(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 475 645 A2**

(12) # EUROPEAN PATENT APPLICATION

(21) Application number : **91307962.0**

(51) Int. Cl.^{5} : **B22D 17/32,** B22D 17/14

(22) Date of filing : **30.08.91**

(30) Priority : **14.09.90 JP 245789/90**

(43) Date of publication of application :
18.03.92 Bulletin 92/12

(84) Designated Contracting States :
FR GB IT

(71) Applicant : **RYOBI LTD.**
No. 762, Mesaki-cho
Fuchu-shi, Hiroshima-ken (JP)

(72) Inventor : **Yamauchi, Noriyoshi, c/o Ryobi Ltd.**
No. 762, Mesaki-cho
Fuchu-shi, Hiroshima-ken (JP)
Inventor : **Ishida, Hitoshi, c/o Ryobi Ltd.**
No. 762, Mesaki-cho
Fuchu-shi, Hiroshima-ken (JP)
Inventor : **Kawai, Kazuaki, c/o Ryobi Ltd.**
No. 762, Mesaki-cho
Fuchu-shi, Hiroshima-ken (JP)

(74) Representative : **Jackson, Peter Arthur**
Gill Jennings & Every, 53-64 Chancery Lane
London WC2A 1HN (GB)

(54) **Method for controlling gas venting arrangement in injection molding apparatus, and device for controlling the same.**

(57) A method for controlling a gas venting arrangement in an injection molding apparatus, and a device for controlling the gas venting arrangement for avoiding production of inferior molded product by means of a monitoring of a flow mode of a molten metal passing through metal molds. The gas venting arrangement includes a gas venting valve (43) disposed to selectively close a gas vent passage (29) communicating with a mold cavity (9). A first molten metal detection means (69) is disposed at the gas vent passage and a second detection means (101) is disposed thereat at a position downstream of the first sensor with respect to a flowing direction of the molten metal. Detection signals from these detection means are transmitted to a control means (102) for computing an actual molten metal flowing period. This flowing period is compared with a preset period for determination of production of the inferior product.

EP 0 475 645 A2

The present invention relates to a method and device for controlling a gas venting arrangement in an injection molding apparatus such as die-casting machine. More particularly, the invention relates to such method and device in which flowing period of an injected molten metal within a metal mold is detected for determining existence of inferior mold products on a basis of the detected flowing period.

Examples of injection molding apparatus are described in Japanese Patent Application Kokai Nos. Sho-62-214859, Sho-63-303672 and Hei 2-197365, and Japanese Utility Model Application Kokai No. Sho-63-25244. Details of the example will be described with reference to Fig. 4.

Fig. 4 is a cross-sectional view showing a structure of a conventional injection molding apparatus in which a stationary metal mold 1 and a movable metal mold 3 are provided. A runner 5 is defined between the stationary and movable metal molds 1 and 3, and a mold cavity 9 is formed at a position above the runner through a gate 7.

At a lower portion of the stationary metal mold 1, a casting sleeve 11 is insertedly disposed which is in communication with the runner 5. One end portion (right side in Fig. 4) of the casting sleeve 11 is formed with a casting port 13 through which the molten metal is casted. Within the casting sleeve 11, a plunger 15 is slidably accommodated, reciprocable rightwardly and leftwardly in the drawing. The plunger 15 is connected to an injection cylinder 19 through a plunger rod 17. Upon operation of the injection cylinder 19, the plunger 15 is reciprocable within the casting sleeve 11.

A striker 21 is provided on one end of the injection cylinder 19 at a position confronting the plunger 15. Further, a limit switch 23 for starting vacuum evacuation and a high speed limit switch 25 are provided at positions along a moving stroke of the striker 21.

The stationary and movable metal molds 1 and 3 define parting faces 27 at which a mold cavity 9 and a gas vent passage 29 in communication therewith are formed. The gas vent passage 29 is connected to a vacuum suction means 33 through a pipe 31. The vacuum suction means 33 includes an electromagnetic change-over valve 35, a tank 37, a vacuum pump 39 and a drive motor 41. The electromagnetic change-over valve 35 has a first change-over position 35a and a second change-over position 35b, and when the valve 35 is changed over to the first position 35a, the gas vent passage 29 is brought to fluid communication with the vacuum suction means 33 so as to positively perform gas sucking operation within the gas vent passage 29 and the mold cavity 9.

A gas vent valve 43 is positioned in the gas vent passage 29. The gas vent valve 43 is opened or closed by a valve driving mechanism 45. That is, the gas vent valve 43 includes a valve body 47 and a valve stem 49 which is connected to a piston 53 slidably disposed in a cylinder 51. Further, a compressor 55 is disposed. A compressive air from the compressor 55 is applied to a front chamber 63 or a rear chamber 65 of the cylinder 51 through an electromagnetic change-over valve 57 and pipes 59, 61. Thus, the piston 53 is slidably moved leftwardly or rightwardly in Fig. 4 so as to move the valve body 47 toward and away from a seat portion 67 for closing or opening the gas vent valve. The electromagnetic valve 57 has a first change-over position 57a and a second change-over position 57b. Upon change over operation of the valve 57, the compressive air is supplied to one of the front chamber 63 and the rear chamber 65.

