A. E. BOOKWALTER.

ELECTRIC FURNACE FOR SMELTING ORES.

APPLICATION FILED APR. 26, 1917.

1,297,641.

Patented Mar. 18, 1919.

4 SHEETS—SHEET 1.

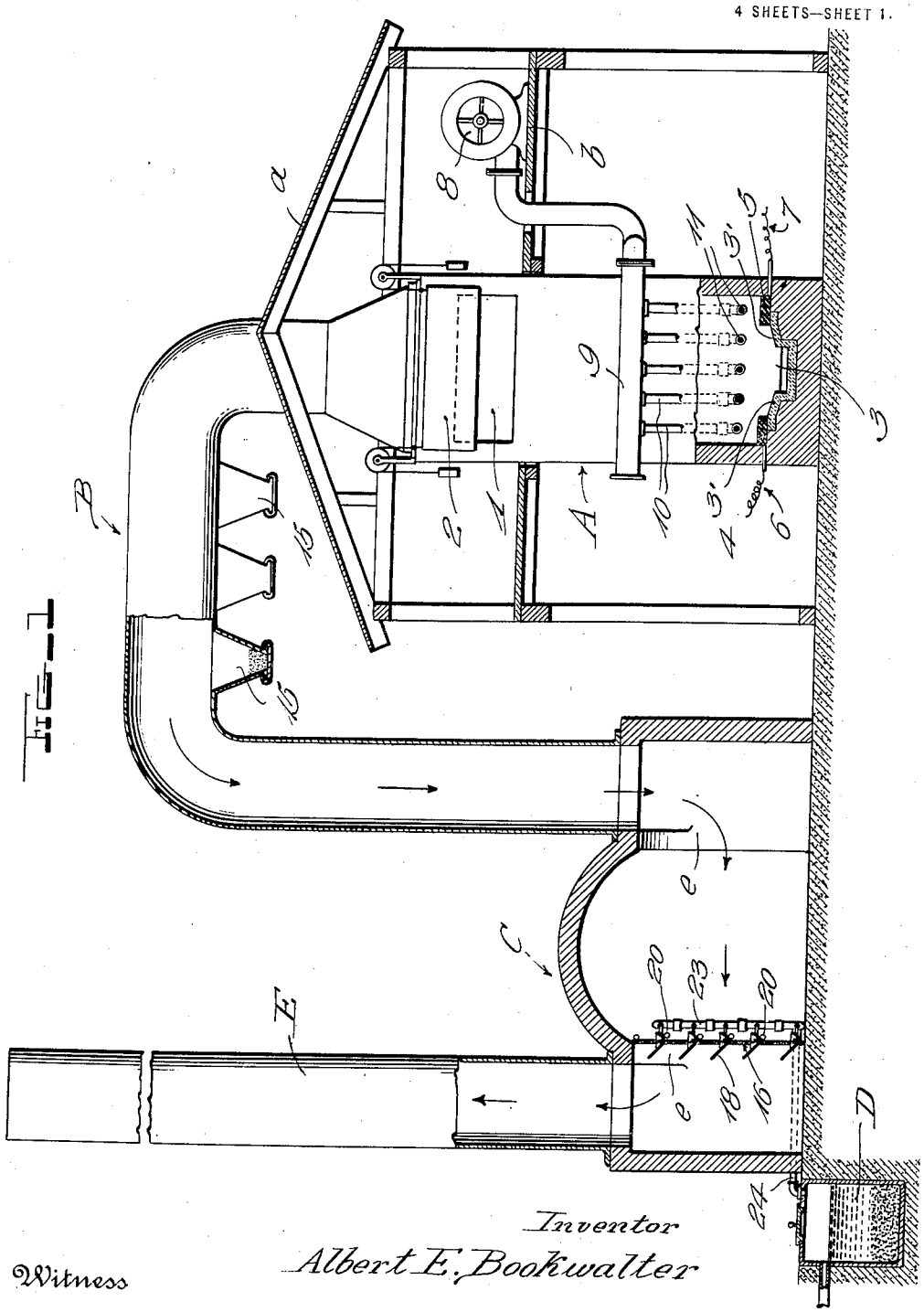


FIG. 1

Witness

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4 SHEETS—SHEET 2.

