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(54) Title: APPARATUS AND METHOD FOR THE MANUFACTURE OF PRODUCTS

(57) Abstract: An apparatus for the manufacture of products, comprising a mold with at least one mold cavity which has at least one movable wall part, wherein drive means are provided for driving the at least one movable wall part, which mold cavity comprises at least one injection point and defines at least one flow path between said injection point and a part of said mold cavity forming a longitudinal edge, at a distance from said injection point, while said at least one first movable wall part extends around or opposite said injection point, along at least a part of said flow path.

**Title: Apparatus and method for the manufacture of products.**

The invention relates to an apparatus and method for the manufacture of products.

Injection molding is a known method that is used for the manufacture of products, especially, though not exclusively so, from plastic. A mass in  
5 liquid, at least molten, form is then introduced under pressure into a mold cavity and allowed to solidify therein. A disadvantage of such a method is that relatively high pressures need to be used to fill the entire mold cavity, so that the properties of the starting material are adversely affected, in particular when plastic is used. Moreover, the maximum attainable flow path in the case  
10 of relatively thin products is relatively short, so that it is difficult, if possible at all, to manufacture large, thin-walled products by injection molding, especially from high-melt plastics.

It has previously been proposed to effect injection molding in a mold cavity with a movable wall part. In that way, initially the flow path can be  
15 enlarged in cross section, so that the mass can pass more easily. When the mold cavity is filled wholly or partly, the movable wall part is then moved forward, in the direction of an opposite wall part, so that the flow path is adjusted to the desired cross section. In this way, the required pressures for injecting the mass and hence also the required closing pressure for keeping the  
20 mold closed, can be lowered. Such a method is for instance described in WO 2004/024416.

An object of the invention is to provide a method for the manufacture of products of a high quality.

Another object of the invention is to provide a method for the  
25 manufacture of, in particular, plastic products with low internal stresses.

A further object of the invention is to provide a method for the manufacture of products with relatively thin walls that allows the use of

relatively low injection pressures and where relatively low closing pressures suffice, in proportion to conventional injection molding.

At least one of these objects or other objects is or are achieved with a method according to the invention.

5 In a first aspect, a method according to the invention is characterized in that a mold is used having at least one mold cavity, which mold cavity has at least one movable wall part. A mass is introduced under pressure into the mold cavity such that it is moved between the at least one  
10 movable wall part and an opposite mold part. Then, the first movable wall part is pressed in the direction of the opposite wall part of the mold cavity, so that the intermediate mass is somewhat compressed and displaced. As a result, the mold cavity can be filled simply and with little pressure, and holding-pressure after introduction of the mass can be largely omitted.

In a second aspect, the first movable wall part extends around said  
15 injection point and this injection point is movable together with the at least one first movable wall part. Upon injection of the mass, this can be introduced into a relatively large space, so that relatively little injection pressure is required. Upon movement of the first movable wall part towards a product-forming second position, furthermore, little pressure will be formed in the mold  
20 cavity so that the pressure on the injection point and in particular an injector is limited, thereby preventing damage.

In a third aspect, at least one second movable wall part is provided which extends at a distance from the injection point, next to the at least one first movable wall part, while drive means are provided for movement of the at  
25 least one second movable wall part relative to the first at least one first movable wall part. In that way, during use, the mass can be displaced in a stepped manner.

In a fourth aspect, the at least one first or second movable wall part is movably included in an opening of a surrounding wall part, while a  
30 longitudinal edge of this opening proximal to an opposite wall part of the mold

cavity is rounded off. The flow path for the mass thus becomes more flowing while the flow resistance is somewhat reduced. Thus, furthermore, in a surprising manner, sheet formation in an end product at the location thereof is prevented.

5 In or with an apparatus according to the invention, preferably, control means are included for controlling the movements of the or each movable wall part such that the timing, speed and acceleration thereof can be accurately controlled. Preferably, the or each first movable wall part and a second movable wall part extending next to it and/or therearound can be  
10 moved relatively to each other and/or to the injection point.

In a fifth aspect, control means are provided for driving the at least one movable wall part along a main direction of movement and for the injection of a mass in the mold cavity, which control means are designed for bringing the at least one movable wall part in a first position during at least a  
15 first period of injection of said mass, and then moving the at least first wall part to an intermediate position, during or after the injection of the mass, and, successively, moving the at least first movable wall part to a second position, while the intermediate position and the second position are located on two opposite sides of the first position, viewed along said main direction of  
20 movement.

The invention further relates to a method for the manufacture of products, in particular utilizing an apparatus according to the invention.

In clarification of the invention, exemplary embodiments thereof will be further elucidated on the basis of the drawing. In the drawing:

25 Fig. 1 schematically shows in cross sectional side view a first embodiment of an apparatus according to the invention;

Fig. 2 schematically shows in cross sectional side view a second embodiment of an apparatus according to the invention;

30 Fig. 2a shows an enlargement of a detail of an apparatus according to Fig. 2;

Fig. 3 schematically shows a product manufactured with an apparatus according to the invention;

Fig. 4 schematically shows in cross sectional side view a third embodiment of an apparatus according to the invention;

5 Figs. 5A and 5B show two steps in a method according to the invention; and

Fig. 6 shows in side view another product manufactured with the aid of an apparatus and method according to the invention, on which schematically, impressions are indicated of movable wall parts of a mold with  
10 which it has been manufactured.

In this description, identical or corresponding parts have identical or corresponding reference numerals. The embodiments represented are merely shown by way of illustration and should not be construed to be limitative in any manner. Many variations thereon are possible.

15 In this description, exemplary embodiments are given of apparatuses, in particular molds, and method for manufacturing products, starting from plastic. However, also other materials can be used in such apparatuses, for instance masses based on biopolymers, metals and the like. In this description, frontal surface is understood to mean at least a projected  
20 surface at right angles to a respective direction of movement or viewing direction. Movable wall part should herein be understood to mean at least a portion of a wall of a mold cavity that co-forms a part of a product to be formed, which movable wall part may be provided at least, though not exclusively so, on an outer side, an inner side and/or as a core part of/for the mold cavity.  
25 Opposite wall part should herein be understood to mean at least a wall part of the mold cavity which, viewed in the direction of movement of the respective movable wall part, is situated opposite the respective wall part. As to projected surface, this can have a same size as the movable wall part or be smaller or larger. The wall parts can have mutually facing sides that are flat or have a  
30 profiled, curved, angled or other shape deviating from flat. The or an opposite

surface or a part thereof may also be formed by a movable wall part. In the embodiments shown, as drive means for movable wall parts, hydraulic means such as piston-cylinder assemblies are shown. However, other means may be provided, such as, for instance, pneumatic or electric drive means such as a screw spindle motor, a stepping motor, link mechanisms drivable by, for instance, a press which is used for closing the mold or other means obvious to those skilled in the art. The molds shown in the drawing can be used on conventional presses for opening and closing the mold and can be filled using a filling device known per se, for instance a screw feeder, hot runner devices or other injection molding devices known per se. In the embodiments shown, always a single mold is shown, but naturally also multiple (multi-cavity) and/or stacked molds (stack molds) may be designed in a comparable manner. Conventional injection molding is understood to include, in this application, injection molding as described in the introductory portion, in a mold whose mold cavity, upon injection of the mass is in the product forming condition and to that end, has the geometry of the product to be formed.

