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(54) DEVICE FOR REMOVING EXTRANEOUS AIR FROM A CLEAN ROOM

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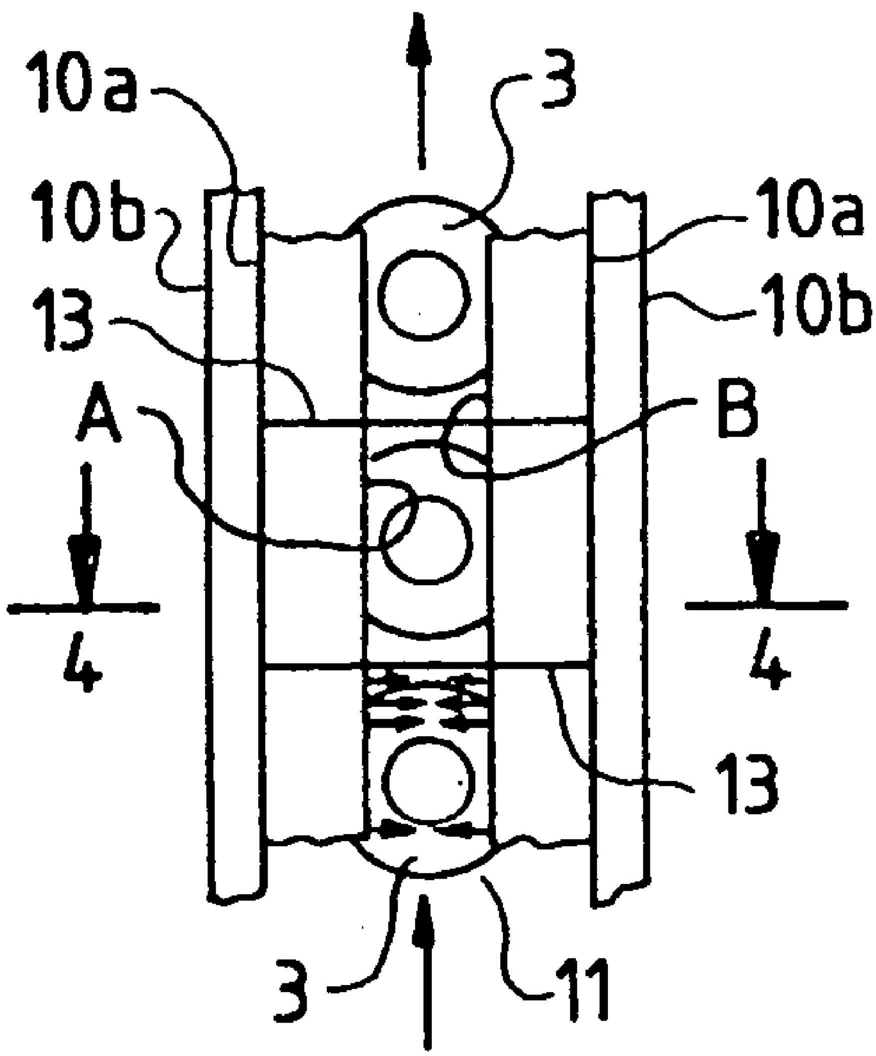
(57) ABSTRACT

A device eliminating extraneous air, which is imported by open containers (3), from a clean room (1) enclosing a bottle processing machine (14, 20; 24). The, clean room is constantly replenished with clean gas to compensate for gas losses. The device includes a discharge cell (9) mounted in the clean room (1) and communicating with ambient via a discharge cell conduit (12, 17) and with the clean room via an aperture (11). Mutually oppositely situated slit nozzles (A, B) are mounted at the edge of the aperture (11) and blow clean gas at each other in the plane of the aperture (11). The discharge cell (9) is configured so as to enclose at least the container mouth zone at least at the filling site of the container (3).



