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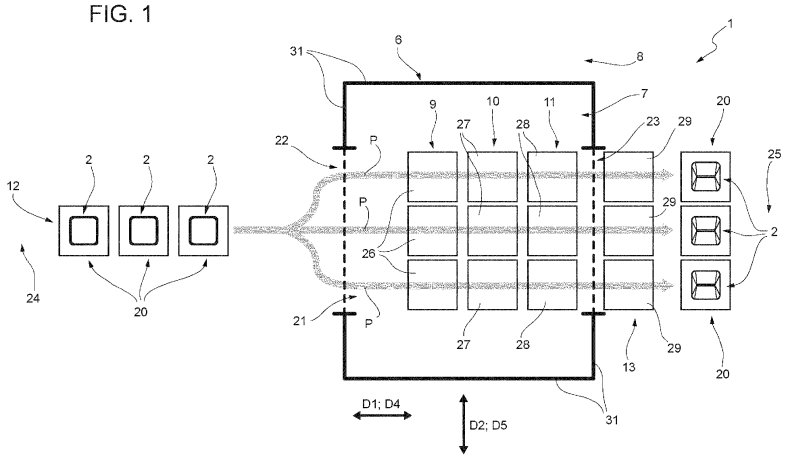
(54) FILLING MACHINE FOR FILLING A POURABLE PRODUCT INTO RECEPTACLES

(57) There is described a filling machine (1, 1', 1") for filling a pourable product into receptacles (2) and comprising an isolation chamber (6) delimiting an inner environment (7), a sterilization apparatus (9) at least partially arranged within the inner environment (7), a filling apparatus (10) at least partially arranged within the inner environment (7), a closing apparatus (11) at least partially arranged within the inner environment (7) and a conveying apparatus (12) configured to advance the receptacles (2) at least within the inner environment (7). The conveying apparatus (12) comprises a plurality of carriers (20, 20'), each one configured to carry at least one receptacle (2) at a time and a planar motor (21) configured to move each one of the carriers (20, 20') within the inner environment (7) and such to advance the receptacles (2) in order of mentioning to the sterilization apparatus (9), the filling apparatus (10) and the closing apparatus (11) .

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a filling machine for filling a pourable product, preferentially a pourable food product, into receptacles.

[0002] Advantageously, the present invention relates to a filling machine for the filling of ready-to-fill containers with a pourable product, preferentially a pourable food product.

BACKGROUND ART

[0003] As is known, many liquid or pourable food products, such as fruit juice, UHT (ultra-high-temperature treated) milk, wine, tomato sauce, etc., are sold in packages, in particular sealed packages, made of sterilized packaging material.

[0004] A typical example is the parallelepiped-shaped package for pourable food products known as Tetra Brik Aseptic (registered trademark), which is made by sealing and folding a laminated strip packaging material. The packaging material has a multilayer structure comprising a carrier and/or paper base layer, covered on both sides with layers of heat-seal plastic material, e.g. polyethylene. In the case of aseptic packages for long-storage products, the packaging material also comprises a layer of oxygen-barrier material, e.g. an aluminum foil, which is superimposed on a layer of heat-seal plastic material, and is in turn covered with another layer of heat-seal plastic material forming the inner face of the package eventually contacting the food product.

[0005] There are known automatic filling machines, which are configured to form the packages from packaging blanks of a multilayer packaging material and to fill these with a pourable product. The known automatic filing machines comprise respective first conveying means for advancing the packaging blanks and respective folding means configured to fold the packaging blanks into receptacles having a closed end (e.g. an end having sealed portions) and an open-end so as to form ready-to-fill containers. The automatic packaging machines also comprise respective second conveying means, e.g. a respective conveyor belt, for advancing the receptacles to a filling station at which the containers are filled by means of a filling device through the respective open-ends with the pourable product and afterwards to a closing station at which the open-ends are closed by a closing device, e.g. by means of a sealing process. Typically, the filling and closing steps are executed within a controlled environment so as to guarantee needed hygienic conditions.

[0006] There are also known filling machines, which are directly fed with the already formed receptacles, e.g. the ready-to-fill containers, and which comprise the second conveying means, the filling device and the closing device so as to fill the receptacles with the pourable product and to close the receptacles afterwards.

[0007] In order to reach high-throughput filling machines it is known to rely on an architecture based on rotary conveying devices, which come along with a significant complexity and space requirements.

[0008] Even though the known filling machines provide for satisfying results, a desire is felt in the sector to further improve the known packaging machines.

DISCLOSURE OF INVENTION

[0009] It is therefore an object of the present invention to provide an improved filling machine for filling receptacles with a pourable product, preferentially a pourable food product.

[0010] Advantageously, it is an object of the present invention to provide an improved filling machine for filling ready-to-fill containers with a pourable product, preferentially a pourable food product.

[0011] According to the present invention, there is provided filling machine according to the independent claim 1.

[0012] Preferred embodiments of the filling machine are claimed in the claims being directly or indirectly dependent on claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Three non-limiting embodiments of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of a filling machine according to a first embodiment of the present invention, with parts removed for clarity;

Figure 2 is a schematic top view of a detail of the filling of the filing machine of Figure 1 carrying a receptacle to be filled, with parts removed for clarity;

Figure 3 is a schematic view of a filling machine according to a second embodiment of the present invention, with parts removed for clarity;

Figure 4 is a schematic view of a filling machine according to a third embodiment of the present invention, with parts removed for clarity;

Figure 5 is a schematic view of a filling machine according to a fourth embodiment of the present invention, with parts removed for clarity; and

Figures 6a and 6b schematically show a variant of the detail of Figure 2, with parts removed for clarity.

BEST MODES FOR CARRYING OUT THE INVENTION

[0014] Number 1 indicates as a whole a filling machine for filling a pourable product into receptacles 2.

[0015] Preferentially, filling machine 1 may be configured to fill a pourable food product, such as (pasteurized) milk, fruit juice, wine, tomato sauce, salt, sugar, emulsions, yoghurt, yoghurt drinks, beverages with pulp, milk drinks etc., into receptacles 2.

[0016] According to some preferred non-limiting embodiments, receptacles 2 may be formed from a multilayer packaging material.

[0017] Preferentially, the multilayer packaging material may comprise at least one layer of fibrous material, such as e.g. paper or cardboard, and at least two layers of heat-seal plastic material, e.g. polyethylene, interposing the layer of fibrous material in between one another. One of these two layers of heat-seal plastic material may define the inner face of package 2 contacting the pourable product.

[0018] Moreover, the multilayer packaging material may also comprise a layer of gas- and light-barrier material, e.g. aluminum foil or ethylene vinyl alcohol (EVOH) film, in particular being arranged between one of the layers of the heat-seal plastic material and the layer of fibrous material. Preferentially, the packaging material may also comprise a further layer of heat-seal plastic material being interposed between the layer of gas- and light-barrier material and the layer of fibrous material.

[0019] According to some alternative embodiments, receptacles 2 could be formed from other materials such as glass, metal such as aluminum, composite materials, plastic and/or their combinations.

[0020] An alternative receptacle 2 may comprise e.g. a bottle formed from plastic, glass, aluminum or the like.

[0021] With particular reference to Figure 2, each receptacle 2 may comprise an open-end portion 3 and a closed end portion 4 opposite to the open-end portion 3. In more detail, each open-end portion 3 and the respective closed end portion 4 may be spaced apart from one another along a longitudinal axis A of the respective receptacle 2.

[0022] Preferentially, each open-end portion 3 comprises a respective opening 5.

[0023] Filling machine 1 may be configured to fill the pourable product into receptacles 2 through the respective openings 5.

[0024] Moreover, filling machine 1 may be configured to close the respective open-end portions 3, preferentially the respective openings 5, of each receptacle 2 after filling the receptacle 2 with the pourable product.

