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(54) Injection mold for aluminum pieces in line

(57) The invention relates to an injection mold for aluminum pieces which allows obtaining several pieces in line simultaneously. The mold comprises three parts, a fixed part, a movable part and an intermediate part. When the parts are coupled together, cavities or spaces are defined between them, communicated through a feeding conduit. The spaces are filled with cast aluminum such that the pieces are obtained when the aluminum solidifies.

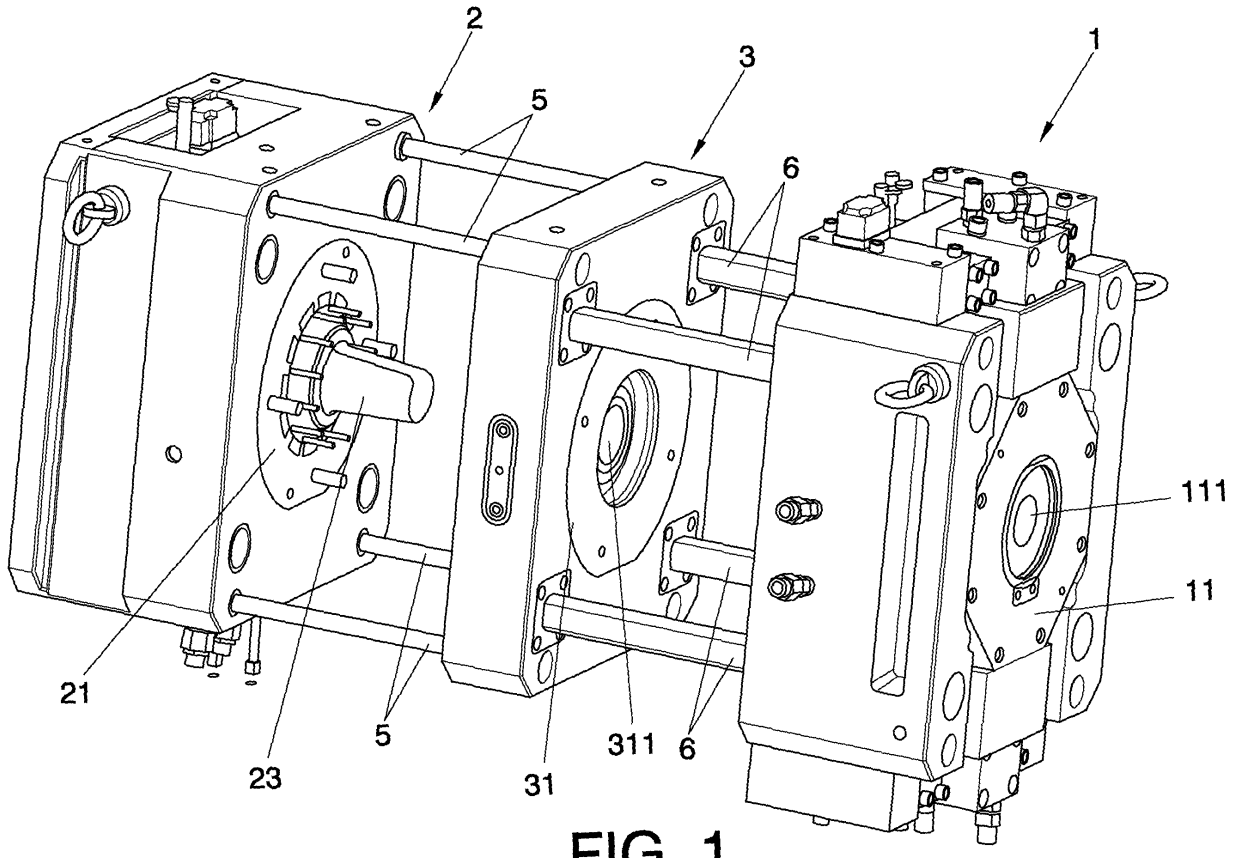

FIG. 1

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Description

Technical Field of the Invention

[0001] The invention is comprised within the field of injection molds for aluminum and specifically molds which allow obtaining several pieces simultaneously.

Background of the Invention

[0002] In the process of casting aluminum by injection under pressure, identical pieces are cast at the maximum production rate, forcing the cast metal under high pressures into the metal molds and attempting to minimize the cycle time per piece produced. The mold is formed by two parts which, when they are connected, form a space which the cast aluminum fills. When the aluminum solidifies, the desired piece is obtained. To carry out this process, the two parts of the mold are securely seamed together in order to withstand, without separating, high pressures, which is achieved with the closing force of the injecting machine which must withstand the injection pressure multiplied by the projected area of the piece plus the feed system. When the aluminum has solidified, the two parts of the mold are unlocked and opened to extract the hot cast piece.

[0003] The mold can be simple, i.e., it can allow obtaining one piece in each working cycle, or it can be multiple, with several cavities to obtain several pieces in each working cycle.

[0004] Molds with several cavities for injecting aluminum pieces are normally complex and require a large investment. In a multi-cavity mold, the cavities are placed on the same plane, therefore the projected surface is proportional to the number of cavities and the mold size increases with the number of cavities. In turn, the necessary closing force is multiplied with the closing number, a larger machine with a greater tonnage being necessary (with the subsequent increase in the investment). On the other hand, the placement of movable carriages for obtaining complex geometries is hugely encumbered in multi-cavity molds due to the movement of the carriages of one cavity interfering with the other.

[0005] In the injection of plastic pieces, it is possible to obtain several pieces in line, in one and the same working cycle, i.e., two or more pieces are obtained simultaneously, one after the other. In this sense, molds consisting of more than two mold parts, called sandwich molds, are known. For example, patent document US 7,320,591 describes a device for molding plastic pieces, formed by three plates, a fixed plate, a movable plate and an intermediate plate.

[0006] The advantage of sandwich molds is that the pieces (in patent US 7,320,591) are two in number, which is more than the number of pieces that would be obtained in a mold consisting only of two parts, which allows obtaining more pieces per unit of time.

[0007] Another example of this type of mold is described in patent document US 4,589,840, which describes a plastic injection mold formed by a fixed mold, a movable mold and an intermediate mold. The injection nozzle is located in the fixed mold, and the plastic reaches each of the cavities through multiple feeding conduits, which cavities will form the pieces to be obtained. The plastic is heated at high temperatures and branches out from the feeding conduit, connected to the injection nozzle, in order to fill each of the cavities.

[0008] This type of mold is suitable only for injecting plastics, given that if another type of material is used, for example, aluminum, it would not reach each of the cavities, since it would begin to solidify before reaching them; furthermore, the incoming material valve or sensor-type control systems can be sophisticated but with aluminum they would degrade too quickly due to the temperature and pressure.

[0009] Therefore, it would be desirable to have a sandwich-type injection mold that is suitable for obtaining two or more aluminum pieces simultaneously without having to use molds that are too bulky and expensive and that, as mentioned, multiply the machine requirements in terms of plate size and closing force, in turn reducing the possibility of placing multiple or movable carriages, as occurs with the usual multiple cavity molds.

