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## (54) Apparatus for the aeration of water, beverages and liquids in general

(57) An apparatus (10) for the aeration of water, beverages and liquids in general, comprises a tank (11) provided with one or more inlets (17) connected to a supply (A) of the liquid to be aerated, one or more inlets (19) connected to a source (B) of gas under pressure, and one or more outlets (21) for removal of the aerated liquid, and also comprises valves (18, 20, 22) which regulate the flow of fluid along each inlet (17, 19) and each outlet (21); at least one rotating member (24) provided with agitating means is housed in a freely rotatable manner inside the tank (11) and is arranged opposite the gas inlet so as to be actuated by the gas introduced into the tank (11) and so as to agitate the liquid to be aerated which has been introduced into the tank (11). This apparatus is simple, reliable, low-cost and requires little maintenance.

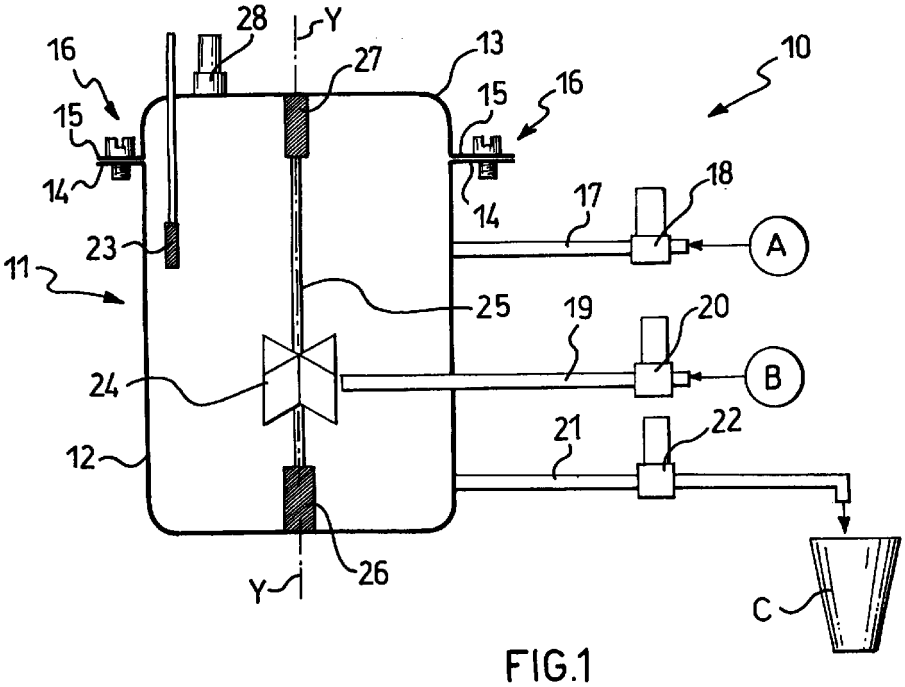


FIG.1

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## Description

**[0001]** The present invention relates to an apparatus for the aeration of water, beverages and liquids in general.

**[0002]** A known type of apparatus for the aeration of water essentially comprises a tank having two inlets and an outlet, a probe inside the tank for checking the level of the water inside the tank, a high-pressure pump for the introduction of water, connected to one of the two tank inlets, while the other inlet is connected to a carbon dioxide source, solenoid valves mounted on the inlets and on the outlet which allow or prevent the flow of fluid, and an electronic command and control unit connected to the probe, to the pump and to the solenoid valves for management thereof.

**[0003]** According to the operating principle of this apparatus, carbon dioxide is first introduced into the tank and water is then introduced into the tank by means of the high-pressure pump. This pump vaporises the water, or rather reduces it into minute particles, so that there is intimate contact between water and carbon dioxide and so that the carbon dioxide therefore dissolves in an optimum manner in the water. Once aeration of the water has occurred, the apparatus is ready to deliver the aerated water upon request. In order to allow delivery of the aerated water, more carbon dioxide than that required for aeration of the water is introduced into the tank so that the tank always has inside it the pressure needed to discharge it. When the tank has been discharged down to a minimum water level, a new cycle involving filling and aeration of the water inside the tank in the manner described above commences.

**[0004]** Such an apparatus is certainly efficient, but there is the problem of the high cost of the high-pressure pump which increases substantially the cost of the entire apparatus.

