

Feb. 4, 1958

E. VALLAK

2,821,758

HOT TOPS

Filed Nov. 21, 1956

3 Sheets-Sheet 1

Fig. 1.

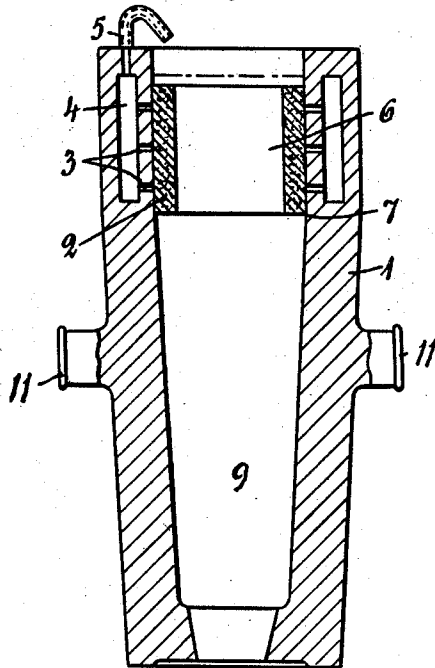
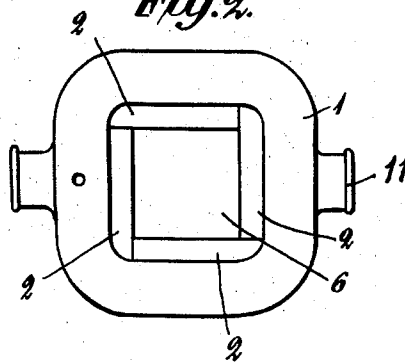


Fig. 2.



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Fig. 3

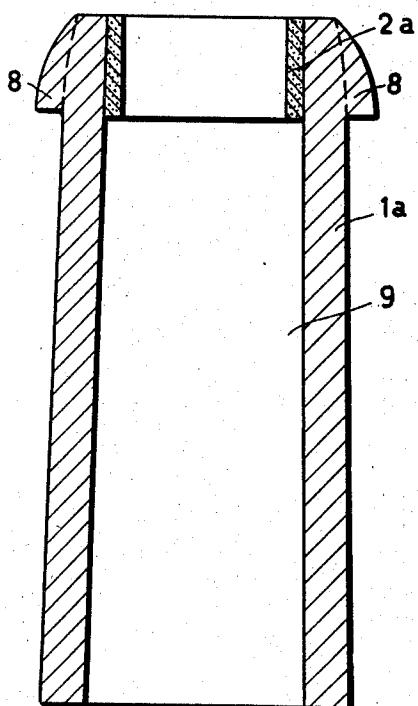


Fig. 5

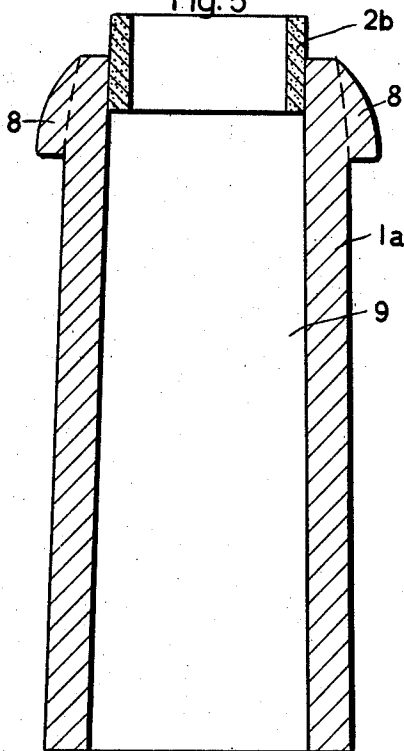


Fig. 4

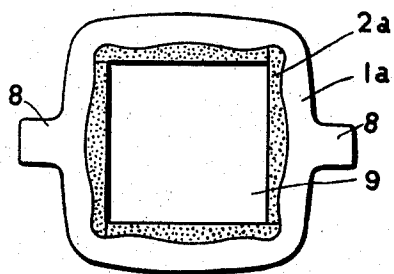
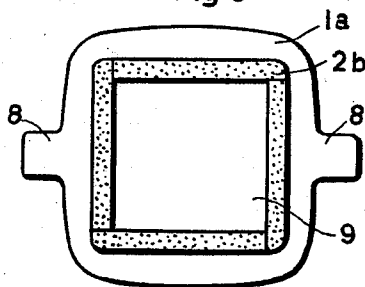


