Description

TECHNICAL FIELD

This invention relates to the use of fluid pressure in a method, system and device utilized therein for injection molding and plastic article.

BACKGROUND ART

It is known in the plastic molding art to use pressurized fluid in conjunction with the plastic molding of articles. The pressurized fluid is typically nitrogen gas which is introduced into the mold cavity with the molten plastic.

The pressurized fluid serves at least two purposes. First, it allows the article so formed to have hollow interior portions which correspond to weight and material savings. Second, the pressurized fluid within the mold cavity applies outward pressure to force the plastic against the mold surfaces while the article sets up. This is desirable toward enhancing surface quality by minimizing sink marks in areas of the article having relatively thicker plastic sections, such as structural ribs.

However, the added equipment and process control parameters required to implement fluid injection contribute significantly to the cost and complexity of this type of injection molding.

Another concern is that when the gas and plastic are injected into the mold from the same nozzle, the gas gets trapped in the nozzle area thereby foaming any molten resin in that area during venting. This foamed plastic causes blemishes (i.e. splay) in the next part when injected into the mold.

Of particular concern are the fluid charging components and circuits needed to charge, inject and vent the pressurized fluid at the controlled times and pressures necessary for quality part production on a repeatable, volume basis. Prior art devices addressing this concern have answered with complex valves and seals which are expensive, difficult to operate, and require maintenance or replacement at frequent intervals. The problem is especially acute with seals whose performance diminishes over their useful life.

GB 2 139 548 describes a method for the injection molding of a plastic article in an injection colding system including a resin injection nozzle and a mold having a injection aperture for receiving molten resin from the nozzle at an upstream position, a mold cavity at a downstream position and a resin flow path for fluidly communicating the injection aperture and the mold cavity betweeen the upstream and downstream positions, the method comprising the steps of :

a) pressurizing a charge of fluid at a perdetermined pressure level;

b) injecting a quantity of molten plastic from the injection nozzle through the injection aperture and the flow path and into the mold cavity at a nominal plastic injection pressure;

c) communicating the charge of pressurized fluid to an orifice opening to the resin flow path in the mold between the upstream and downstream positions; introducing the fluid charge into the flow path from the orifice to distribute the molten plastic within the mold cavity;

d) containing the fluid under presssure within the articles until it has set up in the mold cavity; and

e) venting the fluid to ambient.

US 4 101 617 discloses a method for making a hollow-shaped body from a thermoplastic resin by injection molding, which method comprises injecting an amount of molten resin sufficient for preparation of the hollow-shaped body from an injection nozzle into a mold through an injection aperture in the mold. The method also includes the steps of injecting gas under pressure through said injection nozzle and an aperture to expand and distribute the molten resin over the interior surfaces of the mold. A hollow-shaped body is formed within the mold with a gas entry opening in the hollow-shaped body. The method also includes the steps of cooling the hollow-shaped resin body so formed to a temperature beneath the softening point of the resin and separating the mold and the injection nozzle after the resin has cooled beneath its softening point. In this way, the interior of the hollow-shaped body is open to the atmosphere through the injection aperture and the gas entry opening to equalize the pressure within the body with the ambient pressure. The method finally includes the step of opening the mold to remove the hollow-shaped body.

According to the invention there is provided a method for the injection molding of a plastic article in an injection molding system including a resin injection nozzle and a mold having a injection aperture for receiving molten resin from the nozzle at an upstream position, a mold cavity at a downstream position and a resin flow path for fluidly communicating the injection aperture and the mold cavity betweeen the upstream and downstream positions, the method comprising the steps of:

a) pressurizing a charge of fluid at a perdetermined pressure level;

b) injecting a quantity of molten plastic from the injection nozzle through the injection aperture and the flow path and into the mold cavity at a nominal plastic injection pressure;

c) communicating the charge of pressurized fluid to an orifice opening to the resin flow path in

the mold between the upstream and downstream positions; introducing the fluid charge into the flow path from the orifice to distribute the molten plastic within the mold cavity;

d) containing the fluid under presssure within the articles until it has set up in the mold cavity; and

e) venting the fluid to ambient at a controlled rate wherein the charge of pressurized fluid is introduced into the flow path after the quantity of molten plastic is introduced into the flow path and in that the introduced fluid charge is prevented from travelling from the flow path through the injection aperture and into the injection nozzle.

In some embodiments the introduced fluid charge is prevented from travelling into the injection nozzle by introducing the fluid charge into the flow path at a fluid injection position, the resin having a greater resistance to fluid charge travel between the fluid injection position and the upstream position than between the fluid injection position and the downstream position.

The invention also provides an injection molding system for the injection of plastic articles comprising:

an injection molding machine including an injection nozzle for injecting molten plastic through the nozzle;

a mold having a resin injection aperture for receiving the molten plastic at an upstream position, a cavity defining the shape of the molded article at a downstream position and a plastic flow path for fluidly communicating the injection aperture and the cavity between the upstream and downstream positions;

fluid charge means for pressurizing a charge of fluid at a predetermined level; and

fluid circuit means interconnecting the flow path and the fluid charge means between the upstream and downstream positions at an orifice opening to the flow path for introducing the fluid charge into the flow path simultaeously with or after plastic injection, so that the fluid charge distributes the molten plastic in the mold cavity; wherein the mold includes a sprue, the sprue having the injection aperture and at least part of the flow path wherein the fluid circuit means is contained within the sprue and wherein the sprue includes a bushing having the orifice and wherein the injection nozzle communicates with the bushing and the fluid charge is communicated to the orifice in the bushing said fluid circuit means including means for venting pressurized fluid to atmosphere after molding said article and for preventing the introduced fluid charge from travelling from the flow path through the injection aperture and into the nozzle.

The fluid circuit can include a valve having open and closed positions for introducing the fluid circuit means including valve means having open and closed positions, said valve means introducing the fluid charge to the flow path through the orifice in the open position and preventing communication of the fluid charge to the flow path in the closed position.

The invention further provides a device for use with an injection molding systen of the type including an injection nozzle and a mold having a mold cavity at a downstream position, a resin injection aperture at an upstream position and a resin flow path for fluidly communicating the injection aperture and the mold cavity, the device being for assisting in the introduction of pressurized fluid into the cavity and for preventing the fluid from travelling from the flow path, through the injection aperture and into the nozzle, the device comprising:

a body adapted to seat in the mold between the injection nozzle and the mold cavity, said body defining at least part of the resin flow path communicating the injection aperture with the cavity, the body having an orifice opening to the flow path, an external fluid port and a fluid passage extending between the external fluid port and the orifice wherein the orifice is dimensioned to be sufficiently small to resist entry of the relatively viscous molten resin.

