E. H. ROTHERT.

REDUCTION FURNACE.

APPLICATION FILED JAN. 21, 1911.

1,007,606. **Patented Oct. 31, 1911.**

3 SHEETS—SHEET 1.

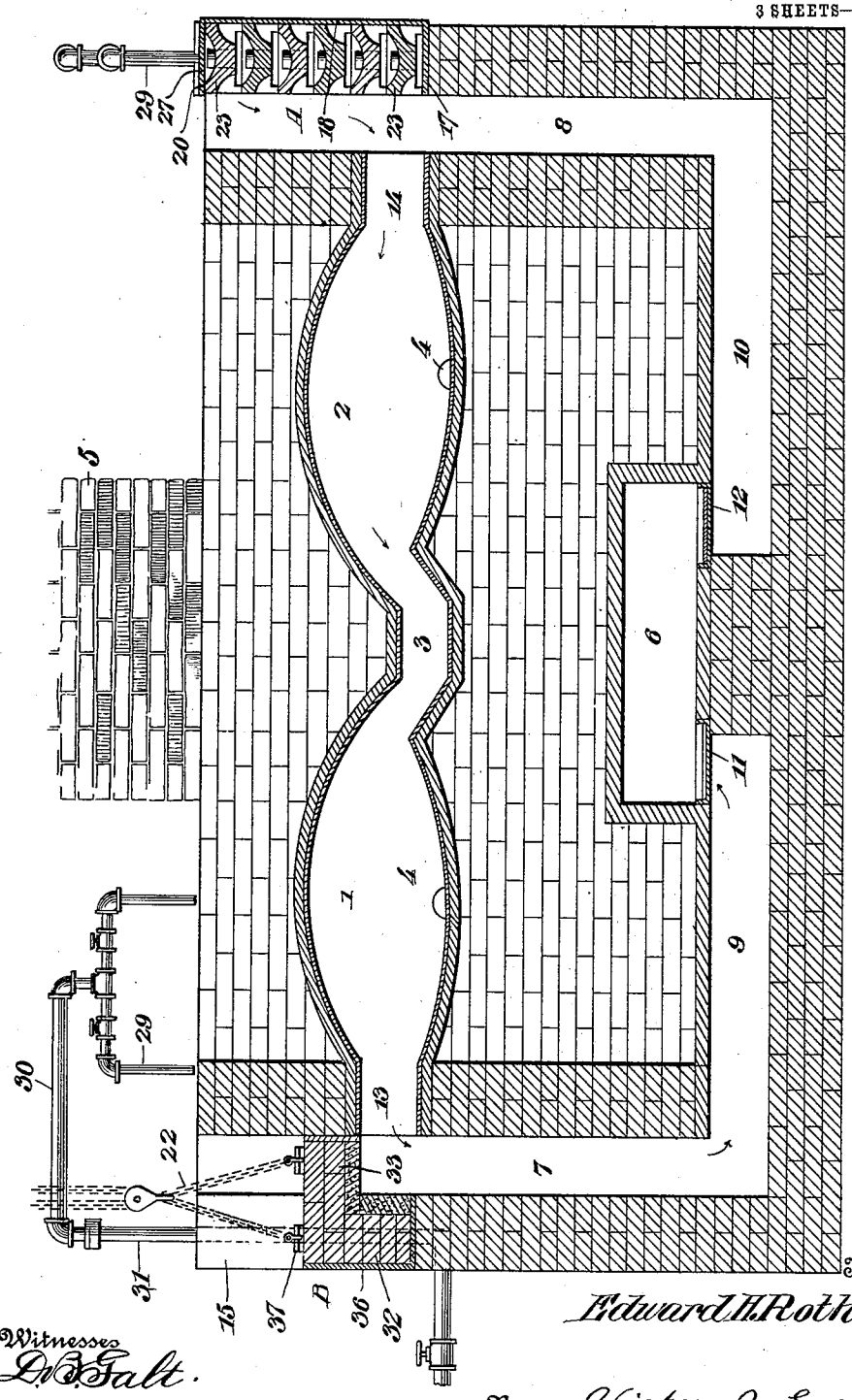

Fig. 1.