Fig. 2

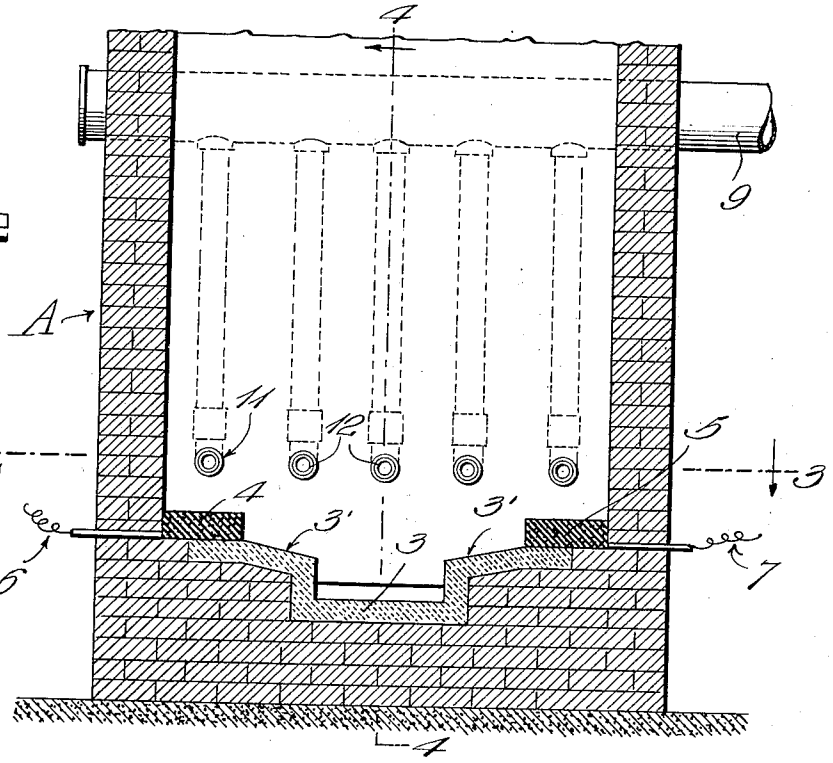
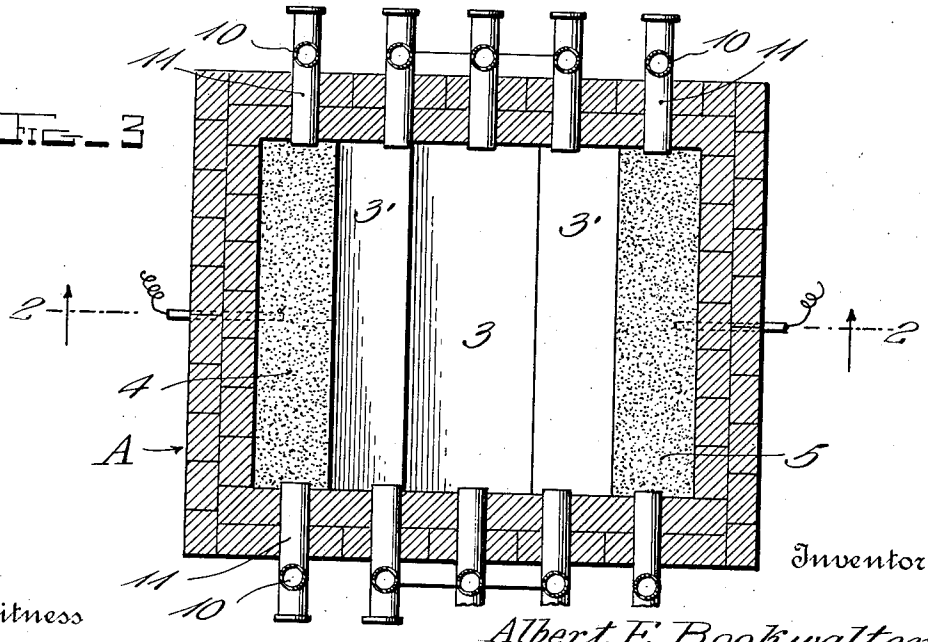


