J. A. BRINELL.

METHOD OF TREATING STEEL AND IRON INGOTS.

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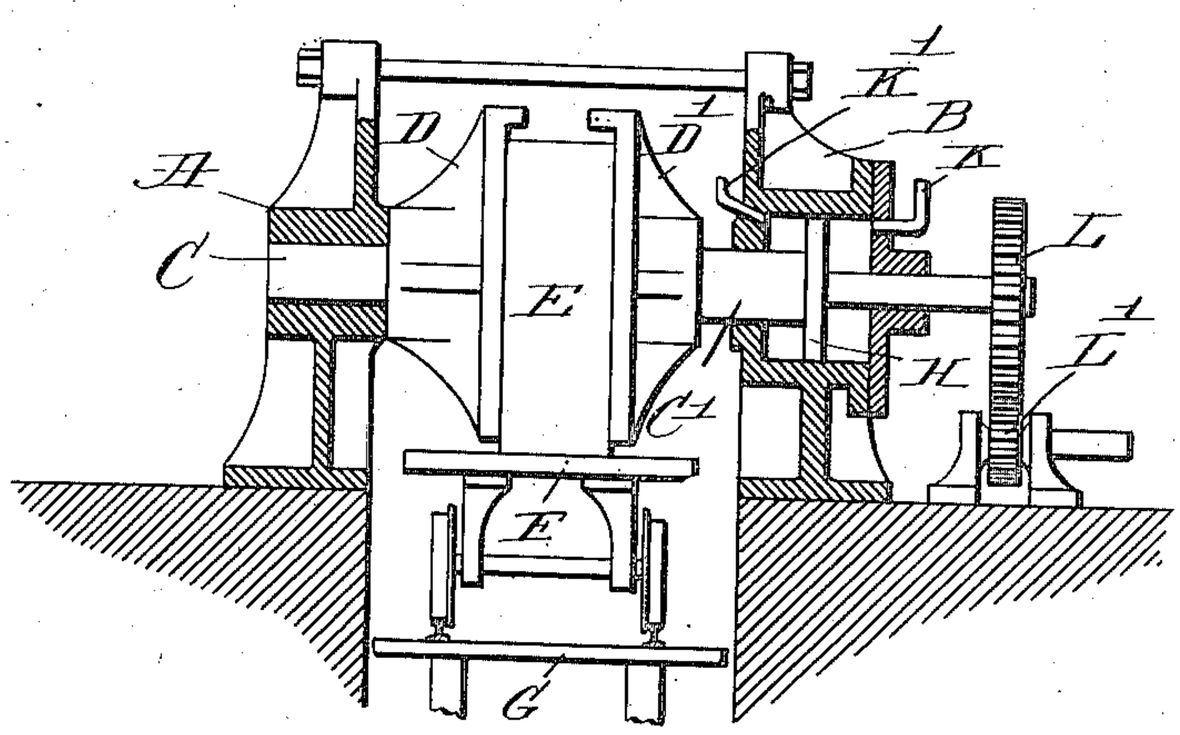

Witnesses:
Joseph M. Ward.
Fred. S. Grunbaf.

Inventor.
Johan August Brinell,
by Lemley & Gregory
Atty's

UNITED STATES PATENT OFFICE.

JOHAN AUGUST BRINELL, OF STOCKHOLM, SWEDEN.

METHOD OF TREATING STEEL AND IRON INGOTS.

976,145. Specification of Letters Patent. Patented Nov. 22, 1910.

Application filed January 10, 1908. Serial No. 410,119.

To all whom it may concern:

Be it known that I, JOHAN AUGUST BRINELL, a subject of the King of Sweden, and resident of Blasieholmsgaten 3, Stockholm, in the Kingdom of Sweden, have invented certain new and useful improvements in the method of treating steel and iron ingots to diminish the segregation therein and the injurious action of the pipe, of which the following is a specification.

During the setting of the metal in steel and iron ingots in the mold or chill, two phenomena appear, namely, the formation of hollows, blow holes and pipes, and segregation.

