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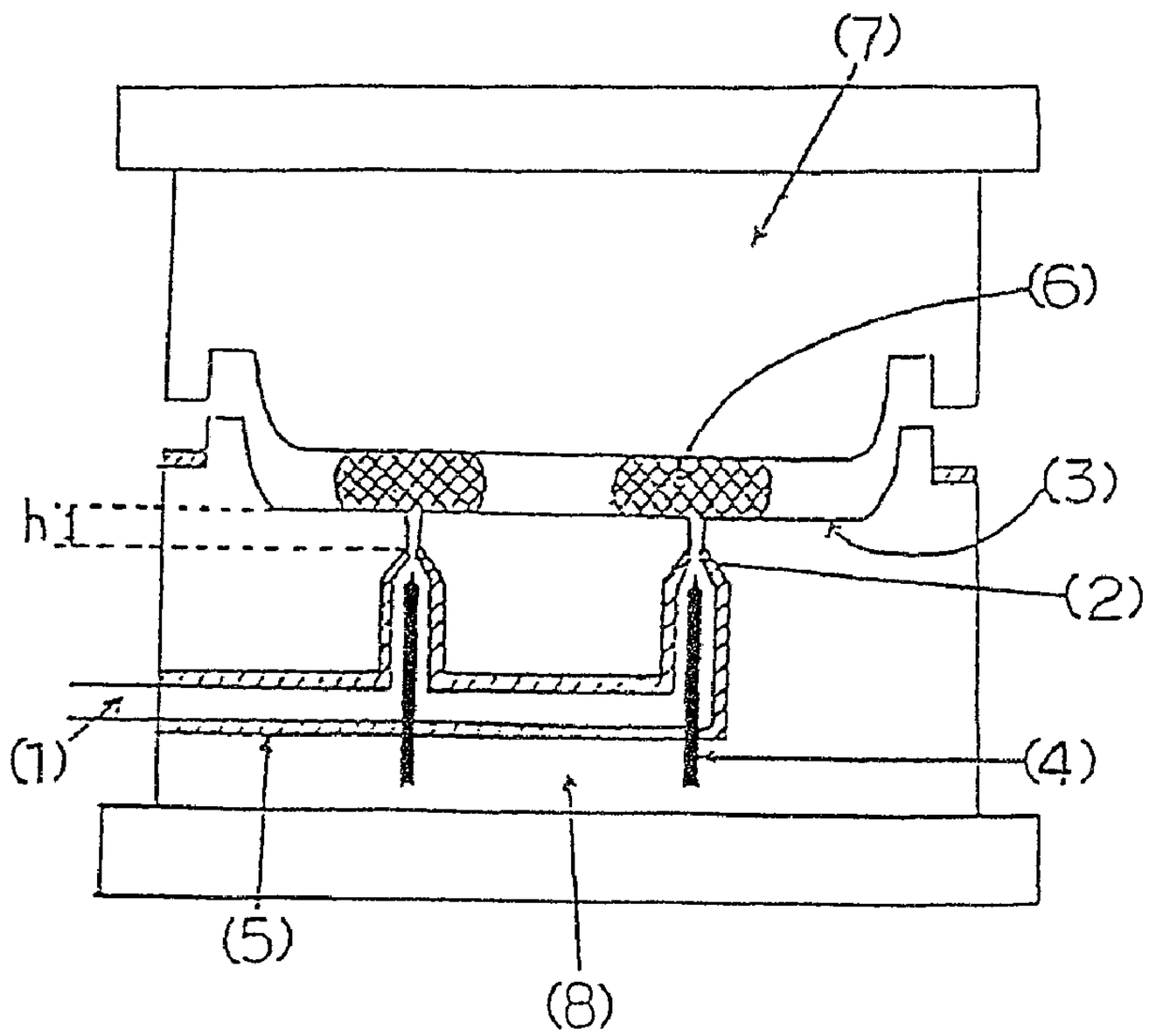
(54) Titre : MOULE POUR PRESSE DE MOULAGE PAR COMPRESSION ET PROCEDE DE MOULAGE PAR COMPRESSION DE RESINE THERMOPLASTIQUE

