June 19, 1923. 1,459,533

H. D. HIBBARD

PUDDLING FURNACE

Filed May 11, 1921 2 Sheets-Sheet 1

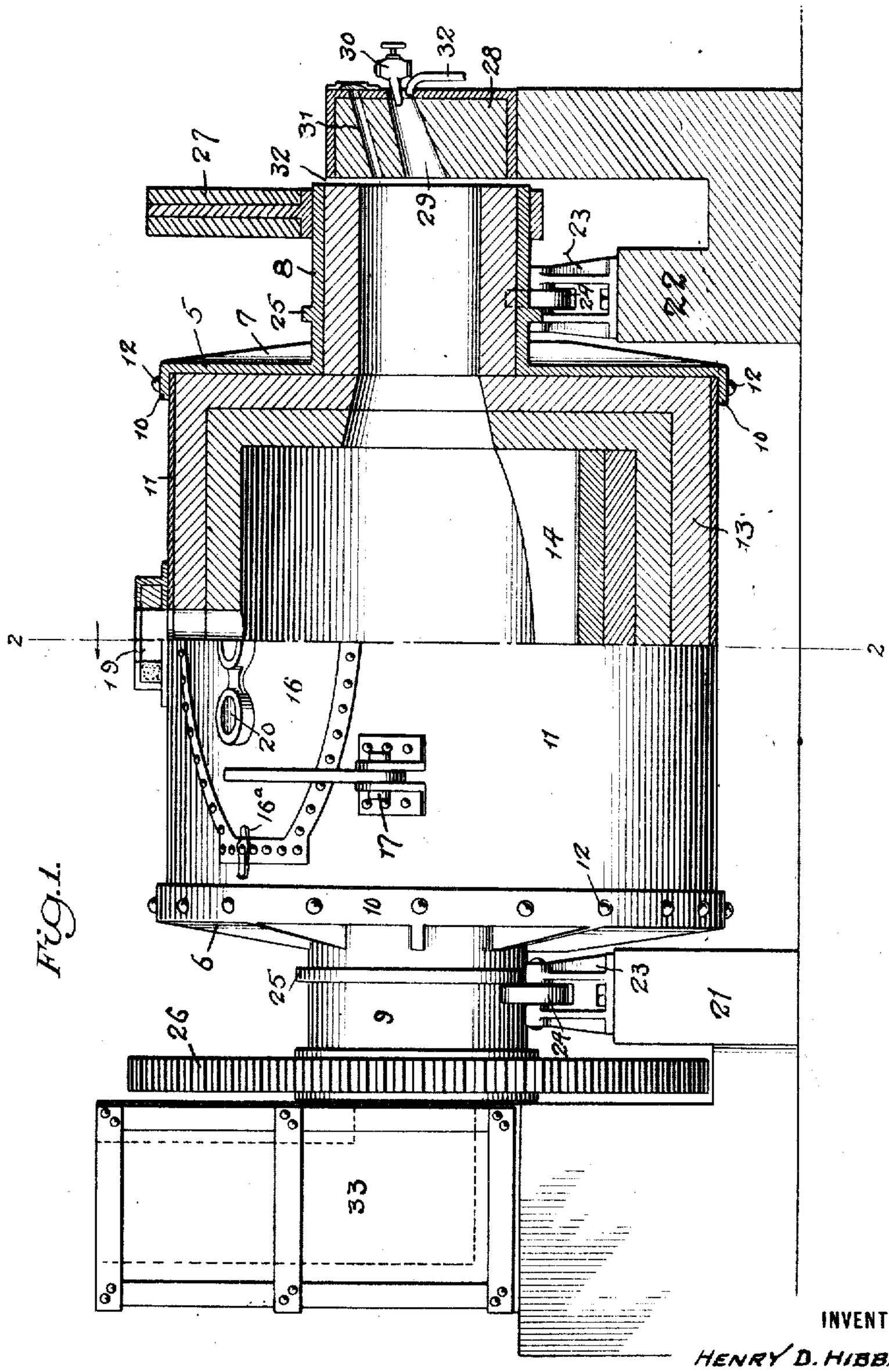

Fig. 1.

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2 Sheets-Sheet 2

Fig. 3.