When the liquid mass of metal is cooled in the mold, the exterior layers thereof are the first to become set, and when the inner portions of the ingot cool and contract, they are unable to fill the entire space inclosed by the exterior layers which have first become set, and by reason of this fact, a hollow, called the pipe, is formed at the upper end of the ingot. If now, as is often the case, communication be established between the atmospheric air and the inner part of the pipe during the setting of the interior metal, the walls of the pipe are coated with scale and the welding of the pipe in the subsequent working of the ingot will be practically impossible.

Even if the admission of air to the pipe be prevented, subsequent welding will often be more or less incomplete, especially if the steel contains sulfur, as an impurity, because it will diminish the welding capacity of the steel to a great degree. Consequently, the more free from sulfur those parts of the steel in which the pipe is formed, the greater is the possibility of welding the same together during the subsequent working of the ingot, so that the presence of sulfur is made substantially harmless if it be disseminated through the metal. Even other bodies, such as manganese, carbon and silicon will act in the same way as the sulfur to diminish the welding capability of the metal, though in a less degree.

The other phenomenon above referred to which appears during the cooling of steel ingots is termed segregation. That is to say, the separation, especially of carbon, sulfur, phosphorus and manganese, which bodies or substances are lighter than the steel, and therefore tend to rise to the surface and gather in the upper portions of the interior of the ingot. The quality of such segregated bodies in the upper portions of the ingot is often as much as one and a half times as great as the quantity of such bodies or substances in other parts of the ingot. Those portions of a steel ingot which first become set, to wit: the external portions thereof which are nearest the mold or chill, have a composition which is most analogous to that of the liquid steel. In the inner portions of the ingot which set more slowly, the segregating bodies have time enough to rise toward the upper end of the ingot, from which it follows that the lower portion of the ingot will be more free from, and the upper portion more rich in these segregative bodies.

My present invention has for its object the production of a method for treating ingots whereby a more homogeneous composition of the steel or iron in the inner part thereof may be obtained, and in accordance with my invention, I secure the desired results by slowly turning or revolving the ingot during the cooling a sufficient number of times, either continuously or intermittingly, to prevent segregation or to equalize and distribute throughout the mass of the ingot any bodies or substances which may have segregated to a greater or less extent.

In practice the turning of the ingot should be performed in such manner that the bodies therein which have been segregated will be caused to move from the upper to the lower portions of the mass of metal which are still liquid, as the turning reverses the ingot. By continuing or maintaining the rotative movement of the ingot, the tendency of such bodies as have been named to rise toward the upper portion of the metal is overcome or counteracted to such an extent that a mechanical mixing or distribution is effected by the turning movement to cause an equalization and substantially thorough mixture of the pure and impure bodies of the metal, whereby the segregation is so diminished that those portions of the ingot in which the pipe is formed will consist of a much better metal than heretofore, the segregative bodies or substances being distributed throughout the length of the ingot with very considerable uniformity, so that during subsequent working of the ingot, the welding of the pipe portion thereof will be greatly facilitated.

Inasmuch as the pipe always tends to form

close beneath the upper set portion of an ingot, it will extend more or less along the longitudinal axis of the ingot if the latter be slowly turned while its longitudinal axis occupies a horizontal position and maintains such position until the ingot has become set throughout.

By slowly turning or revolving the ingot a number of times in a vertical plane while the inner portions of the ingot are still liquid, the pipe can be located at any desired part of the ingot while the substances or bodies tending to segregate will be distributed along the ingot.

The revolving or turning of the ingot must be carried on at such a slow rate that no centrifugal force will be generated as it will be manifest that such centrifugal action would prevent the proper distribution of the segregative bodies.

Heretofore in the treatment of ingots, the mold filled with the steel is left to cool, covered or uncovered at its upper end until the pipe has formed. As the upper surface of the ingot becomes set more slowly than other parts of the same, the communication between the atmospheric air and the pipe heretofore referred to is often established and the walls of the pipe become oxidized.

As the lower part of the ingot is surrounded by metal which has become set, it will be understood that if the ingot is then turned so that, for instance, the lower end is uppermost the pipe formed will be without any communication with the air. If now, during the later stage of the cooling the ingot is turned back to the original position occupied during the casting operation, a layer of said steel impermeable to air has also been formed at the end which was turned upward during the casting, but this process differs materially from my method of treatment herein set forth as will be apparent.

