No. 775,026. PATENTED NOV. 15, 1904.

W. B. BURROW.

MECHANICAL PUDDLING FURNACE.

APPLICATION FILED OCT. 14, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

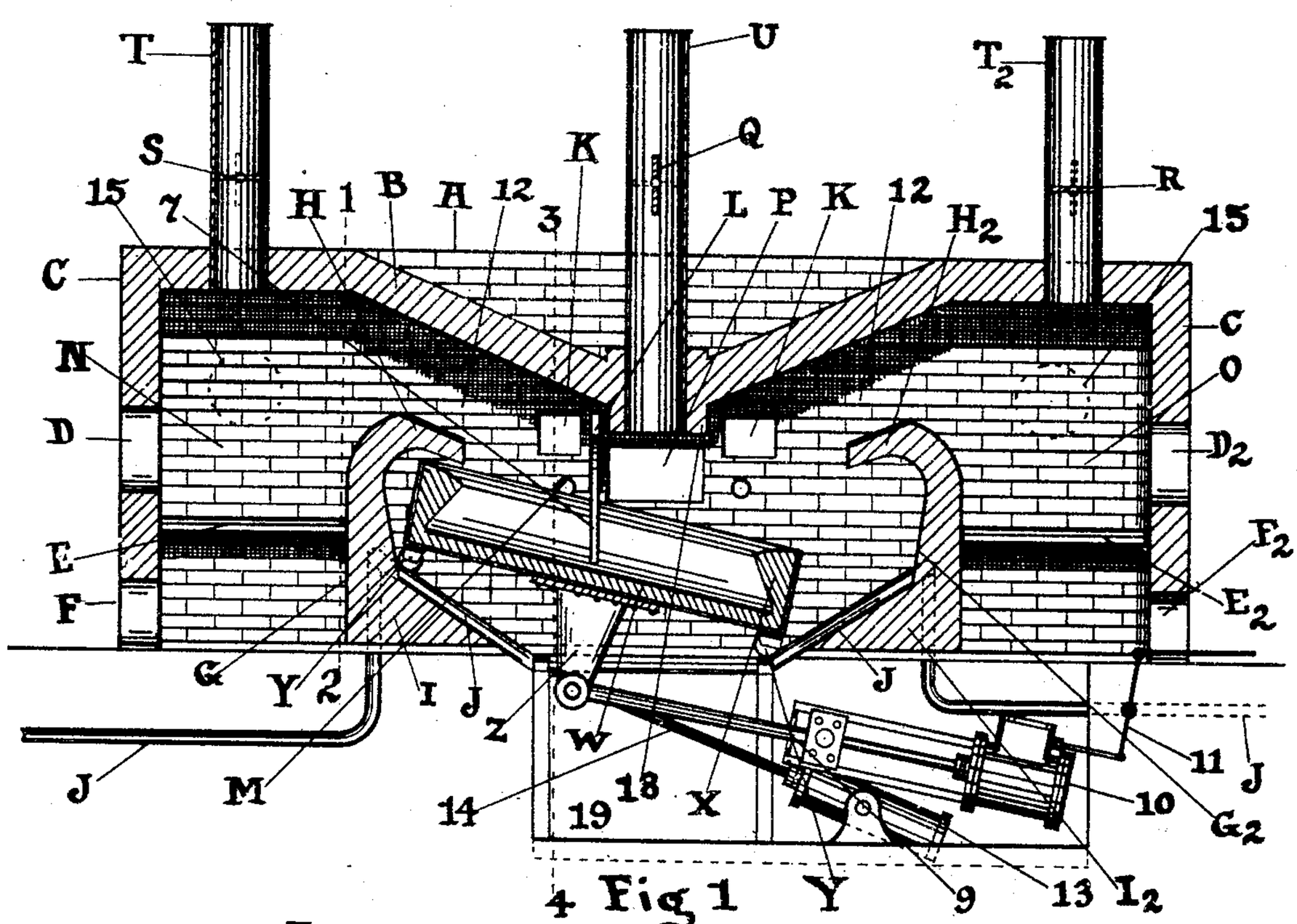

Fig 1

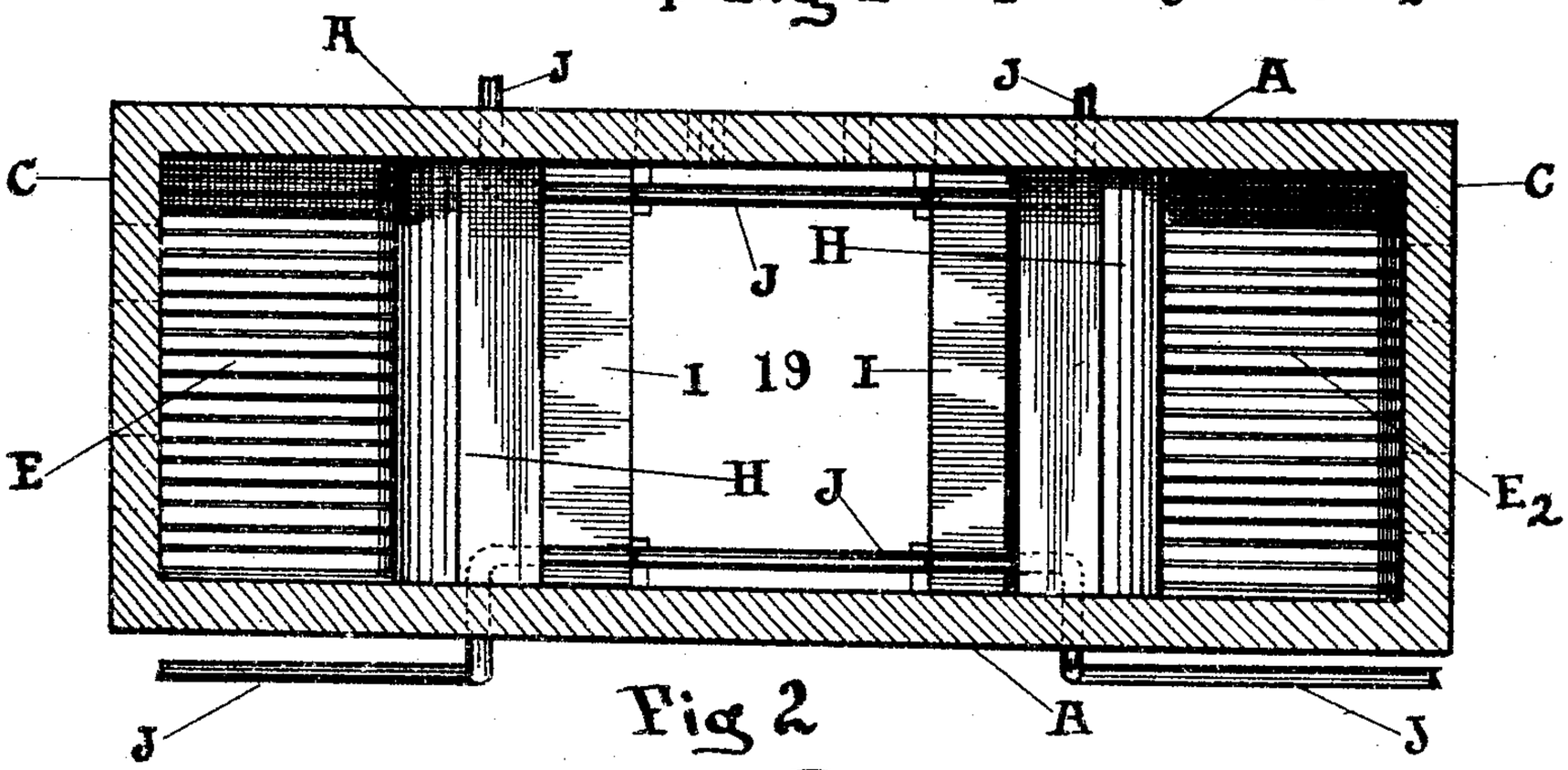

Fig 2

Witnesses
J. C. Hall
A. J. Smith

Walter B. Burrow
Inventor

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NO MODEL. 2 SHEETS—SHEET 2

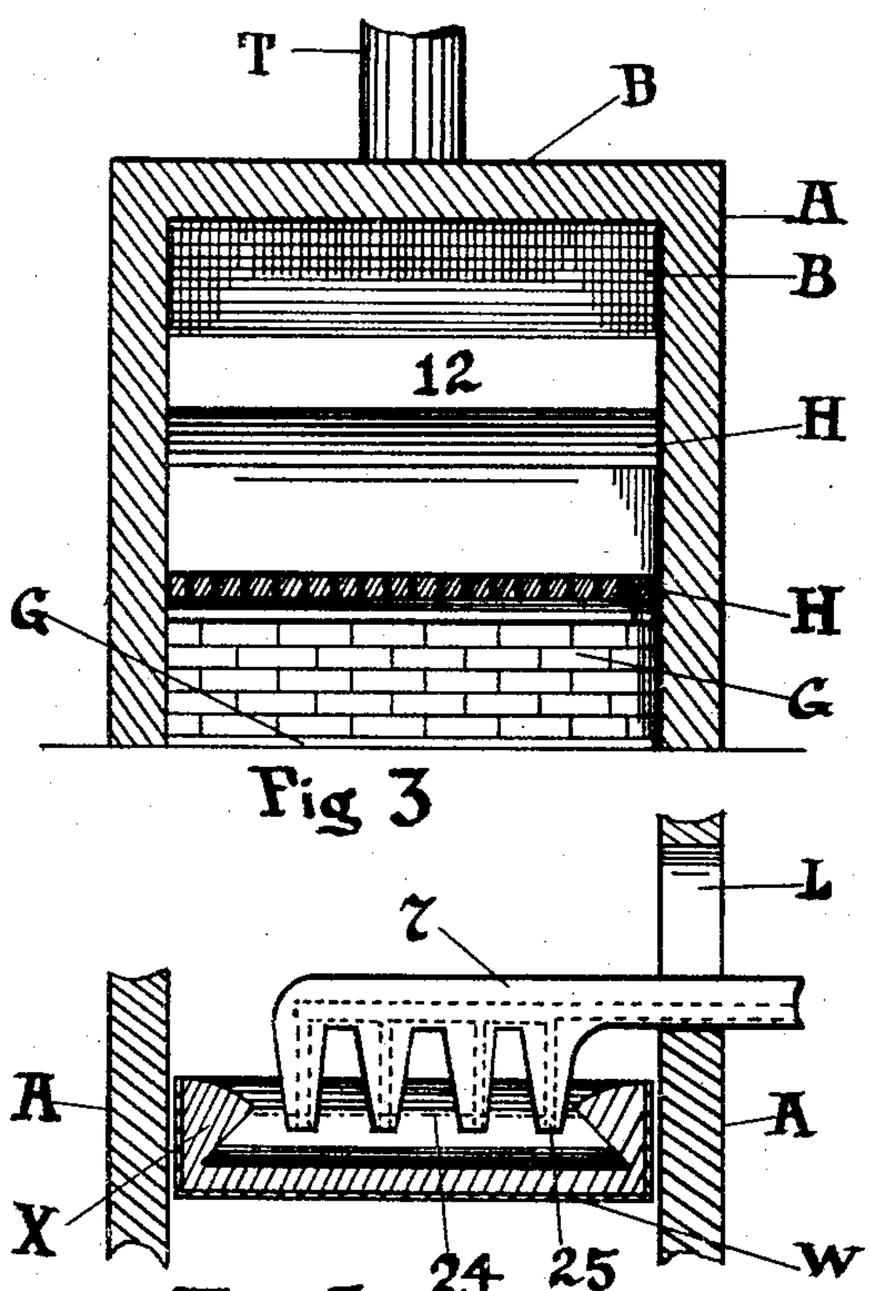

Fig 3

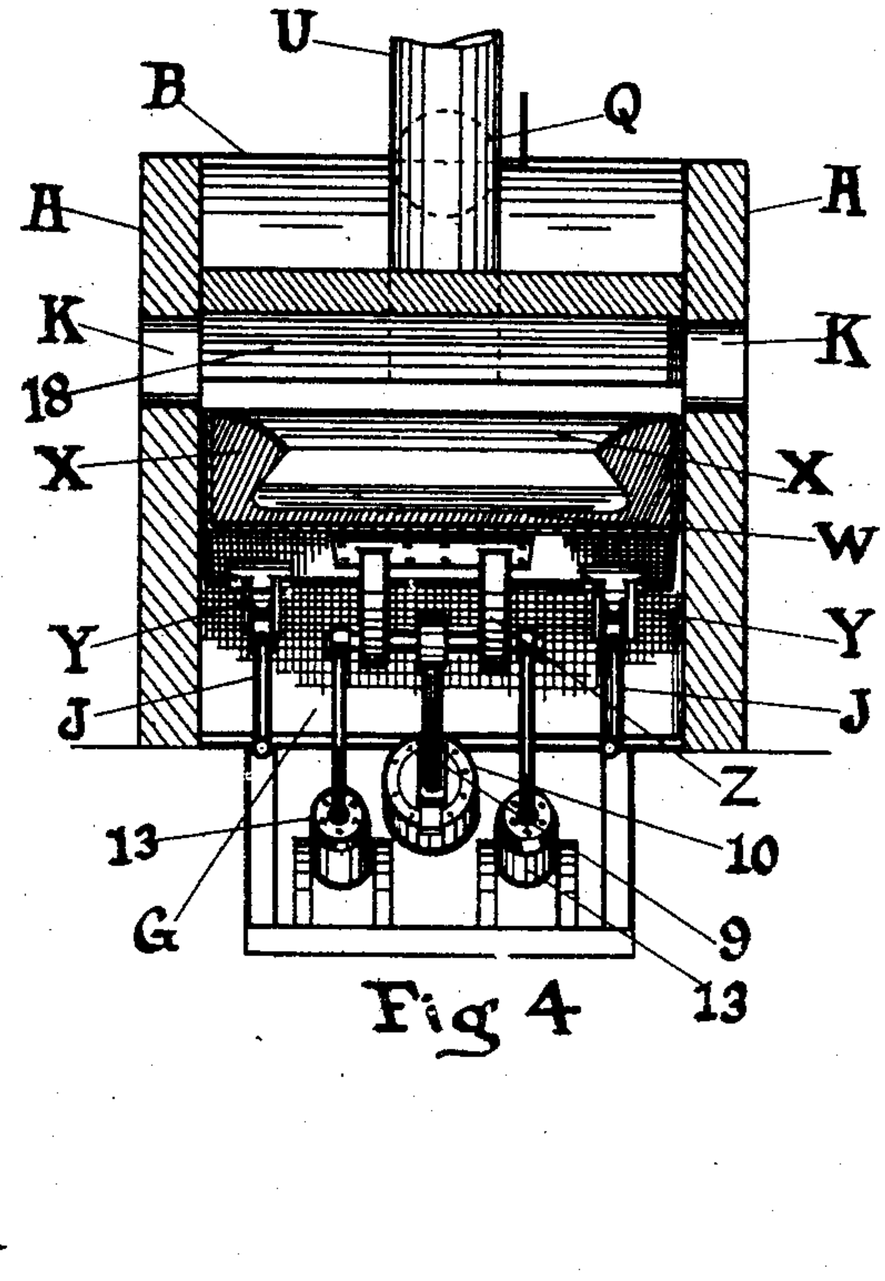

Fig 4

Fig 5

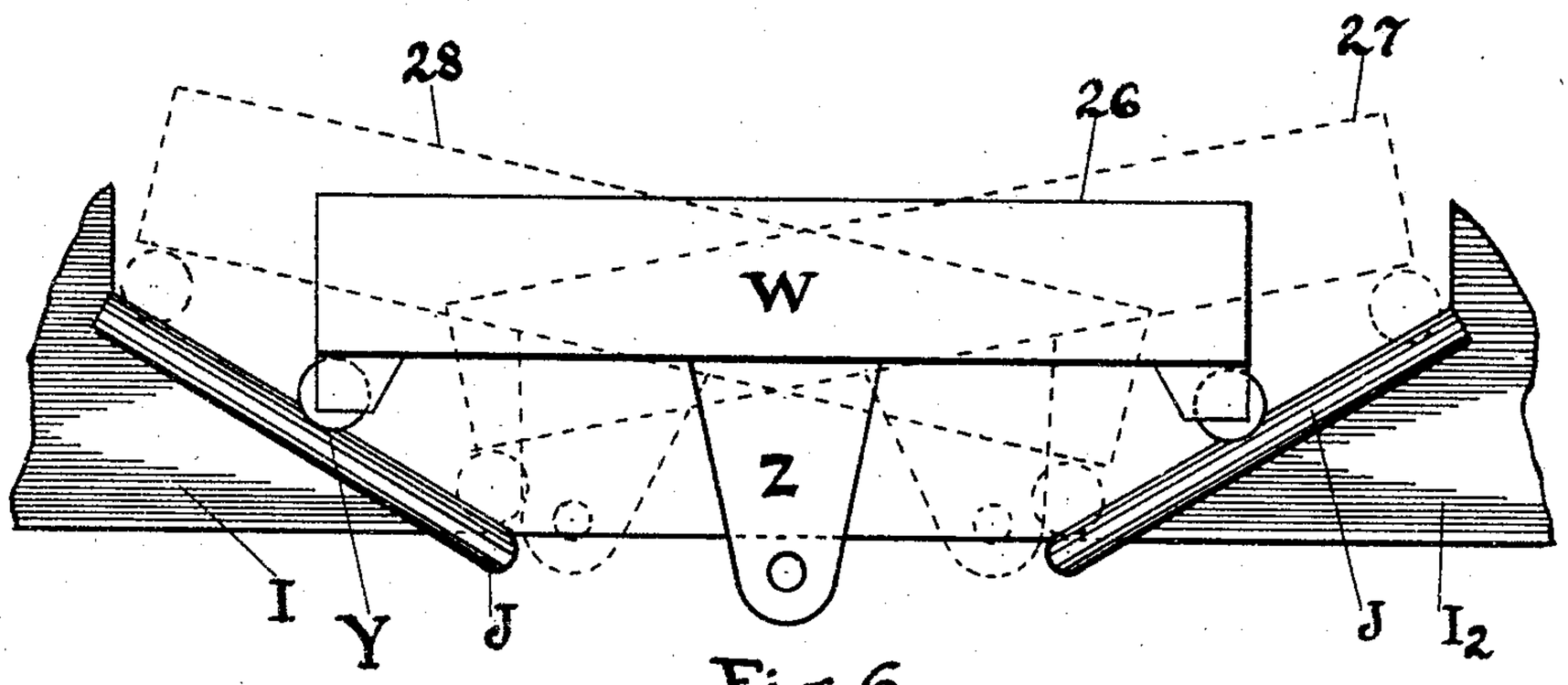

Fig 6

Witnesses
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A. J. Smith

Inventor

No. 775,026. Patented November 15, 1904.

UNITED STATES PATENT OFFICE.

WALTER B. BURROW, OF NORFOLK, VIRGINIA.

MECHANICAL PUDDLING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 775,026, dated November 15, 1904.