Fig 6



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HOT TOPS

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Fig.7

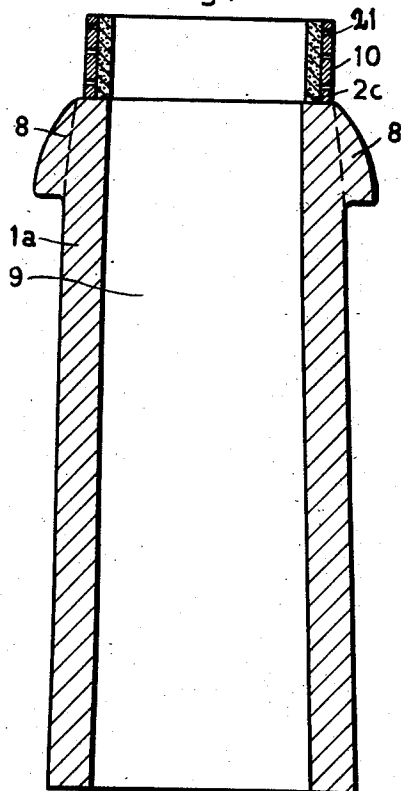


Fig.9

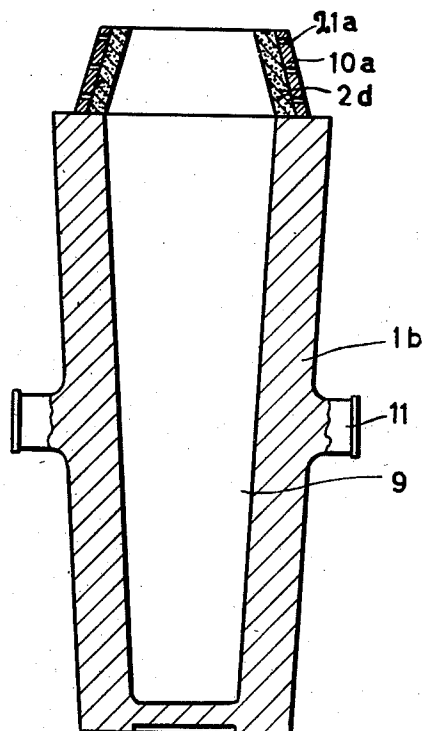


Fig.8

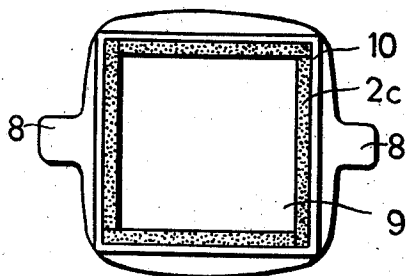
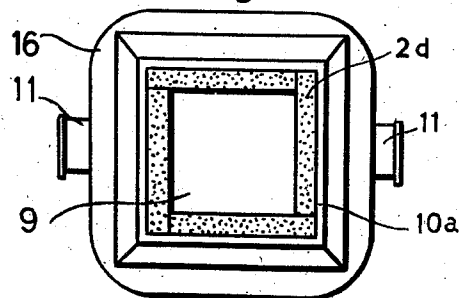


Fig.10



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2,821,758

HOT TOPS

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Application November 21, 1956, Serial No. 623,629

Claims priority, application Germany January 25, 1956

13 Claims. (Cl. 22—147)

The invention relates to hot tops for ingot molds, also known in the trade as feeders, feeding head boxes, or sinking head boxes.

This is a continuation-in-part, reference being had to my copending application, Ser. No. 351,546, filed April 28, 1953, now abandoned due to forfeiture as of April 26, 1957.

The purpose of a hot top is to obtain a heat insulation of the top portion of the ingot, to retain the heat at the upper end of the chill mold to prevent "piping" in the casting.

