Feb. 9, 1954 J. H. JONES 2,668,336

HOT TOP FOR INGOT MOLDS

Filed March 6, 1951

Fig. 1

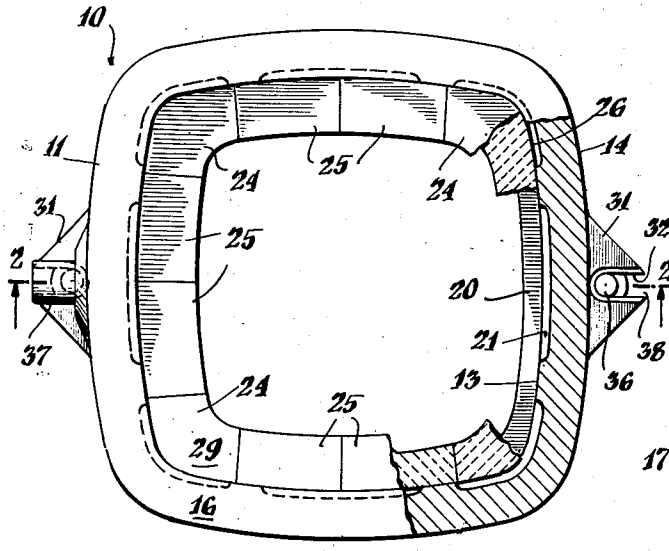


Fig. 3

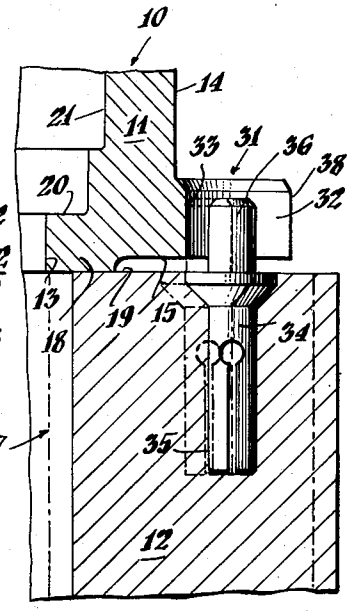
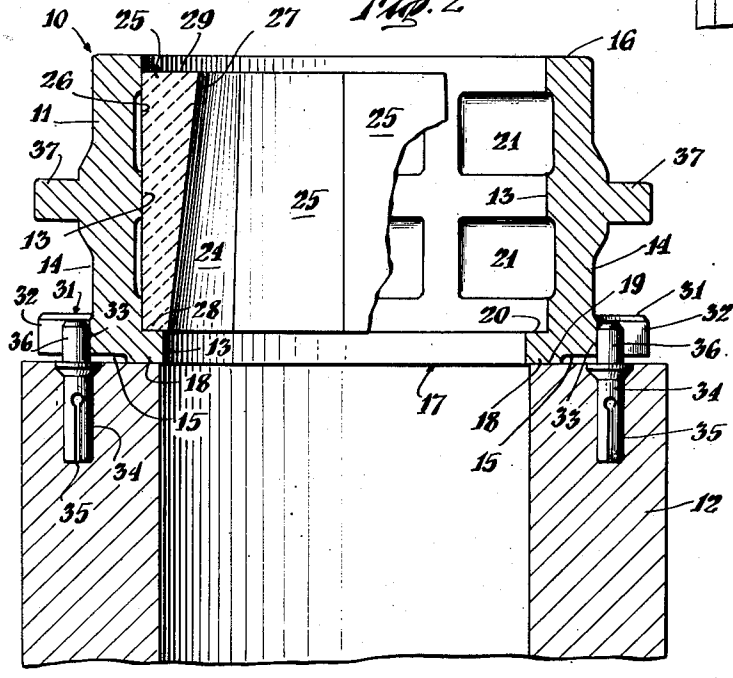


Fig. 2



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Patented Feb. 9, 1954

2,668,336

UNITED STATES PATENT OFFICE

2,668,336

HOT TOP FOR INGOT MOLDS

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Application March 6, 1951, Serial No. 214,088

4 Claims. (Cl. 22—147)

1

This invention relates to mold extensions or hot tops adapted to be positioned on ingot molds and is more particularly concerned with hot tops of the fixed type having improved design to yield a clean smooth surface at the hot top and mold junction of the ingot.

