



(51) International Patent Classification:

A23G 1/20 (2006.01) A23G 1/04 (2006.01)
A23G 3/02 (2006.01)

(21) International Application Number:

PCT/EP2016/063386

(22) International Filing Date:

10 June 2016 (10.06.2016)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

15171649.5 11 June 2015 (11.06.2015) EP

(71) Applicant: NESTEC S.A. [CH/CH]; CT-IAM, Av. Nestlé 55, 1800 Vevey (CH).

(72) Inventors: **BALDWIN, Adam Lee**; 6 Winteringham House, Whitecross Gardens, York Yorkshire YO31 8LZ (GB). **NICOLLE, Benjamin Jonathan**; 1 Chelkar Way, York Yorkshire YO30 5ZH (GB). **PICKLES, William Alan**; 33 Sycamore Avenue, New Earswick, York Yorkshire YO32 4AL (GB). **SUTTON, Jonathan**; 9 Langley Court, Huntington, York Yorkshire YO32 9SG (GB).

(74) Agent: KIRK, Martin; CT-IAM, Avenue Nestlé 55, 1800 Vevey (CH).

(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).

[Continued on next page]

(54) Title: METHOD, APPARATUS AND NOZZLE FOR DEPOSITING

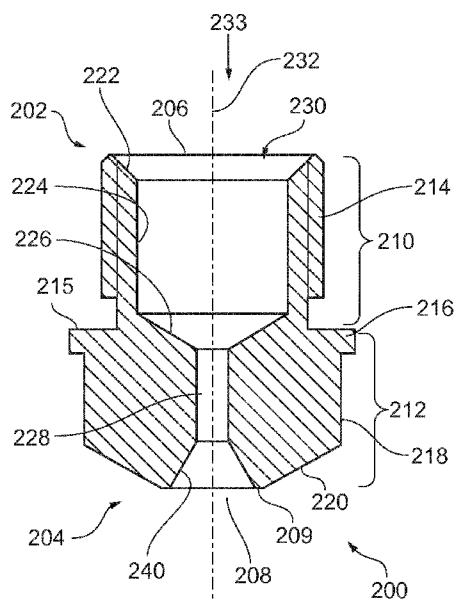


FIG. 5A

(57) Abstract: A nozzle is provided for an apparatus for depositing a liquid, semi-liquid or semi-solid food product. The nozzle (200) comprises a proximal end (202) and a distal end (204), the distal end (204) having an outlet (208) for depositing the liquid, semi-liquid or semi-solid food product. An external surface of the nozzle (200) includes a distal portion (212) that converges towards the outlet (208) at the distal end (204). A bore (230) extends from an inlet (206) to the nozzle (200) at the proximal end (202) of the nozzle (200). The bore (230) has a first portion (228) having a first cross-sectional area and a second portion (240) distal with respect to the first portion. The second portion (240) of the bore flares from the first portion (228) of the bore (230) to meet the external surface (209) at the outlet (208), whereby the outlet (208) has a second cross-sectional area larger than the cross-sectional area of the first portion (228). The flaring of the second portion (240) of the bore (230) enables expansion of the gas in the liquid, semi-liquid or semi-solid food product while within the confines of the flare of the bore (208), while still providing for a controlled flow of the liquid, semi-liquid or semi-solid food product from the outlet.

**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

— *of inventorship (Rule 4.17(iv))*

Published:

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

Method, Apparatus and Nozzle for Depositing

Field

5 The present subject matter is relates to an apparatus for depositing a liquid, semi-liquid or semi-solid food product and to nozzles for such an apparatus. More particularly, but not exclusively, the subject matter relates to such an apparatus and nozzle for use in filling mould cavities for finished confectionery products. The subject matter also relates to a method for depositing a liquid, semi-liquid or semi-solid food product.

10

Background

It is known to deposit liquid, semi-liquid or semi-solid food products in confectionery manufacturing processes. Such products may, for example, be deposited into a mould
15 cavity for producing a finished confectionery product. One example of such a process is the depositing of liquid chocolate into a mould cavity for the production of a chocolate bar. Fillings for confectionery products, such as fondants, caramels, mousses or truffles, may also be deposited.

20 As used herein the term 'chocolate' denotes any products that meet a legal definition of chocolate in any jurisdiction and also include product in which all or part of the cocoa butter is replaced by cocoa butter equivalents (CBE) and/or cocoa butter replacers (CBR). The terms 'chocolate compound' or 'compound' as used herein (unless the context clearly indicates otherwise) denote chocolate analogues characterised by presence of cocoa
25 solids (which include cocoa liquor/mass, cocoa butter and cocoa powder) in any amount, notwithstanding that in some jurisdictions compound may be legally defined by the presence of a minimum amount of cocoa solids. The term 'choco-material' as used herein denotes both chocolate and compound. The term 'chocolate coating' as used herein also refers to a chocolate shell and denotes coatings made from any choco-material. The term
30 'chocolate confectionery' as used herein denotes any foodstuff which comprises choco-material and optionally also other ingredients and thus may refer to foodstuffs such confections, cakes and/or biscuits whether the choco-material comprises a chocolate coating and/or the bulk of the product. Unless the context clearly indicates otherwise it will also be appreciated that in the present invention any one choco-material may be used
35 to replace any other choco-material and neither the term chocolate nor compound should be considered as limiting the scope of the invention to a specific type of choco-material.

In order to produce certain types of food product, it is desirable to add a gas into liquid chocolate prior to depositing. This process is typically known as aeration, and can be used to provide different effects according to the pressures and gases used. Various pressures have been proposed in different applications ranging from about 4 bar to 12 bar. Difference gases can also be used in different applications.

For example, adding carbon dioxide (CO₂) to liquid chocolate prior to depositing can result in a chocolate product with visible bubbles in the final chocolate product; a process typically known as "macro aeration".

By way of a further example, adding nitrogen (N₂) to liquid chocolate prior to depositing can result in a chocolate product where the bubbles that are formed are too small to be seen by the naked eye in the final chocolate product; a process typically known as "micro aeration".

When the liquid chocolate emerges from the outlet orifice of a nozzle of a depositing apparatus, the dissolved gas expands causing the formation of the bubbles. It has been observed in operation under at least certain operating conditions, for example when employing macro aeration, that there can be a build up of chocolate mass around the exit orifice of a nozzle of a depositing apparatus, an effect which is described herein as 'cauliflowering' in view of the similar appearance assumed by such chocolate mass. This effect can be undesirable as the build-up of chocolate mass can potentially fall into the product. This is a problem not specific to a particular type of apparatus for depositing aerated chocolate, but is experienced with different machines for depositing aerated chocolate. It is also to be noted that similar problems are also encountered in the production of other food products, such as the production of dairy products.

International patent application WO 2010/102716 describes an example of an apparatus for depositing a liquid, semi-liquid or semi-solid food product, the apparatus comprising: a fixed volume chamber for receiving the food product under a positive pressure, the chamber being defined by chamber walls, one of the chamber walls being provided with an outlet orifice for depositing the food product, the outlet orifice being provided with a first sealing surface; and a valve spindle arranged for reciprocating movement within the chamber, the length direction of the valve spindle extending substantially perpendicular to the chamber wall in which the outlet orifice is provided, a first end of the valve spindle being provided with a second sealing surface; wherein the second sealing surface of the

valve spindle is arranged for abutting the first sealing surface of the outlet orifice to thereby close the outlet orifice.

European patent application EP 2016837 discloses (see the Abstract) an apparatus with at least one discharge passageway extending to at least one elongate discharge outlet for depositing a confectionery mass, wherein at least one discharge passageway diverges in a direction towards the discharge outlet. It is described in paragraph [0014] that generally, in a plan view, the discharge passageway can be described to have the shape of a fishtail and that, described three-dimensionally, the passage is a hollow truncated pyramid, with the discharge outlet constituting the base, and the inlet end of the discharge passageway constituting the upper part of the pyramid. It is described in paragraph [0010] in EP2016837 that the length of the discharge outlet extends substantially perpendicular to a direction in which molds or any other molding means is moved relative to the discharge outlet, hence the confectionery mass can be deposited into the molds in the shape of relatively wide strips. It is described in paragraph [0011] in EP2016837 that depositing a relatively wide strip of aerated confectionery mass into a mould can reduce a need for shaking or vibrating of the mould.

