United States Patent [19]

Young

[11] **3,722,848**

[45] **Mar. 27, 1973**

[54] HOT TOP SECURING SYSTEM

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[22] Filed: **June 4, 1971**

[21] Appl. No.: **149,982**

[52] **U.S. Cl.** **249/197,** 249/202

[51] **Int. Cl.** **B22d 7/10**

[58] **Field of Search** 249/197–202, 106

[56] **References Cited**

UNITED STATES PATENTS

3,162,913	12/1964	Witt	249/197
3,421,731	1/1969	Koch et al.	249/197

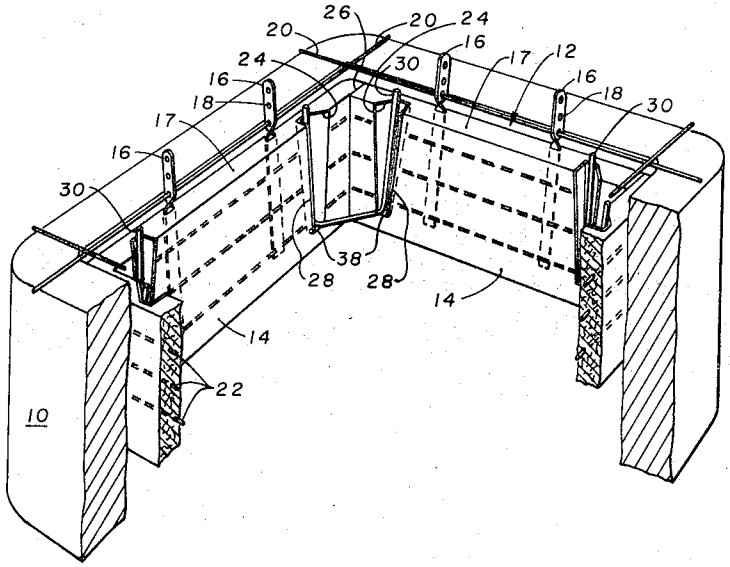
Primary Examiner—Robert D. Baldwin

Attorney—Stephen A. Schneeberger, Eldon H. Luther, Robert L. Olson, John F. Carney and Richard H. Berneike

[57] **ABSTRACT**

A hot top securing system for securing preformed sideboards within an ingot mold. The securing system employs end adjacent side boards having grooves therein which form downwardly convergent wedge receiving grooves at each corner of the mold. Each groove comprises a protective liner secured to the sideboard and so formed and oriented that the required downward convergency results. Wedge means, preferably U-shaped spring rods, are inserted base side down between pairs of grooves at each corner to provide the required securing force.

