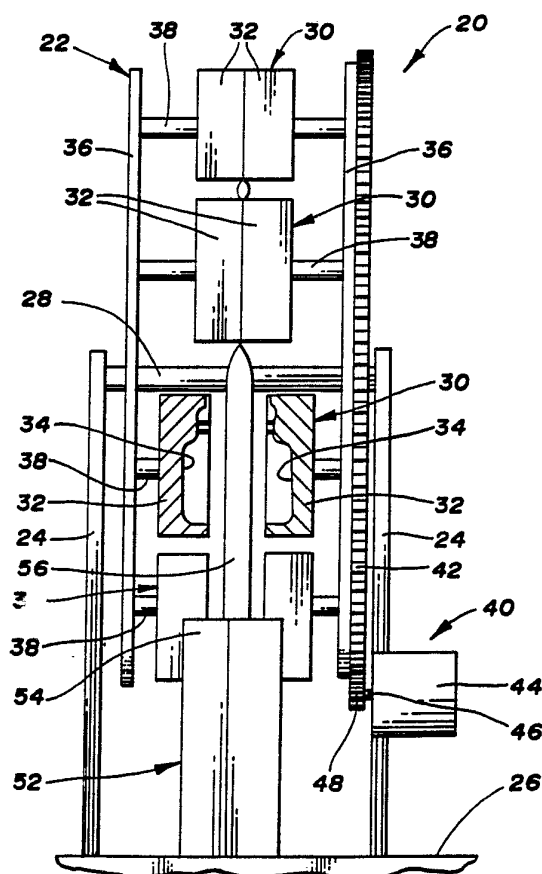




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(21) International Application Number: PCT/US91/04793 (22) International Filing Date: 8 July 1991 (08.07.91) (30) Priority data: 566,256 13 August 1990 (13.08.90) US (71) Applicant: PLASTIPAK PACKAGING, INC. [US/US]; P.O. Box 2500 C, 9135 General Court, Plymouth, MI 48170 (US). (72) Inventor: DARR, Richard, C. ; 3645 Good Road, Seville, OH 44273 (US). (74) Agent: KUSHMAN, James, A.; Brooks & Kushman, 1000 Town Center, Twenty-Second Floor, Southfield, MI 48075 (US).		(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (Euro- pean patent), GN (OAPI patent), GR (European pa- tent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI pa- tent), SU ⁺ , TD (OAPI patent), TG (OAPI patent). Published <i>With international search report.</i>
(54) Title: BLOW MOLDING OF POLYETHYLENE TEREPHTHALATE (57) Abstract A method for making a plastic blow molded product (62) is performed by extruding a hollow parison (56) of hot polyethylene terephthalate from an extruder head (54) at a predetermined speed in a vertical direction and by longitudinally stretching and blow molding the parison by molds (30) of a rotary wheel (22) that rotates the molds at a faster speed than the speed of extrusion such that the blow molding provides a biaxially oriented polyethylene terephthalate product (62). The parison (56) has an intrinsic viscosity greater than 0.9 and its wall thickness is varied to control the wall thickness of the resultant blow molded product (62). Both upward and downward extrusion of the parison (56) is disclosed. Pressurized gas is supplied to the interior of the extruded parison (56) and the pressure thereof is varied by increasing the pressure just prior to the mold closing to provide lateral stretching that permits handled containers to be blow molded from extruded polyethylene terephthalate.		



+ DESIGNATIONS OF "SU"

Any designation of "SU" has effect in the Russian Federation. It is not yet known whether any such designation has effect in other States of the former Soviet Union.

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BLOW MOLDING OF POLYETHYLENE TEREPHTHALATETECHNICAL FIELD

This invention relates to a method for blow molding polyethylene terephthalate and also relates to
5 a blow molded polyethylene terephthalate container.

BACKGROUND ART

Blow molding of polyethylene has previously been performed on rotary machines to manufacture blow molded containers. See, for example, United States
10 Patents: 3,310,834 Simpson et al which utilizes a vertical wheel having a rotary frame on which molds are mounted to receive a downwardly extruded parison to perform the blow molding; 3,764,250 Waterloo which discloses a vertical wheel having a rotary frame on
15 which molds are mounted to receive an upwardly extruded parison to perform the blow molding; and 3,986,807 Takegami et al which discloses a horizontal wheel on which upper and lower molds are mounted to receive a horizontally extruded parison that is longitudinally
20 stretched prior to being clamped within each mold so as to provide biaxial orientation which is stretching of the parison in perpendicular directions so as to increase the strength of the resultant blow molded container.

25 Polyethylene terephthalate containers have previously been blow molded with reciprocating molds either by extrusion of a supported hot parison adjacent the reciprocally openable mold portions as disclosed by United States Patent 3,733,309 Wyeth et al or by
30 reheating and positioning of an injection molded parison between the reciprocally openable mold portions such as

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disclosed by United States Patent 4,802,295 Darr. Both the supported extrusion parison and the reheated injection molded parison are longitudinally stretched to provide biaxial orientation that increases the strength of the resultant blow molded product. The polyethylene terephthalate plastic utilized to manufacture such bottles conventionally has an intrinsic viscosity of 0.72 and a relatively low melt strength with a relatively narrow temperature range as compared to polyethylene, which results in difficulties in manufacturing polyethylene terephthalate containers by any process other than with a reciprocal mold and the supported extrusion parison and the reheated injection molded parison.

15 DISCLOSURE OF INVENTION

 An object of the present invention is to provide an improved method for making a plastic blow molded product from polyethylene terephthalate. In carrying out this improved method, a hollow parison of polyethylene terephthalate is extruded from an extruder head at a predetermined speed in a vertical direction adjacent a closing station of a rotary blow molding wheel having molds with mold portions that close at the closing station to enclose the parison within an enclosed cavity of the closed mold. The wheel is rotated to move the molds at a faster speed than the speed at which the parison is extruded to longitudinally stretch the parison in the vertical direction of extrusion prior to being enclosed within each mold in a sequential manner. Pressurized gas is blown into the enclosed parison within each closed mold to provide a biaxially oriented polyethylene terephthalate blow molded product that conforms to the shape of the mold. Thereafter, each mold is opened for removal of the

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biaxially oriented polyethylene terephthalate blow molded product.

The rotary method for making a polyethylene terephthalate blow molded product as described above permits more economical manufacturing thereof than can be achieved with reciprocal molds as have been utilized in the past. The polyethylene terephthalate parison utilized has an intrinsic viscosity greater than about 0.9 which increases the melt strength of the parison as compared to conventional polyethylene terephthalate blow molding in order to permit the parison to be extruded with a sufficient strength to maintain its shape prior to being enclosed by the molds of the rotary wheel for the blow molding. Also, the parison can be extruded with a wall thickness that is varied to accommodate for the effect of gravity on the vertically extruded hollow parison of polyethylene terephthalate and to otherwise control the wall thickness of the resultant blow molded product.