Fig. 3



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4 SHEETS—SHEET 3.

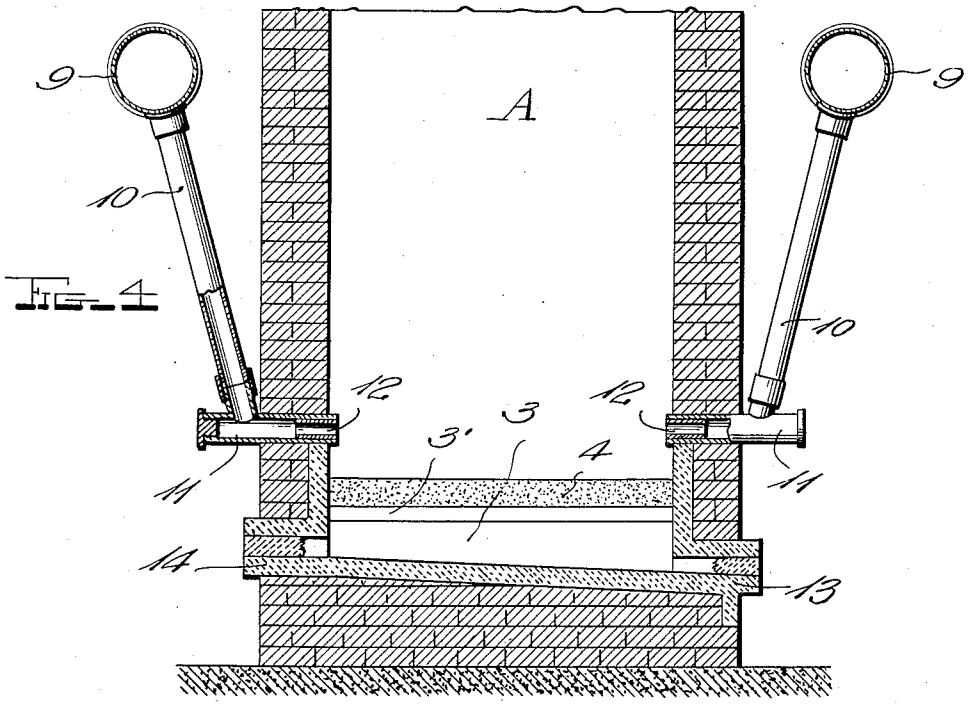


Fig. 4

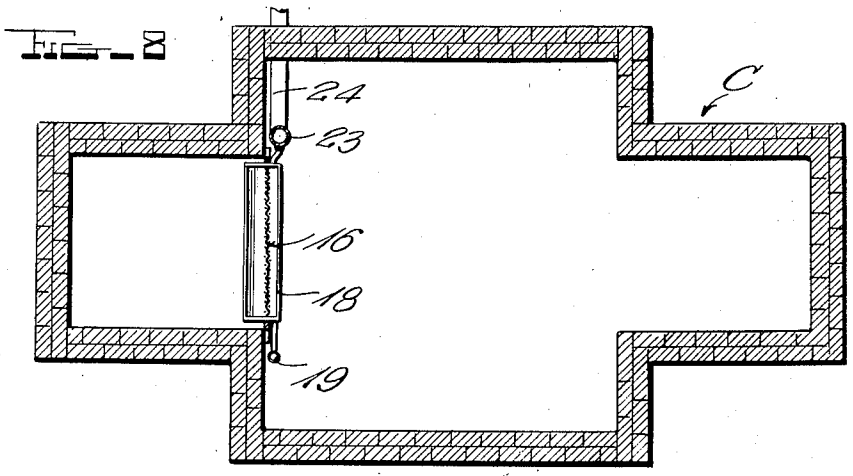


Fig. 8

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4 SHEETS—SHEET 4.

