



(51) International Patent Classification:

B22D 17/14 (2006.01) B22D 18/04 (2006.01)
B22D 17/30 (2006.01)

(21) International Application Number:

PCT/IB2013/000382

(22) International Filing Date:

13 March 2013 (13.03.2013)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

2012-081398 30 March 2012 (30.03.2012) JP

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(81) Designated States (unless otherwise indicated, for every

kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,

BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IS, KE, KG, KM, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
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OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC,
SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every

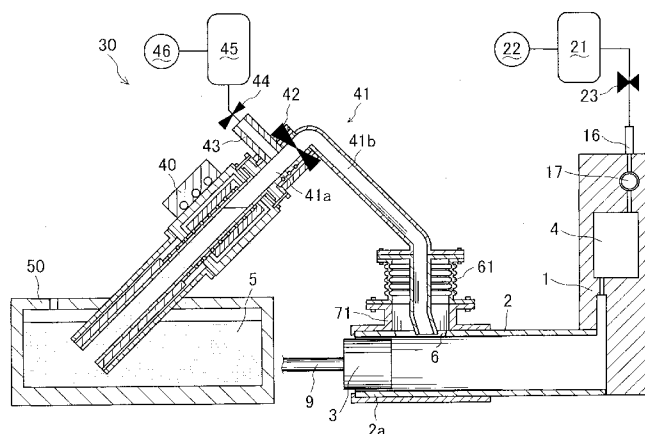
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments (Rule 48.2(h))

(54) Title: MOLDING METHOD AND MOLDING APPARATUS

FIG. 1



(57) Abstract: A molding apparatus (30) is configured so as to form a molten metal holding space (41a) by dividing the inside of a connecting portion (41) into the molten metal holding space (41a) and a molten metal supply port-side space (41b) by closing an on-off valve (42), and pump up molten metal (5) from a molten metal furnace (50) into the molten metal holding space (41a) of the connecting portion (41) with a pump (40). Then a pressure of the molten metal (5) that has been pumped up into the molten metal holding space (41a) is reduced by a pressure-reducing portion, and the molten metal holding space (41a) inside the connecting portion (41) is communicated with a molten metal supply port (6) of an injection sleeve (2) by opening the on-off valve (42), and the molten metal (5), the pressure of which has been reduced in the molten metal holding space (41a), is supplied into the injection sleeve (2).

MOLDING METHOD AND MOLDING APPARATUS

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

[0001] The invention relates to a molding method and a molding apparatus. More particularly, the invention relates to a die cast molding method and a die cast molding apparatus in which molten metal is injected into a cavity of a mold.

10 2. Description of Related Art

[0002] Technology such as that described below is used in typical die cast molding. A fixed amount of molten metal is supplied into an injection sleeve that has a molten metal supply port, through the molten metal supply port. After the molten metal is finished being supplied, an injection tip is advanced by driving means at a predetermined
15 timing, such that molten metal is injected at a high pressure into the cavity of the mold from the injection sleeve (see Japanese Patent Application Publication No. 2003-290899 (JP 2003-290899 A), Japanese Patent Application Publication No. 2005-46905 (JP 2005-46905 A), and Japanese Patent Application Publication No. 2011-131265 (JP 2011-131265 A), for example).

20 [0003] The molding apparatus described in JP 2003-290899 A is configured such that molten metal is pumped up from a molten metal furnace with a ladle, and supplied to a molten metal supply port of an injection sleeve by this ladle. However, with the structure described above, when the molten metal is supplied from the ladle to the injection sleeve, it contacts the atmosphere. As a result, the temperature of the molten metal drops, and the
25 quality of the product decreases due to an oxide film produced on the molten metal and hydrogen gas dissolving in the molten metal. Moreover, in order to reduce the amount of hydrogen gas that dissolves in the molten metal, a process for injecting an inert gas into the molten metal is required.

[0004] On the other hand, the molding apparatuses described in JP 2005-46905 A

and JP 2011-131265 A are configured such that a molten metal supply tube is directly joined to a molten metal supply port of an injection sleeve, and molten metal is supplied via this molten metal supply tube, so it (i.e., the molten metal) will not contact the atmosphere. However, with a structure such as this as well, it is not possible to sufficiently suppress a decrease in the quality of a product due to an oxide film and dissolved hydrogen as described above, because the molten metal still contacts the air inside the molten metal supply tube.