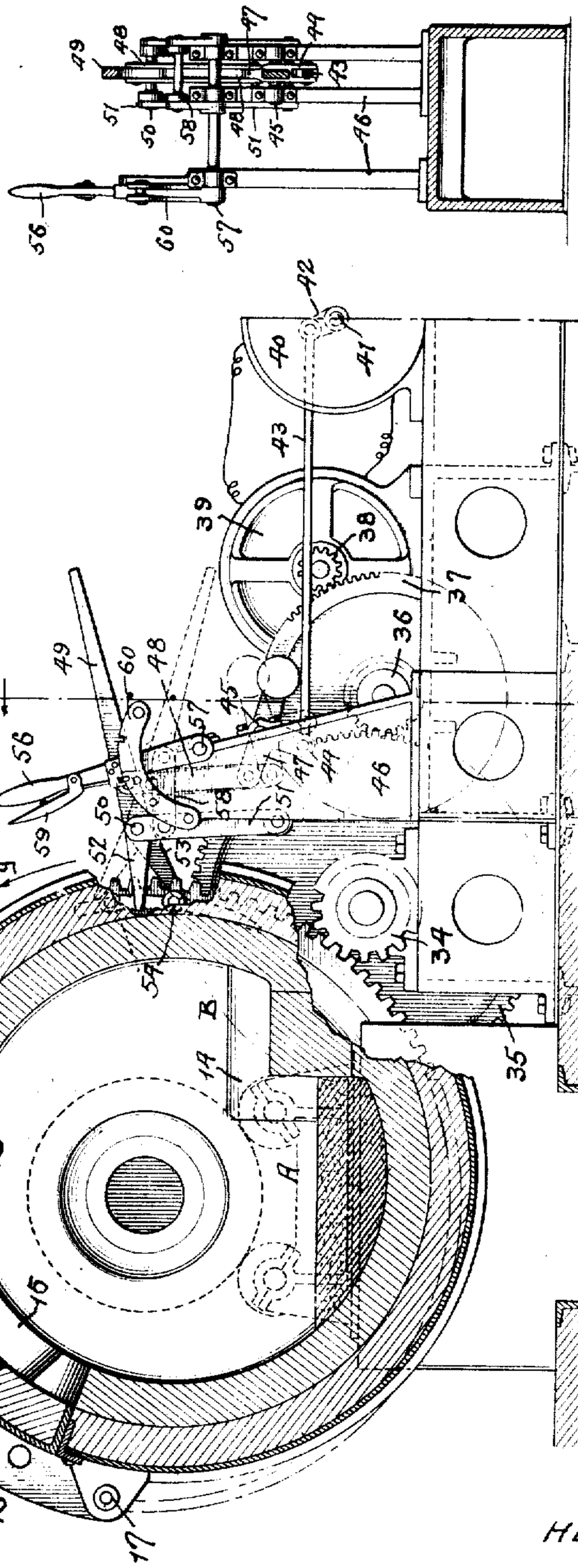

Fig. 2.

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Patented June 19, 1923. 1,459,533

UNITED STATES PATENT OFFICE.

HENRY D. HIBBARD, OF PLAINFIELD, NEW JERSEY, ASSIGNOR TO HIBBARD PROCESS CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

PUDDLING FURNACE.

Application filed May 11, 1921. Serial No. 468,709.

To all whom it may concern:

Be it known that I, HENRY D. HIBBARD, a citizen of the United States of America, residing at Plainfield, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Puddling Furnaces, of which the following is a specification.

My invention relates to puddling, and the object of my invention is to improve in certain features upon the puddling furnace and operations described in my Patent No. 1,362,532, dated December 14, 1920.

In the accompanying drawings—

Fig. 1 is a side elevation, partially in section, of a puddling furnace in which my furnace improvements are embodied in one form;

Fig. 2 is a section on the line 2—2, Fig. 1, partially broken away however; and

Fig. 3 is a section on the line 3—3, Fig. 2, showing the controlling gear.

The construction of a furnace to carry out the puddling reaction can be much simplified, over that disclosed in my prior patent, by making the reaction vessel or basin of cylindrical form, as shown in the accompanying drawings. As here indicated the basin comprises a pair of steel end castings 5 and 6 suitably reenforced by ribs 7 extending radially from the hollow end trunnions 8 and 9 integral with the head castings 5 and 6. The latter are also provided with marginal flanges 10, which embrace the rolled steel shell 11 and are fastened thereto at 12. A lining 13 of basic or neutral brick is provided.

Extending from end to end of the reaction chamber is a dam or partition 14, preferably concave, as indicated, the better to support the bricks, which thus form an arch when the basin is rotated to bring the dam to over-head position. At a suitable point in the wall of the chamber, and preferably at a point substantially opposite that at which the dam 14 is located, a discharge opening 15 is formed. This opening is more or less elliptical, with its long axis substantially parallel to that of the reaction chamber. The bricks at the door opening form oppositely faced longitudinal arches and thus support themselves as well as the lining when the furnace is in such position that displacing strain is imposed thereon. The door 16, hinged at 17 to the shell, and provided with any suitable latching device 16ª for holding it normally shut, closes the opening 15 during the progress of the reaction. It is of course shaped to the door opening, with longitudinally curved sides, and is wider at the center than at the ends. An independent charging, and slag discharging, port 18 is formed adjacent the door opening 15, and has associated with it a short exterior spout 19 for leading off the slag. Peep holes 20 may be formed in the door to permit the progress of the reaction to be followed by the attendant.

