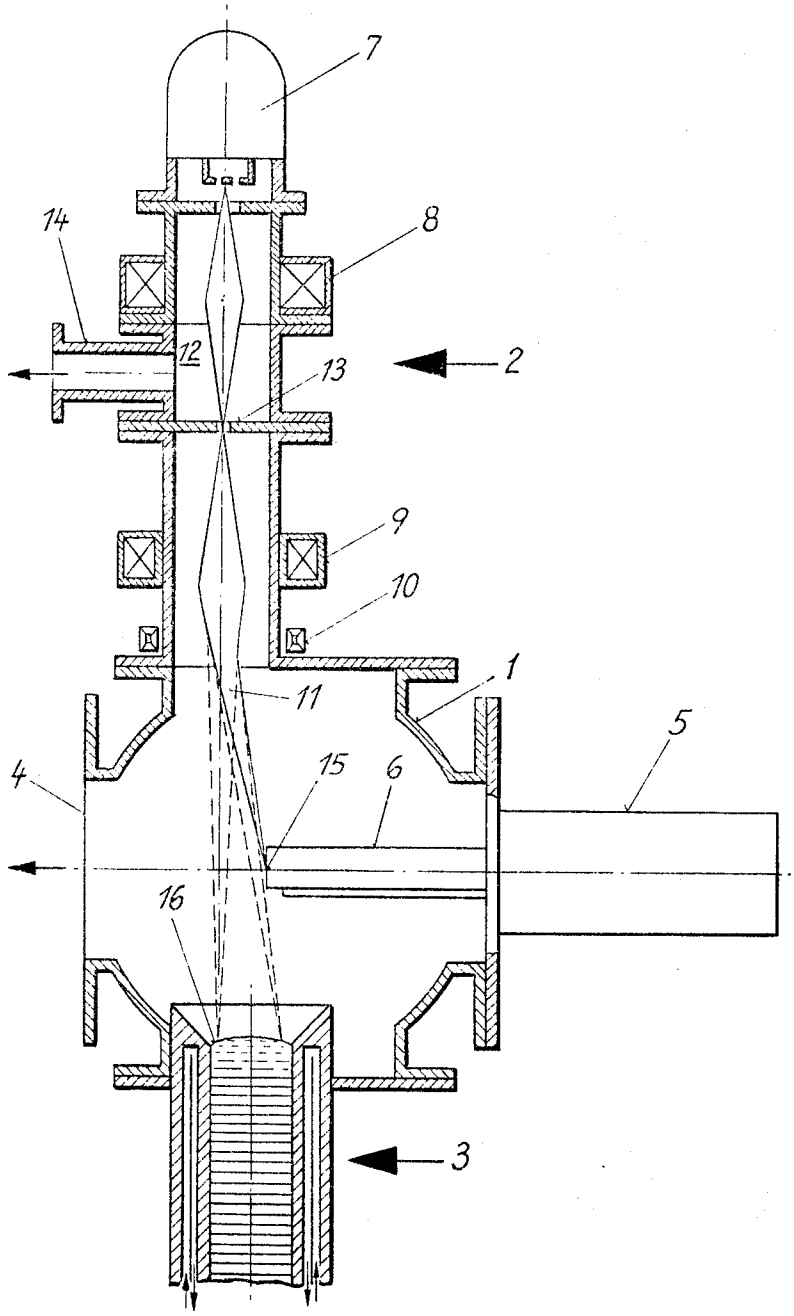
219-121 CROSS REFERENCE SEARCH ROOM

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PROCESS FOR THE VACUUM MELTING OF METALS BY MEANS OF ELECTRON BEAM

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PROCESS FOR THE VACUUM MELTING OF METALS BY MEANS OF ELECTRON BEAM

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1 Claim. (Cl. 13—34)

The present invention relates generally to processes for the vacuum melting of metals by means of electron beams. It is well known that the metal to be melted in a rod shaped piece combined with an electron beam directed onto the rod can be used for continuous melting and the melted drops are caught in a mold. Without further precautions the dropping metal solidifies immediately in the mold and an ingot with nonuniform density and great stratification is produced. This can be minimized if during the melting the mold is kept hot at least on the upper surface so that a continuous fluid mass can be formed while the mold is filled in the course of the melting gradually solidifying from the bottom up.

The keeping the mold hot can be done by the use of an induction heating coil wrapped around it or by bombarding the upper surface of the melt with an electron beam from an additional electron gun. These well known processes have the disadvantage of a relatively large additional expenditure for either a high frequency generator for supplying the induction heating or for the additional electron gun.

