

F. COTTON
PROCESS OF REMOVING SULFUR, ARSENIC, AND OTHER LIKE IMPURITIES FROM
REFRACTORY ORES.

APPLICATION FILED APR. 20, 1907.

922,088.

Patented May 18, 1909

2 SHEETS—SHEET 1

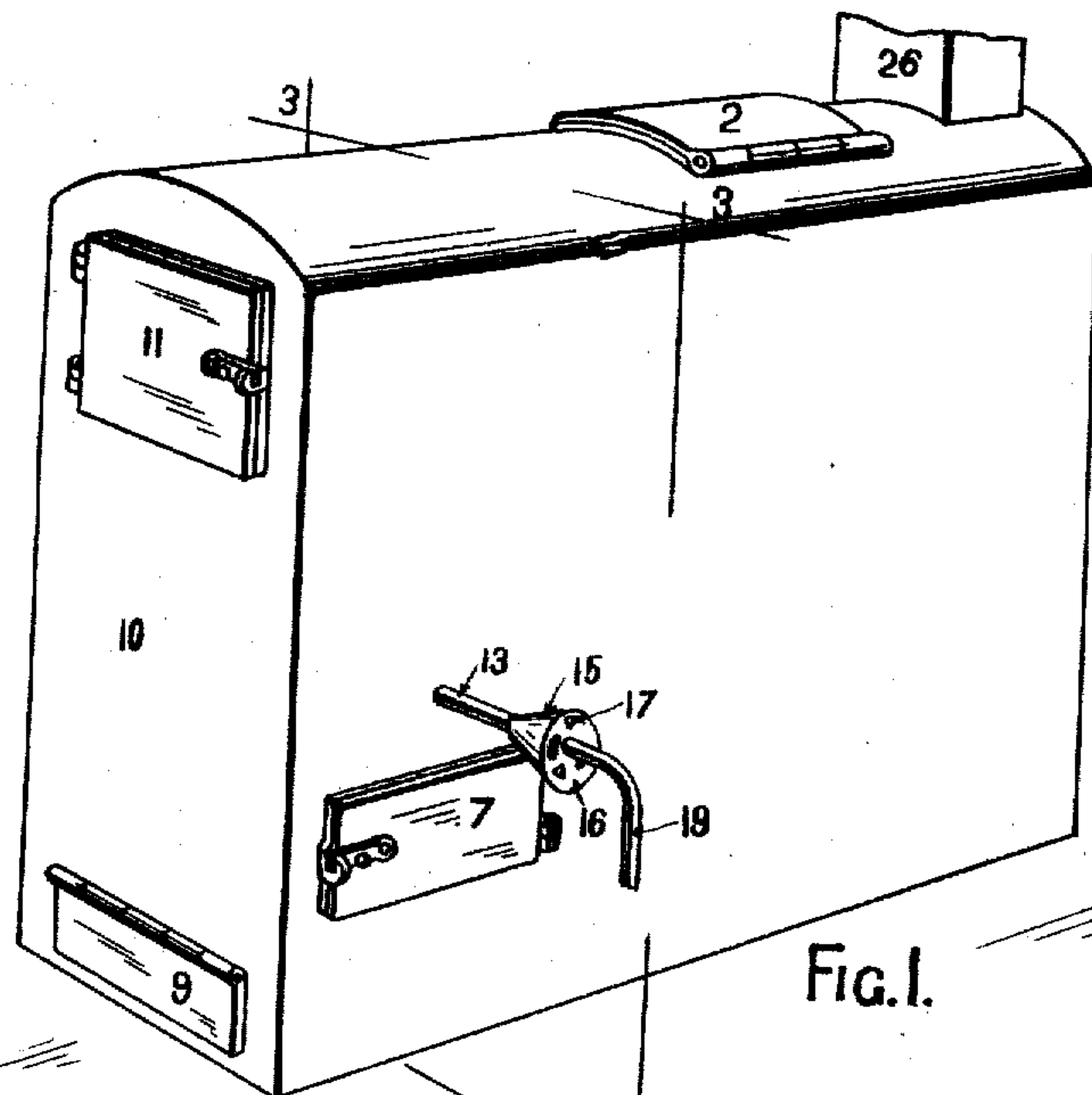


FIG. 1.

