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(54) MOLDING-SYSTEM VALVE

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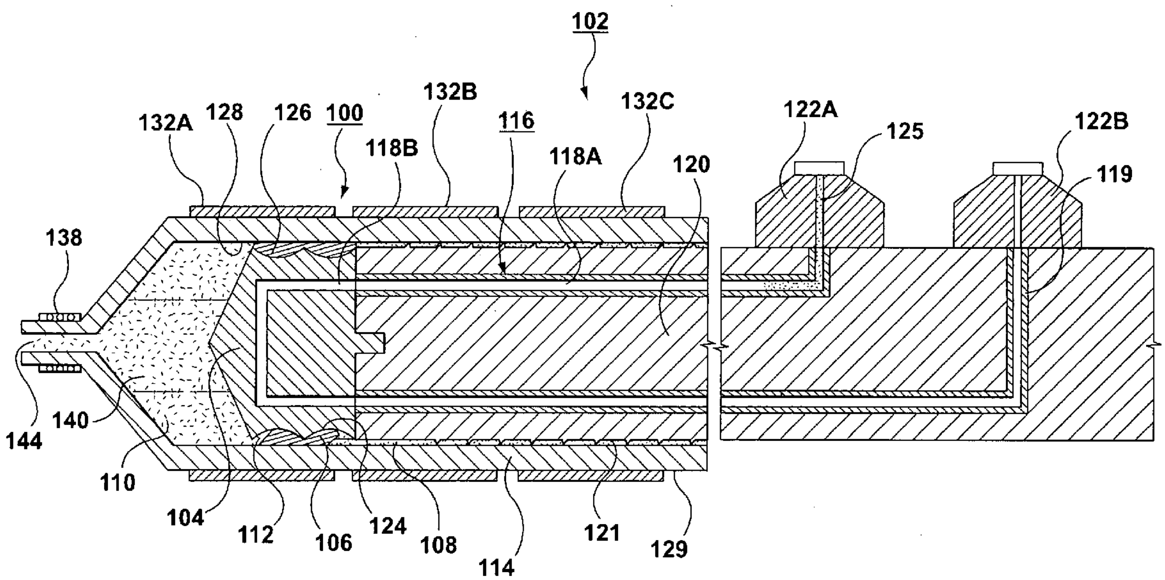
(57) **ABSTRACT**

Disclosed is: (i) a metal-molding-system valve, (ii) a metal-molding system having a metal-molding-system valve, and (iii) a method of a metal-molding-system valve.



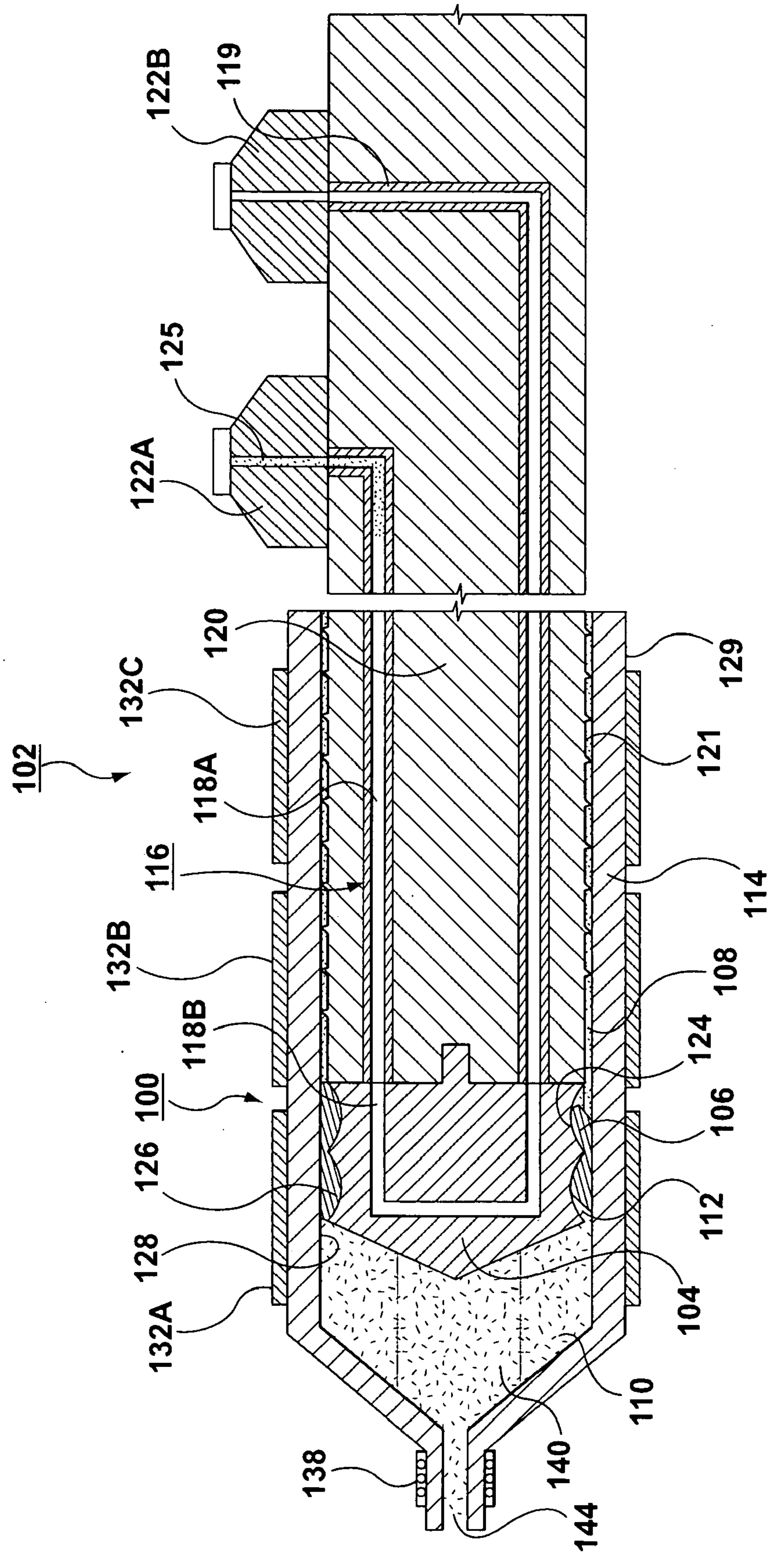
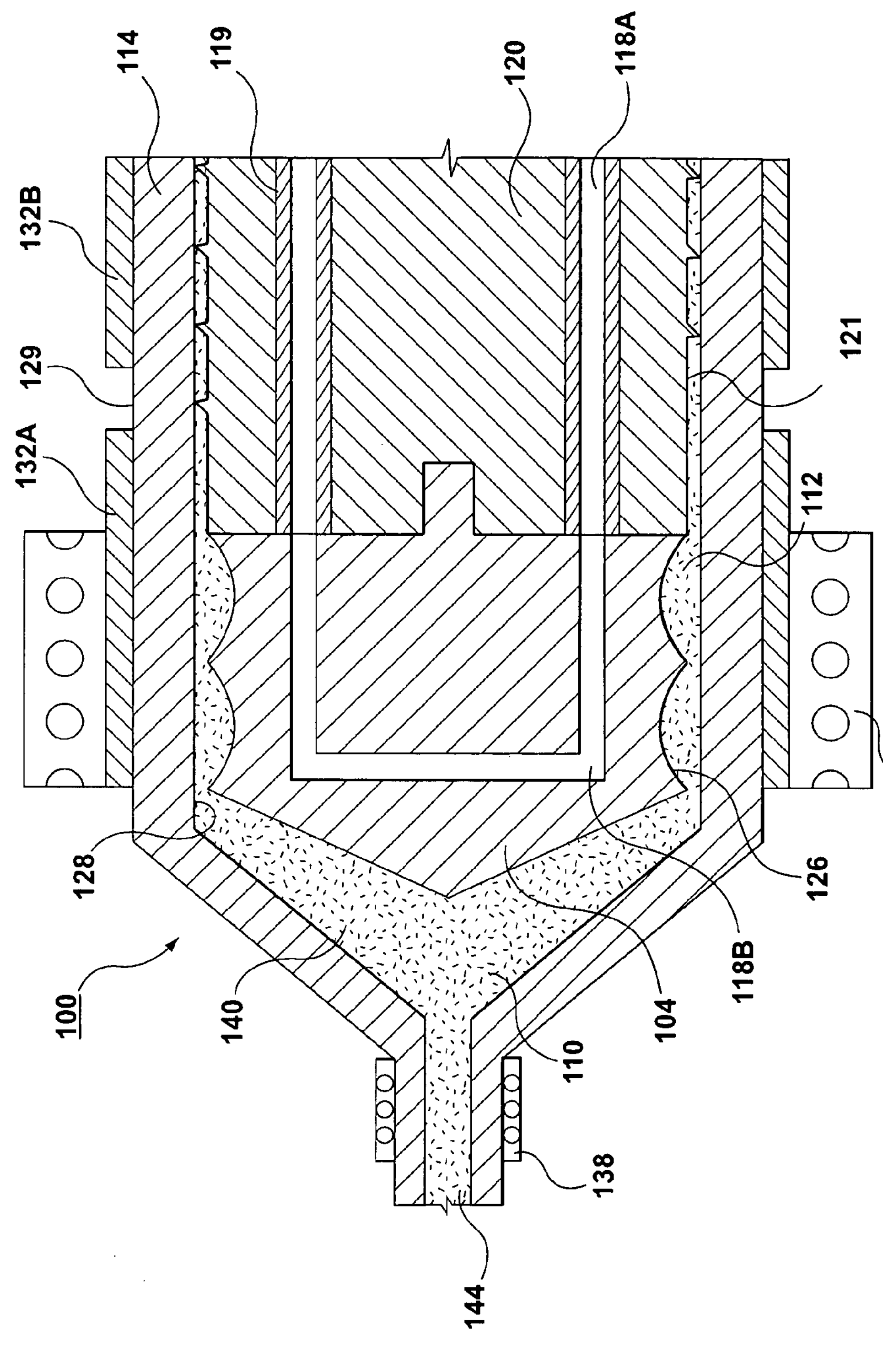

