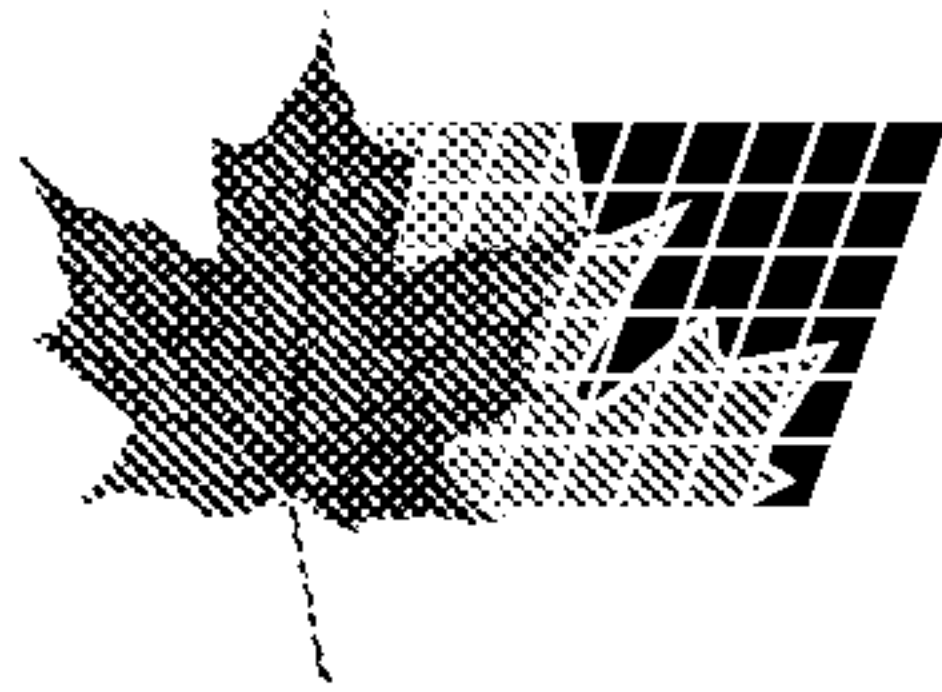




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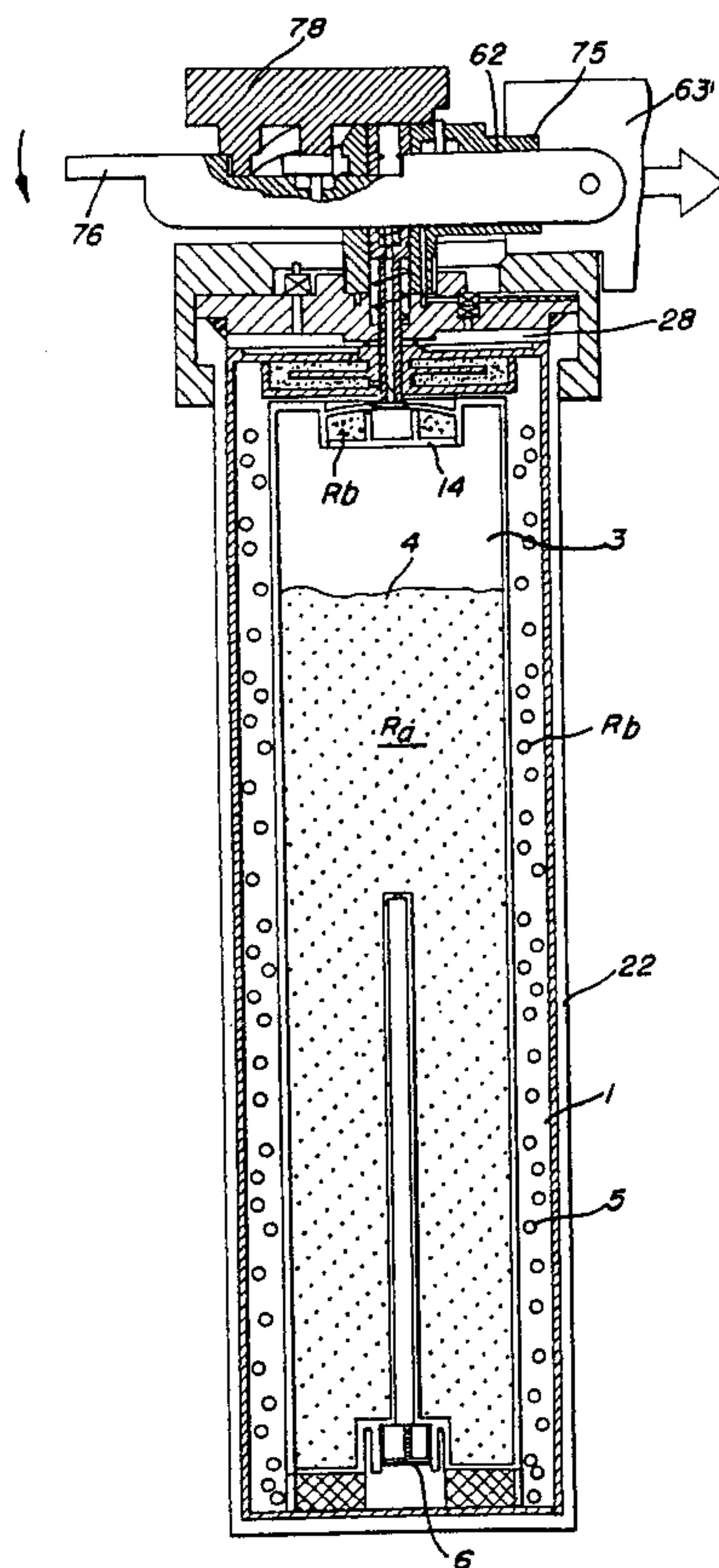
(72) Plester, George, US
(72) Kohl, Horst, US
(72) Preuss, Rolf, US
(72) Troska, Georg, US
(72) Schorr, Frederick D., US
(73) Coca-Cola Company (The), US

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(30) 1990/07/11 (551,077) US

(54) **CARTOUCHE A GAZ JETABLE ET RECIPIENT CONNEXE
POUR DISTRIBUTEUR DE BOISSONS**

(54) **DISPOSABLE GAS GENERATOR CARTRIDGE AND VESSEL
THEREFOR FOR USE IN A BEVERAGE DISPENSER**



(57) Cartouche génératrice de gaz CO₂ à usage unique possédant une configuration cylindrique et comprenant une chambre à réactif intérieure (3) ainsi qu'une chambre à réactif extérieure (2) coaxiales qui communiquent

(57) A disposable CO₂ gas generator cartridge of cylindrical construction anal including inner (3) and outer (2) coaxial reagent chambers which are interconnected when installed in a cylindrical pressure





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quand elles sont installées dans une cuve sous pression cylindrique. Ladite cartouche comporte un ensemble couvercle (23) supérieur comprenant un mécanisme d'actionnement du type poussoir qui est commandé par une surface de came située sur une roue à main. L'ensemble couvercle est relié à un distributeur de boissons gazeuses au moyen d'un dispositif de fixation à déconnexion rapide actionné par la mise en action d'un dispositif d'abaissement de levier déclenché manuellement et comprenant la roue à main. L'actionnement de la roue à main déclenche la génération de gaz et permet aussi de vider la cartouche dans l'atmosphère après son utilisation.

vessel and having a top cover assembly (23) including a pusher type activating mechanism (20) which is operated by a cam surface located on a handwheel. The cover assembly connects to a carbonated drink dispenser by means of a quick disconnect coupling activated by the operation of a manually operated pull down lever assembly including the handwheel. Operation of the handwheel acts to start gas generation and also vent the cartridge to atmosphere when spent.