This aim is generally accomplished by hot tops now in use, but present hot tops are deficient therein that they present the hazard of penetration into the ingot by the gases developing from the combustion of the hot tops, thereby changing the chemical composition of the upper region of the ingot. Some of the present hot tops are also deficient therein that they cannot properly be fitted into the chill mold, thereby presenting the hazard that some steel may penetrate between the chill mold wall and the hot top and during the subsequent cooling adhere to the hot top resulting in the formation of cracks and fissures in the casting.

It is therefore among the objects of the instant invention to avoid the drawbacks of the prior art, and to provide for hot tops, its building blocks or cakes and methods of making them, which are comparably inexpensive, simple to manufacture and easy to apply to the chill molds.

As brought out in detail below, the hot tops in accordance with the invention are formed from powdered or granular material, that may be shaped to close tolerances. The hot tops are porous, and the porosity extends through the height of the hot tops, and provides for sufficient gas permeability to enable gases formed in the combustion of the hot top to escape through the walls of the hot top.

The hot tops may be built from cakes that are formed from pulverized material, such as powdered or granular material, and have the aforesaid "through porosity." This enables the gases arising from the charring or combustion of the hot top substantially to escape from the chill mold to atmosphere through the walls of the hot top without any need to bubble through the molten ingot material. The interior sheet-metal mantle-wall can thus be dispensed with. Further, by producing the hot top from a porous material, the hot top can easily be adapted satisfactorily to the shape of the chill mold, so that the hot top may be fitted so closely to the interior wall surfaces of the chill mold that the molten metal will be unable to penetrate upwards between the chill mold and the hot top and to hang onto the chill mold after the solidification.

The hot top as a whole may be disposed below the top edge of the chill mold and be supported at its lower end on a shoulder or the like on the interior wall surface of the chill mold, but the hot top could alternatively be disposed wholly or partly above the upper edge of the chill mold proper and be surrounded by a sheet-metal wall or the like arranged as an extension of the chill mold proper and provided with perforations through which the gases above referred to may escape from the combustible material.

One specific embodiment of the invention will now be

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described by way of example, reference being had to the accompanying drawings in which:

Fig. 1 is a vertical section through a chill mold incorporating the invention, and

Fig. 2 is a top end view thereof;

Figs. 3 and 4 are similar views of another embodiment;

Figs. 5 and 6 are similar views of still another embodiment;

Figs. 7 and 8 are similar views of a further embodiment, and

Figs. 9 and 10 are similar views of a still further embodiment.

The chill mold proper 1 (Figs. 1 and 2) may be of any suitable shape but has preferably walls which taper slightly downward and which, at the upper portion of the chill mold merge into a section 7 having substantially parallel walls. The hot top 2 is shaped in such a manner that it will fit into the last-mentioned section 7 of the chill mold, and it is supported at its lower end on the transition edge between said section 7 and the tapering lower section of the chill mold. As will be apparent from Fig. 2, the hot top may be composed by four separate plates or pieces fitting together, but alternatively it may be a single-piece structure. The porous material of the hot top may be a suitable fibrous material, such as compressed peat, saw-dust, powdered charcoal, coke or the like, in which case any suitable binding agent may be used, or it may be any other combustible material which is apt to form a heat insulation at the upper portion of the chill mold. The hot top should suitably be introduced into the chill mold to such an extent that the upper edge of the hot top will be disposed below the top edge of the chill mold.

In operation, the steel material is poured into an inner space 9 of the chill mold and into the hollow interior 6 of the hot top. Due to the fusing heat, the walls of the hot top will be charred in the course of the melting process whereby these walls will be still more heat insulating. The gases and vapors then developed will escape through the porous walls of the hot top and will pass to atmosphere through vents or passages 3 made in the chill mold wall opposite the hot top. Such passages may extend through the entire thickness of the chill mold wall to lead the gases to the ambient atmosphere, but alternatively, as illustrated in the drawings (Fig. 1), the gases may be collected within an annular cavity 4 formed in the interior of the mold wall and, in its turn, communicating with the ambient air, suitably through one or more down-turned pipes or nozzles 5 adapted to discharge the gases against the top surface (the broken line in Fig. 1) of the ingot in the chill mold causing these gases to be burnt so as to be utilized for heating the charge without the need of bubbling through the same. When the casting process is completed, the hot top will be substantially completely burnt down.

