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CASTING MOLTEN MATERIAL IN A VACUUM

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FIG. 1.

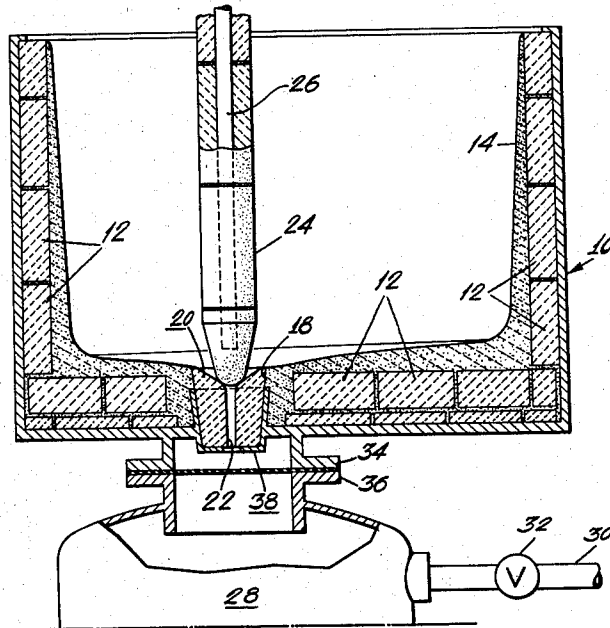


FIG. 2.

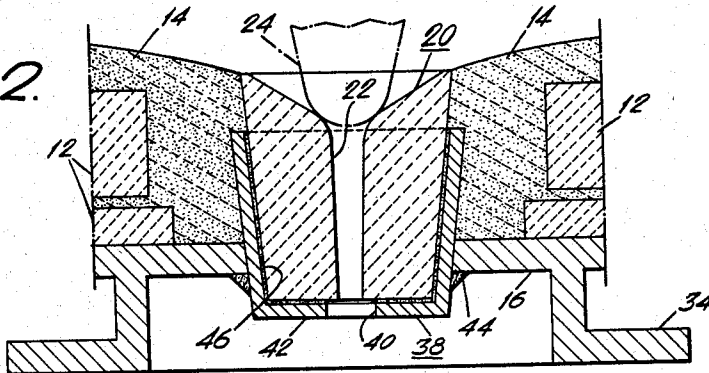
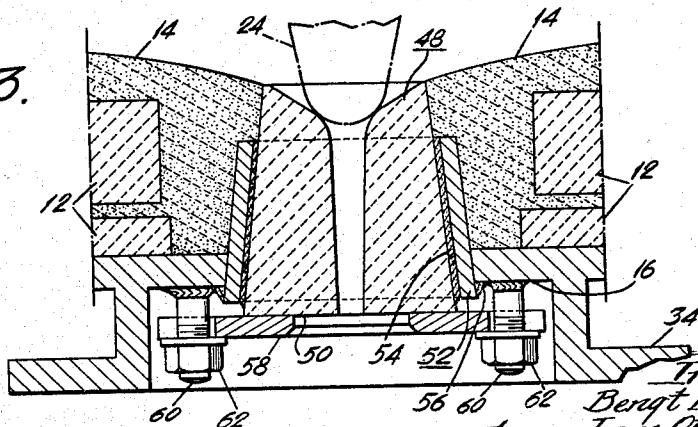


FIG. 3.



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CASTING MOLTEN MATERIAL IN A VACUUM

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6 Claims. (Cl. 22—84)

This invention relates to casting of molten material in a vacuum.

When casting steel or other metals in a vacuum, it is usual to employ, for the molten metal, a delivery container in the form of a pot or ladle constructed of steel plate lined with refractory material, for example brick. The ladle is provided with a duct in its bottom for delivering the molten metal and this duct has a lining of fire-proof brick, constituting a so-called nozzle sleeve. In use, the ladle is positioned over a receiving receptacle which is connected to a suitable pump, by means of which a vacuum is created in the receptacle. In the receiving receptacle the molten metal either enters an ingot mould in which it solidifies, or enters another ladle in which it can be transported for further treatment. It is desirable to create the vacuum in the receiving receptacle before beginning to pour the molten metal thereinto, and for this purpose it has been proposed to apply a membrane over the mouth of the receiving receptacle. This membrane will in use be pierced by the molten jet from the ladle when the pouring begins.

