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(54) **CRUCIBLE FOR A MACHINE FOR CONTINUOUSLY CASTING A BAR OR A COIL OF A METAL ALLOY**

TIEGEL FÜR EINE MASCHINE ZUM STRANGGIESSEN EINER STANGE ODER EINER SPULE AUS EINER METALLLEGIERUNG

CREUSET POUR UNE MACHINE POUR LE COULAGE EN CONTINU D'UNE BARRE OU D'UNE BOBINE D'UN ALLIAGE MÉTALLIQUE

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Description

[0001] The invention is related to the field of the manufacture of bars or coils through continuous casting of copper alloy with additions of chromium, zirconium, or chromium and zirconium which will be called the "material" in the present document. A particular application of the "material" is the manufacture of welding electrodes.

[0002] The manufacture of this material traditionally occurs through casting of billets, then through hot extrusion of these billets, and finally through cold drawing in order to bring them to the final size. An operation of solution annealing, which consists in bringing the alloy at a temperature at which the addition elements (Cr, Zr) have their largest domain of solubility in copper, followed by a quenching in water, will occur after hot extrusion. A precipitation or ageing treatment will be added, generally after drawing, in order to provide the required mechanical and electrical properties.

[0003] EP 0 142 139 discloses a crucible for a machine for continuously casting a bar or a coil of a metal alloy, including a casting chamber and a primary supply chamber for supplying a molten metal alloy.

[0004] EP 2 039 444 discloses a process for manufacturing copper alloy wire rod.

[0005] US 7 036 554 discloses a method and system for casting metal and metal alloys.

[0006] DE 197 47 002 is related to a three-chamber magnesium melting furnace operating by stepwise temperature increase of the melt, in the flow direction through the chambers.

[0007] EP1 649 950 provides a continuous casting solution in the manufacture of welding electrodes. A solution is provided for achieving, directly at the exit of the continuous casting, a wire that is sufficiently thin for being passed directly to the cold mill or drawing bench, thus saving the hot extrusion phase.

[0008] Nevertheless, for some types of material these methods are not satisfactory. As soon as an element highly reactive to oxygen in a hot atmosphere enters into the composition of the alloy, said element becomes oxidized during the pouring from the melting furnace into the casting furnace, and the final composition of the alloy does not contain the required percentage of this element.

[0009] This is in particular the case for zirconium, which very quickly becomes oxidized when it is in the liquid state in copper. Hence, when it is desired to obtain products made of an alloy of copper, chromium and zirconium, the continuous casting method described above does not work.

[0010] The present invention attempts to cope with at least part of the above-mentioned drawbacks and provides a solution, which permits to obtain the material or any product in form of bars and coils made of an alloy comprising an element highly reactive to oxygen in a hot atmosphere, such as for example magnesium, calcium, lithium or titanium.

[0011] To this end, the invention relates to a crucible

for a machine for continuously casting a wire of a metal alloy, including a casting chamber, a primary supply chamber for supplying a molten metal alloy and a channel for transferring said molten metal alloy to the casting chamber.

[0012] This crucible is particular in that it includes, in addition, a secondary supply chamber configured for supplying the machine with a secondary metal and connected to the primary supply chamber through an interior opening arranged at the lower level of said primary supply chamber, and configured so that, in operation, the separation is complete at the level of the surface of said molten metal alloy in the primary supply chamber.

[0013] Thanks to these features, it becomes possible, at the level of the secondary supply chamber, to create an area in which the molten metal alloy is protected against the air, and in which a mixing with an additional component highly sensitive to air at high temperature, as for example zirconium, can thus be contemplated.

[0014] According to other features :

- said transfer channel may be arranged in front of the secondary supply chamber, thus obliging the molten metal alloy to transit through the secondary supply chamber,
- said crucible can be made of graphite, thus allying the good strength in a hot atmosphere of the graphite, insofar as there is no oxygen, and the tendency of the graphite to draw the small quantity of oxygen that remains in the molten metal alloy, making the latter even leaner in oxygen, and thus little reactive to the coming supply of secondary metal.

[0015] The present invention also relates to a machine for continuously casting a bar or coil made of metal alloy, comprising a crucible according to the invention, and a casting furnace surrounding said crucible, said casting furnace containing, in addition, heating elements made of graphite and a ceramic liner for protecting the top of the crucible ; the heating elements made of graphite permit to heat the crucible for maintaining the molten metal alloy at temperature until the casting, and the ceramic liner protects the top of the crucible against oxidation through contact with the air.

[0016] According to other features :

- said liner may include a partition configured so as to separate the secondary supply chamber from the primary supply chamber, thus providing a very practical solution for the separation.