**[0005]** In order to overcome this problem, an apparatus without a pump has been provided, said apparatus having in place of the pump an impeller arranged inside the tank and operated by a high-speed external electric motor connected to the impeller by means of a shaft. In this case, the water is introduced first, followed by the carbon dioxide, and finally the impeller is operated, thereby reducing the water into minute particles. The tank is provided with a relief valve for eliminating the residual carbon dioxide when the minimum water level has been reached; the pressure of the residual carbon dioxide would in fact prevent the introduction of new water, while in the first type of apparatus described it is the pump which overcomes the pressure of the carbon dioxide.

**[0006]** This second type of apparatus is less costly than the first type described, but there is the problem of the seal at the point where the shaft which connects the (external) motor to the (internal) impeller enters the tank. Normally a stuffing-box seal is used. In view of the high speed of the drive shaft, this seal may be subject to wear, thus adversely affecting operation of the apparatus. It is therefore necessary to check the seal periodically and replace it when necessary.

**[0007]** The object of the present invention is to propose an apparatus which does not have the abovementioned problems associated with the known apparatus and which at the same time is simple and efficient.

**[0008]** This object is achieved by means of an apparatus for the aeration of water, beverages and liquids in general, comprising a tank provided with one or more inlets connected to a supply of the liquid to be aerated, one or more inlets connected to a source of gas under pressure, and one or more outlets for removal of the aerated liquid, and comprising valve means which regulate the flow of fluid along each inlet and each outlet, characterized in that it comprises at least one rotating member which is provided with agitating means and is housed in a freely rotatable manner inside the tank and arranged opposite the gas inlet so as to be actuated by the gas introduced into the tank and so as to agitate the liquid to be aerated which has been introduced into the tank.

**[0009]** So that the invention may be understood more fully, a non-limiting example of an embodiment thereof is described below and illustrated in the accompanying drawings in which:

Fig. 1 is a schematic view of an apparatus for the aeration of water according to the invention;
Figs. 2A, 2B, 2C and 2D illustrate operation of the apparatus according to Fig. 1;
Fig. 3 is a schematic view of an apparatus similar to that of Fig. 1 with the addition of a pressure compensation system;
Figs. 4A, 4B, 4C and 4D illustrate operation of the apparatus according to Fig. 3.

**[0010]** The apparatus illustrated in Fig. 1, which is denoted in its entirety by 10, comprises a tank 11 composed of a bottom part 12 and a top part 13 which has dimensions smaller than those of the part 12. The two parts 12 and 13 of the tank 11 are joined by means of respective flanges 14 and 15 which are clamped together by bolts 16. A sealing gasket, not shown, is located between the flanges 14 and 15.

**[0011]** A first inlet pipe 17, connected to a water supply A and on which a shut-off solenoid valve 18 is arranged, leads into the tank 11.

**[0012]** In addition, a further inlet pipe 19, connected to a source B of carbon dioxide under pressure and on which a shut-off solenoid valve 20 is arranged, leads into the tank 11.

**[0013]** Finally an outlet pipe 21, on which a shut-off solenoid valve 22 is arranged, extends from the tank 11.

**[0014]** The tank 11 has, arranged inside it, a probe 23 for detecting the level of the water inside the tank. This probe 23 is fixed using known means to the tank itself.

**[0015]** The tank 11 is also provided internally with an

impeller 24 arranged opposite the pipe 19 for entry of the carbon dioxide. The impeller 24 is integral with a shaft 25 arranged on a central axis Y of the tank 11. One end of the shaft 25 is rotatably supported by a bush 26 integral with the bottom part 12 of the tank 11, while the other end of the shaft is rotatably supported by a bush 27 integral with the top part 13 of the tank 11. The pipe 19 extends inside the tank 11 as far as the impeller 24.

**[0016]** At the top the tank 11 is provided with an external solenoid relief valve 28.

**[0017]** The solenoid valves 18, 20, 22, the probe 23 and the solenoid valve 28 are connected to an electronic command and control unit, not shown, which is responsible for management thereof.

**[0018]** The operating principle of the apparatus 10 is described hereinbelow, with reference to Figs. 2A, 2B, 2C and 2D.

