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(54) **METHOD FOR PRODUCING A METAL PART**

(57) The invention relates to methods of casting metal parts in sand molds, with the particularity that it is not necessary to use sleeves surrounding the feed risers which are arranged outside the part to offset the shrink-

age occurring during the solidification of the molten metals. The operations of placing the sleeves which must be arranged around the risers are eliminated with the method object of the invention, the actual sleeves being made when the sand mold is produced.

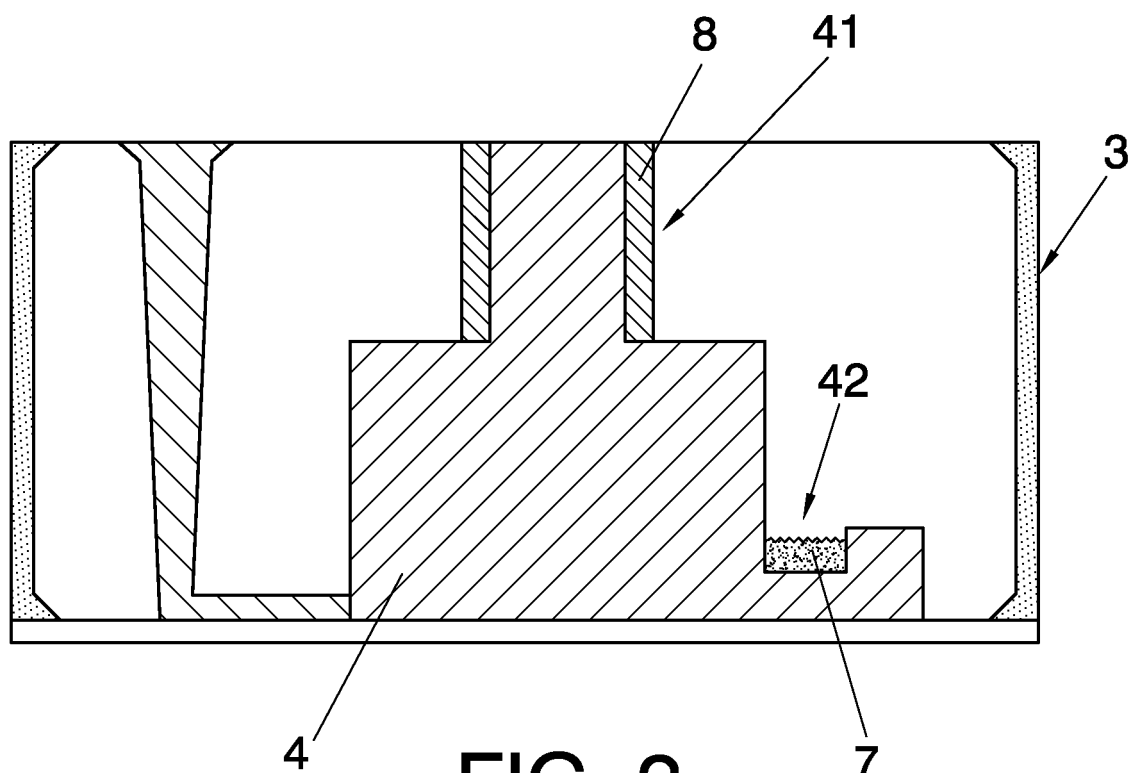


FIG. 2

Description

Technical Field of the Invention

[0001] The invention is comprised among the methods of casting metal parts in sand molds, and it specifically relates to a method which allows supplying insulating and/or exothermic material in areas of the sand mold which will be in contact with the molten metal and in which a greater insulation or heat supply is required.

Background of the Invention

[0002] The production of cast metal parts comprises pouring a molten metal into a mold, the solidification of the metal and demolding of the part formed by means of eliminating or destroying the mold.

[0003] When molten metal is poured into a mold and left to solidify, the metal shrinks during its solidification and its volume is reduced. To offset this shrinkage and to assure the production of quality molded parts, it is usually necessary to use so-called feed risers located outside the part. When the molded part solidifies and shrinks, feeding molten metal from the riser to the part prevents the formation of shrinkage cavities.

[0004] Two casting boxes (of wood, steel, etc.) are generally used to produce a sand mold, in each of which a half mold is produced with a specific portion of the cavity which, when the two half sand molds are joined, will determine the cavity with the shape of the part to be produced.

[0005] A casting box in which the portion of the corresponding model is placed is used to produce each half sand mold, the rest being filled with a mixture of agglomerated sand and its catalyst.

[0006] Joining the half sand molds by the faces presenting the cavity leads to the sand mold with the cavity that is to be filled with molten metal to shape the metal part.

[0007] As discussed above, the volume of molten metals is reduced during solidification. For this reason, when casting metals it is common to use risers arranged outside the part to offset the shrinkage which occurs during solidification. To improve the feed effect and in order for the volume of the feed riser to be kept at a minimum, the feed riser is normally surrounded with an exothermic and/or thermal insulating sleeve for the purpose of keeping the metal of the riser in the molten state for the longest possible time.

[0008] These sleeves are placed before performing the casting operations in a support firmly fixed to the model. After making the mold, the support is removed in order to produce a feed cavity, i.e., the riser surrounded by the sleeve. When the molten metal is introduced through the casting channel or sprue, the metal flows through it, filling on one hand the cavity of the mold which will shape the molded part and, on the other hand, the feed riser. Since the riser is surrounded by the exothermic and/or insulat-

ing sleeve, the metal will be in a liquid state for a longer time period as it solidifies and the metal shrinks in the rest of the part, thus allowing the feed of the molten metal to offset the shrinkage and thus reduce the formation of shrinkage cavities to a minimum.

[0009] Depending on the geometry of the part to be produced, the mold will need more or less risers, and each of them will be surrounded by an exothermic and/or insulating sleeve. Therefore, before pouring the molten metal into the mold, the sleeves will have had to have been placed in their respective risers, considerably increasing the work cycle.

