May 17, 1932. E. L. IVES 1,858,548

METHOD OF MAKING MALLEABLE IRON

Filed Jan. 24, 1929

Fig. 1.

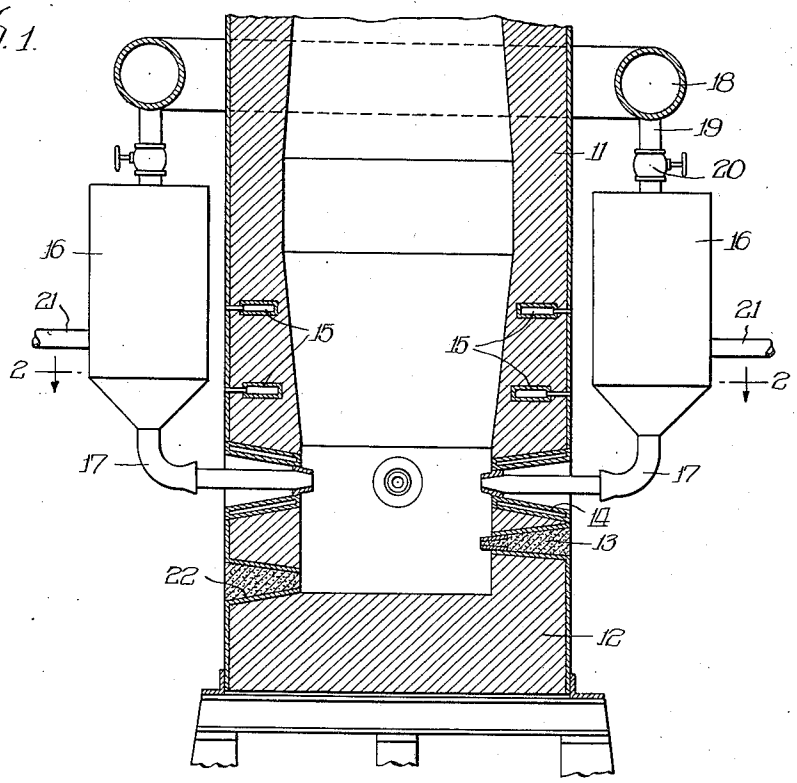
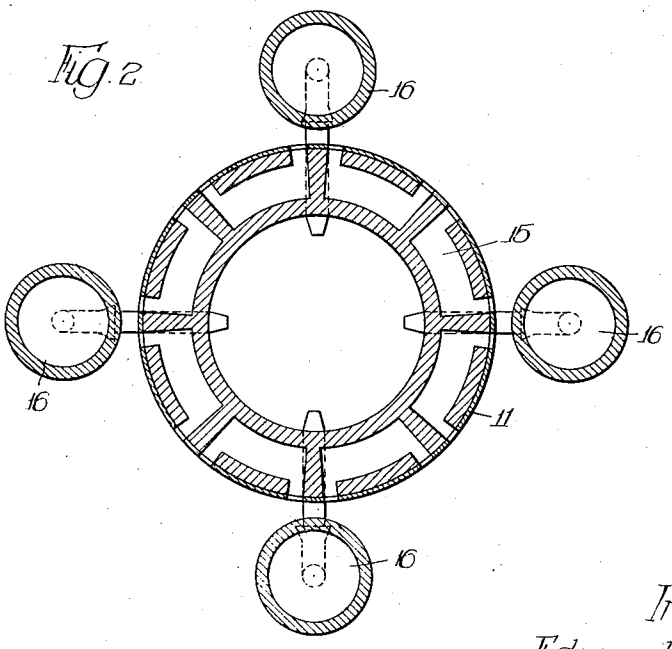


Fig. 2.



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METHOD OF MAKING MALLEABLE IRON

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This invention relates to a new and improved method of making malleable iron for castings to be annealed.

Under the present usual methods of making malleable iron, pig iron of the proper analysis is melted in an air furnace, which is a rectangular furnace built up of refractory material. Oil, gas or powdered coal are used as fuel and the flame and products of combustion pass over the iron, and the carbon in the iron is reduced to the required percentage through contact with the oxidizing flame or through additions of steel scrap or other low carbon material. The fuel cost by this method is very high due to radiation losses, the high temperature of the stack gases leaving the furnace, and also due to the fact that the process is intermittent. The furnace is tapped out periodically and a new cold charge is then placed in the furnace. This method is also expensive due to high repair cost for the upkeep of the furnaces. The reason for employing the air type of furnace lies in the fact that decarbonization can be accomplished without any notable increase in sulphur content, sulphur being an element which is detrimental to the finishing or annealing of the casting.

