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E. A. MOFFITT, ADMINISTRATRIX.

METALLURGICAL FURNACE.

APPLICATION FILED JAN. 25, 1907. RENEWED JAN. 11, 1911.

1,014,971. Patented Jan. 16, 1912.

6 SHEETS—SHEET 1.

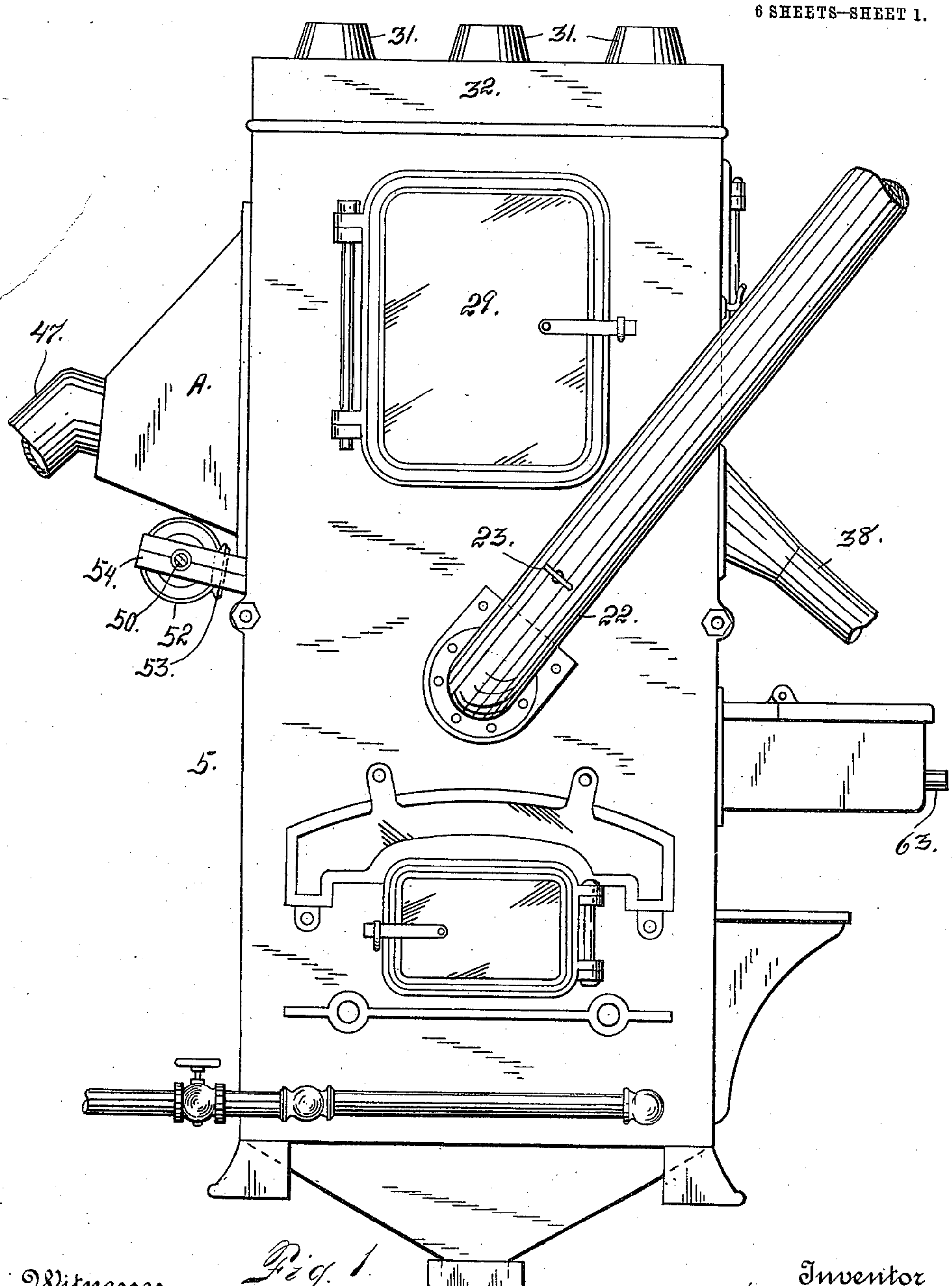

Fig. 1

Witnesses

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6 SHEETS—SHEET 2.