[0010] As previously indicated, the risering areas are defined in the sand mold by the model itself in which, in addition to the geometry of the part to be produced, the risering areas outside the part are shaped. These risering areas must be covered before casting with the corresponding insulating and/or exothermic sleeves.

[0011] When the part presents constrained areas or difficult to feed areas that do not allow feeding the rest of the part before it solidifies, the technique referred to as padding is typically used, which consists of producing in the sand mold a flaring of the constrained area or the area which is difficult for the liquid metal to access, in order to produce an excess of metal which assures complete filling of that area of the cavity. This solution which solves the problem of a suitable casting of the part has the drawback that it is later necessary to eliminate the padding, which involves an expensive deburring operation.

[0012] Until now, the operation of placing the sleeves around the risers has been an essential operation; it would therefore be desirable to be able to do away with this operation by making the sleeves when the sand mold is produced.

[0013] On the other hand, the foundryman generally manufactures the sand molds and the sleeves come from a manufacturer that specializes in sleeves, such that the foundryman does not control the materials and the composition of the sleeves, which involves certain risks because there is a series of materials that are frequently used today in manufacturing sleeves, the use of which under current European laws is restricted because during handling or after casting they can produce emissions or particles that are hazardous to the health.

[0014] However, there materials for manufacturing sleeves with proven use that have shown their efficiency both at the level of complying with the expectations required in terms of insulation and exothermic properties, and in that they can furthermore be supplied to the foundry so that the latter can, "in situ", produce the sleeves and the risering areas required for the manufacture of the part. Sleeves of these features are described in patents EP 1543897 and EP 0265112. It would therefore be desirable to be able to supply insulating and/or exothermic materials when manufacturing the sand mold in those areas in which a greater insulation or heat supply is required.

Description of the Invention

[0015] The object of the invention is a method of producing metal parts by casting a molten metal into a sand mold which allows applying an insulating or exothermic material in areas of the mold which require a greater insulation or heat supply by exothermic reaction, such as rising areas or internal areas of the mold and all this during a process of manufacturing the sand mold. This allows, "in situ", making the sleeves which are to surround the risers and supplying insulating or exothermic material in areas which are difficult to feed that do not allow feeding the rest of the part before it solidifies.

[0016] To that end, the method object of the invention comprises the following steps:

- a) placing, in a casting box, a model for shaping a cavity which will define the shape of the metal part and at least one riser,
- b) pouring a molding sand into the casting box after step a),
- c) pouring an insulating or exothermic mixture into the casting box after step a) to delay the solidification of a molten metal,
- d) extracting the model for shaping the mentioned cavity,
- e) casting a molten metal into the mentioned cavity,
- f) extracting the part produced after the solidification of the molten metal.

[0017] The insulating or exothermic mixture is arranged in contact with the model in some areas in which it is required that the molten metal cast in step e) remains in the liquid state for a longer time period than the rest of the molten metal that is going to shape the part, such that, once the model is removed in step d), the insulating or exothermic mixture delays the solidification of the molten metal cast in step e) in the areas in which the mentioned mixture has been arranged.

[0018] The choice of an insulating or exothermic mixture will depend on the thermal characteristics of the metal which is going to be melted, on the dimensions of the part, on its geometry and on other variants, for example, if the part is a non-ferritic metal part with low melting point, the mixture used could be an insulating mixture.

[0019] If the model placed in the casting box has any area which is difficult to feed or a constrained area which makes it difficult to feed another area of the part with molten metal, the insulating or exothermic mixture will be deposited in contact with the model in that constrained area before pouring the molding sand so that when casting the molten metal, said metal in the mentioned constrained area will remain in the liquid state for a longer time period than the rest of the metal that is going to shape the part and can therefore feed other areas.

[0020] However, if the area in which the insulating or exothermic mixture is going to be deposited corresponds, for example, to a riser, an auxiliary part can be placed

around the mentioned riser such that after pouring the molding sand, the mentioned auxiliary part is removed, a gap being shaped between the molding sand and the model, into which the insulating or exothermic mixture forming the sleeve once it is cured will be poured.

[0021] The auxiliary part used for surrounding the riser can be a bush with a circular section which must be able to be extracted, i.e., separated from the riser easily in order to form the aforementioned gap.

[0022] The insulating or exothermic mixture can be a non-fibrous mixture, such as those described in patents EP 1543897 and EP 0265112, such that the molding sand and the mentioned insulating or exothermic mixtures which will shape the mold can be located in independent tanks. These input materials fall into a hopper and from there into a continuous or batch mixer in which they will be mixed with the corresponding resins and catalysts coming from other tanks. The molding sand along with the resins and catalysts are poured into the casting box. The insulating or exothermic materials which are already mixed with the resins and catalysts are also poured into the casting box in the location corresponding to them.

Description of the Drawings

[0023] To complete the description 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 in integral part of said description, in which the following has been depicted with an illustrative and non-limiting character:

Figure 1 shows a sectional view of the upper casting box in which the corresponding model and the riser, along with the casting channel have been placed.

Figure 2 shows a sectional view of the upper casting box in which an insulating or exothermic mixture has been deposited in an area with difficult access for the molten metal to reach it. Furthermore, it is also observed in this figure that an auxiliary part has been arranged around the riser.

Figure 3 shows a sectional view of the upper casting box in which the molding sand completely filling the box has been poured.

Figure 4 shows a sectional view of the upper casting box once the auxiliary part surrounding the riser and shaping a gap has been removed.

Figure 5 shows a sectional view of the upper casting box with the gap filled with the insulating or exothermic mixture.

Figure 6 shows a sectional view of the upper casting box in the moment in which the extraction of the model and of the casting channel begins.

Figure 7 shows a sectional view of the upper portion of sand mold once the model and the casting channel have been completely removed from the upper casting box.

