(No Model.) 2 Sheets—Sheet 1.

# T. P. BARBOUR.

## PROCESS OF TREATING ORES.

No. 571,468. Patented Nov. 17, 1896.

Fig. 1.

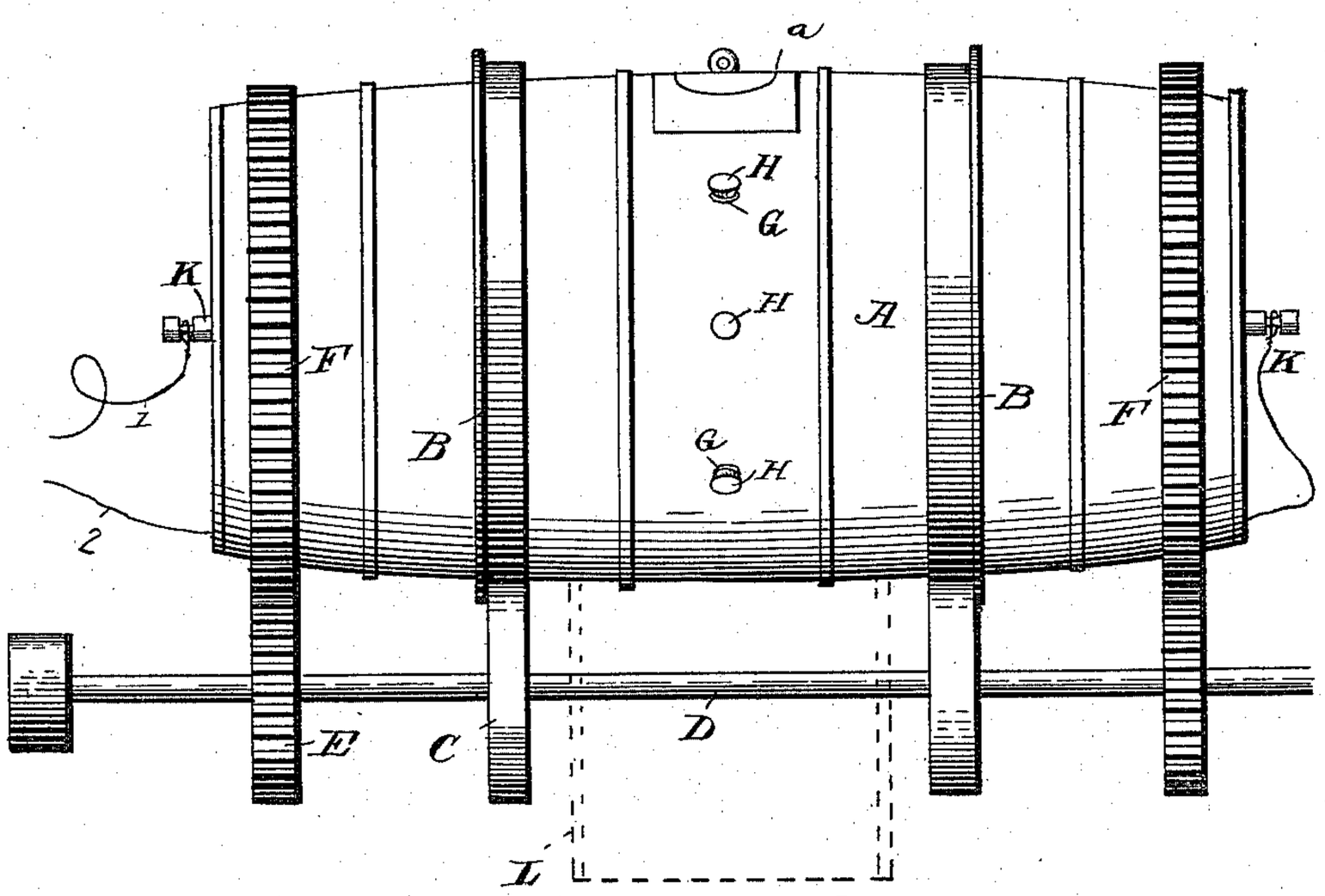