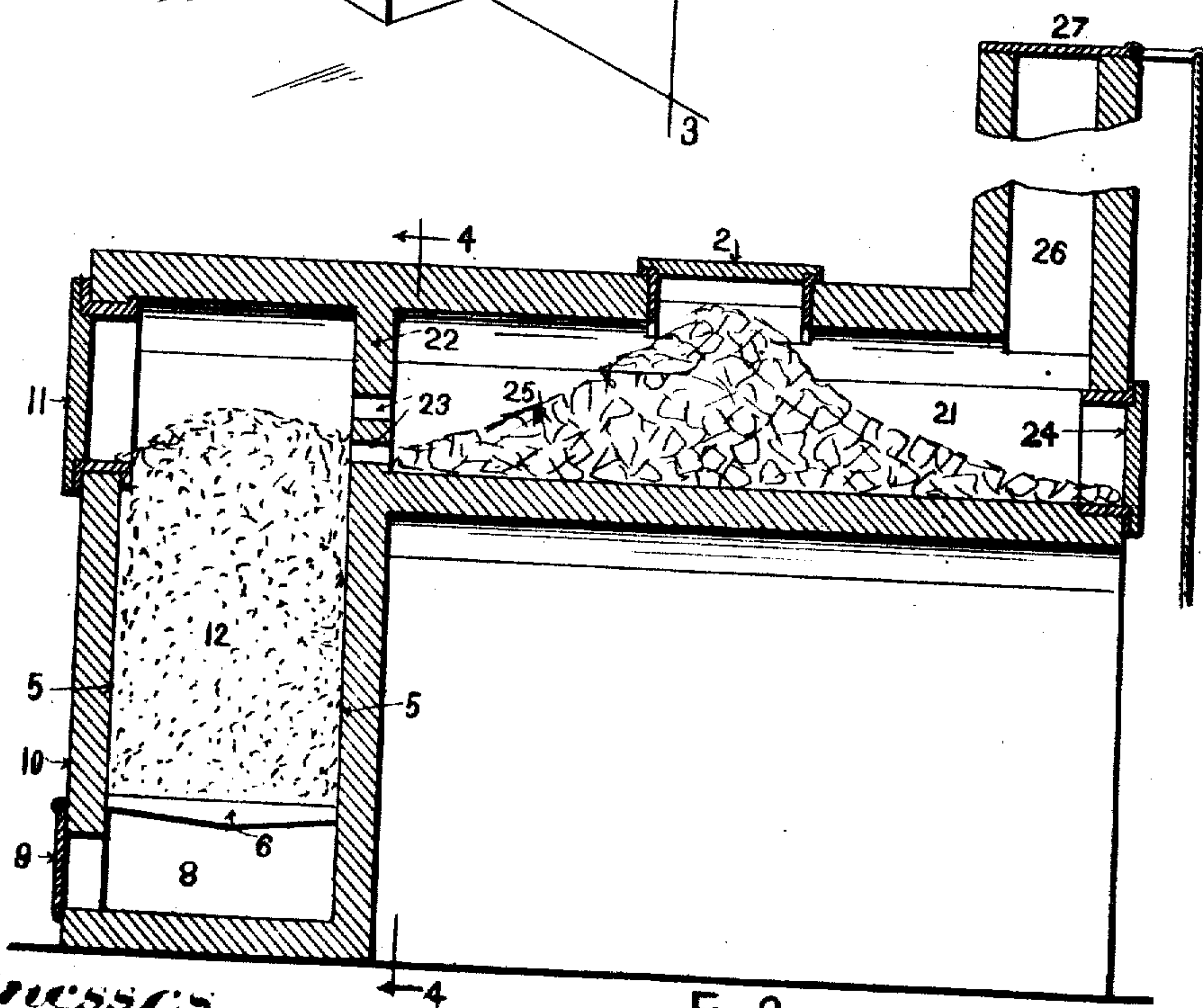


FIG. 2.