Figure 8 shows a sectional view of the complete sand mold, i.e., its upper and lower portions, in which the cavity which is going to shape the part has been filled with the molten metal supplied from the casting channel.

Figure 9 shows a schematic view of an installation comprising the material tanks, dispenser, mixer and other components of the installation.

Preferred Embodiment of the Invention

[0024] Figure 1 shows a casting box (3), namely the upper box, inside which a model (4) has been arranged for shaping a cavity (5), which will define the shape of the metal part (1), and at least one riser (11). Furthermore, the corresponding model for shaping the casting channel or sprue (10) also has been placed in this upper casting box (3).

[0025] Though it is not depicted in the drawings, for shaping the sand mold (2) it is also necessary to have a lower casting box (3) in which the corresponding model for defining another cavity will be placed which, when joined with the cavity defined by the model placed in the upper casting box (3), will shape the cavity corresponding with the part to be produced and which will be filled with molten metal. As previously indicated, first a model is placed in a lower box and molding sand is poured in order to subsequently overturn the lower box and place thereupon the upper box with another model and the feed channels already arranged.

[0026] Figure 1 shows areas (41, 42) which, due to their configuration, are areas in which it is required that the metal which will be cast in the cavity (5) remains in the liquid state for a longer time period than the rest of the metal which is going to shape the part (1).

[0027] In this case, the area (41) corresponds to a riser (11) which will be formed once the molten metal is cast, and the area (42) is an area with difficult access for the molten metal to reach it. The risers are used to offset the shrinkage occurring during the solidification of the metals, such that feeding molten metal from the riser (11) into the cavity (5) allows the complete filling thereof and thus the production of quality parts. To improve feeding from the riser (11) and in order for the molten metal to reach areas with difficult access, such as the area (42) for example, the method object of the invention allows supplying an insulating or exothermic mixture (7) in contact with the model (4) in the areas (41, 42) so that the molten metal cast into the cavity (5) remains in the liquid state in the areas (41, 42) for a longer time period than the rest of the metal which will shape the part (1).

[0028] Figure 2 shows that in the area (42), which is an area that is difficult to feed that does not allow feeding the rest of the part, there has been deposited the insulating or exothermic mixture (7), which allows delaying the solidification of the metal cast in that the area (42). This mixture (7) will be arranged in the area (42) before pouring the molding sand (6) into the casting box (3). It

can also be seen in this Figure 2 that in the area (41), which will form the riser (11), an auxiliary part (8) has been placed around the same, in this case the auxiliary part (8) being a bush with a circular section due to the shape of the riser.

[0029] Once the bush is placed around the area (41) and the insulating or exothermic mixture (7) has been poured, the molding sand (6) is poured as can be seen in Figure 3.

[0030] As is shown in Figure 4, after pouring the molding sand (6) into the casting box (3), the bush is extracted such that a gap (9) is created between the molding sand (6) and the area (41). As is shown in Figure 5, the gap (9) is filled with the insulating or exothermic mixture (7) in order to allow that the solidification of the molten metal in the area (41) once it is cast in the cavity (5) is delayed.

[0031] In Figure 6, the model (4), along with the model shaping the casting channel or sprue (10), are being removed in order to define the cavity (5) which will be filled with molten metal cast through the casting channel (10), as shown in Figure 8. The complete extraction of the model (4) and of the model shaping the sprue (10) is shown in Figure 7. When the models, the casting box (3) are removed and the molding sand is cured, the upper portion of the sand mold (2), the cavity (5) of which will be filled with molten metal, is produced.

[0032] The steps described above will be applied to a lower casting box (2), with the exception that it is not necessary to arrange the casting channels in the lower casting box (3), it is simply necessary to place the corresponding model for shaping a cavity which, along with the cavity produced in the upper casting box (3), will shape a cavity that will be filled with molten metal for shaping the metal part.

[0033] Figure 8 shows the complete sand mold (2), with the upper and lower portions, in which there has been defined a cavity corresponding with the final shape of the metal part (1) to be produced. The cavity of the sand mold (2) has been filled with molten metal through the sprue (10). In the areas (41, 42) in which the insulating or exothermic mixture (7) has been deposited, the molten metal will remain in the liquid state for a longer time period than the rest of the metal in order to completely fill the entire cavity and in order for the metal to reach areas which are difficult to feed, such as the area (42), for example.

[0034] Though it has not been depicted in the drawings, once the molten metal has solidified, the sand mold (2) is destroyed to extract the metal part (1). Once extracted, it will be necessary to remove the riser (11) and the sprue (10) by any of the methods known in the industry.

[0035] Areas (41, 42) in which it is required that the molten metal remains in the liquid state for more time have been produced in the moment of shaping the sand mold (2) with the method object of the invention.

[0036] Figure 9 schematically shows an industrial installation for producing metal parts according to the in-

vention. The installation depicted has three tanks (12) or hoppers with the materials involved in the process. Thus, for example, the sand for shaping the sand mold (2) is in one of these tanks (12), the insulating mixture is in another tank (12) and the exothermic mixture is in another one.

[0037] The suitable amount is dispensed from each tank (12) into a distribution hopper (14) which pours it into a mixer (13). The resins and the catalysts coming from the tanks (15) enter the continuous or batch mixer (13). Once the mixtures, whether the mixed molding sand (6) or the mixed insulating or exothermic mixture (7), are produced, they are deposited by gravity in the casting boxes (3) in the location corresponding to them.

