

June 27, 1972

G. ROCHER ET AL

3,672,918

HOT TOPS

Filed Sept. 14, 1970

2 Sheets-Sheet 1

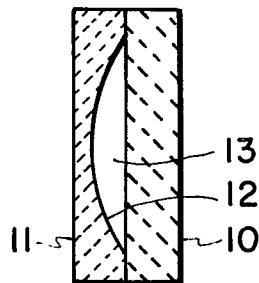


Fig. 1

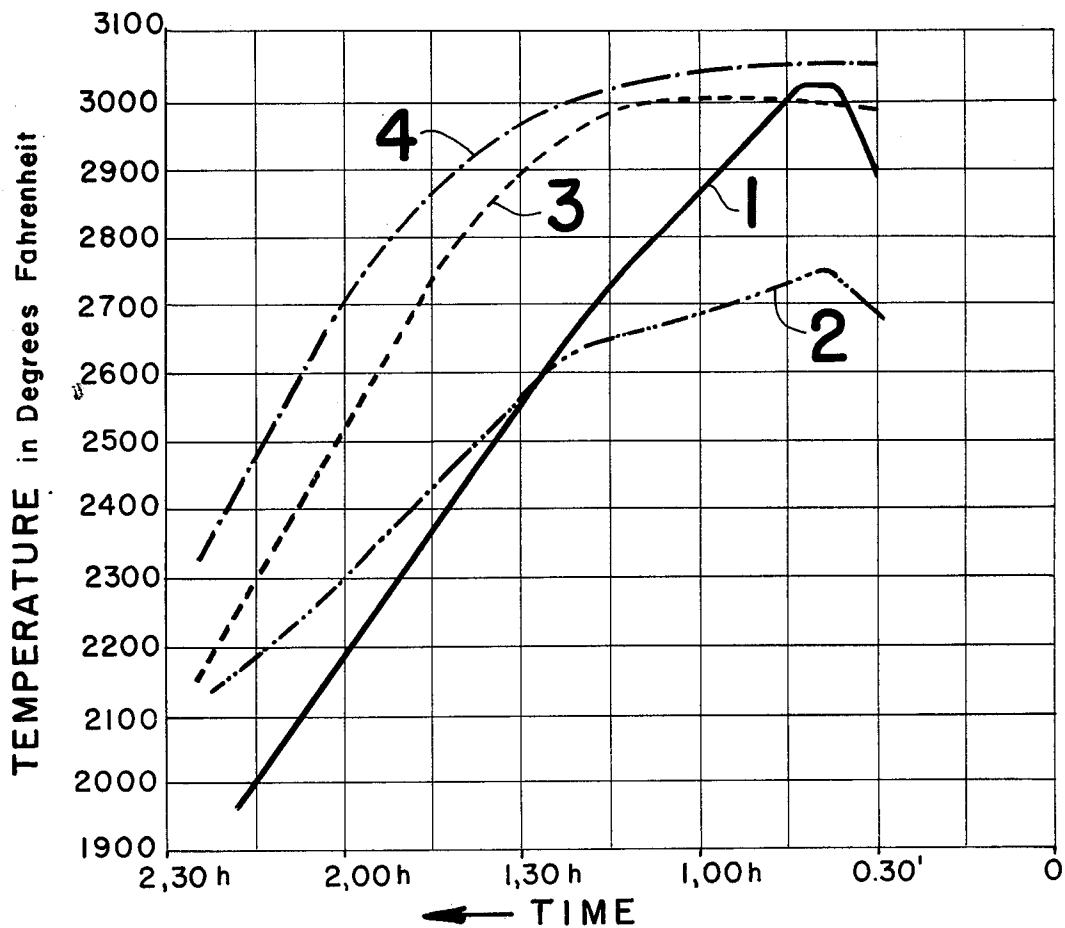


Fig. 3

INVENTORS.