**[0019]** In the rest condition, shown in Fig. 2A, all the solenoid valves 18, 20 and 22 are closed.

**[0020]** In the operating condition, in order to obtain aerated water, water is first introduced, as illustrated in Fig. 2B. In this case the solenoid valve 18 is opened and the water flows into the tank 11 through the pipe 17 up to a predetermined level detected by means of the probe 23 (not illustrated in Figs. 2A, 2B, 2C and 2D).

**[0021]** At this point, as illustrated in Fig. 2C, the solenoid valve 18 is closed and the solenoid valve 20 is opened. In this way carbon dioxide under pressure flows into the tank 11 via the pipe 19. The stream of carbon dioxide strikes the impeller 24 which starts to rotate until it reaches a high speed of rotation. The vanes of the impeller 24 thus violently strike the water and reduce it into minute particles so as to produce intimate contact between the water and carbon dioxide. Once the predetermined quantity of carbon dioxide has been introduced, the solenoid valve 20 is closed again. In order to allow delivery of the aerated water, as described in the introduction, more carbon dioxide than that necessary for aeration of the water is introduced into the tank 11 so that the tank always has inside it the pressure needed to discharge it.

**[0022]** At this point, aerated water is present inside the tank 11. Where there is requirement on the part of the user, the solenoid valve 22 is activated so as to open, as shown in Fig. 2D. The aerated water is pushed outside by the pressure existing inside the tank 11 and is conveyed outside, for example into a cup C.

**[0023]** When the tank 11 is nearly empty, or when the aerated water inside the tank has reached a minimum level again detected by means of the probe 23, the residual carbon dioxide left inside the tank in order to create pressure is discharged via the solenoid relief valve 28 (also not illustrated in Figs. 2A, 2B, 2C and 2D) so as to allow the introduction of fresh water.

**[0024]** At this point a new water aeration cycle commences and the tank is again full of aerated water.

**[0025]** The apparatus according to Fig. 3, denoted in its entirety by 30, comprises the same components as seen in the apparatus 10, which are therefore indicated for the sake of simplicity by the same reference numbers, and in addition comprises a pressure compensation system which allows the solenoid relief valve 28 to be eliminated.

**[0026]** This pressure compensation system comprises a membrane made of deformable material, denoted 31, located inside the tank 11. The edge of the membrane 31 is clamped between the flanges 14 and 15 by the action of the bolts 16. The membrane 31 defines at the top in the part 13, inside the tank 11, a chamber 32 communicating with the exterior via a filling valve 33. The chamber 32 is filled with fluid under pressure, for example air, via the valve 33 and the membrane 31 is thus deformed downwards.

**[0027]** Owing to the presence of the membrane 31 and the associated chamber 32, the bush 27, which supports the top of the shaft 25 of the impeller 24, is displaced downwards inside the part 12 and is supported by a cross-piece 35 integral with the walls of the part 12 itself.

**[0028]** The operating principle of the apparatus 30, illustrated in Figs. 4A, 4B, 4C and 4D, is the same as that of the apparatus 10 with regard to aeration of the water. This aeration process takes place inside the chamber 36 located underneath the chamber 32 and separated from the latter by means of the membrane 31.

**[0029]** The presence of the membrane 31 and the pressurized chamber 32 relates to a given aspect of the operating principle of the apparatus 30. In particular, in the rest condition (Fig. 4A), the membrane 31, as already mentioned, is deformed downwards. During filling with water (Fig. 4B) the membrane 31 is still deformed downwards. When the carbon dioxide is introduced into the tank 11 (Fig. 4C), the pressure thereof inside the tank causes the membrane 31 to rise, reducing the volume of the chamber 32 and correspondingly increasing the volume of the underlying chamber 36 where aeration of the water occurs.

**[0030]** With delivery of the water from the tank (Fig. 4D), the pressure of carbon dioxide present inside the chamber 36 decreases and this causes downwards deformation of the membrane following the thrust of the fluid present inside the chamber 32 which has a pressure greater than that of the carbon dioxide inside the chamber 36. This movement of the membrane 31 results in a reduction in the volume inside the chamber 36, thus restoring the pressure inside this chamber. This avoids having to introduce into the tank a quantity of carbon dioxide greater than that required for aeration in order to allow delivery of the aerated water, as occurs, instead, in the apparatus 10. Moreover, as stated above, the relief valve for discharging this additional carbon dioxide when the tank is nearly empty is no longer necessary.