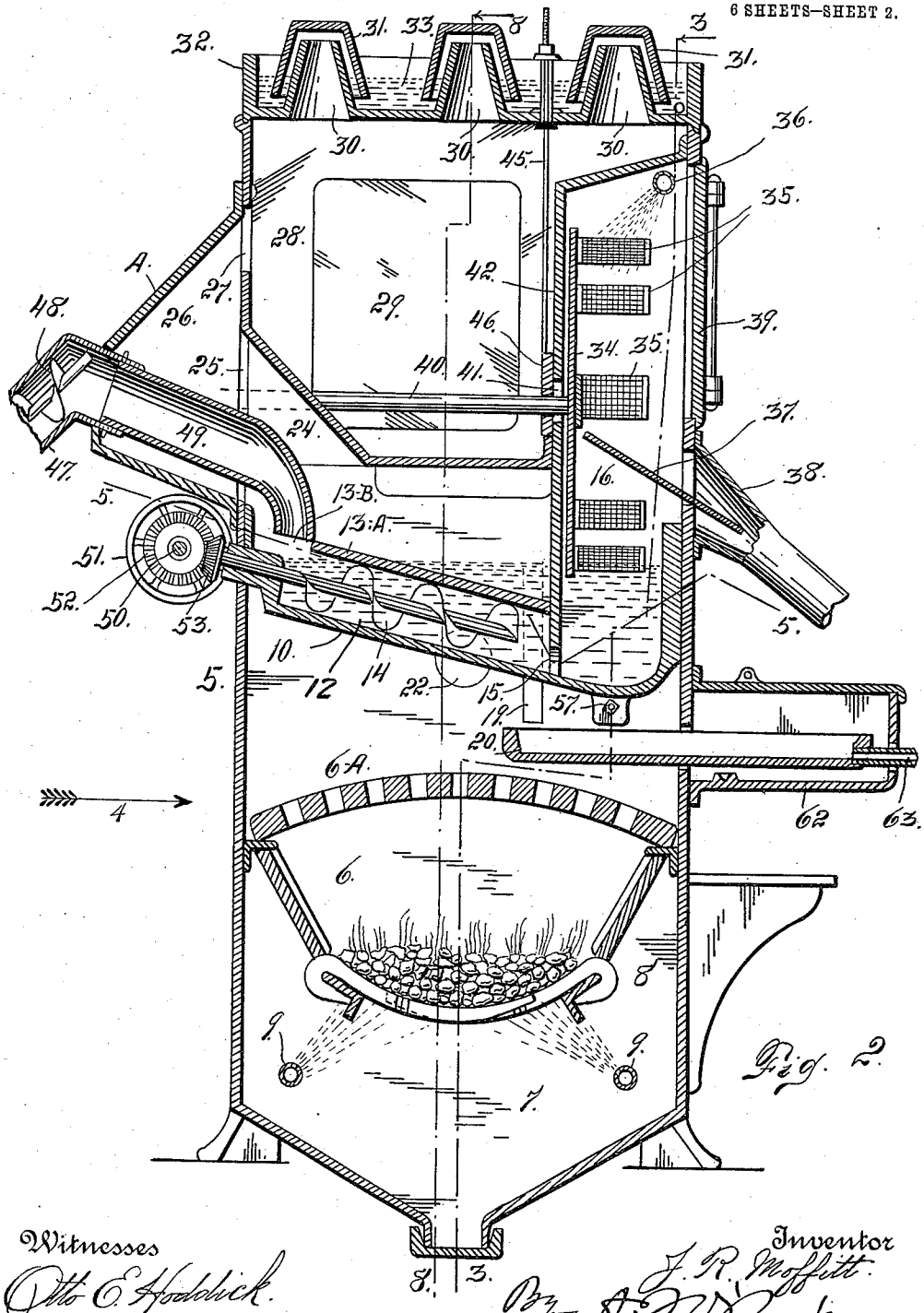

Fig. 2.