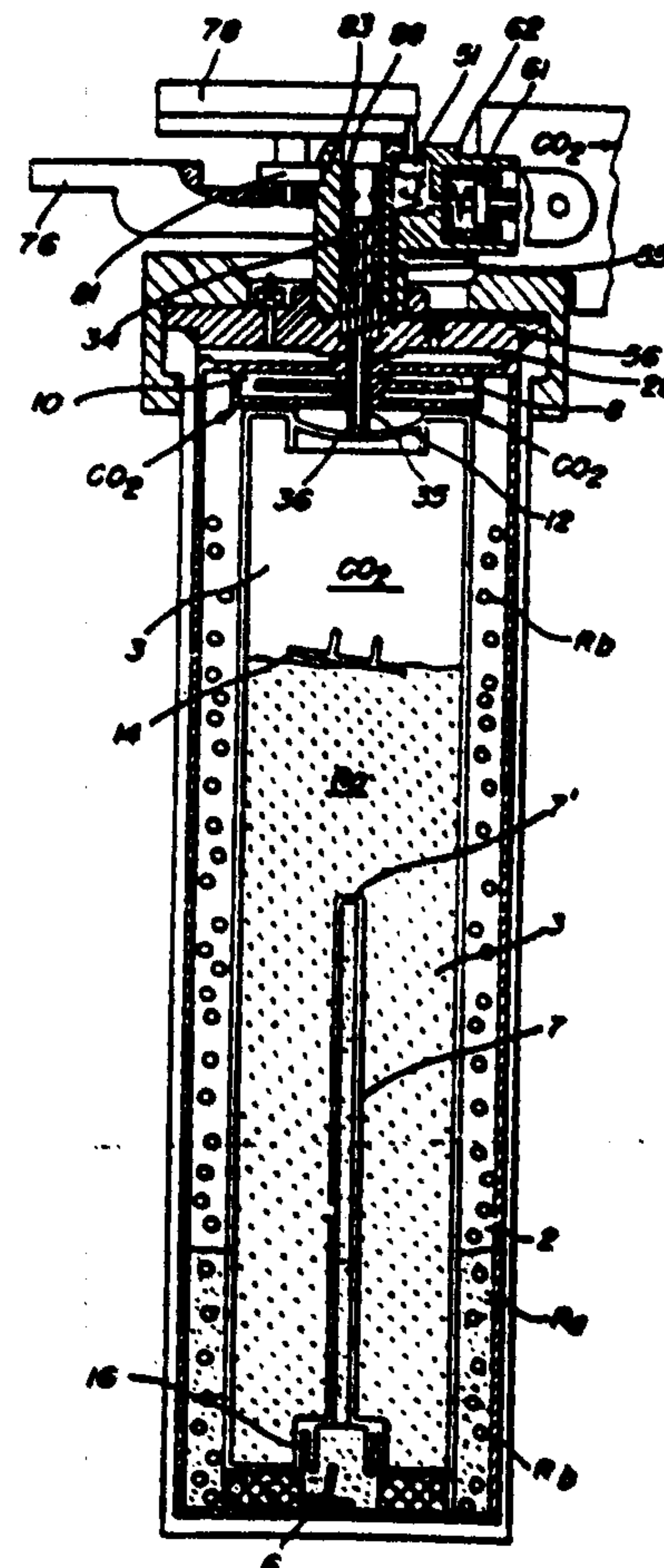
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551,077 11 July 1990 (11.07.90) **US**(71) Applicant: **THE COCA-COLA COMPANY [US/US]; 310 North Avenue, Atlanta, GA 30313 (US).**(72) Inventors: **PLESTER, George ; Rheinstrasse 79, D-4300 Essen 18 (DE). KOHL, Horst ; Waldstrasse 40, D-2060 Bad Oldesloe (DE). PREUSS, Rolf ; Am Rensemoor 26, D-2418 Ratzeburg (DE). TROSKA, Georg ; Erlenstrasse 23, D-4352 Herten 6 (DE). SCHORR, Frederick, D. ; 2108 Heritage Heights, Decatur, GA 30033 (US).**(74) Agent: **BIRCH, Anthony, L.; Birch, Stewart, Kolasch & Birch, 301 North Washington Street, P.O. Box 747, Falls Church, VA 22046-3487 (US).**(81) Designated States: **AT (European patent), AU, BE (European patent), BR, CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), NO, SE (European patent).****Published**
With international search report.(54) Title: **DISPOSABLE GAS GENERATOR CARTRIDGE AND VESSEL THEREFOR FOR USE IN A BEVERAGE DISPENSER**

(57) Abstract

A disposable CO₂ gas generator cartridge of cylindrical construction and including inner (3) and outer (2) coaxial reagent chambers which are interconnected when installed in a cylindrical pressure vessel and having a top cover assembly (23) including a pusher type activating mechanism (20) which is operated by a cam surface located on a handwheel. The cover assembly connects to a carbonated drink dispenser by means of a quick disconnect coupling activated by the operation of a manually operated pull down lever assembly including the handwheel. Operation of the handwheel acts to start gas generation and also vent the cartridge to atmosphere when spent.



DISPOSABLE GAS GENERATOR CARTRIDGE AND
VESSEL THEREFOR FOR USE IN A BEVERAGE DISPENSERBackground of the Invention

The present invention relates generally to gas generators and associated apparatus and more particularly to a disposable CO₂ gas generator cartridge which utilizes
5 chemical reactants to generate the CO₂ gas and the vessel in which it is housed for use in a beverage dispenser.

Conventional CO₂ gas cylinders in beverage dispensers are heavy, relatively expensive and available only as returnable, refillable packages. Since such cylinders are
10 under very high pressure, handling also requires appropriate care.

With the trend toward mini-sized and home dispensers for soft drinks, where the syrup packaging is generally one way, it is logistically attractive to make one way CO₂
15 generators also available. Moreover, certain conventional distribution channels, such as supermarket stores, could only be effectively exploited if one-way gas generators were available. An additional factor is that lay dispenser users are understandably nervous of handling high pressure
20 gas cylinders. High pressure CO₂ capsules, generally containing about 8 g CO₂, are already available, but these are expensive and restricted in practical capacity to a limit of around 1620 g. They do not, therefore, represent a desired solution, since such quantities are barely
25 sufficient for carbonating two liters of beverage without reckoning the considerable additional CO₂ quantities needed for propulsion of the beverage in the dispenser. Inexpensive, light weight, unpressurized or moderately pressurized CO₂ generators packaged in disposable containers
30 could therefore provide a whole scope of new business opportunities with respect to small sized dispensers designed for non-professional users.

In the above referenced related application, which is meant to be incorporated herein by reference, there is
35 shown and described a plurality of first generation disposable CO₂ gas generators which package reactant

chemicals within a system which releases CO₂ at a predetermined pressure on demand, thus allowing the chemicals to be consumed only as and when CO₂ is drawn off, whereby the chemicals react just sufficiently to maintain
5 the required user pressure.

Summary of the Invention

Accordingly, it is an object of an aspect of the present invention to provide an improvement in gas generators which enables the generation of a carbonating
10 gas on demand.

It is an object of an aspect of the present invention to provide an improved carbonating gas generator which is also portable and easily deliverable for use in a beverage dispenser.

15 It is an object of an aspect of the present invention to provide a normally dormant carbonation gas generator which, when activated upon being inserted in a vessel associated with a beverage dispenser, generates gas at or near a desired user pressure.

20 It is an object of an aspect of the present invention to provide a disposable non-pressurized device which can be placed in a vessel for use in a beverage dispenser to subsequently generate CO₂ automatically by mixing prepackaged reagents and thereafter maintaining a
25 predetermined reference pressure therein.

The foregoing and other objects are realized by a carbonating gas generator and vessel therefor which uses a substance, such as sodium bicarbonate, in combination with a liquid acid, typically phosphoric acid, to generate a
30 gas, namely, carbon dioxide (CO₂). The chemicals are packaged within a system so that they remain out of contact with each other until use is desired whereupon they are brought into contact under self-controlled conditions causing CO₂ to be generated and released at a predetermined
35 pressure. The system allows the chemicals to be consumed only as and when CO₂ gas is drawn off, i.e. on demand, whereby the chemicals react just sufficiently to maintain

the required user pressure. The system includes a disposable cartridge of cylindrical construction containing inner and outer coaxial reagent chambers which are interconnected when installed in a vessel having a top cover assembly including an activating mechanism which connects to a CO₂ dispenser by means of a quick disconnect coupling including an activator for delivering CO₂ to the carbonator portion of a beverage dispenser.

Other aspects of this invention are as follows:

- 10 Apparatus for chemically generating a gas for a utilization device, comprising: a cartridge for generating a gas including a pair of containers having a partition therebetween for defining first and second reagent chambers; an elongated reagent feed tube, including a
15 removable closure member, located in said first chamber; a passage between one end of said feed tube and said second chamber for permitting the travel of reagent between said chambers; a first reagent in said first chamber and a second reagent in said second chamber, said first reagent
20 and said second reagent chemically reacting to generate said gas upon contact with each other, said second chamber including a region in the top portion thereof for holding the gas generated; means for starting a reaction between said first and second reagents and including a
25 predetermined portion of said second reagent in the top portion of said first chamber for contacting said first reagent in said top portion thereof for generating a gas thereat and causing a predetermined pressure to be applied to the top of said first reagent in said first chamber to
30 urge said first reagent into the feed tube to remove said closure member and permit said first reagent to traverse said passage and contact said second reagent and thereby generate said gas in said second chamber; and a gas outlet port for coupling said gas out of said cartridge.
- 35 Apparatus for use in connection with a disposable gas generator utilized in a carbonated beverage dispenser, comprising: a pressure vessel for housing a disposable gas generator cartridge therein and including a top portion; a

cover assembly for said pressure vessel and further comprising, a removable cover member locatable on the top portion of the pressure vessel and having a central opening therein, means for securing the cover member to the pressure vessel, and a body member mounted on said cover member and including gas outlet means and means passing through said central opening of said cover member for initiating gas generation within a gas generator cartridge when located in said pressure vessel; and an actuator assembly for operating said means for initiating gas generation and further comprising, lever means attached to said dispenser for locking said cover assembly in position on the dispenser so that said gas outlet means connects to complementary gas inlet means of said dispenser, and a rotatable member mounted on said lever means and having means thereon for contacting and operating said means passing through central opening when rotated to generate carbonating gas for the dispenser.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific example, while indicating the preferred embodiment of the invention, is given by way of illustration only and is not meant to be interpreted in a limiting sense, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art.

Brief Description of the Drawings

The following detailed description of the invention will be better understood when considered together with the accompanying drawings wherein:

Figure 1A is a central longitudinal cross sectional view of a gas generator cartridge according to the subject invention;

Figure 1B is a central longitudinal cross sectional view of a vessel for receiving the cartridge shown in Figure 1A;

Figure 1C is a central longitudinal cross sectional view of the top cover assembly for the cartridge and vessel shown
5 in Figs. 1A and 1B; and

Figure 1D is an exploded central longitudinal view illustrating the assembly of the three components shown in Figures 1A, 1B and 1C.