Claims

1. Method of producing a metal part (1) by casting a molten metal into a sand mold (2), **characterized in that** it comprises:

- a) placing a model (4) in a casting box (3) for shaping a cavity (5) which will define the shape of the metal part (1) and at least one riser (11),
- b) pouring a molding sand (6) into the casting box (3) after step a) for shaping the sand mold (2),
- c) pouring an insulating or exothermic mixture (7) into the casting box (3) after step a) to delay the solidification of a molten metal,
- d) extracting the model (4) for shaping the mentioned cavity (5),
- e) casting a molten metal into the mentioned cavity (5),
- f) extracting the part (1) produced after the solidification of the molten metal,

with the particularity that the insulating or exothermic mixture (7) is arranged in contact with the model (4) in some areas (41, 42) in which it is required that the molten metal cast in step e) remains in the liquid state for a longer time period than the rest of the molten metal that is going to shape the part (1), such that once the model (4) is removed in step d), the insulating or exothermic mixture (7) delays the solidification of the molten metal cast in step e) in the areas (41, 42) in which the mentioned mixture (7) has been arranged.

2. Method of producing a metal part (1) according to claim 1, **characterized in that** after step a) an auxiliary part (8) is placed around the area (41), such that after step b) the mentioned auxiliary part (8) is removed, a gap (9) being shaped between the molding sand (6) and the model (4), into which the insulating or exothermic mixture (7) of step c) is poured.

3. Method of producing a metal part (1) according to claim 2, **characterized in that** the auxiliary part (8) is a bush with a circular section.

4. Method of producing a metal part (1) according to any of the previous claims, **characterized in that** the insulating or exothermic mixture (7) is a non-fibrous mixture.

5. Method of producing a metal part (1) according to any of the previous claims, **characterized in that** the insulating or exothermic mixture (7) is in contact with the molten metal in an area (41) forming the riser (11) to supply heat or insulation.

6. Method of producing a metal part (1) according to any of the previous claims, **characterized in that** the insulating or exothermic mixture (7) is arranged in contact with a portion of the molten metal in an area with difficult access (42) of the part (1) which requires a heat supply or insulation.

7. Method of producing a metal part according to any of the previous claims, **characterized in that** the molding sand (6) and the insulating or exothermic mixture (7) shaping the sand mold (2) are located in independent tanks (12) feeding a mixer (13) in which they are mixed with agglomerating resins so that they access the casting box (3) by gravity.

