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Applicant: **Nippon Tansan Gas Co., Ltd.**  
32-26, Aoi 3-Chome  
Adachi-ku Tokyo-to, 120(JP)

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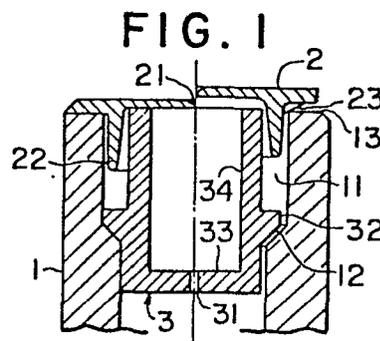
Inventor: **Ozaki, Yohoji**  
201, 2-4, 4-chome Hikonari  
Misato-shi Saitama-ken(JP)

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Representative: **Everitt, Christopher James**  
**Wilders et al,**  
**F.J. CLEVELAND & COMPANY** 40/43 Chancery Lane  
London WC2A 1JQ(GB)

**High pressure gas cartridge.**

A high pressure gas cartridge with a double safety device, comprises a sealing plate (2) with a safety mechanism (21) and a gas regulator (3) which is provided at a nearer portion than the sealing plate (2) in the passage (11) for the gas. Gas is charged in the body (1) speedily through a clearance (32) between the sealing plate (2) or the gas regulator (3) and the body (1). The safety mechanism (21) acts when the inner pressure rises excessively and checks the cartridge from rupturing or moving by letting the gas escape gradually. The gas regulator (3) regulates the gas flow to an amount which is enough for actuating a device or devices using the gas but which does not make the cartridge move or fly by reaction when the sealing plate (2) has broken and the gas becomes free for flowing out.



DESCRIPTION

High Pressure Gas Cartridge

A high pressure gas cartridge may move or fly in  
5 reaction to escape of gas from within when the  
cartridge is in distribution or in use, and this is  
very dangerous. Causes of moving or flying of such a  
cartridge include the following. A first is the case  
10 when the cartridge has been thrown into a fire and the  
sealing plate has exploded due to excessive inner  
pressure. A second is when the sealing plate has been  
pierced by a boy's mischief with a nail. A third is  
when a cartridge is removed from a piercing device  
with some gas remaining in it. The present invention  
15 relates to high pressure gas cartridges which are safe  
in such conditions.

JP-B-57(1982)-54679 discloses a high pressure gas  
cartridge with a safety device. The device is  
20 provided with a small chamber having an orifice under  
the sealing plate, and is so planned as not to produce  
a rocketing or jetting gas stream, as the gas is  
throttled by the orifice when its temperature becomes  
high and the sealing plate is broken. The orifice,  
25 however, has an object to allow the gas to flow

gradually when its pressure becomes high at high  
temperature. Hence the device is impractical as the  
cross-sectional area of the orifice is very small and  
the gas flow induced by the inner pressure at the  
5 normal temperature is very small. Both the sealing  
plate and the small chamber with the orifice must be  
pierced, if this type of device is to be used  
effectively at normal temperatures, and that needs  
strong force and a piercing pin with a long stroke.  
10 This is also impractical.

JP-B-58(1983)-27439 discloses a gas cartridge having  
an orifice in an opening. Interest is directed only  
to controlling quantity of flow of gas. Insufficient  
15 consideration has been given to the task of charging  
the cartridge with gas, and that takes a long time.  
Accordingly, the rate of production of such cartridges  
is limited, so that the cost of production has to be  
high.

20 An object of the present invention is to provide high  
pressure gas cartridges with a double safety device,  
which can be charged speedily with gas, which can be  
saved from rupture of the cartridge body when the  
25 inner pressure is increased excessively, which do not

move or fly in reaction even if the sealing plate has  
been pierced manually and the inner gas can flow out  
freely into atmosphere, and which in general use can  
allow gas to be discharged at a useful flow rate, by  
5 piercing the sealing plate.

Another object of the present invention is to minimize  
the force to be exerted on, and the stroke of a  
piercing pin for piercing the sealing plate.

10

A further object of the present invention is to allot  
the safety function to the safety device of the  
sealing plate when the inner pressure has increased  
excessively and to a gas regulator when the inner gas  
15 flows freely after the sealing plate has been broken.

The foregoing objects and other objects as well as the  
characteristic features of the invention will become  
more apparent and more readily understandable by the  
20 following description and the appended claims when  
read in conjunction with the accompanying drawings.