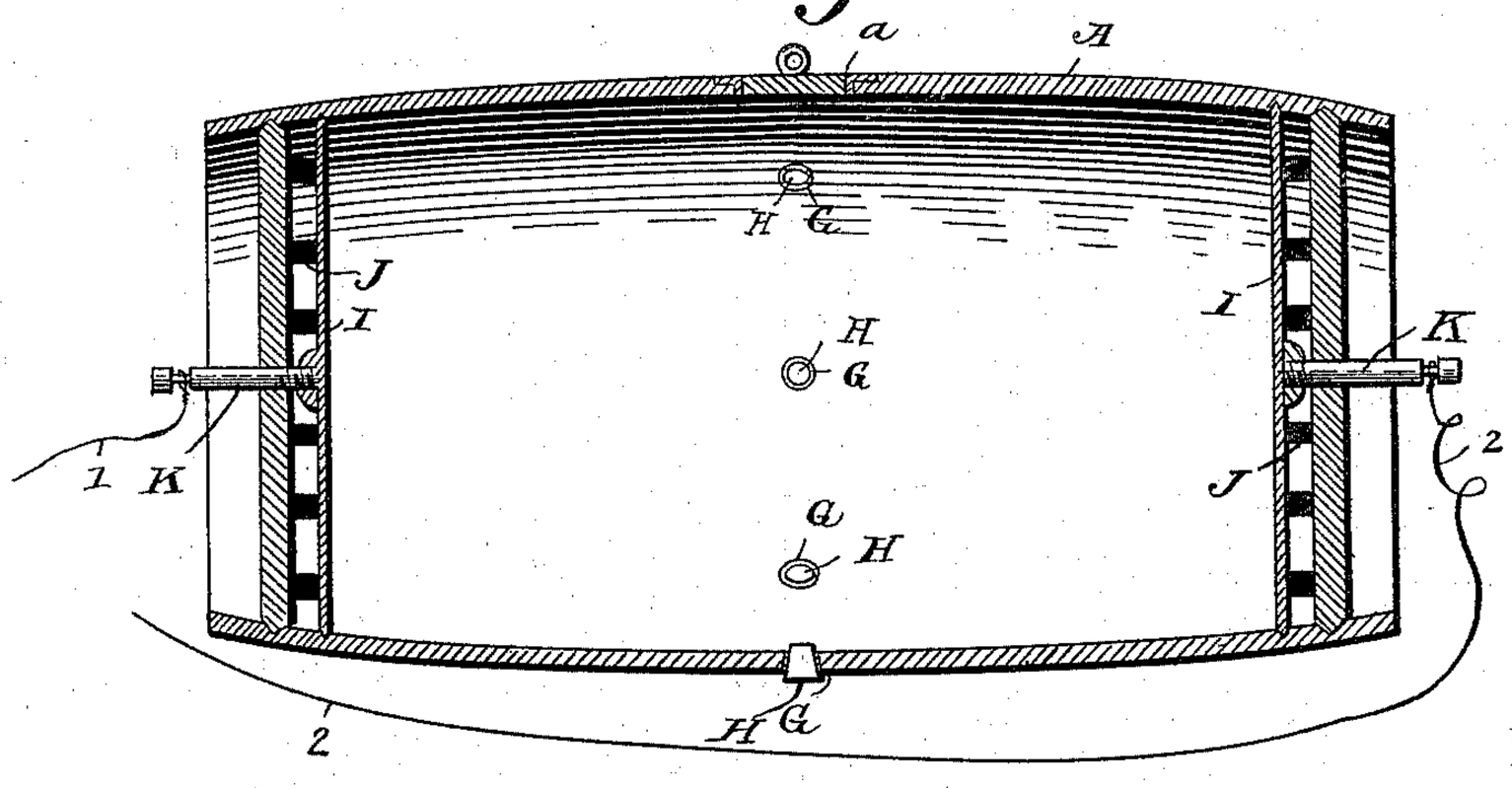



Fig. 2.




Witnesses
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Inventor
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C. A. Snow & Co.

