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(54) **APPARATUS AND PROCESS FOR MANUFACTURING ITEMS MADE OF ALUMINUM ALLOYS OR LIGHT ALLOYS**

VORRICHTUNG UND VERFAHREN ZUR HERSTELLUNG VON GEGENSTÄNDEN AUS ALUMINIUMLEGIERUNGEN ODER LEICHTMETALLLEGIERUNGEN

APPAREIL ET PROCEDE SERVANT A FABRIQUER DES OBJETS EN ALUMINIUM, EN ALLIAGES D'ALUMINIUM OU EN ALLIAGES LEGERS ET AUTRES

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- **PATENT ABSTRACTS OF JAPAN vol. 1995, no. 07, 31 August 1995 (1995-08-31) & JP 07 100614 A (KIRIYUU KIKAI KK), 18 April 1995 (1995-04-18)**

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Description

Technical Field

[0001] The present invention relates to an apparatus for manufacturing items made of aluminum, aluminum alloys, light alloys and the like.

Background Art

[0002] As is known, for die-casting of items made of aluminum, aluminum alloys, light alloys and the like, a casting technique is used which is known as low-pressure casting, wherein the liquid metal is made to rise from the furnace through a duct for introducing the liquid metal that exits upward in a die formed by two or more parts.

[0003] Once the filling of the die has been completed, the liquid metal must solidify, and this occurs normally over a relatively long time, furthermore forming a relatively large sprue at the liquid metal input channel.

[0004] This type of casting has the drawback of having long casting times in addition to a waste of material determined by the sprue and to the fact that the cast item has a structure that is relatively scarcely compacted, since casting occurs at low pressure.

[0005] According to what is disclosed in document WO 02/089625 by the same Applicant, assumed incorporated herein by reference, and which is relevant as state of the art pursuant to Art 54(3) EPC, a casting technique is described which allows to produce items, particularly shoe toe caps, with a particularly compact structure that arises from the fact that the two parts of the die that form the impression of the cast item are mutually closed with a pressing action, thus achieving compaction of the material and considerable structural uniformity, furthermore avoiding the formation of sprue, with the consequent benefits regarding the casting time.

[0006] In this solution it was necessary to provide a relatively precise dosage of the liquid metal and it was therefore necessary to have a dosage device that allowed to introduce dosed quantities of material.

[0007] Although this solution is valid in many respects, it was relatively complicated from a constructive standpoint.

[0008] An apparatus with features as comprised in the preamble of claim 1 is known from WO 00/45979.

Disclosure of the Invention

[0009] The aim of the invention is indeed to solve the above problems, providing an apparatus and a method for manufacturing items made of aluminum, aluminum alloys, light alloys and the like, which allows to cast items that have a very compact structure without however having to use a dosage device to introduce the liquid metal, which is instead in practice dosed automatically by the apparatus.

[0010] Within this aim, an object of the invention is to provide an apparatus and a method that allows to produce items without sprue and with considerably shorter times for obtaining the solidification step.

[0011] Another object of the present invention is to provide an apparatus and a method that allows to provide, with a single casting operation, a plurality of parts that may optionally be different one another, obtaining correct dosage for each cast part.

[0012] Another object of the present invention is to provide an apparatus and a method that by virtue of its particular constructive characteristics is capable of giving the greatest assurances of reliability and safety in use.

[0013] Another object of the present invention is to provide an apparatus and a method that can be obtained easily starting from commonly commercially available elements and materials and is also competitive from a merely economical standpoint.

[0014] This aim and these and other objects that will become better apparent hereinafter are achieved by an apparatus and a method for manufacturing items made of aluminum, aluminum alloys, light alloys and the like, according to the invention, as set forth in the appended claims 1 and 8.

Brief description of the Drawings

[0015] Further characteristics and advantages will become better apparent from the detailed description of an apparatus for manufacturing items made of aluminum, aluminum alloys, light alloys and the like, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a schematic sectional view of the apparatus, taken along a vertical plane, during the initial step of casting;
Figure 2 is a view illustrating the step for introducing the liquid metal in the lower die;
Figure 3 is a view illustrating the step for dosing the liquid metal;
Figure 4 is a view illustrating the step for the closure of the upper die onto the lower die;
Figure 5 is a schematic plan view of a die with three impressions;
Figure 6 is a schematic view of a safety shoe toe cap that can be obtained with the apparatus according to the invention.