Pivots 11 or the like are provided to enable inversion, handling and suspension of the chill mold.

In the embodiment according to Figs. 3 and 4, which show a portion of the chill mold, the internal space 9 of the chill mold 1a tapers upwardly and the hot top 2a is fitted into the top opening of the mold. At the top the chill mold has shoulders 8 on which the mold is suspended. The plates 2a of the hot top may have corrugated external surfaces (Fig. 4) fitting into similar corrugations in the wall of the mold. The plates may be clamped firmly in their place by means of wedges or the like. The combustion gases formed during the casting operation will penetrate through the porous walls of the hot top and escape between said walls and the walls of the mold.

According to Figs. 5 and 6, the hot top extends with

its top portion above the chill mold 1a while the lower portion of the hot top is fitted in the mold.

In the embodiment according to Figs. 7 and 8 the hot top 2c, having substantially parallel walls, rests on the top surface of the chill mold and is surrounded by an envelope 10 of sheet metal, for instance. Said envelope is perforated at 21 so as to allow the gases penetrating through the porous walls of the hot top to escape.

According to Figs. 9 and 10, the chill mold 1b has a shape similar to that shown in Figs. 1 and 2, and the hot top is supported on the top surface of the chill mold but as distinguished from Figs. 7 and 8, the walls of the hot top 2d are not parallel but taper upwardly. The sheet metal casing 10a has a similar shape and is provided with perforations 21a.

When using the embodiment previously referred to, having a perforated mantle-wall of sheet-metal or other difficultly fusible material surrounding the hot top, this mantle-wall, for instance 10 in Fig. 7, could be arranged as an upward extension of the chill mold, or it could be combined with the hot top proper in any suitable manner, for instance as shown in Fig. 9 at 10a.

The cross-section of the chill mold, and thus also of the hot top, may of course vary from case to case.

As shown in some of the embodiments illustrated in the drawings, the hot top need not rest at any abutment of the chill mold, but it may also be fitted and clamped into the top of said mold, if necessary by means of wedges.

The material of the hot tops or sinking head boxes, or of the cakes from which the hot tops may be made, may be either pulverized coke, or pulverized coke and a filler material, and a binding agent, and sometimes a protective coating is applied to some of the surfaces.

By choosing different mixtures and different grain sizes, hot tops can be fabricated with different properties according to divergencies of cake size and shape, carbon content of the steel, and so forth. Generally, different grades of cake will be applied for different grades of steel, and for smaller size cakes, smaller grain size will be used.

The cakes may be produced by various methods and machines, for instance in a machine in accordance with my co-pending patent application Ser. No. 499,454, filed April 5, 1955, now Patent No. 2,781,545, issued February 19, 1957.

The cakes are produced by selecting granular or powdered material of coke, or coke and filler such as saw dust and a binding agent, and compressing the mass to a density of from about 42 to 56 lbs. per cubic ft. (.65 to .9 kg./dm.³), preferably between about 47 and 50 lbs. per cubic ft. (.7 and .8 kg./dm.³). By this compression there will be a decrease in volume at values between 30 and 60 percent and preferably between 40 and 45 percent, calculated on the original volume when the loose mass is compressed. The power of compression approximately corresponds to a weight of about 17.7 lbs. (8 kg.) falling from a height of about .4 in. (5 cm.) for each area of 15.5 sq. in. (one dm.²).

The purpose of using a filler, such as saw dust, is to increase the porosity and the combustibility of the cake.

As a binding agent there may be used a sulphite lye, or a composition of one-half by weight of sulphite waste lye and one-half of water. Alternatively, the binding agent may be water glass 38° Beaumé, or molasses.

Instead of sulphite lye with a water content of about 50% it is possible to use dry powder of sulphite lye. This powder can either be dissolved in hot water before making the cake mixture, or it can be mixed in dry state together with coke and sawdust. Only when the dry mass is properly homogenous is the water added. This is to prevent the sulphite lye from forming lumps, which would give the cake a bad mechanical strength.

