Feb. 13, 1940. H. R. BELDING 2,190,393

METHOD OF PRODUCING CAPPED STEEL

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FIG. 1.

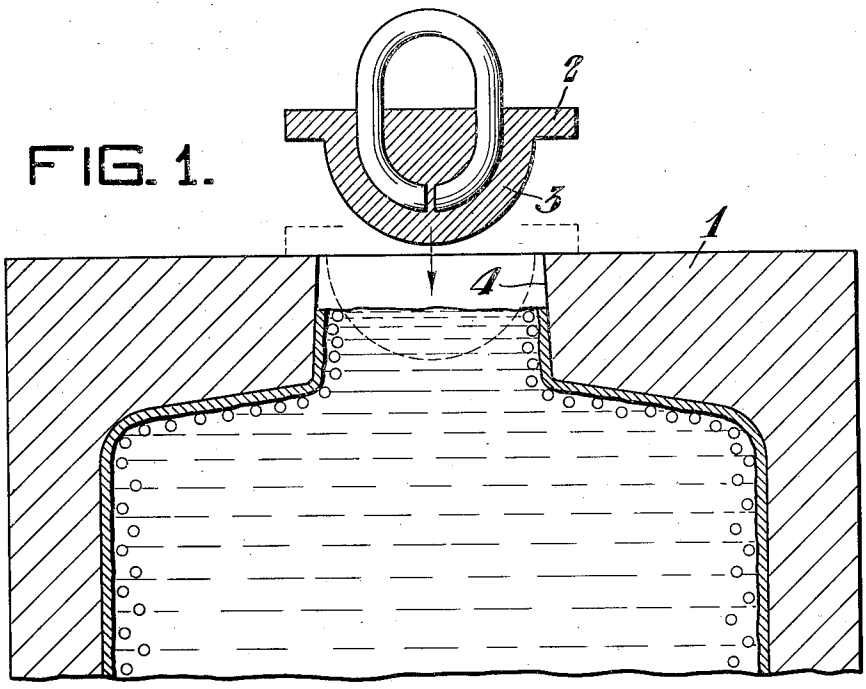
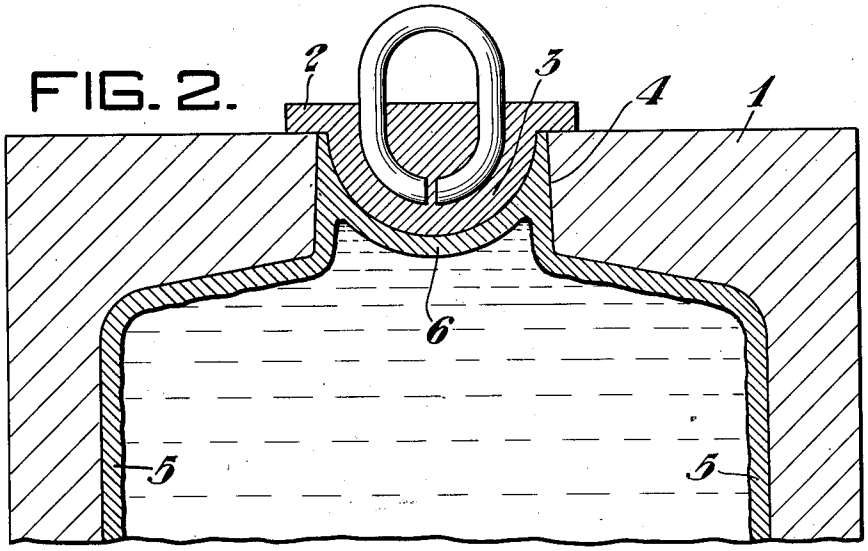


FIG. 2.



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METHOD OF PRODUCING CAPPED STEEL

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4 Claims. (Cl. 22—200)

This invention relates to capped steel, one of the objects being to produce ingots that are the equal of those manufactured by conventional capping practice but which are less apt to be damaged in the soaking pits.

According to the invention, the degree of oxidation of molten steel to be cast in the ingot mold and capped is controlled so that when the steel is cast it neither rises nor falls in the mold any appreciable distance during a time interval at least sufficient to permit capping.

It is to be understood that the steel is not killed. It should be sufficiently oxidized to remain open in the mold whereby it would rim in the absence of capping. Preferably, the degree of oxidation is controlled during the working of the steel in the furnace and by treatment in the ladle, but it is possible, and, in some instances, it may prove necessary to make mold additions for the purpose of adjusting the oxidation of the steel. Thus, aluminum added to the mold will check a falling tendency, while sodium floride will halt undue rising.

This steel is cast, by means of a teeming ladle, for instance, in a suitable ingot mold having an opening in its top exposing the molten metal. A bottle-neck ingot mold is considered most suitable. After casting, the steel, which as previously explained is open, is closed with a cap as soon as possible after casting. It is to be understood that the function of the cap is to contact the molten ingot top and, by its rapid abstraction of heat from the steel, to quickly freeze a crust over the ingot top which prevents further gas evolution and hence mechanically kills the steel so that rimming ceases.