Ways of carrying out the Invention

[0016] With reference to the figures, the apparatus for manufacturing items made of aluminum, aluminum alloys, light alloys and the like, according to the invention, comprises a platen, generally designated by the reference numeral 1, on which there is a lower die 2 with which an upper die 3 cooperates; said upper die can

perform a translational motion toward and away from the lower die.

[0017] There is also a duct 10 for introducing liquid metal, which arrives from below from a furnace 11 of the liquid metal which is preferably of the pressurized type; the duct 10 runs through the platen, where there are usual heating means 12, until it exits at the impressions 20 provided in the lower die.

[0018] In the illustrated specific example there are three lower impressions that are uniformly distributed circumferentially around the input duct 10 and are connected thereto by way of ports 22 that form in practice, as explained hereinafter, ports for the overflow of the liquid metal.

[0019] The lower impression 20 has at least one concave portion 23 that allows to introduce therein a quantity of liquid metal that is a direct function of the geometry of the concave portion; therefore, by introducing the liquid metal and making it rise through the duct, by virtue of a pressing action applied by the furnace, it is possible to fill the concave regions or portions 23 with a quantity of liquid metal that in practice is dosed.

[0020] It is possible to provide level sensors 30 to stop the rise of the liquid metal or it is optionally possible to preset the time and the pressure applied to the liquid metal so as to achieve dosed overflow of said liquid metal.

[0021] Once the concave regions have been filled, the level of the liquid metal is lowered again (Figure 3), so as to provide precise dosage of the metal according to the position of the overflow ports 22 that form the region for the overflow of the liquid metal into the concave regions 23.

[0022] At least one male plug 8 is connected to the upper die 3, can move with respect to the upper die 3, and forms an upper impression 25, which in cooperation with the corresponding lower impression 20 forms the shape of the item being cast. The specific example illustrates a toe cap 21 for safety shoes.

[0023] An important particularity of the invention consist in that after closing the upper die 3 onto the lower die 2 and after dosing the liquid metal, the piston 8, which moves with respect to the upper die 3, closes the port 24 for connection to the liquid metal input duct 10, thus achieving clear separation with respect to the column of liquid metal, which moreover, to perform dosage, had been made to descend in the channel 10, so as to place the free surface of the liquid preferably at the heated region.

[0024] The movement of the male plug 8 with respect to the upper die 3 applies pressure to the liquid metal, producing a particular compaction of said metal and thus obtaining parts that have considerable structural uniformity and improved mechanical strength.

[0025] It is also noted that the particular solution adopted, in which the dosage of the metal is substantially produced by the shape of the lower impression and more particularly by the concave portion of the lower portion, allows to arrange around the same input channel impressions that are different one another and in which the liquid metal is always dosed correctly, said dosage being possibly different in each impression.

[0026] It should be noted that with the arrangement described above it is possible to introduce in the various impressions a dosed quantity of liquid metal without having to resort to particular operations but simply by making the liquid metal that arrives from the input duct overflow and by bringing said liquid metal to a presettable limit that can be determined directly by a level sensor 30, as shown, or optionally by using the time for which pressure is applied to the liquid metal, said pressure causing its rise and consequently its introduction in the various recesses.

[0027] It is evident from what has been described above that the invention achieves the intended aim and objects, and in particular the fact is stressed that the male plug in practice forms a flow control element that closes the port for connection to the liquid metal input duct, avoiding the formation of sprue and also generating pressure on the liquid metal undergoing solidification, which helps to obtain a product with high-level structural and mechanical characteristics.

[0028] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0029] All the details may further be replaced with other technically equivalent elements.

[0030] In practice, the materials used, as well as the contingent shapes and dimensions, may be any according to requirements.