Accordingly, it is desired to find a solution to the problem of cauliflowering in the depositing of aerated chocolate and other food products.

Summary

The presently claimed subject matter is defined in the claims.

In one aspect, a nozzle is provided for an apparatus for depositing a liquid, semi-liquid or semi-solid food product. The nozzle comprises a proximal end and a distal end, the distal end having an outlet for depositing the liquid, semi-liquid or semi-solid food product. An external surface of the nozzle includes a distal portion that converges to the outlet at the distal end. A bore (also described herein as a channel or passage) extends from an inlet to the nozzle at the proximal end of the nozzle to the outlet from the nozzle at the distal end of the nozzle. The bore has a first portion having a first cross-sectional area and a second portion distal with respect to the first portion. The second portion of the bore flares from the first portion of the bore to meet the external surface at the outlet, whereby the outlet has a second cross-sectional area larger than the cross-sectional area of the first portion. The flaring of the second portion of the bore enables controlled expansion of gas in the liquid, semi-liquid or semi-solid food product within the confines of the flare of

the bore, while still providing a controlled flow of the liquid, semi-liquid or semi-solid food product from the outlet.

An apparatus for depositing a liquid, semi-liquid or semi-solid food product can comprise a fixed volume chamber for receiving the food product under a positive pressure, the chamber being defined by chamber walls, one of the chamber walls being provided with an outlet orifice for depositing the food product defined such a nozzle installed in the chamber wall. A valve spindle can be arranged for reciprocating movement within the chamber, a first end of the valve spindle being provided with a second sealing surface arranged for abutting the first sealing surface of the nozzle to thereby close the outlet orifice.

A method of depositing a liquid, semi-liquid or semi-solid food product can comprise operating such an apparatus.

Brief Description of the Drawings

Embodiments are described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic cross-sectional view of an apparatus for depositing a liquid, semi-liquid or semi-solid food product;

Figure 2 is a plan view of the apparatus shown in Figure 1;

Figures 3A and 3B are cross-sectional views through a nozzle as illustrated in WO 2010/102716 illustrating the interaction of sealing surfaces of the nozzle and a valve shaft in first and second positions;

Figure 4A is a perspective view of an embodiment of a nozzle as claimed herein for use with the apparatus of Figures 1 and 2, Figure 4B is a bottom view of the nozzle of Figure 4A, Figure 4C is a side view of the nozzle of Figure 4A and Figure 4D is a cross-sectional view of the nozzle of Figure 4A.

Figures 5A and 5B illustrate example embodiments of nozzles claimed herein.

Figures 6A and 6B illustrate velocity profiles for different nozzle configurations

Detailed Description

An example of a nozzle as described herein for an apparatus for depositing a liquid, semi-liquid or semi-solid food product has the effect of reducing cauliflowering when depositing the liquid, semi-liquid or semi-solid food product. The problem of cauliflowering is not specific to a particular type of apparatus for depositing aerated chocolate, but is experienced with different machines for depositing other food products, whether aerated or not. An example apparatus for depositing a liquid, semi-liquid or semi-solid food product is described herein.

An example depositing apparatus is described in WO 2010/102716 and with reference to Figures 1 and 2 herein. The example apparatus comprises a fixed volume chamber for receiving the food product under a positive pressure, the chamber being defined by chamber walls, one of the chamber walls being provided with an outlet orifice for depositing the food product, the outlet orifice being provided with a first sealing surface. The apparatus also comprises a valve spindle arranged for reciprocating movement within the chamber, the length direction of the valve spindle extending substantially perpendicular to the chamber wall in which the outlet orifice is provided, a first end of the valve spindle being provided with a second sealing surface. The second sealing surface of the valve spindle is arranged for abutting the first sealing surface of the outlet orifice to thereby close the outlet orifice.

The example apparatus 1 for depositing a liquid, semi-liquid or semi-solid food product 3 comprises a fixed volume chamber 5 for receiving the food product 3 under a positive pressure in the range of 4 to 12 bars, for example 4 to 6 bars. The chamber 5 is provided with an inlet 7 and an outlet 9 for supplying the food product 3 to the chamber 5 from a pump (not shown). Suitable pumps and supply lines will be apparent to those skilled in the art. The pump is configured to supply the food product 3 to the chamber at a rate of, for example, approximately 125% of the intended depositing rate.

Side walls 11 of the chamber 5 are provided as a unitary body formed of, for example, a stainless steel casting. Bottom and top walls of the chamber, which are substantially flat, are formed of, for example, stainless steel plates 13, 15 bolted and sealed to the side walls 11.

The bottom wall 13 of the chamber 5 is provided with a plurality of apertures 17 having a two dimensional arrangement for producing a desired depositing pattern (see Figure 2). As shown, the two dimensional arrangement of apertures 17 is a regular row and column array of 64 apertures. Other arrangements are, however, possible. A nozzle 19 is fitted into each of the apertures 17 and defines an outlet orifice through which the food product 3 is deposited. An inside surface of the nozzle 19 is provided with a conical surface, which surface serves as a first sealing surface.

The apparatus also comprises a plurality of valve spindles 21 associated with respective outlet orifices and a plurality of linear pneumatic actuators 23 associated with respective valve spindles 21.

Each valve spindle 21 is in the form of an elongate circular rod, or needle. A first (lower) end of the spindle 21 is provided with a conical surface which serves as a second sealing surface and is adapted for making sealing contact with the first sealing surface of a respective nozzle 19, as described above. The valve spindle 21 has a length slightly less than the internal height of the chamber 5 (measured across the inner surfaces of the bottom and top plates 13, 15 of the chamber 5). A second (upper) end of the valve spindle 21 is attached to a respective actuator 23, which is itself attached to the top plate 15 of the chamber 5. The actuator 23 is attached to the top plate 15 of the chamber 5 such that it can be accessed for repair or replacement without significant disassembly of the apparatus 1.

The actuators 23 and valve spindles 21 are arranged with their axes perpendicular to the bottom and top plates 13, 15 such that the actuators 23 can be operated to longitudinally displace the valve spindles 21 relative to the chamber walls with reciprocating movement. The valve spindles 21 are arranged such that, with the valve spindles 21 in their upper position, the outlet orifices are open so the food product 3 is deposited. With the valve spindles 21 in their lower position, the sealing surfaces of the nozzle components 19 and the valve spindles 21 are in sealing contact to thereby close the outlet orifices and prevent the flow of the food product 3.

The actuators 23 can be operated independently so that the flow of food product 3 can be varied between different outlet orifices, with a selectable number of the outlet orifices being open at any one time.

The actuators 23 are each connected to a pneumatic circuit (not shown) for providing linear movement and a controller (not shown) for controlling the pneumatic circuits. Suitable pneumatic circuits will be known to those skilled in the art. Suitable controllers include programmable logic controllers (PLCs) and suitably programmed computers.

5

In use of the apparatus 1, the controller is arranged to control the actuators 23 to independently open and close the respective outlet orifices for starting and stopping the deposition of the food product 3. The flow rate of the food product 3 through the outlet orifices can be controlled by opening and closing the outlet orifices in a cycle having a frequency of at least 2 Hz, and by varying the proportion of the cycle time in which the outlet orifice is open (i.e. varying the mark-space ratio).

10

The flow rate of the food product 3 through the outlet orifices also depends, at least in part, on the pressure of the food product 3 in the chamber 5. The controller is therefore provided with the output from a pressure sensor (not shown), which measures the pressure in the chamber 5. The controller controls the actuators 23 based on the sensed pressure.

15

Rather than pneumatic actuators, the actuators may alternatively be other types of actuator, such as moving coil electrical actuators. Moving coil electrical actuators may be capable of accurate positional control so that the flow rate of the food product through the outlet orifices can be varied by adjusting the linear position of the valve spindles.

20

The apparatus may be provided with a spreader plate attached to the bottom plate. The spreader plate connects the outlet orifices to a larger plurality of spreader plate outlets. The spreader plate outlets may be provided with a pressure operated valve, the pressure operated valve being arranged to close when a pressure drops below a predetermined pressure greater than atmospheric pressure.

25

The apparatus may be arranged in an intermittent motion (indexed) food product moulding line. When the line is stationary, the apparatus may be moved over a mould cavity at high speed to fill the mould cavity with the food product.

