(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 June 2016 (09.06.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/088023 A1

(51) International Patent Classification:
B65B 29/02 (2006.01) *B65B 7/28* (2006.01)
B65B 39/14 (2006.01) *B65D 85/804* (2006.01)
B65B 51/14 (2006.01)

(21) International Application Number:
PCT/IB2015/059221

(22) International Filing Date:
30 November 2015 (30.11.2015)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
BO2014A000674 1 December 2014 (01.12.2014) IT

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

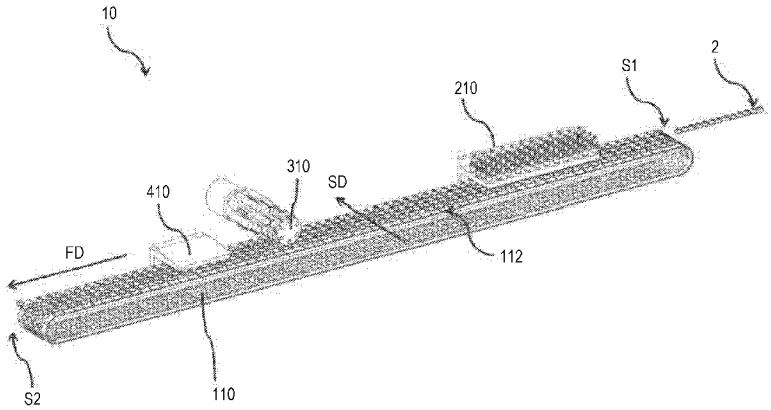
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) Title: MACHINE FOR CONTINUOUSLY MAKING BEVERAGE CAPSULES

FIG. 2



(57) Abstract: This invention relates to a machine (10) for making beverage capsules (1) comprising a hollow body (2) provided with at least a first opening (3') and at least a first covering wall (3) for covering the first opening (3'), wherein a first actuator device is adapted to move a filling unit (210) in parallel with a forming direction (FD) according to a law of motion which includes an operational phase, where filler means (1211, 2211, 3211, 4211) move from a start filling position to an end filling position in the same direction and in synchronism with a first conveyor (110), and a return phase in the opposite direction; a first application unit (310) is provided with a plurality of gripping devices (311) adapted to grip the first walls (3) and to apply the walls (3) simultaneously to all the hollow bodies (2) positioned in each of said rows and continuously to said rows moving forward in succession; a second actuator device is adapted to move the first sealing unit (410) in parallel with the forming direction (FD) according to a law of motion which includes an operational phase, where sealing heads (1411, 241 1, 341 1, 4411) move from a start sealing position to an end sealing position in the same direction and in synchronism with the first conveyor (110), and a return phase in the opposite direction.

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DESCRIPTION

MACHINE FOR CONTINUOUSLY MAKING BEVERAGE CAPSULES

Technical field

This invention relates to a machine for continuously making beverage capsules.

This invention is advantageously applicable to the production of single use capsules for extract or infusion beverages, which this specification expressly refers to but without losing in generality.

Background art

A beverage capsule comprises a hollow body which is tapered in shape, that is to say, which has a transverse cross section with a substantially frustoconical shape. The hollow body has an opening which is closed by a typically disc-shaped wall and contains a dose of liquid and/or powder product. During production of a capsule of his kind, the hollow body is filled through the opening and then sealed by applying the wall to it by thermosealing. In use, the sealed wall is perforated so that the interior of the capsule can be supplied with hot water under pressure, steam or other liquids and/or gases which mix with the product dose to allow dispensing the desired beverage.

Also known are capsules comprising a hollow body having two opposite openings which are sealed by a first and a second wall both applied during production of the capsule (examples of this type of capsule are described in patent applications (EP1892199A1 and EP2465792A2). More specifically, a bottom or top wall is applied to the hollow body before the hollow body is filled with the product dose, whilst the other top or bottom wall is applied to the hollow body after the hollow body has been filled.

Prior art machines for making the aforementioned capsules comprise a conveyor having, mounted thereon, a plurality of plates which are suitably

spaced from each other along the conveyor and which are provided with suitable seats for holding the hollow bodies as they are fed forward. Mounted along the conveyor path are a plurality of capsule forming units which comprise, in particular, a unit for feeding a web of thermoplastic material over the aforementioned plates, where the width of the web is such that the plates are covered by the web. At each feed step of the plates on the conveyor, the forming units are actuated in such a way as to first allow sealing the web of material laid over the capsules and then cutting the continuous sequence of capsules to the correct size and shape, preferably circular. An intermittent-motion machine of this kind is, however, relatively low in productivity and high in maintenance costs.

In other machines developed to increase capsule production speed, the sealing and cutting operations are carried out by one or more units defined by one or more operating wheels. These wheels allow working with continuous motion but require considerable dimensions and significant costs to attain high productivity.

Moreover, at present, capsules whose hollow body is initially without two opposite walls are made in machines which are inefficient, that is to say, low in productivity, and ineffective, that is to say, unable to guarantee high product quality and such as to produce a considerable quantity of waste during use of the material by which the aforementioned walls are sealed.

Disclosure of the invention

The aim of this invention is to provide a machine for making beverage capsules which allows attaining high quality and productivity and which, at the same time, minimizes the production of waste.

A further aim of the invention is to provide a machine for making beverage capsules which is reduced in size compared to traditional machines.

This invention accordingly provides a machine for making beverage capsules as described in the accompanying claims.

Brief description of the drawings

The invention is described below with reference to the accompanying drawings, which illustrate a non-limiting embodiment of it and in which:

- Figures 1A and 1B are two different perspective exploded views of a beverage capsule having a single opening;
- Figure 2 is a perspective view of a first embodiment of a machine according to this invention for making the capsules of Figures 1A and 1B;
- Figure 3A is a perspective view of the filling unit of the machine of Figure 2 in a first embodiment;
- Figure 3B is a perspective view of the filling unit of the machine of Figure 2 in a second embodiment;
- Figure 4 is a perspective view of the application unit and of the sealing unit of the machine of Figure 2;
- Figures 5A and 5B are front plan views of the capsule making machine of Figure 2 when the filling unit and the sealing unit are in a first operating position and in a second operating position, respectively;
- Figures 6A and 6B are two different perspective exploded views of a beverage capsule having two opposite openings;
- Figure 7 is a perspective view of a second embodiment of a machine according to this invention for making the capsules of Figures 6A and 6B;
- Figure 8 is a perspective view of the transfer means of the machine of Figure 7;
- Figure 9 is a front plan view of the transfer means of the machine of Figure 8;
- Figures 10A and 10B are front plan views of the capsule making machine of Figure 7 when the filling unit and the sealing unit are in a first operating position and in a second operating position, respectively.

Detailed description of preferred embodiments of the invention

The numeral 1 in Figures 1A and 1B denotes in its entirety a disposable capsule, that is to say, a single-use capsule for beverages. The capsule 1

comprises a hollow body 2 having a circular opening 3' through which a dose of product for making the beverage can be inserted. The opening 3' is circumscribed by an annular edge 3'' and is closed, during the formation of the capsule 1, by a first wall 3 which is rested on, and thermosealed to, the selfsame annular edge 3''. More specifically, in the embodiment illustrated in Figures 1A and 1B, the first wall 3 is the bottom wall of the capsule 1 and is disc-shaped in order to adapt to the annular configuration of the edge 3''.

The product inside the capsule 1 may be in the form of powder, granules or leaves or even in liquid or semi-liquid form. In the embodiment described below, the capsule 1 contains a beverage concentrate in liquid form.

The numeral 10 in Figures 2, 5A and 5B denotes in its entirety a machine for making beverage capsules 1 according to the invention, in a first embodiment. The capsule making machine 10 comprises a first endless conveyor 110 trained around first drive means (not illustrated). The conveyor 110 is defined by an upper section, supporting the plurality of capsules 1 or hollow bodies 2, and a corresponding lower section, constituted by the return portion during feed. The first conveyor 110 is adapted to feed the plurality of hollow bodies 2 along a forming direction FD for forming the capsules 1 and, more specifically, is provided with a plurality of rows of seats for housing the hollow bodies 2. Each of the rows is located in succession along the forming direction FD and is adapted to house two or more hollow bodies 2 side by side in the seats along a housing direction SD perpendicular to the forming direction FD.

In a preferred embodiment, the first conveyor 110 is a plate conveyor and comprises two supports, for example in the form of an endless belt or chain trained around two end pulleys (not illustrated), one of which is a drive pulley and the other a driven pulley. In the embodiment described here, these supports are defined by a pair of parallel, flexible chains which support a plurality of plates 112 fixed thereto and positioned in succession

along the forming direction FD.

The supports are substantially linear in extension, thus defining a rectilinear shape for the forming direction FD.

Each plate 112 is equipped with a plurality of seats 1112, 2112, 3112, 4112 (illustrated in Figure 3A) positioned in line along the housing direction SD. The plurality of seats 1112, 2112, 3112, 4112 of each plate 112 thus defines each row of seats of the first conveyor 110, as described above. More specifically, in the embodiment described here, each plate 112 is equipped with four seats positioned in line along the housing direction SD but the number of seats on each plate may vary according to production requirements.

The seats 1112, 2112, 3112, 4112 are defined by through openings having one or more recesses which are shaped to retain the capsules 1 or the hollow bodies 2, for example by interference between the seats and the bodies themselves, as they move forward.

In further embodiments, not illustrated, the seats may have different sizes to house and retain capsules or hollow bodies of different sizes. Each seat may also be equipped with means for rocking each hollow body, or capsule, along at least one axis. These one or more axes may be, for example, an axis parallel or corresponding to the forming direction FD and/or to the housing direction SD and/or an axis inclined thereto. Rocking allows the capsules or bodies housed in the respective seats to adapt their positions perfectly to the subsequent operations carried out in different parts of the machine.

In use, the drive pulley is driven with continuous rotary motion about its axis in such a way as to feed the plates 112 carried by the first conveyor 110 forward continuously.

Upstream of the first conveyor 110 there is a feed device (not illustrated) for feeding the hollow bodies 2 to be used to form the capsules 1. This works in phase with the continuous feed motion of the first conveyor 110 in such a way as to guarantee that four hollow bodies 2 are positioned in

the respective seats 1112, 2112, 3112, 4112 at an infeed station S1 located on the first conveyor 110 and defined by one or more plates 112 on the upper section.

In the same way, downstream of the conveyor 110, there is an outfeed device (not illustrated) for removing the formed capsules 1. This device, too, works in phase with the continuous feed motion of the first conveyor 110 in such a way as to guarantee that the capsules 4 are correctly moved away at an outfeed station S2 located on the first conveyor 110 and defined by one or more plates 112 on the upper section.