Claims

1. An apparatus for manufacturing items made of aluminum, aluminum alloys, light alloys and the like, comprising, on a platen (1), a lower die (2) and at least one upper die (3), a duct (10) for introducing liquid metal that is connected to a furnace (11), said liquid metal input duct (10) arriving from below through the platen (1) and leading into said lower die (2), said lower die (2) forming at least one lower impression (20), which has at least one concave portion (23) for introducing a quantity of liquid metal, at least a male plug (8) being associated with said upper die (3), said at least one male plug (8) being adapted to move with respect to said upper die (3) and forming an upper impression (25) that can be coupled to said at least one lower impression (20) in order to determine the shape of the item (21) being cast, said at least one upper die (3) being closable onto said lower die (2) and said at least one male plug (8) being adapted to close said shape and to act as a flow control element for the port (24) that provides a connection to said input duct (10), **characterized in that** it further comprises at least one

overflow port (22) that connects said input duct (10) to said at least one concave portion (23) for introducing therein a quantity of liquid metal that is dosed by overflow and is a direct function of the geometry of said concave portion (23).

2. The apparatus according to claim 1, **characterized in that** it comprises, on said lower die (2), multiple lower impressions (20) that are individually connected to said liquid metal input duct (10).

3. The apparatus according to the preceding claims, **characterized in that** it comprises level sensors (30) for controlling the rise of liquid metal in said input duct (10) to a level that is higher than the level of said connection port (24) to control the overflow of liquid metal.

4. The apparatus according to one or more of the preceding claims, **characterized in that** it is adapted for dosing said liquid metal by overflowing with respect to said connection port (24).

5. The apparatus according to one or more of the preceding claims, **characterized in that** the level of the liquid metal in said liquid metal input duct (10) is controllable by setting time and pressure values inside said furnace.

6. The apparatus according to one or more of the preceding claims, **characterized in that** the closure of said male plug (8) onto the corresponding lower impression (20) of said lower die (2) is suitable to apply pressure to the liquid metal introduced in said concave portion.

7. The apparatus according to one or more of the preceding claims, **characterized in that** said lower impressions (20) formed in said lower die (2) are adapted to provide liquid metal dosages independently one from the other.

8. A method for manufacturing items made of aluminum, aluminum alloys, light alloys and the like with an apparatus according to claim 1, the method comprising the steps of: closing said at least one upper die (3) onto said lower die (2); dosing a quantity of liquid metal on introduction thereof in said at least one concave portion (23) by way of overflowing of the liquid metal with respect to at least one overflow port (22) that connects the concave portion (23) to said input duct (10), the dosed overflow quantity being a direct function of the geometry of said concave portion (23); and moving said at least one male plug (8) to close said shape and to act as a flow control element for the port (24) that provides a connection to said input duct (10);

9. The method according to claim 8, wherein the dosing comprises the steps of: controlling the rise and level of pressurized liquid metal in the input duct (10); and, upon filling of the at least one concave portion (23) with the dosed overflow quantity of liquid metal, lowering the level of the liquid metal in the input duct (10).

Patentansprüche

1. Vorrichtung zur Herstellung von Gegenständen aus Aluminium, Aluminiumlegierungen, Leichtmetalllegierungen oder dergleichen, umfassend einen Pressentisch (1), ein Untergesenk (2) und wenigstens ein Obergesenk (3), einen Kanal (10) für die Zuführung des flüssigen Metalls, der mit einem Schmelzofen (11) verbunden ist und der von unten durch den Pressentisch (1) hindurchläuft und zu dem Untergesenk (2) führt, welches wenigstens einen unteren Formraum (20) bildet, der wenigstens einen konkaven Teil (23) für die Aufnahme einer Menge des flüssigen Metalls aufweist, wobei wenigstens ein Stempel (8) dem Obergesenk (3) zugeordnet und relativ zu diesem beweglich ist und einen oberen Formraum (25) bildet, der mit dem wenigstens einen unteren Formraum (20) in Verbindung gebracht werden kann, um die Form des zu gießenden Gegenstandes (21) vorzugeben, wobei das wenigstens eine Obergesenk (3) mit dem Untergesenk (2) verriegelbar ist und der wenigstens eine Stempel (8) so ausgebildet ist, daß er die Form abschließt und als ein Mengenregelelement für die Öffnung (24) wirkt, die eine Verbindung zu dem Zuführkanal (10) herstellt, **dadurch gekennzeichnet, daß** wenigstens eine Überströmöffnung (22) vorgesehen ist, die den Zuführkanal (10) mit dem wenigstens einen konkaven Teil (23) verbindet, so daß in diesen eine bestimmte Menge des flüssigen Metalls übergeleitet werden kann, welche durch den Überlauf dosiert wird und eine direkte Funktion der Geometrie des konkaven Teils (23) ist.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, daß** in dem Untergesenk (2) mehrere untere Formräume (20) ausgebildet sind, die jeweils einzeln mit dem Zuführkanal (10) für die Zufuhr des flüssigen Metalls verbunden sind.

3. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** Pegelsensoren (30) zur Steuerung des in dem Zuführkanal (10) aufsteigenden, flüssigen Metalls bis zu einem Pegel vorgesehen sind, der über dem Pegel der Verbindungsöffnung (24) liegt, wodurch die Überströmmenge des flüssigen Metalls gesteuert wird.

4. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** diese zur Dosierung des flüssigen Metalls durch den Überlauf an der Verbindungsöffnung (24) ausgebildet ist.

5. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** der Pegel des flüssigen Metalls in dem Zuführkanal (10) steuerbar ist durch Einstellung der Zeit und des Druckes innerhalb des Schmelzofens.

6. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** durch den Abschluß des jeweiligen unteren Formraumes (20) im Untergesenk (2) durch den Stempel (8) Druck auf das in den konkaven Teil (23) eingebrachte, flüssige Metall ausgeübt wird.

7. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** durch die unteren Formräume (20) in dem Untergesenk (2) voneinander unabhängige Dosierungen des flüssigen Metalls bewirkt werden.

8. Verfahren zur Herstellung von Gegenständen aus Aluminium, Aluminiumlegierungen, Leichtmetalllegierungen oder dergleichen mit einer Vorrichtung nach Anspruch 1, bei dem die folgenden Schritte vorgesehen sind:

   - Verschluß des wenigstens einen Obergesenks (3) relativ zum Untergesenk (2),
   - Dosierung einer Flüssigmetallmenge durch Zuführen des flüssigen Metalls in den wenigstens einen konkaven Teil (23) durch Überlauf des flüssigen Metalls über wenigstens eine Überströmöffnung (22), welche den konkaven Teil (23) mit dem Zuführkanal (10) verbindet, wobei die Überströmmenge eine direkte Funktion der Geometrie des konkaven Teils (23) ist,
   - Verschieben des wenigstens einen Stempels (8) zum Abschließen der Form, wobei der Stempel als ein Mengenregelelement für die Öffnung (24) dient, welche eine Verbindung zu dem Zuführkanal (10) herstellt.

9. Verfahren nach Anspruch 8, **dadurch gekennzeichnet, daß** für die Dosierung die folgenden Schritte vorgesehen sind:

   - Steuerung des Anstiegs und des Pegels des unter Druck stehenden Flüssigmetalls innerhalb des Zuführkanals (10),
   - nach dem Füllen des wenigstens einen konkaven Teils (23) mit der dosierten Überströmmenge des Flüssigmetalls Absenken des Pegels des flüssigen Metalls im Zuführkanal (10).