30

Figures 3A and 3B provide an enlarged view of a conventional nozzle 19 as illustrates in Figure 1, showing the interaction between an internal conical surface of the nozzle 28 which forms a first sealing surface and a conical surface 30 provided at the end of the valve spindle 21, which forms a second sealing surface.

35

The nozzle 19 has a generally cylindrical configuration. In the example shown in Figures 3A and 3B, an external screw thread on the nozzle 19 is screwed into an internal screw thread in an aperture 17 in the bottom plate 13 of the apparatus 1. A valve-receiving bore 32 in the nozzle is open to the chamber 5 within the apparatus 1. The valve-receiving bore 32 is connected to an outlet bore 34 of a smaller diameter via the internal conical surface 28. The outlet bore 34, which has a constant cross-section and diameter, ends at the outlet 36 from the nozzle.

As illustrated in Figures 3A and 3B, the valve spindle reciprocates between a first position as shown in Figure 3A and a second position shown in Figure 3B.

In the first position shown in Figure 3A, the conical surface 30 of the valve spindle is spaced from the internal conical surface 28 of the nozzle so that the chamber 5 is connected via the valve-receiving bore 32 and the outlet bore 34 to the outlet 36 of the nozzle, whereby the food product in the chamber 5 can flow under pressure past the conical surfaces 28 and 30 to be deposited from the outlet 28 of the nozzle 19

In the second position shown in Figure 3B, the conical surface 30 of the valve spindle is in contact with the internal conical surface 28 of the nozzle to block the connection between the valve-receiving bore 32 and the outlet bore 34, whereby the food product in the chamber 5 cannot flow past the conical surfaces 28 and 30 to be deposited from the outlet 28 of the nozzle 19.

The dimensions of the nozzle 19 can vary depending upon various parameters including the composition of the food product and/or the gas used for aeration, the pressure under which the product is kept in the chamber 5 and the desired rate of deposition.

As discussed in the background, in use, cauliflowering of the food product can be encountered during depositing of the food product. As the food product leaves the outlet 36 of the outlet bore 34, some of the food product solidifies and builds up on the exterior surface of the nozzle around the outlet 36. The manner in which the food product builds up can resemble the florets of a cauliflower, hence the term cauliflowering. The collection or build up of food material on the exterior surface of the nozzle 19 around the outlet 36 can potentially result in the collected material falling into the food product, which is undesirable.

An embodiment of a nozzle as claimed herein seeks to eliminate or at least mitigate the cauliflowering effect.

Figures 4A-4D illustrates an example of a nozzle 200 as claimed herein that is suitable for use with an apparatus as described with reference to Figures 1 and 2. Figure 4A is a perspective view of an embodiment of a nozzle 200 as claimed herein, Figure 4B is a bottom view of the nozzle of Figure 4A, Figure 4C is a side view of the nozzle of Figure 4A and Figure 4D is a cross-sectional view of the nozzle of Figure 4A, the section taken at line A-A in Figure 4C.

The nozzle 200 of Figures 4A to 4D could be used with the apparatus of Figures 1 and 2 and replace a nozzle 19 as illustrated in Figures 3A and 3B. In this regard, it is to be noted that the length of the valve spindle 21 of Figure 1 can be adjusted to suit the nozzle that is used, whereby the nozzle as shown in Figures 4A-4D does not have to have the same length as the nozzle 19 as shown in Figures 3A and 3B.

Although embodiments of a nozzle are described herein that could be used with the apparatus 1 of Figures 1 and 2, other embodiments of a nozzle as claimed herein could be used with other apparatus. Accordingly, an embodiment of a nozzle as claimed herein could have other forms and other dimensions in other embodiments, whereby the form and the dimensions of the nozzle of Figures 4A to 4D are by way of example only, and the claimed subject matter is not limited to the specific forms and dimensions described with reference to Figures 4A to 4D.

The nozzle 200 has a generally cylindrical configuration with a central channel or passage (referred to hereafter as a bore) 230. It is manufactured as an integral unit using a food grade material, for example stainless steel. Although in a particular example described herein the nozzle 200 is manufactured from stainless steel, for example by machining a block of stainless steel, in alternative embodiments it could be manufactured from another food-grade material, for example from a food-grade metal or plastics material using any suitable manufacturing process, such as machining or moulding. Although the term bore is used herein to describe the channel or passage 230, it is to be understood that the channel or passage 230 need not be manufactured by "boring" that channel or passage 230.

As used herein, the expression "food-grade" when referring to a material herein denotes that the material is permitted to be in contact with foodstuffs suitable for human

consumption as defined under the relevant local legislation (also referred to herein as “suitable for food contact”). At the date of filing the present application in the European Union the relevant rules for materials that are suitable for food contact include the EU Regulation 1935/2004, entitled “Framework Regulation on materials and articles intended to come into contact with food” and EU regulation 2023/2006, entitled “Good Manufacturing Practice for materials and articles intended to come in contact with food”. Also relevant are EU Regulations: 10/2011 on food contact with plastic materials (as amended by 2015/174, 202/2014, 1183/2012, 1183/2012, 1282/2011, 321/2011, 284/2011); 450/2009 on food contact with active and intelligent materials; 282/2008 on food contact with recycled plastic materials; 42/2007/42 on food contact with regenerated cellulose film; 1895/2005 on restrictions of food contact with certain epoxy materials; and EU Directives 500/1984 on national law of food contact with ceramic articles; and 11/1993 on release of N-nitrosamines and N-nitrosatable substances. Thus as used herein “food-grade material” denotes that said material is compliant with the aforementioned EU Regulations and Directives on suitability for food contact and preferably such food-grade materials will also those materials that will continue to be compliant with any updated rules and lists of materials issued under these and/or related EU Regulations or Directives.

The nozzle comprises a proximal end 202 and a distal end 204. The proximal end has an inlet 206 for receiving the liquid, semi-liquid or semi-solid food product. The distal end 204 has an outlet 208 for depositing the liquid, semi-liquid or semi-solid food product. The bore 230 extends from the inlet 206 to the outlet 208.

The exterior of the nozzle comprises various portions extending from the proximal end 202 to the distal end 204.

A proximal portion 210 at the proximal end of the nozzle 200 has a generally cylindrical external surface with an external diameter to be received within a nozzle-receiving aperture 17 of the apparatus 1. The cylindrical external surface of the proximal portion 210 of the nozzle can typically have an external diameter in the range of, for example, 10 mm – 25 mm and a length of in the direction of an axis 232 of the bore 230 from the proximal end 202 to the distal end 204 of the nozzle 200 (hereinafter referred to as the axial direction 233) of in the range of, for example, 10 mm – 35 mm. The actual dimensions in any particular example will depend upon the apertures in the apparatus into which the nozzle is to be inserted and the method of attachment. In the present example, the cylindrical external surface of the proximal portion 210 is formed with an external screw thread 214 to engage with an internal screw thread in a nozzle-receiving aperture

17 of the apparatus 1. However, in other examples, various attachment mechanisms, for example interlocking mechanisms, clips etc. can be provided for attaching the nozzle to a depositing apparatus as will be understood by the person skilled in the art.

5 The example nozzle illustrated in Figures 4A to 4B is provided with distal portion 212 that includes a boss 218 with a hexagonal form to facilitate screwing of the nozzle into a receiving aperture 17 of the apparatus 1. The distal portion 212 of the nozzle 200 illustrated in Figures 4A to 4D is provided with a flange 216 that presents a shoulder 215 that can abut against a lower surface 13 of the apparatus 1 when the nozzle is received
10 with the nozzle-receiving aperture 17 of the apparatus 1. In the example shown the boss could have a diameter in the range of, for example, 10 mm – 25 mm and a length in the axial direction 233 in the range of, for example 8 mm – 20 mm. The flange facilitates accurate location of the nozzle within the nozzle-receiving aperture 17. Although in the example shown, a flange is provided, in another example embodiment, the flange 216
15 could be omitted and instead, the boss 218 could present the shoulder by being configured to have an external diameter larger than that of the cylindrical external surface of the proximal portion 210 of the nozzle 200. Also, although in Figures 4A to 4D the boss 218 is shown as having a hexagonal form, for other example embodiments the boss could have other forms (for example a cylindrical form). The form of the boss 218 can be
20 chosen, for example, based in part on the nature of the attachment mechanism for attaching the nozzle to the apparatus 1.

