



Description

This invention relates to a continuous casting furnace and to a method of continuously manufacturing an elongate cast product, for example, of copper and its alloy for use in electronic components.

A continuous casting furnace is known from DE—C—903137, from which the preambles of the independent claims 1 and 4 start.

The known furnace comprises a continuous casting furnace for manufacturing an elongate cast product comprising:

- (a) a housing defining a chamber;
- (b) a crucible having an open top and accommodated within said chamber for holding a casting material;
- (c) a heater for melting the casting material in said crucible in order to provide a molten casting material;
- (d) an elongate casting nozzle disposed generally vertically above the base of said crucible;
- (e) a cooling means associated with said casting nozzle; and

(f) an inert gas source for introducing inert gas into said chamber whereby when the lower end of said casting nozzle is immersed in said molten casting material, said molten casting material is moved along said casting nozzle by the pressure of said inert gas thereon and said cooling means cools said nozzle thereby solidifying said molten casting material to form the elongate cast product.

A method known from DE—C—903137 comprises the following steps

- (a) providing a continuous casting furnace comprising: a housing defining a chamber; a crucible accommodated within said chamber and having an open top; and an elongate casting nozzle being disposed generally vertically above the base of said crucible;
- (b) charging said crucible with a casting material;
- (c) creating a non-oxidizing atmosphere in said crucible;
- (d) subsequently heating said crucible to melt said casting material in said crucible to form a molten casting material; and
- (e) cooling the molten casting material when it is passed through said elongate casting nozzle.

With the development of the electronic industry, a copper alloy for use as lead frames of IC (Integrated Circuit), LSI (Large Scale Integrated Circuit) and the like has recently been required to have a higher strength and a better electric conductivity. Copper alloys containing active metals such as zirconium (Zr), chromium (Cr) and titanium (Ti) can meet this requirement. However, such a copper alloy product is usually cast in the atmosphere, so that part of the active metals are oxidized to form oxides which are contained in the resultant cast product as inclusions. In addition, when this cast product is subjected to rolling, stringers are caused to develop in the rolled product. Such a product can not be used for lead

frames. To avoid this difficulty, starting materials of the above-mentioned copper alloy may be melted and cast into an ingot under vacuum, and then the ingot is rolled into a bar, a strip or the like. However, this procedure is quite expensive and therefore is not practical.

Also, in the electronic industry, there has been a demand for a wire of pure copper having a diameter of less than 50 microns. When such a copper wire is produced with an ordinary casting method, it is susceptible to breakage. It is thought that this difficulty arises from the presence of the inclusions such as oxides in the cast copper. To avoid this, vacuum melting is necessary, but this is expensive and therefore not practical.

Further, an ingot produced by ordinary vacuum melting has a relatively large diameter and must subsequently be subjected to a hot processing such as a hot rolling to reduce it to a desired diameter or cross-section. During this hot processing, the scales on the ingot are forced into the wire, and part of the iron content of the rolls is transferred to the rolled wire. This also causes breakage of the wire.

An object of the invention is to provide a simple inexpensive method and apparatus for manufacturing high quality elongate products.

Another object of this invention is to provide a continuous casting furnace which, in a non-oxidizing atmosphere, can melt a casting material and continuously cast the molten casting material into an elongate product.

Another object is to provide a method of continuously manufacturing such a cast product.

According to a first aspect of the present invention the continuous casting furnace for manufacturing an elongate cast product is characterised in that:

- (g) said nozzle is hermetically connected to said housing and extends into said chamber;
- (h) said heater is mounted on said crucible;
- (i) either said casting nozzle or said crucible is movable toward the other for immersing the lower end of said casting nozzle in the molten casting material in said crucible; and
- (j) said housing is connected to a vacuum source for creating a vacuum in said chamber when said casting material is melted.