Revendications

1. Appareil de fabrication d'articles constitués d'aluminium, d'alliages en aluminium, d'alliages légers et similaires, comprenant, sur un plateau (1), une filière inférieure (2) et au moins une filière supérieure (3), un conduit (10) destiné à introduire un métal liquide qui est raccordé à un fourneau (11), ledit conduit d'entrée de métal liquide (10) parvenant depuis le dessous à travers le plateau (1) et menant à l'intérieur de ladite filière inférieure (2), ladite filière inférieure (2) formant au moins un empreinte inférieure (20), qui comporte au moins une portion concave (23) destinée à introduire une quantité de métal liquide, au moins un bouchon mâle (8) étant associé à ladite filière supérieure (3), ledit au moins un bouchon mâle (8) étant adapté pour se déplacer par rapport à ladite filière supérieure (3) et formant une empreinte supérieure (25) qui peut être couplée à ladite au moins une impression inférieure (20) afin de déterminer la forme de l'article (21) qui est coulé, ladite au moins une filière supérieure (3) pouvant être fermée sur ladite filière inférieure (2) et ledit au moins un bouchon mâle (8) étant adapté pour fermer ladite forme et pour agir comme élément de régulation d'écoulement pour l'orifice (24) qui forme un raccord avec ledit conduit d'entrée (10), **caractérisé en ce qu'**il comprend en outre au moins un orifice de débordement (22) qui raccorde ledit conduit d'entrée (10) à ladite au moins une portion concave (23) pour y introduire une quantité de métal liquide qui est dosée par débordement et est une fonction directe de la géométrie de ladite portion concave (23).

2. Appareil selon la revendication 1, **caractérisé en ce qu'**il comprend, sur ladite filière inférieure (2), de multiples empreintes inférieures (20) qui sont individuellement raccordées audit conduit d'entrée de métal liquide (10).

3. Appareil selon les revendications précédentes, **caractérisé en ce qu'**il comprend des capteurs de niveau (30) destinés à réguler une élévation de métal liquide dans ledit conduit d'entrée (10) à un niveau qui est supérieur au niveau dudit orifice de raccord (24) pour réguler le débordement de métal liquide.

4. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il est adapté pour le dosage dudit métal liquide par débordement par rapport audit orifice de raccord (24).

5. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le niveau du métal liquide dans ledit conduit d'entrée du métal liquide (10) peut être régulé en fixant des valeurs de temps et de pression à l'intérieur dudit fourneau.

6. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la fermeture dudit bouchon mâle (8) sur l'empreinte inférieure (20) correspondante de ladite filière inférieure (2) est appropriée pour appliquer une pression au métal liquide introduit dans ladite portion concave.

7. Appareil selon une ou plusieurs des revendications précédentes, **caractérisé en ce que** lesdites empreintes inférieures (20) formées dans ladite filière inférieure (2) sont adaptées pour fournir des dosages de métal liquide indépendamment les unes des autres.

8. Procédé de fabrication d'articles constitués d'aluminium, d'alliages d'aluminium, d'alliages légers et similaires avec un appareil selon la revendication 1, le procédé comprenant les étapes consistant à :

fermer ladite au moins une filière supérieure (3) sur ladite filière inférieure (2) ;
doser une quantité de métal liquide à son introduction dans ladite au moins une portion concave (23) à l'aide d'un débordement du métal liquide par rapport à au moins un orifice de débordement (22) qui raccorde la portion concave (23) audit conduit d'entrée (10), la quantité de débordement dosée étant une fonction directe de la géométrie de ladite portion concave (23) ; et
déplacer ledit au moins un bouchon mâle (8) pour fermer ladite forme et pour agir comme élément de régulation d'écoulement pour l'orifice (24) qui forme un raccord avec ledit conduit d'entrée (10).

9. Procédé selon la revendication 8, dans lequel le dosage comprend les étapes consistant à : réguler l'élévation et le niveau de métal liquide sous pression dans le conduit d'entrée (10) ; et, lors du remplissage de la au moins une portion concave (23) avec la quantité de débordement dosée de métal liquide, abaisser le niveau du métal liquide dans le conduit d'entrée (10).

