(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 583 802 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
18.03.2015 Bulletin 2015/12

(51) Int Cl.:
B28B 3/02 *(2006.01)* ***B30B 15/06*** *(2006.01)*
C25D 11/04 *(2006.01)*

(21) Application number: **12188877.0**

(22) Date of filing: **17.10.2012**

(54) **An improved buffer for mold for ceramic industry and mold comprising said buffer.**

Verbesserte Formplatte für die keramische Industrie und Form mit solcher Platte

Paroi dans un matrice de l'indutrie de la céramique et matrice avec un telle paroi

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **19.10.2011 IT AN20110141**

(43) Date of publication of application:
24.04.2013 Bulletin 2013/17

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EP-A2- 0 421 505 **US-A1- 2008 164 402**

- **DATABASE WPI Week 199112 Thomson Scientific, London, GB; AN 1991-085729 XP002677701, -& SU 1 560 416 A (UKR PORCELAIN EARTH) 30 April 1990 (1990-04-30)**

EP 2 583 802 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present patent application for industrial invention relates to an improved buffer for a mold for the ceramic industry in accordance with the preamble of claim 1 and to a mold comprising said buffer.

[0002] The term "mold for ceramic industry" herein indicates a mold used to manufacture ceramic tiles or the like. For the sake of convenience only the term "tile" will be used in the following description to identify the finished product generated by said mold.

[0003] Said molds are used to inject raw material (normally clay, sand and composite materials), compress it and produce a ceramic tile with the desired shape and/or decorative pattern.

[0004] More specifically, referring to Fig. 1, molds (1) comprise a base plate (6), an ejector block (5), a die (9) and buffers (2 and 3). Buffers comprise an upper buffer (2) and a lower buffer (3) that are moved closed to each other and pressed during fabrication of the tile (M), in such manner to define the walls of a chamber (8) where raw material is injected (in the generic direction indicated by arrow IN) for fabrication of the ceramic tile (M). The die (9) is provided with plates (7) that contribute to form the chamber (8) of the mold.

[0005] In the known types of molds upper buffers (2) are usually mounted on a fixed frame of the machinery using the mold (1), whereas lower buffers (3) are mounted on a magnetic base (4) connected with the ejector block (5).

[0006] In practical terms, also the buffers (3) mounted on the magnetic base (4) are defined as "upper", thus creating some confusion in terms of part denomination. From now onwards (description and claims), the term "buffer" will be therefore used to indicate only the lower buffer, viz. the one mounted on the magnetic base (4) and adapted to form the finished surface of the tile (M).

[0007] All molds are currently made of C40 steel, i.e. traditional steel with 0.4% carbon. As explained below, the use of this material is necessary because of the stress involved in the fabrication process of ceramic tiles (M).

[0008] The preparation of a C40 steel buffer normally requires the following steps: preliminary machining of raw semi-finished part made of C40 steel on a machine tool, welding of buffer parts subject to wear, grinding and finishing. Then buffers are covered with glue and/or resin for casting and mounted on the mold, where the casting process is started.

[0009] For the purpose of understanding the present invention, it must be noted that the casting process comprises the following steps: injection of material (sand, clay and the like) to form the tile, realization of chamber (8) formed of the two buffers (2 and 3) that are moved close, leakage of gaseous and solid residues between buffer and plates (7) mounted on die (9) and finally removal of tile (M).

[0010] A mold of this type and in accordance with the preamble of claim 1 is disclosed in the European patent application EP 0 421 505.

[0011] In spite of being functional, known molds are impaired by some drawbacks.

[0012] A first drawback is related with the weight of buffers that, being made of C40 steel, are rather heavy and hinder handling and assembly on mold.

[0013] Another problem is related with the time needed to prepare C40 buffers. As mentioned above, said process is rather long and requires a plurality of machining operations that, in spite of being simple, must be carried out accurately in order to avoid errors in finished products.

