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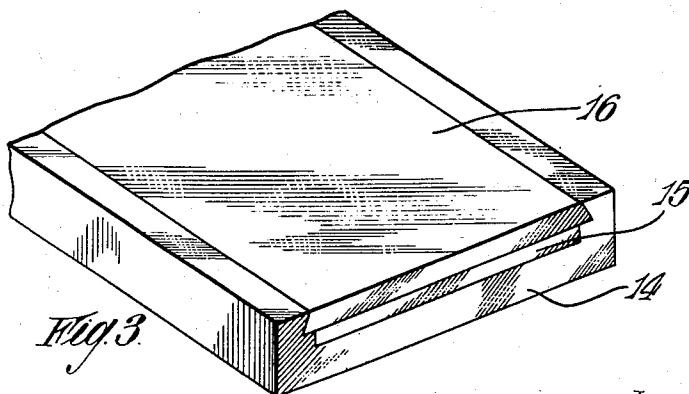
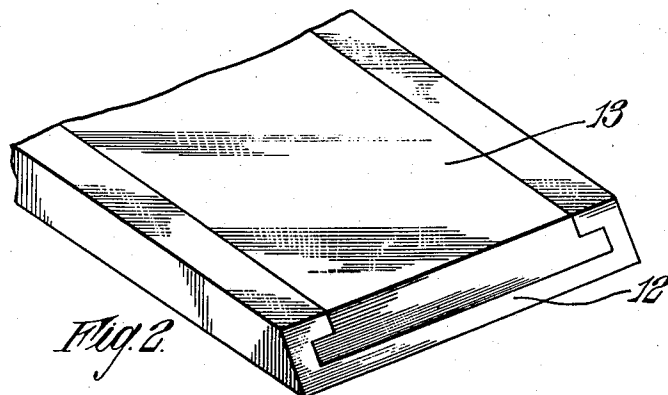
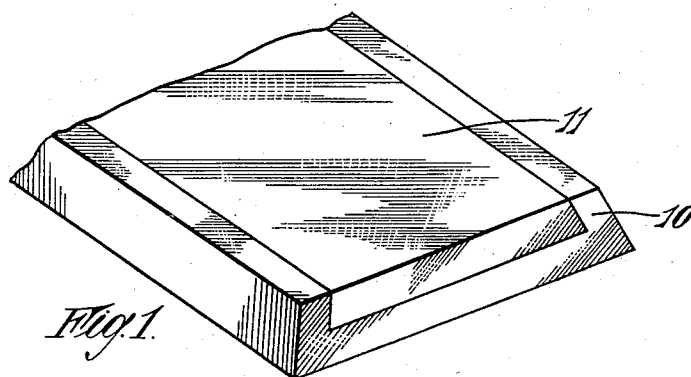
R. C. EDMONDS ET AL

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MANUFACTURE OF METAL INGOTS AND CASTINGS

Filed March 29, 1957

2 Sheets-Sheet 1



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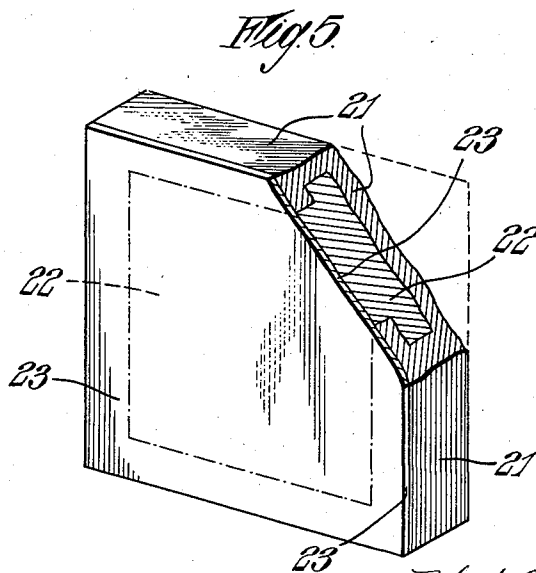
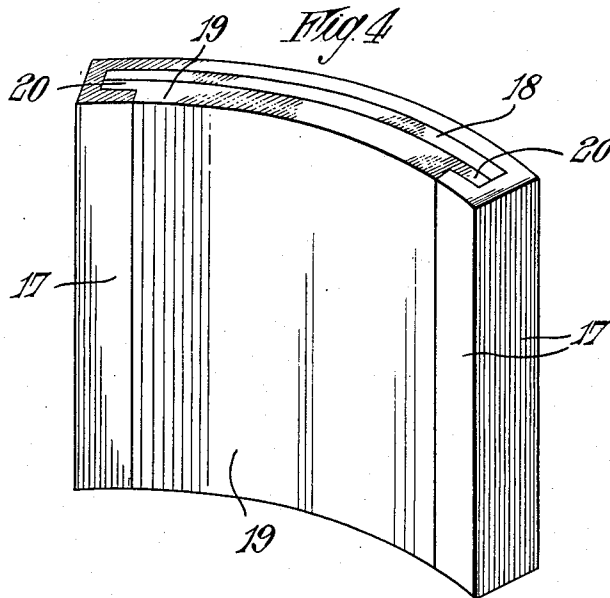
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MANUFACTURE OF METAL INGOTS AND CASTINGS

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Application March 29, 1957, Serial No. 649,388

Claims priority, application Great Britain April 5, 1956

6 Claims. (Cl. 22—147)

The present invention relates to the manufacture of metal ingots and castings and in more particularly concerned with the casting of steel and other metals in ingot form.