Witnesses

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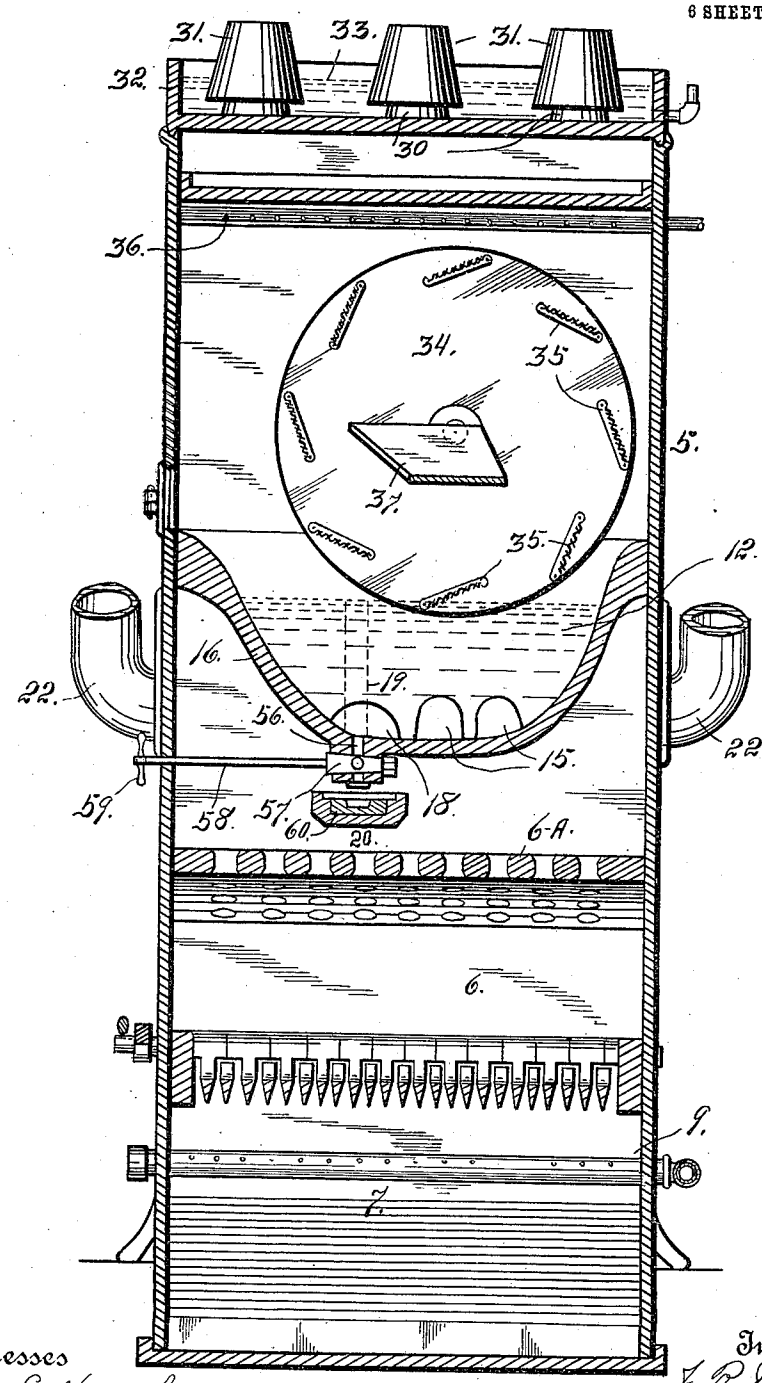
6 SHEETS—SHEET 3.



Witnesses

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Fig. 3. By, [illegible]