Further, a detection means 69 is disposed at the gas vent passage 29. The detection means 69 detects the molten metal urged upwardly in the gas vent passage for performing ON/OFF control to the electromagnetic change-over valve 57 through a control circuit 103, to thereby control opening and closing operation of the gas vent valve 43. More specifically, the control circuit 103 is connected between the detection means 69 and the electromagnetic change-over valve 57. When the molten metal is brought into contact with the detection means 69, the detection means generates the molten metal detection signal, which signal is transmitted to the control circuit 103. In response to the signal, the control circuit 103 transmits a drive signal to the electromagnetic change-over valve 57 to move the latter to the second position 57b.

Furthermore, a controller 109 of the die casting machine is provided. The controller 109 is connected to the electromagnetic change-over valve 35 of the vacuum suction means 33. The limit switches 23 and 25 are also connected to the controller 109, and the injection cylinder 19 is also connected to the controller 109. Moreover, the control circuit 103 is connected to the controller 109.

In operation of the thus organized conventional arrangement, with the gas vent valve 43 being opened, the molten metal is casted through the casting port 13. Then, the injection cylinder 19 is driven in response to a signal from the controller 109 for slidingly moving the plunger 15 leftwardly in Fig. 4. By the sliding movement of the plunger 15, the casting port 13 is closed by the plunger, and further, the vacuum start limit switch 23 is actuated by the striker 21. In response to the actuation of the vacuum start switch 23, the electromagnetic change-over valve 35 is changed-over to the first change-over position 35a by way of the controller 109. By the change-over operation of the electromagnetic change-over valve 35, the gas vent passage 29 becomes communicated with the vacuum suction means 33. Therefore, gas in the casting sleeve 11, the runner 5 and the mold cavity 9 is sucked and discharged through the gas vent passage 29 and the pipe 31. Of course in this case, the electromagnetic change over valve 57 has the first change-over position for maintaining open state of the gas vent valve 43.

When the plunger 15 is further slidingly moved leftwardly, the casted molten metal is filled in the mold cavity 9 and is flowed into the gas vent passage 29, so that the molten metal is brought into contact with the detection means 69 to generate the molten metal detection signal. In response to the detection signal from the detection means 69, the electromagnetic change-over valve 57 is changed-over to the second change-over position 57b by way of the control circuit 103. By the actuation of the electromagnetic change-over valve 57, the compressed air from the compressor 55 is supplied to the front chamber 63 of the cylinder 51, to thereby retractingly move the piston 53 rightwardly in Fig. 4. When the piston 53 is retracted to a predetermined position, the valve body 47 is seated onto the valve seat portion 67 to provide the valve closing position. By the closure of the gas vent valve 43, the gas vent passage 29 is shut off.

After elapse of a predetermined period from the closure timing of the gas vent valve 43, the signal is transmitted to the electromagnetic change-over valve 35 from the controller 109 of the die casting machine. In response to the signal, the electromagnetic change-over valve 35 is changed-over to the second position 35b for suspending the vacuum sucking operation by the vacuum suction means 33. Then, after removal of the molded product, a predetermined preparatory operation is performed for the subsequent molding. Upon completion of the preparatory operation, a signal is transmitted from the controller 109 to the control circuit 103 for obtaining the first change-over position 57a to open the gas vent valve 43.

If a molded product having a desired shape is to be obtained by the employment of the above described conventional arrangement, quality of the molded product may be degraded due to the generation of internal deficiencies such as generation of voids in the molded product if insufficient fluidity mode of the molten metal is provided in spite of the forcible gas discharge by the vacuum sucking operation. This is due to the fact that within the injection molding apparatus, air is involved in the injected molten metal.

In order to monitor the air involvement, various measures have been proposed. For example, an improvement has been made on a structure of the gas venting arrangement for performing sufficient gas venting operation. Alternatively, pressure within the gas vent passage 29 is monitored, and alarm is generated when the pressure is increased to a predetermined level.

According to a gas venting arrangement control system described in the Japanese Patent Application Kokai No. Hei 2-197365 shown in Fig. 4, a position sensor 120 is disposed at the rear chamber 65 of the valve driving cylinder 51 for detecting a position of the gas vent valve 43. The sensor 120 detects the gas vent valve 43, when the latter is moved to a proximal position. The position sensor 120 is connected to a comparison circuit 105′ of a comparison means so as to transmit the position signal to the comparison circuit 105′ which includes a pulse counter. The above described molten metal detection means 69 is also connected to the comparison circuit 105′. Further, the comparison circuit 105′ is also connected to the controller 109. With this arrangement, actual time period starting from the molten metal detection timing by the detection means 69 and ending at the closed timing of the gas vent valve 43 can be measured.