122B
119
125
122A
120
132C
129
102
118A
121
116
114
132B
108
118B
124
100
106
126
112
128
104
132A
110
140
138
144

FIG. 1A


114
119
120
118A
132B
129
132A
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142
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126
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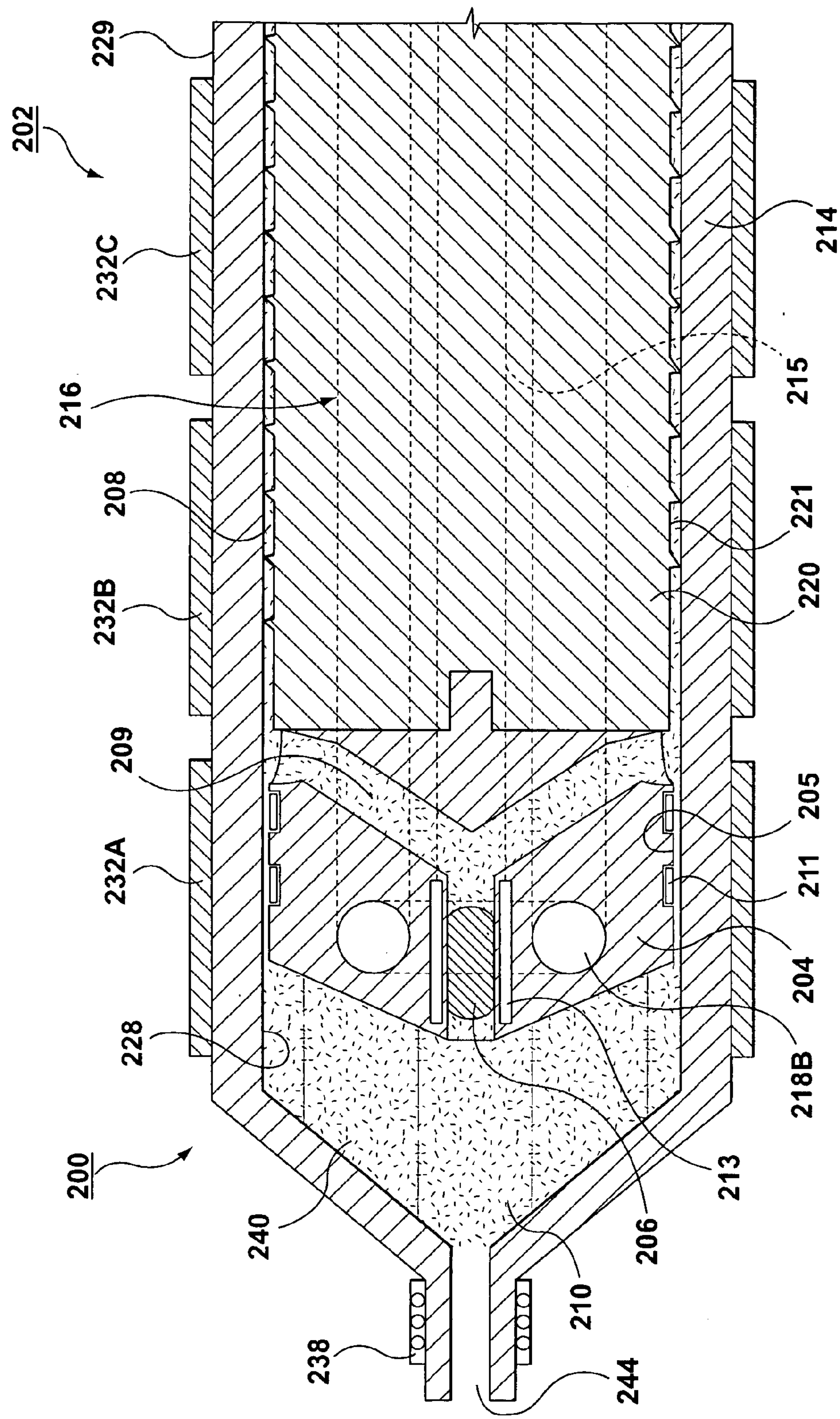
140
104
118B
110
138
144

FIG. 1B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229
232C
216
208
232B
209
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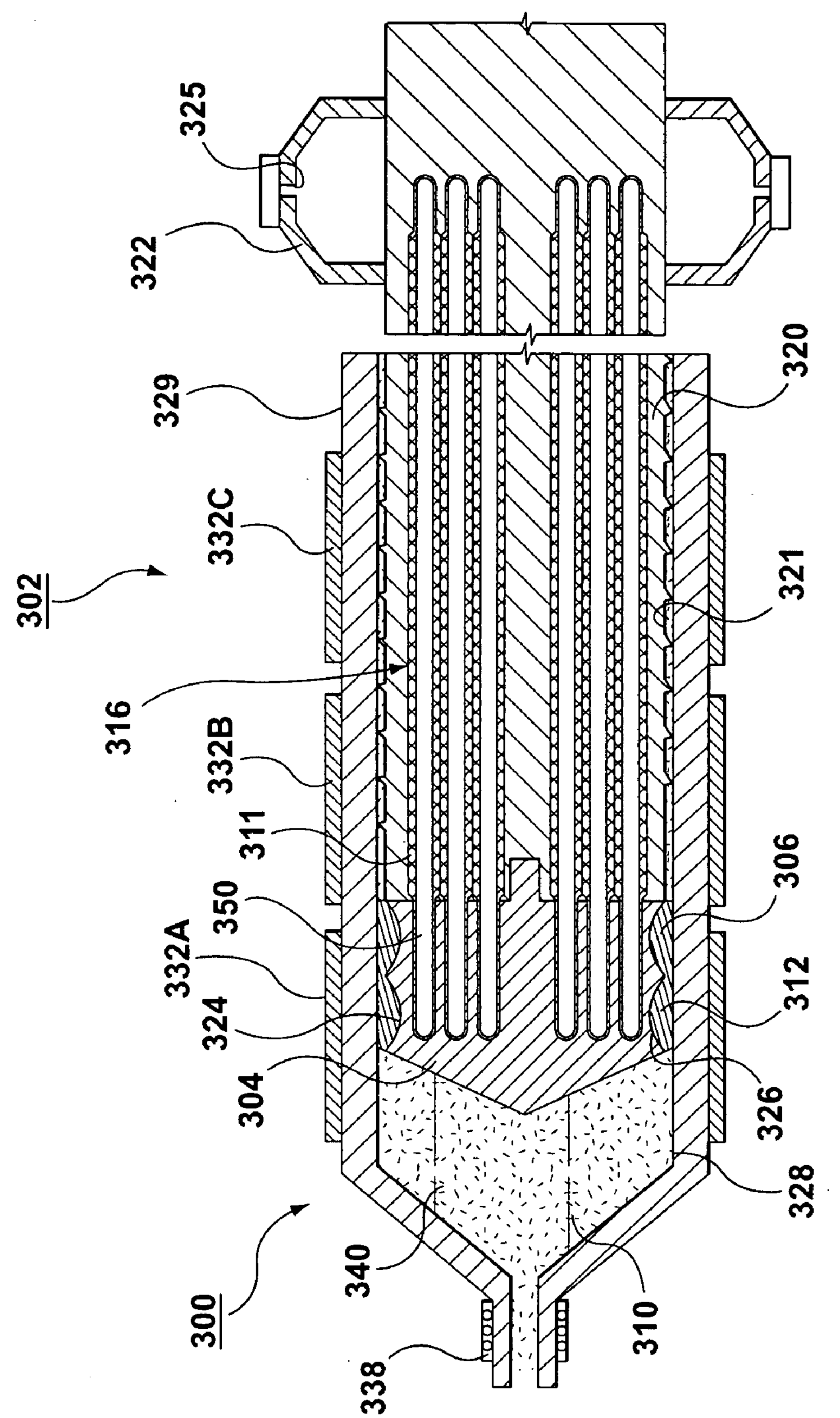
214

