United States Patent Office.

JAMES BALLENY ELKINGTON, OF BIRMINGHAM, ENGLAND.

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IMPROVEMENT IN THE MANUFACTURE OF COPPER AND IN SEPARATING OTHER METALS THEREFROM.

The Schedule referred to in these Letters Patent and making part of the same

To all to whom it may concern:

Be it known that I, JAMES BALLENY ELKINGTON, of Newhall street, Birmingham, in the county of Warwick, England, a subject of the Queen of Great Britain, have invented or discovered new and useful "Improvements in the Manufacture of Copper and in Separating other Metals Therefrom;" and I, the said JAMES BALLENY ELKINGTON, do hereby declare the nature of the said invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, that is to say:

This invention has for its object improvements in the manufacture of copper and in separating other metals therefrom. For this purpose I smelt the copper ore so far as to obtain an impure metal therefrom, which I then cast into plates, and by means of electricity I dissolve these plates and deposit the pure copper onto other plates.

The other metals with which the copper was combined, fall for the most part to the bottom of the vessel in which I operate.

I prefer to employ copper ores which contain sufficient silver materially to injure the copper if smelted in the ordinary way, and which consequently would usually be submitted to a process for extracting the silver before they are smelted. In such ores frequently the quantity of silver is not such as to pay for the cost of extraction, but the process has nevertheless been necessary when copper of high quality is required, to prevent injury to the copper. These ores are particularly suitable for my use, as the silver they contain, which does not raise their price in the market, is recovered by me without any additional cost.

Ores containing a larger quantity of silver, say from eight ounces to the ton and upwards, and which are now always submitted to a process for extracting the silver before they are smelted, can also be advantageously worked by my process, as can also ores containing little or no silver, but in this latter case the advantage of my process over the ordinary process is mainly in the better quality of copper which I obtain.

I smelt the ore in the usual way, so as to obtain all its metallic contents, except such as may be volatile, in the form of regulus, from which stage, by preference, but it is not essential, I carry the metal on to the state of pimple or blister-copper.

This impure metal I cast into plates, say twenty-four inches long, eight inches wide, and one inch thick. One end of the plate is provided at the center with a stout T-shape head of wrought copper; it is placed in the mold in which the plate is cast.

Cast-iron molds are used; the metal is tapped out of the furnace onto a sand floor, and is led by channels into the molds. The plates thus cast are ready to go to the dissolving-house which is laid with a wooden floor inclined from end to end, one-half an inch to the foot. The boards are grooved on their edges, and small strips or tongues of wood are inserted into the grooves, so that there may be no open joints, and the surface is thoroughly saturated and coated with pitch to make it water-tight. The surface of the floor is divided into a number of troughs running from end to end of the building, by ledges of wood fixed down upon it; these are also saturated with pitch. Each trough is of a width to receive three stone-ware jars side by side. The jars are cylindrical, thirty-four inches high, and eighteen inches wide. There are pathways between the troughs for the workmen who attend to the process. Each trough is filled from end to end with jars. There may be, say, about one hundred jars in each trough, and twelve troughs in the width of the building. The jars should be of fire-clay ware, so that they may not be injured by the solution which they receive. Each has a hole in the bottom, closed by a wooden plug; also a hole in the side four inches from the bottom, and another hole diametrically opposite to the first, and four inches from the top.

The jars are set up level on the inclined floor, with wooden wedges saturated with pitch. The jars are connected together from the upper to the lower end of the room, each jar having a pipe passing out from it at the hole near the top and entering the next jar below at the hole near the bottom.

The connections with the jars are made with vulcanized India rubber, and intermediate of the connections the pipes may be of lead, and about one-half inch internal diameter.

The solution which I employ is water charged with as much sulphate of copper as it will dissolve. The sulphate of copper of commerce may be used, or for economy, I sometimes use a solution obtained by boiling the deposit found in the culvert or long flue by which the smoke from the copper-furnace is led to the high chimney; this will furnish a solution of sulphate of copper sufficiently pure for the purpose.

The solution is stored in a tank at the upper end of the dissolving-room; it is admitted into the uppermost jars, and runs from jar to jar, until those at the lower end of the building are filled. Clips are put upon the India-rubber connections to stop the flow through the tubes when the jars are full, and so to maintain the solution at the proper level in the upper jars.