5 Claims, 5 Drawing Figures



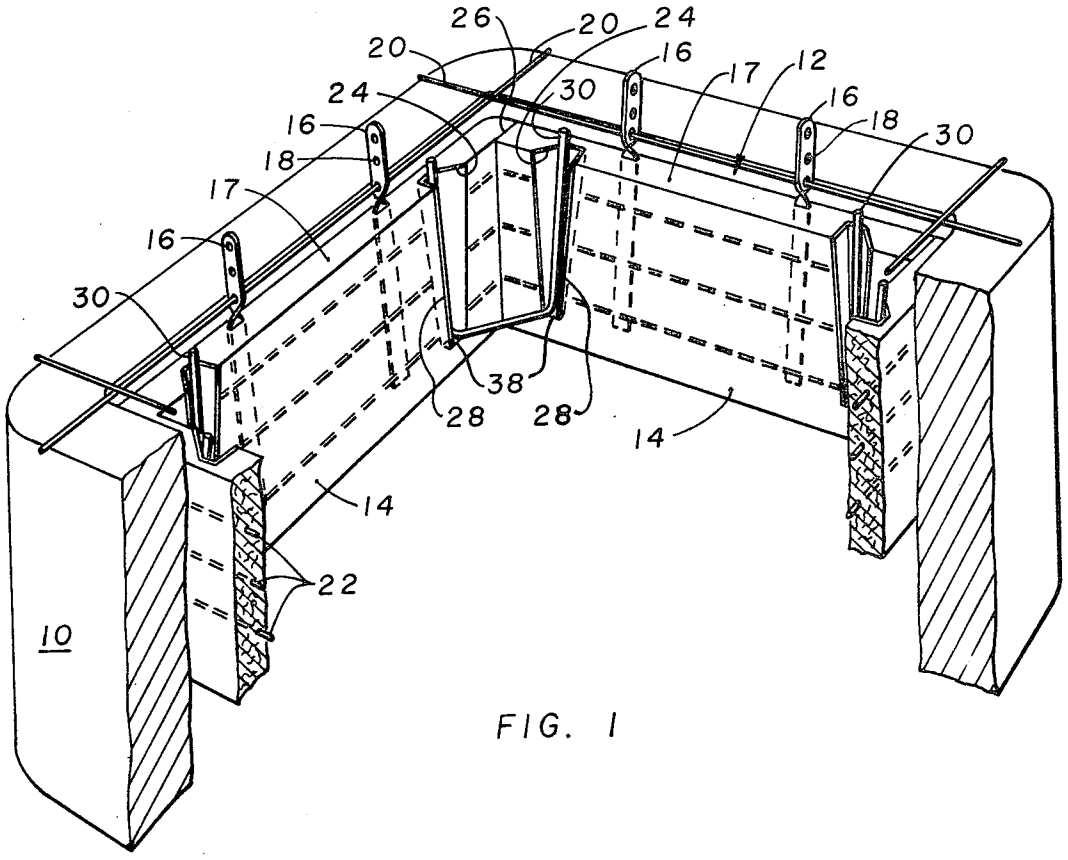


FIG. 1

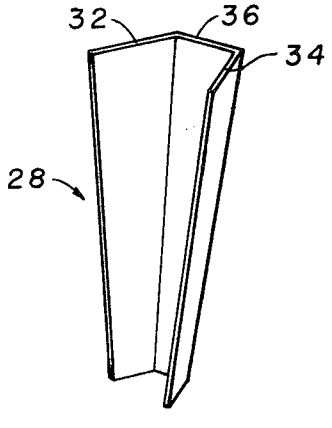


FIG. 3

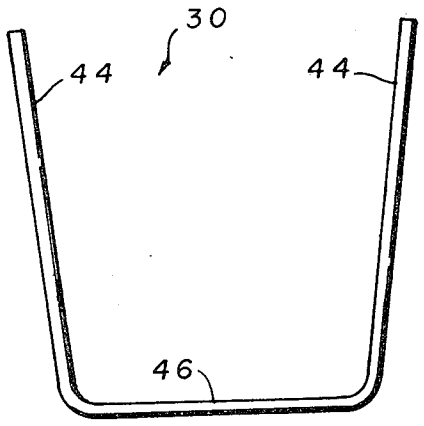


FIG. 5

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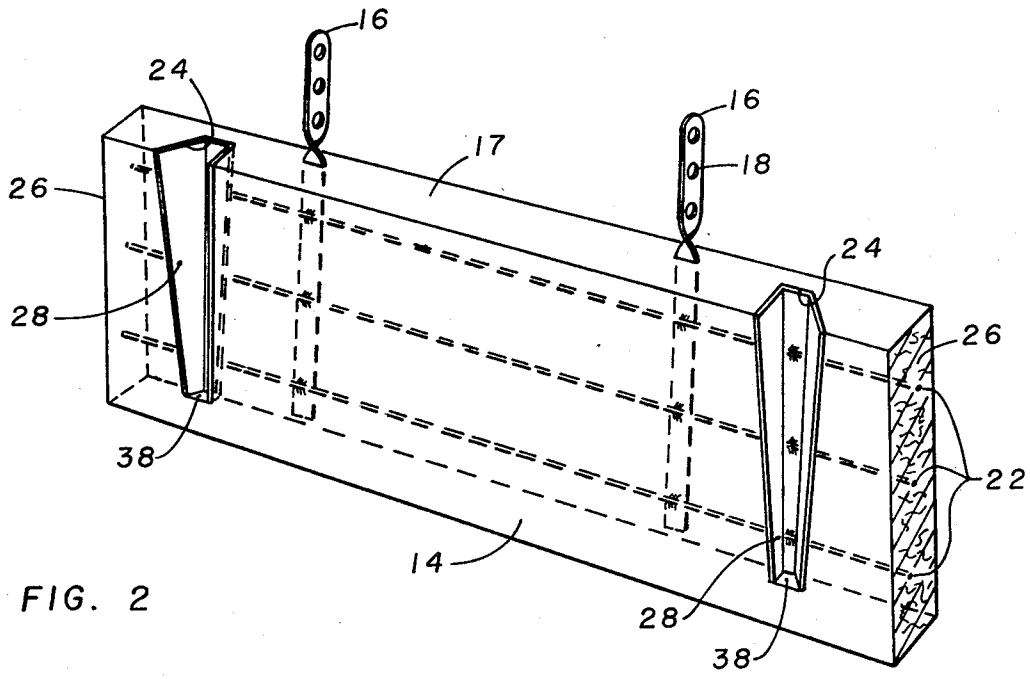

