Dec. 4, 1945. W. C. KIRKPATRICK 2,390,105

METHOD AND APPARATUS FOR CONVERTING ORE

Filed July 4, 1944 2 Sheets-Sheet 1

Fig. 1.

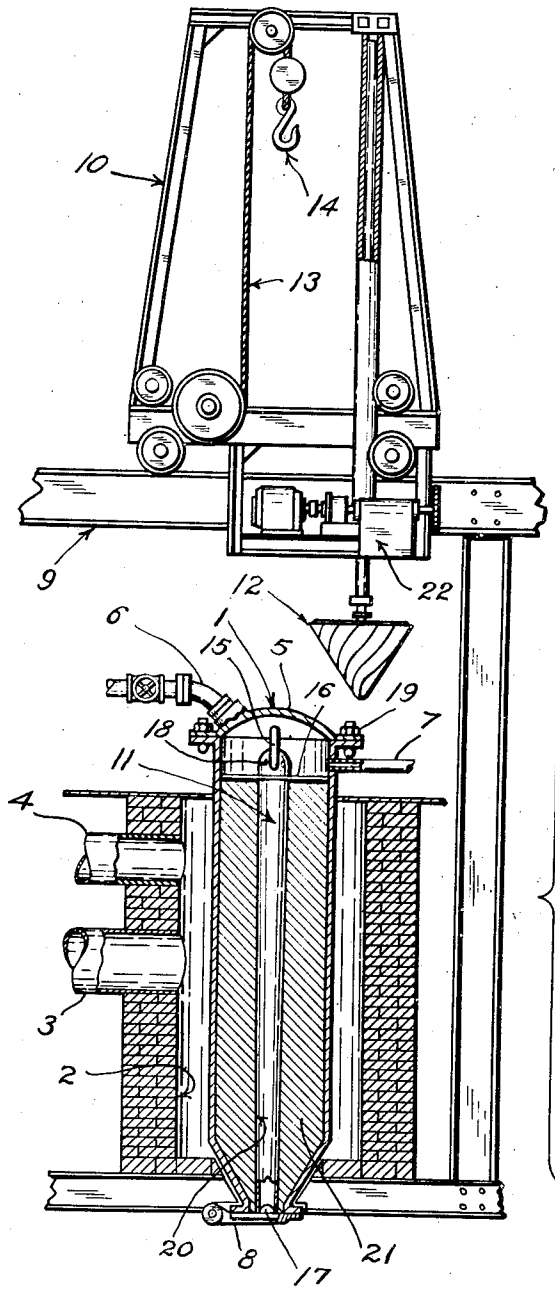
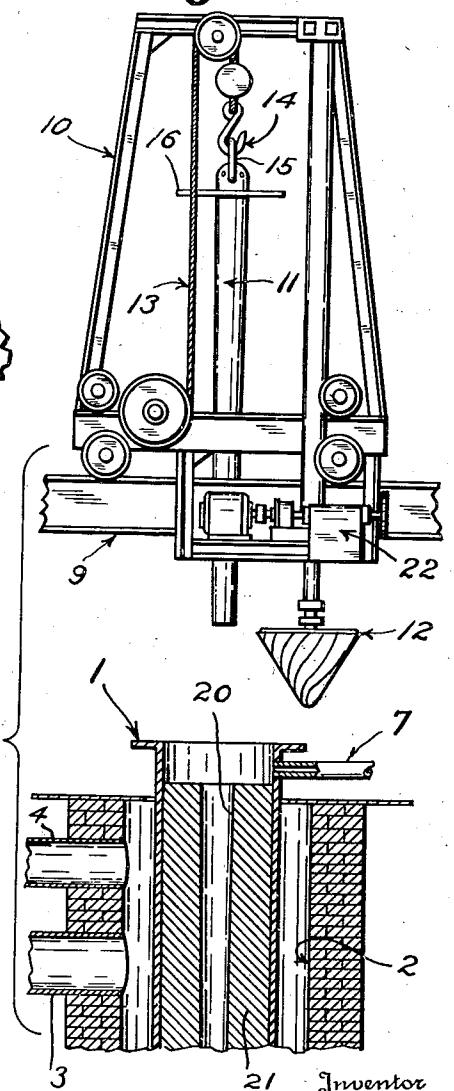


Fig. 2.