When using a sealing membrane, it is possible to evacuate the receiving receptacle before beginning the casting, and this is of particular advantage if the volume of the receiving receptacle is substantial or if it contains parts, for instance an ingot mould or another ladle, which are to be charged with molten metal, and which may possibly emit large quantities of gas. Before the sealing membrane is pierced it is possible to create a satisfactory vacuum in the receptacle but heretofore, even with a pump of large capacity, it has been found difficult, after the membrane has been pierced, to maintain the vacuum during casting. This is due, among other reasons, to the fact that a considerable quantity of gas can enter the receiving receptacle between the nozzle sleeve and its housing in the bottom of the ladle, and because the quantity of gas, mainly due to moisture in the refractory material around the nozzle sleeve, is increased when the molten steel encounters and heats that refractory material.

The present invention has for one of its objects to eliminate the possibility of gas penetrating between the nozzle sleeve and its housing in the bottom of the ladle. The invention thus facilitates maintenance of the vacuum.

According to the invention there are provided means for casting molten materials in a vacuum in which a ladle or the like having a metal exterior and a lining of refractory material is intended to be located above an evacuated receiving receptacle. A nozzle sleeve is provided in the bottom of the ladle or the like for delivering the molten material therefrom. The nozzle sleeve is provided with a metal covering of such form that it partially encloses the side surfaces, and if desired the bottom surface of the nozzle sleeve, with the upper edge of the covering located below the upper surface of the nozzle sleeve.

Additional objects and advantages of the invention will be more readily apparent from the following detailed de-

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scription and embodiments thereof, when taken together with the accompanying drawings in which:

Fig. 1 is a vertical sectional view of one embodiment of the invention showing a ladle and the upper part of a receiving receptacle to which the ladle has been applied,

Fig. 2 is an enlarged vertical sectional view of a portion of the apparatus of Fig. 1 showing details of the invention; and

Fig. 3 is a view similar to Fig. 2 showing a modified form of the invention.

In the embodiment of Fig. 1, a ladle 10 of steel plate is lined with brick 12 and refractory material 14. In the bottom of the ladle there is an opening 18 in which is located a nozzle sleeve 20. The duct 22 through the nozzle sleeve may be closed by means of a stopper 24 of brick fixed to a brick-covered bar 26. Means, not shown, are provided whereby the bar 26 can be raised and lowered to regulate flow of the desired quantity of steel through the duct 22 in the nozzle sleeve 20. During casting, the ladle, as shown in the drawings, is located over a receiving receptacle 28, which can be evacuated by means of a pump, not shown, connected to the vessel by vacuum line 30 having a control valve 32 therein. The ladle 10 and the receptacle 28 are connected through coacting flanges 34, 36 thereon and between which a suitable packing may be inserted such as rubber. The flanges may be cooled by water if desired.

According to the invention the nozzle sleeve 20 is provided with a covering 38 of metal plate, so formed that it partially encloses the sides and if desired the bottom of the nozzle sleeve. The upper edge of said covering 38 is located below the upper surface of the nozzle sleeve. The upper edge of the covering 38 will thus be protected from contact with the molten material in the ladle by the lining 14 of the ladle. The flat bottom of the covering 38 is provided with a central opening 40 of such size that the jet of molten material passing through the duct 22 in the nozzle sleeve 20 does not come into contact with the covering 38. In the embodiment of Figs. 1 and 2 this covering 38 and nozzle 20 are in the shape of truncated cones having the greater diameter upwards, and the cone shaped covering is provided with a flat bottom 42. It should be understood, however, that the invention is not limited to this arrangement of the nozzle sleeve and covering, because in some cases, the cone may be inverted as shown in Fig. 3 and which will be described hereinafter.

