No. 744,034. PATENTED NOV. 17, 1903.

W. B. BROOKFIELD.

MANUFACTURING STEEL.

APPLICATION FILED JULY 20, 1903.

NO MODEL.

Fig. 1.

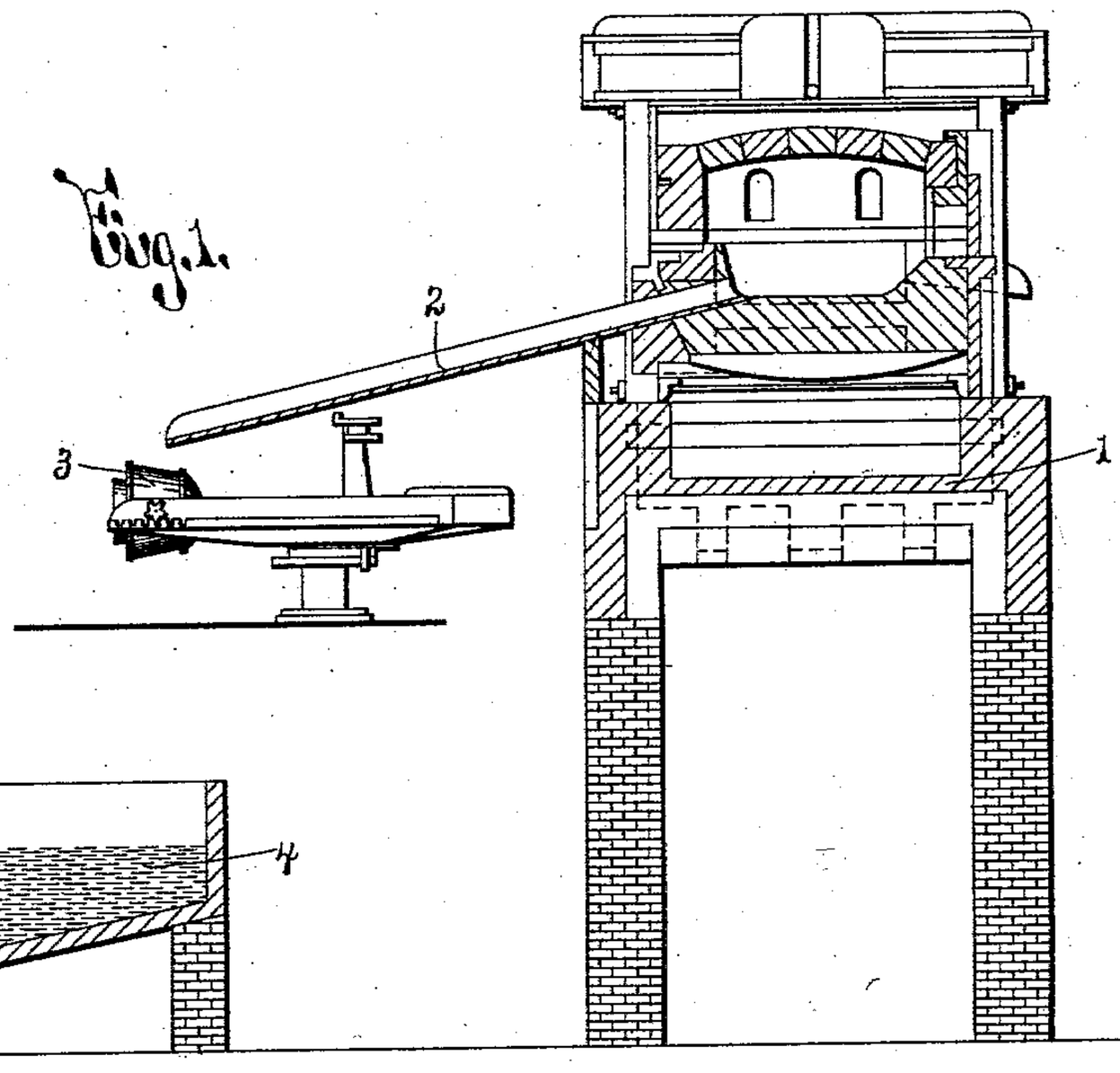


Fig. 3.