**[0031]** With the apparatus 10 and 30, it is possible to

overcome the problem of sealing the shaft in the known apparatus mentioned in the introduction where an external motor and internal impeller are provided, since in this case there is no operation of the external electric motor which is replaced basically by the effect of the flow of carbon dioxide under pressure against the vanes of the impeller, and the shaft of the impeller is located inside the tank so as to eliminate the problems of providing a seal with respect to the exterior.

**[0032]** The apparatus 10 and 30 are moreover less costly since they do not use either a pump or electric motor, but only a few simple passive components.

**[0033]** Among other things, the fact of operating with few passive parts results in a high degree of reliability of the apparatus.

**[0034]** As a result of the compensation system of the apparatus 30, involving the variable chamber 32, it is possible, as seen above, to use less carbon dioxide and thus increase the efficiency of the apparatus.

**[0035]** It is obvious that variations and/or additions may be made to that described and illustrated above.

**[0036]** One or more additional impellers integral with the shaft of the first impeller may be provided, in order to increase the agitating effect.

**[0037]** Several carbon dioxide inlets may also be provided at the point where the impellers themselves are arranged.

**[0038]** The impeller may be replaced by any rotating member provided with agitating means of any type (vanes and the like).

**[0039]** The membrane may be made of any resiliently deformable material. For example it may be made of rubber or may consist of a steel sheet, etc. The membrane may moreover be fixed to the tank in any manner.

**[0040]** Instead of the membrane, it would also be possible to provide a movable piston inside the tank, which has the same effect as the membrane, even though the solution of the membrane is very simple and effective.

**[0041]** The apparatus described may be used in order to introduce any type of gas under pressure into any liquid.

## Claims

1. Apparatus (10, 30) for the aeration of water, beverages and liquids in general, comprising a tank (11) provided with one or more inlets (17) connected to a supply (A) of the liquid to be aerated, one or more inlets (19) connected to a source (B) of gas under pressure, and one or more outlets (21) for removal of the aerated liquid, and comprising valve means (18, 20, 22) which regulate the flow of fluid along each inlet (17, 19) and each outlet (21), characterized in that it comprises at least one rotating member (24) which is provided with agitating means and is housed in a freely rotatable manner inside the tank (11) and arranged opposite the gas inlet so as to be actuated by the gas introduced into the tank (11) and so as to agitate the liquid to be aerated which has been introduced into the tank (11).

2. Apparatus according to Claim 1, in which said rotating member consists of an impeller (24) integral with a shaft (25) supported in a freely rotatable manner inside the tank (11).

3. Apparatus according to Claim 1 or 2, in which the rotating member (24) is arranged on a central axis (Y) of the tank (11) and a gas inlet pipe (19) which extends inside the tank (11) as far as the rotating member (24) is provided.

4. Apparatus according to any one of the preceding claims, in which a plurality of said rotating members (24) coupled in rotation with one another are provided, at least one of said members being arranged opposite the gas inlet.

5. Apparatus according to any one of the preceding claims, comprising means (31, 32, 33) for compensation of the pressure inside the tank (11).

6. Apparatus according to Claim 5, in which said compensation means comprise a member (31) which is movable inside the tank (11) and which divides the tank into a first chamber (32) into which the fluid under pressure is introduced and a second chamber (36) inside which aeration of the liquid occurs, the movable member (31) being displaced inside the tank depending on the difference in pressure between the first chamber (32) and the second chamber (36) so as to vary the volume of the second chamber (36) and correspondingly maintain the same pressure therein.

7. Apparatus according to Claim 6, in which said movable member consists of a resiliently deformable membrane (31).

8. Apparatus according to Claim 7, in which the edge of said membrane (31) is fixed to the tank (11).

9. Apparatus according to any one of the preceding claims, in which the valve means (18, 20) which regulate the entry of the liquid and the gas into the tank (11) allow, during the aeration operation, first entry of the liquid and then entry of the gas into the tank (11).