Witnesses.
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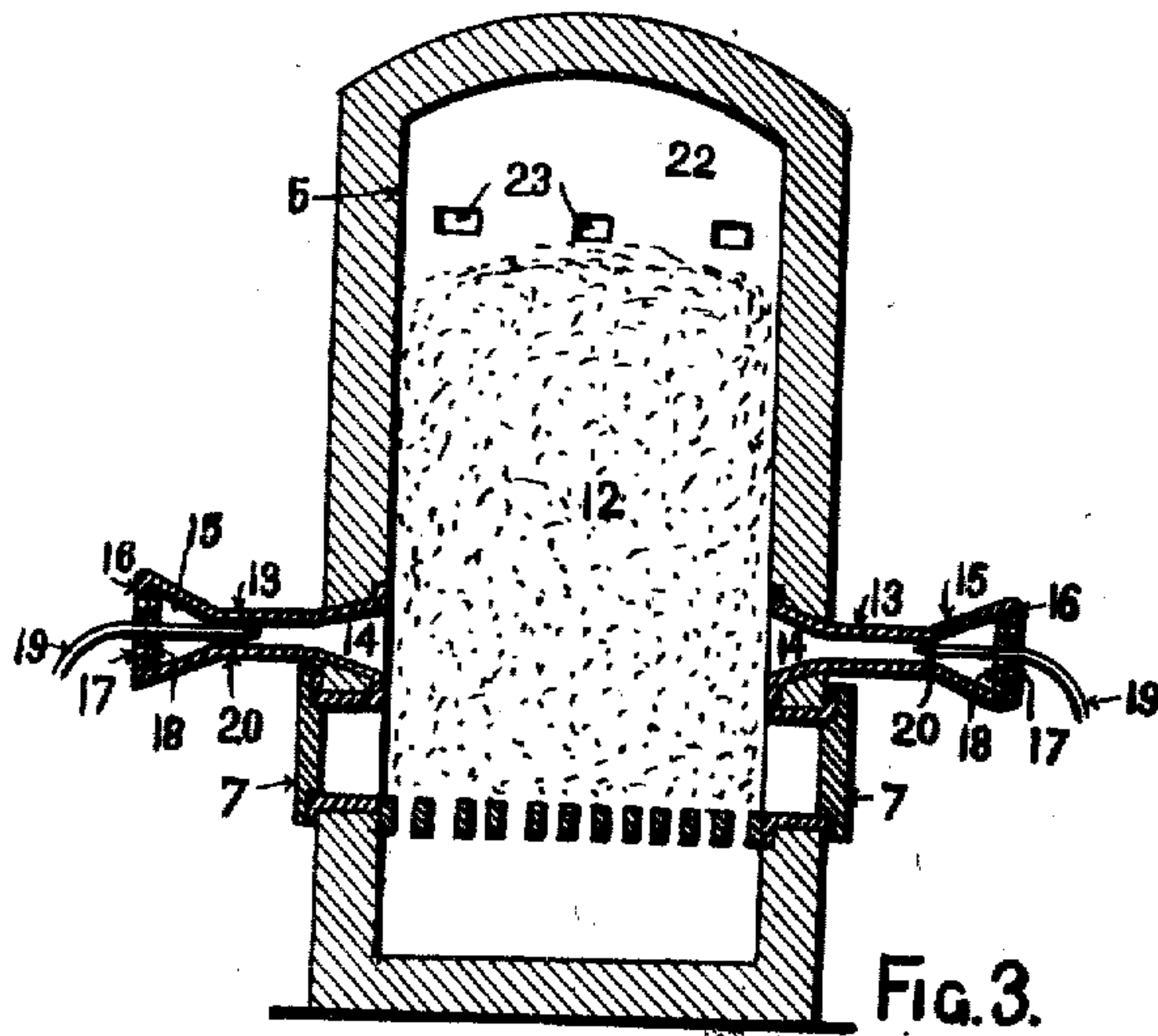


FIG. 3.