(No Model.) 2 Sheets—Sheet 2.

# T. P. BARBOUR.

## PROCESS OF TREATING ORES.

No. 571,468. Patented Nov. 17, 1896.

*Fig. 3.*

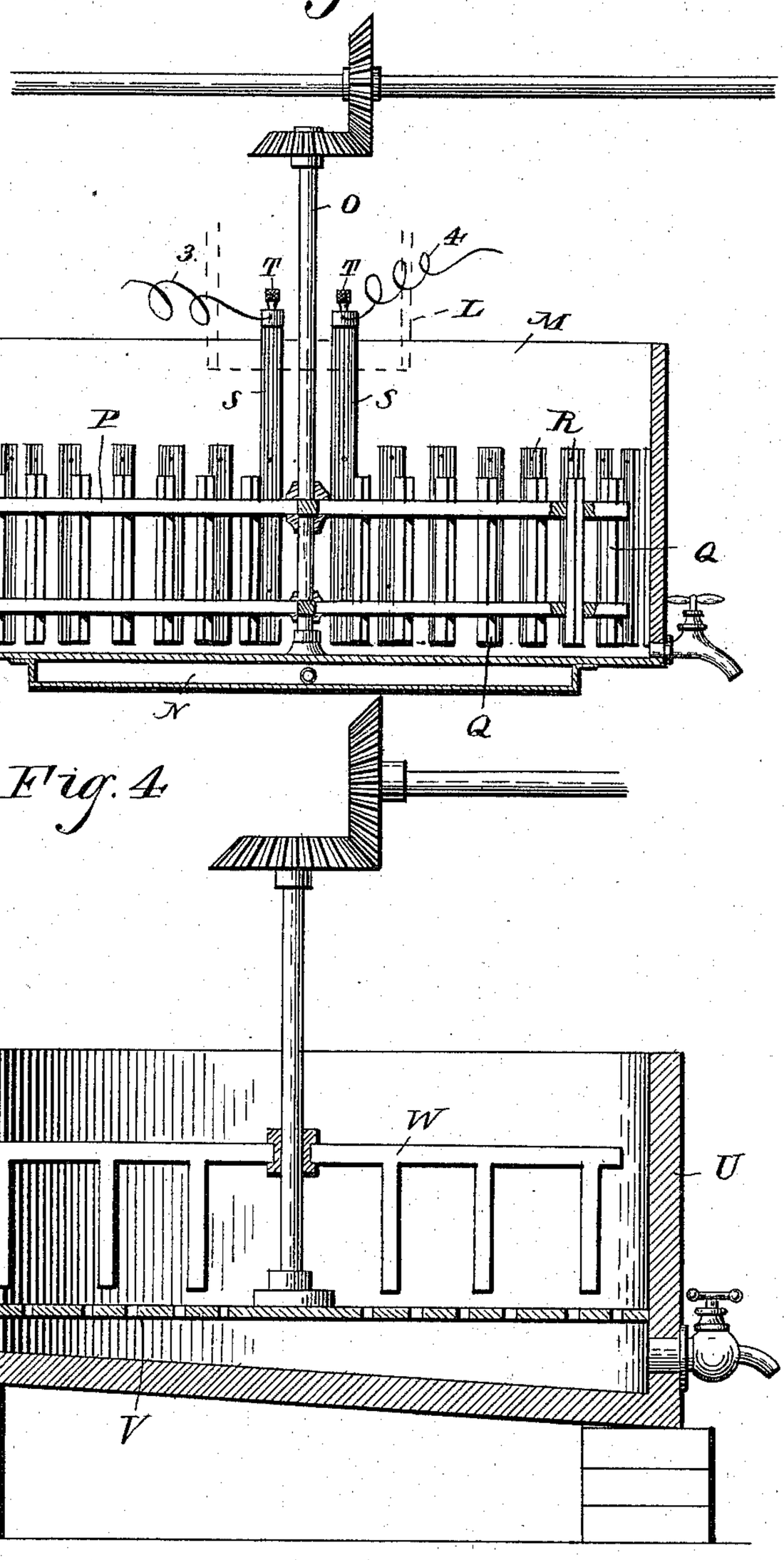


*Fig. 4.*

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# UNITED STATES PATENT OFFICE.