FIG. 2


325
322
329
320
302
332C
321
316
332B
311
306
350
332A
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300
340
310
338

FIG. 3

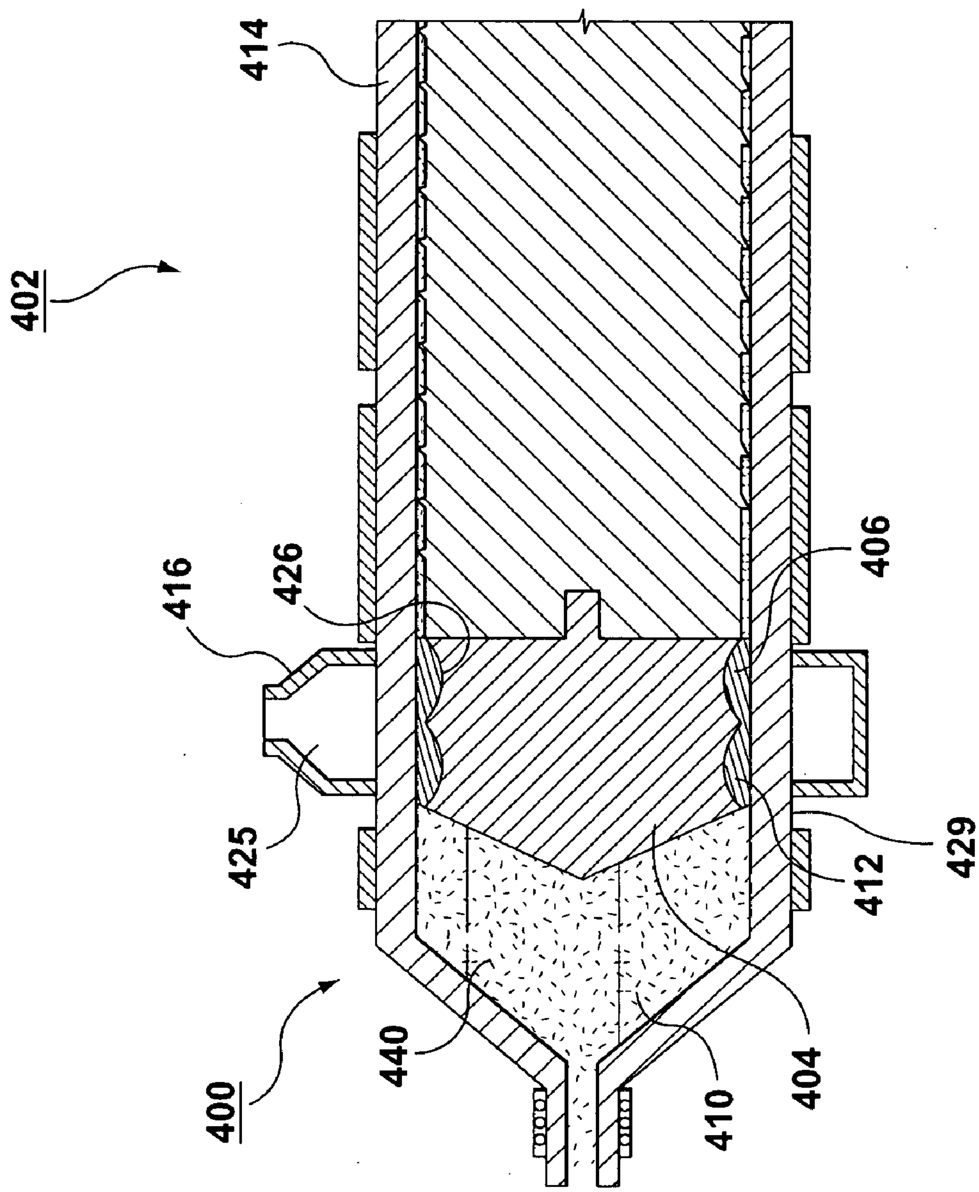

FIG. 4

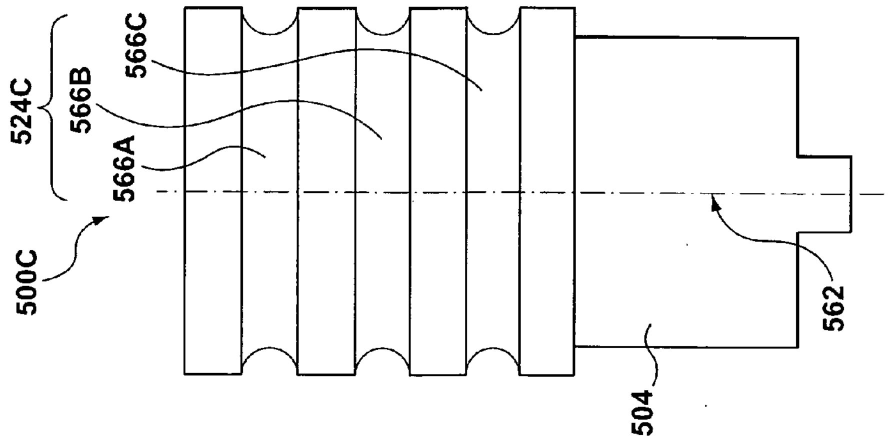

FIG. 5C

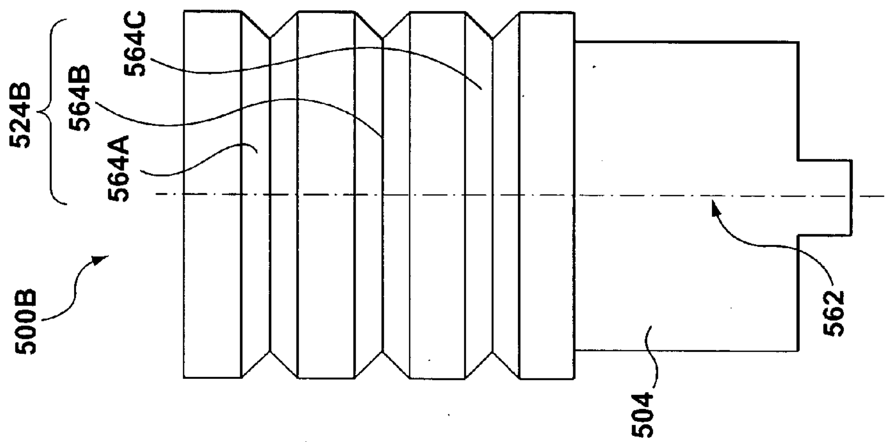

FIG. 5B

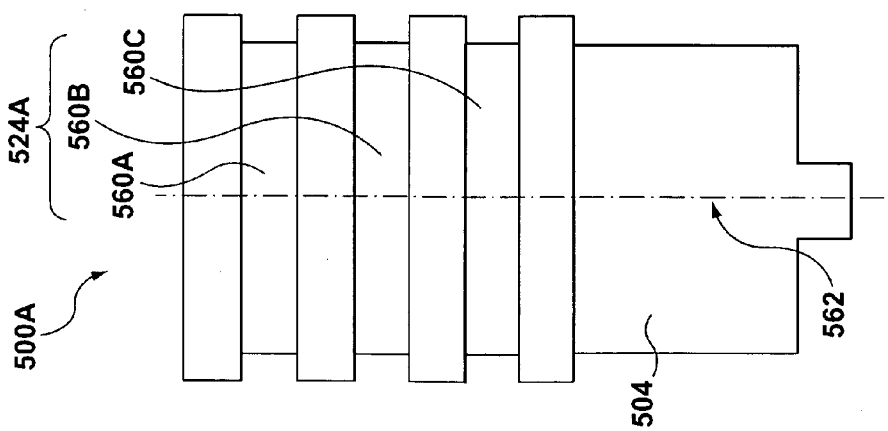

FIG. 5A

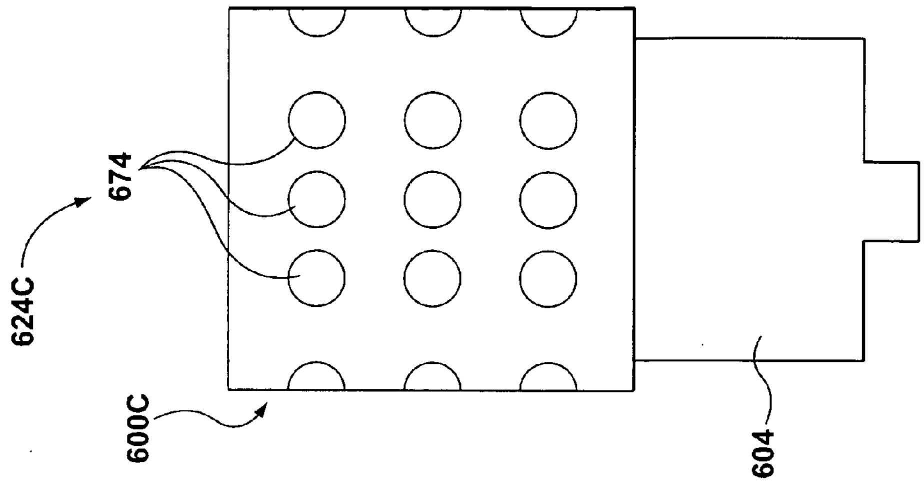

FIG. 6C

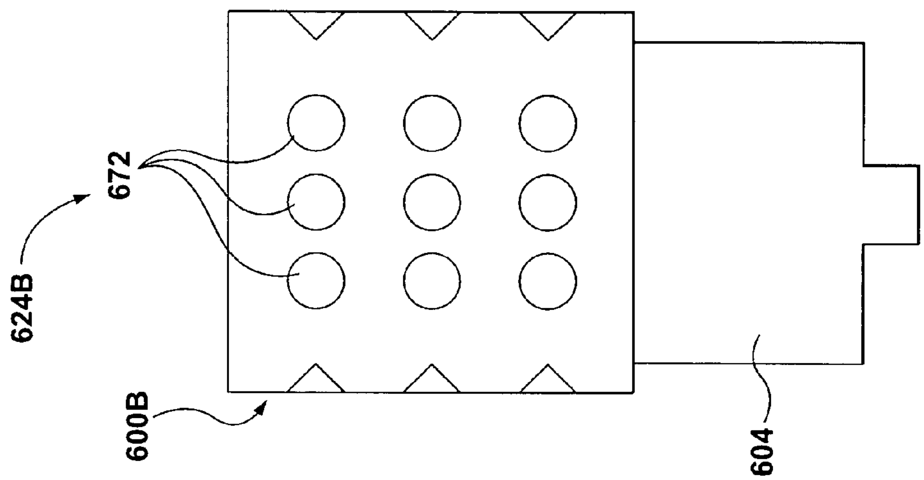

FIG. 6B

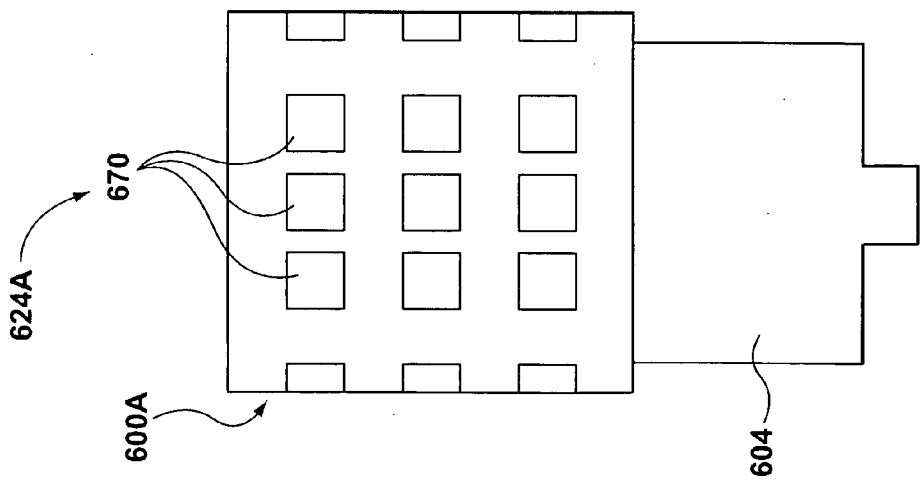

FIG. 6A

MOLDING-SYSTEM VALVE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The following is a list of patent applications related to the present application, in which the Applicant's references numbers are: H-903-0-US, HB-903-0-US and HC903-0-US.

TECHNICAL FIELD

[0002] The present invention generally relates to molding systems, and more specifically the present invention relates to: (i) a metal-molding-system valve, (ii) a metal-molding system having a metal-molding-system valve, and (iii) a method of a metal-molding-system valve.

BACKGROUND

[0003] Examples of known molding systems are (amongst others): (i) the Hylectric™ Molding System, (ii) the Quadloc™ Molding System, (iii) the Hylectric™ Molding System, and (iv) the HyMe™ Molding System, all manufactured by Husky Injection Molding Systems Limited (Location: Bolton, Ontario, Canada; www.husky.ca).

[0004] U.S. Pat. No. 4,908,169 (Inventor: Galic et al; Published: Mar. 3, 1990) discloses a plasticisation method using a reciprocating screw having a double-flighted screw to keep a solid bed under compression and to transfer melt films from the screw and a barrel-heated surface.

[0005] U.S. Pat. No. 5,040,589 (Inventor: Bradley et al; Published: Aug. 20, 1991) discloses injection molding of metal alloys, such as magnesium alloys, with improved yield, productivity, and mold life.

[0006] U.S. Pat. No. 5,680,894 (Inventor: Kilbert; Published: Oct. 28, 1997) discloses an injection-molding apparatus for a metal alloy having dendritic properties. The apparatus includes a sub-ring on a non-return valve assembly, which eliminates piston-ring leakage.

[0007] U.S. Pat. No. 5,750,158 (Inventor: Wissmann et al: Published: May 12, 1998) discloses an apparatus for preheating and blending material being fed to an extruder. The apparatus uses co-rotating screws and a close-temperature control to allow the preheating of materials containing a high-mineral filler content without localised heating or compacting.

[0008] U.S. Pat. No. 5,843,489 (Inventor: Nakano; Published: Dec. 01, 1998) discloses a screw for an extruder. The screw contains a jacket-shaped, spiral channel around a back side of a screw flight linked to inward and outward channels for a dual tube through a centre hole of a screw core.

[0009] U.S. Patent Application Number 2005/0233020A1 (Inventor: Manda et al; Published: Oct. 20, 2005) discloses a non-return valve for use in a molding system. The valve has two complementary spigot portions provided on melt-flow surfaces that are engageable in closely-spaced, overlapping, and parallel arrangement when valve is in a closed configuration.

