No. 880,821. PATENTED MAR. 3, 1908.

J. E. PORTER & A. L. CLARK.

PROCESS OF EXTRACTION.

APPLICATION FILED FEB. 27, 1907.

2 SHEETS—SHEET 1.

Fig. 1.

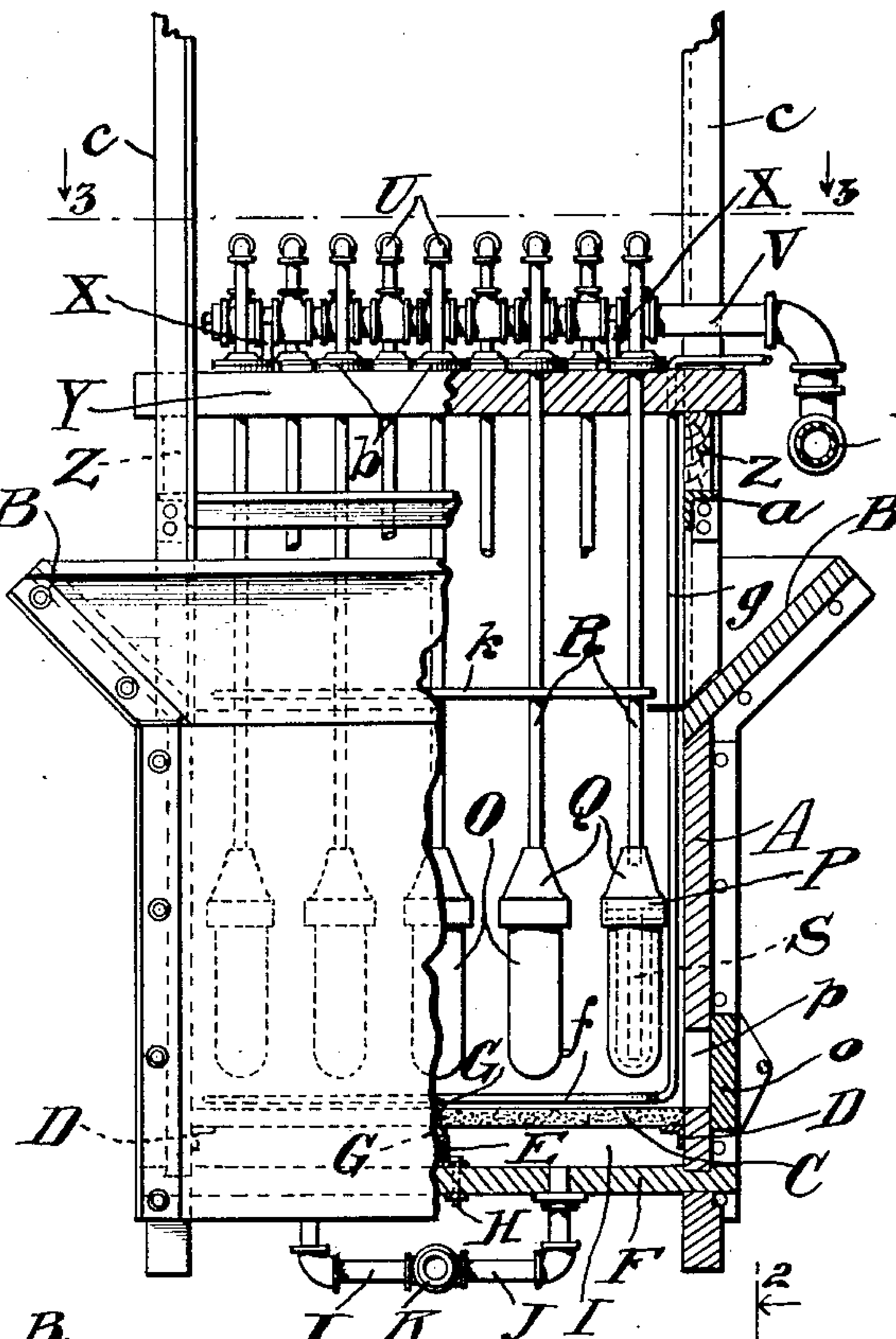
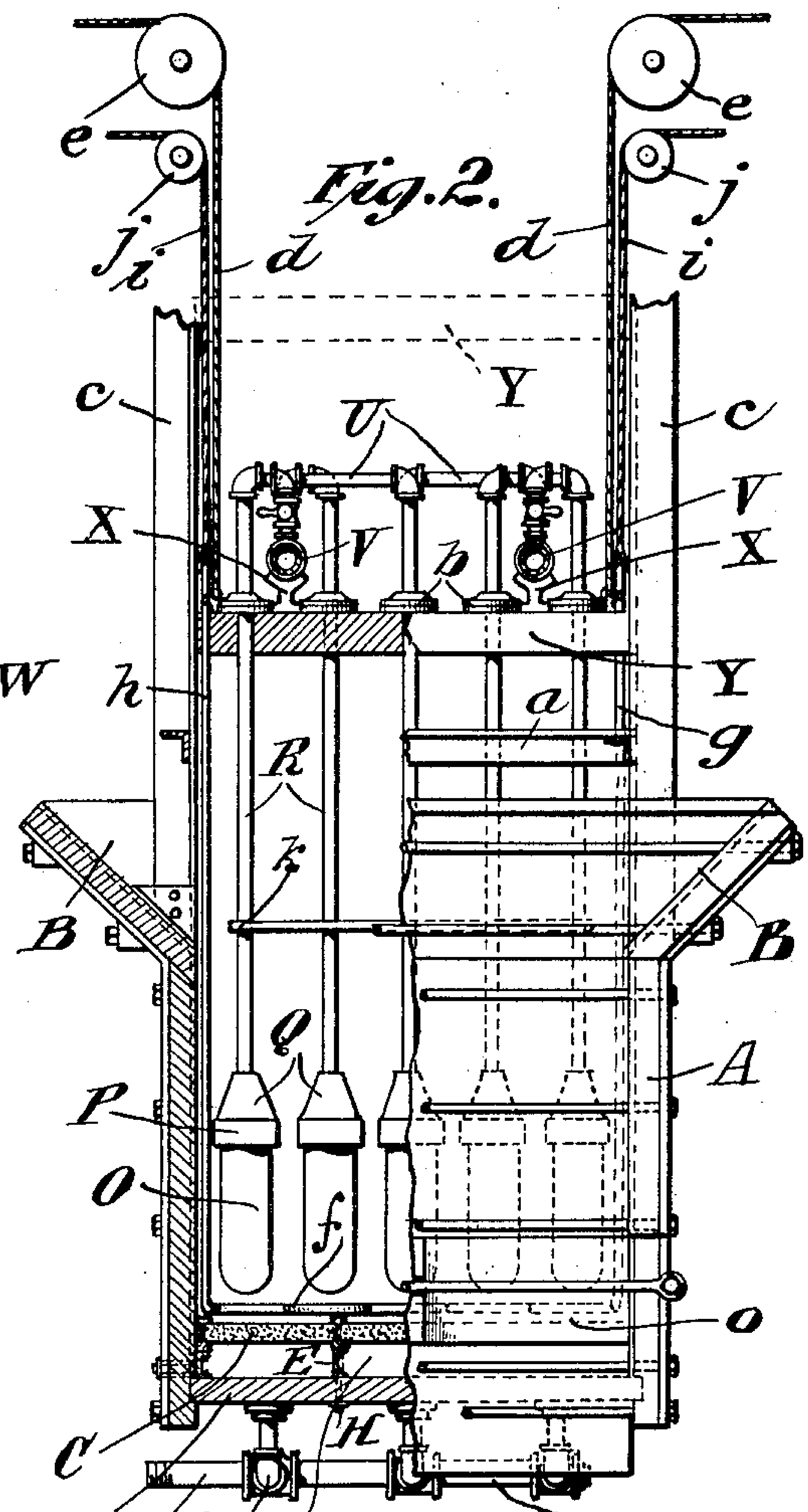