[0017] The present invention finally relates to a method for manufacturing a bar or coil through continuously casting by means of a machine according to the invention, characterized in that it comprises the following steps :

- supplying the primary alloy in the absence of oxygen in the primary supply chamber of the crucible

- adding a secondary metal into said oxygen-free primary alloy in the secondary supply chamber of the crucible
- casting through a casting die

[0018] According to other features :

- said method can comprise an additional step of mixing the secondary metal into the primary alloy, in order to get an homogeneous composition, said mixing being made through mechanical stirring, through the flow of the primary molten alloy supply, through electromagnetic stirring, or any other method,
- said primary molten alloy supply can occur by means of a fore hearth of a melting furnace that contains the liquid metal, which feeds a primary supply chamber of a crucible, and is placed on a liner of said crucible so as to protect a primary supply opening of said crucible from air ingress, thus proposing an effective and simple method of protection,
- the supply of primary alloy into the primary supply chamber at the level of said fore hearth can be regulated by acting on the opening and closing of a stopper, with respect to a nozzle located above and preferably in the middle of the primary supply opening, which provides the advantage of a robust and simple method, the preferred position in the middle providing an ideal flow configuration,
- the opening/closing of the stopper can be actuated depending on a level sensor and depending on the turbulence one wants to create in the primary and/or a secondary supply chambers, the level sensor giving the information when primary alloy needs to be supplied or not, and the turbulence being requested stronger when the degree of homogeneity needs to be increased,
- said secondary metal can be added into a secondary supply chamber, in order to get a type of flow and mixing that results in a good homogeneity of the resulting alloy for the casting step,
- said secondary metal can be added in the pure solid form or in the form of a mother alloy, preferably in the form of powder, preferably inside a tube made of the same material as the primary alloy or as the basic element of the primary alloy, the supply speed of which can be adjusted, thus permitting same to be immersed into the molten metal alloy bath and protected against the air before being at high temperature,
- said supply of primary alloy can occur in a protective atmosphere by adding a protective gas, thus avoiding that said molten alloy becomes loaded with oxygen,
- said primary alloy can be copper alloy or a copper-chromium alloy, and said secondary metal can contain zirconium, thus permitting the casting of a bar or coil made of CuZr or CuCrZr alloy, adapted for

example for the production of spot-welding electrodes.

[0019] The advantage deriving from the present invention consists in the fact that the additional component highly sensitive to air, like zirconium, is introduced into an oxygen-free molten metal. It is thus preserved in its entirety for forming the finally casted alloy, which permits to control the zirconium content of the alloy, while minimizing the consumption of this metal.

[0020] Further features and advantages of the invention will become clear from the following detailed description, which refers to one exemplary embodiment, which is given by way of an indication and is non-restrictive.

[0021] The understanding of this description will be facilitated when referring to the attached drawings, in which :

- figure 1 represents a cross-section of a device according to the invention
- figure 2 represents a view from above of the device of fig. 1 ;
- figure 3 represents the cross-section BB of the device of fig.2 ;
- figure 4 represents a partial cross-sectional view of a fore hearth of a melting furnace
- figure 5 represents a view from above of a crucible according to the invention ;
- figure 6 represents the cross section CC of the device of fig. 2 according to a first embodiment of the invention ;
- figure 7 represents the cross section CC of the device of fig. 2 according to a second embodiment of the invention.

[0022] As shown in figures 1 to 7 of the attached drawing, the present invention relates to a machine 1 for continuous casting. The machine 1 is described hereafter with respect to a manufacture of electrodes made of an alloy of copper, chromium and zirconium. The specialist in the art will easily be able to adapt the solution to other alloys comprising an element highly reactive to oxygen in a hot atmosphere. This machine 1 includes a crucible 7, with a casting chamber 2 provided with a continuous casting die 3, shown when casting upwards. The invention also encompasses the machines 1 with a different number of dies 3, as well as with horizontal or downward casting dies 3, and it is easy for a specialist in the art to adapt it to this case.

[0023] The crucible 7 also includes a primary supply chamber 4 configured for supplying the machine 1 with molten metal alloy, in particular copper and chromium. It includes, in addition, a secondary supply chamber 5 configured for supplying the machine 1 with an alloying metal, in particular zirconium. A transfer channel 6 is arranged between the secondary supply chamber 5 and the casting chamber 2 at a level normally covered with liquid metal in operation, said channel 6 permitting that the molten

metal passes from the secondary supply chamber 5 to the casting chamber 2, or exceptionally comes back from same, for example during a stoppage of the casting in order to absorb an expansion of the molten metal.

