbered) having a slit (not numbered) configured therein. The slit is given through a center of the taper hole to separate the sector from the circle of the nut (80) and hence to expand to lock the nut
 20 (80) in its place with a taper pin (not shown). The slit also gives elasticity to the nut (80) for withstanding high pressure and vibration.

Advantages of the invention

- 25 1. The valve (100) is designed to operate under high pressure and extreme temperatures.
2. The valve (100) is capable of being used in bigger pipeline having bigger cross-section as well as in pipelines of fuel injection systems for rockets and space vehicles to discharge fluid with good force and equally distributing the flow and
 30 pressure from the at least one cavity at the outlet in all sides (360°).
3. The opening and closing of the valve (100) from 0 to 1 is achieved in just ¼ turn of the handle (60). The traverse of the handle (60) is even less in case of the discs

5 (14, 34) with the multiple cavities. The opening and closing of the valve (100) is also capable of being easily interfaced by a screw or through automation using an electronic, a magnetic or a pneumatic system and the like.

4. There is no drop in line pressure when the valve (100) is in the fully open state. The opening of the valve flange would be the area of the cross section of the
10 pipeline and hence flow is without fall in any pressure.

5. The valve (100) is capable of being operated at specific time interval.

6. The at least one cavity (10, 30) on the discs (14, 34) give improved flow which can further be increased by increasing the number of cavities for delivery as per requirement as opposed to presently used systems that suffer resistance in the
15 flow because of change in direction of the flow for example, ball and gate valves in which the angle of flow gets shifted when the valve is not fully open.

7. The valve (100) is capable of creating combustion for air jackets, jets and the like. Optionally, a software program can be interfaced to show exactly how much pressure and delivery of fluid is going into an engine as well as to show the
20 combustion in the engine continuously with the rate of acceleration and retardation like a tachometer.

8. The valve (100) is capable of being used in pneumatics and hydraulics, as a burner and distributor. Generally, the burner is a kind of system where fuel comes out same from all desired directions in equal amount of delivery (as pressure is
25 applied). The fuel is transferred from an original state to further reaction. Pressurized fuel would surely amount to increase in efficacy.

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to
30 be exhaustive or to limit the present invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the

5 principles of the present invention and its practical application, to thereby enable others skilled in the art to best utilize the present invention and various embodiments with various modifications as are suited to the particular use contemplated. It is understood that various omission and substitutions of equivalents are contemplated as circumstance may suggest or render expedient, but such are intended to cover the
10 application or implementation without departing from the spirit or scope of the present invention.

5 **We claim:**

1. A flow control valve (100) comprising:

- a cylindrical body (20) connected between an inlet and an outlet of a pipe for controlling the flow of liquids/gases there through, the cylindrical body (20) having a slit (12) configured centrally thereon and a first disc (14) configured internally therein, the first disc (14) having at least one cavity (10) configured therein, the first disc (14) being selected from any one of a stationary disc (14A) and a flying disc (14B);
- a piston (40) fitted inside the cylindrical body (20) for moving therein, the piston (40) having,

 - a hole (32) configured centrally thereon, the hole (32) adapted to coincide with the slit (12) on the cylindrical body (20), and
 - a second disc (34) configured internally therein to rest on the first disc (14) leaving a gap there between, the second disc (34) having at least one cavity (30) configured therein, the second disc (34) being capable of undergoing a circular movement in response to the movement of the piston (40) resulting in any one of partial alignment, complete alignment and complete misalignment of the at least one cavities (10, 30) with each other for controlling the flow of fluid/gas flowing there through from the inlet to the outlet of the pipe;
- at least one fluid seal (50) positioned between an internal diameter of the cylindrical body (20) and the second disc (34) of the piston (40);
- a handle (60) interconnecting the piston (40) with the cylindrical body (20) by passing through the slit (12) on the cylindrical body (20) into the hole (32) of the piston (40), the handle (60) capable of being moved by any one of a manual means and an actuator device for moving the piston (40) therewith thereby resulting in the circular movement of the second disc (34); and
- a nut (80) for locking the piston (40) inside the cylindrical body (20).

