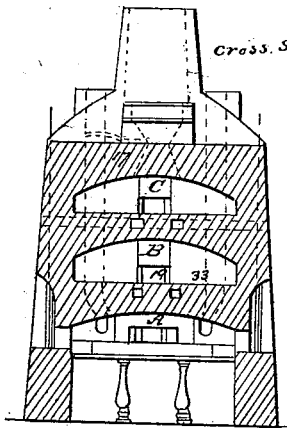
M. S. SALTER.

Furnace for Making Wrought Iron.

No. 6,886. Patented Nov. 20, 1849.

Fig. 1



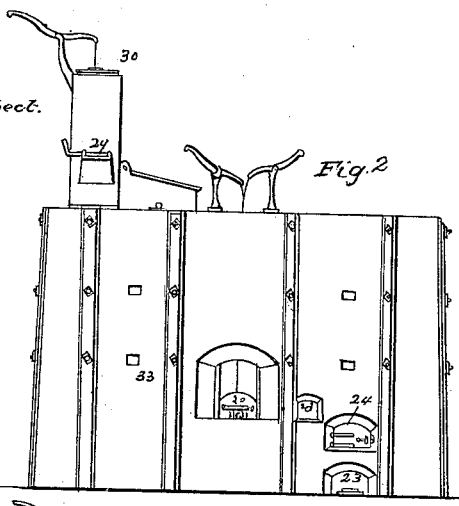


Fig. 2

Fig. 3

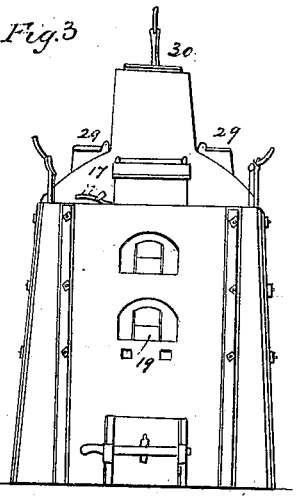


Fig. 4

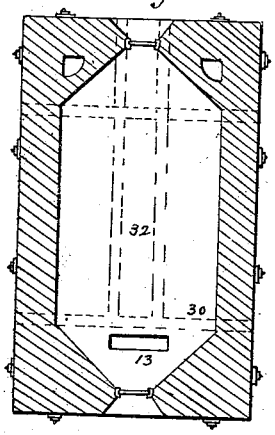


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Fig. 5

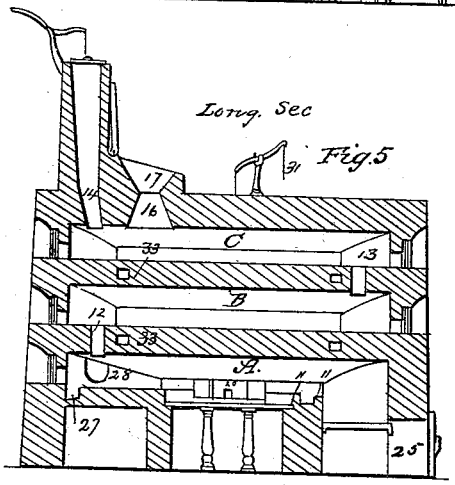


Fig. 6

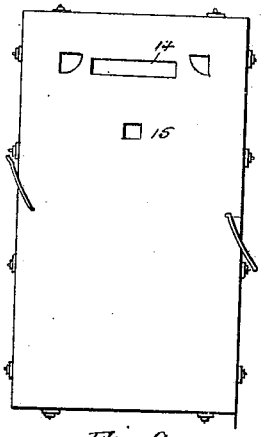


Fig. 7

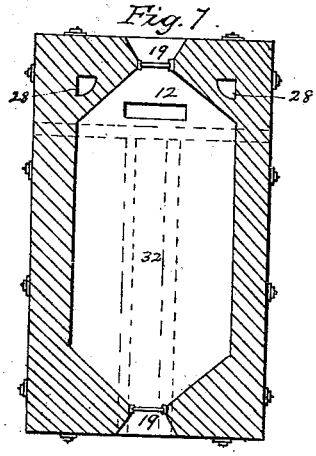


Fig. 8.

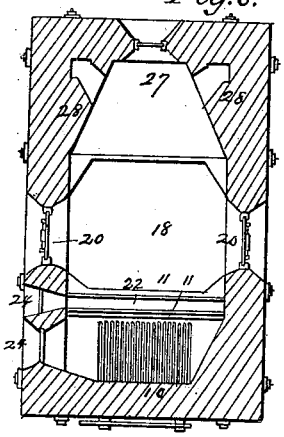
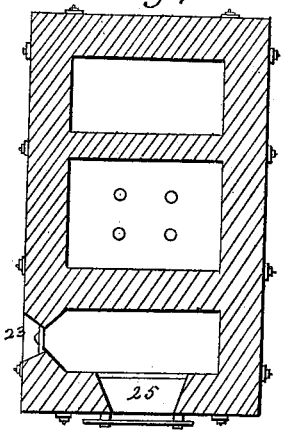


Fig. 9



UNITED STATES PATENT OFFICE.