In the production of steel ingots the molds are provided with mold extensions or hot tops which are separate from the mold proper and in the fixed type of hot top are positioned on the upper face of the mold. When molten metal is poured into the mold an excess is poured so that the level of molten metal stands above the joint between the mold and the hot top. The excess metal is provided as a reservoir so that as the metal in the mold shrinks on cooling the metal in the hot top can feed down into the mold. A neck portion of the ingot which extends into the hot top after the ingot hardens develops a cavity or pipe in its upper end which results from a more rapid cooling of the outer parts of the ingot. It is customary to remove that part of the neck which has the cavity but an effort is made to save as much of the neck as possible because it contains considerable amounts of sound steel which may be rolled into blooms or billets as a part of the ingot. However, if the joint between the mold and hot top is not tight, fins of metal may freeze in the joint; or, if the opening in the bottom of the hot top is not accurately centered over the mold mouth so as to prevent any extension of the ingot outside of the upper inside corner of the mold, hanger cracks will occur in the ingot during solidification. Also, if the hot top is not centered so as to avoid an excessive shoulder or step on the ingot by the hot top lower corner extending too far inside of the mold opening, a fin or sliver will result when the ingot is rolled. In addition, if the proper size differential is not maintained between the opening at the lower end of the hot top and opening at the upper end of mold, one of the above mentioned ingot defects will result. Furthermore, if the entrance from the hot top into the mold mouth is restricted the molten metal in the hot top will not feed properly into the mold and freezes or bridges across, forming a secondary pipe which results in an unsound ingot from which greater portions of the neck must be cut or the entire ingot must pe discarded.

In prior centering devices, excessive looseness between the mold and hot top was necessary to compensate for expansion of the mold. Such devices have been ineffective and have resulted

2

frequently in a shoulder being formed on the ingot of such proportions that a sliver developed on one side, while on the opposite side of the ingot a hanger crack resulted from the hot top extending out beyond the mouth of the mold opening.

An important object of this invention is therefore to provide a hot top which will seal tightly against the upper face of the mold to form a closed joint.

Another object is to provide a hot top construction such that the hot metal in the top will feed readily into the body of the ingot and minimize the amount of freezing or bridging across.

Another important object is to provide an apparatus which will permit the accurate centering or positioning of the hot top upon the mold, said centering and positioning means being so designed that the mold and the hot top do not become bound or warped by expansion of the mold during the pouring process.

Another important object is to prevent the warping of the hot top at the point of contact with the mold by providing adequate means for dissipating quickly heat received at the surface in contact with the mold and the molten ingot.

The invention comprises an improved hot top which may be positioned removably on the upper face of an ingot mold. The hot top has a collar, preferably a single, massive iron casting, which is defined by an inner and outer wall, a lower end and an upper end. The inner wall is of substantially the same size as the mouth of the ingot mold at the line of contact between the hot top with the upper face of the mold. A mold engaging face is provided on the lower end of the collar and extends from the inner wall of the collar outward a distance less than the thickness of the collar. The inner wall of the collar is recessed above the line of contact of the collar with the mold face to form a ledge. Heat insulating means are mounted on the ledge and slope inwardly toward the upper end to define a chamber which is larger at the end adjacent the mouth of the ingot mold and narrower at the upper end of the hot top. Horizontally extending, vertical slots are formed in the lower end of the collar which extend in opposite directions outwardly, said slots being closed at their inner ends. Pins are fixed in the upper face of the mold and extend upward from said face into the slots at their closed ends, when the hot top is in position on the upper face of the mold prior to the pouring of the ingot, to provide accurate centering for the hot top on the mold. For a more complete de-

scription of the invention, reference is now made to the drawings wherein:

Fig. 1 is a top plan view of a hot top device embodying the invention;

Fig. 2 is a vertical section taken along the lines 2—2 of Fig. 1 showing the hot top in position on the upper face of an ingot mold;

Fig. 3 is a detailed view of one of the slots formed in the hot top showing the pin in engagement with the slot.

