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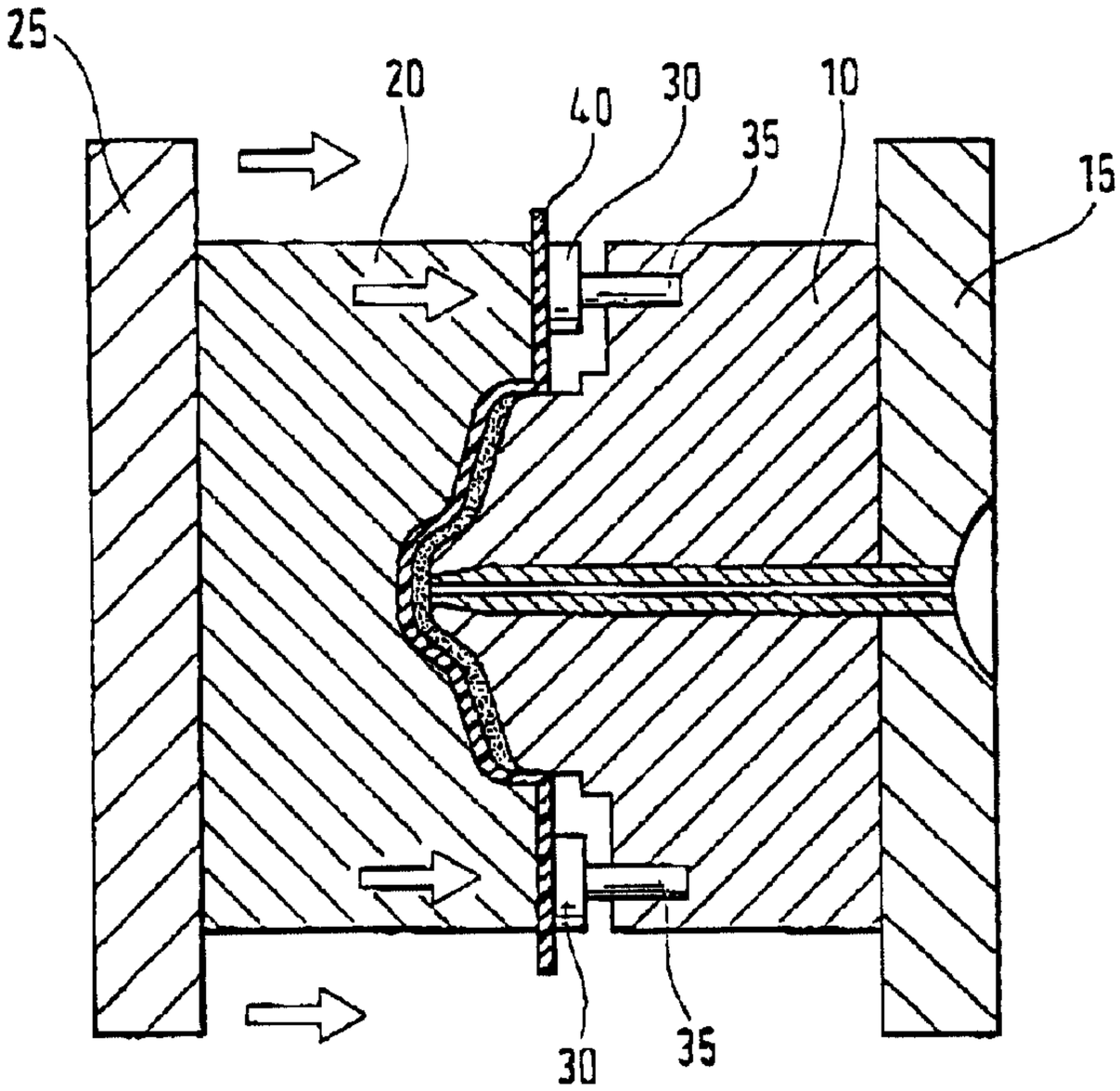
(54) Titre : METHODE DE FABRICATION D'ARTICLES EN PLASTIQUE STRATIFIE MOULES
(54) Title: METHOD OF PRODUCING LAMINATE MOLDED PLASTIC ARTICLES



(57) Abrégé/Abstract:
The invention relates to a method for producing a composite plastic moulded part consisting of at least one layer of a sheet material and a plastic body, using an injection moulding tool. According to this method, the sheet material is placed in the injection moulding tool and deformed as the tool is closed. Negative pressure is then applied to one side of the sheet material or excess pressure is applied to its other side, so that the sheet material comes to rest on a mould half. Plastic material is then introduced into the opening injection moulding tool in such a way that the incoming flow rate of the plastic material and the opening speed of the injection moulding tool are co-ordinated with each other. Once a certain opening gap has been reached, the mould is closed and the plastic moulded part is embossed. The inventive method enables greater embossment distances to be achieved in vertical and horizontal machines.

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(81) Bestimmungsstaaten: CA, JP, KR, US, europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

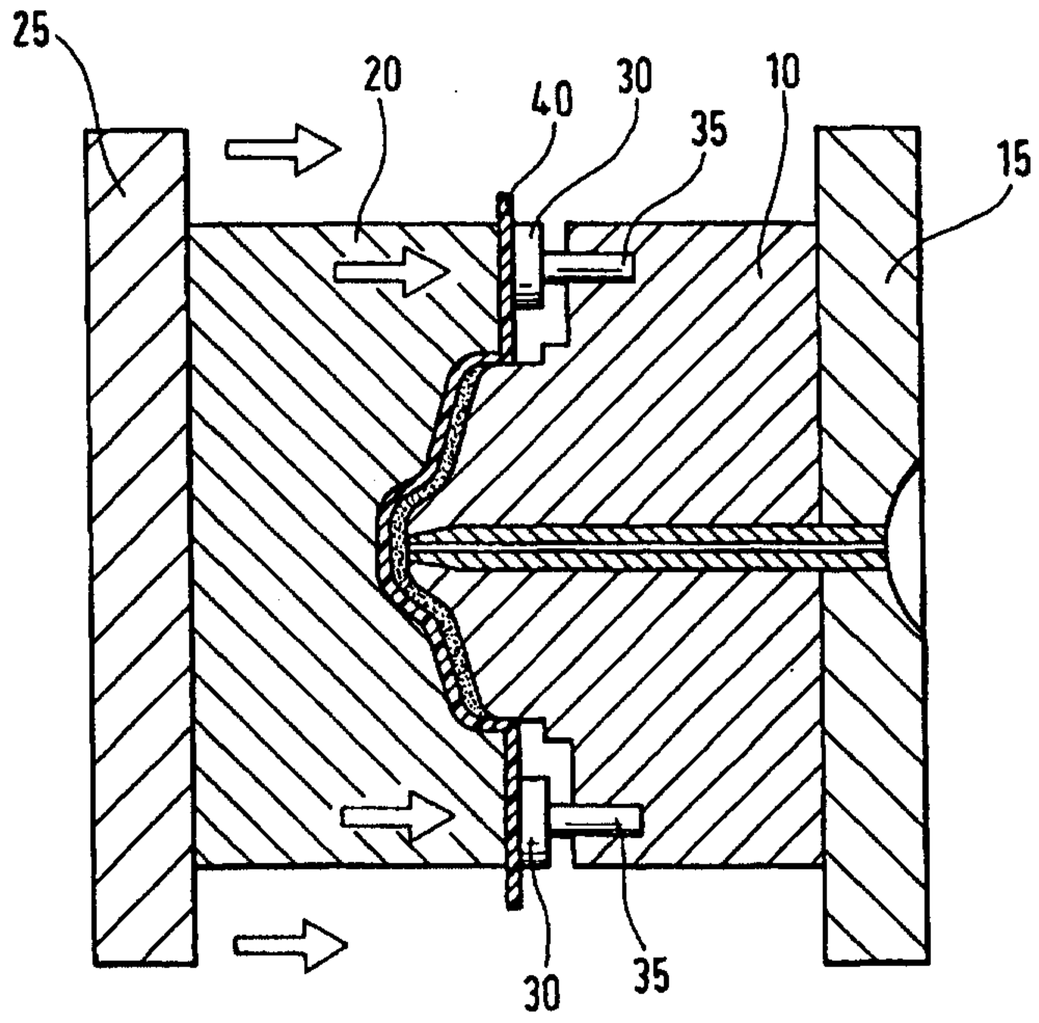
Veröffentlicht
Mit internationalem Recherchenbericht.

