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D E C I S I O N
of 13 February 2001

Case Number: T 0159/98 - 3.2.5

Application Number: 92304093.5

Publication Number: 0512818

IPC: B29C 45/17

Language of the proceedings: EN

Title of invention:
Handle-shaped molded article, method of injection molding thereof and mold for the injection molding

Patentee:
MITSUBISHI GAS CHEMICAL COMPANY, INC.

Opponent:
Battenfeld GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0159/98 - 3.2.5

D E C I S I O N
of the Technical Board of Appeal 3.2.5
of 13 February 2001

Appellant: (Proprietor of the patent)
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Representative:
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 27 November 1997 revoking European patent No. 0 512 818 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: A. Burkhart
Members: P. E. Michel
M. J. Vogel

Summary of Facts and Submissions

I. The appellant (patentee) lodged an appeal against the decision of the opposition division revoking patent No. 0 512 818.

Opposition was filed against the patent as a whole based on Article 100(a) EPC (lack of novelty and inventive step).

The Opposition Division held that the subject-matter of claim 1 lacks an inventive step in view of the documents:

E3: Fachtagung 18. und 19. Sept. 1990 Festung Marienberg, Würzburg, Mehrkomponenten- und Gasinnendruck-Spritzgießverfahren- Tendenzen neuer Verfahrenstechniken,
M. Renger:
Das Gasinnendruckverfahren eine Spritzgießvariante mit besonderen Möglichkeiten.

E4: Fachtagung 18. und 19. Sept. 1990 Festung Marienberg, Würzburg,
Mehrkomponenten- und Gasinnendruck-Spritzgießverfahren Tendenzen neuer Verfahrenstechniken,
K. Rodewald:
Gas-lnjektions-Technik (GIT) - Erste Erfahrung aus Anwendersicht.

The following document cited by the opponent was not referred to in the decision:

E2: EP-A-0310914

II. Oral Proceedings were held before the Board of Appeal on 13 February 2001.

(i) The appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of

- claims 1 to 8, filed during the oral proceedings

- description columns 1 to 16, filed during the oral proceedings

- drawings as granted.

(ii) The respondent (opponent) requested that the appeal be dismissed.

The claims include three independent claims reading as follows:

"1. A method for producing a handle-shaped molded article (1) having a thick grip portion (2) having a hollow structure and at least one thick fitting portion (3) having a solid structure by injection molding by means of an injection molding apparatus (10) equipped with a mold (40) having a cavity (60), a resin gate (46) provided at the entrance to the mold cavity at a part of the mold cavity where the fitting portion of the handle shaped molded article is to be formed and a gas inlet (48) to a part of the mold cavity where the grip portion of the handle-shaped molded article is to be formed and provided at a different position from the resin gate;

which comprises:

injecting a molten resin into the cavity (60) through the resin gate (46), thereby filling molten resin in a fitting portion-forming cavity zone (62) formed of that portion of the mold where the resin gate is provided and the fitting portion is to be formed and further filling molten resin in part of the rest of the cavity,

introducing a pressurized gas into the cavity (60) through the gas inlet (48) while maintaining an injection pressure, P, in front of a screw (12) of the injection molding apparatus and with pressure thereby being applied at the resin gate, the injection pressure P being maintained at a predetermined value, the injection pressure, P, being defined by

$$P = F / S$$

wherein F is an injection force and S is a cross-sectional area of a screw (12) of the injection molding apparatus, and

maintaining the injection pressure and a gas pressure in the gas inlet (48) at predetermined values until the molten resin is cooled and solidified."