The orifice may be positioned to introduce the fluid co-linearly with the direction of resin flow.

The mold may include a sprue having a sprue opening and the device may be adapted to seat in the sprue opening.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a flow chart setting forth the operational steps of one embodiment of the method of the present invention;

Figure 2 is a general schematic view of a system constructed in accordance with the present invention;

Figure 3 is an end view of a sprue bushing employed in the apparatus of Figure 2;

Figure 4 is a fragmentary enlarged view of the central portion of the sprue bushing of Figure 3;

Figure 5 is a sectional view of the central portion of the sprue bushing taken along line 4-4 of Figure 4;

Figure 6 is a detailed schematic view of the pressurized fluid circuit shown schematically in Figure 2;

Figure 7 is a general schematic view of the present invention adapted to a hot runner mold with multiple plastic and fluid entry points in the mold cavity;

Figure 8 is a more detailed diagrammatic view of a hot runner system adaptation consistent with the schematic view of Figure 7;

FIGURE 9 is a sectional schematic view, partially broken away, illustrating a second embodiment of a sprue bushing of the present invention having a rotary pin in a first control position;

FIGURE 10 is a view similar to FIGURE 9 with the rotary pin disposed in a second control position 95 degrees from the first control position;

FIGURE 11 is an end view, partially broken away and in cross-section illustrating the relative shapes of the pin and the plastic injection nozzle of FIGURES 9 and 10;

FIGURE 12 is an end view of the pin of FIGURE 10;

FIGURE 13 is a view similar to FIGURE 9 but illustrating a third embodiment of a sprue bushing having a pin constructed in accordance with the present invention and in its first control position;

FIGURE 14 is a view similar to FIGURE 13 with the pin of FIGURE 13 translated linearly to the left to a second control position;

FIGURE 15 is an end view, partially broken away and in cross-section, illustrating the relative configurations of the pin of FIGURES 13 and 14 and the injection nozzle;

FIGURE 16 is a view similar to FIGURE 9 but illustrating a fourth embodiment of a sprue bushing constructed in accordance with the present invention and in its first control position;

FIGURE 17 is a view similar to the view of FIGURE 16 with the pin of FIGURE 16 translated linearly to a second control position;

FIGURE 18 is an end view, partially broken away, of the pin of FIGURES 16 and 17;

FIGURE 19 is a view similar to FIGURES 16 and 17 with the pin located in a third control position after being translated linearly from the second control position of FIGURE 17;

FIGURE 20 is a schematic view of a modified version of the sprue bushing of FIGURES 2 through 5 having a valve mechanism disposed therein in a first control position in combination with various external directional valves;

FIGURE 21 is a view similar to FIGURE 20 with the internal valve mechanism disposed in its second control position to allow gas to enter the flow path of the plastic; and

FIGURE 22 is an enlarged top plan view, partially broken away, of the sprue bushing of FIGURES 20 and 21 illustrating the plastic flow path through the sprue bushing, the fluid passage extending therethrough and their interrelationship therebetween.

BEST MODE FOR CARRYING OUT THE INVENTION

The present invention will be first described by reference to the operational steps of a first embodiment of the method. Second, the apparatus employed in the first embodiment will be described. The operation of the apparatus in accordance with the method will be described in connection with an injection molding cycle. Finally, alternative embodiments of the apparatus will be described.

General Method of Operation

FIGURE 1 is a flow chart setting forth the general operational steps involved in one embodiment of the method of the present invention. In overview, the method provides for molding of plastic articles with hollow interior sections where pressurized fluid is present in the formation of the article in the mold cavity. The presence of the pressurized fluid creates an outward pressure which minimizes sink marks and reduces the material requirements and weight of the molded article.

In step 1, a charge of fluid is pressurized at a predetermined level which may be higher or lower than the nominal plastic injection pressure. If the charge of fluid is introduced during resin injection, the charge of fluid may be at a lower pressure than the pressure of the plastic injection pressure. If the charge of fluid is introduced after resin injection, the charge of fluid may be either higher or lower than the plastic injection pressure.

In step 2, the quantity of molten plastic is injected from the nozzle of conventional injection molding machine through a flow path into a mold cavity at the nominal injection pressure. The quantity of molten plastic, i.e. the plastic shot, is less than the quantity of plastic which would be ordinarily required to fill the mold cavity.

In step 3, the charge of pressurized fluid, preferably nitrogen gas, is communicated from a chamber where it is introduced into the flow path through an orifice which, in the first embodiment, is of sufficiently small dimension to resist entry of the relatively viscous molten plastic. The relatively greater pressure associated with injection to the molten plastic prevents entry of the fluid charge into the plastic flow until substantial completion of the injection stroke of the molding machine.

In step 4, the charge of pressurized fluid in the first embodiment responds to a reduction of the pressure in the flow path associated with substantial completion of the plastic injection. This causes the fluid charge to enter the flow path and to continue into the mold cavity. The entry of the fluid charge into the cavity is self-executing in response

to the pressure drop at the end of the plastic injection stroke, and no timers, valves or the like are specifically required to introduce the fluid charge into the plastic melt in the mold cavity.

In step 5, the pressurized fluid is contained within the molding while the plastic solidifies and defines the shape of the molded article. During this time pressurized fluid exerts outward pressure which forces the plastic to conform to the detail of the mold surface and exhibit fine detail with minimal sink marks or other surface defects.

In step 6, the fluid is vented to ambient from the mold cavity prior to opening the mold and removing the finished molded article.

Description of the Apparatus

FIGURE 2 is a general schematic view of the first embodiment of a system suited for practicing the plastic injection molding method of the present invention.

The controlled entry of pressurized fluid, typically nitrogen gas, is accomplished by use of a modified mold sprue 10. The sprue 10 includes a disk-shaped insert 12 disposed within a sprue body 14.

The mold sprue 10 cooperates with a conventional plastic injection molding machine 20. The nozzle 18 of the molding machine 20 mates with a concave surface 22 on the face of the insert 12 to provide a continuous path 16 for the flow of plastic from the machine through the sprue 10 and into a mold cavity (not shown).

The flow of molten plastic through the insert 12 may be diverted by a conventional torpedo 24 of the type well known in the art.

The introduction of pressurized fluid to the flow path is through passage segments 26 and 28 formed (by drilling or the like) in the insert. The passage 26 opens into the flow path through an orifice 30 of sufficiently small dimension, e.g. .005 - .040 in., depending on the viscosity of the plastic, to effectively prevent entry of the relatively high viscous molten plastic during injection.