[0024] The crucible 7 is made of graphite. This material has a first advantage, which is that it withstands high temperatures, in the range of 2000°C, at which the molten metal is present. Nevertheless, at these temperatures it becomes quickly oxidized in the presence of oxygen. A ceramic liner 8 has therefore been arranged on the top of the crucible 7, in order to protect it against room air. Ceramic is a good choice for such a liner because it withstands high temperatures and effectively protects the graphite of the crucible from the oxygen of the air; however other materials can also be used. This liner 8 can advantageously completely close the casting and supply chambers 2, 4, 5, while leaving only openings 12 necessary for the dies 3, on the one hand, and 13, 14 for the supply, on the other hand of molten metal and alloying metal. In addition, this liner 8 may comprise a partition 11 (see fig. 7) for separating the primary supply chamber 4 from the secondary supply chamber 5. The liner 8 may alternatively not have such a partition 11, and the separation of the primary supply chamber 4 from the secondary supply chamber 5 is then made by a wall of the crucible 7 itself (see fig. 6). An interior opening 21 is provided in both cases, providing a passage between both chambers. The crucible 7 is furthermore placed in a casting furnace 9 provided with heating elements 10 made of graphite. These heating elements 10 are configured to heat the crucible 7 through radiation. They are in turn heated by the passing through of a current and by joule effect. The complete casting furnace 9 is filled with a protective gas, for example nitrogen, which permits to protect both the heating elements 10 and the outside of the crucible 7 against room air, and thus to avoid their accelerated oxidizing.

[0025] The inside of the crucible 7, forming the casting and supply chambers 2, 4, 5, is protected against the oxygen by the presence of the molten metal.

[0026] In addition, one tries, within the scope of the present invention, to protect the zirconium present in the molten metal against the oxygen. Hereafter will be described the measures aimed at minimizing the presence of oxygen in the molten metal. It is however not possible to completely eliminate the presence of oxygen. Now, graphite is highly reactive to oxygen at the temperatures involved. The graphite of the crucible 7 will thus draw and entrap the oxygen still present in the molten metal, which further reduces the quantity of oxygen likely to oxidize the zirconium.

[0027] The supply of molten copper and chromium alloy occurs through the primary supply opening 13 of the liner 8 towards the primary supply chamber 4. The copper and the chromium are melted in a melting furnace 20 (figure 4), in which they are subjected to heating and magnetic stirring according to known methods.

[0028] The melting furnace 20 is designed with a fore

hearth 15 for transferring the molten copper-chromium alloy to the primary supply chamber 4, through the primary supply opening 13. The form of the fore hearth 15 and the primary supply opening 13 is such that, during operation, the primary supply opening 13 is « closed » by the fore hearth 15 of the melting furnace 20. The transfer occurs in a nitrogen atmosphere, injected into the primary supply chamber 4, in order to avoid any contact of the liquid alloy with oxygen, and to thus minimize the quantity of oxygen contained in the liquid alloy inside the primary supply chamber 4.

[0029] The molten metal alloy flows towards the secondary supply chamber 5, passing through the interior opening 21 under the liner partition 11 when present, the surface of the melt in this secondary supply chamber 5 is protected from air with a graphite powder layer.

[0030] Solid zirconium is simultaneously introduced through the secondary supply opening 14 into the secondary supply chamber 5. The zirconium is heated and melts very quickly, through the conjunction of its low specific heat and its small mass percentage in the alloy. Once it is liquid, the zirconium disperses in the liquid, due to the movements induced by the supply into the two supply chambers 4, 5 and the transfer of the molten alloy through the transfer channel 6. One can also choose to add another mixing means, like a mechanical stirring means, or an electromagnetic stirring means.

[0031] According to the accuracy sought as regards the zirconium content of the alloy, zirconium can be introduced by means of a Cu 50% Zr 50% alloy in the form of more or less small particles, and even in the form of powder in a copper alloying tube 19. According to a particular embodiment, the supply of liquid copper-chromium alloy is regulated through the opening-closing action of a stopper 16 on a nozzle 17 located at the bottom of the fore hearth 15. The opening is actuated when the level sensor 18 arranged in a supply chamber 4, 5 indicates a predetermined low level, the closing is actuated when the level sensor 18 indicates a predetermined high level. The zirconium supply occurs in the secondary chamber 5 in the form of zirconium powder, according to a flow rate adapted to the supply of molten metal alloy into the primary supply chamber 4.

[0032] There can be another level sensor in the casting chamber 2, intended to control the level of molten alloy at the continuous casting die 3. The machine 1 can be configured vertically mobile, in order to allow adjustments so as to guarantee a constant level at said die.

[0033] The advantage of the present invention is that the shape of the liner 8, the primary supply opening 13, the fore hearth 15, the stopper 16 and the nozzle 17 are configured so that in the situation of production:

- the fore hearth 15 is placed on the liner 8 and obstructs the primary supply opening 13, making easy the inerting with nitrogen of the free space of the primary supply chamber 4 above the molten metal alloy.

- The supply into the primary supply chamber 4 occurs by opening the stopper 16, which lets the liquid metal pass from the fore hearth 15 through the nozzle 17, this supply can occur continuously or discontinuously by opening, then closing the stopper 16.

