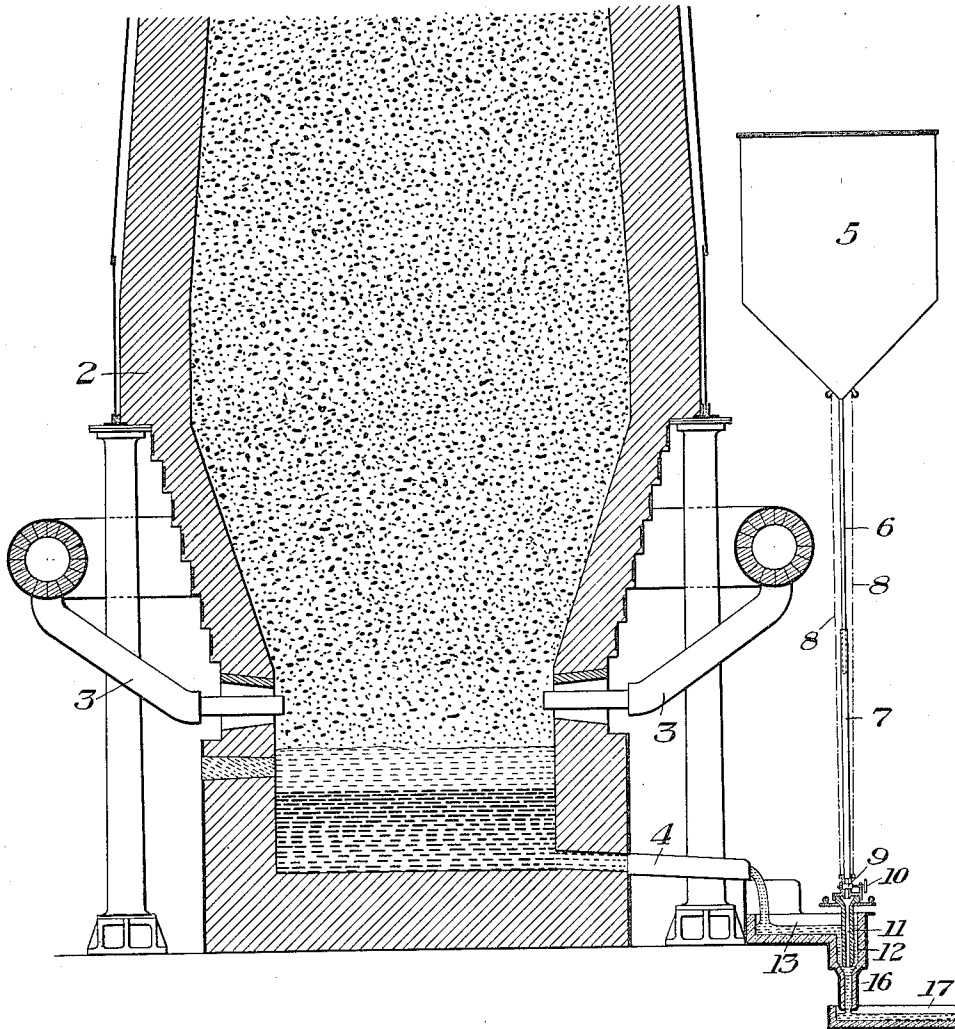


1,151,332.

Fig.1.



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3 SHEETS—SHEET 2.



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MIXING APPARATUS.
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3 SHEETS—SHEET 3.

