(No Model.) 2 Sheets—Sheet 1.

G. D. BURTON.

APPARATUS FOR ELECTRICALLY HEATING METAL.

No. 537,405. Patented Apr. 9, 1895.

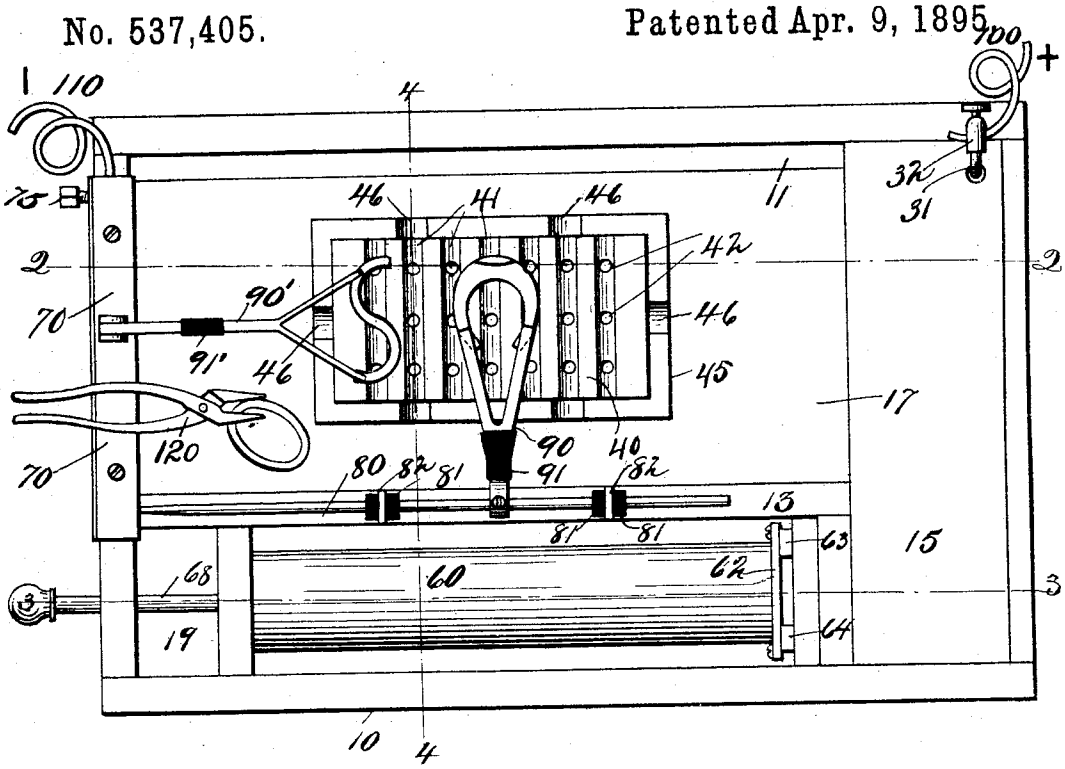

Fig. 1.

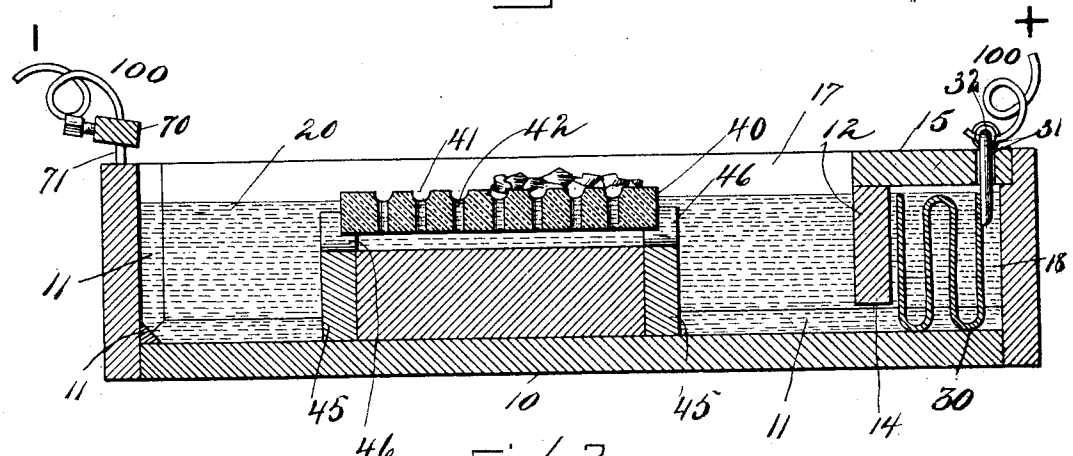

Fig. 2.

