Dec. 8, 1964 C. R. FUNK ETAL 3,159,887

EXOTHERMIC INSERTS FOR HOT TOPS

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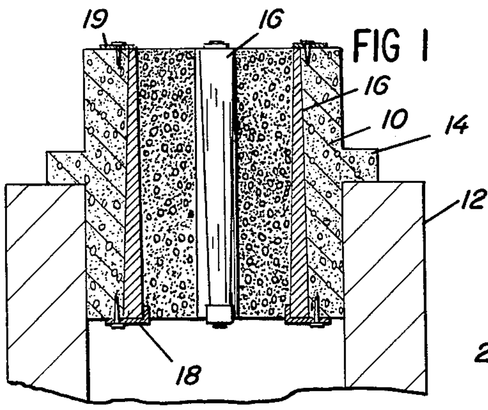


FIG 1

FIG 2

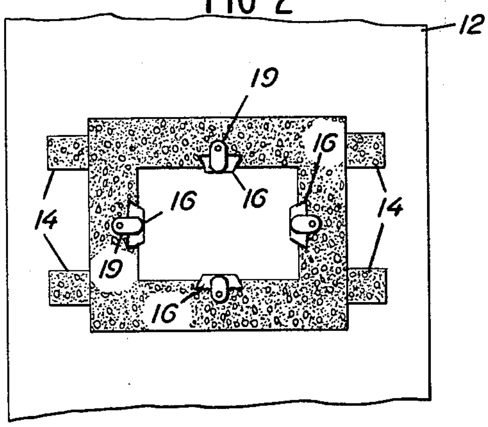
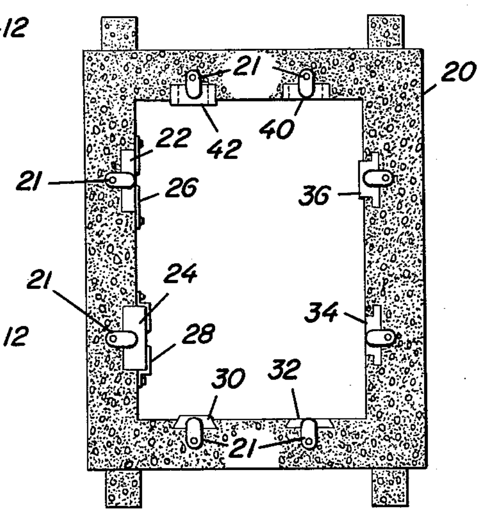