Figure 2 is a central longitudinal cross sectional view
10 partially illustrative of the coupling and activating assembly for the cartridge shown in Figure 1A;

Figure 3 is an enlarged partial cross sectional view of the activating mechanism shown in Figure 2;

Figure 4 is a central longitudinal view partially in
15 cross section which illustrates additional details of the activating mechanism shown in Figure 2 and activator therefor;

Figures 5A-5E are central longitudinal views illustrative of the operation of the apparatus shown in Figures 2-4.

20 Detailed Description of the Invention

Referring now to the drawings, Figure 1A is illustrative of a disposable cartridge 1 comprised of a pair of reagent storage chambers consisting of an outer container 2 and an inner container 3, both cylindrical in shape and mutually
25 coaxial. A first reagent R_1 comprising a liquid acid 4 is placed in the inner container 3 and a second reagent R_2 comprising solid bi-carbonate pellets 5 are placed in the outer container 2. The choice of liquid acid, acid dilution, and bicarbonate is selected so as to provide desired reaction
30 characteristics, i.e. final CO_2 yield, reaction rate, CO_2 purity, pH of spent agents, etc. The liquid acid 4 and bicarbonate pellets 5 are separated by a knock out plug 6 located at the bottom of an elongated centrally located

stand-pipe 7 formed in the inner container 3. The stand-pipe 7 limits the amount of liquid reagent R_b which can flow from the inner container 3 to the outer container 2 when the plug 6 is removed, this limit being equivalent to the
5 available free space left by the reagent R_b in the outer container 2. The stand-pipe 7 thus ensures that no liquid reagent R_b can reach a gas outlet port located at the top of the cartridge 1.

The cartridge 1 further includes a gas filter section 8
10 including a gas inlet port 9. The filter section 8 includes a tortuous path for the CO_2 leaving the cartridge 1 and is filled with filter material 10, which operates to filter the entrained acid vapor. The filter material 10 is granulated bicarbonate or activated carbon or any other substance which
15 can effectively remove traces of reagent 4 from CO_2 gas reaching the outlet port 9.

A reaction starting section 11 is also formed at the top of the inner container 3 and is comprised of a domed shell having a flexible roof member 12 including a sealed opening
20 including a rubber seal 13. An upwardly turned removable plug 14 blocks the mouth of the starting section 11 which is fitted thereto. The plug 14 contacts the flexible roof member 12 which is designed to spring downward once pressed from above beyond a certain point. The purpose of the plug
25 14 is to hold a predetermined amount of reagent R_b e.g. powdered bicarbonate in the domed shell of the starting section 11 and shown by reference numeral 15. When the flexible roof member 12 is pressed down, it springs from an initial convex shape as shown in Fig. 5A to a concave shape
30 as shown in Fig. 5C, and in doing so pushes the plug 14 out of the starting section 11 and ejects reagent 15 into the reagent 4 comprising the liquid acid 4. This causes CO_2 gas to be generated in the head space of the inner container 3.

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The quantity of reagent R_b in the starting section 11 is selected so as to provide a precisely predetermined starting pressure in inner container 3 when domed roof 12 is depressed by a downward force.

5 The starting pressure thus generated in inner container 3 forces reagent R_a (liquid acid) 4 into an orifice 7' at the top of the stand-pipe 7 where it then forces the knock-out plug 6 from a seating portion 16 of the stand-pipe 7 so as to feed liquid reagent R_a in the inner container 3 to the
10 solid reagent 5 in the outer container 2 via the passage 17 at the bottom of the cartridge. The passage 17 between outer container 2 and inner container 3 which also includes a screen 18 and is filled with filter material 19 such as cotton-wool wadding so as to prevent powdered bicarbonate,
15 or other solid reagent R_b from being carried into the inner container 3 through the stand-pipe 7.

When the reagent R_a , i.e. liquid acid 4, mixes with the reagent R_b , i.e. bicarbonate pellets 5, CO_2 is formed and rises to the head space at the top of the outer container 2
20 where it passes over the top of the starting section 11 of the inner container 3 and is coupled to the port 9 through a spring loaded pusher assembly 20 as shown in Figures 2 and 3 where it passes to an outlet port 9' after passing through the filter material 10.

25 Referring now to Figures 1B and 1C, reference numeral 22 designates a pressurized outer vessel into which the cartridge 1 is inserted, as shown in Fig. 1D. A cover assembly 23 is secured to the rim 24 of the vessel 22 where it rests on the rim 25 (Fig. 1A) of the cartridge 1. The
30 cover assembly 23 is comprised of three primary components: a twist-on locking ring 26, a cover member 27 and the pusher assembly 20. A sealing gasket 29 is also employed between the cover element 27 and the rim 24 of the pressure vessel

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when assembled.

Referring now to Figures 2 and 3, the pusher assembly 20 is located in a bore 30 of a body member 31 and is sealed therein by an O-ring 32 and maintained in its topmost rest position by a spring 33. When a downward force is exerted on a first pusher member 34, it is free to move down vertically compressing spring 33. The member 34 includes a hollow end section 35 as further shown in Fig. 3, and contains two side openings therein as shown by reference numerals 36 and 37. A partially hollow needle type member 38 having an internal channel 39 and a side aperture 40, for connecting the openings 36 and 37, is slidably located in the end section 35. The needle member 38 terminates in a second pusher member 41 which is located in a bore 42 of the first pusher member 34 and is biased outwardly by a second relatively smaller diameter spring 43. The second pusher member 41 is further sealed in the bore 42 by an O-ring 44. Another O-ring 45 is used to seal the lower part of the needle type member 38 against the end section 35. A fourth O-ring 46 is used to seal the cover member 27 against a raised inner rim 47 (Fig. 1A) surrounding a central opening 48 in the cartridge 1, forming a CO₂ flow region 28 thereby.

In operation, CO₂ gas at the top of outer container 2 can flow into the opening 36 in the end section 35 of the pusher member 34 to the internal channel 39 of the needle member 38, then out through opening 37 via the side aperture 40 where it enters the cartridge filter section 8 through its inlet port 9 which is positioned to line up with the opening 37 where it then travels through the filter to the outlet port 9'. From the outlet port 9' CO₂ gas passes to a port 59 in the cover 27 via the region 28. When a downward force is exerted on the pusher member 41 of the needle 35, as will be shown subsequently, it is free to move down vertically

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compressing spring 43.

The body member 31 also includes a CO₂ vent valve including chamber 50 which has a vertically moving spring biased piston 51 mounted in an opening 52 which in turn is
5 retained in a topmost position by an expansion type spring 53. The face of piston 41 has a sealing gasket 54 affixed thereto which normally prevents gas from venting through opening 52. When the piston 51, however, moves downwardly, as will be shown, CO₂ gas is permitted to vent to the outside
10 through the opening 52 past the valve stem. The piston 51 is designed to have a weight which is just balanced by spring 53, so that it compresses the spring 53 and opens the vent opening 52 as soon as gas pressure within the cartridge 1 (Fig. 1) drops to a predetermined nominal level (e.g. 0.1
15 bar). The vent chamber 50 is connected to the top of the cartridge 1 and the port 59 by a vertical channel 55 and a horizontal channel 56. A flow resistor 57 and an attitude sensitive valve 58, the details of which are shown in Fig. 3, are located between the port 59 and the channel 56.

20 When the vent valve 51 is closed under pressure, CO₂ gas flows past it to an output channel 59, which in turn leads to a conventional spring biased output valve assembly 60 which includes a self-closing spring biased valve 61 located in a male fitting 62 which is pressed into an opposing female
25 fitting, not shown, located in a dispenser assembly shown generally by reference numeral 63 in Fig. 4.

As shown in Fig. 3, the attitude sensitive valve 58 shuts off flow of the CO₂ if the assembly of Fig. 1D should be tipped beyond, for example, an angle of 45° to vertical. The
30 valve 58 consists of a small piece of rubber tubing 64 at the bottom of which is located a weight 65. This ensures that the tube 64 hangs vertically. The tube 64 includes a pinch point 66 and hangs in a pinch ring assembly 67. The pinch-

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ring assembly 67 is secured in a circular opening 68 of the container cover 27. Any significant deviation off of the vertical causes the member 69 to pinch the tube 64 at the pinch point 66 and close it off. Thus the valve 58 prevents acid or other liquids from entering the region 68 and the gas outlet channel 56 should the equipment be misused and tipped out of vertical, which would normally not occur since the system can only be started when the cartridge 1 is fitted into the vessel 22 and which is thereafter installed in a drink dispenser or other type user equipment. The flow restrictor 57, on the other hand, comprises a rubber diaphragm 70 attached to an apertured disc 71 mounted in a circular opening 72 which intersects the horizontal channel 56. As gas flow increases, the rubber diaphragm 70 is pressed against the apertures 71 of the disc 70, thus restricting CO₂ flow into the channels 55 and 56 leading to output valve assembly 60. Completing the structure shown in Fig. 2, CO₂ exits outlet port 9' where it is fed to the port 59 in the cover element 27 via the CO₂ flow region 28 intermediate the cover 27 and the top of the canister 1 between the inner and outer rims 25 and 47 thereof. A pressure relief valve 73 of a conventional type, whose purpose is to provide an emergency pressure release if an unforeseen gas pressure build up occurs in the cartridge 1, is attached to cover 27 at the location of a small vertical bore 74 through the cover and communicates with the flow region 28.

