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(54) **METHOD OF PACKAGE FILLING IN THE PRESSURE-SEALED AREA AND EQUIPMENT FOR PERFORMANCE OF SUCH FILLING**

VERFAHREN ZUR PACKUNGSBEFÜLLUNG IM DRUCKDICHTEN BEREICH UND VORRICHTUNG ZUR AUSFÜHRUNG SOLCH EINER BEFÜLLUNG

PROCÉDÉ DE REMPLISSAGE D'EMBALLAGE DANS UNE ZONE AUTOCLAVE ET ÉQUIPEMENT PERMETTANT L'EXÉCUTION DUDIT REMPLISSAGE

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Description

Field of technology

[0001] In general, this invention refers to the filling of various type packages with products (especially with beverages, both carbonated and non-carbonated ones) enabling filling of the products (such as milk, beer, wine, lemonade, baby food, juice) into the packages in highly sterile environment of the pressure-sealed filling device with protective atmosphere option, without a secondary contamination from the surrounding environment. The invention - a method of package filling in the pressure-sealed area and equipment for performance of such filling - enables sealing of the package at overpressure.

Background of the invention

[0002] Several principles are used for filling of products (beverages): level filling with gravitation, vacuum or overpressure filling and volumetric filling. Currently, the package being filled passes through the various areas during filling process, from package preparation to package filling and sealing. Air-turbulence occurs during filling and sealing, resulting in eventual secondary contamination of the product being filled. During filling of the carbonated products, the package moves from the pressurized area to the area with atmospheric pressure where it is sealed. Such change of environment affects a quality of beverage carbonation level with resulting possibility of secondary contamination.

[0003] US6230472B1 discloses a method of package filling and a filling equipment in accordance with the preambles of claims 1 and 2.

Summary of the invention

[0004] The invention is defined by the features of claims 1 and 2.

[0005] A neck of package (e.g. PET bottle, glass bottle, aluminium package, combined package,) together with cap from the external non-sterile area is clamped in the area of filling device. These elements are clamped in the bottom rotary section (2). Bottom valve (4) closes the pressurized filling area by pushing into the seat - with option to maintain the atmospheric pressure, overpressure or vacuum - and then the sterilization process starts. A whole internal space of the package (3), neck of package (16), cap (6) and filling area of the filling device (12) is sterilized (e.g. sterilization with: H_2O_2 followed by hot air - temperature activation). Before filling, an air (oxygen) in the filling area can be replaced with inert gas (e.g. nitrogen). Then, the filling with sealing takes place. All the above steps take place in the sealed filling area that is the main and the most important benefit of this filling method. The invention - a method of package filling in the pressure-sealed area and equipment for performance of such filling - provides a high cleanness and even

sterility of filling. In case of this invention method of package filling in the pressure-sealed area and equipment for performance of such filling - the package is sealed before it leaves the filling area. In case of carbonated beverages this means that package is sealed under pressure. A standard filling method requires a relief of filling overpressure to atmospheric pressure after package is filled that results in beverage foaming and escape of the carbonation gas from the beverage (e.g. CO_2). During this filling process, no depressurization takes place before sealing which is an evident benefit. The invention - a method of package filling in the pressure-sealed area and equipment for performance of such filling - enables a more effective filling of carbonated beverages. This invention also enables a skipping of any step (e.g. sterilization, air replacement with inert gas, etc.).

[0006] During standard filling method a secondary contamination from the surrounding area cannot be eliminated. In case of this invention - a method of package filling in the pressure-sealed area and equipment for performance of such filling - a secondary contamination of beverage from the surrounding environment is avoided.

Description of terms used for explanation of invention:

[0007]

Filling equipment - a device where product is filled to the package

Pressure-sealed area - a space where required pressure can be maintained

Product - milk, beer, wine, lemonade, baby food, juice, carbonated and non-carbonated beverages
Sterilization - a physical or chemical process used for elimination of all microorganisms in given environment, object or device

Carbonated beverage - a beverage enriched with carbon oxide

Neck of package - a part of package used for filling of package with product and part suitable for package handling

Sterilization - multifunction needle - a pipeline ending in the filling area through which a peroxide and air mixture, sterile air or inert gas is driven into the filling area

Filling head - a pipeline end, feeding product from the storage tank above the filling point

Sealing head - it serves for firm mounting of cap on the package and tightening of the cap

Filling shut-off valve - a valve sealing area under the filling head to separate this area from the surrounding environment

Bottom valve - a valve used for closing of opening after cap is installed in the sealing head

Product storage tank - a tank with design avoiding a contamination of the product from the surrounding environment and enabling a keeping of the required pressure for filling.

List of figures in drawings

[0008] The invention - a method of package filling in the pressure-sealed area and equipment for performance of such filling - is described in detail using the enclosed figures. Figure 1 shows the filling equipment in respect to the top section as fixed part of the filling equipment. Figure 2 shows the filling equipment with focus on its movable section - the bottom rotary section. Figure 3 shows a top view of the filling equipment. Figure 4 shows three basic positions of the filling equipment during the working cycle. Figure 5 shows the filling equipment during the working cycle, namely in stage 1 - sterilization. For detailed description of the figure and process see a description of process in position 1. Figure 5 shows the filling equipment in filling position. For detailed description of processes showed in Figure 6 see a process description in position 2. Figure 7 and Figure 8 shows the filling shut-off valve in open and closed position. Figure 9 shows the filling equipment during the sealing process. For detailed description of the process showed in this Figure see the process description in position 3. Figures 10 to 14 show the principle of filling equipment as whole, without the bottom rotary section. In this case, the package and cap is in stable position and the operating elements - sterilization (multifunction) needle, feeding head and sealing head - are being exchanged above this position.

[0009] The individual pictures of invention on enclosed drawings are provided for illustration purposes only.

Examples of invention implementation

[0010] The filling equipment consists of two basic sections: top fixed section (1) - Figure 1, 1 and movable section - bottom rotary section (2) - Figure 2. The following operating elements are mounted on these basic sections: sterilization - multifunction needle (7), filling head (9), sealing head (5), filling shut-off valve (13), and bottom valve (4) - Figure 5 and Figure 6. Workmanship and machining of all components requires materials suitable for the food industry, with the lowest possible surface roughness to provide a sterile environment. The temperature and pressure sensors can be installed in the filling area to enable a control of sterilization process. The bottom rotary section (2) is connected with shaft, passing