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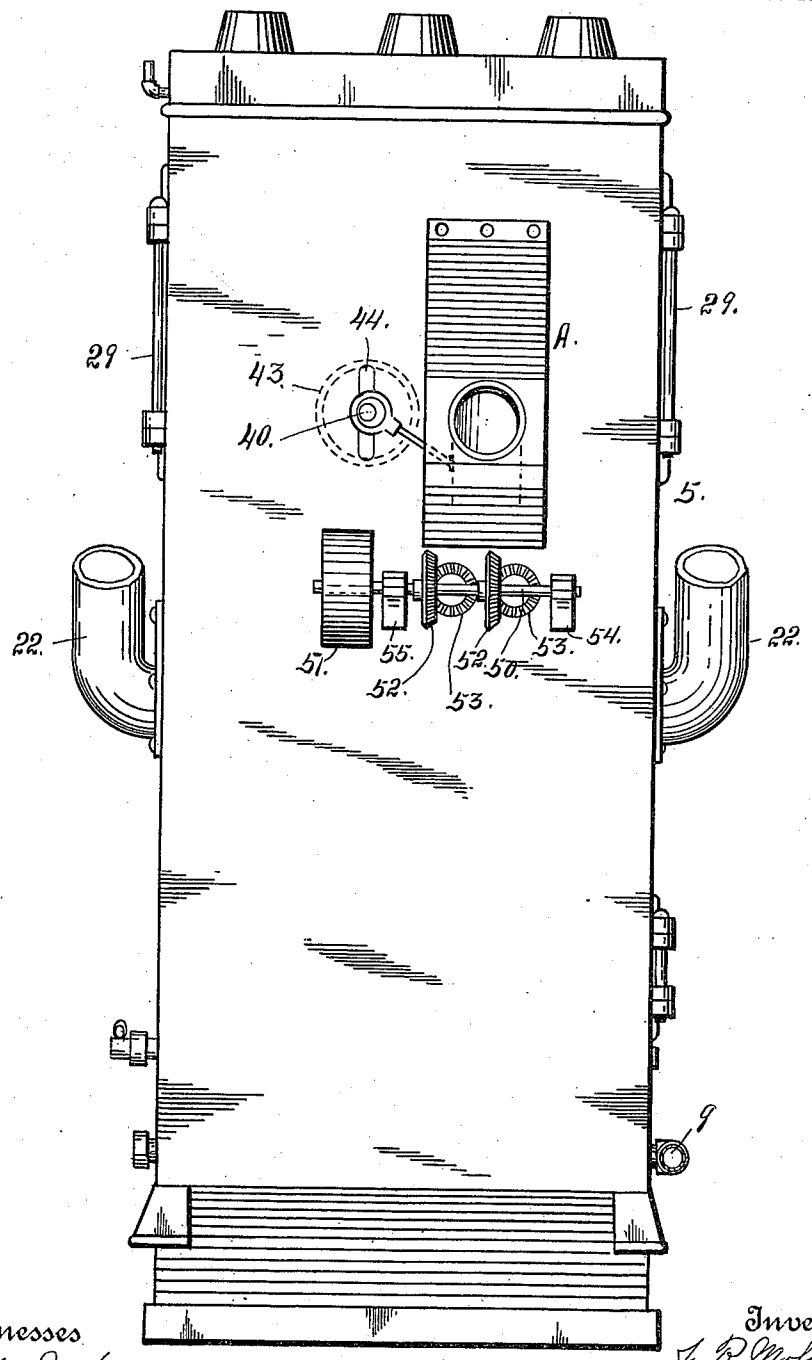
6 SHEETS—SHEET 4.



Witnesses

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Fig. 4.

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APPLICATION FILED JAN. 25, 1907. RENEWED JAN. 11, 1911.

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6 SHEETS—SHEET 5.

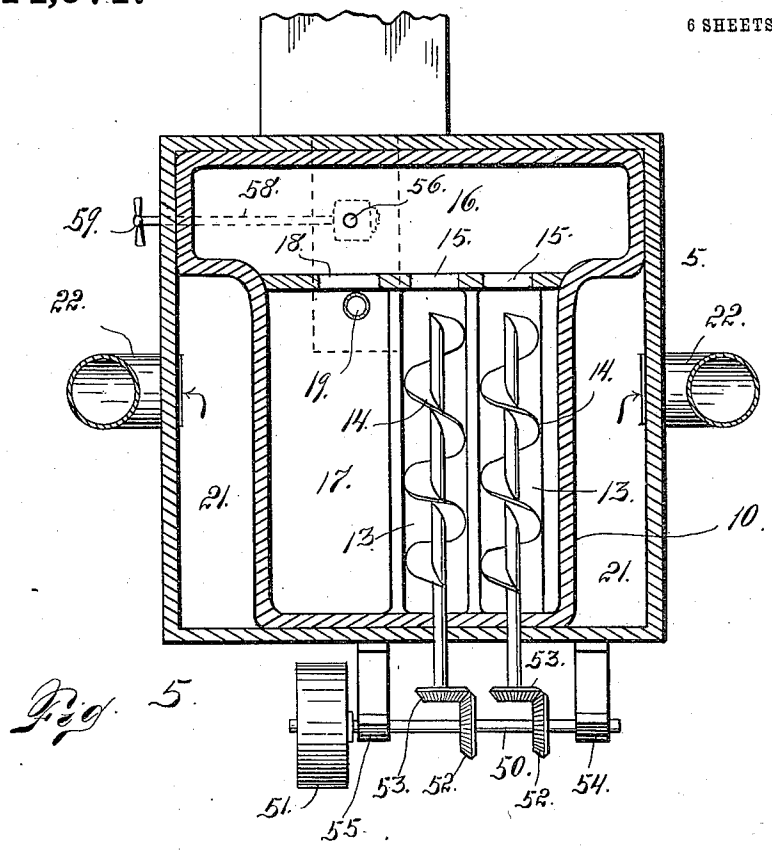

Fig. 5.