George Rocher

Nicholas Orban

BY Webb Bunden Robinson &
Webb

THEIR ATTORNEYS

June 27, 1972

G. ROCHER ET AL

3,672,918

HOT TOPS

Filed Sept. 14, 1970

2 Sheets-Sheet 2

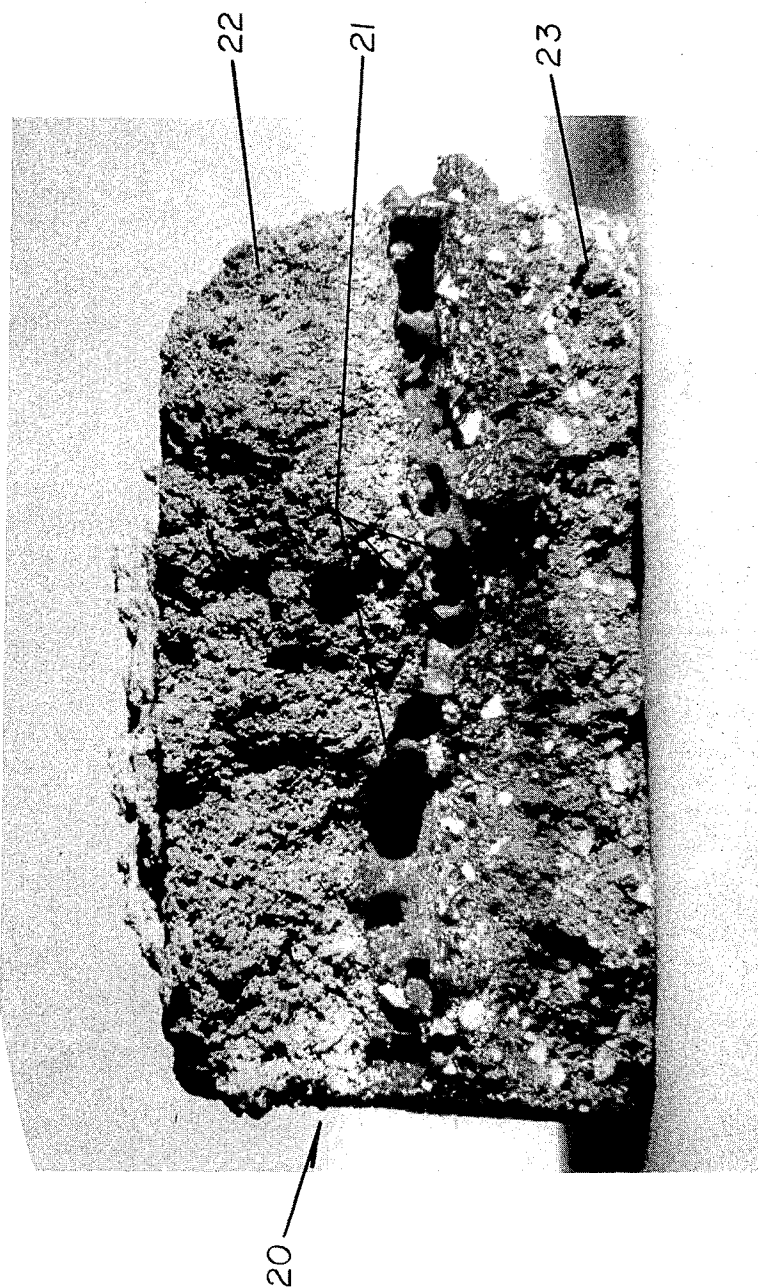


Fig. 2

1

3,672,918
HOT TOPS

George Rocher and Nicholas Orban, Pittsburgh, Pa., assignors to Metallurgical Exoproducts Corporation, McKees Rocks, Pa.

Filed Sept. 14, 1970, Ser. No. 71,824

Int. Cl. B28b 7/34; B22d 7/10

U.S. Cl. 106—38.22

5 Claims

ABSTRACT OF THE DISCLOSURE

A composite hot top board comprising an exothermic layer and an insulating layer bonded together wherein there is a substantial number of randomly spaced, discontinuous and internal voids or a substantial amount of space at the interface between the two layers. Preferably, the voids are formed in situ under use conditions by the decomposition of certain additives in the insulating layer.

Our invention relates to hot tops and, more particularly, to disposable composite hot top boards comprised of an exothermic layer and an insulating layer.

Liquid metals such as steel contract during solidification causing internal shrinkage cavities in the solidified product, generally called the ingot or casting. It is often desirable to control the exact location of these shrinkage cavities which usually form in the center portion of the ingot or casting since it is the last portion to freeze. Control of the shrinkage cavity is accomplished on most types of solidifying metals by using hot tops in or above the top of the mold to keep the metal molten as long as possible so the shrinkage cavity can be continuously filled. This then positions the shrinkage cavity at the uppermost portion of the ingot or casting where it can be removed during later processing without excessive yield loss to the product.

Hot tops are generally either of the permanent type or the disposable type. In the permanent type, hot top refractory brick are lined in metal castings around the top of the mold. Disposable hot tops employ hot top boards which ultimately disintegrate or are otherwise disposed of during a single use, therefore, necessitating new boards for each use of the mold. These boards are generally placed in the mold and secured to the top portion of the inner mold walls to form the hot top. Disposable hot top boards can also be used in place of the permanent brick in the metal castings positioned on top of the ingot mold. The disposable hot tops are generally either insulating boards comprised of materials having an appreciably lower heat conductivity than the molds which are typically cast iron or exothermic containing materials such as aluminothermic compositions which will react to initially give off heat and then retain the heat in the same manner as an insulating board.