(54) Title: MOLD FOR PRESS MOLDING AND PROCESS FOR PRESS MOLDING OF THERMOPLASTIC RESIN USING THE SAME



(57) Abrégé/Abstract:
The present invention is directed to a method of press molding that is carried out using a mold having an upper half, a lower half and a nozzle which opens and closes a molten resin passage provided in the upper half or the lower half and which is located 10-100 mm below a mold cavity side surface of the half. A thermoplastic resin is supplied to a cavity between the upper half and the lower half which is not closed and the mold is clamped. Thus, a molded article having a good appearance can be produced even when the molding cycle is short.

Abstract

The present invention is directed to a method of press molding that is carried out using a mold having an upper half, a lower half and a nozzle which opens and closes a molten resin passage provided in the upper half or the lower half and which is located 10-100 mm below a mold cavity side surface of the half. A thermoplastic resin is supplied to a cavity between the upper half and the lower half which is not closed and the mold is clamped. Thus, a molded article having a good appearance can be produced even when the molding cycle is short.

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MOLD FOR PRESS MOLDING AND PROCESS FOR PRESS MOLDING OF THERMOPLASTIC RESIN USING THE SAME

The present invention relates to a metal mold suitable for the press molding of a thermoplastic resin and a process for the press molding using the mold.

In the description which follows reference is made to the figures. For the sake of convenience they will be introduced briefly as follows:

Fig. 1 shows a longitudinal sectional view of a mold for the press molding of the prior art.

Fig. 2 shows a longitudinal sectional view of a mold for the press molding of the present invention.

A great many plastic moldings are used in many fields, e.g. in automobiles and domestic electrical equipment because of their economy, free shaping and light weight.

A press molding process or an injection molding process is known as a process for the production of such moldings. The press molding process can produce the moldings having less molding strain since they can be molded under a lower pressure than that of the injection molding process so that moldings with less warpage and deformation can be advantageously produced at an inexpensive cost using a molding machine having a small clamping force. In addition, the press molding process is also advantageous in that when various materials are laminated on surfaces of the moldings, the skin materials are unlikely to be damaged since the molding pressure is smaller.

For example, Japanese Patent Kokai Publication No. 22917/1986 discloses such a press molding process for a thermoplastic resin in which the thermoplastic resin in molten condition is supplied through a molten resin passage which is provided in a metal mold body and the resin is compressed. However, the mold used in the process has a nozzle, as

described in the reference, such that the tip portion of the nozzle through which the resin enters the inside of the mold is flush with the cavity side surface of the mold (see Fig. 1). Thus, when molding is repeated using such a mold, the temperature at the portion of the mold near the nozzle is gradually increased by the supplied molten resin. When molding is repeated over a short time (namely, the molding cycle is short), such portion of the mold is insufficiently cooled so that the molded article has a bulge in the region which was adjacent to the insufficiently cooled portion and/or the molded article is glossy, at such region, which is different from that of other regions of the molded article. It is, therefore, difficult to produce an article having a good appearance.

In addition, when a multi-layer molded article comprising a skin material laminated thereon is formed, the article has a bulge on the region which was adjacent to or near the nozzle, so that a molded article having a good appearance cannot be produced by series molding.

When the temperature of the nozzle portion of the mold is set to a relatively lower temperature so as to prevent the temperature increase of the mold surface near the nozzle, not only is it difficult for the molten resin to enter the cavity of the mold, but also the temperature of the molten resin is reduced so that it is likely to produce a defective article. For example, a molded article having a ring-shaped mark in the region corresponding to the inlet through which the molten resin was supplied to the mold cavity.