The distal end of the boss 218 is formed with a conical external distal portion 220 that extends from the hexagonal portion of the boss 218 and converges towards the outlet 208
25 from the nozzle. The example nozzle 200 illustrated in Figures 4A to 4D has a conical (frusto-conical) external distal portion 220 that converges towards the outlet 208 and terminates at a flat distal surface 209 that surrounds the outlet 208 of the nozzle. However, in other examples, the distal flat surface 209 may not be present and the frusto-conical external distal surface 220 may end at the outlet 208. The conical external distal
30 portion 220 can have a length of up to, for example, 20 mm in the axial direction 233 according to a particular embodiment.

The bore 230 that forms the interior of the nozzle 200 comprises various portions extending from the inlet 206 at the proximal end 202 of the nozzle 200 to the outlet 208 at
35 the distal end 204 of the nozzle 200. A first conical portion 222 reduces the diameter of the bore from the inlet 206 to a valve-receiving portion 224 of the bore 230. The conical surface of the first conical portion can have a length in the axial direction 233 in the range

of, for example, 1 mm -10 mm. The cylindrical valve-receiving portion 224 of the bore can have a diameter in the range of, for example, 5 mm – 20 mm, or, for example, 10 mm – 15 mm and a length in axial direction 233 in the range of, for example, 8 mm – 35 mm. A conical valve seat portion 226 extends from the valve-receiving portion 224 to an outlet bore portion 226. The conical valve seat portion 226 forms a sealing portion against which a corresponding conical sealing portion of a valve (for example a conical surface 30 of a valve spindle 21 as illustrated in Figure 3A and 3B) can engage to close the outlet bore portion 228. The surface of the conical valve seat portion 226 extends at a constant angle in the range of, for example, 45° – 70° (the angle chosen to match and angle of a corresponding conical surface 30 of a valve spindle 21) from the valve-receiving portion 224 which has a diameter in the range of, for example 5 mm – 20 mm or , for example, 10 mm – 15 mm to the outlet bore portion 228 having a diameter of a diameter in the range of, for example, 1 mm – 4 mm, or, for example, 1.5 mm to 3 mm.

In an embodiment of the nozzle as claimed herein, the outlet bore portion 228 does not extend all of the way from the conical valve seat portion 226 to the outlet 208 of the bore 230. In an embodiment a flared outlet portion 240 is formed between a distal end of the outlet bore portion 228 and the outlet 208 of the bore 230.

In the example embodiment shown, the outlet bore portion 228 has a constant diameter in the range of, for example, 1 mm – 4 mm or, for example, 1.5 mm – 3 mm and a length in axial direction 233 in the range of, for example, 4 mm – 25 mm. In the example shown, the flared outlet portion 240 of the bore has a length in axial direction 233 in the range of, for example, 1.5 mm – 3 mm and the surface of the flared outlet portion 240 flares at a constant angle in the range of, for example, 15° – 45°, for example 20° – 40° to the axis 232 of the bore 230 to provide an outlet 208 having a diameter in the range of, for example, 3 mm – 8 mm. An example nozzle 200 can be provided with an outlet that is at least twice the diameter, for example of the order of 2 to 3 times the diameter of the outlet bore portion 228. The outlet 208 is formed with a clean and sharp edge where it meets with the flat distal surface 209 or the surface of the external conical distal portion 220, depending on whether or not a flat distal surface is present as discussed above.

As described with reference to Figures 3A and 3B, in an apparatus 1 with a nozzle as described with reference to Figures 4A to 4D, a valve spindle can be arranged to reciprocate between a first position and a second position. In the first position, a conical surface 30 of the valve spindle can be spaced from the conical valve seat portion 226 of the nozzle 200 so that the chamber of the apparatus is connected via the cylindrical valve-

receiving portion 224 and the outlet bore portion 228 to the outlet 208 of the nozzle, whereby the food product in the chamber can flow under pressure past the conical surfaces 30 and 226 to be deposited from the outlet 208 of the nozzle 200. In the second position, the conical surface 30 of the valve spindle is in contact with the conical valve seat portion 226 of the nozzle 200 to block the connection between the cylindrical valve-receiving portion 224 and the outlet bore portion 228, whereby the food product in the chamber of the apparatus cannot flow past the conical surfaces 30 and 226 to be deposited from the outlet 208 of the nozzle 200.

Although in the example shown in Figures 4A to 4D, the surface of the flared outlet portion 240 flares at a constant angle to the axis 232 of the bore 230, in other examples the flared outlet portion 240 may have different configurations. For example, in other embodiments, the flared outlet portion 240 could for example have a parabolic shape or a shape that approximates a parabolic shape.

Figure 5A is an enlarged reproduction of Figure 4D where the flared outlet portion 240 of the nozzle 200 flares at a constant angle to the axis 232 of the bore 230 alongside Figure 5B which shows an alternative configuration where a flared outlet portion 240' of a nozzle 200' flares in accordance with a series of different angles. In the example shown in Figure 5B, the flared outlet portion 240' of a nozzle 200' flares in accordance with a series of different angles to approximate a parabolic shape. The resultant shape comprises a series of part conical surfaces where the angle, relative to the axis 232, of successive part conical surfaces in the axial direction 233 gradually approaches the axial direction 233 of the axis 232. The use of a series of different angles to approximate a parabolic shape facilitates machining of a block of material to manufacture a flared outlet portion 240' approximating a parabolic shape. Like elements in Figure 5B to those in Figure 5A are given the same reference signs. It will be noted that in the example shown in Figure 5B, a flat distal portion 209 of the nozzle is not present and the conical external distal portion 220 extends to the edge of the outlet 208.

The effect of the flared outlet portion 240/240' in combination with the outlet bore portion 228 of the nozzles 200, 200' is to eliminate or at least reduce or mitigate the cauliflowering effect which can be experienced with a nozzle such as described with reference to Figures 3A and 3B. The flared outlet portion 240 allows the expansion of the food material to be controlled as the food product leaves the outlet bore portion 228. For example, this allows controlled expansion of gas within an aerated food product such as

an aerated chocolate-based product where gas is under pressure in the chocolate material.

This technical effect can be illustrated, at least in part, by reference to Figures 6A and 6B, which are computer-generated plots showing velocity profiles 300 of a semi-liquid food product (for example semi-liquid chocolate) exiting example nozzles. Figure 6A is based on a conventional nozzle with a straight bore, such as that provided in the nozzle 19 of Figures 3A and 3B. Figure 6B is based on an example of a nozzle 200 as claimed herein with a flared outlet, such as is shown in Figures 4A to 4D. Similar results to that shown in Figure 6B are also experienced with, for example, an example nozzle 200' as shown in Figure 5B.

In order that the velocities profiles can be directly compared, plots were generated with the geometry based on like-for-like dimensions (length and width of features, angles, etc.) so that the velocity profiles in Figure 6A and Figure 6B are directly comparable. It will be noted that the flared outlet provides an improved velocity profile, which not only reduces the tendency for the food product to collect around the outlet of the nozzle (thereby reducing a tendency for cauliflowering to occur), but also enables a more accurately directed stream of the food product. This can have the technical effect of not only reducing the effect of cauliflowering, but also the further technical effect of enabling more accurate, and potentially more rapid, filling of moulds. As a result, a higher quality product can be manufactured more efficiently.

In the case of a chocolate-based product, as the product cools, the product solidifies. The expansion of gas within an aerated chocolate food product can cause localized cooling of the product, which may encourage cauliflowering. Also, turbulence and/or cavitation effects where a food product leaves an outlet orifice may lead to the food product being deposited around the orifice, resulting in the cauliflowering effect. However, by providing the outlet bore portion 228 in combination with the flared outlet portion 240, 240' of the bore 230 of an example nozzle, the exit of the food product from the nozzle is better controlled, thereby eliminating or at least mitigating or reducing the cauliflowering effect. For example, any deposition of food material within the flared outlet portion 240, 240' at the end of a deposition pulse is then ejected by the very next deposition pulse, avoiding a build of food material.

In addition, as can be seen by comparing Figure 6A and Figure 6B, the use of the outlet bore portion 228 in combination with the flared outlet portion 240, 240' of the bore 230

further improves the accuracy and flow of the food product as it leaves the nozzle. The constant diameter portion of the outlet bore portion 228 enables a controlled directional stream of the food product to be provided, and the flared outlet portion 240, 240' of the bore increases the accuracy and deposition rate of the food product, and further mitigates a tendency to cauliflowering of the food product.