SUMMARY OF THE INVENTION

10 **[0005]** The invention thus provides a molding method and a molding apparatus capable of improving, with a simple structure, the quality of a product.

[0006] A first aspect of the invention relates to a molding method that uses a molding apparatus that is provided with a mold having a cavity, an injection sleeve that has a molten metal supply port and is communicated with the cavity, a molten metal furnace within which molten metal is stored, a connecting portion that connects the molten metal furnace to the injection sleeve by one end of the connecting portion being connected to the molten metal furnace and the other end of the connecting portion being connected to a location opposite the molten metal supply port, a pump that is arranged in the connecting portion and pumps up molten metal from the molten metal furnace, a valve that is arranged in the connecting portion, and that forms a molten metal holding space that holds the molten metal pumped up by the pump, in the connecting portion, and a pressure-reducing portion that is arranged in a portion of the connecting portion where the molten metal holding space is located, and that reduces pressure in the molten metal holding space. This molding method includes forming the molten metal holding space inside the connecting portion by closing the valve; pumping up the molten metal from the molten metal furnace into the molten metal holding space of the connecting portion with the pump; reducing a pressure of the molten metal pumped up into the molten metal holding space with the pressure-reducing portion; communicating the molten metal holding space of the connecting portion with the molten metal supply port of the injection sleeve by

opening the valve; and supplying the molten metal, the pressure of which has been reduced inside the molten metal holding space, into the injection sleeve.

[0007] Also, in the aspect described above, the pumping up of the molten metal may involve pumping up, into the molten metal holding space, molten metal of the same amount as the molten metal that is injected into the cavity.

[0008] Also, in the structure described above, the reducing of the pressure of the molten metal may involve stopping movement of the molten metal from the molten metal furnace to the connecting portion by operating the pump, while the pressure is being reduced.

[0009] Also, in the aspect or structure described above, the molding method may also include injecting molten metal into the cavity; solidifying the molten metal inside the cavity; releasing a molded article formed by the molten metal that has solidified inside the cavity from the mold; and applying a mold release agent to an inside of the cavity. Also, the forming of the molten metal holding space, the pumping up of the molten metal, and the reducing of the pressure of the molten metal of a next cycle may be performed while one of the injecting, the solidifying, the releasing, and the applying is being performed.

[0010] A second aspect of the invention relates to a molding apparatus that includes a mold having a cavity; an injection sleeve that has a molten metal supply port and is communicated with the cavity; a molten metal furnace within which molten metal is stored; a connecting portion that connects the molten metal furnace to the injection sleeve by one end of the connecting portion being connected to the molten metal furnace and the other end of the connecting portion being connected to a location opposite the molten metal supply port; a pump that is arranged in the connecting portion and pumps up molten metal from the molten metal furnace into the connecting portion, and supplies the molten metal into the injection sleeve via the connecting portion; a valve that is arranged in the connecting portion, and that forms a molten metal holding space that holds the molten metal pumped up by the pump, in the connecting portion; and a pressure-reducing portion that is arranged in a portion of the connecting portion where the molten metal holding space is located, and that reduces pressure in the molten metal holding space. The

injection sleeve performs an operation of injecting the molten metal into the cavity. The molten metal holding space is formed by closing the valve. The pump pumps up the molten metal into the molten metal holding space of the connecting portion. The valve communicates the molten metal holding space of the connecting portion with the molten metal supply port of the injection sleeve by opening, and supplies the molten metal, the pressure of which has been reduced inside the molten metal holding space, into the injection sleeve.

[0011] According to the aspect described above, the molding method and the molding apparatus described above are able to improve, with a simple structure, the quality of a product.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Features, advantages, and technical and industrial significance of exemplary embodiments of the invention will be described below with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

FIG. 1 is a sectional view schematically showing a molding apparatus according to one example embodiment of the invention;

FIG. 2 is a flowchart illustrating a reduced-pressure molding method; and

FIG. 3 is a flowchart illustrating a process performed when pouring molten metal.