through the top fixed section (1). By rotation of shaft, the bottom section is positioned in the required position. In the bottom rotary section (2) there is an opening with seat for the bottom valve (4) sealing and opening for mounting of cap - a PET bottle is showed on the figure. The package (3) is clamped in the bottom rotary section - the package is sealed (3) by pushing the package neck (16) onto the sealing surface of the bottom rotary section. The cap is inserted into the bottom valve (4) and valve is closed by pushing the valve sealing surface into the seat on the bottom rotary section (2). In this way, a filling area (12) is sealed and separated from the surrounding environment. The bottom rotary section (2) is set to the position 1 - sterilization (Fig. 4). A minimum peroxide concentration of 35% is required for sterilization by peroxide. A peroxide-air mixture is heated in the heating element of the peroxide evaporator (17) to approx. 200°C. After sterilization valve (23) and drain valve (10) is opened, a peroxide-air mixture is fed through the sterilization - multifunction needle to the package (3), filling area (12) and external surface of the cap (6). Next, the sterilization valve (23) of the peroxide evaporator (17) and the drain valve (10) are closed. In this way, the filling area (12), package (3) and cap (6) is sterilized by peroxide. After opening of the sterilization valve (23) for supply of hot sterile air and after opening of the drain valve (10), the filling area (12), package (3) and cap (6) is blown out through the sterilization (multifunction) needle (7) with sterile hot air, heated to approx. 140°C and prepared in air exchanger (18). The cap (6) is taken by the sealing head (5) and sterilization process using the peroxide and hot air blow is repeated. In this way, an internal surface of the cap (6) is sterilized. Next, the filling area (12) and package (3) can be filled with inert gas - e.g. nitrogen - from the inert gas tank (19). The bottom rotary section (2) is set to the position 2 - filling. In this step, a pressure in the product storage tank (22) is equalized with pressure in the filling area (12) as first. The filling head shut-off valve (13) opens by sliding downward and turning outside the operating area of the filling head (9) - Fig. 6. The filling process starts with opening of the product valve (20). After required volume is filled (regulated by flow meter 21), the product valve (20) closes. The filling head shut-off valve (12) closes by turning under the filling head (9) and sliding upward. The bottom rotary section (2) is set to the position 3 - sealing. The sealing head with cap (6) mounted moves downwards to the package neck (16) by turning around the own rotation axis (15). After sealing, the sealing head (5) returns back to the top initial position - see Figure 9. The filled and sealed package (3) with product (14) - PET bottle showed on the Figure - is removed from position and new empty package is inserted. Next, the whole sterilization, filling and sealing process repeats. The entire filling area is connected to the sanitation circuit, used for cleaning of pipelines, valves and whole filling area after completion of the production batch.

[0011] The above described procedure applies for

showed PET bottle with the screw cap. In case of other package type, the clamping and sealing of the package and eventually a filling method shall be modified accordingly.

[0012] Key for the enclosed drawings - Figures 1 - 9:

- 1 Top fixed section
- 2 Bottom rotary section
- 3 Package
- 4 Bottom valve
- 5 Sealing head
- 6 Cap
- 7 Sterilization (multifunction) needle
- 8 Sealing of the bottom rotary section
- 9 Filling head
- 10 Drain valve
- 11 Bottom section rotation axis
- 12 Filling area
- 13 Filling head shut-off valve
- 14 Product
- 15 Sealing head rotation axis
- 16 Package neck
- 17 Peroxide evaporator
- 18 Air exchanger
- 19 Inert gas tank
- 20 Product valve
- 21 Flow meter
- 22 Product tank
- 23 Sterilization valve
- P1 Pressure in product tank
- P2 Pressure in package
- P3 Pressure in product
- P4 Pressure in filling area

[0013] The filling equipment can be made as assembly, without the bottom rotary section. In such case, the package and cap is in stable position and the operating elements - sterilization (multifunction) needle (33), filling head (25) and sealing head (26) - are being exchanged above this position. For detailed description see attached Figures 10 - 14. The whole sterilization, filling and sealing process is divided to five stages:

Stage 1 - mounting of cap (29) and empty package (30) in the filling equipment.

Stage 2 - closing of filling head shut-off valve (27) and bottom valve (28), opening of drain valve (32), initialization of sterilization process - the filling equipment area, package and cap blow out with the peroxide-air mixture, followed with sterile hot air purging through the sterilization multifunction needle (33) and sterilization pipeline (31), and drain valve (32) closing.

Stage 3 - pressurization of the filling equipment area and package with the inert gas pressure (e.g. with nitrogen) through the multifunction needle (33), opening of the filling head shut-off valve (27) and filling of package (30) with product.

Stage 4 - closing of the filling head shut-off valve (27), sealing of package (30) with cap (29).

Stage 5 - removal of filled and sealed package (30).

[0014] Key for the enclosed drawings - Figures 10 - 14:

- 24 Fixed section
- 25 Filling head
- 26 Sealing head
- 27 Filling head shut-off valve
- 28 Bottom valve
- 29 Package cap
- 30 Package
- 31 Sterilization pipeline
- 32 Drain valve
- 33 Sterilization (multifunction) needle
- 34 Package carrier
- 35 Cap carrier

Claims

1. A method of package filling with various liquids enabling a filling of packages with liquids in sterile, pressure-sealed area of the filling equipment without change of pressure during filling process and with elimination of foaming of the liquids, being filled into the packages, with preservation of the highly sterile environment and package from the moment when package is filled with a given liquid to a package sealing with an appropriate sterilized cap, the method being **characterized in that** the neck of package together with a cap from the external non-sterile area is clamped in a bottom rotary section (2) or fixed section (24), depending on design of the filling device, and a bottom valve (4, 28) used for inserting of cap into the filling equipment closes the pressurized filling area by pushing into a seat - with option to maintain the atmospheric pressure, overpressure or vacuum - and then the sterilization process starts, wherein a whole internal space of the package (3, 30), neck of package (16), cap (6, 29) and filling area of the filling device (12) is sterilized.

2. Filling equipment comprising a pressure sealed area, a filling head, a filling shut-off valve, a valve on the filling head, a sealing head, the filling equipment being adapted for enabling a filling of packages with various liquids in the sterile, pressure-sealed area without a change of pressure and with elimination of liquid foaming during filling, the filling equipment having means for inserting a package and cap into the filling equipment and sterilization by feeding of H₂O₂ and activation of H₂O₂ by hot sterile air, wherein the filling equipment is adapted such that after application of hot sterile air, the filling process starts by turning the valve on the filling head and ends by closing of the filling shut-off valve, turning of the valve on the

filling head back to the filling head and following rotation of the sealing head downwards around the rotation axis together with the loaded cap after a required volume is achieved to close the filled package, wherein the filling equipment is **characterized in that** it consists of two basic sections: top fixed section (1) and mobile section - bottom rotary section (2), wherein the following operating elements are mounted on these basic sections: sterilization - multifunction needle (7), filling head (9), sealing head (5), filling shut-off valve (13), and bottom valve (4), wherein the bottom rotary section (2) is connected with shaft passing through the top fixed section (1), and in the bottom rotary section (2) there is an opening with seat for the bottom valve (4) sealing and opening for mounting of the cap, wherein the filling equipment can be made as assembly, without the bottom rotary section, wherein in such case, the filling equipment is adapted such that the package and cap is in stable position and the operating elements - sterilization multifunction needle (33), filling head (25) and sealing head (26) - are being exchanged above this position.