(54) Title: METHOD FOR PRODUCING COATED PLASTIC MOULDED PARTS

(54) Bezeichnung: VERFAHREN ZUM HERSTELLEN VON BESCHICHTETEN KUNSTSTOFFFORMTEILEN

(57) Abstract

The invention relates to a method for producing a composite plastic moulded part consisting of at least one layer of a sheet material and a plastic body, using an injection moulding tool. According to this method, the sheet material is placed in the injection moulding tool and deformed as the tool is closed. Negative pressure is then applied to one side of the sheet material or excess pressure is applied to its other side, so that the sheet material comes to rest on a mould half. Plastic material is then introduced into the opening injection moulding tool in such a way that the incoming flow rate of the plastic material and the opening speed of the injection moulding tool are co–ordinated with each other. Once a certain opening gap has been reached, the mould is closed and the plastic moulded part is embossed. The inventive method enables greater embossment distances to be achieved in vertical and horizontal machines.



(57) Zusammenfassung

Beschrieben wird ein Verfahren zum Herstellen eines Verbund–Kunststoffformteils aus mindestens einer Lage eines Bahnmaterials und einem Kunststofffkörper mit einem Spritzgießwerkzeug, wobei das Bahnmaterial in das Spritzgießwerkzeug eingelegt wird und durch Schließen des Werkzeugs verformt wird. Anschließend wird Unterdruck an eine Seite des Bahnmaterials oder Überdruck an dessen andere Seite angelegt, so daß das Bahnmaterial sich an eine Werkzeugformhälfte anlegt. Kunststoffmasse wird dann in das sich öffnende Spritzgießwerkzeug so eingebracht, daß die Zuflußrate der Kunststoffmasse und die Öffnungsgeschwindigkeit des Spritzwerkzeugs aufeinander abgestimmt sind. Nach Erreichen einer bestimmten Öffnungsspalte wird dann die Form geschlossen und das Kunststoffformteil geprägt. Durch das erfindungsgemäße Verfahren können sowohl bei Vertikal– als auch bei Horizontalmaschinen große Prägewege realisiert werden.

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METHOD OF PRODUCING LAMINATE MOLDED PLASTIC ARTICLES

The invention relates to a method of producing composite plastic molded articles having at least one layer of web material (sheets, laminates, fabrics, generally flat materials) and a plastic body, with the composite plastic molded articles being made by injection molding.

Such molded plastic articles are currently used, for example, for articles of furniture, household appliances etc. and in the automobile industry for lining the inside of doors, dashboards, trunk linings, visors etc. The coated areas of the molded plastic articles form hereby the visible surfaces, when mounted, and, for esthetic reasons, carry decors and/or have particular surface characteristics, such as color design, surface texture or tactile properties, such as, for example, "soft-touch", i.e. a certain surface resiliency, oftentimes realized by foamed plastic materials. In the following description, coated materials of this type, including sheets, foamed plastics, decorative materials etc. are denoted in general as web materials. Such web materials react oftentimes very sensitive to deformations and heat so that in an injection molding tool embossment paths of up to 150 mm have been used during back injection of web materials in order to reduce the stress on the web material.

For example, EP-0333198 B1 describes a method for making such a composite molded plastic article by placing the web material onto a mold half of an open

injection molding tool and subsequently closing the mold, with plastified plastic mass being introduced into the mold during the closing operation. This method is intended to prevent damage to the web material, when the plastic mass is introduced.

DE-19531143 C2 proposes a different path while also relating to a method of injection molding molded plastic articles. According to this method, the web material is placed into the open mold, the mold is closed again and deforms the web material, and plastified plastic mass is introduced during the subsequent opening operation into the opening mold; after introduction of the plastified plastic mass, the mold is closed and the plastic mass is formed through pressing within the mold cavity.

The above-mentioned printed publications relate to so-called "vertical machines", in which the mold halves move in vertical position.

A so-called horizontal machine, in which the mold halves move accordingly in horizontal direction is known from DE-OS-2548318. In accordance with a method also described in this publication, heated web material is placed between the mold halves, negative pressure is applied on one of the mold halves so that the web material rests upon the inner wall surface of the mold half, the mold is closed except for a gap, subsequently plastified plastic mass is injected into the

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thus slightly enlarged cavity and finally spread in the mold cavity through final closing of the mold.

Conventional wisdom assumed that greater embossment paths cannot be realized in a horizontal machine because the injected plastic mass cake flows downwardly as a consequence of gravitation and thus will not spread in a desired manner.

Thus, it is the object of the invention to provide a method of injection molding composite plastic molded articles, which realizes great embossment paths and can be applied in vertical machines as well as horizontal machines.

This object is attained by a method according to claim 1; The dependent claims set forth advantageous configurations of the invention.

In accordance with the invention, a web material is first placed between the mold halves of an open injection molding tool, the tool is closed as the web material deforms, negative pressure is applied on one side of the web material and/or excess pressure is applied on the other side of the web material, so that the web material bears snugly against one mold half, plastified plastic mass is introduced in controlled amounts into the mold cavity of the injection mold, as opening of the injection molding tool is controlled until reaching a predetermined position, the

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injection molding tool is fully closed, and subsequently, the molded plastic article is withdrawn from the mold.

To support pre-forming, the web material is heated either across the entire area or locally, before placement into the mold or shortly before closing of the mold halves.

The above-referred notion that great embossment paths cannot be realized in horizontal machines or in vertical machines, when the mold flanks are very steep, is based on the thinking that the mass is quenched on the mold wall during injection molding of the plastic mass so as to form a "cold skin"; this cold skin does not adhere to the mold wall surface and slides off the steep mold wall surfaces.

In contrast thereto, the invention is based on the surprising recognition that back injection of web materials does not result in a formation of a cold skin when the plastic mass, the so-called mass cake, is injected, but the plastic mass adheres to the web material and cannot drop. In conjunction with the controlled opening of the mold and the respective introduction of the plastic mass in controlled amounts, the method according to the invention results in a very large mold gaps even when the flanks of the mold extend very steep or in horizontal machines.

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Hereby, the feed rate of the plastic mass and opening and closing movements of the injection molding tool are, preferably, so selected in dependence on one another and on the shape of the molded plastic article that the pressure of the plastic mass on the web material is substantially minimized and the plastic mass migrates essentially radially with respect to the injection point and a swell flow is maintained across the entire injection process.

Preferably, the plastic mass is injected via a sprue channel or several sprue channels, depending on the configuration of the molded plastic article.

To further support the swell flow, further plastic mass may be fed during closing of the molded parts.

In one broad aspect, there is provided method of producing a composite molded plastic article from at least one layer of a web material and a plastic body with an injection molding tool having two mold halves, comprising the steps of: a) placing a thermally insulated web material between the mold halves of the open injection molding tool; b) closing the injection molding tool, thereby deforming the web material; c) at least one of applying negative pressure on one side of the web material and applying excess pressure on the other side thereof; d) introducing plastified plastic mass into the mold cavity of the injection molding tool and simultaneously opening the injection molding tool until reaching a predetermined position, whereby the feed rate of the plastic mass and the opening speed of the injection molding tool are coordinated with one another; e) maintaining a fixed opening gap and continuing to feed plastic mass into the mold cavity; f) closing of the injection molding tool; g) removing the molded plastic article.