[0025] According to some preferred non-limiting embodiments, receptacles 2 may be ready-to-fill containers; i.e. receptacles 2 which have been formed such that they can be sterilized and consecutively be filled with the pourable product.

[0026] According to some possible non-limiting embodiments, filling machine 1 may be coupled to and/or may comprise a preparation machine configured to form receptacles 2 from respective precursors.

[0027] E.g., precursors can be packaging blanks and/or sheets formed from the multilayer packaging material, which can be folded into the respective receptacles.

[0028] Another example of a precursor can be seen in a preform of a polymeric material, which can be molded (e.g. blow molded or compression molded) into bottles (defining receptacles 2).

[0029] Alternatively, receptacles 2 are already provided to the production hall and can then be fed to filling machine 1.

[0030] In further detail, filling machine 1 may comprise:

- an isolation chamber 6 delimiting an inner environment 7, preferentially from an outer environment 8;
- a sterilization apparatus 9 at least partially arranged within inner environment 7 and configured to sterilize receptacles 2 within inner environment 7;
- a filling apparatus 10 at least partially arranged within inner environment 7 and configured to fill receptacles 2 through the respective openings 5 of receptacles 2 with the pourable product and within inner environment 7;
- a closing apparatus 11 at least partially arranged within inner environment 7 and configured to close the respective open-end portions 3, preferentially the respective openings 5, of the receptacles 2 within inner environment 7; and
- a conveying apparatus 12 configured to advance the receptacles 2 at least within inner environment 7.

[0031] According to some possible non-limiting embodiments, filling machine 1 may further comprise a forming apparatus 13 configured to form and shape filled and closed receptacles 2, preferentially for giving a final shape to filled and closed receptacles 2. According to the example of Figure 1, forming apparatus 13 may be arranged within outer environment 8.

[0032] In more detail, conveying apparatus 12 may comprise:

- a plurality of carriers 20, each one configured to carry at least one receptacle 2 at a time; and
- a planar motor 21 configured to selectively and independently move each one of the plurality of carriers 20 within at least inner environment 7 and such to advance receptacles 2 in order of mentioning to sterilization apparatus 9, the filling apparatus and the closing apparatus.

[0033] According to some preferred non-limiting embodiments, filling machine 1 may further comprise a conditioning apparatus configured to condition inner environment 7. Preferentially, the conditioning apparatus may be configured to control an aseptic inner environment 7; i.e. such that the filling of receptacles 2 can occur under aseptic conditions. E.g. the conditioning apparatus may be configured to introduce a sterile gas such as sterile air, into inner environment 7 and/or to maintain (control) a predetermined pressure within inner environment 7 e.g. such that the pressure within inner environment 7 is higher than the pressure outside inner environment 7, e.g. within outer environment 8.

[0034] Moreover, outer environment 8 may not be an aseptic environment.

[0035] According to some preferred non-limiting embodiments, isolation chamber 6 comprises at least one inlet 22 and at least one outlet 23.

[0036] According to one or more embodiments, the at least one inlet 22 may coincide with the at least one outlet 23. In alternative, isolation chamber 6 may comprise a plurality of inlets 22 and/or a plurality of outlets 23.

[0037] As described in the figures, inlet 22 and/or outlet 23 may be dimensioned such that more than one carrier 20 can pass therethrough simultaneously. In alternative, each inlet 22 and/or each outlet 23 may be dimensioned such that only one carrier 20 can pass therethrough at a given time.

[0038] In one or more embodiments, the conditioning apparatus may be configured to apply, at the at least one inlet 22 and/or at the at least one outlet 23, a pressure difference such that the predetermined pressure in the inner environment 7 is greater than a pressure in the outer environment 8. Advantageously, the pressure difference prevents air and particles from passing through the inlet 22 and/or outlet 23 towards inner environment 7.

[0039] Preferentially, isolation chamber 6 may comprise a plurality of walls 31 delimiting inner environment 7. More preferentially, at least one wall 31 has inlet 22 and at least one wall 31 has outlet 23.

[0040] According to some preferred non-limiting embodiments, isolation chamber 6 may extend into a first direction D1, a second direction D2 perpendicular to first direction D1 and a third direction D3 (only indicated in Figures 5a and 5b with respect to a further embodiment) perpendicular to first direction D1 and second direction D2.

[0041] According to the non-limiting example embodiment shown in Figure 1, inlet 22 and outlet 23 are spaced apart from one another along substantially direction D1.

[0042] Preferentially, first direction D1 and second direction D2 may define a substantially horizontal plane and third direction D3 may have a substantially vertical orientation.

[0043] Preferentially, inlet 22 and/or outlet 23 may comprise a respective air lock, preferentially for avoiding the entrance of air and/or contaminations from outer environment 8 into inner environment 7.

[0044] With particular reference to Figure 1, planar motor 21 may be configured to selectively and independently move each one of carriers 20 within inner environment 7 and from inlet 22 to outlet 23.

[0045] According to some possible non-limiting embodiments, planar motor 21 may be configured to advance each carrier 20 along a respective advancement path P within inner environment 7. Preferentially, each advancement path P may extend between at least sterilization apparatus 9 and filling apparatus 10, preferentially sterilization apparatus 9 and closing apparatus 11.

[0046] Preferentially, each advancement path P may extend between inlet 22 and outlet 23.

[0047] According to some possible non-limiting embodiments, planar motor 21 may be configured to selectively and independently move each one of carriers 20 within outer environment 8.

[0048] According to some possible non-limiting embodiments, each carrier 20 may be configured to receive the respective receptacles 2 at a receiving station 24 and to release the respective receptacles 2 at a releasing station 25.

[0049] According to the example shown in Figure 1, receiving station 24 and releasing station 25 may be arranged within outer environment 8. According to such a non-limiting embodiment, planar motor 21 may be configured to introduce carriers 20 through inlet 22 into inner environment 7 and through outlet 23 out of inner environment 7.

[0050] Alternatively, one or both of receiving station 24 and releasing station 25 may be arranged within inner environment 7. E.g. receiving station 24 may be positioned adjacent to inlet 22 and/or releasing station 25 may be positioned adjacent to outlet 23. According to such an embodiment, planar motor 21 may be configured to advance carriers 20 solely within inner environment 7.

[0051] According to some preferred non-limiting embodiments, planar motor 21 may be configured to (cyclically) advance each carrier 20 from receiving station 24 to releasing station 25 and from releasing station 25 to receiving station 24.

[0052] Advantageously, planar motor 21 may be configured to control each carrier 20 along three linear axes and/or around three rotational axes. Preferentially, each carrier 20 may come along with six degrees of freedom.

[0053] In more detail, planar motor 21 may be configured to control the respective positions of each carrier 20 along a respective fourth direction D4 parallel to first direction D1, a fifth direction D5 parallel to second direction D2 and a sixth direction D6 parallel to third direction D6.

[0054] Alternatively or in addition, planar motor 21 may be configured to control an angular position of each carrier 20 about a respective first rotation axis parallel to first direction D1, a second rotation axis parallel to second direction D2 and a third rotation axis parallel to third direction D3.

[0055] Advantageously and with particular reference to Figure 1, planar motor 21 may be configured to selectively and independently move each one of carriers 20 within inner environment 7 and such to advance the respective receptacles 2 in order of mentioning to sterilization apparatus 9 for sterilizing the respective receptacles 2, filling apparatus 10 for filling the respective receptacles 2 with the pourable product and closing apparatus 11 for closing the respective receptacles 2. In other words, planar motor 21 may be configured such that carriers 20 advance along respective advancement paths P such that receptacles 2 become, in use, at first sterilized, then filled with the pourable product and finally receptacles 2 are closed.

[0056] Preferentially, planar motor 21 may also be configured to advance carriers 20 such to advance the re-

spective receptacles 2 from closing apparatus 11 to forming apparatus 13 for forming and shaping the respective receptacles 2.