In one practice of the method, the polyethylene terephthalate parison is extruded upwardly from the extruder head. This upward extrusion is preferably performed such that the polyethylene terephthalate parison has a wall thickness that decreases from the initially extruded parison portion to the finally extruded parison portion associated with each mold to accommodate for the effect of gravity.

In another practice of the method, the polyethylene terephthalate parison is extruded downwardly from the extruder head. This downward extrusion is preferably performed such that the polyethylene terephthalate parison has a wall thickness that increases from the initially extruded parison

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portion to the finally extruded parison portion associated with each mold to accommodate for the effect of gravity.

Pressurized gas is preferably supplied to the interior of the vertically extruded hollow parison of polyethylene terephthalate and the pressure thereof is varied between the initially and finally extruded parison portions associated with each mold. As disclosed, the pressure is increased prior to mold closing to provide lateral stretching of the parison prior to the mold closing. This lateral stretching of the parison facilitates filling of the mold and the capability of manufacturing polyethylene terephthalate containers of constructions that have not been heretofore possible.

The polyethylene terephthalate parison is extruded with a flared configuration that depends upon the relative size of the blow molded products to be made. More specifically, the polyethylene terephthalate parison is extruded with an inwardly flared configuration to make relatively small size blow molded products and is extruded with an outwardly flared configuration to make relatively large size blow molded products.

Another object of the present invention is to provide an improved plastic blow molded product of polyethylene terephthalate.

The improved plastic blow molded product constructed in accordance with the immediately preceding object is embodied by a polyethylene terephthalate blow molded container including an exterior wall and a hollow handle having opposite ends connected to the exterior

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wall as well as an intermediate portion extending between the ends in a spaced relationship to the exterior wall. This handled polyethylene terephthalate blow molded container can be manufactured by virtue of the extruded rotary method described above and the pressurized gas supplied to the interior of the parison prior to mold closing to provide the lateral stretching that fills the mold and permits subsequent mold closing with a portion for forming the handle. In its preferred construction, the handled polyethylene terephthalate container is biaxially oriented to provide enhanced strength.

BRIEF DESCRIPTION OF DRAWINGS

FIGURE 1 is a side elevational view of one embodiment of a rotary plastic blow molding machine for performing the method of the invention by vertical extrusion of a hot parison of polyethylene terephthalate in an upward direction;

FIGURE 2 is an elevational view taken partially in section along the direction of line 2-2 in Figure 1 to further illustrate the manner in which the blow molding is performed;

FIGURE 3 is a partial sectional view that illustrates the parison being extruded upwardly with a converging configuration to make relatively small size blow molded containers;

FIGURE 4 is a partial view that illustrates the parison being extruded upwardly with a diverging configuration to make relatively large size blow molded containers;

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FIGURE 5 is a view of a graph that illustrates how pressurized gas is supplied to the interior of the extruded parison with an increase in pressure near the end of each cycle to provide lateral stretching prior to the mold closing with the parison in the mold cavity;

FIGURE 6 is an elevational view of another rotary plastic blow molding machine for performing the method of the invention by vertical extrusion of a hot parison of polyethelyne terephthalate in a downward direction;

FIGURE 7 is an elevational view taken partially in section along the direction along line 7-7 in Figure 6 to further illustrate the manner in which the blow molding is performed;

FIGURE 8 is a partial view that illustrates the parison being extruded downwardly with a converging configuration to make relatively small size blow molded containers;

FIGURE 9 is a partial view that illustrates the parison being extruded downwardly with a diverging configuration to make relatively large size blow molded containers;

FIGURE 10 is a view of the parting face of one mold portion to illustrate a handled blow molded polyethylene terephthalate container constructed in accordance with the present invention;

FIGURE 11 is a view taken through the closed mold along the direction of line 11-11 in Figure 10; and

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FIGURE 12 is an end view of the blow molded container taken along the direction of line 12-12 in Figure 11.

BEST MODES FOR CARRYING OUT THE INVENTION

5 With reference to Figure 1 of the drawings, a rotary plastic blow molding machine for carrying out the invention is indicated generally by 20 and includes a rotary wheel 22 rotatably mounted by supports 24 on the factory floor 26 with a shaft 28 extending between the
10 supports along the rotary axis A. A plurality of molds 30 are circumferentially spaced about the wheel 22. Each mold 30 includes a pair of mold portions 32 which have associated cavity sections 34. Wheel 22 includes spaced frame portions 36 between which the molds 30 are
15 mounted on mold supports 38 shown in Figure 2. The machine includes conventional actuators for moving the mold portions 32 between open and closed positions during rotation of the wheel. A drive mechanism 40 of the machine includes a bull or drive gear 42 mounted on
20 one of the frame portions 36 of the wheel 22 and also includes a drive 44 whose output 46 is connected to a gear 48 that is meshed with the drive gear 42 to provide rotary driving of the wheel 22 in a clockwise direction as illustrated by arrow 50 in Figure 1.

25 An extruder 52 of the machine 20 has a head 54 that extrudes an unsupported hollow parison 56 of hot polyethylene terephthalate at a temperature in the range of about 250 to 290°C adjacent a closing station 58 where the mold portions 32 of the molds 30 move from the
30 open position to the closed position to enclose the parison within an enclosed cavity of the closed mold. The drive mechanism 40 rotates the wheel 22 to move the molds 30 at a faster speed than the speed at which the

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parison 56 is extruded. Each mold 30 upon closing, such as illustrated by the one mold 30 just above the shaft 28 in Figure 2, longitudinally stretches the parison 56 in the vertical direction of extrusion prior to the parison being enclosed within the next mold in a sequential manner. Conventional blowing of pressurized gas into the enclosed parison 56 within each closed mold 30 provides a biaxially oriented polyethylene terephthalate blow molded product that conforms to the shape of the mold cavity. Continued clockwise rotation of the wheel 22 permits cooling of the blow molded product prior to sequential opening of the molds 30 at an opening station 60 for removal of the biaxially oriented polyethylene terephthalate blow molded product 62 and delivery therefrom on a delivery conveyor 64 in any conventional manner.

It should be noted that it is important for the unsupported polyethylene terephthalate parison 56 to be extruded vertically as illustrated so that gravity does not introduce any adverse bending force that tends to distort the parison prior to the closing of the mold 30 on the rotary wheel 22 and the subsequent blowing that forms the parison to the shape of the mold cavity. Also, the polyethylene terephthalate parison 56 has an intrinsic viscosity greater than about 0.9 as compared to conventional polyethylene terephthalate parisons which have an intrinsic viscosity of about 0.72. This increased intrinsic viscosity of the parison provides greater melt strength so as to permit the unsupported parison to maintain its shape during the extrusion and during the longitudinal stretching that is provided by the rotary wheel machine as previously described as well as during lateral stretching prior to the mold closing as is hereinafter more fully described.