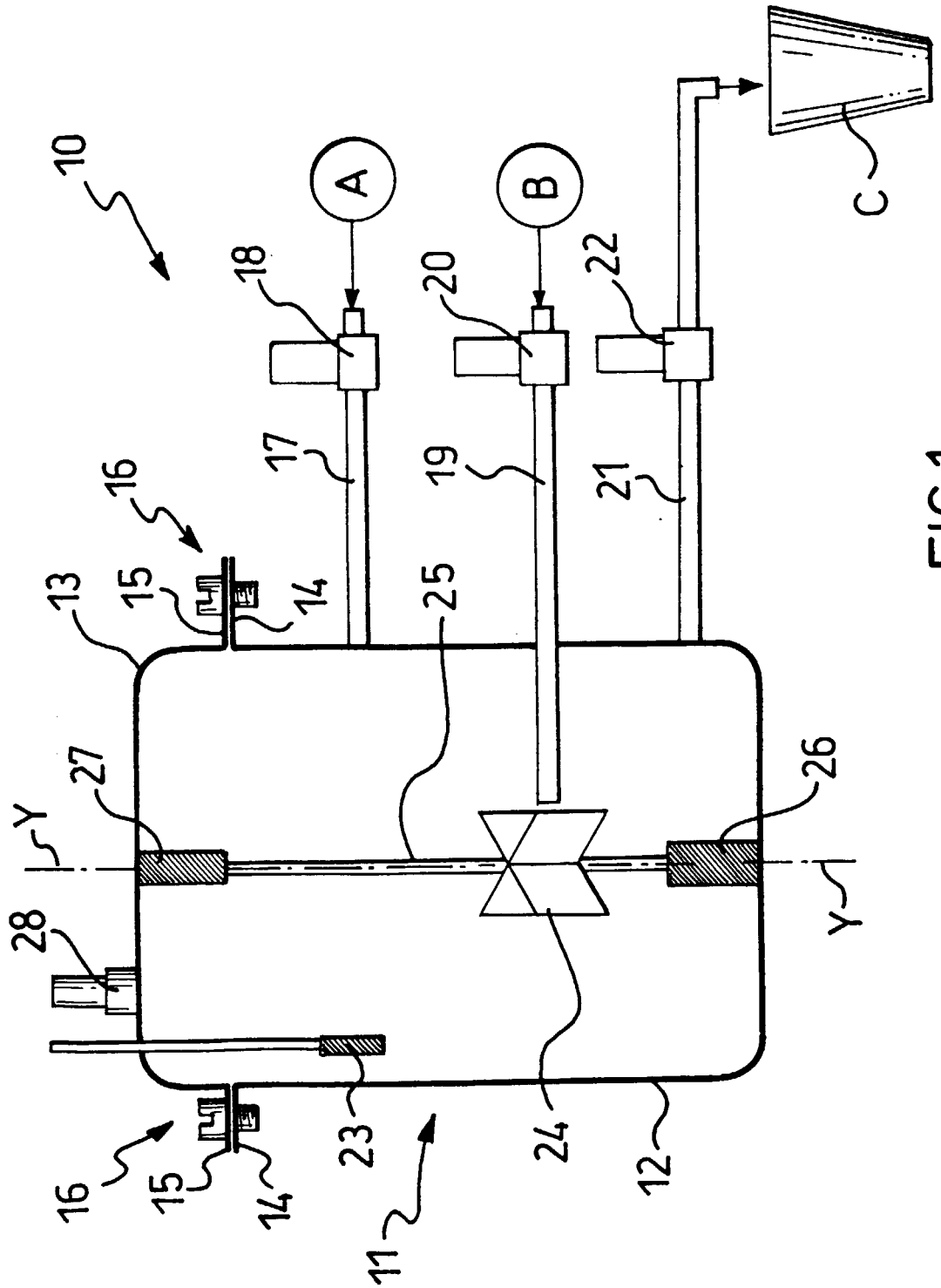


FIG.1

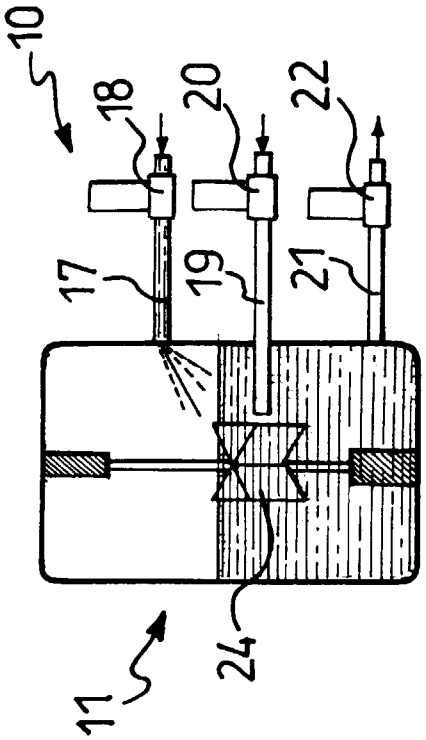


FIG.2B