20

The drawings show embodiments of the present  
invention, and throughout the drawings, the same  
25 numeral shows the corresponding portion.

25

Fig.1 is a side view which shows one form of opening portion of a cartridge in which the present invention is embodied and which is sectioned along the line A-A of Fig.2, that part of the figure to the right of the centre line shows the parts before, and that to the left of the centre line shows them after the sealing plate is joined to the body.

Fig.2 is a plan view of Fig.1 with the sealing plate removed.

Fig.3 is a side view of another embodiment similar to Fig.1, which is sectioned along the line B-B of Fig.4.

Fig.4 is a plan of Fig.3 with the sealing plate removed.

Fig.5 is a sectioned side view of a further embodiment similar to Fig.1.

Fig.6 is a sectioned side view of a further embodiment similar to Fig.1.

Fig.7 is a similar sectional side view of a further embodiment.

5 Fig.8 is a similar sectional side view of a further embodiment.

Fig.9 is a side view similar to Fig.1, sectioned along the line C-C of Fig.10, and in which a filter is used as a regulator.

10 Fig.10 is a plan with that part of the sealing plate below the centre line removed.

15 Fig.11 is a side view of a further embodiment similar to Fig.1 in which those portions of the sealing plate and the regulator to the right of the centre line are not sectioned.

20 Fig.12 is a plan with that part of the sealing plate below the centre line removed, and

Fig.13 is a sectioned side view similar to Fig.1 of a further embodiment in which the regulator is composed of a portion with an orifice and a filter portion.

25

1 is a body of capacity less than 100cc and into the body 1 a high pressure gas, such as CO<sub>2</sub> or O<sub>2</sub>, is charged. There are two types of the body 1, one of which has a shoulder 12 on the inner wall around an opening 11 (see Figs.1,3,5 and 9) and the other has no such shoulder (see Figs.6,7,8,11 and 13).

2 is a sealing plate, which is a usual safety type having a recess 21 operable to vent the inner pressure through a hair crack when the inner pressure rises excessively. There are two types of sealing plate 2, one of which has a circular leg 22 on its underside (see Figs.1,3,5,6,8,9,11 and 13) and the other has no such circular leg (see Fig.7).

These sealing plates 2 are all put on the end face 13 of the opening 11 of the body 1. Gas is charged into the body 1 through a clearance formed between the body 1 and the sealing plate. The clearance is formed either by means of radial protrusions 23 of the sealing plate 2 or of radial grooves 14 in the end face 13 of the body 1. After the body 1 has been charged with gas, the sealing plate 2 is joined onto

the body 1, as before, such as by welding or by calking.

3 is a regulator for regulating gas flow through it.

5 The body 1 is provided with the regulator 3 at the inner side of the sealing plate 2 and in a gas flow path. The regulator 3 has an orifice 31 which is operable to throttle gas flow at the normal temperature within the body 1 so as not to move or  
10 cause the cartridge to fly due to reaction to gas emission, and also forms a clearance 32 for flow of charging gas around itself within the body 1. The regulator 3 may be a plate, but, in the examples shown in the drawings, the regulator 3 takes the form of a  
15 cylinder having a bottom wall 33 and a side wall 34.

The clearance 32 may take various forms. One form of clearance 32 is between the periphery of the regulator 3 and the inner wall of the body 1 (see Figs.6 to 8,  
20 11 to 13). Another is between radial ribs 35 and the inner wall of the body 1 (see Figs.1 to 5,9,10). The clearance 32 may be formed by radial grooves. At all events it is desirable for the clearance 32 to be formed when the regulator 3 is placed in the body 1.

25

There are various possible dispositions of the regulator, such as to put the regulator on the shoulder 12 of the body 1 (see Figs.1,3,5,9), to carry it by calking the lower end of the circular leg 22 of the sealing plate 2 (see Fig.6), to unite the regulator 3 and the sealing plate 2 as one body by a soldered portion 41 by which the regulator 3 is soldered directly to the sealing plate 2 (Fig.7), to spigot the upper portion of the regulator into the aperture formed by the circular leg 22 of the sealing plate 2 (see Figs.8 and 13), to fix the regulator to the sealing plate in a body (Fig.11), etc.

Fig.8 shows a filter 51 supported against the underside of the orifice 31 so that the orifice 31 may not be clogged with residual swarf in the body. The filter 51 does not have a regulating function corresponding to that described for the orifice 31. Though such a filter is not shown in Figs.1 to 7, the same effect can be obtained by providing such a filter at the underside of the orifice in each of those embodiments.