Since the steel does not rise in the mold, it is necessary to cast it to such a level as will permit the cap to dip into the steel. This is contrary to the usual practice of casting a rising steel, positioning the cap and waiting for sealing by reason of the steel eventually rising against the cap bottom. It has the advantage that it permits complete sealing of the ingot top almost immediately after casting. To permit proper dipping of the cap into the steel, a cap having a suitably shaped bottom should be used, that is to say, a cap having a bottom capable of depending into the neck of the bottle-neck mold, provided this type of mold is used.

The advantages involved by the described procedure are, among others, the provision of a thick skin over the blow-holes, thus positively assuring protection for the ingot blow-holes during subsequent heating in the soaking pits and mechanical working; and a noticeable lack of segregation on the part of the metalloids, the metalloid distribution approaching that of a chemically killed ingot.

In some instances it may be desirable to provide a rim thicker than results from the immediate capping described, and, in such instances, the capping may be delayed to provide time for rimming. As soon as the ingot top is sealed by the cap, this rimming stops, there being no danger in any instance of providing an inadequate skin over the blow-holes, provided the degree of oxidation of the steel be such that, when cast, it neither rises nor falls any appreciable distance in the molds. However, metalloid segregation will be noticeable; that is to say, more like a rimmed steel ingot.

For emphasis, it is repeated that, in all cases, the steel here contemplated is of the type which would rim if not capped, but which neither rises nor falls while rimming due to the fact that the gas evolution proceeds at a rate that is neither so rapid as to cause falling due to normal thermal contraction and loss of gaseous constituents, nor so slow as to cause gas entrapment by the steel and subsequent rising of the ingot metal.

When the steel is capped immediately after being cast, high internal gas pressures develop which might conceivably cause rupture of the ingot top and result in a dangerous break-out. This will not occur if the ingot cap is designed to freeze the top of the ingot in the form of a downward spherical crust since the spherical shape is naturally adapted to mechanically withstand fluid pressure.

The accompanying drawing illustrates a cap designed to produce this downward spherical crust, Figure 1 showing the cap ready to be placed over the neck-opening of a bottle-neck mold, and Figure 2 showing the cap in place and the ingot steel capped by a frozen crust.

More specifically, this drawing shows a bottle-neck mold 1 into which oxidized steel has been cast, the cap 2 for capping this steel having a hemispherical metal contacting bottom 3 of at least slightly less diameter than the neck-opening 4 of the mold 1.

The second figure shows the cap in use, the ingot metal being now enclosed by a crust 5 constituting the rim usually associated with the initial freezing of oxidized rimming steel, the top of the ingot being sealed by a crust 6 forming a continuation of the rim.

Due to the cap being of slightly less diameter

than the neck-opening of the mold, and due to the fact that, as illustrated by the first figure, the steel was cast to a level well up ino this neck, the sealing crust 6 encircles the almost perpendicular sides of the hemispherical bottom of the cap and firmly grips the same, due to thermal constriction. This mechanically holds the cap in place and is a substantial aid in the prevention of break-outs, since the cap is held in place so as to support the crust 6. Furthermore, this sealing crust is hemispherical in form due to the fact that it is frozen to form by the hemispherical bottom of the cap. Therefore, as the gas pressure builds up in the steel in the mold, it is resisted by a hemisphere of solidified metal which, due to its form, is structurally strong, so that there is little tendency of this crust 6 to rupture.

In some instances, it may not be necessary to use a hemispherical bottom. Thus, the principle of greater resistance to rupture may be incorporated in a cap having a rounded bottom that is not a truly hemispherical shape but is only an approximation of the same.

I claim:

1. A method of producing a steel ingot, including casting an effervescing steel into an ingot mold, the steel being oxidized to a degree preventing it from appreciably rising or falling in the mold after its casting, the efferverscing of the steel being controlled by dipping a heat absorbing body into the top level of the steel while this top level is molten throughout, the body providing a space between it and the inside of the mold and displacing the molten steel into this space to form a ridge of sufficient thinness to freeze substantially immediately so as to effect complete stoppage of the effervescing of the steel.

2. A method of producing a steel ingot, including casting an effervescing steel into an ingot mold, the steel being oxidized to a degree preventing it from appreciably rising or falling in the mold after its casting, the effervescing of the steel being controlled by dipping a heat absorbing body into the top level of the steel, the body providing a space between it and the inside of the mold and displacing the molten steel into this space to form a ridge of sufficient thinness to freeze substantially immediately so as to effect complete stoppage of the effervescing of the steel.

3. A method of producing a steel ingot, including casting an effervescing steel into an ingot mold, the steel being oxidized to a degree preventing it from appreciably rising or falling in the mold after its casting, the effervescing of the steel being controlled by dipping a heat absorbing body into the top level of the steel, the body providing a space between it and the inside of the mold and displacing the molten steel into this space to form a ridge of sufficient thinness to freeze substantially immediately so as to effect complete stoppage of the effervescing of the steel, the steel contacting portion of the body being shaped to freeze a downward, substantially spherical crust on the steel filling the space within the ridge.

4. A method of producing a steel ingot, including casting an effervescing steel into an ingot mold, the steel being oxidized to a degree preventing it from appreciably rising or falling in the mold after its casting, the effervescing of the steel being mechanically halted practically immediately after its casting by freezing a gas tight crust on the top level of the steel in the mold, this freezing being initiated at a time when this top level is molten practically throughout.

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