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CONVENTION

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REQUEST FOR A STANDARD PATENT AND NOTICE OF ENTITLEMENT

The Applicant identified below requests the grant of a patent to the nominated person identified below for an invention described in the accompanying standard complete patent specification.

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[54]Invention Title:

DEVICE FOR HOLDING BILLETS

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Details of basic application(s):-

3516/94-8	SWITZERLAND	CH	22 November 1994

Applicant states the following:

1. The nominated person is the assignee of the actual inventors.
2. The nominated person is
   - the applicant

   of the basic application.
3. The basic application was the first made in a convention country in respect of the invention.

The nominated person is not an opponent or eligible person described in Section 33-36 of the Act.

DATED: 30 September 1996

By: PHILLIPS ORMONDE & FITZPATRICK
Patent Attorneys
By: **ALUSUISSE TECHNOLOGY AND MANAGEMENT LIMITED**

Our Ref.: IRN 429506
MMH:EJD

David B Fitzpatrick

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DEVICE FOR HOLDING BILLETS

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(56) Prior Art Documents
US 3638930
US 2773923
US 2142846

(57) Claim

1. Holding device for inductive heating of billets of metal alloys having thixotropic properties, and for holding and transporting the heated billets until casting, wherein the holding device is a dish and the dish includes a body in the shape of a tub and a wall at each end, at least the body being formed of a high melting point metal.

9. Holding device for inductive heating of billets of metal alloys having thixotropic properties substantially as herein described with reference to the accompanying drawings.

10. Use of the holding device according to any one of the preceding claims for heating billets of a metal alloy, which has thixotropic properties, up to a temperature range in which the billets are in a semi-solid state, holding them in an induction furnace, and transporting the heated billets until casting.

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COMPLETE SPECIFICATION
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Related Art:

Name of Applicant:

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Invention Title:

DEVICE FOR HOLDING BILLETS

Our Ref : 429506
POF Code: 1526/1526

The following statement is a full description of this invention, including the best method of performing it known to applicant(s):

Device for Holding Billets

The present invention relates to a holding device for inductive heating of billets of metal alloys having thixotropic properties, and for holding and transporting the billets until casting, The invention also relates to the use of the holding device.

Known are e.g. billets or preforms of metal alloys that are manufactured by melting and continuously casting a metal alloy. The melted alloy is processed e.g. by strong stirring at controlled temperature to a semi-solid alloy state in which the partially melted dendritic primary, solid particles are surrounded by a matrix of liquid metal. This semi-solid alloy mix is cast into elongated ingots, under the influence of stirring, and cooled. The ingots may be processed further in this form, worked into preforms or divided into billets. Processing the ingots, preforms or, in particular, billets may take place for example by e.g. heating a billet such that it reaches a semi-solid - in particular thixotropic - state and then working the billet into a shaped form. This shaping process may be in the form of extrusion, forging or casting. Technologies of this kind are known e.g. from the German patent document DE-PS 22 29 453; technical refinements to this are recorded e.g. in DE-PS 30 06 618. The patent document EP 0 131 175 describes a process for continuous production of metal shapes. To manufacture metal shapes, free-standing metal preforms are heated until reaching a semi-solid state i.e. the preforms stand free and the temperature is maintained at a level at which the preform is partially solid. The preforms are transferred by a carrying facility to the shaping facility, said transfer taking place without any significant deformation of the preform and without any significant variation in the semi-solid fraction within the preform. The transfer takes place in particular by means of mechanical gripping. Described in EP A 0 513 523 is another casting process in which the metallic melt is brought into a semi-solid state by means of a static mixer and cooled. The billets produced in this manner are heated e.g. in a stainless steel container and fed into the casting chamber of a casting machine.

During the heating up stage it is decisive that various requirements are satisfied in order for the best quality of billet and end product to be achieved. This concerns e.g. uniformity with respect to maintaining the shape of the semi-solid billet and a uniform distribution of temperature in the billet. Also desired is low metal loss e.g. due to metal dripping off the billet, rapid heating up, in order that no grain growth takes place and an exact and reproducible condition at temperature.