A filter, which is essentially different from the filter 51 of the embodiment of Fig.8, is used as a gas flow regulator in the embodiments of Figs. 9 to 13. The filter is of the continuous foam type, and the interstices are selected for a certain pressure of gas. The filter regulates gas flow, either alone or in combination with the orifice 31, such that the regulated gas flow is sufficient to actuate a device which uses the gas (for example an oxygen inhaler) but is not enough to move the cartridge by reaction even if the cartridge is in a state where the sealing plate has been broken and the gas can flow out freely.

Fig.13 shows a regulator 3 which consists of a cylinder portion 3b with the orifice 31 and a filter portion 3a. Of course the regulated gas flow through both portions is determined as stated above. In this case the filter portion 3a can be thinner than in the embodiments of Figs.9 and 11. When the body has been charged with gas and the sealing plate 2 has been joined to the body 1, it is necessary in several embodiments to bar direct access from the interior of the body 1 to the limited recess 21 of the sealing plate through the clearance 32, in order to ensure that the regulator 3 functions as it should.

Therefore, in the embodiment of Fig.1, the top of the regulator 3 is pressed onto the underside of the sealing plate 2. In the embodiment of Fig.3, the upper inner portion of the regulator is closely fitted onto the outer periphery of the circular leg 22, and in the embodiments of Figs.5 and 9, the lower portion of the circular leg 22 is pressed into the regulator 3.

When using the cartridges shown in the drawings, after the cartridge has been attached to a piercing device, it will be sufficient to pierce the sealing plate 2 only. Also, by employing a material for the regulator which a needle N can pierce readily, as in the embodiment of Fig.11, the force that has to be applied to the needle and the stroke of the needle can be minimized. A required quantity of gas is taken out from within the body, through the regulator, by piercing.

When the cartridge is overheated, say by throwing into fire in error or by a fire, the gas within the body 1 expands and the pressure increases. At a certain pressure, the sealing plate 2 begins to bend outwardly and a hair crack through the bottom of the limited

recess 21 forms. The gas in the body begins to flow  
out gradually through the crack and an explosion of  
the body 1 is avoided. Also when, at the normal  
temperature, the sealing plate 2 is pierced by  
5 mischief or the cartridge is removed from the piercing  
device with some gas remaining in it the rate of  
escape of gas is kept fixed by the regulator 3 so that  
the cartridge does not fly and damage is not caused to  
men and beasts or structures.

10

The diameter of the orifice 31 required to avoid the  
cartridge taking off is, in the case of CO<sub>2</sub> gas  
calculated as follows.

15 Calculating condition

Subject works:

Capacities of cartridges 10cc, 50cc, 95cc.

Values of propellant force:

(criterion is total weight) 10cc-30g, 50cc-150g,  
20 95cc-270g.

Working temperatures: 20°C, 100°C, 150°C.

Subject gas:

Carbonic acid gas (CO<sub>2</sub>) (charging ratio) 1.34Calculation (provided that P: pressure Kg/cm<sup>2</sup>,

d: diameter

mm, f: initial quantity of flow l/s and  
charging ratio 1.34)

Subject works	Propellant forces	Temperatures			
			20°C	100°C	150°C
10cc	30g	p	60	388.4	602.0
		d	0.225	0.089	0.071
		f	0.96	0.48	0.43
50cc	150g	p	60	388.4	602.0
		d	0.504	0.198	0.159
		f	4.81	2.41	2.15
95cc	270g	p	60	388.4	602.0
		d	0.676	0.266	0.213
		f	8.66	4.33	3.87

From the above calculation, the diameter of the orifice 31 is deduced as follows.

5

	20°C	100°C	150°C
10cc	0.20	0.08	0.07
50cc	0.50	0.19	0.15
95cc	0.65	0.26	0.21

10

It will be understood that the diameter of the orifice 31 required to avoid the cartridge taking off, even if the sealing plate is broken by a rise in temperature, varies in accordance with the weight of the cartridge though it is not limited to the conclusions of the foregoing calculation if the gas and the charging ratio are changed.

20

As regulation of gas flow when the inner pressure rises excessively is left to a crack through the recess 21, the diameter of the orifice 31 of the regulator 3 and the size of the interstices of the filter can be selected so that they can secure

effective quantity of gas flow at the usual temperature.