[0034] The advantage deriving from the present invention resides in particular in that the zirconium is introduced into an oxygen-free molten metal. It is thus preserved to a maximum for forming the finally casted alloy, which permits to control the zirconium content of the alloy, while minimizing the consumption of this metal.

[0035] In order to control the melting and the mixing of Zr into the basic alloy, it can be easier to introduce the Zr as deep as possible into the secondary supply chamber 5, and to perform a strong stirring in order to melt and mix very well the Zr. In case Zr is in the form of powder in a copper tube 19, the more it is desired that the Zr be released at the bottom of the secondary supply chamber 5, the more the speed of introduction of the copper alloying tube 19 should be increased, so that the copper wall of the tube 19 melts later and releases the Zr deeper. It is possible that by acting in this way more Zr than necessary is introduced, then the copper alloying tube 19 will have to be removed and the supply of Zr will have to be discontinuous.

[0036] In order to improve the stirring in the secondary supply chamber 5 and to accelerate the melting and mixing of the Zr, it can be useful to increase the flow rate of the supply towards the primary supply chamber 4 beyond the flow rate of extraction by the casting dies 3, this will create a turbulence in the primary and secondary supply chambers 4, 5, but will also cause the level of the liquid metal in the whole crucible 7 to rise. It will be necessary to reduce, even stop the supply towards the primary supply chamber 4 by acting on the closing of the stopper 16.

[0037] Although the invention has been described with respect to a particular embodiment, it is understood that it is in no way restricted thereto and that various modifications of shapes, materials and combinations of these various elements can be made without departing from the framework of the invention.

Claims

1. Crucible (7) for a machine (1) for continuously casting a bar or coil of a metal alloy, including a casting chamber (2), a primary supply chamber (4) for supplying a molten metal alloy, **characterized in that** it includes a transfer channel (6), for transferring said molten metal alloy to the casting chamber (2), and it includes in addition a secondary supply chamber (5) configured for supplying the machine (1) with a secondary metal and connected to the primary supply chamber (4) through an interior opening (21) arranged at the lower level of said primary supply chamber (4), and configured so that, in operation,

the separation is complete at the level of the surface of said molten metal alloy in the primary supply chamber (4) .

2. Crucible (7) according to the preceding claim, wherein said transfer channel (6) is arranged in front of the secondary supply chamber (5), between the secondary supply chamber (5) and the casting chamber (2) at a level normally covered with liquid metal in operation, said channel (6) permitting that the molten metal passes from the secondary supply chamber (5) to the casting chamber (2).
3. Crucible (7) according to any of the preceding claims, made of graphite.
4. Machine (1) for continuously casting a bar or coil of a metal alloy, comprising a crucible (7) according to one of the preceding claims, and a casting furnace surrounding said crucible (7), said casting furnace (9) containing, in addition, heating elements (10) made of graphite and a ceramic liner (8) for protecting the top of the crucible (7).
5. Machine (1) according to the preceding claim, wherein said liner (8) includes a liner partition (11) configured to separate the secondary supply chamber (5) from the primary supply chamber (4).
6. Method for manufacturing a bar or coil through continuously casting by means of a machine (1) according to one of claims 4 or 5, **characterized in that** it comprises the following steps:
 - supplying a molten metal alloy in the absence of oxygen in the primary supply chamber (4) of the crucible (7)
 - adding a secondary metal into said oxygen-free primary alloy in the secondary supply chamber (5) of the crucible (7)
 - casting through a casting die (3).
7. Method according to claim 6 which comprises an additional step of mixing the secondary metal into the primary alloy
8. Method according to one of the two preceding claims, wherein said molten metal alloy supply occurs by means of a fore hearth (15) of a melting furnace (20) that contains the molten metal alloy, said fore hearth (15) feeding a primary supply chamber (4) of a crucible (7), and being placed on a liner (8) of said crucible (7) so as to protect a primary supply opening (13) of said crucible (7) from air ingress.
9. Method according to the preceding claim, wherein the supply of molten metal alloy into the primary supply chamber (4) at the level of said fore hearth (15)

is regulated by acting on the opening and closing of a stopper (16), with respect to a nozzle (17) located above and in the middle of the primary supply opening (13).

10. Method according to the preceding claim, wherein the opening/closing of the stopper (16) is actuated depending on a level sensor (18) and depending on the turbulence one wants to create in the primary and/or a secondary supply chambers (4,5).
11. Method according to one of the claims 6 to 10, wherein said secondary metal is added in the pure solid form or in the form of a mother alloy, in the form of powder, inside a copper alloying tube (19) the supply speed of which can be adjusted.
12. Method according to one of the claims 6 to 12, wherein said molten metal alloy supply occurs in a protective atmosphere by adding a protective gas.
13. Method according to one of claims 6 to 13 wherein said molten metal alloy is a copper-chromium alloy, and said secondary metal contains zirconium.