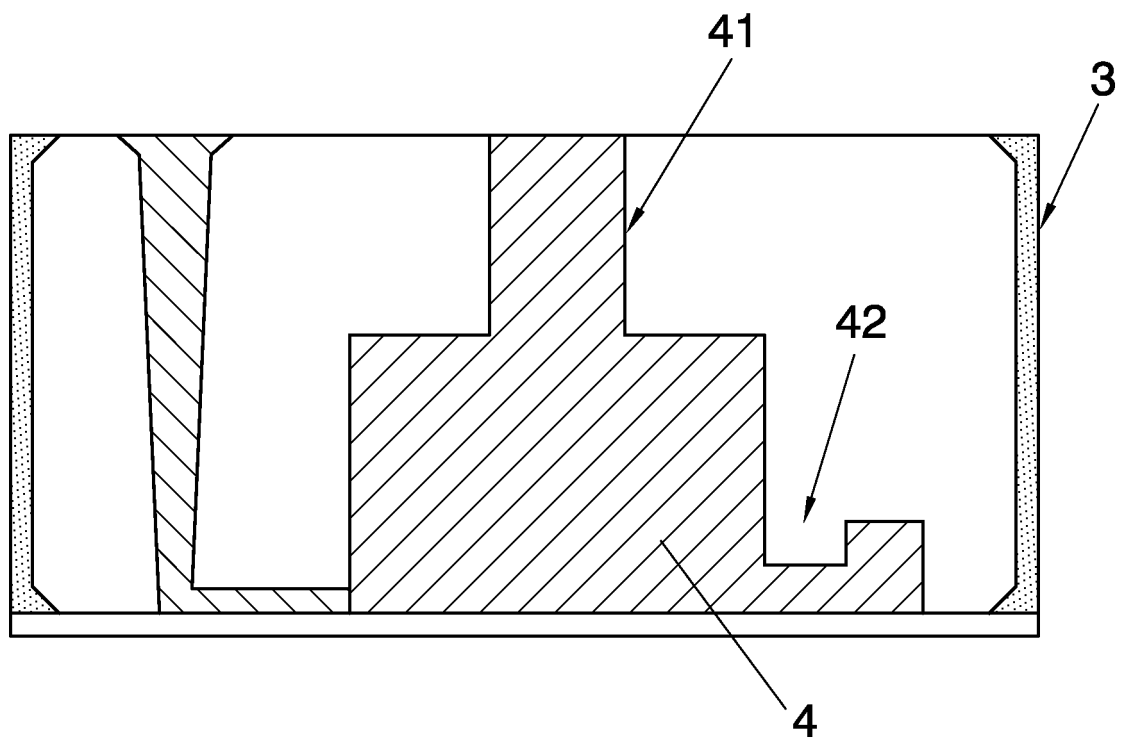


FIG. 1

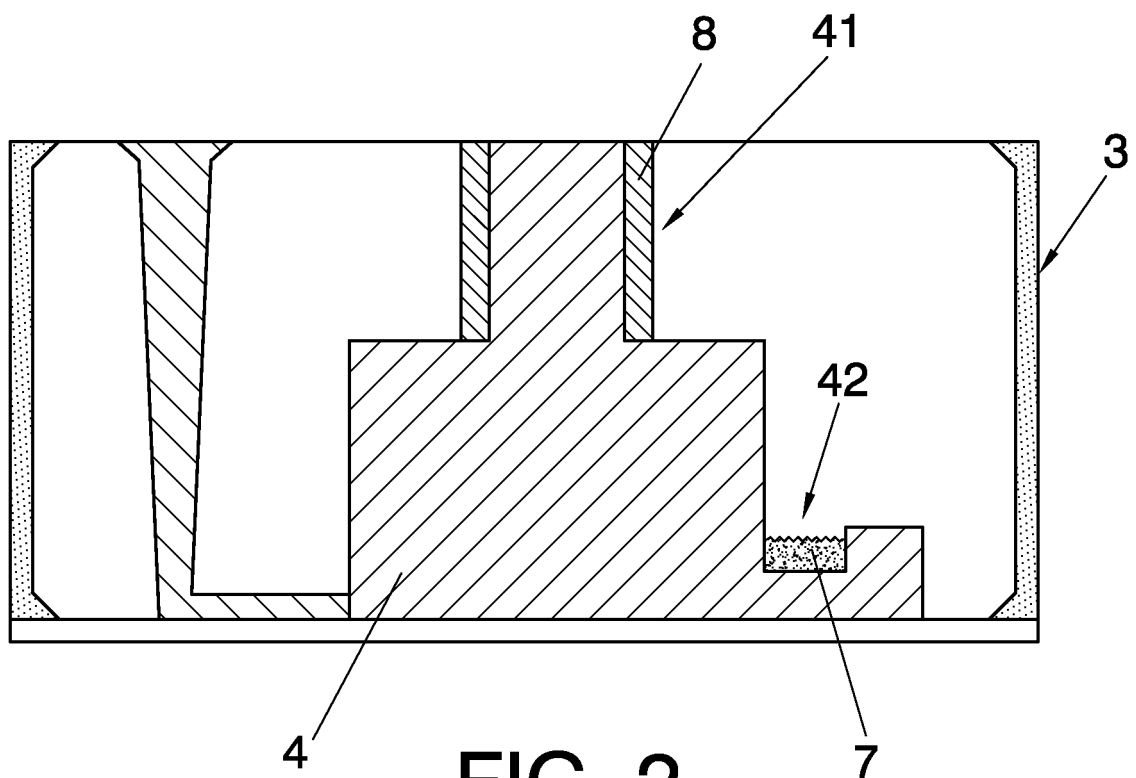