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It is hereinafter more fully described in greater detail, the vertically extruded hollow parison 56 of polyethylene terephthalate is extruded with a wall thickness that is varied to thereby control the wall thickness of the resultant blow molded product 62. More specifically, the wall thickness can be varied to accommodate for the effect of gravity and can also be varied to provide a different wall thickness at different portions of the container as desired to have the requisite strength.

As specifically illustrated in Figures 1 and 2, the polyethylene terephthalate parison 56 is extruded vertically in an upward direction from the extruder head 54 of extruder 52. Also, as illustrated by the two embodiments of the extruder head 54a and 54b as respectively shown by Figures 3 and 4, the polyethylene terephthalate parison 56 is extruded upwardly with a wall thickness that decreases from the initially extruded parison portion 56i to the finally extruded parison portion 56f associated with each mold. This decrease in the wall thickness accommodates for the downward force of gravity so as to provide a uniform wall thickness of the resultant blow molded product. Thus, the initially extruded parison portion 56i associated with each mold has a greater wall thickness than the finally extruded parison portion 56f; however, the force of gravity acting on the parison in a downward direction causes the hot plastic of the parison to flow downwardly to produce a parison upon mold closing with a generally uniform wall thickness between the initially and finally extruded parison portions 56i and 56f.

Both the extruder head embodiment 54a illustrated in Figure 3 and the extruder head embodiment 54b illustrated in Figure 4 supply pressurized gas from

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a source 66 to the interior of the hollow parison 56 of polyethylene terephthalate. This pressurized gas prevents the parison 56 from collapsing as it is extruded upwardly. The pressure of the gas supplied to the interior of the hollow parison 56 is varied between the initially and finally extruded parison portions associated with each mold. More specifically as illustrated in Figure 5, the pressurized gas during each cycle is supplied with a generally uniform pressure during the initial portion of the cycle but is supplied with a greater pressure near the end of the cycle to provide lateral stretching of the parison prior to the mold closing. This lateral stretching as is hereinafter more fully described in connection with Figures 10 through 12 permits manufacturing of containers with constructions that have not been heretofore possible such as the handled polyethylene container hereinafter disclosed.

As illustrated in Figure 3, the extruder head 54a provides extrusion of the polyethylene terephthalate parison 56 with an inwardly flared configuration which is useful in making relatively small size blow molded products. This extruder head 54a includes a body 68a having an interior bore 70a whose outer end 72a tapers inwardly with a frustoconical shape. An extrusion valve element 74a of the extruder head 54a is movable axially within the bore 70a and has an end 76a that tapers inwardly with a frustoconical shape adjacent the bore end 72a. A suitable unshown actuator moves the extrusion valve element 74a axially within bore 70a in a downward direction from the phantom line position to the solid line position during the extrusion cycle to decrease the spacing between the bore end 72a and valve element end 76a and thereby decrease the wall thickness of the parison 56 as it is extruded vertically in an

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upward direction. This decrease in the wall thickness accommodates for the effect of gravity to maintain a uniform wall thickness of the parison 56 upon being enclosed within the mold for blow molding. Also, 5 extrusion valve element 74a has a central passage 78a through which the pressurized gas is supplied from the source 66 through a conduit 80.

With reference to Figure 4, the embodiment of the extruder head 54b is similar to the Figure 3 10 embodiment described above except for the fact that its bore end 72b and its valve element end 76b are flared outwardly with frustoconical shapes instead of inwardly to thereby extrude the polyethylene terephthalate parison 56 with an outwardly flared configuration to 15 make relatively large size blow molded products. Otherwise the construction of the two extruder head embodiments is the same such that like reference numerals with the letter "b" subscript identifier are utilized and the operation is otherwise the same. 20 However, because of the outwardly tapering configurations of the bore and valve element ends 72b and 76b as opposed to inwardly tapering shapes as with the previously described embodiment, the valve element 74b is moved by its unshown actuator downwardly instead 25 of upwardly in order to provide the decreasing wall thickness during the vertical parison extrusion in an upward direction.

As illustrated in Figures 6 and 7, another embodiment of the plastic blow molding machine is 30 identified by 20' and has the same construction as the previously described embodiment except as will be noted such that like reference numerals are applied to like components thereof and most of the previous description is applicable, except as will be noted, and thus need

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not be repeated. The plastic blow molding machine 20' differs from the previously described embodiment in that its extruder 52' has an extruder head 54' that extrudes the unsupported hollow parison 56 of hot polyethylene terephthalate in a vertical direction that is downward as opposed to the vertical upward extrusion of the previously described embodiment. This vertical downward extrusion is adjacent the mold closing station 58' and the molds 30 are moved at a faster speed than the speed of the downward parison extrusion so as to provide the longitudinal stretching prior to the parison being closed within the mold for the blow molding that provides the biaxially oriented polyethylene terephthalate container. After rotation for cooling, the molds 30 are opened at an opening station 60' such that the blow molded product 62 can be removed for delivery on a suitable delivery conveyor.

As previously mentioned in connection with the embodiment of Figures 1 and 2, the polyethylene terephthalate parison 56 of the embodiment of Figures 6 and 7 is extruded at a temperature in the range of 250 to 290°C and has an intrinsic viscosity greater than about 0.9 as compared to conventional polyethylene terephthalate parisons which have an intrinsic viscosity of about 0.72. This increased intrinsic viscosity of the parison provides greater melt strength so as to permit the unsupported parison to maintain its shape during the hot extrusion and during the longitudinal stretching that is provided by the rotary wheel machine as previously described as well as during lateral stretching prior to the mold closing. As is also hereinafter more fully described, the vertical extrusion of the hollow parison 56 of polyethylene terephthalate in a downward direction is provided with a wall thickness that increases from the initial to the finally

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extruded parison portions associated with each mold in order to accommodate for the effect of gravity.

As illustrated in Figure 8, one embodiment of the extruder head 54a' utilized with the plastic blow molding machine 20' of Figures 6 and 7 has its extrusion bore end 72a' and its valve element end 76a' provided with frustoconical shapes that are inwardly tapered such that the polyethylene terephthalate parison 56 flares inwardly during the extrusion. The extrusion valve element 74a' is moved upwardly from the phantom line position to the solid line position during the extrusion to provide the parison with a wall thickness that increases from the initial to the finally extruded parison portions 56i and 56f in order to accommodate for the downward force of gravity acting on the parison and thereby permit forming of a blow molded container product with a uniform wall thickness. Pressurized gas is supplied through the interior passage 78a' of the extrusion valve element to prevent parison collapse and to also provide lateral stretching near the end of the cycle as previously described.

