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HOT TOP FOR STEEL INGOT MOLDS

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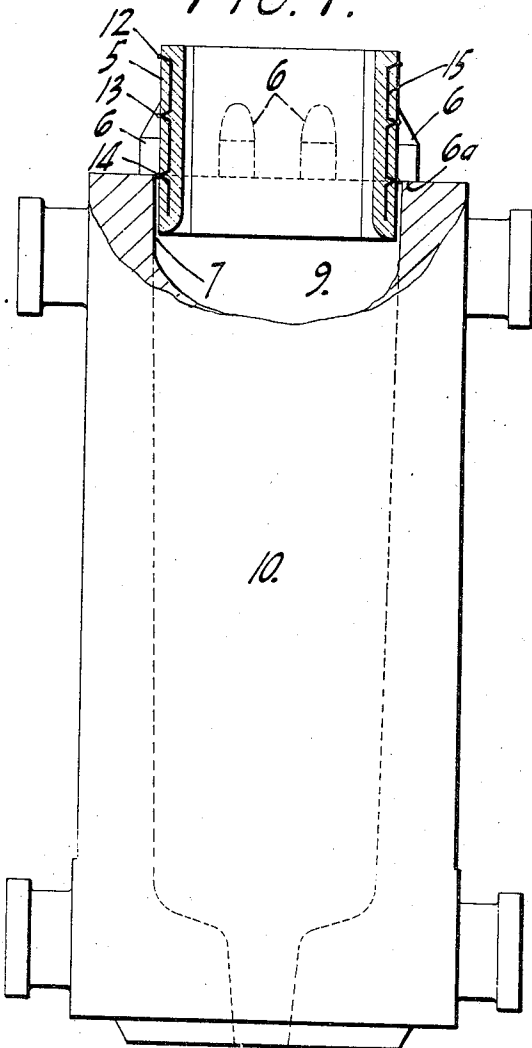
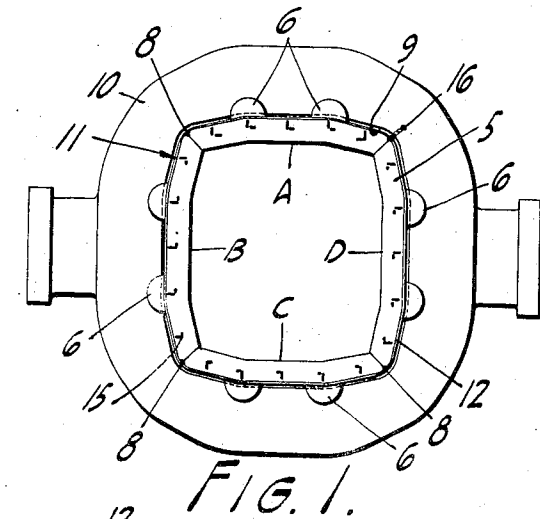


FIG. 2.

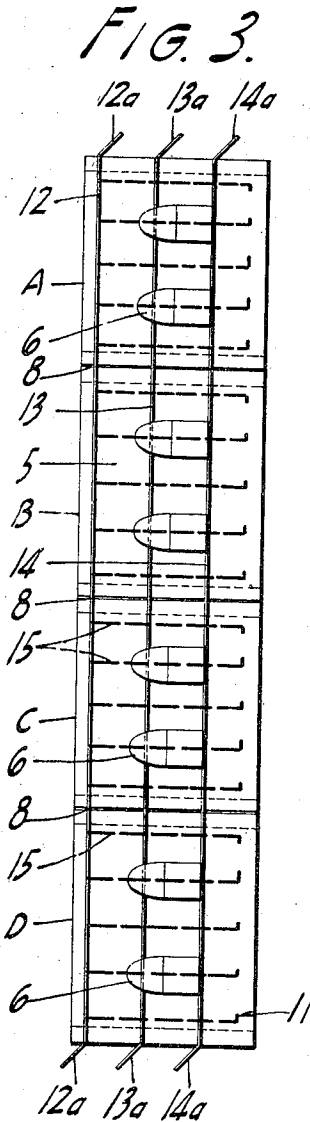


FIG. 4.

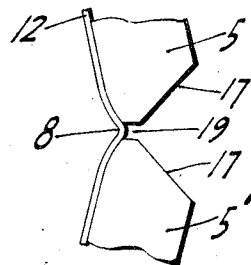
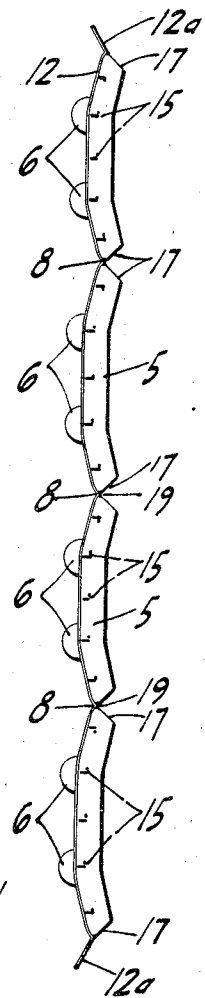


FIG. 5.