In this description, left, right, top, bottom, front and rear are used for reference to the plane of the drawing, unless indicated otherwise

Fig. 1 shows a mold 1 with a first and a second part 2, 3, movable relative to each other with the aid of known means suitable to that end such as a press (not shown). The mold 1 has a mold cavity 4 formed between the parts 2, 3, for, for instance, forming a product 5, such as a crate or box as shown in Fig. 3, from, for instance, plastic. Naturally, the mold cavity 4 can also be suitable for other products. In the second part 3, a central opening 6 is provided, in which a first movable wall part 7 is arranged. The first movable wall part is coupled to first drive means in the form of piston-cylinder assemblies 8, with which the first movable wall part 7 can be moved between a first, retracted position, shown in Fig. 1 at the left hand side of an imaginary central plane 9, and a second, forward position, as shown in Fig. 1 at the right hand side of said central plane 9. It is clear that with the first position, the

distance between the frontal surface 10 of the first movable wall part 7 and the opposite wall part 11 is greater than in the second position. With the movable wall part 7 in the second position, the mold cavity 4 has a product forming configuration, while in the first position, the mold cavity 4 has a volume larger than that of the product 5 to be formed.

The mold 1 and in particular the mold cavity 4 is provided with at least one injection point 12, formed here by an open and optionally closable end 13 of a hot runner injector 14 which is fastened to the movable wall part 7 or is at least fastened such that the injection point 12 can move along with the first wall part 7.

A mold 1 according to Fig. 1 can be used as follows.

The mold 1 is closed and the first movable wall part 7 is brought, together with the injection point and the injector 14, into the first position, so that the mold cavity 4 has a relatively large volume, in particular in front of the injection point 12, viewed in injection direction P. Then, a mass 16 is introduced into the mold cavity with the aid of the injector 14. To that end, the injector 14 is connected via a suitable coupling 15, for instance a sliding fit or a flexible coupling, to a feeder (not shown) for plastic or another suitable material, in liquid form, or in a form that can be liquefied in the injector 14. Herein, liquid is at least understood to include a liquid or viscous mass, such as, for instance, molten plastic. As the mass 16 (in Fig. 5) is introduced in a relatively large space 4A in front of the injection point 12, this can be done with relatively low pressure, so that the injector is not loaded much and virtually no shear will occur in the plastic. Accordingly, the adverse affects, if any, to the properties of the mass such as plastic will only be minimal. As the mass can be introduced with relatively low pressure, the part 11A of the wall part 1 located opposite the injection point can be of virtually flat design. This means that no forming element needs to be provided thereon for distributing the mass stream and, hence, the forces acting on the wall part 11 as a result thereof. This means that in the product 5 at that location, no unwanted

deformations need to arise. This offers the advantage that, for instance, the respective surface can easily be labelled, for instance by in mould labelling techniques, without the label needing to be sprayed on and without the label being damaged through a deformation.

5           After at least the larger part of the mass, for instance more than 90% of the required volume, and preferably virtually all plastic, has been introduced into the mold cavity 4, the first movable wall part 7 is brought, with the aid of a control device 24, together with the injection point 12 and at least a part of the injector 14, by the drive means to the second, forward  
10 position, so that the mass 16 confined between the frontal surface 10 and the wall part 11 is at least partly displaced to other parts of the mold cavity 4, such as, for instance, longitudinal edge 18 forming parts 19. Heat is then developed in the mass, as a result of a combination of internal friction between molecule chains in the mass, friction between the mass and the mold parts  
15 and/or compression of the plastic. The movement of the first movable wall part 7 is preferably done particularly rapidly, for instance in tenths or hundredths of seconds. It is clear that the speed, acceleration and distance of displacement can be selected depending on the mold and product geometry, the plastic used, and for instance the heat capacity of the mold. Without wishing to  
20 be bound to any theory, this heat development appears to occur adiabatically, i.e. without supply of external thermal energy, through the friction and/or compression mentioned, in particular a combination thereof as described in WO 2004/024416. Furthermore, as shown in Fig. 5, use is made of heat that is present in the mass directly adjacent the movable wall part 7, for at least  
25 partly melting already partly solidified parts 16A of the mass 16 again which are at a relatively great distance from the injection point 12 and/or next to fixed wall parts of the mold cavity, so that the resistance experienced by the mass 16 in the mold cavity is limited to a minimum. As a result thereof, the pressure exerted by the mass on the mold parts 2, 3 will be minimal, so that  
30 relatively small forces can suffice for keeping the mold closed. Here, relative is



understood to include being in proportion to the forces which occur in a conventional mold, with conventional injection molding, for forming an identical product 5 from the same mass. During the movement of the movable wall part 7, a pressure pulse may occur in the mass 16. Its influence on the occurring forces however is minimal as it will be absorbed by, in particular, the inertia of the used materials and the mold parts 2, 3.

As a result of the relatively low pressure in the mold cavity 4, a simple closing means of the hot runner or other injector 13 can be utilized, for instance a needle closer, and the injector can be of relatively light design and be moved along with the wall part 7. The mass is set and/or held in motion by the movable wall part 7, and through the heat development, the viscosity of at least a part thereof will be reduced or will at least not increase further, so that the mass can be moved with relatively little pressure for filling the entire cavity 4. In particular also long and/or narrow and/or complex flow paths 20, with, for instance, many bends can thus be completely filled, without the properties of the mass being particularly adversely affected, as will be the case with conventional injection molding of such a product 5, and without a high injection pressure being required, as is the case with conventional injection molding. Furthermore, holding pressure is virtually unnecessary.

In Fig. 2, an alternative embodiment of a mold 1 according to the invention is shown, which is distinguished from that according to Fig. 1 in that the first movable wall part 7 is included in an opening 21 in a second movable wall part 22. The second movable wall part 22 is connected to second drive means 23, comparable to the first drive means 8, which can be controlled by the control means 24, for moving the second wall part 22 from a first position as shown in Fig. 2 at the left hand side of the plane 9, to a second position as shown at the right hand side of plane 9 and, optionally, vice versa. As shown in Fig. 2A, the longitudinal edge 25 of the opening 21 is rounded off at the side proximal to the mold cavity by a radius R, for instance a radius between 0.1 and 5 mm, for instance between 0.2 and 3 mm, so that the mass, when it is

forced therealong by movement of the wall parts 7 and/or 22, will experience less resistance than when this longitudinal edge were to be right-angled, as with known slides. Surprisingly, it has appeared that such rounding-off has a positive effect on, for instance, the prevention of the mass burning through too great a local heating, prevention of sheet formation (flash) at the location of the transition in the product to be formed, and the necessary tolerances.