The plastic injection molding machine 20 includes a barrel 32 with a central cylindrical opening 34. A screw 36 serves to plasticize and advance resin toward the nozzle area. Upon complete plasticization of the resin the screw 36 is hydraulically advanced toward the head of the barrel 32 to inject molten plastic through the nozzle 18. The plastic passes through the sprue insert 12 at a nominal plastic injection pressure through the stroke of the screw 36. This pressure falls upon substantial completion of the stroke and discharge of the plastic from the barrel 32 of the molding machine 20.

The sprue bushing or insert 12 is illustrated in greater detail in FIGURES 3, 4 and 5.

The insert 12 is shown mounted concentrically in a recess in the sprue body 14. Molten plastic passes from the nozzle and around the torpedo through a pair of kidney-shaped apertures 16a and b which serve as first and second branches in the flow path. The pressurized fluid in communicated to the plastic path flow through passage segment 26 and orifice 30 which is mediate the plastic flow branches and co-linear therewith.

The temperature of the insert 12 can be controlled depending on the processing specifications of the plastic being used by employing electrical heater bands or other types of auxiliary heat sources as is well known in the art.

Again with reference to FIGURE 2, the apparatus also includes a mechanism for charging and communication of pressurized fluid, or gas, to the sprue insert 12.

A hydraulic fluid supply 38 directs a working fluid, such as oil, under pressure to a chamber 40 of an accumulator 42 effectively separated into two chambers, having mutually and inversely variable volumes, by a compression piston 44. A fluid supply 46 is provided for directing a charge of gas through a first check valve 48 into the second chamber 50 of the accumulator 42 for pressurization. A valve 54 controls communication of gas from the chamber 50 to the sprue insert 12. A second check valve 52 is connected in series with the control valve 54.

Operation

A typical plastic injection molding cycle is initiated by directing a charge of fluid, normally nitrogen gas, under pressure from the fluid supply 46 into the chamber 50 of the compression cylinder 42, and then directing oil, also under a predetermined pressure from the hydraulic fluid supply 38, into the first chamber 40 of the compression cylinder 42. The compression piston 44 maintains the amount of gas held in the second chamber 50 at a constant pressure as a function of the pressure of the oil in the first chamber 40.

Plastic resin is melted and fed by the rotating screw 36 into the plastic injection apparatus forward chamber of cylinder 34. When the molten plastic has been accumulated therein, the screw 36 is advanced linearly, forcing the molten plastic through the nozzle 18 and into the flow path 16.

During the plastic injection stroke, the gas charge in the second chamber 50 of the cylinder 42 is communicated through fluid lines and the segments 26 and 28 in the sprue bushing insert 12 to the fluid injection orifice 30 in the downstream end of the torpedo 24. The fluid pressure at the

orifice 30 is at a predetermined level which is less than that of the nominal plastic injection pressure, but it is sufficiently high and the dimension of the orifice 30 is sufficiently small to effectively resist the entry of molten plastic thereinto. The level of fluid pressure at the orifice 30 may be determined through a few manual trial cycles and review of the surface quality of the molded articles produced at the trial pressures.

As the plastic injection stroke is substantially completed, the pressure of the plastic will fall below the predetermined pressure of the fluid at the orifice 30. The fluid responds by following the plastic along flow path 16 into the mold cavity.

As the gas is injected, it follows the path of least resistance within the mold cavity. Since the molten plastic cools and hardens from its outer surface inwardly, the gas will penetrate the inner, warmer, softer part of the plastic normally formed with thicker sections, e.g. a structural rib, creating a hollow within the plastic in this area and expanding it outwardly to fill the mold cavity. During the gas injection phase of the molding cycle, the gas pressure can be held at an effectively constant level by maintaining an application of constant oil pressure against the compression piston 44 in the compression cylinder 42; or it can be allowed to decay as the gas expands within the plastic.

In practice it has been found that the injected fluid meets with an initial resistance upon reaching the plastic in the mold cavity, and once it penetrates the plastic the resistance steps down substantially. Hence, an initially higher breakthrough pressure should be maintained for the fluid, and thereafter the fluid pressure can be decreased, in a step function or otherwise, to avoid unnecessarily high fluid pressure within the plastic article while it is setting up in the mold cavity. A controlled reduction in pressure will tend to minimize the chance of straining the part before the plastic has cooled and hardened. If the part is strained, the part will distort outside the mold.

After the plastic has completely filled the mold cavity and the gas flow through the fluid injection orifice 30 has terminated, the oil that had been introduced under pressure to the chamber 40 of the accumulator 42 is evacuated. Subsequently, when the plastic article has cooled sufficiently to be structurally self-supporting, the gas within it is vented to atmosphere under control of the valve 54 through the same passages 26 and 28 by which it entered the insert 12. Ventilation may be accomplished solely via the fluid passage 26 or in combination with movement of the nozzle 18 away from the mold (i.e. sprue break).

It is preferred to meter of regulate the ventilation of gas to ambient to minimize the risk of drawing any fluent plastic or impurities with the fluid and thereby contaminating of clogging the fluid path. The mold can then be opened and the molded article ejected.

With reference to FIGURE 6, the mechanism for charging and pressurizing fluid or gas, for use in the subject molding process, will be described in greater detail.

Initially, power is applied to an electric motor 58, which drives a hydraulic pump 60, forcing hydraulic fluid, or oil, at a pressure controlled by a pressure switch 62, from a reservoir 64 through a directional control valve 66 in its neutral position and back to the reservoir. A shut-off valve 68 is next opened, allowing pressurized fluid, or gas, to flow from a fluid supply, or tank 70, through a pressure regulator 72, an in-line filter 74 and a check valve 48 and into the chamber 50 of the accumulator 42. This charge of gas is retained in the chamber 50 by the check valve 48 and a directional control valve 56.

The directional control valve 66 is energized, and oil is directed to the chamber 40 of the accumulator 42, forcing the compression piston 44 upward and applying pressure thereby to the gas residing in the chamber 50 of the compression cylinder. When the pressure of the oil has reached a preset level controlled by a selected setting on the pressure switch 62 and indicated by a gas pressure gauge 76, the directional control valve 66 is de-energized, isolating the oil in the chamber 40 at this pressure. The directional control valve 56 is then opened long enough to communicate the gas in the chamber 50 of the accumulator 42 through the passages 26 and 28 in the insert 12 shown in FIGURE 2 of the injection orifice 30.