Application filed October 14, 1902. Serial No. 127,241. (No model.)

To all whom it may concern:

Be it known that I, WALTER B. BURROW, a citizen of the United States, residing at Norfolk, in the county of Norfolk and State of Virginia, have invented certain new and useful Improvements in Mechanical Puddling-Furnaces; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to mechanical puddling-furnaces for making wrought or malleable iron for rolling and working in the usual manner.

The object of my invention is to cheapen and quicken the process of puddling and refining iron by mechanical means.

The furnace is so constructed that when molten cast-iron is placed in the movable hearth it is given a horizontal movement back and forth on inclined planes or sloping bases forming a part of the bridge-walls. The rapid rise of the oscillating hearth at each end of the furnace and by its sudden stoppage causes the metal to run down the inclined hearth to the opposite end of the same and is abruptly arrested and dashed against the lining. This action is repeated any number of times until the iron is brought to the desired condition suitable to be rolled and worked. The hearth is lined and prepared in the ordinary manner, with the exception that it is concave near its bottom or bed and tapers from the top downward, forming an overhanging or projecting rim around the entire hearth, its object being to prevent the metal from splashing out at the beginning of the process when the iron is fluid. The overhanging lining also causes the metal to be thrown toward the center of the hearth and to become thoroughly agitated, due to