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An embodiment of the invention will now be described with reference to the attached drawing, in which:

FIG. 1 shows a flow chart for explanation of the closing and opening sequences of a mold of an injection molding tool in conjunction with the supply of plastic mass via an extruder screw, and

FIGS. 2a to 2h show schematic representations of the mold parts in various phases of the injection molding process.

The flow chart of FIG. 1 shows in schematic illustration a cycle of the injection molding process according to the invention with reference to a graph which plots the closing path of the mold halves, i.e. the size of the mold gap (left ordinate) against the time (abscise) in a continuous line, and the screw path (right ordinate) against the time in a broken line. The individual phases of the injection molding process are designated by numerals 1 to 12 and will be described in detail hereinafter.

In a phase zero (not represented in FIG. 1), a suitable web material (decorative material, foamed plastic material etc.) is cut to size, heated across the entire area or only partially in order to provide the elasticity of the web material commensurate with the molded article and to suit it to the process, and placed between the mold halves.

In the phases 1 and 2, the tool is subsequently closed, and negative pressure is applied on one side and/or excess pressure is applied on the other side to conclude the pre-forming of the web material at the end of the phase 3. In the phases 4 to 7, the mold is opened, and plastic mass is fed at the same time. The closing movement of the mold begins in phase 8 and is maintained until the end of the phase 11, whereby plastic mass is continuously being fed also during the phase 8. After the mold is completely closed and after a possible cool-down period (not shown), the mold is opened again in phase 12, the molded plastic article is removed, and a new cycle starts.

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FIG. 2a shows schematically two mold halves 10, 20 of an injection molding tool 100 of a horizontal machine. As is generally known and therefore not described in detail, the injection molding tool includes a stationary mold half 20, which is mounted onto a stationary support 25 and has an inner mold surface 22, and a moving mold half 10, which is mounted onto a moving support 15 and has a sprue channel 50 provided for supply of plastic mass and terminating at an inner mold surface 12. The inner mold surfaces 12 and 22 form in closed state of the mold the cavity for formation of the molded plastic article. As set forth above, pre-cut web material is heated, for example with an infrared radiator, and placed as web material 40, for example by a gripping robot, onto a clamping frame 30 on the mold half 10 of the opened tool. There, it is held by known means (for example, clamping elements, gripping elements or negative pressure) on the clamping frame 30, for example with an infrared radiator. This concludes the above-stated process step 0.

In the subsequent process step 1 (FIG. 2b), the tool is closed until the clamping frame 30 presses the web material 40 against a contact surface of the confronting mold half (female mold) 20.

A further advance of the mold half 20 (male mold) results in a mechanical pre-forming of the web material by the mold halves until a full closure of the mold is realized. This stage is illustrated in FIG. 2c, which further shows that support elements 35 for the clamping frame 30 are retractable in the male mold 10 in

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correspondence with the required closing path. As the clamping frame 30 bears on the contact surface of the female mold 20, a wrinkling of the web material 40 is counteracted.

When the mold is fully closed, the web material 40 does not fully fill out the cavity of the mold as plastic mass is yet to be introduced at a later stage. Therefore, a pneumatic pre-forming is carried out in the above-stated process step 3. During the closing operation (up to 2) or when the mold is fully closed (up to 3), excess pressure is applied via one or more air channels 14 from one side and/or negative pressure is applied via vacuum nozzles (not shown) from the other side, in order to support the preform operation, thereby allowing the web material 40 (depending on the requirements) to be pressed completely upon the inner mold surface 22 of the cavity. This is shown in particular in FIG. 2d together with the detailed view of FIG. 2e. The permanent deformation of the material web is set by the time period of the process steps 2 to 3. In case an elastic deformation is required only, the time period of the process steps 2 to 3 may be reduced to a minimum.

Following the process steps 2 to 3 are the process steps 4 to 7 according to the flow chart of FIG. 1, during which plastic mass is introduced into the opening mold. This is schematically illustrated in FIG. 2f. Apart from the already explained elements, FIG. 2f shows schematically an extruder 60 with an extruder screw 62 in which the plastic material is plastified and accumulated in a collecting

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space 64, and subsequently injected via a nozzle 66 into the sprue channel(s) 50 of the mold half 10. Commencement of the process step 4 initiates the injection process of the plastic mass and the injection mold is opened at the same time with freely program-adjustable speeds up to a controllable embossment path (up to process step 5). The plastic mass is injected through one or more injections points in controlled amounts, so that one or more mass cakes are formed. The size of the mass cakes is defined by the opening period of the injection points. Metering of the mass is suited to the molded article. This process is implemented because the incoming mass cake must be held early enough by the adhesive effect on the web material, and the pressure load on the web material as a consequence of the opening movement should be minimized.

The different ascents of the graph of the closing path in FIG. 1 in steps 4, 5, 6 and 7 indicate that the speeds of the mold opening vary, though the feed rate of the plastic mass remains constant (constant ascent of the graph of the screw path in FIG. 1, broken line). This means, the mold opening speed is relatively great in the phase 4, decreases in the phase 5 and is zero in the phases 6 and 7. This is based on the availability of a steadily increasing cavity in flat workpieces for the expanding plastic cake with increasing radius from the injection point.

This process control ensures that the plastic mass adheres to the web material 40, on the one hand, and to the mold half 10, on the other hand, and

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expands to all sides radially with respect to the injection point so that a falling off of the plastic cake is prevented and swell flow is maintained.

Basically, it is also possible to keep constant the mold opening speed and to accordingly control the injection rate, also a combination of both parameters may be changed. Metering should hereby carried out in such a manner that the plastic mass spreads out essentially radially with respect to the injection point. In practice, further parameters enter into the control/adjustment of a machine, for example, viscosity of the plastic mass, concrete shape of the cavity etc. Suitable values for the various, mutually dependent parameters are, therefore, determined during break-in of a machine through test runs and/or calculations.

In process step 8 of FIG. 1, injection into the closing mold is executed. This means, embossment of the mass cake(s) with defined embossing speeds and embossing pressure commences already during injection of the plastic mass. In this way, the flow fronts in the cavity are kept continuously in motion with the objective of establishing a speed of the flow fronts as constant as possible. FIG. 2g shows the state of the tool at the end of the process step 8.

In the process steps 9 and 10, a tool embossing operation is executed as the tool is further closed until the cavity is completely filled, as shown schematically in FIG. 2h, whereby a residual opening gap a (cf. FIG. 1) remains.

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Elimination of shrinkage is carried out in process step 11; By means of the further acting embossing force and the remaining residual opening gap a, material shrinkage is equalized. Towards the end of process step 11, the tool is almost or just about closed and can be opened (compare FIG. 2h), optionally after a cool-down period.

Finally, the tool is opened again in process step 12, the formed molded plastic article is removed, a new web material is introduced, and the cycle begins anew.

The method according to the invention realizes cycle times of about 60 sec., whereby the plastic mass has, for example, a temperature of about 200 °C and the web material is heated, for example, to 40 °C. Through this heating, the web material can be better shaped and thus conform better to the contours of the inner mold surface. This does not necessarily mean that a deep drawing process is involved here, in which the web material is solidified directly after being pressed against the inner mold half and remains in this mold. Depending on the case of application, other temperatures of up to, for example, 200 °C, may also be applied so that in an extreme case the web material is subject to plastic deformation in step 3.

As already set forth above, the method according to the invention is advantageous in particular for thermally insulated web materials, for example, for foamed plastics. It is also not necessary that the web material is a single-layer

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material, this material may also be a composite material of several layers. Hereby, it is conceivable to add to one layer of the web material, serving as decoration, a further thermally insulated layer in order to further improve the inventive effect.

The chart of FIG. 1 shows by way of example closing paths of up to more than 160 mm. Depending on the used materials, other closing paths, greater (up to above 200 mm) or smaller, may, however, also be used.

