May 5, 1931. W. M. CHARMAN ET AL 1,804,204

HOT TOP FOR INGOT MOLDS

Filed Dec. 31, 1928

Fig. 1.

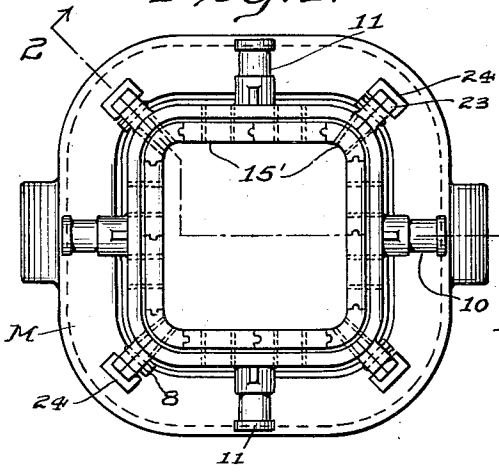


Fig. 2.

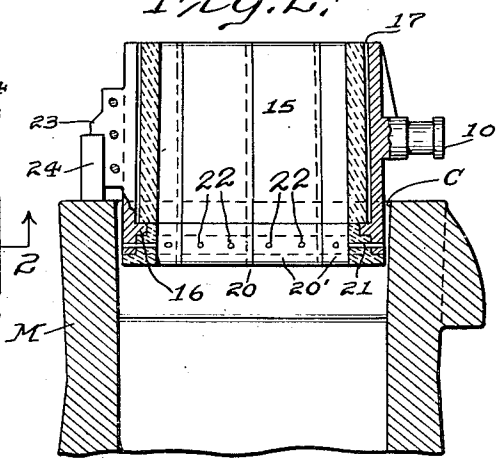


Fig. 3.

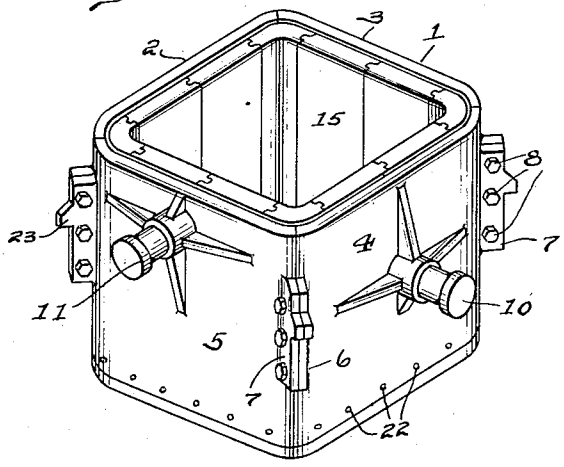


Fig. 4.

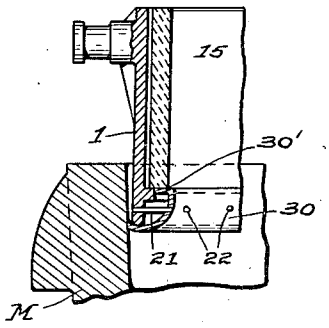


Fig. 5.

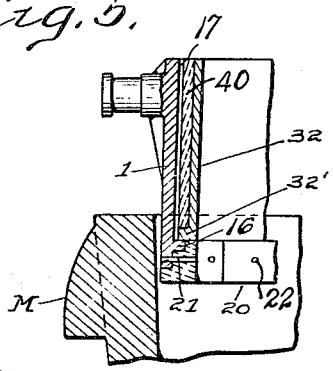
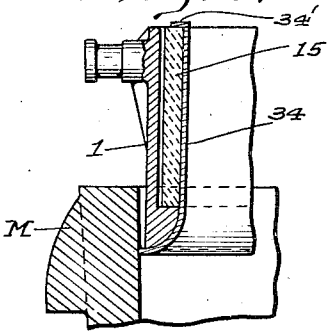


Fig. 6.