DETAILED DESCRIPTION OF EMBODIMENTS

[0013] Next, example embodiments of the invention will be described. The technical scope of the invention is not limited to the example embodiments below. The invention made apparent from the description in the specification and the accompanying drawings broadly covers the entire scope of truly intended technical aspects.

[Structure of a reduced-pressure molding apparatus 30]

[0014]

A reduced-pressure molding apparatus 30 according to one example embodiment of the invention will be described with reference to FIG. 1. In this specification, for the sake

of convenience, the right side of FIG. 1 will be described as the right side of the reduced-pressure molding apparatus 30, and the left side of FIG. 1 will be described as the left side of the reduced-pressure molding apparatus 30.

[0015] As shown in FIG. 1, a cavity 4 is formed in a mold 1 of the reduced-pressure molding apparatus 30. A generally cylindrical injection sleeve 2 that is communicated with the cavity 4 is provided protruding to the left. In other words, the inside of the injection sleeve 2 is connected in a continuous manner to the inside of the cavity 4. Also, the reduced-pressure molding apparatus 30 is configured so as to inject molten metal 5 such as aluminum that has been supplied into the injection sleeve 2, into the cavity 4 by sliding a short round columnar-shaped injection tip 3 to the right inside the injection sleeve 2 and pushing the molten metal 5 out.

[0016] A molten metal supply port 6 is formed in the injection sleeve 2. The molten metal 5 is supplied from this molten metal supply port 6 into the injection sleeve 2 via a connecting portion 41 that will be described later. A support shaft 9 is inserted into the injection sleeve 2 and controlled to advance and retreat by an actuator such as an air cylinder or a hydraulic cylinder, not shown. Also, the injection tip 3 that is arranged on a tip end portion of the support shaft 9 slides in an axial direction inside the injection sleeve 2.

[0017] A suction port 16 for sucking air out of the cavity 4 is provided passing into the cavity 4 in the mold 1. Also, a shut-off valve 17 is provided in a path that connects the cavity 4 and the suction port 16 together. The suction port 16 is connected to a suction portion (a low-pressure tank 21 and a vacuum pump 22 in this example embodiment), such that the suction portion is communicated with the inside of the cavity 4. An on-off valve 23 is provided in a connecting path connecting the low-pressure tank 21 with the suction port 16, and opens and closes this connecting path. Also, the pressure in the cavity 4 starts to be reduced by opening the on-off valve 23 in the connecting path in conjunction with injection control.

[0018] The reduced-pressure molding apparatus 30 includes a molten metal furnace 50 within which the molten metal 5 is stored, a connecting portion 41 that connects

the molten metal furnace 50 to the injection sleeve 2 by one end of the connecting portion 41 being connected to the molten metal furnace 50 and the other end of the connecting portion 41 being connected to a location opposite the molten metal supply port 6, and an electromagnetic pump 40 that is arranged in the connecting portion 41 and pumps up the molten metal 5 from the molten metal furnace 50. The inner peripheral portions of the connecting portion 41 and the electromagnetic pump 40 are made of ceramic. Also, in conjunction with injection control, the electromagnetic pump 40 pumps up the molten metal 5 with electromagnetic force by applying voltage to an internal coil. In this example embodiment, the electromagnetic pump 40 is used, but a configuration that uses another pump such as a displacement pump or a turbo pump (i.e., a rotodynamic pump) that uses a rotor is also possible. Further, in this example embodiment, the molten metal furnace 50 stores molten metal in a state cutoff from the atmosphere.

[0019] The connecting portion 41 is connected to the injection sleeve 2 via a junction tube 61 that has a bellows-type structure that is a vibration absorbing portion. More specifically, a metal or ceramic insulation member 71 that is formed in a tube-shape that is communicated with the molten metal supply port 6 of the injection sleeve 2 is arranged on the injection sleeve 2. Further, the junction tube 61 is arranged on the upper side of the insulation member 71 and supports the connecting portion 41. That is, by having the upper end portion of the junction tube 61, i.e., the side of the junction tube 61 on which the connecting portion 41 positioned, be connected to an intermediate portion of the connecting portion 41, the other end of the connecting portion 41 is positioned near the molten metal supply port 6. The junction tube 61 is formed such that the tube-shaped bellows-type structure is able to expand and contract and bend, so as to absorb vibrations and deformation of the upper end portion or lower end portion of the junction tube 61.