[0057] In one or more embodiments, carriers 20 may be configured to continuously move during advancement, e.g. at least between the sterilization apparatus 9, the filling apparatus 10 and the closing apparatus 11. Optionally, carriers 20 may be configured to uninterruptedly move between inlet 22, sterilization apparatus 9, filling apparatus 10, closing apparatus 11 and outlet 23. That is, carriers 20 may be configured to advance between sterilization apparatus 9, filling apparatus 10 and closing apparatus 11 without stopping. Carriers 20 may be configured to slow down at sterilization apparatus 9, filling apparatus 10 and closing apparatus 11 and/or movable parts of sterilization apparatus 9, filling apparatus 10 and closing apparatus 11 may be configured to move alongside carriers 20 during the advancement thereof.

[0058] According to some possible non-limiting embodiments, sterilization apparatus 9 may comprise a plurality of sterilization devices 26 arranged at a respective sterilization station and configured to sterilize the receptacles 2 advanced to the respective sterilization station.

[0059] According to some possible non-limiting embodiments, filling apparatus 10 may comprise a plurality of filling devices 27, each one arranged at a respective filling station and configured to fill at least a respective portion of the pourable product into the receptacles 2 advanced to the respective filling station. According to the embodiment of Figure 1, each filling device 27 is configured to fill the pourable product into the respective receptacles 2.

[0060] According to some preferred non-limiting embodiment, each sterilization device 26 may be associated to one respective filling device 27; i.e. each sterilization device 26 defines a respective pair with the associated filling device 27 such that these receptacles 2 advanced to the sterilization device 26 are afterwards advanced to the associated filling device 27, thereby the respective pair is static (hence, the pair will not be changed in time). In other words, after having been sterilized by the respective sterilization device 26, each receptacle 2 is advanced to the respective filling device 27 associated with the respective sterilization device 26.

[0061] According to some preferred non-limiting embodiments, closing apparatus 11 may be configured to seal, preferentially heat seal, the respective openings 5 of receptacles 2.

[0062] Preferentially, closing apparatus 11 may be configured to seal at least portions, preferentially being adjacent and/or being part of the respective open-end portions 3, of the multilayer packaging material to one another so as to close and seal the respective openings 5 of the respective receptacles 2.

[0063] In more detail, closing apparatus 11 may comprise a plurality of closing devices 28, preferentially each one having one or more sealing units, arranged at a respective closing station and configured to close, preferentially to seal, the respective openings 5 of the respective receptacles 2 advanced to the respective closing station.

[0064] Preferentially, each closing device 28 may be associated to one respective filling device 27; i.e. each closing device 28 defines a respective pair with the associated filling device 27 such that these receptacles 2 advanced to the closing device 28 have been previously advanced to and filled by the associated filling device 27, thereby the respective pair is static (hence, the pair will not be changed in time). In other words, after filling of a receptacle 2 by means of the respective filling device 27, the receptacle 2 is advanced to the closing device 28 associated with the respective filling device 27.

[0065] According to the non-limiting embodiment of Figure 1, planar motor 21 may be configured to selectively advance each carrier 20 to one respective filling station and each filling device 27 may be configured to fill the receptacles 2 advanced to the respective filling station with the pourable product. Preferentially, afterwards, planar motor 21 may be configured to directly advance each carrier 20 to the associated closing device 28.

[0066] In more detail, according to the embodiment of Figure 1, planar motor 21 may be configured to advance carriers 20 along respective advancement paths P and through one respective sterilization station and the respective filling station and/or one respective filling station and the respective closing station. Preferentially, planar motor 21 may be configured to advance carriers 20 such that a plurality of advancement paths P is present and such that these are parallel to one another when considering advancement between the respective sterilization device 26 and the respective filling device 27, preferentially between the respective sterilization device 26 and the respective closing device 28. Preferentially, advancement paths P from the respective sterilization device 26 to the respective closing device 28 may be rectilinear.

[0067] According to some non-limiting embodiments, forming apparatus 13 may comprise a plurality of forming devices 29, each one arranged at one respective forming station and configured to form and shape the respective receptacles 2 advances to the respective forming station.

[0068] Advantageously, each forming device 29 may be associated to one respective closing device 28 e.g. such that each receptacle 2 after having been closed by the respective closing device 28 is, in use, advanced to the associated forming device 29.

[0069] With particular reference to Figure 2, each carrier 21 may comprise a retaining assembly 30 configured to carry the respective receptacle 2. In the example of Figure 2, retaining assembly 30 may comprise a support surface which carries the respective receptacle 2.

[0070] Alternatively or in addition, each retaining assembly 30 may comprise one or more gripping elements for gripping the respective receptacles 2 and/or a retaining seat for housing a portion of the respective receptacles 2 within the respective seat.

[0071] According to some preferred non-limiting em-

bodiments, planar motor 21 may comprise a plurality of induction coils configured to generate respective local electromagnetic fields and each carrier 20 may comprise at least one magnetic and/or ferromagnetic element configured to interact with the local electromagnetic fields. Moreover, planar motor 21 may be configured to selectively control the induction coils and therewith the respective local electromagnetic fields for selectively advancing the carriers 20 by means of interaction of the respective at least one magnetic and/or ferromagnetic element.

[0072] According to some preferred non-limiting embodiments, planar motor 21 may comprise a plurality of planar motor modules, each one comprising a respective plurality of induction coils.

[0073] Preferentially, the plurality of planar motor modules may be arranged within outer environment 8 or within inner environment 7. Alternatively, a portion of the plurality of planar motor modules may be arranged within inner environment 7 and another portion of the plurality of planar motor modules may be placed within outer environment 8.

[0074] In more detail, planar motor 21 may be configured to control the plurality of induction coils in order to control movement of carriers 20 along first direction D1, second direction D2 and third direction D3 and/or about the first rotation axis, the second rotation axis and the third rotation axis.

[0075] E.g. planar motor 21 may be configured to control movement of carriers 20 along third direction D3 so as to elevate carriers 20; i.e. in order to control a relative distance between carrier 20 from the planar motor modules. Moreover, planar motor 21 may be configured to control movement of carriers 20 along first direction D1 and second direction D2 for defining the respective advancement paths P.

[0076] In use, filling machine 1 fills receptacles 2 with the pourable product.

[0077] According to some possible non-limiting embodiments, prior to filling the receptacles 2, filling machine 1 may also obtain receptacles 2 from respective precursors. Alternatively, receptacles 2 may be fed to filling machine 1.

[0078] In more detail, receptacles 2 are sterilized by sterilization apparatus 9, preferentially one respective sterilization device 26, are then filled with the pourable product by filling apparatus 10, preferentially at least one respective filling device 27 and afterwards receptacles 2 are closed by closing apparatus 11, preferentially by one respective closing device 28. Advantageously, receptacles 2 may also be further formed and shaped by forming apparatus 13 after having been closed by closing apparatus 11.

[0079] At least the sterilization, the filling and the closing of receptacles 2 are executed within inner environment 7.

[0080] Moreover, receptacles 2 are advanced within inner environment 7 while being carried by the respective carriers 20. Planar motor 21 selectively and independently controls movement of carriers 20 so as to advance carriers 20 and therewith the respective receptacles 2 to sterilization apparatus 9, preferentially to one respective sterilization station, then to filling apparatus 10, preferentially one respective filling station and afterwards to closing apparatus 11, preferentially one respective closing station.

[0081] With reference to Figure 3, number 1' indicates an alternative embodiment of a filling machine according to the present invention; as filling machine 1' is similar to filling machine 1, the following description is limited to the differences between them, and using the same references, where possible, for identical or corresponding parts.

[0082] In particular, filling machine 1' differs from filling machine 1 in that forming apparatus 13 is placed within inner environment 7.

[0083] As use of filling machine 1' is similar to the use of filling machine 1, we refer to the description provided with respect to the use of filling machine 1.