MOSES SMITH SALTER, OF NEWARK, NEW JERSEY, ASSIGNOR TO SALTER, NORTON & POINIER.

PROCESS FOR MAKING MALLEABLE IRON DIRECT FROM THE ORE.

Specification forming part of Letters Patent No. **6,886,** dated November 20, 1849.

To all whom it may concern:

Be it known that I, MOSES SMITH SALTER, of Newark, Essex county, in the State of New Jersey, have invented a new and useful furnace for making wrought-iron of a superior quality directly from the ore in a single process and by means of anthracite or other fossil coal or charcoal; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings, making a part of this specification.

The furnace is constructed of masonry with suitable bracings, and lined in the interior, either in whole or in part, with wrought-iron, fire-brick, or other material least affected by heat. It is shaped in a square or oblong square, or round, or oval, or other most convenient form. It is divided into three compartments or chambers, situated one above another.

Figure 1 is a cross-section. Fig. 2 is a side elevation. Fig. 3 is an end elevation. Fig. 4 is the upper chamber. Fig. 5 is a longitudinal section. Fig. 6 is the top of the furnace. Fig. 7 is the middle chamber. Fig. 8 is the lower chamber. Fig. 9 is the foundation-walls.

The numbers for reference are the same for the same objects on the different figures.

The fire place or grate for fuel, No. 10, is within the furnace, and at one end of the lower compartment or chamber, Fig. 8, from which chamber it is partly separated by a wall or two parallel walls, No. 11, raised to a convenient height, and over which walls a space is allowed for the passage of the draft. The draft passes horizontally on in a reverberatory manner along the entire length of the lower chamber, A, Fig. 5; in the roof of which, at the opposite end, there is an opening, No. 12, for its passage up into the middle chamber. It passes in the same manner through the middle chamber, B, Fig. 5, to the opposite end, where there is an opening, No. 13, for its passage up into the upper chamber, C, Fig. 5. It passes again in the same manner through the upper chamber to the opposite end, where it finally escapes by a chimney, No. 14. The ores, with the necessary materials for their reduction, are introduced into the upper chamber through an opening, No. 15, in the roof. Over this opening they are first suspended in a hopper-shaped receptacle, No. 16, which receptacle is provided with a shutter below, No. 17, corresponding with the opening in the roof. The ores are then at suitable intervals of time removed to the opening for the draft, through which they are thrown down to the middle chamber. Next they are removed to the opposite end of the middle chamber, where they are thrown down through the opening for the draft to the lower chamber. Next they are removed in the lower chamber to the finishing-basin, No. 18, near the fire, where the effects of the heat are completed, and whence they are taken out in the metallic state, ready to be finished by hammering or otherwise. Through the sides of all the chambers openings No. 19 are made, through which the ores and the accompanying materials for their reduction may be frequently agitated by suitable instruments, and moved along from one end of the several chambers to the other, and finally through which (No. 20) the metal may be molded and taken out from the furnace. There is another opening, No. 21, opposite the space between the two walls which separate in part the fire-place from the first chamber. The said space No. 22 may be used for reheating the iron. It may also be omitted as not essential, and one separating-wall may be constructed instead of two. There are also openings for the blast, No. 23; for the fuel, No. 24; for the removal of ashes, No. 25, and for the letting off, No. 26, of any liquid matters which may accumulate in the finishing-furnace. Through the floor of the lower chamber there is an opening, No. 27, in the end opposite the fire, through which may fall the cinders and ashes and other solid materials carried along thither by the draft. For the same purpose other suitable receptacles are provided in the other chambers.

To prevent an undue accumulation of heat in the middle and upper chambers, or to prevent the introduction into said chambers of cold air, or air charged with oxygen, coming through openings in the lower chamber, flues No. 28 are made to lead from the lower chamber upward directly through the top of the furnace. These flues are ordinarily kept closed

by dampers No. 29 on their tops, and when they are opened the draft is prevented from pursuing its ordinary passage by a suitable damper, No. 30, metallic or otherwise, closing the top of the chimney. Further, to prevent the too violent effects of the heat, openings No. 33 are made in the sides and ends of the furnace for the introduction of cold air between the roof of the lower chamber and the floor of the middle chamber, and also between the roof of the middle chamber and the floor of the upper chamber. The spaces between the roof of one chamber and the floor of the succeeding chamber above may be greater or less at convenience. Levers No. 31, with cords, chains, or rods attached, are mounted on the top of the furnace for working the shutters in the usual manner. The floors No. 32 of the several chambers may be either horizontal or inclined. The lower chamber is raised up from the ground for the convenience of working, for the easy flowing away of liquid impurities, and for the falling down of ashes and cinders.

