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SECTIONAL HOT TOP

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FIG. 1.

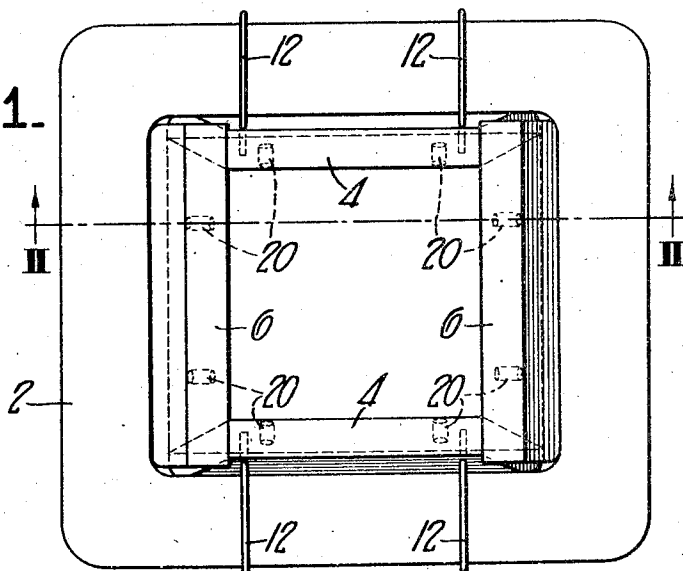


FIG. 2.

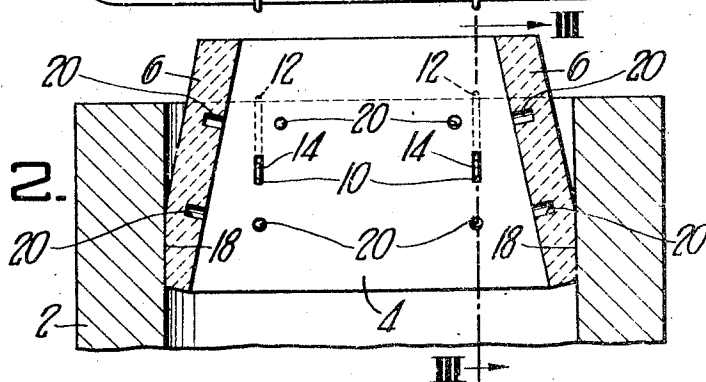
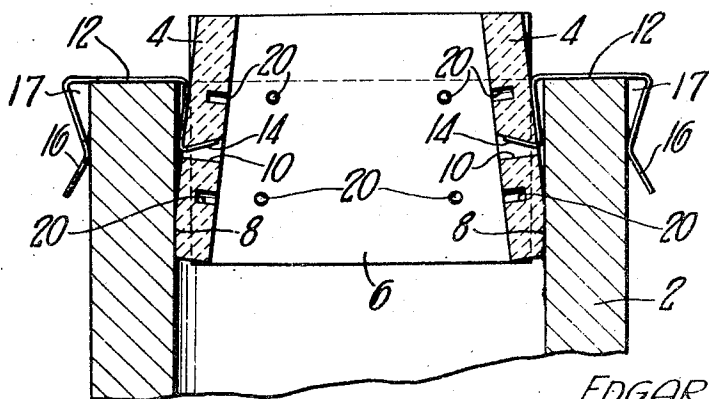


FIG. 3.



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SECTIONAL HOT TOP

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5 Claims. (Cl. 22-147)