Witnesses
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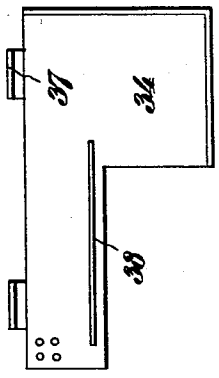
3 SHEETS—SHEET 2.



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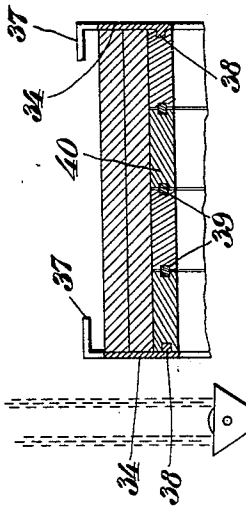

Fig. 5.

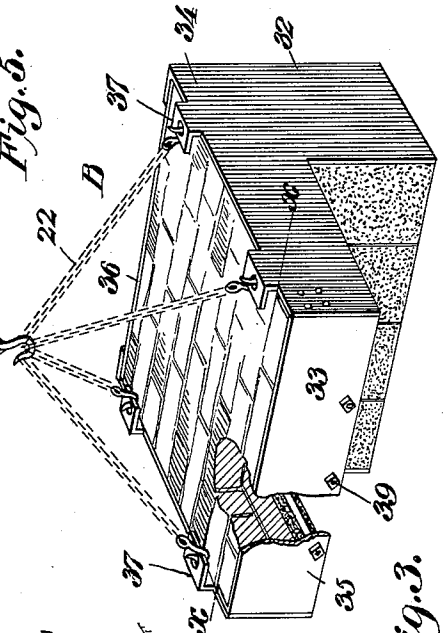

Fig. 3.

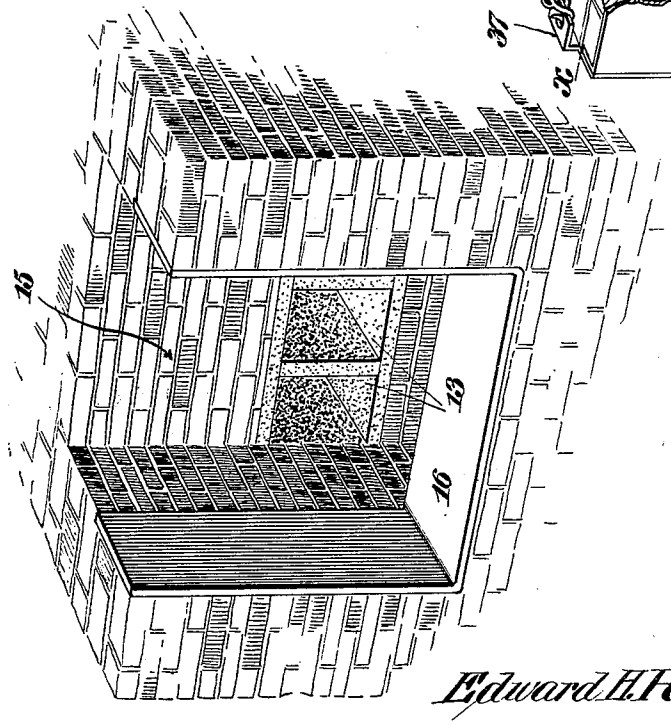

Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 6.

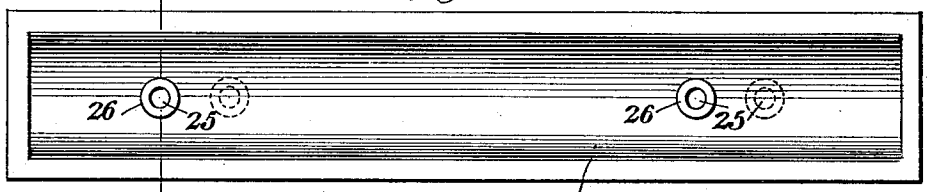
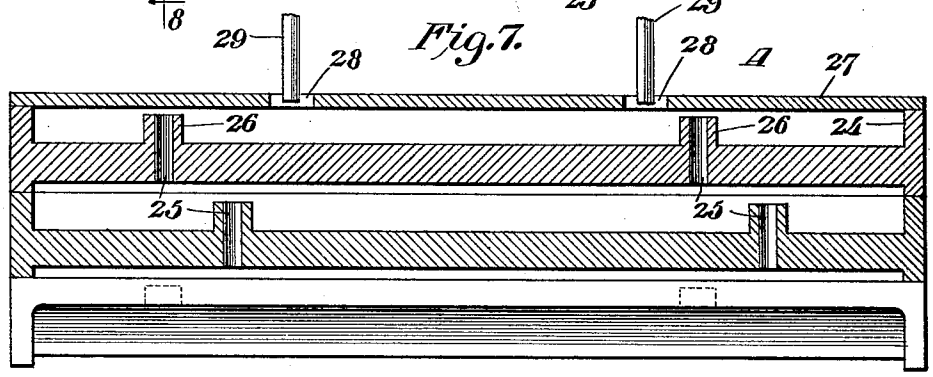


