

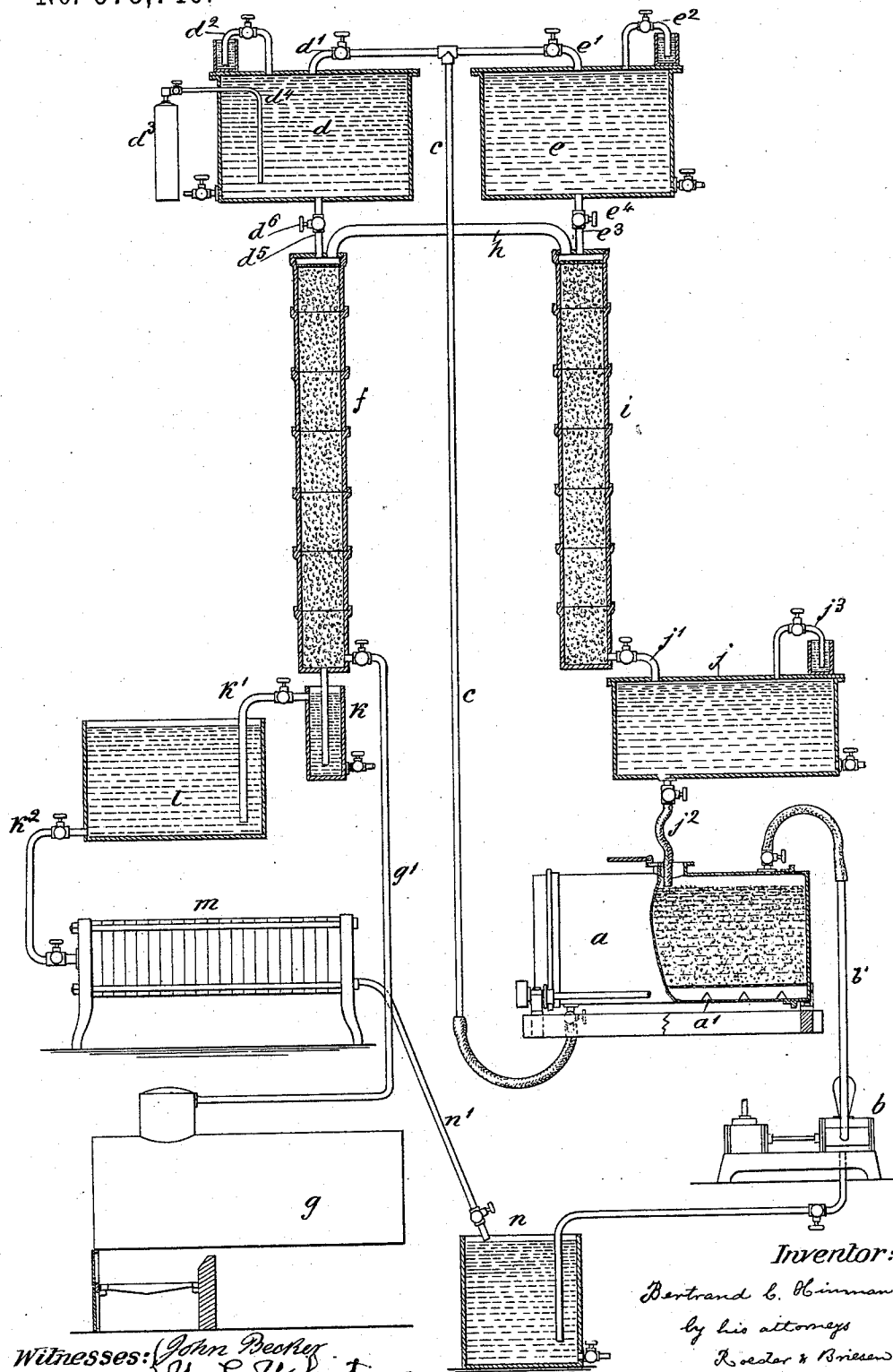
(No Model.)

B. C. HINMAN.

PROCESS OF AND APPARATUS FOR EXTRACTING GOLD FROM ORES.

No. 578,746.

Patented Mar. 16, 1897.



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PROCESS OF AND APPARATUS FOR EXTRACTING GOLD FROM ORES.

SPECIFICATION forming part of Letters Patent No. 578,746, dated March 16, 1897.

Application filed March 5, 1896. Serial No. 581,871. (No model.)

To all whom it may concern:

Be it known that I, BERTRAND CHASE HINMAN, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Processes of and Apparatus for Extracting Gold from Ores, of which the following is a specification.

10 This invention relates to an improved process and apparatus for the extraction of gold from ore by bromin with or without the assistance of chlorin and the recovery of the halogens for continuous use.