In producing metal ingots, it is customary practice, in order to avoid the adverse effects of uneven cooling of molten metal when poured into an ingot mould, to employ low thermal conductivity refractory tiles to provide heat insulation, either by lining the top portion of the ingot mould or by being fitted into a separate ingot head box or hot top which is located on top of the mould. It has been known for a considerable time that both the yield and soundness of ingots produced in such moulds are increased if the refractory tiles are pre-heated prior to pouring the ingot. Attempts have also been made to employ, instead of tiles which only have heat insulating properties, tiles or other moulded shapes such as sleeves made of exothermic material, which set up a heat-producing reaction in contact with the molten metal and thereby delay cooling of the adjacent part of the poured ingot. Exothermic mixtures which can be used in this manner are described in United States Patent No. 2,591,105 and in British Patents Nos. 627,678, 774,490, 774,491, 769,719 and 722,273.

Although such a technique has been utilised on a production scale, its application is limited, particularly for ingots of the inherently cheap metals, since the cost of the exothermic materials can outweigh the advantages of increased ingot yield, increased soundness of ingot and, possibly, increase in the number of ingots produced per ladle of metal. Also, and this is of great importance, the efficiency of the exothermic compounds is reduced, since the fabricated exothermic tiles and similar shapes come into contact with the high thermally conducting metal of the ingot mould or hot top. This results in much of the heat evolved from the exothermic material being wasted instead of being utilised for superheating the tile or similar shape and delaying the solidification of the ingot head metal.

Copending United States application Serial No. 563,465, filed February 6, 1956, now abandoned, discloses the use of a shaped article for use with an ingot mould or other metal casting mould comprising an outer surface, namely that surface which does not come into contact with the molten metal, constituted by a heat insulating and inert material, whereas the inner surfaces, which come into contact with the molten metal, are composed of a mouldable exothermic material, preferably such as described in British Patent No. 627,678 or in any of the copending applications referred to above. Such combined shapes are more efficient than shapes made solely from the exothermic material, or, of course, solely from the backing material; this increased efficiency enables considerable economies to be made in the application of exothermic materials for the feeding of both castings and ingots.

For a large number of applications, particularly in the

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ingot field, the double-layer and occasionally triple-layer shapes of exothermic and refractory materials are equivalent to plane or substantially plane tiles. These tiles, with a surface layer of exothermic materials, are very convenient for insertion into typical ingot head boxes or ingot moulds. In fact, they are used in substantially the same way as the refractory and sometimes insulating tiles commercially available for ingot production.

It has been found, however, that composite tiles of exothermic and insulating refractory material sometimes suffer from certain disadvantages in practice. Thus, bonded exothermic materials are of considerably lower strength than the normal refractory/insulating tiles used for ingot production and abrasion of the exothermic facing layer of the composite tiles can occur during their insertion into a head box or recessed ingot mould. Such abrasion can result in the introduction of particles of exothermic materials into the ingot mould with the possibility of inclusions in the resultant ingot. In addition, abrasion between two adjacent tiles on insertion into either head box or recessed mould can result in a cavity or gap between the two tiles which might be penetrated by the molten metal during the filling of the ingot mould, with increased danger of restricting the contraction of the ingot and consequently the formation of hot tears or cracks in the ingot.

It is an object of the present invention to provide such shapes in a form in which these disadvantages are overcome or materially reduced.

More specifically, the primary object of this invention is to provide an improved composite exothermically reacting tile or like shape for use in lining hot tops such as head boxes and recessed ingot molds.

A further object of this invention is to provide heat producing tiles of the foregoing type for lining hot tops which overcome the difficulties of inclusions in the metal cast in the mold resulting from fragments of exothermically reacting material which break away from the tiles when they are mounted in place.

Still another object of the invention is to provide an improved heat producing tile of the above character which is easily handled, shipped and stored while remaining strong and dry during storage prior to use.

According to the present invention, a shaped article in the form of a tile, slab, brick or the like for use with an ingot mould or other metal casting mould, comprises an outer body, which does not contact the molten metal and which is constituted by a heat insulating and inert material, and an inner layer, for contacting the molten metal, which is constituted by a mouldable exothermic material, the article having side surfaces over at least a part of its periphery which, in use, contact the side surfaces of other said shaped articles, said side surfaces being constituted substantially wholly by the heat insulating inert material, whereby contact between the exothermic material of adjacent said shaped articles is reduced or avoided.

Preferably the heat insulating inert material is in the form of a quadrilateral tile having two opposite upstanding sides and the exothermic material is located in the channel thus present in the tile or the heat insulating material is in the form of a quadrilateral tile having four upstanding sides and the exothermic material is located in the recess thus present in the tile.