With a mold 1 according to Fig. 2, the mass 16 is introduced into the mold cavity 4 with the first 7 and second movable wall part 22 in the first position, so that the volume of the mold cavity is relatively large, in particular in front of the injection point 12. Then, first, the first movable wall part 7 is set into motion, driven by the control means 24, in the direction of the second position and subsequently, the second movable wall part 22. As a result, a cascading motion occurs and the mass 16 is driven in the direction of the longitudinal edges 18. The wall parts 7, 22 can carry out the movement sequentially, but can also, partly, move jointly or, at least, move simultaneously. This means that the second movable wall part can move relative to the first movable wall part 7 and/or relative to the injector 14. Owing to these movable wall parts, an even better controlled urging of the mass 16 can be obtained.

In a further advantageous embodiment, with a mold according to, for instance, Figs. 1 or 2, or an embodiment to be further described according to Fig. 4, during and/or directly after injection of the mass, the first, second and/or further movable wall part can first be somewhat retracted from the first position to an intermediate position, while the frontal surface of the respective wall part is at a greater distance from the opposite wall part 11 than in the first position, whereupon the respective wall part is brought beyond the first position to the described second position. Surprisingly, it has appeared that thus, a particularly good filling of the mold cavity 4 can be obtained, with low pressures for injection and for holding the mold closed. Without wishing to be bound to any theory, this seems to be the result of, inter alia, the effect that

the frontal surface is somewhat moved away from the mass upon movement towards the intermediate position, before it is, once more, contacted therewith at high speed, while with the movement in the direction of the intermediate position, a part of the still liquid mass can be drawn along so that movement is  
5 already formed in the mass before the wall part is brought to the second position.

In Fig. 3, a product 5 is shown in the form of a crate, in perspective view, provided with a bottom 26 and an upstanding wall 27. On the bottom, the contours 28, 29 of the first and second wall part 7, 22, respectively, are  
10 represented in broken lines. Furthermore, the injection point 12 is schematically represented. Furthermore, on the wall 27, in broken lines, the contours 30 of further movable wall parts 31 are represented, as used in an embodiment according to Fig. 4. In the Figures, each time, movable wall parts 7, 22, 32 are represented with a flat frontal surface. However, naturally,  
15 also profiles may have been provided therein, for instance additional flow paths, curves, grooves, creases and the like, so that surfaces of the products to be formed can, for instance, be profiled.

In Fig. 4, schematically, a mold 1 is represented with a mold cavity 4, comparable to the apparatus according to Fig. 1, the injector 13  
20 however being provided at an outer side forming side of the product 5. Only a first movable wall part 7 is shown but naturally, the mold may also be provided with two movable wall parts 22, as shown in, for instance, Fig. 2. With this embodiment, adjacent the longitudinal edge 18, i.e. at a greater distance from the or each injection point 12 than the first and/or second wall parts 7, further, third movable wall parts 31 are provided with drive means 32,  
25 controllable by the control means 24. These third movable wall parts 31 have a frontal surface 31A which is relatively small with respect to the surface of the wall part in which it is provided and with respect to the total surface of the product, formed by the inside and outside thereof. The joint frontal surface of

these third movable wall parts may be smaller than 10% of the surface of the product 5.

During use, the third movable wall parts 31 are moved from a retracted first position, as shown on the left hand side in Fig. 4, to an advanced, second position, as shown on the right hand side in Fig. 4, so that in the proximity of the longitudinal edge 18, the mass is still somewhat compressed and/or displaced while shrinkage of the mass when cooling can be substantially compensated therewith. In that way, deformation of the product can be prevented relatively easily, while furthermore, stresses therein can be limited to a minimum. A method and apparatus with such movable wall parts is described in further detail in the non-prepublished Dutch patent application NL 1032248 of applicant, which is understood to be incorporated herein by reference.

In Figs. 5A and 5B, schematically, a representation is given of a cross section through a part of a mold 4 and the mass 16 introduced therein, directly prior to and directly after, respectively, movement of a movable mold part 7, 22, 31 from a first towards a second position. In Fig. 5A, the mold cavity 4 is relatively large and the mass 16 does not fill it entirely. Against fixed wall parts 11 of the mold cavity 4, a part 16A of the mass has solidified, by giving off heat to the material of the mold 1. However, a part of the mass, in particular in front of the movable wall part 7, 21, 31, still has a temperature above the melting point of the respective mass, so that this part is still substantially liquid. It is clear that a relatively large part of the mass in a part of the mold cavity 4 at a distance from the movable wall part has solidified and would hence, with conventional injection molding, complicate, or even render impossible, passage of more plastic towards a longitudinal edge 18 forming part. However, with a method according to the present invention, use is made, as described hereinabove, of the heat and the liquidity of the remaining part of the mass and the movement of the mass under the influence of the movable wall part that is brought to the second position, as shown in Fig. 5B. In this

way, the hot, liquid part is forcefully driven against and into the already solidified part of the mass, while furthermore, in the mass itself, and between mass and the walls of the mold cavity friction is formed so that heat is generated. As a result, premature cooling down of the mass is prevented and  
5 the temperature in the mass can even be increased as the heat is, at least partly, sooner guided through the mass itself than that it can be completely discharged by the mold. As a result, the mass, once more, reliquifies and becomes at least less viscous, so that without excessive pressure buildup it can be forced further into the mold cavity and in particular along longitudinal  
10 edge 18 forming part 19, for a complete filling of the mold cavity 4. The rounding off 33 of the longitudinal edge 25 of the opening 21 with radius R is clearly visible in Figs. 5A and 5B. The second position (Fig. 5B) of the movable wall part can be such that the frontal surface 10 is positioned such that a small groove 34 is formed between the curved surface 36 of the longitudinal  
15 edge 25 and the side 35 of the movable wall part 7, 22, 31, but it can also be located slightly further downwards than represented in Fig. 5B, so that the frontal surface is approximately flush with the beginning of the curved surface 36 of the longitudinal edge 25. The rounding off 36 offers the advantage that the friction between the mass and the mold part 3 and/or  
20 internally in the mass 16 itself is limited directly adjacent this surface 36, so that the temperature does not become too high at that location, so that burning could occur.