The hot top 10 has a collar 11 which may be made of suitable material such as cast iron and in the form shown is a massive integral casting having thickness and weight greatly in excess of that needed from a structural standpoint, in order to give extra weight to assist in the sealing of the joint between the hot top 10 and the mouth 12 and also to provide a heat-dissipating means, as will be discussed below. The collar has a substantially vertical, inner wall 13, and, an outer wall 14, a lower end 15 and upper end 16.

The inner wall 13 adjacent the lower end of the collar is substantially the same size as the mouth 17 of the mold 12, i. e. at least as small, and no more than slightly smaller than said mouth, present preference being to have this bottom opening of the hot top very slightly smaller than the mold mouth, for best avoidance of hanger cracks.

A shallow boss 18 formed on the lower end 15 and extending around the inner wall 13 is adapted to contact the machined upper face 19 of the mold 12 around the mouth 17.

The inner wall 13 above the line of contact between the boss 18 and the machined face 19 is recessed or set back to form a ledge 20. Additional shallow pockets or recesses 21 are formed in the inner wall 13 above the ledge 20.

Suitable heat-insulating means are provided on the inner wall supported by the ledge 20. In the embodiment shown in the drawings, the heat-insulating means are refractory brick shapes 24 and 25. The shapes 24 are formed to fit in the corners and the members 25 are adapted to be positioned between the corner members. The brick shapes 24 and 25 are provided with vertical outer faces 26 and sloped inner faces 27, the inner face sloping (if desired) appreciably out of a vertical plane. The brick-shaped members 24 and 25 are positioned on the inner wall 13 of the collar with their vertical faces 26 in contact with the wall 13 and with their narrow ends 28 supported on the ledge 20. A suitable adhesive or cement may be provided between the vertical faces 26 and the inner wall 13 to maintain the brick shapes in position. Although the shapes are cut in such fashion that they fit together closely and maintain themselves in position, it has been found desirable to cement them to the inner wall to prevent their displacement in use. The cement or adhesive solidifying in the pockets 21 bonds the members 24 and 25 to the inner wall 13 of the collar.

The sloped inner faces of the brick members 24 and 25 form a chamber in the hot top which may be smaller than the mouth of the inner wall 13 at the lower end of the members and tapers as shown toward the opening formed by the upper ends 29 of the members 24 and 25.

Lugs 31 are provided on opposite sides of the outer wall 14 of the hot top collar. The lugs are bifurcated to form open-ended slots 32 which are closed at the points of bifurcation 33 which are adjacent the outer wall of the collar.

Pins 34 are seated in drill holes 35 in the machined upper face 19 of the mold 12. The upper ends 36 of the pins 34 extend above the face 19 of the mold, and there extend into the slots 32 of the lugs 31, being normally or originally disposed at the closed ends 33 of said slots. Suitable means for lifting the hot top may be provided, such as ears 37 which project from the outer walls 14 to which attachments can be fastened for lifting or positioning.

In order to place the hot top in position on the mold, lifting means are attached to the ears 37. As the hot top is moved into position above the mold and is lowered into the position shown in Fig. 2, upper ends 36 of the pins 34 are received into the slots 32 at the ends 33. Thus, by positioning the hot top on the mold, with the pins cooperating with the slotted lugs 31, the hot top can be centered and positioned accurately on the upper face of the mold and will not be subject to displacement during the pouring operation.