THOMAS P. BARBOUR, OF SAN ANTONIO, TEXAS.

## PROCESS OF TREATING ORES.

SPECIFICATION forming part of Letters Patent No. 571,468, dated November 17, 1896.

Application filed November 7, 1893. Serial No. 490,294. (No model.)

*To all whom it may concern:*

Be it known that I, THOMAS P. BARBOUR, a citizen of the United States, residing at San Antonio, in the county of Bexar and State of Texas, have invented a new and useful Process of Treating Ores, of which the following is a specification.

This invention relates to processes of treating ores; and it has for its object to provide an improved method of reducing gold and silver ores and recovering their metals.

To this end the main and primary object of the present invention is to provide an improved process of the character described which is available for use in connection with all classes of gold and silver ores, but which is more especially adapted to refractory ores in their raw state, and is therefore particularly designed to provide a simple and efficient process for the treatment or ores in their raw state without the necessity of "roasting."

The more or less complicated nature of the refractory ores of gold and silver, and the extremely intractable character of some of their constituents, make the treatment thereof by most ordinary methods very difficult and in many cases utterly impracticable, and thereby leaving the roasting process, with or without salt, as the only really practical method now in use preparatory to the chlorination of the ores. While this roasting process is efficient in producing the results required of it, it is nevertheless attended with many disadvantages from standpoints of complication and expense, and the present invention is therefore particularly useful in the dispensing with this step.

With these and other objects in view the invention consists in the novel process hereinafter fully described and claimed, taken in connection with certain apparatus necessary to the successful carrying out of the process, and which apparatus is illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of the chlorinating-tank. Fig. 2 is a central longitudinal sectional view of the same. Fig. 3 is a sectional view of the metal-precipitating tank. Fig. 4 is a detail sectional view of an ordinary leaching-tank sometimes used in connection with the process.

The construction of the apparatus illustrated in the accompanying drawings will be referred to particularly in connection with the process carried out by the same as the description of such process is proceeded with, and taking the first step of the process it is to be understood that the ore to be treated in its raw state is first pulverized by any of the improved methods of crushing or stamping ores, but preferably by stamps, to an eighty-mesh fineness, that is to say, to such a fineness that it will pass through battery-screens of eighty meshes to the inch. Fine pulverization is essential in order to secure the best results, as it has been found by practical experience and observation that for the purposes of reduction and extraction the finer the ore is pulverized the better the process can be carried out.

A charge of the pulverized ore is fed into the chlorination tank or cask A, through the manhole *a*, in such quantity that when fully charged with ore, water, and chemicals only two-thirds of the capacity of the tank or cask shall be taken up, it having been proven by practical experiment that the very best results are secured by mixing at or below this point.

The chlorination-tank A is essentially a large stout cask made, preferably, of well-seasoned oak, thoroughly soaked with paraffin, and strongly bound with iron bands and castings proportioned throughout to the load which the tank is designed to carry. The said tank is supported in a horizontal position and is provided at a point between both ends thereof and its center with the flanged guide-rings B, completely encircling the same and turning on the vertical guide-rolls C, secured to the horizontal drive-shaft D. The horizontal drive-shaft D also carries the drive-pinions E, which mesh with the spur-rings F, secured exteriorly on the tank, near the opposite ends thereof, and said shaft D may be driven from any suitable driving machinery and provides means whereby the tank is given a smooth and regular rolling motion, said rings B preventing all slipping or lateral motion. The manhole *a* is placed longitudinally of the tank, at a central point thereof, and provides means whereby the said tank may be charged with the ores, chemicals, &c., and in order to provide means for the discharge

of the contents of the tank the same is provided with a circular series of metal-lined bung-holes G, regularly spaced apart and kept closed during the rotation of the tank by means of well-fitting wooden bungs H, which are sufficiently long to project beyond the outer surface of the tank to facilitate their removal when necessary.