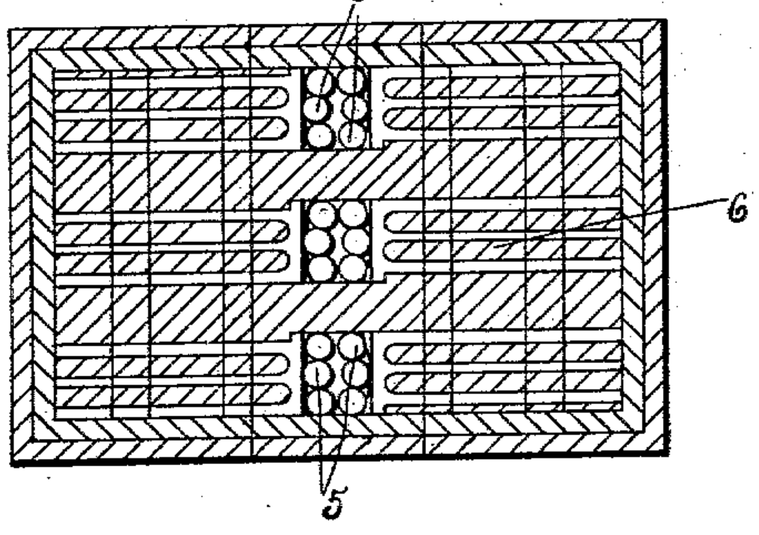
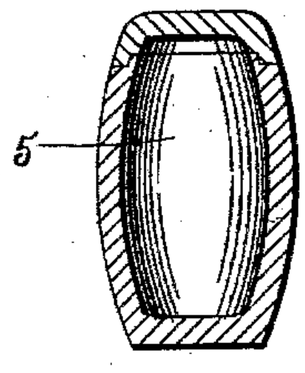


Fig. 2.



WITNESSES:

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No. 744,034. Patented November 17, 1903.

UNITED STATES PATENT OFFICE.

WILLIAM BERTIN BROOKFIELD, OF SYRACUSE, NEW YORK.

MANUFACTURING STEEL.

SPECIFICATION forming part of Letters Patent No. 744,034, dated November 17, 1903.

Application filed July 20, 1903. Serial No. 166,262. (No specimens.)

To all whom it may concern:

Be it known that I, WILLIAM BERTIN BROOKFIELD, of Syracuse, in the county of Onondaga and State of New York, have invented a certain new and useful Process of Manufacturing Steel, of which the following is a specification.

This invention has for its object a process of producing steel known commercially as "crucible-steel" which is particularly practical and causes the product to be especially uniform in hardness and character; and to this end the invention consists in the manner of treatment hereinafter specifically pointed out and claimed.

In describing this invention reference is had to the accompanying drawings, in which like characters refer to corresponding parts in all the views.

Figure 1 is a sectional view, partly in elevation, of the greater portion of one form of apparatus for carrying out my process. Figs. 2 and 3 are sectional views, respectively, of one of the crucibles and a crucible-furnace forming part of said apparatus.

Crucible-steel is produced in a plurality of crucibles of relatively small capacity, for the reason that it has not heretofore been possible to manufacture this steel in bulk, owing to the mechanical difficulties experienced in forming the same into finished bars or plates.

In the commercial manufacture of crucible-steel the component ingredients are inserted into the respective crucibles and are subsequently fused, and the fused mixtures are cast into ingots, which are rolled or otherwise manipulated for forming finished bars or plates. Owing to the insertion of the ingredients composing the steel into a number of different crucibles of relatively small capacity there is obviously more or less variation in the character of the steel produced from the mixtures fused in the respective crucibles. One of the ingredients inserted into the crucibles for forming steel in this manner is molybdenum, and as is obvious to those skilled in the art the molybdenum raises the fusing-point of the mixtures, does not uniformly unite with the iron, and unites to a greater or less extent with the carbon of the crucibles, thus rendering the steel product ununiform and materially lessening the lifetime of said crucibles.