[0020] An on-off valve 42 that serves as a valve that forms a molten metal holding space 41a that holds the molten metal 5 inside the connecting portion 41 is arranged in the connecting portion 41. That is, when the on-off valve 42 is closed, the inside of the connecting portion 41 is divided into the molten metal holding space 41a and a molten metal supply port-side space 41b, such that the molten metal holding space 41a is

formed. Also, the connecting portion 41 is configured such that when the on-off valve 42 is open, the molten metal holding space 41a and the molten metal supply port-side space 41b inside the connecting portion 41 are communicated with one another, and thus the molten metal holding space 41a is communicated with the molten metal supply port 6 of the injection sleeve 2.

[0021] Also, a pressure-reducing portion that reduces the pressure in the molten metal holding space 41a when the inside of the connecting portion 41 is divided into the molten metal holding space 41a and the molten metal supply port-side space 41b by the on-off valve 42, is arranged in a portion of the connecting portion 41 where the molten metal holding space 41a is positioned. More specifically, a suction port 43 that is communicated with the inside of the molten metal holding space 41a is provided in the connecting portion 41. This suction port 43 is connected to a low-pressure tank 45 and a vacuum pump 46 that form a pressure-reducing portion. That is, the pressure-reducing portion is communicated with the molten metal holding space 41a via the suction port 43. An on-off valve 44 is formed in a connecting path connecting the low-pressure tank 45 with the suction port 43, and opens and closes this connecting path. The pressure in the molten metal holding space 41a starts to be reduced by opening the on-off valve 44 in conjunction with injection control.

[0022] The reduced-pressure molding apparatus 30 according to this example embodiment is structured as described above, and performs molding by performing an injection operation that pushes out molten metal 5 supplied by the electromagnetic pump 40 from the molten metal furnace 50 into the injection sleeve 2 via the connecting portion 41, toward the right by the injection tip 3 and injecting the molten metal 5 into the cavity 4, in a condition where the pressure in the cavity 4 is reduced by the suction portion.

[Reduced-pressure molding method using the reduced-pressure molding apparatus 30]

[0023]

Next, a pressure-reduced molding method using the reduced-pressure molding apparatus 30 according to this example embodiment will be described with reference to FIGS. 1 and 2.

[0024] First, in step S1 in FIG. 2, a movable die of the mold 1 is brought into contact with a fixed die and the two are clamped together, thus forming the cavity 4. Next, in step S2 in FIG. 2, a tip lubricant so that the injection tip 3 slides smoothly is applied to the inner peripheral surface of the injection sleeve 2.

5 [0025] Next, in step S3 in FIG. 2, the molten metal 5 is supplied by the electromagnetic pump 40 from the molten metal furnace 50 into the injection sleeve 2 via the connecting portion 41. This molten metal pouring process will be described in detail later.

[0026] Then in step S4 in FIG. 2, the pressure in the cavity 4 is reduced by the
10 low-pressure tank 21 and the vacuum pump 22 that form the suction portion. More specifically, after the molten metal 5 has settled, the pressure in the cavity 4 starts to be reduced by opening the on-off valve 23 sucking out the air inside the cavity 4 with the low-pressure tank 21 and the vacuum pump 22. The molten metal 5 that is undulating due to being poured in step S3 may also be given some time to settle (approximately
15 several seconds, for example) before starting to reduce the pressure.

[0027] Next, in step S5 in FIG. 2, molding is performed by injecting the molten metal 5 into the cavity 4 by pushing the molten metal 5 out with the injection tip 3. More specifically, the molten metal 5 is injected into the cavity 4, the pressure of which has been reduced to a predetermined degree, by an injection operation of the injection tip 3, which is
20 performed by driving an actuator, not shown.

[0028] Next, in step S6 in FIG. 2, air is stopped from being sucked into the cavity 4 by the low-pressure tank 21 and the vacuum pump 22, by closing the on-off valve 23, thereby canceling the reduced-pressure state. The molten metal 5 is solidified inside the cavity 4 by this process.