Having regard to a charging time, the diameter is about 0.6mm in the case of 0.3mm<sup>2</sup> as an example among sectional areas of the orifice from 0.03-0.3mm<sup>2</sup>, which are cited by the inventor. According to experiments by the inventor, the time spent for charging approximately 60g of CO<sub>2</sub> gas in a cartridge having a

) capacity of 95cc was about 3.4 seconds, where the diameter of the orifice was 0.6mm, and was 1.4 seconds in the case of a cartridge which embodied the present invention in which the gas is charged through the clearance 32 between the regulator 3 and the body 1.  
5 Indeed, the gas has been charged more quickly by the order of 2.4 times or more.

CLAIMS

1. A high pressure gas cartridge comprising a body  
(1) to be charged with a high pressure gas, a sealing  
plate (2) which is provided with a safety device (21)  
5 to act for leaking the inner pressure when it becomes  
excessive and which seals an opening (11) of the body  
(1) after the latter has been charged with a high  
pressure gas, and a gas regulator (3) set on the inner  
side of the sealing plate (2) and effective on the  
10 flow of high pressure gas, characterized in that a  
clearance (32), through which the body (1) is charged  
with gas, is formed between the regulator (3) or the  
sealing plate (2) and the body (1), and that the  
regulator (3) is arranged so that the gas flow through  
15 it is sufficient to actuate a device or devices which  
use the gas in operation but which is not to be enough  
to move the cartridge by reaction even if the  
cartridge is in a state where the sealing plate has  
been broken and the gas can flow out freely.

20

2. A high pressure gas cartridge as claimed in  
claim 1, wherein said regulator (3) is a cylinder  
which is closed at an end remote from the sealing  
plate (2) by a wall (33) having an orifice (31)  
25 therein, and which is carried on a shoulder (12)

formed on the inside of the body (1), and wherein said clearance (32) is shut off and the gas in the body is blocked from access to said safety device (21) of said sealing plate (2), bypassing said orifice (31), by joining said sealing plate (2) onto said body (1).

3. A high pressure gas cartridge as claimed in claim 2, wherein said clearance (32) is shut off from the safety device (21) by joining the regulator (3) and the sealing plate (1) around the safety device (21).

4. A high pressure gas cartridge as claimed in claim 2, wherein said clearance (32) is shut off from the safety device (21) by pressing a circular leg (22), which surrounds the safety device (21), into the regulator (3), through the top thereof.

5. A high pressure gas cartridge as claimed in claim 2, wherein said clearance (32) is shut off from the safety device (21) by joining the periphery of a circular leg (22), which surrounds the safety device (21), and the adjacent face of the regulator (3).

6. A high pressure gas cartridge as claimed in claim 1, wherein said regulator (3) is a cylinder which is closed at an end remote from the sealing plate (2) by a wall (33) having an orifice (31) therein, and which is fixed with respect to the sealing plate (2), round the safety device (21), and wherein said clearance (32) is shut off and the gas in the body is blocked from access to said safety device (21) of said sealing plate (2), bypassing said orifice (31), by joining said sealing plate (2) onto said body (1).

7. A high pressure gas cartridge as claimed in any one of claims 2,3,4,5 and 6, wherein said wall (33) has a cavity on its side remote from the sealing plate (2), and a filter (51) for dust is set in the cavity.

8. A high pressure gas cartridge as claimed in claim 1, wherein said regulator (3) is a filter which is of a column type, which has interstices of continuous foam type adapted for a certain pressure of the gas in the body (1), and which is carried on a shoulder (12) formed on the inside of the body (1), and wherein said clearance (32) is shut off and the gas in the body (1) is blocked from access to said

safety device (21) of said sealing plate (2),  
bypassing said regulator (3), by joining said sealing  
plate (2) onto said body (1).

9. A high pressure gas cartridge as claimed in  
claim 1, wherein said regulator (3) is a filter which  
is of a column type, which has interstices of  
continuous foam type adapted for a certain pressure of  
the gas in the body (1), and which is fixed with  
respect to the sealing plate (2), and wherein said  
clearance (32) is shut off and the gas in the body (1)  
is blocked from access to said safety device (21) of  
said sealing plate (2), bypassing said regulator (3),  
by joining said sealing plate (2) onto said body (1).

10. A high pressure gas cartridge as claimed in  
claim 2 and claim 6, wherein said regulator (3)  
consists of a cylindrical portion which has a cavity  
on the side of its wall (33) remote from the sealing  
plate (2), and a filter (51) which is set in the  
cavity and has interstices of continuous foam type  
adapted for a certain pressure of the gas in the body  
(1).