FIG. 2

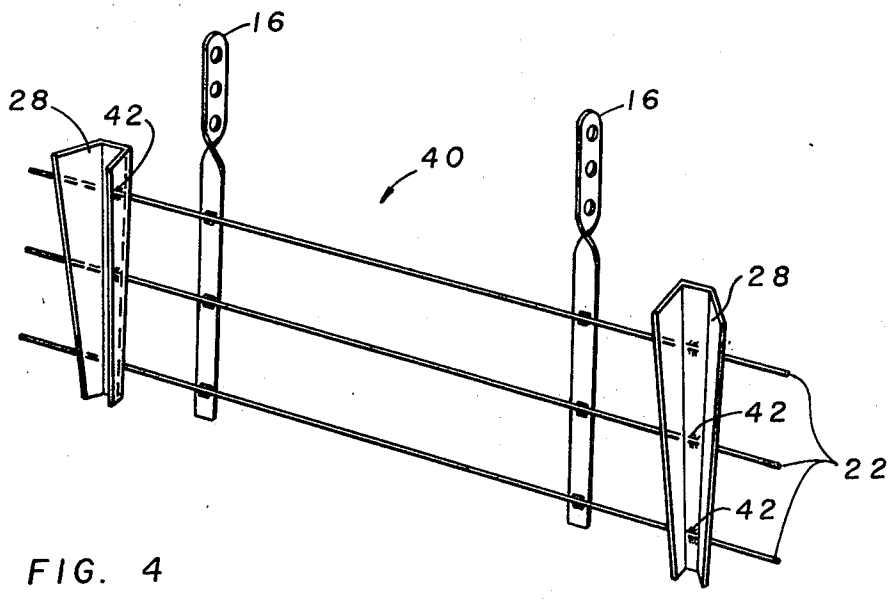

FIG. 4

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HOT TOP SECURING SYSTEM

BACKGROUND OF THE INVENTION

The invention relates to hot tops for ingot molds and more particularly, to the fabrication of preformed sideboard members and the installation thereof within the mold. More particularly still, the invention relates to preformed sideboards having a particular seat or groove structure for receiving wedging means therein when installed in a mold to form a hot top.

The use of hot tops is common in casting metal, especially steel, in ingot form. Because during solidification of the molten ingot there is some shrinkage, voids or piping will form in various areas of the ingot. These voids are undesirable and the portion of the ingot containing them must be removed, thus incurring needless expense and wastage. In order to prevent the formation of such voids, hot tops are provided in the upper portion of the mold. The hot tops are generally comprised of a plurality of sideboards disposed about the upper portion of the mold, each sideboard having thermal insulating and usually exothermic characteristics. The hot top is intended to maintain the metal at the upper part of the ingot in a molten state for a longer period of time than the remainder of the ingot so that potential voids are filled with the molten metal and are thus prevented. The exothermic character of the hot top is obtained through the use of various well-known exothermic materials included in or as a coating on the sideboard. As the molten metal contacts the exothermic material of the sideboard, a large quantity of heat is released. The insulating effects of the sideboard serve to retain the heat in that area and prevent its loss to the mold walls.