- 5 2. The flow control valve (100) as claimed in claim 1, wherein the cylindrical body (20) includes a connector (110) such as a flange fitted on both ends thereof for fitting into the inlet and the outlet of the pipe.
3. The flow control valve (100) as claimed in claim 1, wherein the first disc (14)
10 is fixed on the internal diameter of the cylindrical body (20) by any one of an interference fit method, a welding method and a resin binding method.
4. The flow control valve (100) as claimed in claim 1, wherein the first disc (14) is an integral part of the cylindrical body (20) formed by a method such as a
15 casting/machining method.
5. The flow control valve (100) as claimed in claim 1, wherein the first disc (14) is a flying disc (14B) having at least two guide holes (14B0) configured thereon, the flying disc (14B) is capable of undergoing a reciprocating movement in response to
20 an in-line fluid pressure.
6. The flow control valve (100) as claimed in claim 1, wherein the cylindrical body (20) having the flying disc (14B) is designed to include a bridge plate (16), the bridge plate (16) includes at least two guide pins (16B0) fixed thereon for allowing
25 the flying disc (14B) to undergo reciprocating movement by sliding therein through the at least two holes (14B0).
7. The flow control valve (100) as claimed in claim 1, wherein the second disc (34) is fixed on the internal diameter of the piston (40) by any one of the interference
30 fit method, the welding method and the resin binding method.

- 5 8. The flow control valve (100) as claimed in claim 1, wherein the second disc
 (34) is an integral part of the piston (40) formed by the method such as the
 casting/machining method.
9. The flow control valve (100) as claimed in claim 1, wherein the first disc (14)
10 and the second disc (34) are flat circular metal discs.
10. The flow control valve (100) as claimed in claim 1, wherein the nut (90) is
 fixed on top of bearings (70) inside the cylindrical body (20), the bearings (70) being
 threadbly positioned on top of the piston (40) inside the cylindrical body (20).

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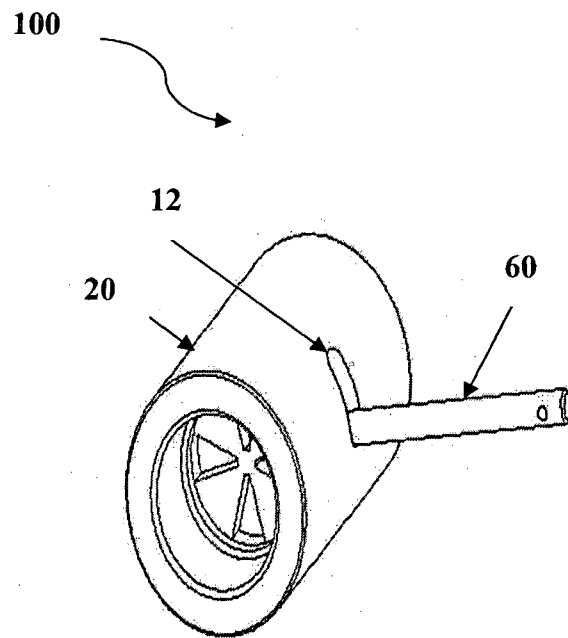