Fig. 5

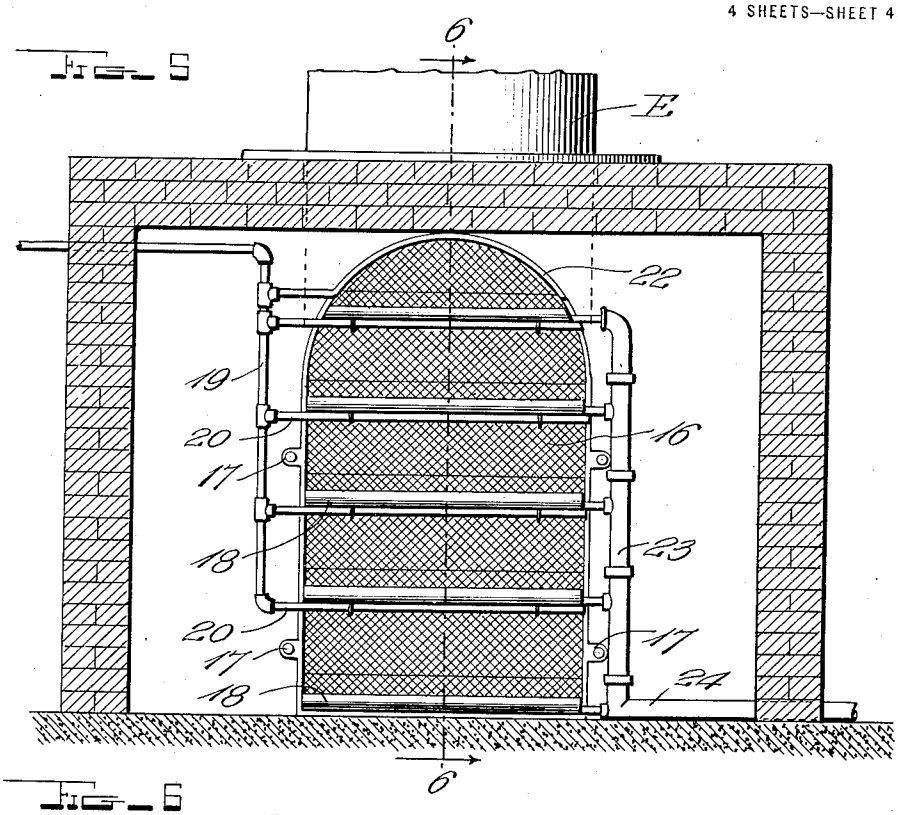


Fig. 6

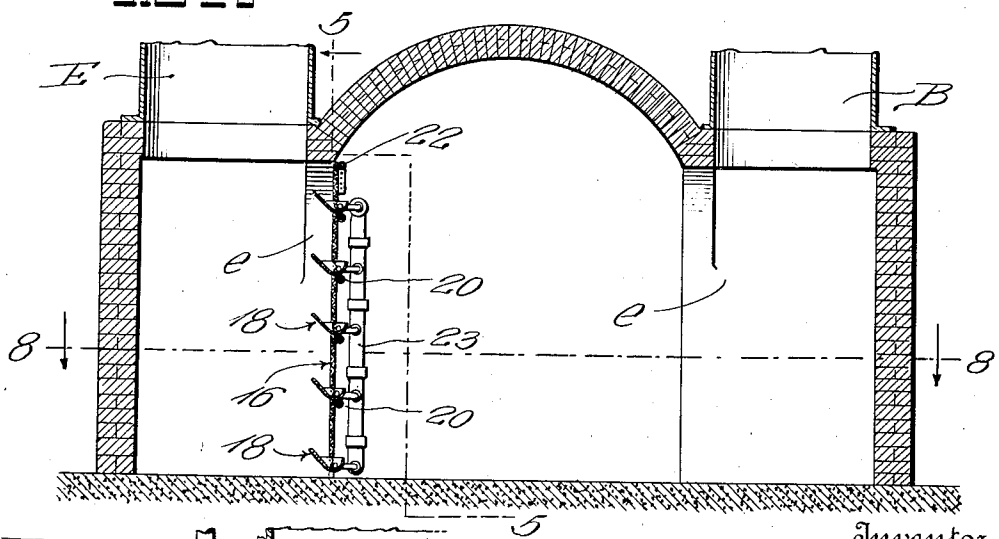
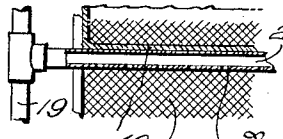


Fig. 7



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UNITED STATES PATENT OFFICE.

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ELECTRIC FURNACE FOR SMELTING ORES.

1,297,641. Specification of Letters Patent. Patented Mar. 18, 1919.

Application filed April 26, 1917. Serial No. 164,778.

To all whom it may concern:

Be it known that I, ALBERT E. BOOKWALTER, a citizen of the United States, residing at Coeur d'Alene, in the county of Kootenai and State of Idaho, have invented certain new and useful Improvements in Electric Furnaces for Smelting Ores; 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.

This invention relates to a new and improved process and apparatus for smelting ores.

One object of the invention is to provide a process for smelting ores whereby the ores are put through a calcining process in a furnace which causes them to be heated to almost the melting or fusing point, and then melting and fusing them by electric means, the current necessary to accomplish this being considerably less than is required in furnaces heretofore known by reason of the heating during this calcining step.

Another object of the invention is to provide a process and apparatus for smelting ores in which there is practically no metal which is not recovered from the crude ores.

A further object of the invention is to provide a dust chamber to be used in connection with the smelting furnace, said chamber being provided with suitable means for collecting the dust carried from the furnace by the strong draft through the same in order that it may be again treated in the furnace.

Another object of the invention is to generally improve upon apparatuses of this character by the provision of an efficient and reliable construction, and one which will be well adapted to the purpose for which it is designed.