Fig. 2.



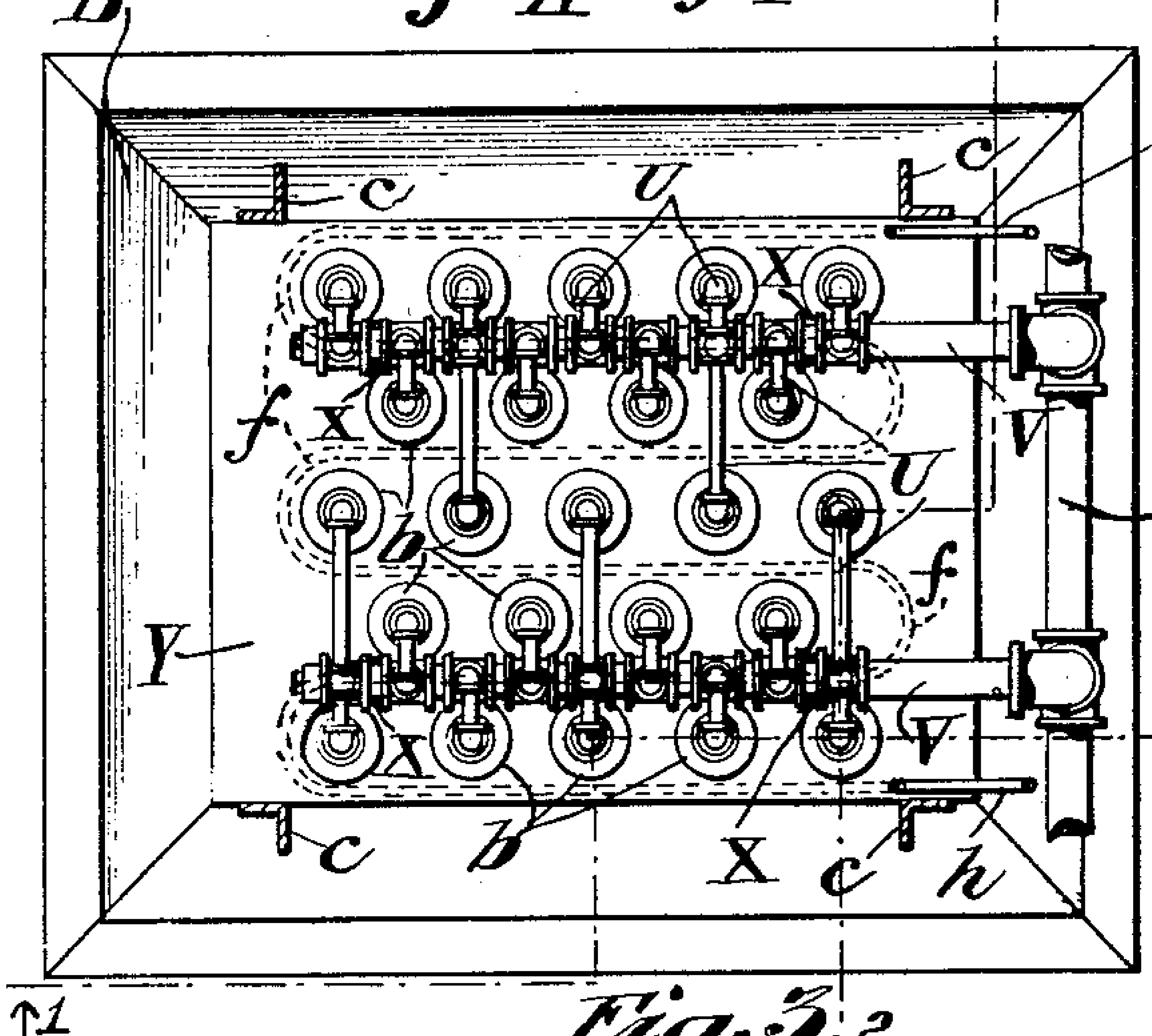
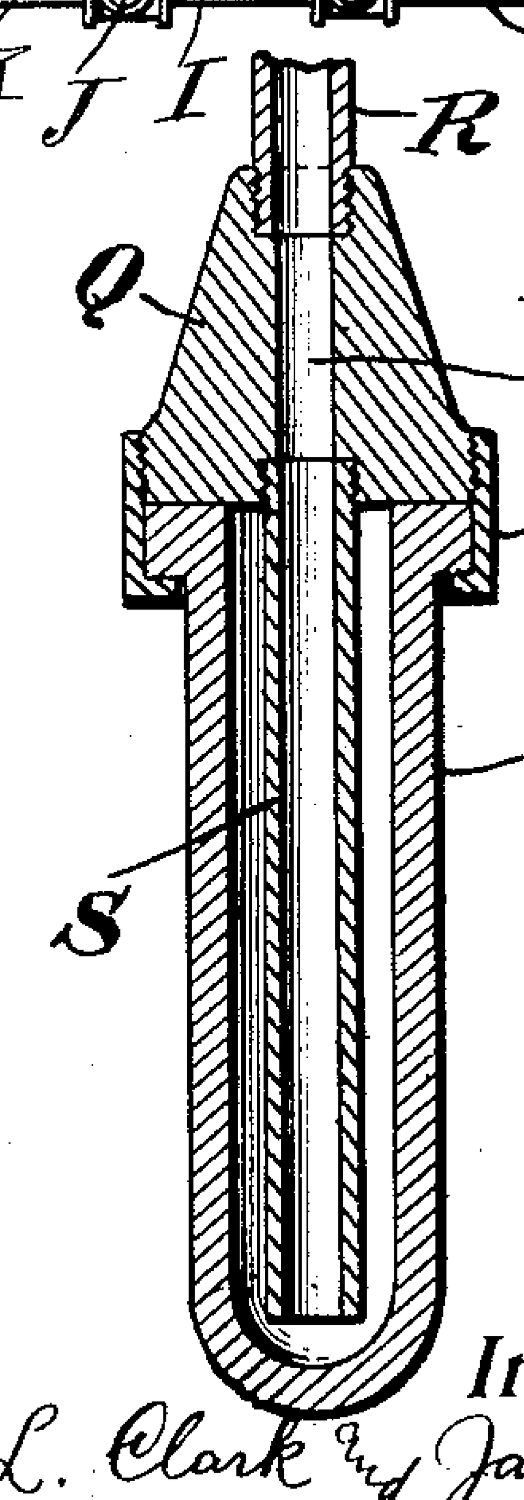


Fig. 3.