Adjustments to the level of the pressure created by the action of the compression piston 44 upon the gas within the second chamber 50 of the compression cylinder 42 can be made at this time by altering the setting of the pressure switch 62 and repeating the previously described preparation cycle until the desired pressure is indicated by the pressure gauge 76.

The directional control valve 67 is energized; and the gas pressure in the chamber 50 forces the compression piston 44 downward, in turn forcing the oil out of the first chamber 40 and through the directional control valve 67 and a counterbalance valve 78 to the reservoir 64. The pressure of the oil being directed to the reservoir 64 is controlled by the counterbalance valve 78, which is set at a pressure slightly below that of the pressure regulator 72. The gas pressure between the latter and the check valve 48 is indicated by a pressure gauge 80.

Following the previously described preparation, a first cycle of operation may be initiated by rotating the screw 36 in the plastic injection molding

machine 20 shown in FIGURE 2 until a predetermined amount of molten plastic has accumulated in the forward chamber 34 of cylinder 32. Directional control valve 66 shown in FIGURE 5 is then energized; and oil is directed to the chamber 40 of the accumulator 42, forcing the compression piston 44 upward and applying pressure thereby to the gas residing in the chamber 50. When the pressure has reached the predetermined level controlled by the pressure switch 62, the directional control valve 66 is de-energized, isolating the oil in the chamber 40 at this pressure and thereby maintaining the charge of gas in the chamber 50 at the same pressure.

The screw 36 in the plastic injection molding machine in FIGURE 2 is then advanced linearly, forcing the molten plastic accumulated in the injection cylinder chamber 34 through the nozzle 18 and into the flow path 16 leading to the mold cavity (not shown). As shown in detail in FIGURES 3-5, within the sprue bushing insert 12, the torpedo spreads the plastic into first 16a and second 16b paths, the cross-sectional areas of which increase in the direction of the plastic flow. At a selected point during or after the linear advance of the screw 36, the directional control valve 56 in FIGURE 6 is opened, allowing the gas in the chamber 50 to flow through the second check valve 52 and directing it through the passage segments 26 and 28 shown in FIGURE 2 to the orifice 30 in the downstream end of the torpedo 24.

After the plastic has filled the mold cavity, the directional control valve 56 is closed, capturing the gas in the mold cavity. The directional control valve 66 is energized, only if the oil and gas pressures were maintained constant during the gas injection phase; and the gas pressure in the chamber 50 forces the compression piston 44 downward, in turn forcing the oil out of the chamber 40 and through directional control valve 67 and the counterbalance valve 78 to the reservoir 64. The pressure of the oil being directed to the reservoir 64 is controlled by the counterbalance valve 78, which is set at a pressure slightly below that of the pressure regulator 72. The gas pressure between the latter and the check valve 48 is indicated by the pressure gauge 80.

After the compression piston 44 has moved to its fully retracted position, directional control valve 67 is de-energized and the valve 66 is energized. Oil is directed to the first chamber 40 of the accumulator 42, once again forcing the piston 44 upward and compressing the gas present in the second chamber 50. When the oil pressure has reached the predetermined level controlled by the pressure switch 62, the directional control valve 66 is de-energized, isolating the oil in the chamber 40 at this pressure and thereby maintaining the charge of gas in the second chamber 50 at the same pressure, ready for the next plastic injection cycle.

After the plastic article has cooled sufficiently within the mold cavity to be structurally self-supporting, a directional control valve 82 is opened, venting the gas from within the hollow plastic article at a metered rate controlled by a flow control valve 84. Thereafter, the directional control valve 82 is closed and the completed article is ejected from the mold.

In the alternative arrangement, the pressure of the fluid during injection into the mold cavity can be regulated in stages. As previously mentioned, the fluid meets with an initially greater resistance until it has penetrated the plastic. For this purpose the valve 85 may be actuated at a selected point in the fluid injection to reduce the pressure in chamber 40. The actuator of valve 85 can be determined on a pre-set time basis, or in response to a sensed pressure drop below a lower limit in the flow path. The sensed pressure drop would correlate with breakthrough of the fluid into the molten plastic. The valve 85 is cooperative with a counterbalancing valve 86 to permit a controlled flow of oil from chamber 40 to the reservoir 64.

In reference to FIGURES 7 and 8, the method of the present invention is shown adapted to a hot runner mold system in which a mold cavity has plural plastic entry points.

FIGURE 7 is a schematic view of a typical mold 90 in cross section with two part cavities 92 and 94. A nozzle 96 mates with a sprue 98 to introduce molten plastic into a runner system having three branches 100, 102 and 104. At each plastic entry point a disk-shaped device 106, similar to the construction of insert 12 of FIGURES 2-5, functions to permit the selective introduction of pressurized fluid into the cavity.

FIGURE 8 is a more detailed diagrammatic view of a conventional hot runner manifold 108. The manifold includes separately adjustable nozzles 110 which supply plastic through the devices 106.

With reference to FIGURES 9 through 22, the method and system of the present invention can also be practiced with apparatus including devices or sprue bushings, generally indicated at 12', 12", 12‴ or 12⁗. The sprue bushings of drawing figures 9 through 22 have parts which are given the same reference numerals as the sprue bushing 12 of FIGURES 1 through 8 to designate parts which are the same or substantially similar in either structure or function to the parts of FIGURES 1 through 8.

For example, the sprue bushing 12' of FIGURES 9 through 12 includes a first body part 13' in which a second body part of cylindrical pin 15' is mounted for rotary movement upon actuation of a rotary actuator, generally indicated at 21'. A shaft

23' of the rotary actuator 21' interconnects the pin 15' to the rotary actuator 21'.

A nozzle 18' having a concave surface 19' mates with the outer cylindrical convex surface 22' of the cylindrical pin 15' at an upstream position after extending through an injection aperture 17' formed in the first body part 13'.

In a first control position of the pin 15' as illustrated in FIGURE 9, a tapered plastic flow aperture 16a' formed completely through the pin 16' is aligned with a tapered plastic flow aperture 16b' formed in the first body part 13' to allow the plastic to flow from the nozzle 18' into the mold cavity(not shown) at a downstream position. The apertures 16a' and 16b' form part of the flow path 16' for the plastic.

In a second control position of the pin 15' as illustrated in FIGURE 10, the pin 15' is rotated to the second control position from the first control position by the rotary actuator 21' approximately 90 degrees so that a fluid passage 26' opens into the flow path 16' through an orifice 30'. The fluid passage 26' extends between an external fluid port 28' in the pin 15' to the orifice 30'.