With a method and apparatus according to the invention, further, the advantage can be achieved that the mass, in particular plastic, can be  
25 introduced into the mold at lower temperature than with conventional injection molding, for instance just above the melting temperature of the mass. Owing to the heat development in the mold cavity, as described, as a result of friction and/or compression, the mass is held or made sufficiently liquid for filling the entire mold cavity, without excessive pressure being required.  
30 Furthermore, in this manner, the advantage is achieved that the cooling time

for cooling down the mass is reduced because less heat is added, so that the cycle time is shortened. Furthermore, thus, the material quality of the mass is maintained better than with conventional injection molding of a comparable product.

5           As clearly appears from the Figures, the longitudinal edge 37 of each of the movable wall parts 7, 22, 21 is located at a distance from a crease 38 of a product 5 which is formed either at least at a distance from a location where different flows of the mass will converge or at a location where, during use, the product will be most heavily loaded. For, for instance, a crate according to  
10 Fig. 3, these are, for instance, the ribs 38 of the upstanding wall, which, upon stacking, will be heavily buckling-loaded. What is prevented by putting the longitudinal edge 37 at a distance from such a position is that the strength thereof is adversely affected. In particular with, for instance, long and/or narrow passages, restrictions as a result of bends and the like, a method  
15 according to the invention is of particular interest.

Fig. 6 shows, in a somewhat transparent representation, a product 5 in the form of a bin 40 with lid 41, interconnected by a hinge construction 42, for instance an integrally formed hinge in the form of a living hinge or, as shown, in the form of a rod 44 rotatable in clamps 43. A wheel set 45 is  
20 connected to the bottom 47, on a rear side thereof. An injection point 12 is shown in a central area of the bottom but also, one or more injection points 12 may be provided at different positions, for instance adjacent an upper longitudinal edge 18. For forming the bottom, a first and a second movable wall part 7, 22 are provided, which are arranged a-symmetrically relative to  
25 the bottom. In the mold, adjacent the upper longitudinal edge 18 forming parts 19, on the four sides, each time, two third moving wall parts 31 are provided, with which the mass can be given a last push and furthermore, any shrinkage of the material that may occur during cooling can be compensated. The third moving wall parts too are preferably moved forward from the first to  
30 the second position so rapidly, that in the mass, in front of the frontal surface

thereof, adiabatic heat development occurs. In Fig. 6A, a possible cross section of the wall of the bin 5 is shown, according to the line VIA-VIA in Fig. 6, which wall is partly hollow, to, preferably, a great distance from the bottom, for instance over virtually the entire height. As a result, a relatively thin inner wall and a relatively thin outer wall 48B are obtained, preferably interconnected by ribs 49, whereby a particularly light, rigid construction is obtained, while the space between the wall parts 48A, B can be relatively small, for instance in the same order as the joint thickness of the wall parts 48, B, for instance some millimetres to one and a half centimetre. With a method according to the invention, such a bin 5 can be designed to be light and strong as, during manufacture, the pressure in the mold cavity is relatively low, and hence the chance of deformation of a core part forming the cavity/cavities in the wall is minimized. Furthermore, wall thickness differences can occur in a simple manner without this leading to unwanted deformations as a result of different cooling paths. In Fig. 6B, an alternative embodiment of a cross section of a wall of a bin 5 is shown, wherein at least one side 50 of the wall 48 has a undulating or ribbed patterns or surface, while the opposite side 51 opposite thereof is, for instance, substantially flat or has an otherwise undulating or ribbed surface so that the wall thickness D1 varies over the width of the bin 5. The thicker parts will ensure rigidity while the thinner parts yield a less heavy product. It has appeared that here, such a wall requires less material than a wall with constant thickness and equal strength, in particular with respect to buckling load. Furthermore, in this manner, a light, form-stable bin is obtained. The ribs 38 are relatively thick, for additional rigidity. Alternatively, ribs can also be integrally formed over the height of the wall, on the inside and/or outside thereof. Inserts, for instance electronic and/or programmable tags for recognition of the bin during use, fastening means for, for instance, the wheels, or other types of elements can simply be injected all around in the production process, while the chance of

damage through pressure is limited to a minimum as a result of low pressure in the mold. Labelling through in mold labelling is also very possible.

The invention is not limited to the embodiments represented in the description and the drawings, which serve merely as illustration. Many variations thereon are possible within the framework of the invention as outlined by the claims. For instance, as indicated, stack molds and multi-cavity molds according to the invention can be used, wherein, in one mold, in one production cycle, also, different products can be manufactured, as the injection pressure is of secondary importance and, by suitably positioning and controlling the movable wall parts, the masses can be moved in the various mold cavities. Different injection points may have been provided, while optionally, with the aid of several of such points, different plastics can be injected simultaneously or in succession. A mold according to the invention can be designed without the first and/or second movable wall parts, for instance only with the third movable wall parts, with which, then, the method according to the invention is carried out. Also, for a first and/or second wall part according to the invention, several first and/or second positions can be provided. Then, for instance, first, a first plastic can be injected into the mold cavity, while the respective wall part is brought to a most advanced first position and the plastic is allowed to at least partly cure, whereupon the movable wall part is retracted to the or a second position, at a distance from the solidified plastic, whereupon a second amount of plastic can be introduced into the mold cavity, against the solidified plastic. The movable wall part can then be held fast during curing of the plastic or it can be moved to a new first position, for forming the product. In this way, a completely or partly laminated product can be obtained. Further, all examples and/or parts thereof shown can be combined, for obtaining alternative embodiments of an apparatus or method according to the invention.

These and many comparable and other variations are understood to fall within the framework of the invention as outlined by the claims.



Claims

1. An apparatus for the manufacture of products, comprising a mold with at least one mold cavity which has at least one first movable wall part, wherein drive means are provided for driving the at least one first movable wall part, which mold cavity comprises at least one injection point and defines at least one flow path between said injection point and a part of said mold cavity forming a longitudinal edge, at a distance from said injection point, while said at least one first movable wall part extends around or opposite said injection point, along at least a portion of said flow path.
- 5
2. An apparatus according to claim 1, wherein said first movable wall part extends around said injection point and said injection point is movable together with said at least one first movable wall part.
- 10
3. An apparatus according to claim 1 or 2, wherein at least one second movable wall part is provided which extends at a distance from said injection point, adjacent said at least one first movable wall part, while drive means are provided for movement of said at least one second movable wall part relative to said at least one first movable wall part.
- 15
4. An apparatus according to claim 3, wherein first drive means are provided for driving the at least one first movable wall part, and second drive means for driving the at least one second movable wall part.
- 20
5. An apparatus according to any one of claims 3 or 4, wherein the at least one first movable second wall part is provided with an opening in which the at least one movable wall part is included, preferably together with the at least one injection point.
6. An apparatus according to any one of the preceding claims, wherein the at least one injection point is formed by a hot runner injector.
- 25
7. An apparatus according to any one of the preceding claims, wherein the at least one injection point has an injection direction which is

approximately parallel to a direction of movement of said at least one first movable wall part, wherein the wall part of the mold cavity located in injection direction opposite said at least one injection point has a target surface that is substantially flat and extends preferably approximately at right angles to said injection direction.