Examples (Mixtures)

In the tables below there are given actual examples of

materials used in the fabrication of such cakes, including the weight, water content and grain size of the materials.

	Weight per vol. unit, lb./cu. ft.	Water content, percent	Grain size distribution in percent of weight	
			¼-½"	½-¾"
Coke.....	43.5	2	20	24
Fine sawdust.....	14.0	8	0	21
Coarse sawdust.....	7.6	8	6	73
Sulphite lye.....	77.0	50	-----	-----

	Weight per vol. unit, lb./cu. ft.	Water content, percent	Grain size distribution in percent of weight	
			½-1½"	1.128"
Coke.....	43.5	2	33	23
Fine sawdust.....	14.0	8	75	4
Coarse sawdust.....	7.6	8	20	1
Sulphite lye.....	77.0	50	-----	-----

Further examples of six different mixtures, designated A, B, C, D, E and F, from actual cake fabrication are given in the table below.

Raw material	Cu. ft. of raw materials in different mixtures					
	A	B	C	D	E	F
Coke.....	3.5	3	2.5	3.5	2.5	5
Fine sawdust.....	1.5	2	2.5	-----	-----	-----
Coarse sawdust.....	-----	-----	-----	1.5	2.5	-----
Sulphite lye.....	1.3-1.4	1.5-1.6	1.9-2.0	1.1-1.2	1.2-1.3	0.6-0.8

Mixtures A, B, and F should be used when the steel temperature is high.

Mixture C, D, and E contains a larger amount of fine sawdust, and are more porous than the mixtures A, B, or F. They are recommended for low steel temperatures.

Further examples of mixtures of cakes, designated G, H, I, J, K, L, M, and N, expressed in liters, are given in the table below.

COMPOSITION IN LITERS									
	G	H	I	J	K	L	M	N	
Coke.....	105	105	15	-----	-----	40	90	90	50
Charcoal.....	-----	45	-----	60	40	-----	30	30	
Peat.....	45	-----	-----	-----	-----	50	30	-----	
Expanded slag.....	-----	-----	-----	50	30	60	-----	-----	
Sand.....	-----	-----	75	50	20	-----	-----	-----	
Sawdust.....	-----	60	60	60	60	-----	30	30	
Waste sulphite.....	50	25	30	35	40	50	45	30	55

Protective coating may be used on those sides of the cake which are in contact with the steel. For steels with carbon content of the order of 1% carbon pickup can be avoided by means of a coating consisting of a mixture of aluminum and iron oxide powders in sulphite lye and/or water glass. A usable mixture is the following: 1 part of Al powder, 1 part of dry sulphite lye powder, 3 parts of iron oxide powder (Fe₂O₃) and 7 to 10 parts of water. The addition of water should be such as to permit the paint to be sprayed with a painting gun when being stirred all the time. One cu. ft. of dry mixture will be sufficient for 52 sq. yards of cake surface.

At lower carbon contents in the steel a protective coating is used consisting of 4.5 parts of sand and 1 part of sulphite lye (50% water). This mixture is worked until it becomes a supple dough and is then put on the cake with a trowel as a layer of about ¼" thickness. The sand should sinter below 1500° C., its grain size should be from 0 to about ¼" and it should contain grains of quartz, feldspar, as well as mica. The layer is put on

soon after the cake has come out of the oven in order to make it dry by the rest heat.

As stated before, the hot tops are characterized by a "through porosity" that extends through the thickness as well as the height of the cake and hence through the height of the hot tops. The "through porosity" is such that it provides for sufficient gas permeability to enable the combustion gases of the hot top to escape through the walls of the hot top itself.

In the following there are given various data concerning the porosity. The volume of the pores between the particles is about 25 percent to 60 percent, preferably between 40 and 50 percent of the cake volume.

Examples (Porosity and gas penetration)

Physical count of actual surface porosity (area) has indicated open pores amounting to from 45 percent to 55 percent in any given area of the surface of the cake.

Internal volumetric porosity (volume) was determined by feeding the internal holes with water. These determinations were made for three type cakes, as set out in the table below.