With these and numerous other objects in view, the invention resides in certain details of construction, the combination and arrangement of parts as will be hereinafter fully described and claimed.

In the accompanying drawings forming a part of the application, and in which similar reference characters designate like parts throughout the several views;

Figure 1 is a view, partly in elevation and partly in section, of the complete apparatus constructed in accordance with this invention for carrying out the steps of the improved process;

Fig. 2 is a vertical sectional view of the smelting furnace taken on the plane of the line 2—2 of Fig. 3;

Fig. 3 is a horizontal sectional view taken on the plane indicated by the line 3—3 of Fig. 2;

Fig. 4 is a vertical sectional view taken on the plane indicated by the line 4—4 of Fig. 2;

Fig. 5 is a vertical sectional view of the dust chamber taken on the plane indicated by the line 5—5 of Fig. 6 and showing the dust collecting means in front elevation;

Fig. 6 is a vertical sectional view taken on the plane indicated by the line 6—6 of Fig. 5;

Fig. 7 is a detail sectional view through one of the horizontal water pipes;

Fig. 8 is a horizontal sectional view of the dust chamber taken on the plane indicated by the line 8—8 of Fig. 6.

Referring more particularly to the drawings, and especially to Fig. 1, the letter A designates a smelting furnace in which the ores are calcined and smelted, B the smoke pipe connected with the upper end of the furnace for conveying the smoke and other products of combustion to a chamber C provided with a dust collecting means, and D a settling tank for separating the dust collected in the chamber C from the water used in the collecting step of the process.