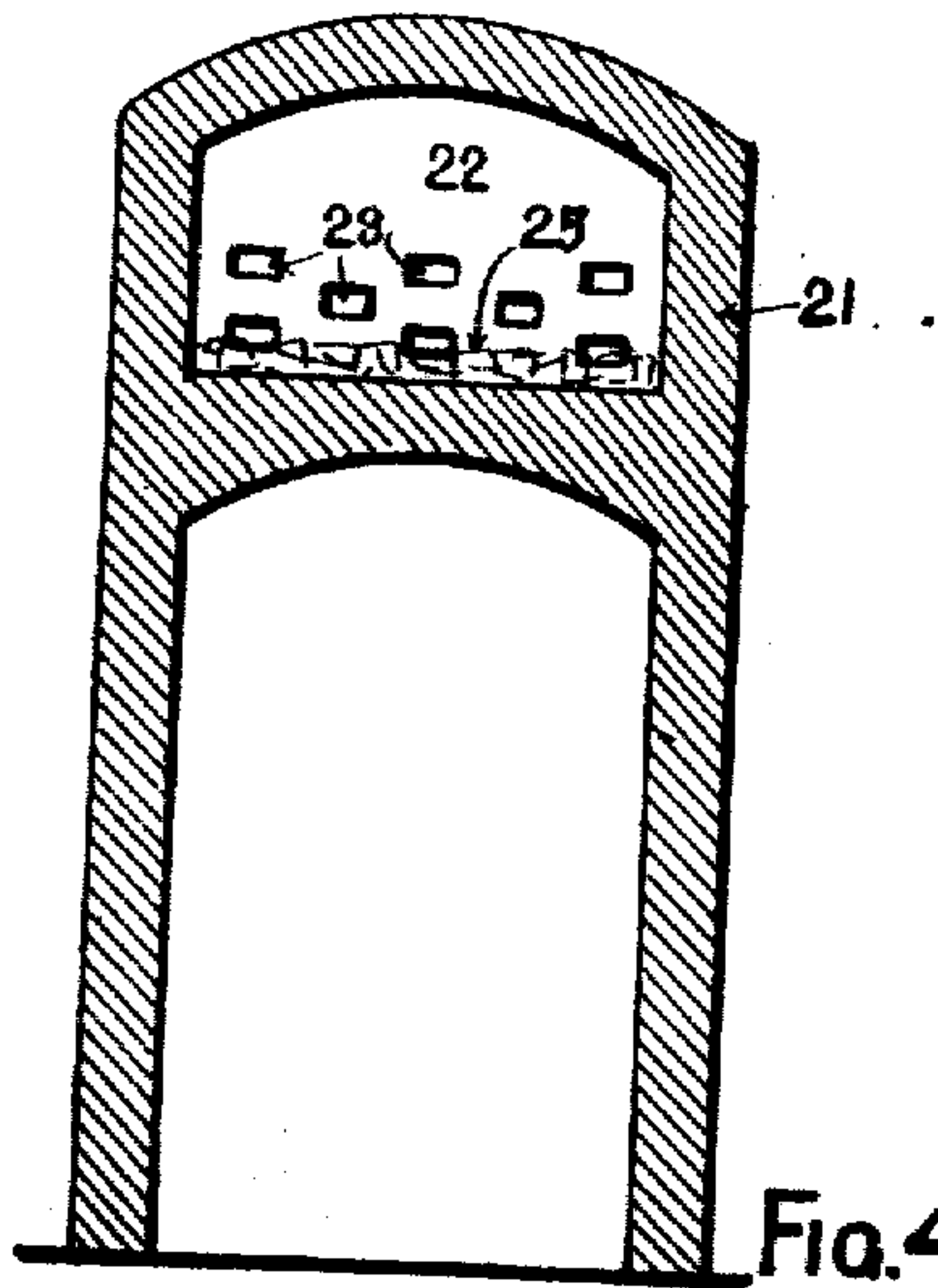


FIG. 4.