The present inventors have made extensive studies to overcome the above identified problems, so as to produce a press molded article of a thermoplastic resin having a good appearance even when the molding cycle is short. They have found that such an object can be achieved by providing the nozzle of the molten resin passage in a portion of the mold which is separated from the cavity side surface of the mold by a specified distance.

Thus, the present invention provides a mold for press molding a thermoplastic resin comprising a molten resin passage in an upper half or a lower half, and a tip portion of a nozzle which opens or closes the molten resin passage located at a portion of the mold which is 10-100 mm below a cavity side surface of the upper half or the lower half. The present invention also provides a process for the press molding of a thermoplastic resin wherein the above described mold is used and the thermoplastic rein in molten condition is supplied, through the molten resin passage and the nozzle, to a cavity between the upper half and the lower half which is not closed, and then the mold is clamped after the molten resin passage is closed to prepare a molded article.

The present invention will be, hereinafter, explained on the basis of the accompanying drawings.

Fig. 2 exemplifies the mold of the present invention, in which the molten resin passage (1) is provided in the lower half, and the tip portion of the nozzle (2) is below the mold cavity side surface (3) of the mold by 10-100 mm (which is indicated by a distance "h" in Fig. 2). In Figs. 1 and 2, the same members have the same reference numerals.

A single nozzle (2) is not necessarily provided for each single resin passage, and two or more nozzles may be provided for each single resin passage as desired.

The nozzle (2) has an opening-closing function for the resin passage and pins (4) are provided in the lower portions of the nozzles to provide the opening and closing operation.

The pin (4) is raised or lowered to supply or stop flow of the molten resin by means of a hydraulic apparatus (not shown).

The pin (4) is lowered when the resin is supplied so that a space is defined between the nozzle (2) and the pin (4) whereby the molten resin passage is in the open position. When a desired amount of the resin has been supplied, the pin (4) is raised and the tip portion thereof closes the opening in the nozzle (2) so that the molten resin passage is closed.

Therefore, the tip portion of the pin (4) should have a shape and a design such that the pin (4) completely closes the opening of the nozzle (2) when the pin (4) is raised and contacts the opening of the nozzle (2). For example, the tip portion may be in a semi-spherical form which inscribes or circumscribes the opening of the nozzle, or in a cylindrical form the diameter of which is larger than that of the opening of the nozzle. The shape and the design may be any that are suitable provided that they achieve their function.

It is critical that the position of the tip portion of the nozzle (2) is located 10-100 mm and preferably 20-80 mm (shown as a distance "h" in Fig. 2) below the cavity side surface (3) of the mold. The portion of the resin passage between the nozzle (2) and the cavity side surface may have the same diameter as that of the nozzle, and preferably such portion of the molten resin passage is tapered so that the diameter of the opening on the cavity side surface is a little larger than the diameter of the nozzle.

When the distance between the tip portion of the nozzle and the cavity side surface is smaller than 10 mm, it is difficult to maintain the temperature on the mold surface at a uniform value and a molded article having a good appearance cannot be produced when the molding cycle is short. When the distance between the tip portion of the nozzle and the cavity side surface exceeds 100 mm, the thickness and weight of the mold is increased.

As the nozzle opening and closing mechanism, in place of the mechanism in which the pin (4) is used for the opening and closing function provided in the lower portion of the nozzle as described above, various mechanisms may be employed. For example, a spring which expands depending on supply pressure of the resin can be provided in the nozzle so that the spring shrinks and the nozzle is in the open position when the resin supplying pressure is applied to the resin in the nozzle by the resin supply, and the spring expands and the nozzle

opening is closed when the resin supply is stopped and there is no resin supplying pressure. It is optional which mechanism is to be employed. It is preferred to employ a mechanism in which the pin is operated by a hydraulic apparatus from the view point that the opening operation and the closing operation are ensured and when the mold has a plurality of the nozzles, the opening and the closing of each nozzle can be controlled separately.