The hot top is normally expended with each pour and a new one must be used for each successive pour. Even so, it is important that the hot tops be restrained closely adjacent the inner faces of the walls of the ingot mold during the pouring of the molten metal so that it is not floated by the rising level of molten steel. A variety of techniques and means have been employed to maintain the hot top within the ingot mold and prevent it from floating when contacted by the rising molten metal.

In some instances a one-piece hot top which snuggly engages the inner faces of the mold walls will suffice to prevent floating of the hot top, however, such one-piece structures are difficult to fabricate and handle and a preference has developed for hot tops formed by combining a plurality of easily formed and handled sideboards.

Some hot top arrangements using sideboards employ spring type hangers which serve to both position and to restrain the sideboards, as examplified by Orrison U. S. Pat. No. 3,002,238. Others, as exemplified by Koch et al. U.S. Pat. No. 3,421,731 use first means for hanging or suspending the sideboards and separate wedging means for restraining the sideboards in close engagement with the mold walls.

Hot tops typified by the above-mentioned Koch et al patent which have sideboards with grooves therein so oriented as to result in a downward convergency between the grooves in a pair of end adjacent sideboards near a corner of the mold and wedge means inserted therein, have found utility in a variety of mold configuration and are generally easily positioned and restrained in place in the mold. However, this type of hot top sideboard and sideboard maintaining system has short-comings, particularly if the material of the sideboard is relatively soft and easily punctured or fractured.

Increasingly, hot tops are being formed of sideboards having increased thermal insulation properties and little or no exothermic material. The high degree of thermal insulation provided by them serves to maintain the upper part of the ingot in the molten state long enough to permit an even solidification without voids. A hot top using such sideboards, sometimes referred to as insulating sideboards, must be formed to ensure that there is no undue heat loss in the area of its use and accordingly, must be secured against the inner face of the mold walls to prevent floating and heat loss to the walls. The sideboards which make up the top preferably form a substantially continuous insulating layer about the inner periphery of the ingot mold. These sideboards are generally softer and more fragile than those conventionally having exothermic characteristics and accordingly, are more easily gouged or fractured by various types of sideboard securing devices. It is necessary that the sideboards of the hot top be maintained in secure engagement with the mold walls while at the same time preventing sideboard punctures or fractures which could jeopardize their insulating effect.

SUMMARY OF THE INVENTION

According to the invention, an improved hot top securing system is provided which ensures that the hot top is in secure engagement with the corresponding inner faces of the mold walls, particularly adjacent the lower edges of the hot top, to prevent its component sideboards from floating in the molten metal. Further, the hot top is secured within the mold in a manner and by means which avoid puncturing or fracturing the sideboards. The hot top securing arrangement is simple and easily installed.

The hot top of the invention is comprised of a plurality of performed sideboards, each sideboard being supported adjacent the inner wall surface of an ingot mold and having grooves in the inner face and adjacent the respective ends thereof for receiving securing means. Each sideboard groove extends in a downward direction and is inclined from the vertical such that when the sideboards are installed each pair of grooves adjacent a corner of the mold is downwardly convergent. Each groove contains a generally rigid protective liner therein which is affixed to the sideboard and serves as a force distributing bearing surface. The groove liner comprises an integral part of the sideboard. Wedging or restraining means are inserted into each pair of grooves adjacent a corner and moved downward to increasingly press said sideboards outward into restraining engagement with the inner surface of the mold walls.

Further, the restraining means used to secure the sideboards against the corresponding inner surface of the mold walls are preferably of low heat capacity and have smooth or rounded surfaces at their points of contact with the protective groove liners. Because at least part of each restraining means is usually contacted by the molten metal of the ingot, the heat loss from the molten metal to the restaining means is reduced when the restraining means are of a material and geometry

which result in a low heat capacity. The smooth or rounded contact portions of the restraining means aid the protective liners in preventing gouging of the sideboard. Spring rod wedges of generally U-shaped configuration and which are inserted, base portion downward, into the adjacent pairs of grooves, are desired.