25 [0029] Then in step S7 in FIG. 2, the mold 1 is opened by separating the movable die of the mold 1 from the fixed die, and a molded article formed by the molten metal 5 that has solidified inside the cavity 4 is released from the mold. Next, in step S8 in FIG. 2, the product formed inside the cavity 4 is removed, and a mold release agent is applied to the cavity 4 for the next cycle.

[Molten metal pouring method]

[0030]

Next, a molten metal pouring method using the reduced-pressure molding apparatus 30 according to this example embodiment will be described with reference to FIGS. 1 and 2.

[0031] First, in step S101 in FIG. 3, the molten metal holding space 41a is formed by dividing the inside of the connecting portion 41 into the molten metal holding space 41a and the molten metal supply port-side space 41b by closing the on-off valve 42 (a molten metal holding space forming process).

[0032] Next, in step S102 in FIG. 3, the molten metal 5 is pumped up from the molten metal furnace 50 into the molten metal holding space 41a by the electromagnetic pump 40 (a pumping process). In this example embodiment, molten metal 5 of the same amount as the molten metal 5 that is to be injected into the cavity 4 is pumped into the molten metal holding space 41a in the pumping process.

[0033] Then in step S103 in FIG. 3, the pressure of the molten metal 5 that has been pumped up into the molten metal holding space 41a is reduced by the pressure-reducing portion (a molten metal pressure-reducing process). More specifically, the pressure of the molten metal 5 inside the molten metal holding space 41a is reduced by starting to reduce the pressure in the molten metal holding space 41a that is connected to the low-pressure tank 45 and the vacuum pump 46, by opening the on-off valve 44. In this example embodiment, movement of the molten metal from the molten metal furnace 50 to the connecting portion 41 is stopped by operating the electromagnetic pump 40, during this molten metal pressure-reducing process, so molten metal 5 will not be drawn up from the molten metal furnace 50 with the decrease in pressure in the molten metal holding space 41a by the pressure-reducing portion.

[0034] Next, in step S104 in FIG. 3, the molten metal holding space 41a and the molten metal supply port-side space 41b in the connecting portion 41 are communicated with each other by opening the on-off valve 42, thus communicating the molten metal holding space 41a with the molten metal supply port 6 of the injection sleeve 2 (a

communicating process). Next, in step S105 in FIG. 3, the electromagnetic pump 40 is driven to supply the molten metal 5, the pressure of which has been reduced in the molten metal holding space 41a, into the injection sleeve 2 (a supplying process). That is, this supplying process becomes step S3 described above.

5 [0035] In this example embodiment, the molten metal holding space forming process of step S101, the pumping process of step S102, and the molten metal pressure-reducing process of step S103 are performed while one of the processes, from among the process of injecting the molten metal 5 into the cavity 4 in step S5, the process of canceling the reduced-pressure state and solidifying the molten metal 5 inside the cavity
10 4 in step S6, the process of releasing the molded article formed by the molten metal 5 that has solidified in the cavity 4 from the mold 1 in step S7, and the process of applying the mold release agent to the inside of the cavity 4 in step S8, of the last cycle, is being performed. In other words, the molten metal holding space forming process (i.e., step S101), the pumping process (i.e., step S102), and the molten metal pressure-reducing
15 process (i.e., step S103) of the next cycle are performed while one of the processes of steps S5 to S8 is being performed.

 [0036] As described above, the reduced-pressure molding apparatus 30 according to this example embodiment forms the molten metal holding space 41a by dividing the inside of the connecting portion 41 into the molten metal holding space 41a and the molten
20 metal supply port-side space 41b by closing the on-off valve 42, and pumps up molten metal 5 into the molten metal holding space 41a of the connecting portion 41 from the molten metal furnace 50 with the electromagnetic pump 40. Then the molten metal 5 that has been pumped up into the molten metal holding space 41a is reduced in pressure by the pressure-reducing portion, and the molten metal holding space 41a inside the connecting
25 portion 41 is communicated with the molten metal supply port 6 of the injection sleeve 2 by opening the on-off valve 42, and the molten metal 5 that has been reduced in pressure inside the molten metal holding space 41a is supplied into the injection sleeve 2.