At opposite ends of the furnace are arranged suitable pedestals 21 and 22, on which are supported brackets 23, each carrying a pair of rollers 24 upon which the trunnions 8 and 9 freely rest. Annular ribs 25 on the trunnions engage the rollers and maintain the basin in predetermined position with respect thereto. On the trunnion 9 is mounted a gear wheel 26 for rocking the basin in the manner hereinafter specified. Where the trunnions are arranged eccentrically with respect to the axis of the furnace body, as indicated in the drawings, (although a concentric arrangement may be employed if preferred) I prefer to mount upon one of the trunnions, for example, upon trunnion 8, an eccentric counterweight 27 to balance the overweight of the body with respect to its axis of oscillation.

Supported upon the pedestal 22, adjacent the end of the trunnion 8, is a block 28 having a passage 29 downwardly directed toward the furnace chamber, and through which may be introduced into the latter a combustible gas or fuel directed thereinto by the nozzle 30. A peep hole 31 may be opened in the block for observing the condition of the flame. A pipe 32 of any suitable size is provided, to lead in, preferably under pressure, the necessary air to support combustion.

Supported upon the pedestal 21, adjacent the end of the trunnion 9, is a stack 33, which is also movable toward or from the trunnion. The ready separation of the block 28 and stack member 33 from the ends of the trunnions 8 and 9 makes it possible quickly and readily to lift the basin from

the supporting bearings 24 and drive connections, for repairs. It may be immediately replaced by another furnace unit, so that puddling operations need be interrupted for only the very short time required to effect the change.

As pointed out in my prior patent, the operation of a puddling furnace of the present type is incident to an oscillation of the basin during the reaction period, followed by a sufficient rotation of the furnace to permit the slag and worked or balled metal to be successively discharged. A suitable driving mechanism for this purpose is indicated in Figs. 2 and 3. Meshing with the gear 26 is a pinion 34 connected through the gear train 35, 36, 37 and 38 with a reversing motor 39, preferably an electric motor, as indicated. To effect the reversal of this motor, I provide a reversing switch 40, the details of which are not shown, but which is provided with an operating spindle 41 with crank arm 42 and connecting rod 43. The latter engages, at its opposite end, one arm 44 of a counterweight bell-crank lever, pivoted at 45 to the standard 46 and having its other arm 47 connected by link 48 to a lever 49. The latter in turn is pivoted at 50 to a link 51 supported by the standard, and is provided with a forked end, the legs 52 and 53 of which straddle the gear 26. Projecting from opposite sides of the latter are studs 54 and 55, which engage one or the other of the legs 52, 53 of the lever 49 and swing the latter either up or down, depending upon the direction of rotation of the gear 26. The location of the studs on the gear 26 is angularly adjustable to control the pour of the charge over the dam at desired intervals, it being possible by the relative location of the studs on the gear to increase or decrease the extent of the oscillation, while still maintaining the charge in the lower portion of the hearth of the basin without coming dangerously close to the door opening. The motion in one direction or the other, imparted by the studs to the lever 49, is transmitted by the latter through the bell-crank 44—47 to the connecting rod 43, and shift the switch through the operating spindle 41 thereof, and thus reverses the motor 39. The drive obtained in this fashion suffices for the oscillation of the basin during the reaction period.

In order to permit the basin to be rotated sufficiently far to dump the slag and charge after the reaction is complete, I provide a hand lever 56 pivoted at 57 on the standard 46 and connected by a link 58 to the link 51, on which the forked lever 49 is supported. By shifting the hand lever 56 in the direction of the arrow X, the lever 49 is moved away from the gear 26 so that its forked ends 52 and 53 are not longer in the path traveled by the pins 54 and 55. A latch 59 associated with the hand lever and engaging the notched segment 60 holds the hand lever in its withdrawn position. The switch shifting lever 49 may now be operated by hand to control at will the extent and direction of rotation of the furnace.