The restraining means preferably have a downwardly convergent configuration such that upon their downward insertion into the pairs of adjacent grooves they pressingly engage the protective liners with a strong restraining force adjacent the bottom edge of the corresponding sideboards and pressingly engage portions of the liners thereabove with a lesser restraining force.

The protective groove liners of the hot top securing system are preferably of sheet metal and are so formed within their corresponding sideboards to provide therein protectively lined grooves which are shallower near the bottom edge of the sideboard than at the top.

The sideboards each preferably include reinforcing elements internal thereto and said protective liners are affixed to the reinforcing elements.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial isometric view of an ingot mold showing therein the hot top securing system of the invention.

FIG. 2 is an isometric view of a hot top sideboard according to the invention.

FIG. 3 is an isometric view of the protective liner employed in the hot top sideboard grooves.

FIG. 4 is an isometric view of the skeletal framework of a sideboard.

FIG. 5 is a front view of the U-shaped spring rod preferred as the sideboard securing means of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 of the drawings, there is shown the upper end of an ingot mold **10** in which is positioned hot top **12**. The side walls of mold **10** may be inclined slightly to facilitate removal of the solidified ingot. Hot top **12** is comprised of a plurality of preformed sideboards **14** positioned closely adjacent the inner wall surfaces of mold **10** and extending in end adjacent relationship about the inner periphery of the mold. It is desirable, particularly if sideboards **14** contain little or no exothermic material, to make the hot top **12** as nearly continuous about the inner periphery of the mole **10** as possible. Each sideboard **14** is initially positioned within the mold **10** by suspending means such as hanger straps **16**. The top edges **17** of the several sideboards **14** making up hot top **12** are positioned flush with or slightly below the corresponding upper edges of the mold **10**.

Hanger straps **16**, as shown in FIG. **1**, have a plurality of vertically spaced holes **18** therein by which the elevational positioning of sideboard **14** within mold **10** may be varied. Steel hanger rods **20** are inserted through holes **18** in hangers **16** at the desired elevation and extend over and rest upon the upper edges of mole **10**. An alternate type of hanger which might be used is one wherein the hanger extends a short distance above the upper edge **17** of the sideboard and then extends rearward of the sideboard to rest upon the upper edge of mold **10**. Such type of hanger, though nonadjustable, permits rapid assembly of hot top **12**.

Each sideboard **14**, seen in greater detail in FIG. **2**, is generally linear and flat and is preformed to various sizes which may be trimmed somewhat if necessary. Each sideboard includes reinforcing members such as metal wires **22** which strengthen and bind the sideboard **14**. A pair of grooves **24** exist in the inner face of each sideboard **14** with one groove being near each end **26** of sideboard **14**. The protective groove liner **28** of the invention is affixed to and against the sideboard **14** within each groove **24** and conforms to the contour of the groove. Hanger straps **16** are affixed to the sideboards **14** as an integral part thereof.

The sideboards **14** in the instant example are comprised essentially entirely of various insulating materials such as fiber wool, highly insulating diatomaceous earth and/or asbestos in combination with a suitable binder, such as a resin. With the possible exception of some shredded paper, this type of sideboard contains no exothermic materials and relies upon its insulating qualities to adequately retard solidification of the ingot in the hot top area. This type of sideboard tends to be somewhat soft and easily deformed.

According to the preferred embodiment of the invention, a pair of sideboards **14** are in end adjacent relationship at each corner of mold **24**, and liners **28** near the ends of each adjacent pair of sideboards **14** form a pair of grooves **24** and liners **28** at each corner. Each pair of end adjacent grooves **24** and accompanying liners **28** at a corner is designed to receive sideboard restraining and engaging means, such as U-shaped metal spring rods **30**. The grooves **24** extend generally downward from the top edge **17** of sideboards **14** and are inclined such that there is a downward convergency between the pair of adjacent grooves at each corner of the hot top **12**. This convergency permits insertion of the sideboard restraining means into the grooves at the upper edges **17** of the respective and adjacent sideboards **14** and results in an increasing pressure against groove liners **28**, grooves **24** and ultimately sideboards **14** as the restraining means are moved downwardly in the grooves toward the bottom edges of sideboards **14**.