SUMMARY

[0010] According to a first aspect of the present invention, there is provided a metal-molding-system valve, including a valve body positionable in a melt-carrying passageway of a metal-molding system, the valve body permitting solidified adherance of a metallic-molding material of melt-carrying passageway to the valve body.

[0011] According to a second aspect of the present invention, there is provided a metal-molding system, having a metal-molding-system valve, including a valve body positionable in a melt-carrying passageway of the metal-molding system, the valve body permitting solidified adherance of a metallic-molding material of melt-carrying passageway to the valve body.

[0012] According to a third aspect of the present invention, there is provided a method of a metal-molding-system valve, including positioning a valve body in a melt-carrying passageway of a metal-molding system, and also including permitting solidified adherance of a metallic-molding material of melt-carrying passageway to the valve body.

[0013] A technical effect, amongst other technical effects, of the aspects of the present invention is the molding-system valve is less prone to wear.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] A better understanding of the exemplary embodiments of the present invention (including alternatives and/or variations thereof) may be obtained with reference to the detailed description of the exemplary embodiments along with the following drawings, in which:

[0015] FIGS. **1**A and **1**B are cross-sectional views of a metal-molding-system valve according to a first exemplary embodiment;

[0016] FIG. **2** is a cross-sectional view of a metal-molding-system valve according to a second exemplary embodiment;

[0017] FIG. **3** is a cross-sectional view of a metal-molding-system valve according to a third exemplary embodiment;

[0018] FIG. **4** is a cross-sectional view of a metal-molding-system valve according to a fourth exemplary embodiment;

[0019] FIGS. **5**A to **5**C are views of metal-molding-system valves according to a fifth exemplary embodiment; and

[0020] FIGS. **6**A to **6**C are views of a metal-molding-system valves according to a sixth exemplary embodiment.

[0021] The drawings are not necessarily to scale and are sometimes illustrated by phantom lines, diagrammatic representations and fragmentary views. In certain instances, details that are not necessary for an understanding of the embodiments or that render other details difficult to perceive may have been omitted.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0022] FIG. **1**A is a cross-sectional view of a metal-molding-system valve **100** (hereafter referred to as "the valve **100**") according to the first exemplary embodiment. The valve **100** is used in a metal-molding system **102** (hereafter referred to as the "system **102**") or in a thixo-molding system. A thixo-molding system is used to process a slurry (part liquid, part solid) of a magnesium alloy.