8. An apparatus according to any one of the preceding claims, wherein said at least one first or second movable wall part is movable in an opening of a surrounding wall part, while a longitudinal edge of said opening facing an opposite wall part of the mold cavity is rounded off.

9. An apparatus according to claim 8, wherein said longitudinal edge is rounded off with a radius between 0.1 and 5 mm, preferably between 0.2 and 3 mm.

10. An apparatus according to any one of the preceding claims, wherein a control device is provided for controlling the drive means, which control device is designed for driving the at least one movable wall part in the direction of an opposite wall part of the mold cavity after at least 90% of a mass required for forming a product has been introduced into the mold cavity.

11. An apparatus according to claims 2 and 10, wherein the control device is designed for successively setting into motion the at least one first movable wall part and the at least one second movable wall part, for movement thereof in the direction of an opposite wall part of the mold cavity.

12. An apparatus according to any one of the preceding claims, wherein control means are provided for driving the at least one movable wall part along a main direction of movement and for the injection of a mass into the mold cavity, which control means are designed for bringing the at least one movable wall part into a first position during at least a first period of injection of said mass, for thereupon moving said at least first wall part to an intermediate position, during or after said injection of said mass, and, directly thereafter moving said at least first movable wall part to a second position, while the

intermediate position and the second position are located on opposite sides of the first position, viewed along said main direction of movement.

13. A method for the manufacture of products, in particular from plastic, wherein an apparatus is used according to any one of the preceding claims,  
5 wherein the first movable wall part is moved from a first position to a second position, while, in the first position, the first movable wall part is located further from an opposite wall part of the mold cavity than in the second position, wherein a mass is introduced in liquid condition into the mold cavity, which mass is partly allowed to solidify in the mold cavity, at least against a  
10 part of the walls of the mold cavity, at a distance from said first movable wall part, while a part of the mass resting against said one movable wall part remains liquid, whereupon during movement of the first movable wall part from the first position to the second position, said liquid part of the mass is at least partly displaced into and/or against said solidified portion of the mass,  
15 wherein said liquid part is displaced so rapidly that friction between molecule chains in the mass occurs, such that temperature increase in the mass is obtained, whereby at least a portion of the solidified mass is heated to above a melting point and takes the liquid form again, whereupon the mass is allowed to solidify completely, after at least the said first movable wall part is brought  
20 into the second position.

14. A method according to claim 13, wherein a mold is used with at least one further movable wall part which is located in and/or adjacent said part forming a longitudinal edge, at a relatively great distance from said injection point, wherein said further movable wall part has been or is brought into a  
25 first position, at a relative great distance from an opposite wall part, while a mass is introduced under pressure into the mold cavity, such that the mold cavity is filled with said mass and this extends between the at least one further movable wall part and the opposite wall part, and fills the mold cavity at least in and/or adjacent said part forming a longitudinal edge, whereupon  
30 the said at least one first movable wall part is moved in the direction of said

opposite first wall part in a manner such that said mass is pressurized between the said at least one first movable wall part and the opposite first wall part and is optionally partly displaced.

15. A method according to claim 13 or 14, wherein said first movable  
5 wall part is moved in the direction of the opposite first wall part so rapidly that in the mass therebetween, adiabatic heat development occurs such that the viscosity thereof is reduced.

16. A method according to any one of claims 13 – 15, wherein each  
10 further movable wall part has a frontal surface that is in leading position in a direction of movement, wherein the frontal surface of said further movable wall part or the joint said further movable wall parts is smaller than approximately 30% of the total product forming surface of the mold cavity, preferably smaller than 20% thereof and in particular smaller than 10%.