The downward convergency of a pair of grooves **24** near a corner of mold **10** may be effected by inclining each groove of the pair toward the corner in a downward direction or it may be accomplished by inclining the grooves away from the corresponding mold walls in a downward direction or possibly a combination of both.

The groove convergency is effected, in the preferred embodiment of the invention, by extending each groove **24** and protective liner **28** in a downward direction in a sideboard **14** and making the depth of groove **24** into sideboard **14** greater at the top than at the bottom. It will be appreciated that the extent or angle of shallowing of a groove and liner relative to the sideboard containing it may be varied to accommodate any angle which the walls of mold **10** might have. For instance, if the inner surfaces of the walls of mold **10** extend in vertical planes, the grooves **24** and liners **28** would be inclined at one angle to the inner surface of

their respective sideboards; but if the molds to be used are of the big-end-down type and the inner faces of their walls inclined outwardly somewhat in the downward direction, the grooves and liners would preferably be inclined at a greater angle to accommodate the outward incline of the mold walls.

It is apparent that this arrangement preserves the downward convergency required of a pair of grooves and liners at each corner of the mold **10**.

FIG. **3** depicts the protective groove liner **28** of the invention. In its preferred form, it is of a durable, substantially non-deformable material, for instance a sheet metal, such as steel. The groove liner **28** is preformed, by conventional metal forming means, to an elongated trough-like shape having side portions **32** and **34** connecting a rear contact portion **36**. The front face remains open and the upper and lower ends of liner **28** are preferably open. The side and rear portions **32**, **34**, and **36**, respectively, of groove liner **28**, as depicted in FIG. **3**, are each planar surfaces extending the full length of the groove liner. However, it will be realized that these portions might also be curved if desired. In a preferred embodiment of the invention wherein the downward convergency of the pairs of grooves **24** and liners **28** adjacent the several corners of mold **10** is effected by inclining said downwardly extending grooves and liners toward the surface of sideboards **14**, the groove liner **28** is performed shallower at one end than the other. Stated another way, rear portion **36** of groove liner **28** extends more deeply into sideboard **14** at one end of the liner than at the other. In order to effect the downward convergency required, the deeper end of each liner **28** is adjacent or preferably flush with the upper edge **17** of its corresponding sideboard and the shallow end is near the lower edge of said sideboard. Groove liner **28** may extend the full height of sideboard **14** or, as seen in FIGS. **1** and **2**, it may be somewhat shorter with the shallow end terminating above the lower edge of said sideboard to form a stop **38** therein which limits downward insertion of the sideboard restraining means. The side portions **32** and **34** of each groove liner **28** are sufficiently open relative to one another and oriented such that the restraining means, spring rod **30**, may be inserted into liner **28** and press against the rear contact portion **36** thereof without interference from said side portions.

In the formation of the individual sideboards **14**, a skeletal framework **40**, as shown in FIG. **4**, is first assembled. Framework **40** is comprised of elongated reinforcing members, such as metal wires **22**, to which are affixed two groove liners **28** near opposite ends thereof and two hanger straps **16** also near opposite ends thereof. Groove liners **28** are secured to reinforcing wires **22** by tack welds **42** at the rear portion **36** of said groove liners. Hanger straps **16** are secured to wires **22** in a manner similar to that used for liners **28**, though preferably to the opposite side of wires **22**. It will be appreciated that reinforcing wires **22** might take the form of a screen mesh and that liners **28** and hanger straps **16** might be secured thereto by means other than welding, as for instance by wire binding. When molding the sideboards **14**, skeletal framework **40** is positioned such that groove liners **28** rest open face down on a surface, with wires **22** and hanger straps **16** above them. A slurry of the insulative material and binder is then pressure cast over and about framework **40** and is subsequently dried, resulting in sideboard **14** as seen in FIG. **2**.

