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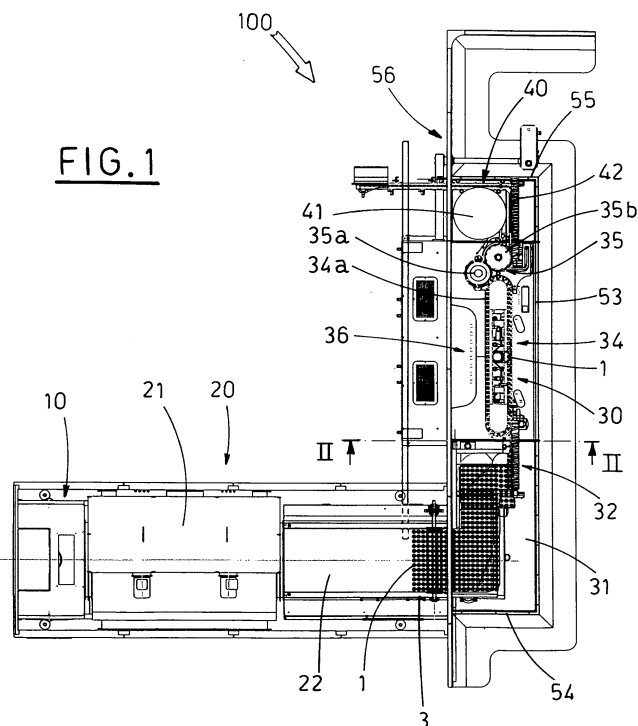
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40137 Bologna (IT)**(54) Machine for packaging products in a protected environment**

(57) A machine for packaging products into relative containers (1) in a protected environment includes a plurality of work stations, respectively, a station (10) for preparing the containers (1), a station (20) for their sterilization and cooling, a container filling station (30) and a container closing station (40). The filling station (30) and the closing station (40) are aligned one after the other, in a controlled atmosphere chamber (50), which is defined by a bottom wall (51), an upper wall (52), a lateral, outer wall (53), front (54) and back (55) walls, and by a lateral,

inner, airtight wall (56, 156), which is situated longitudinally and laterally with respect to the filling station (30) and the closing station (40). The chamber (50) isolates the stations (30, 40) from the respective operating means (60), which are mechanically connected to the respective work station by airtight passages, made in the lateral, inner wall (56). Flow generating means (70) are made in the upper wall (52) for creating and filtering a laminar flow of air (71), directed to the bottom (51) and involving at least the filling station (30) and the closing station (40).

FIG. 1

Description

[0001] The present invention relates to packaging of products in a protected environment.

[0002] In particular, the invention relates to a machine for filling and closing bottles or similar containers in a protected, sterile environment with high purification level.

[0003] It is known that different products, especially pharmaceutical products, must be packaged avoiding any kind of contamination of the product, either by dust particles or others, or by bacteria or other infecting agents.

[0004] Such products are packaged in environments formed by chambers, which are kept constantly sterile and without contaminating particles, or at least keeping the presence of these particles within the prefixed limits, which depend on the requirements of the product to be packaged.

[0005] The above results in the sterile chambers can be obtained by apparatuses, which allow their sterilization, particular absolute filters (HEPA filters - High Efficiency Particulate Air), purifying the air introduced into the environment, as well as the controlled paths for the operators entrance and exit.

[0006] The operators must also undergo dressing, sterilization and decontamination procedures each time they enter the above chamber.

[0007] The packaging machines working in such environments must be sterilizable and the operation means for feeding the product, transporting the containers and packaging the product must be produced with particular materials and techniques.

[0008] The power means for the above mentioned operation means, which could likewise release dust or other contaminating substances, must be entirely sealed, so as to be isolated from the sterile and purified operation environment.

[0009] The packaging operations performed in the above described environments are extremely expensive, difficult and little efficient.

[0010] Actually, the costs of construction and maintenance of the sterile chambers are particularly high.

