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HOT TOP

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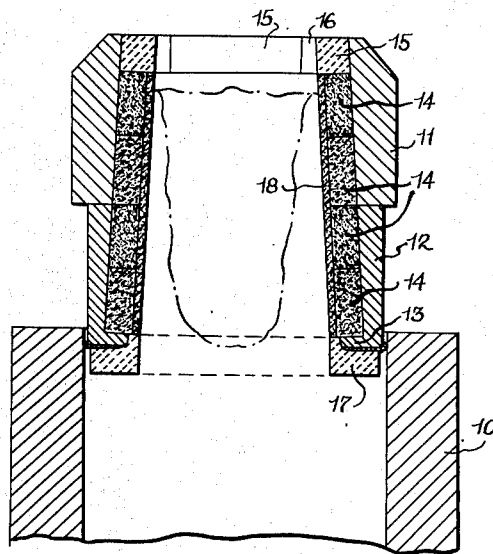


Fig. 1

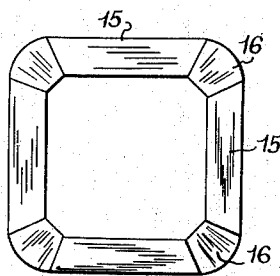


Fig. 2

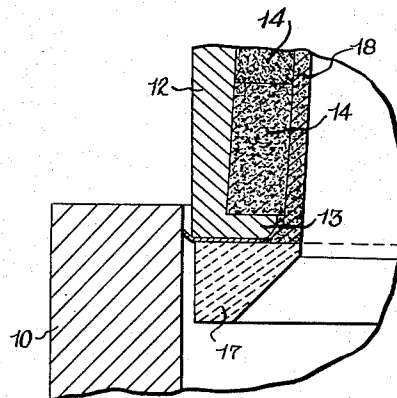


Fig. 3

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HOT TOP

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This invention relates to improvements in hot tops. The invention has utility in equipment for hot topping killed steel ingots. In such equipment the hot top must have a capacity such that it will provide sufficient molten metal to fill any piping that may develop in the ingot, in addition to the metal which goes to make up the sinkhead. In other words a certain amount of the metal originally in the hot top is wasted in the formation of a sinkhead and there must be provided in addition to that metal a supply sufficient to fill the piping in the ingot. If the hot top embodies means for maintaining the metal therein molten for a sufficient length of time, thereby reducing the metal which goes into the sinkhead, the capacity of the hot top may be reduced accordingly and it is then termed in the art a low volume hot top.

The conventional composite hot top comprises a cast iron casing lined with first quality fire brick blocks. Such blocks have a higher softening temperature than the temperature at which molten steels are poured, namely 2600° F. to 2950° F. They possess thermal shock resistance of an acceptable order to withstand first the considerable shock attendant upon filling the hot top when molten metal comes into intimate contact with the relatively cold brick lining and second when the hot top, the face of whose brick lining may be at a temperature as high as 2400° F., is stripped off the sinkhead and cold air rushes up through it to wipe these hot surfaces. These bricks also possess good mechanical strength to withstand the abuse given a hot top upon stripping and handling. When a crane man pulls a hot top off a sinkhead it is rare that a straight up axial lift is achieved, and the consequent cocking action must be resisted by the brick lining.

The heat losses for a hot top employing fire bricks of the first quality grade are considerable, due to their thermal conductivity and their high heat capacity. These losses result in the freezing of metal along the walls of the hot top to form the sinkhead. The volumetric capacity of the hot top therefore must provide sufficient metal for the sinkhead in addition to that supplied to insure adequate feeding of molten metal into the shrinkage cavity of the solidifying ingot. Depending upon the type of steel, its pouring temperature and several other factors, a conventional hot top must have an enclosed volume approximating fifteen percent of that of the combined mold and hot top volumes. Only about four to six percent of the combined volumes is necessary to feed and insure ingot soundness. Hence the

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balance of nine to eleven percent represents waste, loss or scrap and is an item which every steel plant is vitally interested in reducing.

One means for obtaining a low volume, high efficiency hot top, and the one employed in the case of the present invention, consists in the use of lining brick or blocks of high insulating properties. In order to obtain good insulating qualities such brick must be made more or less porous. As the porosity increases and the insulating qualities rise proportionately, the brick becomes more and more fragile and more and more subject to deterioration from thermal and mechanical shock. These factors have rendered it generally unprofitable heretofore to employ lining brick of high insulating qualities as compared with hard, dense first quality fire brick having much lower insulating qualities but resistance to both mechanical and thermal shock and therefore having long life.

