

UNITED STATES PATENT OFFICE.

HENRY WURTZ, OF NEW YORK, N. Y., ASSIGNOR TO WURTZ AMALGAMATION COMPANY, OF SAME PLACE.

IMPROVEMENTS IN EXTRACTING GOLD AND OTHER PRECIOUS METALS FROM THEIR ORES, &c.

Specification forming part of Letters Patent No. 48,499, dated June 27, 1865.

To all whom it may concern:

Be it known that I, HENRY WURTZ, of New York, in the county of New York and State of New York, have invented a new and improved method of extracting gold and other precious metals from their ores and from other materials by amalgamation; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying specimens.

The nature of my invention consists in adding to the quicksilver used for the amalgamation of ores of gold, silver, or other precious metals, by any one of the methods in use, a minute quantity of one or more of the highly-electro-positive metals of the alkalies or alkaline earths—such as sodium, potassium, lithium, rubidium, cesium, barium, strontium, calcium, magnesium, or other metal of this class—in practice sodium or potassium being preferred and used for the sake of economy.

To enable others skilled in the arts of working the ores of the precious metals to apply and use my invention, I will proceed to describe my modes of preparation and operation.

In the preparation of amalgams of sodium and potassium in quantities some care and precaution are requisite in consequence of the intense heat evolved during the union of these metals with quicksilver, which gives rise to an explosive evolution of quicksilver vapor. A deep iron vessel is the best in which to effect the union. I use for different purposes two amalgams containing different proportions of sodium, one containing one part of sodium to twenty-five or thirty parts of quicksilver, and the other not more than one part of sodium to fifty or sixty of quicksilver. The first amalgam, containing about three or four per cent. by weight of sodium, is solid, brittle, and nearly as hard as cast zinc, while the second, containing about two per cent. or less of sodium, is also solid, but in warm weather somewhat pasty and plastic in its consistence.

For the purposes of my invention and for convenience of designation I call these two amalgams "magnetic amalgams Nos. 1 and 2," No. 1 being that one which contains not more than four per cent. of sodium and No. 2 that which contains not more than two per cent.

In the preparation of these magnetic amalgams a given quantity (say one ounce) of sodium is cut into pieces not larger than a hazel-nut. The requisite quantity (according as to which of the two amalgams is required) of quicksilver is then placed in an iron pot or other deep iron vessel and the fragments of sodium thrown one by one upon its surface, each one being touched or stirred about slightly, if necessary, with a glass rod or iron wire, the end of which has been dipped in water. Each fragment of sodium will amalgamate, under these circumstances, with a slight explosion. Care must be taken not to inhale the fumes which arise during this operation, as they consist of a mixture of mercurial and caustic-soda smoke. As the compound becomes richer in sodium, especially when amalgam No. 1 is being prepared, the temperature is very likely to become sufficiently depressed to cause the mass to become wholly or partially solidified. It is then necessary to apply a gentle and carefully-regulated heat during the addition of the remainder of the sodium. Finally, the amalgam must be kept melted for a short time, stirring with an iron rod or spoon until any lumps of hard amalgam which may have been formed have been caused to dissolve, thus rendering the mass wholly uniform in composition. It may then be poured out upon a cold stone to form it into a thin sheet, or may be cast into sticks, rods, or bullets in molds composed of glass, earthenware, soapstone, or other stone, plaster, or other non-metallic substance. These molds must never be made of iron or other metal, for reasons which will appear further on. When cold, these sticks, bullets, or sheets, after being broken into pieces, may be preserved in a corked bottle.

In dry air these amalgams keep indefinitely without change, but dampness gradually impairs their value for my purposes. In very damp climates, therefore, it is well to place in the same bottle with the amalgam a lump of dry quicklime, inclosed in a roomy bag made of stout paper or of two thicknesses of fine linen cloth. This lime will keep the air of the interior of the bottle perfectly dry.

In some cases it may be found desirable to prevent all contact of air with the amalgam by

filling or partly filling the bottle containing it with deoxidized petroleum, benzole, or naphtha. Rectified petroleum or other liquid hydrocarbon is readily deoxidized and rendered suitable for this purpose by previous agitation with a few thin slices of sodium until the latter is no longer tarnished, allowing to settle, and pouring off the clear liquid.

Another plan which I have used to protect these amalgams from moisture is to coat the sticks or fragments with paraffine by dipping them into this substance in a melted state. Under most circumstances, however, the amalgam No. 1 will be found to require no further protection than being kept corked up, but in case of No. 2 additional protection may sometimes be desirable, the most reliable being immersion in rectified petroleum, deoxidized as described.

It is well for me to remark that the substitution for a portion of the sodium of some potassium communicates to these amalgams greater hardness and permanency.

I shall now proceed to describe those special and peculiar qualities of these magnetic amalgams which I have discovered, and which have led to my new applications of them in the arts of amalgamating the ores of the precious metals.