Fig. 4.



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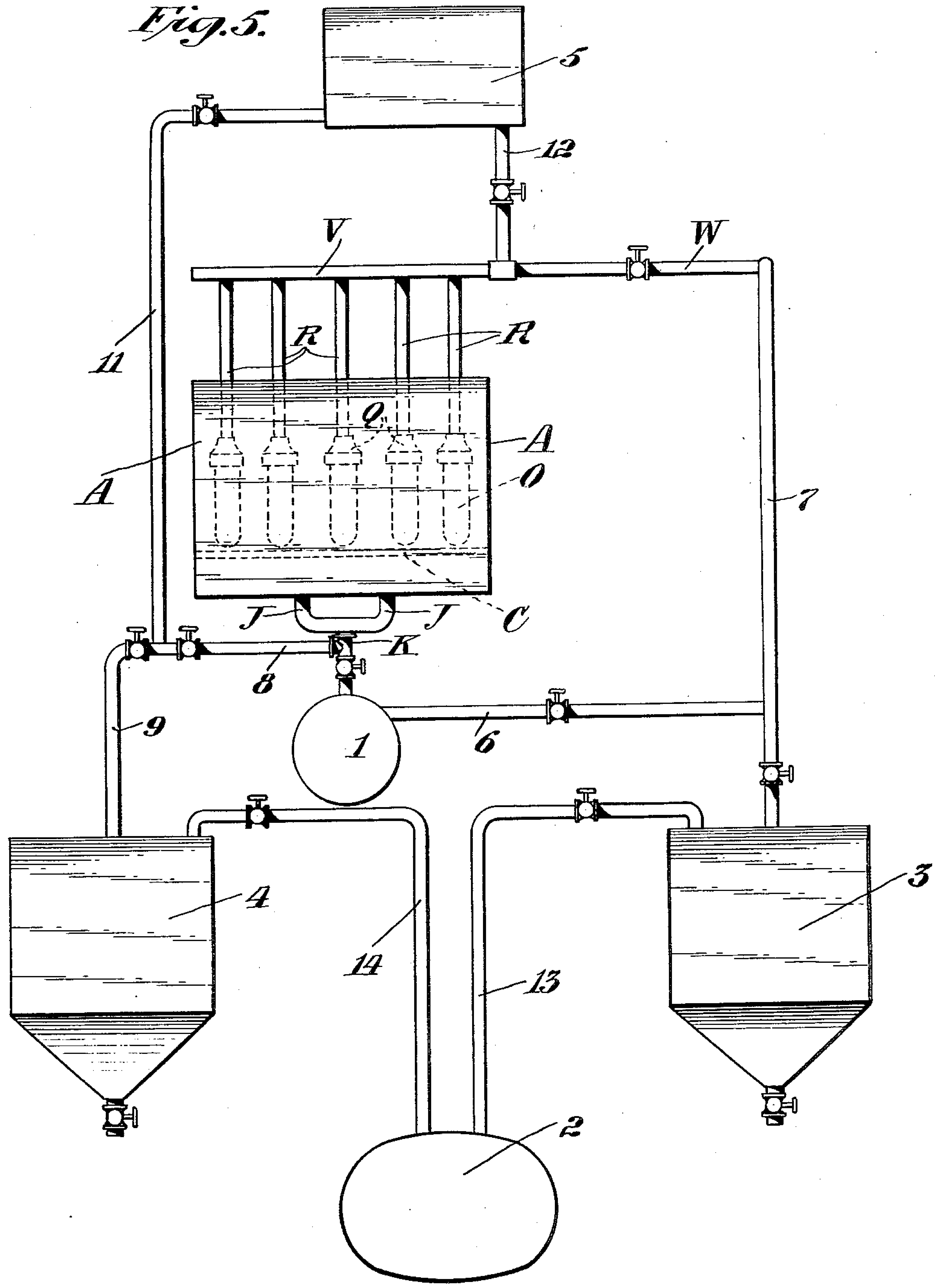
2 SHEETS—SHEET 2.

Fig. 5.



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UNITED STATES PATENT OFFICE.

JAMES EDWARD PORTER, OF SYRACUSE, NEW YORK, AND ARTHUR L. CLARK, OF NEW YORK, N. Y., ASSIGNORS TO THE JUST MINING AND EXTRACTION COMPANY, A CORPORATION OF NEW YORK.