Located in succession along the path defined by the conveyor 110 in the forming direction FD there are a plurality of units adapted to operate in sequence on the hollow bodies 2 fed into the infeed station S1 and until the capsules 1 are formed and fed out at the outfeed station S2. More specifically, in the embodiment illustrated in Figures 2, 5A and 5B, the machine 10 comprises a filling unit 210 for filling the hollow bodies 2, a first application unit 310 for applying the first walls 3 to the filled hollow bodies 2 and a first sealing unit 410 for sealing the first walls 3 themselves. The machine 10, in the first embodiment of it described and illustrated, comprises one of each of the aforementioned types of unit but in alternative embodiments of it, might comprise two or more of each of the aforementioned types of unit. In effect, the capsule making machine might be equipped with two filling units, for example to guarantee process continuity during cleaning operations, or two sealing units, as described further on in connection with the second embodiment.

The filling unit 210 is located along the first conveyor 110 and is adapted to fill the hollow bodies 2 as they move forward. More specifically, the filling unit 210 mounts a group of filler heads arranged in a plurality of rows of filler heads, each adapted to feed a dose of product into a corresponding hollow body 2. Figure 3A illustrates one embodiment of the filling unit 210. This embodiment comprises a mounting structure 212 provided with the group of filler heads 1211, 2211, 3211, 4211 arranged in

equidistant rows. Preferably, the number of filler heads 1211, 2211, 3211, 4211 in each of the rows is equal to the number of retaining seats 1112, 2112, 3112, 4112 in each of the rows of the conveyor 110, that is, of the plates 112. More specifically, in the embodiment described here, there are four filler heads in each row, like the four seats in each row of the conveyor.

The filler heads 1211, 2211, 3211, 4211 are located at fixed positions on the mounting structure 212 and, more specifically, are individually equispaced in the rows along the housing direction SD, and equispaced between the rows along the forming direction FD. The aforementioned equispacings correspond, respectively, to the spacing between the retaining seats 1112, 2112, 3112, 4112 in each of the rows of the conveyor 110 and to the spacings between the seats on consecutive plates 112. As a result, plates or seats with non-uniform spacing or retaining seats of different sizes may require a different or non-equispaced arrangement of the filler heads.

At the filling unit 210, the machine 10 comprises a first actuator device (not illustrated) adapted to move the filling unit 210. This may be an integral part of the filling unit 210 or part of the machine 10, separate but operatively connected to the filling unit 210.

The first actuator device is adapted to move the filling unit 210 in parallel with the forming direction FD according to a law of motion which includes an operational phase and a return phase. In the operational phase, the filler heads 1211, 2211, 3211, 4211 move from a start filling position (illustrated in Figure 5A) to an end filling position (illustrated in Figure 5B) of the capsules 1, and more specifically, of the hollow bodies 2, in the same direction and in synchrony with the first conveyor 110. During the operational phase, each filler head 1211, 2211, 3211, 4211 thus remains operatively connected to a corresponding hollow body 2 for the whole time. More specifically, such connection may be determined by the physical coupling of these elements or by their mere vicinity to each other,

without physical contact. The aforementioned law of motion also includes a return phase in which the filler heads 1211, 2211, 3211, 4211 move from the end filling position to the start filling position in the direction opposite to that of said first conveyor 110.

In a preferred embodiment, not illustrated, the first actuator device comprises means for linearly moving the filling unit 210 along the aforementioned operational and return phases. Such movements may be determined for example by an electric motor, forming part of the first actuator device, which moves the filling unit 210 on rails running parallel to the first conveyor 110.

In a further embodiment, illustrated in Figure 3B, the first actuator device for the filling unit 210' comprises an articulated crank mechanism 213 which determines the movement of the mounting structure 212' relative to the filling machine. The articulated crank mechanism 213 comprises two supporting structures hinged at two opposite portions of the mounting structure 212', and more specifically, at the ends located along the forming direction FD. These supporting structures each comprise two arms 214, 215; 214', 215' adapted to balance the distribution of the forces deriving from the movement of the filling unit 210'. The two supporting structures are connected by means of a link 216 running parallel to the conveyor and adapted to be moved linearly along the forming direction FD with reciprocating motion. More specifically, the two supporting structures and the link 216 are connected to each other by respective interposed crank elements 217, 217' adapted to convert the linear motion of the link 216 into a rotational motion of the cranks 217, 217'. That way, the movement of the link 216 in the direction opposite to the feed direction of the conveyor 110 places the filling unit 210' in the operational phase following the movement of the conveyor 110. Similarly, the movement of the link 216 in the same direction as the feed direction of the conveyor 110 places the filling unit 210' in the return phase.

Downstream of said filling unit 210 and along the first conveyor 110 there

is a first application unit 310 for applying the first walls 3 to each filled hollow body 2. The first application unit 310 is provided with a plurality of gripping devices 311 adapted to grip the first walls 3 and to apply the walls 3 simultaneously to all the hollow bodies 2 positioned in each of the rows and continuously to the rows moving forward in succession.

As illustrated in Figure 4, the first application unit 310 comprises a gripping and application wheel for the first walls 3, which is mounted above the first conveyor 110 and whose axis of rotation is parallel to the housing direction SD and which is moved in the direction opposite to that of the first conveyor 110. More specifically, the aforementioned wheel is positioned vertically above the first conveyor 110, mounted rotatably about a horizontal axis of rotation and adapted to rotate with continuous motion, that is, at a constant speed, about said axis of rotation. The wheel 310 also mounts the plurality of gripping devices 311, each of which is adapted to grip a first wall 3 and apply it to a corresponding hollow body 2.

The first application unit 310 is fed by a feeding unit 510, as illustrated in Figure 4, located in the proximity of the gripping and application wheel, for feeding in succession a plurality of first walls 3 to the corresponding gripping devices 311. The feeding unit 510 is positioned vertically with axis of rotation parallel to the axis of rotation of the gripping and application wheel 310 and above both the first conveyor 110 and the first application unit 310 itself. The feeding unit 510 is adapted to rotate with continuous motion, that is, at a constant speed, about said axis of rotation.

The feeding unit 510 comprises a plurality of arms 511 running parallel to the axis of rotation and equispaced around the rotation surface of the wheel itself. The arms 511 comprise a plurality of suction heads 1511 which retain the first walls 3 to be fed to the gripping and application wheel. More specifically, the suction heads 1511 are juxtaposed with each other in such a way as to minimize, or even eliminate, the spacing between two consecutive walls 3. In effect, the feeding unit 510 may withdraw the walls 3 from one or more suitably shaped feeder drawers.

More conveniently, the unit 510 is adapted to withdraw the first walls 3 from a specific cutting device. In a further embodiment, the feeding unit may be provided, at each suction head mounting arm of it, with specific cutting devices at each suction head in such a way as to make and retain the walls directly on the arm.

More specifically, in the case of withdrawal from a cutting device, or a direct cutting device on the suction head, a web of thermosealable material may be fed from which to cut out the aforementioned walls 3. In such case, to minimize waste during the production of the disc-shaped walls 3, the cuts must be made as close as possible to each other.

To enable the cuts made close to each other to be used to best advantage, the gripping and application wheel 310 is equipped with a plurality of mounting rods 312 running parallel to the axis of rotation and positioned along the circumference of the wheel. The rods 312 are equidistant from each other and from the centre. Further, each mounting rod 312 is equipped with a plurality of gripping devices 311, preferably able to operate separately from each other. In the embodiment described here, the number of gripping devices 311 on each mounting rod 312 is equal to the number of seats 1112, 2112, 3112, 4112 in each row, that is, on each plate 112.

The gripping devices 311 located on each mounting rod 312 are movable along the respective rod between a gripping position and a release position. More specifically, in the gripping position, the gripping devices 311 are juxtaposed with each other in order to grip the walls 3 while at the minimum distance from each other. In the release position, on the other hand, the gripping devices 311 are spaced from each other so as to be positioned at each seat 1112, 2112, 3112, 4112 of one row in order to release the walls 3 and thus apply them to the corresponding hollow bodies 2. This allows minimizing waste because the material the walls 3 are made of is cut at the close-together position, in order to reduce the amount of excess material between two consecutive walls, and then

spaced apart according to the arrangement and size of the hollow bodies 2.

Lastly, downstream of the first application unit 310 and along the first conveyor 110, there is a first sealing unit 410 provided with a plurality of sealing heads adapted to seal the first walls 3 applied in the unit preceding it to each hollow body 2 which has been filled.

As illustrated in Figure 4, the first sealing unit 410 mounts a group of sealing heads arranged in a plurality of rows of sealing heads adapted to join the walls 3 to the hollow bodies 2 by thermosealing, in particular to the annular edge 3''. The sealing unit 410 comprises a mounting structure 412 provided with the group of sealing heads 1411, 2411, 3411, 4411 arranged in equidistant rows. Preferably, the number of sealing heads 1411, 2411, 3411, 4411 in each of the rows is equal to the number of retaining seats 1112, 2112, 3112, 4112 in each of the rows of the first conveyor 110, that is, of the plates 112. More specifically, in the embodiment described here, there are four sealing heads in each row, like the four seats in each row of the first conveyor 110.

The sealing heads 1411, 2411, 3411, 4411 are located at fixed positions on the mounting structure 412 and, more specifically, are individually equispaced in the rows along the housing direction SD, and also equispaced between the rows along the forming direction FD. The aforementioned equispacings correspond, respectively, to the spacing between the retaining seats 1112, 2112, 3112, 4112 in each of the rows of the first conveyor 110 and to the spacings between the seats on consecutive plates 112. As a result, plates or seats with non-uniform spacing or retaining seats of different sizes may require a different or non-equispaced arrangement of the sealing heads.

At the first sealing unit 410, the machine 10 comprises a second actuator device (not illustrated) adapted to move the first sealing unit 410. This may be an integral part of the sealing unit 410 itself or part of the machine 10, separate but operatively connected to the first sealing unit 410.

The second actuator device is adapted to move the sealing unit 410 in parallel with the forming direction FD according to a law of motion which includes an operational phase and a return phase. In the operational phase, illustrated in Figures 5A and 5B, the sealing heads 1411, 2411, 3411, 4411 move from a start sealing position (Figure 5A) to an end sealing position (Figure 5B) of the capsules 1, and more specifically, of the walls 3, in the same direction and in synchrony with the first conveyor 110. During the operational phase, each sealing head 1411, 2411, 3411, 4411 thus remains operatively connected for the whole time to a corresponding hollow body 2 and, more specifically, in physical contact with the annular edge 3''. The aforementioned law of motion also includes a return phase in which the sealing heads 1411, 2411, 3411, 4411 move from the end sealing position to the start sealing position in the direction opposite to that of said first conveyor 110.

In a preferred embodiment, not illustrated, the second actuator device comprises means for linearly moving the first sealing unit 410 along the aforementioned operational and return phases. Such movements may be determined for example by an electric motor, forming part of the second actuator device, which moves the first sealing unit 410 on rails running parallel to the first conveyor 110.