[0011] The packaging machines working therein must be much more reliable than the average, since each failure, requiring maintenance technician's intervention, causes almost inevitably, the necessity to sterilize and purify again the whole sterile chamber and its contents.

[0012] Moreover, the work of the operators of these machines and carrying out other complementary operations, is rather complicated and hard.

[0013] Some of the above disadvantages are avoided by the widespread packaging machines, in which only the spaces surrounding the means for containers transport and for product packaging are isolated from outside and brought to the necessary sterility and purity conditions.

[0014] This result has been obtained by apparatuses, in which the above means are closed by the walls, usually

transparent or semitransparent, fastened tightly to the machine body.

[0015] The machines are usually obtained by assembling work stations and transport devices designed separately and then joined together, as it occurs generally with the packaging machines for products, which do not require the above mentioned safety measures.

[0016] A flow of air, purified with HEPA filters of suitable class and having pressure slightly higher than the atmosphere pressure, circulates inside the so obtained environments, substantially isolated from outside, except for inlet and outlet of containers to fill.

[0017] There are also systems, for sterilizing the isolated environments.

[0018] The flow of air circulating inside the isolated environments must be as laminar as possible, so as to avoid the creation of turbulence, which could raise the residue particles, which are anyway present in some areas of the packaging machine, and thus could contaminate the packaged product.

[0019] However, the creation of a suitable laminar flow during the design of the packaging machine, is not a simple operation.

[0020] The presence of irregular or cantilevered surfaces, the conformation of the transport and packaging devices, as well as the presence of elements connecting different machine work stations or the areas along the path followed by the flow of air, containing mechanisms for operating the above mentioned devices, contribute to disturb considerably the laminar flow.

[0021] Further, the above mentioned mechanisms are often kept inside the packaging machine in positions, which are hardly accessible for the maintenance or fault repairing operations.

[0022] It results obvious from the above explanation that the users need machines for packaging products in sterile and clean environment, which have optimized the circulation of purified air inside the sterile and clean environments, as well as the arrangement of the devices for operating the working and transport stations.

[0023] The main object of the present invention is to propose a structure of machine for packaging products in a sterile and/or pure environment, which wholly fulfills the above specified needs.

[0024] Another object of the present invention is to propose a packaging machine, in which the operating devices are easily accessible for maintenance and fault repairing operations and do not contaminate the sterile or clean area.

[0025] A further object of the present invention is to propose a packaging machine, which is particularly compact and accessible.

[0026] The above mentioned objects are wholly obtained in accordance with the contents of the claims.

[0027] The characteristic features of the invention, as they will result from the claims, are pointed out in the following detailed description, with reference to the enclosed figures, in which:

- Figure 1 is a schematic, top view of a packaging machine, produced according to the invention, in a preferred embodiment;
- Figure 2 is a schematic, lateral section view, taken along the II - II, of the packaging machine of Figure 1;
- Figure 3 is an enlarged view of the particular X of Figure 2a;
- Figure 4 is an enlarged view of the particular Y of Figure 2a;
- Figure 5 is a schematic view of a different embodiment of the packaging machine according to the invention;
- Figure 6 is a schematic, lateral section view, taken along the VI - VI, of the packaging machine of Figure 5;
- Figure 7 shows a different conformation of the device for feeding containers to the packaging machines of Figure 1 and 6.

[0028] With regard to Figures 1 and 2, the reference numeral 100 indicates the whole of a machine for packaging products into relative containers 1, obtained according to a first embodiment of the invention.

[0029] The machine 100 is particularly suitable for filling and closing containers 1, e.g. bottles, with products, which must be packaged in sterile environment, substantially free of particulate contaminating agents, such as some pharmaceutical products.

[0030] In the configuration shown in the above mentioned Figures, the machine 100 includes a plurality of work stations, situated one after another.

[0031] The detailed structure and operation of each of the above work stations are substantially known, and thus they will not be analyzed in the next part of the present description.