WITNESS

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Patented May 5, 1931

1,804,204

UNITED STATES PATENT OFFICE

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HOT TOP FOR INGOT MOLDS

Application filed December 31, 1928. Serial No. 329,486.

Our invention relates to that class of devices known as hot tops and which are utilized in the casting of steel ingots and the like, the function of the hot top being, in general, to keep the upper end of the casting molten a sufficient length of time.

It has been the custom to make hot tops of clay or other more or less plastic material by molding and baking them preparatory to their being placed on the ingot mold and after the ingot is poured to strip the hot top off by a pair of tongs or like implement, but as the material of which the top is formed generally cracks under the heat to which it is subjected, the top tears apart along these cracks during the stripping; in consequence only that part above the cracks is removed by the tongs and it therefore becomes necessary to remove the remaining portion by knocking it off with a crowbar or the like. This operation is a very undesirable one because of the intense heat adjacent the ingots, while, furthermore, it is extremely difficult to thereby remove all of the top material so that a certain amount of the latter is carried with the ingot to the soaking pit. Due to the heat in the soaking pit the residual portion of the hot top frequently melts and runs down the sides of the ingot to the pit floor so that the latter through gradual accumulation of the melted hot top material increases in thickness and correspondingly diminishes the depth of the pit. Additionally the accumulated hot top material in the pit in connection with other impurities also therein accumulated forms a slag which acts as an insulator around the bottom of the ingot thereby preventing the lower end of the ingot from being heated to the same temperature as the rest of the ingot which results in the formation of minute cracks near the bottom of the ingot which appear when the latter is subsequently rolled.

A principal object of our invention, therefore, is the provision of an improved form of hot top through the use of which the disadvantages to which we have referred are entirely overcome and which in addition presents numerous advantages over the forms of hot tops heretofore employed.

A further object of the invention is to provide a hot top which can be used satisfactorily for a plurality of casts; to provide a hot top which may be stripped from the mold without the use of special equipment and which when so stripped leaves but a relatively small amount of refractory material upon the ingot, if any; to provide a hot top by the use of which maximum efficiency in pouring conditions may be obtained and which may be so constructed as to bring about the greatest possible amount of pipe elimination in the ingot with a minimum amount of casting metal in the top and to provide a top of such character that it will freely follow and sink with the fluid metal as the latter shrinks during the cooling of the ingot thus resulting in free contraction of the latter and preventing any "hanging up" of the ingots which frequently occurs with the hot tops at present in use and results in cracks in the ingots.

Still further objects of the invention are to reduce the cost of the hot tops per ingot; to effect a saving in storage space required for the hot tops and the bricks entering into their construction; and to appreciably reduce the cost of repairs to the soaking pits required because of the accumulation therein of residual material from the forms of hot tops heretofore generally employed.

Our invention further includes other objects, advantages and novel features of design, construction and arrangement hereinafter more particularly pointed out or which will be apparent to those skilled in the art from the following description of certain forms of hot tops embodying the principals thereof and illustrated in the accompanying drawings.

In the said drawings Fig. 1 is a top plan view of a hot top constructed in accordance with one form of our invention and disposed on the upper end of an ingot mold preparatory to the pouring of the ingot; Fig. 2 is a vertical section of the hot top and mold on line 2—2 in Fig. 1 looking in the direction of the arrows and Fig. 3 is a perspective view of the hot top shown in the preceding figures. Figs. 4, 5 and 6 are respectively fragmentary vertical sections showing slightly modified forms of the invention. The same charac-

ters of reference are used to designate the same parts in several figures.

Referring now more particularly to that form of the invention shown in Figs. 1 to 3 inclusive, the same comprises a hollow casing generally designated as 1 which is built up of four separate sections 2, 3, 4, 5, respectively provided at their corners with outwardly directed lugs 6 and 7 for the reception of bolts 8 by which the sections are secured together to thereby form a single operatively unitary structure. While we frequently prefer to use a built-up casing of the general nature of that to which we have referred, the casing may, if desired, be cast as a single integral unit, while in any case the size and shape of the lower part of the casing is such that when entered into the mouth of the mold M with which it is intended to be used, a small clearance C will be afforded between the mold wall and the casing extending entirely around the latter.