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CLAIMS:

1. Method of producing a composite molded plastic article from at least one layer of a web material and a plastic body with an injection molding tool having two mold halves, comprising the steps of:

a) placing a thermally insulated web material between the mold halves of the open injection molding tool;

b) closing the injection molding tool, thereby deforming the web material;

c) at least one of applying negative pressure on one side of the web material and applying excess pressure on the other side thereof;

d) introducing plastified plastic mass into the mold cavity of the injection molding tool and simultaneously opening the injection molding tool until reaching a predetermined position, whereby the feed rate of the plastic mass and the opening speed of the injection molding tool are coordinated with one another;

e) maintaining a fixed opening gap and continuing to feed plastic mass into the mold cavity;

f) closing of the injection molding tool;

g) removing the molded plastic article.

2. Method according to claim 1, where the feed rate and the opening speed are so coordinated with one another that the plastic mass expands in the mold cavity essentially in one of a circular manner and radially to all sides about an injection point.

3. Method according to claim 1 or 2, where at least during commencement of the closing operation in step f)

plastic mass is continued to be introduced into the mold cavity.

4. Method according to any one of claims 1 to 3, where the web material is heated across its entire area or locally before or after placement between the mold halves.

5. Method according to any one of claims 1 to 4, where the plastic mass is introduced via one or more sprue channels.

6. Method according to claim 5, where the feed rate of the plastic mass and the opening and closing movements of the injection molding tool are so selected in dependence from one another and from the shape of the molded plastic article that laminate flow is maintained.

7. Method according to any one of claims 1 to 6, where the web material includes foamed plastic.

8. Method according to any one of claims 1 to 6, where the feed rate of the plastic mass and the opening and closing movements of the injection molding tool are so selected in dependence from one another and from the shape of the molded plastic article that the pressure of the plastic mass upon the web material is minimized.

9. Method according to any one of claims 1 to 8, where the mold halves execute the opening and closing movements in horizontal direction.

10. Method according to any one of claims 1 to 9 where the web material is pre-heated to a temperature below 200°C.

11. Method according to any one of claims 1 to 9, where the material is pre-heated to a temperature in the range of 40°C to 60°C.

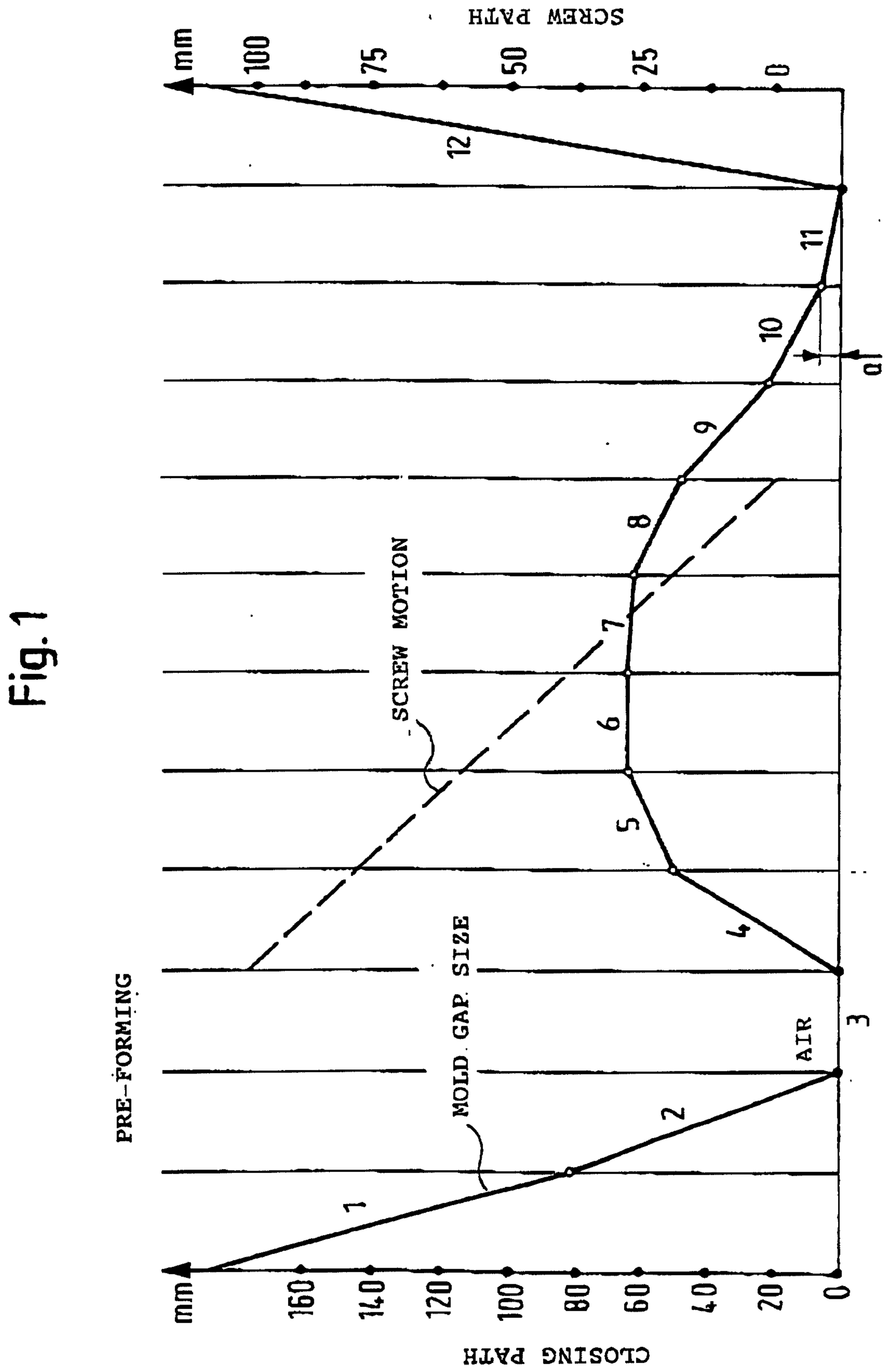
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Fig. 1

