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SHRINK HEAD CASING FOR INGOT MOLDS

Filed July 6, 1925

Fig. 1.

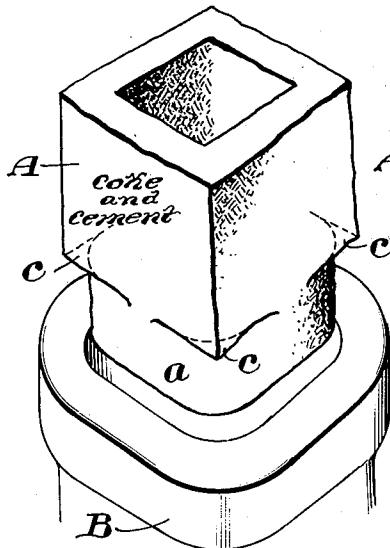


Fig. 3.

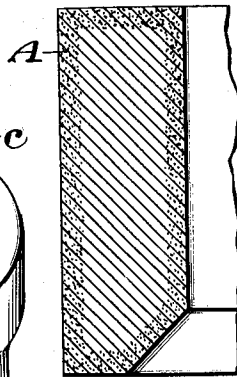


Fig. 2.

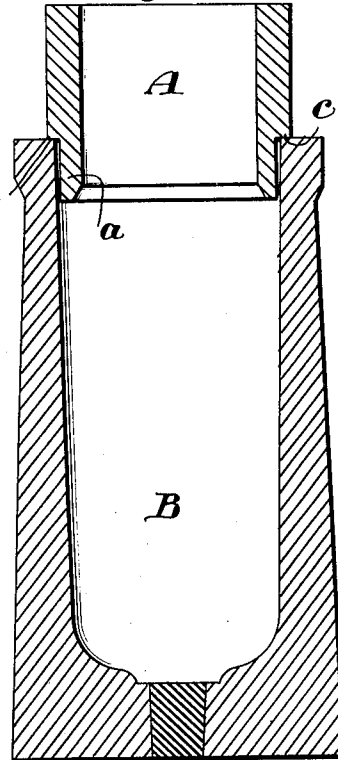


Fig. 4.

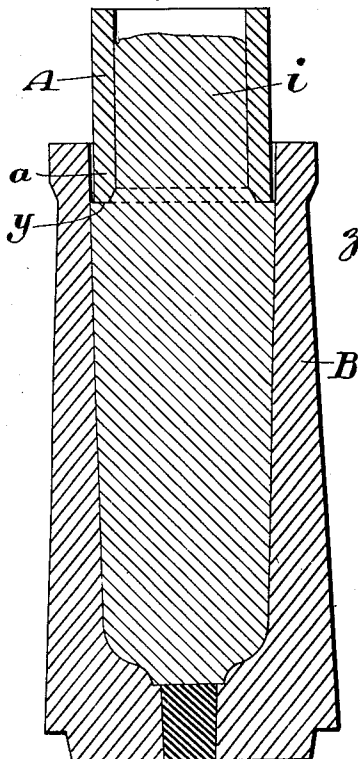


Fig. 5.

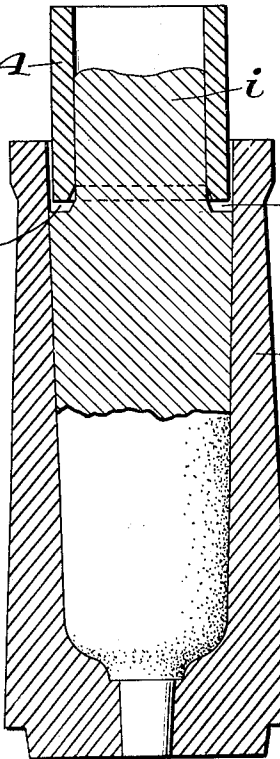
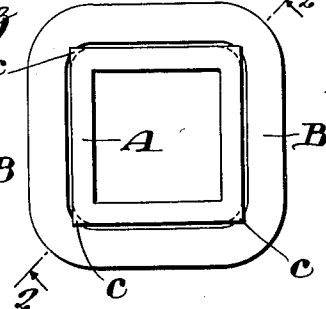


Fig. 6.



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UNITED STATES PATENT OFFICE

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SHRINK-HEAD CASING FOR INGOT MOLDS

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This invention relates to what are commonly called, in the art of ingot casting, feeders, shrink heads, hot tops, or shrink head casings for ingot molds.