The comparison means also includes a setter 107′ connected to the comparison circuit 105′. Set in the setter 107′ is a desirable time period starting from the detection timing of the molten metal by the detection means 69 and ending at the closed timing of the gas vent valve 43 (this intended time period is inputted as a desired count numbers). Therefore, the desirable time period and the actual time period can be compared. If the actual time period is greater than the desirable time period,, the comparison circuit 105′ will generate an alarm and a control signal which is transmitted to the controller 109.

With this arrangement, when the molten metal is detected by the detection means 69, the gas vent valve 43 is closed through the control circuit 103 and the valve driving mechanism 45 as described above. The signal from the detection means 69 is also transmitted to the comparison circuit 120, so that the pulse counter of the comparison circuit 120 will initiate the counting operation. When the gas vent valve 43 is completely closed, the position sensor 120 detects the gas vent valve 43 and the position signal is transmitted to the comparison circuit 120. In response to the position signal, the counting operation of the pulse counter is terminated. That is, can be measured is the actual time period starting from the molten metal detection timing and ending at the complete closure of the gas vent valve 43. The actual time period is compared with the desired time period inputted in the setter 107′. If the actual time period is not within the desired time period, the alarm is generated, and a control signal is generated and sent to the controller 109 for controlling the injection molding apparatus.

However, such arrangement is still not sufficiently available, since flowing mode of the injected molten metal can not be directly detected. Therefore, required is correct and accurate acknowledgement of a dynamic mode of the molten metal within the injection molding apparatus for detecting inferior molded product at high accuracy.

The present invention has been established in light of the above described standpoint, and it is an object of the present invention to provide a method and device for controlling a gas venting arrangement in an injection molding apparatus capable of performing precise acknowledgement of the injected molten metal within the injection molding apparatus in order to detect production of inferior products at high accuracy.

This and other objects of the present invention will be attained by providing a method for controlling gas venting arrangement in an injection molding apparatus including the steps of injecting a molten metal into a mold cavity through a casting port by a plunger driven by an injection cylinder while opening a gas vent valve positioned in a gas vent passage; forcibly closing the gas vent valve in response to a detection of the molten metal in the mold cavity or the gas vent passage; and opening the gas vent valve at a predetermined timing in response to a signal from a controller; characterized by the steps of detecting the injected molten metal at a first point and a second point positioned downstream of the first point with respect to a flowing direction of the molten metal within a metal mold and generating a first molten metal detection signal and a second molten metal detection signal; computing flowing period of the injected molten metal based on the first and second molten metal detection signals; comparing the computed flowing period with a predetermined preset period; and determining existence of inferior mold product as a result of the comparison.

Further, according to the present invention there is provided a device for controlling a gas venting arrangement in an injection molding apparatus including: metal molds in which a mold cavity and a gas vent passage are defined; a plunger for injecting a molten metal into the mold cavity through a casting port; a gas vent valve positioned on the gas vent passage at a position downstream of the mold cavity, the gas vent valve being opened during injection of the molten metal into the mold cavity; a first molten metal detection means disposed at a first position positioned at one of the mold cavity and the gas vent passage for detecting the molten metal and for generating a first molten metal detection signal; a control circuit connected to the first molten metal detection means for generating an output drive signal in response to the first molten metal detection signal; a controller which generates a valve-open signal indicative of an opening of the gas vent valve; a valve driving mechanism connected to the control circuit for forcibly closing the gas vent valve in response to the output drive signal from the control circuit and for opening the gas vent valve in response to the valve-open signal from the controller; characterized by a second detection means disposed at a second position downstream of the first position and on one of the mold cavity and the gas vent passage for detecting the molten metal and generating a second molten metal detection signal; and control means for (A) computing an actual flowing time period of the molten metal in accordance with the first and second molten metal detection signals, (B) comparing the computed actual flowing time with a predetermined preset time period and (C) determining existence of inferior mold product as a result of the comparison.

According to the method for controlling the gas venting arrangement in the injection molding apparatus, firstly, injected molten metal is detected at any two locations on the mold cavity or the gas vent passage. Next, flowing period of the molten metal is computed by detection signals. Then, comparison is made between the computed flowing period and the predetermined setting period for determining the existence of inferior mold products. That is, by directly detecting the flowing mode of the injected molten metal, probability of air involvement within the injected molten metal is detected at high accuracy, to thereby detect the production of the inferior molded products.

Further, the device for controlling the gas venting arrangement in the injection molding apparatus is provided to execute the above described controlling method. By the first and second injected molten metal detection means, the injected molten metal is detected at two locations different from each other. On a basis of the detection signals from the respective detection means, the control means computes the flowing period of the injected molten metal, and compares the computed flowing period with the predetermined setting period for determining the existence of the production of inferior products.