Patentansprüche

1. Tiegel (7) für eine Maschine (1) zum Stranggießen einer Stange oder Spule einer Metalllegierung, umfassend eine Gießkammer (2), eine primäre Zufuhrkammer (4) zum Zuführen einer Metalllegierungsschmelze, **dadurch gekennzeichnet, dass** er einen Überführungskanal (6) umfasst, um die Metalllegierungsschmelze in die Gießkammer (2) zu überführen, und dass er zusätzlich eine sekundäre Zufuhrkammer (5) umfasst, die konfiguriert ist, um die Maschine (1) mit einem Sekundärmetall zu speisen, und über eine innere Öffnung (21), die im unteren Bereich der besagten primären Zufuhrkammer (4) angeordnet ist, mit der primären Zufuhrkammer (4) verbunden und so konfiguriert ist, dass im Betrieb die Trennung im Bereich der Oberfläche der besagten Metalllegierungsschmelze in der primären Zufuhrkammer (4) vollständig ist.
2. Tiegel (7) nach dem vorhergehenden Anspruch, bei dem der besagte Überführungskanal (6) gegenüber der sekundären Zufuhrkammer (5), zwischen der sekundären Zufuhrkammer (5) und der Gießkammer (2) auf einer Höhe angeordnet ist, die im Betrieb normalerweise mit flüssigem Metall bedeckt ist, wobei der besagte Kanal (6) erlaubt, dass die Metallschmelze von der sekundären Zufuhrkammer (5) in die Gießkammer (2) gelangt.
3. Tiegel (7) nach irgendeinem der vorhergehenden Ansprüche, der aus Graphit gefertigt ist.

4. Maschine (1) zum Stranggießen eines Stabes oder einer Spule einer Metalllegierung, umfassend einen Tiegel (7) nach einem der vorhergehenden Ansprüche und einen Gießofen, der den besagten Tiegel (7) umgibt, wobei der besagte Gießofen (9) außerdem Heizelemente (10) aus Graphit und eine Keramikauskleidung (8) zum Schützen des oberen Teils des Tiegels (7) enthält.
5. Maschine (1) nach dem vorhergehenden Anspruch, bei der die besagte Auskleidung (8) eine Auskleidungs-Trennwand (11) umfasst, die konfiguriert ist, um die sekundäre Zufuhrkammer (5) von der primären Zufuhrkammer (4) zu trennen.
6. Verfahren zur Herstellung einer Stange oder Spule durch Stranggießen mittels einer Maschine (1) nach einem der Ansprüche 4 oder 5, **dadurch gekennzeichnet, dass** es die folgenden Schritte umfasst:
 - Zuführen einer Metalllegierungsschmelze in Abwesenheit von Sauerstoff in die primäre Zufuhrkammer (4) des Tiegels (7),
 - Zugeben eines Sekundärmetalls in die besagte sauerstofffreie Primärlegierung in der sekundären Zufuhrkammer (5) des Tiegels (7),
 - Gießen durch eine Gießdüse (3).
7. Verfahren nach Anspruch 6, das einen zusätzlichen Schritt der Zumischung des Sekundärmetalls in die Primärlegierung umfasst.
8. Verfahren nach einem der beiden vorhergehenden Ansprüche, bei dem die besagte Zuführung der Metalllegierungsschmelze mittels eines vorderen Herdes (15) eines Schmelzofens (20) erfolgt, der die Metalllegierungsschmelze enthält, wobei der besagte vordere Herd (15) eine primäre Zufuhrkammer (4) eines Tiegels (7) speist und auf einer Auskleidung (8) des besagten Tiegels (7) angeordnet ist, sodass eine primäre Zufuhröffnung (13) des besagten Tiegels vor Lufteintritt geschützt wird (7).
9. Verfahren nach dem vorhergehenden Anspruch, bei dem die Zufuhr von Metalllegierungsschmelze in die primäre Zufuhrkammer (4) im Bereich des besagten vorderen Herdes (15) durch Einwirkung auf das Öffnen und Schließen eines Stopfens (16) in Bezug auf eine oberhalb und in der Mitte der primären Zufuhröffnung (13) angeordnete Düse (17) reguliert wird.
10. Verfahren nach dem vorhergehenden Anspruch, bei dem das Öffnen/Schließen des Stopfens (16) in Abhängigkeit von einem Füllstandssensor (18) und in Abhängigkeit von der Verwirbelung, die man in der Primär- und/oder einer Sekundärkammer (4, 5) schaffen wünscht, betätigt wird.

11. Verfahren nach einem der Ansprüche 6 bis 10, bei dem das besagte Sekundärmetall in reiner Feststoffform oder in der Form einer Mutterlegierung, in der Form eines Pulvers innerhalb eines Kupferlegierungsrohrs (19), dessen Zufuhrgeschwindigkeit eingestellt werden kann, zugegeben wird.
12. Verfahren nach einem der Ansprüche 6 bis 12, bei dem die besagte Zufuhr der Metalllegierungsschmelze in einer Schutzatmosphäre durch Zugabe eines Schutzgases erfolgt.
13. Verfahren nach einem der Ansprüche 6 bis 13, bei dem die besagte Metalllegierungsschmelze eine Kupfer-Chrom-Legierung ist und das besagte Sekundärmetall Zirkonium enthält.