"5. A method for producing a handle-shaped molded article (1) having a thick grip portion. (2) having a hollow structure and at least one thick fitting portion (3) having a solid structure by injection molding by means of an injection molding apparatus (10) equipped with a mold (40) having a cavity (60), a resin gate (46) provided at the entrance to the mold cavity at a part of the mold

cavity where the fitting portion of the handle shaped molded article is to be formed and a gas inlet (48) to a part of the mold cavity where the grip portion of the handle-shaped molded article is to be formed, and provided at a different position from the resin gate,

which comprises:

injecting a molten resin into the cavity through the resin gate (46), thereby filling molten resin in a fitting portion-forming cavity zone (62) formed of that portion of the mold where the resin gate is provided and the fitting portion is to be formed and further filling molten resin in part of the rest of the cavity,

mechanically closing the resin gate (46), then introducing a pressurized gas into the cavity through the gas inlet (48), and maintaining a gas pressure in the gas inlet at a predetermined value, with the resin gate mechanically closed, until the molten resin is cooled and solidified."

"8. A mold (40) for producing a handle-shaped molded article (1) having a thick grip portion (2) having a hollow structure and at least one thick fitting portion (3) having a solid structure, the mold having a resin gate (46) provided at the entrance to the mold cavity at a part of the mold cavity where the fitting portion of the handle-shaped molded article is to be formed and a gas inlet (48) to a part of the mold cavity where the grip portion of the handle-shaped molded article is to be formed provided at a different position from the resin gate, and further being provided with means (70) for mechanically closing the resin gate."

III. The appellant argued essentially as follows:

The closest prior art is represented by document E3. In Figure 21 of this document there is shown a thick-walled article which may or may not be a handle-shaped article. This figure shows two alternative methods of manufacturing the article by gas assisted injection molding. In one of these methods, gas is injected through the nozzle through which melt is introduced into the mold. In the other, gas is injected into the article at a location spaced from the nozzle. There is no reason to select the second as opposed to the first alternative. There is no disclosure of an article with a solid fitting portion.

The problem to be solved by the invention of the patent in suit is to ensure that the injected gas remains in the thick grip portion and does not enter the solid fitting portion.

E4 does not deal with this problem. It is concerned with methods of injection molding in which gas is injected downstream of a transverse bolt shut-off nozzle (figure 2) and then passes through the sprue and runner to the mold cavity. As shown in the timing diagram of Figure 5.1, pressure is exerted by the screw after the shut-off bolt is closed. Such pressure is not, however, transmitted to the mold cavity, serving merely to prevent gas from passing the shut-off bolt and entering the space between the shut-off bolt and the screw. Figure 5.2 is a timing diagram for an apparatus in which an improved shut-off bolt which is gas-tight is used.

Therefore, the teachings of E3 and E4 do not render obvious the subject-matter of claims 1, 5 and 8.

IV. The respondent argued essentially as follows:

It is agreed that the closest prior art is represented by document E3.

The subject-matter of claim 1 is distinguished over the disclosure of E3 in that the injection pressure and the gas pressure are maintained at predetermined values until the molten resin is cooled and solidified.

The object of the invention is to prevent gas from passing the shut-off bolt and entering the space between the shut-off bolt and the screw.

E4 teaches the solution to this problem as defined in claim 1 (see in particular page 165).

The alternative solution to this problem as claimed in claims 5 and 8, in which a shut-off pin closes the resin gate before introduction of gas, is known from E2.

Therefore, the subject-matter of claims 1, 5 and 8 does not involve an inventive step.

Reasons for the Decision

1. *Novelty*

The novelty of the subject-matter of the claims as maintained by the opposition division was not

questioned by the respondent and, indeed, the prior art does not disclose either maintaining the injection pressure and the gas pressure in the gas inlet at predetermined values until the molten resin is cooled and solidified or providing a closable resin gate at the entrance to the mold cavity at a part of the mold cavity where the fitting portion of the handle shaped molded article is to be formed. The subject-matter of claims 1, 5 and 8 is thus novel.

2. *Inventive step*

2.1 The closest prior art is found in E3. This document discloses a method for producing a molded article having a thick portion having a hollow structure and at least one thick portion having a solid structure by injection molding by means of an injection molding apparatus equipped with a mold having a cavity, a resin gate being provided at the entrance to the mold cavity at a part of the mold cavity where the solid portion of the molded article is to be formed and a gas inlet to a part of the mold cavity where the hollow portion of the molded article is to be formed and provided at a different position from the resin gate; which method comprises injecting molten resin into the cavity through the resin gate, thereby filling molten resin in the portion of the mold cavity where the solid portion of the molded article is to be formed and further filling molten resin in part of the rest of the cavity, and introducing a pressurized gas into the cavity through the gas inlet.

