W. C. ARSEM.

REFINING METALS.

APPLICATION FILED FEB. 9, 1910.

998,665. Patented July 25, 1911.

Fig. 1.

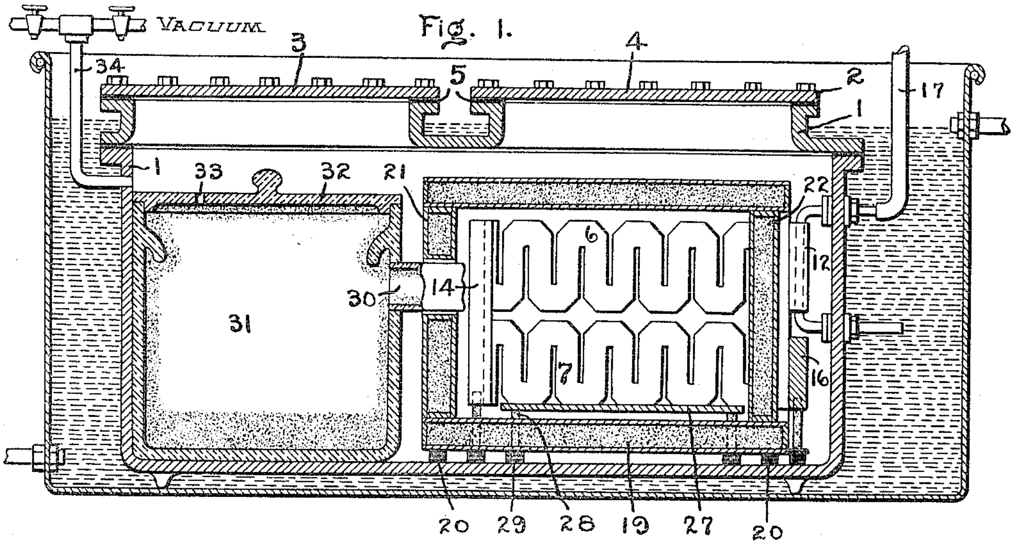


Fig. 2.

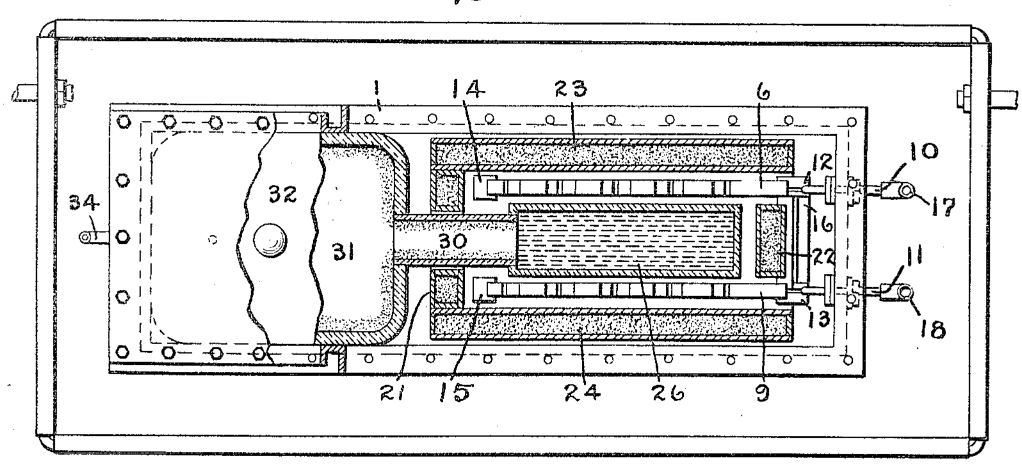
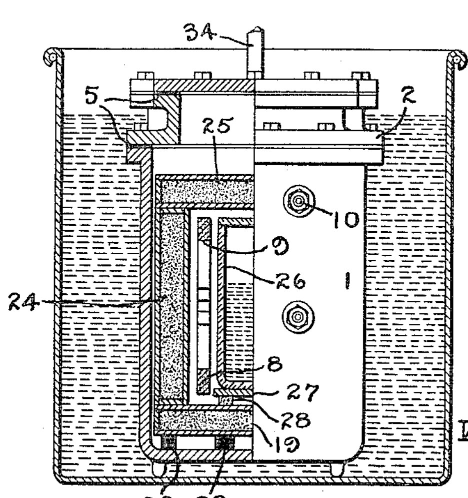


Fig. 3.



WITNESSES
J. Earl Ryan
J. Ellis Glen.

INVENTOR
WILLIAM C ARSEM
BY Allen S. Davis
HIS ATTORNEY

UNITED STATES PATENT OFFICE.

WILLIAM C. ARSEM, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

REFINING METALS.

998,665. Specification of Letters Patent. Patented July 25, 1911.

Application filed February 9, 1910. Serial No. 542,933.

To all whom it may concern:

Be it known that I, WILLIAM C. ARSEM, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Refining of Metals, of which the following is a specification.

The methods at present employed in the refining and separation of precious metals, such as silver and gold, consist in electrolyzing their solutions. The alloy is commonly made the anode in the electrolytic cell; the silver is deposited on the cathode, and the gold, together with platinum and other associated metals, falls to the bottom of the cell as a slime or mud. This mud must then be melted and subjected to further purification as by electrolysis in order to separate the gold from the associated metals.