PROCESS OF EXTRACTION.

No. 880,821. Specification of Letters Patent. **Patented March 3, 1908.**

Application filed February 27, 1907. Serial No. 359,659.

To all whom it may concern:

Be it known that we, James E. Porter, a citizen of the United States, and resident of Syracuse, New York, and Arthur L. Clark, a citizen of the United States, and resident of the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Processes of Extraction, of which the following is a specification accompanied by drawings.

This invention relates to improvements in processes of extraction, more particularly to the cyanid process for extracting precious metals from their ores.

The process applies particularly to the treatment of low grade highly refractory sulphide ores which are unsuitable in their raw state for cyaniding or for profitable treatment commercially by any process.

The objects of the invention are to improve upon the efficiency of the cyanid process, and to this end the invention consists of the process embodying the steps substantially as hereinafter fully described and claimed in this specification, and illustrated in the accompanying drawings, in which

Figure 1 is a partial sectional side elevation of apparatus embodying the invention on the line 1—1 of Fig. 3; Fig. 2 is a partial sectional end elevation of the apparatus on the line 2—2 of Fig. 3; Fig. 3 is a top plan view of the apparatus; Fig. 4 is an enlarged detail vertical sectional view taken through one of the cylinders of the apparatus. Fig. 5 is a diagrammatic view illustrating the apparatus.

Referring to the drawings, A represents a suitable tank, which may be constructed of wood or metal as desired. In this instance the tank is constructed of wood. Any suitable construction may be provided for the tank, and in this instance the tank is provided with a flaring upper edge B to prevent the material from boiling over.

The tank is provided with a false bottom C of suitable rigid material having fine pores such, as, for instance, earthenware or material from which porous cylinders are made. Such material has the advantage of having minute, uniformly distributed pores through which air may be uniformly forced in the form of minute bubbles uniformly distributed through liquid overlying it. And, being rigid it retains its shape, much facilitating such uniform distribution. Any suitable porous mineral septum may be used for a false bottom C, through which air and liquid may be forced or sucked as desired.

As shown, the false bottom C is constructed of slabs supported from the sides of the tank in any suitable manner, as by means of the angle irons D, and supported at the meeting edges or joining surfaces of the slabs by means of brackets E, carried upon the bottom F of the tank and secured thereon in any suitable manner. Preferably metal straps G are arranged above and below the meeting edges of the plates forming the false bottom C, and bolts H pass through the straps and the brackets E.

Means are provided for forcing air into the space I between the bottom F and the false bottom C or for causing suction underneath the false bottom C, in this instance pipes J being provided branching from the main pipe K, said branch pipes either extending through the bottom F or communicating with apertures therein.

If desired, liquid as water or a solution of any character may be forced through the pipes K and J.

Means are provided for raising and lowering the porous cylinders O out of and into the tank A. These cylinders are preferably constructed as indicated in Fig. 4, in which the porous cylinder O of suitable material, as, for instance, earthenware, is secured in a collar P which is screwed on to the head or casting Q, in turn carried on to the screw threaded end of the pipe R. As many of the porous cylinders and supporting devices are provided as desired, and preferably the cylinders are placed in staggered arrangement as indicated in Fig. 3. Preferably the distances between centers of the cylinders are all substantially equal, thereby obtaining a maximum effect in the tank. Also suitably screwed or otherwise secured to the head or casting Q of a cylinder is a pipe S extending substantially the full inside length of the cylinder and open at the bottom near the inner bottom of the cylinder. All of the cylinders are provided with the pipes S, which may be removed as desired and replaced by pipes of different length. The head or casting Q of a cylinder is shown hollow, being provided with the passageway T, so that a continuous passage is formed by the pipes R, passages T and the pipes S. The pipes R all connect with branch pipes

U, leading to longitudinal main pipes V, from which air pressure or suction or water or solutions may be supplied. The main pipes V communicate with a cross pipe W, which in turn leads to the vacuum tank or air pressure receiver. The longitudinal pipes V are supported in suitable cradles X from the cross beams Y, which in turn are carried by the side beams Z on the angle irons *a*.

Any suitable construction may be provided for the frame carrying the piping, whereby the frame may be raised and lowered. In this instance the pipes R are parted and provided with flanged connections *b* above the cross beams Y, whereby the upper portions of the pipes may be removed from the lower portions or else the cylinders may be removed with portions of the pipe R.

We are not to be understood as limiting the invention to the construction of cylinder and supporting means shown and described for any suitable means have been disclosed for carrying out the objects of the invention.