Having shown the details of the disposable, renewable cartridge 1, the pressure vessel 22 in which it is placed, and the cover assembly 23 therefor which make up a composite CO₂ generator unit for installation in a dispenser, reference will now be made to Figure 4 where there is shown the details of an activator and coupling assembly which is used for

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attaching the CO₂ generator as shown in Figure 2 to the dispenser 63. The male fitting 62 is designed to provide a quick release coupling when pressed into a mating counterpart located in a bore 75. A pivoted lever 76 attached to the
5 dispenser 63 at point 77 includes a manually operable handwheel 78. The handwheel 78 is free to rotate in a single direction by being located in a conventional shaft and bearing 79 which also includes a ratchet which restrains
10 clockwise, looking down from the top of the apparatus as shown in Figure 4. The handwheel includes an outwardly projecting element or tooth 81 on the shaft 82 which rotates with the handwheel 78 so as to engage a slot 83 formed in the side surface 84 of the body member 31. As the handwheel 78
15 is rotated clockwise, the tooth 81 engages the slot 83 and prevents the CO₂ generator unit from being uncoupled from the dispenser body 63. It moreover prevents the lever 76 from being raised until a full operating cycle, to be described hereinafter, has been completed.

20 The handwheel additionally includes a pair of cams 84 and 85 having respective cam surfaces which operate to engage the top surfaces 88 and 89 of the plunger member 88 and the needle type member 41. A third cam surface 90 is formed on the perimeter of the handwheel 78 for engaging the valve stem
25 91 of the vent valve 51.

Referring now to Figures 5A-5E, shown thereat is the sequence of operations which take place when operating the apparatus according to the subject invention. Figure 5A is illustrative of the pressure vessel 22 with the cover
30 assembly 23 including the cover 27, the locking ring 26 and pusher assembly 20 secured thereto and with the cartridge 1 ready for use, inserted therein. The apparatus as shown in Figure 5A constitutes a CO₂ generator ready for connection to

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a dispenser.

Figure 5B discloses the apparatus shown in Figure 5A connected to the dispenser 63. This is accomplished by pushing the male portion 62 of the valve assembly 60 (Fig. 2) into the bore 75 followed by a lowering of the lever 76 including the handwheel 78.

Next as illustrated in Figure 5C, the handwheel 78 is rotated clockwise. This causes the tooth 81 to engage the slot 83 which locks the apparatus in place on the dispenser. At the same time, the cam 84 presses on the surface 88 of the pusher 34. This causes the end section 35 to depress the flexible domed roof 12 of the starting section 11, causing the plug 14 to be pushed out, whereupon the reagent R_b contained therein falls into the liquid reagent R_a in the container 3, causing CO_2 to be generated therein. This results in a pressure build-up which forces the liquid reagent R_a into the standpipe 7, forcing the plug 6 from its seat 16. The liquid reagent R_a flows into the outer container 2 where it then reacts with the reagent R_b . CO_2 is formed in the outer container 2 where it rises to the top thereof where it flows into the opening 36 of the pusher member 34. The CO_2 flows through the needle 38 to opening 37 where it is fed into the filter section 8. Upon leaving the filter section via outlet port 9', CO_2 flows into the gas flow region 28 where it is fed to the output valve assembly 61 of the cover assembly 23 via the channels 55 and 56 and as further illustrated in Figures 2 and 3.

When the demand for CO_2 ceases, the pressure in the outer container 2 rises to equal that in the inner container 3 which acts to push the liquid reagent R_a back into the inner container 3, stopping the reaction. As soon as a further demand for CO_2 arises, the pressure in the outer container 2 drops and the liquid reagent reenters the outer chamber 2 to

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contact the reagent R_b . The operation repeats itself in a start/stop mode according to demand.

When the cartridge 1 is spent, as shown in Figure 5D, and prior to its removal from the dispenser 63, the inner
5 container 3 is vented to the atmosphere by a further clockwise rotation of the handwheel 78. This causes the cam surface 85 (Fig. 4) to depress the end of the needle 41, whereupon it projects out from the end portion 35 of the lower end portion 35 of the pusher member 34, to puncture the
10 seal 13. Due to the existence of the side aperture 40 in the needle element 38, as shown in Figure 3, any CO_2 in the upper portion of the inner chamber 3 passes into the filter section 8 from the side opening 37 in the lower section of the pusher member 35 where it exits the canister 1 into the CO_2 flow
15 region 28. From there the gas proceeds to the vent valve 51 which is held open by virtue of the cam surface 90 depressing the valve stem 91.

Following venting of the inner container 3, the handwheel 78 is further rotated clockwise, causing the cam
20 surfaces 84 and 85 to release both the plunger member 34 as well as the needle member 41, causing them to retract away from the domed starter section 11 as shown in Figure 5E. This is accompanied by a resealing of the seal 13. This is further accompanied by a rotation of the tooth 81 out of the
25 slot 83 which, when the lever 76 is moved upward, the CO_2 assembly can be pulled back from the dispenser 63, causing the valve portion 62 to be removed from the bore 75 in a quick release disconnection.

Once the CO_2 generator has been removed from the
30 dispenser 63, the cover assembly 23 can be opened and the cartridge 1 removed from the container 22, whereupon it can be reloaded with a fresh cartridge and reconnected to the dispenser as described above.

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It should be noted that the headroom of the inner container 3 is sealed by virtue of the member 13 and therefore any liquid reagent R_a remaining is trapped within the inner container 3 so that the cartridge 1 can be disposed of safely. Any residual liquid reagent R_a left in the outer container 2 has been neutralized by the reagent R_b . It, however, cannot escape since it is trapped in the annulus 92 created between the filter section 8 and the outer container 2.

10 Having thus shown and described what is at present considered to be the preferred embodiment of the invention, the claimed invention is defined in the following claims.

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CLAIMS:

1. Apparatus for chemically generating a gas for a utilization device, comprising:

a cartridge for generating a gas including a pair of containers having a partition therebetween for defining first
5 and second reagent chambers;

an elongated reagent feed tube, including a removable closure member, located in said first chamber;

a passage between one end of said feed tube and said second chamber for permitting the travel of reagent between
10 said chambers;

a first reagent in said first chamber and a second reagent in said second chamber, said first reagent and said second reagent chemically reacting to generate said gas upon contact with each other, said second chamber including a
15 region in the top portion thereof for holding the gas generated;

means for starting a reaction between said first and second reagents and including a predetermined portion of said second reagent in the top portion of said first chamber for
20 contacting said first reagent in said top portion thereof for generating a gas thereat and causing a predetermined pressure to be applied to the top of said first reagent in said first chamber to urge said first reagent into the feed tube to remove said closure member and permit said first reagent to
25 traverse said passage and contact said second reagent and thereby generate said gas in said second chamber; and

a gas outlet port for coupling said gas out of said cartridge.

2. The apparatus as defined by claim 1 wherein said
30 first reagent comprises a liquid reagent.

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3. The apparatus as defined by claim 2 wherein said removable closure member comprises a pressure activated plug normally closing one end of the feed tube, said plug being removed from said one end of the feed tube by the
5 predetermined pressure applied to the top of the first reagent.

4. The apparatus as defined by claim 2 wherein said first chamber includes a top wall and wherein said means for starting a reaction includes an inverted section of said top
10 wall and an upwardly turned removable plug in said inverted section for holding said predetermined portion of said second reagent until said removable plug is dislodged from said inverted section.

5. The apparatus as defined by claim 4 wherein said
15 inverted section comprises a domed shell including a flexible roof member engageable with said upwardly turned plug, said roof member when flexed springs toward said removable plug and dislodges said plug and release said predetermined portion of said second reagent.

20 6. The apparatus as defined by claim 2 wherein there is further provided filter means in the top portion of said second chamber for filtering said gas at the top portion of said second container fed to said outlet port, said filter means including a tortuous passage for said gas to said gas
25 outlet port and filter material located in said tortuous passage.

7. The apparatus as defined by claim 2 wherein said feed tube is centrally located in said first chamber.

8. The apparatus as defined by claim 7 wherein said feed tube has a length at least equal to one half the length of said first chamber.

9. The apparatus as defined by claim 2 and additionally including means at said passage for restricting said second reagent from reaching said feed tube.

10. The apparatus as defined by claim 9 wherein said means for restricting includes filter material located in said passage.

11. The apparatus as defined by claim 9 wherein said means for restricting includes a screen at one end of said passage.

12. The apparatus as defined by claim 2 wherein said first and second containers comprise cylindrical containers.

13. The apparatus as defined by claim 12 wherein said first and second containers comprise inner and outer coaxial containers, respectively, and wherein said partition comprises a cylindrical wall of said inner container.