The casing may be provided with one or more sets of oppositely disposed trunnions for the attachment of lifting hooks when stripping the hot top from the mold or moving it about and as a matter of convenience we prefer to provide two sets of these trunnions and to locate one set 10, 10 near the center of gravity of the hot top and the other set 11, 11 more nearly adjacent the upper end thereof; under these conditions the latter set of trunnions may be desirably used when stripping the hot top from the mold and the other set when it is desired to turn the hot top upsidedown for inspection or repairs.

As shown, the casing tapers slightly inwardly from its lower edge and is provided with an upper interior lining, generally designated as 15, of refractory or other suitable material desirably in the form of a plurality of interfitting bricks 15'. The bricks forming this lining are vertically supported upon an inwardly directed ledge or shelf 16 extending around the casing a short distance above its bottom and integral with or attached to the casing wall and are desirably so arranged that a small clearance space 17 is left between their outer faces and the casing so as to permit expansion of the bricks when heated, for in the absence of this clearance, some of the lining material being unable to expand under the extreme heat to which it is subjected may crack or crumble and thus become unfit for further use after one or more pourings; however, it is possible to omit the clearance if considered necessary or desirable by constructing the upper lining of refractory or insulating material having substantially negligible expansion or contraction such as, for example, so-called sawdust brick.

We have shown the inner faces of the bricks 15' forming the upper course of brickwork constituting the main lining of the casing as slightly inwardly inclined from bottom to top in correspondence with the inclination of the casing wall, this construction giving good results in practice, but if desired the bricks may be of other shapes with a view to inducing the greatest possible amount of pipe elimination in the ingot with minimum amount of steel in the top. Thus, for example, as the ingot pipe is of generally cone shape, the bricks in the upper course might be made in such form that the interior of the hot top would be of generally corresponding shape with a view, as stated, to securing the maximum amount of pipe elimination. It will be understood that the upper course of bricks 15' form a more or less permanent part of the hot top, as a whole, and are thus utilized for a plurality of casts, being removed from the mold with the casing after the completion of each cast.

A lower course of refractory or other suitable material, generally designated as 20, and preferably formed of bricks 20' is also provided to form a lining for the lower part of the casing adjacent and below the shoulder 16. As in the case of the upper course, these bricks 20' are preferably interfitting and may be of any form suitable for the particular contour of the mold with which the hot top is to be used. Desirably this course of bricks entirely overlies the surface of the casing beneath the ledge 16 as well as the lower edge or face of the casing as best shown in Fig. 2 so that the lower faces of the bricks can rest on the surface of the ingot during the casting operation as hereinafter explained. The bricks or other refractory or suitable material forming the lower course are initially secured to and supported from the casing by means of suitable fastenings, such for instance as pins 21 of wood or other fusible, frangible or burnable material extending through the bricks and into holes 22 drilled through the lower portion or skirt of the casing, also as best shown in Fig. 2.

The casing is also provided with means for effecting its support on the mold preparatory to and during the pouring of the metal, said means preferably comprising ears 23 integral with the lugs 6 and 7, extending outwardly therefrom and adapted to rest on blocks of wood 24 or other suitable supports disposed on the upper end of the mold and operative to support the hot top with the lower course of bricks and the skirt of the casing extending into the mold for a suitable distance as shown in Fig. 2.

Preparatory to the pouring of the metal, the hot top is supported above the mold by means of the blocks 24 or other suitable means as shown in Fig. 2 so that the lower end of the casing as well as the lower course of bricks extend into the mold but are out of contact therewith by reason of the small clearance C of which mention has been made.

