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W. M. CHARMAN ET AL

2,390,500

LOW VOLUME SINKHEAD

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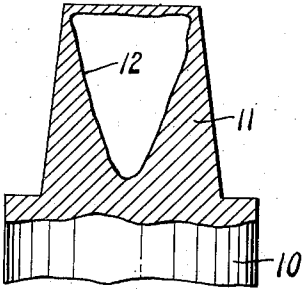


Fig. 1

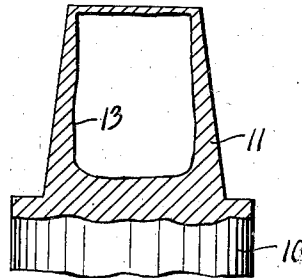


Fig. 2

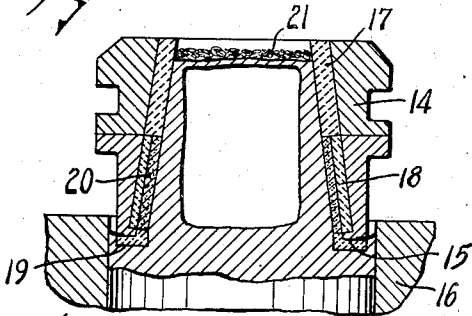


Fig. 3

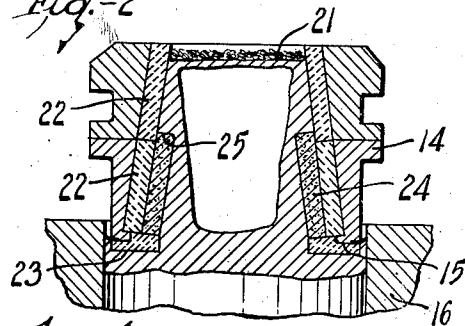


Fig. 4

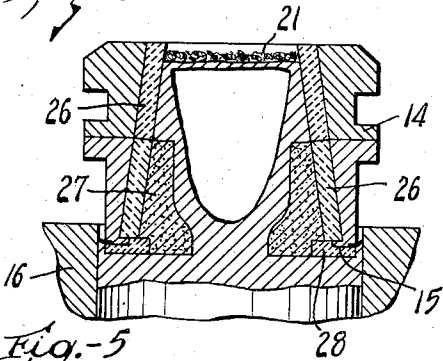


Fig. 5

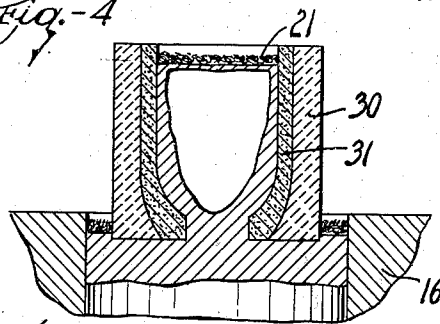


Fig. 6

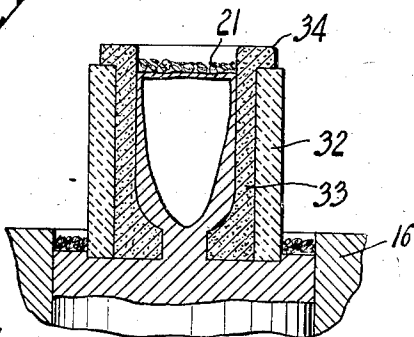


Fig. 7

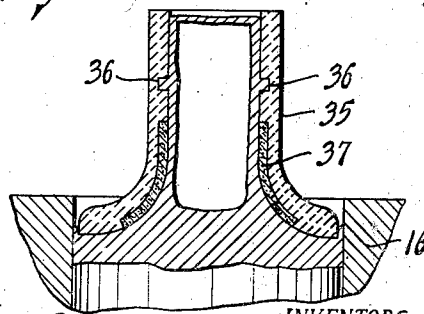


Fig. 8

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LOW VOLUME SINKHEAD

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2 Claims. (Cl. 22-147)

This invention relates to low volume sinkheads and to hot top apparatus for producing sinkheads of that character. More particularly, the invention relates to the art of hot topping or feeding metal ingots and castings, and is concerned with the attainment of efficient feeding or hot topping by smaller amounts of feed metal than have heretofore been considered practicable.