[0014] These inconveniences are worsened by the fact that buffers are used in large quantity, having a limited life of cycles (average 15 days) due to wear and to the frequent changes in tile patterns, shapes and materials.

[0015] As regards wear and the need for welding in the known buffer (3) made of C40 steel, reference must be made to Fig. 2, which is an enlarged detailed view of Fig. 1, i.e. part of a buffer (3) of known type and a plate (7).

[0016] The buffer (3) has an external profile (3D) extending in parallel direction to the surface of the plate (7) opposite to it, and an internal concave area (3A) that represents the bottom of the chamber (8). The concave area (3A) is defined by a perimeter border (3B) having an upper edge (3C) parallel to the bottom surface of the concave area and perpendicular to the external profile (3D).

[0017] During operation the gas flow from the production of the ceramic tile (M) comes out according to the direction of arrow FG of Fig. 2, reaching buffer (3) and plate (7) in an area where they are especially close. This determines a high gas flow rate. It must be considered that gases are loaded with clay pulverulent residues that are able to cause early wear of the buffer (3) by friction. The plate (7) is more resistant because it is formed of tempered ferrous materials that are harder than the buffer (3).

[0018] In a short time the wear of the buffer (3) in said area of the external lateral profile (3D) reduces accuracy of shape in ceramic tiles (M) and increases the space for passage of gas flow (FG), with additional wear and movement of buffers because of vibrations. For this reason, in buffers (3) of known type made of C40 steel, the perimeter border (3B) and in particular the external profile (3D) is covered by a carried-over layer of welding material, which is more wear resistant.

[0019] US2008/164402 discloses a mold for casting green ceramic bodies (transparent or optical ceramic) for optical lenses. Said document suggests using an anodized hardened aluminum mold only for gel casting. Instead, it suggests using steel molds for high-pressure die casting and hot pressing.

[0020] Gel casting is a wet casting process where gel is a liquid containing a small percentage of polymerizable binding agents added to the ceramic slip. The ceramic body has low retraction and is obtained by means of low pressure (0.1 - 50 MPa) at ambient temperature or slightly

higher temperature. For this reason, also an aluminum mold (which is notoriously more fragile than a steel mold) can be suitable. Traditional anodization is a superficial anodization that is made only for 25-30 microns and provides resistance only on the external surface of the mold.

[0021] On the contrary, ceramic casting for tiles is made at high pressure. Casting is made with powders (therefore solid materials) combined with gases at medium and high temperature (from 70-80 degrees). For this type of casting, an aluminum mold is not suitable because of fragility. Although the aluminum mold is traditionally anodized, with anodization surface of 25-30 microns, such a mold would not be suitable; as a matter of fact, document US2008/164402 recommends a steel mold.

[0022] SU 1 560 416 discloses a mold for ceramic production with working surface made of porous aluminum oxide and non-working surface made of non-porous aluminum oxide. Porous aluminum oxide is treated with anodization process. Porous molds are suitable for slip casting and not for ceramic tile casting.

[0023] A first object of the present invention is a buffer for a mold for the ceramic industry as defined in claim 1 and which is able to solve the aforementioned drawbacks.

[0024] Another object of the present invention is a mold comprising said buffer.

[0025] In brief, the purpose of the present invention is to provide a buffer that is less heavy than a known buffer, equally resistant to the stress of ceramic tile fabrication process and faster to make.

[0026] The idea of the present invention is to realize the buffer with aluminum with hard anodization treatment, at least partially on the surface exposed to wear. Said anodization is made in such manner that the anodized surface has thickness of approximately 70-80 microns.

[0027] In fact, the use of an aluminum buffer considerably reduces process time and eliminates some steps of the buffer process, such as welding and grinding.

[0028] It must be noted that, practically speaking, a real technical prejudice existed in the use of said material as alternative solution to C40 steel. In fact, the stress suffered by a buffer during its operating life discouraged the use of aluminum.