Description of the Invention

[0010] The object of the invention is an injection mold for aluminum pieces which can manufacture several pieces in line simultaneously. The mold of the invention comprises:

- a fixed part with a first plate comprising a first cavity,
- a movable part with a second plate comprising a second cavity,
- at least one intermediate part with a third plate comprising a third cavity and a fourth cavity,
- coupling means configured such that the fixed part, the movable part and the intermediate part can occupy a coupling position such that between the first cavity and the third cavity there is defined a first space corresponding with the geometry of at least one first piece to be obtained and, between the second cavity and the fourth cavity there is defined a second space corresponding with the geometry of at least one second piece to be obtained,
- injection means configured to inject cast aluminum in the first and second spaces through an injection conduit.

[0011] The first plate comprises a first hole traversing the first cavity and the third plate comprises a third hole traversing the third and fourth cavity. On the other hand, the movable part has a protuberance which, in the coupling position, can be partially housed in the first and third holes to define a feeding conduit communicating the first and second spaces, the injection means being config-

ured to inject cast aluminum in the feeding conduit and in that the feeding conduit is dimensionally configured so that the cast aluminum completely fills the first and second spaces, such that the cast aluminum can solidify in the first and second spaces and inside the feeding conduit.

[0012] The first hole, the third hole, the injection conduit and the protuberance can be aligned in the coupling position.

[0013] Once the cast aluminum is solidified, the first piece and the second piece are obtained, connected through the solidified aluminum inside the feeding conduit.

[0014] In order for the cast aluminum to completely fill the first and second spaces, it is necessary for the feeding conduit to be sized depending on the characteristics of the pieces to be obtained so as to allow the aluminum to flow quickly to the first and second spaces and to be able to completely fill said spaces before the aluminum starts to solidify. The feeding conduit actually operates by holding the cast aluminum for enough time so as to completely fill the first and second spaces before the aluminum solidification process occurs.

[0015] Once the cast aluminum has solidified, the pieces must be demolded. To that end, the mold can comprise demolding means comprising movement means configured to separate the movable part with respect to the intermediate and fixed parts, such that between the movable part and the intermediate part there is a first separation distance which allows demolding the second piece and between the intermediate part and the fixed part, there is a second separation distance which allows demolding the first piece.

[0016] The movement means can comprise at least one tie rod configured to pull on the intermediate part, the mentioned tie rod comprising at one end at least a first stop, linked to the movable part, such that the movement of the movable part drags the tie rod until it reaches the first separation distance and in that the tie rod comprises a second stop which, once the first separation distance is reached, contacts with the intermediate part, such that the movement of the movable part drags the intermediate part, separating it from the fixed part.

[0017] The first separation distance will be enough so as to allow that, for example, robotized means can be moved into the space created and extract the second piece obtained.

[0018] To guide the movement of the intermediate part, the movement means can comprise at least one guide, and the guide can comprise a third stop configured to limit the second separation distance. Like the first distance, this second distance will be enough so as to allow demolding the first piece obtained and the length of the tie rod and the distance to the stop will be sized so as to make it possible to extract both pieces with manual or automatic means sequentially or simultaneously.

[0019] When the second stop of the tie rod collides with a projection of the intermediate part, the movement of the movable part produces the movement of the intermediate part and therefore the separation of the intermediate part with respect to the fixed part.

[0020] However, as previously indicated, after the injected aluminum solidifies, the pieces are connected through the solidified aluminum inside the feeding conduit. Therefore, in order to carry out the demolding, it is necessary to separate the first piece and the second piece.

[0021] The mold can comprise fracture means configured to separate the first piece from the second piece and from the solidified aluminum inside the feeding conduit in order to separate the pieces.

[0022] The first piece to be obtained can be connected to the feeding conduit through a feeding branch. The mentioned branch can have a width "n" and is connected to the feeding conduit at a sharp angle, such that when the movement means separate the movable part with respect to the intermediate and fixed parts the mentioned feeding branch fractures due to shear stress, thus being separated from the feeding conduit. Once separated from the solidified aluminum inside the feeding conduit, the branch is connected to the first piece.

[0023] The sharp angle formed between the feeding conduit and the branch allows that, when the movement means separate the movable part with respect to the intermediate and fixed parts, the mentioned feeding branch is fractured by shear stress, such that the first piece is separated from the feeding conduit which is dragged together with the second piece.

[0024] The fracture means can comprise locking means for locking the intermediate part configured to limit the movement of the mentioned intermediate part at the start of the movement of the movable part. These locking means can comprise a first step which is in the tie rod, a spring configured to push the mentioned first step against the intermediate part and a second step arranged in the tie rod and configured to contact with a third step of the movable part when the movement of the movable part reaches a distance which is equivalent to the width n.

[0025] Once the cast aluminum has been cut, it is separated from the first piece, and the movable part continues moving until the tie rod collides with the second stop, at which time the first separation distance is reached.

[0026] In the coupling position of the intermediate, movable and fixed parts, the intermediate part exerts pressure on the tie rod in the area corresponding to the first step. At this time the cast aluminum is injected into the first and second spaces. Once the aluminum has solidified, the first piece and the second piece are connected through the solidified aluminum inside the feeding conduit.

[0027] When the movement means separate the movable part with respect to the intermediate and fixed parts, the solidified aluminum inside the feeding conduit is sheared. The spring presses against the intermediate part for the purpose of keeping it connected to the fixed part during the movement of the movable part and thus

being able to fracture the solidified aluminum. The movable part is moved, i.e., it is separated with respect to the intermediate part a distance which is equivalent to the width n of the branch. With this small movement the solidified aluminum inside the feeding conduit is fractured and the first piece is thus separated from the second piece and from the solidified aluminum.

[0028] During the injection, the pressure which the mold has to withstand is very high, therefore it is required that all the parts are perfectly locked so that the cast aluminum flows through the feeding conduit and reaches the first and second spaces. To that end, in addition to the coupling means, the mold can comprise connecting means configured to lock the fixed part, the movable part and the intermediate part when the cast aluminum is injected.

[0029] The connecting means can comprise a locking element which moves in a direction perpendicular to the movement of the movable part, comprising a protuberance fitting in a housing of the intermediate part. The protuberance is inserted in the housing of the intermediate part in the coupling position such that the parts are locked. When the movement means begin to separate the movable part with respect to the intermediate and fixed parts, a rod integral with the movable part can move through an oblique conduit of the locking element such that in the movement of the movable part, the rod slides through the oblique conduit, causing the locking element to come out of position.

Description of the Drawings

[0030] To complete the description being made and for the purpose of aiding to better understand the features of the invention according to a preferred embodiment thereof, a set of drawings is attached as an integral part of said description in which the following is shown with an illustrative and non-limiting character:

- Figure 1 shows a perspective view of the mold object of the invention, with the movable part separated from the intermediate part and the intermediate part separated from the fixed part.
- Figure 2 shows a section view of the mold in the coupling position of the parts and with the solidified aluminum inside the feeding conduit and in the first and second spaces.
- Figure 3 shows a section view of the mold once the movable part has been separated from the intermediate part the first separation distance.
- Figure 4 shows a section view of the mold in which the intermediate part has been separated from the fixed part the second separation distance.
- Figure 5 shows a detail of the connection of the feeding conduit and the feeding branch of the first piece.
- Figure 6 shows a section view of the sequence of movements of the movable part with respect to the intermediate and fixed parts.
- Figure 7 shows a section view of Figure 1.
- Figure 8 shows a perspective view of an example of pieces to be obtained.