Patentansprüche

1. Verfahren zum Abfüllen von Verpackungen mit verschiedenen Flüssigkeiten, das das Abfüllen von Verpackungen mit Flüssigkeiten in einem sterilen, druckabgedichteten Raum der Abfüllvorrichtung ohne Druckänderung während des Füllvorgangs und mit Eliminierung des Aufschäumens von Flüssigkeiten während des Abfüllens in Verpackungen ermöglicht, mit Aufrechterhaltung der hochsterilen Umgebung und Verpackung vom Moment des Abfüllens der Verpackung mit der gegebenen Flüssigkeit bis zum Verschließen der Verpackung mit einem geeigneten sterilisierten Verschluss, **dadurch gekennzeichnet, dass** der Hals der Verpackung zusammen mit dem Verschluss aus dem äußeren unsterilen Bereich je nach Bauausführung der Abfüllvorrichtung im unteren drehbaren Teil (2) oder festen Teil (24) eingespannt ist, und das untere Ventil (4, 28), das zum Einsetzen des Verschlusses in die Abfüllvorrichtung dient, den unter Druck stehenden Abfüllbereich durch das Eindringen in den Sitz verschließt - mit der Möglichkeit der Aufrechterhaltung des atmosphärischen Drucks, Über- oder Unterdrucks - und anschließend der Sterilisationsprozess gestartet wird, wobei der gesamte Innenraum der Verpackung (3, 30), der Hals der Verpackung (16), der Verschluss (6, 29) und der Füllbereich der Abfüllvorrichtung (12) sterilisiert werden.
2. Abfüllvorrichtung bestehend aus einem druckdichten Bereich, einem Füllkopf, einem Abfüllabsperrenteil, einem Ventil am Füllkopf, einem

Verschließkopf, wobei die Abfüllvorrichtung ein Adapter ist, der das Abfüllen von Verpackungen mit verschiedenen Flüssigkeiten in einem sterilen, druckdichten Raum ohne Druckänderung und mit Eliminierung des Aufschäumens der Flüssigkeit während des Abfüllens ermöglicht, die Abfüllvorrichtung verfügt über die Mittel zum Einsetzen der Verpackung und des Verschlusses in die Abfüllvorrichtung und zum Sterilisieren der Abfüllvorrichtung mit H_2O_2 -Zuleitung und zum Aktivieren von H_2O_2 mit heißer Sterilluft, wobei die Abfüllvorrichtung so angepasst ist, dass nach dem Aufbringen der heißen Sterilluft der Abfüllvorgang durch Drehen des Ventils am Füllkopf beginnt und durch Schließen des Abfüllverschlussventils, Zurückdrehen des Ventils am Füllkopf in den Füllkopf und anschließendes Abwärtsdrehen des Verschließkopfes um die Drehachse zusammen mit dem gefüllten Verschluss nach Erreichen des zum Verschließen der gefüllten Verpackung erforderlichen Volumens endet, wobei sich die diese Abfüllvorrichtung **dadurch gekennzeichnet, dass** sie aus zwei Grundteilen besteht: ein oberer feststehender Teil (1) und ein beweglicher Teil - unterer rotierender Teil (2), wobei an diesen Grundteilen die folgenden Leistungselemente angebracht sind: eine Sterilisations-Multifunktionsnadel (7), ein Füllkopf (9), ein Verschließkopf (5), ein Abfüllverschlussventil (13) und ein unteres Ventil (4), wobei das untere rotierende Teil (2) mit einer Welle verbunden ist, die durch den oberen feststehenden Teil (1) hindurchgeht, und in dem unteren rotierenden Teil (2) ein Loch mit einem Sitz zum Abdichten des unteren Ventils (4) und ein Loch zum Anbringen des Verschlusses vorhanden ist, wobei die Abfüllvorrichtung auch ohne den unteren drehbaren Teil ausgeführt werden kann, wobei die Abfüllvorrichtung in diesem Fall so angepasst wird, dass sich die Verpackung und der Verschluss in einer stabilen Position befinden und oberhalb dieser Position sich die Arbeitselemente - die sterilisierende Multifunktionsnadel (33), der Füllkopf (25) und der Verschließkopf (26) - abwechseln.

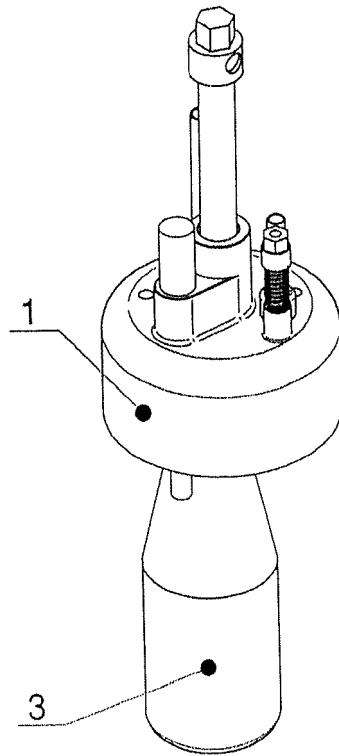
Revendications

1. Procédé de remplissage d'emballages avec des divers liquides permettant le remplissage d'emballages avec des liquides dans un milieu stérile, dans la zone étanche à la pression du dispositif de remplissage sans changement de pression pendant le processus de remplissage et avec l'élimination des mousses des liquides lors du remplissage des emballages, tout en maintenant un environnement hautement stérile et de l'emballage depuis le moment du remplissage de l'emballage avec le liquide donné jusqu'à la fermeture de l'emballage avec un bouchon stérilisé approprié, et ce procédé est **caractérisé par le fait que** le goulot de l'emballage ainsi que le bou-

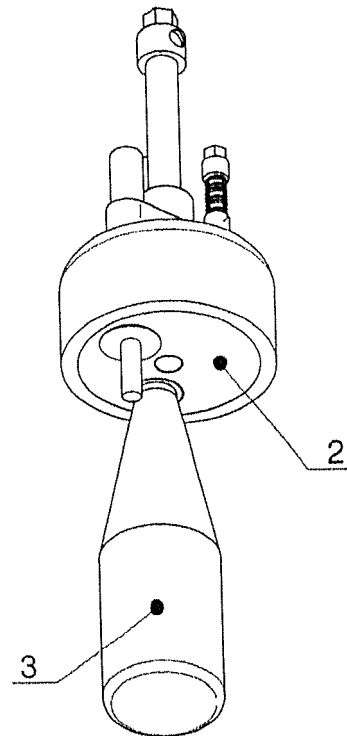
chon de la zone externe non stérile est serré dans la partie rotative inférieure (2) ou la partie fixe (24) dans la dépendance de la construction d'équipements de remplissage, et la valve inférieure (4, 28) utilisée pour insérer le bouchon dans le dispositif de remplissage ferme la zone de remplissage sous pression en la poussant dans le siège - avec une option maintenir la pression atmosphérique, la pression positive ou la pression négative - puis le processus de stérilisation commence, tandis que tout l'espace intérieur de l'emballage (3, 30), le goulot de l'emballage (16), le bouchon (6, 29) et la surface de remplissage dispositif de remplissage (12) sont stérilisés.