Preferably, the nozzle 18' provides a relatively high pressure fluid seal against the pin 15' during plastic injection and during injection of the compressed nitrogen gas. The nozzle 18' provides a relatively low pressure fluid seal to permit movement of the pin 15' while still preventing molten resin from oozing from either the nozzle or the mold.

The fluid passage 26' also serves as a vent port during ventilation of the mold part. Ventilation may be accomplished solely via the fluid passage or in combination with movement of the nozzle 18' away from the mold (i.e. sprue break).

Also, as in the first embodiment, the sprue bushing 12' may be heated.

The pin 15', in combination with the first body part 13' operates like a shutoff valve which is conventionally incorporated within the nozzle 18'. Such a shutoff valve is typically very expensive.

Referring now to FIGURES 13 through 15, there is illustrated a third embodiment of a sprue bushing, generally indicated at 12" wherein, instead of a rotary actuator 21', a linear actuator, generally indicated at 21", is utilized to linearly move the pin 15" between first and second control positions, as illustrated in FIGURES 13 and 14, respectively. In the first control position, a plastic flow aperture 16a" is aligned with a plastic flow aperture 16b". As shown in FIGURE 14, a fluid passage 26" is aligned with the aperture 16b" to allow the communication of the fluid passage 26" with the aperture 16b".

Referring now to FIGURES 16 through 19, there is illustrated a fourth embodiment of a sprue bushing, generally indicated at 12"', which is similar to the sprue brushing 12" of FIGURES 13 through 15. The main difference between the third embodiment and the fourth embodiment is that the venting occurs at one of a pair of vent slots 31"', as best shown in FIGURE 19, upon linear movement of the pin 15"' caused by the linear actuator, generally indicated at 21"'. As in the second embodiment, venting may be accomplished solely by the vent slots 31"' or in combination with sprue break.

In each of the second, third and fourth embodiments, after the gas is vented from the molding or molded article, realignment of the aperture 16a with aperture 16b allows the removal of any plastic within the passages 16a and 16b prior to the beginning of another cycle. Alternatively, the plastic goes into the mold cavity in the next cycle. Because of the misalignment between aperture 16a and 16b in these embodiments, there is no chance for the gas to migrate back to their respective resin injection apertures to contaminate the plastic in their respective nozzles.

Referring now to FIGURES 20 through 22, there is illustrated yet still another embodiment of a sprue bushing 12"" constructed in accordance with the present invention. In this embodiment, a sliding needle valve 33"" is located in the sprue bushing 12"". In the closed position of the needle valve 33"", no plastic can get past the needle valve 33"" during plastic injection.

In the open position of the needle valve 33"", as illustrated in FIGURE 21, gas is injected through a port 28"" and flows through a fluid passage 26"", through an orifice 30"" and into the plastic flow path leading to the mold cavity (not shown). Also, gas is vented from the molding (not shown) in the position illustrated in FIGURE 21 back through the port 28"".

Movement of the needle valve 33"" is controlled by directional valves 35"", 37"", 39"" and 41"" from a nitrogen gas source 43"" in the following sequence. Initially, the directional valve 39"" is energized while the remaining directional valves are de-energized to move the needle valve 33"" to its closed position, as illustrated in FIGURE 20. As previously mentioned, in this position the molten plastic is injected through the aperture 16a"" in the sprue bushing 12"".

When the plastic injection is substantially finished, directional valves 35"" and 41"" are energized and the directional valve 39"" is deenergized to allow the gas pressure at port 28"" to move the needle valve 33"" to its rightmost position as illustrated in FIGURE 21. Concurrently, the gas in port 45"" is vented to atmospheric or ambient pressure through the directional valve 41"".

In the position as illustrated in FIGURE 21, gas can flow through the port 28"", through the passage 26"", through the orifice 30"" and into the plastic flow path.

After the part has set up in the mold, the directional valve 37"" is energized and the directional valve 35"" is deenergized to allow the pressure in the molding to be relieved.

Finally, the directional valve 37"" is deenergized and the directional valve 39"" is energized to move the needle valve 33"" to its closed position, as again illustrated in FIGURE 20 in anticipation for beginning of another cycle.

As illustrated in FIGURE 22, the aperture 16a"" is illustrated as a crescent within which the fluid passage 26"" is partially enclosed. In the first and last embodiments, the orifices 30 and 30"" open into the plastic flow path adjacent the bottom surface of the bushing 12 and 12"" respectively, colinear with the plastic flow. To prevent migration of the gas towards the nozzle, the apertures 16a, 16a"" and 16b are tapered. This difference in cross-sectional area of the resin flow path as well as the relative small size of the resin flow path through the sprue bushing prevent this migration so that the gas is not mixed with the plastic within its nozzle, but rather downstream from the sprue bushing 12"". In each of the embodiments, the resistance of the plastic to gas flow is greater between the orifices 30, 30'. 30", 30"" and 30"" and their respective upstream positions than between the orifices and their respective downstream positions. Consequently, the gas flows from the orifices 30, 30', 30", 30"" and 30"" towards their respective mold cavities at the downstream positions rather than towards their respective upstream positions at the resin injection apertures.

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

Claims

1. A method for the injection molding of a plastic article in an injection molding system (20) including a resin injection nozzle (18) and a mold (90) having an injection aperture for receiving molten resin from the nozzle (18) at an upstream position, a mold cavity (92,94) at a downstream position and a resin flow path (16) for fluidly communicating the injection aperture and the mold cavity (92,94) between the upstream and downstream positions, the method comprising the steps of:

   a) pressurizing a charge of fluid at a predetermined pressure level;

   b) injecting a quantity of molten plastic from the injection nozzle (18) through the injection aperture and the flow path (16) and into the mold cavity (92, 94) at a nominal plastic injection pressure;

   c) communicating the charge of pressurized fluid to an orifice (30) opening to the resin flow path (16) in the mold (90) between the upstream and downstream positions; introducing the fluid charge into the flow path (16) from the orifice (30) to distribute the molten plastic within the mold cavity (92,94);

   d) containing the fluid under pressure within the articles until it has set up in the mold cavity (92, 94); and

   e) venting the fluid to ambient at a controlled rate wherein the charge of pressurized fluid is introduced into the flow path after the quantity of molten plastic is introduced into the flow path and the introduced fluid charge is prevented from travelling from the flow path (16) through the injection aperture and into the injection nozzle (18).

2. A method as claimed in claim 1 wherein the introduced fluid charge is prevented from travelling into the injection nozzle (16) by introducing the fluid charge into the flow path at a fluid injection position (30), the resin having a greater resistance to fluid charge travel between the fluid injection position and the upstream position than between the fluid injection position and the downstream position.

