(No Model.) 2 Sheets—Sheet 1.

W. R. JONES.

METHOD OF MIXING MOLTEN PIG METAL.

No. 404,414. Patented June 4, 1889.

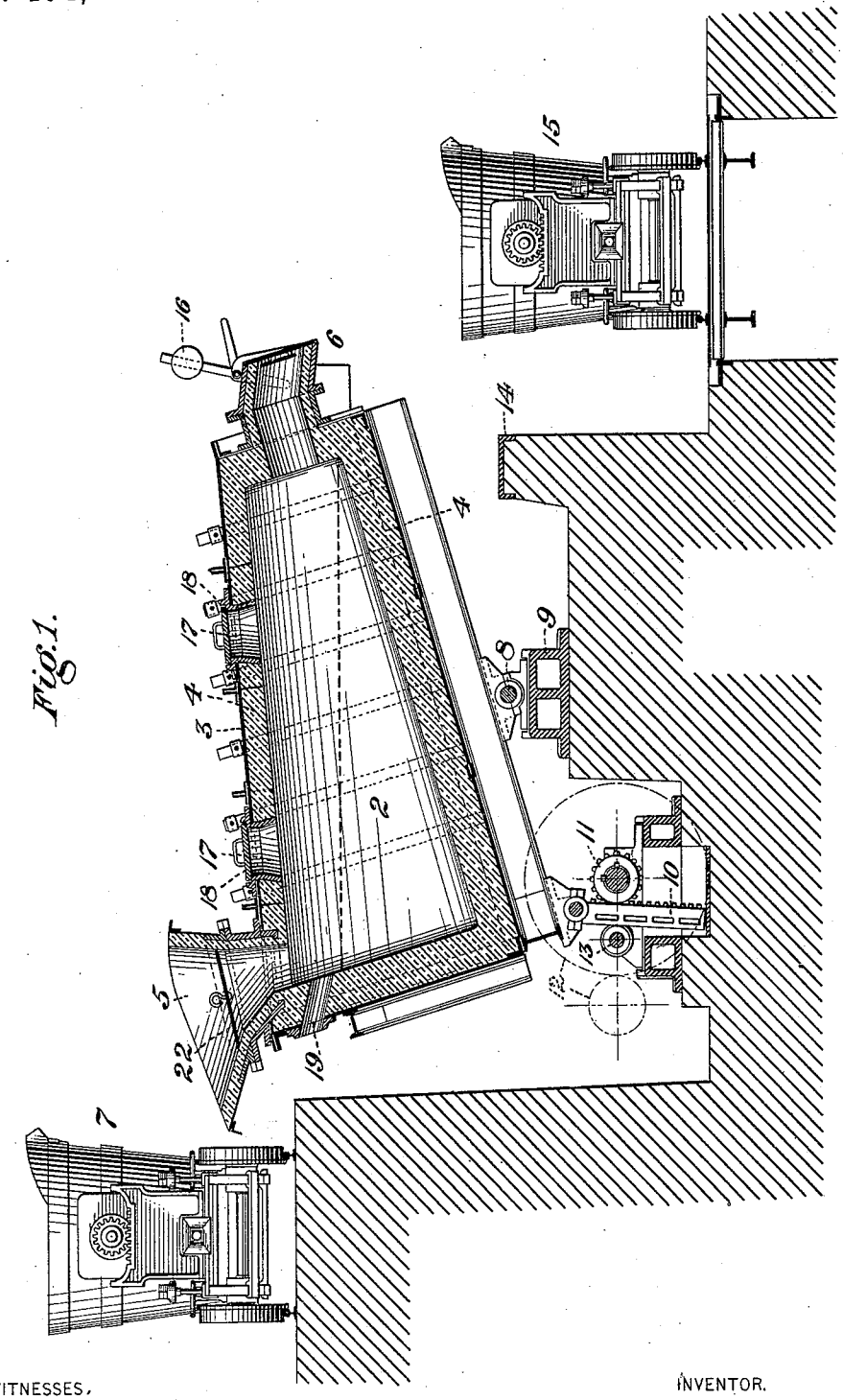


Fig. 1.

WITNESSES,

C. M. Clarke.

W. B. Corwin

INVENTOR.

William R. Jones

by W. Baxewell & Sons

his Attorneys.

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2.

W. R. JONES.

METHOD OF MIXING MOLTEN PIG METAL.

No. 404,414. Patented June 4, 1889.

Fig. 2.

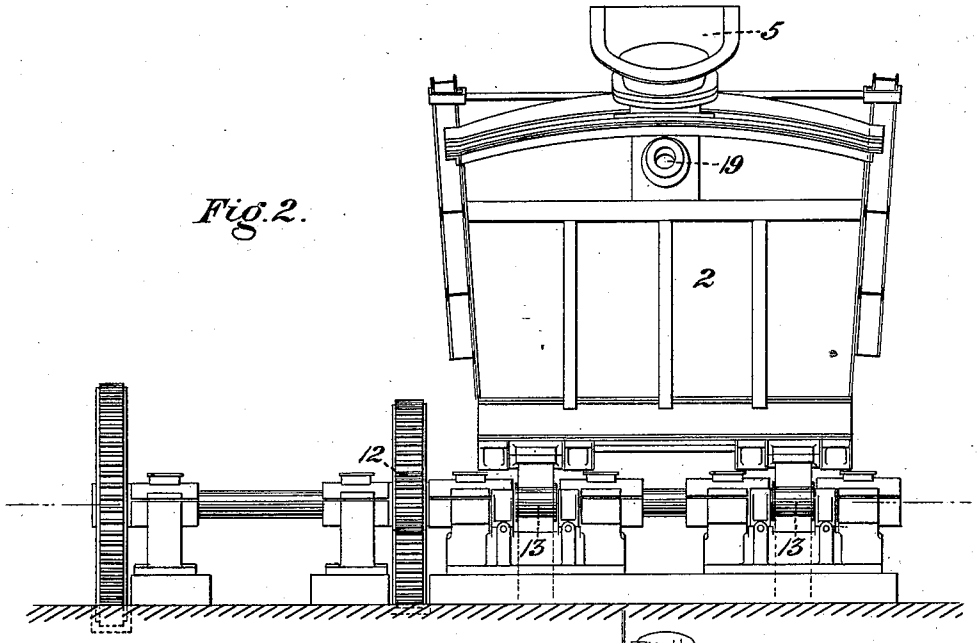
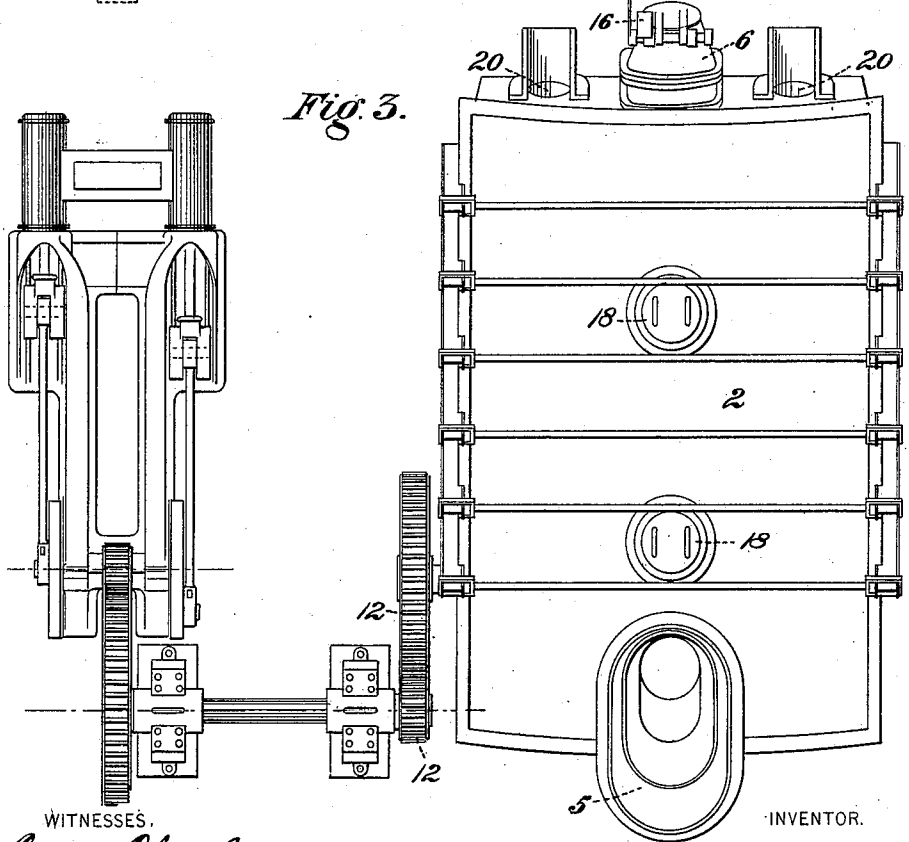


Fig. 3.



WITNESSES.

C. M. Clarke.

W. B. Corwin

INVENTOR.

William R. Jones

by W. Baxwell & Sons

his Attorneys

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM R. JONES, OF BRADDOCK, PENNSYLVANIA.

METHOD OF MIXING MOLTEN PIG METAL.

SPECIFICATION forming part of Letters Patent No. 404,414, dated June 4, 1889.

Application filed October 31, 1888. Serial No. 289,672. (No specimens.)

To all whom it may concern:

Be it known that I, WILLIAM R. JONES, of Braddock, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Methods of Mixing Molten Pig Metal; and I do hereby declare the following to be a full, clear, and exact description thereof.

I shall describe my invention with reference to the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section of apparatus which I have invented for practicing my invention. Fig. 2 is an end elevation of the mixing-vessel and its actuating mechanism, viewed in the direction of the arrow A of Fig. 1. Fig. 3 is a plan view of the parts shown in Fig. 2.

Like symbols of reference indicate like parts in each.

The primary object of my invention is to provide means for rendering the product of steel-works uniform in chemical composition. In practice it is found that metal tapped from different blast-furnaces is apt to vary considerably in chemical composition, particularly in silicon and sulphur, and such lack of uniformity is observable in different portions of the same cast, and even in different portions of the same pig. The following table, giving the analyses of metal contained in different ladle-charges tapped from a blast-furnace at a single casting at the Edgar Thomson Steel Works, Braddock, Pennsylvania, will illustrate the fact: Ladle No. 1 contained silicon 4.15 per cent., sulphur .015 per cent.; ladle No. 2 contained silicon 4.07 per cent., sulphur .025 per cent.; ladle No. 3 contained silicon 2.89 per cent., sulphur .030 per cent.; ladle No. 5 contained silicon 1.23 per cent., sulphur .120 per cent.; ladle No. 6 contained silicon 2.52 per cent., sulphur .061 per cent.; ladle No. 7 contained silicon .66 per cent., sulphur .143 per cent. The consequence of this tendency of the silicon and sulphur to segregate or form pockets in the crude metal is that the product of the refining process in the converters or otherwise in like manner lacks uniformity in these elements, and therefore often causes great inconvenience and loss, making it impossible to manufacture all the articles of a single order of homogeneous composition. Especially is this so in the process of refining crude iron taken from the smelting-furnace and charged directly into the converter without remelting in a cupola, and, although such direct process possesses many economic advantages, it has on this account been little practiced.

For the purpose of avoiding the practical evils above stated I use in the refining process a charge composed not merely of metal taken at one time from the smelting-furnace, but of a number of parts taken from different smelting-furnaces, or from the same furnace at different casts, or at different periods of the same cast, and subject the metal before its final refining to a process of mixing, whereby its particles are diffused or mingled thoroughly among each other, and the entire charge is practically homogeneous in composition, representing in each part the average of the unequally diffused and segregated elements of silicon and sulphur originally contained in each of the several parts or charges. By proceeding in this way not only is each charge for the refining furnace or converter homogeneous in itself, but, as it represents an average of a variety of ununiform constituent parts, all the charges of the converter from time to time will be substantially uniform, and the products of all will be homogeneous.

To this end my invention may be practiced with a variety of forms of apparatus—for example, by merely receiving in a charging-ladle a number of small portions of metal taken from several ladles or receiving-vessels containing crude metal obtained at different times or from different furnaces, the mixing being performed merely by the act of pouring into the charging-ladle, and other like means may be employed. I prefer, however, to employ the apparatus shown in the accompanying drawings, and have made it the subject of a separate patent application, Serial No. 289,673, and, without intending to limit the invention to the use of that specific apparatus, I shall describe it particularly, so that others skilled in the art may intelligently employ the same.

My invention is not limited to its use in connection with converters, since similar advantages may be obtained by casting the

metal from the mixing-vessel into pigs for use in converters, puddling-furnaces, or for any other uses to which pig-iron may be put in the art.

Referring now to the drawings, 2 represents the reservoir before mentioned. It consists of a covered hollow vessel having an outer casing 3, of iron or steel, which is suitably braced and strengthened by exterior beams and tie-rods, as shown in the drawings. The whole interior of the vessel is lined with fire-brick or other refractory lining, which should be of sufficient thickness to retain the heat of the molten contents of the vessel and to prevent chilling thereof. The vessel is strongly braced and supported by braces and tie-rods, and may be of any convenient size, holding, say, one hundred tons of metal, (more or less,) and its shape is preferably such as shown in the drawings, being rectangular, or nearly so, in cross-section and an irregular trapezium in longitudinal section, one end being considerably deeper than the other. At the top of the deeper end, which I call the "rear" end, is a hopper 5, into which the molten metal employed in charging the vessel is poured, and at the front end is a discharge-spout 6, which is so located that the bottom of the spout is some distance above the bottom of the vessel—say two feet in a hundred-ton tank, and more or less, according to the capacity of the vessel—the purpose of which is that when the metal is poured out of the spout a considerable quantity may always be left remaining and unpoured, and that whenever the vessel is replenished there may already be contained in it a body of molten metal with which the fresh addition may mix. I thus secure, as much as possible, uniformity in character of the metal which is fed to and discharged from the tank, and cause the fluctuations in quality of the successive tappings to be very gradual.

For convenient use of the apparatus I have found it best to so arrange it that it is adapted to receive its charges of metals from cars or bogies 7, which run on an elevated track at about the level of the normal position of the hopper 5, and to discharge its contents into similar cars or bogies 15 on a track below the spout 6. In order to facilitate the charging and discharging of the metal, the vessel is set on journals or bearings 8, which have their bearings in suitable pedestals 9, and its rear end is provided with depending rack-bars 10, which are pivotally connected with the bottom of the mixing-vessel 2 and are in gear with pinions 11, the shaft of which is connected by gearings 12 with the driving mechanism of a suitable engine. The pinions are held in gear with the rack-bars by idler wheels or rollers 13. As the journals or bearings 8 are located on a transverse line somewhat in advance of the center of gravity of the vessel, it tends by its own weight to tilt backward into the position shown in Fig. 1, but may be restored to a level position by driving the pinions 11, and thus raising the rack-bars 10 until the front part of the bottom of the vessel comes in contact with a rest or stop 14.

The mode of operation of the apparatus is as follows: When the vessel is in the backwardly-inclined position shown in Fig. 1, it is ready to receive a charge of metal from the car 7. Before introducing the first charge, however, the mixing-vessel should be heated by internal combustion of coke or gas, and when the walls of the vessel are sufficiently hot to hold the molten metal without chilling it it is charged repeatedly from the cars 7 with metal obtained either from a number of furnaces or at different times from a single furnace. The charges of metal introduced at different times into the vessel, though differing in quality, mix together, and when the vessel has received a sufficient charge its contents constitute a homogeneous molten mass, whose quality may not be precisely the same as that of any one of its constituent charges, but represents the average quality of all the charges. If desired, the commingling of the contents may be aided by agitation of the vessel on its trunnions, so as to cause the stirring or shaking of its liquid contents. The mixing-chamber being deeper at its rear than at the front end, as before described, and its normal position when not discharging metal for the purpose of casting being with the bottom inclined upward toward the front or discharging end, and the bottom of the spout being situate above the bottom of the vessel at its forward end, it is adapted to receive and hold a large quantity of molten metal without its surface rising high enough to enter the discharge-spout.

The discharge-spout 6 is furnished with a movable cover operated by a weighted lever 16, which, when closed, serves to exclude the outside air and prevent a draft of air through the vessel and the consequent rapid cooling of the molten contents. If care is exercised in keeping the cover closed, the metal can be kept in a fluid condition for a long time, the heat being kept up by repeated fresh charges of molten metal, and, if necessary or found desirable, by burning gas introduced by a pipe or pipes into its interior.

After the vessel is properly charged, the metal is drawn off into the cars 15 from time to time, as it is needed, by opening the door or cover 16 of the spout 6 and driving the engine 12, so as to elevate the rear end of the vessel and tilt it forward, and thus to discharge any required amount of its contents in the manner before explained into the cars 15, which are transported to the converters, or the metal is cast into pigs or otherwise used. The tilting of the vessel does not, however, drain off all the contents thereof, a portion being prevented from escaping by reason of the elevated position of the spout 6, and as the vessel is replenished from time to time each new charge mixes with parts of previous charges remaining in the vessel, by which

means any sudden variations in the quality of the metal supplied to the converter is avoided. Instead of discharging the metal into the cars 12 and carrying it in the cars to the converters or casting-house, the vessel 2 may be so situate relatively to the other parts of a furnace-plant as to deliver its contents immediately to the converters or other place where it is to be utilized.

I find it in practice very advantageous to employ two or more mixing-vessels constructed substantially as I have described, and to draw a portion of each converter-charge from each of the mixing-vessels. My invention is, however, not limited to the employment of two or any specific number of such vessels.

I shall now describe, briefly, other parts of the apparatus which are desirable and important in its practical use.

At the top of the vessel 2 are man-holes 17, designed to permit of access to its interior for the purpose of repairing or fixing the lining. These holes are provided with suitable covers 18 to exclude cold drafts of air from entering the interior. There is also a hole 19 at the rear end of the vessel near the top, through which a rabble may be inserted for the purpose of assisting or accelerating the mixing of the molten metal, and at the other end, at the level of the bottom of the interior, there are holes 20, provided with suitable spouts to enable all the molten contents to be drawn off when it becomes necessary to do so. (See Fig. 3.) The holes 20 should be provided with suitable stoppers.

I claim—

1. In the art of refining iron directly from the smelting-furnace, the process of equalizing the chemical composition of the crude metal by thoroughly commingling or mixing together the liquid-metal charge and subsequently refining the mixed and equalized charge, substantially as and for the purposes described.

2. In the art of mixing molten metal to secure uniformity of the same in its constituent parts preparatory to further treatment, the process of introducing into a mixing-receptacle successive portions of moltel metal ununiform in their non-metallic constituents, (sulphur, silicon, &c.,) removing portions only of the composite molten contents of the receptacle without entirely draining or emptying the same, and successively replenishing the receptacle with fresh ununiform additions, substantially as and for the purposes described.

In testimony whereof I have hereunto set my hand this 9th day of August, A. D. 1888.

WILLIAM R. JONES.

Witnesses:
E. J. SMAIL,
W. BAKEWELL.