[0029] In particular, the main reason for which aluminum was not considered as acceptable material for the construction of a similar buffer is related with the wear described with reference to Fig. 2. In fact, aluminum is more exposed to wear than C40 steel, and consequently a buffer simply made of aluminum did not have a satisfactory performance because of very short operating life.

[0030] Instead, the use of the hard anodization treatment on an aluminum buffer allows it to withstand the working conditions of a mold for ceramic materials.

[0031] Another advantageous characteristic refers to the special configuration of the external profile of the buffer edge that, together with realization with hard anodized aluminum on the external profile of the edge, permits to increase the performance (i.e. production life) of the aluminum buffer according to the present invention.

[0032] Additional advantageous characteristics are the object of the attached dependent claims.

[0033] For explanatory reasons, the description of buffer and mold according to the present invention continues with reference to the attached drawings, which only have illustrative, not limiting value, wherein:

- Figures 1 and 2 are a view and a detailed view of a mold of known type, respectively;
- Figure 3 is a cross-sectional view of a buffer according to the present invention; and
- Figure 4 is an enlarged detailed view of Fig. 3.

[0034] In Fig. 4 a buffer (30) (adapted to replace buffer 3 of Figs. 1 and 2) is disclosed.

[0035] The buffer (30) comprises a body (34) with concave portion (31) adapted to be the bottom of the injection chamber (8) where raw materials are injected to obtain a ceramic tile (M).

[0036] The concave portion (31) comprises a bottom wall (32) adapted to preferably form the external surface of a ceramic tile (M) (the surface that remains visible when the ceramic tile is laid). The bottom wall (32) is generally flat for at least part of its surface (except for special cases or relief decoration patterns).

[0037] The concave portion (31) is perimetrally defined by an edge (33) completely surrounding the bottom wall (32) and protruding from the body (34).

[0038] The edge (33) comprises an external profile area (35), facing the side of the edge (33) opposite to the side facing the concave portion (31). The external profile area (35) is adapted to be faced towards the plate (7) of the die.

[0039] According to the precepts of the present invention, the buffer (30) is made of aluminum, preferably a Series 5000 or 6000 aluminum alloy.

[0040] Advantageously, at least said external profile area (35) is superficially treated with hard anodization process in such manner to obtain a hard superficial layer (F) with thickness from 70 to 80 microns. Said hard superficial layer (F) is diagrammatically shown in Fig. 3 with a dotted area.

[0041] The term "hard anodization" indicates hard anodic oxidation that gives aluminum high resistance to wear and abrasion and superficial hardness of approximately 500 - 600 Vikers. Being of known type, the detailed description of said treatment is omitted. However, it must be noted that it comprises a transformation of part of the material surface into aluminum oxide, with minimum affected thickness of at least 25 - 30 micron.

[0042] Preferably the entire surface of the buffer (30) undergoes hard anodization in order to improve its characteristics, as shown in Fig. 3.

[0043] It must be noted that the combination of a 5000 or 6000 aluminum alloy and hard anodization with thickness of 70-80 microns gives the buffer a suitable me-

chanical resistance for the specific application with ceramic tiles.

[0044] Another advantageous characteristic of the buffer (30) according to the present invention relates to the special geometry of the edge (33).

[0045] The edge (33) comprises a wear portion (37) that differs from the rest of the buffer in that in said wear portion (37) the edge has a gradually increasing thickness from up down, meaning a material over-thickness.

[0046] More specifically, the edge (33) widens on the side opposite the side facing said concave portion (31), starting from minimum thickness (Smin) (measured at the upper end of the edge) to maximum thickness (SMAX) substantially in correspondence of said body (34) of the buffer. The difference (SMAX-Smin) between maximum thickness (SMAX) and minimum thickness (Smin) of the edge is preferably comprised between 0.05 and 0.08 mm. Evidently, proportions are intentionally misrepresented in the drawings, in order to make the wear portion (37) and its position on the edge (33) more visible.