2. Dispositif de remplissage composé d'une zone étanche à la pression, d'une tête de remplissage, d'une fermeture de la vanne de remplissage, de la vanne sur la tête de remplissage, de la tête de fermeture, tandis que le dispositif de remplissage est adapté pour permettant le remplissage d'emballages avec divers liquides dans un récipient stérile scellé sous pression dans un espace sans changement de pression et avec l'élimination des mousses du liquide pendant le remplissage. Le dispositif de remplissage a des moyens d'insertion de l'emballage et du bouchon dans le dispositif de remplissage et de stérilisation avec la fourniture de H_2O_2 et l'activation de H_2O_2 avec de l'air stérile chaud, tandis que le dispositif de remplissage est adapté ainsi, après l'application d'air stérile chaud, le processus de remplissage commence en tournant la vanne sur la tête de remplissage et se termine en fermant la vanne d'arrêt de remplissage en ramenant la vanne sur la tête de remplissage à la tête de remplissage et en faisant ensuite tourner la tête de fermeture vers le bas autour de l'axe de rotation avec le bouchon rempli après avoir atteint le volume nécessaire à la fermeture de l'emballage rempli, tandis que ce dispositif de remplissage se **caractérise par le fait qu'il** se compose de deux parties de base : la partie supérieure fixe (1) et la partie mobile - partie tournante inférieure (2), alors que sur ces parties de base il y a les éléments puissants montés suivants : aiguille stérilisante multifonctionnelle (7), tête de remplissage (9), tête de fermeture (5), vanne de fermeture de remplissage (13) et vanne inférieure (4), tandis que la vanne rotative inférieure (2) est reliée à l'arbre traversant la partie supérieure fixe (1) et dans la partie inférieure rotative il y a (2) un trou avec un siège pour l'étanchéité du clapet inférieur (4) et un trou pour le montage du capuchon, tandis que le dispositif de remplissage peut également être réalisé sans la partie inférieure tournante, alors que dans un tel cas, le dispositif de remplissage est réglé pour que l'emballage et le bouchon soient en position stable et au-dessus de celle-ci les éléments puissants alternent - aiguille stérilisante multifonctionnelle (33), tête de

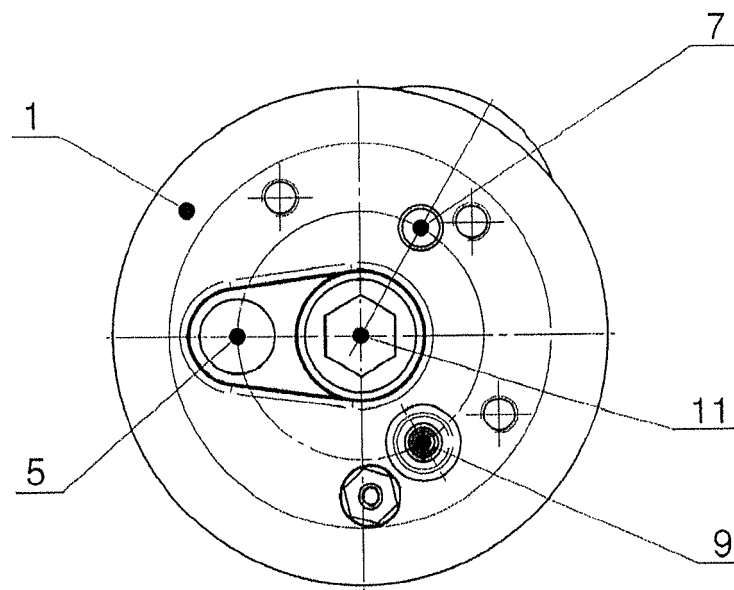
remplissage (25) et tête de fermeture (26).