 [0037] As described above, the reduced-pressure molding apparatus 30 according to this example embodiment is configured such that the molten metal 5 will not contact the

atmosphere when being poured, by supplying the molten metal 5 into the injection sleeve 2 from the molten metal furnace 50 via the connecting portion 41. Therefore, it is possible to inhibit the temperature of the molten metal 5 from dropping and an oxide film from forming on the molten metal 5. In addition, it is possible to reduce the amount of hydrogen gas that dissolves in the molten metal 5, and thus inhibit a decrease in quality of a product.

[0038] Moreover, in this example embodiment, the molten metal 5 that has been pumped up into the molten metal holding space 41a is reduced in pressure by the pressure-reducing portion. As a result, the molten metal 5 is able to be inhibited from contacting the air inside the connecting portion 41, so the amount of hydrogen gas that dissolves in the molten metal 5 is further reduced, which makes it possible to further inhibit a decrease in quality of a product. According to a test performed by the applicant of this application, this example embodiment was compared with a structure that did not reduce the pressure of the molten metal 5 inside the connecting portion 41, and it was found that the example embodiment was able to reduce the amount of dissolved hydrogen gas to only a fraction of that of the comparative structure.

[0039] Also, in this example embodiment, the pressure of the molten metal 5 is reduced for each shot (i.e., each cycle), so the time until injection and forming is able to be shortened, which further inhibits the dissolution of hydrogen gas. That is, the reduced-pressure molding apparatus 30 according to this example embodiment is able to improve, with a simple structure, the quality of a product.

[0040] Also, in this example embodiment, molten metal 5 of the same amount as the molten metal 5 that is to be injected into the cavity 4 is pumped up into the molten metal holding space 41a in the pumping process. Therefore, the supplying efficiency of the molten metal 5 is able to be improved, so the amount of hydrogen gas that dissolves in the molten metal 5 is able to be further reduced.

[0041] Also, in this example embodiment, movement of the molten metal 5 from the molten metal furnace 50 to the connecting portion 41 is stopped by operating the electromagnetic pump 40, during the molten metal pressure-reducing process. As a result,

the molten metal 5 for one shot (i.e., one cycle) is able to be more reliably held and reduced in pressure in the molten metal holding space 41a.

[0042] Also, in this example embodiment, the molten metal holding space forming process (step S101), the pumping process (step S102), and the molten metal pressure-reducing process (step S103) of the next cycle are performed while one of the processes of steps S5 to S8 that are conventionally executed is being executed. As a result, the molten metal 5 is able to be reduced in pressure within the cycle time of the processes of steps S5 to S8. That is, the amount of hydrogen gas that dissolves in the molten metal 5 is able to be reduced without increasing the cycle time.

CLAIMS:

1. A molding method that uses a molding apparatus that is provided with a mold having a cavity, an injection sleeve that has a molten metal supply port and is communicated with the cavity, a molten metal furnace within which molten metal is stored, a connecting portion that connects the molten metal furnace to the injection sleeve by one end of the connecting portion being connected to the molten metal furnace and the other end of the connecting portion being connected to a location opposite the molten metal supply port, a pump that is arranged in the connecting portion and pumps up molten metal from the molten metal furnace, a valve that is arranged in the connecting portion, and that forms a molten metal holding space that holds the molten metal pumped up by the pump, in the connecting portion, and a pressure-reducing portion that is arranged in a portion of the connecting portion where the molten metal holding space is located, and that reduces pressure in the molten metal holding space, the molding method comprising:

forming the molten metal holding space inside the connecting portion by closing the valve;

pumping up the molten metal from the molten metal furnace into the molten metal holding space of the connecting portion with the pump;

reducing a pressure of the molten metal pumped up into the molten metal holding space with the pressure-reducing portion;

communicating the molten metal holding space of the connecting portion with the molten metal supply port of the injection sleeve by opening the valve; and

supplying the molten metal, the pressure of which has been reduced inside the molten metal holding space, into the injection sleeve.

2. The molding method according to claim 1, wherein the pumping up of the molten metal involves pumping up, into the molten metal holding space, molten metal of the same amount as the molten metal that is injected into the cavity.