Preferred Embodiment of the Invention

[0031] As is observed in Figure 1, the mold comprises a movable part (2), a fixed part (1) and an intermediate part (3). The fixed part (1) comprises a first plate (11) in turn comprising a first hole (111) traversing a first cavity (12). The intermediate part (3) comprises a third plate (31) in turn comprising a third hole (311) traversing a third cavity (32) and a fourth cavity (33). The movable part (2) comprises a second plate (21) having a protuberance (23), which can be partially housed in the first hole (111) and third hole (311) to define a feeding conduit (7).

[0032] Figure 5 shows the feeding conduit (7) which is connected to a first space and to a second space through feeding branches (9, 9'), respectively. The first space is defined by the first cavity (12) and the third cavity (32) corresponding with the geometry of a first piece (A), whereas the second space is defined between the fourth cavity (33) and the second cavity (22) corresponding with the geometry of a second piece (B). The cast aluminum is injected into these two spaces to form the pieces (A) and (B), which will be connected through the solidified aluminum in the feeding conduit (7).

[0033] The feeding conduit (7) has to be dimensionally configured so that the cast aluminum completely fills the first and second spaces, such that the cast aluminum can solidify in the first and second spaces and inside the feeding conduit (7). To facilitate filling the first and second spaces with the cast aluminum, the mold can comprise a first feeding branch (9) which is connected to the first space and a second branch (9') connected to the second space. The first branch (9) can also be connected to the feeding conduit (7) at a sharp angle, such that once the aluminum is injected, the first piece (A) is connected to the solidified aluminum inside the feeding conduit (7) through the solidified aluminum inside the branch (9).

[0034] Figure 2 shows the movable part (2), the intermediate part (3) and the fixed part (1) coupled together to cause the cast aluminum to be injected through an injection conduit (4). The pressure which the mold must withstand at the time of the injection is very great, therefore the mold can comprise connecting means which allow keeping the intermediate part (3), fixed part (1) and movable part (2) locked in the coupling position. As seen in this Figure 2, these connecting means can comprise a locking element (16) having a boss (17) which is fitted in a housing (18) of the intermediate part (3).

[0035] The aluminum is injected through the injection conduit (4) which can be aligned with the feeding conduit (7), such that the aluminum flows from the injection conduit (4), completely filling the first and second spaces through the feeding conduit (7).

[0036] Once the aluminum has been injected and solidified, the pieces (A) and (B) obtained are demolded.

Figure 1 shows this demolding position, in which the parts have been separated, i.e., the movable part (2) separated with respect to the intermediate part (3) and fixed part (1), and the intermediate part (3) separated with respect to the fixed part (1). The movable part (2) is separated from the intermediate part (3) a first separation distance, which is a distance that is suitable so as to allow demolding the second piece (B), whereas the intermediate part (3) is separated from the fixed part (1) a second separation distance, which is the distance suitable so as to allow demolding the first piece (A).

[0037] However, as discussed, these pieces (A) and (B) are connected by the solidified aluminum inside the feeding conduit (7), therefore in order to demold the pieces (A) and (B), it is necessary to separate them.

[0038] To that end, the mold can comprise fracture means configured to separate the first piece (A) from the second piece (B) and from the solidified aluminum inside the feeding conduit (7). As discussed, the first piece (A) can be connected to the feeding conduit (7) through the feeding branch (9) which is connected, at a sharp angle, to the mentioned feeding conduit (7). This branch (9) has a width "n" and is configured so that when movement means, not depicted in the figures, separate the movable part (2) with respect to the intermediate part (3) and fixed part (1), the mentioned feeding branch (9) fractures due to shear stress. In other words, when the movable part (2) is separated from the intermediate part (3) the feeding branch (9) fractures due to shear stress, being separated from the solidified aluminum inside the feeding conduit (7). After the fracture, the first piece (A) is separated from the solidified aluminum inside the feeding conduit (7), which is dragged together with the second piece. When the demolding is carried out, what is obtained is the first piece (A) together with the solidified aluminum in the branch (9), and on the other hand, the second piece is obtained together with the solidified aluminum inside the branch (9') and the solidified aluminum inside the feeding conduit (7).

[0039] However, in order for the cutting to be done easily but precisely, the fracture means can comprise locking means for locking the intermediate part (3) configured to limit the movement of the mentioned part (3) at the start of the movement of the movable part (2), for the purpose of keeping the intermediate part (3) connected to the fixed part (1).

[0040] As is observed in Figure 6, these locking means can comprise a first step (8) arranged in a tie rod (5), a spring (13) configured to push the mentioned step (8) against the intermediate part (3) and a second step (14) arranged in the tie rod (5) which contacts with a third step (15) of the movable part (2) when the movement of the movable part (2) reaches a distance which is equivalent to the width n of the branch (9).

[0041] In Figure 6, three phases are depicted corresponding with the phase for the injection, phase for the fracture or separation of the pieces (A) and (B) and phase for the movement of the movable part (2) with respect to the intermediate part (3) and fixed part (1) until reaching a first separation distance which allows demolding the second piece (B).

[0042] In the phase for the injection of the aluminum in the first and second spaces through feeding conduit (7), coupling means, not depicted in the figures, couple the movable part (2), intermediate part (3) and fixed part (1), such that the spring (13) is compressed and the second step (14) is not in contact with the step (15) of the movable part (2). When the movement means start to separate the movable part (2) with respect to the intermediate part (3), the spring (13) pushes the first step (8) against the intermediate part (3) so that said part (3) is connected to the fixed part (1) and, the second step (14) contacts with the third step (15) of the movable part (2). This movement covers a distance which is equivalent to the width "n" of the branch (9). At this time the first piece (A) is already separated from the solidified aluminum inside the feeding conduit (7) and from the second piece (B).

[0043] Subsequently the movement means continue to separate the movable part (2) from the intermediate part (3) until reaching the first separation distance. The first separation distance is reached when a second stop (52) of the tie rod (5) contacts with the intermediate part (3). The second stop (52) can collide, for example, with a boss arranged in the intermediate part (3) such that the movable part (2) drags the intermediate part (3), separating it with respect to the fixed part (1).

[0044] Figure 3 shows how the movable part (2) has reached the first separation distance. The pieces (A) and (B) have been separated and the piece to be demolded is a piece formed by the second piece (B) and the solidified aluminum inside the feeding conduit (7). In this position the second stop (52) has collided with the boss of the intermediate part (2). When the movement means continue to push the movable part (2), the intermediate part (3) is dragged to be separated with respect to the fixed part (1). The second separation distance is reached when a third stop (61) of guides (6) collides with the intermediate part (3). This position is shown in Figure 4. Once the second separation distance has been reached, the first piece (A) can be demolded.