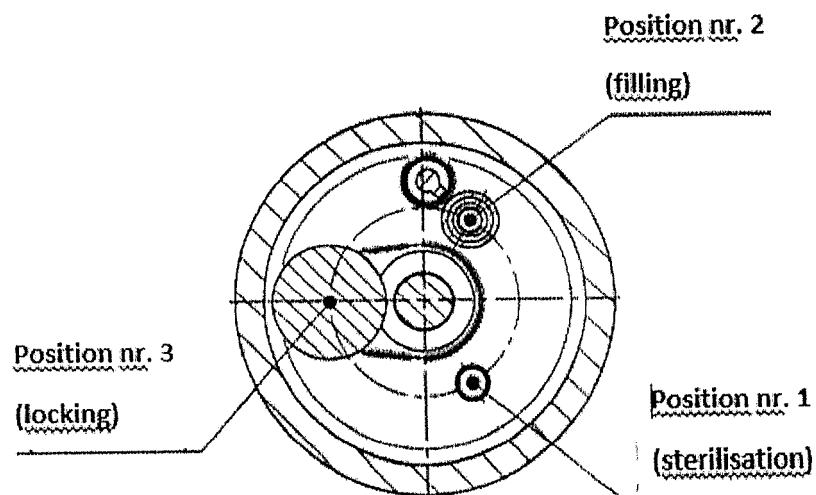
picture 1



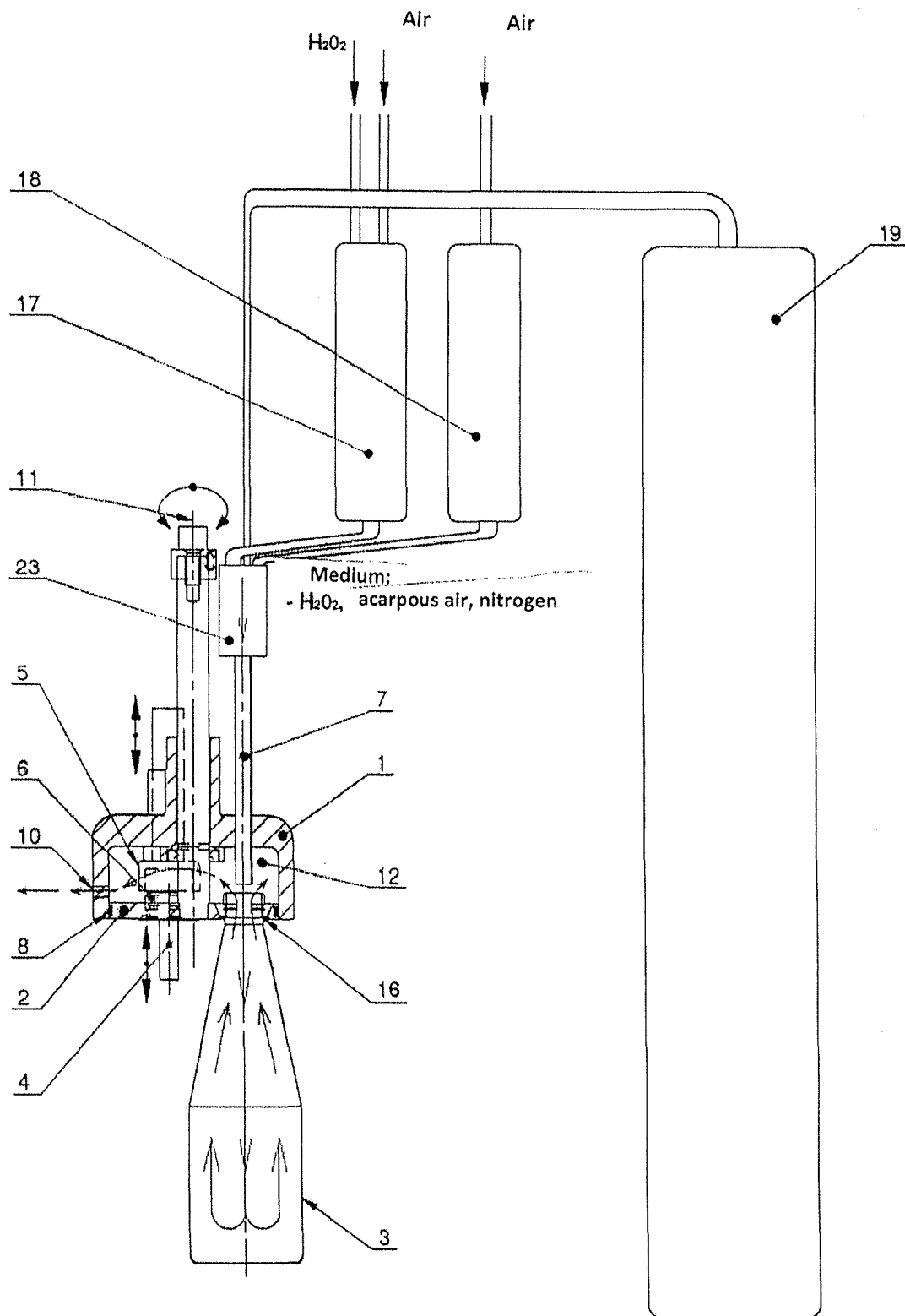
picture 2



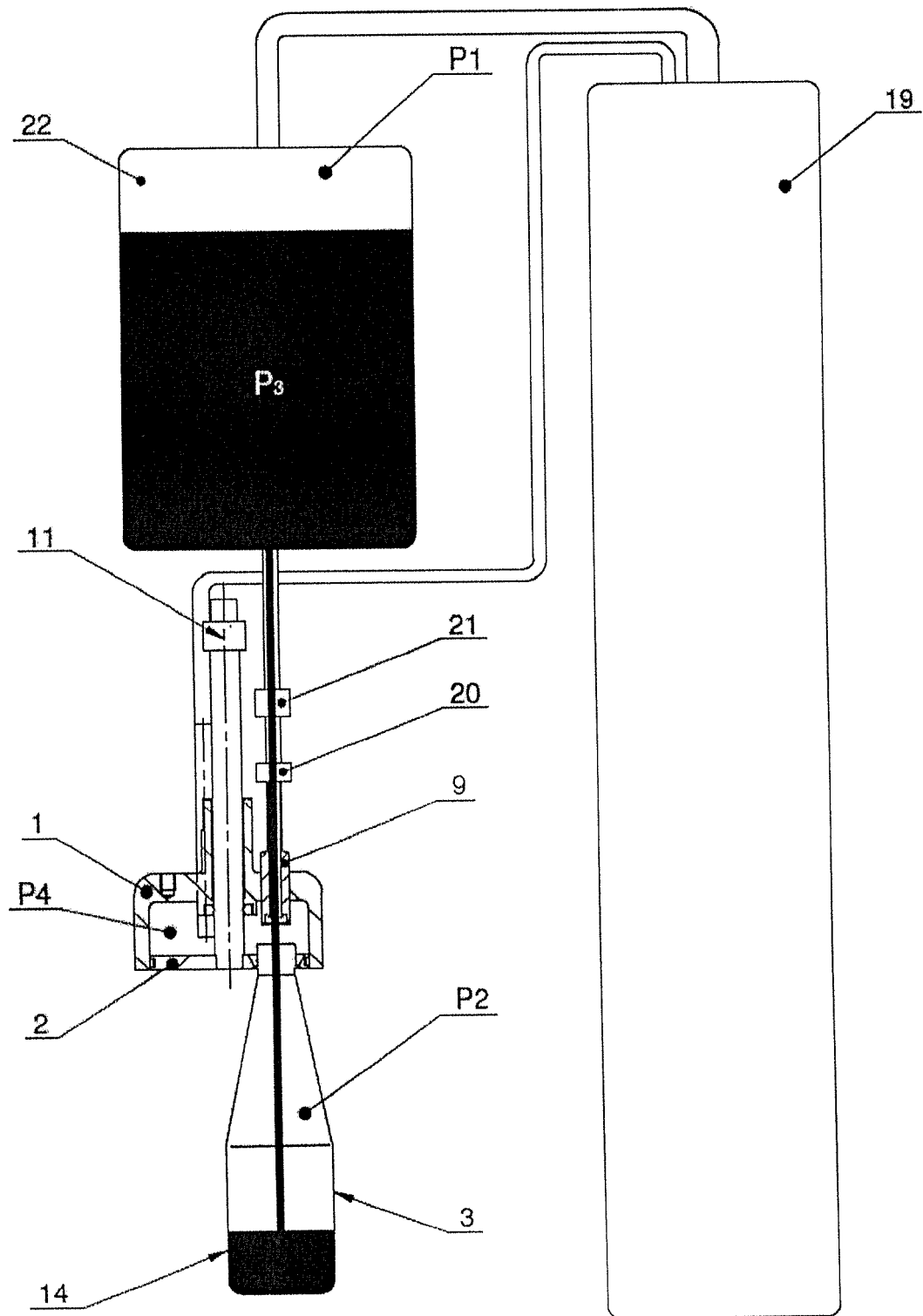
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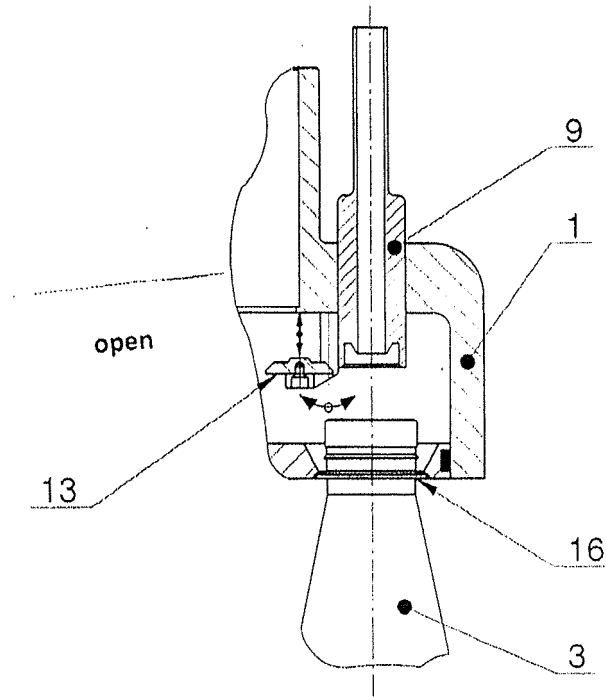
Picture 4