[0084] With reference to Figure 4, number 1" indicates an alternative embodiment of a filling machine according to the present invention; as filling machine 1'' is similar to filling machine 1 and filling machine 1', the following description is limited to the differences between them, and using the same references, where possible, for identical or corresponding parts.

[0085] In particular, filling machine 1" differs from filling machine 1 and filling machine 1' in that planar motor 21 is configured to selectively advance each carrier 20 to a plurality of filling stations and each filling device 27 may be configured to fill receptacles 2 advanced to the respective filling station with a respective portion of the pourable product.

[0086] According to some preferred non-limiting embodiments, filling apparatus 10 may comprise at least a first group of one or more filling devices 27 configured to fill a respective first portion of the pourable product into the respective receptacles 2 and at least a second group of one or more filling devices 27 configured to fill a respective second portion having a different composition than the first portion of the pourable product into the respective receptacles 2. Preferentially, the first portion and the second portion being different.

[0087] Preferentially, filling apparatus 10 may comprise more than two groups of one or more filling devices 27 and the respective filling devices 27 of each group being configured to fill the same portion of the pourable product and being different with respect to its composition in comparison to the respective portions of the pourable product filled into receptacles 2 by the filling devices 27 of the other group.

[0088] In this way and by defining the specific advancement path of each carrier 20 it is possible to obtain a specific mixture of the portions within receptacles 2. In other words, it is possible to obtain receptacles 2 being filled with different compositions of the pourable product.

[0089] Use of filling machine 1'' is similar to the use of

filling machine 1 and filling machine 1' and for this reason in the following we only refer to the differences between the use of filling machine 1" with respect to filling machine 1 and filling machine 1'.

[0090] In particular, filling machine 1" allows a customization of the composition of the pourable product filled into receptacles 2.

[0091] Preferentially, planar motor 21 selectively advances carrier 20 to a plurality of filling devices 27, and each one fills the respective portion of the pourable product into the respective receptacles 2.

[0092] By advancing the carriers 20 to different filling devices 27 it is possible to specifically define the composition of the pourable product.

[0093] With reference to Figure 5, number 1‴ indicates an alternative embodiment of a filling machine according to the present invention; as filling machine 1‴ is similar to filling machine 1, filling machine 1' and filling machine 1", the following description is limited to the differences between them, and using the same references, where possible, for identical or corresponding parts.

[0094] Filling machine 1'" differs from filling machine 1 or filling machine 1' of filling machine 1" in further comprising one or more first intermediate chambers 40 positioned at and/or adjacent to one or more inlets 22 and/or one or more second intermediate chambers 41 positioned at and/or adjacent to one or more outlets 23.

[0095] In Figure 5, filling machine 1'" shows, except for the mentioned differences, the same configuration as filling machine 1'. However, it must be understood that filling machine 1‴ may also have a configuration a filling machine 1 or filling machine 1".

[0096] Preferentially, each first intermediate chamber 40 and/or each second intermediate chamber 41 may be interposed between inner environment 7 and outer environment 8.

[0097] Moreover, carriers 20 moving between inner environment 7 and outer environment 8 may be configured to pass through one or more first intermediate chambers 40 and/or one or more second intermediate chambers 41.

[0098] In further detail, each first intermediate chamber 40 may be connected to inner environment 7 by means of the at least one inlet 22.

[0099] Preferentially, each first intermediate chamber 40 may comprise at least a first opening 42, e.g. opposite to the at least one inlet 22, and even more preferentially, each first intermediate chamber 40 may be connected to outer environment 8 by means of the at least one first opening 42.

[0100] Preferentially, each second intermediate chamber 41 may be connected to inner environment 7 by means of the at least one outlet 23.

[0101] In more detail, each second intermediate chamber 41 may comprise at least a second opening 43, e.g. opposite to the at least one outlet 23, and preferentially each second intermediate chamber 41 may be connected to outer environment 8 by means of the at least one second opening 43.

[0102] In one or more embodiments, the conditioning apparatus may be configured to maintain (control) a predetermined pressure within inner environment 7 and a respective further predetermined pressure in first intermediate chamber 40 and/or second intermediate chamber 41. For example, the predetermined pressure within inner environment 7 may be higher than the respective further predetermined pressure within first intermediate chamber 40 and/or second intermediate chamber 41.

[0103] Advantageously, the respective first intermediate chamber 40 and/or second intermediate chamber 41 may be higher than the pressure within outer environment 8.

[0104] As use of filling machine 1‴ is similar to the use of filling machine 1, we refer to the description provided with respect to the use of filling machine 1 and only highlight the differences.

[0105] In particular, operation of filling machine 1‴ differs from operation of filling machine 1 in that carriers 20 pass through first intermediate chamber 40 prior to entering isolation chamber 6, in particular inner environment 7, through at least one inlet 22 and pass through second intermediate chamber 41 prior to entering outer environment 8.

[0106] Figures 6a and 6b schematically show a variation of carriers 20'.

[0107] In particular, each carrier 21' may comprise at least a first carrier portion 34 and a second carrier portion 35. Preferentially, each first carrier portion 34 and each second carrier portion 35 may comprise a respective magnetic and/or ferromagnetic element for interacting with the local electromagnetic fields selectively generated by the plurality of induction coils.

[0108] Preferentially, each carrier 20 may also comprise a coupling assembly 36 coupled to the respective first carrier portion 34, the respective second carrier portion 35 and carrying the respective retaining assembly 30.

[0109] Advantageously, planar motor 21 may be configured to selectively move each first carrier portion 34 and the respective second carrier portion 35 for advancing the respective carriers 20 at least within inner environment 7.

[0110] Additionally, planar motor 21 may be configured to control a relative position between each first carrier portion 34 and the respective second carrier portion 35.

[0111] Advantageously, each coupling assembly 36 may be designed such that modification of the relative position between the respective first carrier portion 34 and the respective second carrier portion 35 allows to approach or withdraw the respective receptacle to or from planar motor 21. Preferentially, by controlling the relative position between first carrier portion 34 and the respective second carrier portion 35 it is possible to move receptacles 2 along the third direction D3.

[0112] E.g. by doing so it is possible to approach (see Figure 5a) the receptacle 2 towards a respective filling

device 27 and to withdraw (see Figure 5b) the respective receptacles 2 from the respective filling device 27, e.g. for optimizing the filling process.

[0113] According to the specific example shown in Figures 5a and 5b, each retaining assembly 30 may comprise a seat 37 for carrying the receptacles 2 and the coupling assembly 36 may comprise a first coupling element 38 hinged to a respective first carrier portion 34 and the respective seat 37 and a second coupling element 39 hinged to the respective second carrier portion 34 and the respective seat 37.

[0114] The advantages of filling machine 1 or filling machine 1' and filling machine 1'' and filling machine 1‴ according to the present invention will be clear from the foregoing description.

[0115] In particular, filling machines 1, 1', 1" and 1‴ allow high through-put capacities with a simple structure.

[0116] Additionally, filling machines 1, 1', 1" and 1‴ come along with reduced space requirements.

[0117] Moreover, filling machine 1" allows to customize the specific composition of the pourable product filled into the receptacles 2 in an easy, quick and efficient manner.

[0118] Clearly, changes may be made to filling machine 1 or filling machine 1' or filling machine 1" or filling machine 1‴ as described herein without, however, departing from the scope of protection as defined in the accompanying claims.