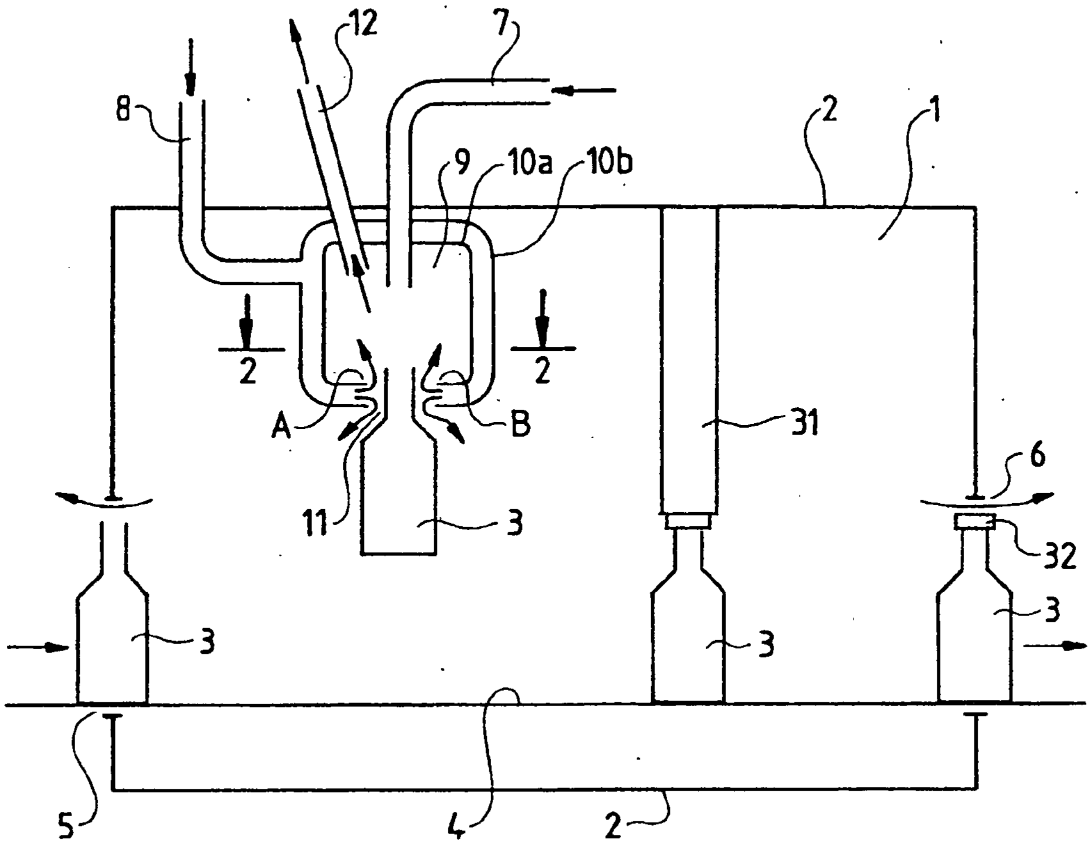


Fig. 1

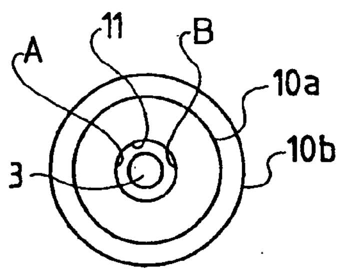


Fig. 2

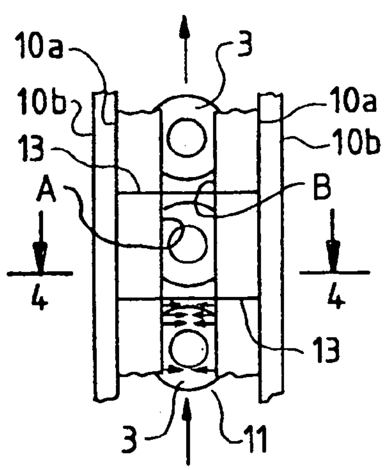


Fig. 3

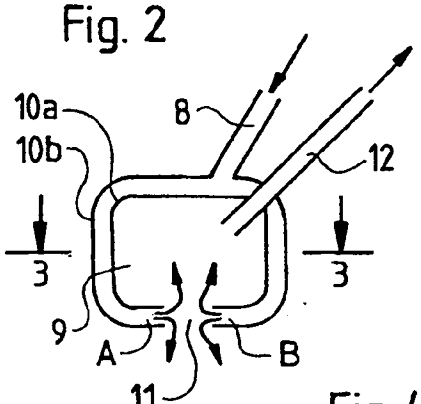


Fig. 4

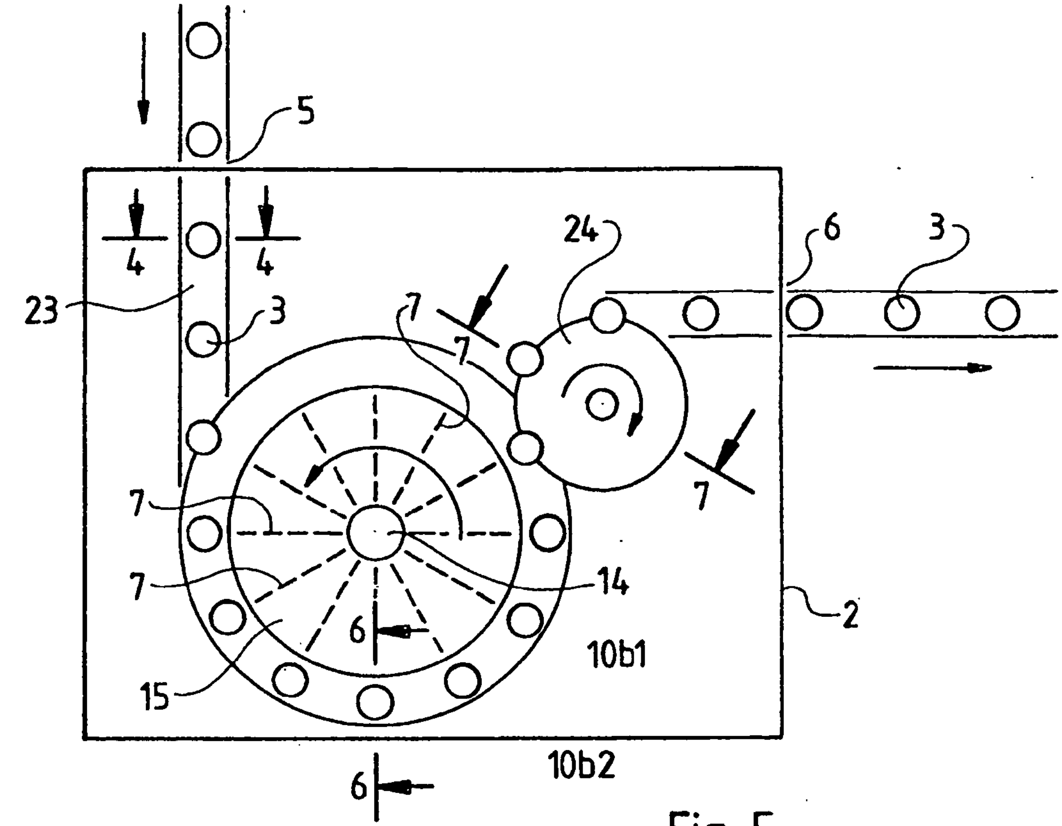

5
4
4
23
3
24
6
3
7
7
7
7
7
14
6
2
10b1
15
10b2
6

Fig. 5

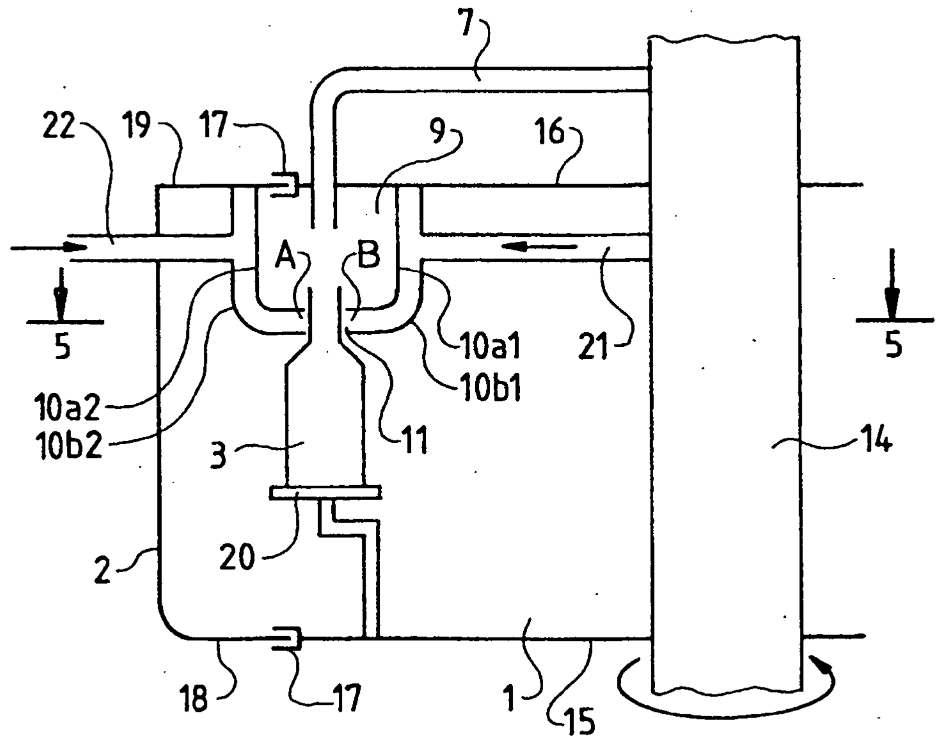

7
22
19
17
9
16
A
B
5
10a1
21
5
10b1
10a2
10b2
11
3
14
20
2
18
17
1
15

Fig. 6

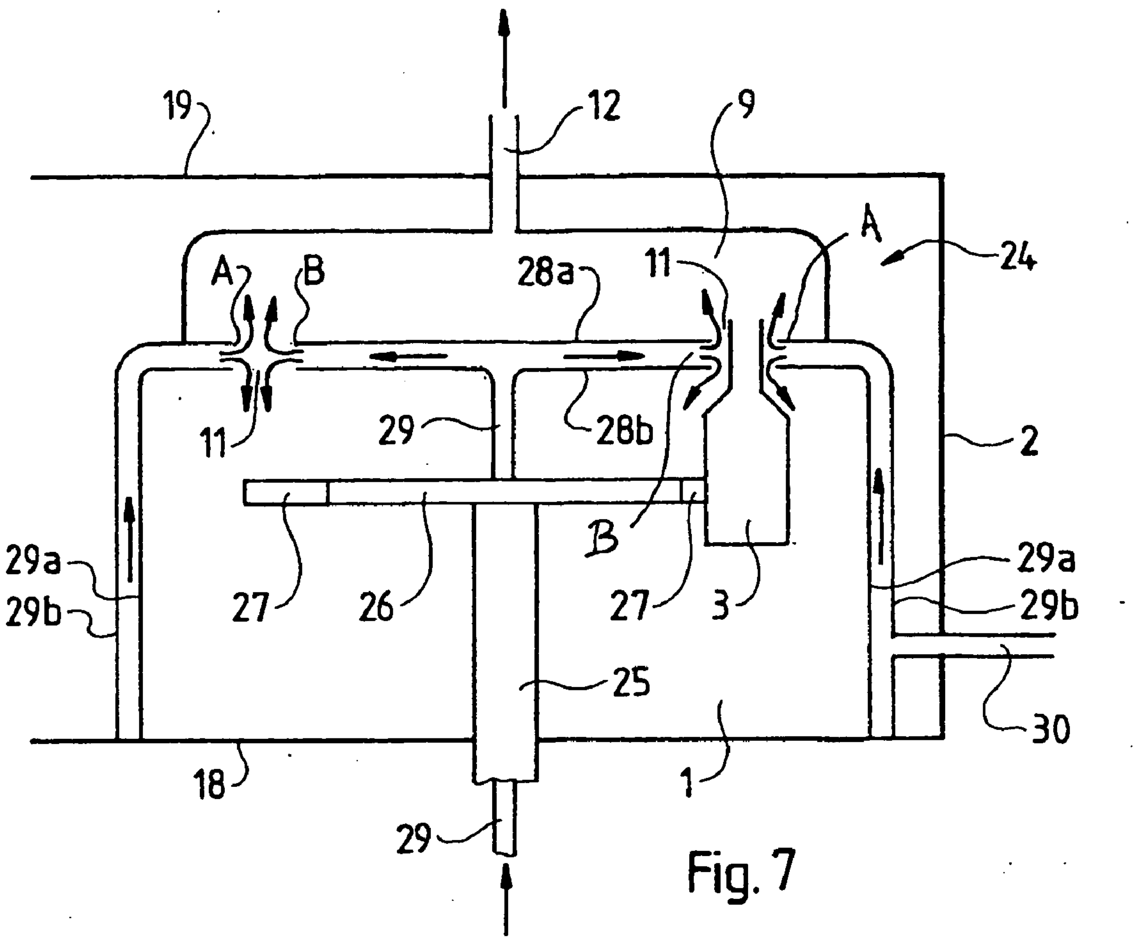

19
12
9
A
24
11
A
B
28a
11
29
28b
2
27
26
B
27
3
29a
29b
29a
29b
25
30
18
1
29

Fig. 7

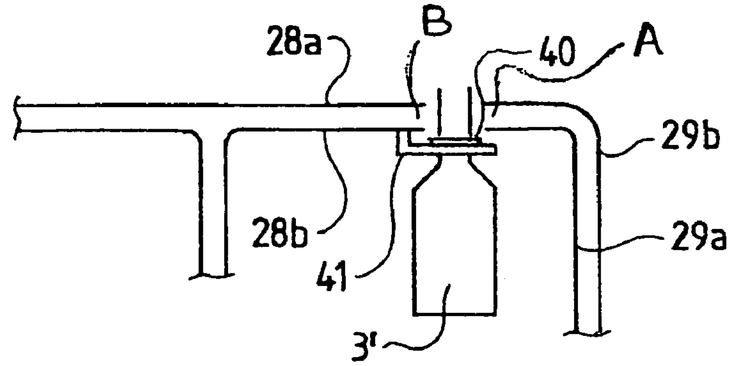

28a
B
40
A
29b
28b
41
29a
3'

Fig. 8

DEVICE FOR REMOVING EXTRANEOUS AIR FROM A CLEAN ROOM

[0001] The present relates to a device defined in the preamble of claim 1.

[0002] Such equipment is used in particular in the beverage industry. Illustratively a filling machine, a subsequent sealing machine and as called for or desired, further machines, are mounted within a clean room of which the leakages may be compensated by a constant supply of a clean gas at a slight pressure above ambience, said clean room assuring, during beverage processing, that the beverage filling may be carried out to be free of contamination.