Fig. 7.



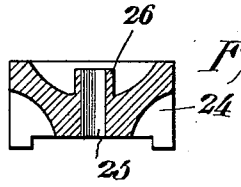


Fig. 8.

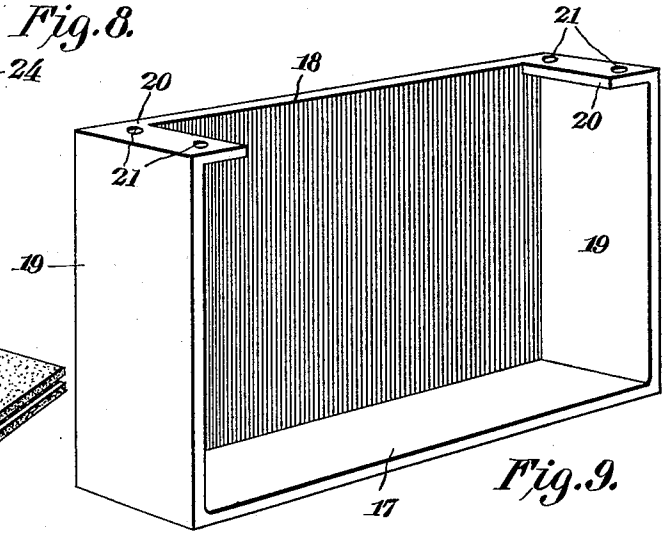


Fig. 9.

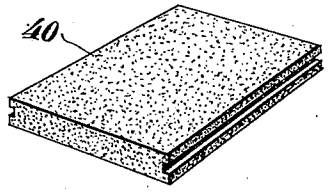


Fig. 10.

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UNITED STATES PATENT OFFICE.

EDWARD H. ROTHERT, OF LEAVENWORTH, WASHINGTON.

REDUCTION-FURNACE.

1,007,606. Specification of Letters Patent. Patented Oct. 31, 1911.

Application filed January 21, 1911. Serial No. 603,903.

To all whom it may concern:

Be it known that I, EDWARD H. ROTHERT, a citizen of the United States, residing at Leavenworth, in the county of Chelan and State of Washington, have invented new and useful Improvements in Reduction-Furnaces, of which the following is a specification.

The invention relates to furnaces particularly designed for reducing ore and is designed most especially to provide a furnace which will save time and economize in fuel, the furnace embodying two reduction chambers and independent passages leading to a single stack, one of the chambers containing the ore to be reduced and the other chamber containing the ore which is partially reduced by the heat escaping from the chamber in which the reduction of the ore is taking place.

A further purpose of the invention is the construction of a furnace in which the burner is adapted to be moved from one chamber to the other and a deflector likewise made movable so that the direct heat may be applied alternately to the chambers, thereby combining in one furnace the advantages of two furnaces.

The invention consists of the novel features, details of construction and combination of parts, which hereinafter will be more particularly set forth, illustrated in the accompanying drawings, and pointed out in the appended claims.