Figure 1a

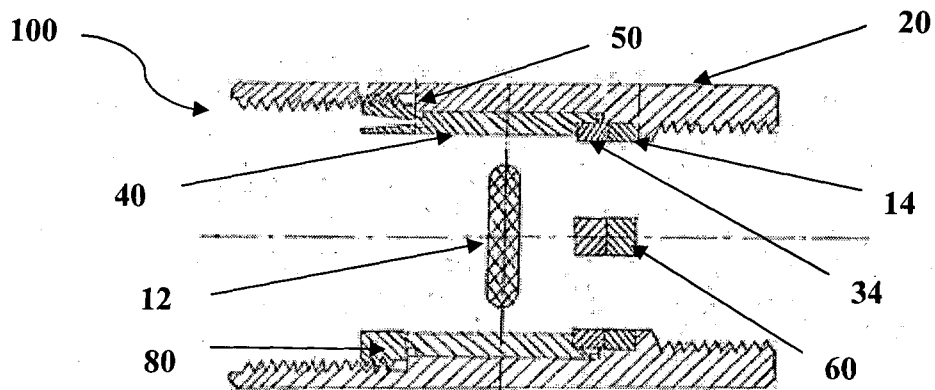


Figure 1b

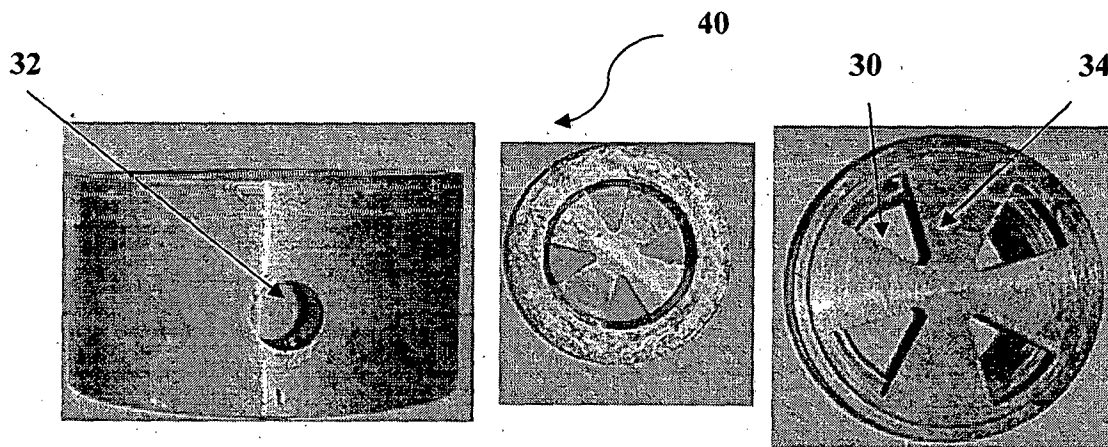


Figure 2a

Figure 2b

Figure 2c

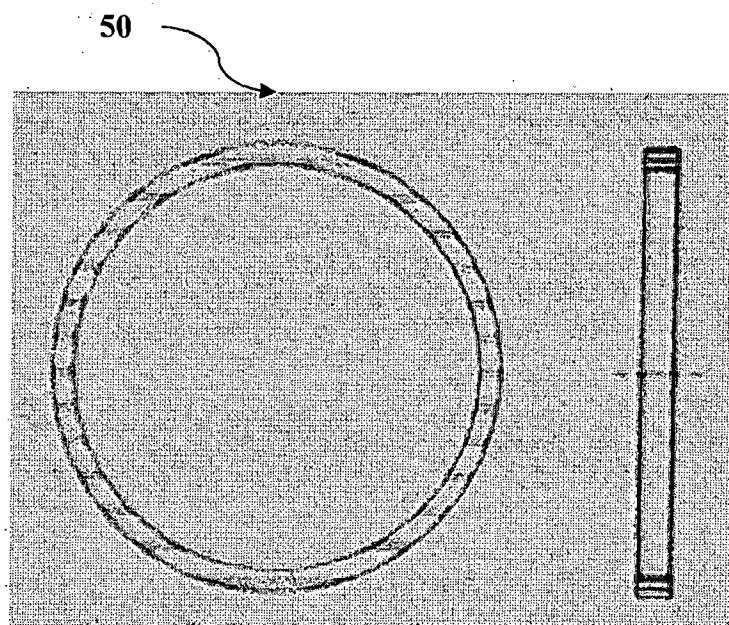


Figure 3

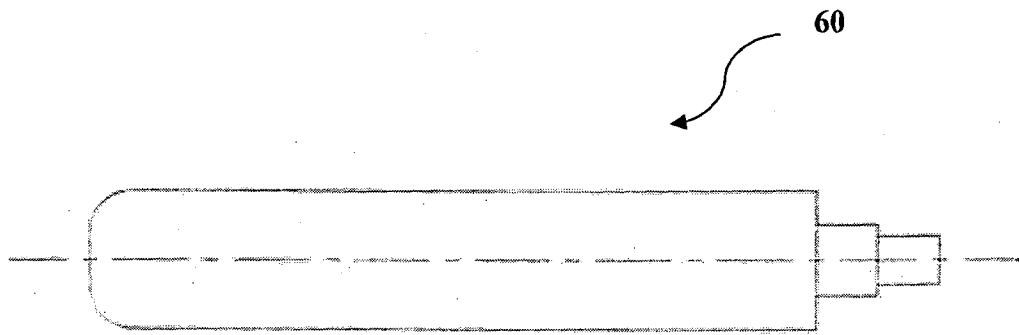


Figure 4