The operation of the furnace may be substantially the same as that described in my previous patent above mentioned. Thus, a charge of iron, preferably melted, is introduced into the basin together with a suitable quantity of a suitable oxidizing reagent, such as oxide of iron, preferably melted, to oxidize the non-ferrous elements in the iron. If these charge elements are in molten condition, they may be charged through the slag opening 18, while the door 16 is maintained closed to preserve the heat of the reaction chamber. The basin is then oscillated back and forth through an arc great enough to pour the whole charge over the dam 14 back and forth from one pocket A to the other pocket B, and vice versa. This action mixes the molten iron and oxide with the result that the non-ferrous elements unite to form oxides of those elements. The first to be oxidized are the silicon, phosphorus and manganese, which give rise to an exothermic reaction, and the non-volatile oxides will enter the slag or cinder. After these the carbon is oxidized and comes off in gaseous form, as carbonic oxide (CO). With the elimination of the carbon, the fusion point of the iron of the charge rises, so that in time it separates in solid particles, or as it is familiarly termed "comes to nature." The oscillations are continued and the separated grains of iron gather together, the temperature of the charge being raised to the welding point by the flame from the burner 30, which may or may not have been previously used, depending upon the condition and nature of the charge. The masses of iron increase in size by the welding together of the gathering clusters of grains, which are brought into contact by being raised in part by the dam and then falling upon the masses upon the other side of the dam. This process is continued until the whole charge has come to nature and is stuck together in one piece, which is compacted by falling over the dam. When ready for discharge, the automatic reversing mechanism, which has occasioned the oscillation of the basin at the rate of, for example, from five to fifteen oscillations per minute, is withdrawn by the hand lever 56, and the basin is rotated in a direction opposite that of the arrow Y, to bring the slag spout 18 and door 15 successively to the lowered position. The molten slag being fluid, will first pass out through its opening 18 and spout 19, after which, upon further rotation of the basin in the same direction, the treated charge of iron in solid condition

passes out of the door 16, which, now unlatched by hand, automatically swings open in this position.

In making iron of superior quality, it is advisable to pour off the first slag containing the bulk of the silicon, phosphorus, manganese, and considerable part of the sulphur originally contained in the iron. After this slag has been drawn off fresh oxide of iron is introduced to oxidize the carbon, preferably together with such flux as may be needed to give a fluid cinder or slag—that is, some silica or fluorspar, or other flux which will tend to lower the fusion point of the cinder. The process may then be completed as described, such portion of the second slag as is not absorbed by the more or less spongy metal of the ball, being poured off in advance of the discharge of the ball.

It may be desirable to impart a more symmetrical form to the worked metal or ball after the reaction is complete. This may be accomplished by disengaging the automatic reversal mechanism and operating the control lever 49 in such manner as to roll the ball back and forth in the area between the dam 14 and the door 16, the duration of this forming operation being under the manual control of the operator at all times, and the slag being preferably retained in the chamber during this forming operation. After suitable shape has been secured the basin is rotated in the direction for discharge, until the ball rolls out of the door 16, now freed from the latch and automatically swinging open as the basin is inverted.

The present construction has the marked advantage of being much simpler to build, line, and to operate than that shown in my prior patent. It is readily removed for repairs so that another unit, ready for use, may be put in its place without any considerable interruption of work. Various modifications in detail of operation, construction and arrangement of parts will readily occur to those dealing with the subject, without departing from the underlying conceptions which I claim as my invention.

I claim—

1. A puddling furnace comprising a cylindrical reaction vessel mounted on a horizontal axis and having an interior dam extending from end to end of the reaction chamber, together with a door opening through the wall of the chamber, said opening being of greater length than width and extending in a direction substantially parallel with the length of the dam.

2. A puddling furnace comprising a cylindrical reaction vessel mounted on a horizontal axis and having an interior dam extending from end to end of the reaction chamber, together with a door opening through the wall of the chamber, said door extending substantially the full length of the reaction chamber in a direction substantially parallel to the length of the dam.

3. A furnace such as specified in claim 1, having adjacent the door an independent charging and slag discharging hole.

4. In a furnace having a reaction chamber, a hollow trunnion opening to said reaction chamber, fixed means for supporting said hollow trunnion during the operation of the furnace, means for heating the charge through said hollow trunnion, and a closure member movable toward and from the open end of the trunnion.

5. A furnace comprising a reaction chamber, a hollow trunnion open to one end of said reaction chamber, fixed means for supporting said trunnion during the operation of the furnace, means for imparting oscillatory motion thereto during the progress of reaction, and for inverting the furnace on said trunnion to discharge the product after the reaction has been completed, together with a stack movable toward and from said trunnion, for the purpose set forth.