As shown, vertical standards or uprights *c* are provided extending upwardly from the tank forming ways for guiding the cross beams Y and side beams Z of the frame work and means are provided for raising and lowering the frame work, in this instance ropes or chains *d* being shown extending over pulleys *e*. These ropes or chains may be provided with counterweights or connected to suitable engines or motors.

Preferably means are provided for heating the mass undergoing cyanidation or other treatment, and in this instance a steam coil is provided comprising the pipes *f* extending back and forth over the area of the tank between the rows of cylinders O, and vertical pipes *g* and *h* lead upwardly from the horizontal pipes *f* to conduct the steam to the coil and carry off the exhaust steam. Means are also provided for raising and lowering the steam pipes, in this instance chains or ropes *i* being provided carried over the pulleys *j* and attached to counterweights or adapted to be operated by a motor or engine. Preferably braces *k* are provided between the pipes R to keep them from swaying. Any suitable braces may be provided for the remainder of the tank and apparatus. Preferably there is a gate *o* for the flushing out opening *p* at the lower portion of the tank.

In the operation of the apparatus, let it be assumed that dry crushed ore is to be cyanided in our apparatus. To the tank A is first added a certain quantity of water, less than the total amount required for the operation and the steam coils *f* are lowered into the water, and steam is turned through the coils to commence heating. The agitation of the liquid is also commenced by turning on air pressure into the pipes K and J leading underneath the false bottom C. The compressed air is forced through the porous false bottom and passes into and through the liquid in finely divided streams, or in other words the air is atomized as it were by means of the mineral septum, and in passing into and through the body of liquid keeps the same in constant and gentle agitation throughout. The air of course emerges from the porous material in the form of excessively minute bubbles and the presence of a constant succession of these minute ascending bubbles in every portion of the mass keeps the fine particles of ore in suspension, permitting no packing or clogging and insuring that each individual particle shall be constantly in contact with a jacketing layer of thoroughly aerated liquid. The cylinders O having been lowered into position in the tank, the ore to be treated is charged into the tank by degrees. While the ore is being charged in, the air pressure is turned on in the pipes W, V, U and R, thereby forcing air out through the porous cylinders O into the mass. The liquid is also agitated by the air passing through the porous false bottom and the porous cylinders, thereby keeping the finely divided material in a state of suspension. Next the desired quantity of alkaline earth oxid is added to the material in the tank sufficient to neutralize any acidity in the ores. If the ore is ground wet to alkalinity this is not necessary. Any acidity in the ore is not only detrimental to the cyanid solution but is further disadvantageous as rendering difficult the uniform state of suspension of the ore which we desire. At the end of about one-half an hour, more or less, the material in the tank will be heated up to the desired degree, which would be about 190 degrees F and the acidity will be removed. The calculated amount of cyanid is then added to the mass and the solution brought up to the required volume and strength in the tank by the further addition of water, if required. The agitation and heating are continued for about five hours, the initial strength of the solution being about one-fourth per cent of potassium cyanid. The heat is maintained about 190 degrees F.

At the end of about five hours, the solution in the tank is strengthened to about six-tenths per cent of potassium cyanid by the addition of more cyanid, and the agitation and heating are continued from about 10 to about 15 hours longer. Constant bulk may be maintained by the occasional addition of fresh water. At certain stages of the operations alkaline earth oxid or peroxid is added for two reasons, first, to neutralize any carbonic acid that might be or have been formed, or that contained in the injected air; secondly, to aid in maintaining the desired suspension of the fine ore particles. Preferably the alkaline earth oxid, or its hydrate, is maintained in excess in the solution. If peroxid is used the additional effect is produced of supplying oxygen to the solution.

At the end of the agitation period the steam coils are raised from the bottom of the tank to a position above the contents of the same. Agitation is continued through the false bottom C while the air pressure is withdrawn from the cylinders O and suction applied through the piping, thereby filtering the solution through the porous cylinders O. By maintaining the air pressure through the false bottom C while suction is applied to the interior of the cylinders O, the filtering operations are very greatly aided and made more efficient, because the agitation of the mass by the air rising from the false bottom causes the slimes to become thoroughly mixed with the solution and prevents them from stratifying, packing, or adhering tightly in muddy layers on the porous cylinders during filtration. This is one of the great advantages of the apparatus owing to which very much more rapid filtration and efficient results are produced than in any other apparatus hitherto devised. Furthermore the upward air currents through the mass keep the liquid circulating or splashing over the entire sides of the cylinders so that instead of having air only sucked through the upper portions of the cylinders, thus losing the vacuum effect the entire mass undergoes filtration. The mass is therefore forced up on the sides of the cylinders instead of leaving the upper portions of the cylinders bare. After the agitation and suction have been continued for the desired time, more water is added to the tank and the suction is continued with agitation through the bottom, thereby removing the valuable solutions which remain in the mass after the first filtration. The agitation stirs up the material in the bottom of the tank and forces it up around the sides of the cylinders.