I have discovered that if the above mentioned metals are subjected to a fractional distillation in a nearly perfect vacuum, a sharp and distinct separation of the silver and gold can be obtained, thereby avoiding the complications and expense incident to getting the metals into solution and refining them electrolytically. I find that silver can be completely distilled from an alloy by heating the alloy to a temperature of about 1300° C. in a nearly complete vacuum. In the type of furnace to be hereinafter described a pressure as low as about 1 millimeter of mercury or even less can be readily obtained. The gold can be separated subsequently from platinum or other refractory metals by raising the temperature to about 1500° C. A furnace whereby my process of separating these metals can be carried out is shown in the accompanying drawings. This furnace, however, forms no part of my present invention, and is claimed by me in a copending application, Serial No. 513,407, filed Aug. 18, 1909. The furnace has a heating chamber in which the alloy can be raised to the requisite temperature and also a condensing chamber in which the distilled product can be collected.

In these drawings, Figure 1 is a sectional elevation of the furnace, showing the heating element, the crucible and its charge being removed from the furnace; Fig. 2 is a sectional plan view of the furnace; and Fig. 3 is an end elevation of the same partly in section.

The main envelop of the furnace consists of a rectangular box 1, preferably of gun metal with a coating of tin, provided with a cover 2 bolted securely in place. The cover 2 has manholes 3 and 4 located respectively above the cold and the hot zones of the furnace. Lead gaskets 5 can be used under the covers to make air-tight joints. The heating element of the furnace consists of four graphite grids 6, 7, 8 and 9 sawed transversely, and with their corners rounded off, as shown in the drawing, so that when current is passed through them they will attain a uniform incandescence throughout substantially their entire length. Current is supplied to these graphite resistance elements by way of water-cooled copper tubes 10 and 11 passing through insulating bushings in the end of envelop 1. The tubes are clamped, respectively, in copper blocks 12 and 13, which in turn are bolted to the graphite grids 6 and 9. The other ends of these grids make contact respectively with the graphite blocks 14 and 15 which make electrical connection with the lower pair of grids. A cross connection 16 of graphite at the end of the furnace completes the electrical circuit. For the sake of avoiding confusion on the drawing, the current supply cables for the tubes 10 and 11 have been omitted but the rubber hose for conducting water to these terminals for cooling purposes is shown at 17 and 18.

The above described heating element consisting of the four grids 6, 7, 8 and 9 is inclosed in a rectangular heat insulating screen, the graphite walls of which are made double throughout with an intervening packing of graphite. The bottom member 19 of the screen rests on insulating buttons 20 of lava and supports the end walls 21 and 22 and also the side walls 23 and 24. The top member 25 rests on the tops of the four side walls. This heat insulating screen serves to limit the radiation of heat outward and serves to reflect and concentrate the heat on the rectangular space inclosed by the heater grids. Within this space may be introduced a rectangular crucible 26 of graphite containing the charge of alloy which may be assumed to consist of silver, gold and perhaps highly refractory metals, such as platinum. The crucible may be conveniently supported on a rectangular platform 27 carried on graphite standards 28 which pass down through holes in the heat insulating screen and terminate in insulating bushings 29. The crucible is preferably provided with a cover to prevent free escape of vaporized material except through the tubular outlet 30 which leads to the condensing chamber 31 at the other end of the furnace.

The condensing chamber may advantageously consist of an earthenware or iron pot fitting snugly against the water-cooled walls of the envelop 1 and of sufficient size to insure complete condensation of the metal distilled over from the hot zone. The condensing chamber may be provided with a cover 32 preferably having an outlet 33 for the ready removal of air when the entire furnace is pumped out by way of pipe 34 which leads to a vacuum pump. I find it desirable to keep the vacuum pump in continuous operation so that the pressure of gases within the furnace may be kept as low as possible. The main envelop 1 of the furnace is maintained cool by the circulation of the water below and on all sides of it up to a level just below the man-hole covers 3 and 4. These are preferably left unsubmerged so that the charging and discharging of the furnace can be carried out without drawing off the cooling fluid and without any considerable dismantling of the furnace.

When a charge of the above alloy has been placed in a crucible 26, current is supplied to the heater grids until the temperature is about 1300° C. At this temperature the silver is completely vaporized from the associated metals and passes over into the condensing chamber 31. This temperature is maintained for several hours, the actual length of time depending upon the amount of alloy in the furnace, a greater amount of alloy requiring a somewhat longer time to completely drive off the silver. After cooling, the furnace is opened by removing the manhole cover 4 and the silver is removed either by cleaning out the condensing chamber 31, or by removing it entirely from the furnace and substituting a similar condensing chamber. If it is desired to separate the gold from associated platinum, the manhole cover 4 is replaced, the furnace is again evacuated and the temperature is run up to about 1500° C. At this temperature the gold is completely distilled and passes over into the condensing chamber 31, a temperature somewhat higher than 1500° can be used to advantage, as there is little danger of volatilizing a refractory metal such as platinum until very high temperatures are reached, the gold passing over more rapidly at temperatures somewhat higher than 1500°. After this heating has been continued for several hours, depending upon the amount of metal to be separated, the furnace is again allowed to cool down and the gold and platinum are removed from the furnace.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. The process of separating gold and silver which consists in heating an alloy of these metals in an attenuated atmosphere to a temperature of about 1300° C. to distil off the silver.

2. The process which consists in heating an alloy of silver, gold and platinum in an attenuated atmosphere at a temperature of about 1300° until the silver is completely vaporized and then raising the temperature to about 1500° to distil the gold.

3. The process of parting gold and silver which consists in heating an alloy containing these metals at a temperature of about 1300° under a pressure of about one millimeter of mercury.

4. The process which consists in heating a mixture of gold and silver in a substantial vacuum at the vaporizing temperature of the silver, thereby parting said metals.

In witness whereof, I have hereunto set my hand this 8th day of February, 1910.

WILLIAM C. ARSEM.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.