In the drawings;

Figs. 1 through 3 show one embodiment of the present invention, and in which

Fig. 1 is a schematic view showing an injection molding apparatus to which a device for controlling a gas venting arrangement according to the first embodiment is applied;

Fig. 2 is a cross-sectional view showing a detection means assembled in a gas vent passage;

Fig. 3 is a view for description of an operation; and

Fig. 4 is a view showing a conventional injection molding apparatus.

A device for controlling a gas venting arrangement in an injection molding apparatus according to one embodiment of the present invention will next be described with reference to Figs. 1 through 3. Incidentally, like parts and components are designated by the same reference numerals as those shown in the conventional arrangement.

As shown in Fig. 1, at a lower position (first position) of the gas vent passage 29, a detection means 69 serving as a first injected molten metal detection means is provided for detecting the injected molten metal. This first detection means is functionally equivalent to the detection means 69 used in the conventional arrangement. At a position (second position) confronting the gas vent valve 43, provided is another detection means 101 serving as a second injected molten metal detection means. Thus, after the first detection means 69 detects the molten metal, the second detection means 101 detects the injected molten metal. On the basis of the detection signals from the first and second detection means 69 and 101, flowing period of the injected molten metal is computed, and existence of the production of inferior products is determined by comparing the computed flowing time period with a preset time period.

More specifically, there are provided a control circuit 103 and a control means 102. The first detection means 69 is connected to the control circuit 103 and the control means 102. The control circuit 103 is connected to the electromagnetic change-over valve 57 of the valve driving mechanism 45 and to a controller 109 of a die casting machine. The control means 102 includes a comparison circuit 105 and a setting circuit 107 connected thereto. The first detection means 69 is connected to the controller 109 through the comparison circuit 105 of the control means 102.

The second detection means 101 is also connected to the comparison circuit 105 of the control means 102. The comparison circuit is connected to an alarm means (not shown).

With this structure, a first molten metal detection signal from the first detection means 69 is inputted into the control circuit 103 and the comparison circuit 105 of the control means 102. On the other hand, a second molten metal detection signal from the second detection means 101 is also inputted into the comparison circuit 105. In response to the first molten metal detection signal, the control circuit 103 generates an output signal to the electromagnetic change-over valve 57 of the valve driving mechanism 45 for closing the gas vent valve 43. The control circuit 103 is known per se, and therefore, further description can be neglected.

In accordance with the first and the second detection signals, the comparison circuit 105 computes actual flowing period of the injected molten metal, and compares the flowing period with a set period preset in the setter circuit 107. Further, determination is made in the comparison circuit as to whether or not the actual flowing period is greater than the preset period. As a result of the determination, the comparison circuit 105 transmits a control signal to the controller 109 of the die casting machine as well as an alarm signal S111 to the alarm means (not shown).

That is, if the determination falls that the actual flowing period is greater than the preset period, assumable is gas involvement in the molded product to consider the product as an inferior product. For the acknowledgement of this fact, operation of the die casting machine is stopped by a stop signal from the controller 109 responsive to the control signal from the comparison circuit 105, and the alarm means is turned ON. On the other hand, if the determination falls that the actual flowing period is smaller than the preset period, the comparison circuit 105 transmits a signal to the controller 109 in order to continue the operation of the die casting machine. Thus, the die casting machine is properly controlled by the control signal from the comparison circuit 105.

Incidentally, the above described controller 109 is connected to the limit switches 23 and 25, the injection cylinder 19, and the electromagnetic change-over valve 35 such as those described above.

Next, an example of the detection means 69, 101 is shown in Fig. 2. The detection means 69 (or 101) includes a metallic holder 3 having a cylindrical shape for holding an electrode rod 1. A front recessed hole 3b is formed in a front side of the holder 3, and a rear recessed hole 3c is formed in another side of the holder, and a communication hole 3a is formed to communicate the front and rear recessed holes 3b and 3c.

In the front recessed hole 3b, a cylindrical insulator 2 is accommodated for electrically insulating the electrode rod 1 from the holder 3. A center bore 2a is formed at a central portion of the insulator 2 so as to allow the electrode rod 1 to pass therethrough. Further, at a front side of the insulator (at a side for detecting the molten metal), tapered portion 2b which increases an inner diameter toward the end is formed. The electrode rod 1 extends in a longitudinal direction of the holder 3 at a center portion thereof. The electrode rod 1 includes a shaft portion 1a and a head portion 1b formed at one end of the shaft portion 1a. The head portion increases its outer diameter toward the end so as to define a tapered head surface 1c in surface intimating contact with the tapered portion 2b of the insulator 2, and a detecting portion 1d is provided in the head portion 2 in contactable with the molten metal. The shaft portion 1a has a rear end portion (left side in Fig. 2) formed with a thread portion 1e. An inner diameter D of the center bore 2a of the insulator 2 is made larger than an outer diameter d of the shaft portion 1a of the electrode rod 1 by a predetermined dimension, so that an annular space 4 is defined between the electrode rod 1 and the insulator 2.