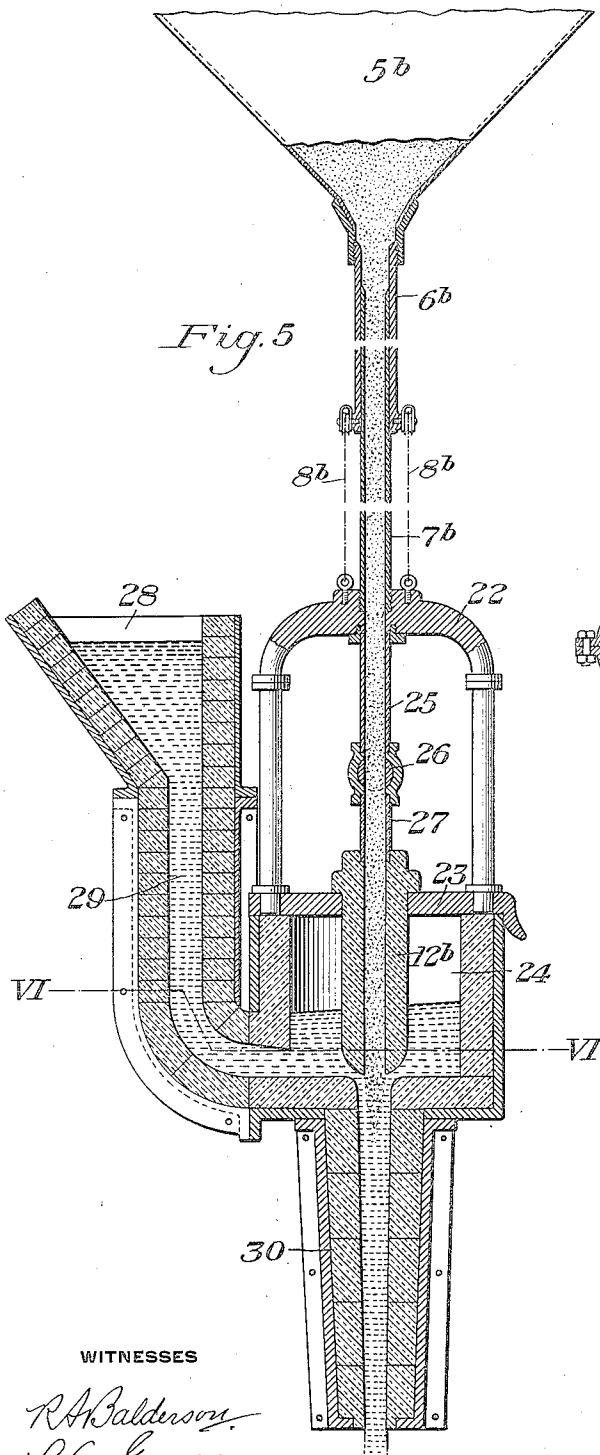


Fig. 5

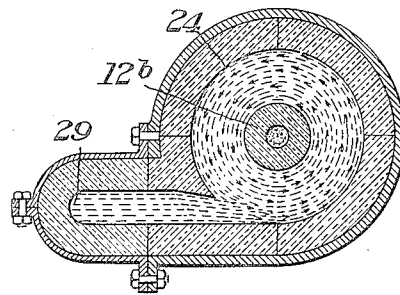


Fig. 6.

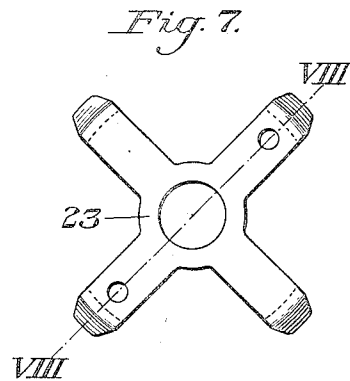


Fig. 7.

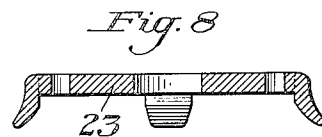


Fig. 8

WITNESSES

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MIXING APPARATUS.

1,151,332.

Specification of Letters Patent.

Patented Aug. 24, 1915.

Application filed November 21, 1914. Serial No. 873,319.

To all whom it may concern:

Be it known that I, RALPH BAGGALEY, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Mixing Apparatus, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a sectional elevation showing a portion of a blast furnace, together with one form of my improved mixing apparatus. Fig. 2 is also a sectional elevation illustrating the mixing apparatus of Fig. 1, but utilizing a ladle for supplying the molten material. Fig. 3 is a detail sectional view showing a modified form of the mixing apparatus having a plurality of feeding tubes. Fig. 4 is a section on the line IV—IV of Fig. 3. Fig. 5 is a sectional view showing another form of mixing apparatus. Fig. 6 is a sectional view, on the line VI—VI of Fig. 5, and Figs. 7 and 8 are plan and sectional views, respectively, of the spider of Fig. 5.

I have invented a new and useful mixing apparatus in which granulated material may be mixed with fluids, but more particularly it is intended for the mingling of flue dust, concentrates, slimes and fines in molten iron or in copper matte.