5 In the casting of steel ingots by the most approved methods, provision is made in the molds for maintaining in a molten condition on the top of the ingot while forming, a pool of metal which supplies to the body of the
10 ingot while being formed and solidified a sufficient amount of molten metal to fill the pipe or vertical cavity which forms or which would otherwise form during the operation. The Gathmann molds are so constructed that
15 the metal solidifies more quickly in the lower portion of the mold than in the upper part thereof, so that the so-called pipe is eliminated from the lower part of the ingot while being cast and only a small pipe or cavity
20 remains in the upper part of the forming ingot when the pouring operation is completed. This is true to a large extent whether the so called feeders or sink heads are used or not, but it is now a common practice to
25 employ shrink head casings inasmuch as they serve to delay the premature freezing or solidification of the top portion of the ingot by maintaining fluid for a longer time and in a better condition, the molten metal at
30 the top of the ingot and thus the formation of pipe in the body of the ingot is further prevented as the liquid steel which descends fills or more accurately stated prevents the formation of pipe or a shrinkage cavity which
35 would otherwise be formed within the body of the ingot if there were a uniform rate of solidification or freezing throughout the entire molten mass. In this way the ingot is so cast that only a small pipe or cavity
40 remains in the final product. The upper part of the ingot being cast which contains a pool of molten metal is sometimes called a feeder, sink head or shrink head and it is also common in the art to call the heat insulating top
45 of the mold or that part which surrounds the pool a feeder or sink head, but this element of the mold is more properly called a shrink head casing. It is, in fact, a part of the mold inasmuch as the upper part of the
50 ingot is cast therein, but it is usually sepa-

rable from the mold proper and made of a different material.

Ordinarily heretofore shrink head casings have been made of refractory material such as fire clay or fire brick material which is
55 of a metallic nature and is extremely hard and brittle, having been baked at a very high temperature and its texture is quite close. In order to make such casings a special plant is required. It has not been the practice to
60 make such casings at steel plants. Thus transportation of the casings has been necessary and the expense is correspondingly increased. When in use the clay casings have been supported on the molds by some means
65 which allow them to descend into the mold cavity as the ingot shrinks and solidifies. This has been found necessary as the casing adheres to the top of the ingot and unless it is allowed to lower with the shrinking ingot
70 it would be broken and prematurely destroyed. When the casting operation is finished the casing remains on the top of the ingot and is usually broken up by hammers or other suitable tools, and thus removed from
75 the ingot before the latter is reheated and passed to the rolls for reducing the ingot to the desired shape. Quite often lumps and finer particles of clay remain on the ingot and become embedded therein while passing
80 through the rolls, thus making flaws in the rolled product which are sometimes serious.

Shrink head casings made of fire clay have rather low insulating qualities, making it
85 necessary to lose a considerable quantity of metal from the top of the ingot where the pipe or cavity occurs, it being necessary to remove or crop this portion of the ingot before the sound portion thereof is rolled.

It is the object of my invention to overcome the defects ordinarily found in shrink head casings made of fire clay as heretofore, and I have found a way of making such casings of material which is not only much
95 cheaper than fire clay or similar refractory material, but is more efficient as it has characteristics which entirely eliminate some of the difficulties heretofore encountered in the use of clay casings.

According to my invention instead of mak- 100

ing shrink head casings of fire clay or similar refractory material of a mineral nature, I obtain superior results by making them of semi-combustible organic matter, such as material resulting from the natural carbonization of vegetable matter, the preferred material being coke or the small particles of coke which are separated from the larger particles, which latter are used for smelting and other such purposes. The surface of this material is slowly combustible when subjected to high heat and this property I have found to be most advantageous when the material is used to make shrink head casings inasmuch as the slow burning of the material in the inner walls or surface of the casing serves to conserve the heat of the molten metal within the top portion of the ingot and it also prevents the adhesion of the ingot metal to the casing when the ingot is shrinking so that the solidifying top portion of the ingot may descend without placing any material strain on the casing. For this reason it is not necessary to jack up the casing while pouring and during the initial solidification of the material. Usually heretofore the casing has been supported on a mold top by wedges or bars which have been withdrawn during the solidification of the ingot, but this I find to be unnecessary and therefore considerable time and labor is saved.

I have stated that I may employ some combustible organic material, such as matter resulting from the natural carbonization of vegetable matter. I may use coke screenings or dust obtained as a by-product in the manufacture of commercial coke or what is known as coke breeze or the rejected pieces of coke of small size which are not otherwise commercially useful or I may use what is known as culm, which is coal dust slack or refuse from coal. In any case I mix the semi-combustible material with a suitable binder and mold the mixture into the required shape for use. Preferably but not necessarily I apply water-proofing material to the walls of the casing to prevent moisture from being absorbed from the atmosphere.

Inasmuch as large quantities of coke screenings are more or less a waste product at coking and steel plants, I prefer to use such material in the manufacture of shrink head casings and in doing so I mix and blend the screenings with a suitable binder, such as Portland cement blended in the proportions of seven parts by weight of coke to one part by weight of cement. The mixture is moistened and is molded to shape by well known methods and when so molded the casing after the mixture has set and hardened is ready for use or the casing may be covered with water-proofing material for the purposes above mentioned.

In the accompanying drawings:

Figure 1 is a perspective view showing the

upper portion of an ingot mold and a shrink head casing made in accordance with my invention.

Figure 2 shows a vertical section of the ingot mold with the shrink head casing supported thereon, the sections being taken on the line 2—2 of Figure 6.