The molten metal is then rapidly teemed into the mold through the hot top until it rises therein sufficiently to enter the clearance space C in which it rapidly congeals or freezes to form a seal at this point. The teeming of the metal is now continued at a slower rate until the level thereof is brought to a suitable point in the top, usually from one to six inches below its upper end depending upon the thermal and physical condition of the steel being poured and the wooden blocks 24 or other support are then knocked away so as to allow the hot top to sink with the metal as its shrinks in the mold thus insuring a freely floating hot top. Thus with our improved hot top there is no tendency whatever for the ingot to be "hung up", that is, to be to any extent suspended from the top as frequently occurs with the hot tops hitherto in use and which are firmly supported on the upper end of the mold. This "hanging up" or sticking of the ingot to the hot top is most undesirable as it tends to cause cracks in the ingot but in our improved hot top, as soon as the blocks 24 or other supports are removed, is entirely supported on the ingot itself and thus free to follow the latter down as it shrinks in cooling, the undesirable condition to which we have referred is entirely prevented.

When the ingot has cooled sufficiently to permit removal of the hot top a pair of lifting hooks are engaged beneath the trunnions 11 and the casing and upper course of bricks lifted off the mold as a unit, while the lower course of bricks automatically separates from the casing and upper course and remains on the ingot since the wooden or fusible pins 21 or other fastenings have been consumed or broken off during the stripping operation during the casting operation by reason of the intense heat to which they were exposed and are thus no longer effective to support the lower course of bricks. The latter may now be readily knocked off the ingot with a bar or the like, an operation which is relatively simple because of the fact that as this course of material is made of separate sections or bricks it readily comes apart and also because of the fact that the total volume or quantity of material in the course is relatively small. In fact, under certain conditions it may often be deemed unnecessary to remove the lower course of material from the ingot at all but instead to allow it to go with the ingot to the soaking pit as even if all of the material should remain upon the ingot by the time it reaches the pit, the total quantity thereof is considerably less than that remaining on the ingot under present practice, unless particular pains have been taken to remove it, and is thus ordinarily not sufficient to cause undesirable accumulation in the soaking pit or otherwise interfere with the treatment of the ingot therein.

After its removal from the mold the hot top may be inverted and allowed to cool, if necessary, so that a new lower course of parting material, such as bricks may be easily pinned or otherwise fastened in place and any patching or other necessary repairs required by the upper course conveniently effected so as to place the hot top in condition for a second cast, such as, for instance, coating the inside of the top with a suitable coating of "slurry" or facing material which acts as a cleavage plane when the top is stripped. As the upper course of bricks are free to expand and contract when required within the hot top casing they are capable of use for a considerable number of times before they are so disintegrated or worn as to require renewal, while of course the casing itself is capable of use substantially indefinitely; thus as a practical matter it is only necessary to renew the lower course of bricks and fusible pins or other suitable fastenings after each cast and to renew the upper course of bricks at relatively considerable intervals.

While under ordinary conditions the employment of the wooden blocks 24 as a means for supporting the hot top on the mold is convenient, it will of course be apparent that the blocks or the like might be made of some compressible material of such character that it would allow the hot top to freely follow the ingot downward while it is shrinking, and under such circumstances the blocks could be left in place throughout the cast instead of being knocked away as when wooden or other substantially non-compressible blocks are employed.

In Fig. 4 we have illustrated a slightly modified form of the invention in which instead of employing a lower course of refractory material we utilize a curved metal shield 30 which extends around the inner periphery of the mold below the upper lining 15 and is pinned in place by fusible pins 21 in a manner similar to the bricks 20′ heretofore described. This metal shield or plate contacts with the surface of the ingot when the mold is filled sufficiently to bring the metal up to the level of the plate and after the fastening means fails the shield is free to remain on the ingot when the casing and upper lining of the hot top is stripped therefrom as heretofore described. It will be noted that the form of shield which we prefer to employ comprises a main curved portion and a small outwardly directed flange 30′ adjacent its upper periphery which extends in under the adjacent portion of the upper course of brickwork, and that the curved portion of the shield is extended outwardly beyond the casing proper so as to span the clearance C between the hot top and the mold and thus form a seal between the parts at this point which at least to some extent supplements or

takes the place of the seal formed by the congealed metal as heretofore described.