The size of the annular space is so designed that the thermal expansion of the electrode rod 1 does not affect the insulator 2 when the temperature of the electrode rod 1 is elevated and the electrode rod 1 is thermally expanded due to the contact with the molten metal. That is, the size of the annular space is so designed as to prevent the electrode rod 1 from being contacted with the inner peripheral surface of the center bore 2a of the insulator 2 in spite of the thermal expansion of the electrode rod 1.

The thread portion 1e is engageable with an electrode head holding member H which urges the tapered head surface 1c at the head portion 1b of the electrode rod 1 toward the tapered portion 2b of the insulator 2 in order to provide intimate contact therebetween for avoiding entry of the molten metal into the holder 3. This holding member H includes an insulation washer 5 in contact with a bottom wall 3d of the rear recessed hole 3c of the holder 3, a fastening nut

7 for depressing the insulation washer 5 through a spring washer 6, and a wire fixing nut 8 threadingly positioned behind the fastening nut 7 for fixing a wire 9 connectable to the electrode rod 1 at a position between the fastening nut 7 and the wire fixing nut 8. The insulation washer 5 is adapted for electrically insulating the holder 3 from the shaft portion 1a of the electrode rod 1. The spring washer 6 is adapted for normally urging the electrode rod 1 leftwardly in Fig. 2 because of the biasing force of the washer 6. Thus, even if the electrode rod 1 is thermally expanded, the insulator 2 and the tapered head surface of the head portion 1b of the electrode rod 1 can be intimately contacted with each other, to thereby avoid entry of the molten metal into the holder 3.

Thus, the spring washer 6 can maintain fastening state of the electrode rod 1 for overcoming the unfastening of the electrode rod 1 when electrode rod 1 is expanded in an axial direction due to the temperature elevation. This fastening can further be ensured if the electrode rod 1 is fastened in a condition where the temperature of the electrode rod 1 is elevated to the operating temperature.

The detection means 69, 101 are connected, through wires 9 connected to the electrode rod 1, to the control circuit 103 or the comparison circuit 105. When the injected molten metal simultaneously contacts the detecting portion 1d and the metal holder 3, the detection means detects the molten metal to generate the detection signal, and the signal is outputted to the control circuit 103 or the comparison circuit 105 through the wire 9.

Incidentally, a relay circuit or a switch circuit is available as the control circuit 103. Alternatively, an electronic circuit such as a flip-flop circuit and monostable multivibrator is also available.

Operation with the above described structure will next be described.

First, injected molten metal is casted through the casting port 15 while the gas vent valve 43 is opened. Then, the injection cylinder 19 is operated in response to the signal from the controller 109 of the die casting machine for slidingly moving the plunger 15 leftwardly in Fig. 1. By the sliding movement of the plunger 15, the casting port 13 is closed, and the vacuum start limit switch 23 is actuated by the striker 21. Therefore, the electromagnetic change-over valve 35 is changed-over to the first change-over position 35a through the controller 109 of the die casting machine. By the operation of the electromagnetic change-over valve 35, the gas vent passage 29 is communicated with the vacuum suction means 33, so that gas within the casting sleeve 11, the runner 5 and the mold cavity 9 is suckingly discharged through the gas vent passage 29 and the pipe 31.

When the plunger 15 is further slidingly moved leftwardly, the injected molten metal is filled in the mold cavity 9, and pushed into the gas vent passage 29. Consequently, the injected molten metal is brought into contact with the detection means 69. Thus, the electromagnetic change-over valve 57 is switched to the second change over position 57b through the control circuit 103 in response to the molten metal detection signal sent from the detection means 69.

By the operation of the electromagnetic change-over valve 57, compressed air in the compressor 55 is supplied to the front chamber 63 of the cylinder 51, so that the piston 53 is retractedly moved rightwardly in Fig. 1. Therefore, the valve body 47 is seated onto the valve seat portion 67 to provide the valve closing state. By the closing operation of the gas vent valve 43, the gas vent passage 29 is shut-off. After elapse of a predetermined period from the closed timing of the gas vent valve 43, the electromagnetic change-over valve 35 is changed-over to the second position 35b in response to the signal from the controller 109 of the die casting machine for suspending the vacuum sucking operation by the vacuum suction means 33.

Further, the signal from the detection means 69 is also inputted into the comparison circuit 105. If the injected molten metal is further filled in the gas vent passage 29, the injected molten metal is brought into contact with the detection means 101. The detection signal from the detection means 101 is inputted into the comparison circuit 105.

In the comparison circuit, flowing period of the injected molten metal is computed on the basis of the inputted two detection signals. Further, the comparison circuit 105 compares the computed time period with the setting period preset into the setter circuit 107. In this case, if the flowing period is greater than the preset period, a signal is outputted to the controller 109 of the die casting machine, and simultaneously, an alarm S111 is outputted.