As molten metal is poured through the hot top into the ingot mold, the mold expands because of the increased temperatures. The increased temperature will cause the mold walls to move outward from the position shown in Fig. 2, and the dotted line position shown in Fig. 3, to the full line position shown in Fig. 3. As the expanding mold wall moves outward, the pin 34 likewise move outward and the upper ends 36 extending into the slots 32 in the lugs 31 move outward from the closed ends 33 of the slots toward the open ends 33. The outwardly extending slots 32 permit the pins 34 to move outward freely in response to the expansion of the mold wall and no binding of the parts of hot top and mold, and no warping can result from the different rates of expansion of mold wall and the hot top.

In the form shown, the hot top is provided with two lugs disposed at opposite sides of the outer wall of the hot top so that accurate initial centering of the hot top on the mold can be effected and the weight of the hot top acts to maintain the positioning once established. Although it will be appreciated that the hot top may be provided with an additional pair of lugs extending from the outer wall at right angles to the presently illustrated lugs, such additional lugs and pins are not necessary for there is no appreciable expansion of the mold until after the ingot has been poured. Therefore, the hot top is firmly held against movement along the lines of the pins 34 by the upper ends 36 of the pins 34 abutting against the ends 33 of the slots 32 and against movement at right angles to the line of the pins by the upper ends 36 abutting against the sides of the slots 32.

It also will be appreciated that although the slots 32 are formed in lugs extending from the outer wall 14 at the lower end 15 of the hot top collar, slots or notches may alternatively be formed in the lower end body itself. However, when the slots are provided in the outwardly extending lugs the operator may position the hot top on the mold with greater facility for the slots are more clearly visible from above and elsewhere.

It has been found that a tight, well-sealed joint can be achieved between the hot top and the machined upper face 19 of the mold by having a restricted area of contact between the hot top and the mold. This is effected by use of the narrow boss 18 which is provided on the lower

end 15 of the hot top and extends around the perimeter of the mouth 17 of the mold 12. The extent of the boss projection 18 from the lower end 15 of the hot top may be, for example, ½" so that if the boss surface becomes warped in use, it can be corrected by machine cutting. As indicated, the annular plane face or surface of the boss 18 is preferably much narrower than the width of the top mold surface 19, both to reduce heat transfer and especially to provide an accurately close fit; for example, where the plane, mold surface 19 is five or six inches wide or more, the annular surface of the boss may have a width of 2½ to 3 inches. The excessive weight of the collar 11 assists in sealing the joint between the hot top and the mold. The large mass of metal in the collar also provides a dam for temperature and minimizes the possibility of warping of the hot top because heat received from the mold face and molten ingot through the boss 19 is dissipated quickly in the metal mass.

The refractory brick may be made in large shapes, such as the corner shapes 24 and the side or lateral shapes 25 so that by adding or omitting some of the side shapes, lining of this type may be made to fit different sizes of hot tops such as squares and rectangles, providing, of course, that the corner shapes remain standard.

It has been found that the use of refractory brick shapes of large extent and considerable mass has resulted in the lining life being extended. Furthermore, by interposing the metal collar, i. e. the ledge 20 and the boss 18 between the refractory lining bricks 24, 25, and the mold face 19 the bricks are not subject to breakage in positioning the hot top and are relieved of the strain of supporting the collar. The sloping walls of the inner face 27 of the refractory brick lining and the wide opening of the hot top adjacent the junction with the mold permits the ingot to settle away from the hot top freely rather than hanging and freezing in the slurry used for an inside dressing of the refractory lining.

The use of hot tops of the type described has resulted in a considerable yield improvement because of the ability to utilize a greater portion of the ingot product whereas previously with the use of conventional hot top ingots objectionable surface conditions at the junction between the hot top and the mold made it necessary to discard steel which was otherwise sound beneath the surface. Mold extensions or hot tops embodying the invention have resulted in achieving the objects sought and produce a superior product at a reduced cost.