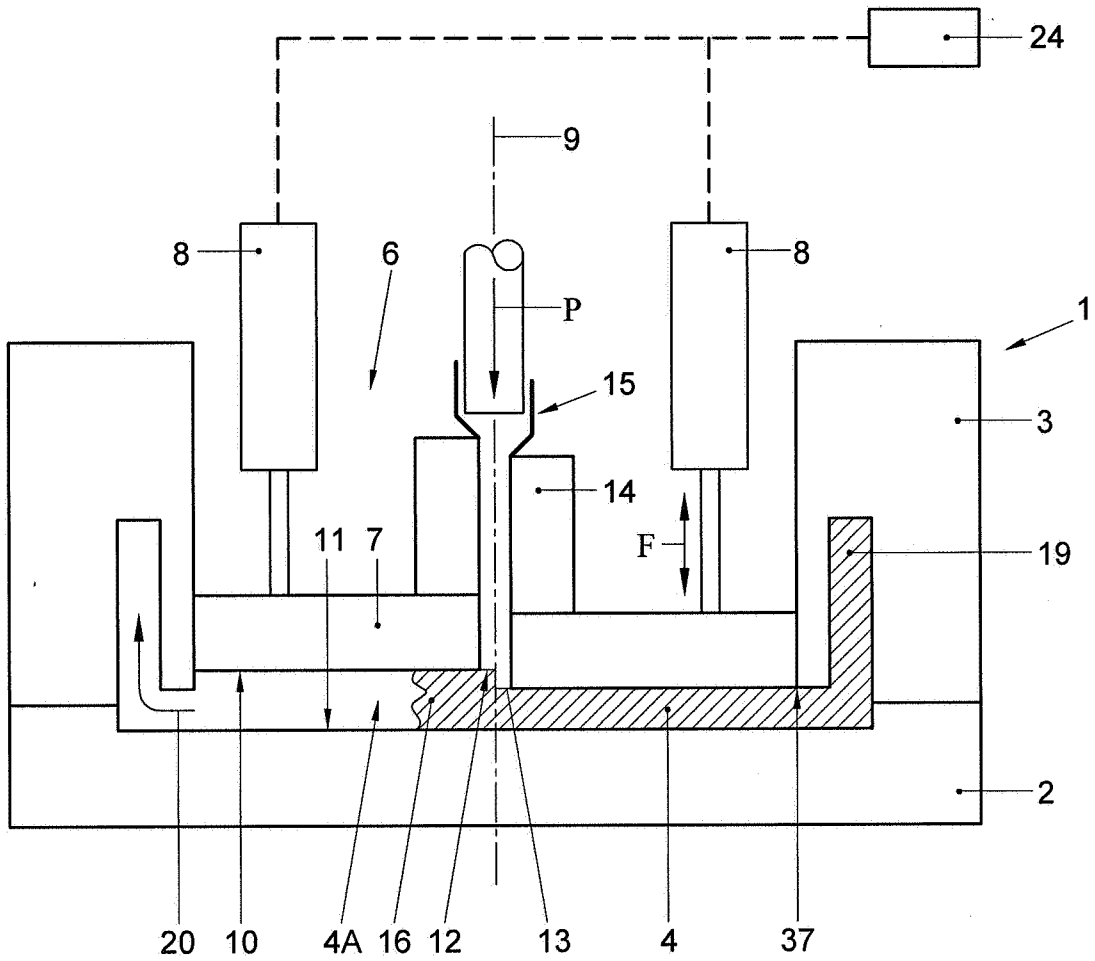


Fig. 1

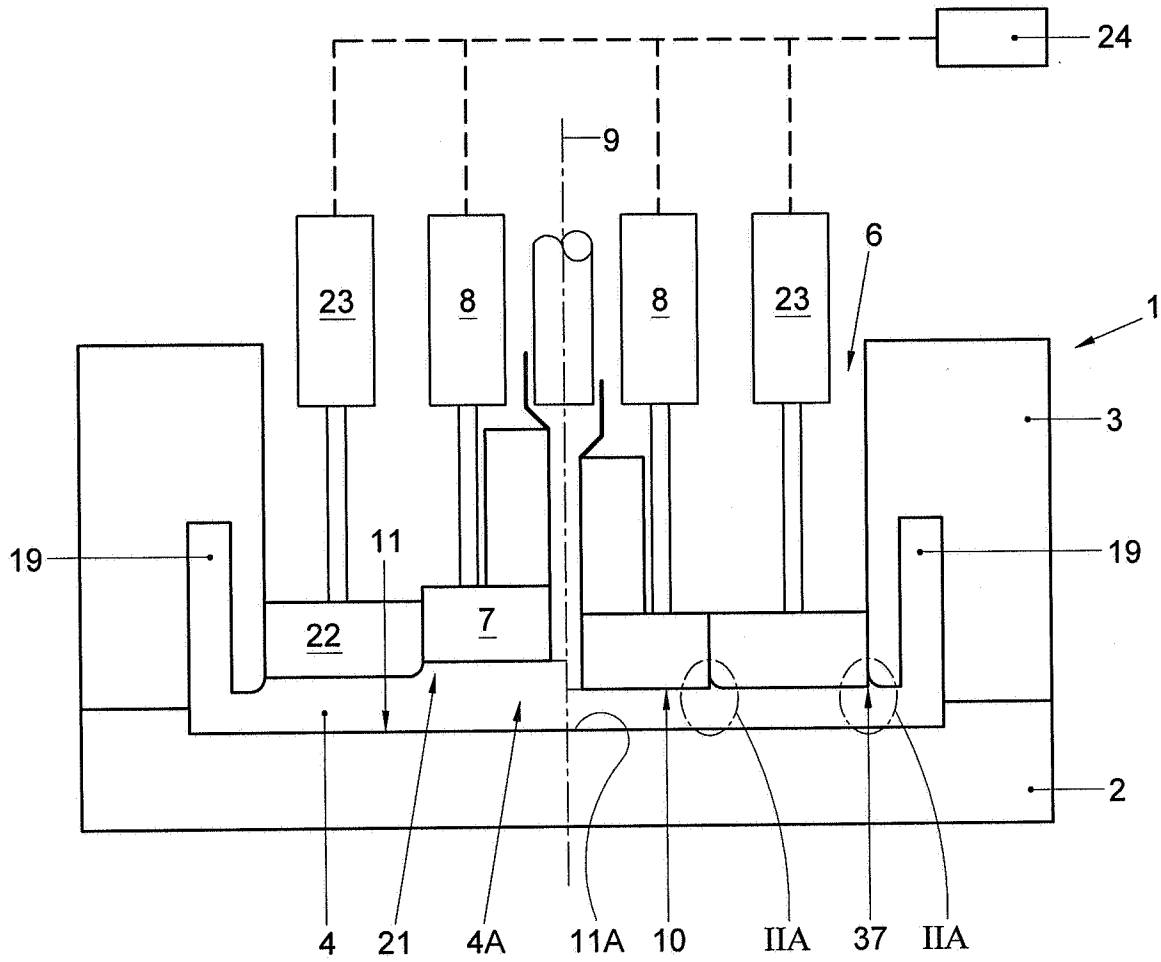


Fig. 2

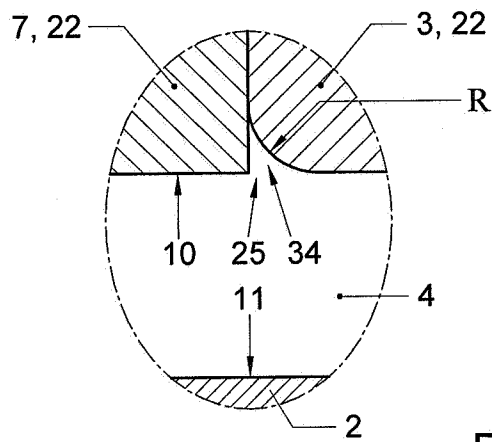


Fig. 2A

