

UNITED STATES PATENT OFFICE.

ROBERT W. KENNEDY, OF ASHLAND, OREGON.

SOLVENT FOR LEACHING ORES.

SPECIFICATION forming part of Letters Patent No. 644,770, dated March 6, 1900.

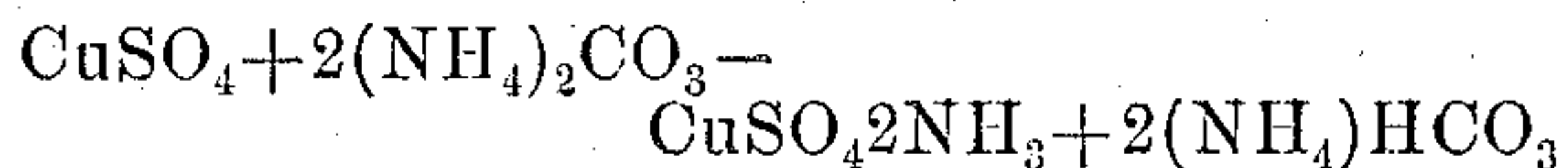
Application filed March 13, 1899. Serial No. 708,936. (No specimens.)

To all whom it may concern:

Be it known that I, ROBERT W. KENNEDY, a citizen of the United States, residing at Ashland, in the county of Jackson and State of Oregon, have invented a new and useful Solvent for Leaching Ores, of which the following is a specification.

My invention relates to a solvent for extracting metals, and particularly rare metals—such as gold, silver, copper, lead, antimony, zinc, arsenic, cobalt, nickel, &c.—from low-grade or refractory ores and by the use of which the extraction of the metals is accomplished without roasting or desulfurizing, and, furthermore, to provide combinations of chemicals suitable to such extraction.

In carrying out my invention I first reduce the ore by crushing to about the size of wheat or corn and then subject it in a suitable receptacle to the action of the solvent, consisting of sodium hyposulfite, together with copper ammonium sulfate. For instance, an efficient combination consists of sodium hyposulfite, ammonium carbonate, and copper sulfate. The principal reaction involved is the formation of copper ammonium sulfate according to



in the solution. Some cuprous sodium hyposulfite may be also formed from the reaction of a little of the copper sulfate with a part of the sodium hyposulfate. The acid ammonium carbonate formed in the solution assists also in the disintegration of the ore. I am aware that copper sulfate has been used in connection with sodium thiosulfate in extracting ores; but in this case the only reaction possible was the formation of the cuprous sodium thiosulfate, which, though a good solvent for some metals, is of course limited in its application. I am aware also that ammonium carbonate has been used in conjunction with sodium thiosulfate; but such use was for decreasing the solvent power of the sodium thiosulfate toward lead compounds rather than for increasing its solvent action on metallic compounds in general. For the successful extraction of such metals as gold, silver, copper, and lead and for many ores the above combination of chemicals is

sufficient, but for other metals, and particularly when they occur in the form of sulfurets or when they occur in the sulfid form mixed with oxids and carbonates or other refractory coatings, I have found it desirable to add to the above solvent such dissolving agents as phosphoric acid, potassium cyanid, and potassium or sodium acetate. The powerful solvent action of potassium cyanid on many usually insoluble compounds of metal and even ore particles of the free metals is well known. The phosphoric acid and potassium acetate have rather limited solvent powers alone, but added to this solution by partial double decomposition with some or all of the constituents previously contained in it add largely to the number of salts present, and thus provide for the formation of a greater variety of double salts, both in the solution itself and specially when it is brought in contact with a complex ore. It is well known that most leaching processes depend for their efficiency on the formation of soluble double salts of the heavier metals with the alkalies. I have thus provided for a large number of these. Also by simultaneously attacking a number of the constituents of any ore the extraction is hastened. Obviously the proportions of the above-named ingredients may be varied to suit the condition or nature of the ore under treatment, but an efficient solvent comprises sodium thiosulfate, one pound; ammonium carbonate, one and one-half ounces; copper sulfate, one-fourth pound, to which for refractory ores may be added glacial phosphoric acid, one-eighth ounce; potassium cyanid, one-half pound; potassium acetate, one-half ounce.

In preparing the original solution containing the first three ingredients above named, enough water is added to give a strength of about 2°, as indicated by an alkali hydrometer, whereas when the auxiliary ingredients are added the strength should be brought to about 3° on an alkali hydrometer. This solvent, prepared substantially as described, is allowed to remain in contact with the ore in the leaching tubs or vats for a suitable length of time, normally for an interval of from eight to twelve hours. The leaching is repeated with fresh or partially-used portions of the solvent until the ore is extracted to

any desired strength, the time required for complete extraction obviously depending on the ore, the temperature, and other circumstances.

5 The solvent is drawn off into a precipitating-vat, and enough of any suitable precipitant added to throw down the metals in the form of sulfid or other insoluble forms. An efficient precipitant consists of calcium sulfid, sodium chlorid, sodium bicarbonate, and
10 protoxid of iron.

This solvent is preferably prepared as follows: A mixture of one pound of sulfur and two pounds of lime or calcium carbonate is
15 exposed to water in a suitable vessel and boiled gently for six or eight hours, this operation serving to bring about the combination of the calcium with the sulfur and the liberation and expulsion of the carbon dioxid
20 present. Sodium chlorid, one-half pound; sodium bicarbonate, one pound, and protoxid of iron, two ounces, are then added, and the boiling continued until the sulfur is completely dissolved or taken up. There is usually
25 a small residuum of lime which may be removed by filtering or otherwise. A small quantity of this precipitant, of which the above-named quantities of ingredients should yield about two and one-half gallons, it being
30 a dark amber-colored liquid, is added to the solution in the precipitating-tank to cause the precipitation of the metals which will appear mainly as sulfids. A portion of the solution is tested with an additional portion of
35 the precipitant to ascertain whether the pre-

cipitation has been complete. If not, more of the precipitant is added to the solution in the tank. The precipitant is collected and worked up by any of the usual methods. The solvent, though more or less reduced in
40 strength, is still valuable and may be brought back to the required strength by addition of a portion of the original materials and used on another portion of ore, the whole cycle of operations being repeated as above indicated.
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Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A solvent for leaching ores comprising sodium thiosulfate, ammonium carbonate, and copper sulfate in water in proportions
50 substantially as described.

2. A solvent for leaching ores, comprising sodium thiosulfate, ammonium carbonate, and copper sulfate in water, with the addition of phosphoric acid, potassium cyanid
55 and sodium or potassium acetate, substantially in the proportions described.

3. A solvent for leaching ores, comprising sodium thiosulfate, ammonium carbonate, copper sulfate, and potassium cyanid in water, in proportions substantially as described.
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In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

ROBERT W. KENNEDY.

Witnesses:

T. R. NORRIS,
FRANK WILLIAMS.