J. A. BRINELL.

METHOD OF TREATING METAL INGOTS.

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976,146.

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Fig. 1.

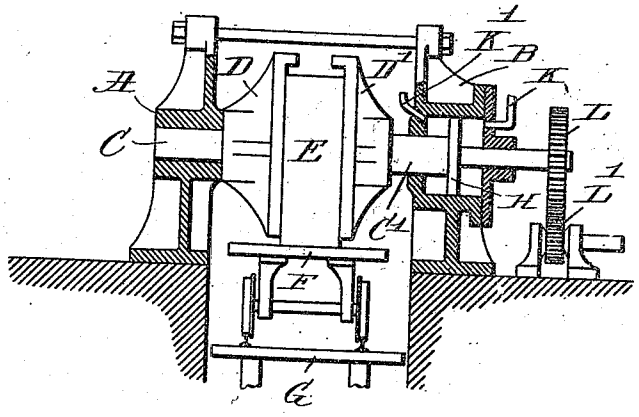


Fig. 2.

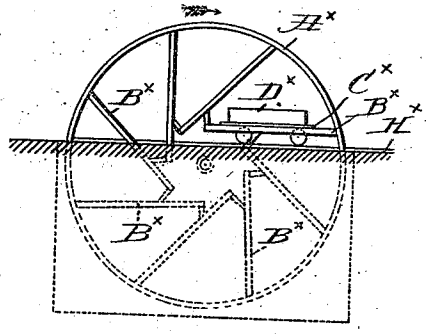


Fig. 3.

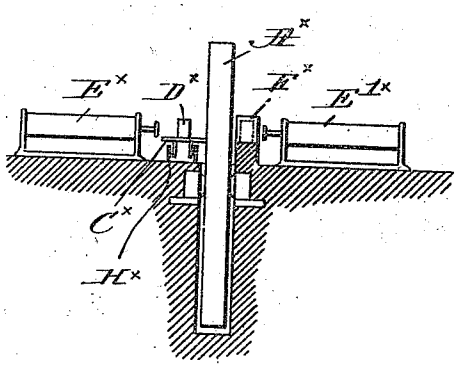
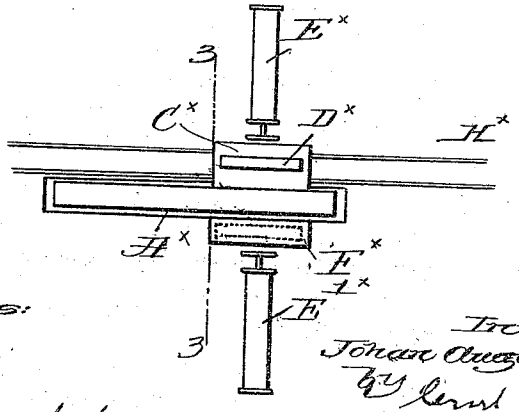


Fig. 4.



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UNITED STATES PATENT OFFICE.

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METHOD OF TREATING METAL INGOTS.

976,146. Specification of Letters Patent. Patented Nov. 22, 1910.

Application filed January 10, 1908. Serial No. 410,120.

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 Metal Ingots to Prevent Segregation and the Formation of Hollows Therein, of which the following is a specification.

After a metal ingot has been cast and during the cooling thereof the metal as it sets is found very frequently to form a hollow, technically termed a pipe, and blow holes are also formed, either or both, all such defects injuring the ingot as is well known to those skilled in the art. In the manufacture of steel and iron, means have been heretofore proposed for regulating the formation of pipes and blow holes, but with the result that a diminution in the bubbles results in an increase in the pipe and vice versa, such means consisting in giving to the metal to be cast a suitable chemical composition, regulating the temperature of casting, etc. In order to produce metal ingots free from pipes and blow holes, either or both, an external compression of the ingot must be effected in order to diminish its volume to the extent of the volume of the pipe and blow holes. Prior to the setting of the metal in the interior of the ingot, another phenomenon frequently appears and which has an injurious action on the homogeneity of the metal, this being the so-called segregation or rising of certain substances in the metal to the upper part of the metal in the ingot remaining liquid. The substances which generally segregate in iron ingots are sulfur, manganese, carbon, phosphorus and other substances. By reason of the segregation, such substances are collected in greater quantity in the upper part of the ingot, in the part where the formation of the pipe occurs and the welding action of the metal forming the walls of the pipe is diminished. Such imperfectly welded portions in the interior of the ingot will diminish very materially the solidity and strength of the objects subsequently made from the ingot, more particularly as it is extremely difficult to discover the before mentioned defects during subsequent manufacturing processes.