Well known in the art is the fact that the hot top or riser maintains the metal in the sinkhead or feed head of the ingot or casting molten long enough to feed the shrinkage or contraction cavity, commonly known as pipe. Conventional steel ingot practice requires that the hot top receive from twelve per cent to twenty-four per cent by volume of the molten metal in the entire ingot to satisfactorily produce a sound, relatively segregation free ingot body available for commercial product. This variable volume depends upon numerous factors, such as size and shape of molds, molten metal temperature and analysis, and pouring practices. The amount of molten metal to satisfy the shrinkage characteristics of the ingot may range from four per cent to eight per cent only, while the remaining metal in the sinkhead is that which must of necessity be present in order to take care of heat losses and thereby make available the small quantity required for feeding pipe. The solidified metal making up the sinkhead is not commercially usable, due to its shape, porosity, impurities, and segregation, and this invention is directed towards reducing the amount of molten metal which must be fed into the hot top or feed head in order to effect efficient hot topping or feeding with a minimum of discarded metal.

One of the objects of the invention is the provision of simple means for decreasing the heat loss through the walls of the hot top in order that the amount of metal frozen into the sinkhead during the active life of the latter may be reduced.

Another object of the invention is the provision of simple means for decreasing the cross-sectional area of the space enclosed by the hot top, particularly near the bottom thereof, while at the same time the heat loss from that portion of the hot top is decreased.

Still another object is the provision of auxiliary lining means containing exothermic material capable of giving off heat at a relatively low rate in order to delay solidification of the metal in the sinkhead, more particularly in the lower portion thereof.

Other objects and features of novelty will ap-

pear as we proceed with the description of those embodiments of the invention which, for the purposes of the present application, we have illustrated in the accompanying drawing, in which

Figs. 1 and 2 are diagrammatic views principally in vertical section, Fig. 1 showing a conventional sinkhead and Fig. 2 showing a sinkhead formed in accordance with the present invention.

Fig. 3 is a vertical sectional view through a fragment of an ingot mold with an ingot therein and a composite hot top embodying the present invention.

Figs. 4 and 5 are similar views of modifications, and

Figs. 6, 7, and 8 are similar views of mold apparatus embodying hot tops made exclusively of refractory material and built in accordance with the invention.

Referring first to Fig. 1, there is here shown a fragment of the upper portion of an ingot 10 having a sinkhead 11 with a cavity 12 therein which is generally V-shaped in vertical section. The sinkhead therefore includes a large mass of metal at and near its lower end particularly. In Fig. 2 the cavity 13, instead of being V-shaped in cross-section, is U-shaped, that is to say, the sinkhead has thinner walls and the metal content is much less than in Fig. 1. The production of a sinkhead of the general characteristics of that illustrated in Fig. 2 is the end sought by the invention.

In Figs. 3, 4, and 5 we have illustrated a cast metal casing 14 of more or less conventional form having upwardly tapered inner wall surfaces and an inwardly extending ledge 15 at its lower end. The hot top is formed to fit within the mold cavity of a mold 16 which may be of generally circular, rectangular or other cross-section. The inner wall of the casing above ledge 15 is covered by a semipermanent refractory lining, which may be a one piece element formed in situ or may be made up of blocks of proper shape fitted to the casing and keyed in position. The term "refractory" as herein used refers to non-metallic heat resistant material.