Arranged inside of the tank A, at a point adjacent to and parallel with the opposite end heads thereof, are the metallic pole-disks I. These pole-disks are solid plates of copper designed to be deeply chined into the body of the tank, so as to make water-tight joints, and are intended to serve as poles for the transmission of electric currents through the fluid pulp, which fills the whole space intervening between them. To prevent the sagging and bending of the pole-disks under the outward pressure of the ore under treatment, and at the same time completely insulating them, insulator bracing-posts J are arranged between the disks and the outer heads of the tank. Connecting-pins K project through and are insulated from the opposite heads of the tank and are connected at their inner ends to the pole-disks, while to their outer extremities are connected the circuit-wires 1 2, which are connected in circuit with a suitable battery or other electric generator. The tank thus described being charged with the proper quantity of ore, finely-pulverized black oxid of copper (monoxid) is added in the proper proportion of about six or eight pounds to a ton of ore and the mixed ores treated with sufficient water to make a pulp of the consistency of thin mortar. The manhole *a* is now closed and sealed and one of the upper bungs removed, and into this open bung-hole sulfuric acid is carefully introduced in a quantity equaling about two-thirds of the weight of the copper oxid employed; but, if found desirable, instead of introducing the chemicals in this manner the oxid of copper may be treated with water and sulfuric acid in a separate vessel and the resulting pulp, when the combination is finished, added to the charge of ore.

After the oxid of copper and the acid have been introduced into the tank, together with the pulverized ore, the rotation of the tank is begun. This rotation should continue for at least one hour and a half, or as long as may be found necessary, and after a sufficient agitation of the materials contained within the tank it will be found that such materials have become thoroughly mixed and the various reactions completed by which the gold and silver are reduced to such a condition as to be readily seized by chlorin gas. These reactions and their rationale are not sufficiently clear for a character explanation of the same, but for the purposes of the present invention it is thought to be sufficient to state that this preliminary treatment of the ores is a perfect substitute in every respect for the ordinary "roasting process," and prepares the ores whereby a very rapid chlorination thereof may be effected. After the preliminary treatment of the ore in the manner just described the rotation of the tank is stopped and a second charge introduced into the same, consisting of eight pounds of black oxid of manganese, thirty pounds of salt, and twelve pounds of sulfuric acid, or in lieu thereof any suitable bisulfate in equivalent proportions. The tank is again given a rolling motion through the means described and the electric current closed over the circuit 1 2, so that the chlorinating-tank, by reason of the pole-disks therein, will be included in such circuit, whereby electric currents may be continually passed through the pulp within the tank during the rotation thereof, and these currents are maintained until the chlorination is completed. Ordinarily an hour and a half or two hours suffices to complete the chlorination, according to the strength of the electric current, and this rapid chlorination is primarily due to the favorable condition in which the ores of the precious metals are left by the oxid-of-copper treatment, combined with the powerful energizing effect of the electric currents on the reagents employed, as well as to the intimate mixture brought about by the constant agitation, whereby every particle is brought into intimate contact with the nascent chlorin at the very instant of its generation. After the chlorination is completed the circuit over the wires 1 2 is broken, while the tank still continues to revolve. One by one as the bungs come into a favorable position the same are loosened by a smart blow of a hammer and are at once driven out by the force of the pulp, which, being kept fluid by constant agitation, at once finds vent or escape through the open bung-holes, and continues to do so till the tank is completely emptied, such pulp, as it is delivered, being adapted to fall into a suitable gutter or trough L, (shown in dotted lines,) by means of which it may be conveyed to the desired point. After the pulp has been discharged from the chlorinating-tank, as just noted, all the bungs are secured in the holes, excepting one of the lower ones, and a hose is introduced through the manhole, whereby the interior of the tank may be thoroughly cleaned of any pulp remaining, the wash-water running out of the lower bung-hole and being conveyed to mix with the chlorinated pulp. At this stage of the process the gold and silver of the ore are held in solution in the form of the chlorids of such metals, and if the details of the chlorination have been properly managed not a grain of either the gold or silver will be found in the pulp or solid matter. This enables the remainder of the process or treatment of the ores to be carried out either by amalgamation or lixiviation, by either of which methods the gold and silver can be recovered with nearly equal results. In case the next step of the process is the preparation of the materials for amalgamation, the chlo-