Another way of treating the mass after the first filtration is to force water outwardly through the porous cylinders O from the interior through the piping, thereby cleaning the surfaces of the cylinders. When the desired amount of water has been forced into the tank the water pressure is removed, and the whole system of cylinders and piping is raised out of the tank, and any suitable form of mechanical agitator lowered in the mass in the tank and operated to agitate the mass mechanically thereby breaking up any lumps that may have remained. At the same time air is continued to be forced through the porous false bottom C to agitate the mass and aid in breaking up the particles therein. After the particles are all broken up and in suspension in the solution the mechanical agitator is removed and the porous cylinders are again lowered into the tank and suction applied to filter the solution as before, while air is being forced through a porous false bottom C. These operations are repeated as often as necessary to remove the valuable solutions. Finally the pressure in the pipes K and J at the bottom of the tank is removed and suction applied to said pipes, thereby filtering the remaining solution through the porous false bottom C and thus recovering the last portions of the valuable solutions.

In Fig. 5, compressed air is supplied from tank 1 to either the cylinders O in the tank A or beneath the false bottom C, or to both at the same time. 2 represents a vacuum tank by means of which a vacuum may be drawn from the cylinders O through the receiver 3 or from the bottom C through the receiver 4, or from both at once. Water or solution may be supplied to the cylinders O or to the bottom C, or to both, from the tank 5. Suitable piping and valves are provided for carrying out these objects. The air pressure tank 1 is connected by pipe 6 with pipe 7, which in turn connects with the supply pipe W and with the receiver 3. Air tank 1 is also connected by pipe 8 with pipe 9 which leads to receiver 10, and pipe 11 connects pipe 8 with water tank 5. Said water tank is also connected by pipe 12 with pipe W. The vacuum tank 2 is connected by pipes 13 and 14 with receivers 3 and 4 respectively. The pipes are provided with suitable valves for enabling the apparatus to be connected with the various tanks as desired.

We claim and desire to obtain by Letters Patent the following:—

1. The process of extracting precious metals from their ores by cyaniding which consists in heating a mass of such ore in the presence of cyanid solution while at the same time forcing air through porous-walled bodies to form very minute bubbles in contact with the lower portion of said mass, thereby aerating and agitating the mass, and then discontinuing the heating and applying suction to a porous-walled body to filter off the cyanid solution.

2. The process of extracting precious metals from their ores by cyaniding which consists in heating a mass of such ore in the presence of cyanid solution while at the same time forcing air through a plurality of porous-walled bodies to form very minute bubbles in contact with the lower portion of said mass at different levels, thereby aerating and agitating the mass, and then discontinuing heating and applying suction to a higher-lying porous walled body to filter off the cyanid solution while at the same time continuing to force air through a lower-lying porous-walled body.

3. The process of extracting precious metals from their ores by cyaniding which consists in heating a mass of such ore in the presence of cyanid solution while at the same

time forcing air through a porous-walled body to form very minute bubbles in contact with the lower portion of said mass, continuing the introduction of air and maintaining the temperature of the mass at about 190 degrees Fahrenheit until the extraction of precious metals is finished, and then discontinuing the heating and applying suction to the porous-walled body to filter off the cyanid solution.

4. The process of extracting precious metals from their ores by cyaniding which consists in heating a mass of such ore in the presence of cyanid solution while at the same time forcing air through a plurality of porous-walled bodies to form very minute bubbles in contact with the lower portion of said mass at different levels, thereby agitating and aerating the mass, continuing the introduction of air and maintaining the temperature of the mass at about 190 degrees Fahrenheit until the extraction of the precious metals is finished, and then discontinuing heating and applying suction to a higher-lying porous-walled body to filter off the cyanid solution while at the same time continuing to force air through a lower-lying porous-walled body.

5. In the extraction of precious metals from their ores by cyaniding, the process which consists in suspending such ore in a cyanid solution and distributing minute air bubbles substantially uniformly throughout the mass of ore and liquid.

6. In the extraction of precious metals from their ores by cyaniding, the process which consists in suspending such ore in a heated cyanid solution and distributing minute air bubbles substantially uniformly throughout the mass of ore and liquid.

7. In the extraction of precious metals from their ores by cyaniding, the process which consists in suspending such ore in a cyanid solution maintained at a temperature of about 190 degrees Fahrenheit during the extraction and during such extraction distributing minute air bubbles substantially uniformly throughout the mass of ore and liquid.

8. In the extraction of precious metals from their ores by cyaniding, the process which consists in suspending such ore in a cyanid solution, distributing minute air bubbles substantially uniformly throughout the mass of ore and liquid during the extraction and after extraction filtering off the liquid while still continuing the introduction of minute air bubbles.