For example, as shown in Fig. 3, assuming that the gas vent valve 43 is closed 6 msec. after the output timing of the detection signal S from the detection means 69, and also assuming that the predetermined setting period preset by the setter circuit 107 is 25 msec. Thus, if the detection means 101 detects the injected molten metal within 25 msec. after the detection of the molten metal by the detection means 69 (see E1 in Fig. 3), it is determined that the injected molten metal is flowed normally without any involvement of air.

On the other hand, if the detection means 101 does not detect the injected molten metal within 25 msec. after the detection of the molten metal by the detection means 69 (see E2), it is determined that the injected molten metal is not flowed normally with the probability of air involvement.

Incidentally, the present invention is not limited to the above described embodiment, but various changes and modifications may be conceivable. For example, the detecting locations at which the injected molten metal is detected are not limited to the above described two points, but another two locations are available. Further, various types of detection means 69, 101 other than those shown in depicted embodiment can be applied.

As described above, according to the method and device for controlling the gas venting arrangement in the injection molding apparatus, the following effects are attainable:

First, existence of inferior molded product can be easily detected without fail. This is due to the fact that the flowing mode of the injected molten metal is directly detected for the determination of the existence of inferior molded product in accordance with the direct detection. Thus, if inferior products are produced, reguired counter-measure can be promptly carried out.

Further, since the detection means 69 which is used for closing the gas vent valve is used as the first molten metal detecting means. Therefore, only the other detection means 101 is required as the second molten metal detection means. Accordingly, simple construction results.

Claims

1. A method for controlling gas venting arrangement in an injection molding apparatus including the steps of:

   injecting a molten metal into a mold cavity (9) through a casting port (13) by a plunger (15) driven by an injection cylinder (19) while opening a gas vent valve (43) positioned in a gas vent passage (29);

   forcibly closing the gas vent valve (43) in response to a detection of the molten metal in the mold cavity (9) or the gas vent passage (29); and

   opening the gas vent valve (43) at a predetermined timing in response to a signal from a controller (109);

   characterized by the steps of detecting the injected molten metal at a first point (69) and a second point (101) positioned downstream of the first point with respect to a flowing direction of the molten metal within a metal mold (1,3) and generating a first molten metal detection signal and a second molten metal detection signal;

   computing flowing period of the injected molten metal based on the first and second molten metal detection signals;

   comparing the computed flowing period with a predetermined preset period; and

   determining existence of inferior mold product as a result of the comparison.

2. The method according to claim 1, characterized in that in the determination step, if the computed flowing period is greater than the preset period, the determination falls that the molded product is an inferior product.

3. The method according to claim 1 or 2, further characterized by the step of generating a control signal to the controller (10) for controlling the injection molding apparatus if the determination in the determination steps falls that the inferior product is produced.

4. The method according to claims 1, 2 or 3, further characterized by the step of generating an alarm signal (S111) if the determination falls that the inferior product is produced.

5. A device for controlling a gas venting arrangement in an injection molding apparatus including:

   metal molds (1, 3) in which a mold cavity (9) and a gas vent passage (29) are defined;

   a plunger (15) for injecting a molten metal into the mold cavity through a casting port (13);

   a gas vent valve (43) positioned on the gas vent passage (29) at a position downstream of the mold cavity (9), the gas vent valve (43) being opened during injection of the molten metal into the mold cavity;

   a first molten metal detection means (69) disposed at a first position positioned at one of the mold cavity (9) and the gas vent passage (29) for detecting the molten metal and for generating a first molten metal detection signal;

   a control circuit (103) connected to the first molten metal detection means (69) for generating an output drive signal in response to the first molten metal detection signal;

   a controller (109) which generates a valve-open signal indicative of an opening of the gas vent valve (43);

   a valve driving mechanism (45) connected to the control circuit (103) for forcibly closing the gas vent valve (43) in response to the output drive signal from the control circuit (103) and for opening the gas vent valve (43) in response to the valve-open signal from the controller (109);

   characterized by a second detection means (101) disposed at a second position downstream of the first position and on one of the mold cavity (9) and the gas vent passage (29) for detecting the molten metal and generating a second molten metal detection signal; and

   control means (102) for (A) computing an actual flowing time period of the molten metal in accordance with the first and second molten metal detection signals, (B) comparing the computed actual flowing time with a predetermined preset time period and (C) determining existence of inferior mold product as a result of the comparison.

6. The device according to claim 5, wherein the control means (102) is characterized by:

a comparison circuit (105) connected to the first molten metal detection means (69) and the second molten metal detection means (101); and

a setting means (107) connected to the comparison circuit (105), the preset time period being set in the setting means (107), the comparison circuit (105) computing the actual flowing time period in which the molten metal flows from the first molten metal detection means to the second molten metal detection means in accordance with the first and the second molten metal detection signals, the comparison circuit also comparing the actual flowing period with the preset time period, and determining the existence of the inferior mold product as the result of the comparison.

7. The device according to claim 5 or 6, wherein the controller (109) is connected to the control means (102), for controlling the injection molding apparatus as a result of the determination.