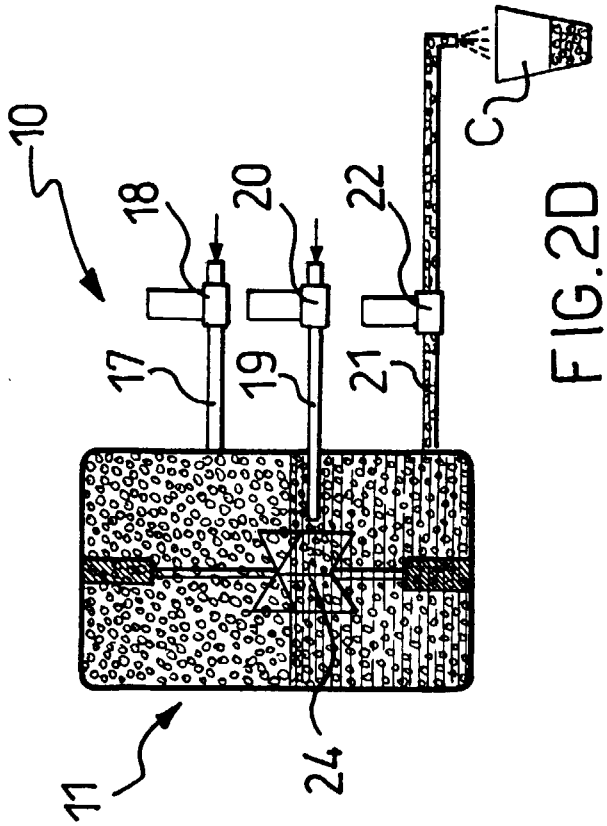


FIG.2D

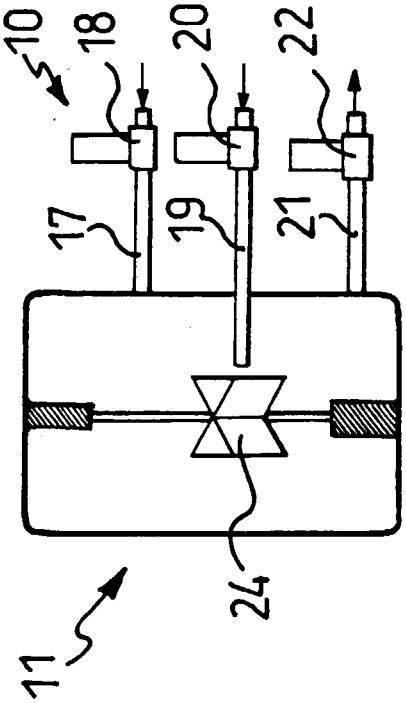


FIG.2A

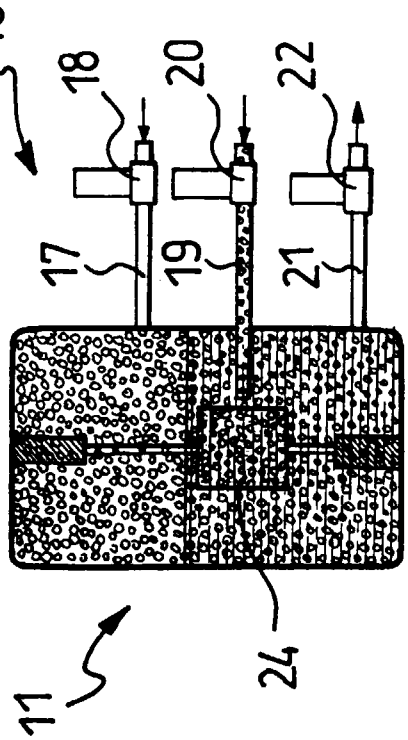