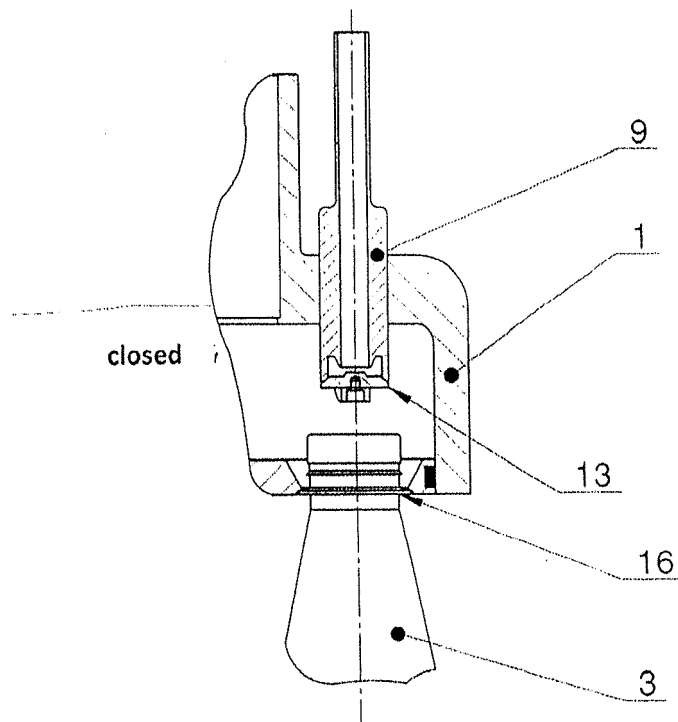
picture 5



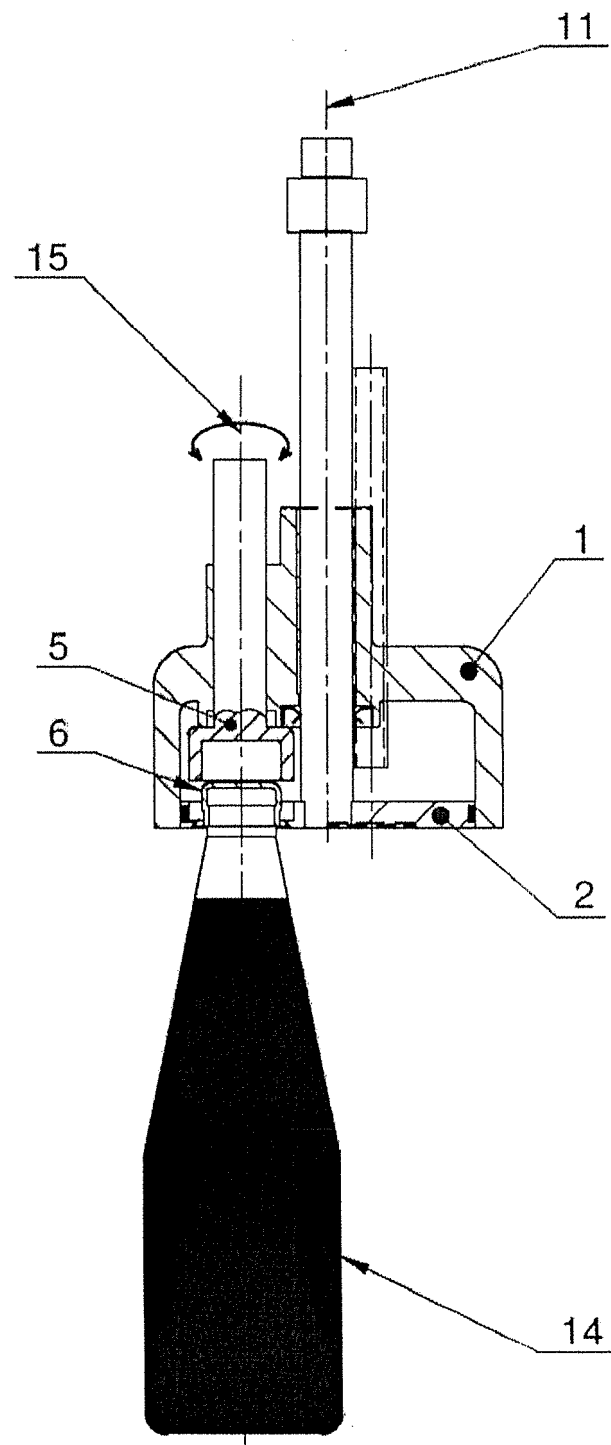
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