Witnesses.
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UNITED STATES PATENT OFFICE.

FRANK COTTON, OF HORNSBY, NEW SOUTH WALES, AUSTRALIA.

PROCESS OF REMOVING SULFUR, ARSENIC, AND OTHER LIKE IMPURITIES FROM REFRACTORY ORES.

No. 922,088.

Specification of Letters Patent.

Patented May 18, 1909.

Application filed April 20, 1907. Serial No. 389,381.

To all whom it may concern:

Be it known that I, FRANK COTTON, a British subject, residing at Hornsby, in the State of New South Wales, Commonwealth of Australia, engineer, have invented a process for removing sulfur, arsenic, and other like impurities from refractory ores and preparing the same for subsequent treatment; and I hereby declare that the following is a full, clear, and exact description of the same.

This invention relates to a process for preparing ores, containing gold and silver associated with impurities such as sulfur, arsenic, antimony, zinc, and the like, for subsequent treatment for the recovery of the gold and silver by any process such as concentrating, smelting, amalgamating, chlorinating, cyaniding, and the invention consists in eliminating the above and other impurities so that an undesirable matte will be prevented from forming during the subsequent treatment of the ore for the recovery of the gold or silver.

The process forming the subject matter of this invention involves three distinct operations or steps, namely:—1. Combining the sulfur when present in the ore with free hydrogen so that it can pass off as a gas. 2. The subsequent oxidation by a reagent such as steam of any of the base metals present in the desulfurized ore, capable of oxidation. 3. Driving off by heat, from the desulfurized and oxidized ore the volatile oxids and remaining volatile impurities. In ores which do not contain sulfur, it may not be necessary to use the first step in the process *i. e.* that of reducing the ore by the action of hydrogen, in which case the ore is only treated as described in the second and third steps of the process. These operations may conveniently be carried out in a furnace which I now proceed to describe and which is illustrated in the accompanying drawings.

Figure 1, is a perspective view of the furnace. Fig. 2, is a longitudinal section thereof. Fig. 3, is a vertical section on plane 3—3 Fig. 1. Fig. 4, is a vertical section on plane 4—4 Fig. 2.

Like characters of reference refer to like parts throughout the specification and drawings.

5 is a furnace of which 12 is the chamber for containing the fuel which is placed

therein through the feed door 11 in the side of the furnace.

6 are the fire bars and 8 is the pit of the furnace, above which are fire doors 7.

9 is a damper placed on the front 10 of the furnace for the purpose of regulating the air supply and raising the temperature of the furnace when required.

At the top and at right angles to the combustion chamber 12 and communicating therewith by means of passages 23 is a narrow horizontal ore chamber 21, into which is placed the refractory ore 25 to be treated, through feed doors 2 and 24 respectively in the top and end thereof.

22 is a partition dividing the ore chamber 21 from the combustion chamber 12.

26 is a chimney, leading from the ore chamber 21, provided with a damper 27 which is utilized to control the draft and thereby regulate the temperature of the furnace.

Extending through the walls of the furnace 5, just above the fire doors 7, are tuyers 13 with flaring mouths 14 and 15. The mouth 15 has a cover 16 with air ports 17 and a damper 18 for regulating the air supply.

19 is a steam supply pipe leading into the flaring mouth 15 and is provided with a nozzle 20. The steam supply can be controlled by any suitable valve placed in the steam pipe.

The fuel to be used in the furnace is preferably slack coal but charcoal, coke, breeze or even wood can be utilized.

The intensity of combustion depends upon the quantity of air supplied to the fuel and is therefore capable of regulation by the greater or lesser opening of the damper 9 and of the damper 27 of the chimney 26, which controls the draft. A certain quantity of air is also drawn in through the air ports 17 in the cover 16 by the action of the steam passing from the nozzle 20. The air so drawn in mixes intimately with the steam from the nozzle 20 and maintains the combustion of the fuel with which the steam comes into immediate contact. These air ports 17 are capable of being more or less opened so as to adjust the quantity of air drawn into the furnace for the purpose for which it is supplied.

