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METHOD AND APPARATUS FOR ELECTROSLAG REMELTING OF METALS, PARTICULARLY STEEL

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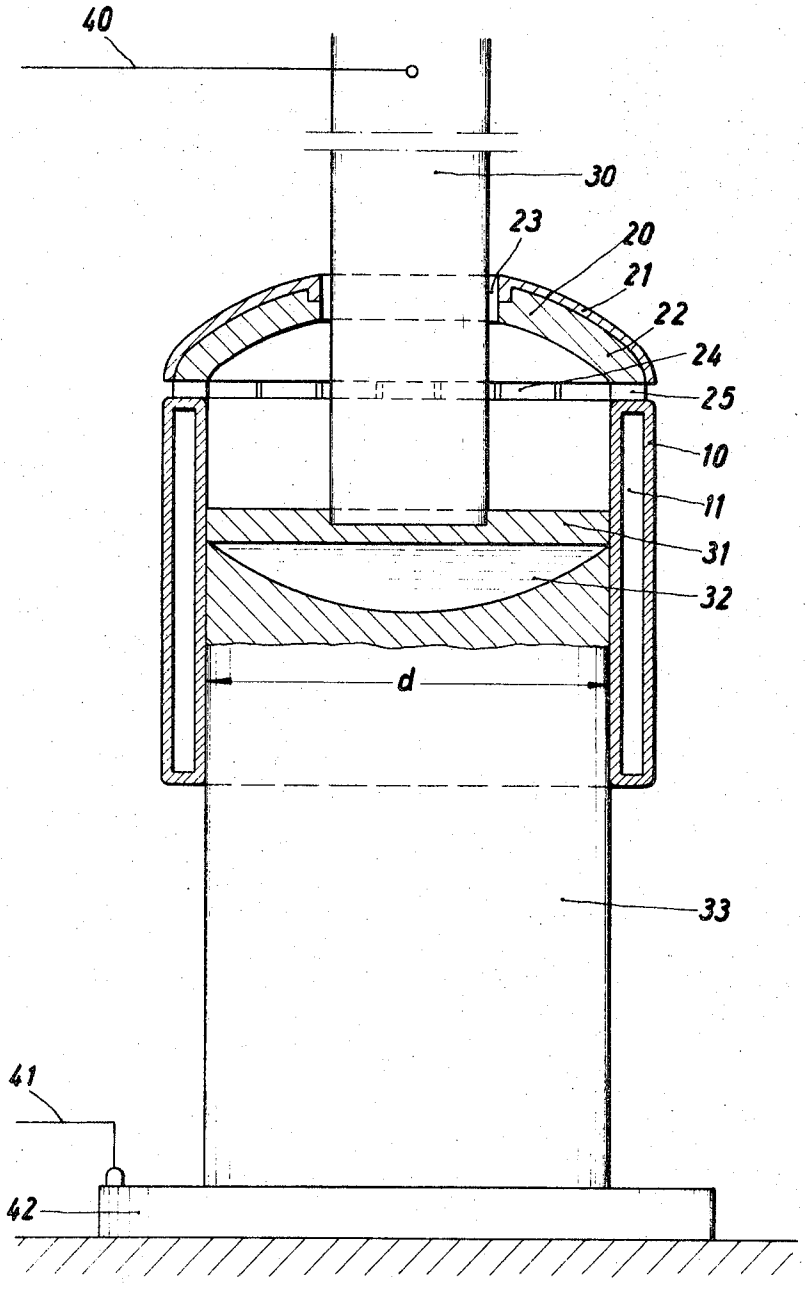

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METHOD AND APPARATUS FOR ELECTROSLAG REMELTING OF METALS, PARTICULARLY STEEL

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ABSTRACT OF THE DISCLOSURE

A process of and an apparatus for electroslag remelting of metals, particularly of steel, in a liquid-cooled mold in which a consumable electrode is melted. The liquid-cooled mold is provided with a lid or cover, which at least in the inner portion thereof overlying the liquid material in the mold is provided with a lining of refractory material, the cover being spaced somewhat above the mold, and having a central opening through which the electrode passes into the mold. Air drawn in through the space between the cover and the mold passes out through the central opening, whereby to cool the refractory lining of the cover.

