July 31, 1923. **1,463,228**

A. SAUVEUR

METHOD OF MANUFACTURING WROUGHT IRON

Filed Jan. 31, 1922

Fig. 1.

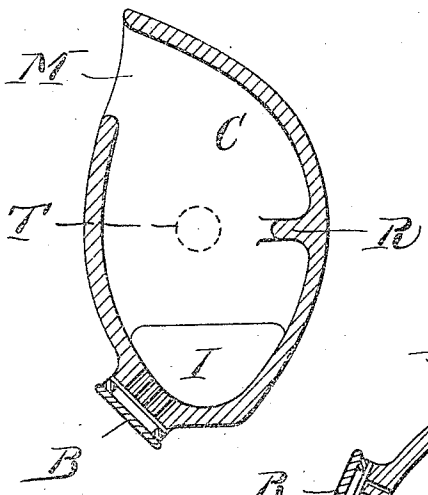


Fig. 2.

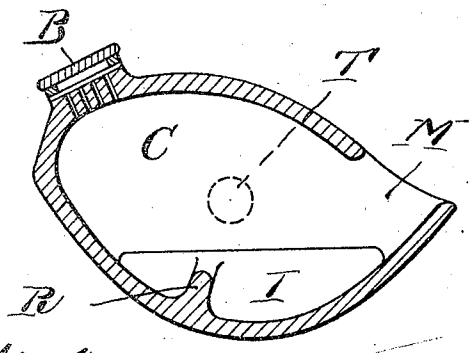


Fig. 3.

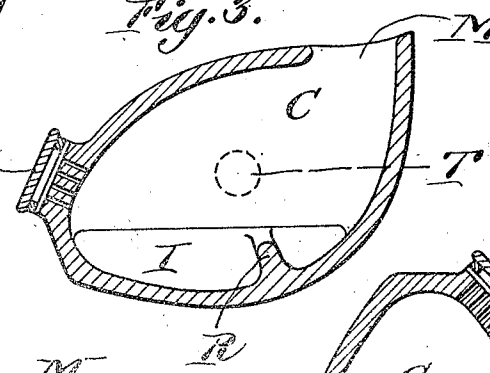


Fig. 5.

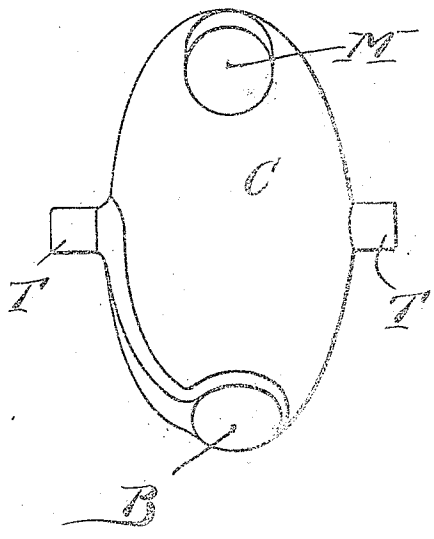
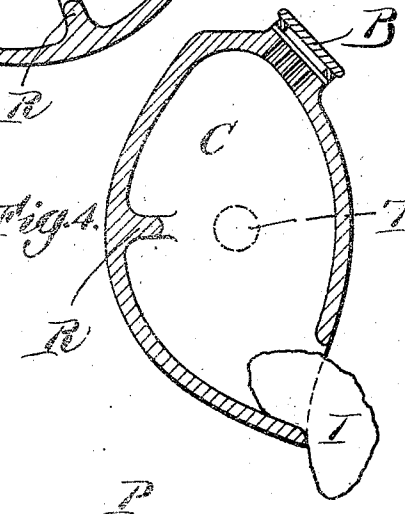


Fig. 4.



P

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UNITED STATES PATENT OFFICE.

ALBERT SAUVEUR, OF CAMBRIDGE, MASSACHUSETTS.

METHOD OF MANUFACTURING WROUGHT IRON.

Application filed January 31, 1922. Serial No. 532,937.

To all whom it may concern:

Be it known that I, ALBERT SAUVEUR, a citizen of the United States of America, and resident of Cambridge, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Methods of Manufacturing Wrought Iron, of which the following is a specification.

My invention relates to the manufacture of wrought iron, and consists of an improved process by which wrought iron may be made as an immediate continuation of and supplement to the long-practised Bessemer process of conversion of pig iron into steel. Otherwise characterized, my invention superposes what is essentially the last stage of a puddling process upon the conversion process, without interruption, and preferably both stages of this continued process will be carried out in one apparatus, namely, the converter. In describing the process, there will be described also sundry improvements and modifications of the Bessemer converter which adapt it to the performance of both stages of the process.

While it is substantially correct to say—as above—that the process alluded to makes wrought iron, it is more precisely definitive to say that the product is wrought iron "ball", i. e., the pasty mixture of iron thoroughly and mutually intermingled with an oxidizing material, which may be comprehensively designated as "slag"; which mixture requires working by a squeezer, or hammer, or in rolls in order to complete the product—wrought iron—through consolidation of the metal at a welding heat, elimination of excess slag and further elimination of the residual small percentage of carbon. In its physical and chemical constitution, the product of the herein described process is the same, and responsive to the same treatment, as the "ball" from a puddling furnace.

In the drawings hereto annexed, which illustrate my invention,—

Figure 1 represents, in section, a bottom blown Bessemer converter, characterized by sundry novel modifications to be described, the converter is here shown in its upright position.

Figure 2, represents the same, tilted on its trunnions to an inclined position, but not enough to discharge its contents.