Similarly, the movement might be produced by means of a crank mechanism (not illustrated) as described previously in connection with the first filling unit 210 which the reader is referred to.

Each of the sealing heads 1411, 2411, 3411, 4411 preferably comprises an annular sealing member of a size such as to be superposed on the corresponding annular edge 3'' which the wall 3 must be thermosealed to.

To place the sealing member in working conditions during the operational phase, the sealing member may be movable between a rest position and a working position. More specifically, the sealing member is maintained in the rest position during the movement of the first sealing unit 410 in the return phase and is placed in the working position during the movement of

the first sealing unit 410 in the operational phase. In the rest position, where no sealing operation needs to be carried out, the sealing member is far from the wall 3, and more specifically, is retracted towards the mounting structure 412. In the working position, on the other hand, where the thermosealing operation has to be carried out, the sealing member is in contact with the wall 3, and more specifically, away from the mounting structure 412.

In a further embodiment, not illustrated, the positioning of the sealing heads into contact with the capsule 1 during the operational phase is accomplished by moving the whole of the first sealing unit 410, and thus keeping fixed the individual sealing members. In such case, the sealing unit 410 is movable perpendicularly to the conveyor 110 between a rest position and a working position, substantially corresponding to the positions just described. More specifically, the perpendicular movement is carried out during the feeding of the unit 410 itself. In the rest position, the sealing member is away from the wall 3, whilst in the working position, the sealing member is in contact with the wall 3. As described previously, the sealing member is maintained in the rest position during the movement of the first sealing unit 410 in the return phase and is placed in the working position during the movement of the first sealing unit 410 in the operational phase.

Lastly, the machine might also be equipped with a unit for checking the seal quality or that the formed capsules are correctly filled (not illustrated). In that case, the machine might be further equipped with a rejection station (not illustrated) located, for example, at the end of the conveyor where the outfeed station S2 is. The rejection station might be defined by one or more plates 112 located along the upper section of the conveyor 110.

The numeral 4 in Figures 6A and 6B denotes in its entirety a variant of a single-use capsule for beverages. The capsule 4 comprises a hollow body 5 having two opposite openings. More specifically, a first circular opening

6' is circumscribed by a first annular edge 6'' and a second opening 7', also circular, is circumscribed by a second annular edge 7''. In the embodiment described here and in view of the frustoconical shape of the capsule 4, the first opening 6' is positioned at the bottom of the hollow body 5 and is larger in size than the second opening 7' opposite to it, positioned at the top of the hollow body 5. The first opening 6' and the second opening 7' are each closed during the forming of the capsule 4 respectively by a first wall 8, constituting the bottom wall of the capsule 4, and a second wall 9, constituting the top wall of the capsule 4, which are applied and thermosealed to the aforementioned annular edges 6'', 7''. More specifically, in this embodiment, both of the walls 8, 9 are disc-shaped in order to adapt to the annular configuration of the respective edges 6'', 7''.

As described previously in connection with the preceding embodiment, the product inside the capsule 4 may be in the form of powder, granules or leaves or even in liquid or semi-liquid form.

In use, the first wall 8 and/or the second wall 9 is/are perforated so that the interior of the capsule 4 can be supplied with hot water under pressure which mixes with the contents of the hollow body 5 to produce the desired beverage. Thus, the walls 8, 9 are applied to the hollow body 5 in succession and, more specifically, one of them is applied before the capsule 4 is filled, whilst the other seals the capsule 4 after the partly closed hollow body 5 has been filled with the desired beverage concentrate.

A capsule 4 of the above mentioned type is made by means of a capsule making machine 20 according to this invention. More specifically, a machine 20 of this type, according to a second embodiment of the invention, is illustrated in Figures 7, 10A and 10B.

The machine 20 comprises a first conveyor 110 and a second conveyor 120 which are operatively connected to each other Each of the conveyors 110 and 120 is equipped with a plurality of units located in succession and

adapted to operate on the hollow bodies 5 in sequence.

The first conveyor 110 corresponds to the conveyor described above in connection with the first embodiment, which the reader is referred to.

In the same way, the units located along the first conveyor 110 are the same as those of the first embodiment described above, namely, the filling unit 210, the first application unit 310, the first feeding unit 510 and the first sealing unit 410. These units are also present in the second embodiment and what is described above in connection with the first embodiment applies, *mutatis mutandis*, also to the second embodiment.

Since the capsule 4 in question requires both a first wall 8 and a second wall 9 to be applied to it, the machine 20 comprises further units for moving the hollow bodies and for thermosealing. More specifically, the machine 20 comprises a second conveyor 120, located upstream of the first conveyor 110, also an endless conveyor trained around second driving means adapted to move it continuously. The second driving means allow moving the second conveyor 120 in the same direction as the first conveyor 110. The aforementioned first conveyor 110 and second conveyor 120 are positioned in alignment along the forming direction FD, defining an endless feed path. The forming direction FD is substantially rectilinear, since each of the two conveyors 110 and 120 are defined by a linear support which, in the aforementioned embodiments, consists of two parallel, flexible chains. The support is provided with the plurality of plates which comprise the seats for housing the capsules and where each plate defines a row of the seats.

Thus, the second conveyor 120 has the same features as the first conveyor 110, which the reader is referred to, differing only in that it is shorter because it does not have a filling device on it. The second conveyor 120 is adapted to feed the plurality of hollow bodies 5 along the forming direction FD where the capsules 4 are formed. More specifically, the hollow bodies 5 are provided with the opposite openings 6'', 7''. Like the first conveyor 110, the second conveyor 120, too, has a plurality of

rows of seats for housing the hollow bodies 5 and which in the embodiment illustrated and described are defined by specific plates. Each of the rows, or plates, is located in succession along the forming direction FD and is adapted to house two or more hollow bodies side by side in corresponding seats along a housing direction SD perpendicular to the forming direction FD. In the second embodiment, too, there are four seats in each row, or plate, but this number may differ according to production requirements.

To allow the second wall to be applied before filling, the machine also comprises a second application unit 320 for applying the second walls and a second sealing unit 420, both located along the second conveyor 120 and, more specifically, positioned in such a way that the second sealing unit 420 is downstream of the second application unit 320.

The second application unit 320 corresponds to the first application unit 310 described above in connection with the first embodiment, which the reader is referred to. The second application unit 320 is provided with a plurality of gripping devices adapted to grip the second walls and to apply the walls simultaneously to all the hollow bodies positioned in each of the rows defined on the second conveyor 120. In the same way, the second application unit 320 is adapted to apply the respective second walls 8 to each row moving forward in succession.

Similarly to the first embodiment, the second application unit 320 is fed by a second feeding unit 520 corresponding to the first feeding unit 510 described above in connection with the first embodiment, which the reader is referred to.

Similarly, the second sealing unit 420 corresponds to the first sealing unit 410 described above in connection with the first embodiment, which the reader is referred to. More specifically, the second sealing unit 420 is equipped with a plurality of rows of sealing heads adapted to seal the second walls to each empty hollow body. A third actuator device (not illustrated) is adapted to move the sealing unit 420 in parallel with the

forming direction FD according to a law of motion which includes an operational phase and a return phase. In the operational phase, illustrated in Figures 10A and 10B, the sealing heads move from a start sealing position (Figure 10A) to an end sealing position (Figure 10B) of the capsules 4 in the same direction and in synchrony with the second conveyor 120. In the return phase the sealing heads move from the end sealing position to the start sealing position in the direction opposite to that of the second conveyor 120. The third actuator device corresponds to the second actuator device described above in connection with the first embodiment, which the reader is referred to.

The machine 20 is further equipped with suitable transfer means 620 adapted to transfer the hollow bodies 5 from the second conveyor 120 to the first conveyor 110. Thus, the transfer means 620 operatively connect the two conveyors 110, 120 to each other and are adapted to transfer the hollow bodies 5 provided with the second wall 9, that is to say, with the wall 9 thermosealed to it, from the second conveyor 120 to the first conveyor 110, where filling and thermosealing of the first wall 8 can then be carried out. More specifically, the transfer means 620 are adapted to transfer the hollow bodies 5 provided with the second wall 9 from the second conveyor 120 to the first conveyor 110 while rotating the hollow bodies 5 by 180° about the housing direction SD, or a direction parallel therewith, so that the first openings 6'' are positioned at the filling unit 210.

In the embodiment illustrated in Figures 8 and 9, the transfer means 620 comprise a first transfer wheel 621 and a second transfer wheel 622, each provided with a plurality of gripping elements and adapted to rotate in a direction opposite to that of the first and second conveyors 110 and 120. The wheels 621, 622 are positioned vertically and each rotates about a horizontal axis of rotation parallel to the housing direction SD. Further, the transfer wheels 621, 622 are positioned to face each other with the respective axes of rotation aligned in a plane parallel to the forming direction FD.

The first transfer wheel 621 is positioned along the second conveyor 120 at a first transfer station. The first transfer station is defined, in the second embodiment, by the outfeed station S4 of the second conveyor 120. In the same way, the second transfer wheel 622 is positioned along the first conveyor 110 at a second transfer station. The second transfer station is defined, in the second embodiment, by the infeed station S1 described earlier on in this description.

Each of the transfer wheels 621, 622 is equipped with a plurality of gripping elements which effectively perform the transfer operation. Each gripping element is preferably defined by a supporting plate 621', 622' provided with a plurality of openings 1621', 2621', 3621', 4621', 1622', 2622', 3622', 4622' shaped to receive the hollow bodies 5.

The transfer wheels 621, 622 are thus adapted to exchange the partly formed capsules 4 between themselves, from the first transfer wheel 621 to the second transfer wheel 622, at a third transfer station S3 defined by the mutual coupling of the gripping elements of each of the transfer wheels 621, 622.

To enable uninterrupted transfer during the continuous rotational motion of the two transfer wheels 621, 622, each gripping element is mounted on the respective wheel by means of an articulated parallelogram which allows further movement of the gripping element – for example a rocking movement – as the gripping element rotates about the axis of rotation of the transfer wheel it is mounted on. The articulated parallelogram comprises two pairs of arms hinged at two opposite portions of the supporting plate 621', 622', and more specifically, at the ends located along the housing direction SD. These pairs of arms are hinged, on one side, to the aforementioned gripping elements and, on the other side, to the mounting structure of the respective transfer wheel 621, 622. Thus, at the transfer stations, the articulated parallelogram allows positioning the respective gripping elements in such a way that the gripping elements are, for the length of time needed to complete the transfer operation, parallel to

the plane from which the hollow bodies 5 picked up or transferred. For example, when approaching the first transfer station, the articulated parallelogram allows rocking the gripping elements until they are positioned parallel to the plates of the first section of the second conveyor 120. The same occurs at the second and third transfer stations, where parallel alignment applies, respectively, to the plates on the upper section of the first conveyor 110 and to the transfer devices of the second transfer wheel 622.