the sudden stoppage at each end of the stroke. The motion is given to the hearth from under its bottom by means of a lug or arm attached directly to the connecting-rod of a reciprocating steam-engine. The arm or lug under the bottom of the hearth is rigidly secured thereto, but allows the hearth to oscillate on the end of the connecting-rod of the engine, which moves in a straight line back and forth, but accommodates itself to the up-and-down motion or oscillations of the hearth when it is ascending and descending the incline planes or slopes and carried by rollers or wheels. When the piston of the engine reaches the end of its stroke, a sudden impact or jerk is imparted to the hearth, and the iron is carried up with it so quickly that it does not have time to fall until the hearth stops, at which point the molten metal runs down the inclined hearth by gravity and dashes against the projecting lining at the opposite end. The sudden and frequent stoppages, and consequently the undulating motion of the iron, exposes it perfectly to the action of the heated gases. The metal as it parts from its carbon becomes finally consolidated into a ball, which is removed to be worked in the usual manner. The operation is assisted by a hollow toothed combing-bar or rabble extending across the furnace in the direction of its width, which combs or rakes the metal as it passes backward and forward and also prevents the fluid iron from dashing too violently against the lining, besides acting as a mixing-tool. The toothed bar is used at the beginning of the process when the metal is fluid and is withdrawn as the metal thickens, as will be hereinafter described.