[0047] So, the wear caused by the passage of gases (FG) between buffer (30) and plate (7) initially wears out only the wear portion (37) without affecting the minimum thickness (Smin) of the border (measured at the upper end).

[0048] The first point subject to wear is the most protruding point (P) of the wear portion (37).

[0049] Fig. 4 is a diagrammatic view showing that wear continues from point (P) for consecutive profile "slices" (37) until it reaches the point (P1) with minimum thickness (Smin), which will be affected only after the overmaterial of the wear portion (37) is completely worn out.

[0050] Given the gradual increase (from minimum thickness to maximum thickness) of the wear portion (37), the friction area between plate (7) and edge (33) is always in correspondence of a point of the wear portion (37) where aluminum is protected by said superficial layer (F) treated with hard anodization, thus extending the wear time of the buffer (30).

[0051] Referring to the mold (1) for ceramic industry illustrated above, the same is likewise the object of the present invention if at least one of its buffers (2 or 3 in Fig. 1) is replaced by a buffer (30) as described above.

[0052] Said mold (1) has been already described, and therefore details are omitted, referring to the description made for Figs. 1 and 2. It must be noted, however, that preferably the buffer (30) with wear portion (37) replaces the buffer (3) of the mold (1), i.e. the one mounted on the magnetic base (4) connected with the ejector block (5). The other buffer (2), instead, is replaced with a buffer without wear portion (37), but likewise made of aluminum or preferably 5000 aluminum alloy with hard anodized surface with 70-80 micron thickness.

[0053] Additional variants are possible within the scope of an expert of the field in the light of the precepts provided herein.

Claims

1. A buffer (30) for mold (1) for ceramic industry comprising a body (34) with concave portion (31) adapted to be the bottom of an injection chamber (8) of raw materials for production of a ceramic tile (M), said concave portion (31) being perimetrally defined by an edge (33) protruding from said body (34) and wherein said edge (33) comprises an external profile area (35) on one side of the edge (33) opposite the one facing said concave portion (31),
characterized in that
said buffer (30) is made of aluminum or aluminum alloy and at least said external profile area (35) is superficially treated with hard anodization process in such manner to obtain a hard superficial layer (F) with thickness from 70 to 80 microns.

2. A buffer (30) according to the preceding claim, wherein it is made of Series 5000 or 6000 aluminum alloy.

3. A buffer (30) according to claim 1 or 2, wherein said hard superficial layer (F) is completely provided on all external surface of the buffer.

4. A buffer (30) according to claim 1 or 3, wherein said edge (33) comprises a wear portion (37) with increasing thickness with respect to minimum thickness (Smin) of said edge (33) measured at one end.

5. A buffer (30) according to claim 4, wherein said increasing thickness of wear portion (37) is a gradually increasing thickness from said minimum thickness value (Smin) to a maximum thickness value (SMAX).

6. A buffer (30) according to claim 4 or 5, wherein said edge (33) widens on the opposite side with respect to the side facing said concave portion (31), until it reaches maximum thickness substantially in correspondence of said body (34).

7. A buffer (30) according to claim 4, 5 or 6, wherein the difference between said minimum thickness value (Smin) and said maximum thickness value (SMAX) is comprised between 0.05 mm and 0.08 mm.

8. A mold (1) for ceramic industry comprising a backing plate (6), an ejector block (5), a die (9) and at least one lower buffer (2) and one upper buffer (2) adapted to be moved close to each other and pressed during fabrication of a ceramic tile (M) in such manner that they define walls of an injection chamber (8)
characterized by the fact that
at least one of said buffers (2) is made as claimed in one or more of the preceding claims.

9. A mold (1) according to the preceding claim, also comprising a magnetic base (4) connected to the ejector block (5), wherein the lower buffer (30) is mounted on said magnetic base (4) and said lower buffer (30) is made as claimed in one or more of claims 1 to 7.