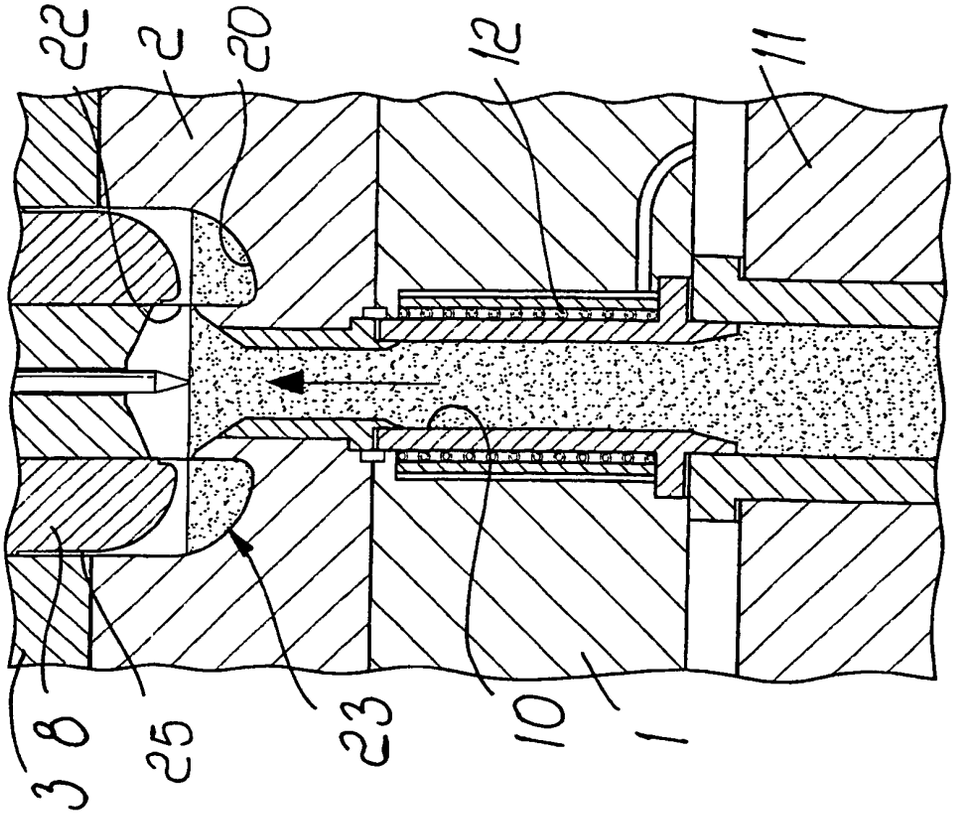


Fig. 2

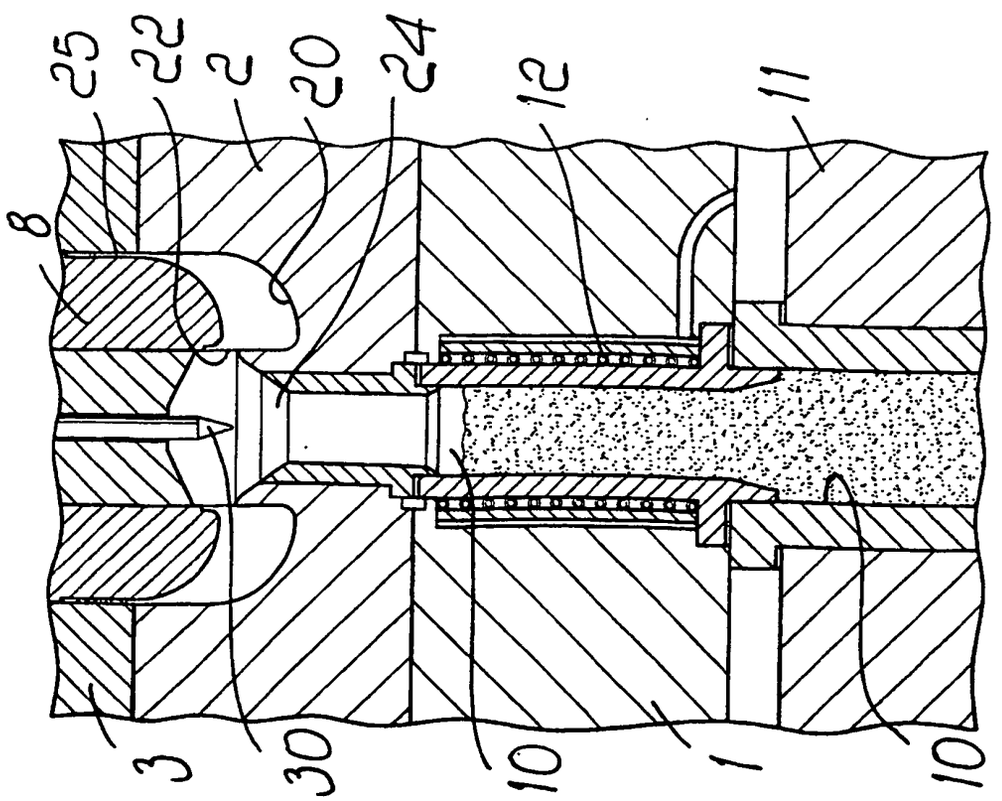


Fig. 1