Claims

1. Injection mold for aluminum pieces comprising:

- a fixed part (1) with a first plate (11) comprising a first cavity (12),
- a movable part (2) with a second plate (21) comprising a second cavity (22),
- at least one intermediate part (3) with a third plate (31) comprising a third cavity (32) and a fourth cavity (33),
- coupling means configured such that the movable part (2), the fixed part (1) and the interme-

diate part (3) can occupy a coupling position such that between the first cavity (12) and the third cavity (32) there is defined a first space corresponding with the geometry of at least one first piece to be obtained (A) and between the second cavity (22) and the fourth cavity (33), there is defined a second space corresponding with the geometry of at least one second piece (B) to be obtained,
- injection means configured to inject cast aluminum in the first and second spaces through an injection conduit (4)

characterized in that the first plate (11) comprises a first hole (111) traversing the first cavity (12) and the third plate (31) comprises a third hole (311) traversing the third cavity (32) and the fourth cavity (33), and **in that** the movable part (2) comprises a protuberance (23) which, in the coupling position, can be partially housed in the first and third holes (111, 311) to define a feeding conduit (7) communicating the first and second spaces, the injection means being configured to inject cast aluminum in the feeding conduit (7), and **in that** the feeding conduit is dimensionally configured so that the cast aluminum completely fills the first and second spaces, such that the cast aluminum can solidify in the first and second spaces and inside the feeding conduit (7).

2. Injection mold for aluminum pieces according to claim 2, **characterized in that** in the coupling position the first hole (111), the third hole (311), the injection conduit (4) and the protuberance (23) are aligned.

3. Injection mold for aluminum pieces according to any of the previous claims, **characterized in that** it comprises demolding means comprising movement means configured to separate the movable part (2) with respect to the intermediate part (3) and fixed part (1), such that between the movable part (2) and the intermediate part (3) there is a first separation distance which allows demolding the second piece (B), and between the intermediate part (3) and the fixed part (1) there is a second separation distance which allows demolding the first piece (A).

4. Injection mold for aluminum pieces according to claim 3, **characterized in that** the movement means comprise at least one tie rod (5) configured to pull on the intermediate part (3), the mentioned tie rod (5) comprising at one end at least a first stop (51) linked to the movable part (2), such that the movement of the movable part (2) drags the tie rod (5) until reaching the first separation distance, and **in that** the tie rod (5) comprises at least a second stop (52) which contacts with the intermediate part (3), such that the movable part (2) drags the intermediate part (3) separating it from the fixed part (1).

5. Injection mold for aluminum pieces according to any of the previous claims, **characterized in that** the movement means comprise at least one guide (6) configured to guide the movement of the intermediate part (3), and **in that** the guide comprises at least one third stop (61) configured to limit the second separation distance.

6. Injection mold for aluminum pieces according to any of the previous claims, **characterized in that** comprises fracture means configured to separate the first piece (A) from the second piece (B) and from the solidified aluminum inside the feeding conduit (7).

7. Injection mold according to claim 6, **characterized in that** the first piece (A) is connected to the feeding conduit (7) through a feeding branch (9), which is connected to the mentioned feeding conduit (7) at a sharp angle, the branch (9) having a width n and being configured so that when the movement means separate the movable part (2) from the intermediate part (3) and fixed part (1), the mentioned branch (9) is separated from the feeding conduit (7).

8. Injection mold for aluminum pieces according to any of claims 6 and 7, **characterized in that** the fracture means comprise locking means for locking the intermediate part (3) configured to limit the movement of the mentioned intermediate part (3) at the start of the movement of the movable part (2).

9. Injection mold for aluminum pieces according to claim 8, **characterized in that** the locking means for locking the intermediate part (3) comprise:

- a first step (8) arranged in the tie rod (5),
- a spring (13) configured to push the mentioned first step (8) against the intermediate part (3).
- a second step (14) arranged in the tie rods (5) and configured to contact with a third step (15) of the movable part (2) when the movement of the movable part (2) reaches a distance equivalent to the width n.

10. Injection mold for aluminum pieces according to any of the previous claims, **characterized in that** it comprises connecting means configured to lock the fixed part (1), the movable part (2) and the intermediate part (3) when the cast aluminum is injected, the mentioned connecting means comprising:

- a locking element (16) which moves in a direction perpendicular to the movement of the movable part (2), comprising a boss (17) fitting in a housing (18) of the intermediate part (3),
- a rod (19) integral with the movable part (2)

which can move through an oblique conduit (20) of the locking element (16), such that when the movement means separate the movable part (2) with respect to the intermediate part (3) and fixed part (1), the rod (19) slides through the oblique conduit (20), causing the locking element (16) to come out of position.