According to a second aspect of the present invention the method of continuously manufacturing an elongate cast product is characterised by:

- (f) said non-oxidizing atmosphere being created in step (c) by evacuation of said chamber;
- (g) providing said casting nozzle with a cap removably attached to the upper open end thereof and hermetically connecting the nozzle to said housing to extend into said chamber;
- (h) introducing inert gas into said chamber after step (d) to increase the pressure therein to atmosphere pressure;
- (i) moving either of said casting nozzle and said crucible toward the other to immerse a lower end of said casting nozzle in the molten casting material in said crucible;
- (j) removing said cap from the upper end of said

casting nozzle and inserting one end portion of a starting wire into said casting nozzle from the upper open end thereof;

(k) increasing the pressure of the inert gas in said chamber to move the molten casting material along said casting nozzle into contact with said starting wire; and

(l) moving said starting wire upwardly out of said casting nozzle together with the elongate cast product formed in step (e).

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Fig. 1 is a schematic cross-sectional view of a continuous casting furnace provided in accordance with one embodiment of the present invention;

Fig. 2 is a cross-sectional view of a casting nozzle incorporated in the casting furnace, showing a starting wire inserted therein; and

Fig. 3 is a cross-sectional view of a modified continuous casting furnace.

A continuous casting furnace 10 schematically shown in Fig. 1 comprises a box-like air-tight housing 11 of a relatively large size defining a chamber 12. An evacuation conduit 13 is connected at one end to a first port 13a formed in the side wall of the housing 11 and at the other end to a vacuum source 13b for creating a vacuum of 10^{-3} to 10^{-4} mm Hg in the chamber 12. Another conduit 14 is connected at one end to a second port 14a in the side wall of the housing 11 and at the other end to an inert gas source 14b for introducing inert gas into the chamber 12. The conduits 13 and 14 are also connected at the other ends to a vacuum source (not shown) and an inert gas source (not shown), respectively. Valves 15 and 16 are mounted on the conduits 13 and 14, respectively.

A crucible 18 for melting a casting material such as copper or its alloy is accommodated within the housing 11, the crucible 18 having an open top through which the crucible 18 is charged with the casting material. A high-frequency induction coil 19 is wound around the crucible 18 so that the crucible 18 is adapted to undergo radiofrequency induction heating to melt the casting material in the crucible 18.

A flanged aperture 21 is formed through a top wall of the housing 11. A casting nozzle 23 in the form of a cross-sectionally circular tube is received in the flanged aperture 21 in an air-tight manner for sliding movement along an axis thereof, the casting nozzle 23 being disposed vertically. The casting nozzle 23 may be of any polygonal cross-section such as a square cross-section. Although not shown in the drawings, the casting nozzle 23 is provided with a water cooling means. The casting nozzle 23 serves as a mold for continuously casting a length of wire as herein-after more fully described. The casting nozzle 23 is disposed substantially at the center of the crucible 18 and is vertically movable by an actuator means (not shown) between an upper

inoperative position in which the lower end of the casting nozzle 23 is retracted from the crucible 18 and a lower operative position in which the lower end of the casting nozzle 23 is immersed in the molten casting material in the crucible 18. A cap 25 is adapted to be removably attached to the upper end of the casting nozzle 23 for closing it in an air-tight manner. The casting nozzle 23 can be made of graphite, but it is preferred that the surface of the bore of the graphite casting nozzle 23 is coated with a protective film made, for example, of SiC when it is intended to produce the cast product of the copper alloy containing the active metals such as Zr and Cr.

The operation of the continuous casting furnace 10 will now be described.