It is an object of the present invention to provide a new and improved method for the production of malleable iron, whereby such iron may be produced by a continuous process, or may be produced intermittently with low thermal loss if desired.

It is a further object to provide a method of this character which may be carried out in a shaft type of furnace.

It is an additional object to provide such a method which does not add objectionably to the sulphur content of the iron produced.

Other and further objects will appear as the description proceeds.

I have shown somewhat diagrammatically in the accompanying drawings one form of furnace adapted for carrying out my improved method.

In the drawings—

Figure 1 is a vertical section of the lower portion of the furnace; and

Figure 2 is a horizontal section taken on line 2—2 of Figure 1.

In the drawings, the lower portion of the furnace 11 is provided with a closed bottom 12, a cinder notch 13, a tapping hole 22, and a plurality of water cooled tuyère blocks 14. The furnace walls are also provided with a plurality of water cooled bosh plates 15 which may be supplied with cooling water in any desired manner.

A plurality of combustion chambers 16 are located adjacent the furnace and passages 17 lead from the combustion chambers into the furnace chamber through the tuyère blocks 14. The bustle pipe 18 leads air and fuel to pipes 19 which are controlled by valves 20. These pipes 19 are connected to suitable nozzles or ports in the chambers 16, depending upon the type of fuel used, which may be powdered coal or slack or coke breeze or any type of liquid or gaseous hydrocarbon. The passages 21 are provided to introduce secondary air into the combustion chambers 16. The furnace charge may be supported in the furnace on a bed of coke or other loose material located at the point of entrance of the hot gases into the furnace.

This furnace may be operated continuously to produce malleable iron and hence the heat losses due to intermittent operation are obviated. The combustion in the separate combustion chambers may be so maintained as to maintain a neutral atmosphere in the cupola or shaft furnace, and the decarbonization accomplished by the addition of iron ore of suitable analysis to the charge of pig iron. A small amount of coke may be charged with the iron and ore in addition to the initial charge of coke which serves to support the charge in the cupola.

Where a material portion of the charge consists in iron ore, the combustion may be so controlled as to give a somewhat reducing atmosphere in the cupola for the reduction of the ore. The reduction may take place in whole or in part directly with coke in the charge at the higher temperatures lower in the furnace.

In this method of operating the cupola, using combustion chambers external to the

heating chamber of the furnace, it will be understood that while normally the entire combustion will take place in the combustion chambers, the combustion may extend to some extent into the furnace chamber or secondary air may be admitted to the cupola in conjunction with the products of combustion from the combustion chambers.

In numerous experiments in developing the present invention it was determined that little or no sulphur is added to the melted iron and that by charging ore with the pig iron and coke, the carbon content of the molten iron can be reduced to any desired point, so that a base malleable hot metal can be produced by my new method that will have the desired carbon and sulphur.

Another advantage of my method is the low cost of melting together with greater capacity of melting for each furnace installed. It also has the advantage that the production of hot metal can be started at will by applying the powdered coal and stopped by shutting it off, or the rate can be increased or decreased by varying the amount of powdered coal or other fuel burned per unit of time. I preferably use the type of furnace described above which permits of continuous operation without shutting down for repairing the bottom.

My invention is capable of being carried out in other forms of apparatus and I contemplate such changes and modifications as come within the spirit and scope of the appended claims.

I claim:

1. The method of making malleable iron which comprises melting pig iron together with iron ore in a reducing atmosphere in a shaft furnace whereby the iron ore is reduced and the resultant iron from the pig iron and ore may have a carbon content lower than that of the pig iron in the charge.

2. The method of making malleable iron which comprises melting pig iron together with iron ore, in a vertical melting chamber by passing through said materials in the chamber the highly heated products of combustion carried on externally of the heating chamber, the pig iron and ore being so proportioned as to give a resultant iron of a selectively determined carbon content less than that of the pig iron of the charge.

Signed at Chicago, Illinois, this 17th day of January, 1929.

EDWARD L. IVES.