In Fig. 5 we have shown still another form of the invention in which the upper course of bricks or other material in the hot top is faced on its inner side with metal. This metal is desirably in the form of a cast sleeve 32 having an outwardly turned flange or shoulder 32' at its lower end upon which the brick lining 40 can rest and which in turn rests on the ledge 16. The brick or other refractory lining 40 thus forms an insulator between the metal sleeve 32 and the casing but does not normally entirely fill the space between these parts, the clearance 17 being left to permit the requisite expansion of the bricks and having some further advantage as an insulating air space. The metal sleeve 32 thus comes in contact with the fluid metal in the top and after the ingot is poured the top is stripped off with the refractory 15 and casing 1 in the manner heretofore described, the lower course of bricks 20 remaining on the ingot after being released by failure of the fastening means, in this instance by the fusing of the pins 21. This form of the invention may be found desirable under certain conditions and of course tends to prolong the life of the upper lining of refractory by preventing direct contact of the molten metal therewith.

In the form of the invention shown in Fig. 6 the upper lining 15 is also faced with metal preferably in the form of a relatively thin sheet 34 which extends around and against the inner face of the refractory and thus lies between the latter and the molten metal in the top. In this form of the invention, the skirt of the casing below the ledge 16 which serves to support the refractory is preferably curved downwardly and outwardly and the metal lining 34 similarly curved and extended beyond the casing sufficiently to span the clearance C as in the form of the invention shown in Fig. 4. To initially support the metal lining in the hot top, the former, if desired, is provided at its upper end with a plurality of small tabs 34' which, after the lining is inserted, are bent outwardly over the adjacent refractory material and thus serve to hold the metal lining in place. When the hot top is stripped from the mold after the pouring of the ingot, the adherence of the lining to the metal in the hot top is greater than the resistance offered by these tabs so that the latter straighten out and allow the casing and refractory to be stripped off, the metal lining 34 remaining on the ingot and passing therewith to the soaking pit. The use of this form of the invention, as well as that shown in Fig. 4, thus eliminates the transference of any refractory material whatever to the soaking pit with the ingot and as the small amount of unconsumed metal remaining from the shield 30 or the lining 34 as the case may be is entirely unobjectionable during the treatment of the ingot in the soaking pit, these forms of the invention will frequently be preferred over those employing the lower course of the brickwork. Of course a new metal lining must necessarily be inserted each time the hot top is used but the refractory material only requires renewal at relatively long intervals as it is quite thoroughly protected by the metal lining and kept out of contact with the molten metal in the hot top.

As the forms of the invention shown in Figs. 4, 5 and 6 are used in substantially the same manner as the form shown in the preceding figures as heretofore fully described, any extended reference thereto would be superfluous as the same will be readily comprehended by those skilled in the art.

It will thus be apparent that we have provided an improved hot top which may be utilized for a plurality of successive casts by merely inserting after each pouring a new lower course of bricks or other refractory or a new shield or metal lining depending on the particular form of the invention and which embodies many other advantages and novel features to which reference has heretofore been made.

Moreover, while to enable those skilled in the art to readily understand and practice the invention, we have herein illustrated and described several forms thereof with considerable particularity, we do not thereby desire or intend to specifically limit ourselves thereto or to any precise details in the design, construction and arrangement of the various parts of any of them as numerous modifications may be made therein if desired to adapt the hot top to particular operating conditions or for other purposes without departing from the spirit and scope of the invention as defined in the appended claims.

Having thus described our invention we claim and desire to protect by Letters Patent of the United States:

1. A hot top adapted to extend within the end of an ingot mold, and to rest upon the top of the ingot when poured, means for supporting the hot top temporarily during the pouring operation, and parting means protecting the end of the hot top and facilitating stripping of the hot top from the ingot.

2. In a hot top of the full floating type adapted to extend inside the top of an ingot mold comprising a casing, means protecting the lower end of the casing and adapted to secure parting between the casing and an ingot when the hot top is stripped therefrom.

