Dec. 23, 1941. G. BEHRENDT 2,266,734

INGOT MOLD LINING

Filed April 21, 1939

Fig. 1

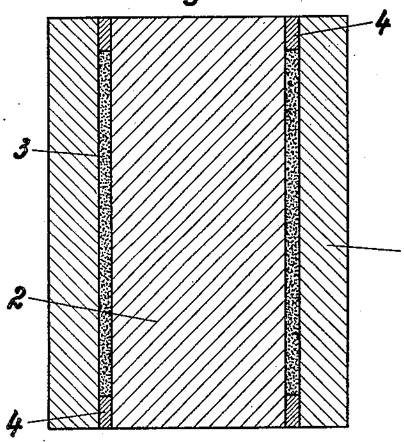


Fig. 2

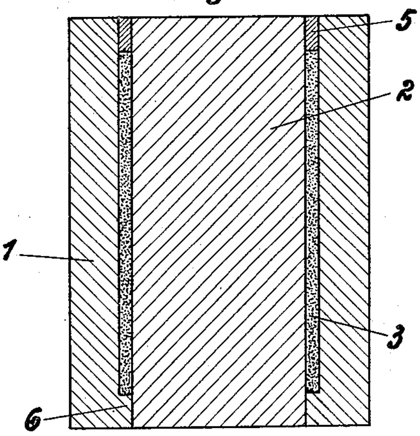


Fig. 3

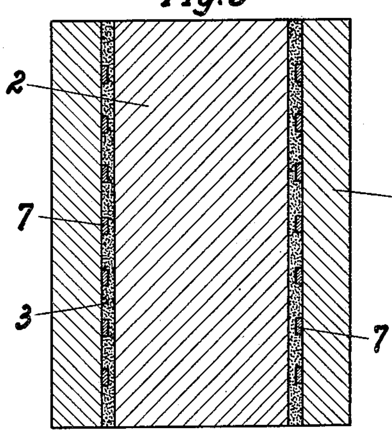


Fig. 4

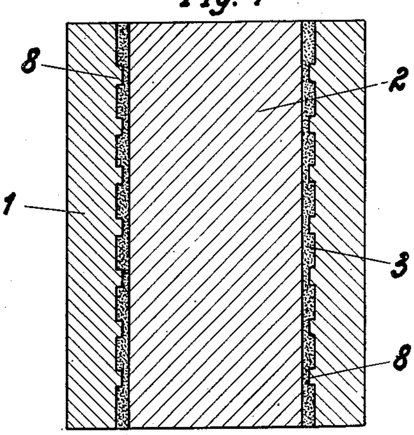


Fig. 5

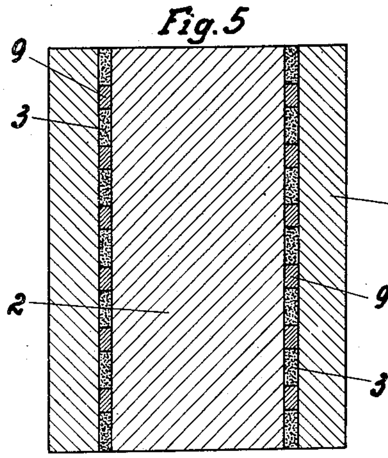
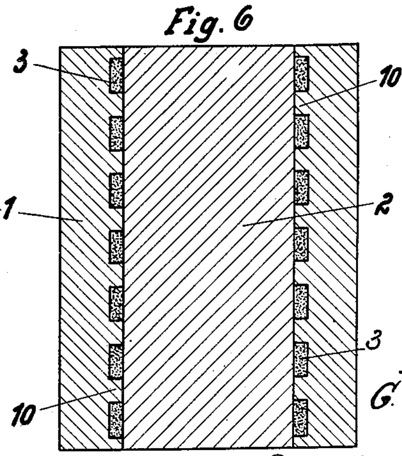


Fig. 6



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Patented Dec. 23, 1941 2,266,734

UNITED STATES PATENT OFFICE

2,266,734

INGOT MOLD LINING

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Application April 21, 1939, Serial No. 269,245
In Germany July 9, 1937

6 Claims. (Cl. 22—189)

In the ordinary unlined molds made of thick walled cast iron, dead welding with subsequent casting pores are easily caused by the sudden cooling effect of the cold mold walls, for example when casting killed steel, because the liquid surface of the ingot solidifies at the edges subjected to the strong cooling effect of the mold wall, remains adhering thereto and is washed over. Moreover, the transcrystallization caused by the strong conducting off of heat by the mold walls prevents the separation and rising of the non-metallic substances, especially of the products of deoxidation, in that these particles after being formed, have not sufficient time to rise in the interior of the liquid ingot before their path is blocked by the crystallites growing in from the sides, consequently they become imprisoned in the ingot. The cause for the formation of secondary pipes during the casting of ingots which are long in proportion to their thickness in ordinary chill molds is also only due to a too rapid beginning of a solidification of the ingot, as the ingot then easily solidifies sooner in the middle portion than at the head and base, with the result that the passage downwards into the contraction and shrinkage cavities is barred to the liquid material collected in the head of the ingot.

Another example of the detrimental effect of a too rapid conducting off of heat through the ordinary casting molds is the ring of bubbles occurring in the unkilled steels, whose formation is explained by the fact that the gas bubbles formed cannot escape upwards owing to the strong transcrystallization but hang on the pointed crystallites.

The chilling effect of the cold mold also has the disadvantage that, when casting large ingots, cracks frequently form especially in the longitudinal direction of the ingot. These cracks form the more easily the more sensitive the material of the ingot is to tensile stressing under heat. Consequently, experience has shown that great difficulties are encountered in casting or in centrifuging Thomas steel in molds of large diameter.

