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Paton et al.

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[54] **ELECTRON BEAM MELTING INSTALLATION**

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[51] **Int. Cl.** **B22d 27/02**

[58] **Field of Search** ..... 164/50, 250, 84, 85, 87, 164/88, 136, 276; 219/60 R, 60 A; 118/49.1, 49.5

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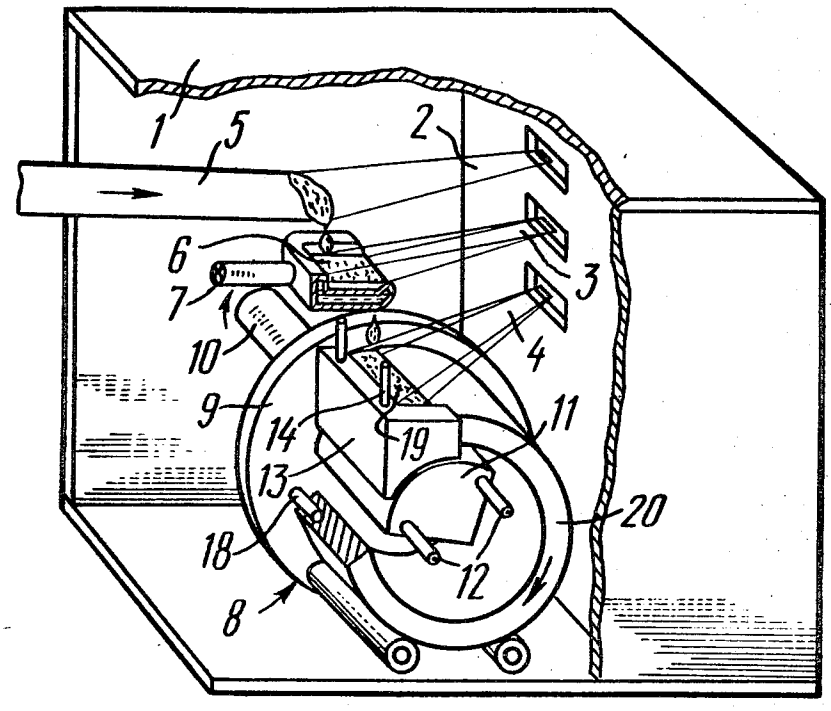
[57] **ABSTRACT**

An electron beam melting installation for manufacture of rings and pipes from a consumable material employs a vacuum chamber having electron beams for melting, into which chamber the consumable material is fed, preferably in the form of a bar. Molten material from the bar is deposited into a water-cooled intermediate vessel wherein the material is maintained in molten state by an electron beam. The molten material is gradually discharged into a metal crystallization unit, also disposed in the vacuum chamber. The crystallization unit employs an L-shaped member arranged to be capable of controlled vertical movement on the circumference of a sector-shaped element. The sector-shaped element is secured to a rotatable seeding or forming disk which is slowly rotated by means of a hollow shaft. Molten material deposited into a recess formed by the L-shaped member crystallizes, slowly adding to the pipe or ring which is being formed. The region of said recess is heated by further electron beam means to control the crystallization of molten material. The hollow shaft, the intermediate vessel and the L-shaped member are expediently water-cooled to improve the performance of the installation. By slowly rotating the hollow shaft and the seeding disk when molten material is continuously crystallized, pipes or rings of the consumable material may be formed.