[0032] In particular, the machine 100 includes a station 10 for preparing containers 1, e.g. washing station, aimed at cleaning the containers 1 of all potential contaminating agents.

[0033] The above agents are usually powders and residues of the processing, which the containers have undergone previously.

[0034] A sterilization and cooling station 20, situated downstream of the preparation station 10, is aimed at receiving the containers 1, already cleaned but not yet sterilized, in order to heat sterilize them and to prepare them for subsequent filling operations.

[0035] The sterilization and cooling station 20 includes a heat sterilization tunnel 21, connected upstream to the washing station 10, and a containers 1 cooling area, following the tunnel 21 and including substantially a closed environment, which consists of a moving belt 22 and a

device of absolute filtering and of cooling air circulation.

[0036] The belt 22 is aimed at conveying the containers 1, substantially in bulk, to an inlet aperture 3 of a controlled atmosphere chamber 50, with an operation rate such as to allow the cooling up to temperatures compatible with the product to be packaged.

[0037] The above mentioned chamber 50 according to the first embodiment, is at 90° with respect to the washing station 10 and the sterilization station 20.

[0038] The chamber 50 is aimed at receiving a filling station 30 and a closing station 40 of the containers 1, where the containers cannot get in contact with contaminating agents, both particulate (powder) or biological (microorganisms).

[0039] The chamber 50 is particularly shaped in such a way, as to assure, first, that the contaminating agents do not penetrate therein from the outer environment, and second, that there are no accumulations of residues, even minimal, of the above mentioned contaminating agents (with the subsequent proliferation thereof in case of microorganisms), which possibly manage to penetrate into the chamber.

[0040] The chamber 50 is defined by a bottom wall 51, an upper wall 52, a lateral outer wall 53, a front wall 54, a back wall 55, and a lateral, inner, airtight wall 56.

[0041] The latter is made in one body with the filling station 30 and the closing station 40, longitudinal and lateral thereto, and is aimed at isolating the above mentioned work stations from the respective operating means 60.

[0042] For this purpose, the operating means 60 are situated in a longitudinal space 61 of the packaging machine 100, adjacent to the chamber 50 and separated therefrom by the lateral, inner wall 56.

[0043] The operating means 60 are properly connected to the respective work stations, by airtight passages, made in the lateral, inner wall 56.

[0044] The flow generating means 70, situated in a position corresponding to the upper wall 52, are aimed at generating a flow of purified air, substantially laminar, directed to the bottom 51 of the chamber 50, and involving the filling station 30 and the closing station 40.

[0045] For this purpose, the flow generating means 70 include, arranged according to known techniques, fans and HEPA filters of a class suitable to the purification required for the chamber 50, which depends on the requirements of the product to be packaged.

[0046] The fans are aimed at withdrawing air from the outside environment, as well as from a re-circulation conduit 80, in prefixed proportions.

[0047] In particular, it is advantageous to re-circulate the most of the already purified air circulating in the chamber 50 and to allow a certain discharge of air outwards of the chamber 50, reintegrating the missing quantity with taking new air from outside.

[0048] For this purpose the re-circulation conduit 80 (see also Figure 4) extends from an aperture 81, made in the bottom wall 51, in the lower part of the packaging

machine 100, then along an ascender section, made outside the space 61, up to an inlet 71, made in the flow generating means 70.

[0049] The aperture 81 extends preferably in the bottom wall 51, for most of the longitudinal extension of the chamber 50, and possibly along the whole extension thereof.

[0050] Thus, the flow of air, which reaches the bottom of the chamber 50, is extracted without creating turbulences on the bottom or flows of air returning to the work stations.

[0051] The lateral, inner wall 56 is particularly shaped to convey the laminar flow 71 from the upper part of the chamber 50, through the filling station 30 and the closing station 40, toward the bottom of the chamber 50, offering a minimum resistance to the feeding of the flow and thus minimizing the generation of turbulent motions.

[0052] The lateral, inner wall 56 includes a lower section 56a, substantially vertical, which extends from the bottom wall 51 and defines a minimum width of the chamber 50.