Claims

1. Filling machine (1, 1', 1") for filling a pourable product into receptacles (2), the filling machine (1, 1', 1") comprises:

    - an isolation chamber (6) delimiting an inner environment (7);
    - a sterilization apparatus (9) at least partially arranged within the inner environment (7) and configured to sterilize the receptacles (2) within the inner environment (7) ;
    - a filling apparatus (10) at least partially arranged within the inner environment (7) and configured to fill the receptacles (2) through respective openings (5) of the receptacles (2) with the pourable product within the inner environment (7);
    - a closing apparatus (11) at least partially arranged within the inner environment (7) and configured to close the respective openings (5) of the receptacles (2) within the inner environment (7); and
    - a conveying apparatus (12) configured to advance the receptacles (2) at least within the inner environment (7);

    wherein the conveying apparatus (12) comprises:

    - a plurality of carriers (20, 20'), each one configured to carry at least one receptacle (2) at a time; and
    - a planar motor (21) configured to selectively and independently move each one of the carriers (20, 20') within the inner environment (7) and such to advance the receptacles (2) in order of mentioning to the sterilization apparatus (9), the filling apparatus (10) and the closing apparatus (11) .

2. Filling machine according to claim 1, wherein the filling apparatus (10) comprises a plurality of filling devices (27), each one arranged at a respective filling station and configured to fill at least a respective portion of the pourable product into the receptacles (2) advanced to the respective filling station.

3. Filling machine according to claim 2, wherein the planar motor (21) is configured to selectively advance each carrier (20, 20') to one respective filling station; wherein each filling device (27) is configured to fill the receptacles (2) advanced to the respective filling station with the pourable product.

4. Filling machine according to claim 2, wherein the sterilization apparatus (9) comprises a plurality of sterilization devices (26), each one associated to one respective filling device (27), arranged at a respective sterilization station and configured to sterilize the receptacles (2) advanced to the respective sterilization station; and/or

    the closing apparatus (11) comprises a plurality of closing devices (28), each one associated to one respective filling apparatus (10), arranged at a respective closing station and configured to close the respective openings (5) of the respective receptacles (2) advanced to the respective closing station;
    wherein the planar motor (21) is configured to advance the carriers (20, 20') along respective advancement paths (P), preferably parallel advancement paths (P), through one respective sterilization station and the respective filling station and/or one respective filling station and the respective closing station.

5. Filling machine according to claim 2, wherein the planar motor (21) is configured to selectively advance each carrier (20) to a plurality of filling stations;
    wherein each filling device (27) is configured to fill the receptacles (2) advanced to the respective filling station with a respective portion of the pourable product.

6. Filling machine according to any one of the preceding claims, further comprising a forming apparatus

(13) configured to form and shape the receptacles (2) within the inner environment (7) or within an outer environment (8), wherein the isolation chamber (6) delimits the inner environment (7) from the outer environment (8).

7. Filling machine according to any one of the preceding claims, further comprising a conditioning apparatus configured to condition the inner environment (7) so as to maintain an aseptic inner environment, preferably the conditioning apparatus is configured to introduce a sterile gas into inner environment (7) and/or to maintain a predetermined pressure within inner environment (7), such that a pressure within inner environment (7) is higher than a pressure outside inner environment (7).

8. Filling machine according to any one of the preceding claims, wherein the planar motor (21) comprises a plurality of induction coils configured to generate respective local electromagnetic fields;

wherein each carrier (20, 20') comprises at least one magnetic and/or ferromagnetic element configured to interact with the local electromagnetic fields;
wherein the planar motor (21) is configured to selectively control the induction coils and therewith the respective local electromagnetic fields for selectively advancing the carriers (20, 20').

9. Filling machine according to claim 8, wherein the planar motor (21) comprises a plurality of planar motor modules, each one comprises a respective plurality of the induction coils;
wherein the plurality of planar motor modules is arranged within an outer environment (8) and/or within the inner environment (7).

10. Filling machine according to any one of the preceding claims, wherein each receptacle (2) is at least partially formed from a multilayer packaging material;
wherein the closing apparatus (11) is configured to seal at least portions of the multilayer packaging material to one another so as to close and seal the respective openings (5) of the receptacles (2).

11. Filling machine according to any one of the preceding claims, wherein the isolation chamber (6) comprises an inlet (22) and an outlet (23);
wherein the planar motor (21) is configured to advance each receptacle (2) between the inlet (22), the sterilization apparatus (9), the filling apparatus (10), the closing apparatus (11) and the outlet (23).

12. Filling machine according to any one of the preceding claims, wherein each carrier (20') comprises a first carrier portion (34) and a second carrier portion (35);

wherein the planar motor (21) is configured to selectively move each first carrier portion (34) and each second carrier portion (34) for advancing the carriers (20') within at least the inner environment (7) and for controlling a relative position between each first carrier portion (34) and the respective second carrier portion (35);
wherein each carrier (20') also comprises a retaining assembly (30) configured to carry the respective receptacle (2) and a coupling assembly (36) coupled to the respective first carrier portion (34), the respective second carrier portion (35) and carrying the respective retaining assembly (30) ;
wherein each coupling assembly (36) is designed such that modification of the relative position between the respective first carrier portion (34) and the respective second carrier portion (35) allows to approach or withdraw the respective receptacle (2) to or from the planar motor (21) .

13. Filling machine (1) according to any of the preceding claims, wherein the isolation chamber (6) comprises at least one inlet (22) and/or at least an outlet (23) and wherein the filling machine (1) further comprises at least one intermediate chamber positioned at the at least one inlet (22) and/or at the at least one outlet (23).

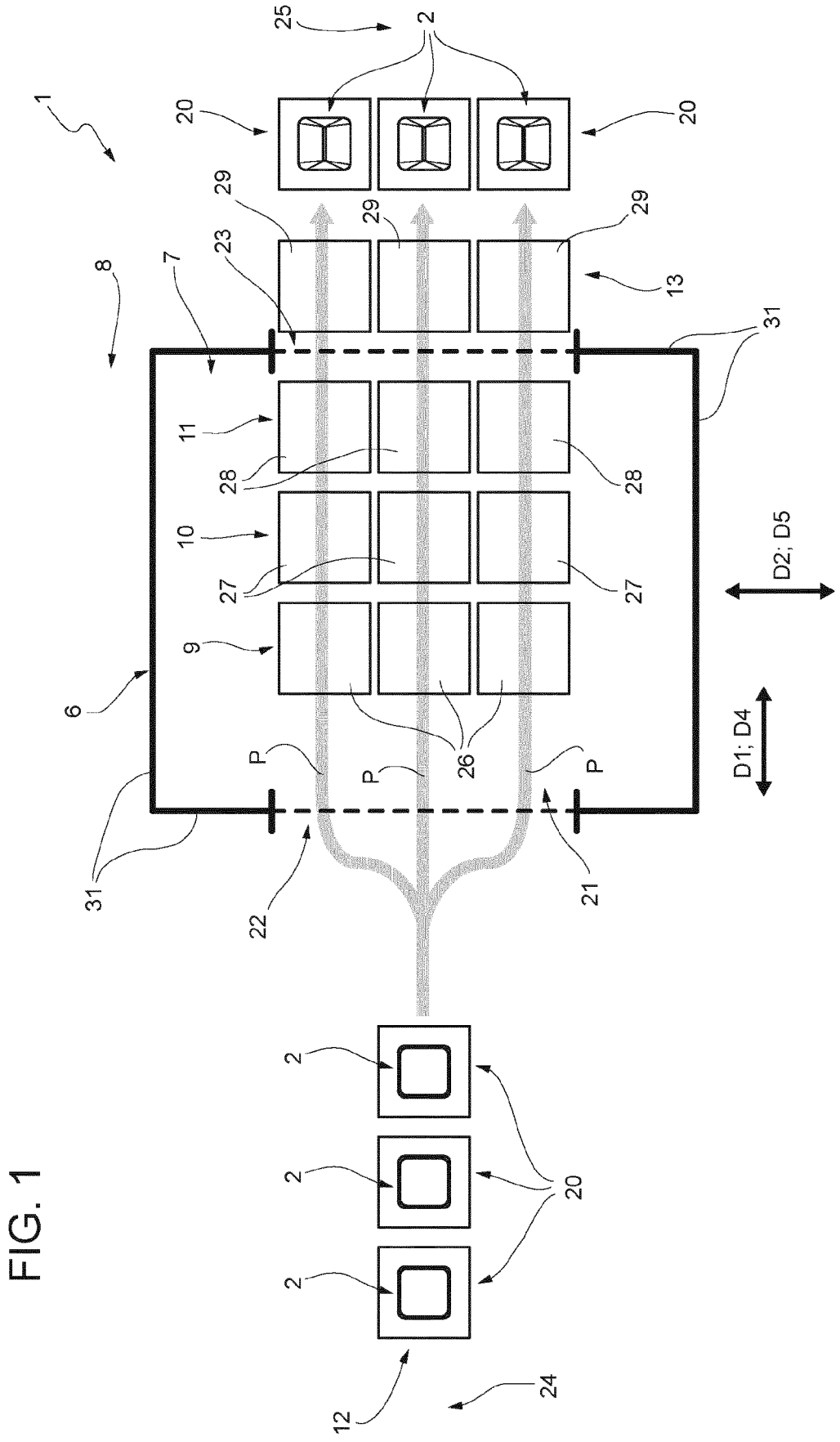
14. Filling machine (1) according to any of the preceding claims, wherein:

- each carrier (20, 20') is configured to move uninterruptedly during advancement between the sterilization apparatus (9), the filling apparatus (10) and the closing apparatus (11), and/or
- the sterilization apparatus (9), the filling apparatus (10) and/or the closing apparatus (11) comprise movable parts configured to move alongside the plurality of carriers (20) during advancement thereof through the respective apparatus (9, 10, 11).

15. Method of filling receptacles (2) with a pourable product comprising the steps of:

- providing a filling machine (1, 1', 1") according to any one of the preceding claims;
- advancing receptacles (2) within the inner environment (7) by means of the planar motor (21) controlling advancement of the carriers (20, 20') and to the sterilization apparatus (9), the filling apparatus (10) and the closing apparatus (11);
- sterilizing the receptacles (2) by means of the

sterilization apparatus (9);
- filling the receptacles (2) with the pourable product by means of the filling apparatus (10);
- closing the respective openings (5) of the receptacles (2) by means of the closing apparatus (11).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2
20
20
25
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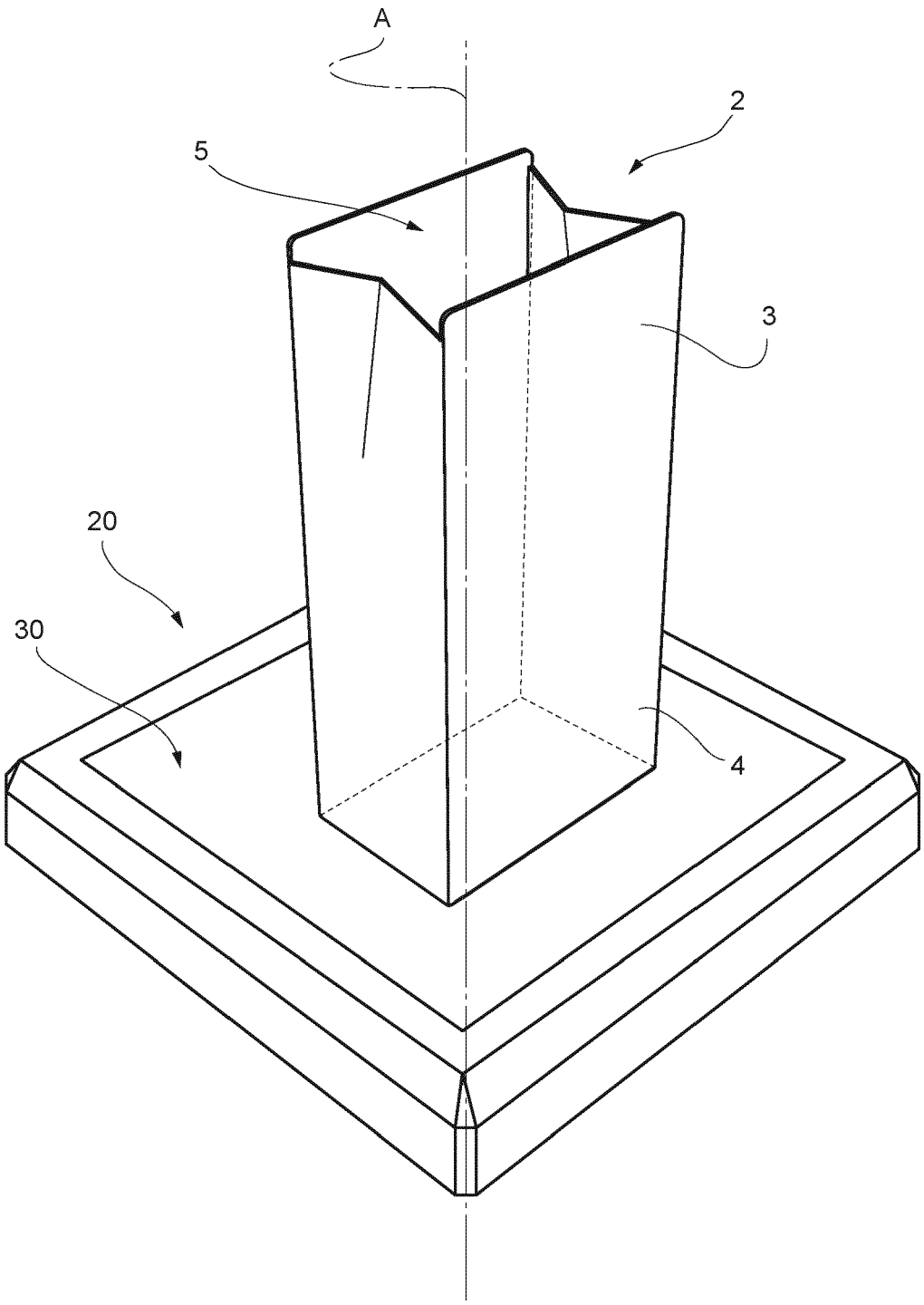
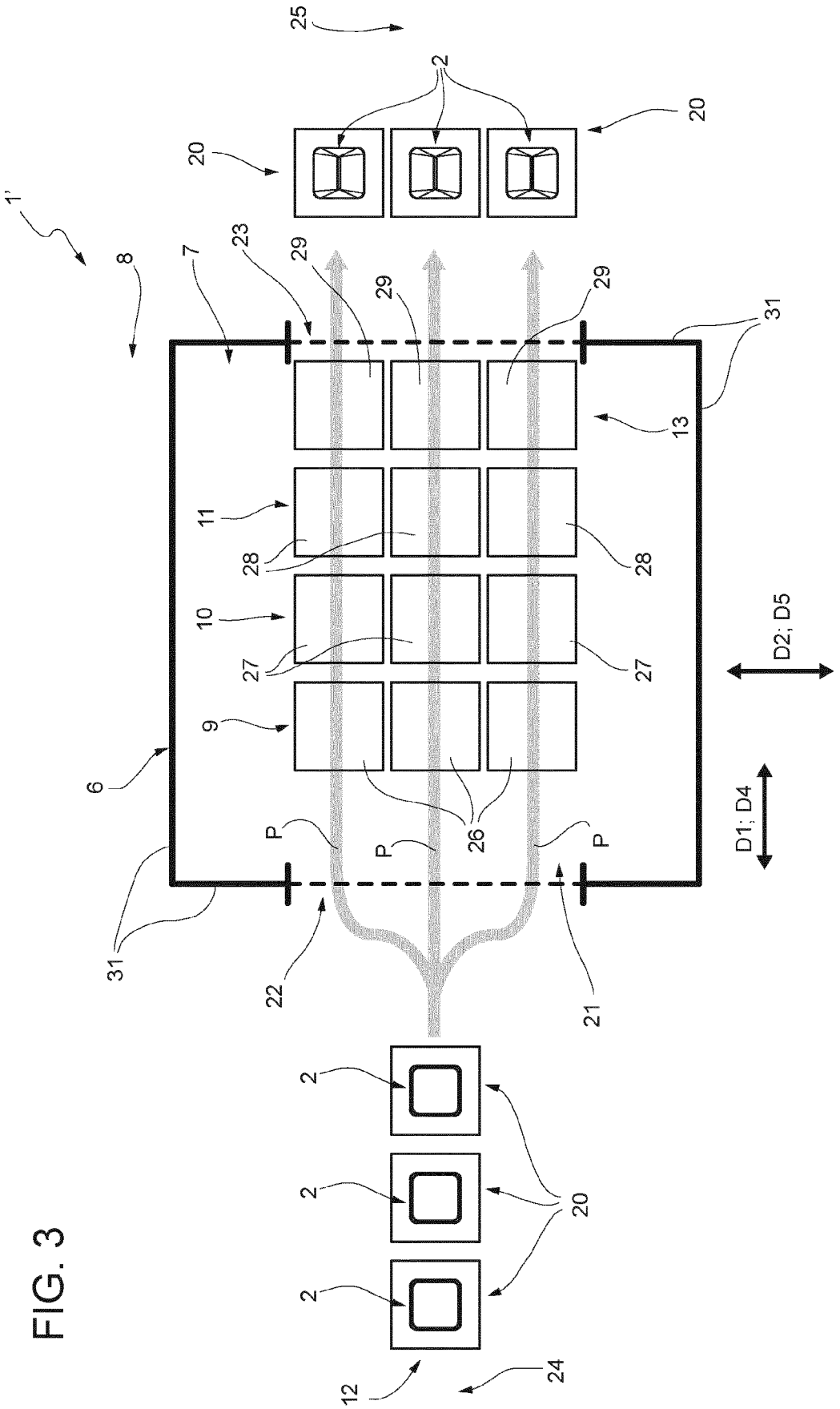
7
8
13
31
31
11
28
28
10
27
27
9
6
D2; D5
D1; D4
P
P
P
26
31
22
21
2
2
2
20
12
24