The inclined bases or slopes of the furnace on which the hearth operates are a part of the bridge-walls and are located at each end of the furnace and taper toward the center of the furnace. The upper parts of the bridge-walls extend toward the roof of the furnace and curve downward in order to direct the hot gases on the hearth-bed in all its various positions.

Referring to the drawings, Figure 1 is a sectional elevation of the furnace and movable hearth. Fig. 2 is a sectional plan showing the grates and fireplaces, the curved upper parts of the bridge-walls, and their sloping bases. Fig. 3 is a cross-section on the line 1 2 in Fig. 1. Fig. 4 is a section through the line 3 4 in Fig. 1. Fig. 5 is a part section through the line 3 4 in Fig. 1, showing the hearth, part of the side walls, and the toothed

bar or rabble in position. Fig. 6 is in outline and shows the various positions assumed by the hearth when at rest and when running up and down the sloping or wedge-shaped bases of the bridge-walls.

The furnace is square or rectangular in shape and is built of refractory brick and constructed to withstand the shocks and jars produced by its operation.

In the drawings, similar characters of reference indicate like parts in all the views.

A represents the side walls.

B is the downward-tapering roof, having the shape of a flattened V, it being closer to the hearth at the center of the furnace than at the curved upper ends of the bridge-walls.

C represents the end walls, D and D^2 are the fire-doors, E and E^2 are the grates, and F F^2 are the ash-pit doors, of the two furnaces or fire-boxes N and O.

G and G^2 are the two bridge-walls, having curved upper ends shown at H and H^2.

I and I^2 are the sloping or wedge shaped bases of the bridge-walls, upon which the track J is laid and also for giving an up-and-down motion to the hearth W. The curved or upper parts of the bridge-walls, as at H and H^2, have the same angle as that of the roof B, and consequently parallel with it, so as to form the gas passages or flues 12.

K represents the charging-doors at the sides of the furnace.

L is a narrow door for the introduction and withdrawal of the tooth-bar or rabble 7.

M is a peep-hole for examining the interior of the furnace when in operation.

P is a central charging-door for the removal of the finished product.

Q, R, and S are dampers in the chimneys T, T^2, and U.

Either one of the fireplaces can be operated as desired, one chimney being in that case an outlet for the other, and when so working the central damper Q is closed, and when both are used the exit of the spent gases is through the central stack U.

X is the overhanging lining of the hearth W and made so as to form a cavity entirely around it near the bed. The projecting rim so formed prevents the splashing out of the metal.

Y represents wheels or rollers which support the hearth at each end and render it movable.

Z is a lug or arm attached to the bottom of the hearth-plates or frame and is pivoted and free to move upon the connecting-rod 9 of the steam-engine cylinder 10.

11 represents the valve-operating levers for the cylinder 10.

12 represents gas flues or passages formed by the pendent roof B and the curved or angular upper parts H and H^2 of the bridge-walls G and G^2.

13 represents steam or hydraulic cushion cylinders placed under the furnace in the pit 19 and are for the purpose or relieving the sudden shock of the oscillating hearth.

14 represents the plunger-rods of the cushion-cylinders 13.

15 (shown by dotted circles) represents the fuel-gas inlets when the furnace is to operate with such.

18 is the lowest point of the pendent roof B, near which point the gases meet when both fireplaces N and O are used, the outlet for the spent gases being through the central stack U.

19 is the engine-pit and is used to inspect and repair the mechanism under the furnace.

24, Fig. 5, is the approximate metal-level in the hearth W.

25 represents the openings in the teeth of the hollow combing bar or rake 7 and shown by dotted lines.

