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ART OF REFINING IRON AND STEEL PRODUCTS

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FIG. 1

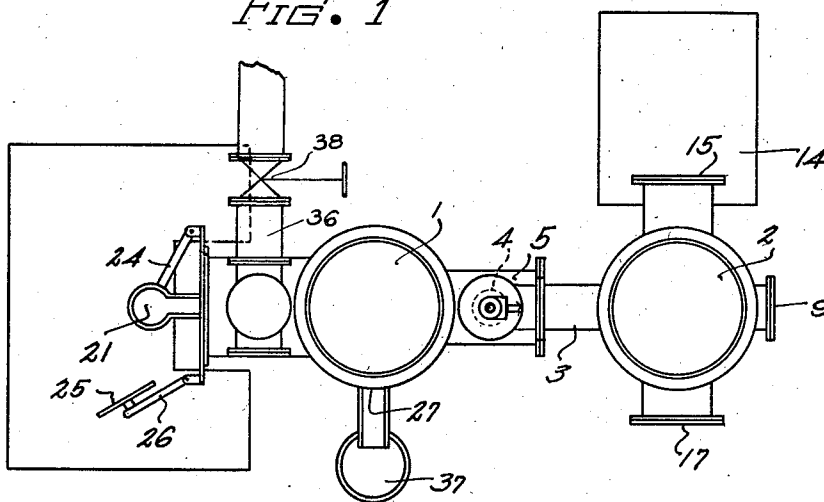
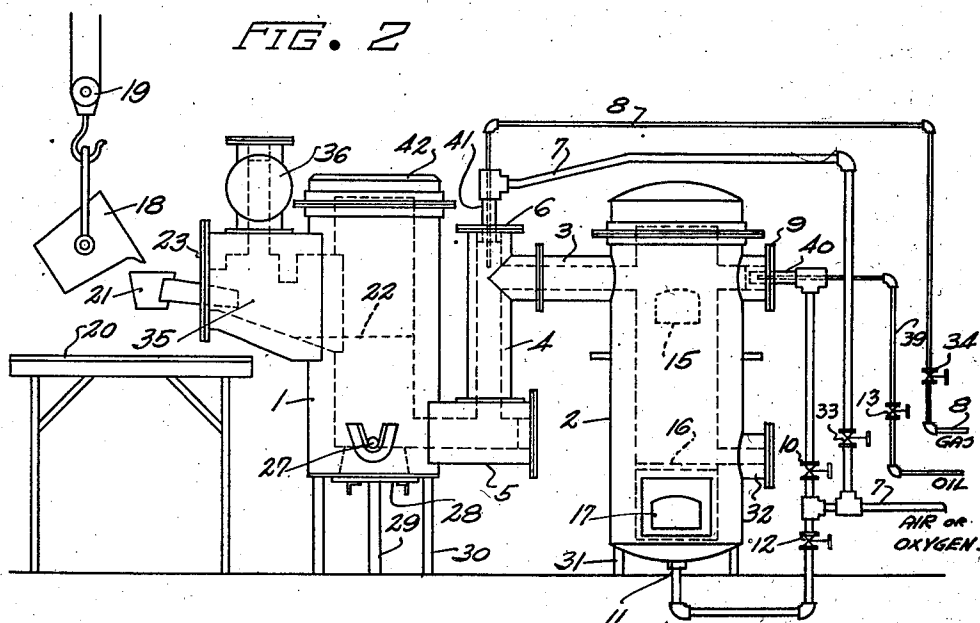


FIG. 2



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ART OF REFINING IRON AND STEEL PRODUCTS.

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My invention relates to the manufacture of iron and steel and is particularly useful in making refined iron and steel products.

My object is to improve the physical properties of ferrous metals to the extent that the improvement may be easily recognized and economically carried out, and, in general, my process consists in obtaining molten metal, deemed desirable for the purpose, in a suitable receptacle and subjecting said molten metal to the treatment or treatments hereinafter stated, in order that the tensile and transverse strengths of the metal after treatment shall be greater than the said strengths of the metal before treatment; and that the grain or structure of the metal after treatment shall be closer or finer than the grain or structure of the metal before treatment; and at the same time making the treated metal of the desired hardness.

It is a recognized truth of chemistry that liquids absorb gases, and it is admitted by authorities conversant with chemical principles that the amount of gas that a liquid will absorb is dependent upon four things, viz, the nature of the liquid; the nature of the gas; the temperature; and the pressure.

I have conceived that liquid iron or steel will follow the general law of liquids and the basis of my work heretofore and of the present invention is that by control of the kind of gas and the amount of gas, that I force into and through molten metal, at a given temperature and at a given pressure, I can get a substantial improvement in and control of the metal treated. Whether or not I change or replace the gases in molten metal by gases used by me I cannot say, but by operating under the process herein described I do make a very substantial, commercial and useful improvement in the iron treated.

My invention contemplates producing the gases principally relied upon for the refinement of molten metal by the combustion of carbonaceous fuel adjacent to the molten metal and forcing said gases into and through the said metal so that the heat of combustion will enter the molten metal along with the products of combustion and subject such metal to both the heat of combustion and to the chemical action of the gases in the products of combustion.

My invention contemplates regulating the ratio of the amount of fuel used to the amount of oxygen or air used so that the operator

can control the character of the products of combustion, making them either oxidizing with respect to the metal, or reducing with respect to iron oxide, as may be found necessary to increase the temperature of the molten metal or to purify it in the manner desired within the contemplated range of treatment.

My invention also contemplates the provision of means for first treating the molten metal with oxygen or air, according to the well known Bessemer process so that, if desired, its manganese, silicon and carbon content may be first lowered and the metal heated, after which the treatment with heat and gas from the products of combustion, in the manner above described, may be used.

My invention further contemplates introducing into the molten metal, either along with or after its treatment with the gases in the products of combustion, hydrogen gas or gas containing hydrogen which will be forced through the molten metal so as to assist in its de-oxidation and purification.

By introducing the heat produced in the combustion of fuel along with the gaseous products of combustion it is obvious I am able to raise the temperature of the metal treated, and at the same time the molten metal is subjected to the chemical action of said products of combustion.

As shown in the drawings:—

Fig. 1 is a plan view of an apparatus that I have used; and

Fig. 2 is an elevation or side view of said apparatus.

Like numbers on the two figures refer to the same parts.

I do not specifically confine myself to this type of apparatus or to the arrangement shown, because my process can be carried out in other types of apparatus.

Describing the apparatus shown in the drawings, 1 is a receptacle or refiner connected to a gas producer or furnace 2 by means of flues or pipes 3, 4 and 5, which are made of steel and lined with fire brick or refractory materials. The refiner 1 is connected at cover plate 6 with a controlled and measured air supply pipe 7 and a controlled and measured gas pipe supply 8. The furnace 2 is connected at cover plate 9 with a controlled and measured air supply through valve 10 and at flange 11 with a controlled and measured air supply through valve 12. A controlled and measured supply of oil is shown connected to

furnace 2 at cover plate 9 and controlled by valve 13. Under certain conditions this oil supply may be connected directly to refiner 1 at cover plate 6.

5 Coke, coal or wood is put into furnace 2 from platform 14 through door 15 and burned on grates 16 and ashes are removed through door 17. Molten metal is obtained in ladle 18 and handled by crane 19 to platform 20, whereupon a man stands and pours the metal into basin 21 from whence it flows into refiner 1 and should come to the approximate level 22 in refiner 1 and in neck or connection 4. The arrangement of the opening 23 to the connection 35 is such that the spout of basin 21 can be swung into it by means of small crane 24 or it can be closed by means of a door 25 swung into it by crane 26. A tapping hole 27 of usual design is provided and so also is a removable bottom 28 supported by prop 29, for tapping the metal out of the refiner 1, and for cleaning the refiner. Supports for the refiner 1 are indicated at 30 and for the furnace 2 are marked 31. A poking and firing hole for the furnace 2 is provided at 32. The controlling valves 10, 12, 13 and the valves 33 in pipe 7 and 34 in pipe 8 are all placed within easy reach of the operator's stand.

My improved process is carried out with the apparatus described above, substantially as follows:

Kindling is placed on grates 16 through firing hole 32, ignited and then coke, coal or wood is charged into furnace 2 through door 15 onto grates 16 where the fuel is burned by means of oxygen or air being supplied by natural draft through flue 36, or by forced draft, and the furnace 2, connections 3, 4 and 5 and refiner 1 are all heated red hot inside ready to receive a charge of metal. Molten metal is then poured into basin 21 and thence flows into refiner 1 and rises therein to about the level 22 at which level the metal may be skimmed through the opening 23. As soon as the metal is poured into refiner 1, as stated, basin 21 is swung out of opening 23 by means of small crane 24 and door 25 by means of crane 26 is swung against opening 23 in such manner as to close the said opening tightly.

50 The next step is to see that openings 15, 17 and 32 are all closed tightly after the furnace 2 has been filled with fuel. All valves having been previously closed, the operator can then open any one or more of the valves 12, 10, 33, 13 and 34 and subject the metal in refiner 1 to intimate contact with the gases in the products of combustion. The gases will come into the upper part of connection 4 and force the liquid iron down as a piston through said connection 4 into connection 5 and will pass therethrough into and through the molten metal. After the metal has been brought to a desired purification it is tapped out of refiner 1 into ladle 37.

65 It will be obvious that the refiner 1, being

juxtaposed to the furnace 2 and connected therewith by highly heated refractory lined connections 3, 4 and 5, will receive the gases at practically the same temperature as they leave the furnace 2 and thus the heat from the products of combustion will be conserved and delivered to the molten metal in the refiner while at the same time the chemical reactions take place therein. The ratio of the amount of fuel used to the amount of oxygen or air used may be regulated and controlled by the operator by the manipulation of the valve controls so that the products of combustion as delivered into the molten metal will be either oxidizing with respect to the metal or reducing with respect of iron oxide, as may be necessary to increase the temperature of the metal and to purify it as desired. Obviously the operator may first blow the molten metal in the refiner 1 with a blast of air or oxygen through pipe 7 in accordance with the well known Bessemer process, and after this blowing step, the partially purified metal can then be treated either by the carbonaceous gases from the furnace 2, or by a gas such as hydrogen or a gas containing hydrogen admitted through pipe 8 under control of valve 34, or by a combination of carbonaceous gas and hydrogen gas. It will also be apparent that, by the utilization of an oil supply through pipe 39 under control of valve 13, oil may be charged into the furnace 2 to produce carbonaceous gases, it being noted that the pipe 39 leads through the intake connection 40 for air entering the cover 9 in such manner that an air jet can be turned on by opening valve 10 which will spray the oil with an injector effect into the furnace 2. In like manner since the gas pipe 8 leads through the intake connection 41 for the air pipe 7, where it enters the cover plate 6, by opening valve 33 air or oxygen can be admitted with such gas. The refiner 1 is provided with a suitable cover 42 and 37 is a ladle for receiving treated metal when it is tapped out.

I provide a valve 38 in the outlet pipe 36 and by partly closing this valve I can operate the refiner under a controllable range of pressure above atmosphere, and by continuing or discontinuing the treatment with hot gases generated by the combustion of fuel I can control the temperature of the molten metal. Thus, my process makes provision for treatment of the molten metal under a variable pressure and temperature range which can be manipulated to obtain the best result.

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

1. A process of treating molten metal, by which regulated and controlled volumes of gases are forced into molten metal while controlling the temperature and pressure of said

molten metal so that the amount of gases absorbed by the molten metal may be definitely controlled.

2. The process of producing metal of a predetermined analysis, which comprises providing purified metal in a molten state, introducing chemical constituents of the metal to be produced in a gaseous state into the molten mass, and controlling the temperature and pressure of the molten mass under treatment to control the incorporation by absorption of said chemical constituents in the metal.

3. The process of producing a metal of a predetermined analysis, which comprises bringing the metal to a molten state and purifying it, introducing chemical constituents of the metal to be produced in a gaseous state into the molten mass, and controlling the tem-

perature and pressure of the molten mass under treatment to control the incorporation by absorption of said chemical constituents in the metal.

4. The process of producing a metal of a predetermined analysis, which comprises bringing the metal to a molten state and purifying it, introducing chemical constituents of the metal to be produced in a gaseous state into and through the molten mass in intimate contact therewith, and controlling the temperature and pressure of the molten mass under treatment to control the incorporation by absorption of said chemical constituents in the metal.

In testimony whereof I affix my signature.

CHARLES W. HILL.