First, the valve 15 is opened to evacuate the chamber 12 via the conduit 13 to a vacuum of a predetermined level. At this time, the casting nozzle 23 is held in its upper inoperative position, and the upper end of the casting nozzle 23 is closed by the cap 25. Then, the induction coil 19 is energized to melt the casting material in the crucible 18 to provide a molten casting material 26. Then, the valve 15 is closed to stop the evacuation of the chamber 12, and subsequently the valve 16 is opened to feed inert gas such as argon gas to the chamber 12 via the conduit 14 to increase the pressure of the chamber 12 to atmospheric pressure. Then, the casting nozzle 23 is moved downwardly to immerse its lower end in the molten casting material 26 in the crucible 18. Then, the cap 25 is detached from the upper end of the casting nozzle 23. Then, one end portion of a starting wire 28 of a circular cross-section is inserted into the casting nozzle 23 from its upper end as shown in Fig. 2, the diameter of the starting wire 28 being slightly smaller than the inner diameter of the casting nozzle 23. The other end of the starting wire 28 is connected to a suitable take-up means (not shown) such as a take-up reel. Then, the pressure of the inert gas in the chamber 12 is increased to a level slightly greater than the atmospheric pressure, so that the molten casting material 26 in the crucible 18 is moved upwardly along the casting nozzle 23 and is brought into contact with the lower end of the starting wire 28. Then, the starting wire 28 is hauled upwardly either continuously or intermittently so that the molten material is cooled by the water cooling means and solidified during the passage through the casting nozzle 23 to produce a cast wire 29 having a circular cross-section corresponding to the bore of the casting nozzle 23. The cast wire 29 so produced is wound around the take-up reel. As the casting operation proceeds, the molten material 26 in the crucible 18 decreases, and therefore the casting nozzle 23 is gradually moved downwardly during the casting operation to ensure that the lower end of the casting nozzle 23 is dipped in the molten material 26 in the crucible 18. When the molten material 26 in the crucible 18 is almost consumed, the casting operation is stopped. And, the above procedure is repeated.



With the continuous casting furnace 10, the molten casting material, for example, of the copper alloy, containing active metals such as Zr, Cr and Ti, is formed in the vacuum, and this molten material is cast in the atmosphere of the inert gas. Therefore, the active metals are not subjected to oxidation, and stringers due to oxides of such active metals are not present in the resultant cast product of the copper alloy. Thus, a casting product of good quality can be obtained. In addition, by virtue of the provision of the elongate casting nozzle 23, the casting product can be obtained in the form of a wire. Therefore, an elongate final product can be easily obtained merely by drawing or rolling the cast wire into a predetermined cross-section. This will reduce the processing cost.

Further, since the molten material 26 is urged to move along the casting nozzle 23 under the influence of the pressure in the chamber 12 against the gravity, the molten casting material in the casting nozzle 23 is solidified under pressure, thereby enhancing the soundness of the cast product.

Further, when the casting operation is completed, the molten material at the lower end of the casting nozzle 23 is finally returned to the crucible 18 upon upward movement away from the crucible 18. Thus, the molten material 26 is subjected to substantially no loss, thereby much improving the yield.

Alternatively, in operation, the use of vacuum can be omitted. In this case, the inert gas is introduced from the inert gas source 14b into the chamber 12 when the casting material is melted in the crucible 18. Then, the casting nozzle 23 is moved downwardly to immerse its lower end in the molten casting material in the crucible 18. Then, the starting wire 28 is inserted into the casting nozzle 23, and subsequently the pressure of the inert gas in the chamber 12 is increased, so that the molten casting material in the crucible 18 is moved upwardly along the casting nozzle 23 and is brought into contact with the lower end of the starting wire 28.

Fig. 3 shows a modified continuous casting furnace 10a which comprises a housing 11 defining a chamber 12. An evacuation conduit 13 is connected to the housing 11, and an inert gas-feeding conduit (not shown) is also connected to the housing 11. The housing 11 is supported by legs 31 on a base 30 which is in turn supported on a horizontal floor 32 by legs 33. A water jacket 34 is hermetically received in and secured to a flanged aperture 21. A casting nozzle 23 is received in the water jacket 34, and the lower end of the casting nozzle 23 extends beyond the lower end of the water jacket 34. A hydraulic cylinder 35 is mounted on the base plate 30 and extends hermetically through a bottom wall of the housing 11, the cylinder 35 having a vertically-disposed piston rod 35a operatively associated therewith. A horizontal support plate 36 is mounted on the upper end of the piston rod 35a. A crucible 18 is placed on the support plate 36. A

high-frequency induction coil 19 is wound around the crucible 18. A mounting plate 38 is mounted on the base 30 through legs 39. An electric motor 41 is mounted on the mounting plate 38 through a mounting member 42. An output shaft of the motor 41 is connected to a pair of opposed pinch rolls 44 through a reduction gear train 45.