FIG 3



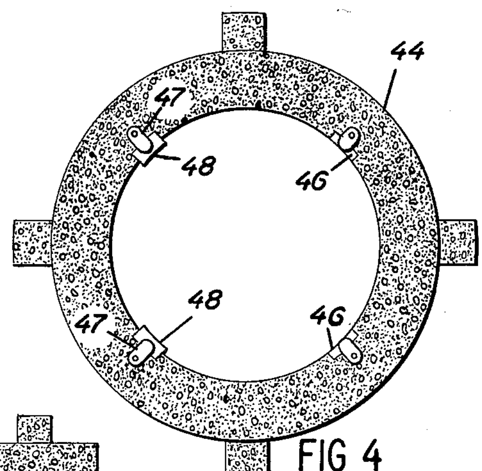


FIG 4

FIG 5

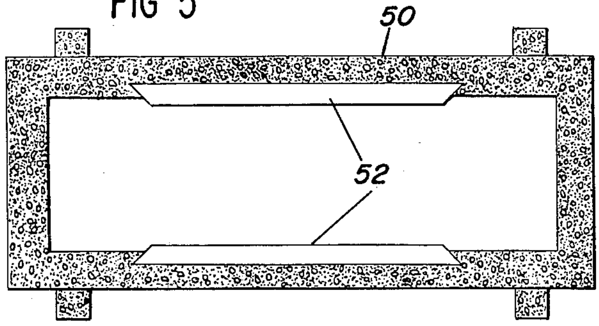


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FIG 6

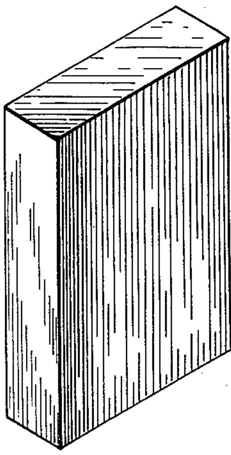


FIG 7

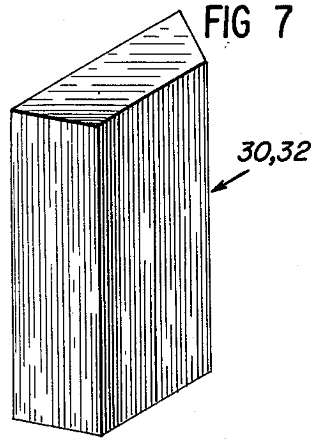


FIG 8

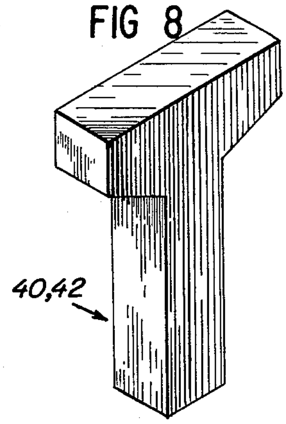


FIG 9

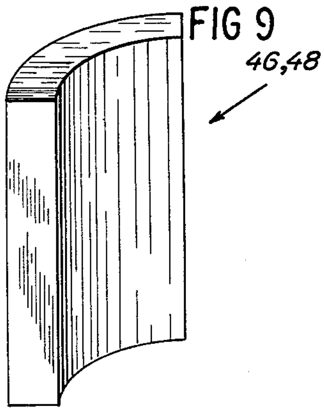


FIG 10

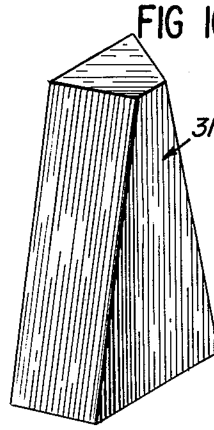


FIG 11

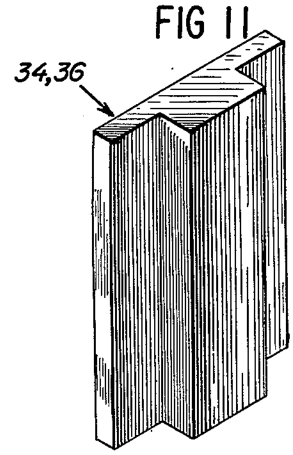


FIG 12

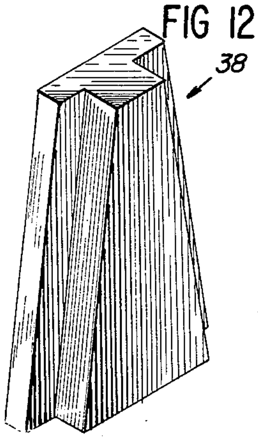
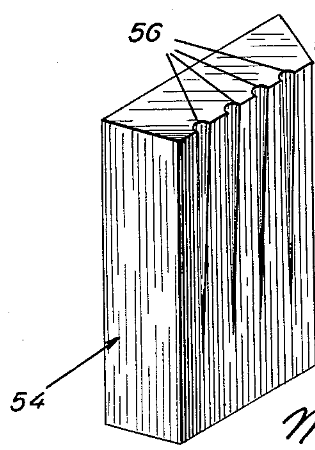


FIG 13



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EXOTHERMIC INSERTS FOR HOT TOPS

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6 Claims. (Cl. 22—147)

This invention relates to the art of hot topping metal ingots and castings. More particularly it relates to a hot top structure which includes inserts made of exothermic material; the hot tops and exothermic inserts being so designed and correlated to function efficiently at less cost than present designs.