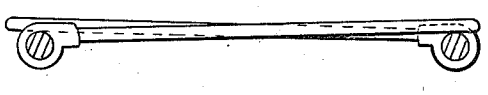

Fig. 6.

Witnesses
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METALLURGICAL FURNACE.

APPLICATION FILED JAN. 25, 1907. RENEWED JAN. 11, 1911.

1,014,971. Patented Jan. 16, 1912.

6 SHEETS—SHEET 6.

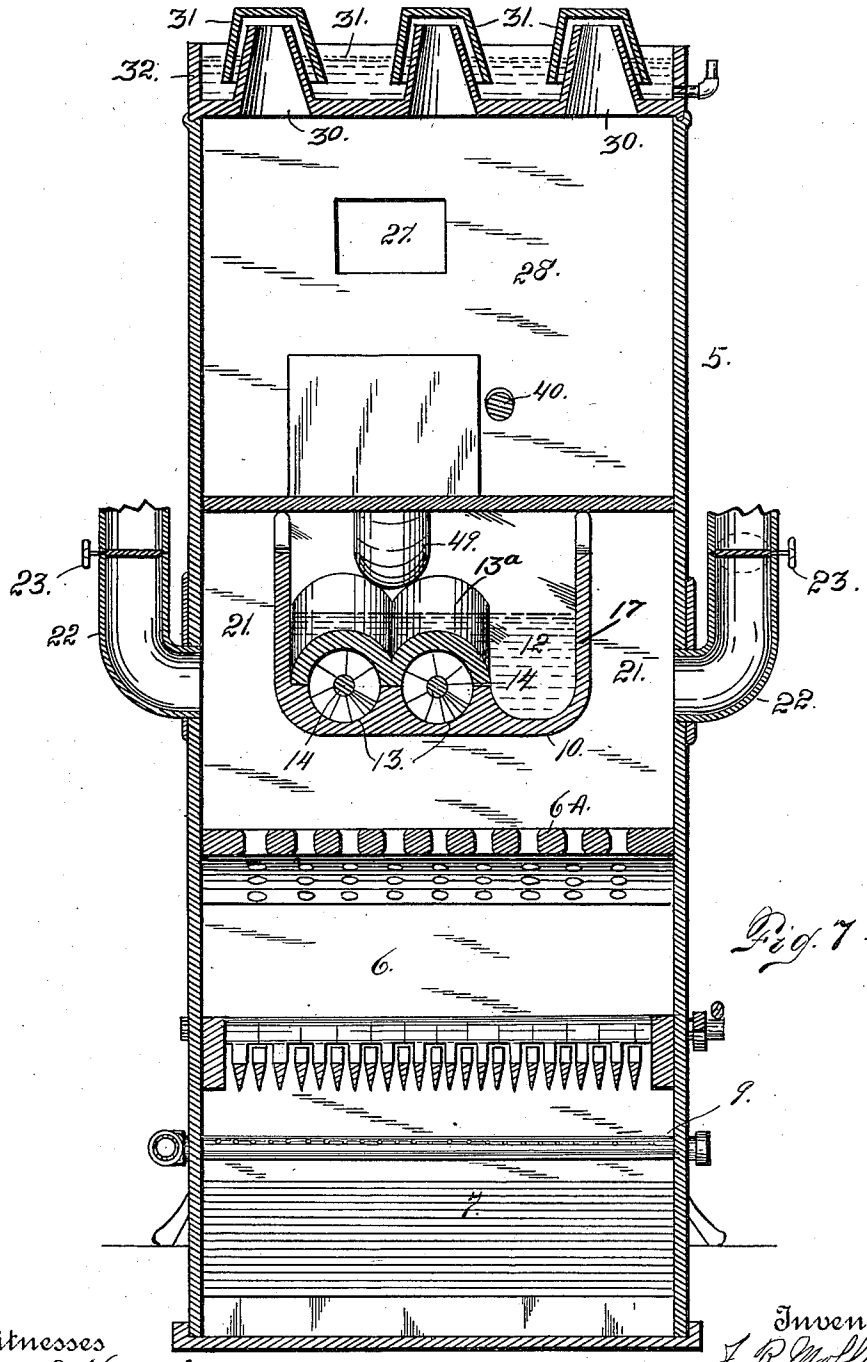

Fig. 7.

Witnesses

Otto E. Hoddick.

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UNITED STATES PATENT OFFICE.

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METALLURGICAL FURNACE.