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Fig. 3

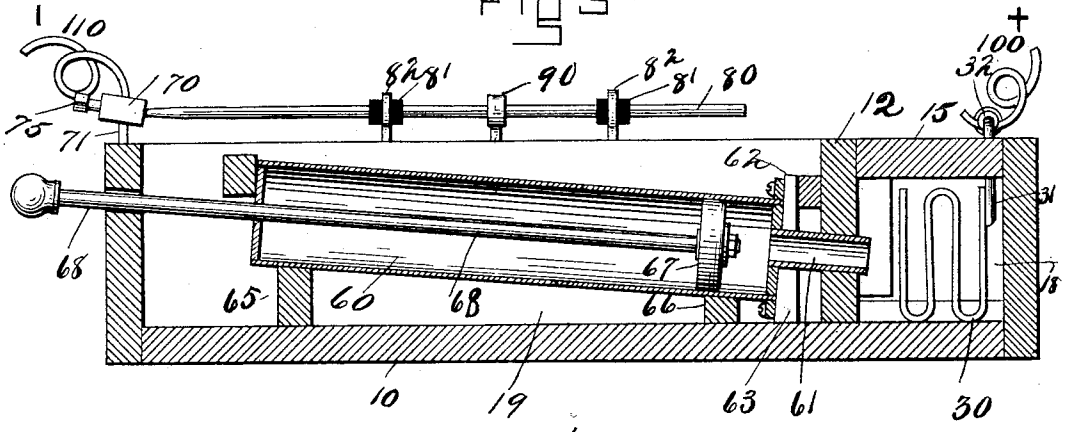


Fig. 4.

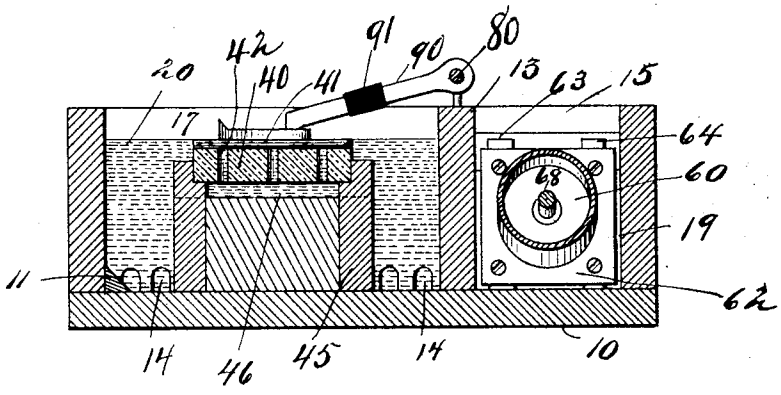


Fig. 6.

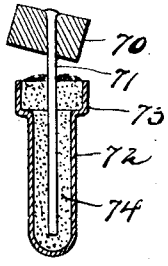
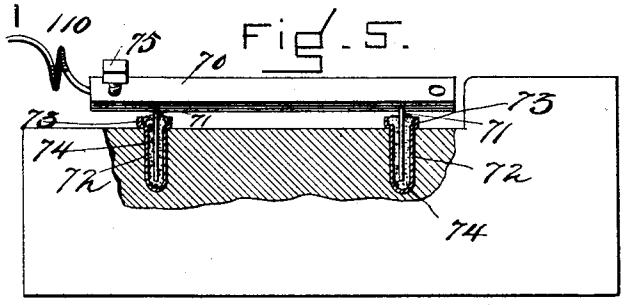


Fig. 5.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR ELECTRICALLY HEATING METAL.

SPECIFICATION forming part of Letters Patent No. 537,405, dated April 9, 1895.

Application filed March 16, 1895. Serial No. 542,004. (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 certain new and useful Improvements in Apparatus for Electrically Heating Metals and Ores, of which the following is a specification.