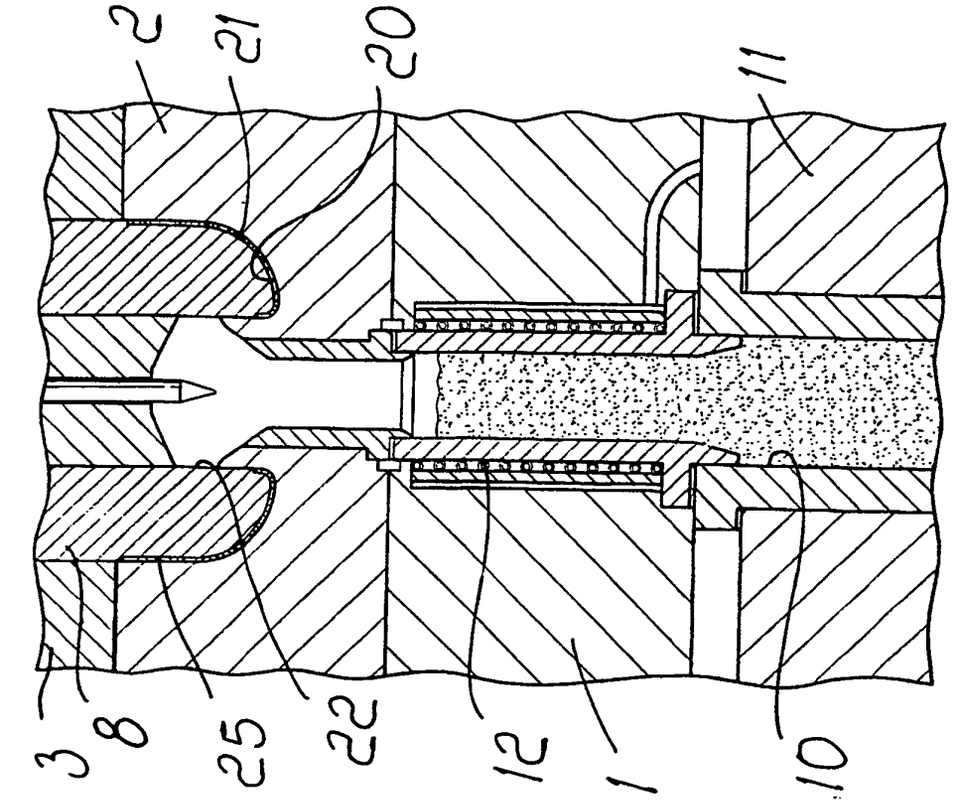


Fig. 4

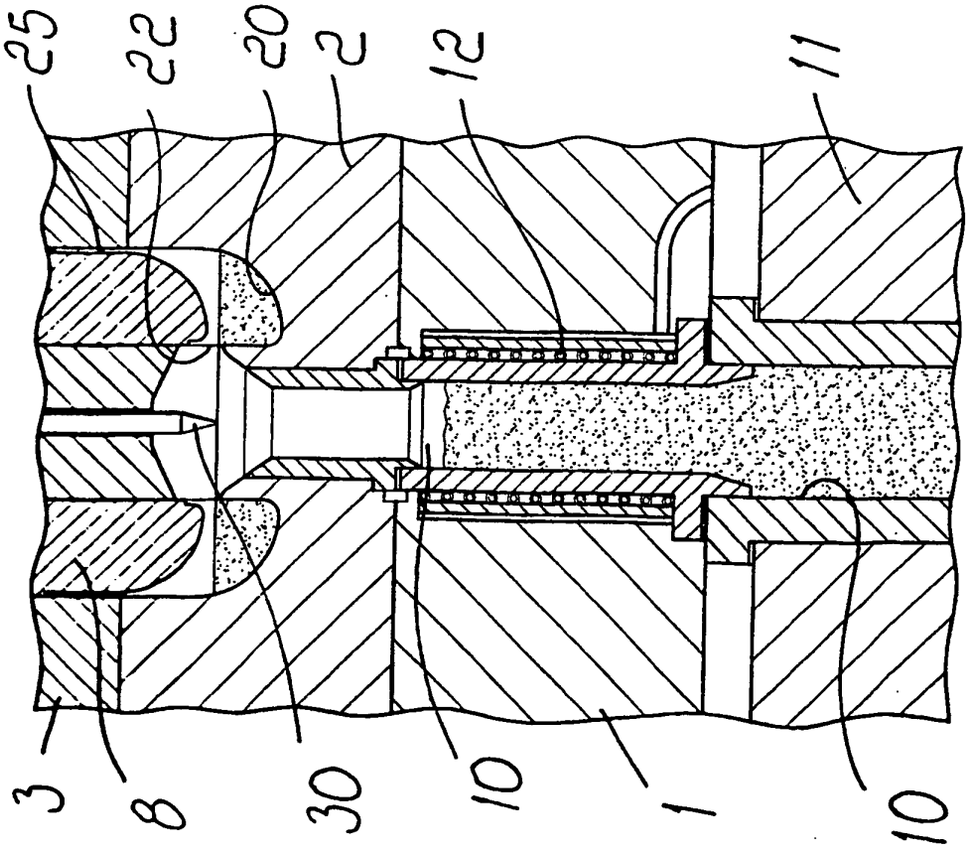


Fig. 3