2 Claims, 2 Drawing Figures



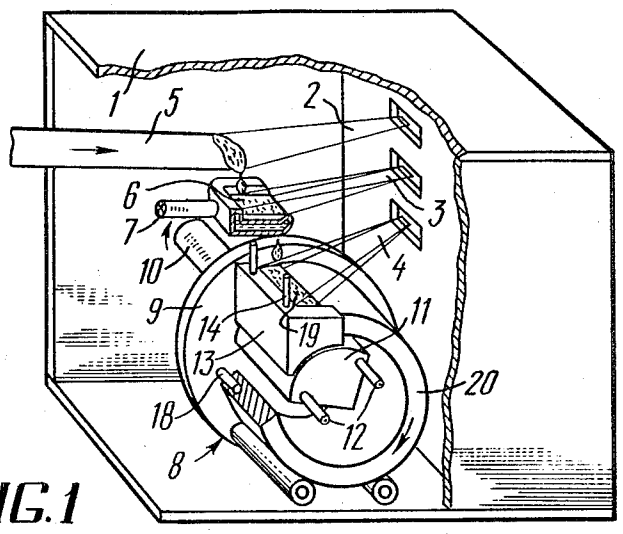


FIG. 1

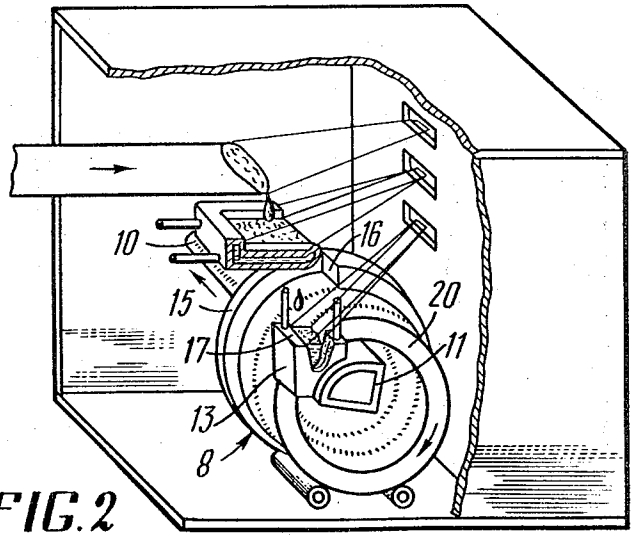


FIG. 2

ELECTRON BEAM MELTING INSTALLATION

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to electrometallurgy and more particularly to the manufacture of monolithic and multilayer rings and pipes of large diameters and lengths by the use of electron beam installations.

DESCRIPTION OF PRIOR ART

Known in the art is an electron beam installation for the manufacture of pipes which comprises a vacuum chamber with a charging means, electron guns as well as a water-cooled intermediate vessel and a vertically drawing metal crystallization vessel arranged therein.

The inside surface of the pipe in said known installation is formed by a water-cooled copper rod introduced into the crystallization vessel in the direction of its centre.

However, this installation has a number of disadvantages.

The water-cooled copper rod being surrounded by the melt absorbs considerable heat energy, which eliminates the possibility of manufacture of large diameter pipes.

In addition, the rod may get jammed when the lower part of the pipe cools, and this may cause formation of ruptures and cracks on the inside surface of the pipe.

Also, this in prior art installation also multilayer cast billets cannot be obtained.

The purpose of the present invention is to overcome the disadvantages of the above mentioned known installation.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an electron beam installation in which it is possible to obtain monolithic and multilayer rings and pipes of large diameters and lengths.

With these and other objects of the invention in view, an electron beam installation for the manufacture of rings and pipes is provided, which comprises a vacuum chamber with a charging means, electron guns and a water-cooled intermediate vessel and a metal crystallization vessel arranged therein; according to the invention said metal crystallization vessel is made in the form of a seeding disk one side of which is rigidly secured on an end of a rotating shaft end extending through a side wall of the vacuum chamber by a fixed sector adjacent to the free side of said seeding disk and by an L-shaped barrier mounted with the possibility of movement on the cylindrical surface of the fixed sector.

To obtain long pipes, the seeding disk is made in the form of a spiral turn and coupled with the mechanism for turning and moving the disk along the shaft longitudinal axis.

Such a construction of the installation, according to the invention, would allow to obtain monolithic and multilayer rings and pipes of large diameter and length.

BRIEF DESCRIPTION OF THE DRAWING

One particular embodiment of the invention will now be described with reference to the accompanying drawings, in which:

FIG. 1 is a general view, in part section, of the installation according to the invention; and

FIG. 2 is a general view, in part section of the installation according to the invention employing another embodiment of the metal crystallization vessel.

DESCRIPTION OF PREFERRED INVENTIVE EMBODIMENTS

The electron beam installation comprises a vacuum chamber 1 (FIG. 1) having vacuum pumps and an electric power source (not shown). Within vacuum chamber 1 electron guns 2, 3, 4 are arranged.

A charging means (not shown) is mounted on a side wall (not shown) of vacuum chamber 1 to feed consumable material 5 to the melting zone at which is directed electron gun 2 designed for melting consumable material 5. A water-cooled intermediate vessel 6 is mounted in vacuum chamber 1 to receive the flowing down molten metal and second electron gun 3 is directed into the vessel 6.

The intermediate vessel 6 is secured to a hollow rod 7, which is extended through the side wall of vacuum chamber 1 whose inner cavity is intended to supply and to draw off cooling water to/from the intermediate vessel 6. A second electron gun 3 is directed at the intermediate vessel 6.

Under the intermediate vessel 6 a water cooled vessel 8 for the metal crystallization is arranged, the third electron gun 4 being directed to the vessel 8.