The operation of the continuous casting furnace 10a is carried out generally as described above for the continuous casting furnace 10 of Fig. 1. More specifically, the hydraulic cylinder 35 is operated to extend its piston rod 35a to move the crucible 18 upwardly toward the casting nozzle 35, so that the lower end of the casting nozzle 23 is immersed in a molten casting material 26 in the crucible 18. Then, a starting wire (not shown) is inserted into the casting nozzle 23, and the pressure of the inert gas in the chamber is increased so that the molten casting material 26 in the crucible 18 is moved upwardly along the casting nozzle 23 and is brought into contact with the lower end of the starting wire as described above for the continuous casting furnace 10 of Fig. 1. In this condition, the starting wire is held by the pinch rolls 44. Then, the motor 41 is operated to move the starting wire upwardly through the pinch rolls 44, so that the continuously-cast wire coming out of the casting nozzle 23 is guided by guide rolls 47, 48 and is wound around a take-up reel (not shown). The molten casting material is cooled by the water jacket 34 when it is passed through the casting nozzle 23 and is solidified to form the cast wire. As the casting operation proceeds, the piston rod 35a of the hydraulic cylinder 35 is gradually extended to ensure that the lower end of the casting nozzle 23 is immersed in the molten casting material 26.

The invention will now be illustrated by way of the following Examples.

Example 1

A cross-sectionally circular wire of copper alloy containing 0.4% of Cr and 0.1% of Zr was cast using the continuous casting furnace 10a of Fig. 3. The casting nozzle 23 was made of graphite having a protective coating of SiC formed on the surface of the bore of the nozzle, the nozzle 23 having an inner diameter of 12 mm. The crucible 18 was a graphite crucible (#60) and had a capacity of 50 kg. A power source for the high-frequency induction coil 19 had a capacity of 70 KW. The chamber 12 was held at a vacuum of 1×10^{-4} mm Hg during the melting of the casting material in the crucible 18. After this melting operation, argon gas was introduced into the chamber 12 and the pressure of the argon gas in the chamber 12 was maintained at a pressure of 1.5 kg/cm²G (the atmospheric pressure+0.5 kg/cm²) during the casting operation. In the manner described above, the cross-sectionally circular wire of the copper alloy having a diameter of 12 mm was continuously cast. Subsequently, the cast wire was shaved to a diameter of 10 mm. Then, the diameter of the shaved wire was further reduced to 60 μ m by cold rolling and drawing to



form a fine wire. The structure of this wire was observed, and it was found that no stringer was present in the fine wire and that the wire had a smooth texture. During the drawing operation, the wire broke less than once per 70 Kg of the wire. Thus, the strength of the wire was excellent, and in addition the electrical conductivity of the wire was excellent. Also, the shaved wire having a diameter of 10 mm was formed by cross-rolling and rolling into a strip having a thickness of 0.2 mm and a width of 40 mm. No stringer was found in this strip. Then, the strip was subjected to plating. A plating defect occurred less than once per 1 m² of the strip. Thus it was well suited for use as a lead frame of an IC or the like.

Example 2

50 Kg of a wire having a diameter of 12 mm was cast according to the same procedure of Example 1 except that the casting material was oxygen free copper and that the casting nozzle 23 of graphite had no coating on the surface of the bore of the nozzle. The wire was subjected to shaving, cold rolling, drawing and annealing so that the diameter of the wire was finally reduced to 25 μ m to form a very fine wire. Since the casting material was melted under vacuum, the wire had a negligible amount of inclusions. Also, since the casting was carried out under pressure, casting defects did not develop in the cast wire. Further, since the cast wire coming out of the casting nozzle 23 had such a small diameter as 12 mm, a hot rolling operation could be omitted, so that the cast wire did not have any scales which would otherwise develop during such a hot rolling. Therefore, the cast wire did not break during the later stage processing described above.