As illustrated in Figure 9, another embodiment of the extruder head 54b' utilized with the plastic blow molding machine 20' shown in Figures 6 and 7 has the same construction as the Figure 8 embodiment except that its extrusion bore end 72b' and its valve element end 76b' have outwardly tapering constructions of frustoconical shapes that provide an outwardly flared polyethylene terephthalate parison 56 extruded vertically in the downwardly direction to manufacture relatively large size blow molded container products as opposed to relatively small size ones. With this embodiment, the extruder valve element 74b' is moved downwardly to increase the parison wall thickness from

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the initially extruded parison portion 56i to the finally extruded parison portion 56f associated with each mold in order to accommodate for the downward force of gravity. Pressurized gas is supplied through the passage 78b' of the extrusion valve element to the interior of the parison 56 to prevent parison collapse and to also provide lateral stretching just prior to the mold closing as previously described.

As illustrated in Figures 10 through 12, the polyethylene terephthalate product 62 manufactured by the blow molding described above produces a container 82 after removal of the blow head 84 and plastic flash produced during the blow molding. This container 82 includes a body portion 86 having an exterior wall 88 as well as having a dispensing spout 90 illustrated at an upper location with respect to the container which is shown in a sideways orientation. A hollow handle 92 of the container is illustrated in Figure 10 and has opposite upper and lower ends 94 and 96 that are respectively connected to the exterior wall 88 as well as having an intermediate portion 98 that extends between these handle ends in a spaced relationship to the exterior wall at its adjacent portion 88a. The handle 92 defines an opening 99 through which a hand can be inserted to lift the container. This handle construction is formed by an interior mold projection 100 of the associated mold portion 32 which cooperates with a like interior mold projection of the other associated mold portion to clamp the parison with portions of the parison extending on each side of the clamped mold projections to form the container body portion and the handle after the blow molding. This forming is possible by virtue of the blowing just prior to the mold closing to laterally stretch the parison

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from the initial diameter D_i to the final diameter D_f of a larger size.

As is evident from the above description, the longitudinal stretching of the polyethylene terephthalate container 82 by the rotary wheel whose molds move faster than the speed of extrusion and the lateral stretching by both the increased interior parison pressure just prior to the mold closing and the subsequent blowing pressure in a conventional manner results in a biaxially oriented polyethylene terephthalate container. After the blow molding and the removal of the container 82 from the associated mold, the blow head 84 is trimmed as is exterior flash to complete the blow molding operation. At the container bottom 102 illustrated in Figure 12, the parting line 104 has an elongated parison portion 106 that corresponds to the diameter D_f of the parison upon mold closing and also has blown end portions 108 that correspond to the extent to which the container is blown outward in a lateral direction from its centerline during the blow molding within the enclosed mold.

It should be appreciated that the polyethylene terephthalate utilized to vertically extrude the parison 56 may have any necessary chemical additives to provide the requisite hot strength as well as providing clarity of the resultant blow molded product. The specific polyethylene terephthalate resin utilized is sold by Eastman Chemical Products, Inc. of Kingsport, Tennessee, United States of America under the designation X20291.

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While the best modes for carrying out the invention have been described in detail, those familiar with the art to which this invention relates will recognize various alternative designs and embodiments
5 for practicing the invention as defined by the following claims.

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WHAT IS CLAIMED IS:

1. A method for making a plastic blow molded product, comprising:

extruding a hollow parison of polyethylene
5 terephthalate from an extruder head at a predetermined speed in a vertical direction adjacent a closing station of a rotary blow molding wheel having molds with mold portions that close at the closing station to enclose the parison within an enclosed cavity of the closed
10 mold;

rotating the wheel to move the molds at a faster speed than the speed at which the parison is extruded to longitudinally stretch the parison in the vertical direction of extrusion prior to being enclosed
15 within each mold in a sequential manner;

blowing pressurized gas into the enclosed parison within each closed mold to provide a biaxially oriented polyethylene terephthalate blow molded product that conforms to the shape of the mold; and

20 thereafter opening each mold for removal of the biaxially oriented polyethylene terephthalate blow molded product.

2. A method for making a plastic blow molded product as in claim 1 wherein the polyethylene
25 terephthalate parison has an intrinsic viscosity greater than about 0.9.

3. A method for making a plastic blow molded product as in claim 1 wherein the vertically extruded hollow parison of polyethylene terephthalate is extruded
30 with a wall thickness that is varied to thereby control the wall thickness of the resultant blow molded product.

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4. A method for making a plastic blow molded product as in claim 1 wherein the polyethylene terephthalate parison is extruded upwardly from the extruder head.

5 5. A method for making a plastic blow molded product as in claim 4 wherein the polyethylene terephthalate parison is extruded upwardly with a wall thickness that decreases from the initially extruded parison portion to the finally extruded parison portion
10 associated with each mold.

6. A method for making a plastic blow molded product as in claim 1 wherein the polyethylene terephthalate parison is extruded downwardly from the extruder head.

15 7. A method for making a plastic blow molded product as in claim 6 wherein the polyethylene terephthalate parison is extruded downwardly with a wall thickness that increases from the initially extruded parison portion to the finally extruded parison portion
20 associated with each mold.

8. A method for making a plastic blow molded product as in any one of claims 1 through 7 wherein pressurized gas is supplied to the interior of the vertically extruded hollow parison of polyethylene
25 terephthalate and the pressure thereof is varied between the initially and finally extruded parison portions associated with each mold.