It would therefore be desirable to provide a device which meets these requirements and which may be used with billets, also known as preforms, manufactured in any kind of manner.

According to a broad aspect, the present invention provides a holding device for inductive heating of billets of metal alloys having thixotropic properties, and for holding and transporting the heated billets until casting, wherein the holding device is a dish and the dish includes a body in the shape of a tub and a wall at each end, at least the body being formed of a high melting point metal.

In one embodiment of this invention the body of the dish is tub-shaped, the cross-section of the tub shape being a part of a circle or part of an oval with continuing walls that may be vertical to inclining outwards slightly. The cross-section of the body may be essentially tube-shaped and may be such that the cross-section of the body describes a part of a circle with a sector angle of e.g. 120° to 210°, with reference to 360° (degrees of angle) for the whole tube-shaped cross-section. Preferred is a fraction of the body making up 150° to 180°. Correspondingly, the fraction making up the opening amounts to 240° to 150°.

Usefully, the holding device is in the form of a shell with a tub-shaped body of round to oval cross-section and the billet has a round to oval cross-section, and the billet is accommodated in the holding device in the lying position.

Further, preferred is a holding device which is in the form of a dish with a tub-shaped body that is round to oval in cross-section and the billet is a accommodated in the holding device in the lying position, and the length of the billet is greater than the largest diameter of the billet.

As a rule the billets are round in cross-section, may however also be oval in cross-section or polygonal in cross-section, and may have e diameter e.g. of 50 mm to 150 mm, and the length may be e.g. 80 mm to 500 mm.

According to the present invention an advantageous holding device is such that it has a shell with a body and at each end of the body an end wall, where the body and one or both end walls contain or are made of a high melting point metal of the series: iron-carbon-containing metals such as steel, stainless steel, "Thermax" steel, hot working steel or of the series tantalum, niobium, vanadium, tungsten or titanium or alloys thereof. The choice of high melting point metal depends on the metal to be processed, and the softening point of the high melting point metal should be adequately greater than the temperature at which the billet is to be processed.

The dish exhibits in particular a body and at each end of the body an end wall, and one or both end walls may preferably contain or be of ceramic materials. Suitable ceramic materials are e.g. Al_2O_3, Al_3O_4, BN, SiC, Si_3N_4, MgO, TiO, ZrO_2, stabilised, such as yttrium-stabilised ZrO_2, glasses or refractory cements or mixtures that contain the above mentioned materials The end walls may preferably be of fibre-reinforced ceramic material, or contain such materials, and the fibres of the fibre-reinforced ceramic material may be e.g. of SiC, Al_2O_3, glass or carbon.

The end walls may also be made up of combinations of the above mentioned metals and ceramic materials.

The end walls may e.g. be plate, disk or mussel shaped and be flush with the body or project beyond the cross-section of the body. The extra part of the end wall may be facing the opening in the dish and the end walls may at the same time form feet that prevent the dish from rolling or tilting.

As described above, the dish is tub-shaped with a round to oval cross-section and the billet likewise exhibits a round to oval cross-section, the inner diameter of the body being 0.2 to 10 mm larger than the largest diameter of the billet. The length of the shell is usefully 1 to 10 mm larger than the maximum length of billet. The height of the shell is for example 0 to 60 mm greater than half of the diameter of the billet. The end walls may e.g. be disk-shaped and the height of the end walls may be 30 mm smaller to 20 mm larger than the diameter of the billet. The thickness of the body of the shell may e.g. be 0.5 to 5 mm , and the wall thickness of the ceramic material of the end wall may be e.g. 2 to 15 mm. Typical examples of dishes that are used in practice exhibit a length of approx. 80 mm to 530 mm and a diameter of approx. 50 mm to 170 mm.

The dish may in some cases exhibit devices which enable the dish to be gripped by hand or a mechanical device, transported, emptied and finally cleaned; the dish may also exhibit devices which correspond to holding or transporting devices in the heating facility. This may e.g. be hook or ring-shaped elements or pins, bolts or the like which are shaped on or mounted on the body or are shaped on or mounted on the end walls.