FIG. 1

FIG. 2




25
2
20
20
1'
8
7
23
29
29
29
31
13
11
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28
10
27
27
9
6
D2; D5
D1; D4
P
P
P
26
31
22
21
2
2
2
20
12
24

FIG. 3

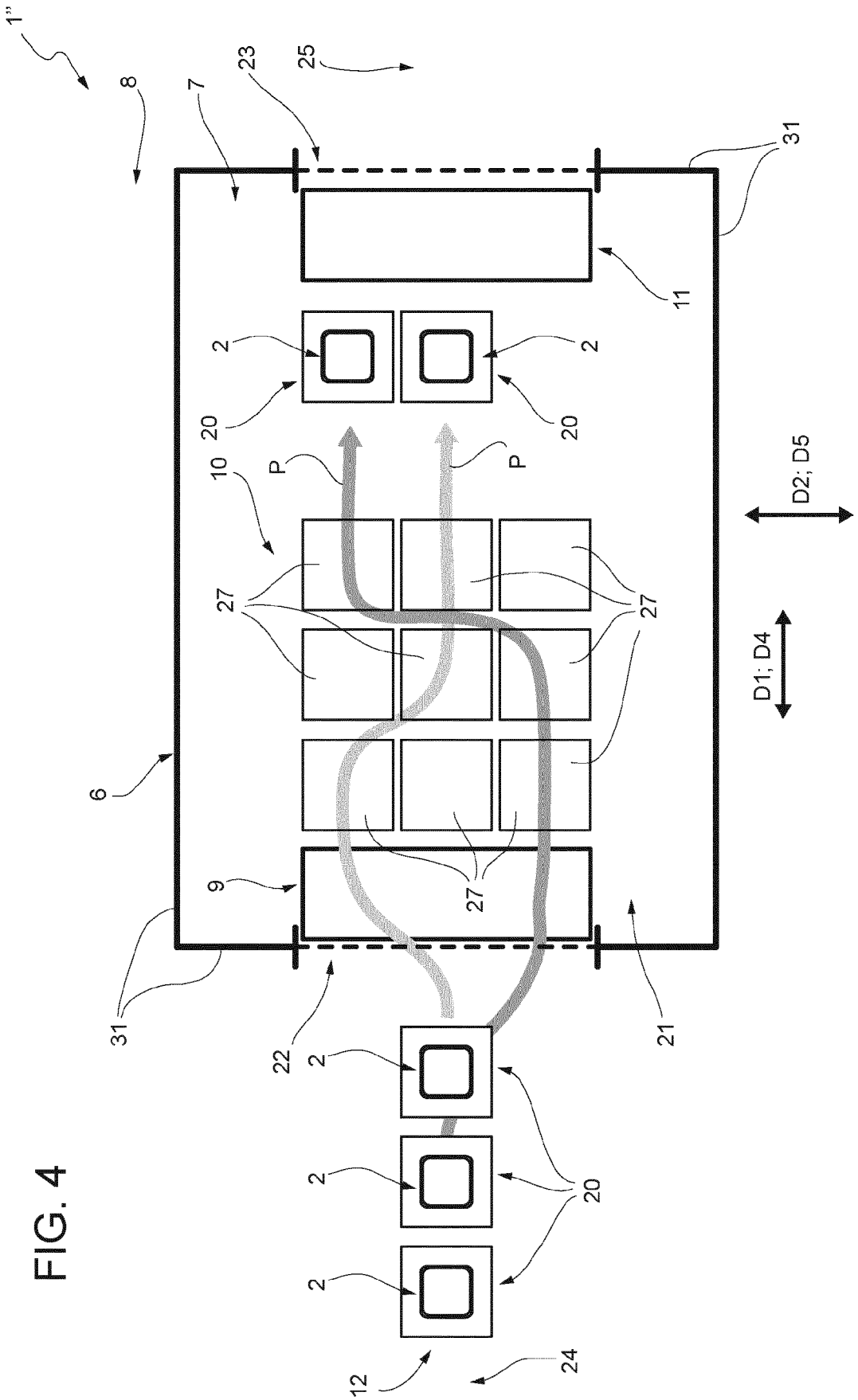
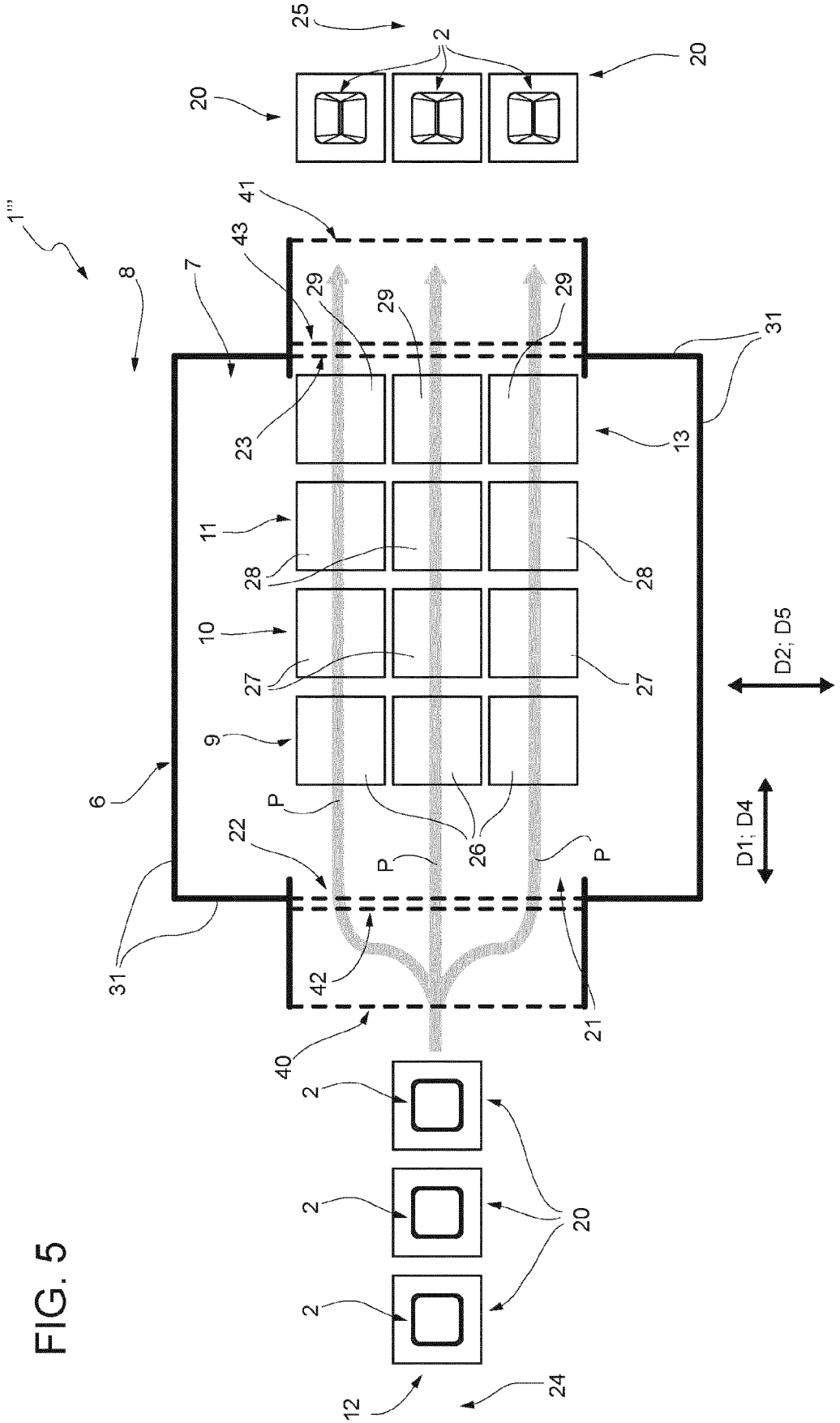