In accordance with the present invention high insulating brick are used for the major part of the lining of a composite hot top, but they are protected against deterioration from the great heat of molten steel and from physical blows and abrasion by a veneer of refractory material of the proper thickness applied to the inner surfaces of the blocks. By the use of this protective veneer it is possible to employ a porous fire brick of an intermediate grade having safe working temperatures in the range of 2200° to 2600° F. as the semipermanent lining, and having heat conductivity about one-third or less of that of first quality fire brick. The veneer material is prepared as a moldable mortar which may be troweled or otherwise applied to the inner surface of the lining blocks. Its thickness may be of the order of one-half inch, which is more than sufficient to prevent molten steel from contacting the insulating fire brick, and sufficient to cut down the transmitted heat to an extent such that the surface temperature of the insulating blocks will not exceed the safe working temperature thereof. The veneer is relatively soft, and therefore of such nature as to permit easy stripping of the hot top from the sinkhead. Furthermore it easily absorbs mechanical forces imposed by misaligned stripping.

In order to insure obtaining a veneer of the desired thickness I provide gauging means at the top and bottom of the hot top with which the veneer may be made flush. This I accomplish by making the bottom ring extend inwardly beyond the lining blocks a predetermined amount and by providing above the porous lining blocks an

upper course of hard fire brick which also projects inwardly beyond the insulating blocks to constitute the gauging means and to provide a rigid overhanging course as a protection for the insulating blocks. The hard upper course is particularly advantageous because it can be used in a hot top casing such as has been employed heretofore in conventional composite hot tops, and has a very long life because of its location at the top of the casing where the heat from the molten metal is less intense than elsewhere. Furthermore it is not important to employ high insulating brick at the top of the casing because the molten metal is poured to a level somewhat beneath the top of the hot top, and after pouring it feeds down quite rapidly in the first stages of ingot solidification and therefore the upper portions of the sinkhead never acquire much thickness.

One of the objects of the invention therefore is the provision of means for hot topping which shall reduce the amount of metal in the sinkhead and correspondingly increase the percentage of good ingot metal in proportion to the total metal poured.

Another object is the provision of a novel gauging means for determining the thickness of the veneer coating applied to the inner surface of the insulating lining of the hot top.

A further object is the provision of means of the character stated which may be applied to conventional hot top castings now in common use.

Other objects and features of novelty will appear as I proceed with the description of those embodiments of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawing, in which

Fig. 1 is a vertical sectional view of a composite hot top embodying the invention.

Fig. 2 is a plan view of the upper course of lining blocks, and

Fig. 3 is a fragmental vertical sectional view on a larger scale showing a modification.

In Fig. 1 of the drawing the upper portion of an ingot mold is indicated at 10, and in operative relation with it is a composite hot top embodying the invention. The casing of the hot top is illustrated as made up of two iron castings 11 and 12, primarily for economy in manufacture and maintenance. Any suitable means for fastening the castings together may be employed. At the lower end of the casing there is an intumed ledge 13, and on this ledge are supported insulating blocks 14 of the character previously mentioned. These blocks are fire brick whose insulating qualities depend upon high porosity effected by burn-out material incorporated in the mix, which burns upon the firing of the brick. They are light in weight and fragile. They are made in various grades, those having the best insulating qualities being adapted for use in top service temperatures very much less than the pouring temperature of steel. Such brick will not withstand mechanical abuse nor the penetration of their porous structure by liquid metal or slag, in which respect they differ markedly from first quality fire brick.

The insulating blocks 14 are laid up in one or a plurality of courses depending somewhat upon the size of the hot top. In every case they terminate at a level well below the top of the casing. They are preferably fitted to the casing and are so formed as to be locked in place thereagainst in a manner well known in the art. The joints

are preferably filled with high temperature cement which also functions to attach them together as well as to prevent the flow of metal into the cracks between the bricks.