3. In a hot top of the full floating type adapted to extend inside the top of an ingot mold, comprising a casing, a heat retaining lining for the casing including means protecting the lower end of the casing and adapt-

ed to secure parting between the casing and the ingot when the hot top is stripped therefrom.

4. In a hot top of the full floating type, parting means for the upper inner surface thereof adapted to facilitate stripping of the hot top from the ingot, and separate parting means covering the lower end of the casing adapted to protect the latter against the heat of the metal as well as to facilitate stripping the hot top from the ingot.

5. In a hot top of the full floating type comprising means for retarding the radiation of heat, a parting means covering the lower end of the hot top and extending outwardly toward the mold wall, said means being adapted to facilitate the stripping of the hot top from the ingot.

6. In a hot top for ingot molds, a casing, a lining therefor comprising an upper course of semi-permanent material, means for supporting the upper course upon the casing, a lower course of material, and separate means for detachably supporting the lower course from the casing.

7. In a hot top for ingot molds, a casing provided with an internal ledge, a lining for the casing supported upon said ledge, and a lower course of lining material detachably suspended from the bottom of said casing.

8. In a hot top for ingot molds, a casing, a lower lining course for the protection of the lower end of said casing, said course comprising elements previously formed with openings therethrough adapted to receive fastenings for removably attaching the course to said casing.

9. In a hot top for ingot molds, a casing, a lower lining course for the protection of the lower end of said casing, said course comprising a plurality of non-plastic refractory elements with interfitting edges, certain of said elements having openings therethrough adapted to receive fastenings for removably attaching the course to said casing.

10. In a hot top for ingot molds, a casing, a lining therefor comprising an upper course of refractory material, means for supporting the upper course upon the casing, a lower lining course of refractory material meeting the upper course on the inner side of the hot top and extending outwardly beneath said casing, and separate means for detachably supporting the lower course from the casing.

11. In a hot top for ingot molds, a casing, a lining therefor comprising an upper course of material, means for supporting the upper course upon the casing, a lower lining course comprising a plurality of separate blocks, and means for supporting said last named course from the casing temporarily prior to and during the pouring of the metal, said last named means being adapted to fail when the hot top is stripped from the mold.

12. In a hot top for ingot molds, a casing, a lining therefor comprising an upper course of material, means for supporting the upper course upon the casing, a lower lining course of refractory material meeting the upper course on the inner side of the hot top, said lower course comprising a plurality of separate blocks, and means for supporting said last named course from the casing temporarily prior to and during the pouring of the metal, said last named means being adapted to fail when the hot top is stripped from the mold.

13. A device of the class described adapted for operative association with an ingot mold and comprising a casing, a semi-permanent lining of suitable material within the casing terminating short of the lower end thereof, and releasably supported means below said lining adapted to contact with the surface of an ingot during the casting thereof in the mold and to separate from the casing and the lining when the latter are lifted from the mold after the ingot has been cast therein.

14. A hot top for an ingot mold comprising a casing adapted to extend into the mouth of the mold, a suitable semi-permanent lining disposed within the casing and terminating short of the bottom thereof, means for supporting said lining in the casing and releasably supported means extending below said lining and casing adapted to contact with the upper end of the ingot as it is formed within the mold and to separate from the lining and the casing when the latter are stripped from the mold after the ingot has been poured.

15. A hot top for an ingot mold comprising a metal casing adapted to extend into the mouth of the mold and provided with means for supporting the casing adjacent thereto preparatory to the casting operation, a lining of suitable material in the upper part of the casing, means carried by the casing for supporting said lining therein, means disposed below said lining and enclosing the lower end of the casing operative to rest on the surface of the ingot after the same has been poured and means for securing said last mentioned means to the casing adapted to fail and permit separation of said last mentioned means from the casing and the lining when the latter are unitarily stripped from the mold after the pouring of the ingot has been completed.

