No. 658,536. Patented Sept. 25, 1900.

G. M. WESTMAN.

APPARATUS FOR TREATING ORES.

(Application filed Dec. 16, 1899.)

(No Model.)

Fig. 1.

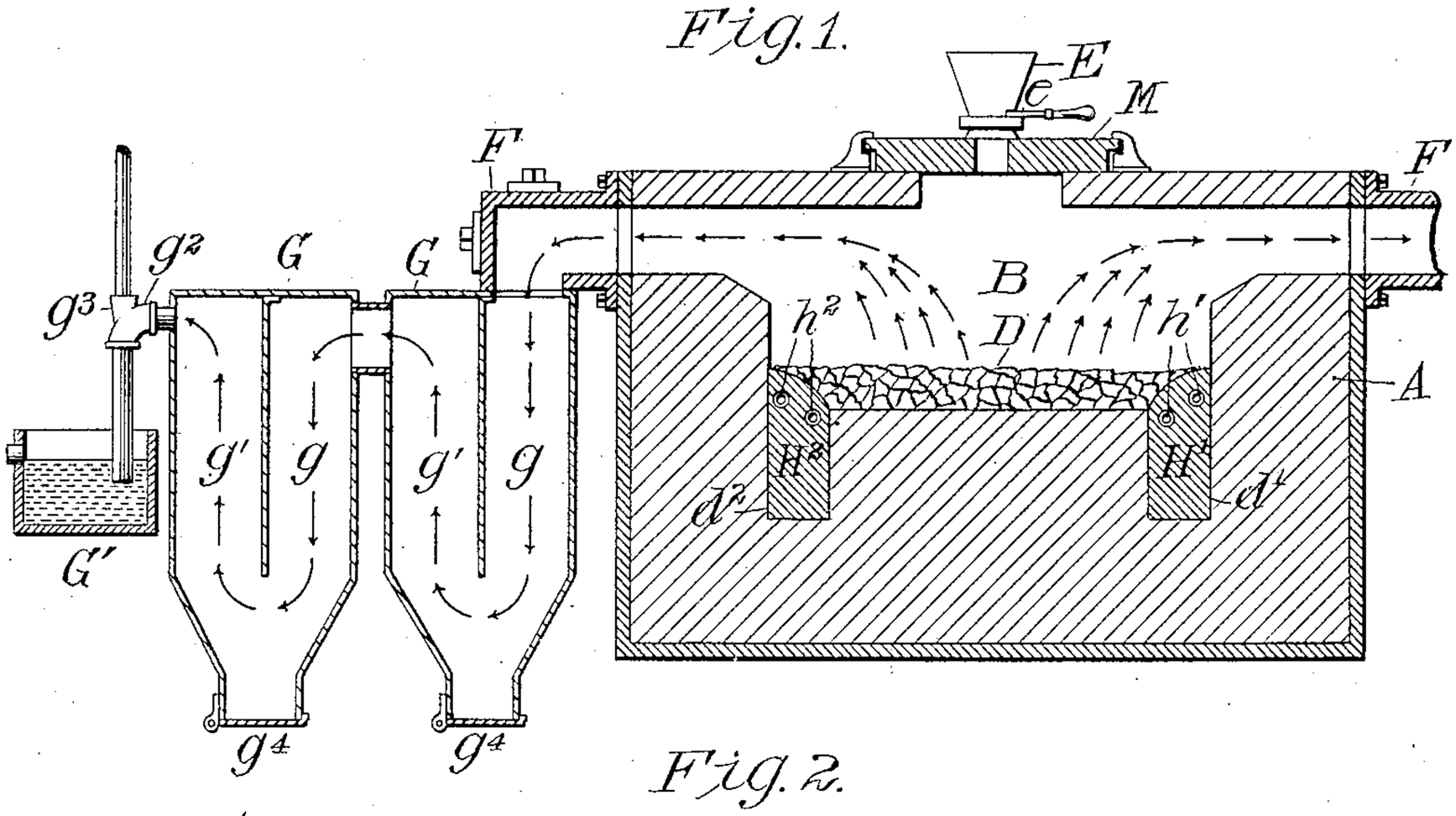

Fig. 2.