[0023] The valve **100** includes a valve body **104** that is positionable in a melt-carrying passageway **108** of the system **102**. The valve body **104** permits solidified adherance of a metallic-molding material **110** of (disposed in) melt-carrying passageway **110** to the valve body **104**. Preferably, solidified adherance of the metallic-molding material

108 to the valve body **104** permits repeatable operation of the valve body **104**. The metallic-molding material **110** is hereafter referred to as the "melt **110**".

[0024] Preferably, responsive to a cooling mechanism **116** actuated to cooling the melt **110**, a metallic plug **106** is formable between the valve body **104** and the melt-carrying passageway **108**. The metallic plug **106** is solidifyable to (formable to, detachably adherable to) and meltable from (deformable from) the valve body **104**. The metallic plug **106** (a thixo plug in the case of a thixo-molding system) is formable to the valve body **104**. The metallic plug **106** (hereafter referred to as "the plug **106**") is formable from a melt **110** (a metallic molding material). Preferably, the melt **110** includes an alloy composition of magnesium (such as AZ91D). According to a variant, other alloys or types of metals are used (zinc, aluminum, etc).

[0025] The valve body **104** defines a cavity **112** in cooperation with a molding-system component **114** (for example: a barrel) of the system **102**. For simplifying the description of the first exemplary embodiment, the molding component **114** is hereafter referred to as "the barrel **114**"; however, according to other variants, the molding component **114** is a component other than "the barrel". The cavity **112** is configured to have the plug **106** formed therein at least in part. The valve body **104** includes or defines an outer surface **126**. The valve body **104** is attached (preferably threadably attached) to a processing screw **120** having an outer surface **121** and the processing screw **120** is useable in the barrel **114**. The barrel **114** defines an outer barrel wall **129** and also defines a barrel inner wall **128** which faces the outer surface **126** of the valve body **104** and faces the processing screw **120**.

[0026] The outer surface **126** of the valve body **104** is configured to be cooled by a cooling mechanism **116**. The cooling mechanism **116** is configured to form a plug **106** between the outer surface **126** of the valve body **104** and the barrel inner wall **128**. Details of the cooling mechanism **116** will be described below in more detail.

[0027] During the operation of the system **102**, the processing screw **120** transports the melt **110** through a melt-carrying passageway **108** which is defined between the barrel inner wall **128** and the outer surface **121** of the processing screw **120**. The melt-carrying passageway **108** extends from a hopper (not depicted, but located to the right side of FIG. **1**A) to a machine nozzle **144** that extends from the barrel **114**. The melt **110** is transported past the valve body **104** and toward the machine nozzle **144** upon rotational actuation of the processing screw **120**. The melt **110** is accumulated within an accumulation zone **140** defined between the valve body **104** and the machine nozzle **144**. Although the nozzle **144** is depicted (in FIG. **1**A) in an open condition, it is understood that a plug (not depicted in FIG. **1**A) will be formed within the nozzle **144** by using the cooling mechanism **138**; it is understood that once a plug is formed in the nozzle **144**, accumulation of the molding material in the accumulation zone **140** may then begin. The melt **110** is deposited into the accumulation zone **140** where the melt **110** is collected (during a recovery phase) and then injected (during an injection phase) into a mold cavity defined by a mold (not depicted) which is operatively connected to the machine nozzle **144**.

[0028] The processing screw **120** is actuatably rotated via an actuation mechanism (not depicted). Rotation of the processing screw **120** is sufficient to transport the melt **110** into the accumulation zone **140** (this is the recovery phase) and this action builds up an accumulation (or a shot) of melt in the accumulation zone **140**. The screw **120** translates away from the machine nozzle **144** during recovery. The actuation assembly then slidably translates the processing screw **120** which injects the shot of melt from the accumulation zone **140** and into the mold cavity (this is the injection phase). Upon slidable translation of the processing screw **120**, the valve body **104** becomes slidable and translatable as well since the valve body **104** is connected to the processing screw **120**.

[0029] The plug **106** is created or formed, within the cavity **112**, upon actuation of the cooling mechanism **116** after the shot of melt has been accumulated within the accumulation zone **140**. The cooling mechanism **116** cooperates with the processing screw **120** and cooperates with the valve body **104**. The cooling mechanism **116** defines a cooling circuit **118**A that extends within the processing screw **120** (at least in part). The cooling circuit **118**A is, preferably, enwrapped by an insulation layer **119** (at least in part) which avoid the cooling circuit **118**A from absorbing heat from the processing screw **120**. The valve body **104** defines a cooling circuit **118**B that is in fluid communication with the cooling circuit **118**A. Preferably, the molding material freezes in the cavity **112** to form the plug **106** and it would be acceptable that some of the molding material was to freeze elsewhere along the surface of the nozzle body **104** which is being generally cooled. The amount of cooling directed to forming the plug **106** should be enough to form the plug and no more to cause adverse cooling of the molding material. The amount of cooling would have to be determined by some experiementation. A layer of frozen molding material may form to and adhere to the front surface of the body **104**, but it may be best (preferably) to minimize this condition from occuring.

[0030] Preferably, the processing screw **120** cooperates with a manifold **122**A and a manifold **122**B. Preferably, the manifolds **122**A, **122**B include rotary-fluid couplings. The manifolds **122**A, **122**B are adapted to permit the screw **120** to be rotatable (by way of using gaskets, bearings, etc as known to those skilled in the art). The manifold **122**A receives, within a coolant holding area, a cooling fluid **125** (under pressure), transfers the cooling fluid **125** into the cooling circuit **118**A. The cooling fluid **125** then flows from the cooling circuit **118**A, into the cooling circuit **118**B of the valve body **104**, back into another branch of the cooling circuit **118**A and then into the manifold **122**B which permits the cooling fluid **125** to exit from the processing screw **120**. The cooling fluid **125** removes heat from the valve body **104**. In response to the removal of this heat from the valve body **104**, the plug **106** is formed adjacent to the valve body **104** and within the cavity **112**. The cooling fluid **125** is deposited into the cooling circuits **118**A and **118**B for a calculated duration and possesses a sufficient cooling effect to form the plug **106**.

[0031] The valve body **104** includes a melt-receiving feature **124** that faces the cavity **112**. The plug **106** is formed and eventually, if the cooling process of the cooling mechanism **116** acts with sufficient duration and strength, adheres to the melt-receiving feature **124**. Preferably the plug **106** forms and adheres to both the melt-receiving feature **124** and detachably adheres to the barrel inner wall **128** so as to provide an efficient barrier that prevents backflow of melt from the accumulation zone **140** backwardly toward the hopper and the manifolds **122**A and **122**B upon translation of the processing screw **120** toward the accumulation zone **140**. The plug **106** detachably adheres to the body **104** in that the plug **104** may form and temporarily adhere to the body **104** so as to significantly reduce or prevent leakage of molding material (once the plug **106** is formed and adhered to the body **104**); however, the formed and adhered plug **106** is sheared off the from the inner surface of the barrel **114** once the screw **120** is made to translate (but the plug **106** may continue to adhere to the valve body **104** after the plug **106** has been sheared off the barrel **114**).

[0032] The melt-receiving feature **124** acts to facilitate or enhance bonding with the plug **106** so that as the valve body **104** is translated forwardly toward the machine nozzle **144** the plug **106** does not become detached from the valve body **104**. In an alternative embodiment, the valve body **104** does not include the melt-receiving feature **124** since the plug **106** may be adhered to the valve body **104** with sufficient a bonding strength. Generally, the plug **106** is adherable and unadherable (depending on the ability of the cooling mechanism **116**) to and from any one of the valve body **104**, the barrel **114** and any combination and permutation thereof. The plug **106**, although adhered to the barrel **114** and/or to the valve body **104** is shearable from either the valve body **104** and/or the barrel **114** upon actuation of the processing screw **120** which translates the valve body **104** toward the accumulation zone **140**. Preferably, the plug **106** is adhered to the melt-receiving feature **124** so that the plug **106** becomes shearable (as close as possible) from the barrel inner wall **128** of the barrel **114** while remaining adhered to the melt-receiving feature **124** of the valve body **106**. According to a variant, a small gap (not depicted) is permitted between the formed plug **106** and the inner wall of the barrel, and the small gap is small enough so as to permit creation of a sufficient pressure drop from the front to the back of the valve body **104**. After the screw **120** is stroked forwardly, cooling may be shut off and this arrangement permits melting of the plug **106** (if so desired).

[0033] Once the injection phase has been completed, the plug **106** is no longer required. The plug **106** is preferably melted by actuation of a heater **132**A placed accordingly along the barrel outer surface **129**. Before the recovery phase begins, the remaining heaters **132**B and **132**C may be actuated to melt any solidified melt disposed in the melt-carrying passageway **108**, and a thixo plug (not depicted) is formed in the machine nozzle **144**. According to a variant, the plug formed in the nozzle **114** may be substituted for a mechanical valve (for example).