[0053] An intermediate section 56b extends oblique from the lower section 56a, so as to widen gradually the chamber 50 in a region corresponding to the work stations 30, 40.

[0054] An upper section 56c extends vertically from the end of the intermediate section 56b up to the upper wall 51.

[0055] The above described conformation of the lateral, inner wall 56 allows advantageously to house the operating means 60 of the work stations 30, 40, which are contained in the chamber 50, in the space 61, immediately below the intermediate section 56b of the 56.

[0056] This makes particularly efficient the positioning of the operating means 60 and their accessibility for maintenance and possible repairs, assuring at the same time an advantageous conformation of the chamber 50, regarding the conveying of the laminar flow toward the bottom thereof.

[0057] According to a second embodiment, shown in Figures 5 and 6, the preparation station 10 and the sterilization and cooling station 20 of the packaging machine 100 are aligned with the subsequent filling station 30 and the closing station 40.

[0058] Such a configuration, functionally identical to the one described in the first embodiment, allows a reduction of the width of the packaging machine 100, increasing its total length.

[0059] In the above mentioned configuration, the inlet aperture 3 for the sterilized containers is wider, thus it allows a better flow of the sterilized containers from the sterilization and cooling station 20 to the filling station 30.

[0060] The chamber 50 includes also, for merely constructive reasons, a lateral, inner wall 156 shaped differently.

[0061] Actually, its lower section 156a and intermediate section 156b are made as the corresponding sections of the wall 56 according to the first embodiment.

[0062] The lateral, inner wall 156 includes also an upper section 156c, divided in two different parts, first 157 and second 158, substantially vertical and mutually staggered, so as to further widen the upper part of the chamber 50.

[0063] The first part 157 and the second part 158 are connected by a substantially horizontal plate 159.

[0064] The filling station 30 includes an inlet belt 31, aimed at receiving the containers 1 in bulk, coming from the cooling station 20 through the inlet aperture 3.

[0065] Feeding means 32, 33 are situated downstream of the belt 31 for withdrawing single containers and feeding them orderly.

[0066] Figures 1 and 5 show feeding means 32, which include a linear screw conveyor of prefixed pitch.

[0067] According to a constructive variant, the packaging machine 100 includes feeding means 33, which are a carrousel feeder, having seats 33a, situated along its edge at a prefixed pitch.

[0068] An endless conveyor 34, having a plurality of seats 34a, arranged with the same pitch as the above mentioned feeding means 32, 33, is situated subsequent thereto, and is operated in step relation therewith, to receive therefrom the containers 1 and to bring the latter below a linear filling device 36, of tracking type, and then near the closing station 40.

[0069] The machine includes also transferring means 35, situated immediately downstream of the conveyor 34 for transferring the containers 1 to the closing station 40 in a prefixed sequence.

[0070] The transferring means include in particular a group of carrousel conveyors 35a, 35b, arranged one after the other and operated to rotate in step relation with the conveyor 34 feeding.

[0071] The closing station 40 includes a cap applying device, with a carrousel, operated continuously and in step relation with the already briefly described means of the filling station 30.

[0072] The closing station includes a screw conveyor 42 for withdrawing the containers 1 from the filling station.

[0073] The structure of the above described work stations, situated inside the chamber 50, is known in itself, or anyway protected separately by different and independent patent applications, and it will not be described, because it is not strictly relevant to the objects of the invention.

[0074] Therefore, it is understood that different configurations of the packaging machine 100 according to the present invention, are possible, like the presence of further devices and functional blocks, not described here.