10. A mold (1) according to claim 8, also comprising a fixed frame on which said upper buffer (2) is connected, wherein said upper buffer (2) is made as claimed in any one of claims 1 to 3.

Patentansprüche

1. Pressstempel (30) für eine Pressform (1) für die Keramikindustrie umfassend einen Körper (34) mit einem konkaven Anteil (31), der dazu geeignet ist, den Boden einer Kammer (8) zum Einspritzen von rohen Keramikmassen zur Herstellung einer Keramikfliese (M) zu bilden, wobei der konkave Anteil (31) rundum von einem Rand (33) definiert wird, der aus dem Körper (34) auskragt und wobei der Rand (33) einen äußeren Profilbereich (35) auf einer Seite des Randes (33) umfasst, die der Seite gegenüberliegt, die auf den konkaven Anteil (31) gerichtet ist,
dadurch gekennzeichnet, dass
der Pressstempel (30) aus Aluminium oder einer Aluminiumlegierung hergestellt ist, wobei mindestens der äußere Profilbereich (35) oberflächlich hartel-oxiert ist, um eine harte Oberflächenbeschichtung (F) mit einer Dicke von 70 - 80 Mikron zu erzielen.

2. Pressstempel (30) nach dem vorstehenden Anspruch, wobei er aus einer Aluminiumlegierung der Serie 5000 oder 6000 hergestellt ist.

3. Pressstempel (30) nach Anspruch 1 oder 2, wobei die gesamte Außenfläche des Pressstempels eine oberflächliche Hartbeschichtung (F) aufweist.

4. Pressstempel (30) nach Anspruch 1, 2 oder 3, wobei der Rand (33) einen verschleißbaren Anteil (37) aufweist, der eine zunehmende Dicke bezogen auf die Mindestdicke (Smin) des Randes (33) besitzt, die an einem seiner Enden gemessen wird.

5. Pressstempel (30) nach Anspruch 4, wobei die zunehmende Dicke des verschleißbaren Anteils (37) eine allmählich von der Mindestdicke (Smin) zur Höchstdicke (SMAX) zunehmende Dicke ist.

6. Pressstempel (30) nach Anspruch 4 oder 5, wobei der Rand (33) sich auf der Seite, die der Seite gegenüberliegt, auf die der konkave Anteil (31) gerichtet ist, verbreitert, bis er im Wesentlichen an dem Körper (34) die Höchstdicke erreicht.

7. Pressstempel (30) nach Anspruch 4, 5 oder 6, wobei der Unterschied zwischen der Mindestdicke (Smin) und der Höchstdicke (SMAX) zwischen 0,05 mm und 0,08 mm beträgt.

8. Pressform (1) für die Keramikindustrie umfassend eine Basisplatte (6), einen Ausstoßblock (5), eine Matrize (9) und mindestens einen unteren Pressstempel (30) sowie einen oberen Pressstempel (2), die dazu geeignet sind, aneinander angenähert und während der Herstellphase der Keramikfliese (M) zusammengepresst zu werden, um die Wände einer Einspritzkammer (8) zu definieren,
dadurch gekennzeichnet, dass
mindestens einer der Pressstempel (30, 2) entsprechend einem oder mehreren der vorstehenden Ansprüche realisiert ist.

9. Pressform (1) nach dem vorstehenden Anspruch umfassend ferner einen magnetischen Sockel (4), der mit einem Ausstoßblock (5) verbunden ist, wobei der unter Pressstempel (30) auf dem magnetischen Sockel (4) angebracht und der untere Pressstempel (30) gemäß einem beliebigen der Ansprüche von 1 bis 7 realisiert ist.

10. Pressform (1) nach Anspruch 8 umfassend ferner einen festen Rahmen, mit dem der obere Pressstempel (2) verbunden ist, wobei der obere Pressstempel (2) gemäß einem beliebigen der Ansprüche von 1 bis 3 realisiert ist.