The steel-making industry has for many years used hot tops on its molds for ingots. Hot tops comprise removable extensions of the mold and when ingots are poured, the hot tops hold the upper portion of the molten steel which subsequently reducts in volume as the steel cools and produces within the hot top a shrinkage cavity. The steel which solidifies inside the hot top is subsequently severed from the ingot inasmuch as it is not commercially usable due to its shape, porosity, impurities, and is therefore discarded. With conventional steel ingot practices, wherein exothermic heating in the hot top is not employed, the metal discarded around the shrinkage cavity may amount to as high as 24% by volume of the metal in the entire ingot and usually amounts to 13–17% of the volume of the ingot, depending upon the ingot size and the grade of steel. This percentage of volume is considered excessive and a well-known means of reducing same is by the employment of exothermic material in the hot tops. Patent No. 2,390,500, to Walter M. Charman et al., of December 11, 1945, and Patent No. 2,841,843, to Nouveau, of July 8, 1958, refer to methods of using exothermic material in ingot molds.

The use of exothermic material in the hot top reduces the volume which has to be discarded from the ingot to 10% more or less of the weight, in that additional heat is added through the exothermic reactions to keep the metal in the hot top molten, and the shrinkage cavity formed is thus less conical in shape with a corresponding reduction in the volume of metal surrounding the shrinkage cavity.

The most common method of using exothermic material in hot tops is the employment of exothermic boards to line the inner face of the mold. This requires special and expensive assembling and holding means to hold same in position. Moreover, these boards are placed below the top of the mold so that the mold wall acts as a back support which in turn reduces the usable portion of the mold.

Solutions have been proposed which involve the use of exothermic material as auxiliary lining both on the inside and the outside of the hot top structures. Also, tiles or the like with exothermic inserts have been suggested as lining for hot tops. However, the present practices and suggested workable solutions all have the disadvantage that the resultant hot top is too expensive for making simple carbon and simple alloy steels. The increased good steel yield in such steel grades generally does not justify the added expense of such known hot tops.

Many of the disadvantages of known exothermic type hot tops and other types of hot tops used in the art can be eliminated or greatly reduced by the invention disclosed herein.

The present invention provides a concrete or clay hot top which can be molded at the steel making plant and is provided with recesses for specially designed exothermic inserts which can be strategically located to:

(1) Increase the feeding efficiency of the hot top;

(2) Replace to a degree some of the refractory in the present hot tops thus reducing the dirt to be cleaned up;

(3) Permit a design which can be used on the mold, partly within the mold, or all the way within the mold;

(4) Reduce the amount of exothermic material required with increased economy;

(5) Reduce the frequency of breakage where exothermic boards are used;

(6) Insure a more positive control of the exothermic reactions;

(7) Shorten the height of the standard hot top;

(8) Decrease the volume of hot top metal;

(9) Retain hot top height for better metal feeding into ingot which is not realized with exothermic side boards placed in the top portion; and

(10) Retain hot top height for ease of stripping.

The primary object of this invention is provision of a hot top structure with exothermic inserts designed to function within the hot top to provide the above advantages and to be sufficiently inexpensive so that substantial savings are possible in the production of the less expensive grades of steel.

Other objects and features of novelty will appear as we proceed with the description of the embodiments of the invention which, for the purposes of the present application, have been illustrated in the accompanying drawings, in which:

FIGURE 1 is a vertical sectional view through the upper portion of an ingot mold with a hot top resting thereon which includes exothermic inserts in accordance with the present invention;

FIGURE 2 is a plan view of the hot top shown in FIGURE 1;

FIGURE 3 is a plan view of the hot top showing more than one insert per side including several modified types of inserts;

FIGURE 4 shows a round hot top with exothermic inserts located around the diameter;

FIGURE 5 shows a plan view of an elongated rectangular shaped hot top with the exothermic inserts in the sides only;

FIGURE 6 is a perspective view of an exothermic insert of parallelepipedal form;

FIGURE 7 is a perspective view of an insert with tapered sides;

FIGURE 8 is a perspective view of an exothermic insert of T-shape;

FIGURE 9 is a perspective view of an exothermic insert such as fits into a round hot top as shown in FIGURE 4;

FIGURE 10 is a perspective view of an exothermic insert which is tapered from its bottom;

FIGURE 11 is a perspective view of an exothermic insert having a flat T cross-section;

FIGURE 12 is a perspective view of an exothermic insert similar to that shown in FIGURE 11 but tapered from the bottom upwardly; and

FIGURE 13 is a perspective view of an exothermic insert having serrations in its upper portion.