26, 27, and 28 in Fig. 6, show the different positions taken by the oscillating hearth, 26 being the normal or charging position and 27 and 28 the right and left hand limits of its stroke, which is shown by dotted lines. The hearth is composed of heavy steel plates with vertical sides and ends over which hard refractory brick is laid of the desired shape and the usual material applied over the brick.

The furnace and hearth are strongly made in order to withstand the shocks caused by their operation.

The working of the furnace is as follows: After the hearth has been prepared in the usual manner it is brought to the proper temperature by the heated gases. Molten cinder is allowed to run on the hearth-bed while it is in the position shown in Fig. 6 at 26, after which the hearth is given a few oscillating strokes up and down the inclined bases of the bridge-walls in order to distribute the cinder evenly over the bed. The molten iron is then run in and the horizontal and oscillating motion resumed. After several strokes the oxidizing agent—such as roll-scale, iron ore, or other similar material—is added through the side door K on top of the iron, after which the toothed combing bar or rake is inserted through the opening L and the teeth immersed to within a few inches from the bottom of the hearth-bed, which thoroughly mixes the charge and prevents undue splashing. The hearth actuated by the connecting-rod of the engine by means of the lug or arm Z exerts a straight or horizontal movement; but as it ascends the inclined track J, located on the wedge-shaped blocks I and I^2, Fig. 6, the hearth is given an alternate rise and fall, as indicated by dotted lines 27 and 28. After the iron shows signs of thickening by the loss of its carbon the toothed bar 7 is withdrawn and the process continued until the metal is rolled about into a more or less irregular-shaped mass, at which stage it is removed through the door P by suitable means and taken to the squeezer and finished in the

customary manner, the iron thus brought to a sudden stop, and by the jerking action the metal is carried up the inclined track before it has time to descend. Hence it rushes down with considerable force and strikes the overhanging lining at the opposite end and is thoroughly agitated and brought to nature in a much quicker time than is possible where the reversals are slow, as the strokes can be more frequent and stopped more abruptly than can be done in any other furnace. The heated gases are allowed to pass from both fires to the central part or middle of the furnace, where they are deflected downward upon the hearth by the angular or pendent roof B, then taking an upward course to the central chimney U. The maximum heat of the products of combustion is where the gases meet, and this takes place upon the metal in the hearth, and thus exposes the iron to a very high temperature, which can be rendered more or less intense by means of suitable dampers.

The hearth W and the track J are protected from the heat by suitable means, the latter consisting of thick iron or steel pipe, through which cold water is kept circulating. The hollow track is secured upon and has the same angle as the wedge-shape bases or blocks I and I^2 and consists of two lengths, and each is connected to a water-supply. The two sections are shown in Fig. 2 and also shows the track J crossing the pit 19, where it can be examined or renewed. The rollers or wheels Y are concave, so as to fit the pipe of which the track J is composed.

The toothed combing-bar or rabble 7, as shown in Fig. 5 and already referred to, is intended to help the agitation and the mixing of the iron and being hollow and provided with outlets at the ends of the teeth gives a medium for the introduction of purifying and oxidizing agents by means of air-blasts.

Unless where otherwise stated the process is conducted according to known rules of the art to which my invention relates.

In my furnace a large amount of iron can be treated at once, and the action is such as to expose a continual new layer of metal to the action of the heated gases.

The very abrupt stoppage or impact given to the iron by a cessation of all motion in a fraction of a second is more advantageous than a slow dashing at each end of the hearth, due to the fact that the inclined position is not produced quickly enough. Consequently the mass of iron succumbs to gravity before a reversal of the motion takes place.

The overhanging or projecting lining of the hearth shown at X in Figs. 1, 4, and 5 causes the fluid metal to be thrown inward to the center of the hearth at each stroke.

The toothed combing bar or rake prevents any violent surging or dashing against the ends of the hearth at the beginning of the operation.

The number of oscillations of the hearth varies according to the nature of the iron, but increases as the metal becomes thick and then decreasing when the mass consolidates into lumps or balls.

In my invention the hearth or metal bed only is movable, and its cost compared with machines in which the entire furnace vibrates is much less.

The furnace can be modified to suit the conditions under which it is to work.

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

1. In a stationary reverberatory mechanical puddling-furnace for making wrought-iron, the combination of a wheeled or roller-supported oscillating and horizontally-operated hearth, a concavity in the lining near the bed of the hearth, a projecting overhanging refractory rim or ledge over the said concave lining and the bed, the said rim extending entirely around the inside of the hearth, a lug or arm under the bottom of the hearth, and means for imparting a rocking motion to the arm or lug and the hearth in the direction of its length, as described.