A quantity of one of them dissolved in one hundred times its weight or more of quicksilver communicates to the whole a greatly-enhanced power of adhering to metals, and particularly to those which, like gold and silver, lie toward the negative end of the electrochemical scale. This power of adhesion in the case of these two metals is so great that the resistance which their surfaces when in the native state usually oppose to amalgamation, due to films of air or other substances which appear to adhere tenaciously to their surfaces, is instantly overcome, whether their particles be coarse, fine, or even impalpable. Even an artificial coating of oil or grease (which is such an enemy to amalgamation that the smoke from the miners' lamps is pronounced by some to be highly deleterious in gold and silver mines) forms not the slightest obstacle to instant amalgamation by this magnetic quicksilver. The atoms of the quicksilver are, as it would seem, put into a polaric condition by a minute addition of one of those metals which range themselves toward the electro-positive end of the scale, so that its affinity for the more electro-negative metals is so greatly exalted that it seizes upon, and is absorbed by, their surfaces instantaneously, just as water is absorbed by a lump of sugar or other porous substance soluble in it. Such quicksilver even adheres strongly, unlike ordinary quicksilver, to surfaces of iron, and hence the objection to the use of iron molds in casting the amalgams.

My improvement in amalgamating methods consists simply in adding to the quicksilver used for amalgamation, from time to time, about

one-hundredth part, more or less, of its weight of one of these magnetic amalgams. In wet processes of amalgamation—for instance, in the riffles of a sluice—I prefer to use the amalgam No. 1, which dissolves with great difficulty and slowness in the quicksilver, and therefore keeps it in the magnetic condition for a long time in spite of the slow oxidation of the sodium by the water. In amalgamation processes in the dry way, in which a very minute quantity of sodium goes a great way, I prefer to use No. 2, which dissolves with much greater rapidity in the quicksilver. The frequency with which these additions of magnetic amalgam are to be made cannot be precisely specified, as it will depend on many circumstances, such as the temperature and other conditions of the water, the nature of the process used, &c.; but experience will easily furnish a guide in each individual case as to how often the additions are to be made. In a sluice and in many other cases the quicksilver can easily be tested at any time to ascertain whether it still retains the magnetic property by throwing into it a grain or two of gold-dust.

In the common method of amalgamation by causing auriferous materials to pass over amalgamated plates of copper or other metal, a great economy is effected by using, in connection with the magnetic amalgam, iron plates instead of copper. In this case the amalgam is best crushed to coarse powder and sprinkled from time to time over the amalgamated surface.

The power which these magnetic amalgams communicate to quicksilver, of coating or enfiling surfaces of iron, renders them of peculiar value in every form of arrastra, drag-mill, or other amalgamating apparatus which has internal surfaces of iron, such surfaces becoming coated with quicksilver, and thus immensely enlarging the surfaces of its contact with the particles of ore, and particularly with those particles of gold which are so fine as to remain suspended in the water.

Other valuable modifications arise out of this power of enfiling iron surfaces, such as the keeping of iron or steel surfaces which are used in crushing ores continually coated with quicksilver. Quicksilver possessed of the magnetic quality may be kept dropping or trickling upon the surfaces of crushing-rollers, or in those forms of machinery in which heavy iron balls are kept in motion rolling over the ore the surfaces of these balls may be kept enfilmed.

Another valuable quality communicated to quicksilver by these magnetic amalgams is a far greater cohesive attraction for its own particles. It is rendered more viscid, more difficult to divide mechanically, and when thus divided runs together again instantly upon contact. It follows that the granulation or flouring of the quicksilver during the amalgamation of ores, which usually gives rise to so important a loss of this costly agent, is reduced to a minimum or altogether prevented.

It will be found desirable, as in all other cases where quicksilver is used and ores containing arsenic or sulphur operated upon, to remove as much as practicable of the arsenic or sulphur by previous roasting or other chemical treatment.

It is clear that these methods, while peculiarly fitted for the treatment of ores which contain metals in their native state, is also suitable for the extraction of metals from artificial or accidental mixtures, such as sweepings, old crucibles, bricks from furnaces, and chimneys, &c.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination, with quicksilver, when used for the extraction, by amalgamation, of metals from their ores or their mixtures with other materials, of metallic sodium or metallic potassium or any other highly-electro-positive metal equivalent in its action thereto, as above set forth.

2. In those amalgamators in which amalgamated plates of copper or other metal are used, the substitution for the plates of copper or other metal of plates or surfaces of iron coated with quicksilver combined with sodium or other highly-electro-positive metal, as above set forth.

3. The coating of iron, steel, or other metallic surfaces between or under which ores or other materials are crushed with quicksilver combined with sodium or other highly-electro-positive metal, as above set forth.

4. The prevention of the granulation or flouring of quicksilver when used in any method of amalgamating ores or other materials by addition thereto of sodium or other highly-electro-positive metal, as above set forth.

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Witnesses:

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