Accordingly, there has been described a nozzle for an apparatus for depositing a liquid, semi-liquid or semi-solid food product, for example a chocolate-based product. The nozzle comprises a proximal end and a distal end, the distal end having an outlet for depositing the liquid, semi-liquid or semi-solid food product. An external surface of the nozzle includes a distal portion that converges towards the outlet at the distal end. A bore extends from the inlet to the nozzle at the proximal end of the nozzle to the outlet from the nozzle at the distal end of the nozzle. The bore has a first portion (for example the outlet bore portion 228) having a first cross-sectional area, and a second portion (for example the flared outlet portion 240) distal with respect to the first portion, wherein the second portion of the bore flares from the first portion of the bore to meet the external surface at the outlet, whereby the outlet has a second cross-sectional area larger than the cross-sectional area of the first portion.

Although particular embodiments are described herein, it will be appreciated that the claimed subject matter is not limited to the specific embodiments described, and that alternative configurations are possible within the scope of the appended claims.

For example, in the described examples, the various portions of the bore 230 are circular in cross-section perpendicular to the axis 232 to facilitate manufacture. It is to be noted that the various portions of the bore may not be exactly circular and may deviate therefrom due, for example, to manufacturing tolerances. Indeed, it is to be noted that the various portions of the bore 230 could have a different shape in cross-section perpendicular to the axis 232. For example, one or more portions of the bore 230 could be elliptical or oval in cross-section. In this regard, although in the described examples, the flared outlet portion 240 of the bore has a surface that defines part of a right conical surface that has a circular cross-section perpendicular to the axis 232, in other examples the flared outlet portion 240 may have a different shape in cross-section perpendicular to the axis 232. For example, in an alternative example, the flared outlet portion 240 may define part of the surface of, for example, an elliptic or oval cone terminating in an outlet 208 that has an elliptical or oval shape perpendicular to the axis 232 and/or an oblique cone that tends to an apex that is not aligned above the center of the outlet 208.

According to particular embodiments therefore, where reference is made to a conical surface or a part thereof, or a frusto-conical surface, this may be a right conical surface or part thereof or it may be another type of conical surfaces or a part thereof.

Claims

1. A nozzle for an apparatus for depositing a liquid, semi-liquid or semi-solid food product, wherein the nozzle comprises:

a proximal end and a distal end, the distal end having an outlet for depositing the liquid, semi-liquid or semi-solid food product;

an external surface including a distal portion that converges towards the outlet at the distal end; and

a bore extending from an inlet to the nozzle at the proximal end of the nozzle to the outlet from the nozzle at the distal end of the nozzle, the bore having a first portion having a first cross-sectional area and a second portion distal with respect to the first portion, wherein the second portion of the bore flares from the first portion of the bore to meet the external surface at the outlet, whereby the outlet has a second cross-sectional area larger than the cross-sectional area of the first portion.

2. The nozzle of Claim 1, wherein the flared surface of the second portion flares at a constant angle with respect to an axis of the bore to define part of an internal conical surface that extends to the outlet from the nozzle.

3. The nozzle of Claim 1 or Claim 2, wherein a flared surface of the second portion flares at an acute angle with respect to an axis of the bore.

4. The nozzle of Claim 1, wherein the flared surface of the second portion flares in accordance with a series of different angles.

5. The nozzle of Claim 1, wherein the flared surface of the second portion flares in accordance with a series of different angles to approximate a parabolic shape, for example where the flared surface of the second portion comprises a series of part conical flared surfaces where the angle relative to an axial direction of successive part conical flared surfaces in the axial direction gradually approaches the axial direction.

6. The nozzle of any one of the preceding claims, wherein a flared surface of the second portion flares at an angle of greater than 15° degrees and less than 45° with respect to the axis of the bore, for example at an angle greater than 20° degrees and less than 40° with respect to the axis of the bore.

7. The nozzle of any one of the preceding claims, wherein the first portion of the bore has a substantially constant cross-sectional area that extends over a length of the bore greater than a length of the bore over which the second portion of the bore extends.

5 8. The nozzle of any one of the preceding claims, wherein a diameter of the outlet is at least twice a diameter of the first portion of the bore.

9. The nozzle of any one of the preceding claims, wherein at least one of:
a diameter of the first portion of the bore is between 1 mm and 4 mm, for example
10 between 1.5 mm and 3 mm.

10. The nozzle of any one of the preceding claims, wherein a distal portion of the external surface of the nozzle is frusto-conical converging towards the outlet.

15 11. The nozzle of Claim 10, wherein the distal portion of the external surface of the nozzle is frusto-conical converging towards the outlet and terminating at a flat distal surface that surrounds the outlet.

12. The nozzle of any one of the preceding claims wherein a proximal portion of the
20 external surface of the nozzle is configured for attachment to the apparatus.

13. The nozzle of any one of the preceding claims wherein the bore further comprises a further portion between the proximal end of the nozzle and the first portion of the bore, the further portion having a third cross-sectional area larger than the first and second
25 cross-sectional areas, wherein the inner surface of the bore has a portion that flares from the further portion of the bore to the inlet to the nozzle to define a conical surface for the inlet to the nozzle the inner surface of the bore has a portion that flares from the first portion of the bore to the further portion of the bore to define an internal conical surface defining a first sealing surface in the form of a valve seat.

30

14. An apparatus for depositing a liquid, semi-liquid or semi-solid food product, the apparatus comprising:

a fixed volume chamber for receiving the food product under a positive pressure, the chamber being defined by chamber walls, one of the chamber walls being provided
35 with an outlet orifice for depositing the food product defined by the nozzle of Claim 13 installed in the chamber wall; and

a valve spindle arranged for reciprocating movement within the chamber, a first end of the valve spindle being provided with a second sealing surface;

wherein the second sealing surface of the valve spindle is arranged for abutting the first sealing surface of the nozzle to thereby close the outlet orifice.

5

15. A method of depositing a liquid, semi-liquid or semi-solid food product, the method comprising operating the apparatus of Claim 14, including:

providing the food product to the fixed volume chamber under a positive pressure, the chamber being defined by the chamber walls; and

10

reciprocating the valve spindle such that the second sealing surface of the valve spindle intermittently abuts first sealing surface of the nozzle to thereby open and close the outlet orifice.

