

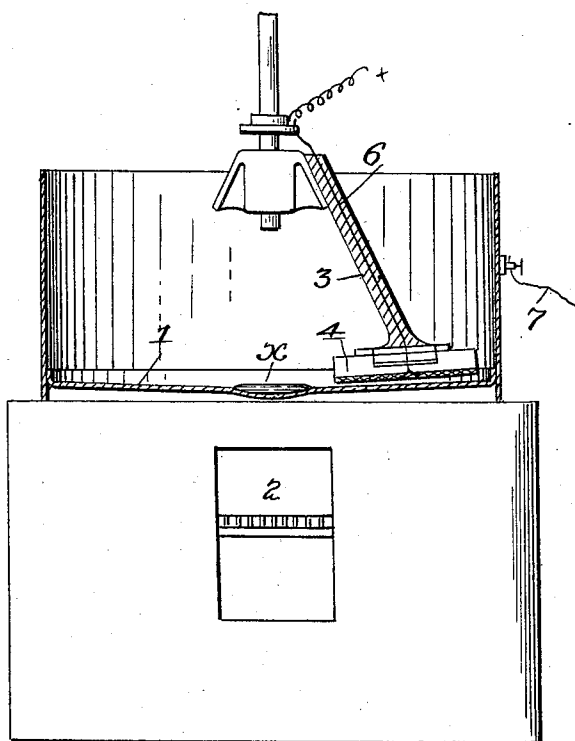
(No Model.)

J. H. HAYCRAFT.

PROCESS OF TREATING AURIFEROUS AND ARGENTIFEROUS ORES.

No. 579,872.

Patented Mar. 30, 1897.



*Attest*  
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# UNITED STATES PATENT OFFICE.

JOSEPH HENRY HAYCRAFT, OF ADELAIDE, SOUTH AUSTRALIA, ASSIGNOR  
TO THE HAYCRAFT'S GOLD EXTRACTION COMPANY, LIMITED, OF SAME  
PLACE.

## PROCESS OF TREATING AURIFEROUS AND ARGENTIFEROUS ORES.

SPECIFICATION forming part of Letters Patent No. 579,872, dated March 30, 1897.

Application filed September 29, 1894. Serial No. 524,463. (No specimens.)

*To all whom it may concern:*

Be it known that I, JOSEPH HENRY HAYCRAFT, metallurgical chemist, a subject of the Queen of Great Britain, and a resident of Adelaide, in the Province of South Australia, have invented a certain new and useful Improved Process of Treating Auriferous and Argentiferous Ores, of which the following is a specification.

My invention relates to an improved process of extracting gold and silver from certain finely-divided auriferous and argentiferous ores.

It consists, essentially, in a combination at one and the same time and in one and the same vessel of certain known processes of electrolytic chlorination and electro-amalgamation which have previously only been worked in separate combinations or in separate vessels.

I propose to describe my invention with reference to auriferous ores, but consider it equally suitable for certain classes of argentiferous ores.

In order that my invention may be the better understood, I will first describe the apparatus in which it is preferably to be carried into effect, though wishing it to be distinctly understood that I make no claim for the apparatus as part of my invention.

The accompanying drawing shows a pan in section with my furnace and stirrer combined therewith.

This apparatus consists of a circular iron pan 1 with a rounded bottom heated by a furnace 2, the pan being preferably so arranged as to be capable of being tilted for the discharge of its contents. Within the pan I provide a revolving stirrer 3, having four or more arms projecting downward and each terminating in a shoe or block 4, the shoes being arranged so as not to meet in the center of the pan. The shoes or blocks are formed, preferably, of carbon, and are shaped to the contour of the bottom of the pan, so that the whole of the lower face of the block or shoe is as near as may be equidistant from the inside of the pan, with an intervening space of about a quarter of an inch or more, as required. I do not confine myself to any particular intervening space, but find in practice

that within certain limits the nearer the anodes are to the cathode the better the result. The stirrer is so arranged that it can be actuated at any desired speed and can be raised or lowered as required by the class of ore under treatment or for the discharge of the contents of the pan. Suitable connections are made with a dynamo-electric machine, the pan being made the cathode and the stirrer with its arms the anode.

The electrical connections are shown at 6 7, one of which extends down through the stirrer-arm.

The shoes forming the positive poles of the bath are close to the cathode and revolve below the body of the ore-pulp under treatment and do not meet toward the center, so that the well of mercury at *x* is left undisturbed and unmixed with the ore-pulp.