The exact location, width and number of inserts used will vary from shop to shop according to the end use of the product, the grades of steel produced, and the mold design. It will be appreciated that varying the number, size and location of inserts does not affect the scope of the invention insofar as these matters will be within the knowledge of one skilled in the art.

Referring now to FIGURE 1, a hot top **10** which may be made of concrete or clay rests on the upper edge of the ingot mold **12**. The hop top **10** carries around its periphery a number of lugs **14** for handling the hot top and providing a base for resting same on the ingot mold

12. Four exothermic inserts **16** are received in slots within the interior of the hot top **10**. It will be noted that the inserts **16** are thicker in their lower portion than in the upper portion. Thus the trapezoidal cross-section of the insert **16** is constant insofar as its length and angular incidence of the sides are concerned. But the lengths of the sides increase in a uniform manner from top to bottom. This provides for an increased exothermic reaction in the lower portion of the hot top **10** as the steel is drawn into the lower portion of the hot top by the solidifying of steel in the ingot **12**.

In FIGURE 2 it will be noted that the inserts **16** are received in grooves which flare or taper inwardly. Thus, the inserts **16** are secured insofar as lateral movement is concerned. Securing means such as angle plates **18** which are nailed or otherwise secured to the lower portion of the hot top **10** beneath the inserts **16** serve to maintain the inserts **16** in position and from sliding downward due to gravity. Similar plates **19** are secured by nails or other appropriate means over the inserts to retard any tendency of the inserts to rise due to buoyancy when the molten steel is contained in the hot top.

Whereas FIGURE 2 shows the employment of only one insert **16** on each of the four inner sides of the hot top, FIGURE 3 shows a pair of inserts carried within the hot top **20** on each inner side. For the purposes of illustration only, each of the eight inserts shown in FIGURE 3 are different. As a general rule, however, the inserts are either all the same, or only two or rarely three different types are employed, depending upon the desired result. Inserts **22** and **24** are parallelepipeds with rectangular sides, being roughly in the shape of a board. The insert **22** is flush with the hot top **20** and is held in place with flat bar retainers **26** which are nailed or otherwise secured to the hot top **20** along the sides of the insert **22**. Plates (not shown) similar to angle plates **18** may be placed at the bottoms of the inserts and plates **21** are secured on the top to prevent vertical movement. Insert **24** is secured to the hot top **20** in a manner similar to that of insert **22** except that the retainers **28** are offset to accommodate the extension of the insert **24** beyond the inner face of the hot top **10**. The advantages of the inserts **22** and **24** reside in their practicality of use. They may be prepared in convenient standard sizes and cut to the particular lengths desired for the hot top involved.

The inserts **30** and **32** are trapezoidal in cross-section, but the cross-section is uniform throughout the length of the inserts in contrast to the inserts **16** shown in FIGURE 1. The interlocking fit of the inserts **30** and **32** with the hot top **20** prevents all movement except vertical movement which is prevented by angle plates (not shown) such as angle plates **18** in FIGURE 1 and plates **21** on the top. Insert **30** extends outwardly from the inner surface of the hot top **20** whereas insert **32** is flush with such surface. Accordingly, in the initial stages of the inserts' reaction, insert **30** will have more surface exposed to the molten metal than insert **32**. The more surface exposed by insert **30** produces a greater heat transference to the molten metal from the exothermic reaction in insert **30** during its initial stages of reaction, whereas insert **32** reacts more nearly uniformly until the insert is spent. The same distinction, of course, exists between inserts **22** and **24**. FIGURE 6 shows an insert such as inserts **22** and **24** whereas FIGURE 7 shows an insert such as inserts **30** and **32**.

Inserts **34** and **36** have a more positive tongue-and-groove interlock with the hot top **20** than is the case with inserts **30** and **32**. A perspective view of insert **34** is shown in FIGURE 11 which, it will be noted, has a uniform T-shaped cross-section.