The furnace A is somewhat similar to smelting furnaces now in use in that it is provided in its wall near its upper end with an opening 1 through which it is charged. This opening 1 is closed when not in use by a door or cover 2 which is hung or suspended by means of suitable cables passing over pulleys. However, it is to be understood that other means than this may be employed for closing the opening. The furnace A is substantially square in cross section and is provided at its lower end with a well 3 in which the molten metal collects and is drawn from the furnace. As clearly shown by Fig. 3 of the drawings the well 3 extends substantially horizontally across the bottom of the furnace midway between two opposite sides. The walls of the well 3 are substantially upright for a short distance, and then they are flared outwardly and upwardly on an incline to provide a hearth 3′ for sup-

porting the ore and for directing the molten metal into the well.

Adjacent the well 3 and fixed in the walls of the furnace A in any suitable manner are electrodes 4 and 5 composed preferably of a composition of graphite, iron shavings or filings and silica clay. These electrodes 4 and 5 are substantially rectangular in configuration in plan view and extend parallel with the well 3 on opposite sides of the same. Conductors 6 and 7 connect the electrodes with a suitable source of current in which is arranged a rheostat for controlling the same.

The furnace A is preferably housed or in fact covered by a suitable shed *a* having a flooring *b* arranged substantially on a plane with the lower side of the charging opening 1 of the furnace. Mounted upon the flooring *b* is a fan blower 8, and connected to the blower is a pair of bustle pipes 9 which are disposed on opposite sides of the furnace A and extend at right angles to the well 3, and are disposed in a plane slightly below the flooring *b*. Connected to the lower side of each of the bustle pipes 9 is a series of vertically disposed pipes 10, the latter being arranged on the exterior of the furnace A and having connected to their lower ends twyers 11. These twyers are all disposed in substantially the same horizontal plane which is spaced slightly above the plane of the electrodes 4 and 5, and as clearly shown in Fig. 2 of the drawings they are provided with removable and separable bushing members 12 to regulate the air supplied to the furnace.

The well 3 is provided at one end with a spout 13 whereby the molten metal may be drawn from the furnace. It is to be understood that the well is slightly inclined from the spout 3 to cause the metal to run from the latter when it is being drawn off.

At the other end of the well there is provided a slag spout 14 through which the slag and other refuse material is removed from the furnace.

The pipe B heretofore mentioned is of arched formation. One of the ends of this pipe is secured in a convenient manner to the upper end or top of the furnace A, while the other end of the pipe is mounted on or secured to the top of the chamber C. Arranged upon the lower side of the horizontal portion or crown of the pipe B is a series of hoppers or pockets 15 which are capable of catching any mineral that may pass through the pipe and which may condense therein. The lower ends of these hoppers are provided with suitable closure members which may be operated to remove such mineral therefrom.

The connection of the pipe B with the chamber C is at one end of the latter. At the other end of the chamber is a vertical comparatively high smoke pipe E. The ends of the chamber C below the pipes B and E are less in width than the intermediate portion of the chamber and communicate with this intermediate portion by openings *e*. Disposed across the opening *e* adjacent the smoke pipe or stack E is a wire screen 16. This screen 16 is mounted and secured to the framework of the opening *e* in any convenient manner herein shown as consisting of a plurality of lugs 17. Extending transversely across the opening *e* is a series of vertically spaced horizontal and parallel troughs 18, the lowermost trough being disposed at the extreme lower end of the screen 16.

The numeral 19 represents a vertical water supply pipe to which are connected a series of vertically spaced horizontally extending pipes 20 disposed on the side of the screen 16 adjacent the intermediate portion of the chamber C and arranged directly beneath the troughs 18. The lower sides of the pipes 20 are provided with a plurality of apertures or openings 21 through which water is sprayed upon the screen. An additional spray pipe 22 bent into substantially semicircular shape to conform to the shape of the upper portion of the opening *e* is also connected to the supply pipe 19. The troughs 18 communicate with a vertically disposed collecting pipe 23, the lower end of which is connected to a pipe 24 which conveys the water and other material to the settling tank D above briefly described.