Fig. 2a

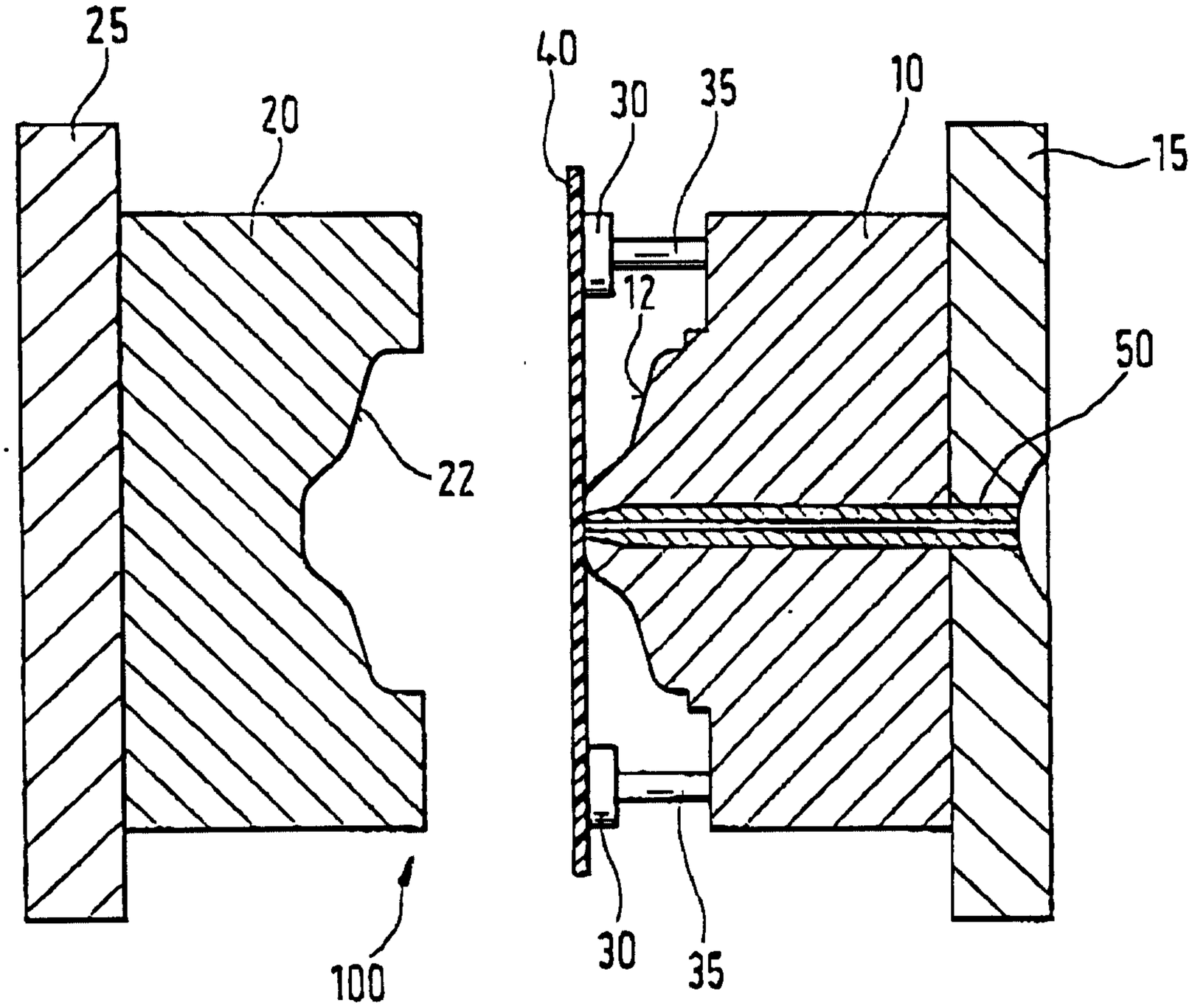

Fig. 2b

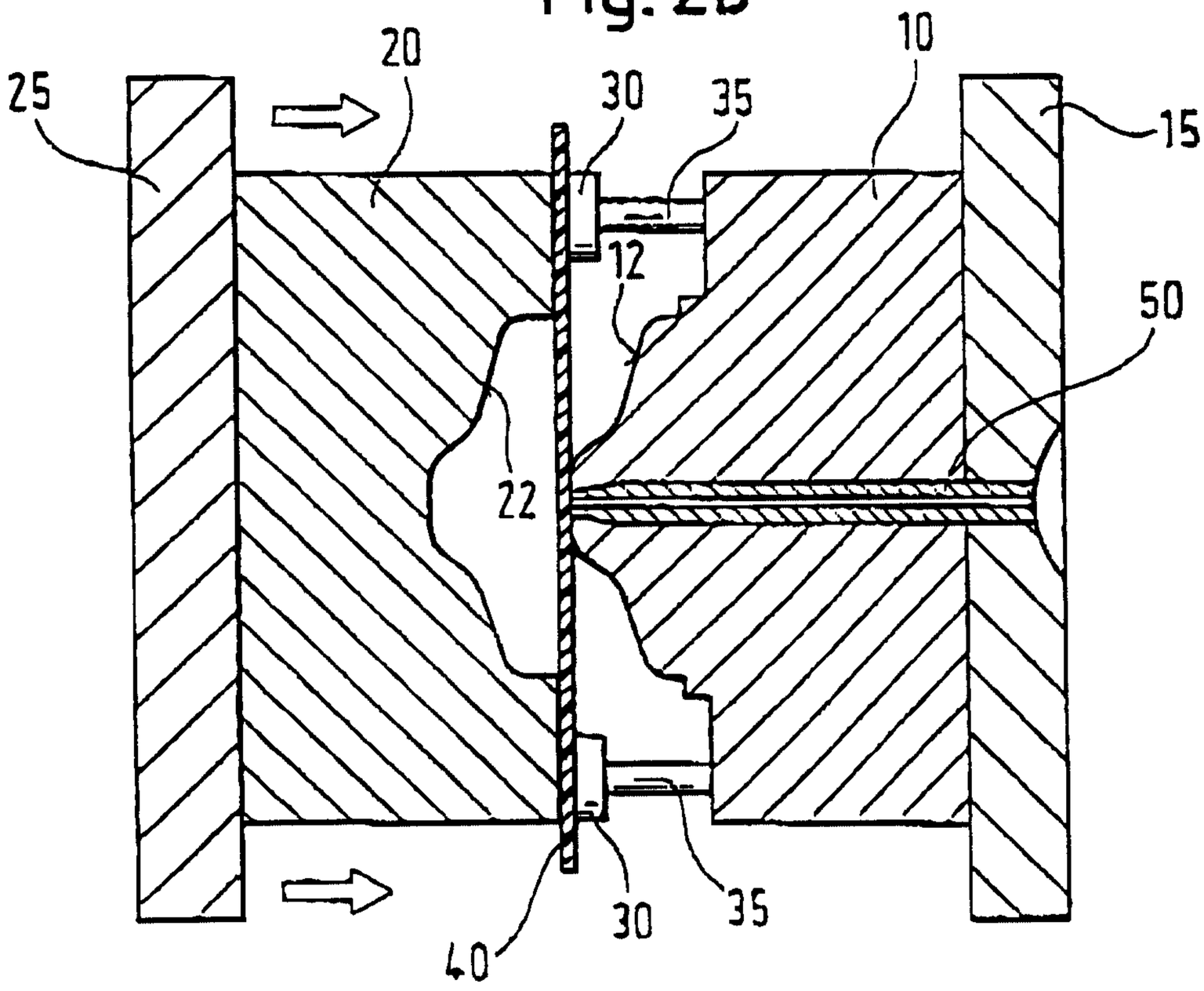

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Fig. 