Inventor

WILLIAM C. KIRKPATRICK

By R. S. Burt

Attorney

Dec. 4, 1945. W. C. KIRKPATRICK 2,390,105

METHOD AND APPARATUS FOR CONVERTING ORE

Filed July 4, 1944 2 Sheets-Sheet 2

Fig. 3.

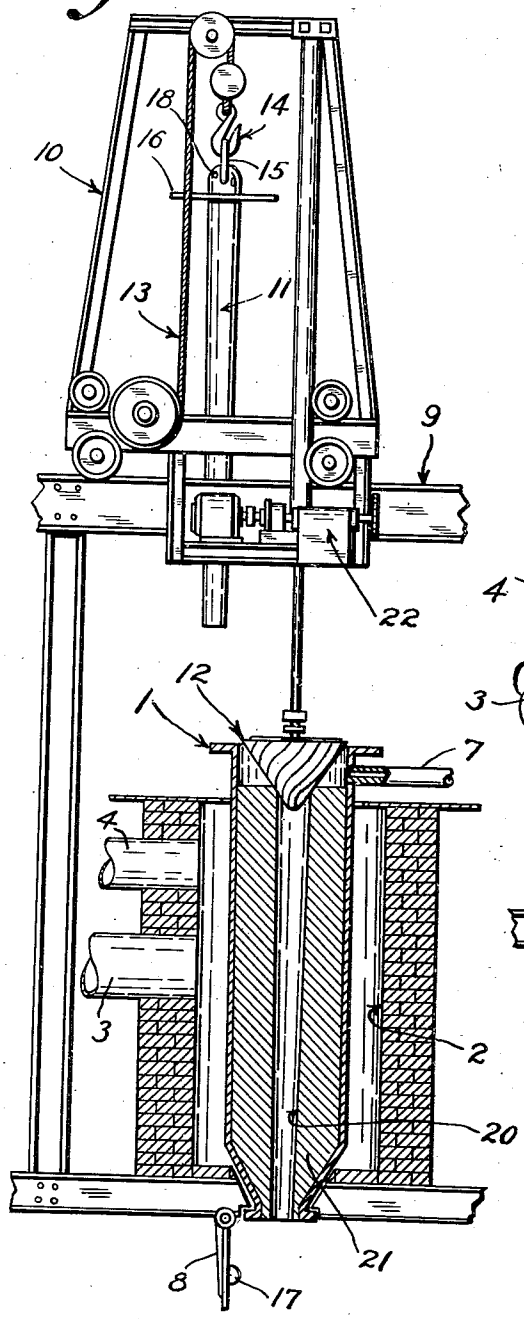
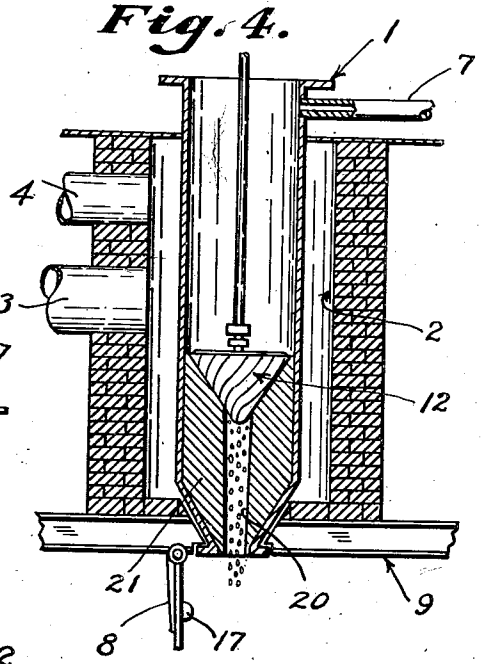


Fig. 4.