Referring to the drawings, forming a part of the specification, Figure 1 is a vertical central longitudinal section of an ore reducing furnace embodying the invention. Fig. 2 is a detail perspective view of the upper part of an end of the furnace, showing the space adapted to receive either the deflector or the gang of burners. Fig. 3 is a perspective view of the deflector, showing a part of the tackle for suspending and transferring both the deflector and gang of burners from one end of the furnace to the other. Fig. 4 is a view in elevation of one of the side pieces of the deflector as seen from the inner wall. Fig. 5 is a section of the upper part of the deflector on the line *x*—*x* of Fig. 3. Fig. 6 is a top plan view of one of the burners. Fig. 7 is a vertical central longitudinal section of a number of burners placed one upon the other, showing the cap and the oil supply pipes. Fig. 8 is a transverse section on the line 8—8 of Fig. 6. Fig. 9 is a perspective view of the frame for receiving the gang of burners. Fig. 10 is a detail perspective view of one of the tiles forming the part of the deflector which extends over the passage.

Corresponding and like parts are referred to in the following description, and indicated in all the views of the drawings, by the same reference characters.

The furnace may be of any construction and comprises two chambers 1 and 2 which are arranged in substantially the same horizontal plane and are connected by means of a narrow passage 3. An opening 4 is provided for drawing off the metal after the ore has been reduced. The stack 5 communicates with a passage 6, which occupies a central position and is located below the passage 3 connecting the reducing chambers 1 and 2. Vertical passages 7 and 8 are formed in the end walls of the furnace and communicate with horizontal passages 9 and 10. Dampers 11 and 12 control communication between the passages 6, 9 and 10. The passage 7 communicates at its upper end with the reduction chamber 1 through an opening 13. The passage 8 communicates with the chamber 2 through an opening 14. A heater A is provided for reducing the ore and may be located at either end of the furnace. A deflector B is also provided to be located at either end of the furnace to direct the heat escaping from the second chamber into the passage communicating therewith so as to pass off through the stack 5. The parts A and B are adapted to be interchanged so that the ore may be completely reduced in one of the chambers and partly roasted in the other and vice versa. The deflector is of such construction as to close the upper portion of the vertical passage above the opening establishing communication between the vertical passage of the reduction chamber, thereby preventing the escape of the gases through the vertical passage after leaving the second chamber. The upper portion of each end wall of the furnace above the plane of the reduction chambers is formed with a recess 15, which is protected by means of a metal lining 16, as indicated most clearly in Fig. 2, said recess being adapted to receive either the deflector or heater.

The heater A comprises a frame, as indicated most clearly in Fig. 9, said frame consisting of a bottom 17, a back 18, and end

walls 19, the latter having inwardly extending flanges 20 at their upper ends in which openings 21 are formed to receive hooks or attaching devices at the ends of chains or like connections 22 forming part of a hoisting tackle for lifting and transferring the heater and the deflector from one end of the furnace to the other. The frame is adapted to receive a gang of burners, each burner being of rectangular form and consisting of a shallow trough 23 and end pieces 24, the latter closing the ends of the trough and forming supports for the burner. The burners are placed one above the other in vertical position and are spaced apart to admit of air having free access thereto so as to support combustion. The burners have openings 25 in their bottoms through which the liquid fuel is adapted to pass from one burner to the burner next below. Short tubes 26 project vertically from the bottom of each burner in line with the openings 25 thereof, the upper ends of the tubes 26 terminating a short distance from a horizontal plane touching the upper edge of the burner so that liquid fuel will overflow the tubes 26 and pass down through the openings 25 before overflowing the walls of the burner. The openings 25 are arranged so as not to aline vertically, with the result that oil overflowing one burner is received by the burner next below and so on through the series, thereby keeping the oil in all the burners of the series at a given level or supplied with a proper amount of fuel. A cap plate 27 is placed over the top burner of the series and has openings 28 through which the delivery ends of oil pipes 29 project for supplying liquid fuel, such as crude petroleum, to the topmost burner, which when full overflows, the oil being received in the burner next below, each burner in order being supplied with oil to a level corresponding with the plane of the upper ends of the tubes 26. The back 18 of the frame confines the flame from the burners, thereby causing such flame to pass into the vertical passage, thence into the reducing chamber adjacent the heater so as to thoroughly reduce the ore therein. The gases and products of combustion pass from the first or primary reducing chamber into the second chamber through the opening 3, thence into the vertical passage at the opposite end of the furnace down through the horizontal passage into the passage 6 and out through the stack 5. The supply pipes 29 are carried by a pipe 30, which has swivel connection with a pipe 31, thereby admitting of the pipes 29 being thrown out of the way when shifting or moving the heater and deflector from one end of the furnace to the other.