Claims

1. A continuous casting furnace for manufacturing an elongate cast product comprising:
 - (a) a housing (11) defining a chamber (12);
 - (b) a crucible (18) having an open top and accommodated within said chamber (12) for holding a casting material (26);
 - (c) a heater (19) for melting the casting material (26) in said crucible (18) in order to provide a molten casting material;
 - (d) an elongate casting nozzle (23) disposed generally vertically above the base of said crucible (18);
 - (e) a cooling means (34) associated with said casting nozzle (23); and
 - (f) an inert gas source (14b) for introducing inert gas into said chamber (12) whereby when the lower end of said casting nozzle (23) is immersed in said molten casting material, said molten casting material is moved along said casting nozzle (23) by the pressure of said inert gas thereon and said cooling means (34) cools said nozzle (23), thereby solidifying said molten casting material to form the elongate cast product, characterised in that:
 - (g) said nozzle (23) is hermetically connected to

said housing (11) and extends into said chamber (12);

(h) said heater (19) is mounted on said crucible (18);

(i) either said casting nozzle (23) or said crucible (18) is movable toward the other for immersing the lower end of said casting nozzle (23) in the molten casting material in said crucible (18); and

(j) said housing is connected to a vacuum source (13b) for creating a vacuum in said chamber (12) when said casting material is melted.

2. A continuous casting furnace according to claim 1 characterised by a power cylinder (35) mounted on said housing (11) for moving said crucible (18) toward said casting nozzle (23).

3. A continuous casting furnace according to claim 1 or 2 characterised by a drive means (41, 45) for moving the elongate cast product out of said casting nozzle (23).

4. A method of continuously manufacturing an elongate cast product comprising the steps of:

(a) providing a continuous casting furnace comprising: a housing (11) defining a chamber (12); a crucible (18) accommodated within said chamber (12) and having an open top; and an elongate casting nozzle (23) being disposed generally vertically above the base of said crucible (18);

(b) charging said crucible (18) with a casting material (26);

(c) creating a non-oxidizing atmosphere in said crucible (18);

(d) subsequently heating said crucible (18) to melt said casting material (26) in said crucible to form a molten casting material; and

(e) cooling the molten casting material when it is passed through said elongate casting nozzle (23), characterised by:

(f) said non-oxidizing atmosphere being created in step (c) by evacuation of said chamber (12);

(g) providing said casting nozzle with a cap (25) removably attached to the upper open end thereof and hermetically connecting the nozzle (23) to said housing (11) to extend into said chamber (12);

(h) introducing inert gas into said chamber after step (d) to increase the pressure therein to atmospheric pressure;

(i) moving either of said casting nozzle (23) and said crucible (18) toward the other to immerse a lower end of said casting nozzle (23) in the molten casting material (26) in said crucible (18);

(j) removing said cap from the upper end of said casting nozzle and inserting one end portion of a starting wire into said casting nozzle from the upper open end thereof;

(k) increasing the pressure of the inert gas in said chamber (12) to move the molten casting material along said casting nozzle (23) into contact with said starting wire; and

(l) moving said starting wire upwardly out of said casting nozzle together with the elongate cast product formed in step (e).



form a fine wire. The structure of this wire was observed, and it was found that no stringer was present in the fine wire and that the wire had a smooth texture. During the drawing operation, the wire broke less than once per 70 Kg of the wire. Thus, the strength of the wire was excellent, and in addition the electrical conductivity of the wire was excellent. Also, the shaved wire having a diameter of 10 mm was formed by cross-rolling and rolling into a strip having a thickness of 0.2 mm and a width of 40 mm. No stringer was found in this strip. Then, the strip was subjected to plating. A plating defect occurred less than once per 1 m² of the strip. Thus it was well suited for use as a lead frame of an IC or the like.

Example 2

50 Kg of a wire having a diameter of 12 mm was cast according to the same procedure of Example 1 except that the casting material was oxygen free copper and that the casting nozzle 23 of graphite had no coating on the surface of the bore of the nozzle. The wire was subjected to shaving, cold rolling, drawing and annealing so that the diameter of the wire was finally reduced to 25 μm to form a very fine wire. Since the casting material was melted under vacuum, the wire had a negligible amount of inclusions. Also, since the casting was carried out under pressure, casting defects did not develop in the cast wire. Further, since the cast wire coming out of the casting nozzle 23 had such a small diameter as 12 μm, a hot rolling operation could be omitted, so that the cast wire did not have any scales which would otherwise develop during such a hot rolling. Therefore, the cast wire did not break during the later stage processing described above.