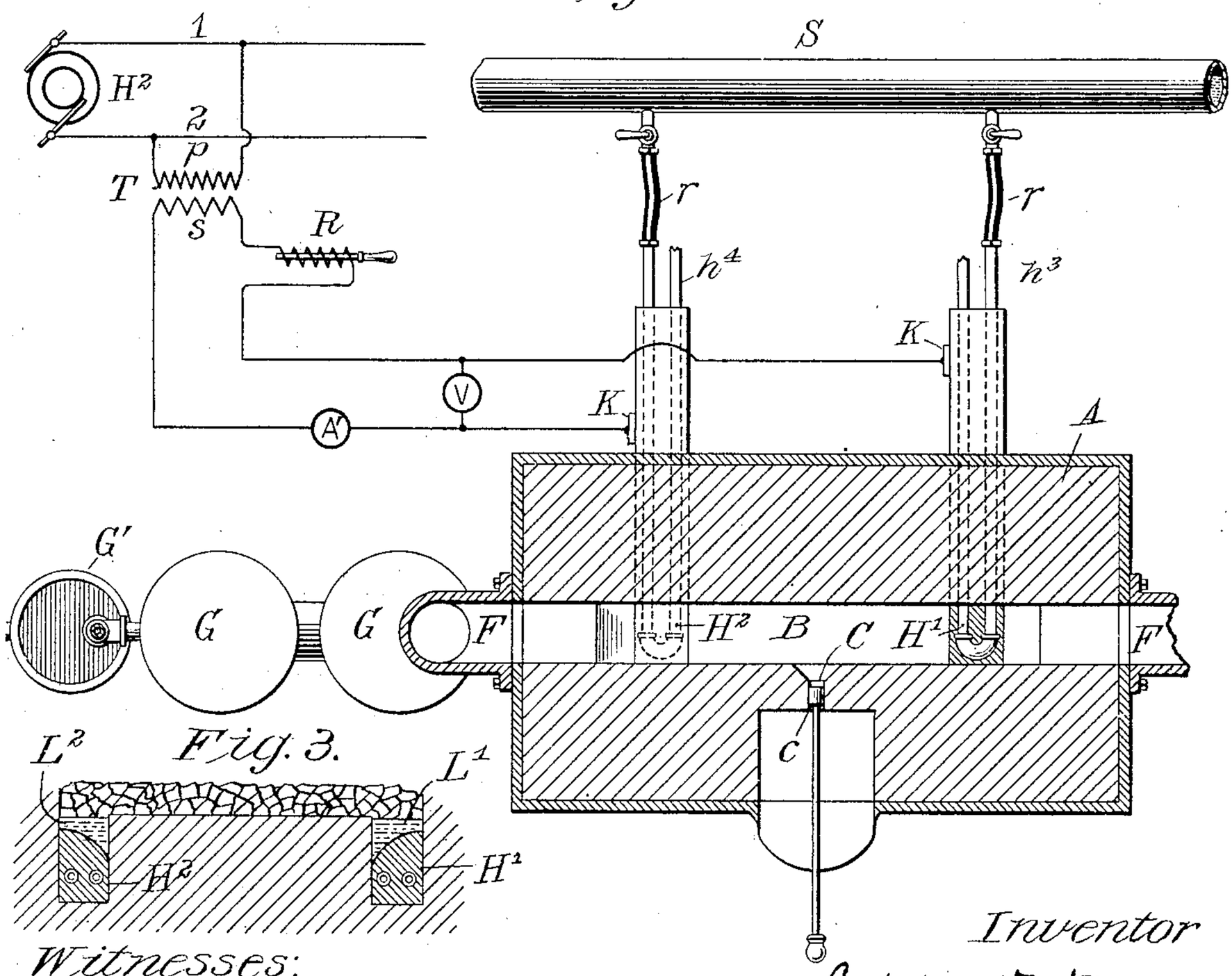

Fig. 3.

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UNITED STATES PATENT OFFICE.

GUSTAF M. WESTMAN, OF NEW YORK, N. Y., ASSIGNOR TO THE ARSENICAL GOLD REDUCTION COMPANY, OF NEWARK, NEW JERSEY.

APPARATUS FOR TREATING ORES.

SPECIFICATION forming part of Letters Patent No. 658,536, dated September 25, 1900.

Application filed December 16, 1899. Serial No. 740,517. (No model.)

To all whom it may concern:

Be it known that I, GUSTAF M. WESTMAN, a subject of the King of Sweden and Norway, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Apparatus for the Treatment of Ores, of which the following is a specification.

My invention relates to the class of apparatus employed in the reduction of ores, the object being to provide a practicable and economical apparatus for treating, more particularly, arsenic or similar ores and collecting the arsenic and at the same time saving any precious metals or other valuable bi-products which may be contained in the ores operated upon.

The treatment of arsenic ores in considerable quantities has usually been found extremely difficult and dangerous, owing to the poisonous qualities of the arsenic-vapors, and any usual process of treatment involves heating in more or less open furnaces, and much of the arsenic-vapor is then liable to escape into the air. Such processes can therefore be carried on usually only in uninhabited districts. By my invention the freeing of the arsenic from the ore is accomplished in a closed chamber, from which the vapors are led off and gathered in a suitable condensing chamber or vessel. At the same time the precious metals, which are usually present in more or less abundance, may be collected and saved. The heating and melting is accomplished by means of electric currents.

In the accompanying drawings, Figure 1 is a vertical section of a furnace or apparatus for carrying out the process, and Fig. 2 is a horizontal section of the same. Fig. 3 illustrates a modification.

Referring to the drawings, A represents the wall of the furnace, and B the melting-chamber therein. Two electrodes H and H′ extend along the bottom of the chamber B. These electrodes I usually construct of cast-iron. They are provided with means for circulating water therethrough for keeping them cool. These means consist of openings h' h^2, and a convenient way to manufacture them consists in forming U-shaped pipes h^3 and h^4, of wrought-iron, as shown in Fig. 2, and casting the iron electrodes about the pipes, so that the pipes are embedded within the cast-iron portions. Suitable means, as indicated at K, are employed for furnishing electrical connection with the electrodes. The pipes are connected with a hydrant or reservoir S for supplying water to pass through the electrodes, and thus keep them cool. The electrodes H and H′ are usually placed in depressions d' d^2. The confronting upper surfaces may be curved, as shown, in approximately the form of sections of parabolas to expose considerable superficial area to the ore, and thus secure good electrical contact therewith. They are respectively connected with the terminals of any suitable source of electricity, and for reasons hereinafter pointed out I usually prefer to use alternating electric currents. In the drawings I have represented an alternating-current generator H^2, the terminals of which are connected by conductors 1 and 2 with the terminals of the primary coil p of a converter T. The secondary coil s has one of its terminals connected with the electrode H′, while the remaining terminal is connected with the electrode H^2. A suitable regulating device R for adjusting the current may be included in the secondary circuit of the transformer or converter T. The coils of the transformer are so proportioned with reference to the electromotive force of the generator as to deliver currents of the required electromotive force and quantity to the furnace. It is not always essential that alternating electric currents be employed; but they possess the advantages of ready production and convenient control and freedom from electrolytic effects, whereas with continuous currents there would be a tendency to reduce one of the electrodes and build up the other by electrolytic action. Moreover, continuous currents usually tend to break up the chemical combinations of the baser metals in the matte, and hence consume much of the energy uselessly.

The ore (indicated at D) is fed into the furnace through a suitable hopper E, which may be closed tightly by a slide or cover e to prevent the escape of the vapors of arsenic when the furnace is in operation. The circuit for

the electric current is completed from one electrode to the other through the mass of ore D. This ore may be any arsenical ore bearing sufficient iron or other metal to afford a conducting path for the current. An ore which affords a large supply of arsenic and which may be treated with advantage by my process, is what is known as "mispickle." The resistance offered by the ore is sufficiently great to cause sufficient heat to be generated therein to melt it and to thereby liberate the arsenic, which then passes in the form of metallic vapor through the pipe or pipes F into any suitable form of condensing vessel—such as indicated at G G, for instance. In the drawings I have shown the vessels G G as being made in compartments, so that the vapors pass downward through the compartment *g* and upward through the compartment *g'*. At the base of the condensing vessels suitable openings are provided for access thereto in order to remove the arsenic, as indicated at g^4. The vapors passing through the condensing vessels may pass out at a pipe g^2, being urged foward by a water-injector g^3, of any suitable character, the water then passing into the vessel or tank G', where any arsenic remaining may be collected. The character and construction of the condensing vessels may be modified, as found convenient. It is usually desirable to insulate the sources of water furnished to cool the electrodes from each other, as otherwise the pipes conveying the water might afford a short circuit between the electrodes. The water may be derived, however, from a single hydrant through sections of rubber hose *r r* or other non-conducting material. The constant circulation of water keeps the electrodes sufficiently cool, and thus prevents the loss of current in the electrodes, such as might otherwise result from the increased resistance offered thereby when heated to a very high temperature. The melted ore freed from the arsenic may be drawn off through one or more taps C, which may be opened and closed by a plug *c*, as desired.