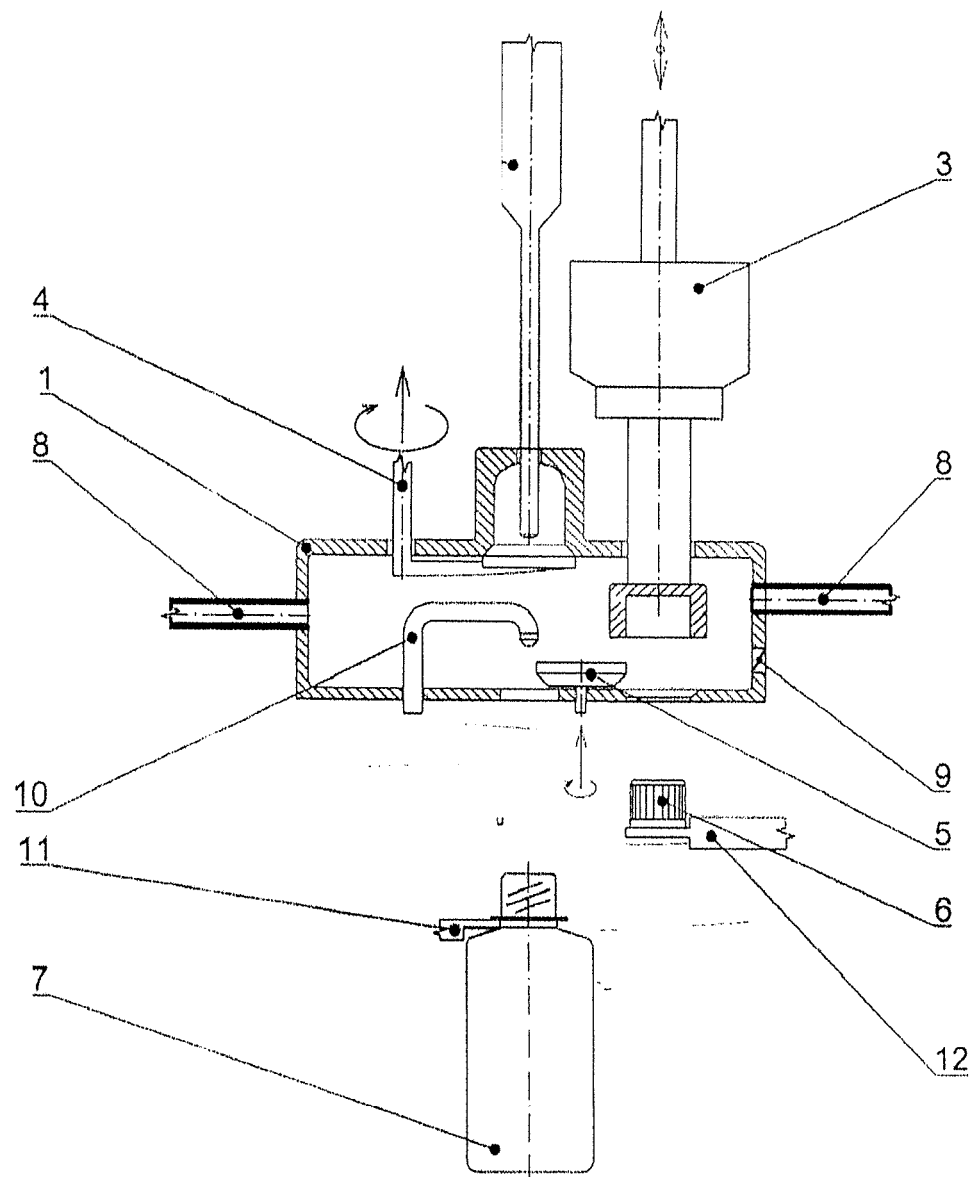
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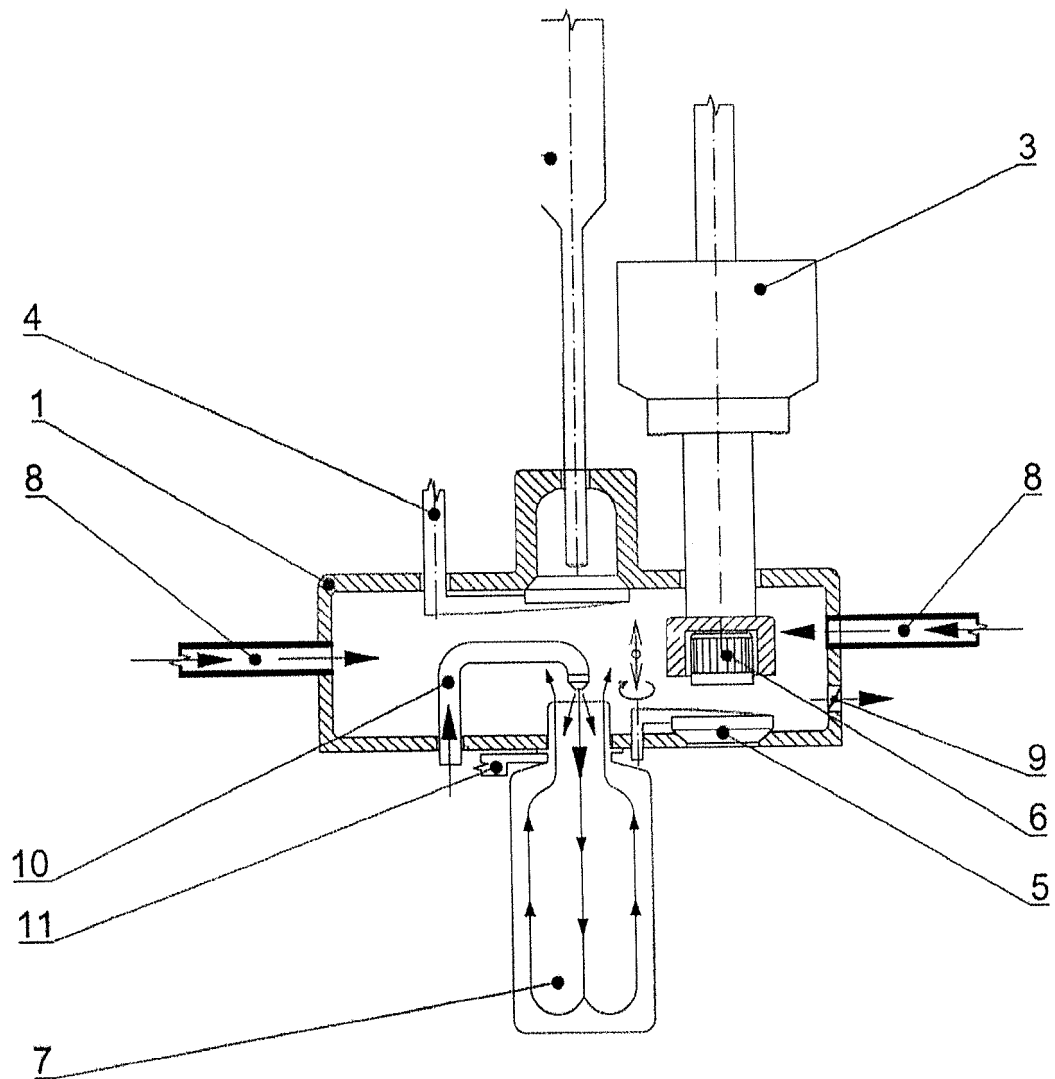
picture 8