So far as the diminution of segregation is concerned the revolving of the ingot will be effective even after the steel has become set sufficiently to permit the ingot to be removed bodily from the mold, and accordingly, my present invention is not limited to the bodily turning or rotating of the ingot end for end when the latter is still in the mold, but it also comprehends such treatment when the ingot has been removed from the mold.

The time for rotating the ingot as well as the number of rotations required will depend on the dimensions of the ingot as well as on other circumstances, and the duration of rotation must be to a large extent ascertained by experiments for ingots of different dimensions.

The means for carrying out my invention may be of any suitable character, and in the accompanying drawing I have shown one form of apparatus adapted for practicing my invention.

The drawing represents in front elevation and partial section an apparatus for treating ingots in accordance with my invention.

Referring to the drawing, A, B are two uprights which provide suitable bearings for alined and horizontal shafts C, C′ rotatably mounted in the bearings, said shafts having rigidly attached to their inner ends opposed heads or holding members D, D′.

A piston H rigidly attached to the shaft C′ is movable in a cylinder formed in one of the uprights as B, said cylinder being provided with suitable conduits K, K′ for the supply of a suitable pressure producing medium, such, for instance, as water. Gearing L, L′ is arranged to rotate the shaft C′ from any suitable source of power, not shown. The faces of the gears in practice are of sufficient width to remain in meshing engagement when gear L is moved axially by the inward or outward movement of piston H.

In using the apparatus the ingot after its removal from the mold or before such removal, as may be most desirable, is placed upon a suitable carriage F, by which it is brought between the opposed heads or holding members D, D′ and fluid is then supplied to the cylinder by means of the conduit K, to move the piston H to the left so that the ingot whether in the mold or out of it, and indicated at E, is subjected to sufficient pressure only to be held in position between the members D, D′. The carriage F is then lowered out of the way by means of a suitable elevator G, and the shafts C, C′ are rotated slowly by or through the gearing illustrated so that the ingot held between the heads D, D′ is turned or rotated bodily end for end about a substantially horizontal axis, which in the apparatus herein shown, passes through or intersects the ingot at right angles to its longitudinal axis. It will be understood, however, that during the slow rotation of the ingot so that first one and then the other end thereof is turned uppermost, said ingot will not be subjected to any more pressure than is sufficient to hold it in place between the heads D, D′. As the slow rotation proceeds with a complete reversing or changing of the ingot end for end, those bodies in the metal which tend to segregate are thereby distributed throughout the mass of more or less liquid metal in the interior of the ingot from one to the other end thereof in such a manner that the segregation of such bodies in any one part of the ingot is prevented.

The rotative movement is maintained during the setting of the interior metal for such a period as may be best determined by observation and experiment, according to the dimensions of the ingot, and in view of

other circumstances, which might have a qualifying effect upon the process.

I make no claim herein to the particular form of apparatus for carrying out my invention, as various forms of apparatus may be devised for the purpose.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. The herein described method of treating steel or iron ingots to diminish segregation and the injurious action of the pipe formed therein, which consists in slowly rotating the ingot end for end a sufficient number of times during the setting of the metal to maintain the segregative bodies distributed with substantial uniformity throughout the length of the ingot.

2. The herein described method of treating steel or iron ingots to diminish segregation and the injurious action of the pipe formed therein, which consists in slowly rotating the ingot end for end, about an axis at right angles to its length and maintaining such rotative movement during the setting of the metal, to cause the segregative bodies to be distributed with substantial uniformity throughout the length of the ingot.

3. The herein described method of treating steel or iron ingots to diminish segregation and the injurious action of the pipe formed therein, which consists in slowly rotating the ingot while in the mold about a substantially horizontal axis intersecting the ingot transversely and maintaining such rotative movement for a sufficient period during the setting of the metal to cause a distribution of the segregative bodies along the ingot.

4. The herein described method of treating steel or iron ingots to diminish segregation and the injurious action of the pipe formed therein, which consists in slowly rotating the ingot about a substantially horizontal axis at right angles to its length and maintaining such rotative movement continuously during the setting of the metal for a sufficient period to effect the distribution of the segregative bodies along the length of the ingot.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

JOHAN AUGUST BRINELL.

Witnesses:

AXEL EHRNER,

HJALMAR ZETTERSTROM.