Revendications

1. Tampon (30) pour moule (1) pour l'industrie de la céramique, comprenant un corps (34) ayant une portion concave (31) apte à constituer le sol d'une chambre (8) d'injection de matières premières pour la réalisation d'un carreau (M) de céramique, ladite portion concave (31) étant définie sur son périmètre par un bord (33) qui fait saillie du dit corps (34) et où ledit bord (33) comprend une zone de profil externe (35) sur une face du bord (33) opposée à celle qui est tournée vers ladite portion concave (31),
caractérisé en ce que
ledit tampon (30) est réalisé en aluminium ou en alliage d'aluminium, étant au moins ladite zone de profil externe (35) traitée en surface avec un traitement d'anodisation dure, de manière à obtenir une couche superficielle dure (F) ayant une épaisseur comprise entre 70-80 microns.

2. Tampon (30) selon la revendication précédente, où il est réalisé en alliage d'aluminium Séries 5000 ou 6000.

3. Tampon (30) selon la revendication 1 ou 2, où ladite

couche superficielle dure (F) est présente sur toute la surface externe du tampon.

4. Tampon (30) selon la revendication 1 ou 3, où ledit bord (33) comprend une portion d'usure (37) ayant une épaisseur croissante par rapport à une épaisseur minimale (Smin) du dit bord (33) mesuré à son extrémité terminale.

5. Tampon (30) selon la revendication 4, où ladite épaisseur croissante de ladite portion d'usure (37) est une épaisseur progressivement croissante depuis ladite valeur d'épaisseur minimale (Smin) à une valeur d'épaisseur maximale (SMAX).

6. Tampon (30) selon la revendication 4 ou 5, où ledit bord (33) s'élargit sur son côté opposé par rapport à celui tourné vers ladite portion concave (31), jusqu'à atteindre l'épaisseur maximale substantiellement en correspondance du ledit corps (34).

7. Tampon (30) selon la revendication 4, 5 ou 6, où la différence entre ladite valeur d'épaisseur minimale (Smin) et ladite valeur d'épaisseur maximale (SMAX) est comprise entre 0.05 mm et 0.08 mm.

8. Moule (1) pour l'industrie de la céramique, comprenant une plaque de base (6), un bloc éjecteur (5), une matrice (9) et au moins un tampon inférieur (2) et un tampon supérieur (2), aptes à être rapprochés l'un de l'autre et pressés pendant la phase de fabrication d'un carreau (M) de céramique, de manière à définir les parois d'une chambre d'injection (8),
caractérisé en ce que
au moins l'un des dits tampons (2) est réalisé conformément à une ou plusieurs des revendications précédentes.

9. Moule (1) selon la revendication précédente, comprenant également un socle aimanté (4) relié au bloc éjecteur (5), où ledit tampon inférieur (30) est monté sur ledit socle aimanté (4) et ledit tampon inférieur (30) est réalisé conformément à l'une quelconque des revendications de 1 à 7.

10. Moule (1) selon la revendication 8, comprenant également un châssis fixe auquel ledit tampon supérieur (2) est raccordé, où ledit tampon supérieur (2) est réalisé conformément à l'une quelconque des revendications de 1 à 3.