3. The molding method according to claim 2, wherein the reducing of the pressure of the molten metal involves stopping movement of the molten metal from the molten metal furnace to the connecting portion by operating the pump, while the pressure is being reduced.

4. The molding method according to any one of claims 1 to 3, further comprising:
injecting molten metal into the cavity;
solidifying the molten metal inside the cavity;
releasing a molded article formed by the molten metal that has solidified inside the cavity from the mold; and
applying a mold release agent to an inside of the cavity,
wherein the forming of the molten metal holding space, the pumping up of the molten metal, and the reducing of the pressure of the molten metal of a next cycle are performed while one of the injecting, the solidifying, the releasing, and the applying is being performed.

5. A molding apparatus comprising:
a mold having a cavity;
an injection sleeve that has a molten metal supply port and is communicated with the cavity;
a molten metal furnace within which molten metal is stored;
a connecting portion that connects the molten metal furnace to the injection sleeve by one end of the connecting portion being connected to the molten metal furnace and the other end of the connecting portion being connected to a location opposite the molten metal supply port;
a pump that is arranged in the connecting portion and pumps up molten metal from the molten metal furnace into the connecting portion, and supplies the molten metal into the injection sleeve via the connecting portion;

a valve that is arranged in the connecting portion, and that forms a molten metal holding space that holds the molten metal pumped up by the pump, in the connecting portion; and

a pressure-reducing portion that is arranged in a portion of the connecting portion where the molten metal holding space is located, and that reduces pressure in the molten metal holding space.

wherein the injection sleeve performs an operation of injecting the molten metal into the cavity; the molten metal holding space is formed by closing the valve; the pump pumps up the molten metal into the molten metal holding space of the connecting portion; the valve communicates the molten metal holding space of the connecting portion with the molten metal supply port of the injection sleeve by opening, and supplies the molten metal, the pressure of which has been reduced inside the molten metal holding space, into the injection sleeve.