Disposable composite hot top boards have also been employed. These boards consist of a layer of exothermic material press bonded to a layer of insulating material. The insulating layer is positioned against the mold wall and the exothermic layer is in contact with the molten metal.

Our invention improves upon the composite hot top board by increasing the insulating properties over extended periods of time. Because of the increased properties we are able to increase the yield from ingots over those yields previously obtained on comparable products. Further, our invention can be utilized in a manner so that the characteristics essential to achieving improved insulating properties are the result of in situ reactions, brought about by the molten metal environment. This

2

then permits hot tops of our invention to be manufactured in a manner similar to that employed on known hot tops, yet improved results are achieved thereover.

Our invention is a composite hot top board of the disposable type in which a substantial amount of space exists at the interface of the exothermic and insulating layers. This space is preferably in the form of randomly spaced, discontinuous and internal voids which are formed in situ under a use environment as described hereinafter.

In the accompanying drawings and photograph we have shown our presently preferred embodiments in which:

FIG. 1 is a section showing an embodiment of our composite hot top;

FIG. 2 is a photograph showing the actual structure of the hot top after in situ formation of voids; and,

FIG. 3 is a graph showing a comparison of insulating properties of our embodiment of FIG. 2 and present day hot tops.

We have found that a composite hot top having an exothermic layer and insulating layer and a substantial amount of space at the interface therebetween substantially improves the insulating properties over hot top boards employed heretofore.

Our hot top can be manufactured with the space between the two layers. This is shown in FIG. 1, where an insulating layer 10 is press bonded against an exothermic layer 11 by means well-known to those skilled in the art. Exothermic layer 11 has a recess 12 along its inner surface so that a substantial amount of space 13 is formed between the layers at their interface. Of course, the recess could be in the insulating layer or in both layers, and the criticality lies in the fact that a substantial amount of space must exist at the interface between the respective layers.

Preferably, the space at the interface is formed in situ in the form of a plurality of voids. In FIG. 2 we show an actual piece of our composite hot top 20 after use. A plurality of randomly spaced, discontinuous and internal voids 21 were formed in situ at the interface between the exothermic layer 22 and insulating layer 23. The hot top boards were prepared by press bonding a flat surface of insulating layer 23 to a flat surface of exothermic layer 22. The voids 21 were formed in situ during actual use in an ingot mold teemed with molten steel.

The actual composition of the exothermic layer 22 and the insulating layer 23 of the composite hot top 20, shown in FIG. 2, is given in the following Table I.

TABLE I.—COMPOSITION OF HOT TOP¹

Exothermic layer	Percent	Insulating layer	Percent
Al additives.....	59.0	Grog.....	32
Sodium chlorate.....	3.3	Perlite.....	5.5
Perlite.....	2.8	Fly ash.....	62.5
Magnetite.....	10.5		
Hematite.....	5.4		
Cryolite.....	2.8		
Sand (20 mesh).....	16.2		

¹ Percentages are dry ingredients and do not include binder which was a silica gel.

It is presently believed that the fly ash which melts at about 1900° F. decomposes to form a gas (called bloating) at the interface, thereby creating the randomly spaced, discontinuous and internal voids. Apparently the temperature to accomplish this bloating is only sufficient at the immediate vicinity of the interface as can clearly be seen from FIG. 2 wherein the insulating layer 23 remains intact throughout the balance of its thickness. This temperature at the interface will be somewhere above 2500° F. due to the molten metal in the ingot mold and the exothermicity of the exothermic layer 22. A fly ash content of at least 50 percent (dry ingredients) in the insulating layer is desirable to insure sufficient voids to optimize the insulating properties.

These various compositions outlined in Table I for the particular hot top shown in FIG. 2 can vary within rather broad limits with the criticality residing in the use of a material such as fly ash in sufficient amounts, such as the 50 percent minimum described above, to decompose in use to create the voids at the exothermic-insulating interface. The following Table II outlines such a range of compositions which can be employed.

TABLE II.—COMPOSITION OF HOT TOP¹

Exothermic layer	Percent	Insulating layer	Percent
Al additives.....	40-70	Grog.....	20-40
Sand additives.....	10-30	Perlite.....	2-12
Iron oxide additives.....	5-30	Fly ash.....	50-80
Grog.....	0-15		
Magnesia.....	0-10		
Cryolite.....	0-10		
Perlite.....	0-10		
Sodium chlorate.....	1-10		

¹ Percentages are dry ingredients and do not include a binder.