Specifically stated, the object of my present invention is to provide an efficient apparatus for mingling concentrates, flue dust, slimes and fines with copper matte in accordance with the methods described and claimed in my United States Patent No. 900,467, dated October 6, 1908, and also to provide for mingling of light iron blast furnace flue dust with heavy molten iron, as described and claimed in my United States Patent No. 1,081,921, dated December 16, 1913. In both of the above described patents I accomplish the mixing or mingling of the light granulated material with the heavy molten fluid by dropping the latter a sufficient distance to create by its fall a vortex in a second vessel. The comminuted material is then delivered through a pipe or otherwise into the bottom portion of such vortex and the falling molten metal carries the light material down into the body of the molten material and produces a very thorough mix or mingling without the objectionable feature of air bubbles which occur if the comminuted material be driven

into the molten body with an air blast. I found in my tests that this method of mingling the two worked well with copper mattes when properly done. Sometimes, however, it was not properly done and the result was an improper or unsuccessful mingling of the two. In practising the art described in my Patent No. 1,081,921, I experienced the same difficulty from improper handling, but I also found in my tests that there were other objectionable features. For instance, I found that the air currents from the hot molten iron carried a large amount of the light flue dust away so that a serious loss of flue dust resulted. I also found that better results were produced in practicing the art disclosed in this patent if an opportunity were afforded for a continuous burning process during the fall of the molten metal into the secondary vessel. My tests showed that in this manner, practically all of the coke and limestone particles could be quickly burned out, as well as a very large proportion of the silicate contents of the flue dust.

In order to illustrate this feature of the process, I quote the two following analyses:

Analysis of iron before treatment—in test No. 1:—silicon .86—sulfur .085—manganese .36—total carbon 3.58—phosphorus .22.

Analysis of iron after treatment—in test No. 1:—silicon .80—sulfur .078—manganese .32—total carbon 3.51—phosphorus .20.

In this test the flue dust was converted into iron which analyzed as follows: silicon 2.25—sulfur .100—manganese .60—total carbon 3.10—phosphorus .28—iron 84%.

Analysis of iron before treatment—in test No. 2:—silicon 1.37—sulfur .090—manganese .48—total carbon 3.40—phosphorus .25.

Analysis of iron after treatment—in test No. 2:—silicon 1.28—sulfur .090—manganese .44—total carbon 3.15—phosphorus .25.

In this test the flue dust was converted into iron that analyzed as follows:—silicon 2.54—sulfur .092—manganese .54—total carbon 2.83—phosphorus .25—iron 82%.

In each test the iron was benefited and the flue dust was transformed into an iron product much better in every way than sintered or nodulized flue dust, because it could be remelted in the blast furnace with approximately one ton of coke to ten tons of iron product.

Referring first to that form of my invention shown in Fig. 1 and parts of which are

also illustrated in Fig. 2, the numeral 2 designates the hearth and bosh portion of an iron blast furnace of the usual construction, having the twyers 3, and the tap-out 4 leading from the hearth. 5 designates a suitable bin or receptacle in which the dust or similar material to be mixed with the molten metal delivered from the tap-out 4 is placed in bulk. Preferably, such flue dust is dried and screened before being placed in this hopper, so as to flow freely and to be free from all lumps of coke, brick-bats, or other large particles of foreign material which may have become mixed therewith. Depending from the bottom of the hopper is a discharge pipe formed in two telescopic sections 6 and 7, the lower section 7 being adapted to be slid upon the upper section 6 by any suitable means, such as the chains 8. The lower pipe section 7 has a valve-fitting 9 at its lower end for a control valve 10, by means of which the rate of discharge can be either controlled or stopped at will. This fitting is arranged to fit over the upper end of a nozzle 11 of refractory material and which extends downwardly within a well 12 formed at one end portion of a receptacle 13 into which the molten metal is delivered from the tap-out 4, as shown in Fig. 1, or in any other suitable manner, as by the ladle 14 shown in Fig. 2. The receptacle 13 and well 12 have a refractory lining 15, and the well 12 has a depending refractory lined mixing-funnel or discharge extension 16 for delivering the mixed material into any suitable receptacle such as the trough 17 which delivers the material into an open-hearth furnace 18.

It will be noted that the nozzle 11 extends a considerable distance down into the molten metal in the well 12, so that the dust or other comminuted material is introduced into and mixed with the molten metal at a point well below its surface.

In the modification shown in Figs. 3 and 4 the lower section 7^a on the discharge pipe and the valve-fitting 9^a having the control valve 10^a are arranged to discharge into an intermediate receptacle 19. This receptacle has a plurality of discharge openings 20 in its bottom, each of which communicates with a refractory nozzle 21. These refractory nozzles extend downwardly into the well 12^a in a similar manner to the nozzle 11 of Figs. 1 and 2. The purpose of this arrangement is to provide a plurality of these nozzles so that the dust or similar material can be mixed with the molten metal simultaneously at a plurality of points. The apparatus as thus described works very satisfactorily in the mingling of concentrates, flue dust, fines, etc., in copper matte, in accordance with the method of my said Patent No. 900,467, since, as will be readily seen, the comminuted material is delivered below

the surface of the molten bath and no failure in the mix can result. There are also no losses from air currents.