Claims

1. A continuous casting furnace for manufacturing an elongate cast product comprising:

(a) a housing (11) defining a chamber (12);
(b) a crucible (18) having an open top and accommodated within said chamber (12) for holding a casting material (26);

(c) a heater (19) for melting the casting material (26) in said crucible (18) in order to provide a molten casting material;

(d) an elongate casting nozzle (23) disposed generally vertically above the base of said crucible (18);

(e) a cooling means (34) associated with said casting nozzle (23); and

(f) an inert gas source (14b) for introducing inert gas into said chamber (12) whereby when the lower end of said casting nozzle (23) is immersed in said molten casting material, said molten casting material is moved along said casting nozzle (23) by the pressure of said inert gas thereon and said cooling means (34) cools said nozzle (23), thereby solidifying said molten casting material to form the elongate cast product, characterised in that:

(g) said nozzle (23) is hermetically connected to

said housing (11) and extends into said chamber (12);

(h) said heater (19) is mounted on said crucible (18);

(i) either said casting nozzle (23) or said crucible (18) is movable toward the other for immersing the lower end of said casting nozzle (23) in the molten casting material in said crucible (18); and

(j) said housing is connected to a vacuum source (13b) for creating a vacuum in said chamber (12) when said casting material is melted.

2. A continuous casting furnace according to claim 1 characterised by a power cylinder (35) mounted on said housing (11) for moving said crucible (18) toward said casting nozzle (23).

3. A continuous casting furnace according to claim 1 or 2 characterised by a drive means (41, 45) for moving the elongate cast product out of said casting nozzle (23).

4. A method of continuously manufacturing an elongate cast product comprising the steps of:

(a) providing a continuous casting furnace comprising: a housing (11) defining a chamber (12); a crucible (18) accommodated within said chamber (12) and having an open top; and an elongate casting nozzle (23) being disposed generally vertically above the base of said crucible (18);

(b) charging said crucible (18) with a casting material (26);

(c) creating a non-oxidizing atmosphere in said crucible (18);

(d) subsequently heating said crucible (18) to melt said casting material (26) in said crucible to form a molten casting material; and

(e) cooling the molten casting material when it is passed through said elongate casting nozzle (23), characterised by:

(f) said non-oxidizing atmosphere being created in step (c) by evacuation of said chamber (12);

(g) providing said casting nozzle with a cap (25) removably attached to the upper open end thereof and hermetically connecting the nozzle (23) to said housing (11) to extend into said chamber (12);

(h) introducing inert gas into said chamber after step (d) to increase the pressure therein to atmospheric pressure;

(i) moving either of said casting nozzle (23) and said crucible (18) toward the other to immerse a lower end of said casting nozzle (23) in the molten casting material (26) in said crucible (18);

(j) removing said cap from the upper end of said casting nozzle and inserting one end portion of a starting wire into said casting nozzle from the upper open end thereof;

(k) increasing the pressure of the inert gas in said chamber (12) to move the molten casting material along said casting nozzle (23) into contact with said starting wire; and

(l) moving said starting wire upwardly out of said casting nozzle together with the elongate cast product formed in step (e).



Patentansprüche

1. Stranggußschmelzofen zur Herstellung eines Stranggußerzeugnisses, umfassend

(a) ein Gehäuse (11), das eine Kammer (12) bildet,

(b) einen Schmelztiegel (18), der oben offen ist und in der Kammer (12) zur Aufnahme eines Gußmaterials (26) angeordnet ist,

(c) eine Heizvorrichtung (19) zum Schmelzen des Gußmaterials (26) im Schmelztiegel (18), um geschmolzenes Gußmaterial bereitzustellen,

(d) eine längliche Gießdüse (23), die im wesentlichen vertikal über dem Boden des Schmelztiegels (18) angeordnet ist,