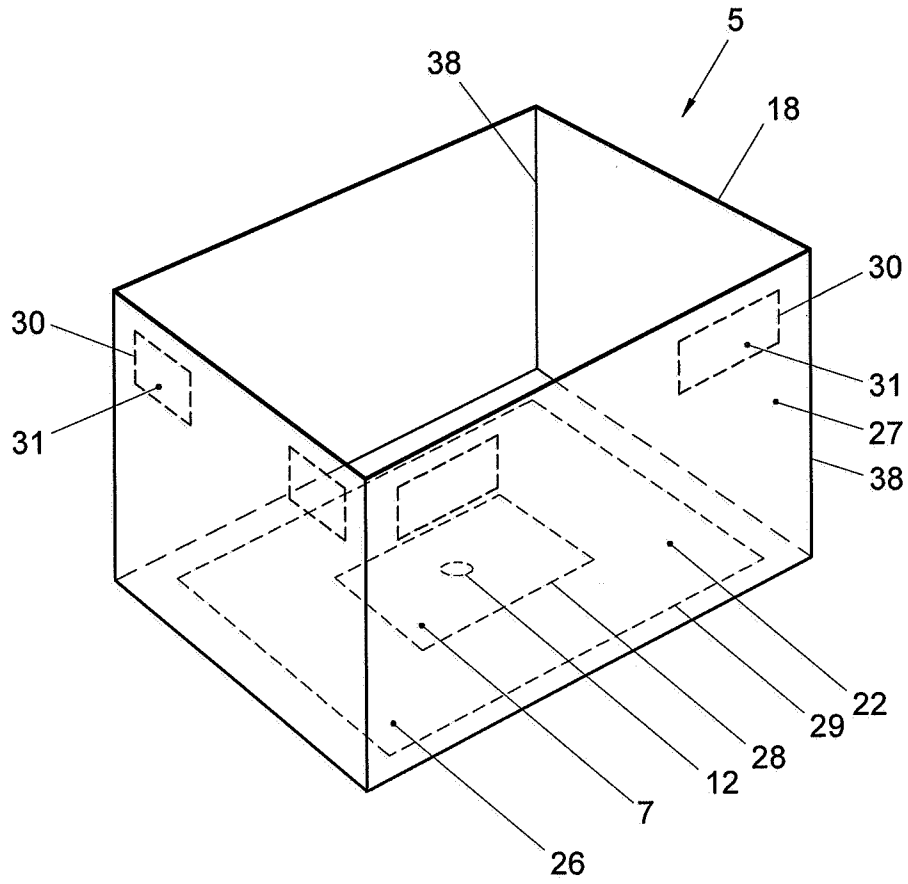


Fig. 3

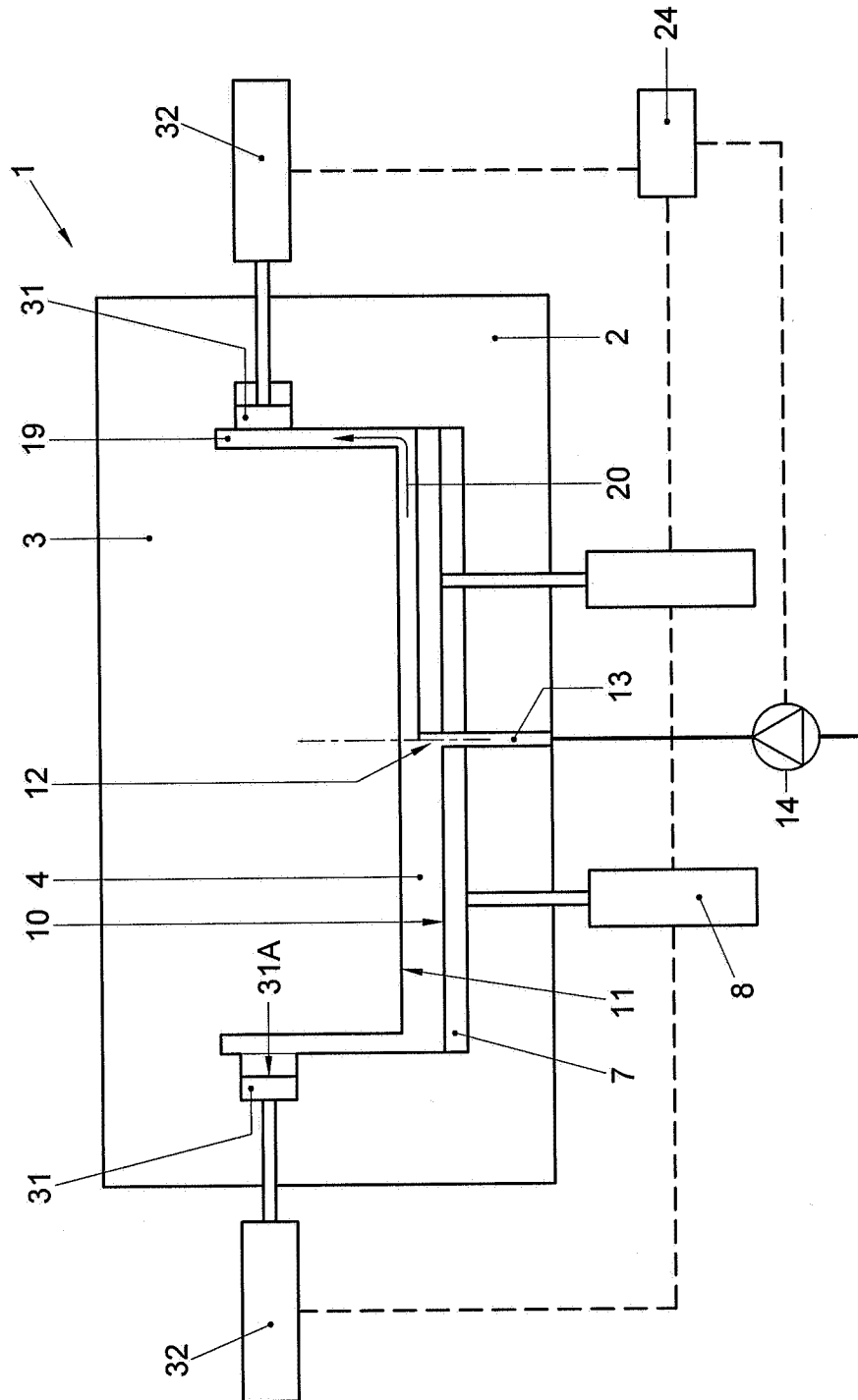


Fig. 4



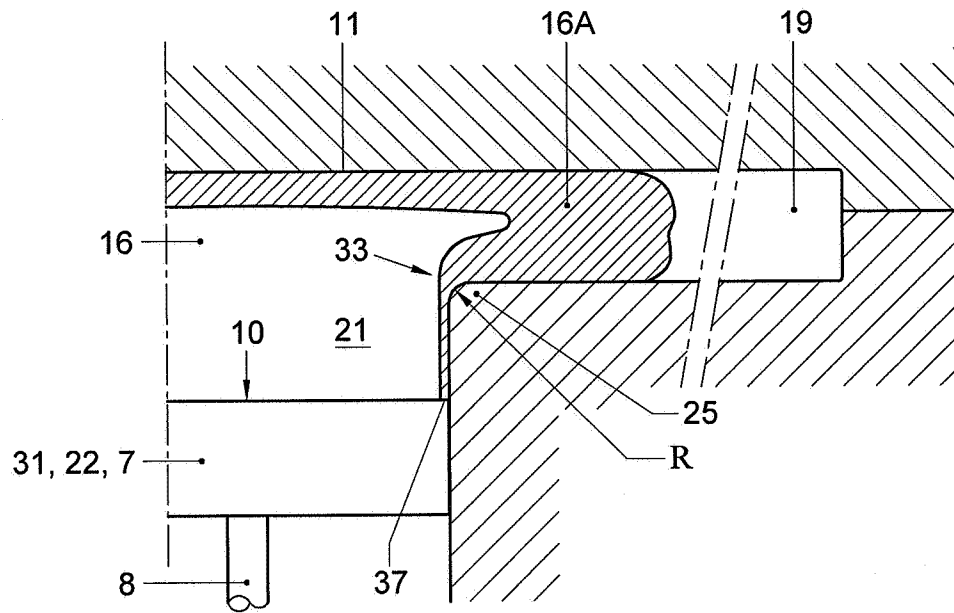


Fig. 5A

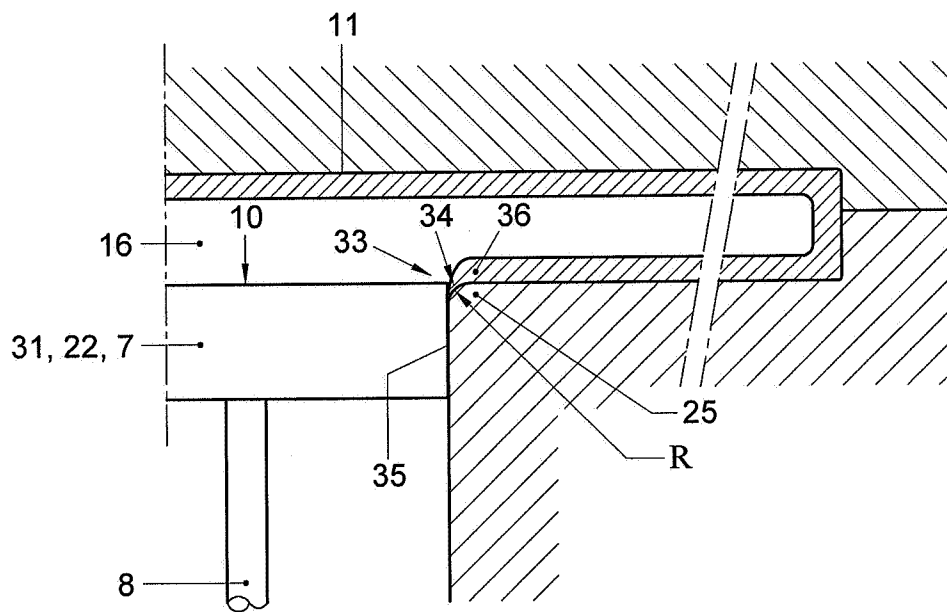