15 By means of this invention the gold is extracted in a rapid and complete manner, and substantially all the bromin, free and combined, is recovered, while the strength of the bromin solution to be used on the ore can be regulated to any desired degree.

The accompanying drawing represents a sectional elevation of my improved apparatus designed to carry my process into effect.

25 The letter *a* represents a revolving barrel provided with a filter *a'* and connected by a pipe *c*, having valves *d' e'*, to two intermediate tanks or reservoirs *d e*, having vents *d² e²*. The tank *d* is connected to a chlorin-cylinder *d³* by a pipe *d⁴* and also to a vaporizing-tower *f* by pipe *d⁵*, having valve *d⁶*. The tower *f* is preferably made of stoneware and is filled with coarse pebbles or broken or perforated plates, so as to cause a fine subdivision of the liquid running through it. At or 30 near its lower end a heating-pipe *g'* opens into the tower and discharges steam drawn from a boiler *g* or another heating medium, such as hot air. The lower end of the tower *f* also connects by a liquid seal *h* and an overflow-pipe *k'* with a receiving or precipitating tank *l*, which in turn, by pipe *k²*, connects with a filter-press *m*. This press connects by pipe *n'* with a sump-tank *n*, which may be connected to the barrel *a* by a pipe *b'*, having pump *b*.

45 The upper end of the tower *f* communicates by pipe *h* with a condensing-tower *i*, that may be of a similar construction as the tower *f*. At its upper end the tower *i* connects with the tank *e* by a pipe *e³*, having valve *e⁴*, while at its lower end it communicates with a bromin-tank *j*, having vent *j³*, by pipe *j'*. The

bromin-tank in turn, by pipe *j²*, communicates with barrel *a*, so that in this way all the parts of the apparatus are connected directly or indirectly with each other. 55

In carrying out my improved process by means of the apparatus described I proceed as follows: The pulverized ore is charged into the revolving barrel *a* and is treated therein with a strong aqueous solution of bromin. The strength of the bromin solution depends upon the character of the ore, the more bases being present the more bromin being required. Generally from about 60 three to twenty pounds of bromin per ton of ore will be found sufficient, an excess of bromin being always desirable. After the barrel has been charged with the ore and solution it is closed and revolved for, say, from one to two hours, when all the gold and soluble bases will have been converted into bromids. The motion of the barrel is now stopped and water or a bromin solution is forced into it by means of pump *b*. This causes the strong solution of bromin and bromids to be forced through filter *a'* and pipe *c* into the tank or reservoir *d*, the valve *d'* being open and the valve *e'* being closed. 70 After the strong solution has thus been discharged into the tank the valve *d'* is closed and the valve *e'* opened, so that the weaker solution will now flow from barrel *a* into the tank *e*. When all the gold and bromin have thus been leached out, the contents of barrel *a* are emptied into conveniently-arranged 85 hoppers and sluices to be conveyed to the dumps.

The strong solution in tank *d* will contain all the bromin in excess and also the bromid salts of gold and other soluble bases 90 which have been formed during the operation. For the purpose of setting free the combined bromin from the bases I now introduce into tank *d* chlorin from cylinder *d³* or other source by pipe *d⁴*. The amount of chlorin to be introduced depends upon the amount of combined bromin, an equivalent portion of the former being necessary to displace the latter, but I prefer in all cases to use a slight excess of chlorin, as this excess is an advantage and is recovered, together with the bromin. Instead of introducing the chlorin from a cylinder it may be generated 100

in the tank *d* by any known means. Any other agent may be employed in place of the chlorin, which has the capacity of displacing the bromin from the bromids and thus setting free the bromin, as, for instance, permanganate of potash and acid or peroxid of sodium and an acid. If preferred, the chlorin may be introduced into the tower *f* as a gas, or the chlorin or other reagent may be introduced directly into the barrel *a*, the purpose always being to set free the bromin from the bromids which may have been formed during the operation. The contents of tank *d* are now allowed to run through pipe *d*² into the vaporizing-tower *f*, into which steam is introduced through pipe *g*¹. As the steam ascends it heats the pebbles or plates contained within the tower and also the solution, which slowly trickles down between the pebbles and which is thus subdivided into a larger number of streamlets, exposing thereby an increased surface to the action of the steam. The bromin and the excess of chlorin are thus vaporized and are carried through the pipe *h* into the condensing-tower *i*. Here the vapors meet a stream of the weak solution from the second tank *e*, which is discharged into said tower by opening the valve *e*⁴ and are condensed into a bromin solution containing the excess of chlorin.

The strength of the bromin solution may be regulated by allowing more or less water or weak solution to run from the tank *e* into the condenser *i*. The bromin solution thus formed is conveyed from the condenser by pipe *j*¹ into the original bromin-tank *j*, from which it is charged into the barrel *a* by pipe *j*², to be used for dissolving the gold in a fresh charge of ore. It will be seen that in this way not only the bromin is recovered, but also the excess of chlorin which has been vaporized and condensed simultaneously with the bromin. Thus the chlorin is also collected in tank *j*, and being in solution with the bromin is ready to act upon the bases in the fresh charge of ore.