1/5

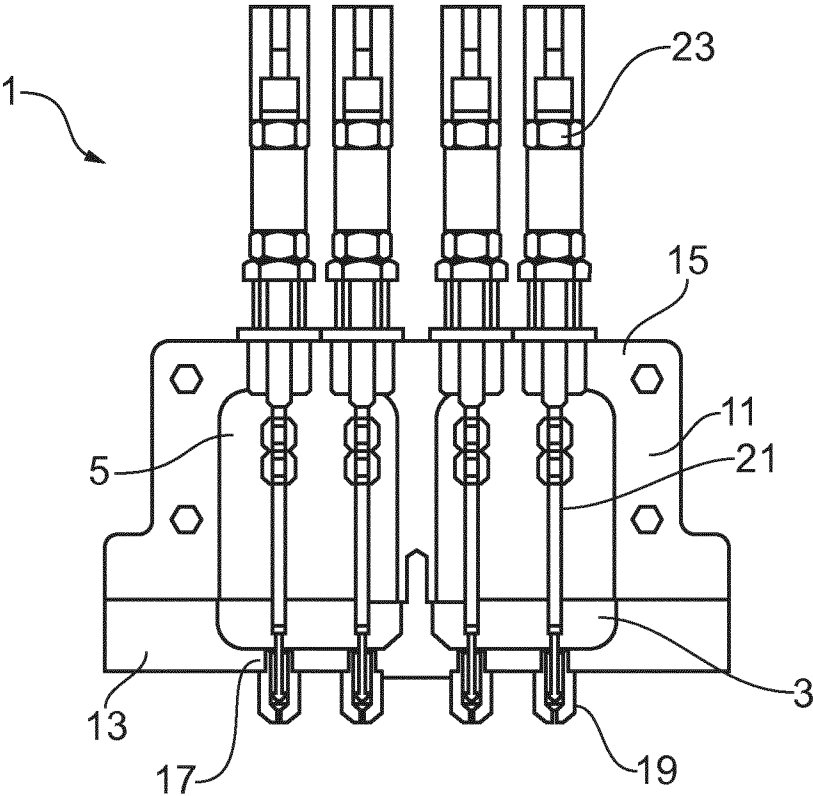


FIG. 1

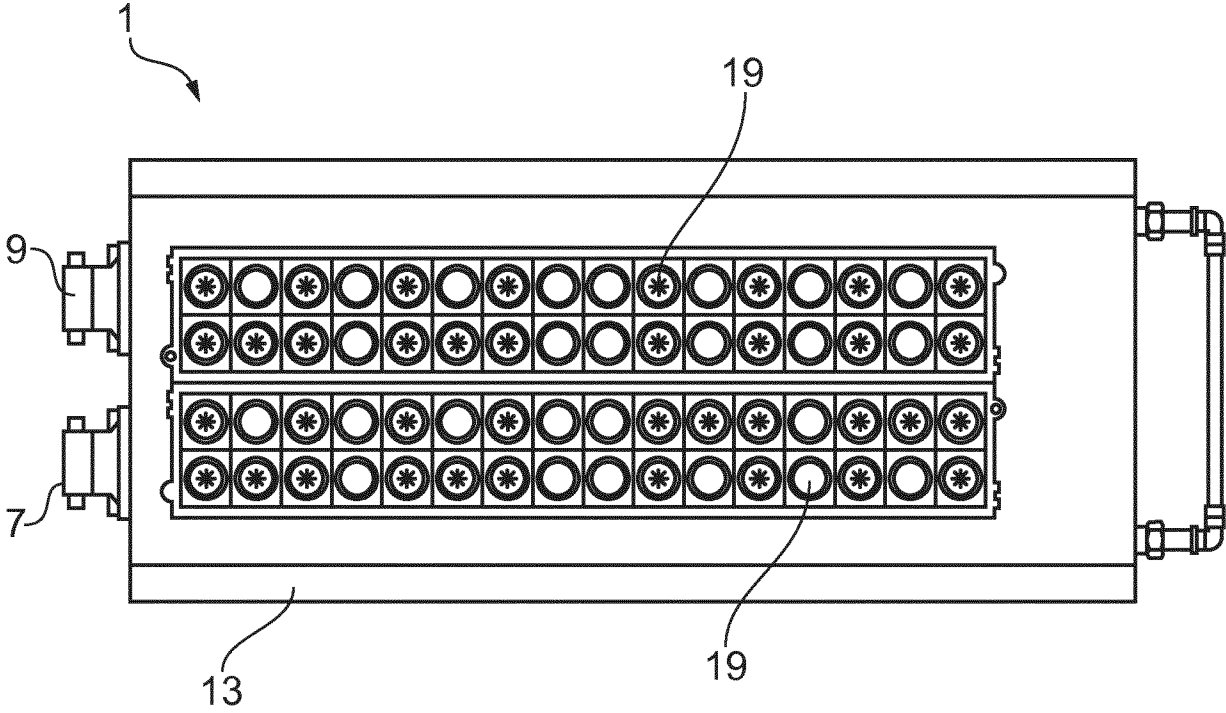


FIG. 2

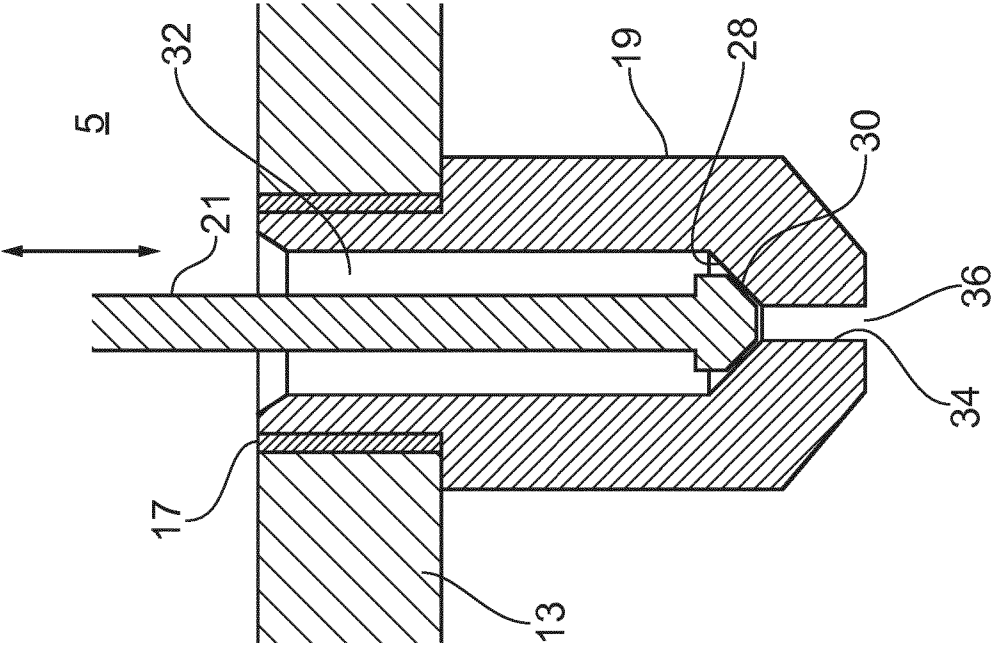


FIG. 3B

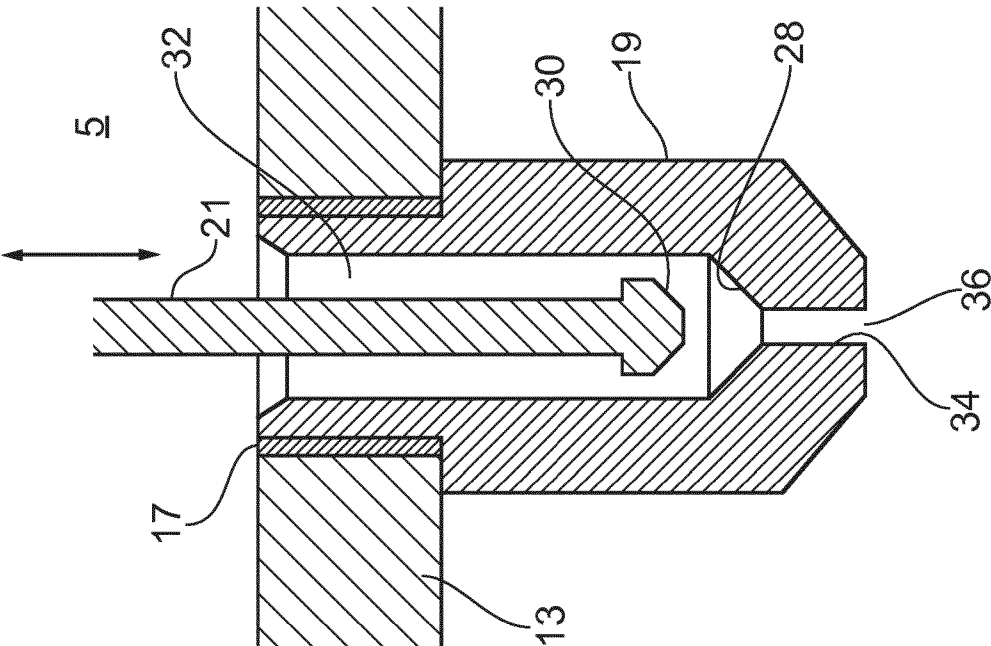


FIG. 3A

3/5

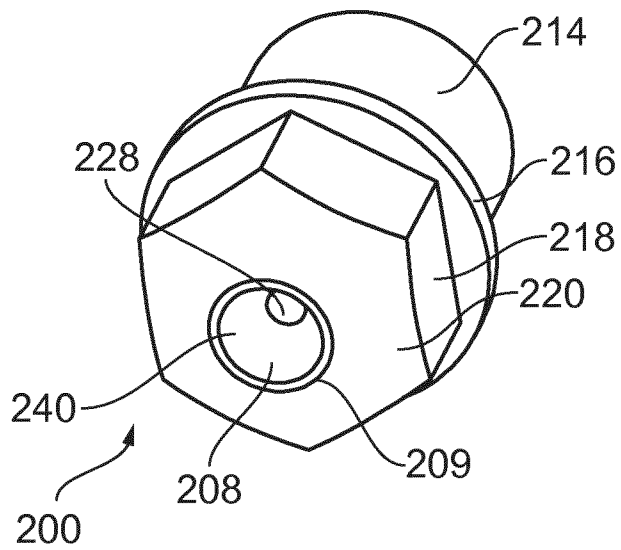


FIG. 4A

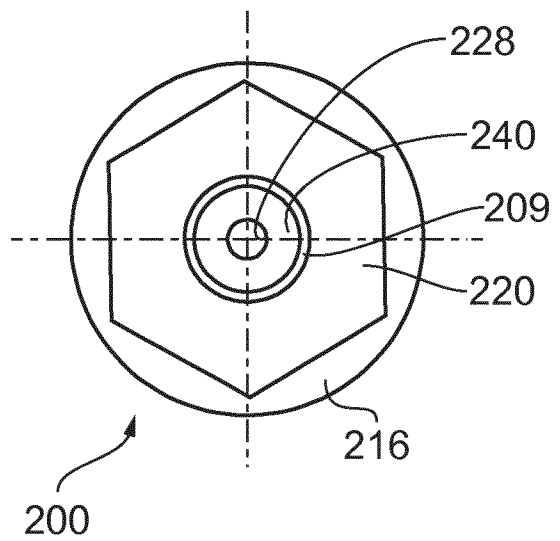


FIG. 4B

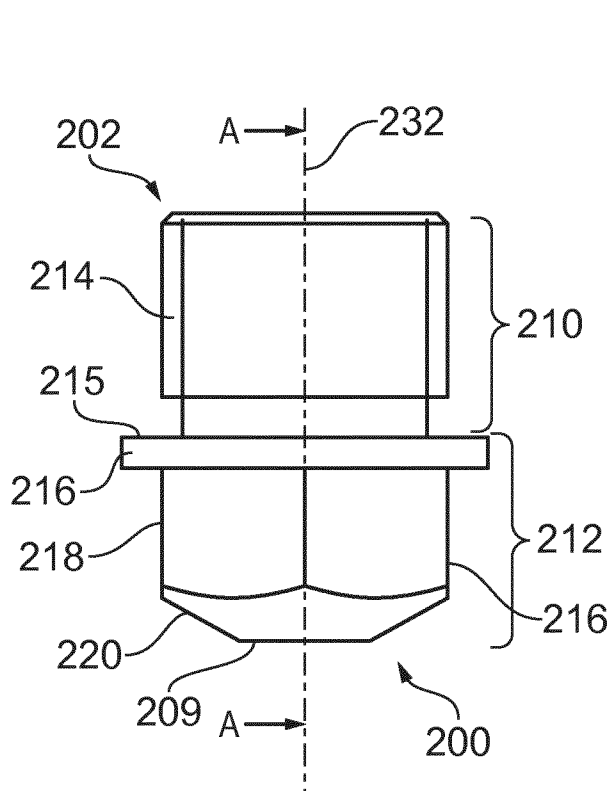


FIG. 4C

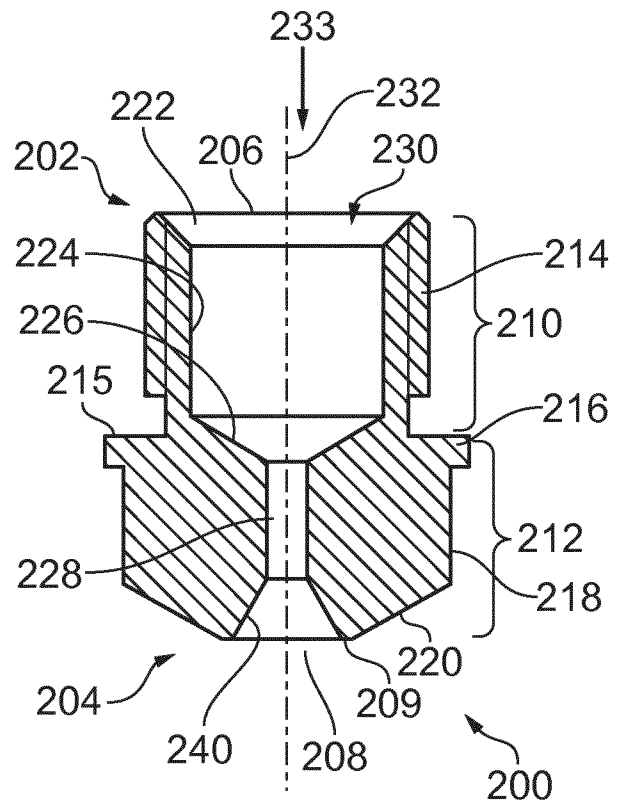


FIG. 4D

4/5

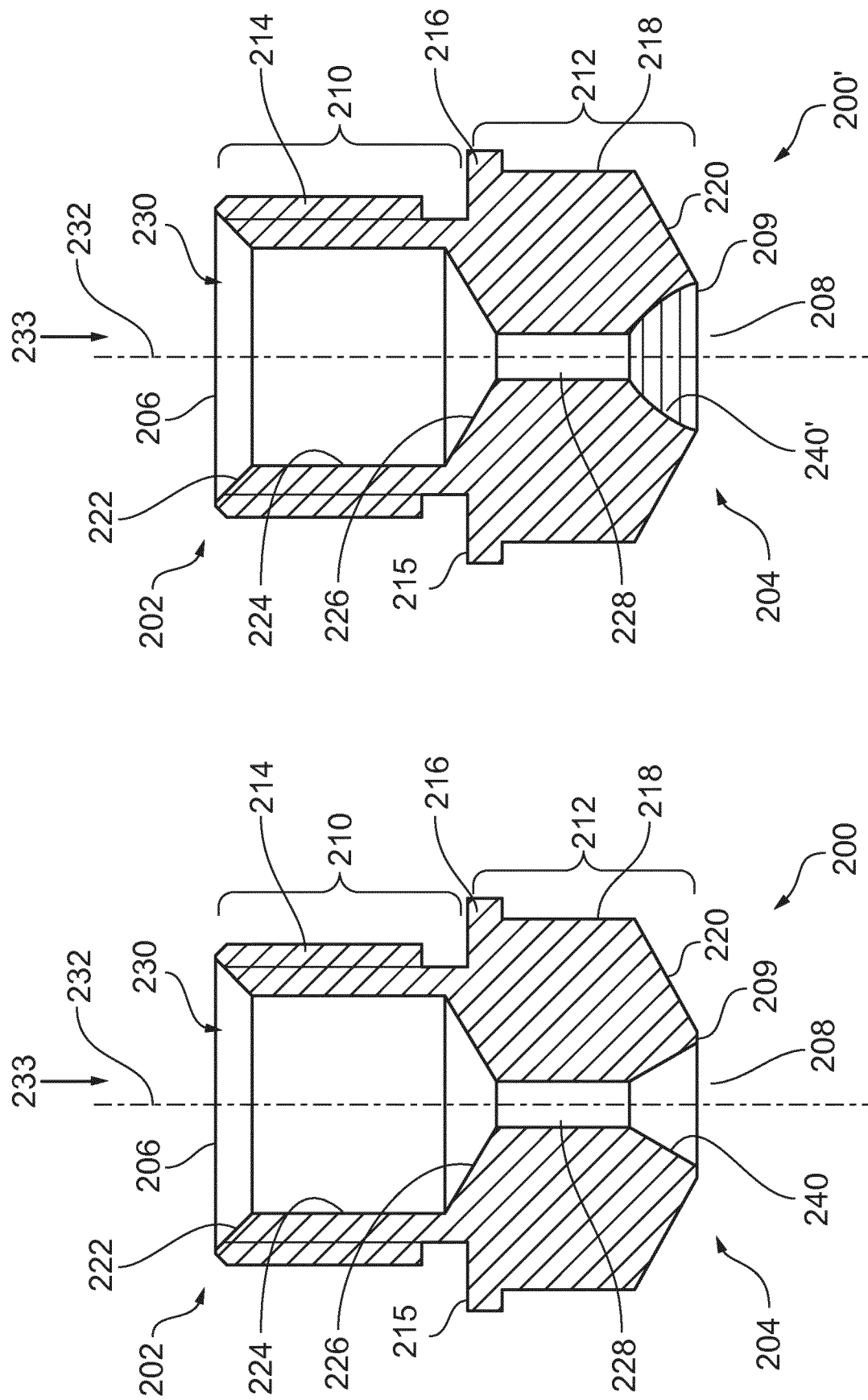


FIG. 5B

FIG. 5A

5/5

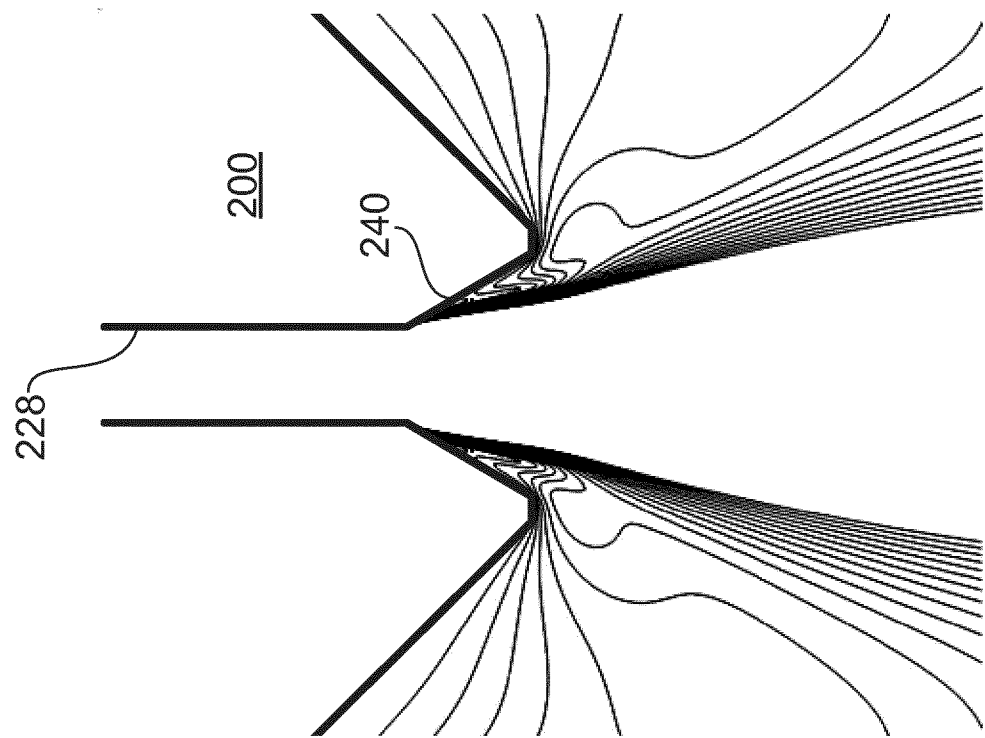


FIG. 6B

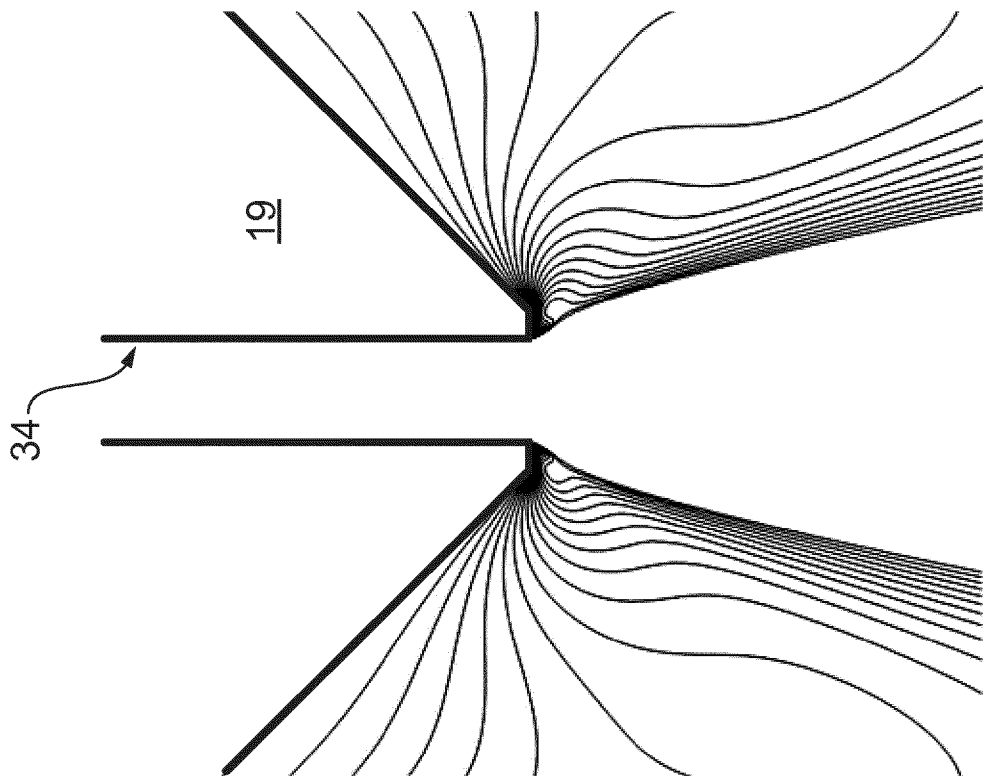


FIG. 6A

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/063386

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23G1/20 A23G3/02 A23G1/04
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)
A23G

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 2 016 837 A2 (KRAFT FOODS R & D INC [US]) 21 January 2009 (2009-01-21) cited in the application abstract; claim 1; figures 1,3 paragraph [0009] - paragraph [0017] paragraph [0032] - paragraph [0033] -----	1-15