This invention relates to a method of and an apparatus for electroslag remelting of metals in a mold, in which a consumable electrode is melted under a layer of molten slag.

In known methods of carrying out electroslag remelting, the mold is open at the top so that during the electroslag remelting process great quantities of heat are lost from the top of the mold.

The invention has among its objects the overcoming of disadvantages in the methods and apparatuses for electroslag remelting of metals in the prior art, in that heat losses formerly encountered in the melting of the metal are greatly reduced. This result is accomplished, in accordance with the present invention, by providing the mold, which is preferably liquid-cooled, with a cover, such cover having a size at least sufficient to cover the opening in the upper end of the mold, the inner or lower side of the cover being lined with refractory material, for example, a rammed or pressed-in lining. The cover is provided with an opening through which the consumable electrode passes into the mold.

The invention will be more readily understood by reference to the single figure of the drawing which somewhat schematically shows, by way of example, an illustrative mold for carrying out the method of the invention, the view being taken in vertical axial section, certain of the parts being shown in elevation.

At the upper end of a water-cooled mold **10** there is provided a dome-shaped cover **20**; the mold **10** has concentric radially spaced inner and outer walls which provide a liquid-receiving cooling chamber **11** therebetween. The lid or cover **20** is of such size and shape as at least to completely overlie the open upper end of the mold **10**; the cover has a circular opening **23** centrally thereof through which a consumable electrode, which is supported by a means above the mold (not shown), passes into the mold **10**. The hole **23** is somewhat larger in diameter than the electrode **30**. The lower end of the electrode **30** is disposed spaced somewhat above the upper surface of the molten metal bath **32** which is formed by the melting of the electrode, such lower end of the electrode lying immersed in a layer **31** of the molten slag which covers the top of the molten metal bath. It will be understood that a current passes from the lower end of

the electrode **30** and the molten metal bath **32**, whereby the lower end of the electrode is progressively melted.

As the process proceeds, the mold **10** is progressively raised whereby progressively to expose a block **32** having a diameter *d* equal to the inner diameter of the inner wall of the mold. The block **32** is of steel in this instance, which has been formed by the solidification of molten metal **32** derived from the melting of a steel electrode **30**. The lower end of the metal block **32** rests upon a copper bottom plate **42**, one conductor **41** from a source of electric power being connected to the plate **42**, another conductor or bus bar **40** from such electric power source being connected to the electrode **30**. Conductors **40** and **41** may be connected, for example, to the secondary winding of an electrical power transformer (not shown).

The cover or lid **20** is made up of an outer mantle **21** made of metal, the mantle carrying an inner refractory layer or lining **22**. The refractory material **22** may, for example, be poured, rammed, or otherwise formed in place in the mantle **21**. The inner surface of the lining **22** is dome-shaped, and is generally parallel to the outer and inner surfaces of the mantle **21**. In the embodiment shown, the lid or cover **20** has a diameter which is substantially the same as that of the outer wall of the mold **10**, the lid being disposed coaxially of the mold, whereby the molten metal-receiving cavity in the mold is completely covered by the lid. The lid **20** is supported on the mold **10** by an annular spacing means **25** disposed between the upper end of the mold **10** and the lower edge of the lid **20**. The spacer means **25** has an inner diameter which is the same as that of the inner wall of the mold **10**, the spacer being placed coaxially of the mold and lid. The spacer **25** has a plurality of substantially identical radially extending uniformly angularly spaced openings **24** therethrough, whereby the space within the upper end of the mold **10** communicates with the atmosphere. Spacer **25** is made of electrically insulating material, whereby to prevent any chance of short-circuiting the electrode **30** to the mold **10**.