[0003] The relevant contaminations may be bacterial germs which illustratively interfere with sterile beverage filling/bottling because hampering extended keeping of the bottled/packed beverage. In such a case the pure gas is a sterile gas, for instance sterile air, sterility being attained for instance using sterilizing filtering. Illustratively the contaminations also may be in the form of undesired extraneous gas such as oxygen. Preferably many beverages shall be bottled/packaged in the absence of oxygen, namely in an oxygen-free clean room. The clean gas used under such conditions might be nitrogen or CO_2. Lastly the contaminations also may be in the form of entrained dust if the containers must be filled in dust-free manner. Such requirements moreover may arise in combination, for instance when filling/packaging beverages which are optimally processed both in the absence of oxygen and in the absence of germs. In such a case the clean gas might be CO_2 filtered until sterilization.

[0004] Clean room leakages arise especially at the intake and outlet apertures where the containers are moving into and out of said room. These leakages may be compensated by an appropriate replenishment of clean gas. The purpose of a constant clean air flow through the clean room is to flush out the contaminations entering said room.

[0005] The main portion of the contaminants entering the clean room is introduced by the containers which arrive in said room while being open and which contain ambient air contaminated for instance with noxious oxygen and noxious germs. When such a container is filled with a beverage, the contaminated air is expelled from the container and enters the clean room. Known equipment of the state of the art to remove such entrained extraneous air typically operate on the principle of constantly flushing the clean room.

[0006] This known design incurs the drawback of high clean-gas consumption required to eliminate the substantial proportion of extraneous air and also the entire clean room coming into contact with said extraneous air, the entering germs being able to deposit at far corners from which they may be eliminated only with difficulty by means of said clean-air flushing.

[0007] The objective of the present invention is to create equipment of the above kind allowing to remove more economically and more thoroughly the extraneous air that was introduced by the containers.

[0008] This problem is solved by the features of claim 1.