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HOT TOP FOR STEEL INGOT MOLDS

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7 Claims. (Cl. 22—188)

It is well known to those skilled in the art that hot tops of present-day design for use in connection with steel ingot molds are usually made in one piece and of fire brick or other refractory materials which must go through a cycle of treatment at high temperature for an extended period of time, occupying, as they do, considerable space in storage, and being made from material which cannot be salvaged. Where hot tops have heretofore been made of sections, these sections have been separate from the assembly wire and fastened together by means of such separate wire passed around the exterior of the hot top.

One of the principal objects of my invention has been to provide a hot top which shall be made from a plurality of sections having a permanently attached wire reinforcing mesh, portions of which are located preferably at or near the outer surface of the sections and connecting the panels in hinged manner.

Another object of my invention has been to construct a hot top of such material that it can be bonded by the use of a temperature sufficient only to mature the composition but not sufficient to oxidize the embedded wires.

A further object of my invention has been to make my hot top of materials which shall produce an endothermic effect as a result of contact with the molten steel, whereby the heat of the steel contacting the hot top will be so rapidly absorbed as to quickly solidify any molten metal which would otherwise escape through a loose joint or crack.

Moreover, the composition of my hot top is such that a carbon dioxide gas is generated at the surface thereof which is in contact with the heated metal which gas acts as a barrier to the flow of heat to the interior of the wall of the hot top, thereby making it possible to use relatively thin walls and yet protect the embedded wires against excessive heat.

Furthermore, my composition contains a small percentage of combustible materials which are burned out at the low temperature to which my hot top is subjected when baking, thereby providing numerous voids and making the composition very porous, thus adding to the insulating value of the material and also protecting the embedded wires against the effects of excessive heat.

Furthermore, it has been an object to use such materials in my hot top which will not chemically combine by direct contact with steel, either molten or solidified, thereby avoiding adhesion between the hot top and the steel.

Another object has been to use a basic material for the composition of my hot top which is not only readily available but which in many cases constitutes what is ordinarily waste material, thereby greatly reducing the cost of my hot top.

Moreover, it has been an object to provide a composition for hot tops and a method of making the hot top therefrom which shall require only sufficient heat to mature the composition but insufficient to decompose the refractory materials employed in the composition.

Another object has been to provide a hot top formed with a plurality of panels secured together by means of flexible metallic reinforcing wires, whereby the hot top when not in use may be stored in flat position, the wires between sections functioning as hinges when the hot top is formed into shape and ready for use, the extreme ends of the wires projecting beyond the adjacent end surfaces of the outer sections whereby the entire hot top may be fastened together by twisting such wires.

A further object of my invention has been to make my hot top of a composition which, after the hot top has been discarded, may be used as part of a regular standard charge to any blast furnace, thereby making it possible to salvage the otherwise useless hot top.

The above objects and advantages have been accomplished by the device hereinafter described, made from my composition and in accordance with my method.

Fig. 1 is a plan view of my hot top folded and installed within the top of a steel ingot mold;

Fig. 2 is an elevational view of a steel ingot mold, partly in section, showing my hot top fully in section and in position upon the mold;

Fig. 3 is an exterior view of my hot top with the panels lying flat in extended manner, in which position they may be conveniently stored, handled or shipped;

Fig. 4 is an edge view of my hot top showing it in the position occupied in Fig. 3; and,

Fig. 5 is an enlarged view of portions of two adjacent panels showing the bevel at the joining edges and a cut-away portion at the hinged joint therebetween.

For convenience of illustration, I have shown my invention as being formed of four panels A, B, C and D, each being shaped in such contour as to fit the mouth of the ingot mold when they are folded in assembled position, as shown in Figs. 1 and 2. Each of these panels is provided with a body part 5 made of my novel composition, to be hereinafter described.