2c

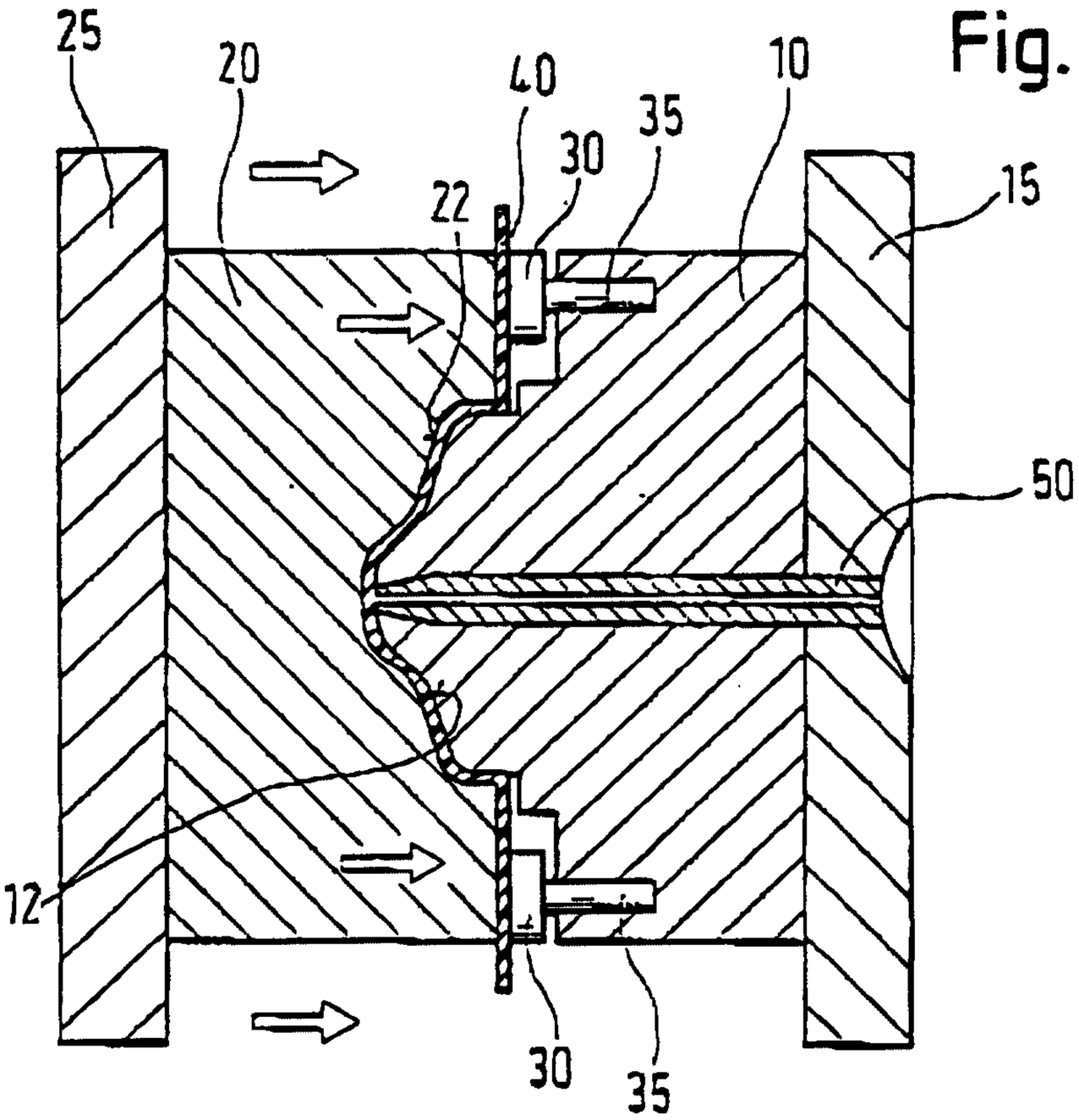

Fig. 2d

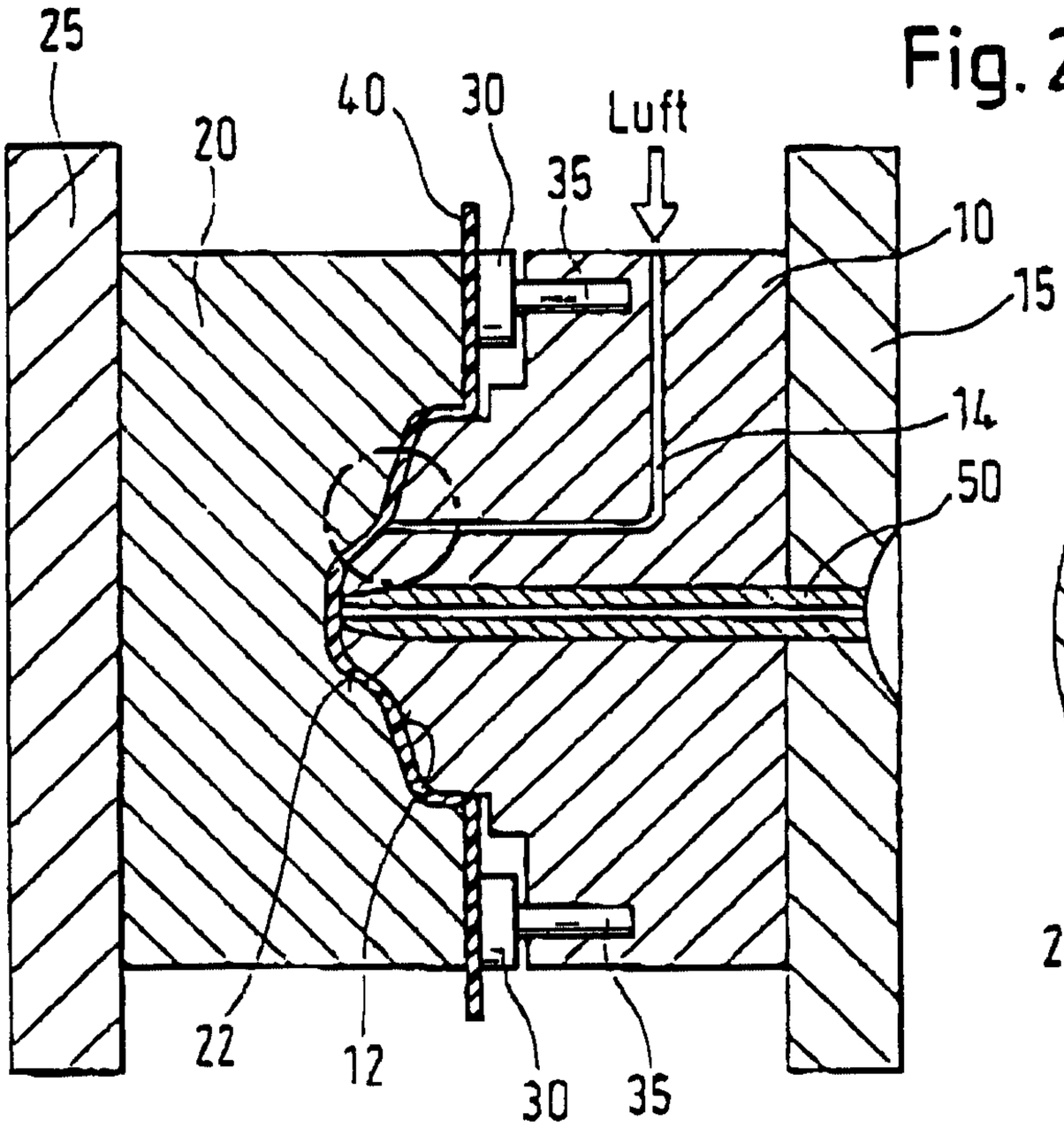

Fig. 2e