My improved process is as follows: A charge of finely-divided ore having been placed in the pan is covered with water, preferably hot, to any desired depth, according to the size of the charge. I find in practice that with a charge of about one ton a depth of three to six inches well answers the purpose. Mercury is added equal to about five per cent. of the weight of the charge of ore, but varying in quantity according to the nature and quality of ore under treatment; also, about one per cent. of chlorid of sodium and about one-eighth per cent. of chlorid of barium. I may use, however, any other suitable soluble salts capable of yielding chlorine by electrolysis. Thus if the ore contains a large proportion of pyrites the sodium chlorid may be replaced by chlorid of lime. The temperature of the contents of the pan is raised until the water commences to boil gently, and about this temperature is maintained during the operation. In the meantime the stirrer is caused to revolve slowly, but at such sufficient speed as will prevent the ore from settling into a hard mass. The dynamo being connected so as to make the pan the cathode and the stirrer with its arms the anode, a current of electricity is passed continuously through the charge of sufficient intensity to decompose the soluble salt and cause it to yield chlorine. I find in practice that a current of about two hundred amperes at an in-

tensity of about three volts well answers the purpose with a charge of, say, one ton, but do not confine myself to any particular current. The operation is continued for about one hour, but dependent upon the class of ore under treatment, water being added from time to time to replace that lost by evaporation. The pan is then tilted and the contents removed into a separator. The mercury recovered may be used over and over again with fresh quantities of ore until it is judged to be sufficiently charged with gold to render it desirable to separate the amalgam in the usual way.

It must be well understood that the proportions of mercury and of the soluble salts are to be varied according to the class of ore under treatment and that the figures given are only approximate, though found to well answer the desired purpose.

The chemical reactions which take place appear to be as follows: On the electric current being applied chlorin is set free by electrolysis upon the carbon blocks or shoes of the stirrer, and owing to the position of these the chlorin is forced to permeate the whole mass in rising to the surface of the charge. The chlorin, being in a nascent state, acts rapidly on the minute particles of gold with which it comes in contact and forms with them chlorid of gold. At the same time the mercury at the bottom of the pan under the action of the heat rises, and, assisted by the action of the stirrer, permeates the charge. The mercury being the cathode, the chlorid of gold is decomposed by electrolysis and deposited in metallic form on the particles of mercury, by which it is at once amalgamated. Under the constant circular action and agitation of the stirrer the amalgam as formed descends to the bottom of the pan, where the mercury seizes upon any particles of coarse gold which may descend by gravitation to the bottom of the charge.

Though described with respect to chlorin and soluble reagents yielding chlorin, I am of opinion that my process should equally answer with bromin and soluble salts yielding bromin.

I am well aware that the various parts of my process, either singly or in certain combinations, are well known, and wish it to be well understood that I do not claim as my invention any one of them singly or specifically or any two or more of them together in any combination whatever, except as the entire and particular combination indicated.

The black coating which gradually forms on the bottom of the pan around the mercury-well consists, mainly, of iron oxid, as proved by chemical tests. That it is practically a non-conductor of electricity is shown by the fact that the chlorin set free on the carbon shoes escapes as chlorin. This is proved by working the pan without any charge of ore in it and with only sufficient salt water in the

pan to cover the carbon shoes. The gas then escapes at once and has been proved to be chlorin. If the black coating had been a good conductor of electricity, hydrogen would have been set free and, combining with the chlorin, would form hydrochloric acid. This is not found to be the case. Hence the black oxid is a non-conductor. As to the reaction whereby the black coating is formed, the iron of the pan is naturally an electropositive metal, while the carbon shoes are electronegative. If now while the dynamo is cut off from the pan a connection is made by a wire from the pan to the shoes and a galvanometer placed in circuit, a reverse current will at once be shown—i. e., the pan has become the anode and the shoes the cathode. Now in practice when a charge of ore has been treated and is being run out of the pan the current from the dynamo is cut off, because if allowed to pass through the pan when the charge gets low, the escape of chlorin becomes inconvenient to the workman, but as soon as the dynamo is cut off the reverse action comes into play and the bottom of the pan becomes for a short time the anode. Then it is that the iron becomes oxidized. When the current from the dynamo is turned on again, the pan at once becomes the cathode and the peroxid is reduced to a sub-oxid. By degrees the coating gets thicker and the reaction less and less, until in about a week the coating has become sufficient to make the bottom of the pan practically a non-conductor.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. The herein-described process of treating ores consisting in introducing the ore into a pan adding thereto mercury and soluble salts capable of yielding chlorin by electrolysis raising the ore contents of the pan to about the boiling-point of water and passing a current of electricity through the heated mass while stirring the same to secure a simultaneous electrolytic chlorination and electro-amalgamation, and maintaining the anode out of vertical alinement with the mercury cathode substantially as described.

2. In combination, the pan having a concave bottom with a central well, the furnace under the pan, the stirrer-shoes arranged to revolve about the central well leaving the same free means for revolving the shoes about the well and electrical connections to the shoes and pans, said shoes forming the anodes being out of vertical alinement with the mercury in the central well forming the cathode substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

JOSEPH HENRY HAYCRAFT.

Witnesses:

FRANCIS H. SNOW,  
CHARLES S. BURGESS.