A somewhat preferable form of my invention is, however, shown in Figs. 5 to 8, inclusive, particularly in the mixture of iron blast furnace flue dust with molten iron, in accordance with the method of my Patent No. 1,081,921. In this form of my invention the hopper 5^b, telescopic discharge pipes 6^b and 7^b, and nozzle 12^b are substantially the same as in Fig. 2, except that the pipe 7^b is secured at its lower end in a frame or yoke 22 supported by a spider 23 resting on top of the well 24, into which the nozzle 12^b extends. The frame or yoke 22 carries the pipe section 25 forming a continuation of 7^b and having a control valve 26 and a "sight" 27 of glass. The well 24 is shown as receiving its supply of molten metal from a hopper 28 having the vertical discharge opening 29 leading downwardly from its bottom and entering the well 24 in a horizontal tangential direction, as shown in Fig. 6. The molten metal can be delivered into the hopper 28 either as in Fig. 1, or as in Fig. 2, or in any other suitable manner. Preferably, the hopper 28 is of such a height as to create sufficient pressure to give a strong swirling or vortex action within the well 24, this action being increased by the tangential location of the inlet into said well. The result is a more thorough mixing, without air bubbles; and the funnel 30 which conducts the mixture out of the well affords ample opportunity for burning out all of the coke, limestone and silicon in the flue dust during the passage of the molten bath through it. This burning out action is also present in the forms of my invention first described.

The spider 23 is preferably made removable so that the nozzle which it supports may be lifted entirely out of the vortex well or basin 24 for the purpose of repairs, or for removing obstructions from the well or basin itself, or from the mixing funnel 30. The valve 26 provides means for regulating the flow, which can be observed at all times by the operator through the sight 27.

In the use of all forms of my invention, it is of prime importance that a steady, continuous flow of both the molten metal and the comminuted material be maintained during the mixing operation.

I do not desire to limit myself to the particular embodiments of my invention which I have herein shown and described, as it will be obvious that it will be susceptible to various other embodiments within the spirit and scope of the appended claims.

I claim:

1. Mixing apparatus of the character described, comprising a receptacle for molten metal having a constantly open discharge opening, and a delivery member for the dust

or other comminuted material and having its discharge below the normal level of the molten metal in said receptacle and in the direction of the flow through said opening, substantially as described.

2. Mixing apparatus of the character described, comprising a mixing receptacle or well having a constantly open discharge opening, means for supplying molten metal thereto, and a delivery nozzle for the flue dust or like material, said nozzle extending into the receptacle or well to a point below the normal level of the molten metal therein and into a position to discharge into the stream of molten metal flowing to said opening, substantially as described.

3. Mixing apparatus of the character described, comprising a receptacle for molten metal, having an outlet opening, and arranged when in use to have a constant flow therethrough, and a delivery member for the dust or other comminuted material to be mixed therewith, said member extending into said receptacle to a position to be well within the flowing stream of metal through the mixer; substantially as described.

4. Mixing apparatus of the character described, comprising a receptacle for molten metal, having an outlet opening, and arranged when in use to have a constant flow therethrough, and a delivery member for the dust or other comminuted material to be mixed therewith, said member having an elongated nozzle which extends into said receptacle to a point below the normal level of the molten metal therein, and having its discharge opening extending in the direction of the outlet opening of the receptacle; substantially as described.

5. Mixing apparatus of the character described, comprising a receptacle for molten metal, having an outlet opening, and arranged when in use to have a constant flow

therethrough, and a delivery member for the dust or other comminuted material to be mixed therewith, said member extending into said receptacle to a position to be well within the flowing stream of metal through the mixer, together with means for producing a rotary or whirling movement of the metal around said member; substantially as described.

6. Mixing apparatus of the character described, comprising a mixing receptacle, having a constant open discharge, and a plurality of delivery nozzles for the material to be mixed, said nozzles extending to a point within the receptacle where they are well within the body of molten metal flowing to said discharge, together with means for effecting a gravity feed of material into said nozzles; substantially as described.

7. Mixing apparatus of the character described, comprising a mixing receptacle or well, an elevated hopper for the molten metal, and a receptacle or passage leading downwardly from said hopper and entering the well in a tangential direction, substantially as described.

8. Mixing apparatus of the character described, comprising a mixing receptacle or well, an elevated hopper for the molten metal, and a receptacle or passage leading downwardly from said hopper and entering the well in a tangential direction, together with means for delivering flue dust or like material into said well at a point near the bottom thereof, substantially as described.

In testimony whereof, I have hereunto set my hand.

RALPH BAGGALEY.

Witnesses:

W. C. LYON,
H. M. CORWIN.