To facilitate the transfer operations, the transfer stations and the gripping elements may be further provided with suitable actuator means (not illustrated) adapted to expel the hollow bodies 5 from the respective seats to enable them to be transferred, or to retain the hollow bodies 5 in the new seats they have been transferred to. These actuator means may be defined, for example, by piston actuators or actuators which use compressed air, suction and/or air jets.

The capsule making machines 10, 20 described in the foregoing offer numerous advantages.

First of all, they allow attaining high hourly outputs, that is to say, high numbers of capsules made per unit of time, while guaranteeing the production of capsules of high quality.

In effect, the machine according to the invention allows obtaining a considerably higher output under equal conditions of power used to drive the capsule forming units since all the operations are performed during the continuous and uninterrupted feeding of the conveyor.

The continuous operation allows the machine to reduce the working stresses and fatigue loads typical of intermittent-motion machines used for the same purpose. In effect, by operating with continuous motion, the machine can reach high hourly outputs without subjecting the products to mechanical stresses, that is to say, to high acceleration/deceleration.

Further, the continuous operation of the units for applying and sealing the walls allows minimizing waste during capsule production.

The arrangement of the retaining seats in rows, like that of the filler heads, the sealing heads and the gripping devices allows the machine to have a considerably smaller footprint than prior art machines with the same production capacity.

Moreover, the linear movement of the filling and sealing units makes it possible for all the devices operating on them to be used simultaneously, unlike those of rotary machines where the operating devices are used one or a few at a time during the rotational cycle. This in turn means considerably reduced footprint and costs for the machine because for the same production output a larger number of parts work simultaneously. For the same reasons, the feeding speeds of the individual units are considerably reduced.

The machine described above is also easy and inexpensive to construct since it is made up of structurally simple parts with few movements which are easy to accomplish.

Lastly, the capsule making machine described above allows ample room to move around each component, which facilitates both initial assembly and subsequent maintenance (from routine cleaning to substitution) of the components.

CLAIMS

1. A machine (10) for making beverage capsules (4), said capsules comprising a hollow body (5) provided with a first opening (6') and a second opening (7') and with a first covering wall (8) and a second covering wall (9) for covering said openings (6', 7'), said machine (10) comprising:

- at least a first endless conveyor (110) trained around first driving means adapted to move said first conveyor (110) continuously, said first conveyor (110) being adapted to feed a plurality of said hollow bodies (5) along a forming direction (FD) for forming said capsules (4);
- at least one filling unit (210) for filling said hollow bodies (5) provided with a plurality of filler heads (1211, 2211, 3211, 4211) and positioned along said first conveyor (110);
- at least one first application unit (310) for applying said first walls (8) to each filled hollow body (5) and positioned along said first conveyor (110) downstream of said filling unit (210);
- at least one sealing unit (410) positioned along said first conveyor (110) downstream of said application unit (310) and provided with a plurality of rows of sealing heads (1411, 2411, 3411, 4411) adapted to seal said first walls (8) to each filled hollow body (5);
- a first and a second actuator device adapted to move said filling unit (210) and said first sealing unit (410) in a direction parallel to said forming direction (FD) with a law of motion which includes an operational phase, where said filler heads (1211, 2211, 3211, 4211) and said sealing heads (1411, 2411, 3411, 4411) move, respectively, from a start filling or sealing position to an end filling or sealing position of said capsules (4) advancing in the same direction as, and in synchrony with, said first conveyor (110), and a return phase, where said filler heads (1211, 2211, 3211, 4211) and said sealing heads (1411, 2411, 3411, 4411) move, respectively, from said end filling or sealing position to said start filling or sealing position in the direction opposite to that of said first conveyor (110), wherein

said first application unit (310) is provided with a plurality of gripping devices (311) adapted to grip said first walls (8) and to apply said walls (8) simultaneously to all said hollow bodies (5) positioned in each of said rows and continuously to said rows moving forward in succession;

characterized in that it comprises:

- a second endless conveyor (120), positioned upstream of said first conveyor (110), and trained around second driving means adapted to move said second conveyor (120 continuously in the same direction as said first conveyor (110), said second conveyor (120) being adapted to feed a plurality of said hollow bodies (5) along a forming direction (FD) for forming said capsules (4);
- a second application unit (320) for applying said second walls (9) to each empty hollow body (5) and positioned along said second conveyor (120);
- a second sealing unit (420) positioned along said second conveyor (120) downstream of said second application unit (320) and provided with a plurality of rows of sealing heads adapted to seal said second walls (9) to each empty hollow body (5);
- a third actuator device adapted to move said second sealing unit (420) in a direction parallel to said forming direction (FD) with a law of motion which includes an operational phase, where said sealing heads move from a start sealing position to an end sealing position of said capsules (4) in the same direction and in synchronism with respect to said second conveyor (120), and a return phase, where said sealing heads move from said end sealing position to said start sealing position in the opposite direction with respect to said second conveyor (120), wherein the first conveyor (110) and the second conveyor (120) are operatively connected by transfer means (620) adapted to transfer the hollow bodies (5) provided with the second wall (9) from the second conveyor (120) to the first conveyor (110) and to rotate the hollow bodies (5) by 180° about the

housing direction SD so that the first opening (6') is positioned at the filling unit (210).

2. The machine (20) for making capsules (4) according to claim 1, characterized in that the second conveyor (120) is provided with a plurality of rows of seats for housing the hollow bodies (5), each of said rows being positioned in succession along said forming direction (FD) and being adapted to house two or more hollow bodies (5) side by side in the seats along a housing direction (SD) perpendicular to the forming direction (FD); said second application unit (320) being provided with a plurality of gripping devices adapted to grip said second walls (9) and to apply said second walls (9) simultaneously to all said hollow bodies (5) positioned in each of said rows and continuously to said rows moving forward in succession.

3. The machine (20) for making capsules according to claim 2, wherein said first conveyor (110) and said second conveyor (120) are positioned in alignment along said forming direction (FD), said forming direction (FD) being substantially straight, said conveyors (110, 120) being respectively defined by a frame extending in a straight line and supporting a plurality of plates provided with said retaining seats, said plates defining each of said rows of seats.

4. The machine (20) for making capsules according to claim 1, wherein said transfer means (620) comprise a first transfer wheel (621) and a second transfer wheel (622), each provided with a plurality of gripping elements (621', 622') and adapted to rotate in a direction opposite to that of said first conveyor (110) and second conveyor (120), said first transfer wheel (621) being positioned along said second conveyor (120) at a first transfer station and said second transfer wheel (622) being positioned along said first conveyor (110) at a second transfer station, said first transfer wheel (621) and said second transfer wheel (622) being adapted to transfer said empty hollow bodies (5) from said first transfer wheel (621) to said second transfer wheel (622) at a third transfer station defined by

the mutual coupling of said gripping elements (621', 622') of each of said transfer wheels (621, 622).

5. The machine (10; 20) for making capsules (1; 4) according to claim 1 or 2, wherein the application units (310, 320) comprise a gripping and application wheel to grip and apply said walls (8, 9), positioned above the respective conveyor (110, 120) and having an axis of rotation which is parallel to said housing direction (SD), said gripping and application wheel being provided with said gripping devices (311) and being moved in a direction opposite to said conveyors (110, 120).

6. The machine (10; 20) for making capsules (1; 4) according to claim 5, wherein said gripping and application wheel is provided with a plurality of mounting rods (312) positioned parallel to said axis of rotation and along the circumference of said gripping and application wheel, each of said mounting rods (312) being provided with a plurality of said gripping devices (311) in a number equal to the number of said retaining seats (1112, 2112, 3112, 4112) in each of said rows.

7. The machine (10; 20) for making capsules (1; 4) according to claim 6, wherein said gripping devices (311) of each of said mounting rods (312) are movable along the respective rod (312) between a gripping position, where said gripping devices (311) are positioned side by side so as to grip said walls (8, 9), and a release position, where said gripping devices (311) are spaced from one another so as to be positioned at each retaining seat (1112, 2112, 3112, 4112) of the same row to release said walls (8, 9).

8. The machine (10; 20) for making capsules (1; 4) according to one or more of the preceding claims, wherein each of said sealing heads (1411, 2411, 3411, 4411) comprises an annular sealing member movable between a rest position, where said sealing member is far from said wall (8, 9), and a working position, wherein said sealing member is in contact with said wall (8, 9); said sealing member being maintained in said rest position during the movement of said sealing unit (410; 410, 420) in said

return phase and is placed in the working position during the movement of said sealing unit (410; 410, 420) in said operational phase.

9. The machine (10; 20) for making capsules (1; 4) according to one or more of the preceding claims, wherein each of said sealing heads (1411, 2411, 3411, 4411) comprises an annular sealing member and wherein said sealing unit (410; 410, 420) is movable perpendicularly to said conveyor (110; 110, 120) between a rest position, where said sealing member is far from said wall (8, 9), and a working position, wherein said sealing member is in contact with said wall (8, 9); said sealing member being maintained in said rest position during the movement of said sealing unit (410; 410, 420) in said return phase and is placed in the working position during the movement of said sealing unit (410; 410, 420) in said operational phase.

10. The machine (10; 20) for making capsules (1; 4) according to one or more of the preceding claims, wherein the application unit (310; 310, 320) comprises a gripping and application wheel to grip and apply said walls (8, 9), positioned above the respective conveyor (110; 110, 120) and having an axis of rotation which is parallel to said housing direction (SD), said gripping and application wheel being provided with said gripping devices (311) and being moved in a direction opposite to said conveyors (110; 110, 120).

11. The machine (10; 20) for making capsules (1; 4) according to claim 10, wherein said gripping and application wheel is provided with a plurality of mounting rods (312) positioned parallel to said axis of rotation and along the circumference of said gripping and application wheel, each of said mounting rods (312) being provided with a plurality of said gripping devices (311) in a number equal to the number of said retaining seats (1112, 2112, 3112, 4112) in each of said rows.

12. The machine (10; 20) for making capsules (1; 4) according to claim 11, wherein said gripping devices (311) of each of said mounting rods (312) are movable along the respective rod (312) between a gripping

position, where said gripping devices (311) are positioned side by side so as to grip said walls (8, 9), and a release position, where said gripping devices (311) are spaced from one another so as to be positioned at each retaining seat (1112, 2112, 3112, 4112) of the same row to release said walls (8, 9).

13. The machine (10; 20) for making capsules (1; 4) according to one or more of the preceding claims, wherein the number of said filler heads (1211, 2211, 3211, 4211) in each of said rows is equal to the number of said retaining seats (1112, 2112, 3112, 4112) in each of said rows of said conveyor (110; 110, 120).

14. The machine (10; 20) for making capsules (1; 4) according to one or more of the preceding claims, wherein the number of said sealing heads (1411, 2411, 3411, 4411) in each of said rows is equal to the number of said retaining seats (1112, 2112, 3112, 4112) in each of said rows of said conveyor (110; 110, 120).