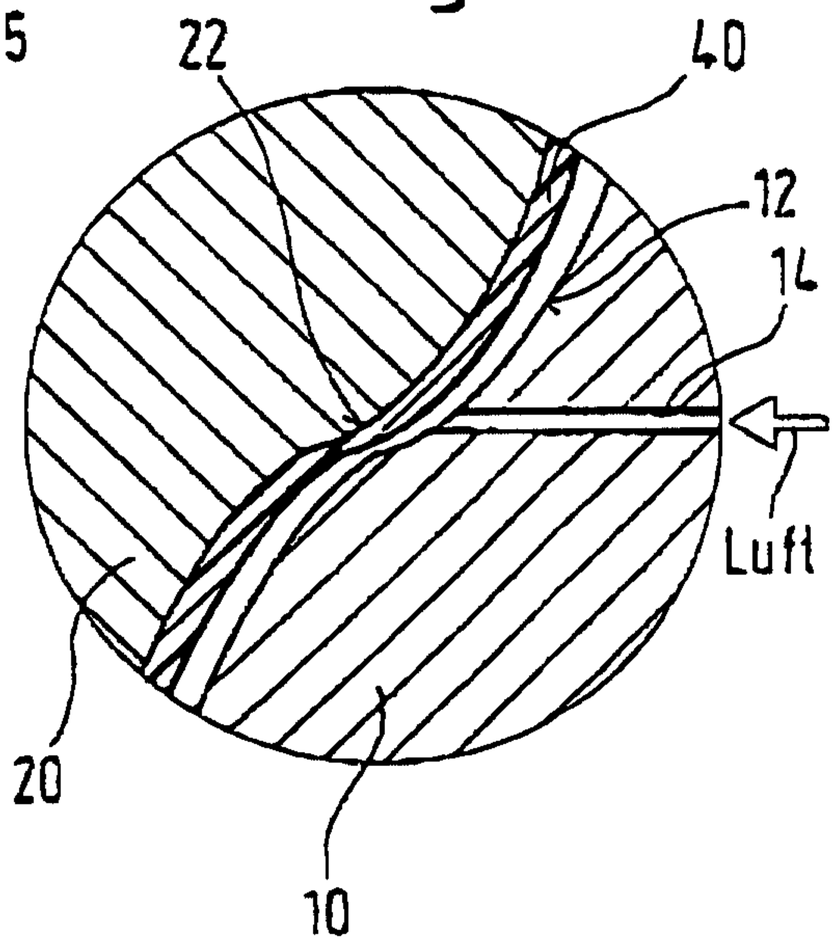

Fig. 2f

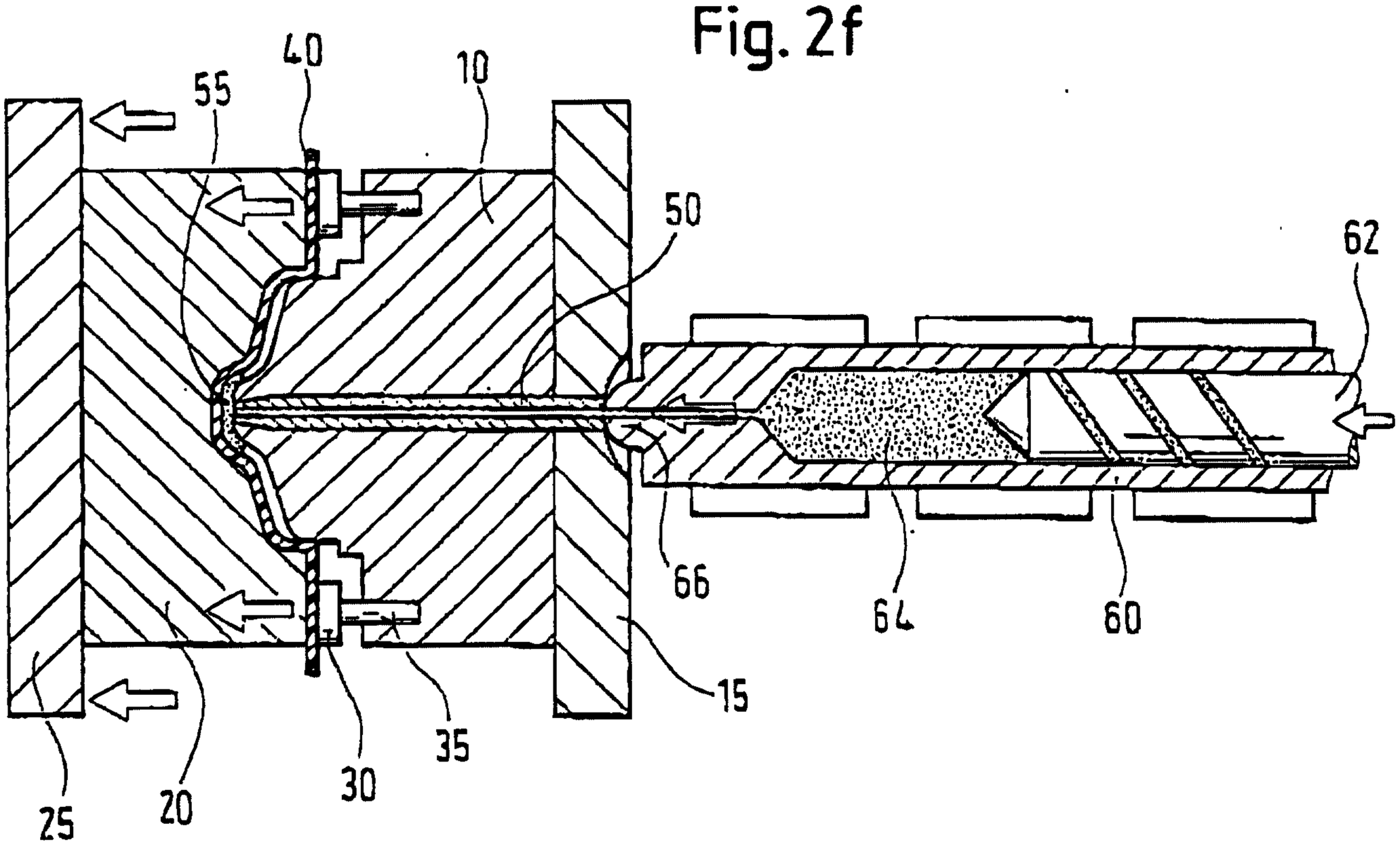
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Fig. 2g