The hot gold solution from which the bromin and chlorin have been separated in the vaporizing-tower *f* runs through the water seal *k* and overflow *k*¹ into the receiving or precipitating tank *l*, where the gold in solution is precipitated by hydrogen sulfid or any other suitable reagent. The solution being hot and in an ideal condition precipitation takes place rapidly, so that the contents of the tank *l*, together with the flocculent precipitates, can after a few minutes be forced through the filter-press *m*, where the precipitated gold is retained, while the freed solution is allowed to run into the sump-tank *n* by pipe *n*¹. The pump *b*, which displaces the gold solution in barrel *a*, may draw its supply of water from this sump-tank, so that no loss of precious metal can take place.

It will be seen that by my invention an apparatus and a continuous and economical process of extracting gold from ore is pro-

vided and that practically all the bromin is recovered, as well as the excess of chlorin that may have been employed. Moreover, as all the solutions are continuously used over again none of the gold in solution can possibly be lost.

What I claim is—

1. The process of extracting gold from ore, which consists in treating the ore with bromin, filtering the solution, increasing its surface by subdivision, separating the free bromin from the subdivided solution by vaporization, and precipitating the gold, substantially as specified.

2. The process of extracting gold from ore, which consists in treating the ore with bromin, filtering the solution, increasing its surface by subdivision, separating the free bromin from the subdivided solution by vaporization, condensing the bromin vapors, and precipitating the gold, substantially as specified.

3. The process of extracting gold from ore, which consists in treating the ore with bromin, adding a reagent to set free the bromin, subdividing the solution to increase its surface, separating the bromin from the subdivided solution by vaporization, and precipitating the gold, substantially as specified.

4. The process of extracting gold from ore, which consists in treating the ore with bromin, adding chlorin to the solution, subdividing the solution to increase its surface, separating the bromin from the subdivided solution by vaporization, and precipitating the gold, substantially as specified.

5. The process of extracting gold from ore, which consists in treating the ore with bromin, adding chlorin, subdividing the solution to increase its surface, vaporizing the bromin and chlorin from the subdivided solution, condensing the bromin and chlorin vapors, and precipitating the gold, substantially as specified.

6. The process of extracting gold from ore, which consists in treating the ore with bromin, adding chlorin, subdividing the solution to increase its surface, vaporizing the bromin and chlorin from the subdivided solution, condensing the bromin and chlorin vapors, precipitating the gold, and adding the condensed halogens to a fresh body of ore, substantially as specified.

7. An apparatus for extracting gold from ore, which consists of a vaporizing-tower filled with pebbles or other obstructive bodies, a dissolving vessel and a condensing-tower communicating with the vaporizing-tower, and a vaporizing-pipe that communicates with the lower end of the vaporizing-tower, substantially as specified.

8. An apparatus for extracting gold from ore, which consists of a dissolving vessel, a pair of intermediate tanks connected therewith, a vaporizing and a condensing-tower connected respectively to the intermediate tanks and also to each other, and a vaporizing-

pipe communicating with the lower end of the vaporizing-tower, substantially as specified.

9. An apparatus for extracting gold from ore, which consists of a vaporizing-tower, a dissolving vessel and a vaporizing-pipe communicating respectively with the upper and lower ends thereof, a liquid seal at the bottom of the vaporizing-tower and a receiving or precipitating tank communicating with the liquid seal, substantially as specified.

10. An apparatus for extracting gold from ore, which consists of a vaporizing-tower, a dissolving vessel and a condensing-tower communicating with the vaporizing-tower, and a vaporizing-pipe and a receiving or precipitating tank communicating with the lower end of such tower, substantially as specified.

11. An apparatus for extracting gold from ore, which consists of a dissolving vessel, a pair of intermediate tanks connected therewith, a vaporizing and condensing tower connected respectively to the intermediate tanks and also to each other, and a vaporizing-pipe

and a receiving or precipitating tank communicating with the lower end of the vaporizing-tower, substantially as specified.

12. The combination in an apparatus for extracting gold from ore, of the following elements: a dissolving vessel, a pair of intermediate tanks connected therewith, a vaporizing and a condensing tower connected respectively to the intermediate tanks, and also to each other, a vaporizing-pipe communicating with the lower end of the vaporizing-tower, a liquid seal at the bottom of such tower, a receiving or precipitating tank communicating with the liquid seal, and a filter-press communicating with the receiving or precipitating tank, substantially as specified.

Signed at New York, in the county of New York and State of New York, this 4th day of March, A. D. 1896.

BERTRAND CHASE HINMAN.

Witnesses:

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