This settling tank D may be of any suitable construction, and is here shown as being provided with a pipe through which the water is drawn off.

The ore to be smelted such as lead, silver or copper, is fed into the furnace through the opening 1. After a certain amount of it has been placed therein, a layer of fuel such as wood or coke is placed upon the ore. Another layer of ore is added, then another of fuel, and more layers of first ore and then fuel are added until the furnace is completely filled. The blower 8 is then started and a strong draft of air is thus sent through the material in the furnace from the lower end thereof. The fuel being ignited will heat the ore to a considerable extent and drive off practically all of the volatile matter contained therein. The temperature of the ore will practically reach the melting point of the metal contained therein. By this time the ore, almost in a molten state, will be disposed at the bottom of the furnace and upon the hearth formed by the inclined edges of the wall of the well 3. The current of electricity is then turned on, and this current will pass from one of the electrodes 4 and 5 through the ore to the other electrode, the resistance of the ore being a considerable amount will cause it to become

heated and quickly melt. When melted, the metal will run into the well 3 from which it is drawn by the spout 13. Other ore will drop down upon the hearth and thus the smelting operation is comparatively a continuous one, it being understood that the furnace is continuously charged. The slag and other refuse material is removed from the furnace from time to time through the spout 14.

The twyers 11 are provided with bushings 12 having the proper size openings in order that the correct amount of air may be supplied to the furnace, taking in consideration the kind of ore being treated.

The products of combustion and smoke pass vertically through the furnace to the pipe B, and thence to the chamber C. Owing to the very strong draft created through the furnace a large amount of dust containing minerals will be blown through the pipe B to the dust chamber. Some of this dust will collect in the hoppers 15 in the horizontal portion of the pipe B, and some of the gases will condense and fall into these hoppers. This material is removed from the hoppers and again placed in the furnace to remove the valuable minerals therefrom.

As smoke and other gases pass through the chamber C and up the smoke stack E a great amount of dust will be collected upon the screen 16. This screen is continuously sprinkled with water from the pipes 20 and 22 so that the dust is caused to collect in the troughs 18. The water and dust will then be conveyed through the pipe 23 and pipe 24 to the tank D. Dust will settle to the bottom of this tank, and when a considerable quantity has been thus accumulated the water is allowed to drain off from the tank and sediment is collected and pressed into bricks and again fed to the furnace.

From the foregoing description it will be seen that the objects of the invention have been effectively carried out as an improved and practical furnace for smelting ores has been provided. Practically all of the minerals contained in the ores are collected, and hence there is very little waste or refuse material. The cost of smelting ores is reduced by the use of this process, first by calcining the ores by heating them with wood or coke, and then allowing the metals to be completely melted or fused by the passage therethrough of an electric current when almost in a molten condition. A considerably less amount of current is required than is required in the furnaces heretofore known for there the current is passed through a comparatively cold ore.

As various changes in form, proportion and in the minor details of construction may be resorted to without departing from the principle of this invention it is to be understood that I do not wish to be limited to the precise construction herein shown and described.

I claim:

In a smelting furnace, a furnace shell having a rectangular bottom and a polysided wall rising therefrom, said bottom having along its central portion a relatively narrow well provided with a molten metal outlet, a pair of one piece electrodes extending from one side to the opposite side of the furnace and lying on said bottom on opposite sides of and parallel to said well, said electrodes abutting the remaining two opposite sides of said wall and being spaced from said well, said bottom of the furnace inclining downwardly from said electrodes to said well and forming means for supporting the ore to be melted by the electric current passing between said electrodes.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

ALBERT E. BOOKWALTER.

Witnesses:
ELMER C. RAUCH,
W. J. BURNS.