In the press molding process, the molten resin is supplied at a low pressure to a cavity in the mold which is not completely closed and then or while pressurized so that edge portions of the cavity are filled with the resin and then the shaping is carried out. Therefore, when the mold has a plurality of the nozzles, gate balance is greatly affected and thus the nozzle arrangement and the amount of the molten resin supplied through each nozzle should be adjusted properly. In addition, when the resin temperature, the mold temperature and its distribution are not proper, the shape of the molded article is adversely affected by them. In order to deal with this problem properly, the opening and the closing of the molten resin passage should be carried out over an extremely short time period and the opening and closing periods of each nozzle should be separately controlled.

The present mold may comprise a plurality of thin tubes therein through which a heating medium is circulated to keep the mold at a desired temperature. Also the mold may comprise a heater (5) in a periphery of the molten resin passage so as to keep the temperature of the molten resin constant. In addition, a cavity may be provided around a periphery of the heater in order that heat from the heater does not affect the mold.

Using the mold of the present invention, the thermoplastic resin in the molten condition is supplied through the resin passage into the space between the upper half and the lower half which is not closed, the nozzle is closed, and clamping of the mold is carried out so that a molded article having a good appearance is produced.

When the thermoplastic resin is molded according to the present press molding process, timely resin supply to the cavity between the upper half and the lower half at the time when clearance of the cavity becomes proper is also important as disclosed in, for example, Japanese Patent Kokai Publication No. 22917/1986 so as to effectively produce the molded article having a good appearance. For the purpose of such timely supply, it is preferred that the molten resin be supplied when the clearance between the upper half and the lower half is (C+0.1) to 50 mm wherein C is the clearance on final clamping, and during the supply, the clamping is carried out at a rate of not more than 30 mm/sec. or the clamping is temporarily stopped, and then the clamping is re-started at the same time of or just before the completion of the supply of the molten resin.

In the case in which a skin material is beforehand supplied between the upper half and the lower half and lamination molded, it is preferred that the molten resin is supplied when the clearance of the cavity is (C+5) to (C+100) mm in order that the skin material is not damaged by the pressure and heat.

The thermoplastic material which is used in the present press molding process is any material which is usually used in injection molding or extrusion molding. For example, a polypropylene, a polyethylene, a polystyrene, an acrylonitrile/butadiene copolymer and a nylon can be used.

When the skin material is used in the present process, it includes a polyvinyl chloride sheet, a thermoplastic elastomer sheet or a leather like sheet thereof the surface of which is embossed or a woven fabric, a nonwoven fabric or a fabric the back side of which is laminated with an expanded polyethylene sheet, an expanded polypropylene sheet or an expanded polyurethane sheet and so on.

When the thermoplastic resin is press molded according to the present process, molding conditions are not specifically limited and conventional molding conditions are applied. For example, in the case in which a polypropylene is used as the thermoplastic resin, when the skin material is not laminated, the preferred conditions for the production of the molded article having a good appearance include a resin temperature of 200-280°C and a mold temperature of 50-100°C and when the skin material is laminated, the preferred conditions include a resin temperature of 170-220°C and a mold temperature of 20-50°C.

It is, of course, that those preferred temperatures depend on properties of the used resin and the used skin material, and thus, the conditions are not particularly limited to those temperatures.

As described above, since the mold for the press molding according to the present invention has the nozzle the tip portion of which is located the proper distance below the mold surface, the cavity side surface of the mold is hardly affected by the heat from the tip portion of the nozzle. Therefore, when the thermoplastic resin is press molded using the present mold, the molded article having a good appearance can be produced even when the molding cycle is short.

Examples

In order to explain the present invention more concretely, examples will be, hereinafter, described. However, the present invention is not necessarily limited by those examples.

Example 1

In a press molding apparatus comprising an upper half and a lower half, the lower half (8) as shown in Fig. 2 was used in which the molten resin passage was provided and the tip portions of the two nozzles were separated from the cavity side surface of the mold by a distance of 20 mm.