8. The device according to claim 5, 6 or 7, further characterized by alarm means connected to the control means for generating an alarm if the computed actual flowing time period is greater than the preset time period.

Fig. 1

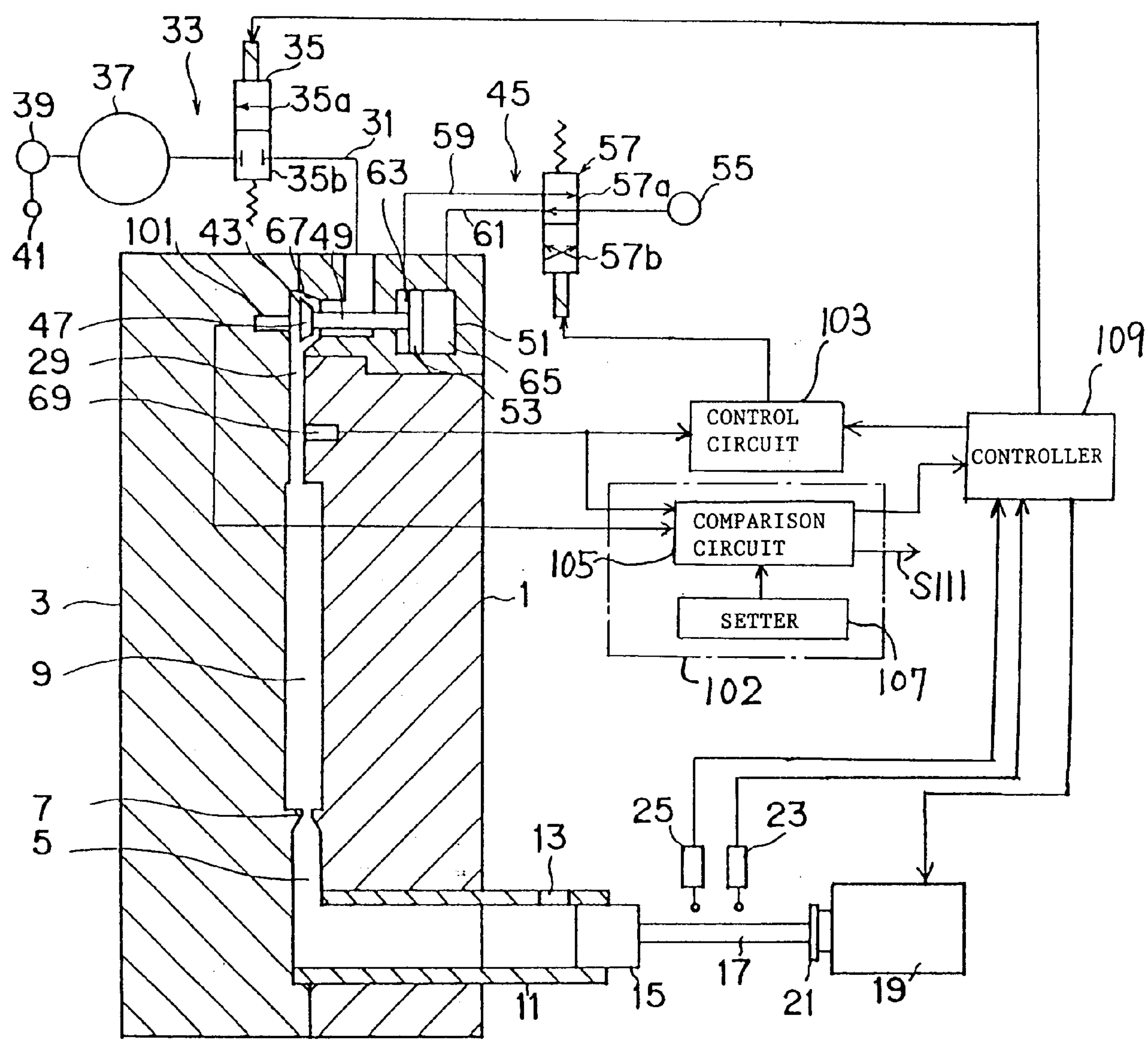
33
35
37
39
35a
31
45
59
57
35b
63
57a
55
41
101
43
67
49
61
57b
47
51
103
109
29
65
69
53
CONTROL CIRCUIT
CONTROLLER
COMPARISON CIRCUIT
105
S111
3
1
SETTER
102
107
9
7
5
25
23
13
17
21
19
11
15