(e) eine Kühlvorrichtung (34), die der Gießdüse zugeordnet ist, und

(f) eine Edelgasquelle (14b) zur Einleitung von Edelgas in die Kammer (12), wobei bei Eintauchen des unteren Endes der Gießdüse (23) in das geschmolzene Gußmaterial dieses sich unter dem darauf lastenden Druck des Edelgases längs der Gießdüse (23) bewegt und die Kühlvorrichtung (34) die Düse (23) kühlt, wodurch das geschmolzene Gußmaterial verfestigt wird, um ein längliches Gußerzeugnis zu bilden,

dadurch gekennzeichnet, daß

(g) die Düse (23) mit dem Gehäuse (11) hermetisch verbunden ist und in die Kammer (12) ragt,

(h) die Heizvorrichtung (19) an den Schmelztiegel (18) angesetzt ist,

(i) entweder die Gießdüse (23) oder der Tiegel (18) zueinander verstellbar sind, damit das untere Ende der Gießdüse (23) in das geschmolzene Gußmaterial im Schmelztiegel (18) eintaucht, und

(j) das Gehäuse zur Erzeugung eines Vakuums in der Kammer (12) beim Schmelzen des Gußmaterials an eine Vakuumquelle (13b) angeschlossen ist.

2. Stranggußschmelzofen nach Anspruch 1, gekennzeichnet durch einen an das Gehäuse (11) angesetzten Leistungszylinder (35) zur Verstellung des Schmelztiegels (18) in Richtung zur Gießdüse (23).

3. Stranggußschmelzofen nach Anspruch 1 oder 2, gekennzeichnet durch Antriebsmittel (41, 45) zum Herausbewegen des länglichen Gußerzeugnisses aus der Gießdüse (23).

4. Verfahren zur kontinuierlichen Herstellung eines länglichen Gußerzeugnisses mit folgenden Verfahrensschritten:

(a) Bereitstellen eines Stranggußschmelzofens mit einem Gehäuse (11), das eine Kammer (12) bildet, einem Schmelztiegel (18), der in der Kammer (12) angeordnet und oben offen ist, und einer länglichen Gießdüse (23), die im wesentlichen vertikal über dem Boden des Schmelztiegels (18) angeordnet ist,

(b) Beschicken des Schmelztiegels (18) mit einem Gußmaterial (26),

(c) Erzeugen einer nicht-oxidierenden Atmosphäre im Schmelztiegel (18),

(d) anschließendes Erwärmen des Schmelztiegels (18) zum Schmelzen des Gußmaterials (26)

im Tiegel zwecks Bildung eines geschmolzenen Gußmaterials, und

(e) Abkühlen des geschmolzenen Gußmaterials beim Passieren durch die längliche Gießdüse (23),

gekennzeichnet durch

(f) Erzeugen der nicht-oxidierenden Atmosphäre im Schritt (c) durch Evakuieren der Kammer (12),

(g) Versehen der Gießdüse mit einer Kappe (25), welche an das obere offene Ende der Düse abnehmbar angesetzt wird, und hermetisch dichtes Verbinden der Düse (23) mit dem Gehäuse (11) derart, daß sie in die Kammer (12) ragt,

(h) Einleiten von Edelgas in die Kammer nach Schritt (d) zum Anheben des darin befindlichen Druckes auf Atmosphärendruck,

(i) Verstellen der Gießdüse (23) zum Schmelztiegel (18) oder des Schmelztiegels zur Gießdüse zum Eintauchen eines unteren Endes der Gießdüse (23) in das geschmolzene Gußmaterial (26) im Tiegel (18),

(j) Entfernen der Kappe vom oberen Ende der Gießdüse und Einführen eines Endstückes eines Startdrahtes in die Gießdüse vom oberen offenen Ende her,

(k) Erhöhen des Druckes des Edelgases in der Kammer (12) zum Bewegen des geschmolzenen Gußmaterials längs der Gießdüse (23) bis zum Berühren des Startdrahtes, und

(l) Aufwärtsbewegen des Startdrahtes aus der Gießdüse zusammen mit dem in Schritt (e) geformten Stranggußerzeugnis.