1/2

FIG. 1

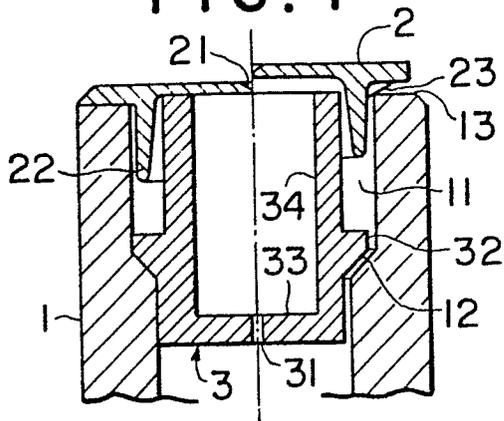


FIG. 3

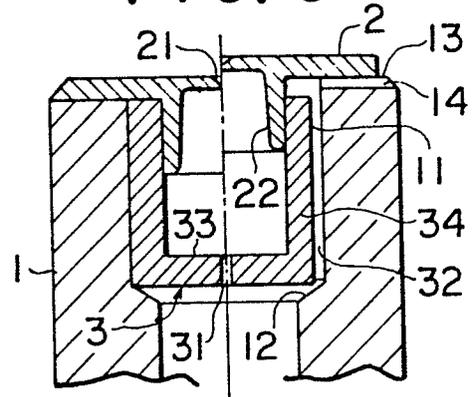


FIG. 2

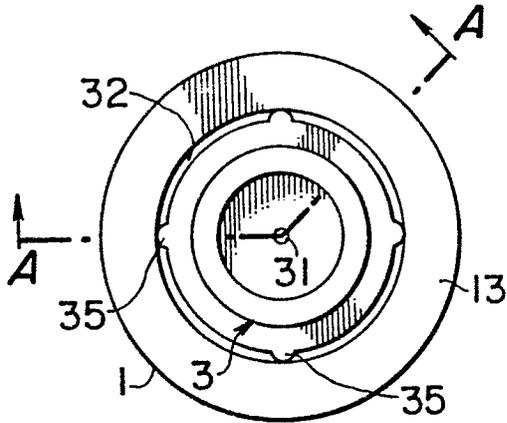


FIG. 4

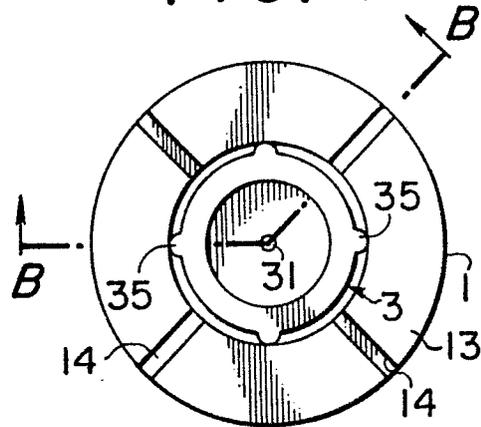


FIG. 5

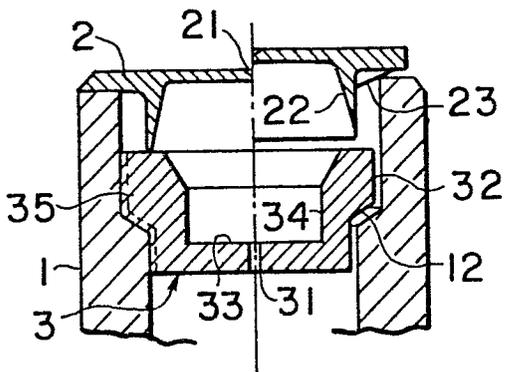


FIG. 7

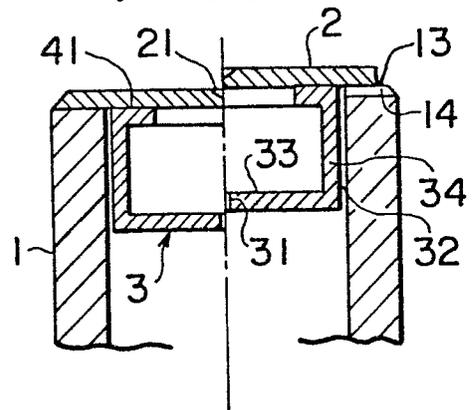