When the process is in operation, two clips are taken off, say once in twenty-four hours, so as to cause the solution to flow through all the jars, and transfer the

solution from the bottom of one jar to the top of the next, so as thoroughly to mix it, as in working it tends to become weak at the top of the jar. This means of readily equalizing the density of the solution is of great practical importance.

At the lower end of the room is a tank to receive the solution. When it is thus allowed to run through, it is pumped back into the upper reservoir.

The same tank receives the contents of the jars when they are emptied onto the floor beneath by the removal of the bottom plug, as hereinafter described.

In the gang-ways between the floor-troughs, a truck runs to carry the cast-copper plates to the jars in which they are to be dissolved. Six metal plates are suspended in each jar; they are hung in couples from the horizontal copper bars, having forks upon them to receive the T-form heads of the plates. These bars rest at their ends on other bars of wood laid on the jars, so as each to extend across a row of three jars, and the same bars also support over each jar two other metal cross-bars to support plates to receive the deposit of copper from the solution.

There are four receiving-plates in a jar, two suspended from each bar. They are interposed between the cast plates.

Conducting-strips of sheet-copper are laid upon the wooden bars, so as to couple the cast plates of one jar to the receiving-plates of the next jar, and so throughout the series of, say, one hundred jars.

Each metal cross-bar is made to bear on a connecting-strip at one end, and at the other on a wooden block saturated with pitch. The jars are each provided with a false bottom of wood to prevent breakage of the jar in case a plate should fall.

The receiving-plates may be of wrought copper, but I prefer to employ, in the first instance, gutta-percha coated with bronze powder. As soon as a deposition of copper is obtained, the gutta-percha is stripped off and the copper left to receive a further deposit. A series of, say one hundred jars being thus coupled up into a circuit, I connect to the terminals of the series one or more electro-magnetic machines. I prefer to employ the machines manufactured by Messrs. H. Welde & Co., of Manchester.

The machines, called by the makers three-and-a-half-inch machines, are those which I use, and I drive them at twenty-five hundred revolutions per minute. With three such machines working into a series of one hundred jars, a deposition of four or five pounds of copper in each jar may be obtained in twenty-four hours without injury to the solution. When the cast plates become so far dissolved as to be unfit for further use, they are removed.

Their remains are washed in the lower solution tank to remove the deposit from their surfaces, and they are melted and recast.

The wrought T-heads may be used an indefinite number of times, as I protect them from solution by coating their stems with wax.

The receiving-plates are allowed to grow until they attain a convenient weight; they may either be melted and cast into cakes and afterwards rolled in the usual way of working copper, or the plates as they come from the vats may be sent into the market.

The solution may be worked for a very long time, evaporation being supplied by the addition of water acidulated slightly with sulphuric acid, ultimately will become so charged with sulphate of iron as to make it inconvenient to work it further. If, however, the metal be advanced to the pimple or blister stage before casting the plates, it will take but little iron into the solution.

The silver or other metals, excepting the iron, with which the copper of the cast plates was contaminated, sinks to the bottom of the jars, and is there allowed to accumulate until it reaches the lower side hole. When this happens the bottom plugs are taken out of all the jars of the series, and the contents washed out into the floor trough, which discharges them into the tank at the end of the building; here they settle. From time to time, the tank is pumped dry and the sediment is taken out. There are two such tanks at the lower end of the room, to allow of one being put out of use for emptying.

The sediment may be treated in any ordinary and well-known manner, for the recovery of the silver it contains, and other metals may be separated from it, should it be considered desirable to do so.

Having thus described the nature of my said invention, and the manner of performing the same, I would have it understood that,

What I claim as my improvement in the manufacture of copper and in separating other metals therefrom, is—

The smelting copper ore so far as to obtain an impure metal therefrom, then casting the same into plates, and by means of electricity dissolving these plates and depositing the pure copper onto other plates, whilst the metals with which it was contaminated are left in a pulverulent state.

Also, the general arrangement of the dissolving-house with its inclined water-tight floor draining into a tank at its lower end, and with the dissolving apparatus arranged thereon, substantially as herein described.

Also, so arranging the apparatus that a flow of the solution may be established from time to time from the bottom of one jar to the top of the next, so that the solution may be prevented from settling into different layers of different strengths.

Also, the use as described, of a solution prepared by boiling and washing the deposit from the furnace-culvert.

Also, the smelting ores containing eight ounces of silver or more to the ton of ore, so as to obtain the silver and copper in the metallic form and alloyed together, and then separating the metals by dissolving and redepositing the copper by means of electricity.

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Witnesses:

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