[0009] The present invention provides a separate discharge cell within the said clean room, said discharge cell enclosing that space where the potentially contaminated air escapes from the containers. Foremost said discharge space is the region where containers are being filled with the filling material, moreover there are other zones where impure air may spread for instance on account of gas drafts. The entire container, or only the zone of its mouth may be enclosed by the clean room. If air escapes from the container, for instance during the filling procedure, then it reaches the discharge cell from where it is made to pass through the exhaust conduit out of the clean room in the ambience. The discharge cell aperture toward the clean room is fitted with slit or gap nozzles blowing clean gas in the plane of the aperture. Clean gas expelled in this manner from mutually opposite zones of the aperture's edge in the plane of this aperture is incident on the container situated in the opening and is deflected in portions both into the discharge cell and into the clean room. In the absence of a container, the gas flows impinge on each other and also will be guided both into the discharge cell and into the clean room. Regardless of a container being situated in the aperture or the aperture being clear, a ram flow or pressurized flow is kept up which is guided in portions into the discharge cell and into the clean room. By means of the ram flow that it generates, the aperture supplies not only air to both the discharge cell and the clean room, but also acts as the opening to move the containers into and out of the discharge cell. Leakage of contaminated air from the discharge cell into the clean room is reliably prevented. In this manner excess pressure is generated both in the discharge cell to expel extraneous air that had entered it through the exhaust conduit into the ambient air and into the clean room which, in this manner, shall be supplied additionally or solely with clean gas for its flushing. In this manner clean room contamination by extraneous air is averted entirely and is restricted only to the very small region of the discharge cell. Improved purity of the clean room may be attained in this manner at reduced clean gas consumption. By means of its stream component directed into the discharge cell, the ram flow in the region of the discharge cell opening assures an air flow which is substantially parallel to the container axis at said container's mouth. Therefore contaminated air issuing from the mouth is entrained in the exit direction by the clean air flowing past said mouth and removed as waste. Interfering turbulence that might substantially spread the contaminated air is precluded.

[0010] The discharge cell also may enclose the entire container. Advantageously and according to claim 2, said cell however shall enclose only the upper zone of one or several containers, namely, the container mouth zone, where the air to be eliminated does accumulate. According to claim 3, the discharge cell advantageously is bell-shaped to receive only one container.

[0011] Alternatively and according to claim 4, the discharge cell is an elongated tunnel with an aperture in the form of an elongated slot. This tunnel may be fixed in position, and containers may be configured in fixed manner within the tunnel and illustratively being moved jointly with a displaceable tunnel segment, for instance as regards moving containers in multi-tracks along cross-paths transverse to the direction of transportation, each cross path being fitted with one tunnel. Alternatively however the containers also may be moved longitudinally through the tunnel using for instance an appropriate conveying means. In this manner the spreading of extraneous air may be prevented for instance using gas drafts even when the containers are not filled at such sites.

[0012] The features of claim **5** are advantageous. When a tunnel is fed with clean gas from an elongated aperture running in the tunnel direction by means of the ram flow at this aperture, and when also the discharge cell conduit is in the form of an elongated slot running parallel thereto, then the flow will cross the discharge cell along a short path transversely to the tunnel direction. Air flows in the tunnel direction are precluded thereby, which otherwise might entail dragging germs between the containers.

[0013] The features of claim **6** are advantageous in this design. If for instance a rotary filling machine is mounted in the clean room, then the discharge cell may assume the form of the longitudinally split tunnel in the peripheral zone of said machine comprising the container places, one part of said tunnel revolving with the filling machine and the other part being firmly affixed to the clean room housing. The two edges of the tunnel are fitted with slit nozzles blowing at each other. Moreover the tunnel is also divided longitudinally at another site. This may be a slot advantageously acting as a discharge cell conduit and making possible problem-free rotary connection of a clean room housing part revolving jointly with the said machine to a clean room stationary housing part.

[0014] The features of claim **7** are advantageous. In this manner the presently conventional neck grip of plastic bottles may be integrated economically beneath a neck flange.

[0015] The present invention is shown illustratively and schematically in the appended drawings, all walls shown in cross-section being indicated for simplicity by a single line.

[0016] **FIG. 1** is a cross-section of a clean room containing a simple, single container filling machine,

[0017] **FIG. 2** is a section of the discharge cell along line **2-2** in **FIG. 1**,

[0018] **FIG. 3** is a section corresponding to **FIG. 2** of a tunnel-shaped discharge cell,

[0019] **FIG. 4** is a section along line **4-4** of **FIG. 3**,

[0020] **FIG. 5** is a strongly diagrammatical axial section of a rotary filling machine in a clean room,

[0021] **FIG. 6** is a section along line **6-6** in **FIG. 5**,

[0022] **FIG. 7** is a section of a discharge star-wheel along line **7-7** in **FIG. 5**, and

[0023] **FIG. 8** is a cutaway of **FIG. 7** of an embodiment variation with a neck flange support.

[0024] **FIG. 1** shows a clean room **1** enclosed by a housing **2**. Containers **3** are shown as bottles and are moved on a conveyor belt **4** through the clean room which they enter at an intake gate **5** and which the leave through an exit gate **6**. The container **3** raised at this site by omitted means is being filled with beverage. In the process, extraneous air entrained by the said container escapes and would contaminate the clean room throughout.

[0025] For that purpose clean gas, for instance sterile air or CO_2, is fed through a conduit **8** to the clean room and exits from it at the gates **5**, **6** as indicated by arrows. This thorough flushing assures constantly cleaning the clean room **1**.