1,014,971. Specification of Letters Patent. Patented Jan. 16, 1912.

Application filed January 25, 1907, Serial No. 354,000. Renewed January 11, 1911. Serial No. 602,095.

To all whom it may concern:

Be it known that I, JOHN R. MOFFITT, a citizen of the United States, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Metallurgical Furnaces; and I do 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, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in furnaces for the saving of precious metal values by fusion, the material to be treated, after being roasted or sufficiently deprived of its impurities such as sulfur, being passed through a bath of molten metal preferably copper containing a small percentage of phosphorous for the purpose of increasing its mobility. Provision is made after discharging the material into the molten bath, for carrying the gangue, tailings or non-fusible ash, into a separate chamber where it rises to the top of the molten mass and is skimmed off or removed, all as hereinafter fully described. In this way the non-fusible ash is separated from the fused precious metal values, which are removed from the bath by overflowing, the overflow passing downwardly through a discharge pipe whereby the bath is maintained at a predetermined level, a fire box is located below the molten bath, whereby the latter is supplied with sufficient heat to maintain the necessary mobility or fluid condition of the bath. Provision is made at the top of the structure above the bath, for removing or condensing any fumes which otherwise would escape in the atmosphere.

Having briefly outlined my improved construction, I will proceed to describe the same in detail reference being made to the accompanying drawing in which is illustrated an embodiment thereof.

In this drawing, Figure 1 is a front elevation of my improved furnace. Fig. 2 is a central vertical section of the same. Fig. 3 is a section taken on the line 3—3 Fig. 2. Fig. 4 is a side elevation looking in the direction of arrow 4 in Fig. 2. Fig. 5 is a cross section taken on the line 5—5 Fig. 2. Fig. 6 illustrates the lever arms for shaking the grates. Fig. 7 is a section taken on the line 8—8 Fig. 2.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate the body of the furnace, in the lower part of which is located a fire pot 6 hung in the chamber 8 and into which air under pressure is introduced by blast pipes 9. Above the fire pot, is located a chamber 10 containing a metallic bath 12, in the bottom of which are located troughs 13 through which pass screw conveyers 14 whereby the non-combustible ash is forced through openings 15, into a chamber 16 which also contains the molten metal. The chamber 10 is composed of two compartments in one of which the troughs 13 are located. The other compartment is designated 17 and the molten liquid only reaches the chamber 17 after passing through the chamber 16. In other words the metal which is reduced to the molten condition within the troughs 13, passes first through the openings 15 into the chamber 16, and thence through an opening 18 into the compartment 17 of the chamber 10. In the compartment 17 is located a standpipe 19 open at both extremities, its lower extremity passing through the bottom of the chamber 10. As the molten metal rises in the chamber 10, it overflows into the pipe 19 and passes downwardly therethrough into a separating pan 20 hereinafter described.

On the opposite sides of the chamber 10, and between the same and the vertical side walls of the furnace are formed compartments 21 which the products of combustion enter as they leave the fire box or pot 6. This fire box is provided with a grated covering 6^A which serves to disseminate the heat and products of combustion as they leave the fire box, whereby the more even distribution of the heat and products of combustion is obtained, as they pass upwardly to the chamber 10. A flue 22 leads from each compartment 21, for carrying off the smoke and products of combustion when a fresh fire is made. After the fire has been burning for some time or has gotten well started, dampers 23 located in these flues may be closed. In this event the heat and products of combustion from the fire box are compelled to pass upwardly around the chamber 10, thence into a compartment 24, thence through an opening 25

into an exterior compartment 26, and thence through an opening 27 into a chamber 28 located above the chamber 10 but cut off therefrom. Access is gained to this chamber 28 by means of doors 29. The top of the chamber 28 is provided with funnel-shaped exits 30, each of which is provided with a hood 31 somewhat larger than its exit. The lower extremity of each hood 31 projects below the surface of a tank or receptacle 32 carrying a quantity of liquid 33. The function of these hooded exits together with the liquid containing-receptacle, is to condense any fumes which may have escaped the chamber 28. The primary function of the last named chamber, is to condense as far as possible any volatile metallic fumes which are not caught in the molten bath. The heat and products of combustion are compelled to take the above described course because the air is introduced into the furnace under pressure and this is the course of the least resistance as the rest of the furnace is hermetically sealed.