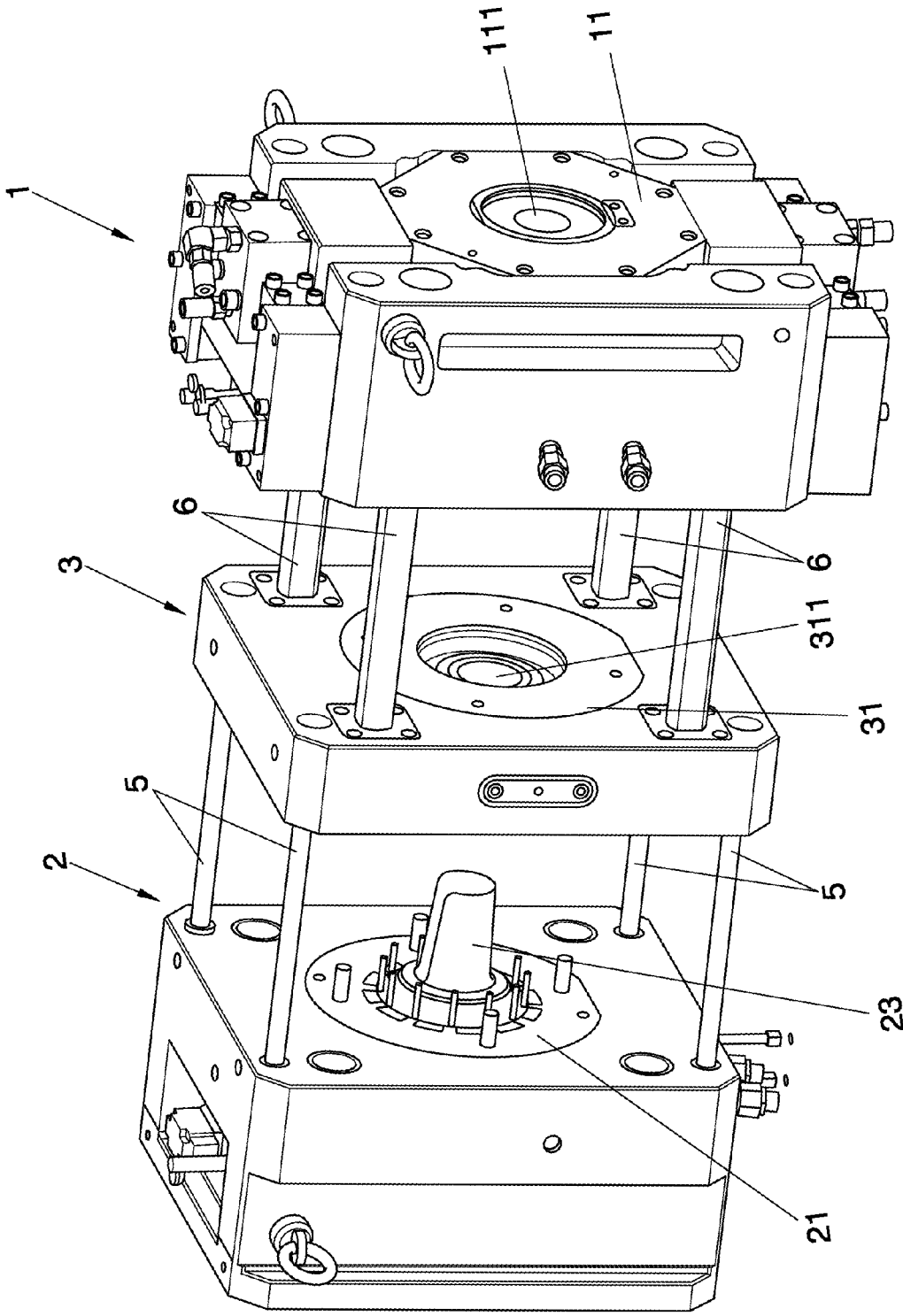

FIG. 1

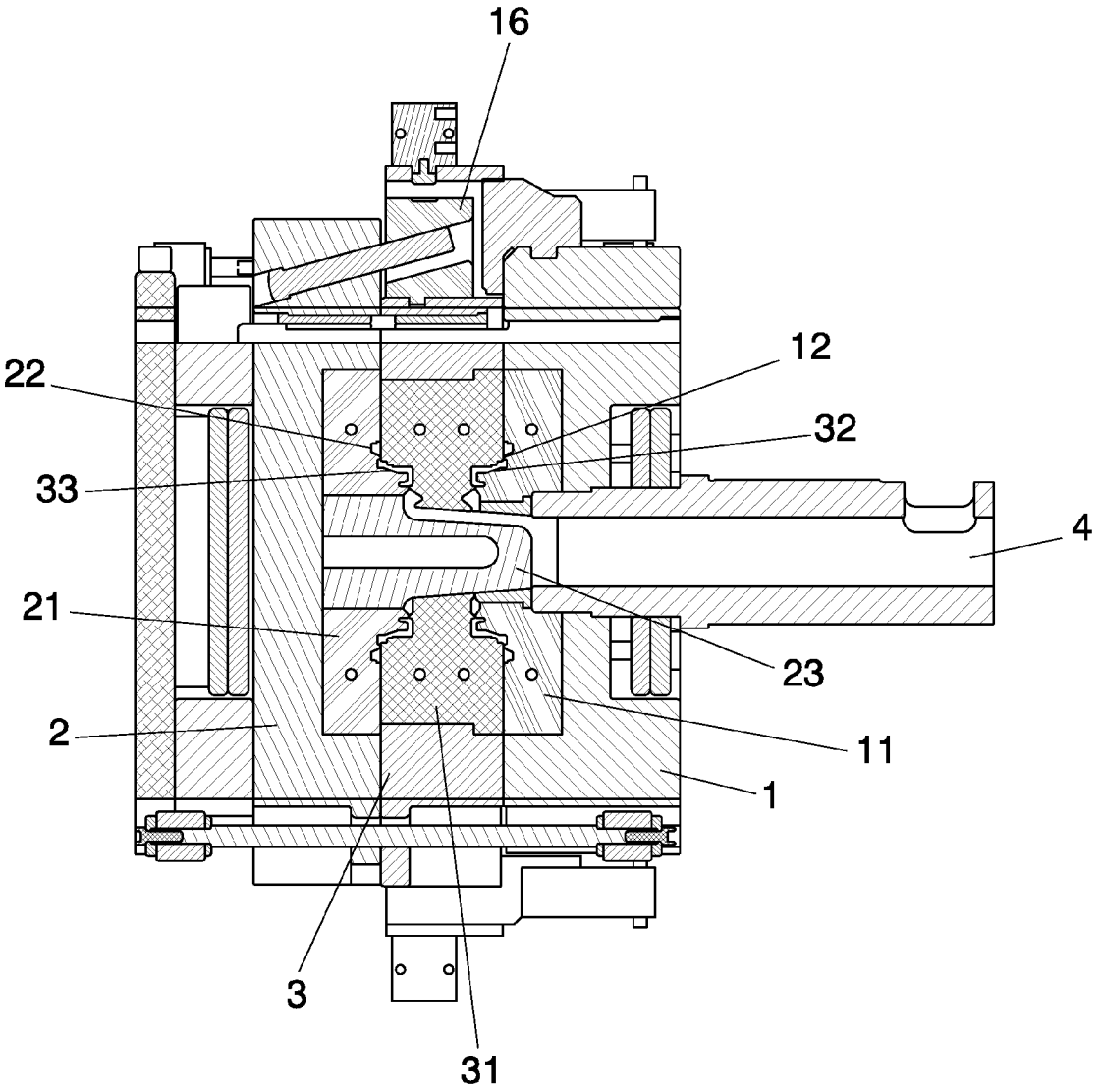

FIG. 2

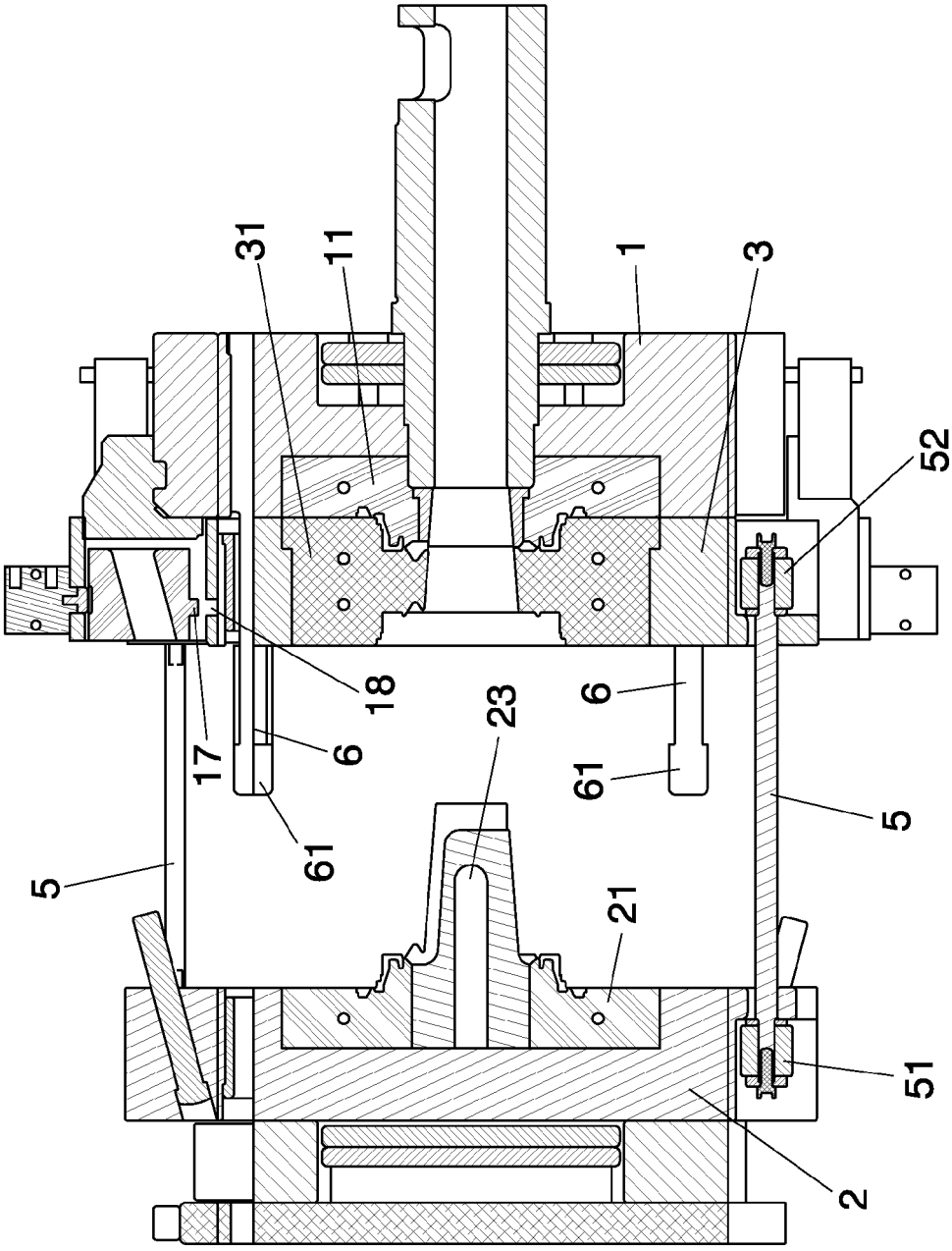

FIG. 3

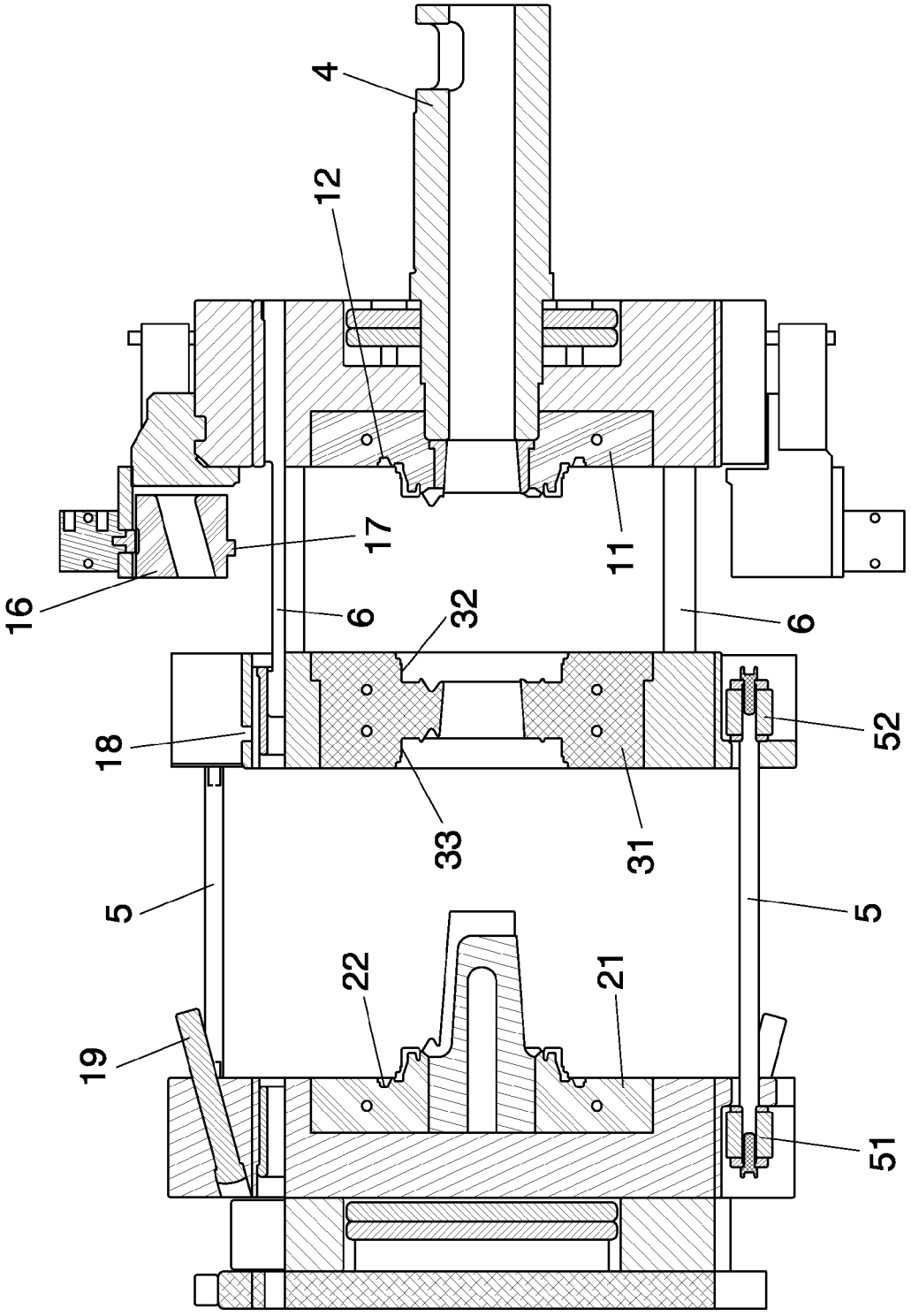

FIG. 4

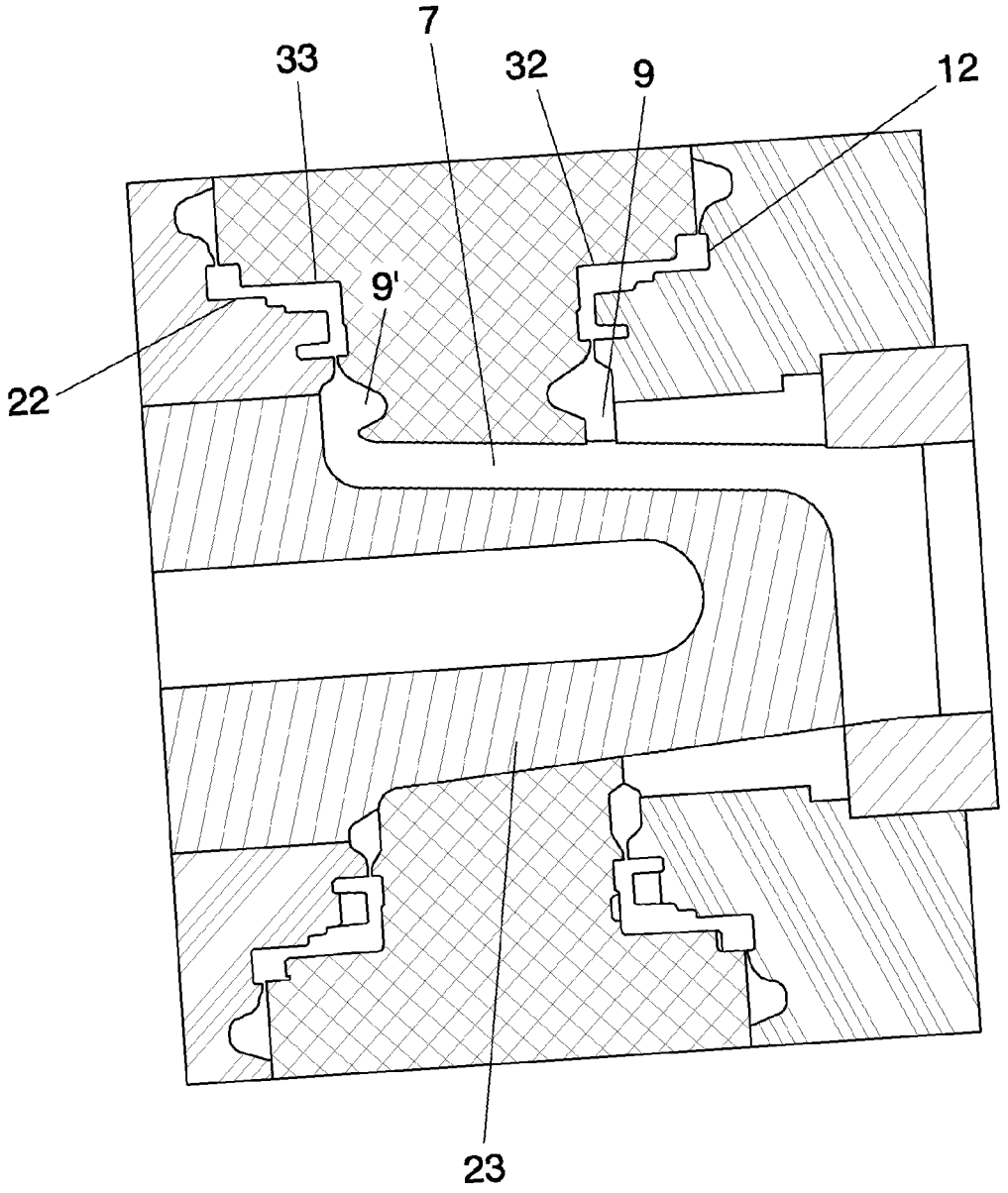