In accordance with the provisions of the patent statutes, the principles of this invention have been described together with the best mode of applying those principles; however, it should be understood that the structure disclosed is but one mode of utilizing the invention and the structure described is merely illustrative, for the invention may be carried out by other and alternative means. Also, while it is contemplated to use the various features and elements in the combinations and relations described, some of these may be altered and modified in ways other than those suggested, without departing from the spirit and scope of the invention.

I claim:

1. In combination a hot top and an ingot mold wherein the hot top is removably positioned on the upper surface of the mold, said combination comprising, a collar defined by an inner and an outer wall, a lower end and an upper end, a mold-

engaging face provided on the lower end extending from the inner wall outward in a narow perimeter around the mouth of the mold, the inner wall adjacent the lower end defining an opening at least as small as, and no more than slightly smaller than, said mouth, heat insulating means mounted on the inner wall above the mold engaging face, the collar being formed to define at least two horizontally extending, vertical slots extending in opposite directions from the vertical axis of the collar, and opening on the lower end of the collar, each of said slots having at least one closed end at its inner extent, pins fixed in the upper face of the mold extending upward from said face and into the slots substantially against their closed ends prior to the pouring of the ingot.

2. The combination of a hot top and ingot mold in which the hot top is removably positioned on the upper surface of the mold, comprising, a massive metal collar of less wall thickness than the ingot mold, said collar having a mold-engaging lower face, an inner wall and an outer wall, said inner wall defining an opening being of substantially the same size as the mouth of the ingot mold at the line of contact of the upper face of the ingot mold with said lower mold-engaging face of the collar, said mold-engaging face extending from the inner wall of the collar outwardly on the mold surface a distance less than the thickness of the collar, heat insulating means on the inner wall of the collar, at least two lugs on the outer wall of the collar extending outwardly therefrom in opposite directions and formed to define horizontally extending, vertical slots, said slots extending outwardly from said outer wall and being closed at the end adjacent said wall, pins fixed in the upper face of the ingot mold and extending upward from said face into the said slots substantially against the closed ends adjacent the said outer wall when the hot top is positioned on the upper face of the mold prior to the pouring of the ingot.

3. The combination of a hot top and an ingot mold in which the hot top may be removably positioned on the upper face of the ingot mold, comprising, a collar having inner and outer walls which are vertical, a lower face and an upper end, a narrow boss extending from the lower face of the collar and adapted to engage the upper face of the ingot mold, said boss extending from the inner wall of the collar outwardly with respect to the mold surface a distance less than the thickness of the collar, said inner wall defining an opening being of substantially the same size as the mouth of the ingot mold at the lower face of said collar, heat resisting means disposed on the inner walls of the collar, said heat resisting means having sloping inner walls to define an opening which tapers toward the upper end of the collar, and lugs on the outer wall at opposite sides thereof and adjacent the lower face of the collar, said lugs being shaped to define horizontally extending, vertical slots having at least one closed end adjacent the outer walls, pins mounted in the upper face of the mold extending upward vertically into said slots substantially against said closed ends thereof when the hot top is positioned on the upper face of the mold prior to the pouring of the ingot.

4. The combination of a hot top and an ingot mold in which the hot top may be removably positioned on the upper face of the ingot mold, comprising, in combination with an ingot mold having a vertical, metal-receiving opening, a col-

lar structure defining an opening about a vertical axis substantially conforming with the said mold opening, means at opposite sides of said collar structure defining horizontally extending, outwardly open, vertical slots, each closed at its inner end, and upwardly projecting pins carried by the mold and respectively seating in the slots, said slots being disposed for engagement of the closed end of each with the corresponding received pin prior to the pouring of metal into the mold, and said collar structure and mold being mutually free for outward displacement of the

mold, upon expansion of the latter by the heat of poured metal, to carry the pins outwardly in guided relation in the slots.

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