FIG. 6

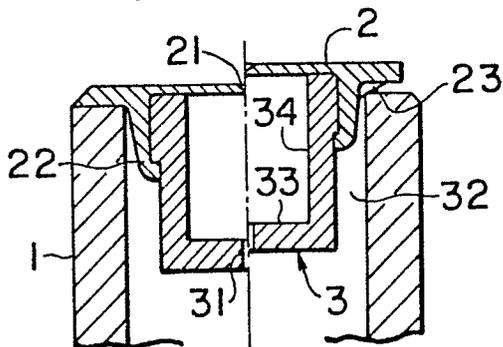


FIG. 8

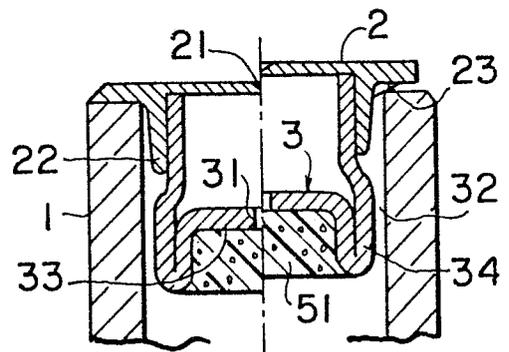


FIG. 9

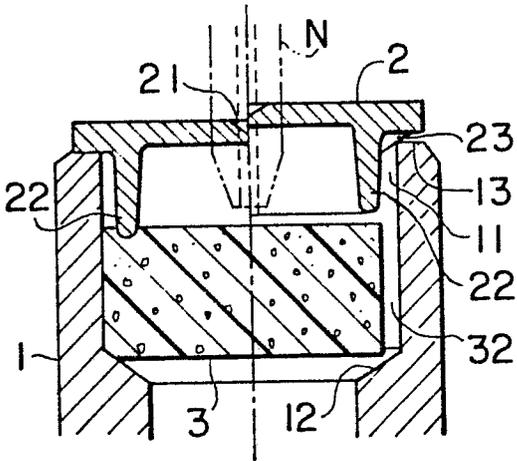


FIG. 11

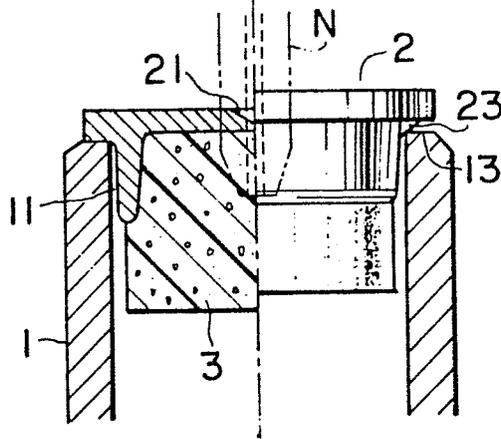


FIG. 10

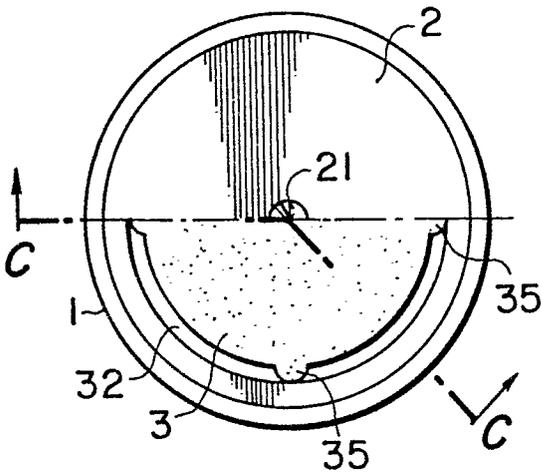


FIG. 12

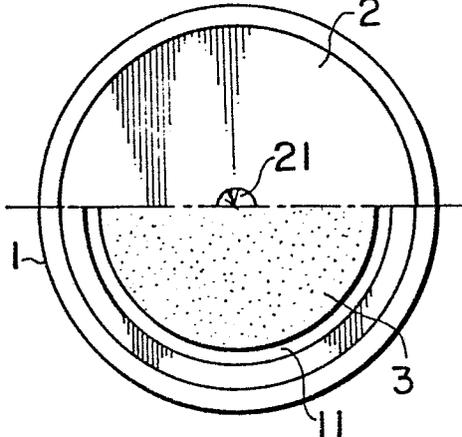


FIG. 13