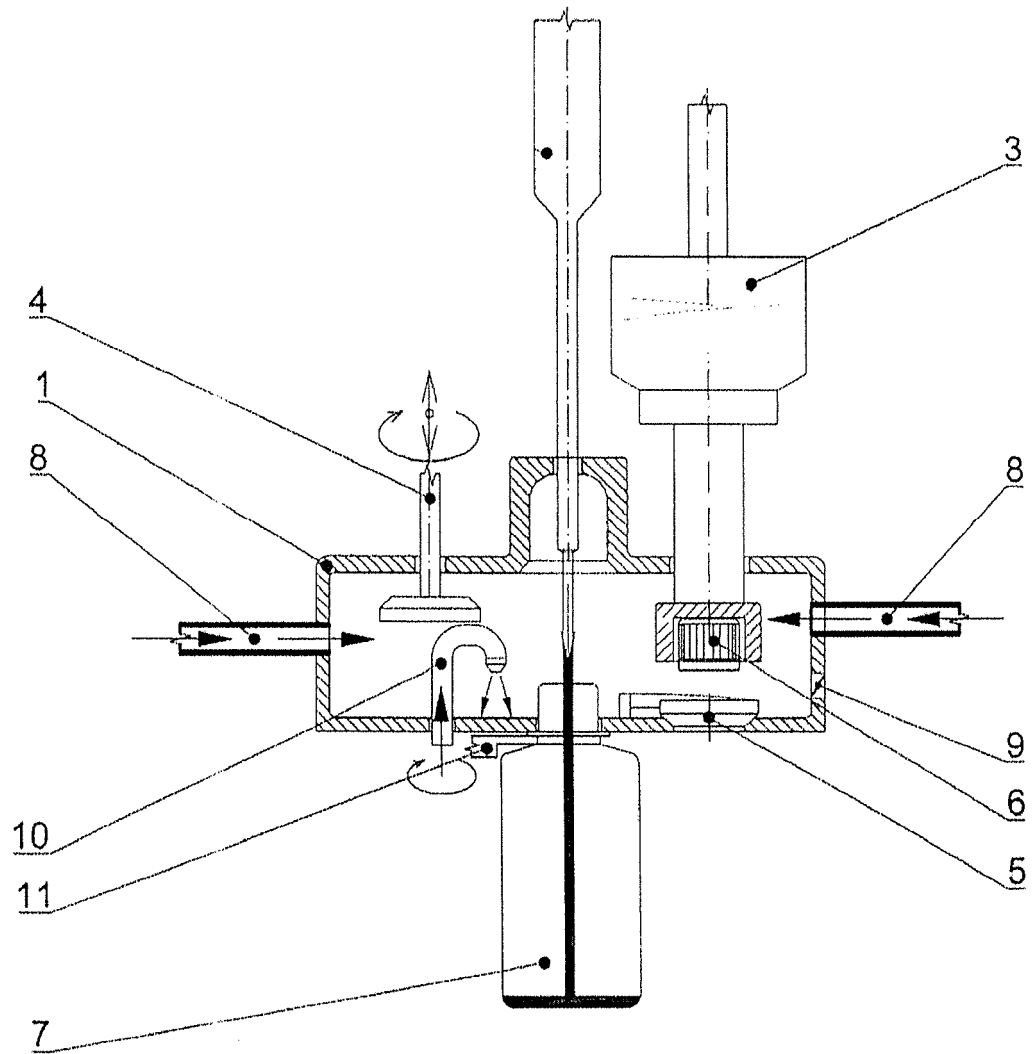
picture 9



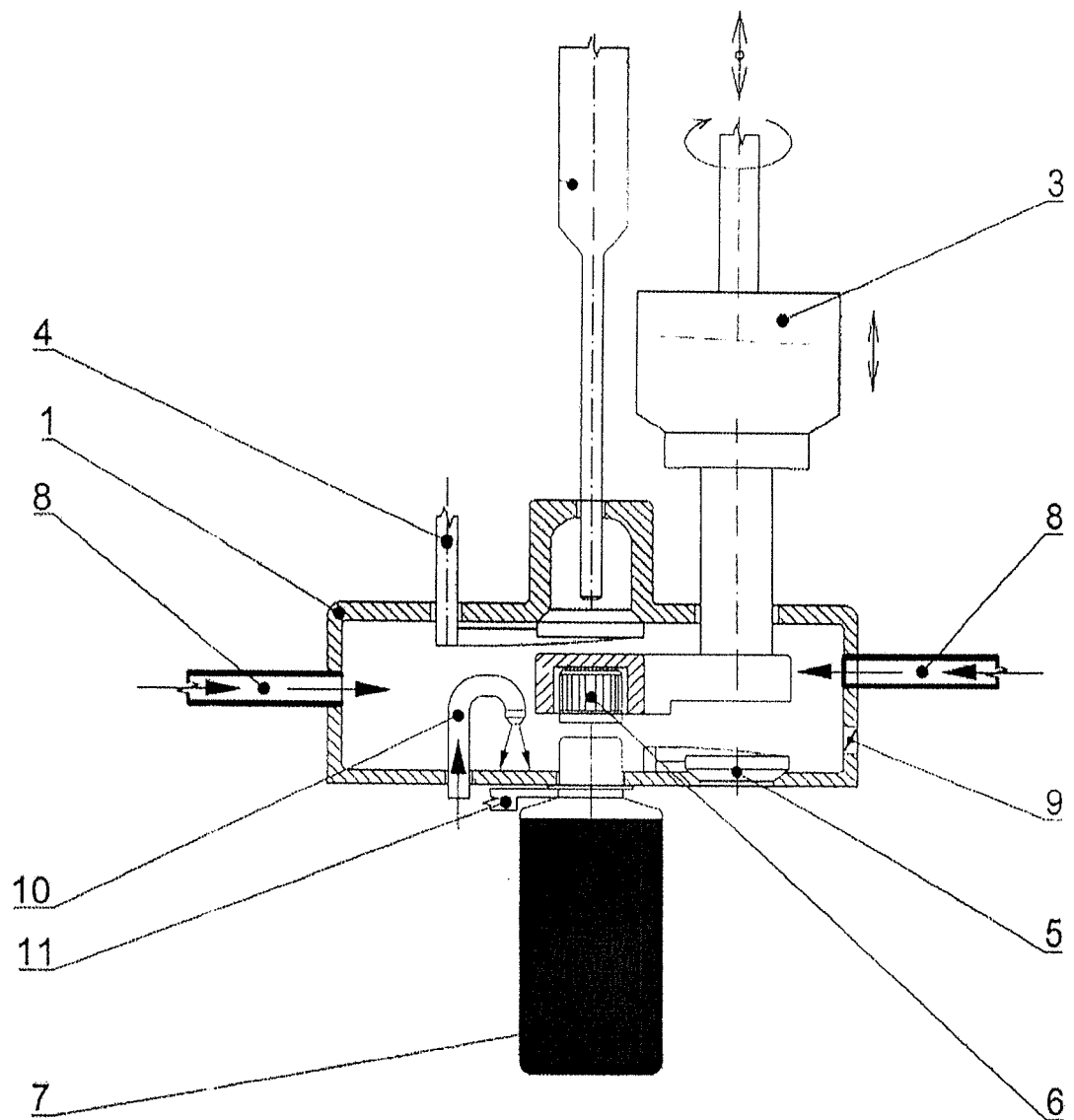
picture 10



picture 11



picture 12



picture 13

REFERENCES CITED IN THE DESCRIPTION

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