6. A furnace comprising a reaction chamber, hollow trunnions at opposite ends thereof, fixed pedestals upon which said trunnions are freely journaled, means for imparting oscillatory motion to the furnace reaction chamber during the operation of the furnace, and for inverting the chamber for discharge after reaction has been completed, together with stack and blast members respectively movable toward and from the trunnions at opposite ends of the furnace, and supported on said pedestals, substantially as described.

7. A furnace having a reaction chamber, hollow trunnions opening to opposite ends of said reaction chamber, fixed means for supporting said trunnions during the operation of the furnace, a stack associated with one trunnion, means for introducing a heating blast through the other trunnion, a closure member for the latter, said closure member and stack being movable out of engagement with the respective trunnions to permit the reaction chamber to be freely lifted out of operating position.

8. A furnace having a reaction vessel, means for oscillating the latter, and adjustable automatic means for reversing the direction of oscillation.

9. A furnace having a reaction vessel, reversible motor means for imparting oscillatory movement thereto, and means moving with the vessel for effecting the automatic reversal of the direction of rotation, together with means for varying the extent of the automatic oscillation.

10. A pudding furnace comprising a pair of end castings, and intermediate the same

a cylindrical sheet metal shell, together with a refractory lining for the latter, and a dam formed in said lining and extending longitudinally substantially the full length of the furnace chamber.

11. A puddling furnace comprising a reaction chamber, a door opening substantially the full length of said chamber, a latch for holding said door normally closed, said door being hinged to the shell of said chamber and automatically swinging open by gravity on the inversion of said chamber to discharge the metal worked therein.

12. A puddling furnace installation comprising a reaction chamber having hollow open-ended trunnions at its opposite ends upon which it is freely supported, means for automatically oscillating said furnace, means movable into juxtaposition with the ends of said hollow trunnions but readily separable to permit said furnace to be freely lifted from its bearings and drive connections.

13. A metallurgical furnace comprising a cylindrical reaction vessel mounted on a horizontal axis, and having a door opening therein extending substantially the length of the reaction chamber, said door opening being of substantially elliptical shape, together with a door normally closing said opening.

14. A metallurgical furnace comprising a cylindrical reaction vessel mounted on a substantially horizontal axis, a refractory lining therefor, a substantially elliptical door opening therein extending substantially the length of the reaction chamber, the refractories lining said opening being arranged in the form of opposed arches, together with a door normally closing said opening.

15. A metallurgical furnace comprising a cylindrical reaction vessel mounted on a substantially horizontal axis, a refractory lining therefor, a substantially elliptical door opening therein extending substantially the length of the reaction chamber, the refractories lining said opening being arranged in the form of opposed arches, together with a door normally closing said opening, said door having a refractory lining of substantially the same shape as said opening and affording in the closed position of the door a substantially continuous refractory lining for the exterior of the reaction chamber.

16. An oscillating furnace having a projection in its bottom, and a chamber at either side of the projection with each wall of the projection forming a part of one of the chambers, and the bottom of each chamber being carried upward in a plane at right angles to the axis of oscillation of the furnace, the centers of curvature of each bottom being outside the axis of oscillation.

17. An oscillating furnace having a projection in its bottom, and a chamber at either side of the projection with each wall of the projection forming a part of one of the chambers, and the bottom of each chamber being carried upward in a plane at right angles to the axis of oscillation of the furnace, the centers of curvature of each bottom being outside and below the axis of oscillation.

18. An oscillating furnace having a projection in its bottom, and a chamber at either side of the projection with each wall of the projection forming a part of one of the chambers, and the bottoms of the chambers being curved upward in a plane at right angles to the axis of oscillation of the furnace and meeting above the dam in merging curves the centers of which are below the axis of oscillation.

19. An oscillating furnace having a projection in its bottom, and a chamber at either side of the projection with each wall of the projection forming a part of one of the chambers, and the bottoms of the chambers being curved upward in a plane at right angles to the axis of oscillation of the furnace and meeting above the dam in merging curves the centers of which are below the axis of oscillation, together with a longitudinally extending discharge door opening substantially opposite said projection.

20. An oscillating furnace having a longitudinally extending arch projecting from its bottom to form a dam, and a chamber at either side of said projection with each wall of the projection forming a part of one of the chambers, and the bottom of each chamber being curved upward in a plane at right angles to the axis of oscillation of the furnace and meeting above the dam in merging curves.

21. An oscillating furnace having a projection in its bottom, and a chamber at either side of the projection with each wall of the projection forming a part of one of the chambers, and the bottom of each chamber being curved upward in a plane at right angles to the axis of oscillation of the furnace, the ridge of the projection being curved downward from opposite ends of the furnace toward the middle thereof.

In testimony whereof I have signed my name to this specification.

HENRY D. HIBBARD.