It has therefore been proposed, to cast large round ingots, for example for gun barrels and ship's shafts in cast iron molds, which ought to have a thick lining of some refractory material, such as silica material. The thick refractory lining is intended to very considerably slow the cooling and to avoid the above mentioned defects. The cost of producing a thick fire-proof lining for molds is, however, so high and the cooling and the stripping of the ingots so tedious that such a proposition could not be taken up in practice.

The object of the invention is to render it possible to produce large cast ingots which must be free from surface defects.

It has been found, that it is possible to produce such lined molds by casting the mold with a very thin fire-proof lining having great density and high mechanical strength, such as can be obtained by a special mixture of different sizes of grain.

If those particles of a substance which pass through a sieve with mesh width of 4 mms. and remain lying on a sieve with a 2 mm. mesh width are described as coarse, those particles which pass through a sieve with 2 mm. mesh width and remain on a sieve with 0.85 mm. mesh width are described as medium sized and those particles which pass through a sieve with 0.85 mm. mesh width are described as fine, the composition can be mixed for example of 40% coarse and 60% fine grains, or of 40% coarse grains, 40% medium grains and 20% fine grains. With such mixtures a dense lining having high physical strength to resist the mechanical action of liquid casting material is obtained after the sintering of the refractory lining introduced into the mold.

The thin refractory lining according to the invention can be produced by lining the mold with thin stones or preferably by ramming or centrifuging the refractory material into the mold.

Moreover, it is advisable according to the invention to produce the refractory lining from a mixture of different materials whose expansions under heat are contrary to one another, so that neither during the drying operation nor during the casting operation an expansion or contraction of the refractory material take place.

Thus, a working in or possibly a detaching of the lining from the mold is prevented. Such a lining may, for example, have the following composition: 75% burnt chamotte (coarse), 13% fresh clay (fine) and 12% quartz (fine) with as little water as possible or with a binding medium capable of hardening such as dextrine or sulfite liquor.

It may be advisable, to assist the adhesion of the thin layer of the lining by embedding iron wires or rods in the mass. The known detrimental expansion of the iron can then be accounted for by the composition of the lining mass. Metal insertions, such as iron rings, are also preferably embedded at different planes in the refractory lining for obtaining rapid cooling.

As the mold has a cooling effect, the lining, if it is made according to the invention, is not burnt through quite so strongly as is otherwise usual for refractory masses. On the other hand, the lining is subjected to higher wear chiefly at its lower and upper ends by the stripping of the ingot.

It is therefore advisable to secure the edges of the lining at the top and at the bottom by rings of more solid material.

Several embodiments of the invention are illustrated by way of example in longitudinal section one in each of the figures of the accompanying drawing, in which 1 designates the mold, 2 the ingot and 3 the lining.

According to Fig. 1 the lining is protected at the top and bottom by rings 4 of previously strongly burnt and consequently wear-proof refractory plates. According to Fig. 2 for example the lining is secured at the top by an iron ring 5 which may be loosely inserted or screwed into the mold, whereas at the bottom the mold has an annular shoulder 6 of the thickness of the lining.

On the other hand it is possible to arrange such rings for securing the lining in other planes than only at the top and bottom. Figs. 3 and 4, for example, show longitudinal sections of molds with such types of construction. These rings 7 may be loosely screwed in (Fig. 3) or form a part 8 of the mold wall (Fig. 4). These rings evidently exert a cooling effect and reduce the checking effect to the heat flow produced by the lining. This cooling is intensified the more the thickness of the lining is reduced. In Figs. 5 and 6, for example, loose rings 9 and rings 10 forming part of the mold wall are shown, which rings extend right through the lining and consequently have a strong cooling effect. By varying the number and thickness of these rings it is possible to regulate the cooling speed to suit the desired purpose.

To ensure ingots which are as smooth as possible, it is advisable after the refractory lining has been fitted in the mold, to smooth its surface with the aid of a template or to grind it smooth with the aid of a grinding machine.

Other known measures, which increase the chemical and mechanical resistance of the refractory lining according to the invention against the action of the casting material and of the slags, may also be used to advantage without departing from the scope of the invention.

I claim:

1. An ingot mold lining for casting heavy steel ingots suitable for repeated use, including a thin lining body of refractory material, said material being composed of a mixture of grains of burnt chamotte, fresh clay and quartz with different sizes sintered to a high strength to resist the mechanical action of the casting material, the expansion coefficient of the different composite parts of the refractory material behaving oppositely under heat so that expansion and contraction do not occur during drying and casting.

2. A lining as specified in claim 1, in which the mixture is composed of 40% coarse and 60% fine grain material.

3. A lining as specified in claim 1, in which the mixture is composed of 40% coarse, 40% medium and 20% fine grain material.

4. A lining as specified in claim 1, in which the mixture is composed of burnt chamotte 75%, fresh clay 13% and quartz 12%.

5. An ingot mold lining for casting heavy steel ingots adapted to be used repeatedly, which comprises a metal mold lined with a thin coating of refractory material composed of particles of different size adapted to increase the density and strength of said refractory and consisting of a major portion of burnt fire clay with minor proportions of fresh clay and silica in amount sufficient to reduce the expansion coefficient of said material to the point at which substantially no expansion and contraction takes place during drying and casting.

6. An ingot mold lining for casting heavy steel ingots adapted to be used repeatedly, which comprises a metal mold lined with a thin coating of refractory material composed of a major proportion of relatively coarse particles of burnt fire clay and minor proportions of fine fresh clay and fine silica in amount sufficient to reduce the expansion coefficient of the material to the point at which substantially no expansion and contraction takes place during drying and casting.

GERHARD BEHRENDT.