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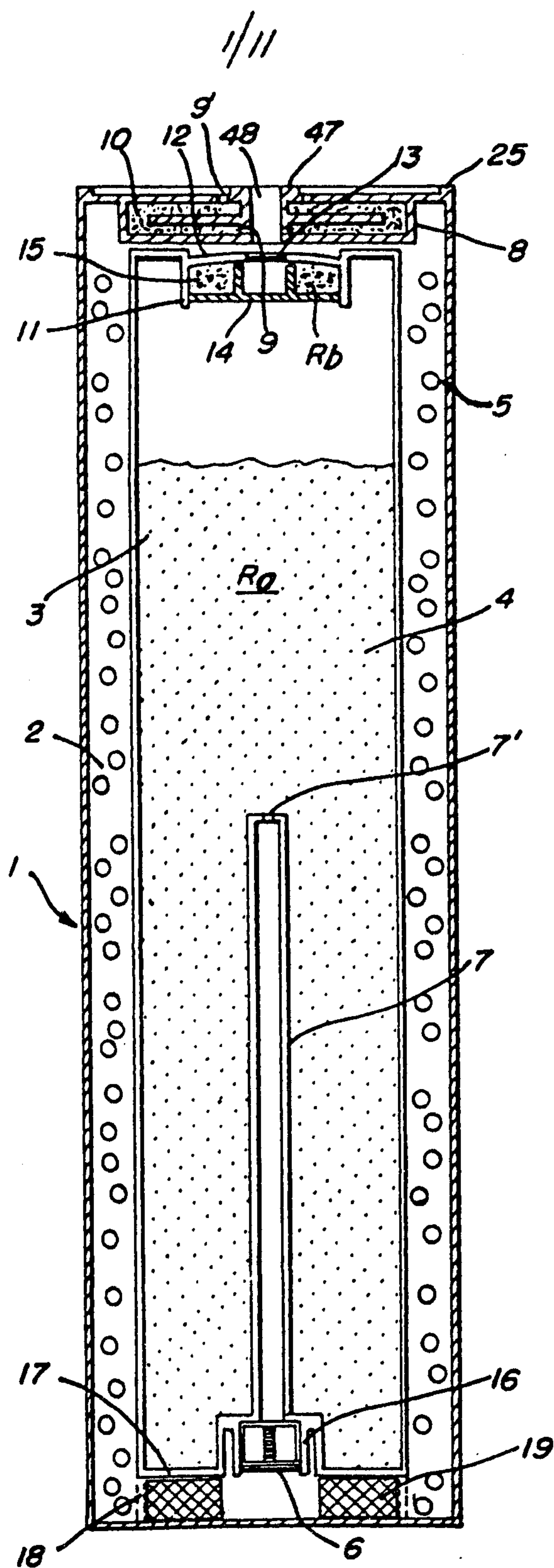


FIG. 1A

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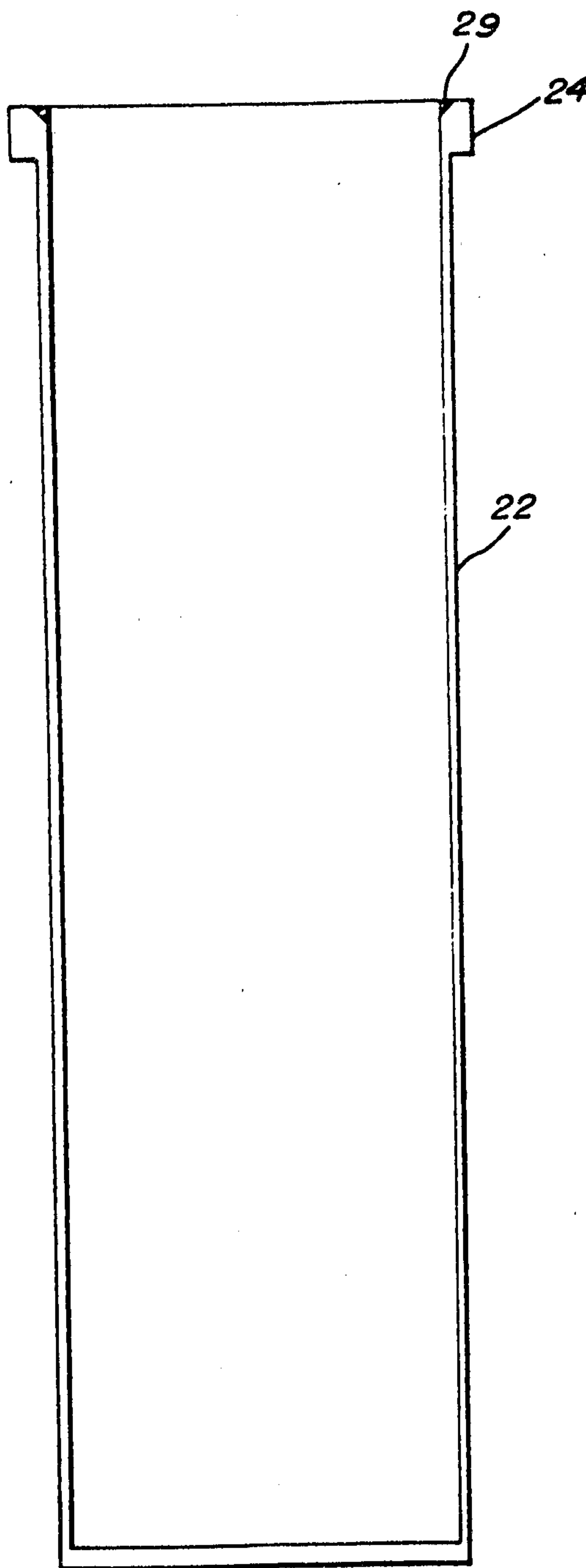