2.2 A problem associated with the production of handle-shaped molded articles in which the solid portion forms

a fitting portion and the hollow portion forms a grip portion is that gas tends to enter the fitting portion, thus reducing the strength thereof.

It was suggested on behalf of the respondent that the problem to be solved is to prevent gas from passing the shut-off bolt and entering the space between the shut-off bolt and the screw. This more general problem cannot, however, be accepted as being the problem with which the present invention is concerned, since gas would have to pass through the fitting portion of the mold cavity before entering the space between the shut-off bolt and the screw.

2.3 The patent in suit offers two alternative solutions to the above problem, the first being defined in claim 1 and the second in claims 5 and 8.

The solution of claim 1 involves applying pressure to the resin in the mold by means of the screw of the injection molding apparatus during introduction of pressurized gas. The pressure applied to the melt is such as to maintain a balance with the gas pressure as the resin cools and sets. Whilst the gas pressure serves to maintain the surface of the grip portion in contact with the surface of the mold cavity, thereby achieving a good surface finish, the pressure exerted on the melt ensures that the gas bubble does not extend into the fitting portion. By virtue of the fact that pressure is exerted on the screw, further melt can be supplied from the space in front of the screw to the sprue and runner, thereby compensating for shrinkage of melt in the runner during cooling and solidification.

The second solution is defined in claim 5 and involves

closing off the gate into the mold cavity at the entrance to the mold. Whilst contraction of the melt in the article during setting is compensated for by the gas, it is not necessary to compensate for shrinkage in the runner, since this is isolated from the article.

2.4 These solutions are not suggested by the cited prior art.

E4 relates to the experience of a user in operation of the apparatus shown in Figure 2 of this document. This apparatus includes a shut-off bolt in the nozzle of the injection molding apparatus. Gas is supplied to the nozzle downstream of the shut-off bolt. It is not concerned with the type of apparatus in which gas is injected directly into the mold cavity. It thus does not attempt to offer a solution to the problem set out above, since the use of such an apparatus to form a handle-shaped article would involve passing gas through the resin gate into the fitting portion.

The timing diagram shown in Figure 5.1 shows that the shut-off bolt is closed after injection of the melt is completed and before gas injection is commenced. It is thus not possible to continue to exert pressure on the melt in the mold by means of the screw of the injection molding apparatus. Whilst the screw does continue to exert pressure during the period shown in Figure 5.1 as the "Nachdruckzeit", this pressure being exerted after completion of melt injection and continuing until gas pressure is released, the shut-off bolt is closed and this pressure is only exerted in the space between the screw and the shut-off bolt and serves to prevent gas from passing the shut-off bolt and entering the space between the screw and the shut-off bolt.

E2 is also concerned with a method of gas injection molding in which gas is supplied through the melt injection nozzle and in which the supply of melt is closed off before gas is supplied to the mold (see figure 5.5). In place of a shut-off bolt which is moved transversely to the melt flow, a rotatable pin is used. Nevertheless, as in E4, gas passes through the resin gate and it remains impossible to continue to exert pressure on the melt in the mold by means of the screw of the injection molding apparatus during gas injection.

Neither of documents E2 and E4 thus addresses the problem solved by the two alternative concepts of the patent in suit.

2.5 The subject-matter of claims 1, 5 and 8 thus involves an inventive step. The remaining claims are directly or indirectly appendant to these claims and also involve an inventive step.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent in amended form on the basis of the following documents:

- claims 1 to 8, filed during the oral proceedings of 13 February 2001

- description columns 1 to 16, filed during the oral proceedings of 13 February 2001

- drawings as granted.

The Registrar: The Chairman:

M. Dainese A. Burkhart