No. 884,015. PATENTED APR. 7, 1908.

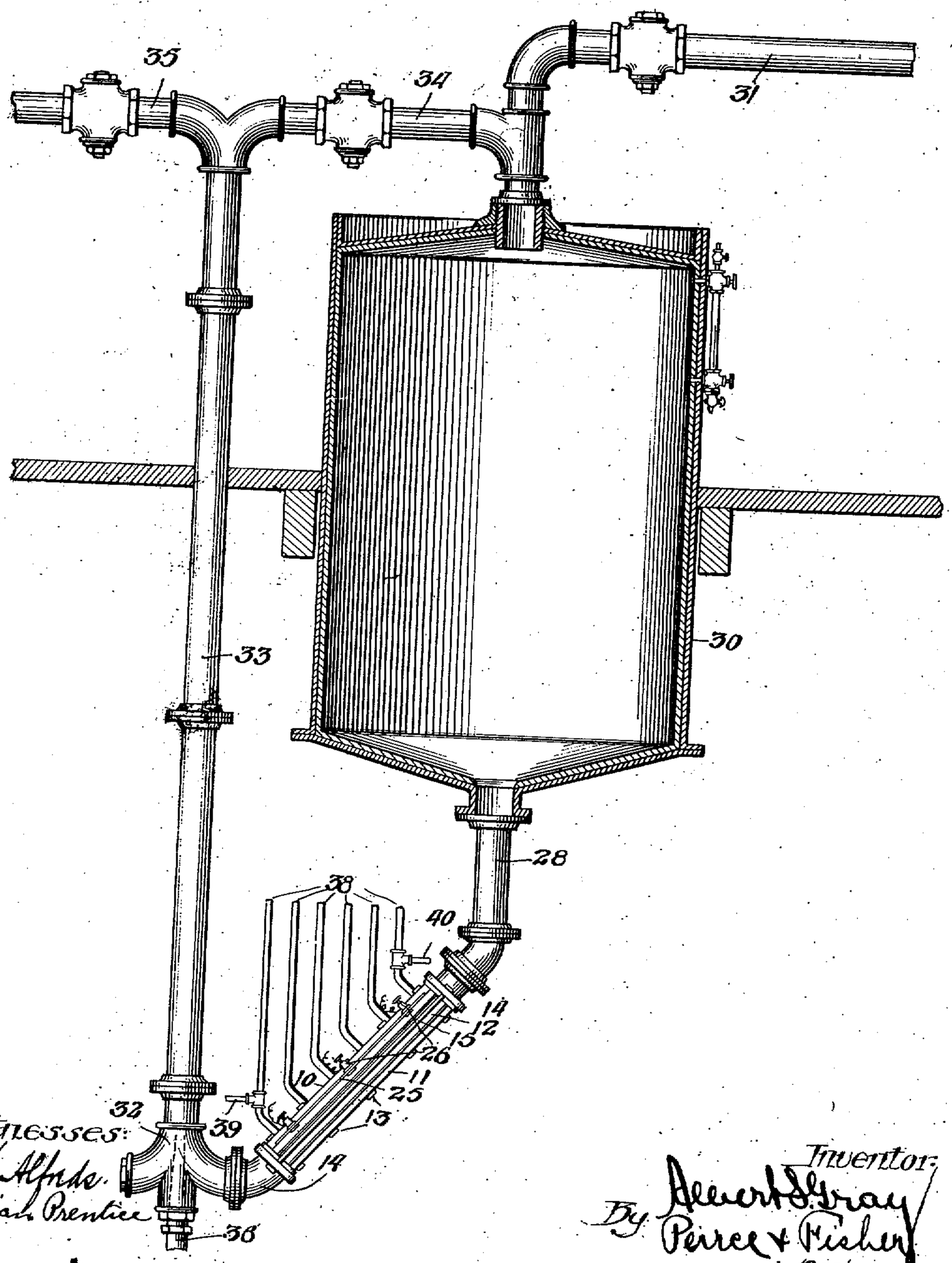
A. S. GRAY.

ELECTROLYTIC CELL.