FIG. 2

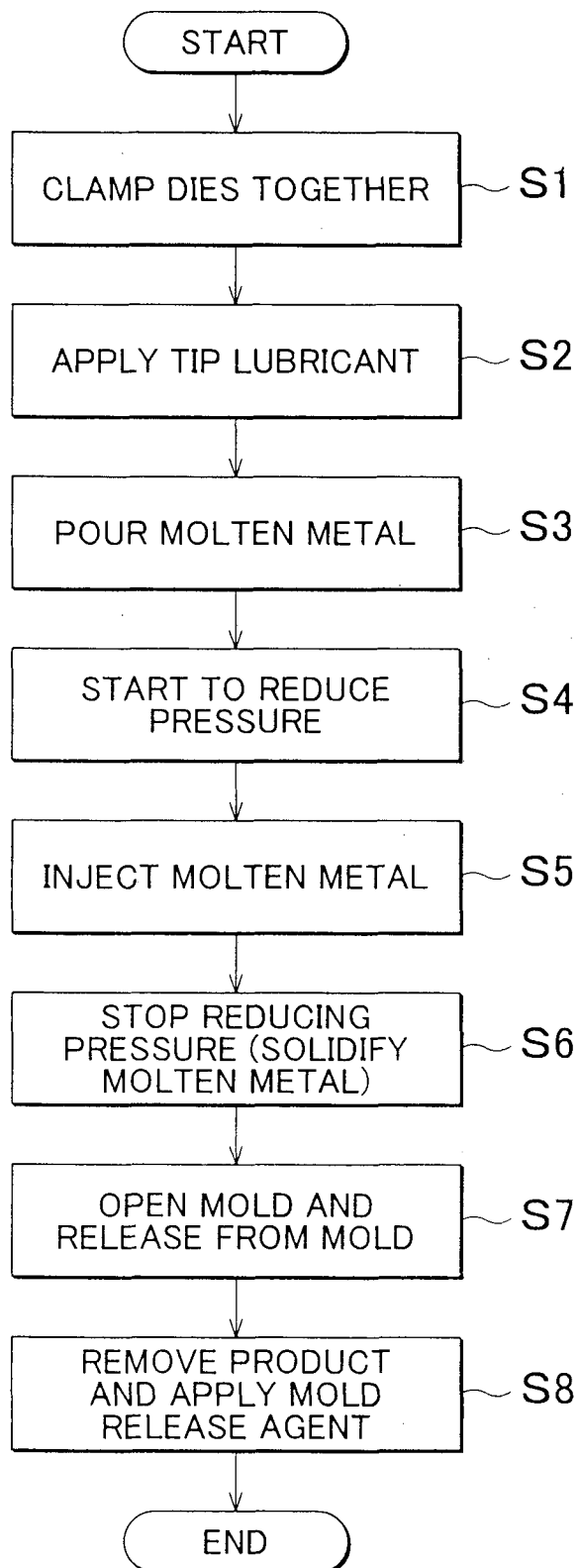
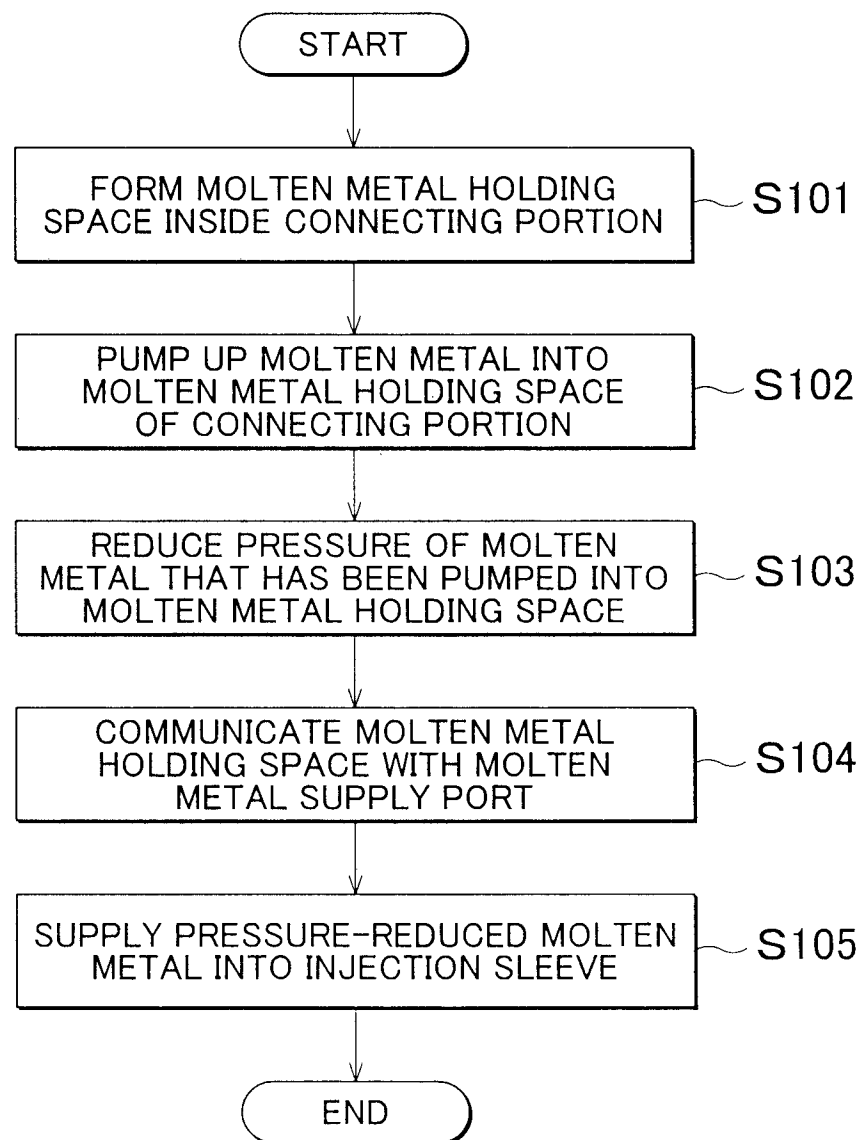


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/000382

A. CLASSIFICATION OF SUBJECT MATTER INV. B22D17/14 B22D17/30 B22D18/04 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B22D		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
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Date of the actual completion of the international search 3 September 2013		Date of mailing of the international search report 12/09/2013
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2013/000382

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2007069255	A	22-03-2007	NONE