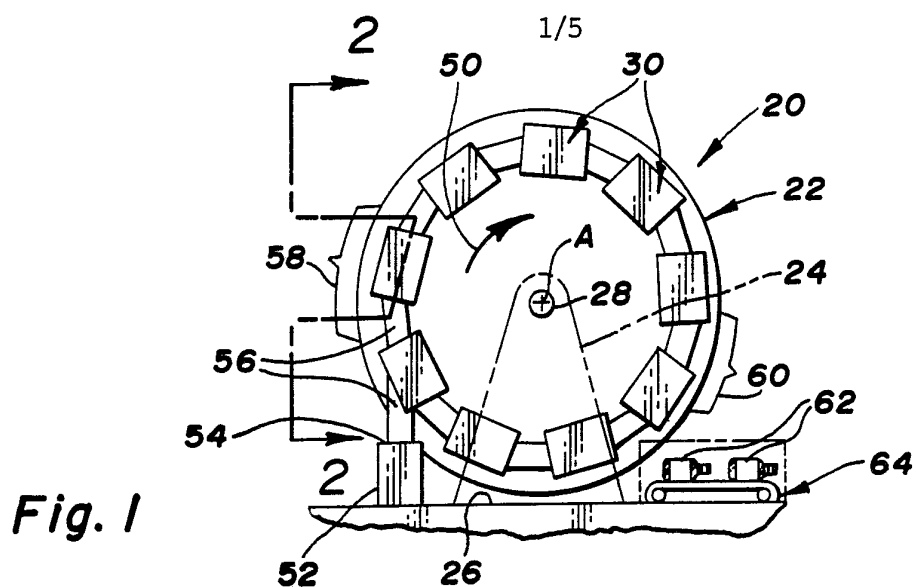
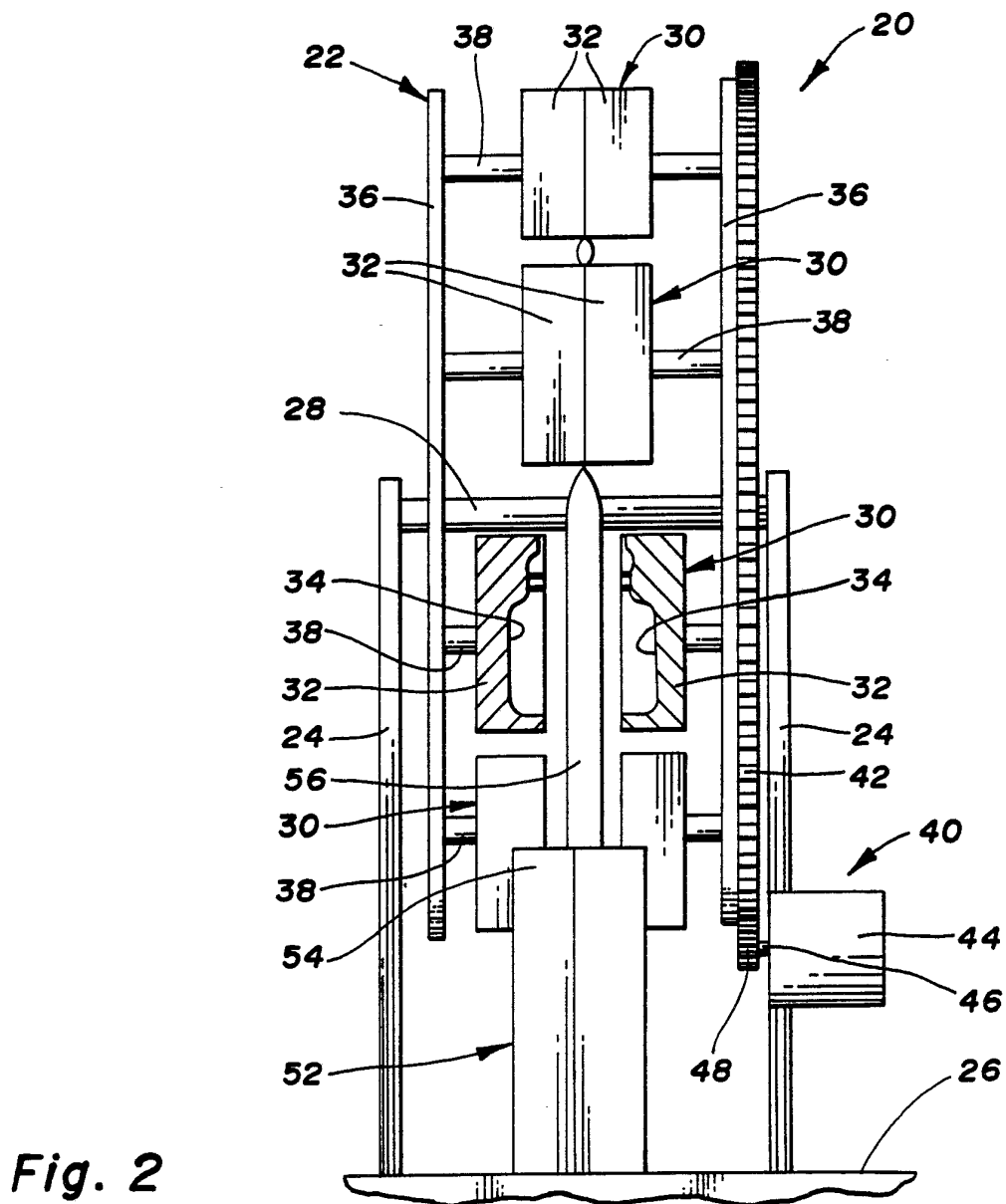
9. A method for making a plastic blow molded product as in claim 8 wherein the pressure of the
30 pressurized gas supplied to the interior of the hollow parison of polyethylene is increased prior to mold