Claims

1. Packaging machine for packaging products into containers (1) in a protected environment, the machine including a plurality of work stations, respectively, a station (10) for preparing said containers (1), a sta-

- tion (20) for their sterilization and cooling, a container filling station (30) and a container closing station (40), **characterized in that** at least said filling station (30) and closing station (40) are situated aligned one after the other, in a controlled environment chamber (50), said chamber (50) being defined by a bottom wall (51), an upper wall (52), a lateral, outer wall (53), front (54) and back (55) walls, and by a lateral, inner, airtight wall (56, 156), which is situated longitudinally and laterally with respect to the filling station (30) and the closing station (40), for isolating them from respective operating means (60), which are mechanically connected to respective work stations through airtight passages, made in the lateral, inner wall (56, 156), with flow generating means (70) situated in said upper wall (52) for creating and filtering a laminar flow of air (71), directed to said bottom (51) and involving at least said filling station (30) and the closing station (40).
2. Packaging machine, as claimed in claim 1, **characterized in that** said lateral, inner wall (56) includes a substantially vertical lower section (56a), extending from said bottom wall (51), an oblique intermediate section (56b), extending from said lower section (56a), so as to widen gradually the chamber (50) in a region corresponding to said work stations (30, 40), and a substantially vertical upper section (56c), extending from said intermediate section (56b) up to said bottom wall (51).
 3. Packaging machine, as claimed in claim 1, **characterized in that** said lateral, inner wall (156) includes a substantially vertical lower section (156a), extending from said bottom wall (51), an oblique intermediate section (156b), extending from said lower section (156a), so as to widen gradually the chamber (50) in a region corresponding to said work stations (30, 40), with an upper section (156c) being divided into two separated parts, a first part (157) and a second part (158), which are substantially vertical and mutually staggered, so as to further widen the upper part of the chamber (50), said first part (157) and second part (158) being connected by a substantially horizontal plate (159).
 4. Packaging machine, as claimed in claim 1, **characterized in that** said operating means (60) of the filling station (30) and closing station (40) are contained in space (61), situated longitudinal in the packaging machine (100), adjacent to said airtight chamber (50) and separated therefrom by said lateral, inner wall (56).
 5. Packaging machine, as claimed in claim 1, **characterized in that** it includes at least one re-circulation conduit (80) of the purified air introduced into said airtight chamber (50) by said flow generating means (70), which extend from an aperture (81), made in said bottom wall (51), to an inlet (72) of the flow generating means (70), said conduit bringing at least a part of the flow of air circulating inside the chamber (50) back to the inlet of said flow generating means (70).
 6. Packaging machine, as claimed in claim 5, **characterized in that** said re-circulation conduit (80) extends substantially along the whole length of said airtight chamber (50).
 7. Packaging machine, as claimed in claim 1, **characterized in that** said laminar flow of air (71) inside the chamber (50) is in overpressure with respect to the environment external thereto.
 8. Packaging machine, as claimed in claim 1, **characterized in that** said filling station (30) includes an inlet belt (31), which receives in bulk the containers (1), coming from an inlet aperture (3); feeding means (32, 33), withdraw said containers (1) from said belt (31) and feed them orderly; an endless conveyor (34), having a plurality of seats (34a), suitably spaced apart, withdraws said containers (1) from said feeding means (32, 33) and brings them below a linear filling device (36), of tracking type, which fills them, then said conveyor (34) brings the containers to said closing station (40); transferring means (35), situated immediately downstream of said conveyor (34) for transferring said containers (1) to the closing station (40) in a prefixed sequence.
 9. Packaging machine, as claimed in claim 8, **characterized in that** said feeding means (32) include a linear screw conveyor, whose pitch is identical to the one of the seats (34a), and which is operated in step relation with the movement of the latter.
 10. Packaging machine, as claimed in claim 8, **characterized in that** said feeding means (33) include a carrousel feeder, having seats (33a), situated along its edge at a prefixed pitch, which is identical with the pitch of the seats (34a) of said conveyor (34), said feeder (33) being operated in step relation to the conveyor (34) movement.
 11. Packaging machine, as claimed in claim 8, **characterized in that** said transferring means (35) include a plurality of carrousel conveyors, situated one after another and operated so as to be rotated in step relation to the conveyor (34) movement.
 12. Packaging machine, as claimed in claim 1, **characterized in that** said closing station (40) includes a cap applying device (41), of carrousel type, operated continuously, and a screw conveyor (42)

for withdrawing the containers 1 from said filling station (30).