Fig. 2

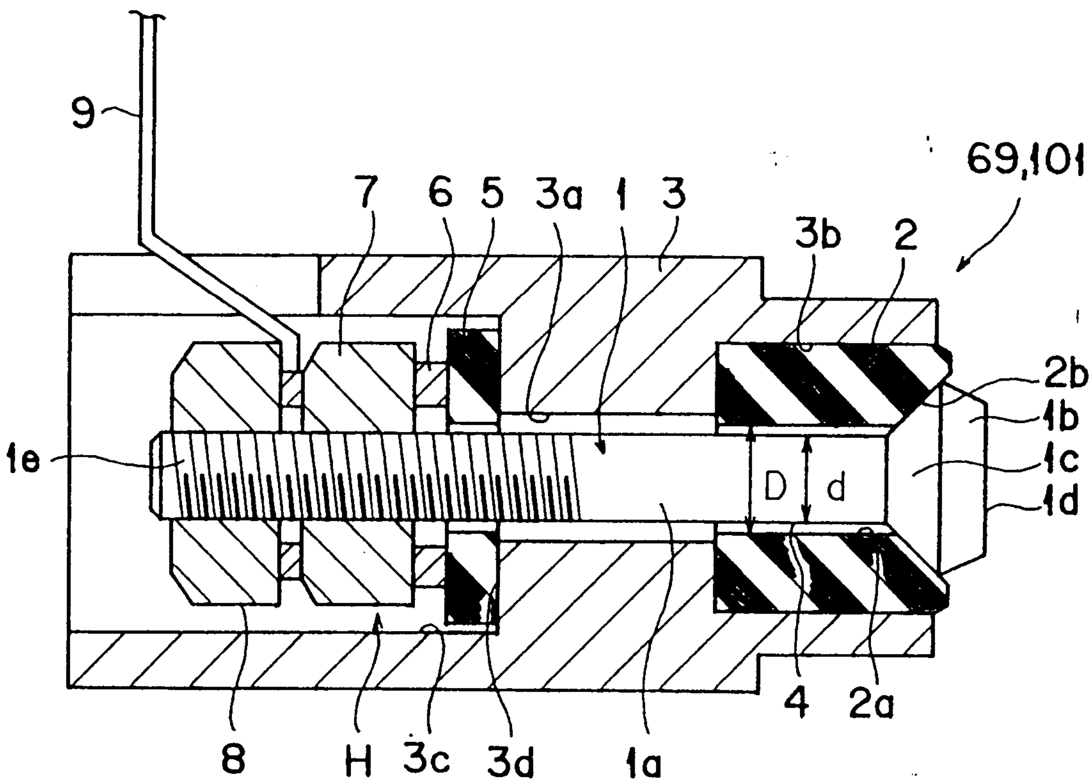

Fig. 3

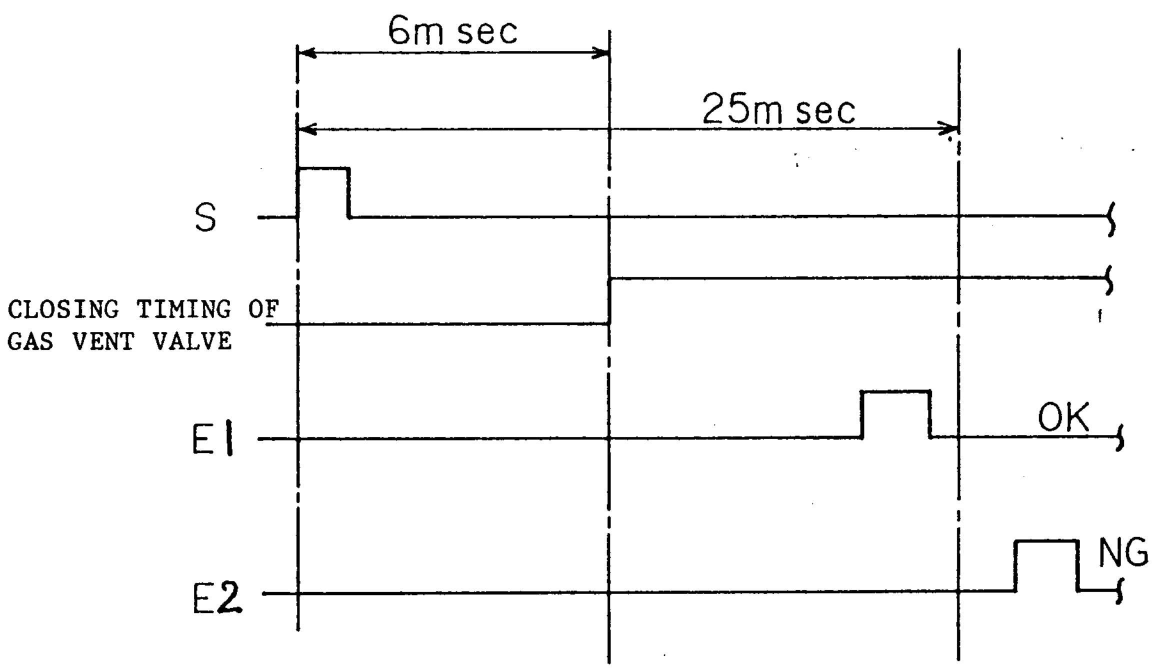

Fig. 4
Prior Art