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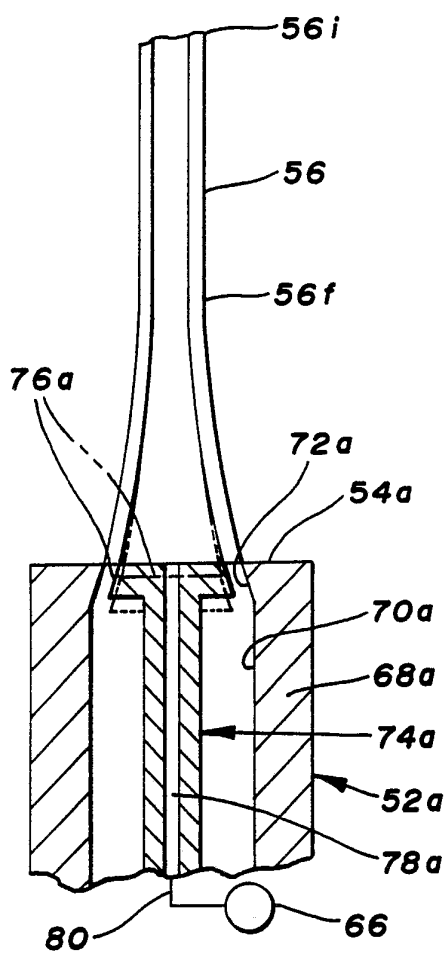
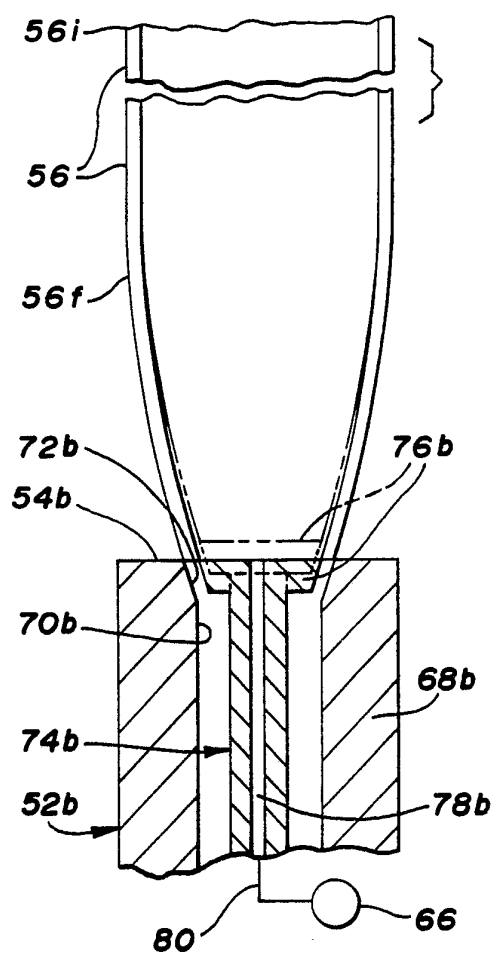
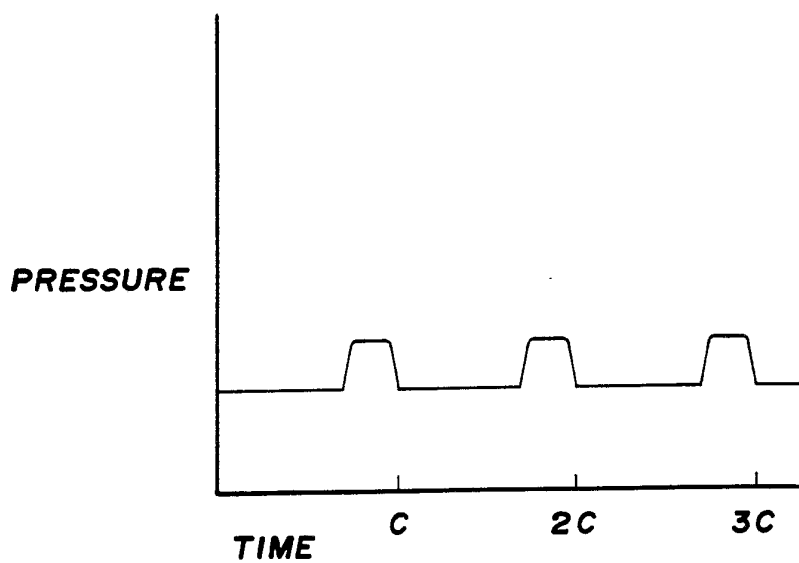
closing to provide lateral stretching of the parison prior to the mold closing.

10. A method for making a plastic blow molded product as in claim 1 wherein the polyethylene
5 terephthalate parison is extruded with an inwardly flared configuration to make relatively small size blow molded products.

11. A method for making a plastic blow molded product as in claim 1 wherein the polyethylene
10 terephthalate parison is extruded with an outwardly flared configuration to make relatively large size blow molded products.



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**Fig. 3****Fig. 4****Fig. 5**

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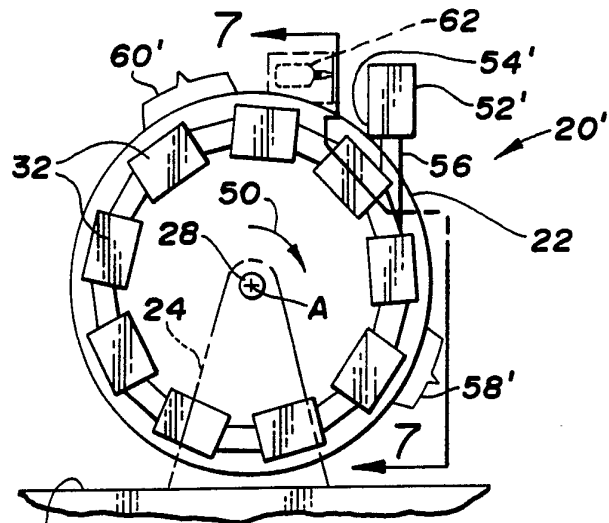