2. In a stationary mechanical puddling-furnace for balling and massing iron, the combination of an oscillating hearth, trough or metal bed provided with supporting wheels or rollers, a projecting lining over the bed or bottom of the said hearth, and incline planes or wedge-shape runways for alternately raising and lowering each end of the hearth, and vertical walls integral with and extending upward upon the said inclined planes or slopes, and angular projections at the tops of the said walls for deflecting the heated gases upon the hearth, a hollow water-cooled track for supporting the hearth upon the inclined planes or slopes, and means for horizontally operating and oscillating or rocking the said hearth up and down the inclined tracks, as described.

3. In a stationary mechanical puddling-furnace for puddling or massing iron, the combination of a wheeled oscillating hearth, a concave and overhanging lining in the hearth or trough, a lug or arm under the hearth for a connection to a source of power to actuate the hearth and give it an oscillating or rocking motion, a sloping or inclined water-cooled track for elevating each end of the hearth and rocking the same, a bridge-wall at each end of the furnace, having inclined runways or slopes at their bases or lower ends, and projections at the upper ends or the highest points of the said bridge-walls, the said projections extending over the ends of the said hearth when at the conclusion of its stroke, as described.

4. In a stationary mechanical puddling-fur-

nace for making wrought or malleable iron, the combination of a reciprocating oscillatory hearth or metal bed, a projecting lining extending over the said bed, means for imparting and retarding motion to the hearth, and bridge-walls at each end of the furnace, the said walls provided with incline planes or wedge-shape bases beneath the hearth and within the furnace, and curved projections upon the highest points of the bridge-walls, the said projections extending toward the center of the furnace and over the ends of the hearth when at the conclusion of its stroke, to direct the heated gases thereon, and a hollow track upon the inclined bases of the bridge-walls to elevate and depress the said hearth in its oscillations, as described.

5. In a stationary puddling and balling furnace, the combination of a roller-supported oscillating hearth, a projecting lining extending around the hearth and over the metal bed thereof, means for imparting a combined rocking and horizontal movement to the said hearth, and inclined tracks for the passage of the hearth to alternately elevate and depress each end thereof, and bridge-walls having inclined or wedge-shape bases for the said track, beneath the hearth, and curved overhanging projections at the tops of the said bridge-walls extending over the hearth, a pendent roof covering the furnace and hearth having its lowest point at the center of the said furnace, the said roof forming gas flues or passages with the said overhanging projections, and an outlet for the waste gases at the lowest point of the said roof, as described.

6. In a stationary mechanical puddling and refining furnace, the combination of a roller-supported tilting and horizontally-movable hearth, a concave and projecting lining on the said hearth, means for causing a rocking motion to the hearth in the direction of its length, a bridge-wall at each end of the furnace, provided with angular or inclined bases or bottoms and curved projections at their highest point, to deflect the heated gases on the hearth, a water-cooled track on the said inclined bases of the bridge-walls, a pendent angular roof parallel to the projecting upper ends of the bridge-walls, forming flues for the products of combustion, and fireplaces at each end of the furnace to supply the said flues and the hearth with the heated gases, as described.

7. In a stationary reverberatory mechanical puddling-furnace for making and refining iron and steel, the combination of a rockable and horizontally-movable roller-supported hearth, a concave lining within and around the said hearth, a lug or arm beneath the said hearth for a connection to a source of power, means for imparting a rocking or oscillating motion to the said arm and hearth, and bridge-walls at each end of the furnace having wedge-shape or inclined bases, and curved projections at the upper ends of the said walls above the hearth and partly over it, a water-cooled track on the inclined bases of the bridge-walls for supporting the movable hearth thereon, means for directing the heated gases on the hearth or metal bed in all its positions, a fireplace at each end of the furnace to supply the hearth with the products of combustion, and a stationary, detachable toothed or forked combing-bar or rabble to stir and rake the metal as the hearth rocks or oscillates, the said rake or rabble extending into and across the hearth in the direction of its width, as described.

In testimony whereof I have signed my name to this specification in the presence of two witnesses.

WALTER B. BURROW.

Witnesses:

JOHN A. BAECHER,

ANTONIO J. SMITH.