3. An injection molding system for the injection of plastic articles comprising:

   an injection molding machine (20) including an injection nozzle (18) for injecting molten plastic through the nozzle;

   a mold (90) having a resin injection aperture for receiving the molten plastic at an upstream position, a cavity (92,94) defining the shape of the molded article at a downstream position and a plastic flow path (16) for fluidly communicating the injection aperture and the cavity between the upstream and downstream positions;

   fluid charge means (42,44,50) for pressurizing a charge of fluid at a predetermined level; and

   fluid circuit means (26) interconnecting the flow path and the fluid charge means between the upstream and downstream positions at an orifice (30,30',30") opening to the flow path for introducing the fluid charge into the flow path simultaeously with or after plastic injection, so that the fluid charge distributes the molten plastic in the mold cavity; characterised wherein the mold includes a sprue (10), the sprue (10) having the injection aperture and at

After the part has set up in the mold, the directional valve 37"" is energized and the directional valve 35"" is deenergized to allow the pressure in the molding to be relieved.

Finally, the directional valve 37"" is deenergized and the directional valve 39"" is energized to move the needle valve 33"" to its closed position, as again illustrated in FIGURE 20 in anticipation for beginning of another cycle.

As illustrated in FIGURE 22, the aperture 16a"" is illustrated as a crescent within which the fluid passage 26"" is partially enclosed. In the first and last embodiments, the orifices 30 and 30"" open into the plastic flow path adjacent the bottom surface of the bushing 12 and 12"" respectively, colinear with the plastic flow. To prevent migration of the gas towards the nozzle, the apertures 16a, 16a"" and 16b are tapered. This difference in cross-sectional area of the resin flow path as well as the relative small size of the resin flow path through the sprue bushing prevent this migration so that the gas is not mixed with the plastic within its nozzle, but rather downstream from the sprue bushing 12"". In each of the embodiments, the resistance of the plastic to gas flow is greater between the orifices 30, 30'. 30", 30"" and 30"" and their respective upstream positions than between the orifices and their respective downstream positions. Consequently, the gas flows from the orifices 30, 30', 30", 30"" and 30"" towards their respective mold cavities at the downstream positions rather than towards their respective upstream positions at the resin injection apertures.

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

Claims

1. A method for the injection molding of a plastic article in an injection molding system (20) including a resin injection nozzle (18) and a mold (90) having an injection aperture for receiving molten resin from the nozzle (18) at an upstream position, a mold cavity (92,94) at a downstream position and a resin flow path (16) for fluidly communicating the injection aperture and the mold cavity (92,94) between the upstream and downstream positions, the method comprising the steps of:

   a) pressurizing a charge of fluid at a predetermined pressure level;

   b) injecting a quantity of molten plastic from the injection nozzle (18) through the injection aperture and the flow path (16) and into the mold cavity (92, 94) at a nominal plastic injection pressure;

   c) communicating the charge of pressurized fluid to an orifice (30) opening to the resin flow path (16) in the mold (90) between the upstream and downstream positions; introducing the fluid charge into the flow path (16) from the orifice (30) to distribute the molten plastic within the mold cavity (92,94);

   d) containing the fluid under pressure within the articles until it has set up in the mold cavity (92, 94); and

   e) venting the fluid to ambient at a controlled rate wherein the charge of pressurized fluid is introduced into the flow path after the quantity of molten plastic is introduced into the flow path and the introduced fluid charge is prevented from travelling from the flow path (16) through the injection aperture and into the injection nozzle (18).

2. A method as claimed in claim 1 wherein the introduced fluid charge is prevented from travelling into the injection nozzle (16) by introducing the fluid charge into the flow path at a fluid injection position (30), the resin having a greater resistance to fluid charge travel between the fluid injection position and the upstream position than between the fluid injection position and the downstream position.

3. An injection molding system for the injection of plastic articles comprising:

   an injection molding machine (20) including an injection nozzle (18) for injecting molten plastic through the nozzle;

   a mold (90) having a resin injection aperture for receiving the molten plastic at an upstream position, a cavity (92,94) defining the shape of the molded article at a downstream position and a plastic flow path (16) for fluidly communicating the injection aperture and the cavity between the upstream and downstream positions;

   fluid charge means (42,44,50) for pressurizing a charge of fluid at a predetermined level; and

   fluid circuit means (26) interconnecting the flow path and the fluid charge means between the upstream and downstream positions at an orifice (30,30',30") opening to the flow path for introducing the fluid charge into the flow path simultaeously with or after plastic injection, so that the fluid charge distributes the molten plastic in the mold cavity; characterised wherein the mold includes a sprue (10), the sprue (10) having the injection aperture and at

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least part of the flow path wherein the fluid circuit means is contained within the sprue (10) and wherein the sprue (10) includes a bushing (12',12",12"',12"") having the orifice and wherein the injection nozzle communicates with the bushing and the fluid charge is communicated to the orifice in the bushing said fluid circuit means including means for venting pressurized fluid to atmosphere after molding said article and for preventing the introduced fluid charge from travelling from the flow path (16) through the injection aperture and into the nozzle.

4. A system according to claim 3 wherein the fluid circuit means includes valve means (15) having open and closed positions, said valve means (15) introducing the fluid charge to the flow path (16) through the orifice in the open position and preventing communication of the fluid charge to the flow path in the closed position.

5. Device for use with an injection molding systen of the type including an injection nozzle (18) and a mold (90) having a mold cavity (92,94) at a downstream position, a resin injection aperture at an upstream position and a resin flow path (16) for fluidly communicating the injection aperture and the mold cavity, the device being for assisting in the introduction of pressurized fluid into the cavity and for preventing the fluid from travelling from the flow path, through the injection aperture and into the nozzle, the device comprising:

a body (12) adapted to seat in the mold between the injection nozzle and the mold cavity, said body defining at least part of the resin flow path (16) communicating the injection aperture with the cavity, the body having an orifice (30) opening to the flow path, an external fluid port (28) and a fluid passage (26) extending between the external fluid port and the orifice characterised in that the orifice is dimensioned to be sufficiently small to resist entry of the relatively viscous molten resin.

6. A device according to claim 5 wherein the orifice (30) is positioned to introduce the fluid colinearly with the direction of resin flow from the injection nozzle (18) to the mold cavity (92,94).

7. A device according to claim 5 or claim 6 wherein the mold (90) includes a sprue (10) having a sprue opening and the device is adapted to seat in the sprue opening.