The final or upper course of the lining is made up of hard fire brick blocks. In the illustrated case, the hot top being square, the blocks may be of two styles only, namely sidewall blocks 15 and corner blocks 16. Hot tops of different size and shape necessitate different size and shape blocks to make up this top course. In any case the different blocks have beveled edges as shown in Fig. 2 by means of which they are wedged in place in the casing. They are also cemented to each other and to the uppermost course of insulating blocks 14. Blocks 15 and 16 are so dimensioned as to project inwardly beyond the blocks 14 a distance which may be of the order of one-half inch.

Depending from the lower end of the casing there is a refractory bottom ring 17 which is secured to the casing by conventional wire clips, not shown, which are adapted to fail when contacted by the molten metal, and thus to permit the bottom ring to remain on the ingot when the hot top is stripped therefrom, as is well understood in the art. This bottom ring protects the lower and inner sides of the ledge 13 and projects inwardly beyond the inner surface of the bottom course of blocks 14 a distance of the order of one-half inch.

When the hot top is conditioned before each heat is poured a veneer coating 18 is applied to the inner surfaces of the insulation blocks 14, the thickness of the coating being gauged by the inwardly projecting portions of the blocks 15, 16 and the bottom ring 17. The heat at the lower end of the hot top is more intense than at the upper portion and hence it is permissible to make the veneer coating at the top somewhat thinner than at the bottom, providing for the same by a change in the extent to which the blocks 15, 16 project inwardly.

The thickness of the veneer must be such that the temperature gradient through it will give a lining face temperature not exceeding the maximum safe operating temperature of the insulating fire brick used. A thickness of one-half inch or more is suitable. This veneer should have low heat conductivity. It may have a silicious base and a suitable binder. It should be of a consistency suitable for troweling and preferably should not be very hard when dried.

When the veneer has been applied it must be dried before the hot top can be used. Drying can be accomplished preferably by subjecting the veneer or the entire assembly to the action of hot air.

In Fig. 3 I have shown a different form of bottom ring 17' which is designed to produce a beveled shoulder on the ingot. In this case the bottom ring does not cover the inner edge of the ledge 13, and hence the veneer material is extended and its thickness increased at that point to protect the ledge. In other respects the description as to Figs. 1 and 2 applies.

Having thus described my invention, I claim:

1. In a low volume hot top, a metal casing having an intumed lower ledge, a semipermanent refractory lining supported by said ledge and backed by the walls of said casing, said lining comprising low heat capacity, low heat conductivity insulating blocks extending upwardly from said ledge to a level below the top of the casing, said lining comprising also a protective

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upper course of first quality fire brick extending from said insulating blocks to the top of the casing and projecting inwardly beyond said insulating blocks a distance of approximately one-half inch, a refractory bottom ring below said ledge extending inwardly beyond said insulating blocks a distance approximately of one-half inch, and a refractory veneer covering said insulating blocks flush with said upper course and said bottom ring.

2. A low volume hot top as defined in claim 1, wherein the depth dimension of said upper lining course is no greater than one-fourth that of the complete lining.

3. In a low volume hot top, a metal casing having an intumed lower ledge, a semipermanent refractory lining supported by said ledge and backed by the walls of said casing, said lining comprising low heat capacity, low heat conductivity insulating blocks extending upwardly from said ledge to a level below the top of the casing, said lining comprising also an upper course of hard fire brick extending from said insulating blocks to the top of the casing and projecting inwardly beyond said insulating blocks a distance of approximately one-half inch, a refractory bottom ring below said ledge extending inwardly beyond said insulating blocks a distance of approximately one-half inch and a molded in place and dried refractory veneer covering said insulating blocks flush with said upper course and said bottom ring.

4. In a low volume hot top, a metal casing having an intumed lower ledge, a semipermanent refractory lining supported by said ledge and

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backed by the walls of said casing, said lining comprising porous insulating blocks low in resistance to pressure and impact extending upwardly from said ledge to a level below the top of the casing, said insulating blocks having safe working temperatures in the range of 2200° to 2600° F. without appreciable deterioration and having low heat capacity and low heat conductivity, said lining comprising also an upper course of first quality fire brick extending from said insulating blocks to the top of the casing and projecting inwardly beyond said insulating blocks, a refractory bottom ring below said ledge extending inwardly beyond said insulating blocks and a molded in place and dried refractory veneer covering said insulating blocks flush with said upper course and said bottom ring, said veneer being sufficiently thick and its heat conductivity being sufficiently low to prevent the inner surfaces of the insulating blocks reaching a temperature higher than the safe working temperature of said blocks when the hot top is filled with molten metal.

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