In order to prevent segregation and the injurious results due thereto, I turn the ingot slowly, and bodily, during the setting of the metal thereof, either continuously or intermittingly, in order to either prevent altogether the segregation hereinbefore referred to or to so distribute the segregating action within the metal that the metal of the ingot when set will be substantially homogeneous and uniform in composition.

My present invention, therefore, has for its object the production of a novel method of treating metal ingots to prevent segregation and the formation of hollows in the ingot, whereby the injurious effects due to segregation and the formation of pipes or hollows is eliminated.

The means for effecting the bodily turning movement and compression of the ingot during the setting of the metal thereof after removal of the ingot from the mold may be of any suitable character, and herein I have shown apparatus adapted for carrying out my invention.

Figure 1 is a front elevation and partial section of an apparatus adapted for treating ingots in accordance with my present invention; Fig. 2 is a side elevation of a portion of a modified form of apparatus for treating the ingots; Fig. 3 is a vertical sectional view on the line 3—3, of Fig. 4, looking toward the right, the wheel, however, being shown in elevation; Fig. 4 is a top plan view of the modified form of apparatus.

Referring to Fig. 1, A, B, are two uprights which provide suitable bearings for alined shafts C, C′ rotatably mounted in the bearings, said shafts having rigidly attached to their inner ends opposed press plates or pressure 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, and said cylinder is provided with suitable conduits K, K′ for the supply of a suitable pressure producing medium, as for instance water. The shaft C′ has rigidly attached to its outer end a gear L meshing with another gear L′, the latter being driven from any suitable source of power, not shown.

In carrying out my invention by the aid of the apparatus shown in Fig. 1, after the ingot has been cast in the usual mold or chill, and has cooled sufficiently to permit its removal, said ingot is removed from its mold or chill and placed upon a suitable carriage F by which it is brought between the

pressure producing members D, D′, the latter being separated to admit the ingot between them. Fluid is then supplied to the cylinder by means of a conduit K to move the piston H by high pressure to the left, viewing Fig. 1, and the ingot E is subjected to external pressure between the press plates or members D, D′. The toothed faces of the gears L, L′, either or both, are in practice made of such width that upon the relatively slight axial movement of the gear L, when the piston H is moved in or out, the teeth of the gears will still remain in meshing engagement. The carriage F which was previously run onto a hydraulic or other elevator G is then lowered out of the way, and the shafts C, C′ and the pressure members D, D′ with the interposed ingot E are slowly revolved by or through the gearing, so that the ingot is turned bodily end for end about a substantially horizontal axis, and in the appartus shown in Fig. 1, the axis about which the ingot is turned passes through such ingot. During the turning movement of the ingot, it is subjected to external pressure, as will be manifest, and the turning and compression are maintained during the setting of the metal in the interior of the ingot. As the metal sets and shrinks, the pressure to which the ingot is subjected causes the metal to be compacted and thereby prevents either the formation of pipe or blow holes, and at the same time the slow and bodily turning movement of the ingot prevents the segregation of the substances in any one part of the ingot. In other words, such particles or substances as would tend normally to segregate are disposed throughout the body of the ingot so that the metal is substantially uniform and homogeneous in its composition.

The modified form of apparatus shown in Figs. 2–4 comprises a vertical open wheel or carrier A^x provided on its interior with a series of non-radial shelves B^x, adapted to receive the ingot. A carriage C^x is mounted to travel on rails H^x running adjacent the shelved side of wheel A^x, to carry the ingot D^x thereto from the casting pit. On opposite sides of the wheel are arranged suitable hydraulic or other pushing devices E^x, E'^x, the former serving to push an ingot from the carriage into the wheel and onto a shelf, while the device E'^x serves to push the ingot in the opposite direction. F^x, Figs. 3 and 4, indicates a suitable hydraulic press of any suitable character. The wheel A^x is turned to bring one of the shelves B^x into horizontal position and the carriage is moved into position adjacent thereto, whereupon the ingot D^x is moved from the carriage to the shelf by means of the pushing device E^x. The wheel A^x is now revolved for a suitable period and the ingot will be carried around therewith and will be turned end for end and more or less moved about, and finally the wheel is stopped with the shelf horizontal on which the ingot rests. Said ingot is then moved by the device E^x into the hydraulic press F^x where it is subjected to pressure and then it is returned to the wheel by the device E'^x, and again subjected to the turning movement, and then again subjected to pressure. When such alternate turning and pressing is completed the ingot is returned to the carriage C^x by the device E'^x and removed. In practice a number of ingots will be treated simultaneously, one shelf after another being loaded and each ingot must make at least one complete revolution with the wheel before it is removed to the press F^x.