13. Packaging machine, as claimed in claim 1,
characterized in that said containers (1) preparing station (10), and sterilization and cooling station (20) are at 90° with respect to said filling station (30) and closing station (40). 5

14. Packaging machine, as claimed in claim 1, 10
characterized in that said containers (1) preparing station (10), and sterilization and cooling station (20) are aligned with said filling station (30) and closing station (40). 15

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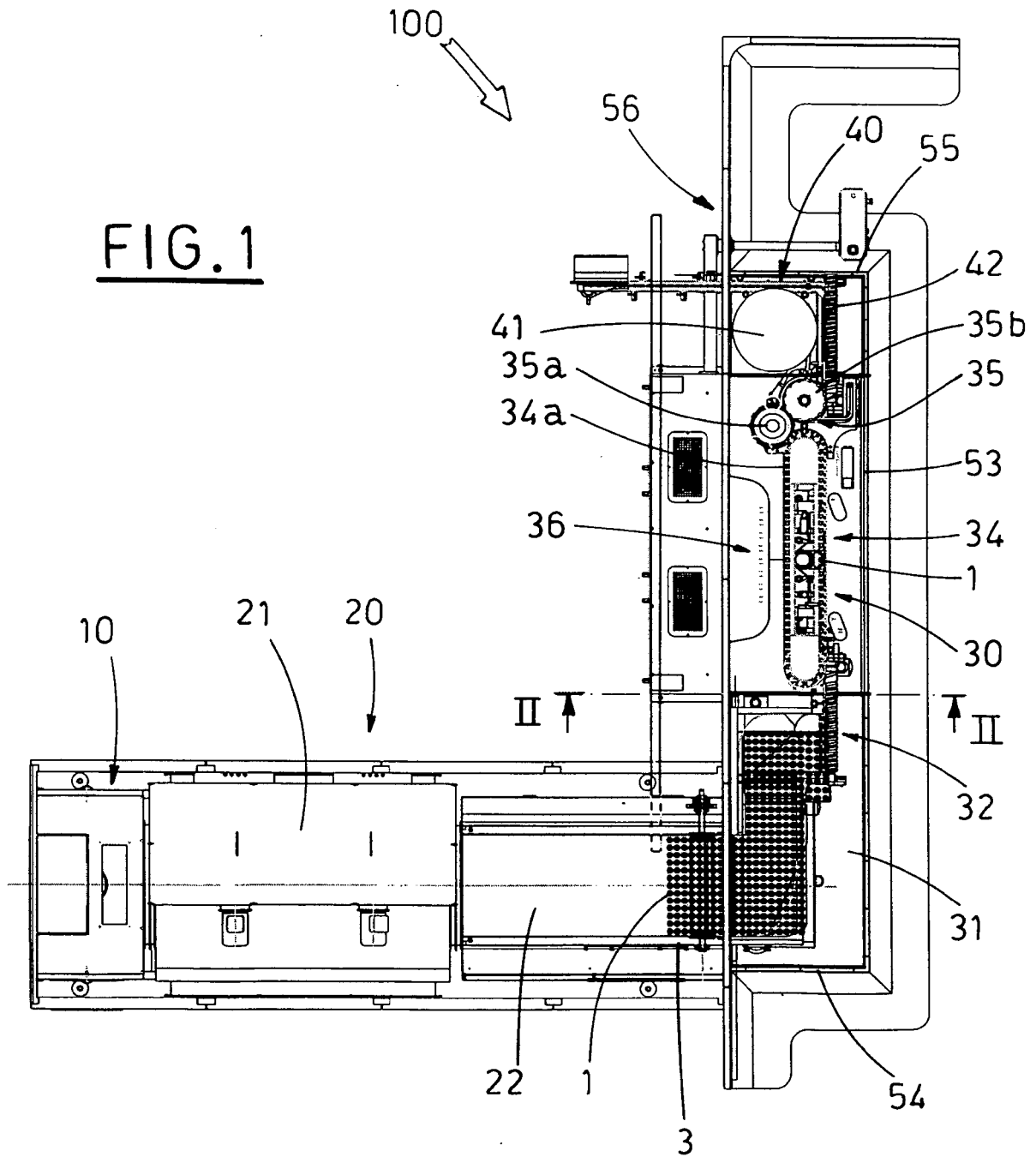
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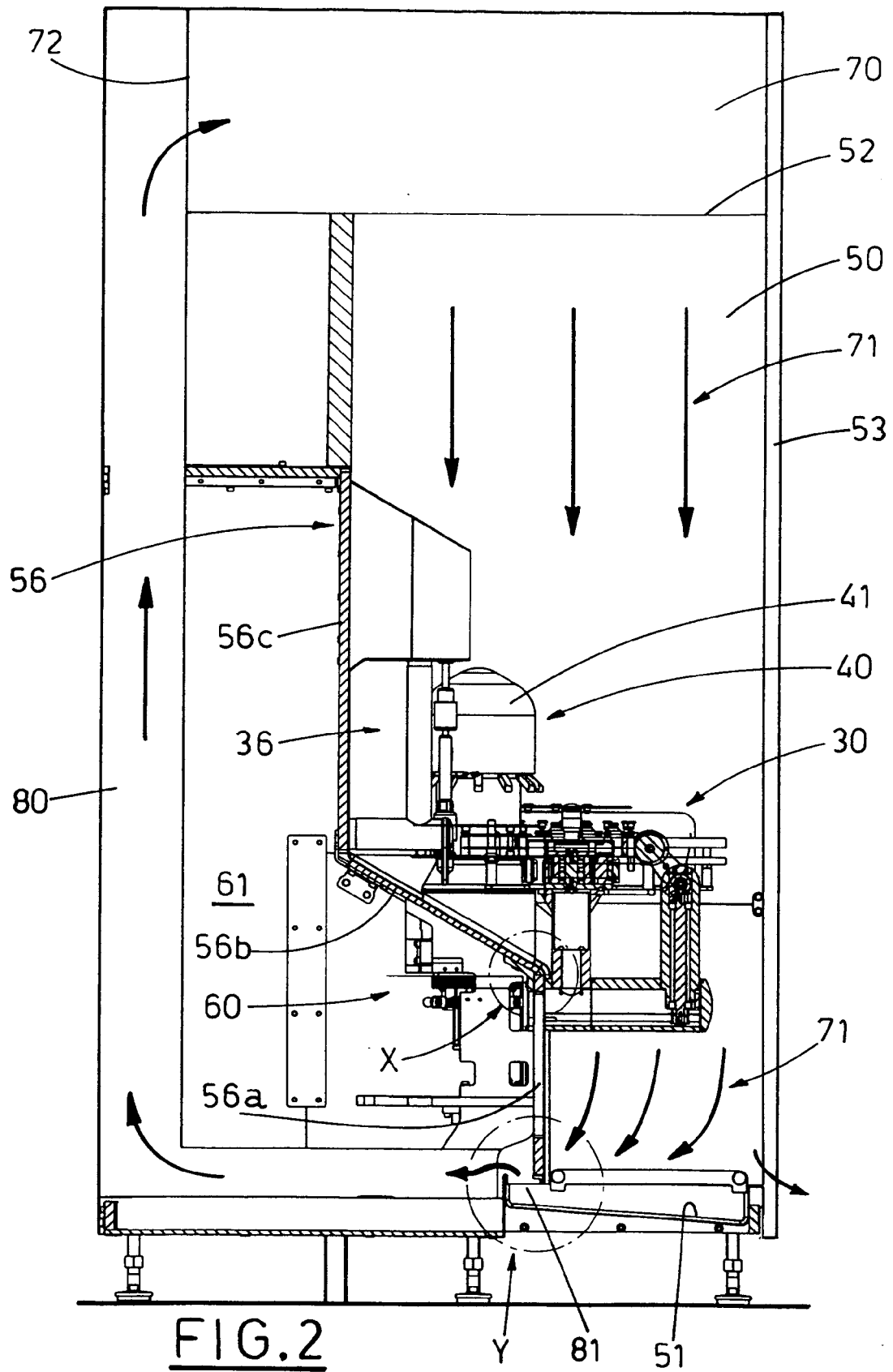
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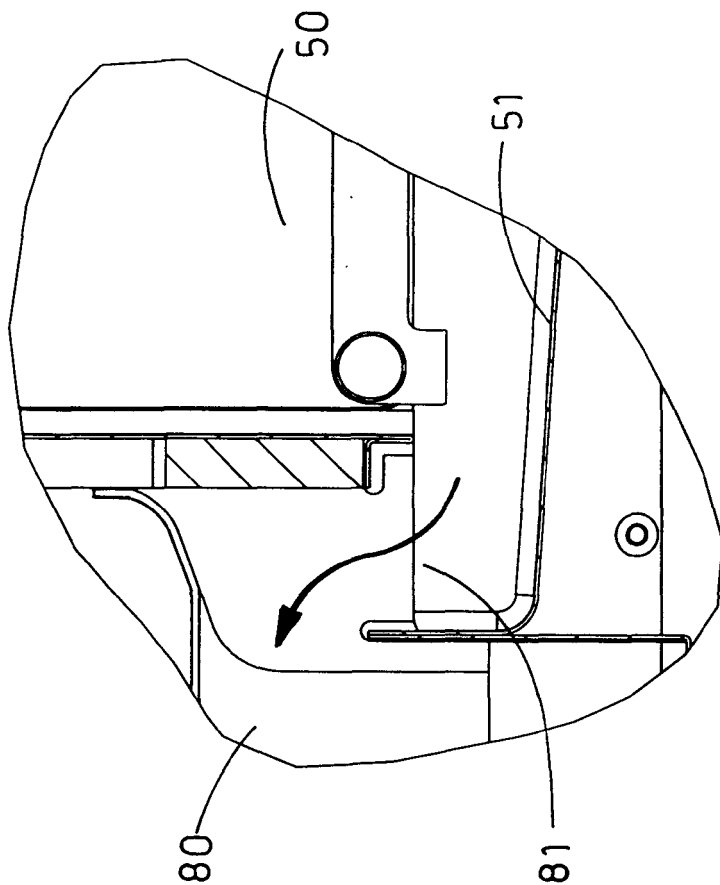