Patentansprüche

1. Verfahren zum Spritzgießen eines Kunststoffgegenstandes mittels einer Spritzgießeinrichtung (20) mit einer Harzspritzdüse (18) und einem Formwerkzeug (90), das eine Einspritzöffnung aufweist zum Aufnehmen von geschmolzenen Harz aus der Spritzdüse (18), die am Anfang eines Fließweges angeordnet ist, einem Formhohlraum (92, 94), der am Ende eines Fließweges angeordnet ist und einem Fließweg (16) für eine Fließverbindung, die die Einspritzöffnung und den Formhohlraum (93, 94) zwischen dem Anfang und dem Ende des Fließweges verbindet, mit den Schritten:

a) unter Druck Setzen einer Fluidladung auf eine vorbestimmte Druckhöhe;

b) Einspritzen einer Menge geschmolzenen Kunststoffs durch die Einspritzdüse (18) und durch die Einspritzöffnung sowie den Fließweg (16) in den Formhohlraum (92, 94) mit einem bestimmten Kunststoffeinspritzdruck;

c) Herstellen einer Verbindung für die vorbestimmte unter Druck gesetzte Fluidladung mit einer Öffnung (30), die zum Harzfließweg (16) im Formwerkzeug (90) zwischen dem Anfang und dem Ende des Fließwegs geöffnet ist; Einbringen der Fluidladung in den Fließweg (16) durch die Öffnung (30), um den geschmolzenen Kunststoff innerhalb des Formhohlraums (92, 94) zu verteilen;

d) Halten des Fluids unter Druck innerhalb der Gegenstände bis es im Formhohlraum (92, 94) erstarrt ist und

e) Entlüften des Fluids zur Umgebung mit einer vorgegebenen Geschwindigkeit, wobei die unter Druck gesetzte Fluidladung in den Fließweg eingebracht wird, nachdem die Menge von geschmolzenen Kunststoff in den Fließweg eingebracht wurde und die Fluidladung daran gehindert wird, vom Fließweg (16) durch die Einspritzöffnung in die Einspritzdüse (18) zu fließen.

2. Verfahren nach Anspruch 1, bei dem die eingebrachte Fluidladung daran gehindert wird, in die Einspritzdüse (16) einzudringen, indem die Fluidladung in den Fließweg an einer Stelle (30) der Fluideinspritzung eingebracht wird, in der das Harz der Bewegung der Fluidladung einen größeren Widerstand zwischen der Fluideinspritzposition und dem Anfang des Fließwegs entgegenbringt, als zwischen der Fluideinspritzposition und dem Ende des Fließweges.

3. Spritzgießeinrichtung zum Spritzgießen von Kunststoffgegenständen mit

- einer Spritzgießmaschine (20) mit einer Spritzdüse (18) zum Einspritzen von geschmolzenen Kunststoff durch die Düse;
- einem Formwerkzeug (19) mit einer Harzeinspritzöffnung zur Aufnahme von geschmolzenen Kunststoff am Anfang eines Fließweges, einem Formhohlraum (92, 94), der die Form des geformten Gegenstandes am Ende eines Fließweges bestimmt, und einem Kunststoffließweg (16) zum Herstellen einer Fließverbindung zwischen der Einspritzöffnung und dem Formhohlraum zwischen dem Anfang und dem Ende des Fließweges;
- Mittel (42, 44, 50) zum unter Druck Setzen einer Fluidladung auf eine vorbestimmte Druckhöhe und
- Mittel (26) zum Leiten des Fluids, die eine Verbindung zwischen dem Fließweg und den Mitteln zum unter Druck Setzen des Fluids zwischen dem Anfang und dem Ende des Fließweges an einer Öffnung (30, 30', 30") herstellen, die sich zum Fließweg öffnet, um die Fluidladung in den Fließweg gleichzeitig oder nach dem Einspritzen des Kunststoff einzubringen, so daß die Fluidladung den geschmolzenen Kunststoff im Formhohlraum verteilt, dadurch gekennzeichnet, daß die Form einen Anguß (10) mit der Einspritzöffnung und wenigstens einem Teil des Fließweges aufweist, wobei die Mittel zum Leiten des Fluids innerhalb des Angusses (10) angeordnet sind und der Anguß (10) eine Buchse (12', 12", 12"', 12"") mit einer Öffnung aufweist und die Einspritzdüse mit der Buchse in Fließverbindung steht, die Fluidladung mit der Öffnung in der Buchse in Verbindung steht, die Mittel zum Leiten des Fluids Mittel aufweisen, um ein Entlüften des unter Druck gesetzten Fluids zur Umgebung nach dem Formen des Gegenstandes vorzunehmen und um zu verhindern, daß die eingebrachte Fluidladung von dem Fließweg (16) durch die Einspritzöffnung in die Düse hineinwandert.

4. Einrichtung nach Anspruch 3, bei der die Mittel zum Leiten des Fluids ein Ventil mit einer geöffneten und einer geschlossenen Stellung aufweisen, wobei das Ventil (20) die Fluidladung in den Fließweg (16) durch die Öffnung in der geöffneten Stellung hindurchläßt und in der geschlossenen Stellung eine Verbindung der Fluidladung zum Fließweg verhindert.

5. Vorrichtung zur Verwendung mit einer Spritzgießeinrichtung mit einer Einspritzdüse (18) und einem Formwerkzeug (19) mit einem Formhohlraum (92, 94) am Ende eines Fließweges, einer Harzeinspritzöffnung am Anfang eines Fließweges und einem Fließweg (16) zum Herstellen einer Fließverbindung zwischen der Einspritzöffnung und dem Formhohlraum, wobei die Vorrichtung dafür vorgesehen ist, das Einbringen des unter Druck gesetzten Fluids in den Formhohlraum zu unterstützen und den Rückfluß des Fluids vom Fließweg durch die Einspritzöffnung und in die Düse zu verhindern und die
   - einen Einsatz (12) aufweist, der am Formwerkzeug zwischen der Einspritzdüse und dem Formhohlraum anliegt, wobei der Einsatz wenigstens einen Teil des Harzfließweges (16) umfaßt und der die Verbindung zwischen der Einspritzöffnung und dem Formhohlraum herstellt, wobei der Einsatz eine Öffnung (30), die sich zum Fließweg öffnet sowie einen äußeren Fluideingang (28) und einen Fluiddurchgang (26), der sich zwischen dem äußeren Fluideingang und der Öffnung erstreckt, aufweist, dadurch gekennzeichnet, daß die Öffnung so bemessen ist, daß sie ausreichend klein ist, um dem Eintritt von verhältnismäßig zähem, geschmolzenen Harz zu widerstehen.