All of the non-fusible ash, is forced by the screw conveyers 14 into the chamber 16 which extends upwardly above the chamber 10 and terminates but a short distance below the top of the furnace. Within this chamber 16, is located a rotary disk 34 carrying skimming blades 35, adapted to remove the ash from the top of the molten metal within the chamber 16. As this ash is carried upwardly by the skimmer blades, it is acted on by an air jet entering through a pipe 36, whereby the ash is driven against a deflecting plate 37 and discharged through a conduit 38 into which the deflecting plate projects. This plate 37 is downwardly inclined, its upper extremity terminating quite close to the disk, being located, however, in such a manner as not to interfere with the rotation of the latter whose skimmer blades 35 are located near its outer edge. Access is gained to the upper part of the chamber 16 by means of a door 39. The disk 34 is mounted on a shaft 40 which passes through a slotted opening 41 in the wall 42 between the chambers 16 and 28. This shaft 40 protrudes beyond the interior wall of the furnace and is operated by a pulley 43 connected with any suitable power. The exterior wall of the furnace is also slotted as shown at 44, to permit a vertical adjustment of the shaft 40 together with the skimmer disk 34. This adjustment may be necessary by reason of the varying depth of the metallic bath within the chamber 16 and from which the skimmer blades remove the ash as heretofore explained. The shaft 40 together with its connections is vertically adjustable by means of a rod 45 which projects upwardly through the top of the furnace. The lower extremity of this rod is provided with a valve plate 46 through which the shaft 40 passes. This plate is of sufficient area to keep the slotted opening 41 closed regardless of the vertical adjustment of the shaft.

The material to be treated may be carried upwardly through a conduit 47 by means of a screw conveyer 48, and delivered to a chute 49, whence it passes to the inclined troughs 13 provided with the conveyer screws 14 which are operated from a shaft 50 provided with a power pulley 51 which may be connected with a line shaft or any suitable motor. The power is transmitted from the shaft 50 to the conveyer screws by means of beveled gears 52 and 53. The shaft 50 is mounted in bearings 54 and 55 which are secured exteriorly to the wall of the furnace.

The bottom of the chamber 16 is provided with an outlet opening 56 controlled by a valve 57 having a stem 58 which projects beyond the outer wall of the furnace and is provided with a hand piece 59 for manipulating purposes. The molten metal drawn off from this chamber passes into a pan 20 from which it flows through an outlet pipe 63 which is connected with one extremity of the pan. This pan has one extremity located directly under the pipe 19 and its opposite extremity supported within a housing 62.

When the furnace is in operation, it will be assumed that the chambers 10 and 16 contain a quantity of molten metal preferably copper carrying a percentage of phosphorus to increase its fluidity. The material to be treated is in the form of an ash passing from a roasting furnace (not shown). This material is carried upwardly by the screw conveyer 48 and discharged into the chute 49 and thence into the troughs 13. The temperature of the furnace at the point where the chute discharges into the troughs 13, is at the melting point. This temperature is also practically maintained around the chute its entire length, by virtue of the housing A which extends outside of the wall proper of the furnace and through which the chute 49 passes. This being the case the metallic values contained in the material are soon reduced to a molten condition and add to the volume of the molten mass within the chambers 10 and 16, and when the level of this metal is sufficiently high to enter the outlet pipe 19, the material passes into the pan 60. It is of course assumed that the furnace fire is made and that the temperature surrounding the chambers 10 and 16 is sufficiently high to reduce the metallic contents of the material to a fluid condition within a comparatively short time. The non-fusible ash is forced through the openings 15 and thence into the chamber 16, and rises upwardly through the molten mass therein and forms a scum on the top thereof,

the latter being removed by the paddles 35 of the revoluble disk 34, and finally passing out through the discharge conduit 38 under the influence of the compressed air jet entering the pipe 36 as heretofore explained. If any of the metallic values within the chamber 10 are volatilized under the influence of the degree of heat maintained as heretofore explained, these values will pass into the chamber 28 in the upper part of the furnace, and the latter being cooler than in the region nearer the molten mass, will naturally condense the volatilized product. If, however, any of the volatilized products remain uncondensed, they will pass upwardly through the fume outlets 30, and are caused to enter the liquid 33 by reason of the hoods 31. Hence these volatile products whether metallic or otherwise will be condensed by the said liquid.