9. In the extraction of precious metals from their ores, by cyaniding, the process which consists in suspending such ore in a cyanid solution contained in a tank provided with heating elements at its base and with a bottom of porous material, and during extraction maintaining suspension of such ore by the conjoint influence of convection currents from such heating elements and air forced through such porous bottom to form very minute bubbles.

10. In the extraction of precious metals from their ores by cyaniding, the process which consists in suspending such ore in a cyanid solution contained in a tank provided with heating elements at its base and with a plurality of porous-walled elements at and near said base, during extraction maintaining suspension of such ore by the conjoint influence of convection currents from such heating elements and air forced through such porous-walled elements to form very minute bubbles and after extraction filtering off the cyanid solution by suction applied to such a porous-walled element while maintaining suspension by air forced through another such porous-walled element.

11. In the extraction of precious metals from their ores by cyaniding, the process which consists in suspending such ore in a cyanid solution maintained in an alkaline condition by an alkaline earth during extraction and distributing minute air bubbles substantially uniformly throughout the mass of ore and liquid during extraction.

12. In the extraction of precious metals from their ores by cyaniding, the process which consists in suspending such ore in a heated cyanid solution maintained in an alkaline condition by an alkaline earth during extraction and distributing minute air bubbles substantially uniformly throughout the mass of ore and liquid during extraction.

13. In the extraction of precious metals from their ores by cyaniding, the process which consists in suspending such ore in a cyanid solution maintained at a temperature of about 190 degrees Fahrenheit during extraction and also maintained in an alkaline condition by an alkaline earth, and distributing minute air bubbles substantially uniformly throughout the mass of ore and liquid during extraction.

14. The process substantially as herein described of extracting precious metals from their ores by cyaniding, which consists in filling a tank having a porous bottom and containing cylinders having porous walls with less water than the total amount required for the operations, heating said water to about 190 degrees Fahrenheit, charging in the pulverized ore, adding a solution of cyanid to the mixture, forcing air into the mass through the porous bottom of the tank and also through the porous cylinders to form very minute bubbles, continuing the heating and forcing of air into the mass for about five hours, then strengthening the cyanid solution in the tank, and continuing the forcing of air into the mass and heating from about ten to about fifteen hours longer, then discontinuing the heating and applying suc-

tion to the porous cylinders, thereby filtering the solution through said cylinders.

15. The process substantially as herein described of extracting precious metals from their ores by cyaniding, which consists in filling a tank having a porous bottom and containing cylinders having porous walls with less water than the total amount required for the operations, heating said water to about 190 degrees Fahrenheit, charging in the pulverized ore, adding a solution of cyanid to the mixture, forcing air into the mass through the porous bottom of the tank and also through the porous cylinders to form very minute bubbles, continuing the heating and forcing of air into the mass for about five hours, then strengthening the cyanid solution in the tank, and continuing the forcing of air into the mass and heating from about ten to about fifteen hours longer, then discontinuing the heating and applying suction to the porous cylinders, thereby filtering the solution through said cylinders, while continuing the forcing of air through the porous bottom of the tank.

16. The process substantially as herein described of extracting precious metals from their ores by cyaniding, which consists in filling a tank having a porous bottom and containing cylinders having porous walls with less water than the total amount required for the operations, heating said water to about 190 degrees Fahrenheit, charging in the pulverized ore, adding the desired quantity of alkaline earth oxid to the mass, adding a solution of cyanid to the mass, forcing air into the mass through the porous bottom and through the porous cylinders to form very minute air bubbles, continuing the air pressure and heating for about five hours, then strengthening the cyanid solution in the tank, and continuing the air pressure and heating from about ten to about fifteen hours longer, discontinuing the heating and applying suction to the porous cylinders, thereby filtering the solution through said cylinders.

17. The process substantially as herein described of extracting precious metals from their ores by cyaniding, which consists in heating the pulverized ore and cyanid solution to about 190 degrees Fahrenheit in a tank having a porous bottom and provided with porous filter cylinders in the tank, while at the same time forcing air upwardly through the porous bottom into the mass and through the porous cylinders to form very minute air bubbles in the mass, thereby agitating and aerating the mass, continuing such treatment for about five hours, then strengthening the cyanid solution, and continuing the agitation and heating from about ten to about fifteen hours longer, then applying suction to the porous cylinders and filtering the solution therethrough.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

JAMES EDWARD PORTER.
ARTHUR L. CLARK.

Witnesses for Porter:
F. E. ENGELHARD,
STUART C. HEMINGWAY.

Witnesses for Clark:
FRANK C. ERB,
FREDERIC W. ERB.