This invention relates to an apparatus for heating metals to the fusing point or to a working heat and for smelting ores, by means of an electric or voltaic arc sprung between the metal or ore and an electrolytic bath.

The objects of the invention are to provide a simple, cheap, and convenient apparatus for this purpose. The form herein shown is especially adapted for use as a forge for blacksmiths.

The invention consists in certain novel features of construction and combination of elements hereinafter set forth and claimed.

Figure 1 of the accompanying drawings represents a plan of this apparatus. Fig. 2 represents a vertical longitudinal section thereof on line 2—2 of Fig. 1. Fig. 3 represents a vertical longitudinal section thereof on line 3—3 of Fig. 1. Fig. 4 represents a vertical transverse section thereof on line 4—4 of Fig. 1. Fig. 5 represents a front elevation, the front wall being partly in section showing the studs for supporting the negative terminal and the insulated sockets for said studs. Fig. 6 represents an enlarged vertical section of one of said sockets, the stud and a transverse section of said terminal.

A vessel 10, preferably in the form of a tank, and constructed of or lined with a material which is a non-conductor of electricty, is designed to contain a bath 20 through which an electric current is passed. If constructed of wood or earthenware, this vessel is coated on its inner surface with asphaltum or coal tar, in the same manner in which tanks for electro-plating purposes are usually coated. Such a coating prevents the tank from absorbing the solution and thereby avoids short circuiting of the current through the walls of the tank, which might occur under a heavy voltage, if such walls were saturated with the solution. When constructed of wood the joints may be covered by strips 11 which prevent shrinkage and render the tank tight. This vessel when constructed as herein shown is provided with a vertical transverse partition 12 near one end and a longitudinal partition 13 near one side. These partitions or screens divide the vessel or tank into a main compartment 17, an anode compartment 18 and a pump compartment 19, the anode compartment being provided with a cover 15 to protect the anode. These partitions 12 and 13 are provided with holes 14 below the surface of the bath so that the solution may flow freely from one compartment to the other or they may, if desired, be in the form of reticulated screens composed of non-conductive material.

The bath 20 partially fills the vessel or tank 10 and is composed of an electrolyte having a density greater than water and capable of evolving hydrogen. This bath may consist of a solution of chloride of sodium of a density of 1.050 for small work, but when larger pieces of metal are to be heated or ore is to be treated, the density should be increased according to the size of the article to be heated. I have used for this purpose a solution of sal-soda of a specific gravity of 1.305 at 84° Fahrenheit; also a solution of equal parts of sal-soda and cream of tartar of a specific gravity of 1.255 at 77° Fahrenheit; also a solution of water, carbonate of soda, and borax in the proportion of three quarts of water to twelve pounds of carbonate of soda and one pound of borax.

An anode plate 30 is disposed in the solution, preferably in the anode compartment 18 of the vessel 10. This anode is preferably in the form of a serpentine plate and composed of lead. This anode plate is provided at one end with a copper conductor 31 which extends through a hole in the cover 15 and is provided with a binding post 32 above said cover for connection with the electric circuit. The location of the anode within the compartment prevents contact of the work therewith and avoids a short-circuiting of the current.

A hearth 40 composed of fire clay or other suitable non-conductive material is supported in the vessel on a suitable bed 45. This bed is composed of fire clay or any non-conductive material and it supports the hearth in such manner that the solution may flow underneath the latter as illustrated in Figs. 2 and 4. As shown it is provided with openings 46 at its

top. The hearth is preferably provided with an irregular surface on its upper side preferably formed by a number of grooves 41. It is also provided with perforations 42 which extend from the bottom of the grooves through the hearth, and open into the space beneath the hearth. The grooves 41 may be disposed a greater or less distance apart and ribs 43 having flat bearing surfaces of greater or less breadth may be formed between the grooves.