rinated ore and wash-water is conveyed directly to the metal-precipitating tank M, the agitator of which is already in motion when the chlorinated pulp is introduced, so as to keep the pulp fluid and in good working condition, whereby no time may be lost between the chlorination and precipitation, so that the conversion of the chlorid to metallic silver is going on in the tank M during the discharge of the pulp from the chlorinating-tank, and to secure this result advantage is taken of the electrolytic action of zinc upon the salts of silver and that action stimulated and intensified by an electric current.

The metal-precipitating tank M is an open circular vessel of suitable size arranged vertically and preferably made with oak sides and an iron bottom, to which is secured a closed steam-chamber N, in which is kept up a circulation of steam in order to heat up the tank to facilitate and expedite the precipitation of the silver from its chlorid solution. Suitably mounted inside of the metal-precipitating tank M is a vertical agitator-shaft O, driven by suitable shaft connections and carrying inside of said tank a radial series of horizontal agitator-arms P, disposed at right angles to the shaft and carrying a vertical series of square or diamond shaped agitator-bars Q, of solid zinc, and which bars extend above the upper arm to the usual level of the pulp and below the lower arm to within one-quarter of an inch of the bottom. These zinc agitator-bars are adapted not only to agitate the fluid pulp within the metal-precipitating tank, but also act in an auxiliary capacity together with the circuit-plates R. The zinc circuit-plates R are secured to the interior wooden surface of the tank by suitable screws, and are of a height equal to the average depth of the pulp in the tank, but terminate short of the metallic bottom of the tank. Two adjacent zinc plates, at one side of the tank, are provided with the upper extensions S, reaching to the top of the tank and carrying binding-screws T, to which are connected the terminals of the circuit-wires 3 4, which are adapted to be included in a suitable generator-circuit and so arranged that the direction of the electric current entering the tank shall be the same as the direction of the rotation of the agitator therein.

As soon as the electric circuit is broken on the wires 1 2 and the current is thereby cut off from the chlorinating-tank the circuit is closed over the wires 3 and 4 through the tank M, so that the operation of precipitation and agitation in the tank M may be commenced while the tank A is discharging. It will be well understood by those skilled in the art that the fluid pulp while it is agitated in the tank M comes under the influence of the zinc intensified by the currents of electricity playing in every direction throughout the said tank, thereby providing means for very quickly precipitating metallic silver from its chlorid solution, and it has been found by practical tests that the period of time required for this precipitation is very little longer than the time required for the discharge of the pulp from the tank A. After the precipitation of the metallic silver from the pulp solution in the tank M the electric current is cut off and the pulp allowed to settle to the bottom of the tank. The solution is now drawn off into any suitable receptacle or tank, providing convenient means whereby the gold may be precipitated from the solution by ordinary methods, as will be hereinafter referred to, and after this solution is drawn off the tank M is filled with water to a point corresponding to the height of the first solution. Agitation is again commenced and continued a suitable length of time, after which the pulp is allowed to settle and the clear solution drawn off into the vessel or tank containing the gold solution. More water is now added to the pulp to give to the same a suitable consistency, and from two to five pounds of salt and about two pounds of fine granulated zinc added. The pulp, together with the added salt and zinc, is now taken from the tank M and passed to an amalgamating-pan for treatment. This pan may be of any improved modern type, but is preferably one of that character heated by steam. Quicksilver is added in the usual way and in a quantity to suit the requirements of the process. Agitation is begun in the amalgamating-pan as soon as the pulp is transferred and is kept up until amalgamation is complete. The pulp is then thinned and transferred to the settler, where, being properly washed, the amalgam is collected and retorted and the silver product run into bars. This amalgamation step is well understood by those skilled in the art and need not be further described.