FIG.2C

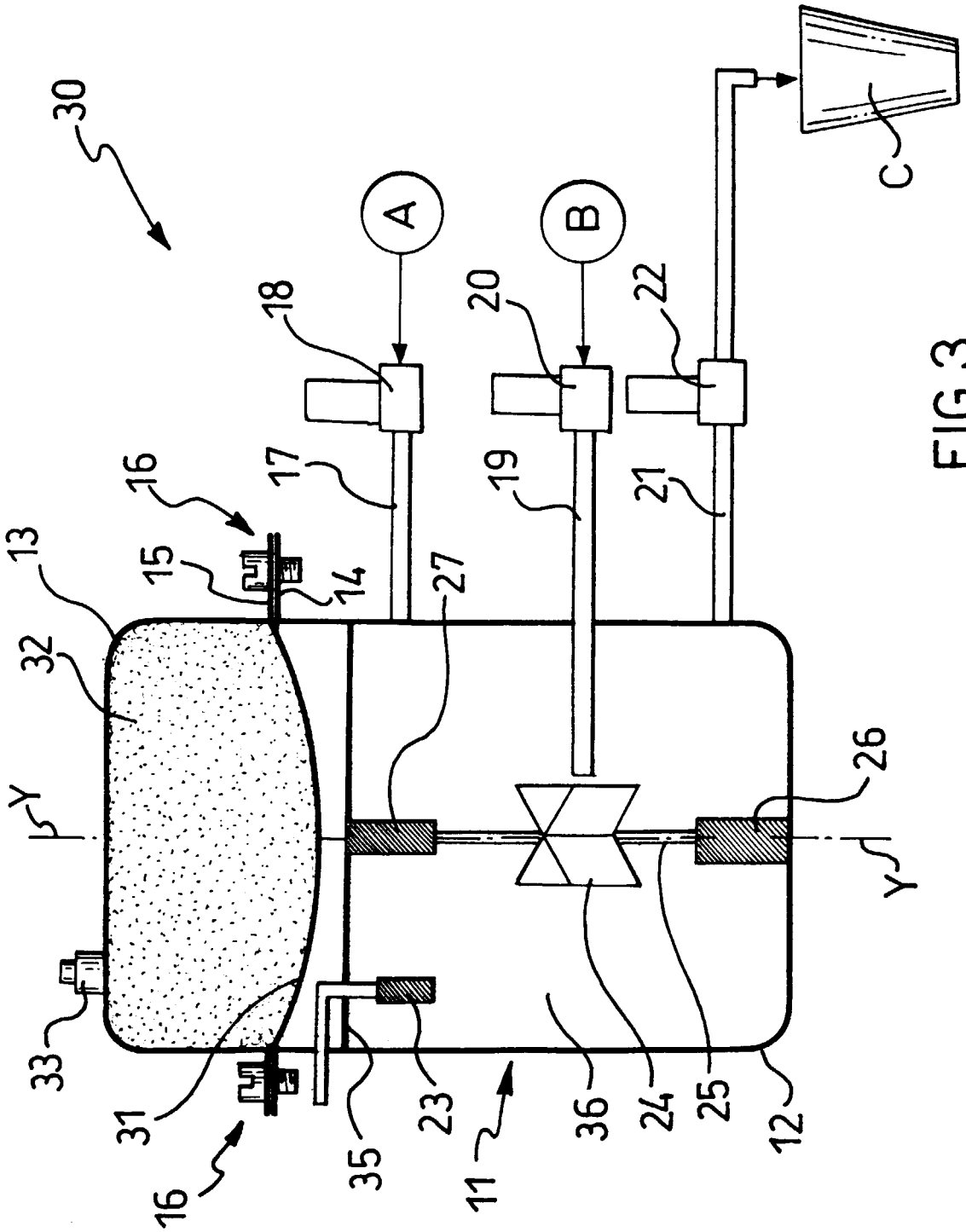
30
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FIG.3