15. The machine (20) for making capsules according to one or more of the preceding claims, wherein said first conveyor (110) and said second conveyor (120) are respectively defined by a frame extending in a straight line and supporting a plurality of plates provided with said retaining seats, said plates defining each of said rows of seats.

16. The machine (20) for making capsules according to one or more of the preceding claims, wherein the first conveyor (110) is provided with a plurality of rows of seats (1112, 2112, 3112, 4112) for retaining the hollow bodies (2), each of said rows being positioned in succession along the forming direction (FD) and being adapted to house two or more hollow bodies (2) side by side in the seats (1112, 2112, 3112, 4112) along a housing direction (SD) perpendicular to the forming direction (FD).

17. The machine (20) for making capsules according to one or more of the preceding claims, wherein the filling unit comprises a plurality of rows of filler heads (1211, 2211, 3211, 4211), each adapted to feed a dose of product into a corresponding hollow body (2); at least a first application

unit (310) for applying said first walls (3) to each filled hollow body (2) and positioned along said first conveyor (110) downstream of said filling unit (210).

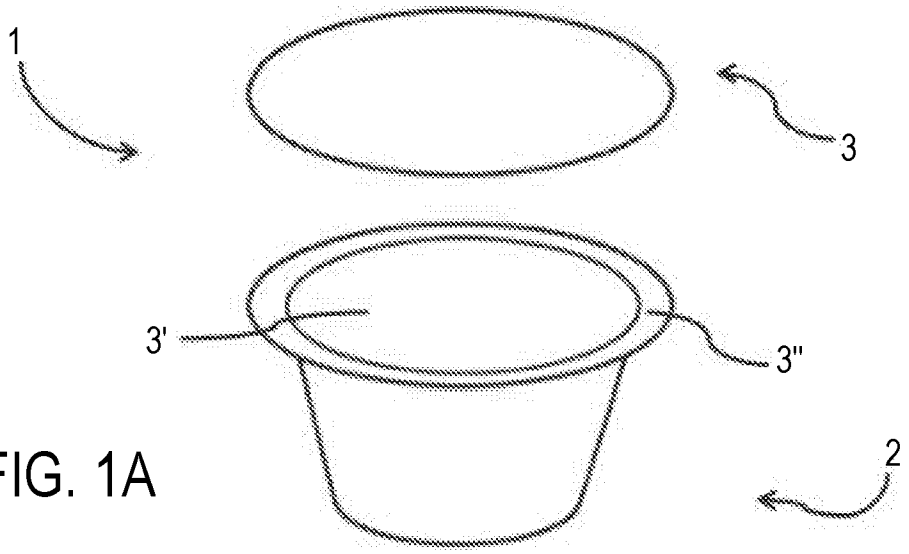


FIG. 1A

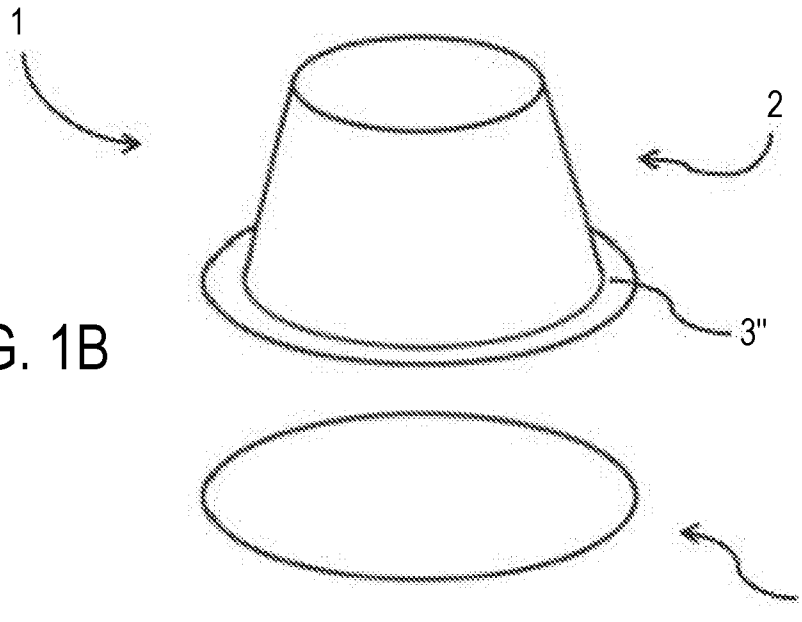


FIG. 1B

FIG. 2

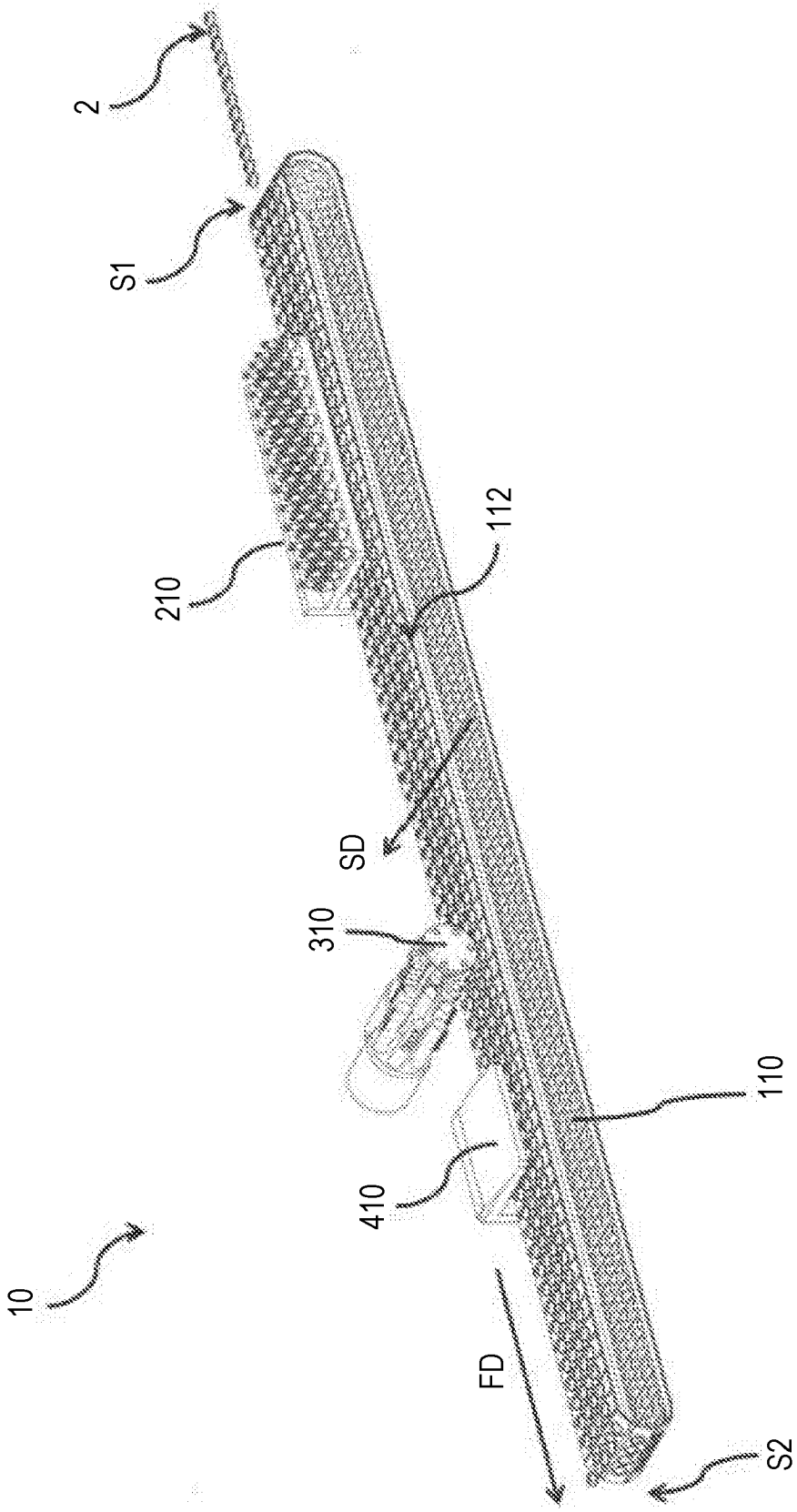


FIG. 3A

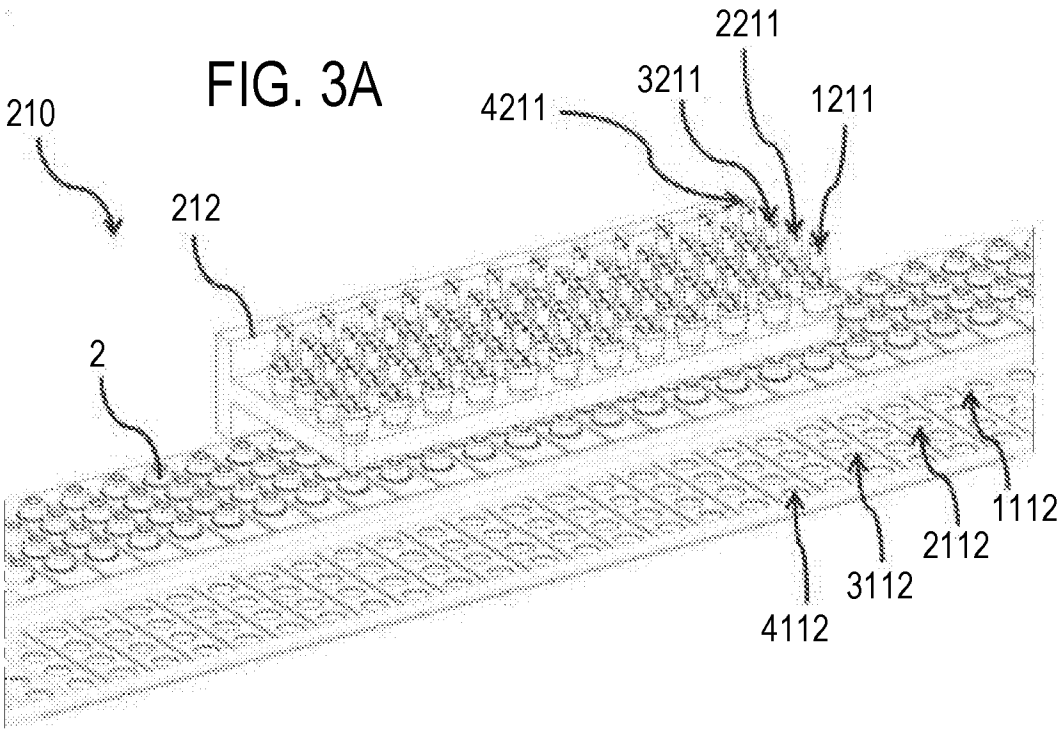
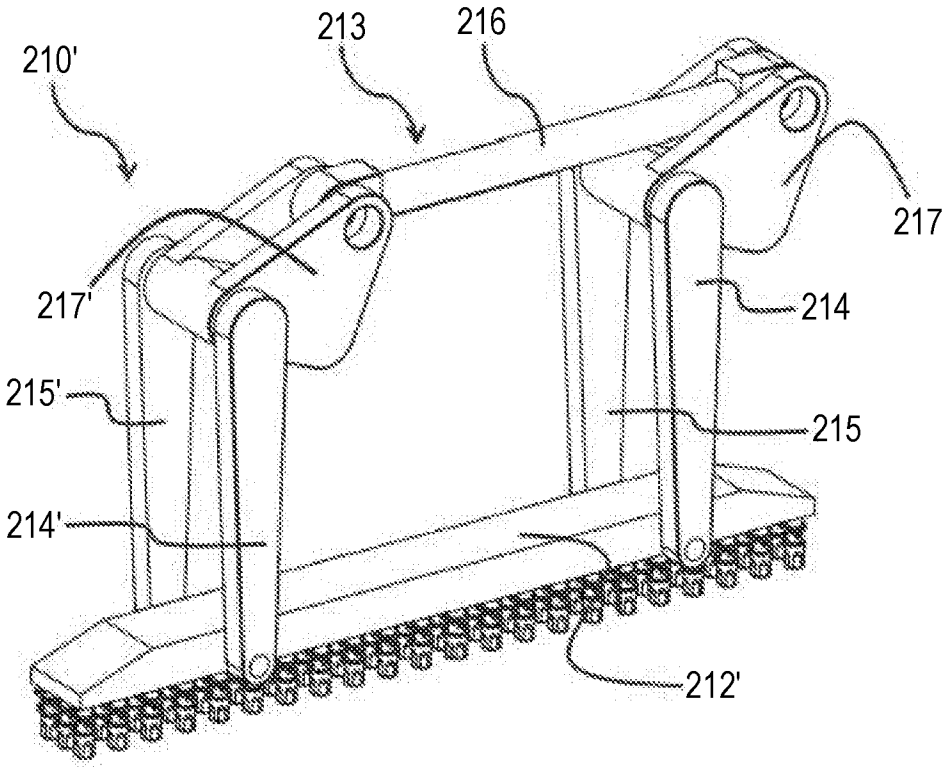