It will be observed that by the apparatus illustrated in Fig. 1 the ingot can be subjected to compression simultaneously with the slow bodily turning movement of the ingot, or it may be subjected to the pressure at intervals alternating with the turning. That is, the press plates D, D′ may be set up sufficiently to grasp the ingot with sufficient force to hold it and the pressure increased at intervals, or the pressure may be gradually increased simultaneously with the bodily turning, which is about an axis which intersects the ingot. On the other hand, in the apparatus illustrated in Figs. 2, 3 and 4 the turning of the ingot and the compression thereof must be alternated, and the ingot is turned bodily about an axis external thereto but at right angles to its own longitudinal axis, as will be manifest.

Whichever apparatus be employed to carry out my invention it will be understood that the turning of the ingot is at a slow rate of speed, so that there is no centrifugal action present, as such centrifugal action would be objectionable and would nullify in large part one of the features of my invention, to wit, the uniform distribution of the various substances or components of the metal throughout the same as it sets.

Whatever the particular character of the apparatus employed for carrying out my process of treatment it must be so arranged that the ingot, during the setting of the metal, can be subjected to a high pressure externally applied, for preventing the formation of a pipe or hollow, and also turned slowly to counteract or prevent segregation.

The compression and bodily turning of the ingot can be carried on simultaneously or in alternation, and continuously or intermittingly, as may be desired.

It may be noted in regard to the apparatus illustrated in Figs. 2, 3 and 4 that by omitting the hydraulic press F^x the ingot can be compressed while in the wheel A^x, for it is then only necessary to move the piston-plungers of the pressure devices E^x, E'^x against opposite sides of an ingot while on

a shelf B× horizontally positioned between such devices.

I make no claim herein to the particular form of apparatus for carrying out my novel method of treating ingots, as the apparatus may be constructed in various forms, as will be obvious.

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 metal ingots to prevent segregation and the formation of hollows therein, which consists in slowly turning the ingot about an axis at right angles to its length and subjecting it to pressure during the setting of the metal of which the ingot is composed.

2. The herein-described method of treating metal ingots to prevent segregation and the formation of hollows therein, which consists in slowly turning the ingot bodily end for end and subjecting it to external pressure during the setting of the metal composing the ingot.

3. The herein-described method of treating metal ingots to prevent segregation and the formation of hollows, which consists in casting the ingot; removing it from the mold and turning it bodily and slowly as the metal in the interior of the ingot is setting, and subjecting the ingot to external pressure during the setting of the metal.

4. The herein-described method of treating metal ingots to prevent segregation and the formation of hollows, which consists in casting the ingot, removing it from the mold and turning it slowly and bodily and compressing it between press plates during the setting of the metal composing the ingot.

5. The herein-described method of treating metal ingots to prevent segregation and the formation of hollows, which consists in removing the cast ingot from the mold, turning the ingot bodily about a horizontal axis and subjecting it to external pressure during the setting of the metal.

6. The herein-described method of treating metal ingots to prevent segregation and the formation of hollows, which consists in removing the cast ingot from the mold and subjecting it to external pressure and simultaneously turning the ingot bodily end for end during the setting of the metal.

7. The herein-described method of treating metal ingots to prevent segregation and the formation of hollows, which consists in subjecting the ingot to compression between press plates and slowly turning the ingot end for end, such compression and turning of the ingot being effected after the ingot has been taken from the mold and while the metal is setting.

8. The herein-described method of treating metal ingots to prevent segregation and the formation of hollows, which consists in subjecting the ingot, after removal from the mold, to the combined action of external pressure and a slow bodily turning movement continued during the setting of the metal in the interior of the ingot.

9. The herein-described method of treating metal ingots to prevent segregation and the formation of hollows, which consists in removing the ingot from the mold and suspending and compressing it between opposed pressure members, and rotating said pressure members and the interposed ingot slowly about a substantially horizontal axis during the setting of the metal in the interior of the ingot.

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

JOHAN AUGUST BRINELL.

Witnesses:
HJALMAR ZETTERSTROM,
AXEL EHRNER.