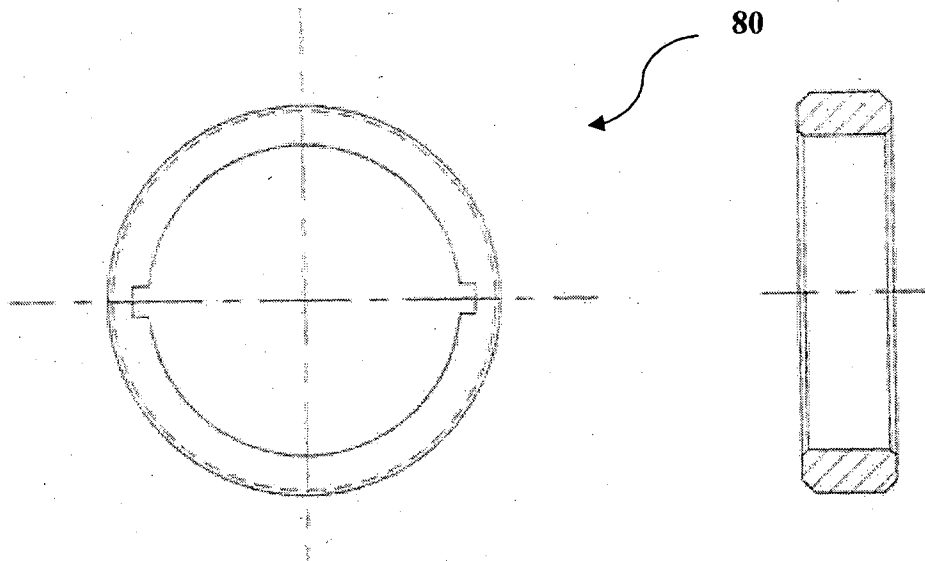


Figure 5

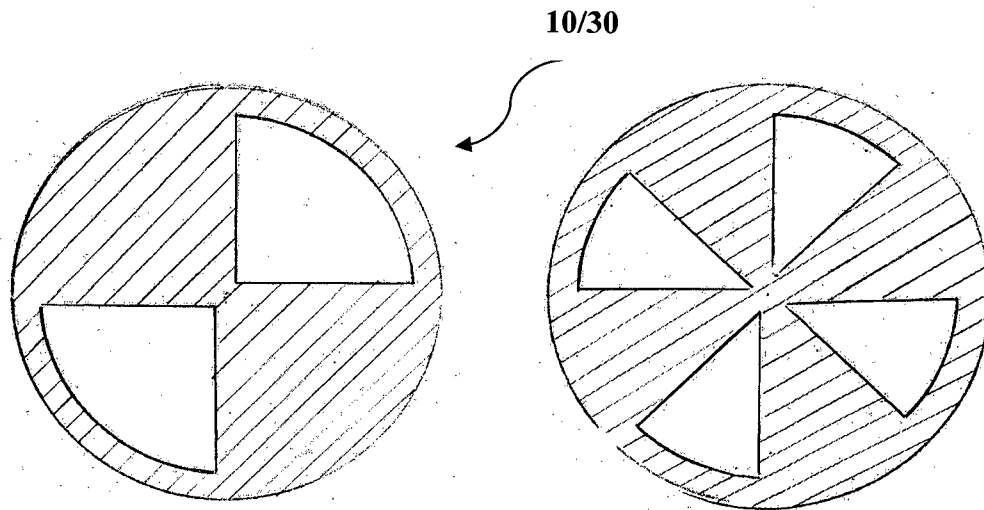


Figure 6a

Figure 6b

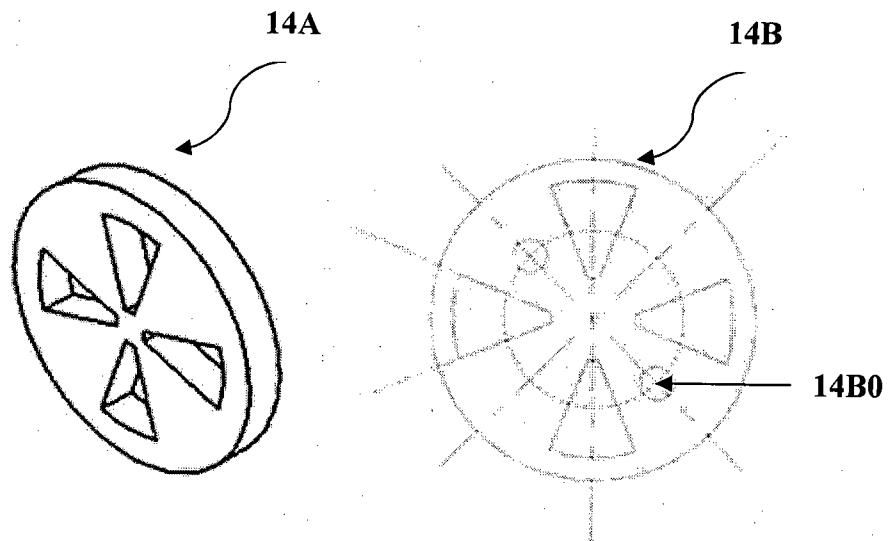


Figure 7a

Figure 7b

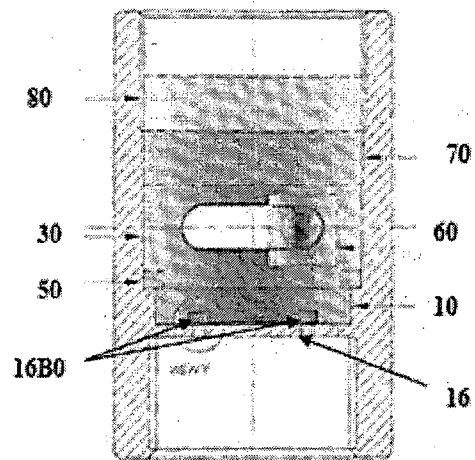


Figure 8a