Much of the heavy precious metals, such as gold and silver, sink downward and gather above the electrodes, and I have found it useful in some instances to employ a layer of lead, as indicated at L' L^2 in Fig. 3, upon the surfaces of the electrodes to gather the precious metals. The electrodes are here shown as having their upper surfaces of the iron portions H' H^2 below the bottom of the chamber B. The lead will usually be in a molten state, but being of greater specific gravity than the mass of ore it will remain at the bottom of the chamber, and owing to the cooling action of the water flowing through the electrodes it will not be raised to a sufficiently-high temperature to vaporize or distil. Without this cooling action more or less of the lead would usually pass off into the matte. It is not essential, however, that the precious metals be collected within the furnace, as they may be carried off in the matte and afterward recovered therefrom. After the ore has been melted and the arsenic driven off, the molten iron sulfids or other material composing the matte is drawn off through the tap C, and a new charge is placed in the furnace.

A number of charges may usually be treated before it is necessary to remove the precious metal from the lead in case the latter is employed; but if they are left in the matte they can be recovered in the usual way.

For the purpose of affording convenient access to the furnace it may be provided with a lid M of sufficient size. The walls of the furnace may be of fire-clay or other suitable material, but the portions against which the ore rests should be composed of a non-conductor of electricity.

For the purpose of determining the current and electromotive force a suitable amperemeter A' and a voltmeter V may be provided in a well-known manner.

The matte which is withdrawn from the furnace being freed from arsenic may be readily and safely treated by any suitable process to recover the iron and other metals which it may contain.

I claim as my invention—

1. In a furnace for treating electric conducting ores by means of electric currents, the combination of two horizontal electrodes of cast-iron, and wrought-iron pipes extended within the body of each electrode for forming a cooling-fluid circuit, said electrodes being located in depressions in the bottom of the furnace, a horizontal bed between the electrodes for receiving the ore to be treated, a vapor-escape flue in the upper portion of the furnace and a tap extending from the bed of the furnace at a point between the electrodes for withdrawing molten metal therefrom.

2. The combination of a melting-chamber, a source of electric currents, and two compound electrodes connected with said source extending along the bottom of said chamber and each consisting of a horizontal iron portion and a covering of lead, substantially as described.

3. An electrode for electric reduction-furnaces consisting of parallel superposed strata of iron and lead, the lead above and the iron portion being perforated for the passage of a cooling fluid therethrough.

4. In a furnace for the reduction of ore, the combination of electrodes composed of superposed layers of iron and lead, the lead above, and means for cooling the iron to prevent vaporization of the lead.

5. In a furnace for the reduction of ores, a bottom having a depression and a compound metallic electrode placed therein, the upper portion thereof consisting of a more-fusible metal than the under portion thereof, the upper surface being below the general surface of the bottom.

6. In a furnace for the reduction of ores, a

bottom having depressions and electrodes placed therein below the general surface of the bottom, each of said electrodes consisting of two layers of metals having different melting-points, the more fusible metal constituting the upper layer.

7. In a furnace for treating ores, the combination of a melting-chamber having the depressions d', d^2, and the electrodes H, H', located in said depressions, and having perforations h', h^2, and the superposed strata of lead.

8. In a furnace for treating ores, the combination of compound electrodes comprising a normally-non-fused portion and a superposed readily-fusible portion, the chamber having depressions receiving the electrodes, the charging and discharging openings, and the removable cover.

9. In a furnace for electrically treating ores, the horizontal electrodes having fluid-passages therethrough, and having superposed relatively-fusible portions in combination with the insulated sources of cooling fluid, and connections from the sources to the respective fluid-passages.

10. In a furnace for electrically heating ores, one or more metallic electrodes comprising a normally-non-fused portion and a superposed readily-fusible portion, and a water-circuit through the normally-non-fused portion.

Signed at New York, in the county of New York and State of New York, this 21st day of November, A. D. 1899.

GUSTAF M. WESTMAN.

Witnesses:

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J. H. JONES.