Figure 3, represents the same, tilted in the aspect opposite to that of Figure 2.

Figure 4, represents the same, completely inverted to discharge its contents, and

Figure 5, represents the converter in side elevation.

The converter is an ellipsoidal vessel C, in general proportions and contour not unlike the Bessemer converters generally used. In the manufacture of wrought iron "ball", the size of the apparatus should be such that the ball delivered may be of practicably wieldy proportions. Its discharge opening M should, by preference, be relatively larger than in the usual case, and be placed somewhat further to one side, from the longer axis of the vessel. The wind-box B and tuyères connected therewith, is located to one side, and on the same side of the longer axis as the discharge opening M. The known type of side-blown converter can be advantageously employed. On the other side of the converter vessel, projecting into its interior, about midway between the tuyères and the discharge opening, there is provided a weir R. The proportions and location of this weir are subject to variations within practicable limits, the essential point being, that when the converter is tilted so that its longer axis approaches the horizontal, the weir shall lie across the then lower side of the converter, so as to constitute an obstacle to the flow of liquid material from one end of the converter toward the other.

Such an apparatus as is above briefly described will be found adapted to the performance of my new process. Molten pig iron is charged into the converter in the usual manner, the air blast turned on, and the converter swung to its upright position as indicated in Fig. 1. Here the charge of molten pig iron is designated at I. The reduction of its carbon content and other nonferrous elements proceeds in the manner characteristic of Bessemer action. If it be considered advisable, the air blast may be moderated so as to avoid objection of slag and oxide formed during the oxidation, for the reason that retention of this material is essential to, or at least beneficial in, the final stages of the continuous process. The preliminary object is, to produce a low-carbon steel by Bessemer action, while retaining in the converter and mixed with the iron, the material which may comprehensively be termed "slag", and which contributes to decarbonization of iron, under suitable atmos-

pheric conditions, by transferring oxygen from the air to the iron with which it is mixed. Particularly with respect to the second stage of my process, presently to be described, a proportion of such slag suitable to the development of wrought iron "ball", thoroughly distributed through the iron, is required. The amount of slag requisite may be produced in the converter as an incident to the Bessemer action; it may, however, be wasteful to protract the Bessemer action, at the expense of iron, until the requisite proportion of slag is produced, and therefore, the process may be enhanced economically by introducing slag, or other suitable oxidizing substance of any desired composition, into the converter at any stage consistent with the fusion of such introduced material, preferably after the Bessemer action.

A mild steel, mixed with slag, having thus been prepared in the converter the converter is swung toward a horizontal position, so as to uncover the tuyères. The blast of air through the charge then ceases, and with this the further generation of heat ceases, and the charge begins to cool. The converter, now functioning as a mechanical puddling furnace, is rocked back and forth on its trunnions T, from the position shown in Fig. 2, to that shown in Fig. 3, and vice versa; causing the mixture of mild steel and slag to cascade back and forth over the weir R. The importance of beginning this rocking motion and cascade action immediately after the air blast ceases to play through and keep stirred the charge of mixed components, characterized by very discrepant specific gravities, and of continuing the intermixture by sustained cascade-action, will be obvious when the final object of the process is kept in view, viz: the production of a pasty wrought-iron "ball" through which slag is uniformly distributed. As the charge in the converter-vessel cools, it becomes pasty, and when it has been thus worked as long as is necessary or considered advisable, the converter vessel is inverted, as in Fig. 4, over a traveling table P, or other carrying device; which conveys the "ball" to the squeezer, hammer, press or rolls where it is finally worked into wrought iron in the usual manner.

Since it is not permissible to allow molten metal to enter the tuyères of a converter, the wind-box and tuyères may with advantage be placed at one side of the longer axis of the apparatus. Thereby, also, a greater available cubic capacity for working the metal during the cascade-agitation stage of the process, will be provided. In the side-blown converter the wind-box and tuyères are placed at one side, and because of this feature it is well adapted to the conduct of my process. Side-blown converters being moreover of smaller capacity than the usual bottom-blown converters may be preferred to bottom-blown converters owing to the mechanical difficulties of working the very large ball which the latter would supply. Maintenance of the air blast (whatever the position of the tuyères), will guard against entrance of iron to the tuyères, and the blast may be continued for this precautionary purpose, even though the tuyères be located at one side, and thus above the general level of the charge while the converter is being rocked in the manner herein described. This maintenance of the air blast will obviously be unnecessary when a side-blown vessel is used. Among the economies and advantages believed to inhere in the above described process are: that time, labor, and heat are conserved by making the transition from pig iron to wrought iron continuous and uninterrupted, and by applying to the manufacture of wrought iron the most rapid method of refining and decarbonization known, namely, the Bessemer process.

What I claim and desire to secure by Letters Patent is:

1. The method of manufacturing wrought-iron ball, characterized by the following operations: reducing the carbon content of molten pig iron to a low percentage by Bessemer action, retaining slag and iron oxide produced by said action, in the decarbonized iron; lowering the temperature of the mixture of decarbonized iron and slag, while subjecting it to continued cascade agitation and thereby maintaining mutual distribution of the said components.

2. The method of manufacturing wrought-iron ball, characterized by the following operations: reducing the carbon content of molten pig iron to a low percentage by Bessemer action, retaining slag and iron oxide produced by said action, in the decarbonized iron and adding oxidizing material to the mixture; lowering the temperature of the mixture of decarbonized iron and slag, while subjecting it to continued cascade agitation and thereby maintaining mutual distribution of the said components.

Signed by me at Boston, Massachusetts, this twenty-third day of January, 1922.

ALBERT SAUVEUR.