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This invention relates to a sectional hot top for ingot molds and the like. When liquid steel is poured into an ingot mold, it immediately loses heat at a rapid rate to the comparatively cold cast iron mold and a wall of metal is frozen adjacent the mold, which wall continues solidifying inwardly at a decreasing rate. Since solid steel, just below the temperature of solidification, is approximately 3% heavier than liquid steel, the freezing results in a contraction of approximately this amount. Once the outer wall of the ingot has frozen and contracted, the dimensions of the ingot are substantially fixed (except for solid contraction in cooling of the ingot). Therefore, the contraction caused by further freezing of the liquid in the interior of the ingot results in a continuing drop in the level of the remaining liquid metal. This progressive freezing of the sides and sinking of the central liquid column results in a funnel shaped central cavity known as pipe which may extend downward 50% or more from the top of the completely solidified ingot, and which causes a weakness in any product rolled therefrom. In order to prevent the formation of such deep pipe in the ingot, a hot top made of refractory material is commonly used in the upper portion of the ingot mold to retard the heat loss from this portion, thereby providing a feeder reservoir of liquid metal. Types of hot tops commonly in use are (1) a one-piece refractory hot top which can be used only once; (2) a "semi-permanent" type consisting of a metal housing lined with refractory brick and having a refractory ring attached to its base by spring wire, which ring acts as a separator between the ingot and the housing during pouring and remains on the ingot after removal of the hot top; and (3) sectional types which must be fastened together by means of wire or the like.

Manufacturing limitations result in variations of perhaps as much as $\frac{1}{2}$ " to $\frac{3}{4}$ " in inside dimensions of molds of the same design. Because of this variation of size, and because of the possibility of metal splashes of previous pourings adhering to the inside top edges of the mold and for ease of insertion, it is necessary that the outer dimensions of a one-piece refractory hot top be appreciably smaller than the nominal inside dimensions of the mold in which it is placed and they are commonly made $\frac{1}{2}$ " to $\frac{3}{4}$ " smaller than the molds. This results in a peripheral clearance all around between the mold and the hot top, varying between $\frac{1}{4}$ " and $\frac{3}{4}$ ". In pouring the ingot, the liquid steel may rise into this opening to form metallic fins which are very objection-

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able, especially on three-high blooming mills, where they may spread out in rolling and catch on mill guides, causing considerable damage to the equipment. The fins may also, and frequently do, entrap refractory material from the hot top which, when carried to the mill with the ingot, may cause damage to the roll or ingot surfaces during rolling of the ingot. In order to prevent the formation of such fins when using one-piece refractory hot tops, the peripheral clearance may be filled with plastic refractory material, such as clay, or the ingot may be back-poured. In the latter method, the steel is poured until it is just above the lower edge of the hot top, the stream is then shut off, and the ladle is moved to pour the next mold to the same height, following which it is moved back to fill the hot top of the first mold, etc.

Sealing the peripheral clearance with plastic refractory is objectionable because (1) the ingot molds must be at least warm to dry the moisture from the plastic refractory before the ingot is poured; (2) if the filler is not thoroughly dry when the steel is poured, it may cause the steel to boil, allowing refractory material to drop out to contaminate the ingot surface and/or interior; and (3) placing the plastic refractory is a laborious hand job during which the heat of the mold and the obnoxious fumes of the mold coating rise directly into the workman's face. Interrupted pouring is objectionable because (1) the doubling of the number of nozzle shut-offs results in increased stopper head and nozzle erosion and frequently leads to pouring difficulties such as dribbles, leakers or runners; and (2) when the partially filled ingot is allowed to stand for a short period (about one minute) the products of deoxidation or dirt float to the top of the ingot and the impact of the reopened stream may drive this material well down into the ingot interior, thus resulting in entrapped non-metallic inclusions in the center of the ingot.

When using a semi-permanent hot top, strips of light gage sheet metal known as wiper strips may be inserted between the lower edge of the metallic housing and the refractory ring. The outer edges of these strips project about $\frac{1}{2}$ " to $\frac{3}{4}$ " beyond the hot top and fit the inside of the mold, the edges being bent slightly upward so as to permit insertion of the hot top in the mold and to remain in fairly close contact with the inside walls of the mold when the hot top is in position. When the liquid metal comes in contact with the wiper strips, it is chilled sufficiently to prevent rising in the peripheral clearance. The

trouble of placing four of these strips on each hot top, together with the refractory ring and the spring wire fastening clips therefor, is a disadvantage of this method.

Conventional one-piece clay hot tops are supported on the tops of the molds by lugs projecting from the sides of the hot tops and wooden blocks are placed under these lugs to vary the height of hot top setting in accordance with the ingot weight desired. If these blocks are not removed after pouring, cracks known as hanger cracks are formed close to the shoulder of the ingot due to the stresses caused by the contraction thereof.