The holding device according to the invention is employed for inductive heating of billets of a metal alloy with thixotropic properties and for holding and transporting the billets until casting. The heating up of the billet is very important as the condition of the billet i.e. its

strength is available only in a very small temperature range, and long heating up times must be avoided. If the billet is too warm, the metal alloy becomes too fluid or too pasty; if the billet is too hard, then it can not be processed or if so then only poorly.

During the heating of vertical standing preforms according to the present state-of-the-art, it is almost impossible to prevent at least small amounts of metal from dripping out of the billet. This has consequences in that this metal is no longer available for processing, and has to be recycled. In addition, the variable amount of metal leaking out leads to irregular billet conditions i.e. the heavier billet or the billet with less leakage is harder at the end of the heating up stage. With the holding device according to the present invention these difficulties are overcome in a simple manner. The billet lying down is not deformed by its own weight, and the risk of leakage of liquid metal from the billet is minimised. As no metal leaks out, the amount of metal is constant and the energy fed to the billet is distributed uniformly in the pre-calculated amount of metal. Transporting the billet in the holding device to the facility for processing it is without problem as the billet in the pasty form is supported to a large degree by the holding device. Holding devices according to the invention usefully feature a shell with end walls made of ceramic material. The advantage of this is that the induced currents do not, or only to a small degree, penetrate the ceramic material so that the ends of the billet are not subjected to an energy input from the side walls. As the thermal radiation of the ceramic material is small, uniform distribution of heat in the billet is achieved to a greater degree.

A further advantage of the present holding device is the use of a high melting point metal at least for the body. The body heats up quickly and releases no foreign material, such as ceramic oxides and the like, to the billet; also no foreign materials are transferred with the billet into the casting chamber.

The holding device according to the present invention serves for inductive heating of billets or preforms out of metals such as e.g. iron and steel, copper, magnesium, zinc or aluminium and alloys of these metals.

Preferred embodiments of the present invention are hereafter described by way of illustrative example with reference to the accompanying drawings.

Figure 1 shows an end view and a front elevation of one example of the holding device according to the invention for billets of metal alloys having thixotropic properties. The dish 1 features a body 2 and end walls 3 made of high melting point metal. The end walls 3 may be attached to the body 2 e.g. by welding. The body 2 is tub-shaped. The inner cross-section of the body 2 forms approximately a semi-circle 7, and end walls 3 standing vertical and parallel to each other are provided on both sides of the semi-circle.

Figure 2 shows an end view and a front elevation of another exemplified holding device according to the invention for billets of metal alloys having thixotropic properties. The shell comprises a body 2 which is essentially tub-shaped in cross-section and is of a high melting point metal. Mounted at the ends 4 of the body are ring-shaped closures 5 which form the stops for the end walls 3 that are made of ceramic material. The end walls are fixed by a seam 6 of refractory cement. The end walls 3 of ceramic material. or also out of high melting point material may, in an alternative version, be inserted for example in grooves at the edge of the body 2 and held fast e.g. by the spring action of the body, or cemented in by refractory cements or the metals may be welded together.

The present invention relates also to the use of the holding device for heating billets of a metal alloy, which has thixotropic properties, up to a temperature range in which the billets are in a semi-solid state, holding them in an induction heated furnace, and transporting the billets until casting.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Holding device for inductive heating of billets of metal alloys having thixotropic properties, and for holding and transporting the heated billets until casting, wherein the holding device is a dish and the dish includes a body in the shape of a tub and a wall at each end, at least the body being formed of a high melting point metal.

2. Holding device according to claim 1, wherein the holding device is a shell with a tub-shaped body, the cross-section of the tub shape being a part of a circle or part of an oval with continuing walls that may be vertical to inclining outwards slightly, or the cross-section of the body is essentially tube-shaped and is such that the cross-section of the body describes a part of a circle with a sector angle of e.g. 120° to 210° with reference to 360° (degrees of angle) for the whole tube-shaped cross-section.