Revendications

1. Creuset (7) pour une machine (1) de coulée en continu d'une barre ou d'une bobine d'un alliage métallique, comportant une chambre de coulée (2), une chambre d'alimentation primaire (4) destinée à alimenter un alliage de métal en fusion, **caractérisé par le fait qu'il** comporte un canal de transfert (6) destiné à transférer ledit alliage de métal en fusion vers la chambre de coulée (2) et qu'il comporte en outre une chambre d'alimentation secondaire (5) configurée pour alimenter la machine (1) en métal secondaire et connectée à la chambre d'alimentation primaire (4) par une ouverture intérieure (21) disposée au niveau inférieur de ladite chambre d'alimentation primaire (4) et configurée de sorte que, en fonctionnement, la séparation soit complète au niveau de la surface dudit alliage de métal en fusion dans la chambre d'alimentation primaire (4).
2. Creuset (7) selon la revendication précédente, dans lequel ledit canal de transfert (6) est disposé face à la chambre d'alimentation secondaire (5), entre la chambre d'alimentation secondaire (5) et la chambre de coulée (2) à un niveau normalement recouvert de métal liquide en fonctionnement, ledit canal (6) permettant au métal en fusion de passer de la chambre d'alimentation secondaire (5) à la chambre de coulée (2).
3. Creuset (7) selon l'une quelconque des revendications précédentes, réalisé en graphite.
4. Machine (1) de coulée en continu d'une barre ou d'une bobine en alliage de métal, comprenant un creuset (7) selon l'une des revendications précédentes, et un four de coulée entourant ledit creuset (7), ledit four de coulée (9) contenant, en outre, des éléments chauffants (10) réalisés en graphite et un revêtement céramique (8) destiné à protéger la partie

supérieure du creuset (7).

5. Machine (1) selon la revendication précédente, dans laquelle ledit revêtement (8) comporte une cloison de revêtement (11) configurée pour séparer la chambre d'alimentation secondaire (5) de la chambre d'alimentation primaire (4).
6. Procédé de fabrication d'une barre ou d'une bobine par coulée en continu au moyen d'une machine (1) selon l'une des revendications 4 ou 5, **caractérisé par le fait qu'il** comprend les étapes suivantes consistant à:
- alimenter un alliage de métal en fusion en l'absence d'oxygène vers la chambre d'alimentation primaire (4) du creuset (7),
 - ajouter un métal secondaire dans ledit alliage primaire exempt d'oxygène dans la chambre d'alimentation secondaire (5) du creuset (7),
 - couler à travers une filière de coulée (3).
7. Procédé selon la revendication 6, qui comprend une étape additionnelle consistant à mélanger le métal secondaire dans l'alliage primaire.
8. Procédé selon l'une des deux revendications précédentes, dans lequel l'alimentation d'alliage de métal en fusion a lieu au moyen d'un foyer avant (15) d'un four de fusion (20) qui contient l'alliage de métal en fusion, ledit foyer avant (15) alimentant une chambre d'alimentation primaire (4) d'un creuset (7) et étant placé sur un revêtement (8) dudit creuset (7) de manière à protéger une ouverture d'alimentation primaire (13) dudit creuset (7) contre l'entrée d'air.
9. Procédé selon la revendication précédente, dans lequel l'alimentation d'alliage de métal en fusion vers la chambre d'alimentation primaire (4) au niveau dudit foyer avant (15) est régulée en agissant sur l'ouverture et la fermeture d'un bouchon (16), par rapport à une buse (17) située au-dessus et au centre de l'ouverture d'alimentation primaire (13).
10. Procédé selon la revendication précédente, dans lequel l'ouverture/fermeture du bouchon (16) est actionnée en fonction d'un capteur de niveau (18) et en fonction de la turbulence que l'on souhaite créer dans les chambres d'alimentation primaire et/ou secondaire (4, 5).
11. Procédé selon l'une des revendications 6 à 10, dans lequel ledit métal secondaire est ajouté sous forme solide pure ou sous forme d'un alliage mère, sous forme de poudre, dans un tube d'alliage de cuivre (19) dont la vitesse d'alimentation peut être ajustée.
12. Procédé selon l'une des revendications 6 à 12, dans

lequel ladite alimentation d'alliage de métal en fusion a lieu dans une atmosphère protectrice en ajoutant un gaz protecteur.

13. Procédé selon l'une des revendications 6 à 13, dans lequel ledit alliage de métal en fusion est un alliage de cuivre et de chrome, et ledit métal secondaire contient du zirconium.