Inventor

WILLIAM C. KIRKPATRICK

By R. S. Berry

Attorney

Patented Dec. 4, 1945 2,390,105

UNITED STATES PATENT OFFICE

2,390,105

METHOD AND APPARATUS FOR CONVERTING ORE

William C. Kirkpatrick, Alhambra, Calif., assignor to John R. Thompson and Wilma Thompson, both of Los Angeles, Calif.

Application July 4, 1944, Serial No. 543,497

9 Claims. (Cl. 75—0.5)

This invention has for an object the provision of a method and apparatus by means of which complex refractory ores are economically and expeditiously converted into simple soluble sulphate compounds.

Heretofore processes, such as the Rankin process, for converting complex refractory ores, as above noted, while chemically efficient have been impracticable, if not prohibitive of use, due to the great bulk, and size of the apparatus required, the difficulty of removing the digest which solidifies on conversion and the resultant high equipment and operating costs. It has been the practice in carrying out such a process to use large pots, for example five feet in diameter, so that workers can get inside such pots with jack hammers to dig and drill out the solidified digest. This operation takes a great deal of time and is difficult and costly. Moreover, due to the large sizes and high pressures and loads developed, the pots have necessarily been made of heavy cast alloys and were therefore costly, cumbersome and presented dangerous explosion hazards.

The present invention provides for a saving of time, labor and costs in carrying out processes such as hereinbefore described, by reason of the particular manner and means hereof by which the digest solidifies with a bore or opening formed therein, and the particular manner and means hereof by which particles of the digest are removed and caused to discharge from the retort through the bore until the entire digest is removed.

A further object of my invention is to provide ore converting apparatus in which a vertical retort having a discharge gate for gravitationally releasing the digest, a simple core member, a reaming tool and a travelling crane are so relatively arranged and manipulated that the core may be readily and easily positioned in and removed from the retort to form a bore through the solidified digest, and the reaming tool may be likewise easily positioned and removed and operated to readily drill out the digest from top to bottom so that the released portions of the digest will gravitate through the bore and gate, thus making it possible to carry out complex refractory ore conversion processes at a lower cost and much more expeditiously than heretofore.

With the foregoing objects in view, together with such other objects and advantages as may subsequently appear, the invention resides in the parts and in the combination, construction and arrangement of parts hereinafter described and claimed, and illustrated by way of example in the accompanying drawings, in which:

Fig. 1 is a fragmentary semi-schematic view in side elevation and section of apparatus by means of which the method hereof may be carried out showing the core positioned in the retort to form the bore through the digest which solidifies upon conversion, also showing how the reaming tool and crane are related to one another and the retort;

Fig. 2 is a semi-schematic view similar to Fig. 1 showing the core and top of the retort removed preparatory to positioning the reaming tool for reaming out the retort;

Fig. 3 is a view of the apparatus similar to Fig. 2 showing the crane and reaming tool positioned to commence the reaming out operation;

Fig. 4 is a fragmentary view in section and in elevation showing how the reaming tool is operated to remove the digest.

In the accompanying drawings I have shown an apparatus with which the present invention may be carried out and wherein a vertical retort 1 is mounted in a heating chamber 2 having a heating intake 3 and a flue 4. The retort has a suitable removable head 5 with which is connected a valved intake means 6 for feeding a charge of prepared semi-fluid ore into the retort. A suction feed connection 7 is made with the retort whereby a flow of ore is induced into the retort from the source and supply of prepared ore, not shown, it being understood that the ore is mechanically and chemically prepared and reduced to semi-liquid or liquid state under any formula and process known to make possible conversion to simple sulphates under heat treatments. In this connection it should be noted that any suitable means, not shown, may be employed for providing the requisite heat in the chamber 3 and likewise any suitable suction means, not shown, may be employed to create a suction in the retort through the connection 7 to induce the feed of prepared ore into the retort.

As here shown the retort is provided with a somewhat conical open lower end closed by a suitably latched gate 8 which when opened permits of discharge of digested ore from the retort.