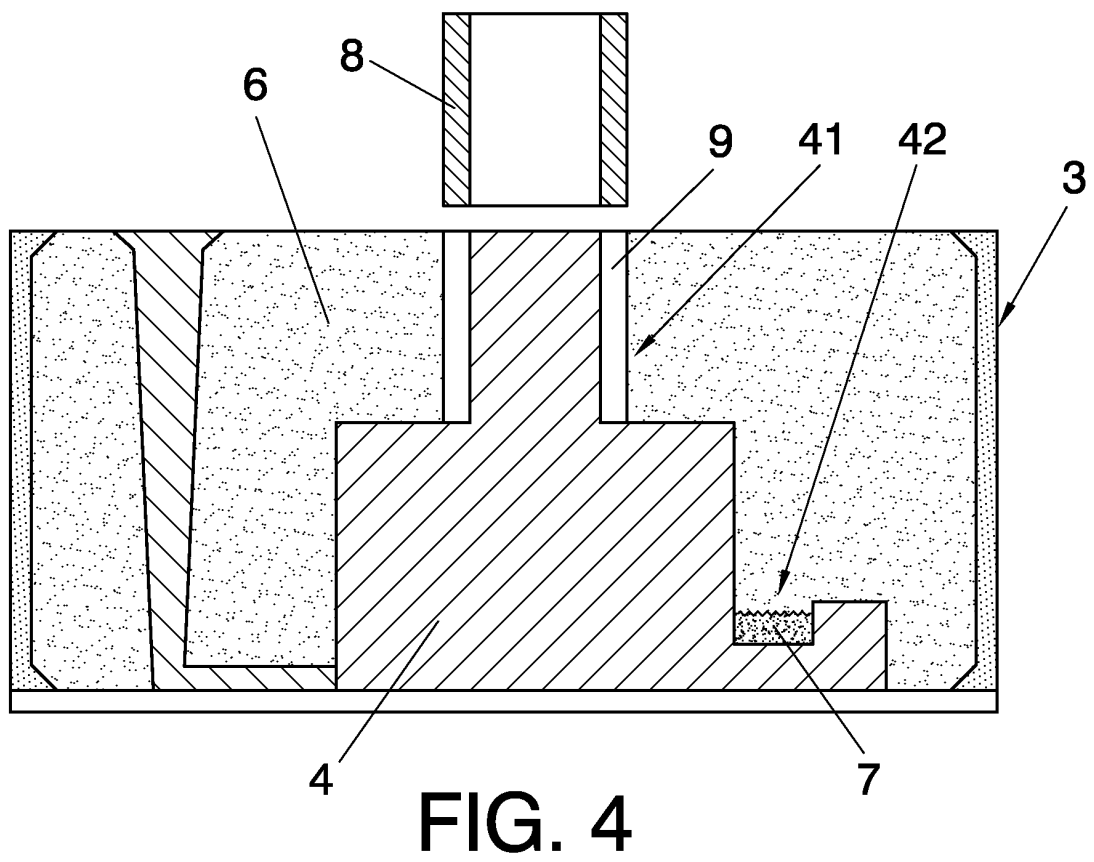
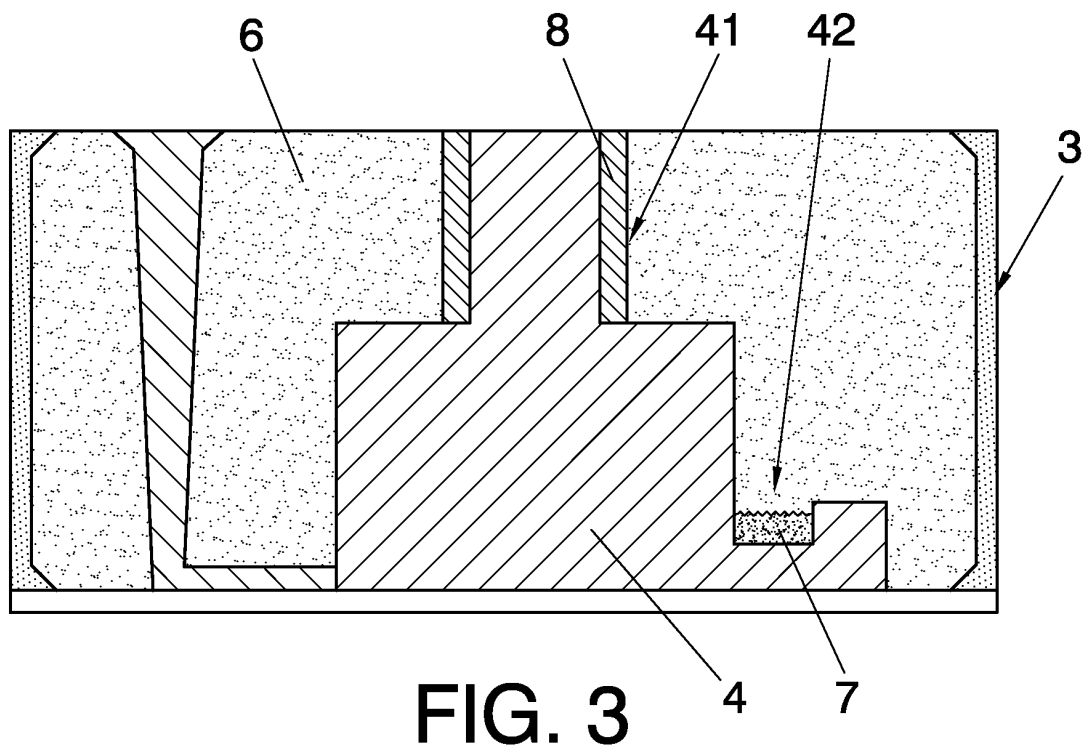