In Fig. 3 this semipermanent lining comprises an upper course 17 and a lower course 18 of less thickness than the upper course. The lower course 18 rests upon the ledge 15 of the casing and the upper course 17 rests upon the course 18. A refractory bottom ring 19, also of conventional form is temporarily supported in known manner from the casing 14, as by means of spring clips and covers and protects the lower end of the latter with its ledge 15. The ring 19 is in-

tended for single use and ordinarily parts from the casing and stays with the ingot when the hot top is stripped therefrom. Inwardly of the lining course 18 we provide auxiliary lining means 20 of a thickness such as to present a surface flush with the inner surface of the lining course 17 and the inner surface of bottom ring 19. This auxiliary lining 20 may be applied in paste form and permitted to dry thoroughly before the hot top is used, or it may be preformed in one or a plurality of pieces and dried before being placed in the hot top.

The composition of this auxiliary lining means may vary. It should include some exothermic compound. Its exothermic action should be relatively slow in order to extend approximately over the period of time required for the freezing of the ingot body. As a rule its exposed surfaces should be sealed off with a substantially impervious coating to prevent the escape of gases into the molten metal until a thin shell has been formed thereof, although in some cases it may be advisable to provide vents for the discharge of such gases. However, the aforesaid impervious coating plus the low degree of exothermicity or combustibility of the auxiliary lining prevents the generation of gases in such quantity as to make hazardous the filling of the hot top or to contaminate the molten ingot.

While we do not wish to be limited to the use of any particular material or combination of materials in the construction of the auxiliary lining means, we may mention as possible compounds, sources of carbon such as coal, coke breeze, tar and graphite, sources of silicon such as ferro-silicon, sources of aluminum such as dross, or any other materials which, when suitably compacted, will in the presence of entrained air or oxygen or oxygen obtained from an included oxidizing agent, oxidize or burn with the liberation of the desired amount of heat, and at such a slow rate as to counterbalance heat losses from the hot top metal other than to the ingot body, or add a desired quantity of heat to effect the advantages attained by the invention. The compacting may include sintering, cementing, fusing, or packaging, but in any case, the auxiliary lining should be thoroughly dry and should not be displaceable by molten metal.

Farm or forest products or by-products in general which will function as heretofore described can be used as constituents of the auxiliary lining. For example, a compacted lining block may be formed of straw or vegetable hulls, such as oats or rice, mixed with a suitable binder, the block being faced with an inert wash to prevent undue gassing.

In order to prevent the escape of heat from the top surface of the metal the latter is preferably covered promptly with a layer 21 of exothermic or insulating material, a number of which are readily available for this purpose. Oat hulls, rice hulls and straw may be mentioned. They burn more or less quickly but the ash which forms builds up a porous blanket which has an excellent heat insulating effect.

In the Fig. 4 construction a semipermanent lining 22 may be of the same thickness throughout its extent. The bottom ring 23 is similar to the ring 19 except that it projects inwardly beyond the face of the lining 22, this projecting portion serving as a support for auxiliary lining means 24 of the same character as the lining means 20 above described. Lining means 24 extends upwardly part way only of the height of the hot

top and may be of considerable thickness, so that it materially decreases the cross-sectional area of the space within the lower part of the hot top. Hence it tends to reduce the horizontal dimensions of the sinkhead at the same time that it reduces heat loss and thereby tends to lessen the thickness of the sinkhead wall.

The auxiliary lining 24 remains upon the ingot when the hot top is stripped therefrom, and since it is not of a character to harden materially under the influence of the heat of the ingot, it is readily penetrated by the bits of a handling crane, and these bits may be caused to enter it just beneath the shoulders 25 in the sinkhead, thereby providing a secure grip on the latter.

The construction of Fig. 5 differs from that of Fig. 4 principally in that it causes a constriction between the sinkhead and the ingot proper and tends to reduce still further the horizontal dimensions of the lower part of the sinkhead. Here again the semipermanent lining 26 may be of the same thickness throughout its extent, and its lower part is covered by auxiliary lining means 27 of the same general character as the lining means 20 and 24. Lining means 27, however, increases in thickness toward its lower end, as shown, and covers the inner edge of the bottom ring 28.