It will be noted that insert **38** shown in FIGURE 12 also has a T cross-section. However, unlike insert **34**, it is tapered towards the top and need only be secured to the hot top at its lower aspect. In a similar manner, insert **31** has a trapezoidal cross-section which tapers towards the top and thus need only be secured in its lower aspect. The increased area which is exposed in the lower aspect in each of these modifications provides an increased heat generating area which, in turn, tends to level the bottom of the sink-hole of the cooling metal in the hot top and decreases the amount of metal which must be removed. However, inserts **31** and **38** must, in effect, be custom made and cannot be produced in long lengths such as inserts **22**, **24**, **30**, **32**, **34**, and **36**, which can be cut to the desired lengths like boards.

Inserts **40** and **42** have upright T-shapes as shown in FIGURE 8. This shape is af value where, because of the size of the hot top, the shrinkage cavity is expected to be concentrated in the upper portion of the hot top. If desired, and the hot top is so adapted, this insert may be used with the head of the T inverted to produce an increased heat generating area in the lower position of the hot top for the opposite effect. Inserts **40** and **42** are normally secured in place by securing means as illustrated for inserts **22** and **24**, which need, obviously, only to be placed at the head of the T.

The hot tops may sometimes be cylindrical in configuration such as hot top **44** shown in plan view in FIGURE 4. In such event, curved inserts **46** and **48** as shown in FIGURE 9 are fitted in the recesses provided in the hot top. It will be appreciated that such inserts **46** and **48** are curved versions of inserts such as **22** and **24** heretofore described in FIGURE 3. The straight sides of inserts **46** and **48** are directed towards the central longitudinal axis of hot top **40** and consequently the inserts **46** and **48** are held in place by a tongue and groove arrangement and need only be secured against vertical displacement due to gravity or their buoyancy in the molten metal by plates **47** on the top and similar means (not shown) on the bottom of the insert.

FIGURE 5 shows an elongated hot top **50** with two inserts **52** which are similar to insert **30** shown in FIGURE 3, but have a greater width. This modification is illustrated to show the adaptability of the invention to many configurations of hot tops.

FIGURE 13 shows insert **54** which is of special interest. The insert **54** is thus fluted in its upper aspect with tapered channels **56** which diminish as they extend downwardly and finally terminate in the lower aspect of the insert **54**. After molten metal comes into contact with this insert, the increased area in the upper portion provides an increased generation of heat to the metal in the vicinity thereof. However, as the level of the metal lowers due to shrinkage in the mold, the upper portion will be more quickly spent whereas the lower portion with less area in contact with the molten metal and more exothermic material will tend to generate heat for a longer period of time to the metal in its vicinity. This design permits an efficient use of exothermic material with a minimal waste of metal along the sides of the sink-hole.

The foregoing detailed description of the invention and various modifications thereof has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, for further modifications will be obvious to those skilled in the art.

We claim:

1. A hot top of clay, cement, or the like, in combination with an ingot mold having molten metal therein, said hot top including a vertical longitudinal groove of uniform cross-section in the inner face thereof, and an insert of exothermic material of uniform cross-section corresponding to the aforesaid cross-section of said longitudinal groove keyed within and interlocked with said groove, one side of said insert substantially immersed in said molten metal.

2. A combination as set forth in claim 1 wherein said cross-sectional shape of said longitudinal groove is trapezoidal.

3. A combination as set forth in claim 1 wherein said

cross-sectional shape of said longitudinal groove is in the form of a flat T.

4. A hot top in combination with an ingot mold containing molten metal, said hot top having a longitudinal groove in the inner face thereof, said longitudinal groove being wider at the bottom than the top portion, and an insert of exothermic material of a shape corresponding to said groove keyed within and interlocked with said groove, the outer face of said insert substantially immersed in said molten metal.

5. A hot top in combination with an ingot mold containing molten metal, said hot top having a recessed portion in the inner face thereof, said recess being T-shaped, and an insert of exothermic material corresponding in shape to said recess keyed within and interlocked with

said recess, one side of said insert substantially immersed in said molten metal.

6. The invention of claim 1 wherein the exothermic insert for a hot top is fluted in its upper portion.

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