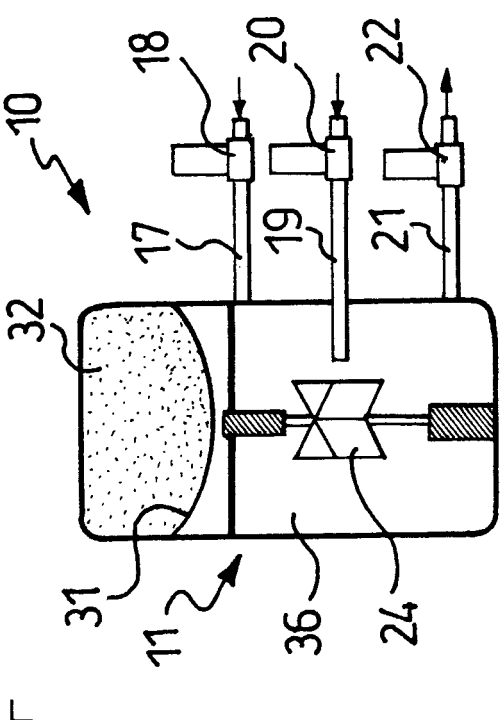


FIG.4A

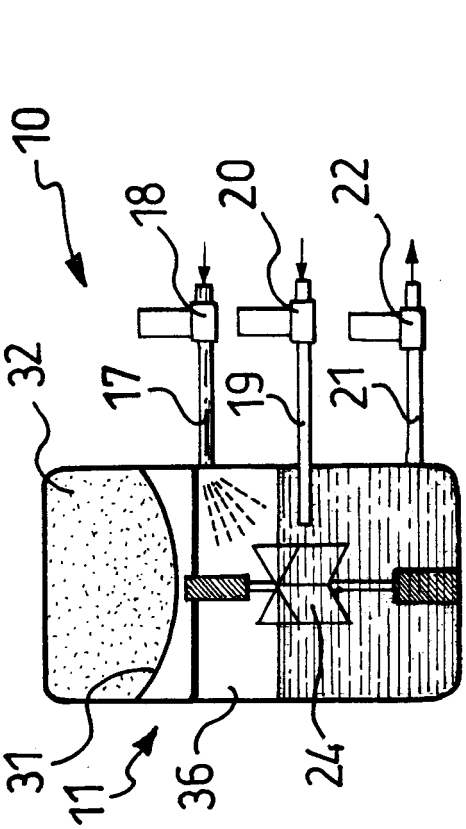


FIG.4B




FIG.4C

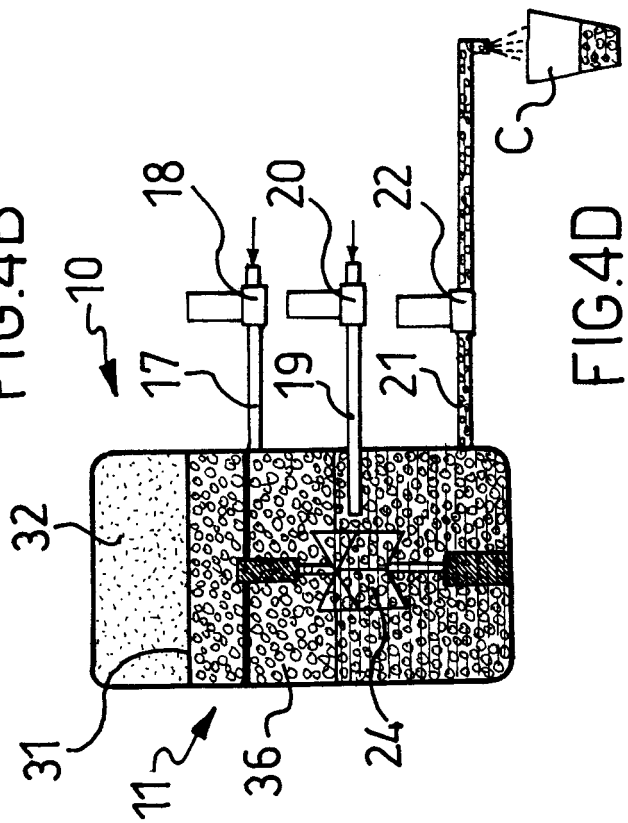


FIG.4D

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# EUROPEAN SEARCH REPORT

Application Number
EP 98 83 0468

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| Y | PATENT ABSTRACTS OF JAPAN vol. 003, no. 104 (C-057), 4 September 1979 & JP 54 082372 A (MITSUI MIIKE MACH CO LTD), 30 June 1979 * abstract; figure * | 4 | |
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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 14 January 1999 | Dugdale, G |

CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 83 0468

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14-01-1999

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