Fig. 6

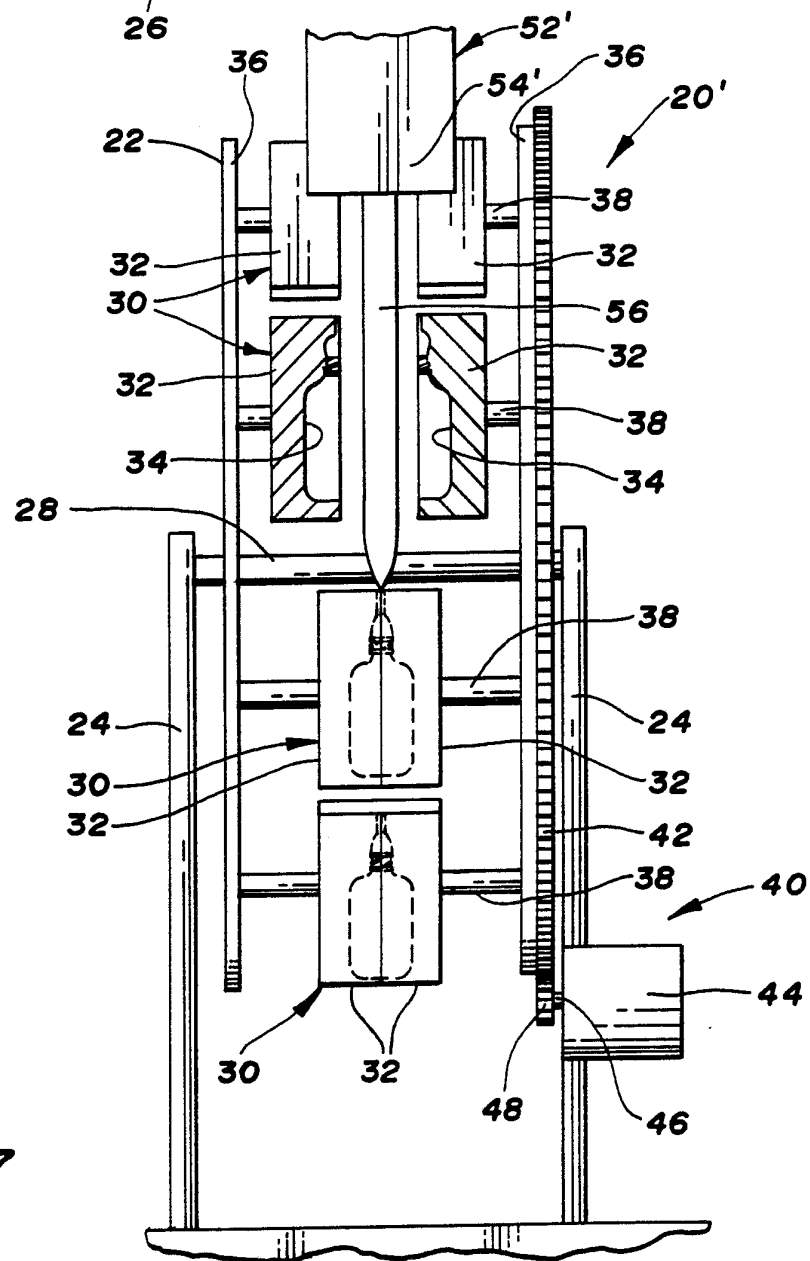


Fig. 7

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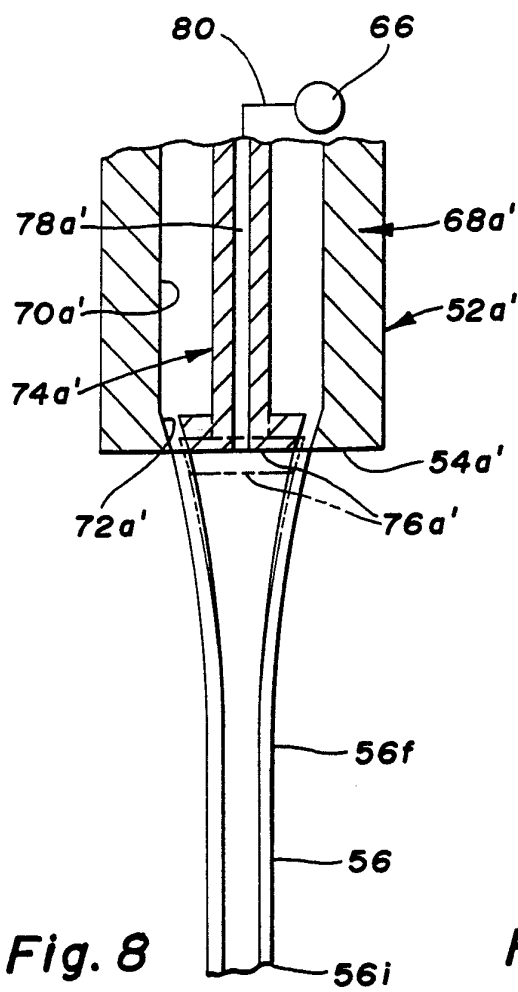