The ease of handling of composite exothermic/refractory tiles is greatly increased by using recessed tiles in which a mouldable exothermic material can be readily formed and then dried in situ. Such recessed tiles may have re-entrant portions, such as typically dove-tailed, rebate or grooved shapes at their edges, to accommodate the exothermic material and to lock or key it mechanically to the tile. Consequently, on insertion of the tiles into the hot top such as a head box or recessed ingot mould

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in juxtaposition to form a lining, only the hard side surfaces of the refractory material come into contact with each other and there is no danger of abrasion of the exothermic material. It will be appreciated that where only one tier of tiles is required, the heat insulating and refractory material of each tile need only be of channel shape and disposed with the channels vertical, so that the upper and lower end surfaces of the tiles include exposed exothermic material, but, where more than one tier of tiles is used, it is desirable for all side surfaces thereof to be constituted by the refractory material.

These shapes have the additional advantages that it is extremely easy to insert layers of highly insulating materials into recessed portions between the refractory backing and exothermic material; thus a layer of such insulators as vermiculite can be spread on to the tile, or alternatively insulating inserts may be readily stuck on to the recessed face of the tile prior to ramming the mouldable exothermic material into position. Such triplex shapes, as described in the above mentioned copending application Serial No. 563,465, can be of even greater efficiency than the duplex shapes.

Finally, it has been found possible with such recessed tiles to overcome one other difficulty of exothermic/refractory tiles. Exothermic materials tend to absorb water and consequently lose strength on standing and the duplex tiles can eventually become unsatisfactory for foundry usage if stored in a humid atmosphere for long times. These recessed tiles make it readily possible to prevent moisture pick-up by sealing a layer of wax paper or some similar water repellant material on the facing edge of the refractory tile so that the exothermic material is completely or substantially covered.

The accompanying drawings, in which the figures each show in perspective view one form of tile, illustrate diagrammatically specific examples according to the invention but are not to be regarded as limiting the invention in any way:

Fig. 1 shows a tile in which the refractory portion 10 has a dovetail channel therein for receiving the exothermic material 11, the tile being bevelled on all sides.

Fig. 2 shows a tile in which the refractory portion 11 has an inverted-T-section channel therein for receiving the exothermic material 13, the tile being bevelled at its ends.

Fig. 3 shows a triplex tile in which the refractory portion 14 has a complex channel therein, forming a rectangular section channel for receiving a highly insulating material 15 and a dovetail portion for receiving the exothermic material 16.

Fig. 4 shows a triplex tile in the form of a part-cylindrical surface. The refractory portion 17 has an inverted-T-section channel therein co-axial with the cylinder formed from a number of the tiles in the lower part of which a layer of highly insulating material 18 is disposed. In the remainder of the channel, an exothermic material 19 is provided so as to have rabbeted portions as at 20.

Fig. 5 shows a flat, recessed tile of rectangular form in which the refractory portion 21 forms all four sides of the tile, an undercut recess in the front surface being filled with exothermic material 22. Over the whole of this front or outer surface, a sheet of wax paper 23 is applied for protecting the exothermic material 22 during storage of the tile.

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Suitable compositions of heat-insulating and inert material are as follows:

	Percent
Grog, sand, crushed firebrick or any other granular refractory material	80-90
Binder (such as sodium silicate, dextrine gum or sulphite lye)	6-10
Clay or fireclay	4-10

To this is bonded, to form a shaped article such as a tile as shown in any of Figs. 1-5, an exothermic material having the following compositions:

	Percent
Aluminum particles	15-50
Sodium nitrate	5-10
Iron oxide	0-5
Core gum	1-5
Cryolite, sodium fluoride or sodium silicofluoride	0.5-10
	(preferably 1-5)
Sand	40-60

We claim:

1. A hot top having an inserted lining composed of a plurality of tiles each of which comprises a body of heat-insulating material having recessed therein a layer of moldable exothermically reacting material, at least two opposite side portions of the tile consisting wholly of said insulating material, the tiles being inserted in juxtaposition to constitute a lining and making edge to edge contact at the said sides consisting wholly of said heat insulating material.

2. The hot top defined in claim 1 wherein each tile has two opposite upstanding sides and exothermically reacting material being located in the channel thus defined in the tile.

3. The hot top defined in claim 1 wherein each tile has four upstanding sides and exothermically reacting material being located in the recess thus defined in the tile.

4. The hot top defined in claim 1 wherein each tile has four upstanding sides and exothermically reacting material being located in the recess thus defined in the tile, the said upstanding sides of the tile having re-entrant angles whereby the exothermically reacting material is keyed to the tile.

5. For use in lining a hot top, a plurality of tiles each of which comprises a body of heat-insulating material having recessed therein a layer of moldable exothermically reacting material, at least two opposite side portions of the tile consisting wholly of said insulating material, the tiles being inserted in juxtaposition to constitute a lining and making edge to edge contact at the said sides consisting wholly of said heat insulating material.

6. The tiles defined in claim 5 wherein each tile has a layer of water-repellent material over the outer surface of the exothermically reacting material.

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