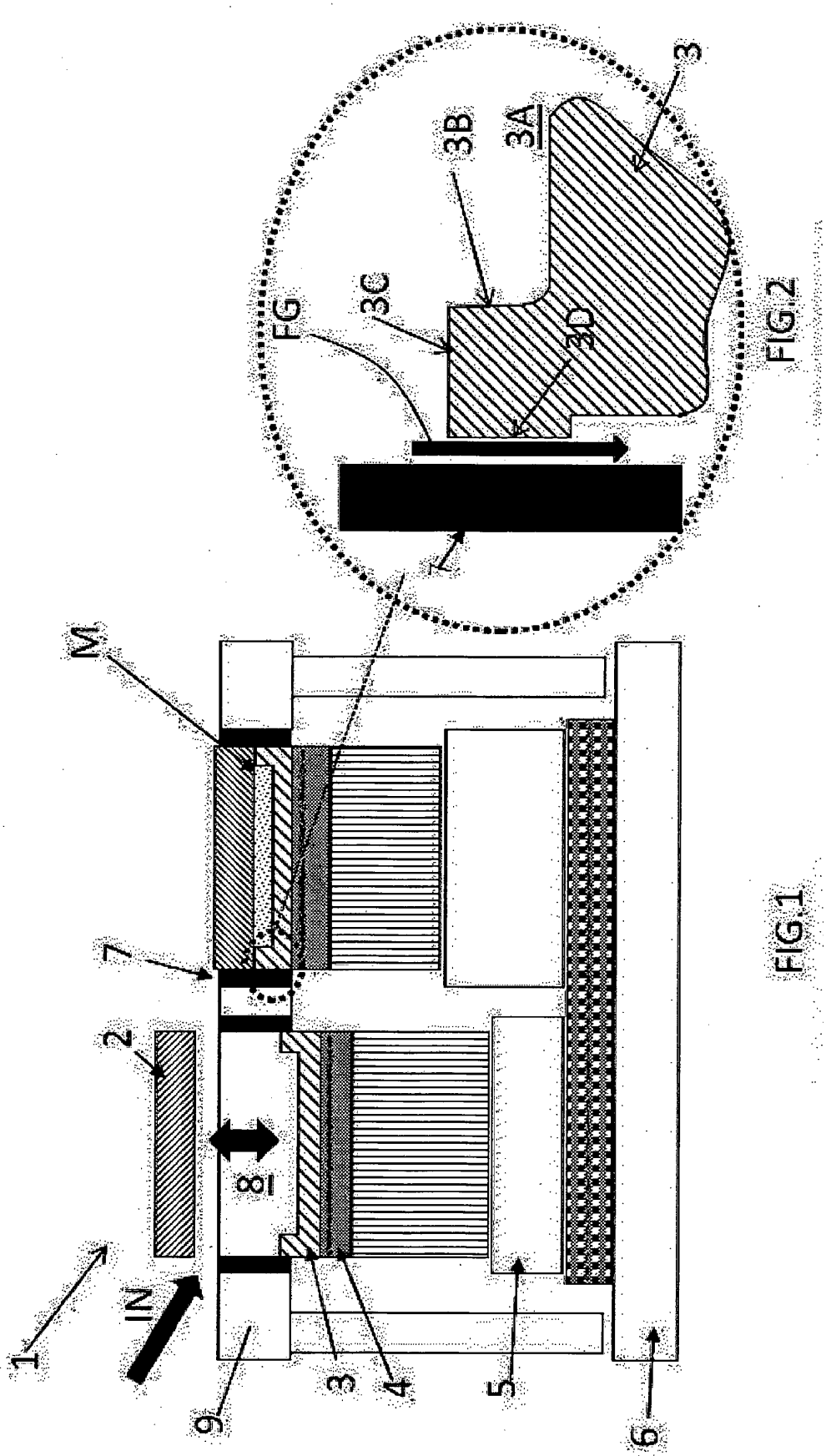

FIG.2

FIG.1

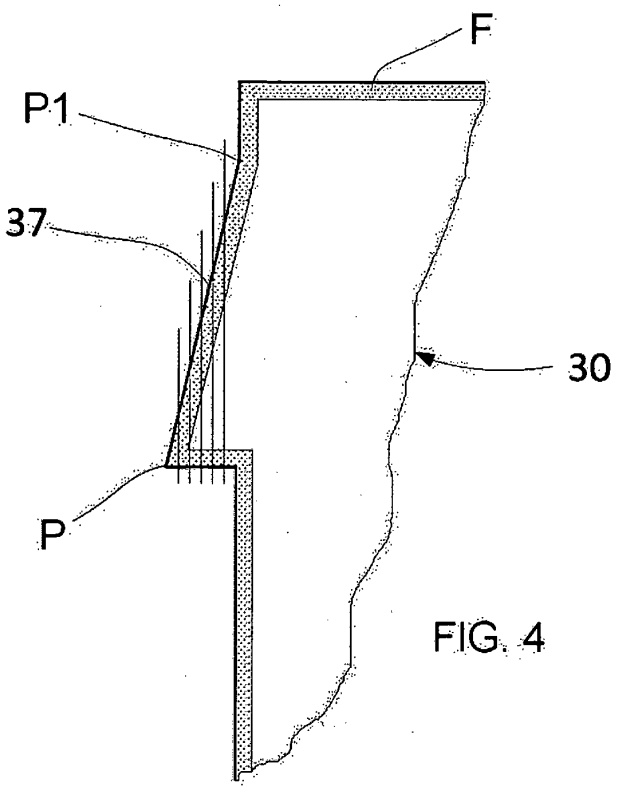

FIG. 4

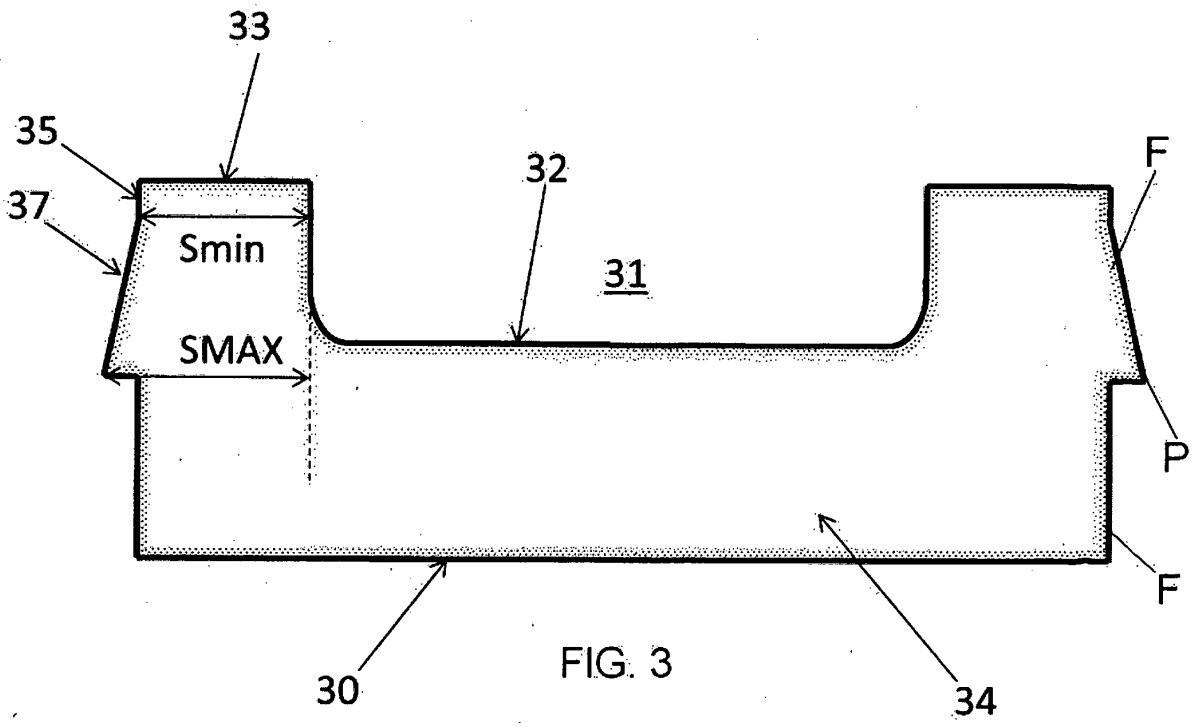

FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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