Fig. 5B

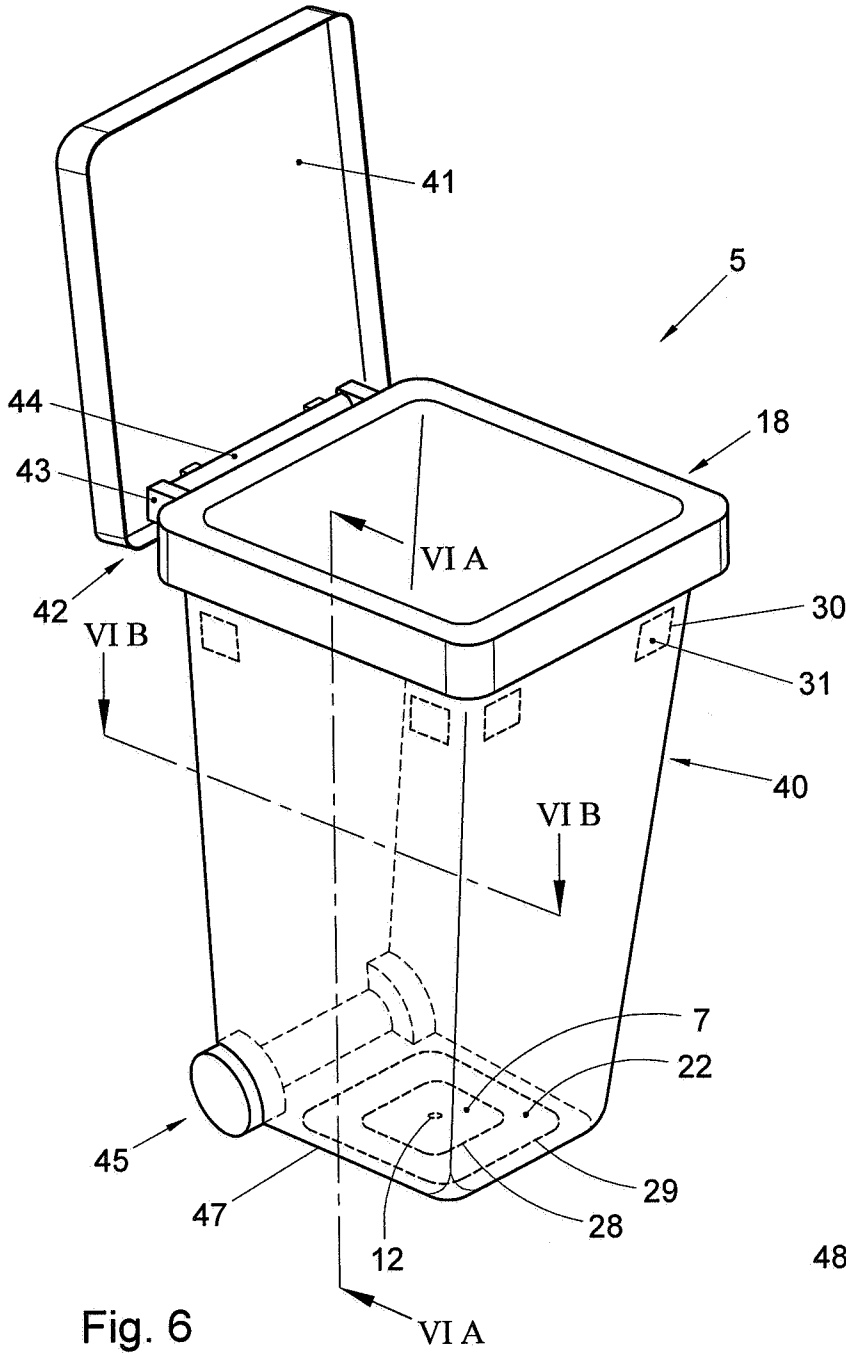


Fig. 6

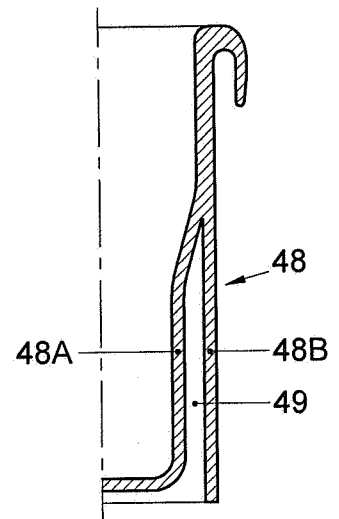


Fig. 6A

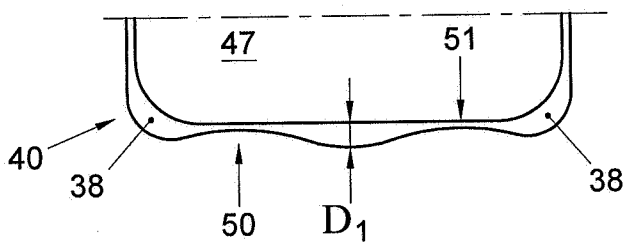


Fig. 6B