By my invention crucible-steel is produced in a novel manner, as follows: Iron and molybdenum are melted together in bulk in suitable means, as an "open-hearth" furnace 1, Fig. 1, and are thus refined, mixed, and united to a maximum degree. I usually first fuse the iron in the furnace 1 and then add the molybdenum and subject the entire mass to heat in said furnace until the metals are thoroughly mixed together. The molybdenum may be reduced to a molten condition before its mixture with the iron in the furnace 1, or it may be fused with a quantity of iron composing from one to fifty per cent. of the molten mixture and then added to the fused iron in the furnace 1. Oxidation of the molybdenum may be reduced to a minimum by fusing the molybdenum in a closed vessel before the mixture thereof with the fused iron in the furace 1 or by inclosing the molybdenum in a metallic case, placing the case within the furnace 1 and pouring the molten iron into the furnace upon the case, and thus fusing said case and releasing the molybdenum which mixes with the fused iron.

The iron and molybdenum compound is reduced to a subdivided or fragmentary condition in any desired manner. If the quantity of molybdenum included in the compound is relatively small, the mixture may be run into molds and cast into ingots, and the ingots may be subsequently rolled into bars or plates, which may be cut by shears or other tools while hot. When a greater quantity of molybdenum is used in the compound, the same is not as readily reduced to a subdivided or fragmentary condition, and consequently the subdivision is effected by dropping the mixture any suitable distance—say, from twenty-five to seventy-five feet—into a body of water or other liquid, whereupon the fused mixture separates into substantially spherical bodies of relatively small size, which are readily cooled in the water and easily handled and fused. In the illustrated apparatus for carrying out my process said iron and molybdenum mixture is conducted from the furnace 1 through a trough 2 into a ladle 3, and while molten is dropped from said ladle into a body of water or other liquid in a receptacle 4. It will be understood that the furnace 1 or the trough 2 is provided with any

desirable means for controlling or preventing the flow of the molten metal from the furnace through the trough. The broken-up or subdivided iron and molybdenum compound is filled into crucibles 5 and fused in a crucible-furnace 6, and when fused or melted is cast into ingots which are subsequently rolled or otherwise manipulated for forming finished bars or plates.

In following out this process I preferably use the iron and molybdenum in the following proportions by weight: iron, ninety-nine to eighty parts; molybdenum, one to twenty parts.

The length of time during which the iron and molybdenum are heated in the furnace may be from one to twelve hours, and the length of time during which the fragmentary product is heated in the crucibles may be from one to six hours.

To those skilled in the art it will be understood that the proportions of iron and molybdenum and the length of time during which the same are subjected to heat is dependent more or less upon the grade of the materials, and that a small amount of silicon, usually less than two per cent., is present in the final product. It will also be understood that instead of iron a good grade of soft steel may be used.

It will be particularly noted that by producing steel as described the materials are refined by the fusing and heating in the furnace and are thoroughly mixed, even though the steel is low in carbon; that the uniting of the iron with the molybdenum when fused in bulk reduces to a minimum the liability of the combination of the molybdenum with the carbon of the crucibles and the resultant disintegration and destruction of the crucibles, and that the entire process greatly facilitates the production of a finished product of maximum uniformity in hardness and character and the manufacture of finished bars or plates which are free from defects to a maximum extent.

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

1. The herein-described process of producing steel, the same consisting in fusing iron and molybdenum in bulk together, reducing the resultant product to a subdivided or fragmentary condition, and then fusing said reduced product in crucibles, substantially as and for the purpose described.

2. The herein-described process of producing steel, the same consisting in fusing iron and molybdenum in bulk together, dropping the fused mixture into a body of liquid and thereby reducing said mixture to a subdivided or fragmentary condition, and then fusing said reduced product in crucibles, substantially as and for the purpose specified.

3. The herein-described process of producing steel, the same consisting in fusing from ninety-nine to eighty parts by weight of iron with from one to twenty parts of molybdenum in bulk together, reducing the resultant product to a subdivided or fragmentary condition, and then fusing said reduced product in crucibles, substantially as and for the purpose set forth.

4. The herein-described process of producing steel, the same consisting in fusing iron, inclosing molybdenum in a fusible case, fusing said molybdenum and the fusible case with the iron, reducing the resultant product to a subdivided or fragmentary condition, and then fusing said reduced product in crucibles, substantially as and for the purpose described.

In testimony whereof I have hereunto signed my name, in the presence of two attesting witnesses, at Syracuse, in the county of Onondaga, in the State of New York, this 16th day of July, 1903.

WILLIAM BERTIN BROOKFIELD.

Witnesses:
S. DAVIS,
D. LAVINE.