FIG. 4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P
26
P
31
42
21
40
2
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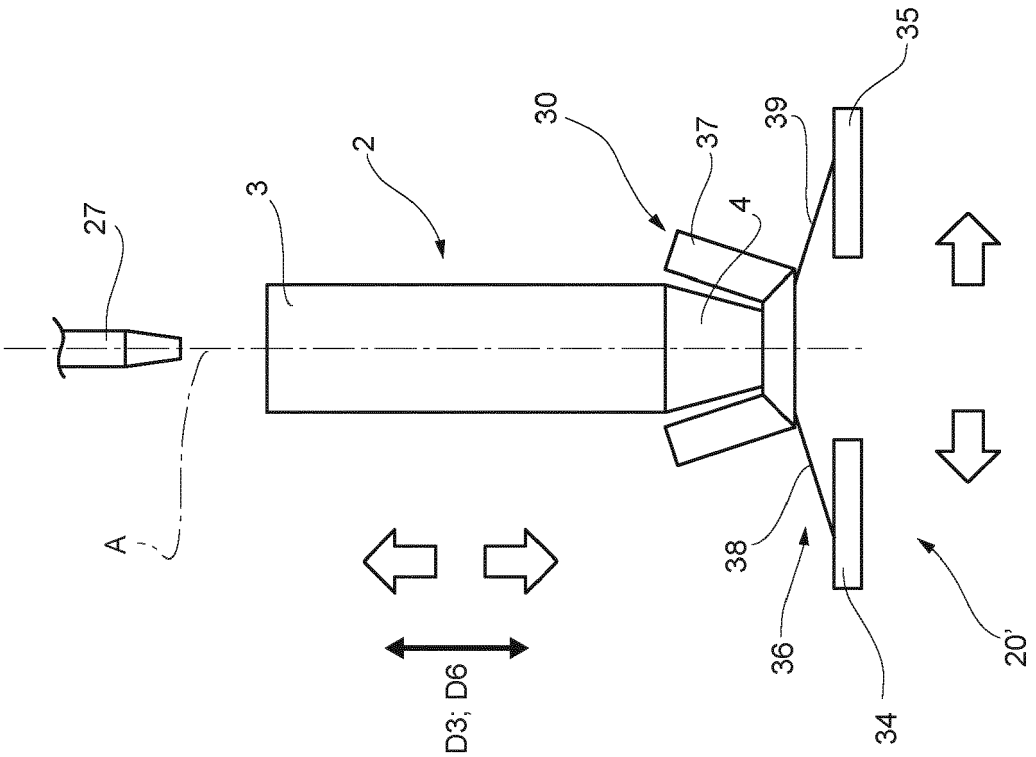
2
20
20
12
24
25
2
20
D2; D5
D1; D4

FIG. 5

FIG. 6b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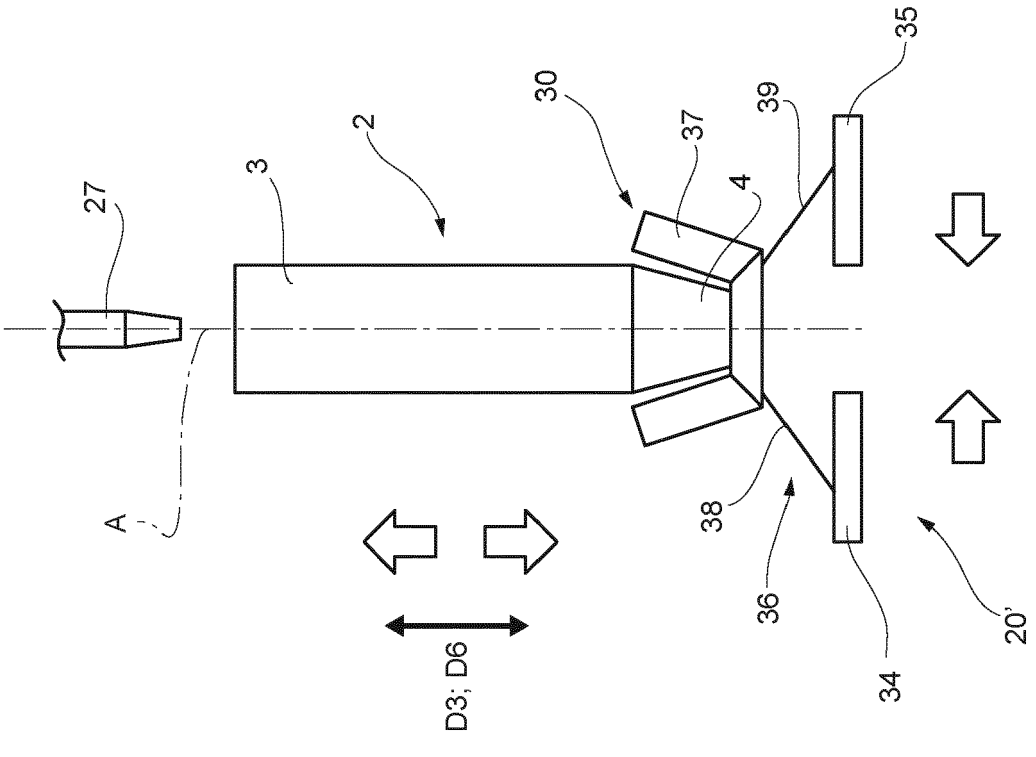
2
30
37
4
39
35
A
38
36
34
20'
D3; D6

FIG. 6a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A
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36
34
20'
D3; D6

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EUROPEAN SEARCH REPORT

Application Number
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Place of search	Date of completion of the search	Examiner
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