Before the panels of my hot top are formed in suitable molds and preferably in the positions shown in Figs. 3 and 4, I prepare a reinforcing wire mesh. This mesh comprises a number of continuous reinforcing wires 12, 13 and 14 spaced apart and extending longitudinally across all of the panels as shown in Figs. 3 and 4 and lying, when in position, either adjacent to the outer surface of the panels or slightly embedded below such surface. The portions of the wires

lying between adjacent panels function as hinges 8 about which the panels are moved when being folded. A plurality of lateral reinforcing wires 15 also form a part of the mesh. As shown in Fig. 2, the lateral wires are bent in saw-tooth formation, the tooth portions thereof extending outwardly and lying opposite the wires 12, 13 and 14 to which they are secured preferably by means of welding. By providing the saw-tooth formation, the body parts of the lateral wires 15 will be embedded somewhat within the panel so as to reinforce the panels and to secure them more firmly to the wires 12, 13 and 14. These wires are extended beyond the extreme edge of each end panel in ends 12a, 13a and 14a. These ends are sufficiently long so that when the panels are folded as shown in Figs. 1 and 2, they may be twisted together so as to hold the panels firmly in position and thereby provide a unitary structure.

As shown in Fig. 5, the lateral edge 17 of each of the panels is cut away at an angle so as to permit the folding of the hot top. So as to facilitate the folding of the panels and to more readily bring the edge surfaces together, it is desirable to provide a space 19 between adjacent panels.

On the exterior surface of each of the panels there are provided lugs 6 which are so positioned as to allow only a portion of the hot top to enter the mouth of the mold. These lugs may be formed integrally with the panels in the molding thereof, or they may be made of metal and secured to the wires 13 and 14 by means of welding.

In my composition, I use preferably limestone or its equivalent as a base material because it has all of the desirable characteristics, and thereby enables me to carry out the objects hereinbefore set forth. Limestone is universally available, and large quantities of waste limestone in the form of tailings are usually procurable at low cost at plants where commercial limestone is crushed and sized. Owing to the generation of carbon dioxide gas caused by contact of the molten steel with the limestone of my hot top, it is preferable to have a small amount of combustible material as a part of my composition, whereby porosity of the finished hot top may be had. Furthermore, it is necessary to have a suitable bond in my composition. I have found that the following materials and proportions by volume are suitable for carrying out my invention, it being obvious that some changes in the proportions and materials may be made without departing from the spirit of my invention:

	Per cent
Limestone tailings, or crushed limestone, passing $\frac{3}{8}$ inch square mesh screen.....	74
Saw-dust passing through the same screen....	10
"Green" bond a commercially available pulverized mixture consisting of 3 parts strong plastic clay, one and one-half parts of "bentonite," and one and one-half parts coke-oven foundry pitch which is a coke-oven residue and which, as is well known, has little adhesion up to substantially 350° F. (not a petroleum derivative).....	6
Foundry pitch as above described (separately added)	10

After suitable molds have been prepared and the wire reinforcing mesh placed in position, my composition is placed within the molds and about the lateral reinforcing wires. The panels

are then baked to a temperature of only approximately 600° F. for four hours. This temperature causes the saw-dust and foundry pitch to practically disappear, leaving the panel composition approximately:

	Per cent
Limestone as CaCO_3 (wholly non-combustible)	94
Plastic clay and bentonite (wholly non-combustible)	6

This baking treatment of the panels develops great physical strength, which, due to the reinforcement of the panels, enables me to use a panel which is much thinner than can be used in any hot top of present-day design.

When my hot top is placed in use upon an ingot mold and molten steel comes into contact with my composition, an endothermic reaction is instantly started $\text{CaCO}_3 + \text{heat} = \text{CaO} + \text{CO}_2$. This endothermic reaction continues at a temperature far below the solidifying temperature of the steel ingot and any liquid steel which flows in between the panels is quickly solidified. This solidified portion cannot be remelted by the molten steel behind it without re-establishing the endothermic reaction and, therefore, the portion remains solidified. Since neither calcium oxide CaO nor carbon dioxide (CO_2) combine chemically with liquid or solid steel merely by direct contact with each other, there can be no adhesion between my hot top and the steel ingot.

From the foregoing it will be understood that my composition in the carbonate or raw state is at least 90% basic. Furthermore, it will be obvious that instead of raw limestone (CaCO_3), raw dolomitic limestone (CaMgC_2O_6) or raw magnesite (MgCO_3) may be used. It is well known to those skilled in the art that the last two mentioned materials are seldom if ever used by the steel industry except in their calcined or dead-burned state, i. e., CO_2 burned out. Due to my method of manufacturing, much of the limestone remains in its raw carbonate form in which form either the limestone dolomite or magnesite will sustain the complex smelting and fluxing reactions occurring in the operation of a blast furnace, thereby making my hot top readily salvageable as a blast furnace charge. The almost negligible weight of steel wire in the mesh theoretically acts as "seed" in the group of reducing reactions in the blast furnace, when liquid metallic iron is about to start separating from the iron ore. In other words, the presence of the steel mesh in my composition when used as a blast furnace charge stimulates the first throw-down.