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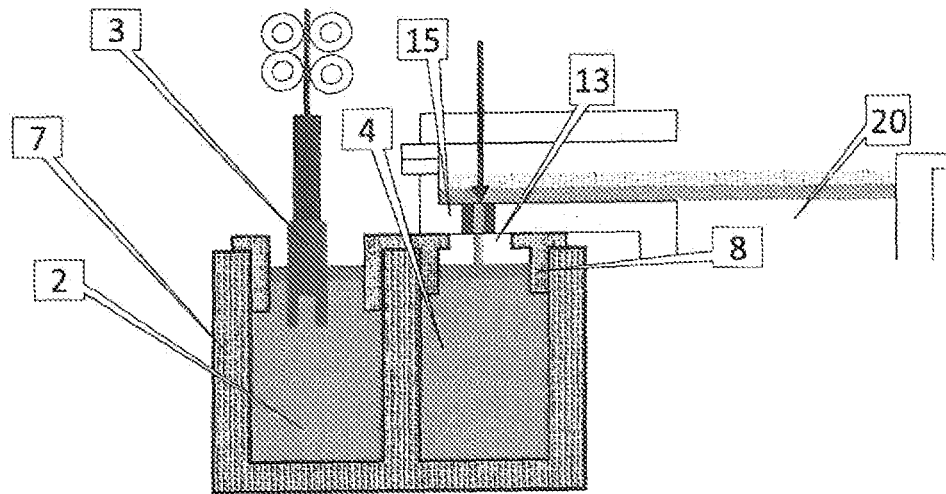


Fig. 1

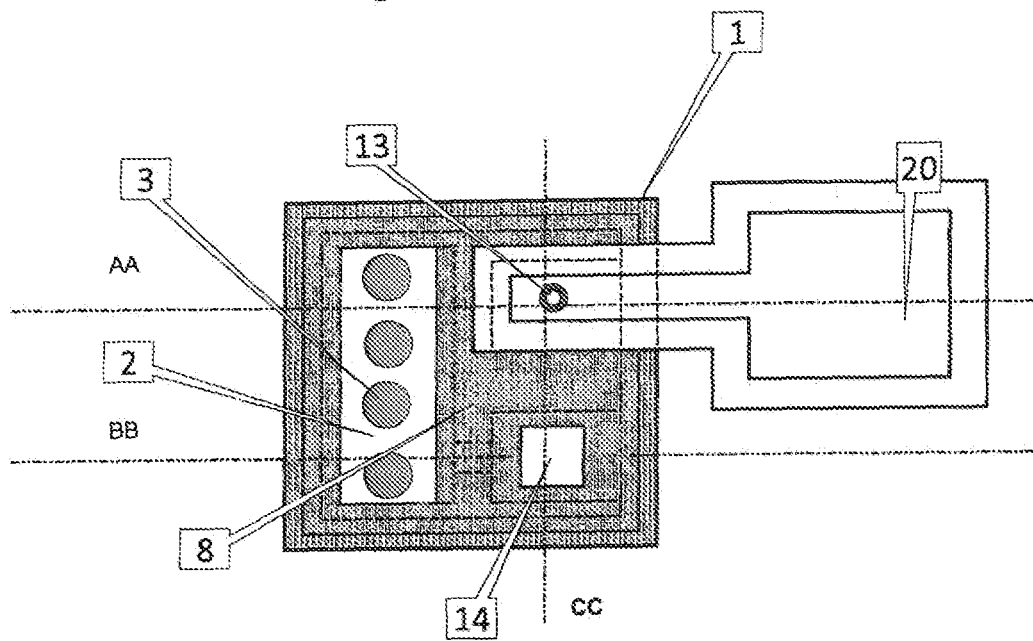


Fig 2

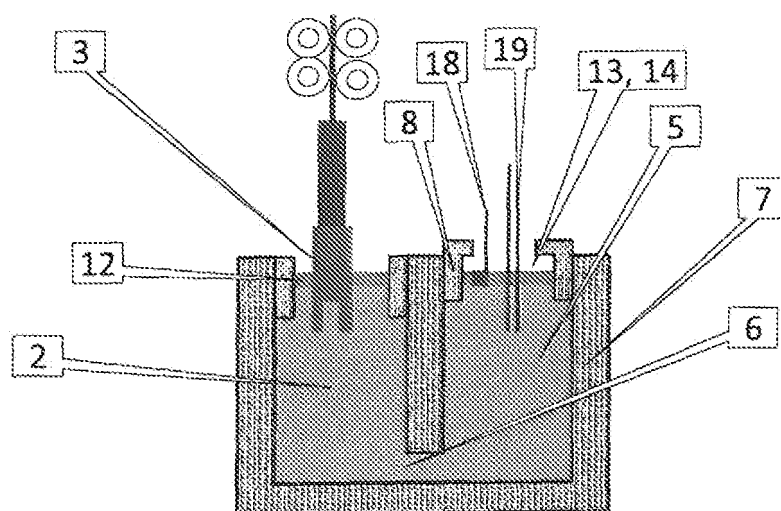


Fig. 3

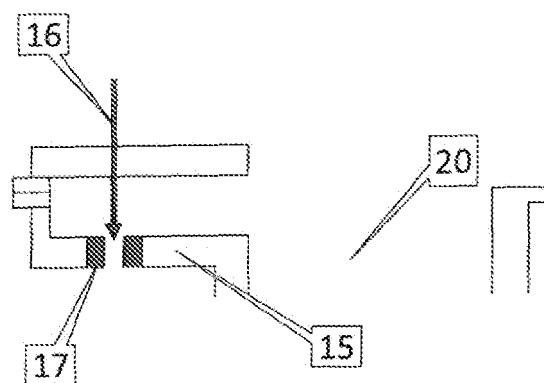


Fig 4

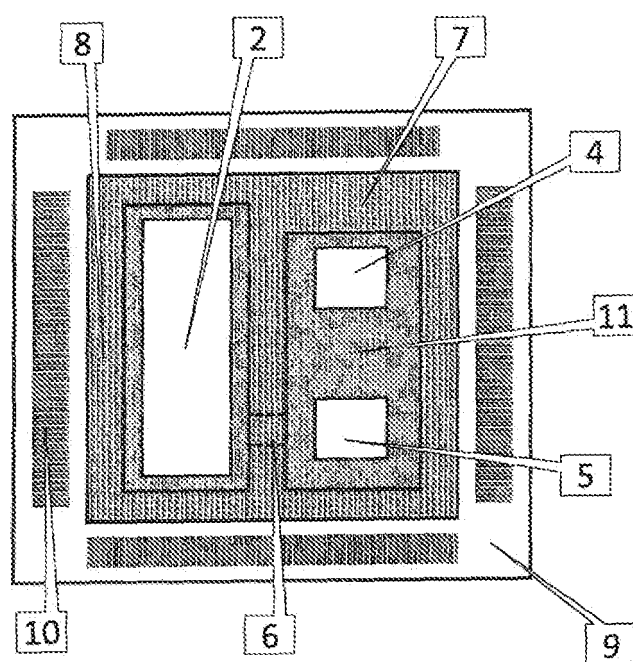


Fig 5

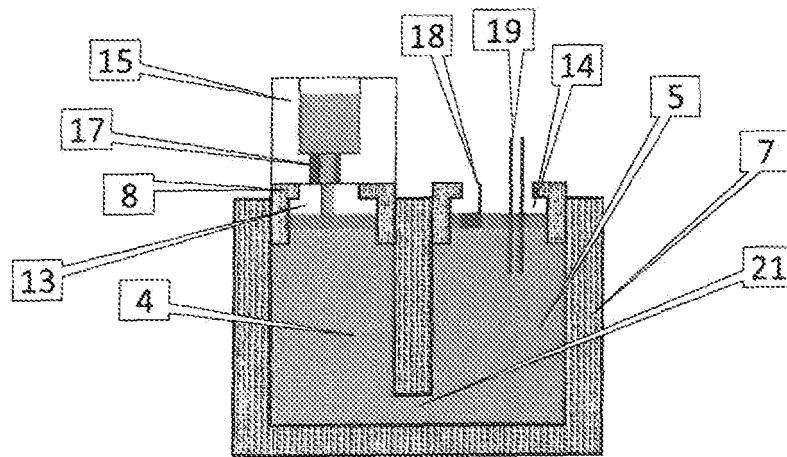


Fig. 6

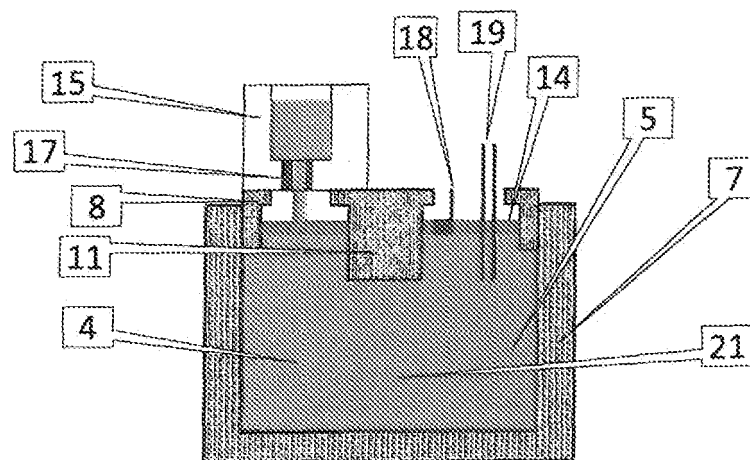


Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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