A pump 60 is disposed in the vessel or connected therewith, preferably in the compartment 19. This pump is used to change the level of the solution in the main or open hearth compartment 17. The barrel of the pump is attached at one end to a plate 62 fastened to suitable supports 63 and 64. The plate 62 is provided with a pipe 61 which serves as an inlet and discharge tube for this purpose. This pump barrel is preferably disposed on an incline and rests near its ends on blocks 65 and 66. The piston 67 is provided with a piston rod 68 which extends through the front side of the tank. The upper end of the pump barrel is closed and the lower end thereof is open through the tube 61. When the piston rod is pulled out a portion of the solution is drawn into the pump barrel and the level of the solution in the hearth compartment is lowered below the surface of the hearth. When the piston rod is pushed inward the liquid is driven out of the pump barrel and flows through the openings 14 in the partitions or screens into the main or hearth compartment 17 and elevates the solution therein to a level with or a plane above the surface of the hearth. The solution flows readily underneath the hearth through the openings 46 in the sides of the bed and passes freely through the vertical holes 42 in the hearth to the grooves 41 on the upper surface thereof and if necessary it overflows the surface of the hearth between said grooves. In order to form the arc on the under side of the material being heated it is necessary to have some of the solution on the under surface thereof and these grooves enable the solution to come into electrical connection with the under side of the work so that an arc is formed thereunder.

A terminal 70 in the form of a bar composed of copper or other suitable conductive material, is supported at the front edge of the tank on insulated studs 71. One end of this bar is provided with a socket for receiving a conductor connected with the negative pole of the electric source and with a set screw 75 for clamping the conductor in the socket. This bar is preferably beveled and serves as a rest on which the tool or implement for grasping the article to be heated may form contact for closing the circuit. To secure firmness of the support and prevent moisture from entering the wall of the tank or vessel, sockets 72 of porcelain or other suitable non-conductive material, such as vulcanized fiber, are inserted in the front wall of the box. These sockets are preferably provided with enlargements 73 near their tops which enlargements project above the recessed edge of the side wall of the vessel. The supporting studs 71 for the bar 70 project into these sockets and a non-conductive composition 74 composed of sulphur and grease melted together is filled into the pockets and cements the studs therein, making the supports for the terminal strong, water-tight and non-conductive.

A conductive rod 80 is supported at one side of the tank in any suitable manner and adapted to slide to bring one end into contact with the terminal 70. As shown the rod is supported in porcelain eyes 81 adjusted in metal holders 82 inserted in the upper end of the longitudinal partition 13. An electrode 90 is hinged to the rod 80 and is adapted to rest at its free end upon the work on the hearth 40 to establish electrical connection therewith. This electrode may be of any suitable form. As shown it is forked to rest upon the heels of a horse shoe to be heated. It may be adjusted on rod 80 to bring it over different parts of the hearth. It is provided with an insulated handle 91 of any suitable construction. A positive conductor 100 is connected at one end with the anode plate 30 and at the other end with the positive pole of a source of electric current. A conductor 110 is connected at one end to the terminal 70 and at the other end to the negative service wire or negative pole of the dynamo.

An automatic electrode 90′ similar to the electrode 90 may be hinged directly to the terminal 70 and form contact with an article on the hearth. This electrode is provided with an insulated handle 91′ which may be in the form of a rubber covering.

In the use of this apparatus for heating a horse shoe, the horse shoe is placed on the hearth 40 as indicated in Figs. 1 and 4 and the electrode 90 is swung down into contact with said horse shoe. Then the pump piston 67 is pushed inward and drives out the contents of the solution contained in the barrel, or a portion thereof, whereby the level of the solution in the tank 10 is raised to or above the surface of the hearth 40 and into contact with the shoe or other article resting on the hearth. The contact of the liquid with the metal closes the circuit and an electric voltaic arc is immediately sprung between said article and the liquid. This arc tends to heat the horse shoe or other article at the desired point and when sufficiently heated, the pump piston is drawn outward and the liquid lowered, whereby the current is cut off. The horse shoe may then be removed and forged as desired.

When using the apparatus for heating a bar or plate of metal, this bar or plate may be laid flat on the hearth in contact with the plain surfaces thereof and arcs will be sprung only along those parts which are disposed over the grooves in the hearth, so that a bar or piece of metal may be heated at any desired point or points and other parts thereof left practically cold being heated only by conduction.

Then by moving the bar, if desired, it may be heated in other parts. In this way the length or breadth of the part being heated can be regulated by the width of the groove in the hearth and different given points of the bar may be heated as desired.