In accordance with my invention a suitable framework generally designated 9 is provided to support the retort and heating chamber therefor as well as a travelling crane 10 which latter is provided for removing and replacing the retort head 5 as well as positioning and removing a core member 11 and a reamer 12. The core member and reamer are supported by the crane as shown in the upper half of Fig. 2, when the apparatus is not in use. This frame work may be used to conveniently support all necessary equipment such as batch hoppers for milled ore, chemical storage tanks, batch mixers, etc. (not shown), which are used to prepare the ore for treatment in the retort.

When the apparatus is prepared for operation, the head 5 is removed and the core member 11 is positioned in the center of the retort as shown in Fig. 1, this being easily accomplished by appro-

priate manipulation of the crane and its hoisting means 13 which latter includes a hook 14 adapted to engage an eye 15 at the upper end of the core member. A spider 16 mounted on the core member, together with a centering projection 17 on the gate 8, hold the core member centered in the retort. The core member is tubular and provided with openings 18 above the ore level so that equal pressures inside and outside the core will be obtained.

After the core is mounted in place the head 5 is mounted in place by means of the fastenings 19 and the retort is then charged with ore up to, say approximately the level of the spider 16, and the heating and digesting operation is commenced, the core holding the ore displaced during the digesting operation. In this connection it should be noted that any suitable standard or well known non-corrosive lining or coating means (not shown) may be provided for the retort and core member to prevent acid corrosion.

When the digestion treatment is completed the ore will have formed a solidified digest column around the core and the next step in the method requires the removal of the head and the core member 11, both of which operations are readily effected by means of the crane. When the core is lifted out a clean opening or bore 20 is provided through the center of the solidified digest 21 which then has a tubular formation. In this connection it should be noted that the core member 11 is tapered somewhat to facilitate its withdrawal from the solidified digest.

Next, the crane 10 is manipulated to position the reamer 12, as shown in Fig. 3, against the top of the solidified digest 21 with the point of the reamer centered in the bore 20. In this connection it is seen that the reamer 12 has a diameter slightly less than that of the inside diameter of the retort so that during operation of the reamer through its operating mechanism 22 carried by the crane, the retort will be progressively and thoroughly reamed out from top to bottom and the loosened or freed particles of the digest will be caused to gravitate through the bore 20 and out through the opened gate 8 as shown in Fig. 4.

It is now seen that with my improved method, complex and difficult refractory ores may be converted into simple sulphate compounds in less time and with less labor and costs than heretofore as well as with apparatus which is comparatively simple and inexpensive and subject to a more expeditious manipulation and operation than heretofore.

It is important to note that the apparatus hereof readily lends itself to operation in gangs or multiple units so that a plurality of the retorts and their associated elements and accessory apparatus may be simultaneously or progressively operated as one complete multiple unit plant, with an appreciable saving in time, labor and costs.

My invention, as will now be apparent, provides a novel and efficacious method of converting complex and difficult refractory ores into simple sulphates, a soluble compound, soluble in water. This method consists in introducing such ore in a chemically and mechanically prepared liquid or semi-liquid state under formulae and processes known to produce simple sulphate compounds wherein the ore is digested or converted, into an enclosure such as a retort, displacing the ore as by means of a core member placed in the retort, subjecting the ore to heat while ore displaced by the core member until a solidified digest column is formed, removing the core member and providing an open ended axial bore or opening in the solidified digest, then progressively removing particles of the solidified column from one end of the column to the other as by a reaming action and causing the freed and removed particles to be gravitationally discharged through the bore during the reaming operation until the digest is removed from the retort.

It is important to note that the step of reaming out the retort not only expedites removal of the digest but cuts and reduces the digest to sizes most suitable for effective treatment in a dissolution, filtration and precipitation plant (not shown) to which the comminuted digest is conveyed in any suitable manner.

It is now seen that my method provides for treatment in a practicable and commercially desirable manner of many rare and strategic metals to produce metallic salts and electrolytic metals of many kinds, due primarily to my efficient and expedient method and apparatus for removing the digest.

While I have shown and described a specific embodiment of my invention I do not limit myself to the exact details of construction set forth, and the invention embraces such changes, modifications and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

I claim:

1. The method of treating ore which forms a solidified mass when digested in a retort, which consists in displacing the ore during the digesting thereof in a retort to form a solidified column of digested ore having an axial bore therethrough, then removing particles of the digest progressively from one end of the column to the other and discharging such removed particles through the bore until the entire digest is removed from the retore.