FIG. 1B

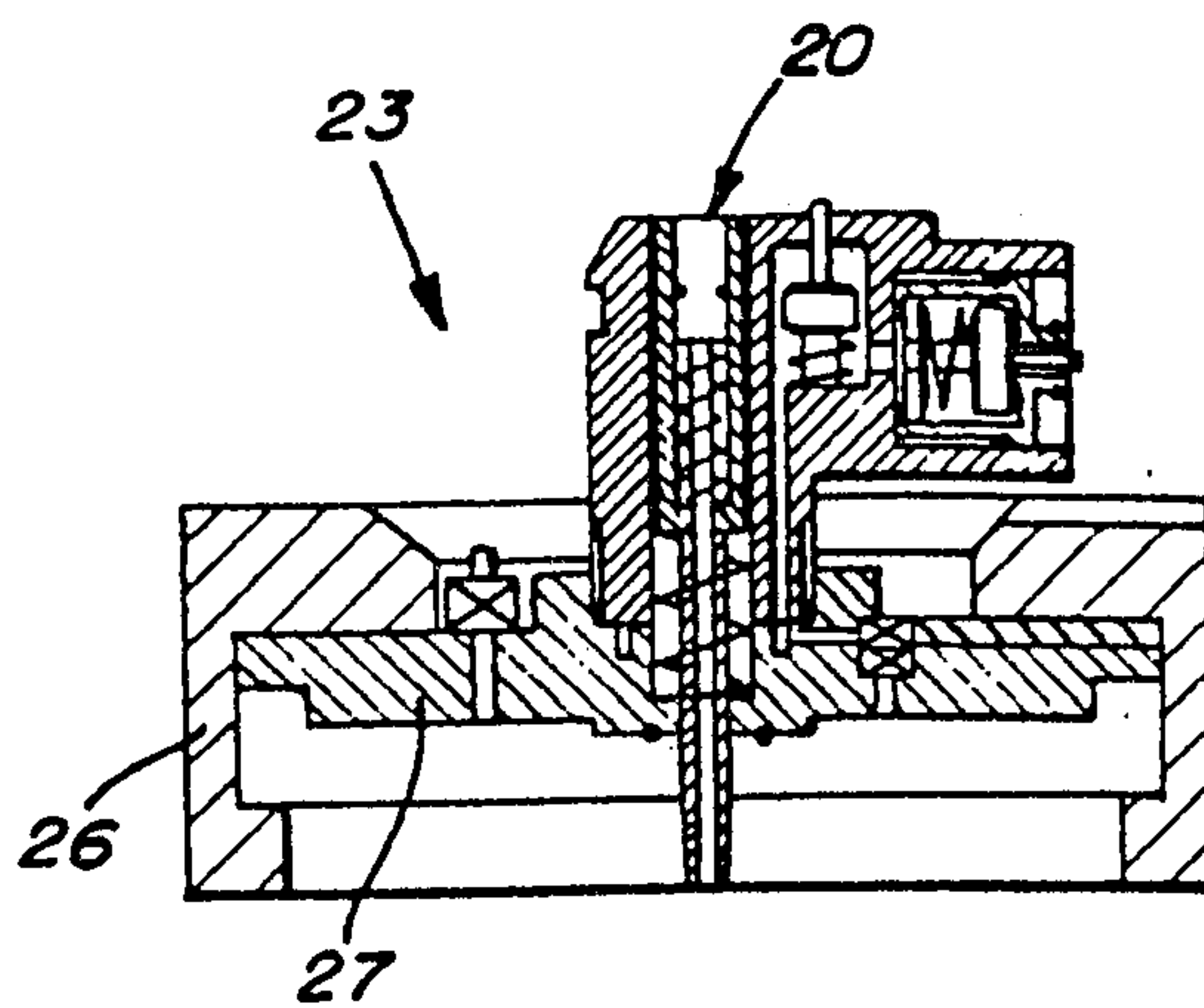


FIG. 1C

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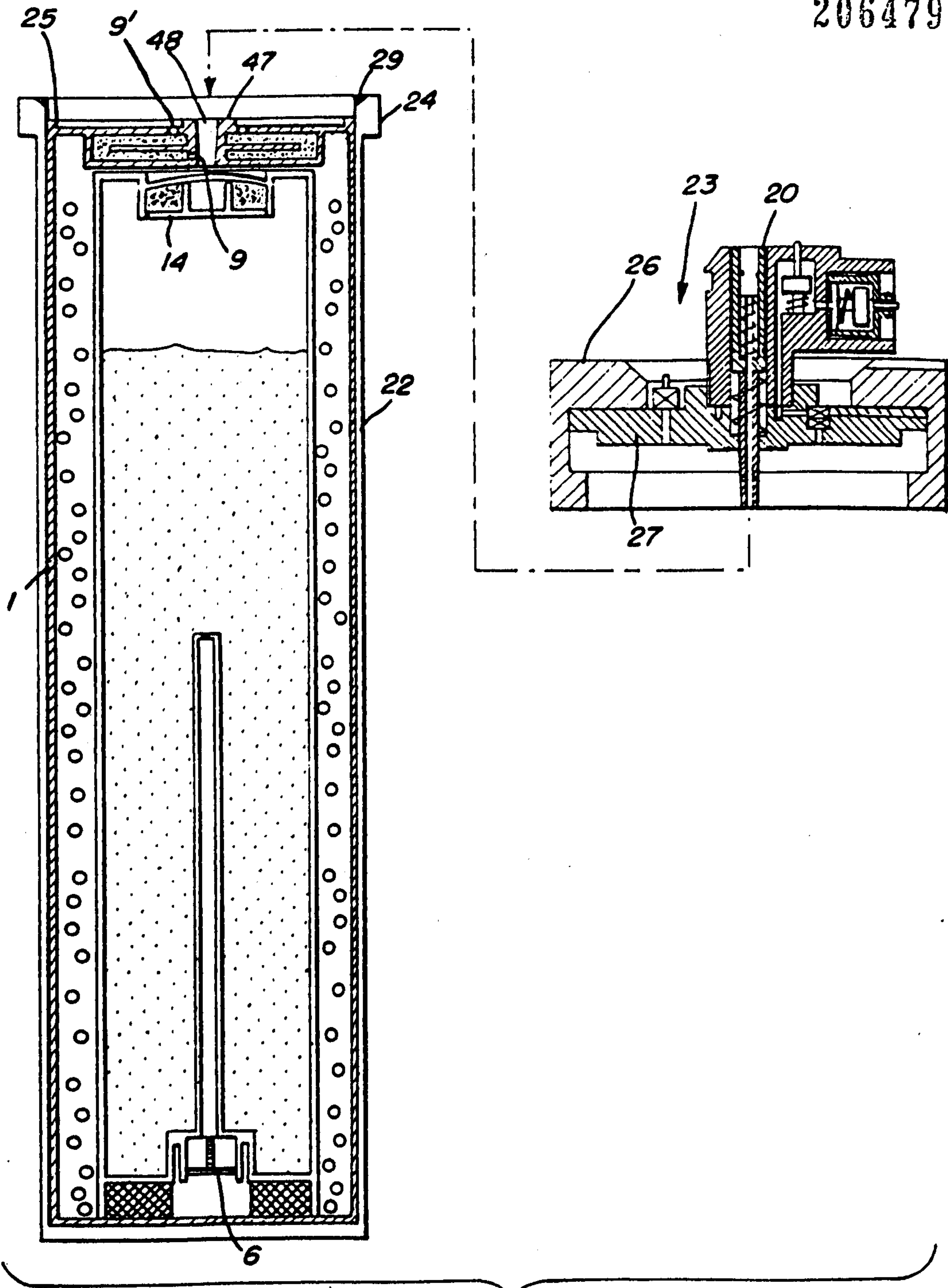


FIG. 1D

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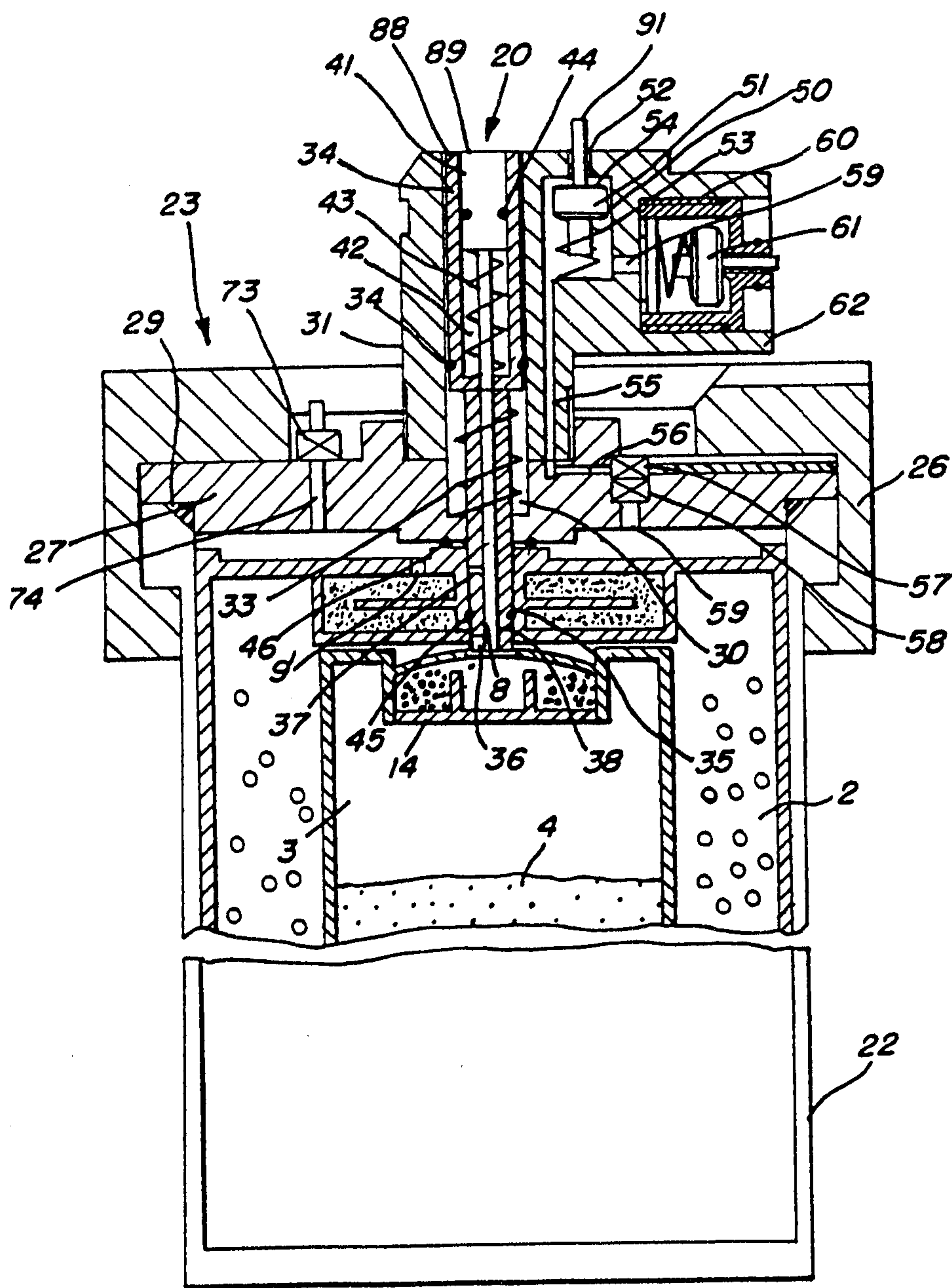