As shown in the drawing the troughs 13 are formed integral with the wall of the chamber 10. These troughs are closed at the top by a cover 13^A, the said cover having its inner surface shaped to conform to the shape of the body of the troughs. The troughs and cover together form two cylindrical chambers in which the conveyer or feed screws 14 are located. These screws fit closely within the chambers. The upper extremity of the cover or that adjacent the feed chute 49, is open as shown at 13^B, to allow the material to enter the troughs. As soon as this material enters the trough, it is caught by the feed screws and submerged within the molten liquid with which the chamber 10 is provided. In this way the material is maintained in the submerged position and its entire fusible contents quickly reduced to liquid form. The non-fusible ash as heretofore explained is forced into the chamber 16 through the openings 15, rises to the top of the liquid within the chamber 16. While the molten metal enters the compartment 17 of the chamber 10 by way of the opening 18, the non-fusible ash is prevented from entering this compartment since it immediately rises to the top of the molten metal within the chamber 16. It is therefore impossible for it to reach the compartment 17 since the opening 18 is at the bottom of the partition 42. By virtue of this construction the molten metal is separated from the non-fusible ash and discharged from the furnace as heretofore explained.

Having thus described my invention, what I claim is:

1. A metallurgical furnace provided with a chamber adapted to contain a metal bath, means for feeding material into the bath and submerging the material so fed, means for removing the ash from the bath, a condensing chamber, and a liquid seal for the condensing chamber, for the purpose set forth.

2. A furnace provided with a chamber adapted to hold molten metal, a second chamber separated from the first named chamber, means for introducing material to be treated into the first named chamber, means for forcing the non-fusible portion of the material from the first named chamber into the second named chamber, and a liquid seal in communication with the first named chamber, for the purpose set forth.

3. A metallurgical furnace provided with a chamber adapted to hold molten metal, means for discharging material to be treated into a metallic bath contained within the said chamber, means for submerging the material within the said bath and causing it to travel in the submerged condition a suitable distance, and means for permitting the non-fusible material to rise to the top of the bath within the chamber, and means for skimming off the non-fusible ash.

4. A metallurgical furnace provided with a chamber adapted to contain a metallic bath, means for feeding material into the bath and means for submerging the material so fed to the bath, and causing it to travel in a submerged condition a suitable distance after which the non-fusible portion of the material is allowed to rise to the top of the molten mass, means for removing the said non-fusible portion as fast as it accumulates, a condensing chamber located above the metallic bath and in communication therewith, a liquid receptacle mounted on top of the furnace and communicating with the condensing chamber by hooded outlets, whereby volatile products escaping from the furnace are caused to enter the liquid, substantially as described.

5. A furnace provided with a chamber adapted to hold a molten metal, a second chamber separated from the first named chamber by a partition, the two chambers communicating through an opening formed in the bottom of the chamber, means for introducing material to be treated into the first named chamber, means for forcing the non-fusible portion of the said material from the first named chamber to the second named chamber through the opening in the partition, a rotatable skimmer located in the second chamber for removing the non-fusible portion of the material as fast as it rises to the top of the molten mass, and a liquid seal in communication with the first named chamber, for the purpose set forth.

6. A furnace comprising two chambers separated by a partition having openings in its bottom, the first named chamber being provided with two compartments, one of which communicates with the second chamber by way of one of the said openings in the partition, and in the other of which is located a conveyer screw by means of which material fed to the furnace is forced through

one of the openings in the partition to the second chamber, the screw being surrounded by a casing, the two chambers adapted to contain a bath of molten metal, a rotary device located within the second chamber for removing the non-fusible portion of the material from the top of the said metal, and a liquid seal in communication with the first named chamber, for the purpose set forth.

7. A furnace provided with a chamber adapted to hold molten metal, a partition separating the chamber into two compartments communicating with each other through an opening formed in the lower part of the said partition, the said opening being below the level of the molten mass when the furnace is in use, means for discharging material to be treated into one of said compartments, means located in the said compartment for forcing the non-fusible ash of the material through the opening in the said partition into the second compartment in which the ash is free to rise to the top of the molten mass, means located within the second chamber for removing or skimming off the ash from the top of the mass, and a liquid receptacle mounted on top of the furnace, for the purpose set forth.

8. A furnace provided with a chamber adapted to hold a metallic bath, means for feeding material into the bath, a condensing chamber located above the metallic bath, and a liquid receptacle mounted on the furnace and in communication with the condensing chamber, for the purpose set forth.

9. A furnace provided with a chamber adapted to hold molten metal, a second chamber communicating with the first named chamber, a condensing chamber located within the first named chamber, and a liquid seal for the condensing chamber, for the purpose set forth.

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

JOHN R. MOFFITT.

Witnesses:
DENA NELSON,
A. J. O'BRIEN.