The substantial improvement in insulating properties of the composite hot top with the in situ void formation is shown by the curves in FIG. 3. Curve 1 represents the insulating properties of a standard exothermic hot top board presently produced and having a composition somewhat similar to that shown in Table I for the exothermic layer. The actual composition of the hot top depicted by curve 1 of FIG. 3 differed from that shown in Table I by having less aluminum-containing additives, the aluminum-containing additives being replaced with grog, magnesia and 100 mesh silica sand. The additional aluminum additives in the exothermic layer of our composite hot top insures sufficient temperature to result in the bloating and resultant voids.

Curve 2 of FIG. 3 is a typical curve for a standard insulating hot top board. Although many compositions are used for insulating boards, curve 2 is representative of the results obtained from insulating boards in general.

Curve 3 represents a composite hot top board formed of an exothermic layer and an insulating layer having compositions the same as the hot tops shown for curves 1 and 2, respectively. Curve 4 represents our new composite hot top having the composition shown in Table I. It can be seen that the temperature of the molten metal (represented by the ordinate of the graph) is maintained higher and for a longer period of time by our composite hot top as compared to the other three forms of hot tops.

As would be expected from these improved insulating properties, the yields from ingots made in molds employing our new hot tops have likewise been increased. A recent experimental run on low carbon fully aluminum killed steels resulted in an ingot to slab yield of 89 percent as compared to a typical yield of only 83 per-

cent on the same steel grade in the same mold size and using standard types of hot tops.

Our hot tops can be set in the ingot molds in the same manner as existing disposable hot tops. The insulating layer is positioned adjacent the mold wall, thus exposing the exothermic layer to the molten metal upon teeming.

We claim:

1. A composite hot top board characterized by improved insulating properties over extended periods of time comprising an exothermic layer bonded to an insulating layer, said insulating layer comprising at least fifty percent by weight fly ash, the interface between the exothermic and insulating layers having a plurality of randomly spaced, discontinuous and internal voids formed in situ.

2. The hot top board of claim 1 wherein the insulating layer comprises by weight at least 50 percent fly ash, the balance being grog, perlite and a silica gel binder.

3. The hot top of claim 2 wherein the insulating layer comprises by weight 50-80 percent fly ash, 2-12 percent perlite and 20-40 percent grog and a binder.

4. The hot top of claim 3 wherein the insulating layer comprises about 62.5 percent fly ash, 32 percent grog, 5.5 percent perlite and a silica gel binder.

5. A composite hot top board characterized by improved insulating properties over extended periods of time comprising an exothermic layer and an insulating layer, said exothermic layer comprising by weight 40-70 percent aluminum additives, 10-30 percent sand additives, 5-30 percent iron oxide additives, 0-15 percent grog, 0-10 percent magnesia, 0-10 percent cryolite, 0-10 percent perlite, and 0-10 percent sodium chlorate, and said insulating layer comprising by weight 20-40 percent grog, 2-12 percent perlite, and 50-80 percent fly ash, said hot top forming a plurality of randomly spaced voids in situ at the interface of discontinuous and internal said exothermic and insulating layers.

References Cited

UNITED STATES PATENTS

2,821,000	1/1958	Nouveau	249—201 X
3,183,562	5/1965	Moore	249—200 X
3,262,165	7/1966	Ingham	249—197 X
3,297,296	1/1967	Edstrom et al.	249—197
3,432,138	3/1969	Shephard et al.	249—200 X

FOREIGN PATENTS

921,976	3/1963	Great Britain	249—201
---------	--------	---------------------	---------

LORENZO B. HAYES, Primary Examiner

U.S. Cl. X.R.

106—38.27, 38.3, 38.9; 249—197, 202

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,672,918 Dated June 27, 1972

Inventor(s) George Rocher and Nicholas Orban

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Table II

Column 3 Line 18 --1-10-- should read --0-10--.

In Claim 5

Column 4 Lines 35, 36 and 37

These lines should read --hot top forming a plurality of discontinuous and internal randomly spaced voids in situ at the interface of said exothermic and insulating layers. --

Signed and sealed this 28th day of November 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,672,918 Dated June 27, 1972

Inventor(s) George Rocher and Nicholas Orban

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Table II

Column 3 Line 18 --1-10-- should read --0-10--.

In Claim 5

Column 4 Lines 35, 36 and 37

These lines should read --hot top forming a plurality of discontinuous and internal randomly spaced voids in situ at the interface of said exothermic and insulating layers.--

Signed and sealed this 28th day of November 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents