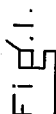


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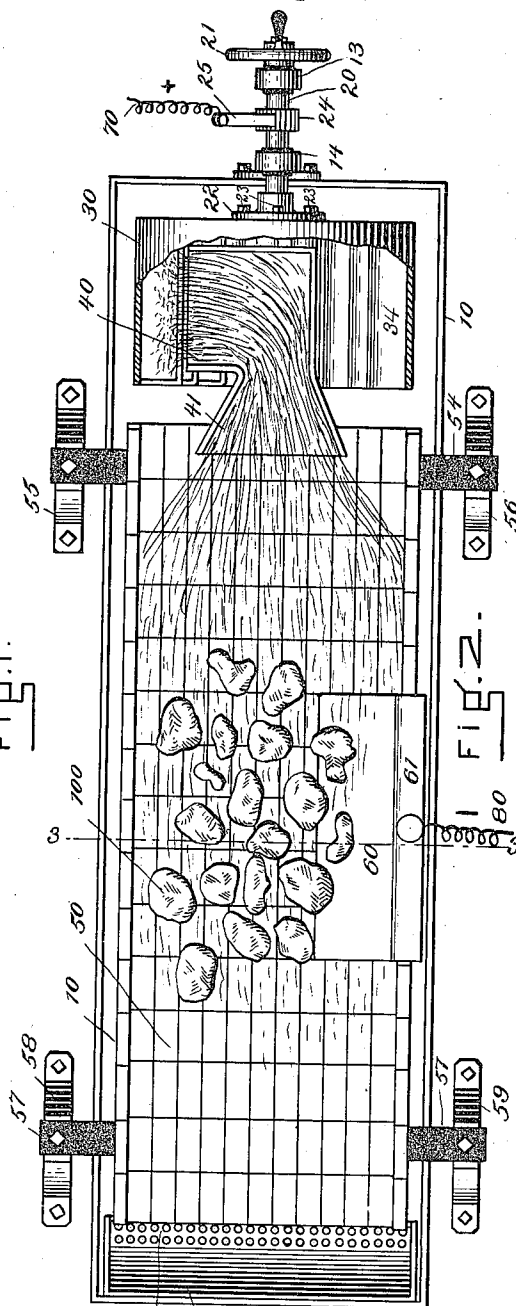
ART OF AND APPARATUS FOR ELECTRICALLY SMELTING ORE.

Patented Apr. 9, 1895.



WITNESSES:

S. M. Dorsett,
Secy.



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INVENTOR:
Geo. D. Burton
By J. C. Somes
Attorney.

(No Model.)

2 Sheets—Sheet 2.

G. D. BURTON.

ART OF AND APPARATUS FOR ELECTRICALLY SMELTING ORE.

No. 537,005.

Patented Apr. 9, 1895.

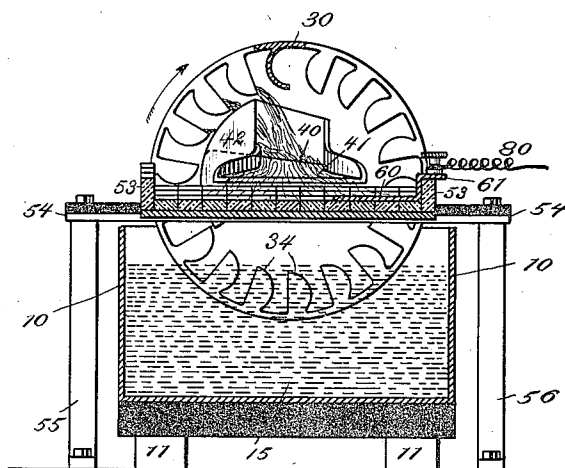


Fig. 3.

WITNESSES

S. M. Dorsett,
J. H. Reed.

INVENTOR.

Geo. D. Burton
By J. C. Jones,
Attorney.

UNITED STATES PATENT OFFICE.

GEORGE D. BURTON, OF BOSTON, MASSACHUSETTS.

ART OF AND APPARATUS FOR ELECTRICALLY SMELTING ORE.

SPECIFICATION forming part of Letters Patent No. 537,005, dated April 9, 1895.

Application filed April 26, 1894. Serial No. 509,130. (No model.)

To all whom it may concern:

Be it known that I, GEORGE DEXTER BURTON, a citizen of the United States of America, residing at Boston, in the county of Suffolk, in the State of Massachusetts, have invented a certain Art of and Apparatus for Electrically Smelting Ore, of which the following is a specification.

This invention relates to the smelting of ores by the voltaic arc.

The object of the invention is to effect the smelting operation in a rapid, economical and thorough manner.

The invention consists principally in smelting ore by subjecting it to the action of a stream of a suitable watery liquid, which constitutes a part of an electric circuit, the electric current being of such a character that a voltaic arc is formed between the ore and the liquid by the heat of which the metal is quickly fused, the liquid serving to distribute the arc and its heating effect throughout the mass, lumps or particles of ore, which are partially submerged in the liquid and partially exposed.

The invention consists further in an apparatus for carrying out the process.

Figure 1 of the accompanying drawings represents a longitudinal section of this electric bath smelting apparatus. Fig. 2 represents a plan thereof, the bucket wheel being partially in section. Fig. 3 represents a transverse section of the apparatus on lines 3—3 of Fig. 2.

The same reference numbers indicate the same parts in all the figures.

A reservoir or receptacle for containing a conductive solution which serves as a medium for conveying the electric current to the ore to be smelted, may be in the form of a tank 10, preferably composed of wood or other non-conducting material and supported on insulated legs or blocks 11. This tank is provided with a bracket 12 having shaft bearings 13 and 14. A shaft 20 is supported in the shaft bearings 13 and 14. This shaft is provided at its inner end with a disk 22 and at its outer end with a driving wheel 21, which may be in the form of a hand wheel as shown, or otherwise. A contact collar 24 is disposed on the shaft and a brush 25 connected with one electric pole bears on said collar, these parts serv-

ing to convey the electric current to or from the shaft. The shaft and disk may be composed of iron, steel or copper, preferably of soft steel. The contact collar is preferably composed of copper.

A bath 15 from which the stream of electrified liquid is taken and to which said stream returns is contained in the tank or receptacle 10. This bath consists preferably of a weak solution of a chemical salt. In its preferred form it is composed of water, carbonate of soda, and powdered borax. I have used this solution in the proportions of eight quarts of water to twelve pounds of carbonate of soda, and one pound of powdered borax. The solution should have the specific gravity of about 1.100 at 76° Fahrenheit. Another form of solution is water, and equal parts of cream of tartar and chloride of sodium, the specific gravity of the solution being about 1. at 76° Fahrenheit.

An annular bucket wheel 30 having a closed end 31 is supported at the inner end of the shaft 20 over the tank 10, the lower portion of said wheel dipping into said tank. This wheel is secured to the shaft by bolts 23 passing through the disk 22 and the end 31, or in any suitable manner, said end being provided with holes 33 for the passage of the liquid when the wheel rotates in the bath. This bucket wheel is provided with a series of buckets 34 disposed around the wheel and attached to the inner face of the rim thereof. As the wheel rotates partially within the tank 10 the buckets dip into the solution 15 within said tank as they descend on one side and carry up said solution as they ascend on the other side of the axis of the wheel. The bucket wheel is composed wholly or in part of conductive material so as to convey the electric current from the shaft to the liquid raised by the buckets. A raceway 40 is disposed at an elevated point on the ascending side of the axis within the circle on which the inner edges of the buckets impinge. This raceway is composed of metal or other suitable electro-conductive material, such for instance as lead, and it is disposed in the upper portion of the annular space around which the buckets revolve. This raceway is provided with a flaring mouth 41 which projects at the open end of the bucket wheel. The raceway, if de-

sired, may be provided with a dependent hood 42 adjacent to the ascending buckets of the bucket wheel, said hood serving as a guard to prevent the spilling of the liquid from the buckets before they reach the plane of the raceway. A bent arm (not shown) bolted to the tank 10 supports the raceway.

An ore-holder 50 is disposed in position to receive the liquid from the mouth of the raceway. This ore-holder when constructed as shown in the drawings, consists of an inclined hearth preferably composed of a base of non-conducting material, such as wood, and a covering of fire brick or fire clay or any incombustible non-conductive material, and side flanges 53 of like material. This hearth is supported at its upper end on a cross bar 54 mounted on standards 55 and 56, and at its lower end on a cross bar 57 mounted on standards 58 and 59. These cross bars are preferably constructed of or provided with insulating material to prevent the passage of the current therethrough.

An electrode 60 is disposed at one side of the hearth about midway the length thereof. As shown this electrode consists of a metallic plate resting on the hearth provided with a flange which overlies the flange of one side thereof. This plate extends partially across the hearth and serves as a cathode.

A conductor 70 attached to the binding post of the contact collar 24 on the shaft 20 connects said shaft with the positive pole of a direct current or other dynamo or other electric source and a conductor 80 connects the cathode plate 60 with said electric source.

A screen 90 composed of nonconductive material is disposed in the tank at or below the lower end of the hearth 50, its bottom being perforated. It is provided with an inclined deflecting plate 91 which serves to break up the stream which falls into it.