The temperature of the upper half was set at 90°C and the temperature of the lower half was set at 80°C. A polypropylene (available from Sumitomo Chemical Co., Ltd. under the name of Sumitomo-Noblen® AX568, having a melt flow index of 65g/10min.) at a temperature of 260°C was used as the thermoplastic resin. The resin was supplied into the lower half and press molded by the following procedure to produce molded articles.

The molten resin (6) was supplied into the cavity through the molten resin passage by lowering the pin (4) using a hydraulic cylinder so that the nozzle (2) was opened, and the pin (4) was raised so that the opening of the nozzle (5) was closed and the resin passage was closed after a desired amount of the resin was supplied whereby supply of the resin was finished.

Firstly, lowering the upper half (7) was started. The lowering of the upper half (7) was temporarily stopped when the cavity clearance became 3 mm, and then the supply of the molten resin (6) was started. Just before the supply of a desired amount of the molten resin (6) was completed, the lowering of the upper half (7) was re-started so that the molten resin (6) was press-shaped, then the resin was cooled for 40 seconds while pressure was applied and then the upper half was raised so that the molded article was removed. The thickness of the molded article was 1.8 mm and the molding cycle was 55 seconds. Even when such a molding procedure was repeated 500 times in series, the molded articles produced had a good appearance without bulges or defective gloss.

Example 2

Using a mold in which the tip portion of the nozzle (2) was 65 mm below the cavity side surface of the mold, the following molding procedure was carried out.

A skin material the back side of which was an expanded polypropylene sheet (expansion ratio: 15) having an embossed surface and a thickness of 3 mm was laminated to a polyvinyl

chloride sheet having a thickness of 0.5 mm by means of an adhesive. The adhesive had been beforehand placed on the lower half with the side of the polyvinyl chloride sheet being on the upside.

Then, the upper half is lowered till the cavity clearance between the upper half (7) and the lower half (8) became 50 mm, the lowering rate of the upper half was set at 5 mm/sec. and the molten resin (6) was supplied through two nozzles (2). The molten resin was supplied between the skin material and the lower half while it pressed the skin material against the upper half surface. When the cavity clearance became 20 mm, the resin supply was completed and, at the same time, the pin (4) was raised so that the opening of each nozzle (2) was closed and the resin passage was stopped. When the upper half (6) was lowered, the molten resin was pressured and the edge portions of the cavity were filled with the fluid resin while the resin pressed the skin material thereon against the upper half. The application of the pressure with cooling was maintained for 40 seconds and then the upper half was raised so that the intended multi-layer molded article was removed. The cycle of this molding procedure was 65 seconds. Even when such a molding procedure was repeated 100 times in series, the molded multi-layer articles were produced each of which had a good appearance without bulges nor defective gloss.

Comparative Example 1

Example 1 was repeated except that a mold in which the tip portion of the nozzle (2) was 5 mm below the cavity side surface of the mold was used. The articles molded by this arrangement up to the fifteenth cycle had a good appearance. However, the articles molded in the twentieth or more cycles had depressions on portions which were adjacent to the nozzles, and the article molded in the thirtieth or more cycle had remarkable deformations.

Since the tip portion of the nozzle is separated from the cavity side surface of the mold by the proper distance in the mold for the press molding according to the present invention, the cavity side surface of the mold is hardly affected by the heat from the nozzle. Thus, when the press molding of the thermoplastic resin is carried out using the mold, a molded article having a good appearance can be produced even when the molding cycle is short.

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Claims:

1. A mold for the press molding of a thermoplastic resin which comprises a molten resin passage in an upper half or a lower half, and a tip portion of a nozzle which opens and closes the molten resin passage and which is placed 10-100 mm below a cavity side surface of the upper half or the lower half.

2. A process for the press molding of a thermoplastic resin which comprises supplying a thermoplastic resin to the mold according to claim 1, from the molten resin passage through the nozzle, to a cavity between the upper half and the lower half which is not closed, and clamping the two halves together after the molten resin passage is closed.