[0034] FIG. **1**B is a detailed cross-sectional view of the valve **100** of FIG. **1**A. The valve **100** is shown immediately after the injection phase but before initiation of the recovery phase. For clarity, immediately after injection, the plug **106** may continue to exist (even though the plug **106** has been sheared off the barrel **114**). However, the heater **142** may be actuated so as to add heat to the barrel **114** sufficiently enough to melt the plug **106** completely (the melted condition of the plug **106** is depicted in FIG. **1**B). During the injection phase, the processing screw **120** is translated forwardly toward the machine nozzle **144**, and the melt **110** accumulated in the accumulation zone **140** is then forced through the machine nozzle **144** into the mold cavity of the mold (not depicted). During the recovery phase, the melt **110** is transported by the processing screw **120** along the melt-carrying passageway **108** to deposit into the accumulation zone **140**. This accumulation of the melt within the accumulation zone **140** causes the processing screw to translate backwardly toward the manifold **122**A (not shown). At this time, the plug **106** may be reheated enough to remelt the plug **106** if so desired.

[0035] Prior to the injection phase, a thixo plug (not depicted) is formed within the machine nozzle **144** by using a nozzle cooling mechanism **138**. This thixo plug is blown out from the nozzle **144** during the injection phase to allow the melt **110** in the accumulation zone **140** to enter the mold cavity. Upon injecting the melt accumulated in the accumulation zone **140**, another shot of the melt **110** must be accumulated. This is accomplished by melting the plug **106** (not shown) which is adhered to the valve body **104** by using the heater **132**A. If needed heaters **132**B and **132**C may be used to melt any potentially solidified melt that may have formed unintentionally (for whatever reason). After a calculated duration, sufficient to melt the plug **106** and reform another thixo plug (not depicted) in the machine nozzle **144**, the recovery phase may be repeated. This is then followed by repetition of the injection phase. In a variant (not depicted), the heater **142** is and induction heater that is attached to the barrel **114** to increase effectiveness for melting the plug **106**. The induction heater **142** is a fast-acting heating mechanism. According to a variant, a mechanical nozzle is used in place of forming and blowing out a plug from the nozzle **144**.

[0036] FIG. **2** is a cross-sectional view of a metal-molding-system valve **200** (hereafter referred to as "the valve **200**") according to the second exemplary embodiment. To facilitate an understanding of the second exemplary embodiment, elements of the second exemplary embodiment (that are similar to those of the first exemplary embodiment) are identified by reference numerals that use a two-hundred designation rather than a one-hundred designation (as used in the first exemplary embodiment). For example, the valve body of the second exemplary embodiment is labeled **204** rather than being labeled **104**, etc.

[0037] Preferably, the valve body **204** includes a valve passageway **209**, a valve seal **211**, a cooling circuit **218**B and a valve heater **213**. The valve passageway **209** is defined within the valve body **204**, and allows the plug **206** to be formable therein. The valve passageway **209** extends from the accumulation zone **240** to the melt-carrying passageway **208**. The passageway **208** is defined by the processing screw **220** and the barrel **214**. The valve passageway **208** receives the melt **210**, and then it passes the melt **210** to the accumulation zone **240** during a recovery phase.

[0038] The valve body **204**, which defines a valve body surface **205**, accommodates the valve seal **211**. The valve seal **211** is located on the valve body surface **205**, and the valve seal **211** is adjacent to the barrel **214**. The valve seal **211** interacts with the barrel inner wall **228** to substantially prevent a backflow of melt (the metallic molding material) from the accumulation zone **240** along the barrel inner wall **228** and toward the melt-carrying passageway **208** during an injection phase. The valve body **204** defines the cooling circuit **218**B. The cooling circuit **218**B is connected to the cooling mechanism **216**, which is actuated to form the plug **206**. The cooling circuit **218**B is placed accordingly in the valve body **204** as to not interfere with any mechanisms and/or assemblies defined therein. The valve heater **213** is positionable within the valve body **204** adjacent to the valve passageway **209**. The valve heater **213** is electrically connected to a valve-heater connection **215**. The valve-heater connection **215** extends from the valve heater **213** into the processing screw **220** and over to an electrical power source (not depicted). The valve heater **213** is placed along the valve passageway **209** to remove the plug **206** prior to commencement of the injection phase. In a variant (not depicted), the heater **213** is omitted and the plug is removed by throttling the cooling to the valve body **204** and allowing the valve body **204** to reheat by conduction from the molding material.

[0039] FIG. **3** is a cross-sectional view of a metal-molding-system valve **300** (hereafter referred to as "the valve **300**") according to the third exemplary embodiment. To facilitate an understanding of the third exemplary embodiment, elements of the third exemplary embodiment (that are similar to those of the first exemplary embodiment) are identified by reference numerals that use a three-hundred designation rather than a one-hundred designation (as used in the first exemplary embodiment). For example, the valve body of the third exemplary embodiment is labeled **304** rather than being labeled **104**, etc.

[0040] The valve body **304** is configured to have a plug **306** formable within the cavity **312**. The cooling mechanism **316** includes heat pipes **350**. Using heat pipes in screws is known to those skilled in the art (reference is made to Japanese Patent JP 61-188125. Preferably, the valve body **304** and the processing screw **320** are configured to accommodate a set of heat pipes **350** (or a single heat pipe). The heat pipes **350** include a heat conductive material such as aluminum or copper and the heat pipes **350** are filled with a heat-transfer medium (for example: a wick material and/or a coolant medium) that conducts heat from one end of the heat pipes **350** to the other end. Preferably, the coolant medium or the wick material is chosen from a chemical element or composition that absorbs heat effectively (for example: mercury or sodium). Preferably, a sufficient number of heat pipes **350** are used to remove heat from the cavity **312** in order to form (at least in part) the plug **306** therein (preferably after the recovery phase). Preferably, the heat pipes **350** are oriented such that heat is absorbed from the cavity **312** at a receiving end of the heat pipes **350** and then the absorbed heat is transported to a relief end (or an opposite end) of the heat pipes **350**. The relief end of the heat pipes **350** is in fluid communication with a manifold **322**. Toward the end of the recovery phase, the manifold **322** distributes the coolant fluid **325** (under pressure) over the relief end of the heat pipes **350** to remove heat therefrom. This heat removal from the valve body **304** forms (at least in part) the plug **306**. In order to prevent the heat pipes **350** from absorbing heat from the processing screw **320**, the heat pipes **350** may be encapsulated within an insulation layer **311**. As an option, at the end of injection but before recovery, the heat pipe **350** is permitted to deliver heat to the valve body **304** so as to melt the plug **306**. Heat pipes and the operation of heat pipes are known to those skilled in the art, and therefore no further description is provided for heat pipes. According to a variant (not depicted), the heat pipes **350** depicted in FIG. **3** are used along with the valve body **204** of FIG. **2**, and this arrangement permits elimination of the heater **213**.

[0041] FIG. **4** is a cross-sectional view of a metal-molding-system valve **400** (hereafter referred to as "the valve **400**") according to the fourth exemplary embodiment. To facilitate an understanding of the fourth exemplary embodiment, elements of the fourth exemplary embodiment (that are similar to those of the first exemplary embodiment) are identified by reference numerals that use a four-hundred designation rather than a one-hundred designation (as used in the first exemplary embodiment). For example, the valve body of the fourth exemplary embodiment is labeled **404** rather than being labeled **104**, etc.

[0042] A cooling mechanism **416** is used to form the thixo plug **406**. The cooling mechanism **416** cooperates with the barrel **414**. The cooling mechanism **416** is positioned adjacent to the valve body **404** along the barrel outer wall **429**. The cooling mechanism **416** removes heat from the barrel outer wall **429** adjacent to a region proximate to where the valve body **404** is located. The cooling mechanism **416** delivers a coolant fluid **425** (under pressure) toward the end of the recovery phase to form (at least in part) the plug **406**.

[0043] FIGS. **5**A to **5**C are cross-sectional views of metal-molding-system valves **500**A, **500**B and **500**C (hereafter referred to as "the valves **500**A, **500**B, **500**C) according to the fifth exemplary embodiment. To facilitate an understanding of the fifth exemplary embodiment, elements of the fifth exemplary embodiment (that are similar to those of the first exemplary embodiment) are identified by reference numerals that use a five-hundred designation rather than a one-hundred designation (as used in the first exemplary embodiment). For example, the mold body of the fifth exemplary embodiment is labeled **504** rather than being labeled **104**. The valves **500**A, **500**B and **500**C each include meli-receiving features **524**A, **524**B, and **524**C respectively, and each has a plurality of various types or shapes of grooves. The valve body **504** has a longitudinal axis **562** that extends from the center therethrough.

[0044] FIG. **5**A shows the valve **500**A that includes the melt-receiving feature **524**A that has a plurality of rectangular-shaped grooves **560**A, **560**B, and **560**C that are aligned (preferably) orthogonally to the longitudinal axis **562**. The rectangular-shaped grooves **560**A, **560**B, **560**C are arrayed successively at calculated, offset distances therebetween. The arrangement of the rectangular-shaped grooves **560**A, **560**B, and **560**C is not limited to this configuration (for example: they may be irregularly spaced and/or the rectangular-shaped grooves may be inclined non-orthogonally from the longitudinal axis **562**).