After the chlorination of the ores, if it is desired to proceed by the method of lixiviation, the chlorinated pulp and solution from the tank A, instead of in the first instance being conveyed to the tank M, as in the amalgamation process, is conveyed directly to the leaching-tank U, having a false perforated bottom V and an ordinary revolving rake-agitator W, which is of the ordinary construction employed in processes of this character. Water is added to the pulp as it is introduced into the leaching-tank and agitation set up so as to thoroughly mix the water with the pulp. Now the solution which, it must be remembered, carries all the gold and silver chlorids is leached off and conveyed to the tank M, in which agitation has already been started and the proper electric connections made. Fresh water is added to the pulp in the leaching-tank, thoroughly agitated in the pulp, and then leached off to be mixed with the first solution in the tank M. Now simply the chlorids of gold and silver in solution, without the pulp, are in the metal-precipitating tank M, and the method of procedure is substantially the same as that

previously described in connection with such tank. Agitation is kept up until the chlorid of silver in solution is decomposed by the combined electrolytic action of zinc, salt, and the electric current, so that pure metallic silver in a fine powder deposits itself on the bottom of the tank M. The action in the tank M is continued until all the silver in the solution has been precipitated, when the agitation is stopped and the electric current broken, so that the solution may be left to thoroughly settle. As soon as this takes place the solution is drawn off carefully, so as not to disturb the precipitate, and is conveyed to a suitable vessel or tank for the precipitation of the gold, as already referred to. The silver precipitate from the tank M is collected, washed, dried, and fused for bullion.

After the silver has been recovered by either amalgamation or lixiviation, as described, attention is next directed to the gold solution contained in any suitable tank or vessel. To this gold solution is added a solution of protosulfate of iron, and if gold be present it will be precipitated as a dark-brown powder, which is pure metallic gold. This solution is allowed to also settle fully and is then drawn off into another suitable vessel or tank, while the gold powder remaining is collected, fused, and run into bars.

To the solution drawn off from the gold precipitate a solution of caustic potash is added, whereby zinc, if present, may be recovered in the form of a white amorphous powder, which, when heated, becomes zinc-oxid or the "zinc-white" of commerce; and if it is desired to ascertain if copper be present in the ores the solution from the zinc precipitate is treated with scrap-iron, which causes the copper to be deposited in a metallic state as a very fine dust, which may be collected and used in that state or fused, as preferred.

From the foregoing it is thought that my improved process for recovering gold and silver from their ores will be fully understood by those skilled in the art, and I would state that I am aware that zinc has been employed as a precipitant of silver from both cyanid and hyposulfite solutions, and in this connection it is to be noted that the process involved by the present invention prepares the materials in such a manner whereby the precipitation by zinc is effected from the "original solution" without employing any chlorid solvent, such as cyanid of potash or hyposulfite of soda.

It is to be understood that slight changes in my process may be resorted to without departing from the spirit of the present invention, for in the employment of copper oxid and sulfuric acid in the preliminary treatment of the ore I do not confine myself to that combination, but may also use metallic copper with sulfate of copper, or even sulfate of copper alone, according to the nature of the ore, and such other minor changes as might be found expedient to observe.

Having thus described the invention, what is claimed, and desired to be secured by Letters Patent, is—

1. The herein-described process of treating ores which consists in first treating the raw material with copper oxid and sulfuric acid, then chlorinating the pulp thus treated, introducing the chlorinated mass into a suitable agitator having zinc therein, and establishing an electric current through the mass in the presence of zinc, substantially as set forth.

2. A chlorinating-tank for treating ores consisting of a revoluble cask having a single manhole and a circular series of bung-holes, copper pole-disks secured within the cask at opposite ends thereof and arranged in an electric circuit, insulator bracing-posts arranged between said disks and the outer heads of the tank, flanged guide-rings encircling said cask at an intermediate point, spur-rings encircling the cask near its opposite ends, and a horizontal drive-shaft carrying guide-rolls engaging said flanged guide-rings and drive-pinions engaging said spur-rings, substantially as set forth.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

THOMAS P. BARBOUR.

Witnesses:
W. W. TOBEY,
MILFORD P. NORTON.