When pouring into any so-called floating type of hot top (i. e., one not firmly attached to the mold), the liquid steel exerts an upward pressure equal to the weight of steel displaced by the hot top and has a tendency to cause the hot top to float or rise above its original position. In order to prevent this, it has been necessary to insert wooden wedges in the peripheral clearance around the top of the mold.

In previous designs of sectional hot tops, it has been necessary to hold the component portions together by wire or other devices to withstand the outward pressure of the poured steel.

It is an object of my invention to provide a sectional hot top which eliminates the peripheral clearance.

Another object is to provide a sectional hot top which is self-wedging, and will not float upward even if steel is poured continuously to the top of the hot top without any shut-off.

A third object is to provide a sectional hot top which requires no wiring or other extraneous device to insure it holding together during pouring.

A fourth object is to provide a sectional hot top which cannot cause hanger cracks in the ingot under any conditions of pouring.

A fifth object is to provide a sectional hot top which remains on the ingot even after stripping, thus preventing the formation of pipe or secondary pipe in the ingot regardless of how soon after pouring the ingot is stripped.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

Figure 1 is a top plan view of the hot top in place on a mold;

Figure 2 is a sectional view on the line II—II of Figure 1; and

Figure 3 is a sectional view on the line III—III of Figure 2.

Referring more particularly to the drawings, the reference numeral 2 indicates the top of a rectangular big-end-down mold. It will be understood that the invention is equally applicable to big-end-up molds and that the inside faces of the mold may be smooth or of any desired contour. The hot top consists of two side slabs 4 and two end slabs 6. The side slabs have their lower edges bevelled at 8, the outside faces of the bevelled portion being of the same contour as the interior of the mold, the remaining portion of the outside and the entire interior surfaces of these slabs being flat. The bottom of the side slabs are substantially wider than the top in order to form a wedge surface on each end of the slab. Slots 10 are provided in the side slabs 4 for the insertion of support hooks 12 which are preformed with a hook portion 14 having a slightly smaller angle than the slot so that when inserted as shown, the hooks will remain rigidly attached to the slab. The

hooks are supported on top of the mold as shown, and the outer portion of each hook is flared at 16 to permit ready placing thereof over the top of the mold. Clearance 17 is provided between the wire hook and the mold to allow for scrap or rough edges thereon. By locating slots 10 below the centers of the slabs, the weight of the overhanging top portion causes the bevelled lower portion to contact the mold closely. Further, the support hook wire has ample clearance and causes no separation between mold and hot top, as it would if the hook were placed under the bottom of the slab. The end slabs 6 have a bevelled lower edge 18 similar to the bevelled lower edge 8, but the tops and bottoms of these slabs are of substantially the same width, slightly less than the width of the mold, and no wedge surface is formed on the edges.

In assembling the hot top on the mold, a pair of hooks 12 are placed in the openings 10 of each side slab 4 and the slabs placed in position and supported from the top of the mold, as shown, with their lower bevelled faces in contact with the mold. The end slabs 6 are then wedged in place with their outer lower bevelled faces in contact with the mold wall and their inner flat faces in contact with the wedge surfaces of the side slabs 4. This locks the hot top in place and prevents it from floating as the metal rises therein. The joints remain closed during pouring without binding wire or other fastening, because the outward pressure of the steel against the lower part of the slabs is greater than its outward pressure against the top of the slabs. The bevelled lower edges contact the mold for a sufficient distance to prevent metal rising between the mold and the slabs. This is true regardless of the exact size of the mold; if the dimensions of the mold vary from the specified dimensions, the end slabs may be slightly higher (if the mold is smaller) or lower (if the mold is larger) but this variation in height is too small to be of any practical significance. Even should either dimension vary from the specified dimension more or less than the other, the close contact of the lower edges of the hot top with the mold wall is still assured, thus making this design effective under all practical conditions. To produce ingots of different heights (hence weights) for economical rolling into various sizes and weights of product, several slots similar to 10 may be preformed in the side slabs. By this means the hot top may be set at different heights with the same hooks. If it is desired to set the hot top higher in the mold than shown in the sketch, the slots 10 may be set lower and small channel slots for the wires preformed in the bevelled face of the side slabs to prevent spacing the latter from the mold. The slabs may be made of any suitable refractory material such as fire clay, coke, or limestone. In some cases it may be desirable that the slabs remain on the ingot after the mold is stripped therefrom and for this purpose the slabs may optionally be provided with openings 20 in their inner surface into which the hot metal flows. During stripping the wire hooks 12 are bent upwardly by the mold without pulling the slabs from the ingot. Since the top of the ingot is thus protected by the hot top at all times, no pipe or secondary pipe can be formed in the ingot, regardless of how soon after pouring the ingot is stripped.