2211
3211
4211
1211
210
212
2
1112
2112
3112
4112

FIG. 3B


213
216
210'
217
217'
214
215'
215
214'
212'

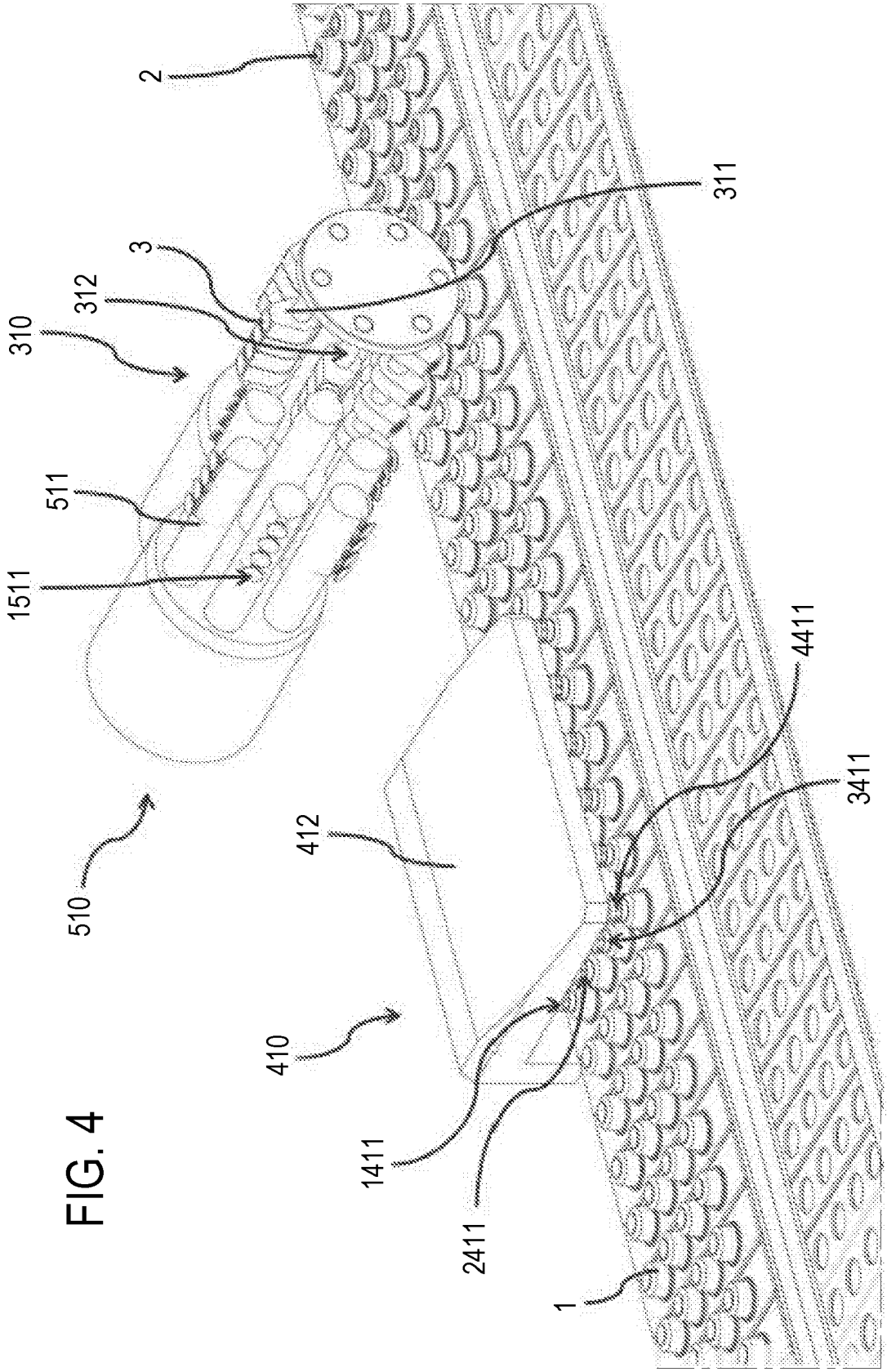


FIG. 4

FIG. 5A

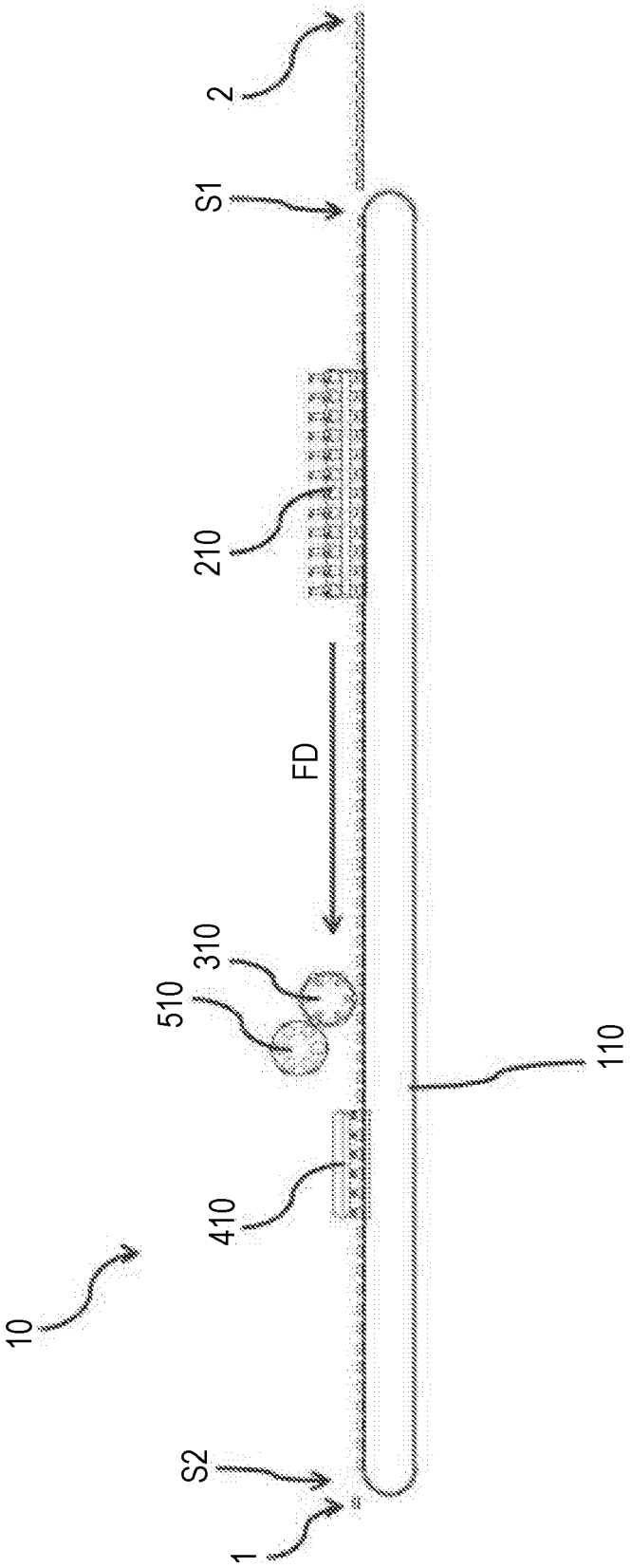
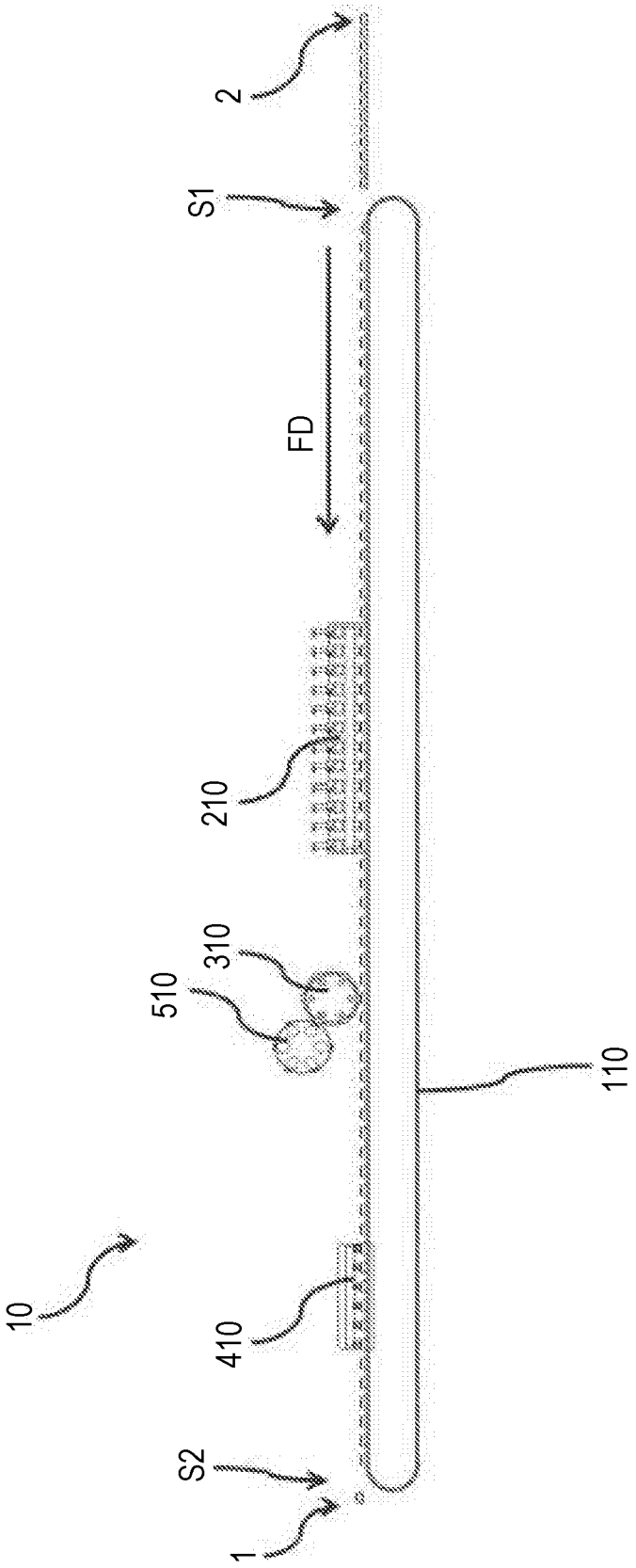