The construction of my furnace as above specified affords the following advantages: First, the gradual heating of the ores with the necessary materials for their reduction as they are moved nearer to the fire from chamber to chamber, and from one end of a chamber to the other end; second, opportunity is afforded for the frequent agitation of the ores with their accompanying materials, by which agitation the impurities are freely allowed to escape, the ores and their accompanying materials become well and properly mixed together, and all the ores and their accompanying materials become in turn equally exposed to the heat and to the draft; third, the opportunity for the ores and their accompanying materials to fall down from chamber to chamber, this being attended with all the several advantages enumerated as attending agitation, with this addition, that these advantages are varied and modified somewhat differently in falling down, and are rendered more complete, at the same time that they retain their elevated temperature. The draft is unconfined and moves freely and rapidly for carrying off the impurities. The atmospheric air is deprived for the most part of its free oxygen by the fuel of the fire-place, and therefore, while passing rapidly through the ores, it does not oxidize the metal, and does not consume the carbon, which is consequently allowed freely to extract the oxygen from the ores. By this gradual heating and freedom of draft and frequent agitation an opportunity is afforded for the free escape of impurities in their natural order, beginning with the more volatile and ending with the more fixed. Such escape of gaseous products is more difficult, while a mass of solid materials, from which they are generated, remains at rest. The agitation may be carried on at different temperatures, so that the objects which it cannot effect at one degree of heat it will at another. This is the purpose of the three several chambers, of which the upper is the heating and vaporizing, the middle the mixing, and the lower the reducing and finishing chamber.

The ores can be reduced to metals of more than ordinary purity by the above-mentioned means provided for the escape of their impurities. The ores of iron may be reduced to wrought or malleable iron without first carbonizing the iron. The ores of iron may be reduced also to a carbonized state, either as steel or as cast or pig iron. This may be done by having less agitation and adding an excess of carbon.

The necessary materials for the reduction of the ores may be introduced at different temperatures and at different stages of reduction, according as their presence may be needed, For example, when lime is required for separating silica from iron ore, such lime need not be introduced at the beginning of the process, when the temperature is low, for at such temperature it cannot act upon the silica, and its presence would certainly interfere with the free expulsion of other impurities. It may, therefore, be introduced partly in the middle and partly in the lower chamber as it may take due effect, and in quantities as it may be needed. The carbonic-acid gas evolved from the limestone or shells introduced in the lower chamber tends to protect the carbon and ores and impurities from the residuum of free oxygen left in the draft.

Another great advantage from the use of my furnace is that it yields a greater percentage of metal from any given amount of ore than is obtained by other furnaces heretofore used, the ores and the necessary materials for their reduction being through the whole process completely under control, subject to such various treatment as they may require at different stages of reduction, and opportunities being afforded for the escape of impurities without their combining with and carrying off the metals.

One of the great advantages for the reduction of iron ores by my furnace is this, that it will reduce such ores by the use of anthracite coal alone, both as fuel and as the deoxidizing agent on the ores. The impurities of that coal—such as sulphur—are expelled at a low temperature before such coal acts on the ore, and consequently before the metals still in the ore can be effected by such impurities.

Another important advantage is the saving of coal to a large amount, both as a fuel and as a deoxidizing agent. This is effected as a deoxidizing agent because no more coal is used than is necessary to extract the oxygen from the ores, none entering into the iron, and also from the rapidity of the operation, very little being carried off by the draft.

The saving of coal as fuel is effected partly by the various facilities already enumerated for the expulsion of impurities, partly by the prevention of the escape of heat, one chamber being compacted upon another, and partly by

the long continuous range of the draft, to the whole force of which the ores are exposed by their position, agitation, and falling.

By the freedom of draft in my furnace there is no mechanical pressure by said draft upon the ores. Therefore it cannot by the force of such pressure prevent the chemical decomposition of the ores, nor carry away the pulverized particles of ores and carbon.

I am aware that ores are roasted in kilns and furnaces separate from the furnaces in which they are afterward fluxed and reduced, and also that in forge-fires and similar iron-works the flux is added in the ordinary working-hearth, where it is necessarily heated at considerable expense of time and fuel, and, finally, that in high-blast furnaces the flux is simply mixed with the ore, usually in separate charges, and that under this treatment the ore and flux are often very imperfectly mixed and incorporated; and it is to overcome these different imperfections of the ordinary processes of making iron that my plan of operations has been devised. I flux my ore by working in a separate and appropriate chamber.

What I claim as my invention, and desire to secure by Letters Patent, is—

The process of manufacturing iron directly from the ore in a furnace composed of three combined chambers one above another, all actuated by the same fire, whereof the upper chamber is used for heating and deoxidizing, the middle chamber for fluxing and working, and the lower chamber for reducing and finishing the iron, substantially in the manner and for the purposes herein set forth.

M. SMITH SALTER.

Witnesses:

A. S. HAMLIN,

WM. WILLIAMS.