Fig. 1 Prior Art

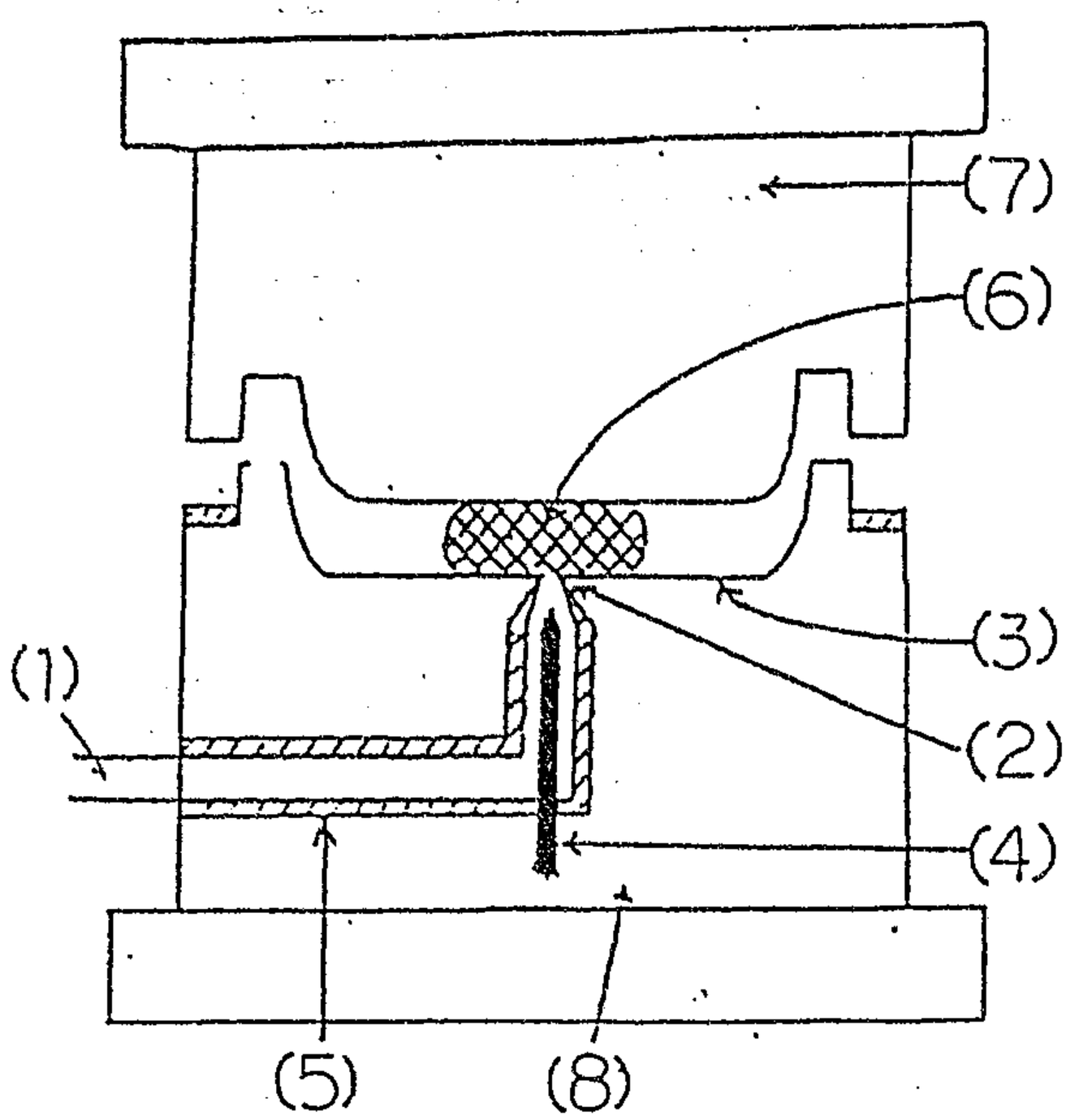