FIG 2

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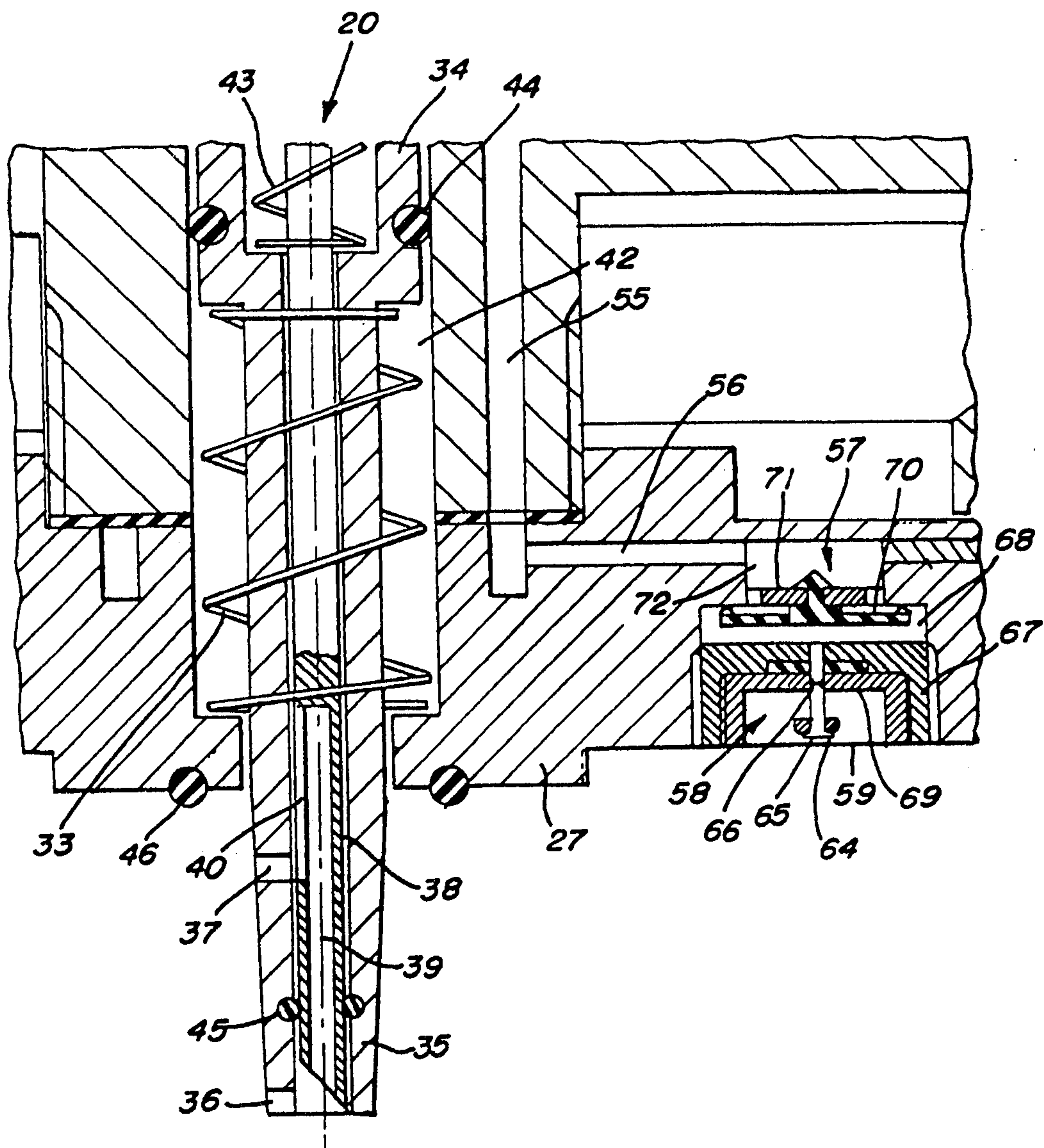
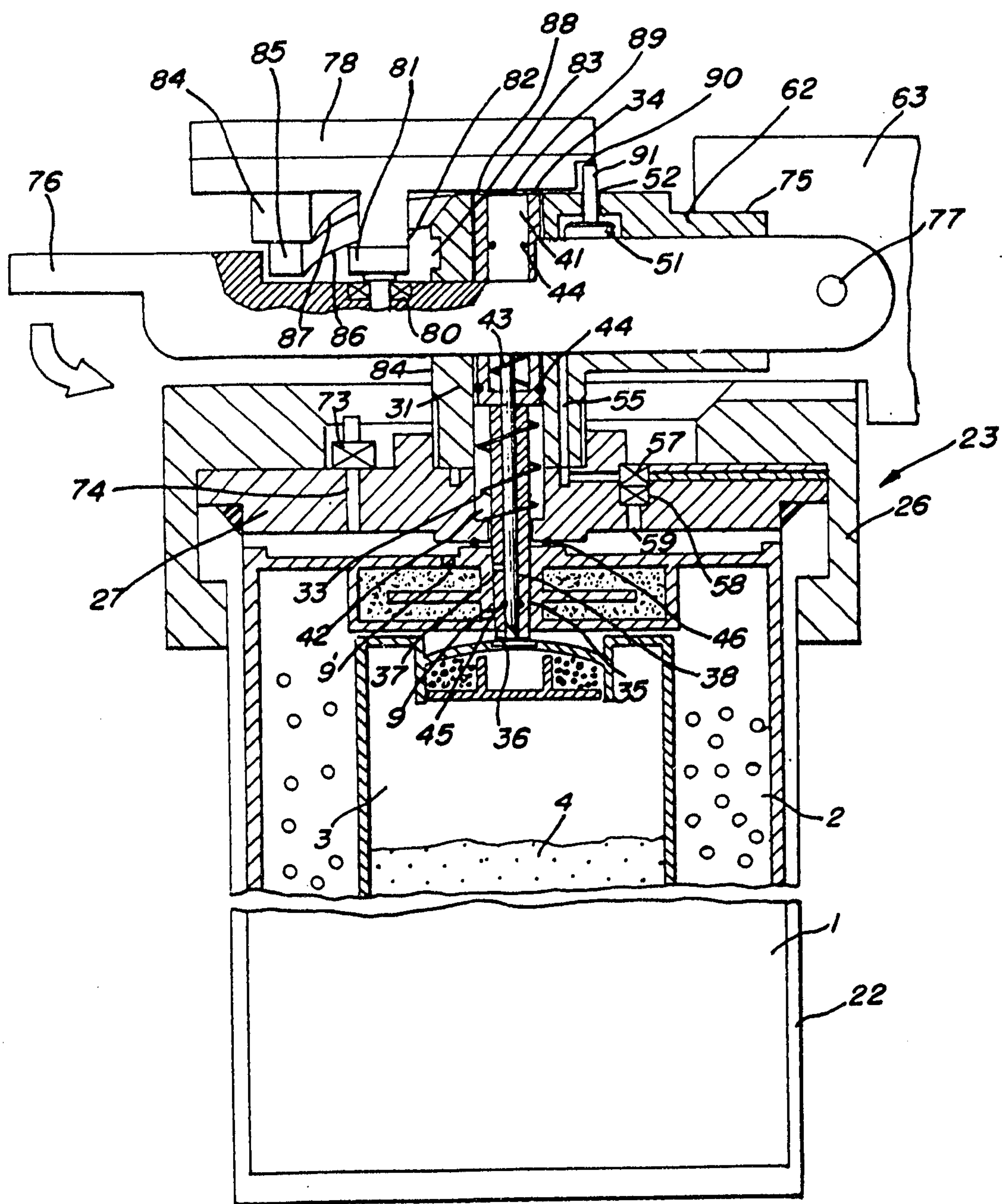