Figure 3 is a detail view in vertical section of a portion of the shrink head casing, showing how its walls may be treated with water-proofing material, which material may if desired be made to impregnate to a short extent in the casing walls.

Figure 4 shows a vertical section of an ingot mold and casing and indicates how the molten metal rises into the casing during the pouring operation.

Figure 5 is a view similar to Figure 4 and indicates how the ingot draws away from the casing without moving the latter during the shrinkage of the ingot.

Figure 6 is a top plan view of an ingot mold and a shrink head casing made in accordance with my invention resting thereon.

In the drawings a shrink head casing is indicated at A and an ingot mold at B. The particular shape of the casing is not essential. Various shapes may be used, but that illustrated in the drawings is preferred. As shown the casing is of general rectangular form in horizontal cross section. The lower part of the casing is rounded at its four corners as indicated at *a*, thus producing a lower part which is adapted to enter the mold cavity and shoulders *c* which are adapted to rest on the top of the mold and thus support the casing. While I prefer to mold the casing in one integral piece, it may be made in sections. When the mold is of large size, a sectional casing may be found to be preferable.

As before stated, while heretofore shrink head casings have ordinarily been made of refractory material, such as fire clay baked at a high temperature in a special plant generally remote from the steel plant, the casings made in accordance with my invention are made of slowly combustible material and may be made at the steel plant or at a large plant where the material is produced, inasmuch as I employ as a principal ingredient of the casing coke dust or small particles or similar material and combine such coke with a suitable proportion of commercial Portland cement which is readily obtainable.

The screened or sifted coke or coke dust or small particles of coke are mixed and blended with a suitable binder, such as Portland cement, preferably in the proportions of substantially seven parts of coke by dry weight to one part of cement. This blended mixture should be suitably moistened and it may then be molded to the desired shape in molds of any suitable construction. It is not necessary to bake, kiln dry or heat the molded article. It may be air dried without

added heat. This has been done in twenty-four hours with good results. When thus dried, the casing may be used as a shrink head casing for ingot molds in the usual way.

I have found that no other treatment is essential, but I preferably apply water-proofing material to the walls of the casing in order that the latter may not absorb moisture from the atmosphere, because the presence of free moisture in the casing would be apt to produce steam when the casing is in use and this might result in a rupture of the casing or cracking thereof. It would also have a deleterious effect upon the molten metal at the top of the forming ingot.

Any suitable water-proofing material may be employed. I have found that heated liquid coal tar is a suitable water-proofing material when set after cooling to atmospheric temperature and this may be used if desired although many other water-proofing materials would give good results.

Experience has demonstrated that shrink head casings made in the manner hereinbefore described stand up well in service and their cost is relatively small compared with the cost of fire clay casings most generally employed. As before stated the coke material is semi-combustible. Coke contains fully 90% carbon. Fire clay contains no carbon or any substantial amount of combustible material. This quality of combustion I find is a valuable characteristic of coke when used for making shrink head casings.

As shown in Figure 4, the molten metal rises into the casing while the ingot is being formed and this molten metal ignites or causes to slowly burn the inner contacting surface of the casing. I have found that for this reason the heat of the molten metal at the top of the forming ingot is further conserved and the metal remains molten longer than it does when a fire clay or refractory casing is employed. I have also found that by reason of this forced ignition and slow combustion of the inner walls of the casing and the lower edge thereof, the casing is rendered non-adherent to the top of the ingot at any time so that when the ingot shrinks while solidifying it will freely draw away from the casing without imparting material strain thereon so that it is not necessary to employ wedges to jack up the casing during the initial period of the pouring. The casing may be supported directly on the mold top as indicated in Figure 2. By referring to Figure 4 it will be seen that the ingot has an upper shrink head portion *i* within the casing. At the time illustrated in Figure 4, the lower edge of the casing comes in contact with a ledge *y* of the body of the ingot, but as the ingot shrinks and solidifies, it lowers or shrinks away from the casing leaving a vacant space indicated at *z* in Figure 5. This is made possible owing to the fact that the

heat of the ingot within the casing ignites and burns the inner ingot contacting walls of the casing to such an extent that its contained combustible material is made ashy and soft and without cohesive or adhesive formation, and the upper or top portion of the ingot within the casing readily slides downwardly without moving the casing or putting any harmful strain thereon.

It will be observed that the shrink head casing or hot top for ingot molds hereinbefore described involves the use of finely divided carbon in some form integrated, blended, or mixed with a suitable binder. It will also be observed that the invention includes a hot top for a mold formed of coke dust (which contains fully 90% carbon) integrated, blended or mixed with a suitable binder. I heretofore stated that the preferred material is coke and that I may use coke screenings or dust and I wish to claim these features specifically.

I claim as my invention:

A shrink head casing for ingot molds made from a mixture of coke screenings mixed with Portland cement in proportions by weight of about seven parts of coke to one part cement.

In testimony whereof, I have hereunto subscribed my name.

EUGENE L. MESSLER.