While one embodiment of my invention has been shown and described, it will be apparent that other adaptations and modifications may

be made without departing from the scope of the following claims.

I claim:

1. A hot top for a mold comprising a pair of slabs of refractory material, the bottoms of said slabs being substantially wider than the tops to form a wedge surface on each end, a bevelled lower portion on each of said slabs, means for supporting the slabs in spaced apart relationship on the mold with their bevelled lower portions contacting the mold with a space between adjacent ends of the slabs, a second pair of slabs of refractory material one located in each of the spaces, a bevelled lower portion on each of said second pair of slabs contacting the mold, the bottom edges of the first pair of slabs having a length greater than the inside width of the mold minus twice the thickness of the second pair of slabs, the inner faces of the second pair of slabs contacting the wedge surfaces to lock all the slabs in place.

2. A hot top for a mold comprising a pair of slabs of refractory material, the bottoms of said slabs being substantially wider than the tops to form a wedge surface on each end, a bevelled lower portion on each of said slabs, a hanger attached to each slab above the bottom thereof so that the bevelled lower portions contact the mold, said hangers supporting the slabs in spaced apart relationship on the mold with a space between adjacent slabs, a second pair of slabs of refractory material one located in each of the spaces, a bevelled lower portion on each of said second pair of slabs contacting the mold, the bottom edges of the first pair of slabs having a length greater than the inside width of the mold minus twice the thickness of the second pair of slabs, the inner faces of the second pair of slabs contacting the wedge surfaces to lock all the slabs in place.

3. A hot top for a mold comprising a pair of slabs of refractory material, the bottoms of said slabs being of less width than the width of the mold and the top of the slabs being of substantially less width than the bottom to form a wedge surface on each end, a bevelled lower portion on each of said slabs, a hanger attached to each slab above the bottom thereof so that the bevelled lower portions of the slab will bear against the mold, said hangers supporting the slabs on opposite sides of the mold, a second pair of slabs of refractory material located on the sides of the mold between the first named pair of slabs, a bevelled lower portion on each of said second pair of slabs contacting the mold, the bottom edges of the first pair of slabs having a length

greater than the inside width of the mold minus twice the thickness of the second pair of slabs, the inner faces of the second pair of slabs contacting the wedge surfaces to lock all the slabs in place.

4. A hot top for a mold comprising a pair of slabs of refractory material, the bottoms of each of said slabs extending around a substantially greater portion of the periphery of the mold than the tops thereof to form a wedge surface on each end of each slab, a bevelled lower portion on each of said slabs, means for supporting the slabs in spaced apart relationship on the mold with their bevelled lower portions contacting the mold with a space between adjacent ends of the slabs, a second pair of slabs of refractory material one located in each of the spaces, a bevelled lower portion on each of said second pair of slabs contacting the mold, the bottom edges of the first pair of slabs having a length greater than the inside width of the mold minus twice the thickness of the second pair of slabs, the inner faces of the second pair of slabs contacting the wedge surfaces to lock all the slabs in place.

5. A sectional hot top for a mold comprising two side and two end slabs of refractory material, the bottoms of said side slabs being substantially wider than the tops to form a wedge surface on each end, a bevelled lower portion on each of said slabs, means for supporting each of the side slabs on opposite sides of the mold with their bevelled lower portions contacting the mold, the bottom edges of the side slabs having a length greater than the inside width of the mold minus twice the thickness of the end slabs, the end slabs being located on opposite ends of the mold with their bevelled lower portions in contact with the mold walls and their inner faces in contact with the wedge surfaces of the side slabs whereby all of the slabs are locked in place.

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