FIG. 2



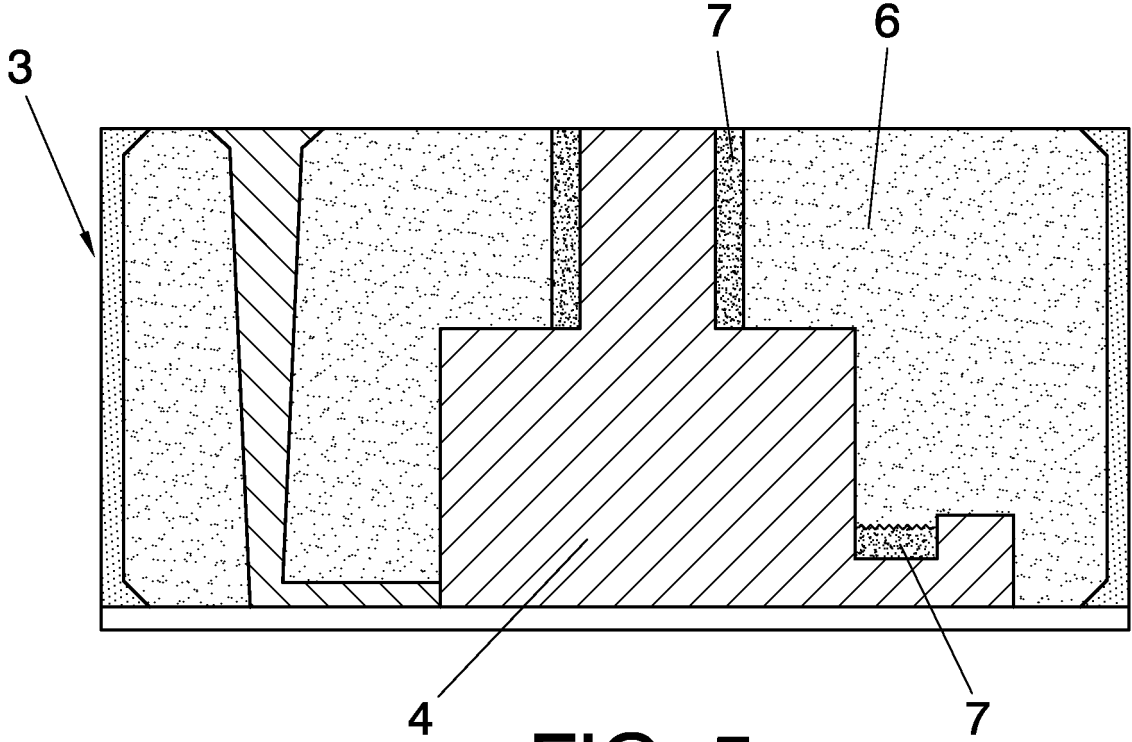


FIG. 5

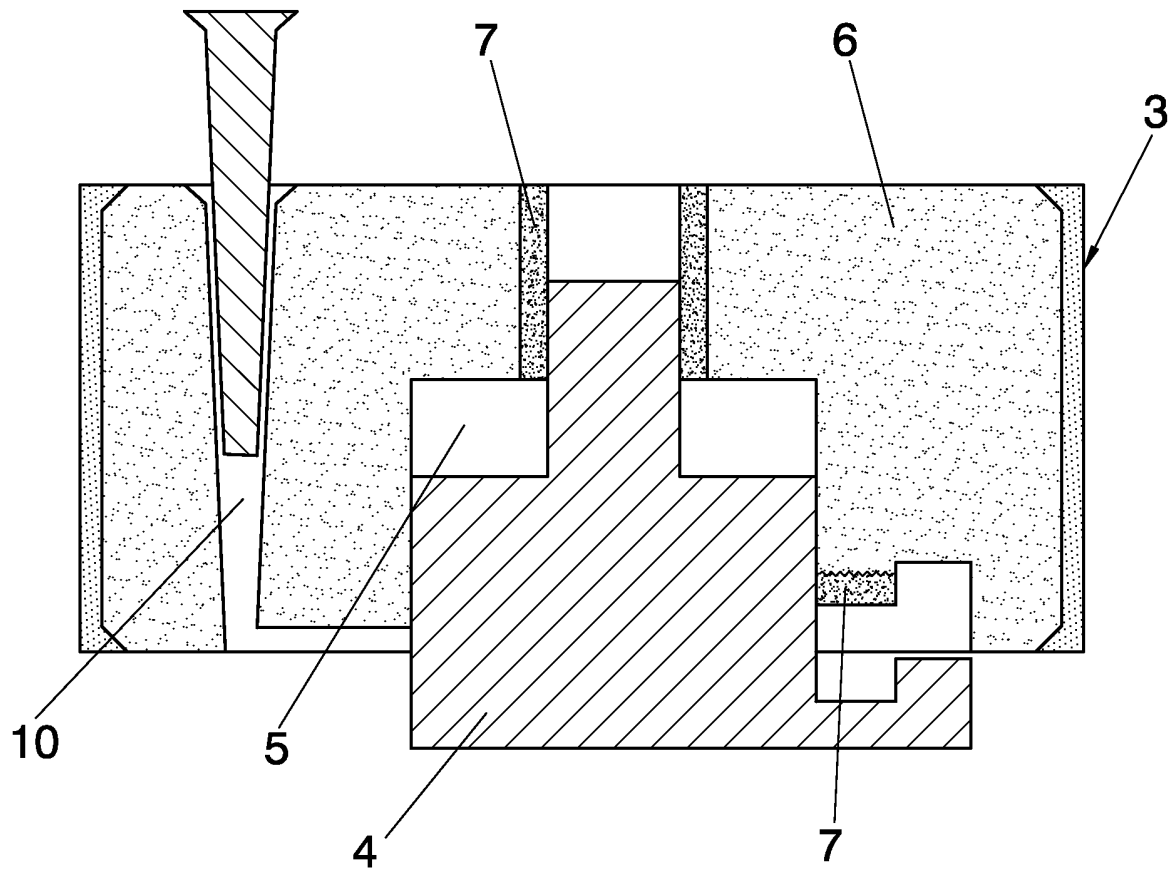


FIG. 6

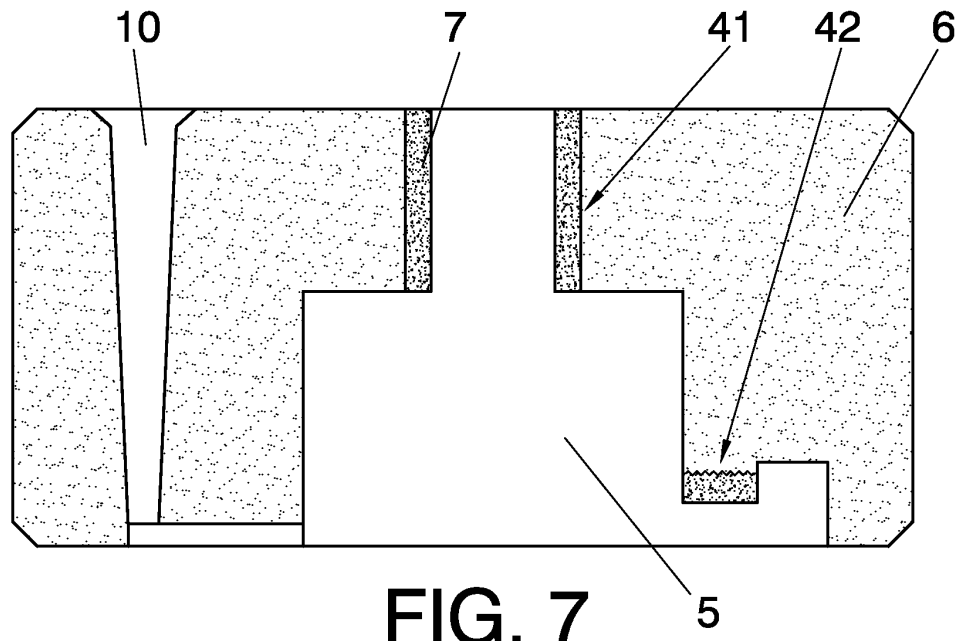


FIG. 7

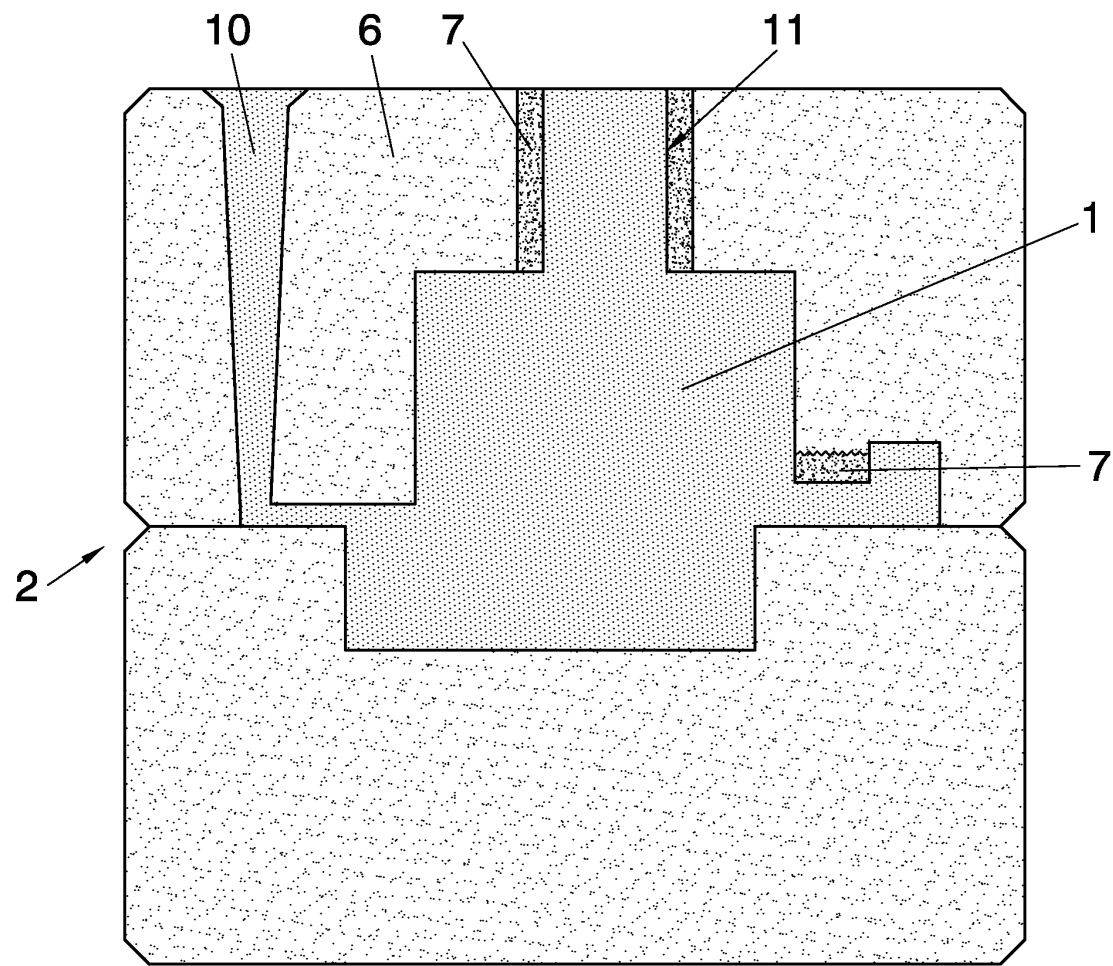


FIG. 8

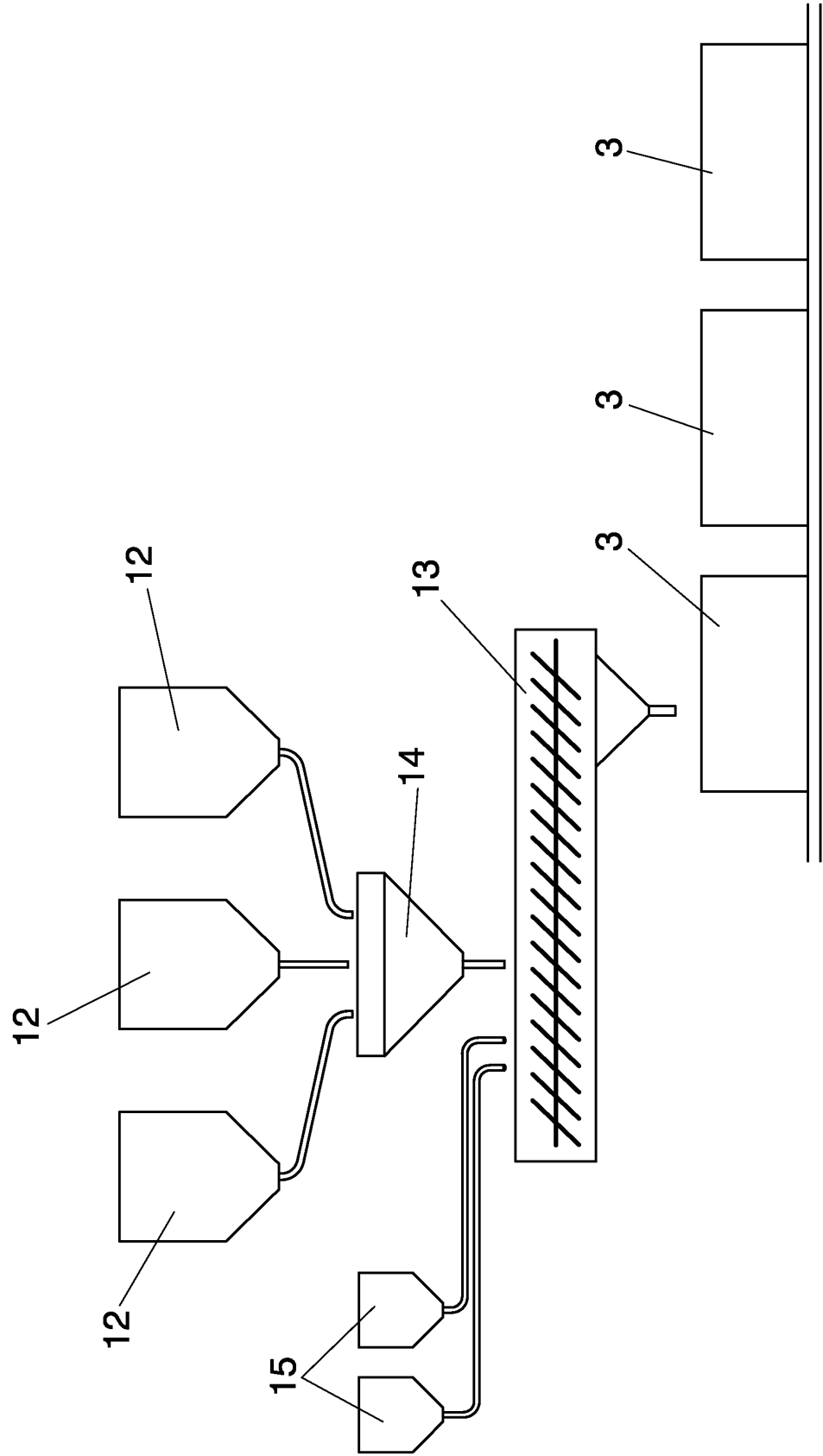


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No

PCT/ES2010/070377

A. CLASSIFICATION OF SUBJECT MATTER INV. B22D7/10 B22C9/08 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B22D B22C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search		Date of mailing of the international search report
4 February 2011		18/02/2011
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