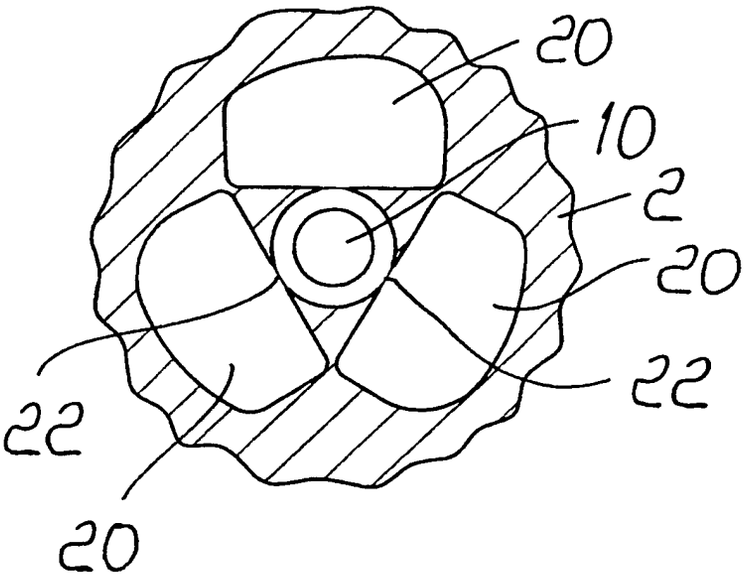


Fig. 5

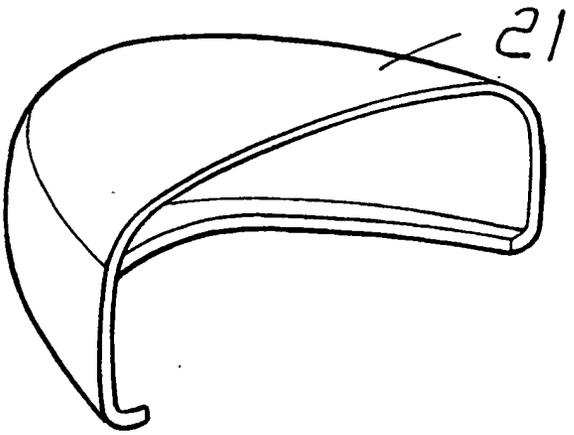


Fig. 6