A	WO 02/13618 A2 (GERVAIS DANONE SA [FR]; AYMARD PIERRE [FR]; BELOUIN FRANCOIS [FR]; GOE) 21 February 2002 (2002-02-21) page 14, line 13 - page 15, line 3; figures 2a-2c -----	1-15
A	EP 0 034 884 A2 (MONO OAKES LTD [GB]) 2 September 1981 (1981-09-02) abstract; figures 1,3,4,6 page 8, line 4 - line 19 ----- -/-	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

3 August 2016

Date of mailing of the international search report

12/08/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Gaiser, Markus

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/063386

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2 127 850 A (TAYLOR WILLIAM J) 23 August 1938 (1938-08-23) page 1, left-hand column, line 6 - line 19; figures 2,6,8 page 1, left-hand column, line 44 - right-hand column, line 43 page 2, left-hand column, line 23 - right-hand column, paragraph 16 -----	1,14,15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/063386

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2016837	A2	21-01-2009	AT 546051 T 15-03-2012
		BR PI0803416 A2 15-09-2009	
		CA 2638084 A1 20-01-2009	
		EP 2016837 A2 21-01-2009	
		UA 100363 C2 25-12-2012	
		US 2009020566 A1 22-01-2009	
WO 0213618	A2	21-02-2002	AR 036981 A1 20-10-2004
		AT 323414 T 15-05-2006	
		AU 7991501 A 25-02-2002	
		CN 1446051 A 01-10-2003	
		CZ 20030383 A3 13-08-2003	
		DE 60118932 T2 12-04-2007	
		EP 1307105 A2 07-05-2003	
		ES 2261451 T3 16-11-2006	
		FR 2812793 A1 15-02-2002	
		WO 0213618 A2 21-02-2002	
EP 0034884	A2	02-09-1981	AR 224676 A1 30-12-1981
		AU 538350 B2 09-08-1984	
		AU 6756981 A 03-09-1981	
		BR 8101019 A 25-08-1981	
		DD 156566 A5 08-09-1982	
		DE 3169779 D1 15-05-1985	
		DK 81381 A 26-08-1981	
		EP 0034884 A2 02-09-1981	
		ES 8207309 A1 01-12-1982	
		FI 810556 A 26-08-1981	
		GB 2070197 A 03-09-1981	
		GB 2070202 A 03-09-1981	
		IE 50684 B1 11-06-1986	
		JP S56138581 A 29-10-1981	
		NO 810628 A 26-08-1981	
		NZ 196173 A 14-12-1984	
		US 4384678 A 24-05-1983	
		ZA 8100786 B 31-03-1982	
US 2127850	A	23-08-1938	NONE