Because of the high temperature to which the space within the mold **10** is subjected, the described structure provides for a convection stream of air within the upper end of the mold and the lid **20**. Thus, cool air enters through the openings **24** in the spacer **22**, and upon being heated, passes upwardly along the inner surface of the refractory lining **22** and then through the annular space provided between the circular opening **23** in the lid **20** and the electrode **30**. Such convection stream of air substantially uniformly cools the lower surface of the refractory material **22** and eliminates its local overheating. Thus, the refractory material **22** has an exceptionally long service life.

In the example shown, the block of metal **33** is of circular cylindrical shape. According to the invention, however, the block **33** may have other cross-sections such as rectangular or quadrilateral, in general depending upon the shape of the mold **10** and its lid or cover **20**.

During the practice of the invention, the passage upwardly of large amounts of heated air from the mold is prevented. Thus, the method and apparatus of the present invention present important advantages in that there is a much lower specific consumption of electrical energy for the production of a given weight of solid electroslag remelted metal than in methods and apparatuses in accordance with the present invention.

Although the invention is illustrated and described with reference to one preferred embodiment thereof, it is to be expressly understood that it is in no way limited to the disclosure of such a preferred embodiment, but is capable of numerous modifications within the scope of the appended claims.

What is claimed is:

1. Apparatus for the electroslag remelting of metals, comprising an open-topped mold for reducing heat losses during electroslag remelting, means for supporting a consumable electrode above the mold, electric circuit means connected between the electrode and metal in the mold produced by melting of the lower end of the electrode, a cover overlying the molten metal-receiving space of the mold, a lining of refractory material affixed to the cover to confront the molten metal in the mold, the cover having a central opening through which the electrode passes into the mold, an annular spacing member disposed coaxially of the mold and cover and having an inner diameter at least equal to the diameter of the inner wall of the mold, the spacer having generally radially directed passages therethrough so that air is drawn through the radial passages between the cover and the mold and passes out through the central opening thereby cooling the refractory material layer of the cover.

2. Apparatus according to claim 1, comprising an annular spacing member disposed coaxially of the mold and cover and having an inner diameter at least equal to the diameter of the inner wall of the mold, the spacer having generally radially-directed passages therethrough.

3. Apparatus according to claim 2, wherein the spacer is made of electrically insulating material.

4. Apparatus according to claim 3, wherein the cover is dome-shaped and the electrode passes vertically centrally through the central opening in the cover, the electrode having a diameter somewhat less than the opening in the cover so as to form a passage between them, air being drawn inwardly from the atmosphere through the passages in the spacer and after being heated rises through the opening between the central hole in the cover and the electrode, whereby to abstract heat from the refractory lining of the cover to prevent its local overheating.

5. Apparatus according to claim 4, wherein the electrode is disposed coaxial of the central hole in the cover, and the passages through the spacer are at least substantially identical and are uniformly spaced, whereby the flow of air over the refractory lining is uniform.

6. A process for the electroslag remelting of metals in the water-cooled mold, in which a consumable electrode is melted, comprising the steps of providing the mold with a cover having a central opening and an inner and outer portion in order to reduce heat losses during the process, said mold having a molten metal-receiving space, the inner portion of the cover overlying said molten metal-receiving space of the mold and being provided with a protective layer of refractory material, and coaxially introducing said consumable electrode into said metal-receiving space via said central opening, spacing the cover from the mold and cover and having an inner diameter at least equal to the diameter of the inner wall of the mold, the spacer having generally radially directed passages therethrough, whereby a convection air current is produced so that air is drawn through the space between the cover and the mold and passes out through the central opening thereby cooling the refractory material layer of the cover.

7. A process according to claim 6, comprising spacing the cover from the mold by an annular spacing member disposed coaxially of the mold and cover and having an inner diameter at least equal to the diameter of the inner wall of the mold, the spacer having generally radially directed passages therethrough.

8. A process according to claim 7, wherein the cover is dome-shaped, the electrode passes vertically centrally through the central opening in the cover, the electrode having a diameter somewhat less than the opening in the cover so as to form a passage between them, air being drawn inwardly from the atmosphere through the passages in the spacer and after being heated rises through the opening between the central hole in the cover and the electrode, whereby to abstract heat from the refractory lining of the cover to prevent its local overheating.

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