Before any charge is introduced into the

furnace the latter is raised to a temperature somewhat under that to which the ore is subsequently to be exposed during the desulfurizing operation.

5 A charge of ore having been previously broken into fragments about the size of ordinary road metal is introduced into the heated ore chamber and brought to a temperature equivalent to that of iron at a dull
10 red heat, which temperature is maintained during the first (desulfurizing) and second (oxidizing) operations of the process. Care must be taken during these operations not to exceed the temperature indicated, in order to prevent the agglomeration in a coherent mass of the more infusible metals
15 such as iron, copper, etc., which if the indicated temperature is exceeded will be produced by the reduction of iron pyrites, copper pyrites etc., present in the ore.

The hydrogen gas required during the desulfurizing operation is produced together with carbon monoxid by forcing superheated steam from the nozzles 20 through
25 the burning fuel in the combustion chamber in such limited quantity as to permit of the steam being dissociated into its constituent elements i. e. hydrogen and oxygen by contact with the burning fuel, the oxygen combining with the carbon of the fuel to form carbon monoxid and the hydrogen being
30 liberated in a free state. The mixed gases thus produced pass from the fuel over the heated ore in the ore chamber and the hydrogen acts upon the sulfur contained in
35 the ore and converts it into sulfureted hydrogen which with the unaffected carbon monoxid escapes through the chimney 26. The pressure within the furnace is, during
40 this and the next operation kept slightly above atmospheric pressure by partially closing the damper 27 of the chimney. The time necessary to desulfurize the ore varies according to the amount of sulfur present
45 in it. The desulfurizing operation should be continued until the escaping gases are free from sulfureted hydrogen. A pipe passing through the wall of the ore chamber may be provided for the purpose of
50 drawing off samples of gases to be tested for sulfureted hydrogen.

When the ore has been desulfurized as above described the supply of steam is increased so as to cause a large proportion of
55 it to pass through the burning fuel in the furnace chamber and into the ore chamber 21 without undergoing decomposition. The superheated steam is carried over the desulfurized ore in the ore chamber and converts
60 any reduced iron, copper, or other oxidizable metals present into their respective oxids,

and the free hydrogen from the steam liberated in the operation may be allowed to escape or may be collected to be used in the earlier part of the process.

65 The oxidation takes place rapidly but the time occupied varies of course with different ores. It is easy to ascertain whether the oxidation is complete by removing samples of the ore from the ore chamber and testing
70 the same for the presence of oxidizable metals in the metallic state.

During the oxidizing operation a portion of the more volatile oxids produced will pass out through the chimney. After the ore
75 has been desulfurized and oxidized as above described the steam supply is cut off and the air supply and draft through the furnace increased by opening the damper 9 so as to render the combustion more active and raise
80 the temperature of the ore to that of iron at a bright red heat. Any remaining volatile impurities such as arsenic, antimony, or zinc are driven off and may if it is thought desirable be recovered by condensation in a
85 condensation chamber provided for that purpose.

After the volatile impurities have been driven off as indicated by the absence of white fumes escaping from the chimney the
90 ore is removed from the ore chamber and allowed to cool. It is then in a comparatively friable and porous condition and ready for ordinary treatment by concentrating, smelting, amalgamating, chlorinating, or cyanid-
95 ing.

As soon as one charge of ore has been treated by the process above described and removed from the ore chamber the furnace is ready for the reception of a further charge.
100

Having thus fully described my invention what I claim as new and desire to secure by Letters Patent is:

A process for the preparation of auriferous and argentiferous refractory ores contaminated with impurities such as sulfur, arsenic, antimony, zinc and the like, consisting of the removal of the sulfur by the action upon the heated ore of free hydrogen under slight pressure, the subsequent oxidation of the base metals capable of oxidation, present in the desulfurized ore by the action of steam upon the same and the final driving off by heat from the desulfurized and oxidized ore of the remaining volatile oxids
105
110
115 present.

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

FRANK COTTON.

Witnesses:

WALKER SIGMONT,
WILLIAM NEWTON.