The preferred sideboard restraining means, as earlier mentioned, take the form of U-shaped spring rods **30**. Each spring rod **30** is placed, base portion down, in a pair of groove liners **28** at or near the top edge **17** of end adjacent sideboards **14** and is manually or mechanically moved downwardly in said liners to a position near the bottom edges of the corresponding sideboards **14**, as seen in FIG. **1**. The spring rod **30** is inserted to a position at which there are exerted outward forces against the liners **28** and the respective sideboards **14** which are sufficient to positively engage said sideboards with the inner surfaces of the walls of mold **10** to prevent floating by the molten metal. A stop **38** may be formed at the lower end of each groove **24** to limit the downward positioning of the spring rods **30**. Protective groove liners **28** are essentially rigid and serve to somewhat distribute the outward forces applied by spring rod **30**, though the greatest pressure or force occurs near the lower edge of the sideboard **14**.

The U-shaped spring rod **30** is preferred as the restaining and engaging means of the invention because it is simple, has rounded or smooth surfaces at the principal points of contact with groove liners **28** and has a generally lower heat capacity than a wedge plate of similar material. The latter characteristic is particularly significant when the sideboards **14** of hot top **12** contain little or no exothermic material.

A further characteristic of the U-shaped spring rod **30** exists wherein arms **44** extend from base portion **46** in a divergent manner of conversely, toward base portion **46** in a convergent manner. The angle of convergency of spring rod arms **44** is made slightly greater than the downward convergency of a pair of groove liners **28** at a corner of mold **10** so that arms **44** pressingly engage groove liners **28** and thus are easily retained therein. Further, the arms **44** are able to provide additional restraining forces to sideboards **14** through liners **28** above the area of principal restraining pressure provided by base portion **46** of spring rod **30**.

While I have illustrated and described a preferred embodiment of my invention, it is to be understood that such is merely illustrative and not restrictive and that variations and modifications may be made therein without departing from the spirit and scope of the invention. I, therefore, do not wish to be limited to the precise details set forth but desire to avail myself of such changes as fall within the purview of my invention.

What is claimed is:

1. A hot top for an ingot mold comprising:
   a. a plurality of performed sideboards in end adjacent relationship, means for suspending said sideboards adjacent corresponding inner wall surfaces of said mold, each of said sideboards having a pair of downwardly extending inclined grooves in the inner face thereof and positioned near the ends thereof respectively, the incline of each said groove being such that each pair of grooves at respectively adjacent end portions of said sideboards have a downward convergency, a protective liner in each said groove secured against and conforming to the surface thereof whereby

force applied to a relatively small portion of each said liner is distributed over a larger area of said sideboard; and

b. generally U-shaped spring rods insertable into each of said pairs of adjacent grooves having protective liners, each said spring rod comprised of a base portion and two arms, said arms joining said base portion at each end thereof through rounded corners and being mutually convergent toward said base portion, the angle of said convergency being slightly greater than said downward convergency between pairs of grooves at respectively adjacent end portions of said sideboards, said spring rods being movable along said protective liners to a position at which said rounded corners pressingly engage said liners in said grooves adjacent the lower edges of said sideboards and said spring rod arms pressingly engage a portion of said protective liners thereabove for restraining said sideboards flushly against said inner wall surfaces and preventing said sideboards from floating when said ingot is poured into said mold.

2. The combination according to claim 1, wherein the incline of said grooves in each said sideboard is in a direction toward the inner face of said sideboard.

3. The apparatus according to claim 1 wherein said protective liners are of substantially rigid metal, said sideboards having a metal wire framework integral therewith and said protective liners are secured to said framework.

4. The combination according to claim 3 wherein the cross sectional area of each said protective liner and corresponding groove decreases in a downward direction.

5. The combination according to claim 4 wherein said means for suspending said sideboards comprise at least two hangers located near opposite ends of said sideboard, a first end of each said hanger being secured to said metal wire framework and the other end of each said hanger adapted to be supportingly engaged by said ingot mold.

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