The deflector B is substantially of L-form and comprises a vertical member 32 and a horizontal member 33. The vertical member 32 is adapted to fit within the recess 16 at either end of the furnace and the horizontal member 33 is adapted to extend over the upper portion of the vertical passage so as to close the latter and cause the products of combustion to pass downward through the passage and out through the stack. The deflector comprises a metal frame and a filling of tile and fire brick or like refractory material. The tile is arranged to receive the direct action of the heat and is backed up by fire brick or like material. The metal frame is formed of end pieces 34 of L-form, a front 35 and a back 36, the several parts being bolted or otherwise secured. Ears 37 project inwardly from the upper edges of the end pieces 34 and are apertured to receive the hooks or attaching devices at the ends of the chains or flexible connections 22. Horizontal ribs 38 are formed upon the inner sides of the end pieces 34 and in conjunction with bars 39 support the tiles 40, which line the lower side of the horizontal portion of the deflector. The tiles 40 have grooves in their edges which receive the ribs 38 and bars 39, as indicated most clearly in Fig. 5.

The dampers 11 and 12 may be of any construction so as to control communication between the passage 6 and the passages 9 and 10. When the damper 12 is closed and the damper 11 open the hot air, gases and products of combustion pass from the chamber 1 into the passage 7, through passage 9 into passage 6 and out through the stack 5. It is assumed that the heater A is at the right hand end of the furnace and the deflector B at the left hand end, as indicated in Fig. 1. The flame from the heater passes through opening 14 into chamber 2, thereby reducing the ore contained therein, after which the heat passes through the passage 3 into the chamber 1, partially roasting the ore contained therein. After the ore has been reduced in the chamber 2 the heater A is transferred from the right hand end of the furnace to the left hand end and the deflector B is moved from the left hand end of the furnace to the right hand end. The chamber 2 is tapped to draw off the metal and the residue is removed and a new charge supplied thereto. The partially roasted ore in chamber 1 is now completely reduced and the fresh charge in the chamber A is roasted. After the ore has been reduced in the chamber 1 the latter is tapped and the heater and the deflector are again moved to change positions. It will thus be understood that the furnace performs the same office as two furnaces and utilizes the heat from the primary reducing chamber to partially roast the ore in the secondary chamber. Time is thus saved and an economy in the consumption of fuel effected.

From the foregoing description, taken in connection with the accompanying drawings, the advantages of the construction and of the method of operation will be readily apparent to those skilled in the art to which the invention appertains, and while I have described the principle of operation of the invention, together with the device which I now consider to be the embodiment thereof, I desire to have it understood that the device shown is merely illustrative, and that such changes may be made when desired as are within the scope of the claims appended hereto.

Having thus described the invention what is claimed as new, is:—

1. An ore reducing furnace comprising intercommunicating chambers and having damper controlled passages connecting the terminal chambers with the stack, a heater adapted to be removably fitted to either end of the furnace, and a deflector likewise adapted to be fitted to either end of the furnace so that the heater and deflector may alternately interchange places to admit of thoroughly reducing the ore in one chamber and partially roasting the ore in the other chamber and vice versa.

2. An ore reducing furnace provided with two horizontally disposed chambers having communication at their inner ends, said furnace having vertical passages at its ends and damper controlled passages connecting said vertical passages with the stack and said furnace further provided with recesses in its end walls in communication with the vertical passages, a heater adapted to be fitted in either of the recesses, and a deflector adapted to be removably fitted in the other recess, said heater and deflector being alternately interchangeable for reversing the direction of flame through the reduction chambers.

3. An ore reducing furnace having horizontally arranged intercommunicating chambers and having vertical passages in communication with the outer ends of the chambers and having damper controlled passages connecting the vertical passages with the stack, said furnace being further provided with recesses leading into the vertical passages, a heater adapted to be fitted in either one of said recesses, and a deflector of substantially L-form adapted to be fitted in either one of said recesses, said heater and deflector being alternately interchangeable to reverse the direction of the flame through the reduction chambers.

In testimony whereof I affix my signature in presence of two witnesses.

EDWARD H. ROTHERT.

Witnesses:
L. J. NELSON,
WM. KNOWLTON.