[0045] FIG. **5**B shows the valve **500**B that includes the melt-receiving feature **524**B that has a plurality of v-shaped grooves **564**A, **564**B, **564**C. The v-shaped grooves **564**A, **564**B, and **564**C are arrayed successively at a calculated offset distance between one another. The arrangement of the v-shaped grooves **564**A, **564**B, and **564**C is not limited to this configuration (for example: they may be irregularly spaced apart and/or may be inclined non-orthogonally from the longitudinal axis **562**).

[0046] FIG. **5**C shows the valve **500**C that includes the melt-receiving feature **524**C that has semispherical-shaped grooves **566**A, **566**B, **566**C. The semispherical-shaped grooves **566**A, **566**B, and **566**C are arrayed successively at a calculated offset distance apart from each other. The arrangement of the semispherical-shaped grooves **566**A, **566**B, and **566**C is not limited to this configuration (for example: they can be irregularly spaced apart from one another and/or may be inclined non-orthogonally from the longitudinal axis **562**.

[0047] According to a variant (not depicted), the melt-receiving features **524**A, **524**B, **524**C are not used in the valve body **504**. According to another variant (not depicted), the melt-receiving features **524**A, **524**B, **524**C are not used in the valve body **504**, and the side walls of the body **504** are tapered towards a front end of the body **504** (towards the top side of FIG. **5**).

[0048] FIGS. **6**A to **6**C are cross-sectional views of a metal molding-system valve **600** (hereafter referred to as "the valve **600**) according to the sixth embodiment. To facilitate an understanding of the sixth exemplary embodiment, elements of the sixth exemplary embodiment (that are similar to those of the first exemplary embodiment) are identified by reference numerals that use a six-hundred designation rather than a one-hundred designation (as used in the first exemplary embodiment). For example, the mold body of the sixth exemplary embodiment is labeled **604** rather than being labeled **104**. The valve **600**A, **600**B and **600**C each include melt-receiving features **624**A, **624**B, and **624**C respectively (each having a plurality of recesses).

[0049] FIG. **6**A shows the valve **600** that includes the melt-receiving feature **624**A that has a plurality of rectangular-shaped recesses **670** that are aligned (in rows) orthogonally to a surface of the valve body **604**. The rectangular-shaped recesses **670** are arrayed successively at calculated offset distances from one another. The arrangement of the rectangular-shaped recesses **670** is not limited to this configuration (for example: they may be irregularly spaced and/or inclined non-orthogonally from a longitudinal axis of the valve body **604** and/or placed in a random pattern onto the valve body **604**).

[0050] FIG. **6**B shows the valve **600**B that includes the melt-receiving feature **624**B includes a plurality of conically-shaped recesses **672**. The conically-shaped recess **672** are arrayed successively at calculated offset distances from one another. The arrangement of the conically-shaped recesses **672** is not limited to this configuration (for example: they may be irregularly spaced apart, etc).

[0051] FIG. **6**C shows the valve **600**C that includes the melt-receiving feature **624**C that has semispherical-shaped recesses **674**. The semispherical-shaped recesses **674** are arrayed successively at a calculated offset distance from each other. The arrangement of the semispherical-shaped recesses **674** is not limited to this configuration (for example: they may be irregularly spaced apart, etc).

[0052] According to a variant (not depicted), the melt-receiving features **624**A, **624**B, **624**C are not used in the valve body **604**. According to another variant (not depicted), the melt-receiving features **624**A, **624**B, **624**C are not used in the valve body **604**, and the side walls of the body **604** are tapered towards a front end of the body **604** (towards the top side of FIG. **6**). According to another variant, the melt-receiving feature **624** includes a plurality of divots.

[0053] The description of the exemplary embodiments provides examples of the present invention, and these examples do not limit the scope of the present invention. It is understood that the scope of the present invention is limited by the claims. The concepts described above may be adapted for specific conditions and/or functions, and may be further extended to a variety of other applications that are within the scope of the present invention. Having thus described the exemplary embodiments, it will be apparent that modifications and enhancements are possible without departing from the concepts as described. Therefore, what is to be protected by way of letters patent are limited only by the scope of the following claims:

What is claimed is:

1. A metal-molding-system valve, comprising:

a valve body positionable in a melt-carrying passageway of a metal-molding system, the valve body permitting solidified adherance of a metallic-molding material of melt-carrying passageway to the valve body.

2. A metal-molding-system valve of claim **1**, wherein solidified adherance of the metallic-molding material to the valve body permits repeatable operation of the valve body.

3. The metal-molding-system valve of claim **1**, wherein responsive to a cooling mechanism cooling the metallic-molding material, a metallic plug is formable between the valve body and the melt-carrying passageway.

4. The metal-molding-system valve of claim **1**, wherein a metallic plug is solidifyable to and meltable from the valve body.

5. The metal-molding-system valve of claim **1**, wherein the valve body is slidable within a melt-carrying passageway defined by a metal-molding system.

6. The metal-molding-system valve of claim **1**, wherein a metallic plug is formable from a metallic-molding material carried by a melt-carrying passageway defined by a metal-molding system.

7. The metal-molding-system valve of claim **1**, wherein a metallic plug is formable from a metallic-molding material, the metallic-molding material including an alloy of magnesium.

8. The metal-molding-system valve of claim **1**, wherein a metal-molding component is configured to have a metallic plug formable adjacent thereto.

9. The metal-molding-system valve of claim **1**, wherein a metallic plug is adherable and unadherable to and from any one of the valve body, a metal-molding component of the metal-molding system and any combination and permutation thereof.

10. The metal-molding-system valve of claim **1**, wherein the valve body is configured to define a cavity, the cavity is configured to have a metallic plug formed therein.

11. The metal-molding-system valve of claim **1**, wherein:

a metal-molding system has a metal-molding component, the metal-molding component includes a barrel, the barrel defines a melt-carrying passageway; and

the valve body is receivable in the melt-carrying passageway.

12. The metal-molding-system valve of claim **1**, wherein responsive to a cooling mechanism cooling the metallic-molding material, a metallic plug is formable between the valve body and the melt-carrying passageway, the cooling mechanism includes cooling circuits adapted to carry a cooling fluid.

13. The metal-molding-system valve of claim **1**, wherein responsive to a cooling mechanism cooling the metallic-molding material, a metallic plug is formable between the valve body and the melt-carrying passageway, the cooling mechanism cooperates with a processing screw and the valve body.

14. The metal-molding-system valve of claim **1**, wherein responsive to a cooling mechanism cooling the metallic-molding material, a metallic plug is formable between the valve body and the melt-carrying passageway, the cooling mechanism cooperates with a processing screw and the valve body, the cooling mechanism includes manifolds configured to communicate a cooling fluid to a cooling circuit defined in the processing screw, the manifolds are mounted to a barrel of a metal-molding system.

15. The metal-molding-system valve of claim **1**, wherein the valve body includes a melt-receiving feature.

16. The metal-molding-system valve of claim **1**, wherein a metal-molding system includes a barrel, and wherein the valve body includes an outer surface, the valve body is attachable to a processing screw useable in the barrel, the barrel having a barrel inner wall facing the outer surface of the valve body, the outer surface of the valve body configured to be cooled by a mechanism, the cooling mechanism is configured to form a metallic plug between the outer surface of the valve body and the barrel inner wall.

17. The metal-molding-system valve of claim **1**, wherein the valve body defines a valve passageway, a metallic plug is formed in the valve passageway.

18. The metal-molding-system valve of claim **1**, wherein the valve body defines a valve passageway, a metallic plug is formed in the valve passageway, the valve passageway extends from an accumulation zone to a melt-carrying passageway defined by a processing screw and a barrel.

19. The metal-molding-system valve of claim **1**, wherein the valve body cooperates with a valve seal placed between the valve body and a barrel.

20. The metal-molding-system valve of claim **1**, wherein the valve body cooperates with a valve heater, the valve heater is locatable adjacent to a valve passageway.

21. The metal-molding-system valve of claim **1**, wherein a heating mechanism includes a heat pipe.

22. The metal-molding-system valve of claim **1**, wherein a heating mechanism includes a heat pipe embedded in a processing screw.

23. The metal-molding-system valve of claim **1**, wherein a metal-molding system includes a barrel, the barrel interacts with a cooling mechanism, the cooling mechanism is configured to cooperate with the barrel, and the cooling mechanism is positionable adjacent to the valve body.

24. The metal-molding-system valve of claim **1**, wherein the valve body includes a melt-receiving feature, the melt-receiving feature includes a plurality of grooves.