FIG. 5

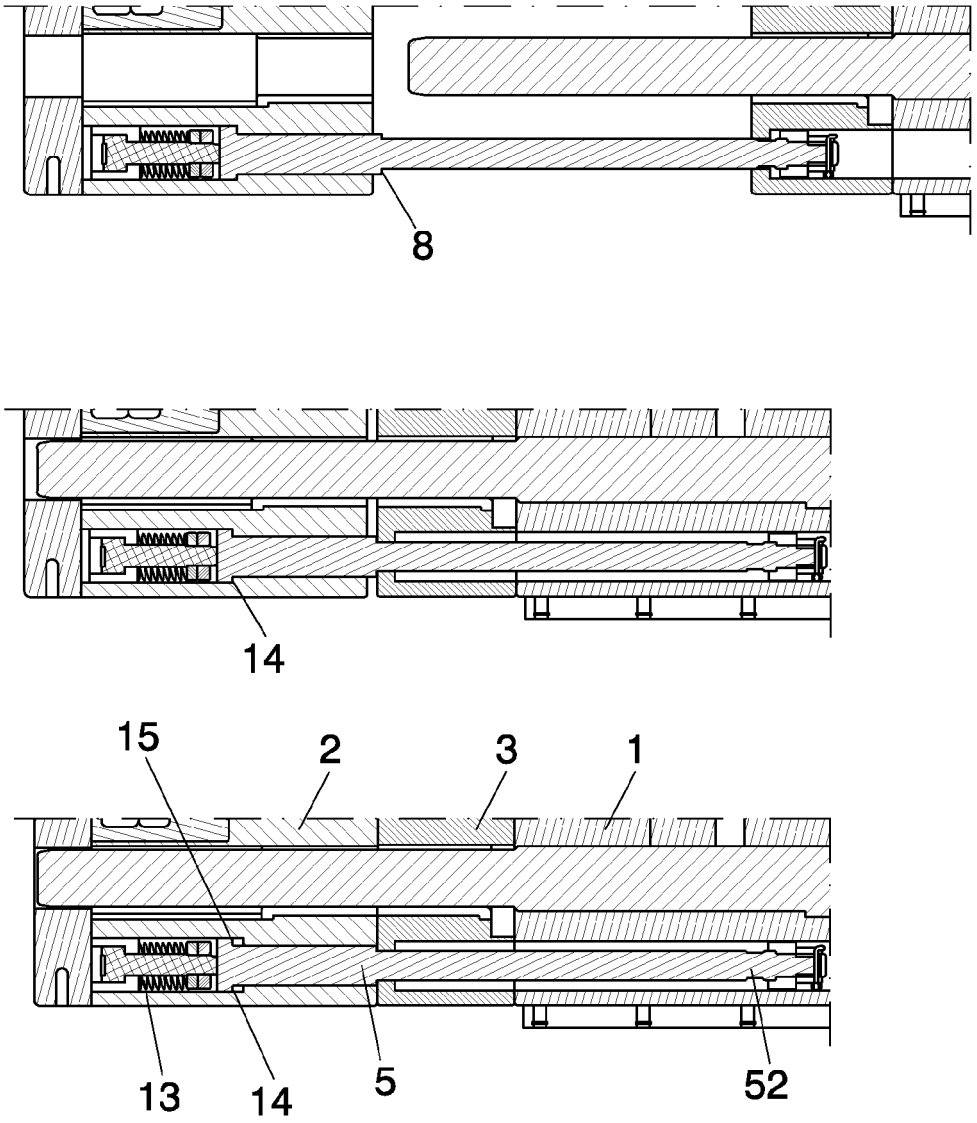

FIG. 6

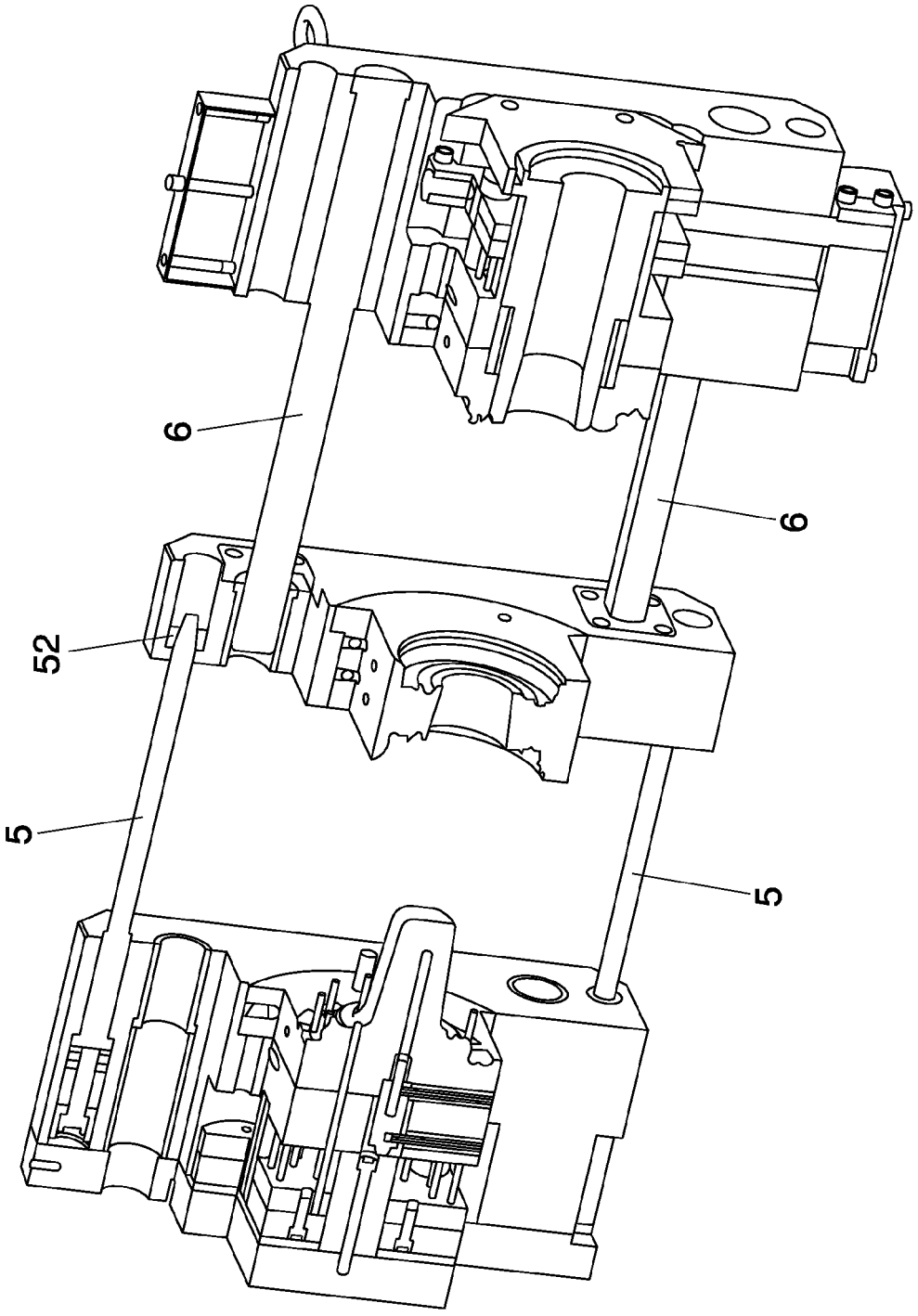

FIG. 7

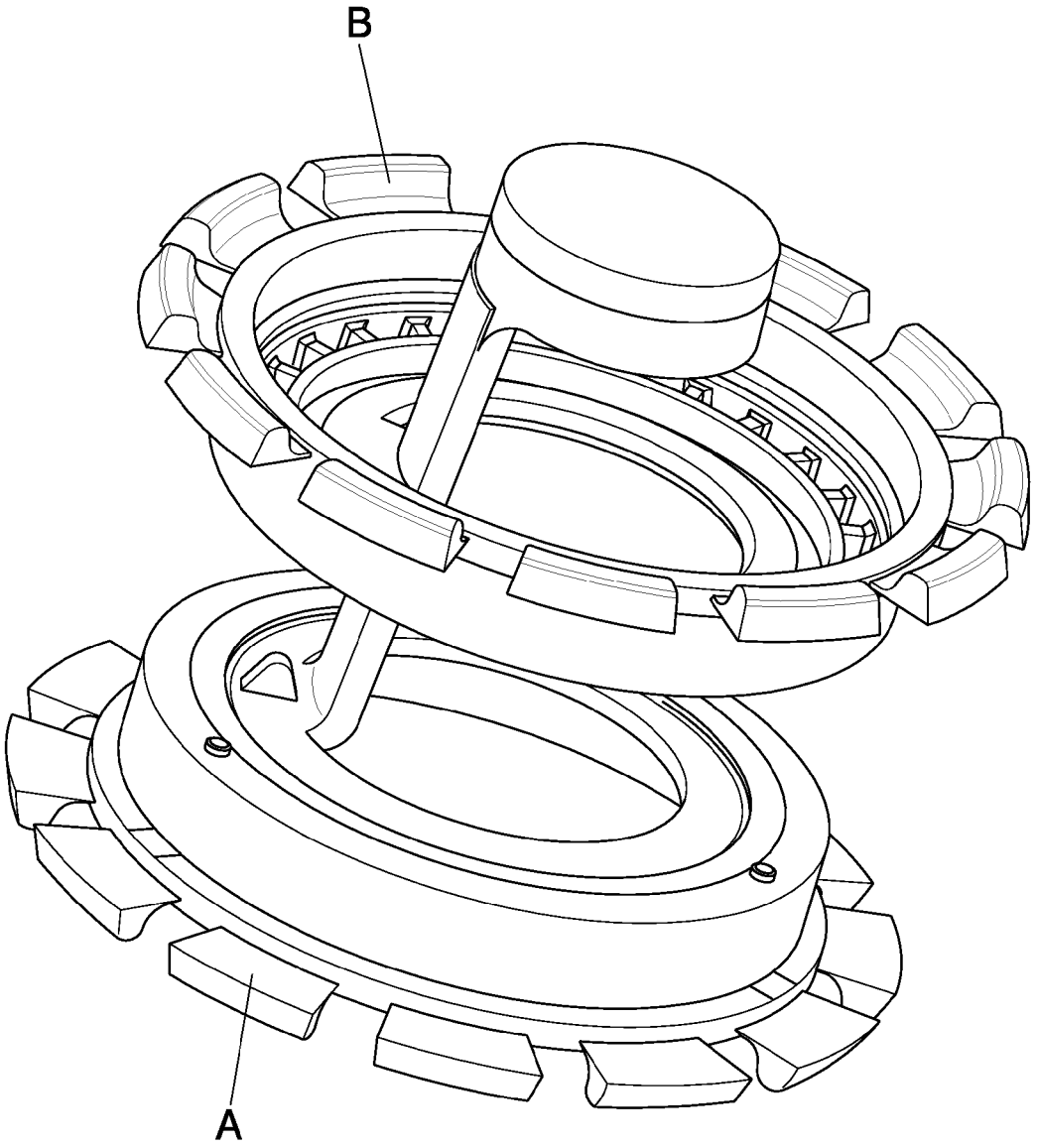

FIG. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 09 38 2053

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 02/38311 A1 (IDRA PRESSE S P A [IT]; MORTARI GRAZIANO [IT]) 16 May 2002 (2002-05-16) * figure * -----	1-10	INV. B22D15/00 B22D17/00 B22D17/10
A,D	US 4 589 840 A (SCHAD ROBERT D [CA]) 20 May 1986 (1986-05-20) * the whole document * -----	1-10	

TECHNICAL FIELDS SEARCHED (IPC)

B22D
B22C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 October 2009	Hodiamont, Susanna

CATEGORY OF CITED DOCUMENTS

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