FIG. 4

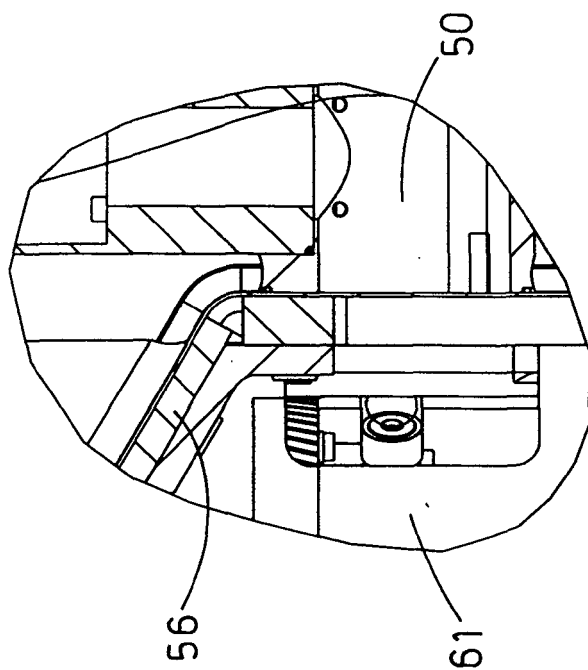


FIG. 3