Metal crystallization vessel 8 is defined by seeding disk 9 one face of which is secured to horizontal rotatable hollow shaft 10 extending through the back wall of vacuum chamber 1 and coupled with a driving mechanism (not shown); a metal sector 11 is fixed adjacent to the free face (not shown) of the seeding disk and mounted on hollow rods 12 extending through the front wall of vacuum chamber 1; an L-shaped barrier 13 is mounted on the cylindrical surface of fixed sector 11 facing at or being opened towards intermediate vessel 6. By means of hollow rods 14 extending through the upper cover (not shown) of vacuum chamber 1, L-shaped barrier 13 is connected with (not shown) mechanism for imparting a vertical movement (not shown).

Hollow shaft 10 and hollow rods 12, 14 are introduced into the vacuum chamber via seals and are adapted to supply and draw-off the cooling water into and from seeding disk 9, fixed sector 11 and L-shaped barrier 13 respectively.

For the manufacture of monolithic and multilayer pipes of a large diameter, in metal crystallization vessel 8 (FIG. 2), the seeding disk is made in the form of a spiral turn 15 with a bench 16 whose length is equal to the internal length of wall 17 of L-shaped barrier 13.

The installation operates as follows.

Prior to commencing the melting, a seeding pin 18 is inserted into the seeding disk 9 (FIG. 1) and arranged in front of L-shaped barrier 13.

The charging means (not shown) feeds consumable material 5 (FIG. 1) into vacuum chamber 1 where this material is melted by a beam of electrons of electron gun 2 and flows down into intermediate vessel 6 heated by a beam of electron gun 3. The intermediate vessel 6 fills up with liquid metal, it overflows on the cylindrical surface of water-cooled fixed sector 11, said surface being defined by seeding disk 9 at one side and L-shaped barrier 13 at the other two sides. A metal bath 19 thus formed is heated by a beam of electrons of electron gun 4.

After building up a first portion of metal and its crystallization, seeding pin **18** (which has been mounted in the area of metal bath **19** prior to melting) firmly connects billet **20** being formed with seeding disk **9**. Shaft **10** and seeding disk **8** coupled therewith are made to rotate and, as a result, billet **20** begins to move away from L-shaped barrier **13**. The cavity formed at the cylindrical surface of fixed sector **11** is continuously filled with the metal from intermediate vessel **6** and so on.

After the first layer of billet **20** is formed, L-shaped barrier **13** is radially raised by means of its vertical movement mechanism (not shown). Said barrier, sliding along the wedge-like edge of the formed annular billet raises to the height equal to the thickness of the first formed layer of billet **20**. The resultant cavity is filled with the liquid metal and then the installation starts to form the second layer; and so on.

In order to obtain monolithic and multilayer pipes of large diameter and length, L-shaped barrier **13** (FIG. **2**) is arranged at the cylindrical surface of water-cooled fixed sector **11** near bench **6** made in the form of a spiral turn **15** of seeding disk **9**, and after crystallization of the first seed portion of liquid metal the formation of pipe billet **19** is accomplished by building up successive spiral turns.

After the first layer of pipe billet **20** the required length is formed, and the L-shaped barrier **13** is raised to the height equal to the thickness of the first layer of billet **20**; thereafter, seeding disk **9** is reset to its initial position and the formation of the second layer is started, and so on.

As a result of this process, monolithic and multilayer rings and pipes of large diameter and length can be produced.

What we claim is:

1. An electron beam melting installation for the manufacture of rings and pipes, comprising: a vacuum chamber; charging means for feeding a consumable material into said vacuum chamber for being melted and formed into rings and pipes; electron guns arranged in said vacuum chamber and adapted for melting the consumable material; a water-cooled intermediate vessel arranged in said vacuum chamber for receiving molten consumable material and retaining the consumable material in molten state; a vessel for metal crystallization arranged in said vacuum chamber under said intermediate vessel and comprising a seeding disk one side of which is rigidly secured to an end of a rotatable shaft sealingly extending through a side wall of the vacuum chamber, a fixed sector adjacent to a free side of said seeding disk and an L-shaped barrier mounted on the cylindrical surface of the fixed sector and provided with means for causing a controlled vertical movement thereof, whereby by slow rotation of said rotatable shaft and the seeding disk, single or multilayer rings and pipes can be manufactured from said consumable material.

2. An electron beam installation as claimed in claim **1** wherein said seeding disk comprises a spiral turn and is coupled with a mechanism for turning and moving said disk along the longitudinal axis of said shaft.

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