3. Holding device according to claim 1, wherein the holding device features a shell with a tub-shaped body, the billet has a round to oval cross-section and is accommodated in the holding device in the lying position, and the length of the billet is greater than the largest diameter of the billet.

4. Holding device according to claim 1, wherein the holding device has a shell with a tub-shaped body and at each end of the body an end wall, where the body and one or both end walls contain or are made of high melting point metals of the series iron-carbon-containing metals such as steel, stainless steel, „Thermax" steel, hot working steel or of the series tantalum, niobium, vanadium, tungsten or titanium or alloys thereof.

5. Holding device according to claim 1, wherein the holding device has a shell with a tub-shaped body land at each end of the body an end wall, and wherein one or both end walls preferably contain or are of ceramic material, preferably

containing Al_2O_3, Al_3O_4, BN, SiC, Si_3N_4, MgO, TiO, ZrO_2, stabilised, such as yttrium-stabilised ZrO_2, glasses or refractory cements.

6. Holding device according to claim 5, wherein end walls are of fibre-reinforced ceramic material, or contain such material, and the fibres of the fibre-reinforced ceramic material are of SiC, Al_2O_3, glass or carbon.

7. Holding device according to claim 1, wherein the dish has a tub-shaped body with a round to oval cross-section and the billet exhibits a round to oval or polygonal cross-section, the inner diameter of the body is 0.2 to 10 mm larger than the largest diameter of the billet and the length of the shell is usefully 1 to 10 mm larger than the maximum length of billet.

8. Holding device according to claim 1, wherein the height of the shell is 0 to 60 mm greater than half the average billet diameter.

9. Holding device for inductive heating of billets of metal alloys having thixotropic properties substantially as herein described with reference to the accompanying drawings.

10. Use of the holding device according to any one of the preceding claims for heating billets of a metal alloy, which has thixotropic properties, up to a temperature range in which the billets are in a semi-solid state, holding them in an induction furnace, and transporting the heated billets until casting.

DATED: 11 February, 1998
PHILLIPS ORMONDE & FITZPATRICK
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Abstract

Holding device for inductive heating of billets of metal alloys having thixotropic properties, and for holding and transporting the billets until casting. The holding device is a dish and the dish exhibits a body in the shape of a tub and a wall at each end, at least the body being out of a high melting point metal, for example steel.

34349/95

Figure 1

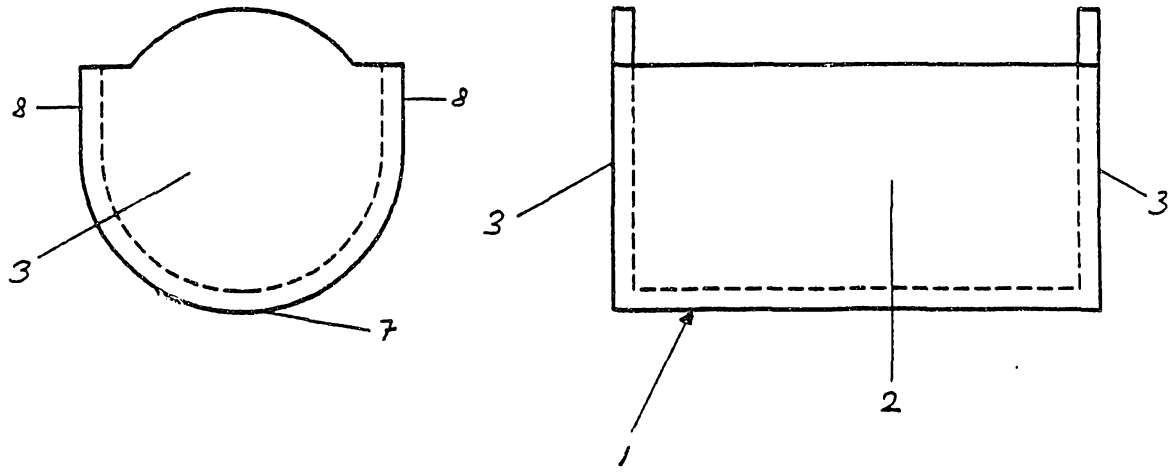

Figure 2