Mixture		Volumetric "Through Porosity"
Coke, percent	Filler, percent	Empty space (by volume) determined; percent
100	-----	39.5
70	30	44
60	40	48.5

The volumetric "through porosity" is thus preferably between 40 percent and 50 percent (empty space as compared to the entire volume).

The "gas penetration" is between 80-300, depending on the composition of the cake. The gas penetration is a factor stating the amount of air, expressed in cubic centimeters, passing through a cube of cake having the dimension of one cubic centimeter, per minute, at a pressure drop of one centimeter water column.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

Having thus described the invention, what I claim as new and desire to be secured by Letters Patent, is as follows:

1. In combination with a chill mold for casting steel and other metals, a hot top adapted to be disposed at the top of said chill mold in the casting operation, and composed of combustible gas permeable material so as to enable gases formed in the combustion of said hot top to escape outwards from the chill mold through the walls of said hot top, the lateral wall of the chill mold being provided substantially at the level where the hot top is mounted during the casting process with at least one aperture for allowing said gases to escape, said aperture opening into a cavity arranged within the lateral wall of the chill mold and communicating with at least one outlet pipe directed inwards towards the top of the chill mold to discharge said gases against the top surfaces of the ingot in said mold.

2. A hot top, for use in connection with a chill mold for casting materials and adapted to be disposed near the upper portion of said chill mold during the casting, said hot top being composed of combustible material having a through porosity of from 25 to 60 percent by volume.

3. A hot top, for use in connection with a chill mold for casting materials and adapted to be disposed near the upper portion of said chill mold during the casting, said

hot top being composed of combustible material having a through porosity of from about 40 to 50 percent by volume.

4. A hot top, for use in connection with a chill mold for casting materials and adapted to be disposed near the upper portion of said chill mold during the casting, said hot top being composed of combustible granular material having a through porosity of from about 40 to 50 percent by volume.

5. A hot top, for use in connection with a chill mold for casting materials and adapted to be disposed near the upper portion of said chill mold during the casting, said hot top being composed of combustible powdered material having a through porosity of from about 40 to 50 percent by volume.

6. A hot top, for use in connection with a chill mold for casting materials and adapted to be disposed near the upper portion of said chill mold during the casting, said hot top being composed of combustible material having a gas permeability of from 80 to 300 wherein gas permeability is the amount of air in cubic centimeters passing per minute at a pressure drop of one centimeter water column through a cube of one cubic centimeter of the hot top.

7. A hot top, for use in connection with a chill mold for casting materials and adapted to be disposed near the upper portion of said chill mold during the casting, said hot top being composed of a combustible material of pressed 100 percent pulverized coke and having a through porosity of about 39.5 percent by volume.

8. A hot top, for use in connection with a chill mold for casting materials and adapted to be disposed near the upper portion of said chill mold during the casting, said hot top being composed of a mixture of about 70 percent pulverized coke and about 30 percent saw dust and having a through porosity of about 44 percent by volume.

9. A hot top, for use in connection with a chill mold for casting materials and adapted to be disposed near the upper portion of said chill mold during the casting, said hot top being composed of a mixture of about 60 percent pulverized coke and about 40 percent saw dust and having a through porosity of about 48.5 percent by volume.

10. A hot top, for use in connection with a chill mold for casting materials and adapted to be disposed near the upper portion of said chill mold during the casting, said hot top being composed of combustion material having a through porosity of a surface count indicating open pores of from 45 to 55 percent of the surface area.

11. A hot top, for use in connection with a chill mold for casting materials and adapted to be disposed near the upper portion of said chill mold during the casting, said hot top being composed of combustible material including from 50 to 100 percent pulverized coke and from 50 to 0 percent saw dust, respectively, and a binding agent and having a through porosity of from 25 to 60 percent by volume.

12. A hot top as claimed in claim 11, said binding agent comprising material taken from a group consisting of sulphite lye, sulphite lye and water in equal proportions by volume, water glass 38° Beaumé, and molasses.

13. A hot top as claimed in claim 11, and a protective coating comprising a mixture of aluminum and iron oxide powder in sulphite lye.

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