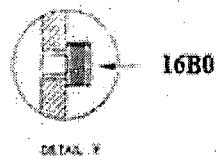


Figure 8b

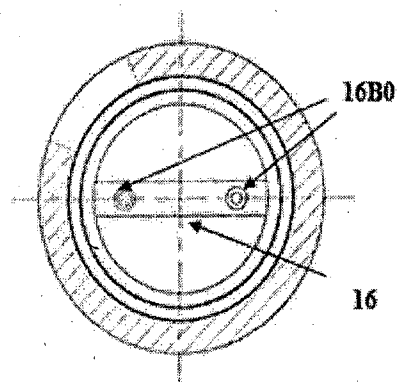


Figure 8c

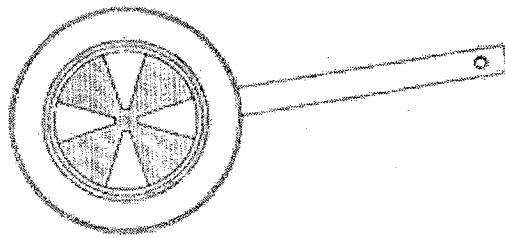


Figure 9a

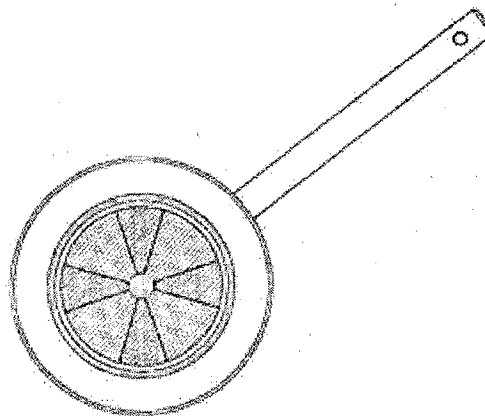


Figure 9b

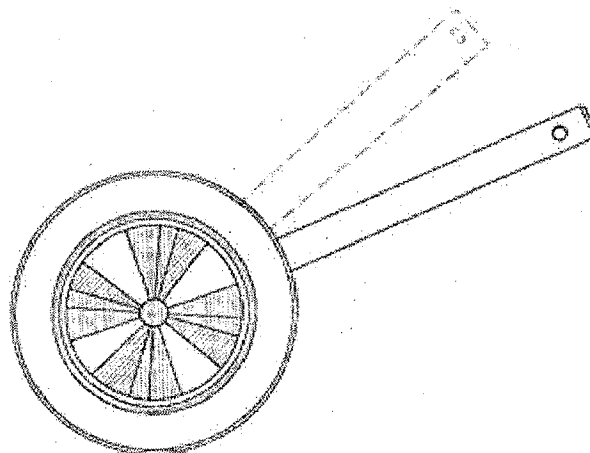


Figure 9b