When using the apparatus for smelting ores, the ore is placed on the hearth as illustrated in Fig. 2. When the pump piston is pushed inward whereby the liquid is raised into contact with the ore on the hearth, the circuit is thus closed and an electric arc sprung between the ore and the liquid and the metals in the ore are smelted and flow onto the hearth and drop in globules through the holes therein. These holes facilitate the rise of the liquid into contact with the material on the hearth. The grooves in the hearth permit the liquid to come into contact with the under side of the ore or metal and afford facilities for the springing of an arc underneath such article or material. It is not desired that the solution shall totally submerge the article or ore, but that the total area of the article should be wet in the solution, and this can be effected by raising the level of the liquid above the entire article or material to be heated and then lowering it so that the liquid comes in contact with only a portion thereof leaving top portion exposed.

The bath may be used at the same time or separately for heating an article held in a holder or tongs 120 which rest on the terminal 70 and support the article to be heated in the solution near the surface thereof.

When a bar or piece of metal is laid on the hearth and the solution is elevated to the working point, arcs are formed under the bar along those parts which are disposed over the grooves. By moving the bar different parts thereof can be heated. Any particular part or parts desired are heated by placing that part or those parts over the groove or grooves.

The serpentine anode having a large surface exposed to the solution, acts as a cushion for the current when the circuit is made or broken, since portions of the current will pass through the spaces between the poles of the plates.

I claim as my invention—

1. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a hearth for supporting the material to be heated provided with perforations, and electric conductors for connecting said solution and material with opposite electric poles.

2. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a perforated hearth for supporting the material to be heated provided with grooves on its upper face, and means for establishing an electric arc between the solution and the material on the hearth.

3. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a hearth for supporting material to be heated, provided on its upper face with grooves, and intermediate plain surfaces, which prevent the formation of arcs at those points, and means for establishing an electric arc between the solution and the material on the hearth.

4. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a hearth for supporting the work to be heated, provided with perforations, a bed for supporting said hearth provided with openings for the inflow of liquid under said hearth, means for depressing and elevating said solution in relation to said hearth, and electric conductors for connecting the work and solution with opposite electric poles.

5. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a hearth for supporting the material to be heated, a pivoted electrode adapted to be swung into contact with the material on said hearth, means for depressing and elevating said solution in relation to said hearth, and electric conductors for connecting said solution and electrodes with opposite electric poles.

6. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a hearth for supporting the material to be heated, a conductive bar, a hinged electrode in electric connection with said bar and adapted to be swung into contact with the material on said hearth, means for depressing and elevating said solution in relation to said hearth, and electric conductors for connecting said bar and solution with opposite electric poles.

7. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a hearth for supporting the material to be heated, a conductive bar, a conductor movable into and out of contact with said bar, a hinged electrode on said conductor adapted to swing into contact with the material on said hearth, means for depressing and elevating said solution in relation to said hearth, and electric conductors for connecting said bar and solution with opposite electric poles.

8. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a hearth for supporting material to be heated, a conductive rest, a conductor, a hinged electrode connected to said conductor and adapted to be swung into contact with the material on said hearth, another electrode hinged to said rest and also adapted to be swung into contact with material on said bed, means for elevating and depressing the level of the solution in relation to said hearth, and electric conductors for connecting said solution and material with opposite electric poles.

9. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a hearth for supporting the material to be heated, a conductive rest, a

slide rod adapted to be moved into and out of contact with said rest, a hinged electrode on said slide rod adapted to be swung into contact with the material on said hearth, a hinged electrode supported on said rest and adapted to be swung into contact with the material on said bed, and means for elevating and depressing the level of the solution in relation to said hearth, and electric conductors for connecting said bar and solution with opposite electric poles.

10. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a hearth for supporting the material to be heated, means for elevating and depressing the level of the solution in relation to said hearth, sockets of insulating material inserted in the edge of said vessel studs supported in said sockets, a conductive rest supported on said studs, and electric conductors for connecting said solution and rest with opposite electric poles.

11. In an electrolytic heating apparatus the combination of a vessel for containing an electrolytic solution, a hearth for supporting the material to be heated, means for elevating and depressing the level of the solution in relation to said hearth, a plurality of electrodes adapted to be swung into contact with the material on said hearth, and electric conductors for connecting and disconnecting said electrodes in the same circuit to form a multiple-arc current through said material.

12. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a hearth for supporting the material to be heated, means for elevating and depressing the level of the solution in relation to said hearth, and an anode in said solution in the form of a serpentine plate, a perforated partition for protecting said plate, and conductors for connecting said anode and the material with opposite electric poles.

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Witnesses:
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