It has also already been proposed to permit the forward part of the electron beam directed onto the upper surface of the melt to wander at the same time over the end of the rod to be melted, located over the mold, in order to slowly melt it. This method has the decided disadvantage that a shadowing of a part of the beam by the rod to be melted is inevitable and therefore the upper surface of the molten pool will be unequally heated. Moreover the effects to be carried out on the surface of the molten pool and on the rod to be melted cannot be controlled independently of one another.

The object of the invention will be to propose a new process for the vacuum melting of metals by means of electron beams, which eliminates these difficulties, by which the metal is to be melted from a solid, preferably rod formed piece, and falls dropwise into a mold, which is further characterized by the fact that the one and the same electron beam being deflectable by well known means is used to melt from the solid metal piece and also to keep the melt hot in the mold. It is alternately directed onto the metal piece to be melted from and onto the upper surface of the melt in the mold.

How the process according to the invention can be materialized by way of example and what special advantages it offers will be described in the following detailed description taken in connection with the accompanying drawing in which the single figure shows an electron beam melting furnace with the following parts:

Furnace housing **1** to which an electron beam generator **2** above and a water cooled mold **3** below can be flanged vacuum tight. Numeral **4** indicates the vacuum connection, **5** shows a holder and feed arrangement, for a melt rod of the metal to be melted away, flanged to the furnace housing. The electron beam generator is essentially composed of the cathode part **7** and an electron optical system with electron lenses and deflectors **8**, **9** and **10** well known in the art which focus the electrons coming from

the cathode into a beam **11**. The chamber **12** of the electron beam generator is separated from the furnace space by a diaphragm **13** with a small diaphragm opening therein and is evacuated by a separate pump through the connection **14**. This makes it possible to hold a better vacuum in **12** than in the furnace space.

The beam **11** produced by the electron beam generator passes through the existing means for deflection, is directed according to choice onto the forward end **15** of the melt rod **6** or onto the upper surface **16** of the melt in the mold, during which, by means of a prearranged suitable duty cycle according to a program defined from the metallurgical point of view, for example by carrying out calculations on the stronger cooling in the neighborhood of the mold wall, the different zones of the melt surface and the rod to be melted off can be swept over with different rates and intensities, for example, it can be guided in circular paths over the melt surface or definite areas of the rod to be melted off can be heated stronger than the others. A focused electron beam is especially adapted to this purpose. The invention proposes further that the distribution of the total available performance of the electron beam be in proportion to the times of duration during which the beam is directed on the melt rod and on the melt surface.

The arrangements which are necessary to operate the electron beam generator or to achieve the feed of the melt rod or for its rotation during the melting off or means for tilting a mold with a spout will not be more precisely described here because they are well known.

The process that is the object of this invention provides great advantages. It is simple and more economical, since only one electron beam generator must be used, which naturally is increased in capacity to give an adequate performance, than a greater number of electron guns, which must be supplied and controlled separately. The process of alternating bombardment of the single spot to be heated through a deflected electron beam is also easier to handle than the above mentioned already known proposal, with one electron beam directed onto the surface of the molten pool in the mold and which strikes the rod to be melted at the same time, melting it.

By the melting off method according to the invention the metal melted off of the melt rod will be solidified without gradation in the center **6** of the melt pool and also, that the delay time of the fluid materials on the surface of the rod to be melted will be optimal for the needs of degassing.

The invention refers further to an electron beam melting furnace for the carrying out of the novel process. One such furnace, which, as described, shows a mold and attachments and a feed arrangement for a laterally arranged rod of the metal to be melted as well as an electron beam generator, is characterized by the fact that well known means for the deflection, at will, of the electron beam is provided on the one hand onto the end of the melt rod situated over the mold and on the other hand onto the upper surface of the molten pool in the mold.

I claim:

A method for the vacuum melting of metals with an electron beam wherein the melt stock is drip melted into a mold which is disposed below the melt stock comprising the steps of:

axially aligning and focusing the electron beam on the melt in said mold adjacent the radial outward edge thereof and radially spaced from the end of the melt stock,

deflecting said beam to scan the surface of the melt in said mold for a controlled time duration,

alternately deflecting said focused beam to strike the melt stock for a controlled time duration whereby the respective quantities of heat supplied to the melt stock and to the melt in the mold are controlled by regulating the first and second mentioned time durations.

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