As shown more particularly in Fig. 2, the covering 38 and the bottom plate 16 of the ladle are joined together, for example by welding at 44, to provide a gas tight joint. The space between the nozzle sleeve 20 and its covering may be sealed by a thin layer of fire-proof material 46, for example porcelain or a suitable clay composition which may be mixed with waterglass. The construction according to the invention makes it possible to remove a worn out nozzle sleeve and insert a new one into the same covering in an apparent manner.

As shown in Fig. 2, the upper edge of the covering 38 is lower than the top of the nozzle sleeve 20. For a nozzle sleeve having a height of about 150 mm., the height of the covering 38 may suitably be about 100 mm. A suitable thickness for the covering 38 is about 3 mm. It will be understood that if the covering 38 reached upwardly into contact with the molten material in the ladle it would conduct heat to the outer metal covering of the ladle, which would be undesirable. Moreover the upper edge of the covering 38 would be liable to adhere to any residue of molten material which may have been left to solidify in the ladle after use. This would render it difficult to remove the residue.

The covering 38, being sealed with respect to bottom 16, operates to prevent gas from passing between the

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nozzle sleeve 20 and the refractory lining 14, from the interior of the ladle 10 to the receptacle 28 and thus destroying the vacuum in the latter.

It has been found that with a nozzle sleeve covering of this character it is possible, even without a sealing membrane for the receptacle 28, to create a good vacuum in the receptacle before the molten material has been delivered into the ladle, at which time the duct in the nozzle sleeve is sealed only by the stopper 24. This vacuum can be maintained without difficulty during casting.

In Fig. 3 a modification is shown wherein similar parts have been designated with like reference characters. Here the nozzle sleeve 48 is again in the shape of a truncated cone but having its larger diameter 50 at the bottom. A covering 52 of metal is provided over a central portion of sleeve 48 between which is a sealing layer 54 of porcelain or the like similar to the layer 46. The covering 52 is welded to bottom 16 at 56. In this form the nozzle sleeve is inserted from the bottom outside and support means are required in the nature of apertured support plate 58 removably secured in place by means of bolts 60 secured to bottom 16, and coacting nuts 62 in an obvious manner. It is not necessary in this form to provide covering 52 with a bottom similar to that shown at 42 in the other figures. The principles of operation of the two embodiments are the same.

Manifestly minor changes in details of construction can be effected in the invention without departing from the spirit and scope thereof as defined in and limited solely by the appended claims.

We claim:

1. In apparatus for casting molten materials in a vacuum, including a ladle having a metal exterior and a lining of refractory material and adapted to be positioned above an evacuated receiving receptacle for discharge thereinto, and a nozzle sleeve in the bottom of the ladle for delivering the molten material therefrom; a metal

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cover for said nozzle sleeve partially enclosing the side surfaces of the nozzle sleeve and interposed between said sleeve and said lining, the upper edge of said cover terminating below the upper surface of the nozzle sleeve and said metal cover being protected from the interior of said ladle by said refractory material.

2. Apparatus as claimed in claim 1, wherein the exterior of said nozzle sleeve and the cover of the nozzle sleeve are of truncated conical shape.

3. Apparatus as claimed in claim 2, in which the conical cover and nozzle sleeve are positioned with the larger diameter uppermost, and said cover being substantially flat at its lower end and covering the bottom surface of said nozzle sleeve.

4. Apparatus as claimed in claim 3, said cover of said nozzle sleeve being united in a gas-tight manner, with a bottom plate of said ladle.

5. Apparatus as claimed in claim 1, and a layer of fire-proof material sealing the space between said nozzle sleeve and said cover.

6. Apparatus as claimed in claim 1, wherein the exterior of said nozzle sleeve and the cover therearound are of truncated conical shape and positioned with the larger diameter thereof downward, said nozzle sleeve being insertable in said ladle from the bottom and detachable securing means for said nozzle sleeve contactable with the lower end thereof.

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