FIG. 5B



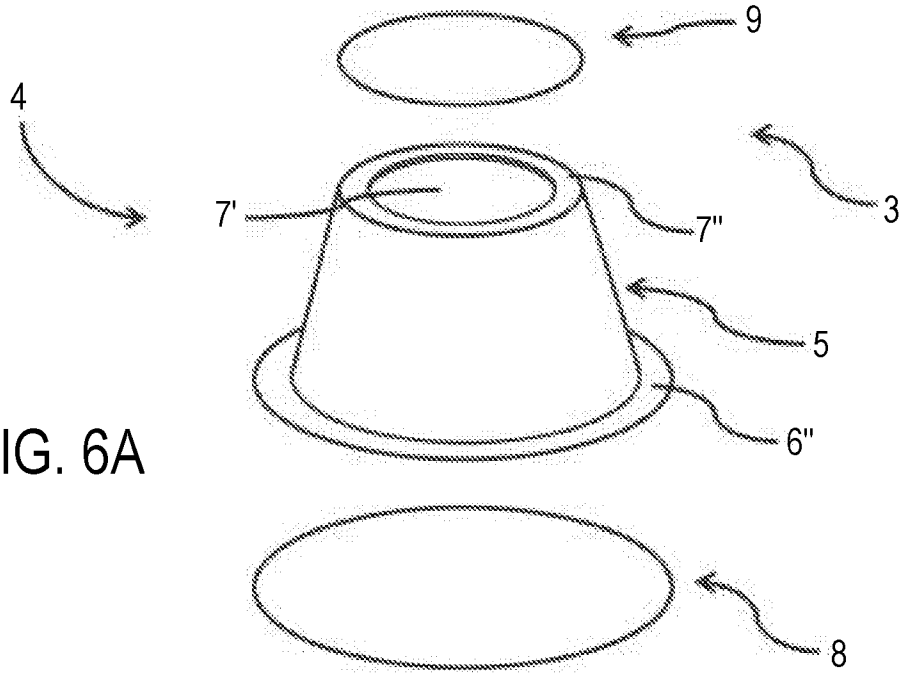


FIG. 6A

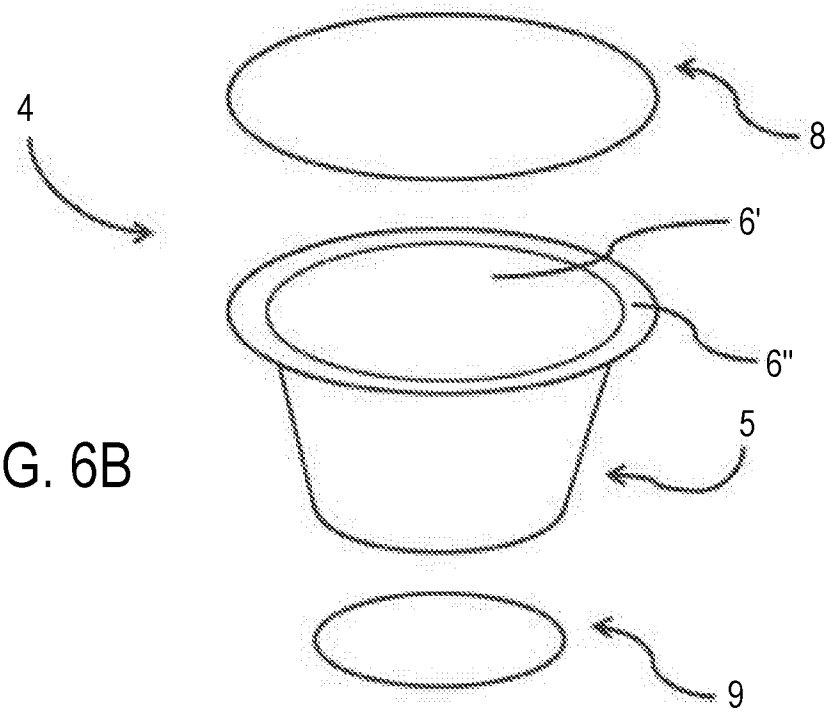


FIG. 6B

FIG. 7

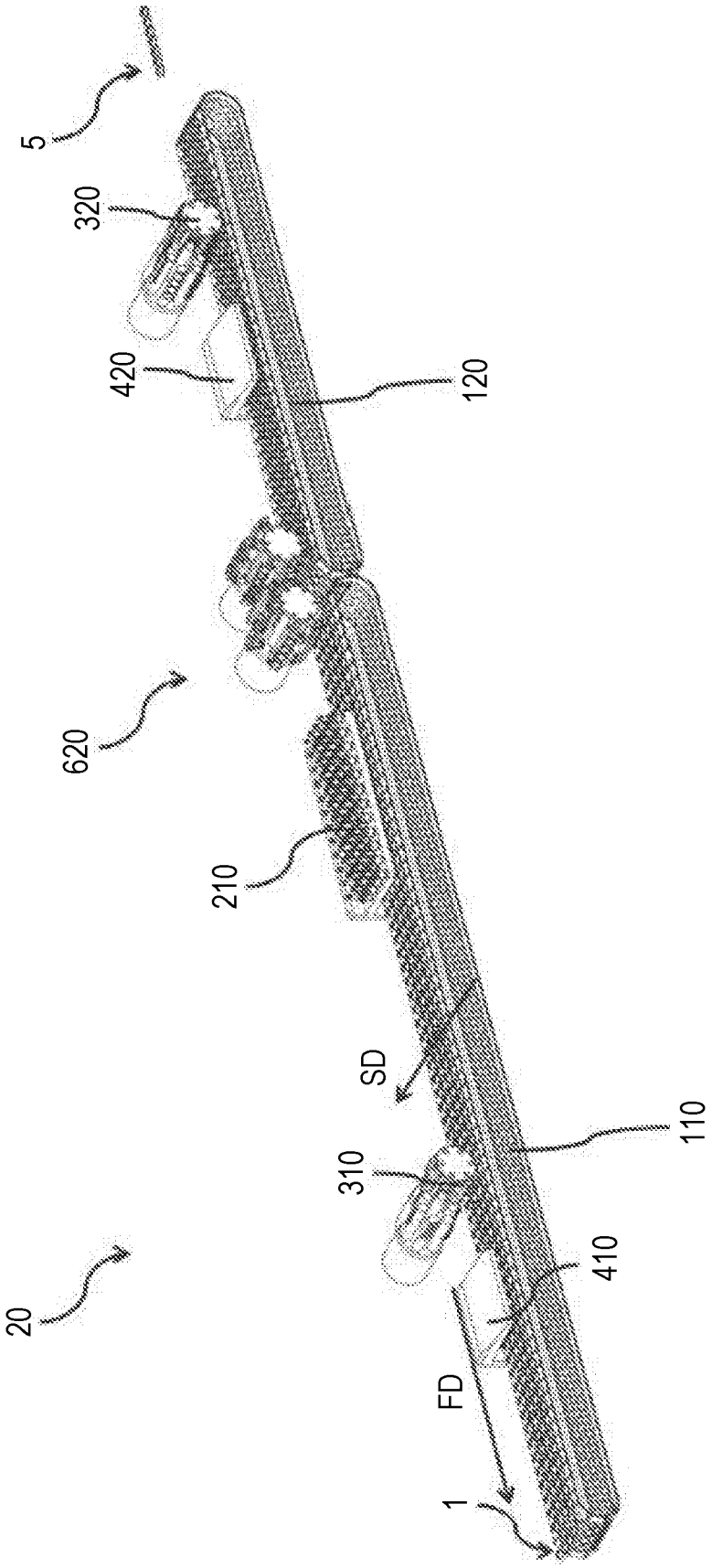


FIG. 8

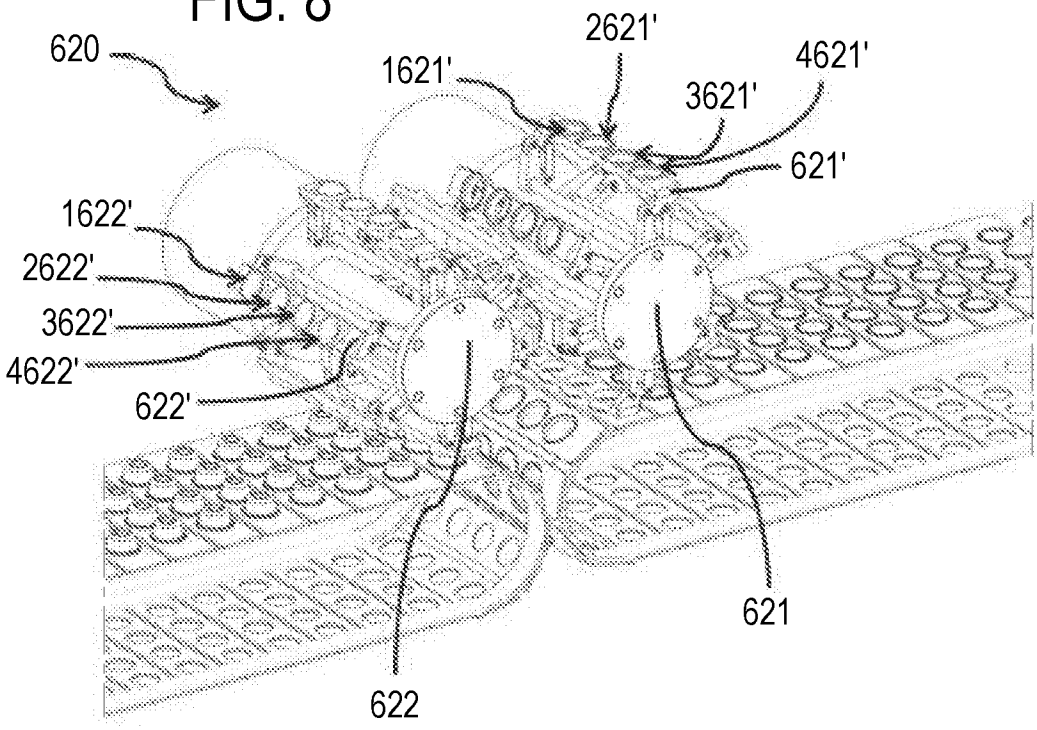

620
1621'
2621'
4621'
3621'
621'
1622'
2622'
3622'
4622'
622'
621
622

FIG. 9

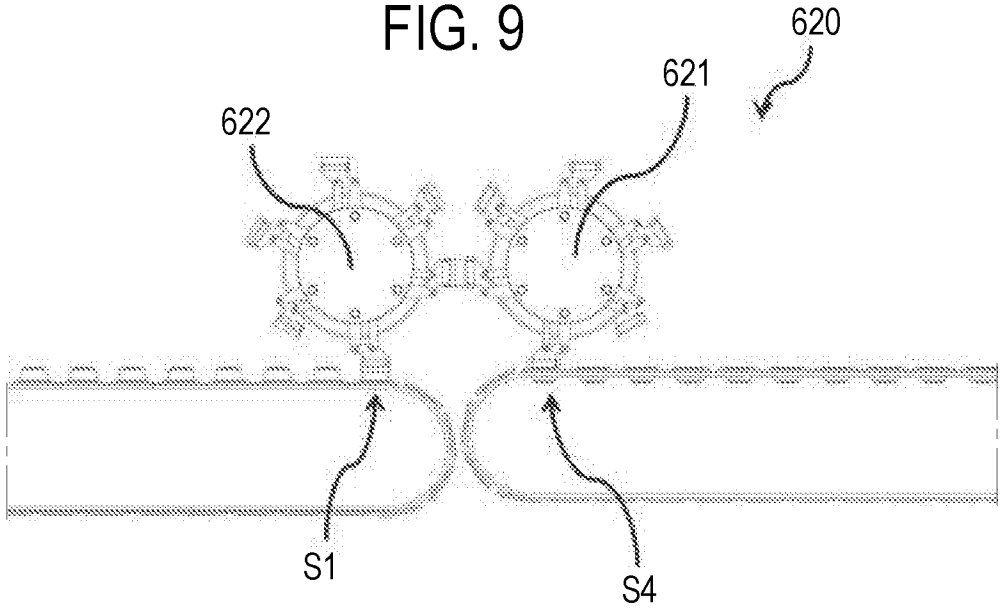

620
621
622
S1
S4

FIG. 10A

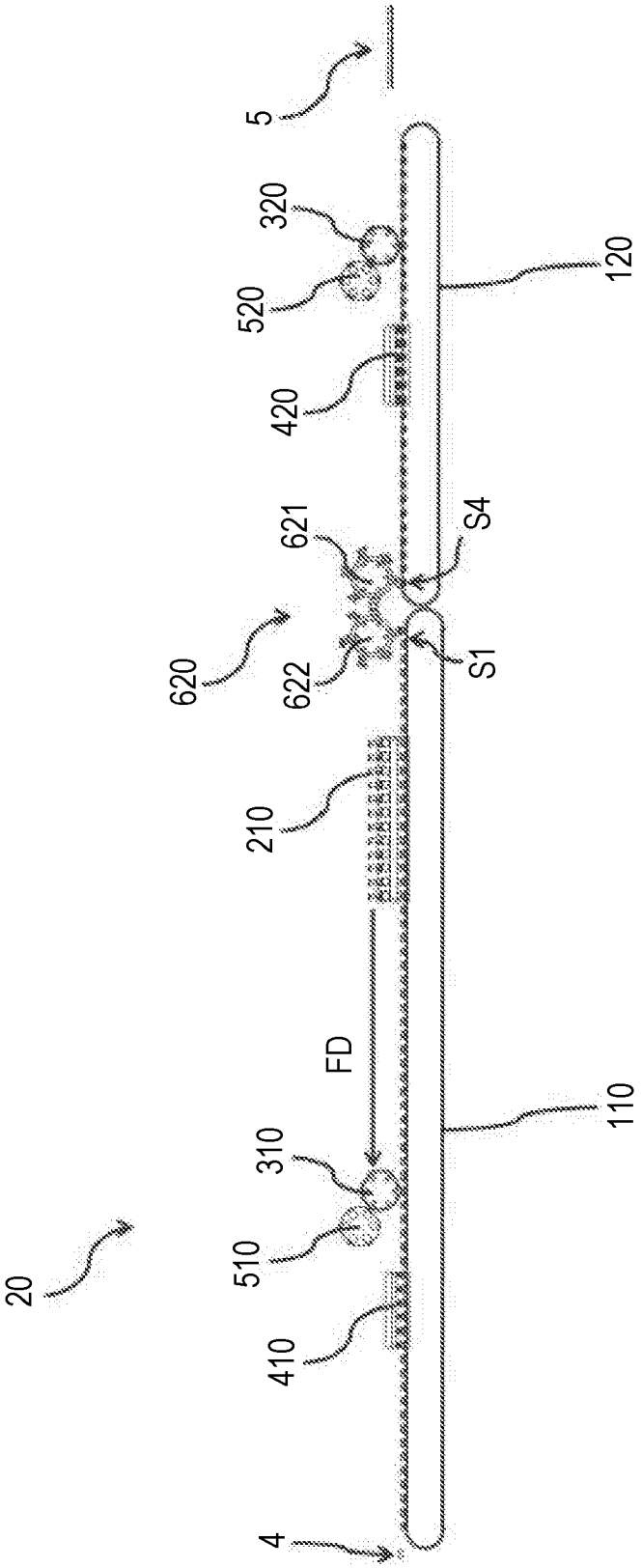
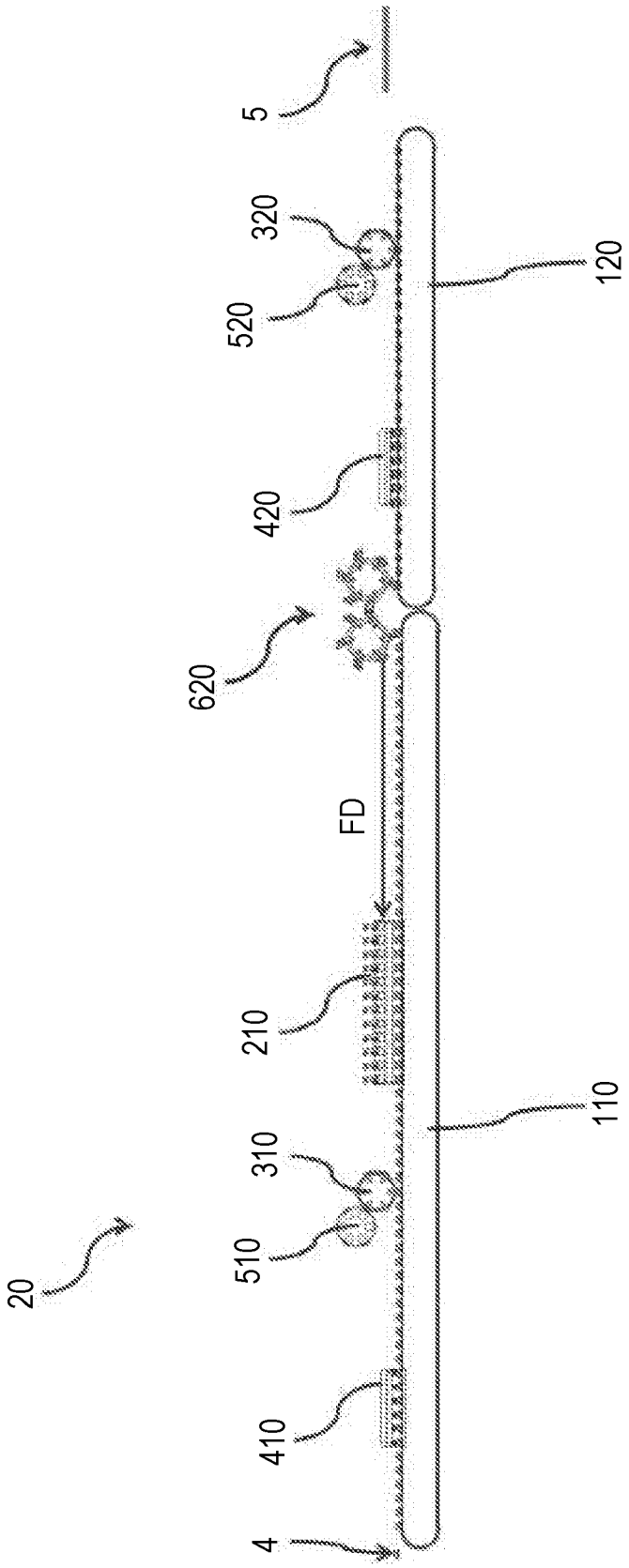


FIG. 10B



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/059221

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65B29/02 B65B39/14 B65B51/14 B65B7/28 B65D85/804
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65B B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 965 656 A (GERBEN RALPH D) 29 June 1976 (1976-06-29) abstract column 1, line 12 figures 1-2 column 3, line 20 - line 47	1-17
A	EP 1 892 199 A1 (TCHIBO GMBH [DE]) 27 February 2008 (2008-02-27) abstract figures 1-6	1-17
A	DE 102 46 061 A1 (BOSCH GMBH ROBERT [DE]) 15 April 2004 (2004-04-15) abstract; figures 1-3	1-17

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 February 2016	11/02/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Damiani, Alberto

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/059221

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2013/162392 A1 (NOVADELTA COM E IND DE CAFES S A [PT]) 31 October 2013 (2013-10-31) the whole document -----	1-17
A	WO 2010/007633 A1 (GIMA SPA [IT]; QUADRELLI FILIPPO [IT]) 21 January 2010 (2010-01-21) the whole document -----	1-17

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2015/059221

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