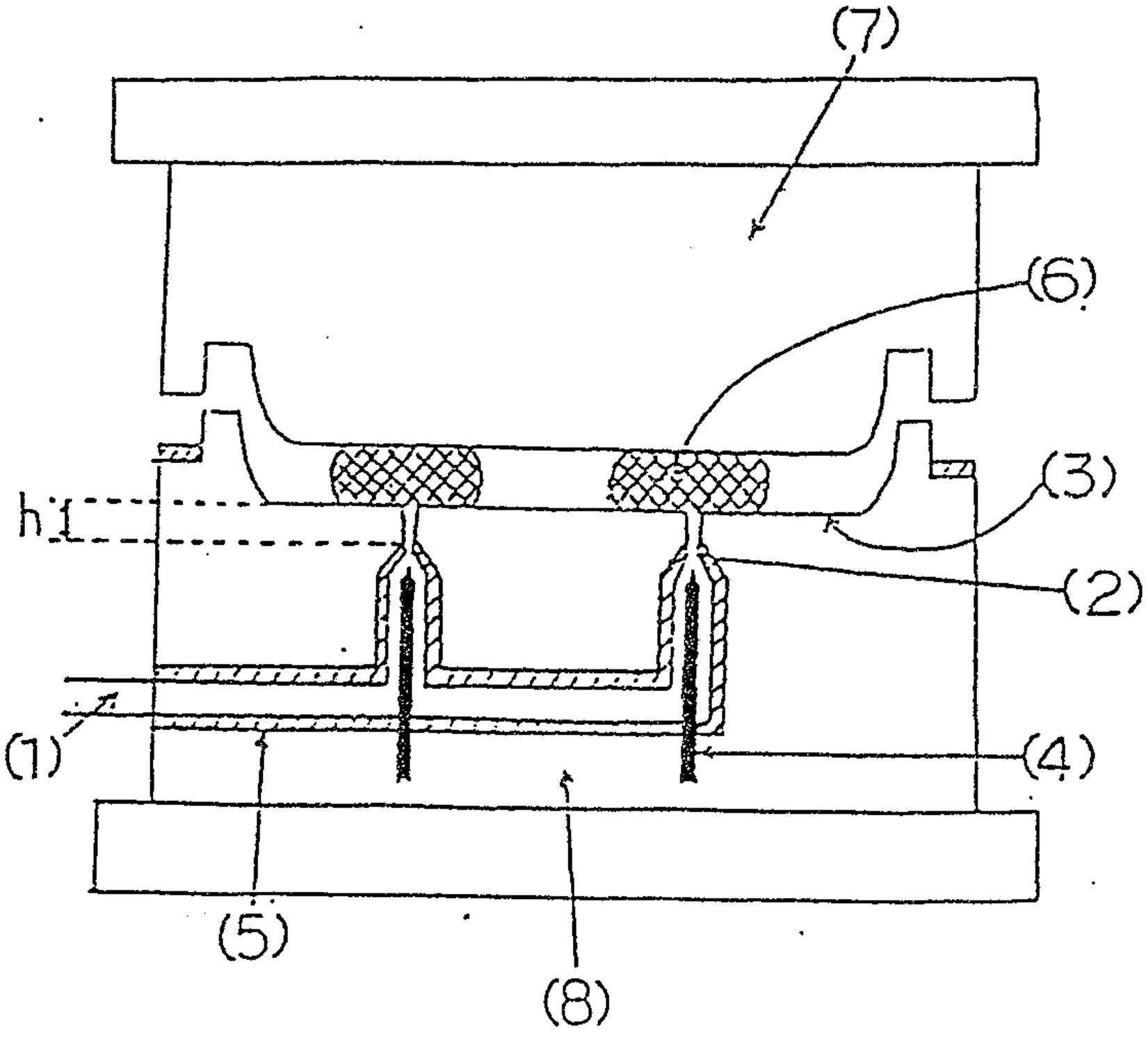
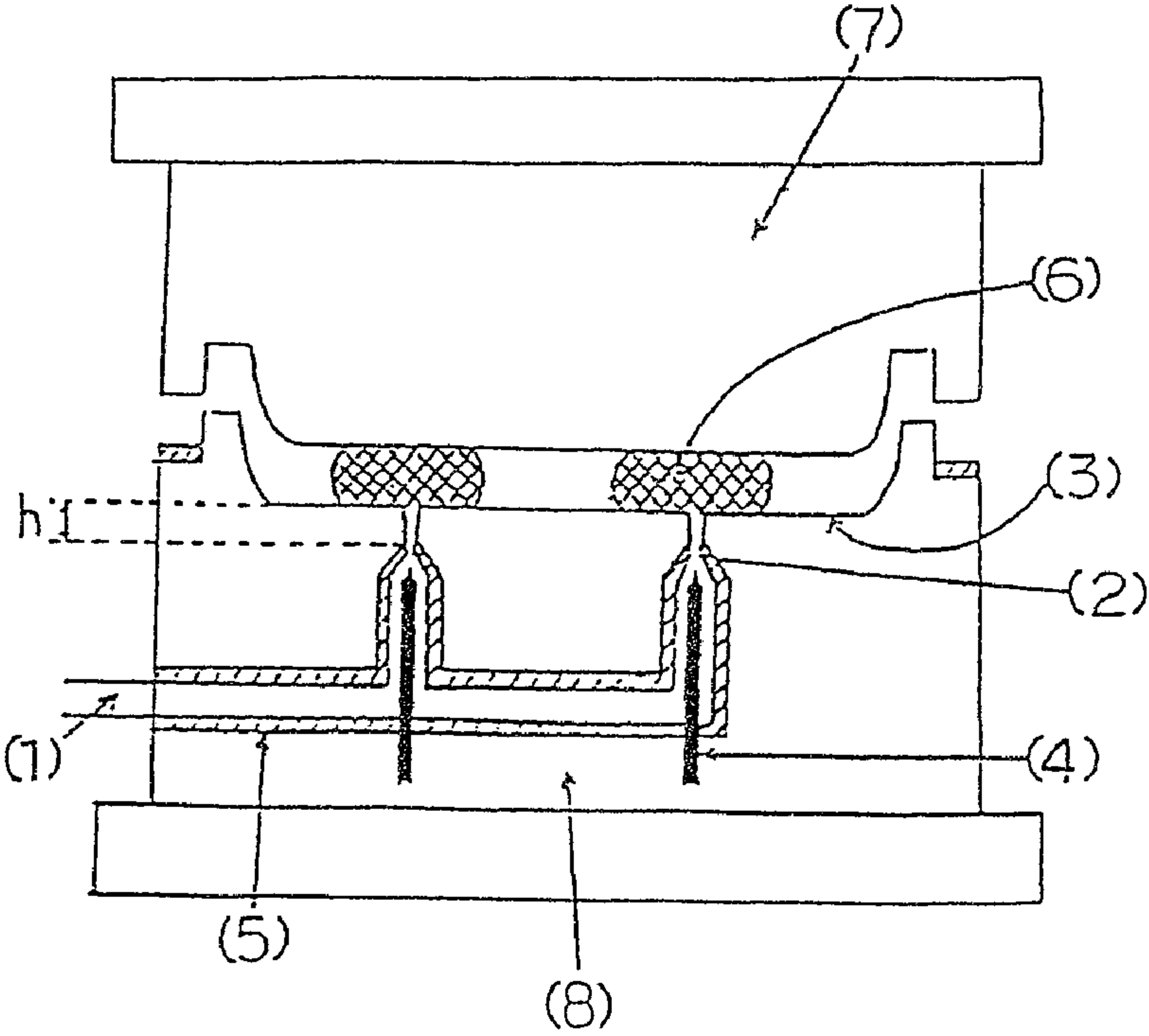


Fig. 2

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