6. Vorrichtung nach Anspruch 5, bei der die Öffnung (30) so angeordnet ist, daß das Fluid in Richtung des Harzflusses von der Einspritzdüse (18) zum Formhohlraum (92, 94) eingebracht wird.

7. Vorrichtung nach Anspruch 5 oder Anspruch 6, bei der das Formwerkzeug (90) einen Anguß (10) mit einer Angußöffnung aufweist und wobei die Vorrichtung zur Anlage an die Angußöffnung angepaßt ist.

Revendications

1. Procédé pour le moulage par injection d'un article en matière plastique dans un système de moulage par injection (20) comprenant une buse d'injection de résine (18) et un moule (90) comprenant une ouverture d'injection pour recevoir une résine fondue à partir de la buse (18) au niveau d'une position amont, une cavité de moulage (92, 94) au niveau d'une position aval et un parcours d'écoulement de résine (16) pour mettre en communication fluide l'ouverture d'injection et la cavité de moulage

(92,94) entre les positions aval et amont , le procédé comprenant les étapes consistant à :

a) pressuriser une charge de fluide à un niveau de pression prédéterminé ;

b) injecter une quantité de plastique fondu à partir de la buse d'injection (18) par l'ouverture d'injection et le parcours d'écoulement (16) et dans la cavité de moulage (92, 94) à une pression nominale d'injection de la matière plastique ;

c) communiquer la charge de fluide pressurisée à un orifice (30) s'ouvrant sur le parcours d'écoulement de la résine (16) dans le moule (90) entre les positions amont et aval ; introduire la charge de fluide dans le parcours d'écoulement (16) à partir de l'orifice (30) pour distribuer la matière plastique fondue à l'intérieur de la cavité de moulage (92, 94) ;

d) maintenir le fluide sous pression à l'intérieur des articles jusqu'à ce qu'il ait atteint la cavité de moulage (92, 94) ; et

e) décharger le fluide à l'atmosphère ambiante à une vitesse contrôlée, étape dans laquelle la charge de fluide pressurisée est introduite dans le parcours d'écoulement et dans laquelle la charge de fluide introduite ne peut se déplacer à partir du parcours d'écoulement (16) à travers l'ouverture D'injection ni dans la buse d'injection (18).

2. Procédé selon la revendication 1 dans lequel la charge de fluide introduite ne peut ne se déplacer dans la buse d'injections (16) en introduisant la charge de fluide dans le parcours d'écoulement au niveau de la position d'injection du fluide (30), la résine présentant une résistance plus grande au déplacement de charge de fluide entre la position d'injection du fluide et la position amont qu'entre la position d'injection du fluide et la position aval.

3. Système de moulage par injection d'articles en matière plastique moulée comprenant :

une machine de moulage par injection (20) incluant une buse d'injection (18) pour injecter la matière plastique fondue à travers la buse ;

un moule (90) comportant une ouverture d'injection pour la résine destinée à recevoir le plastique fondu au niveau d'une position amont, une cavitè (92, 94) définissant la forme de l'article moulé à une position aval et un parcours d'écoulement de la matière plastique (16) pour mettre en communication de fluide l'ouverture d'injection et la cavité entre les positions amont et aval;

un moyen de charge du fluide (42, 44, 50) pour prossuriser une charge de fluide à un niveau prédéterminé: et

un moyen de circuit de fluide (26) raccordant le parcours d'écoulement et le moyen de charqe de fluide entre les positions amont et aval au niveau d'un orifice (30, 30' , 30") s'ouvrant sur le parcours d'écoulement pour introduire la charge de fluide dans le parcours d'écoulement en même temps que l'injection de matière plastique ou après elle, de façon que la charge de fluide répartisse la matière plastique fondue dans la cavité de moulage ; caractèrisè en ce que le moule comprend une carotte (10) , la carotte (10) comportant l'ouverture d'injection et au moins une partie du parcours d'écoulement dans lequel le moyen de circuit de fluide est contenu à l'intérieur de la carotte (10) et dans lequel la carotte (10) comprend un raccord (12', 12", 12"', 12"") comportant l'orifice et dans lequel la buse d'injection communique avec le raccord et la charge de fluide est mise en communication avec l'orifice dans le raccord ledit moyen de circuit de fluide comprenant un moyen pour décharger le fluide pressurisé à l'atmosphère après moulage dudit article , et pour empêcher la charge de fluide introduite de se déplacer à partir du parcours d'écoulement (16) à travers l'ouverture d'injection et dans la buse.

4. Système selon la revendication 3 dans lequel le moyen de circuit de fluide comprend un moyen de soupape (15) ayant des positions ouverte et fermée, ledit moyen de soupape (15) introduisant la charge de fluide vers le parcours d'écoulement (16) à travers l'orifice en position ouverte et empêchant une communication de la charge de fluide vers le parcours d'écoulement dans la position fermée.

5. Dispositif pour une utilisation avec un système de moulage par injection du type comportant une buse d' injection (18) et un moule (90) comprenant une cavité de moulage (92, 94) au niveau d'une position aval , une ouverture d'injection de résine au niveau d'une position amont et un parcours d'écoulement de la résine (16) pour établir une communication de fluide entre l'ouverture d'injection et la cavité de moulage, le dispositif étant prévu pour aider a l'introduction d'un fluide pressurisé dans la cavité et pour empêcher le fluide de se déplacer du parcours d'écoulement, à travers l'ouverture d'injection et dans la buse , le dispositif comprenant :

un corps (12) adapté pour être posé dans le moule entre la buse d'injection et la cavité de moulage, ledit corps définissant au moins une partie du parcours d'écoulement de la

résine (16) faisant communiquer l'ouverture d'injection avec la cavité, le corps ayant un orifice (30) s'ouvrant sur le parcours d'écoulement, un orifice de fluide extérieur (28) et un passage de fluide (26) s'étendant entre l'orifice de fluide extérieur et l'orifice caractérisé en ce que l'orifice est de dimension suffisamment petite pour résister à l'entrée de la résine fondue relativement visqueuse.

6. Dispositif selon la revendication 5 dans lequel l'orifice (30) est disposé en vue d'introduire le fluide de façon colinéaire à la direction de l'écoulement de la résine allant de la buse d'injection (18) à la cavité de moulage (92, 94).

7. Dispositif selon la revendication 5 ou la revendication 6 dans lequel le moule (90) comprend une carotte (10) comportant une ouverture de carotte et le dispositif est adapté pour être placé dans l'ouverture de carotte.