Fig. 8

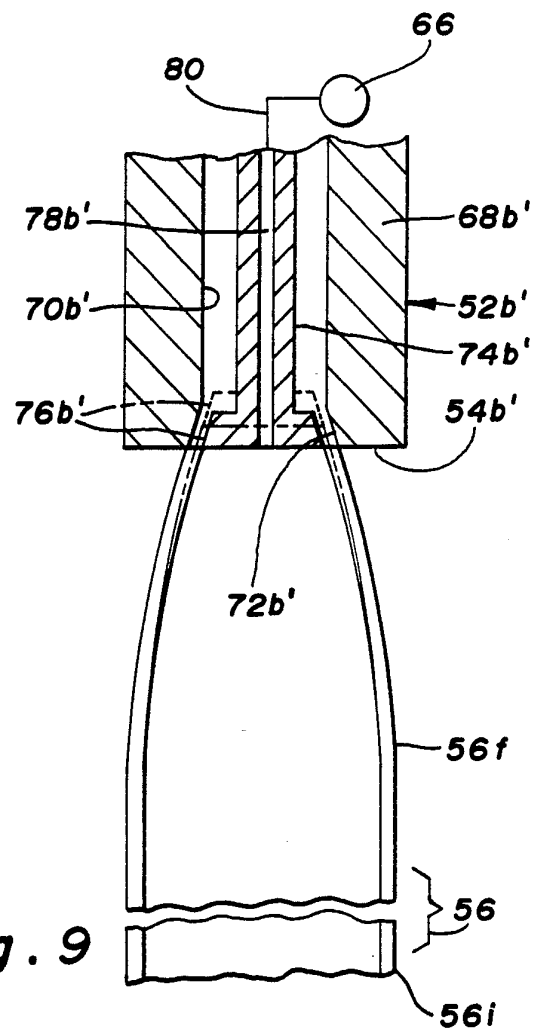


Fig. 9

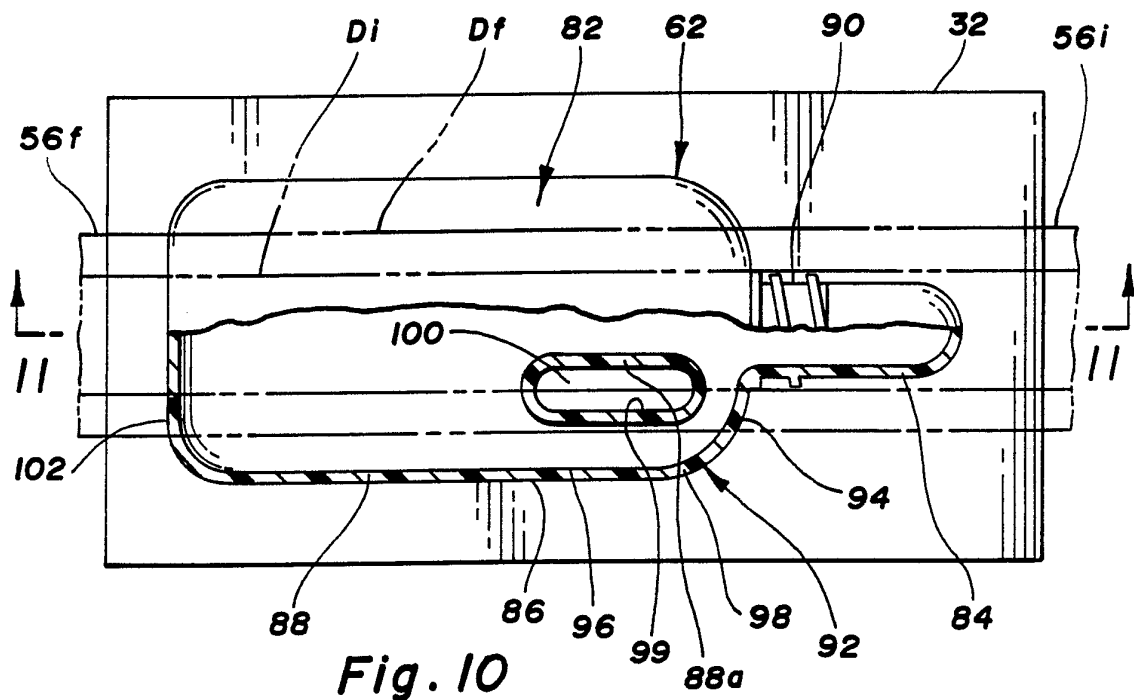
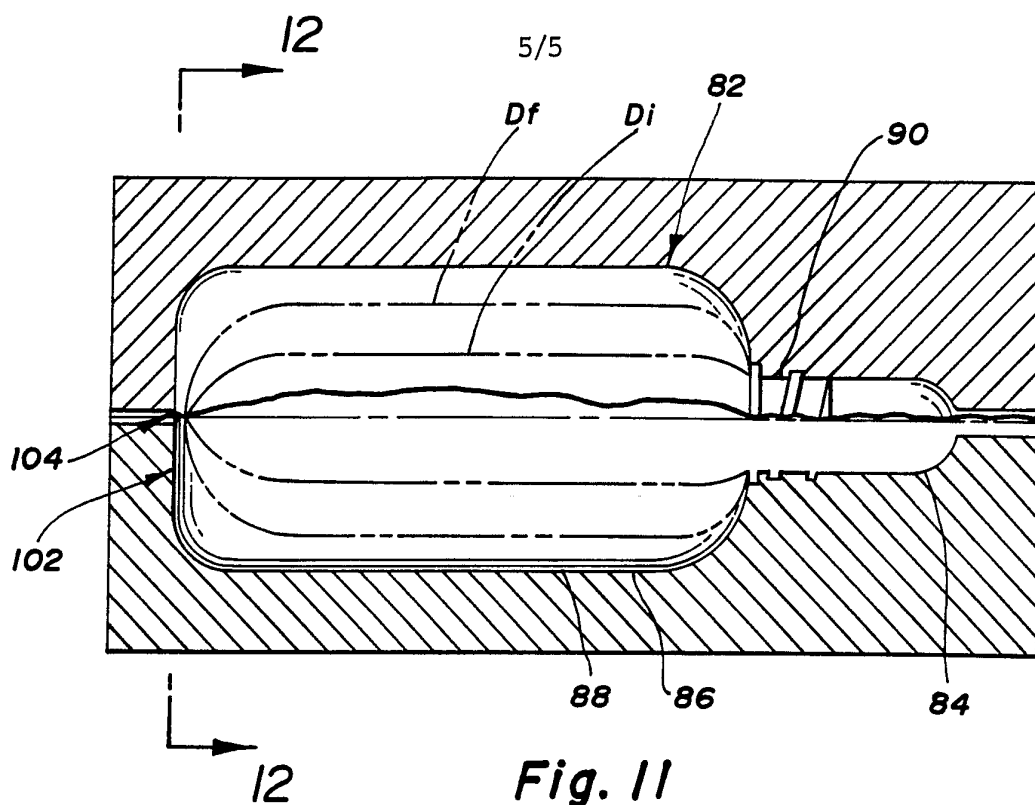
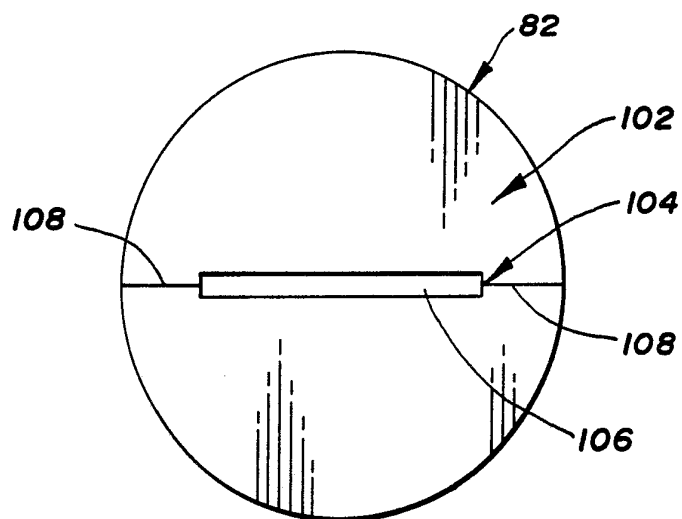
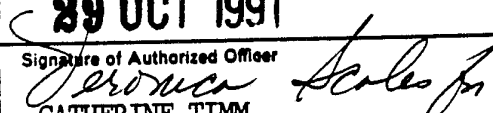


Fig. 10



INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/04793

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC(5): B29C 49/04; B29C 49/10; B29C 49/36		
U.S. CL.: 264/529,532,541,543; 425/529,530,540		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
U.S. CL.	264/529,532,541,543 425/529,530,532,540	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category [*]	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	US, A, 3,764,250 (WATERLOO) 09 October 1973, See Fig. 1.	1-11
Y	US, A, 3,608,015 (MARTELLI) 21 September 1971, See Fig. 1 and 2, abstract.	1-11
Y	US, A, 4,219,527 (EDELMAN) 26 August 1980, See example I and II, abstract).	1-11
Y	AU, B, 238,168 The Metal Box Co., Inc., 18 August 1960, See page 1, lines 12-18; page 2, lines 1-20 and page 2, lines 43-45.	1-11
Y	US, A, 3,584,091 (NAVE) 10 July 1969, See abstract.	1,2,4,6,8,9
Y	CA, A, 716,987 The Metal Box Co. Inc., 31 August 1965, See Figure 2.	10,11
A	JP, A, 47-48,269 (SHAWA YUKA K.K.) 26 December 1963, See Figs. 1-7.	10,11
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>[*] Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"&" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
11 OCTOBER 1991		29 OCT 1991
International Searching Authority		Signature of Authorized Officer
ISA/US		 CATHERINE TIMM

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A	US, A, 3,614,807 (LAGOUTTE) 13 June 1969, See Figs. 1-7.	1-11
A	NL, A, 7,303,267 (SAINT-GOBAIN) 11 September 1973, See entire document.	1-11
A	US, A, 3,585,262 (NAVE) 15 June 1971, See abstract.	1-11
A	US, A, 3,632,249 (PEARSON) 04 January 1972, See Figs. 1 and 2, abstract.	1-11

V ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE 1

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers _____, because they relate to subject matter ¹² not required to be searched by this Authority, namely:
2. ☐ Claim numbers _____, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:
3. ☐ Claim numbers _____, because they are dependent claims not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ **OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING:**

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
☐ No protest accompanied the payment of additional search fees.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
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A	US, A, 2,750,624 (COATES) 19 June 1956, See Fig. 2.	1-11
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A	US, A, 4,213,750 (KUBOTA) 22 July 1980, See Fig. 2, abstract.	1-11
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