My hot top is furthermore, suitable as a blast furnace charge because of the fact that it is baked at low temperature and the calcining effect does not occur until contacted by the hot steel, and then only to a short depth below the surface of the panel, thereby leaving the remaining thickness of the panel uncalcined and thereby suitable as a blast furnace charge. Furthermore, since the remaining portions of the panels remain uncalcined, and the calcined portion soon reverts to CaCO_3 , it is obvious that 94% of the mineral mass of my hot top is suitable as a limestone charge of a blast furnace.

Obviously, due to the use of limestone or its equivalent, the calcining action, produced by contact with the hot steel, generates carbon dioxide gas (CO_2) which acts as a barrier to the flow of

heat through the panels of the hot top thereby providing an insulating wall of gases which continue at a temperature below the solidifying temperature of the liquid steel. The presence of this gas prevents deep calcining penetration into the panels thereby not only protecting the embedded wire mesh but leaving the hot top in such condition that it is suitable after normal use as a part of a blast furnace charge.

Since the small amount of combustible material is burned out of the panels of my hot top during the initial baking process at low temperature, suitable porosity of the material is brought about. This porosity not only acts as a further insulator against the passage of heat into the panels, but also provides for rapid escape of the carbon dioxide gas.

While I have described the use of limestone as a basic component of my composition, it is obvious that any other waste or by-product, calcium hydroxide and/or calcium carbonate, procurable as waste products in many industrial operations, can be substituted therefor. Instead of the foundry pitch it is obvious that I may use any other heat-developed binder having similar characteristics, or any other binder which will give to my composition the desired physical strength.

What I claim is:

1. A granular hot top composition composed of crushed, screened limestone in major amount to effect an endothermic reaction and the generation of carbon dioxide gas when subjected to molten steel, a combustible saw-dust to provide connecting pores in the finished product after initial baking to permit the escape of said gas, a "green" bond, and foundry pitch in minor amount but of a sufficient quantity to bind the composition together in a coherent mass.

2. A granular hot top composition comprising substantially 74% of crushed screened limestone, substantially 10% of saw-dust, substantially 6% of "green" bond, and substantially 10% of foundry pitch.

3. A method of making a hot top for steel ingots, comprising the preparation of a composition consisting in major amount of metal carbonate which is capable of decomposition when subjected to the heat of molten steel, a granular combustible material, and a bond in minor amount containing carbonaceous material, then molding said composition into suitable form, and then subjecting the molded form to a temperature sufficient to burn out the combustible material, said temperature being insufficient to decompose said metal carbonate, whereby connect-

ing pores are produced in the structure permitting the escape of carbon dioxide gas upon subsequent use of the hot top.

4. A method of making a hot top for steel ingots, comprising the formation of a plurality of permanently connected and reinforced panels, each being composed in major amount of a metal carbonate which is subject to decomposition in the presence of the heat of molten steel, a granular combustible material, and a bond in minor amount including foundry pitch and clay, and then subjecting the panels to a temperature sufficient to burn out the combustible material, said temperature being insufficient to decompose said metal carbonate, whereby connecting pores are produced in the structure permitting the escape of carbon dioxide gas upon subsequent use of the hot top.

5. The method of making a hot top comprising the formation of a mixture of refractory materials composed of crushed screened limestone in major amount, saw-dust, a "green" bond, and foundry pitch in minor amount, molding said composition into suitable form, and baking the hot top at a temperature sufficiently high to burn out the saw-dust and pitch but not sufficiently high to decompose the limestone, whereby connecting pores are produced in the structure permitting the escape of carbon dioxide gas upon subsequent use of the hot top.

6. A hot top comprising a walled body formed in major amount with a decomposable metal carbonate as an essential ingredient, a suitable bond in minor amount, and a granular combustible material uniformly dispersed throughout the composition prior to the baking process during manufacture, whereby upon baking connecting pores are produced in the structure permitting the escape of carbon dioxide gas upon subsequent use of the hot top.

7. A method of making a hot top for steel ingots, comprising the preparation of a composition having substantially 74 parts of a metal carbonate, a substantially 10 parts of foundry pitch bond, substantially 10 parts of a combustible material, and substantially 6 parts of a plastic binder, molding said composition in desired form, and then reducing the bond and binder content of the finished product by the application of a temperature sufficient to carbonize a portion of the bond and binder, whereby the finished product will contain substantially 96 parts of the carbonate and substantially 4 parts of the bond and binder.

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Certificate of Correction

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THOMAS C. EAYRS.

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 61, for the words "bond a" read *bond—a*; and second column, line 19, for " $\text{CaCO}_3 + \text{heat} = \text{CaCO} + \text{CO}_2$ " read $(\text{CaCO}_3 + \text{heat} = \text{CaO} + \text{CO}_2)$; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of January, A. D. 1945.

[SEAL]

LESLIE FRAZER,
Acting Commissioner of Patents.