[0026] A sealing machine **31** is mounted beyond the filling site and seals caps **32** onto the containers **3** within the clean room **1**.

[0027] The above shown equipment is state of the art.

[0028] The design of **FIG. 1** comprises furthermore an discharge cell **9** configured within the clean room **1** and entered by the filling tube **7**, said discharge cell enclosing from above the upper portion of the container **3** in its filling position, in this instance enclosing the neck zone.

[0029] The wall of the discharge cell **9** is a dual wall, namely walls **10***a* and **10***b*. The double wall **10***a*, **10***b* encloses the container **3** by a discharge cell lower aperture **11**, the discharge cell communicating at the lower aperture **11** with the inside of the clean room **1**. Otherwise the double wall **10***a*, **10***b* seals off the discharge cell **9**.

[0030] The gap subtended between the walls **10***a* and **10***b* is connected to the conduit **8** and is fed with clean gas that can exit from the gap at the aperture **11** of the discharge cell **9**. At that site the double walls **10***a*, **10***b* subtend a slit nozzle A, B blowing gas in the direction of the plane of the aperture **11**.

[0031] As shown in **FIG. 1**, the gas exiting at A and B impinges the container **3** and is deflected in approximately equal portions upward into the discharge cell **9** and downward into the clean room **1**.

[0032] The inside of the discharge cell **9** communicates to the outside by an exhaust conduit **12** through the housing **2** of the clean room **1**, and as a result the gas is continuously blown out of the discharge cell **9** into the ambience. In particular, the extraneous air escaping from the container **3** being filled with beverage by the filling tube **7** is expelled in this manner into the ambience and will not reach the clean room **1**. The flow of clean gas in the vicinity of the slit nozzle A, B at the aperture **11** of the discharge cell **9** acts as a gas curtain blocking extraneous air from the container **3** from accessing the clean room **1**.

[0033] The gas flowing at the aperture **11** of the discharge cell **9** into one portion of the clean room **1** may be used as the sole flushing element therein as far as and beyond the gates **5**, **6**, or it may be supported by a further clean gas feed conduit into the clean room **1**.

[0034] Only one discharge cell **9** surmounting one container **3** is shown in **FIGS. 1 and 2**, of which the aperture **11**, as indicated in **FIG. 2**, is circular and as a result comprises a closed rim. In this embodiment mode, the slit nozzle running along the rim is nevertheless denoted by the two references A, B in order to make plain their mutually opposite action and to emphasize the comparison with the other embodiment modes.

[0035] **FIG. 3** is a cross-section using as far as possible the same references as above and showing a design of the discharge cell **9** which rather than being pot-shaped as in **FIGS. 1 and 2** to receive only one container **3**, in this embodiment mode is elongated to receive several containers **3** arrayed in a row as shown by **FIG. 3**. A section along line **4-4** is shown in **FIG. 4**.

[0036] Even in this embodiment mode, the discharge cell **9** is configured inside the clean room **1** which is omitted in this instance. The aperture **11** of the elongated, tunnel-like discharge cell of this embodiment mode is an elongated slot, and, as shown by the arrows indicated in **FIG. 3**, clean gas fed from the slit nozzles A, B is being blown from the edges of said elongated slot into the annular space between the double walls **10***a* and **10***b* in the plane of the aperture **11**. The cross-section of **FIG. 4** shows a site of the tunnel-like discharge cell **9** without a container in the aperture **11**. It will be noted that in this instance again the mutually oppositely flowing gas forming a ram flow is deflected in portions into the discharge cell **9** and outward into the clean room.

[**0037**] The containers **3** may be moved through the tunnel-like configuration of **FIGS. 3 and 4** into the direction indicated by the arrows of **FIG. 3** for instance when using a conveyor means (omitted) mounted underneath said conveyor. Furthermore baffle plates **13** may be provided between the containers, said baffle plates projecting from below through the aperture **11** into the discharge cell **9** which they block substantially transversely, and moving jointly with the containers **3**. This design reduces entrainment of extraneous air between the containers **3**.

[**0038**] Moreover entrainment of extraneous air between the containers may be reduced in that the exhaust conduit **12** instead of being a tube at a site of the elongated tunnel assumes the shape of an elongated slot running the length of said tunnel. Incoming clean air from the slot **17** forming the said aperture therefore will flow through the tunnel cross-section and will move substantially transversely to the exhaust conduit **12**. This feature further reduces transverse entrainment between the containers.

[**0039**] The design shown in **FIG. 3** of an elongated tunnel also may accommodate a row of bottles in stationary manner, said bottles for instance being processed simultaneously, illustratively being filled. In one machine embodiment for instance, wherein the bottles are moved on several tracks in rows transverse to the direction of conveyance, one tunnel segment as shown in **FIG. 3** may be associated with each such row of bottles, said tunnel segment being displaceable jointly with said rows in the direction of conveyance.

[**0040**] **FIGS. 5 and 6** also show a clean room **1** enclosed by a housing **2**, said clean room in this instance however receiving a rotary filling machine which otherwise is conventional. The filling machine rotates about a vertical shaft **14** which supports a co-rotating central base element **15** and a cover element **16** of the housing **2**. As shown by **FIG. 6**, the base element **15** and the cover element **16** each are fitted with a gap seal **17** at their periphery to seal them coarsely but in frictionless manner against stationary top and bottom elements **18**, **19** of the housing **2**.

[**0041**] The containers **3** rest on plates **20** supported, as shown, on the co-rotating base element **15**.

[**0042**] A discharge cell **9** revolves about the shaft **14** and corresponds in its radial section basically to the embodiment of **FIGS. 3-4**, though it revolves in bent manner about the machine's periphery.

[**0043**] The double walls **10***a*, **10***b* in this embodiment are exactly the same as in the embodiment of **FIGS. 3 and 4**, however the tunnel is longitudinally split on one hand at the elongated slot aperture **11** and on the other hand at the upper gap seal **17**, as a result of which the outer double wall **10***a***2**, **10***b***2** is affixed to the stationary housing **2** whereas the inner double wall **10***a***1**, **10***b***1** is seated on the rotating cover element **16**, i.e. revolving with the machine. Clean gas is fed from the shaft **14** fitted with appropriate conduits through a conduit **21** to the gap between the co-rotating inner double walls **10***a***1** and **10***b***1** and through a stationary conduit **22** from the outside to the outer double walls **10***a***2** and **10***b***2**.

[**0044**] By comparison with the discussions relating to **FIGS. 3 and 4**, it also follows from the above embodiments of **FIGS. 5 and 6** that the gas flow directed from the gap space sides at the slit nozzles A, B into the elongated slotted aperture **11** does blow upward by one component into the discharge cell **9** and downward by another component into the clean room **1**. The blown-in gas being considered escapes both from the discharge cell **9** and from the clean room **1** thought the gap seals **17**, where the upper gap seal **17** at the discharge cell **9** acts as an exhaust conduit similar to the exhaust conduit **12** in **FIGS. 1 and 4**. Also, gas escapes from the clean room **1** through the intake and exit gates **5**, **6** (**FIG. 5**).

[**0045**] While the containers **3** in their positions shown in **FIG. 6** are revolving about the shown filling machine, they are being filled through filling tubes **7** centrally situated above the plates **20**, said filling tubes being connected to appropriate feed conduits in the shaft **14** and being configured in their radial portion in the spoke-like manner represented in **FIG. 5**.

[**0046**] Air entrainment between the containers **3** also may be prevented in the circular, tunnel-like discharge cell **9** shown in **FIG. 6** in the manner already discussed in relation to **FIG. 3**.

[**0047**] The containers **3** are fed in the direction of the arrow to the apparatus shown in FIGS. **5** through an intake gate **5** and then to the periphery of the revolving machine by a straight conveyor means **23** above which is mounted an elongated discharge cell corresponding to the embodiment modes of **FIGS. 3 and 4**. This discharge cell already allows trapping extraneous air issuing in this feed zone from the containers and illustratively escaping from them due to gas drafts.

[**0048**] After revolving about the rotating filling machine, the containers **3** exit the clean room **1** having been rotated about a rotating star **24** shown in section in **FIG. 7** and through an exit gate **6**.

[**0049**] As shown in **FIG. 7**, the star **24** is mounted within the housing **2** of the clean room **1** between said housing's bottom element **18** and cover element **19** and it is driven by a vertical shaft **25** in synchronization with the revolving filling machine. A starwheel **26** affixed to the shaft **25** seizes the containers **3** in sockets **27**, Any externally rotating railing to keep the containers in their sockets as well as metal chutes configured underneath the containers were omitted to simplify the drawing.

[**0050**] The star **24** also is fitted with a discharge cell **9** in the manner of the above discussed embodiment modes, said cell communicating upward through an exhaust conduit **12** with the ambience. A co-rotating double pane **28***a*, **28***b* is configured above the starwheel **26** and inside the upper neck zones of the containers **3** to feed through a supply tube **29** the shaft **25** with clean gas and subtending a slit nozzle **8** at its rim.

[**0051**] Another stationary slit nozzle A is subtended by the shown double bell jar **29***a*, **29***b* in annular form and encircles the upper part of the containers **3** at the level of the double pane **28***a*, **28***b* and is supplied with clean gas through a stationary conduit **30**. The aperture **11** is designed as a circumferential slot and situated between the outwardly blowing slit nozzle A and the inwardly blowing slit nozzle B, the same flow conditions that were discussed in relation to **FIGS. 1 through 4** also applying in the aperture **11**.

[**0052**] Clean gas flows both upward in the discharge cell **9** and downward in the clean room **1**, as a result of which contamination of this clean room **1** by air issuing from the container **3** shall be prevented also in the region of the star **24**. This feature is especially advantageous when the machine shown in **FIG. 5** runs in the opposite direction, that is, when the containers **3** filled with impure air then are fed through the star **24** into the clean room **1**, or when, in a clean room larger than shown in **FIG. 5**, several revolving machines are mounted in series, for instance one rotating filling machine and one rotating sealing machine, which would be connected through such a star.

[**0053**] As regards the containers shown as bottles **3** in the Figures, they may be contemporary conventional plastic bottles with neck flanges, which in the state of the art are preferably held at the neck (neck handling). They may be held at the neck by tongs, or by simple U-shaped neck holders seizing the underside of the flange. Such a device is shown in **FIG. 8** which represents a cutaway of the right-hand region of **FIG. 7**, though as an embodiment variant wherein a neck flange bottle **3'** is held in place underneath its flange **40** by U-shaped support **41**. In such a case the star-wheel **26** shown in **FIG. 7** may be eliminated. In that case the supports **41** must be substituted in corresponding numbers and in appropriate position for the sockets **27 (FIG. 7)** on the revolving pane **28***b*.

[**0054**] Such bottle supports may also be used in the embodiment of **FIG. 6**. In that case the supports **41** may be mounted in their appropriate positions on the wall **10***b***1**.

[**0055**] In the embodiment modes shown above, the slit nozzles A and B blow their flows exactly in the plane of the aperture **11** of the discharge cell **9** so that they impinge on each other. As a result and as illustrated in **FIG. 4**, a symmetrical ram flow ensues which moves equal portions of clean gas into the discharge cell **9** and into the clean room **1**.

[**0056**] It may be desirable however to vary the ratio of the gas flows into the discharge cell **9** and into clean room **1**, for instance to move a larger proportion into the clean room **1**. This goal may be implemented in different ways.

[**0057**] On one hand, the slit nozzles A and B that are accurately pointing at each other in the plane of the aperture in the above embodiment modes now may be designed to point toward the discharge cell **9** or to the clean room **1** at a slight angle. If for instance in **FIG. 4** the nozzles A and B were pointing slightly down, then the two nozzles' flows would be slightly asymmetric, namely a larger flow would be allotted downward, that is into the clean room **1**. Reversely, the nozzles A, B also may point slightly upward, entailing a larger flow into the discharge cell **9**.

[**0058**] The gas flows ratio also may be controlled using the flow impedances incurred by said gas flows on their path through the discharge cell **9** to the outside or through the clean room **1** to the outside. Illustratively (**FIG. 1**), the cross-section of the exhaust conduit **12** may be changed in order to change its flow impedance relative to that of the intake and exit gates **5**, **6**.

[**0059**] The shown embodiments always indicate an open discharge cell **9** pointing downward by its aperture **11** toward the clean room **1**. Therefore the standing bottles with the openings upward are inserted through the aperture **11** into the discharge cell **9**. However, in embodiment modes not shown here, the discharge cell **9** jointly with its aperture **11** also might point upward or laterally, as a result of which the bottles **3** by means of their necks would have to be inserted from the side or from above. Such a configuration may be advantageous for instance when the bottles would arrive suspended directly from a rinser.

[**0060**] In the above shown embodiment modes, the slit nozzles A, B are each subtended at the edges of the double walls **10***a*, **10***b*; **28***a*, **28***b*; **29***a*, **29***b* which supply the clean gas issuing from the said slit nozzles. Consequently the case enclosing the discharge cell **9** is substantially double walled. In an alternative and omitted embodiment mode, the case of the discharge cell **9** also may be a single wall, and the double wall mandatory to subtend a slit nozzle may be restricted to the immediate vicinity of the slit nozzles A, B. Illustratively a tube connected to the clean gas supply conduit may be installed along the edges of the aperture **11**, said tube being longitudinally open, and this opening forming the slit nozzle.

[**0061**] In the illustrative embodiment shown above, for instance in **FIGS. 1**, **6** and **7**, the container **3** enters the exhaust discharge cell **9** only by its upper mouth zone while its remaining portion is outside said cell in the clean room **1**. In the case of a larger discharge cell, the container also may enter more deeply into the discharge cell (not shown), or even be moved into it as a whole.

1. A device to eliminate extraneous air, which was introduced by open containers (**3**), from a clean room (**1**) that is filled with clean gas and encloses container processing machines (**14**, **20**; **24**), the clean room being constantly supplied with clean gas to compensate for gas losses, said device comprising:

a discharge cell (**9**) mounted in the clean room (**1**) and communicating, via an exhaust conduit (**12**, **17**), which runs out of the clean room (**1**), with ambient and, via an aperture (**11**), with the clean room (**1**), and,

mutually oppositely blowing slit nozzles (A, B) being disposed at an edge of the aperture (**11**) and blowing clean gas at each other in a plane of the aperture (**11**), the discharge cell (**9**) being configured such that, at least at the filling site of the containers (**3**), the discharge cell at least encloses mouth zones of the containers.

2. The device as claimed in claim 1, wherein the discharge cell (**9**) encloses at least an upper zone of the container (**3**).

3. The device as claimed in claim 1, wherein the discharge cell (**9**) is bell-shaped and comprises a circular aperture (**11**).

4. The device as claimed in claim 1, wherein the discharge cell **(9)** is elongated and tunnel-like and comprises a slot-shaped aperture **(11)**.

5. The device as claimed in claim 4, wherein the discharge cell conduit is a slot **(17)**.

6. The device as claimed in claim 4 used to process containers **(3)** revolving at the periphery of a rotary machine **(7**, **14**, **20**; **26)**, wherein the discharge cell **(9)** is split longitudinally, with one part of the discharge cell **(10***a***1**, **10***b*; **28***a*, **28***b*) revolving jointly with the machine **(14)**, another part **(10***a***2**, **10***b***2**; **29***a*, **29***b*) of the discharge cell being connected to the stationary housing **(2)** of the clean room **(1)**.

7. The device as claimed in claim 6 for use with neck-flange bottles **(3')** held by neck supports **(41)**, wherein the neck supports **(41)** are mounted on the revolving part **(10***b***1**; **28***b*) of the discharge cell **(9)**.

* * * * *