2. The method of treating ore which forms a solidified mass when digested in a retort, which consists in displacing the ore during the digesting thereof in a retort to form a solidified column of digested ore having an axial bore therethrough, then reaming out the digest progressively from one end of the column to the other and continuously discharging through the bore the digest particles removed by the aforesaid reaming operation.

3. The method of digesting refractory ore, which consists in charging a retort with ore which will be converted into a solidified columnar mass when digested, displacing the ore in the retort both axially and radially, subjecting the ore to digesting treatment while displaced as aforesaid until the ore solidifies and forms a column of digested material having an axial bore therethrough, then reaming out the retort from one end of the column to the other to remove particles of the digest, and discharging such particles from the retort through said bore.

4. The method of digesting refractory ores in a retort in which the ore solidifies as a column when digested, which method consists in feeding ore to be digested into a digesting retort, displacing the ore in the retort by introduction of a core therein which extends entirely through the mass of ore, then subjecting the ore with the core therein to a digesting treatment until the ore forms a solidified column around the core, removing the core to define a bore through the solidified digest, then reaming out the retort and discharging

through the bore the digest removed by said reaming operation.

5. The method of digesting ore, which consists in feeding a charge of ore into a retort, maintaining upright in the charge a member for displacing ore along an axial path extending through the lower end of the charge, subjecting the charge to digesting treatment until the charge forms a solidified mass, removing the ore displacing member to define an axial opening in the solidified digest, then reaming out the retort to remove particles of the digest progressively from the top to the bottom of the retort and gravitationally discharging the removed particles through said opening.

6. In apparatus for treating ore, an upright retort open at its ends, a head removably mounted on and closing the upper end of the retort, a gate for opening and closing the lower end of the retort, means for introducing a charge of ore into the retort, means for subjecting the ore to digesting treatment which causes the ore to form a solidified digest, and a removable core in said retort extending axially through the charge and which when removed after the digest solidifies defines an opening through the solidified digest affording the gravitational discharge of the digest as particles of the latter are progressively removed from the upper end to the lower end of the solidified mass.

7. In apparatus for treating ore, an upright retort open at its upper and lower ends, a head removably mounted on and closing the upper end of the retort, a gate for opening and closing the lower end of the retort, intake means for introducing a charge of ore into the retort, a core member removably mounted in the retort so as to extend axially through the charge of ore and which on removal after digesting treatment of the ore defines an opening extending axially through the digest, means for subjecting the ore in the retort to a digesting treatment until the ore solidifies around the core, and means for reaming out the retort to remove particles of the solidified digest and cause the same to gravitationally discharge from the retort through said axial opening.

8. In apparatus for treating ore, an upright retort open at its ends, a head removably mounted on and closing the upper end of the retort, a gate for opening and closing the lower end of the retort, means for introducing a charge of ore into the retort, means for subjecting the ore to digesting treatment which causes the ore to form a solidified digest, a removable core in said retort extending axially through the charge and which when removed after the digest solidifies defines an opening through the solidified digest affording the gravitational discharge of the digest as particles of the latter are progressively removed from the upper end to the lower end of the solidified mass, and means associated with said retort for placing the core in and removing it from the retort.

9. In apparatus for treating ore, an upright retort open at its ends, a head removably mounted on and closing the upper end of the retort, a gate for opening and closing the lower end of the retort, means for introducing a charge of ore into the retort, means for subjecting the ore to digesting treatment which causes the ore to form a solidified digest, a removable core in said retort extending axially through the charge and which when removed after the digest solidifies defines an opening through the solidified digest affording the gravitational discharge of the digest as particles of the latter are progressively removed from the upper end to the lower end of the solidified mass, means associated with said retort for placing the core in and removing it from the retort, and a reaming device carried by said last named means and movable thereby into and out of position for progressively removing particles of the digest.

WILLIAM C. KIRKPATRICK.