FIG. 3

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**FIG 4**

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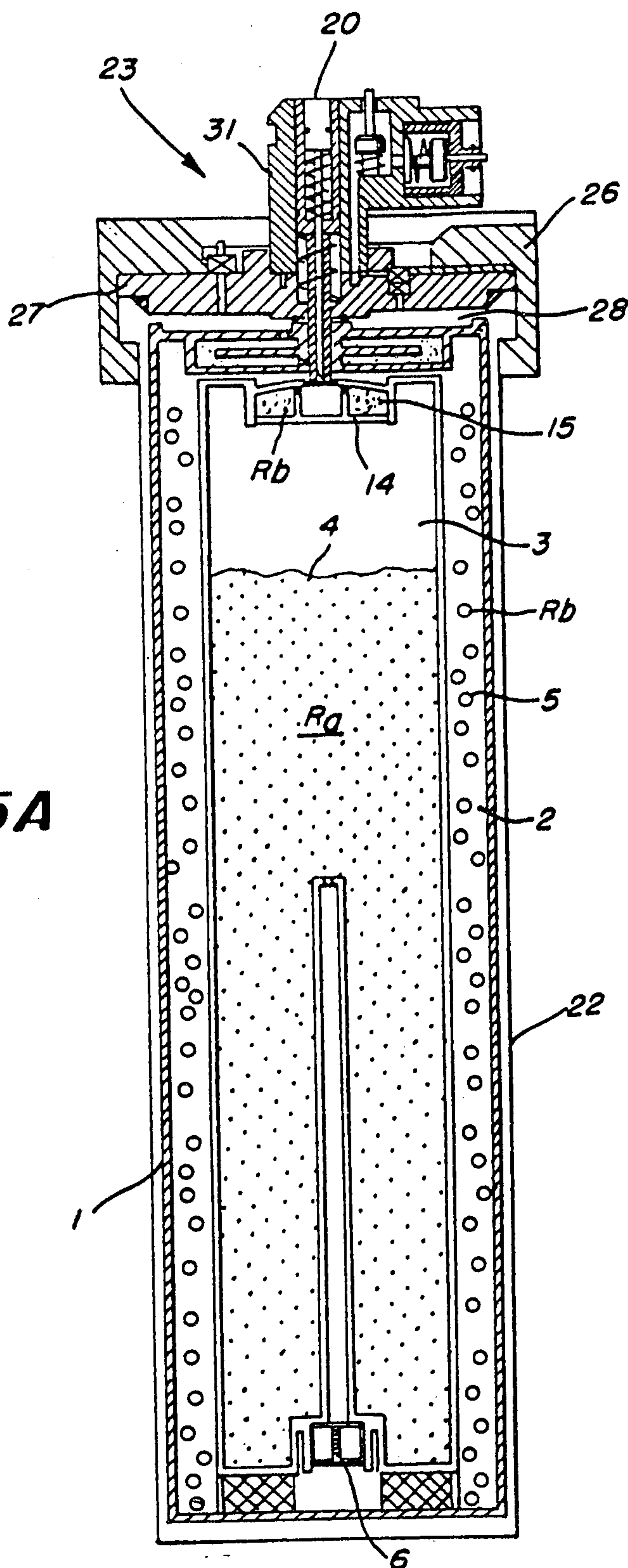
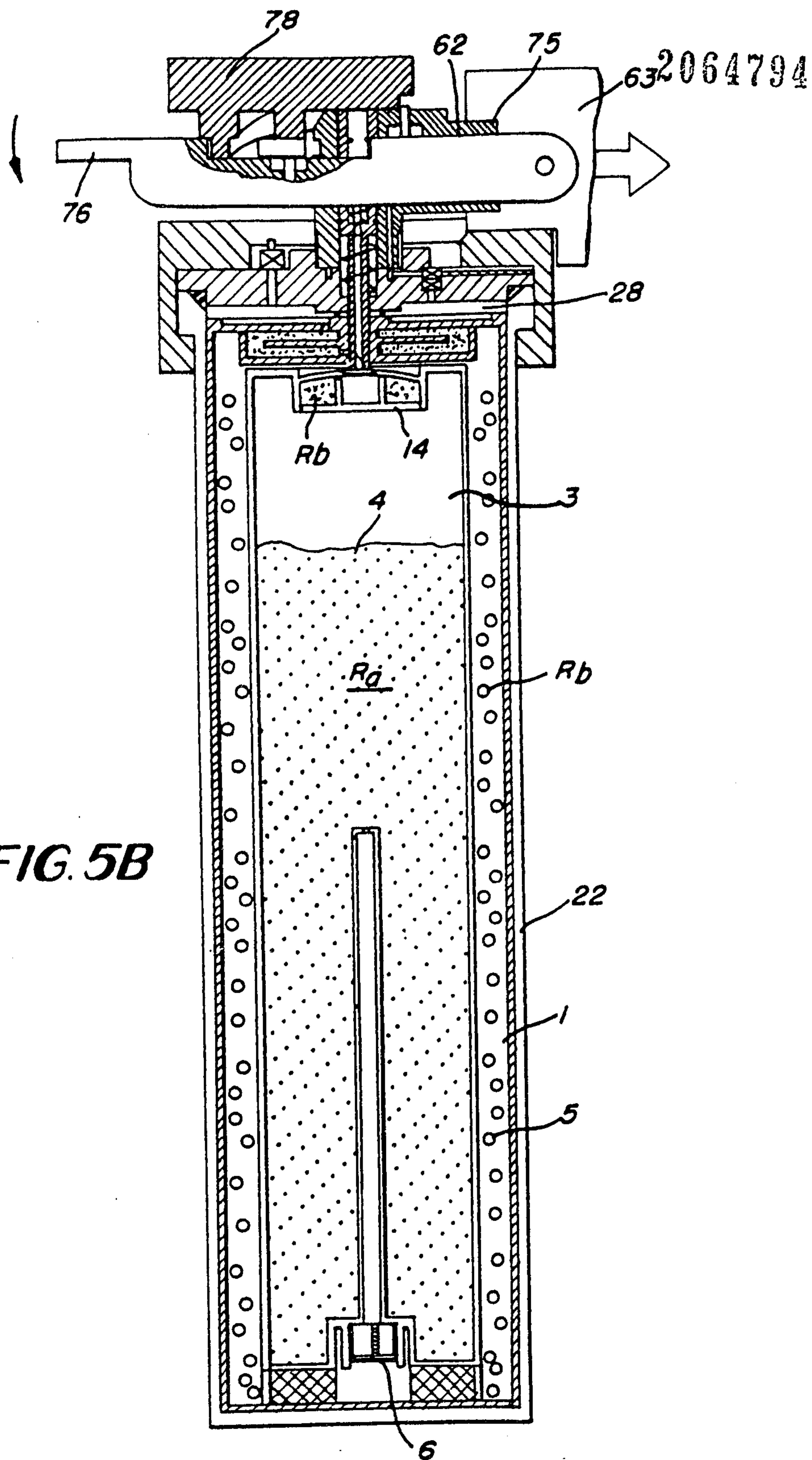
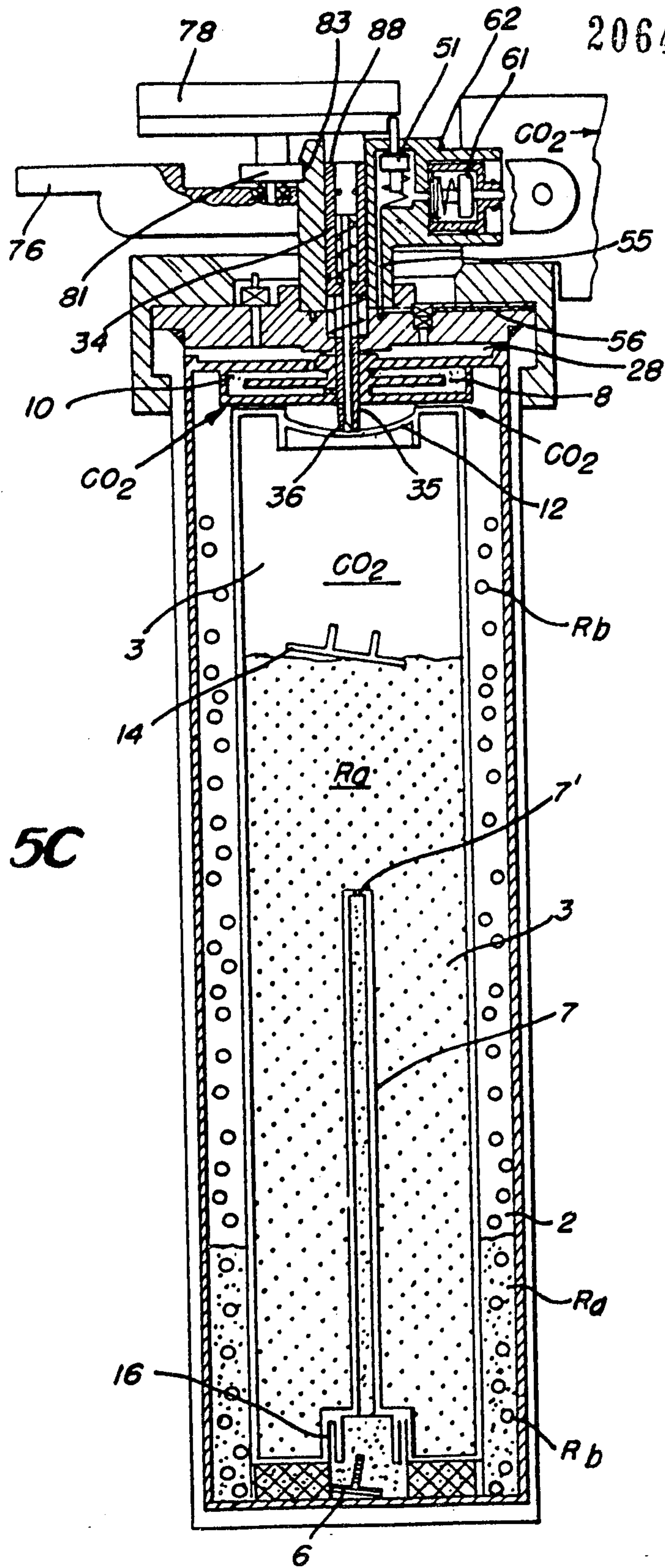


FIG. 5A

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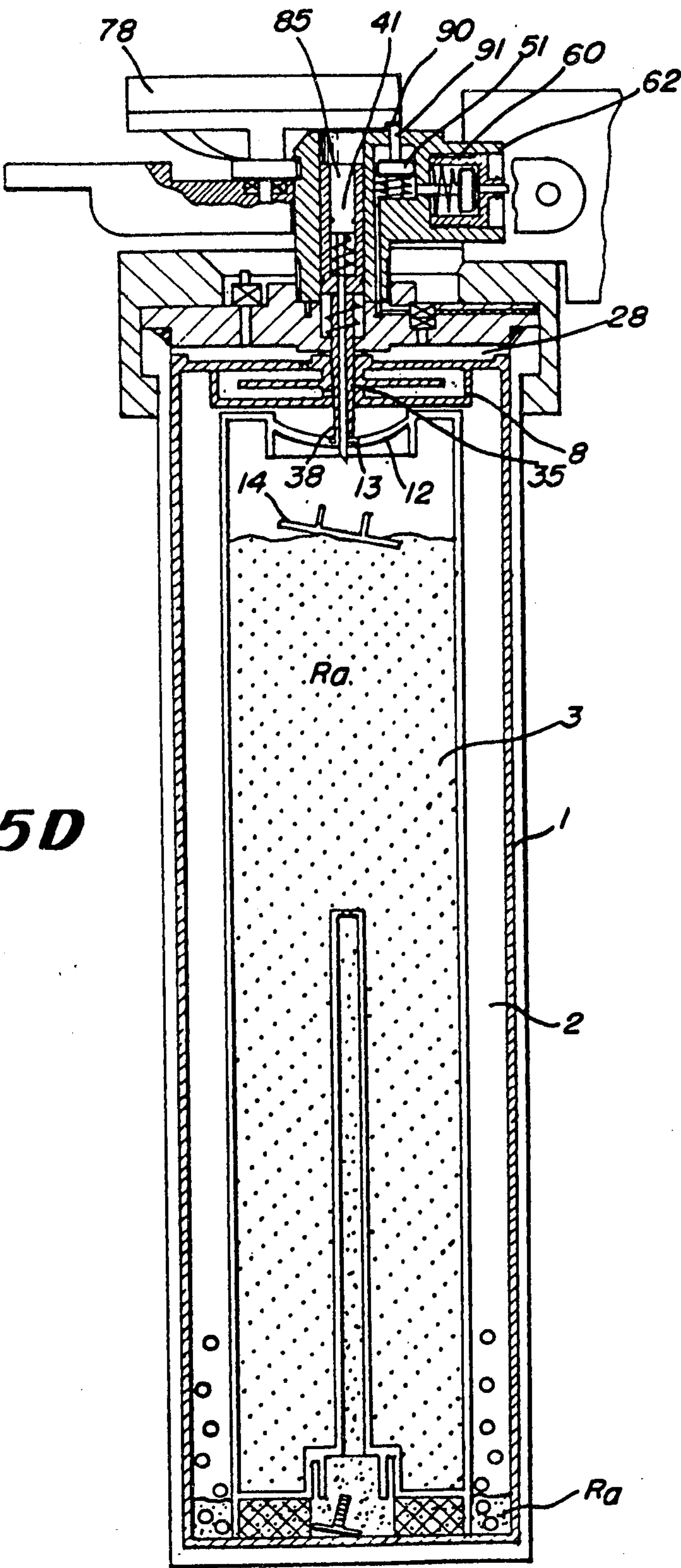


FIG. 5D