25. The metal-molding-system valve of claim **1**, wherein the valve body has a longitudinal axis extending therethrough, the valve body includes a melt-receiving feature, the melt-receiving feature includes a plurality of grooves aligned orthogonal to the longitudinal axis.

26. The metal-molding-system valve of claim **1**, wherein the valve body includes a melt-receiving feature, the melt-receiving feature includes a plurality of any one of rectangular shaped grooves, v-shaped grooves, semispherical-shaped grooves and any combination and permutation thereof.

27. The metal-molding-system valve of claim **1**, wherein the valve body includes a melt-receiving feature, the melt-receiving feature includes a plurality of divots.

28. A metal-molding system, comprising:

a metal-molding-system valve, including:

a valve body positionable in a melt-carrying passageway of the metal-molding system, the valve body permitting solidified adherance of a metallic-molding material of melt-carrying passageway to the valve body.

29. A metal-molding system of claim **28**, wherein solidified adherance of the metallic-molding material to the valve body permits repeatable operation of the valve body.

30. The metal-molding system of claim **28**, wherein responsive to a cooling mechanism cooling the metallic-molding material, a metallic plug is formable between the valve body and the melt-carrying passageway.

31. The metal-molding system of claim **28**, wherein a metallic plug is solidifyable to and meltable from the valve body.

32. The metal-molding system of claim **28**, wherein the valve body is slidable within a melt-carrying passageway defined by a metal-molding system.

33. The metal-molding system of claim **28**, wherein a metallic plug is formable from a metallic-molding material carried by a melt-carrying passageway defined by a metal-molding system.

34. The metal-molding system of claim **28**, wherein a metallic plug is formable from a metallic-molding material, the metallic-molding material including an alloy of magnesium.

35. The metal-molding system of claim **28**, wherein a metal-molding component is configured to have a metallic plug formable adjacent thereto.

36. The metal-molding system of claim **28**, wherein a metallic plug is adherable and unadherable to and from any one of the valve body, a metal-molding component of the metal-molding system and any combination and permutation thereof.

37. The metal-molding system of claim **28**, wherein the valve body is configured to define a cavity, the cavity is configured to have a metallic plug formed therein.

38. The metal-molding system of claim **28**, wherein:

a metal-molding system has a metal-molding component, the metal-molding component includes a barrel, the barrel defines a melt-carrying passageway; and

the valve body is receivable in the melt-carrying passageway.

39. The metal-molding system of claim **28**, wherein responsive to a cooling mechanism cooling the metallic-molding material, a metallic plug is formable between the valve body and the melt-carrying passageway, the cooling mechanism includes cooling circuits adapted to carry a cooling fluid.

40. The metal-molding system of claim **28**, wherein responsive to a cooling mechanism cooling the metallic-molding material, a metallic plug is formable between the valve body and the melt-carrying passageway, the cooling mechanism cooperates with a processing screw and the valve body.

41. The metal-molding system of claim **28**, wherein responsive to a cooling mechanism cooling the metallic-molding material, a metallic plug is formable between the valve body and the melt-carrying passageway, the cooling mechanism cooperates with a processing screw and the valve body, the cooling mechanism includes manifolds configured to communicate a cooling fluid to a cooling circuit defined in the processing screw, the manifolds are mounted to a barrel of a metal-molding system.

42. The metal-molding system of claim **28**, wherein the valve body includes a melt-receiving feature.

43. The metal-molding system of claim **28**, wherein a metal-molding system includes a barrel, and wherein the valve body includes an outer surface, the valve body is attachable to a processing screw useable in the barrel, the barrel having a barrel inner wall facing the outer surface of the valve body, the outer surface of the valve body configured to be cooled by a mechanism, the cooling mechanism is configured to form a metallic plug between the outer surface of the valve body and the barrel inner wall.

44. The metal-molding system of claim **28**, wherein the valve body defines a valve passageway, a metallic plug is formed in the valve passageway.

45. The metal-molding system of claim **28**, wherein the valve body defines a valve passageway, a metallic plug is formed in the valve passageway, the valve passageway extends from an accumulation zone to a melt-carrying passageway defined by a processing screw and a barrel.

46. The metal-molding system of claim **28**, wherein the valve body cooperates with a valve seal placed between the valve body and a barrel.

47. The metal-molding system of claim **28**, wherein the valve body cooperates with a valve heater, the valve heater is locatable adjacent to a valve passageway.

48. The metal-molding system of claim **28**, wherein a heating mechanism includes a heat pipe.

49. The metal-molding system of claim **28**, wherein a heating mechanism includes a heat pipe embedded in a processing screw.

50. The metal-molding system of claim **28**, wherein a metal-molding system includes a barrel, the barrel interacts with a mechanism, the mechanism is configured to cooperate with the barrel, and the mechanism is positionable adjacent to the valve body.

51. The metal-molding system of claim **28**, wherein the valve body includes a melt-receiving feature, the melt-receiving feature includes a plurality of grooves.

52. The metal-molding system of claim **28**, wherein the valve body has a longitudinal axis extending therethrough, the valve body includes a melt-receiving feature, the melt-receiving feature includes a plurality of grooves aligned orthogonal to the longitudinal axis.

53. The metal-molding system of claim **28**, wherein the valve body includes a melt-receiving feature, the melt-receiving feature includes a plurality of any one of rectangular shaped grooves, v-shaped grooves, semispherical-shaped grooves and any combination and permutation thereof.

54. The metal-molding system of claim **28**, wherein the valve body includes a melt-receiving feature, the melt-receiving feature includes a plurality of divots.

55. A method of a metal-molding-system valve, comprising:

positioning a valve body in a melt-carrying passageway of a metal-molding system, and permitting solidified adherance of a metallic-molding material of melt-carrying passageway to the valve body.

56. The method of claim **55**, further comprising:

repeatably operating the valve body inspite of solidified adherance of the metallic-molding material to the valve body.

57. The method of claim **55**, further comprising:

forming a metallic plug between the valve body and the melt-carrying passageway.

58. The method of claim **55**, further comprising:

solidifying and melting a metallic plug to and from the valve body.

59. The method of claim **55**, further comprising:

sliding the valve body within a melt-carrying passageway defined by a metal-molding system.

60. The method of claim **55**, further comprising:

forming a metallic plug from a metallic-molding material carried by a melt-carrying passageway defined by a metal-molding system.

61. The method of claim **55**, further comprising:

forming a metallic plug from a metallic-molding material, the metallic-molding material including an alloy of magnesium.

62. The method of claim **55**, further comprising:

forming a metallic plug formable adjacent to a metal-molding component.

63. The method of claim **55**, further comprising:

adhereing and unadhereing a metallic plug to and from any one of the valve body, a metal-molding component of the metal-molding system and any combination and permutation thereof.

64. The method of claim **55**, further comprising:

defining a cavity in the valve body, the cavity is configured to have a metallic plug formed therein.

65. The method of claim **55**, further comprising:

receiving the valve body in the melt-carrying passageway, a metal-molding system has a metal-molding component, the metal-molding component includes a barrel, the barrel defines a melt-carrying passageway.

66. The method of claim **55**, further comprising:

forming a metallic plug between the valve body and the melt-carrying passageway responsive to a cooling mechanism cooling the metallic-molding material, the cooling mechanism includes cooling circuits adapted to carry a cooling fluid.

67. The method of claim **55**, further comprising:

forming a metallic plug between the valve body and the melt-carrying passageway, responsive to a cooling mechanism cooling the metallic-molding material, the cooling mechanism cooperates with a processing screw and the valve body.

68. The method of claim **55**, further comprising:

forming a metallic plug between the valve body and the melt-carrying passageway responsive to a cooling mechanism cooling the metallic-molding material, the cooling mechanism cooperates with a processing screw and the valve body, the cooling mechanism includes manifolds configured to communicate a cooling fluid to a cooling circuit defined in the processing screw, the manifolds are mounted to a barrel of a metal-molding system.

69. The method of claim **55**, further comprising:

including a melt-receiving feature in the valve body.

70. The method of claim **55**, wherein a metal-molding system includes a barrel, and wherein the valve body includes an outer surface, the valve body is attachable to a processing screw useable in the barrel, the barrel having a barrel inner wall facing the outer surface of the valve body, the outer surface of the valve body configured to be cooled by a mechanism; the cooling mechanism is configured to form a metallic plug between the outer surface of the valve body and the barrel inner wall.

71. The method of claim **55**, further comprising:

defining a valve passageway in the valve body; and

forming a metallic plug in the valve passageway.

72. The method of claim **55**, further comprising:

defining a valve passageway in the valve body; and

forming a metallic plug in the valve passageway, the valve passageway extends from an accumulation zone to a melt-carrying passageway defined by a processing screw and a barrel.

73. The method of claim **55**, further comprising:

cooperating the valve body with a valve seal placed between the valve body and a barrel.

74. The method of claim **55**, further comprising:

cooperating the valve body with a valve heater, the valve heater is locatable adjacent to a valve passageway.

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