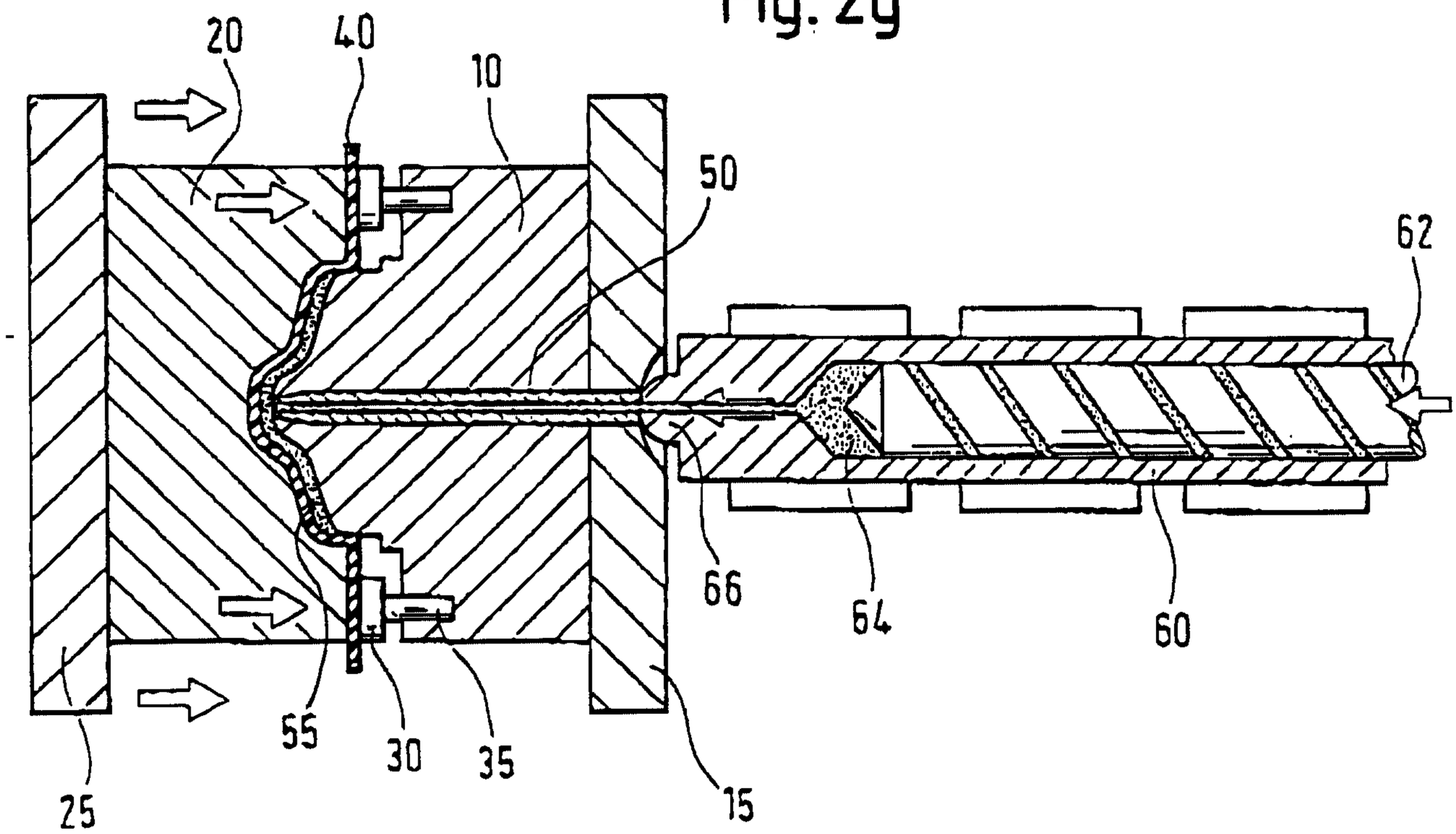
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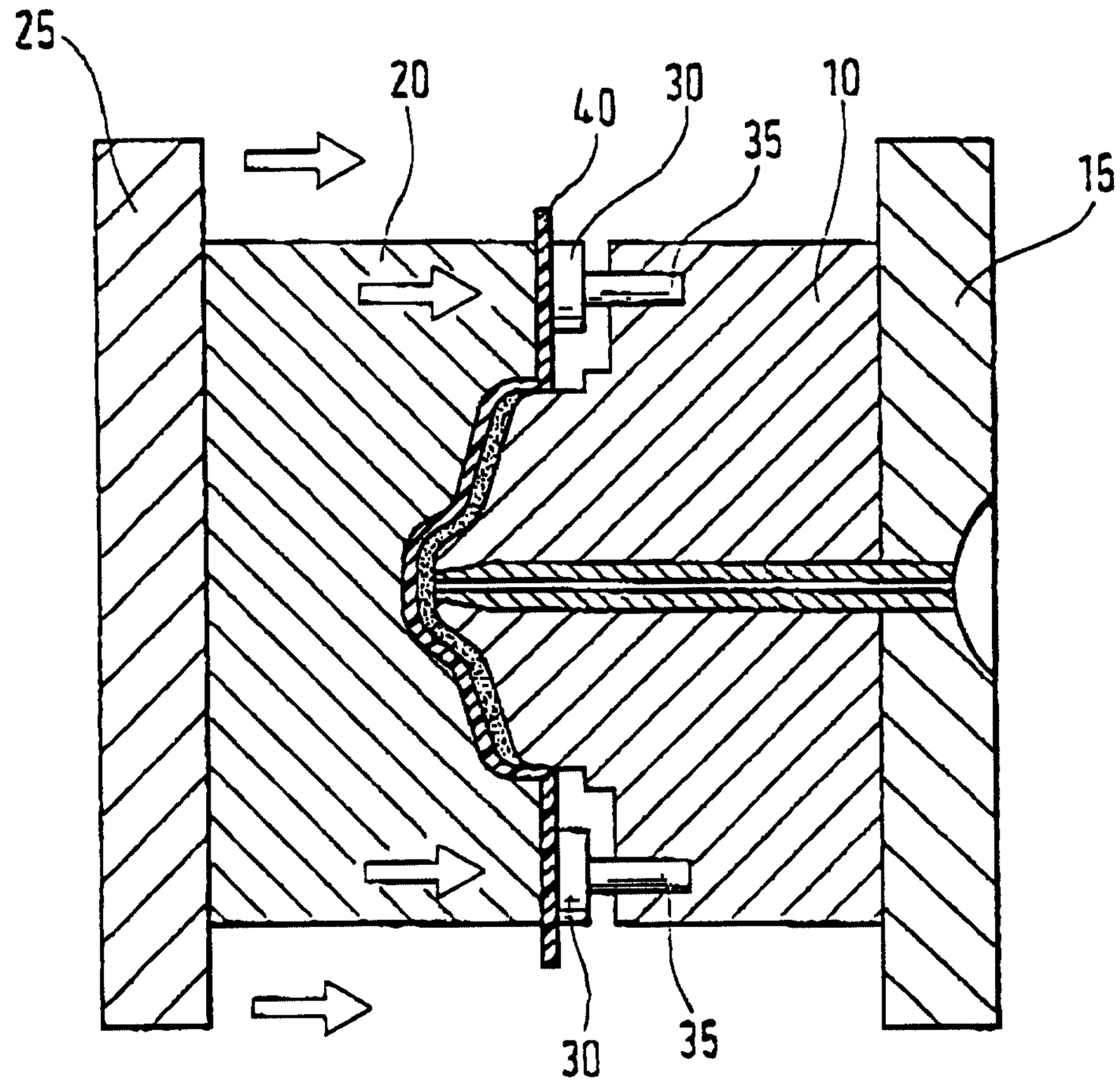
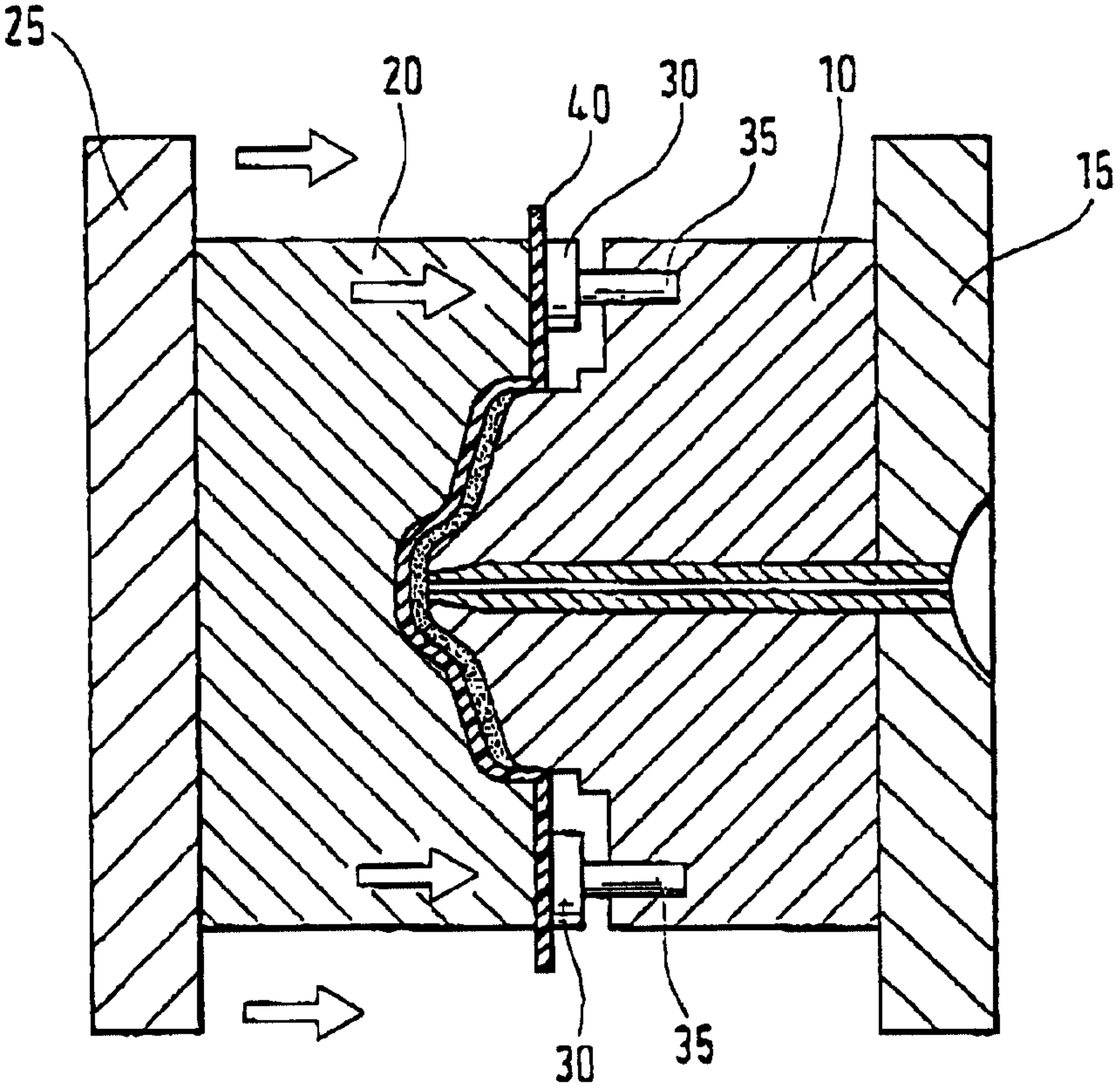
Fig. 2h

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