Revendications

1. Four pour fabriquer par coulée continue un produit moulé allongé comportant:

(a) une enceinte (11) délimitant une chambre (12);

(b) un creuset (18) ouvert à sa partie supérieure et adapté à l'intérieur de ladite chambre (12) pour contenir une matière à couler (26);

(c) un appareil de chauffage (19) pour fondre la matière à couler (26) dans ledit creuset (18) afin de procurer une matière de coulée en fusion;

(d) une buse de coulée allongée (23) disposée généralement verticalement au-dessus de la base dudit creuset (18);

(e) des moyens de refroidissement (34) associés à ladite buse de coulée (23); et

(f) une source (14b) de gaz inerte pour introduire du gaz inerte à l'intérieur de ladite enceinte (12) de sorte que lorsque l'extrémité inférieure de ladite buse de coulée (23) est immergée dans ladite matière de coulée en fusion, ladite matière de coulée en fusion est entraînée le long de ladite buse de coulée (23) par la pression dudit gaz inerte sur lui et lesdits moyens de refroidissement (34) refroidissent ladite buse (23), en solidifiant de ce fait ladite matière de coulée en fusion pour former le produit moulé allongé, caractérisé par le fait que:

(g) ladite buse (23) est hermétiquement reliée à ladite enceinte (11) et dépasse à l'intérieur de



ladite chambre (12);

(h) ledit appareil de chauffage (19) est monté sur ledit creuset (18);

(i) l'un ou l'autre de ladite buse de coulée (23) ou dudit creuset (18) est mobile vers l'autre pour que l'extrémité inférieure de ladite buse de coulée (23) soit immergée dans la matière de coulée en fusion dans ledit creuset (18);

(j) ladite enceinte est reliée à une source de vide (13b) pour produire le vide dans ladite chambre (12) lorsque ladite matière de coulée est fondue.

2. Four pour coulée continue selon la revendication 1, caractérisé par un cylindre moteur (35) monté sur ladite enceinte (11) pour déplacer ledit creuset (18) vers ladite buse de coulée (23).

3. Four pour coulée continue selon les revendications 1 ou 2 caractérisé par des moyens d'entraînement (41, 45) pour sortir le produit moulé allongé de ladite buse de coulée (23).

4. Procédé de fabrication continue d'un produit moulé allongé comportant les étapes suivantes:

(a) réaliser un four pour coulée continue comportant: une enceinte (11) délimitant une chambre (12); un creuset (18) adapté à l'intérieur de ladite chambre (12) et ouvert à sa partie supérieure; et une buse de coulée allongée (23) qui est disposée généralement verticalement au-dessus de la base dudit creuset (18);

(b) remplir ledit creuset (18) avec une matière à couler (26);

(c) créer une atmosphère non oxydante dans ledit creuset (18);

(d) chauffer ensuite ledit creuset (18) pour fondre ladite matière de coulée (26) dans ledit creuset pour former une matière de coulée en

fusion; et

(e) refroidir la matière de coulée en fusion quand elle passe à travers ladite buse de coulée allongée (23), caractérisé par le fait que:

(f) on crée ladite atmosphère non oxydante pendant l'étape (c) par la production de vide dans ladite chambre (12);

(g) on munit ladite buse de coulée d'un couvercle (25) fixé d'une manière amovible à l'extrémité supérieure ouverte de cette buse et on relie la buse (23) hermétiquement à ladite enceinte (11) de manière qu'elle dépasse à l'intérieur de ladite chambre (12);

(h) on introduit un gaz inerte à l'intérieur de ladite chambre après l'étape (d) pour augmenter la pression intérieure jusqu'à la pression atmosphérique;

(i) on déplace l'un de ladite buse de coulée (23) et dudit creuset (18) vers l'autre pour que l'extrémité inférieure de ladite buse de coulée (23) soit immergée dans la matière de coulée en fusion (26) dans ledit creuset (18);

(j) on enlève ledit couvercle de l'extrémité supérieure de ladite buse de coulée et on introduit une extrémité d'un fil de démarrage dans ladite buse de coulée à partir de l'extrémité supérieure ouverte de cette dernière;

(k) on augmente la pression du gaz inerte dans ladite chambre (12) pour déplacer la matière de coulée en fusion le long de ladite buse de coulée (23) jusqu'à ce qu'elle vienne en contact avec ledit fil de démarrage; et

(l) on soulève ledit fil de démarrage hors de ladite buse de coulée simultanément avec le produit moulé allongé formé pendant l'étape (e).