A one piece refractory hot top 30 is shown in Fig. 6, the wall thickness of which increases at the bottom. Within this refractory enclosure we mount auxiliary lining means 31, which is preferably preformed to fit within and be supported by the member 30.

The Fig. 7 construction is similar to that of Fig. 6, but the refractory hot top 32 may be of the same thickness from top to bottom, while the preformed auxiliary lining means 33 has an outwardly directed flange 34 at its upper end to rest upon the upper end of the member 32 in order to provide a support for the auxiliary lining means. In this construction as well as in the construction of Fig. 6 a constriction is formed at the junction of the sinkhead and the ingot proper.

In the form of the invention illustrated in Fig. 8 the one piece refractory hot top 35 is shaped somewhat like an inverted mushroom, that is its walls are flared outwardly at the lower end so as to approach closely the inner surfaces of the mold 16. The upper part of the hot top may be a cylinder of comparatively small diameter, so as to reduce the horizontal dimensions of the sinkhead, and it may have recesses 36 at oppositely located positions in order to provide projections on the sinkhead under which crane bits may effect a good grip. The auxiliary lining means 37 in this case is applied to a recess in the inner surface of the member 35 either as a paste or as a preformed and dried element of one or more pieces.

The hot top is employed in the conventional manner, that is it is supported temporarily upon blocks resting upon the top of the mold until the molten metal being poured into the mold rises therein to the height previously determined upon. A layer of insulation or exothermic material is then deposited upon the surface of the molten metal as indicated at 21, and the hot top supporting blocks are knocked out, permitting the hot top to "float" with the ingot. The metal in the conventional hot top remains molten for a longer time than that in the mold proper, due to the insulating effect of the semipermanent lining in the case of a composite top or to the baked refractory of which one piece hot tops are

made. It is unavoidable that some heat should be dissipated through these refractory enclosures, and it is impracticable to prevent such loss entirely, but by our invention this heat loss is compensated to a considerable extent at least, that is to say when the hot metal strikes the auxiliary lining means containing exothermic material, slow combustion is caused to take place and heat is given off to replace the heat loss through the hot top walls. The metal in the hot top or in the lower part of the hot top therefore remains molten longer than would otherwise be the case, and the tendency for it to freeze inwardly a considerable distance from the outer surfaces of the sinkhead, as in Fig. 1, is overcome so that the cavity is widened considerably at the base thereof, as illustrated in the remaining figures of the drawing. A lower volume of molten metal is required to give the desired soundness and chemical homogeneity to the ingot body, and the amount of discarded metal is considerably reduced.

Other advantages accruing to the use of the invention are smaller hot tops, less frequent replacements of the semipermanent linings 18, 22 or 26 of a composite hot top, because of the protection interposed between them and the molten metal, and the possibility of using high insulating refractories as the semipermanent linings

which will not withstand contact with molten metal, but when afforded the protection of the auxiliary linings 20, 24 or 27, will provide still more efficient hot topping.

Having thus described our invention, we claim:

1. In a composite hot top, a metal casing, a semipermanent refractory lining covering the inner wall of the casing, and auxiliary lining means covering the lower portion of said semipermanent lining for reducing the cross-sectional area of the space enclosed by the lower portion of the hot top and for decreasing the heat loss from said lower portion.

2. In a composite hot top, a metal casing, a semipermanent refractory lining covering the inner wall of the casing, and auxiliary lining means covering the lower portion of said semipermanent lining for reducing the cross-sectional area of the space enclosed by the lower portion of the hot top and for decreasing the heat loss from said lower portion, said auxiliary lining means being retained by the sinkhead when the hot top is stripped from the ingot, and being adapted to be penetrated by the bits of a handling crane.

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