16. A hot top for an ingot mold comprising a metallic casing having its lower end formed to enter the mouth of the mold, means carried by the casing operative to support the casing adjacent the mouth of the mold preparatory to the casting operation, a lining of refractory material within the casing and spaced from the inner face thereof, means for supporting the lining therein, means extending below said lining and over

the lower end of the casing operative to engage the surface of the ingot when the same has been formed in the mold and support the casing on the ingot after said supporting means have been relieved from the weight thereof and means for securing said last mentioned means to the casing and adapted to fail and permit the separation thereof from the casing and the lining when the latter are unitarily stripped from the mold after the ingot has been poured.

17. A hot top for an ingot mold comprising a casing having its lower end adapted to extend into the mouth of the mold, a semi-permanent lining of suitable material in the upper part of the casing, means for supporting said lining therein and a separate course of refractory material releasably secured to the casing below said lining and adapted to rest on the surface of the ingot after the same has been poured in the mold.

18. A hot top for an ingot mold comprising a casing having its lower end adapted to extend into the mouth of the mold, a semi-permanent lining of suitable material in the upper part of the casing, means for supporting the lining in the casing, a separate course of refractory material disposed below said lining and means operative to secure said course to the casing preparatory to the pouring of the ingot and to fail and permit the separation of said course from the casing after the ingot has been poured to thereby allow the casing and the lining to be stripped from the ingot as a unit.

19. A hot top for an ingot mold comprising a metallic casing having its lower end adapted to extend into the mouth of the mold, a semi-permanent lining of suitable material disposed in the upper part of the casing, means carried by the casing for supporting the lining therein, a lower course of refractory material disposed below said lining and extending beyond the lower end of the casing and heat weakened means operative to initially secure said course to the casing preparatory to the pouring of the ingot and to permit the separation of said course from the casing after the ingot has been poured to thereby allow the casing and lining to be stripped from the ingot as a unit.

20. A hot top for an ingot mold comprising a metallic casing having its lower end adapted to extend into the mouth of the mold, a lining of suitable material disposed in the upper part of the casing, means carried by the casing for supporting the lining therein, a lower course of refractory material disposed in the casing below said lining and extending over the lower end of the casing and a plurality of pins adapted to be weakened by heat extending between said lower course and the casing operative to secure them together preparatory to the pouring of the ingot and to lose strength during the pouring thereof to permit said course to separate from the casing and the lining when the latter are unitarily stripped from the ingot after the same has been poured.

21. A hot top comprising a casing, a suitable lining disposed in the upper part of the casing, means disposed adjacent the bottom of the casing adapted to contact with the surface of the ingot after the latter has been formed in the mold, and means for supporting the hot top in operative position on the mold during the pouring of the ingot and operable to release said support and permit said first mentioned means to support the hot top by engagement with said ingot during the cooling thereof after the ingot has been poured, said first named means being adapted to be stripped from the hot top in the removal of the latter.

22. A hot top comprising a casing adapted to extend into the mouth of the mold, a lining for the upper part of the casing, means for initially supporting the casing from the mold during the pouring of the ingot and means carried by the casing and extending over the lower end thereof adapted to engage the surface of the ingot after the same has been poured and support the hot top therefrom to thereby permit the hot top to sink relatively to the mold as the ingot shrinks while it is cooling, said last named means being adapted to be stripped from the hot top in the removal of the latter.

23. A hot top for ingot molds comprising a casing adapted to extend into the mouth of the mold, a lining for the upper part of the casing, means for supporting the casing in operative position on the mold preparatory to and while the ingot is being poured, and means carried by the casing and adapted to be stripped therefrom in the stripping operation and extending under the lower extremity thereof adapted to engage the ingot after it has been poured and thereafter support the hot top solely from the ingot whereby the hot top is free to sink with the ingot relatively to the mold as the ingot shrinks during cooling.

In witness whereof we have hereunto set our hands this 28th day of December, 1928.

WALTER M. CHARMAN.
HARRY J. DARLINGTON.