In carrying out this process by the use of this apparatus, the ore such as gold or silver bearing sulphites, in the form of lumps is disposed on the hearth 50, some of the particles resting on the cathode plate 60 and some directly on the hearth itself. The entire surface of the ore is dampened or made wet with the solution by sprinkling or otherwise supplying a sufficient quantity of liquid thereto. The surface of the ore is thus rendered somewhat conductive to lead the current over it. The bucket wheel is then rotated in the direction of the arrow and the buckets 34 thereof elevate the conductive solution contained in the tank 10 and discharge it into the elevated raceway 40 and said liquid passes through said raceway and is discharged at the mouth 41 thereof in a stream or spray or cascade onto the hearth 50, and running down said hearth comes in contact with the lumps of ore, as 100, which lie upon the cathode plate and upon the hearth adjacent to said plate. The stream of liquid is comparatively small and the current possesses a high tension. The circuit is closed by contact of the stream with the moist ore

and a current of say, from five hundred to one thousand volts and from one hundred to three hundred ampères passes therethrough. A voltaic arc is formed around the particles of ore whereby the latter are smelted. The fused metal runs down the inclined hearth 50 and falls at the lower end thereof into the non-conducting screen or perforated receptacle 90. It then may fall through the perforations in the bottom of said receptacle into the tank below.

As all minerals fuse at different degrees of heat, it is evident that when silver, lead and gold are found together the lead would melt first, and, with a proper flux, would separate itself from the gold and silver. The silver, melting at a lesser degree of heat than the gold, will separate from the gold with the proper flux, and so on.

Where rebellious ores are being smelted, containing a large quantity of sulphur and arsenic, the action of the electrified bath upon such ores is to cause the sulphur to burn and also the arsenic to pass off in the shape of oxides. The metal, as it comes out from these different ores, runs by the aid of the fluxes and the force of the liquid, to the receptacle at the end of the smelter, and when it strikes the water in its molten state, the water cools it and the several kinds of metal are found in the shape of globules or buttons, separated from each other at the bottom of the tank.

It is believed that the electric current of a character such as described applied in the manner substantially as set forth decomposes the water of the liquid and develops hydrogen gas around the particles of ore, and that the voltaic arc or flame is formed through the hydrogen thus developed, the hydrogen serving as a fuel to increase the heating effect. I find in practice that a flame is formed in the midst of the ore and over the stream approximate to the cathode. It is also believed that in the case of sulphides and other ores containing combustible elements such elements become consumed and aid in developing heat.

If a stream of liquid sufficient to submerge the ore, or one otherwise too large, be used, the current will pass without the formation of an arc and the desired heating effect will not be attained.

At the negative pole sometimes I use a lead plate and sometimes a copper plate, sometimes iron. I find that with lead and aluminum, when extracted from the ore or the clay, sometimes lead deposits in the shape of an oxide on the top of the liquid in the tank. This oxide of lead is removed and then melted by heating. Aluminum particularly leaves the clay in this way, presenting a bright surface at the top of the liquid, which we skim off and then heat and form into a mass. This is caused in one respect by the specific gravity of the liquid being greater than that of the metal. Where the metal has a greater gravity than the liquid it passes to the bottom of the tank, although it will, in some cases, with

certain fluxes, be deposited in the shape of oxides on the surface of the liquid.

In place of the bucket wheel for elevating the liquid I may use a pump or other suitable means.

I claim as my invention—

1. The art of separating metals from ore containing them and from one another, which consists in subjecting the ore containing a plurality of metals to the action of a voltaic arc sprung between the ore and a chemical solution, the ore being partially submerged in the solution and partially exposed, until the metals contained in the ore are fused and exude from the ore in liquid form, said metals on contact with the solution forming into separate globules.

2. The combination of an inclined hearth composed of non-conductive material and adapted to receive ore, means for supplying a stream of liquid to said hearth, an electrode disposed on said hearth, and means for forming an electric arc between the ore and said liquid.

3. The combination of an inclined hearth,

a device for discharging a conductive liquid onto said hearth, a cathode on said hearth, and means for forming an electric arc between said ore and liquid.

4. The combination of a tank for containing a conductive liquid, a raceway disposed above said tank and provided with an outlet for the liquid, a hearth adapted to receive the liquid from said outlet, means for elevating the liquid from said tank to said raceway, and means for connecting said liquid and hearth with opposite electric poles.

5. The combination of a tank, an inclined hearth therein provided with a perforated receptacle at its lower end, a raceway at its upper end for discharging the liquid onto said hearth, means for elevating the liquid from said tank to said raceway, and means for connecting the liquid and the hearth with opposite electric poles.

GEO. D. BURTON.

Witnesses:

E. F. PHILIPSON,

WALTER L. HAYDEN, Jr.