APPLICATION FILED MAR. 16, 1906.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

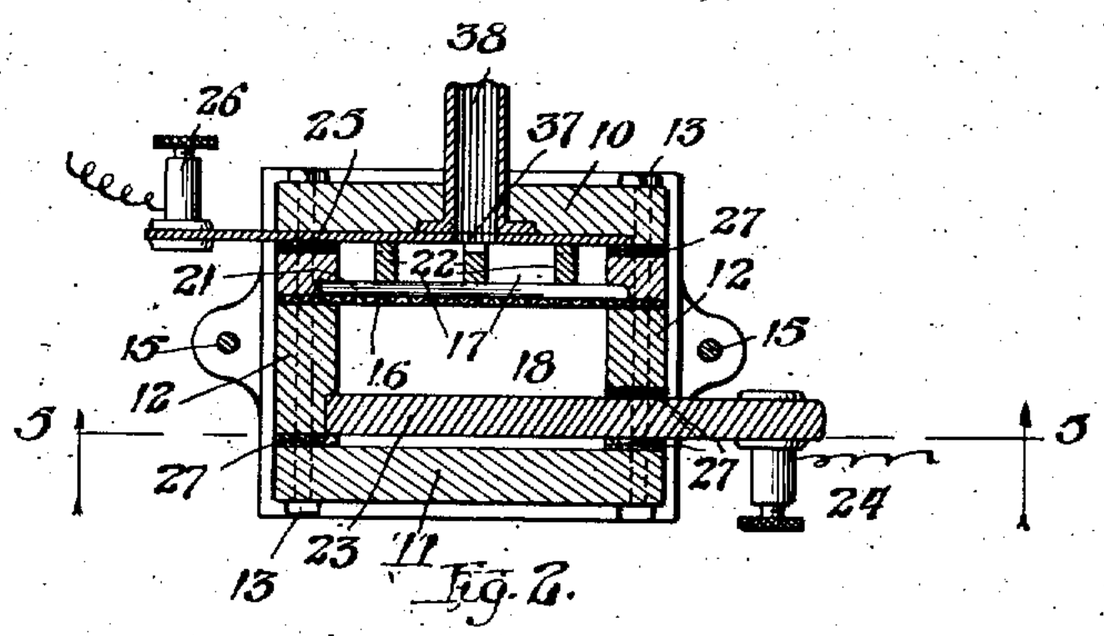


Fig. 2.

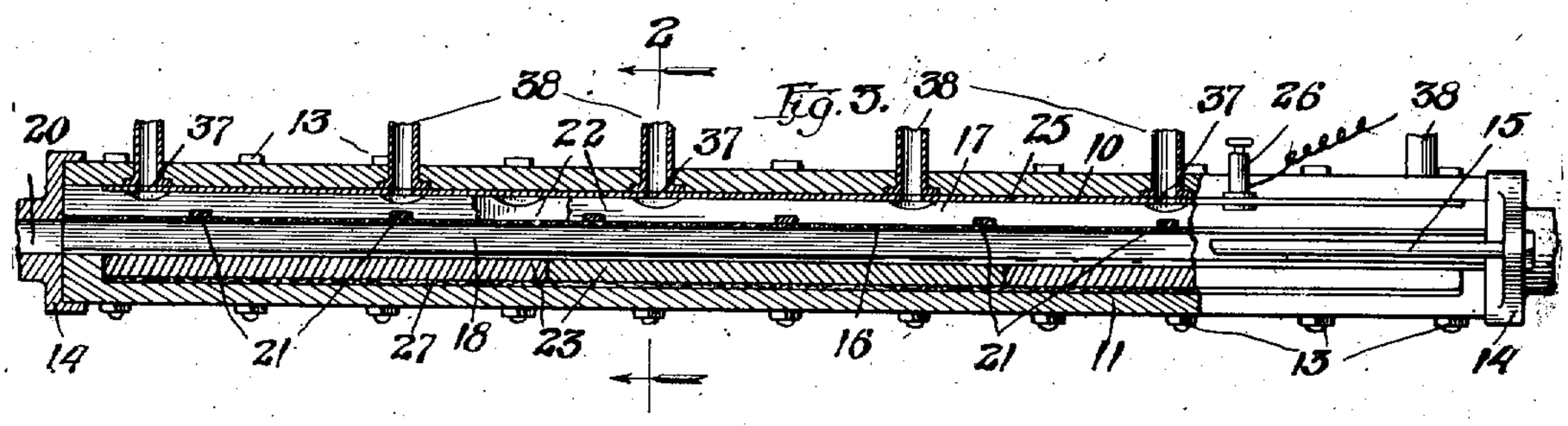


Fig. 3.

Fig. 4.

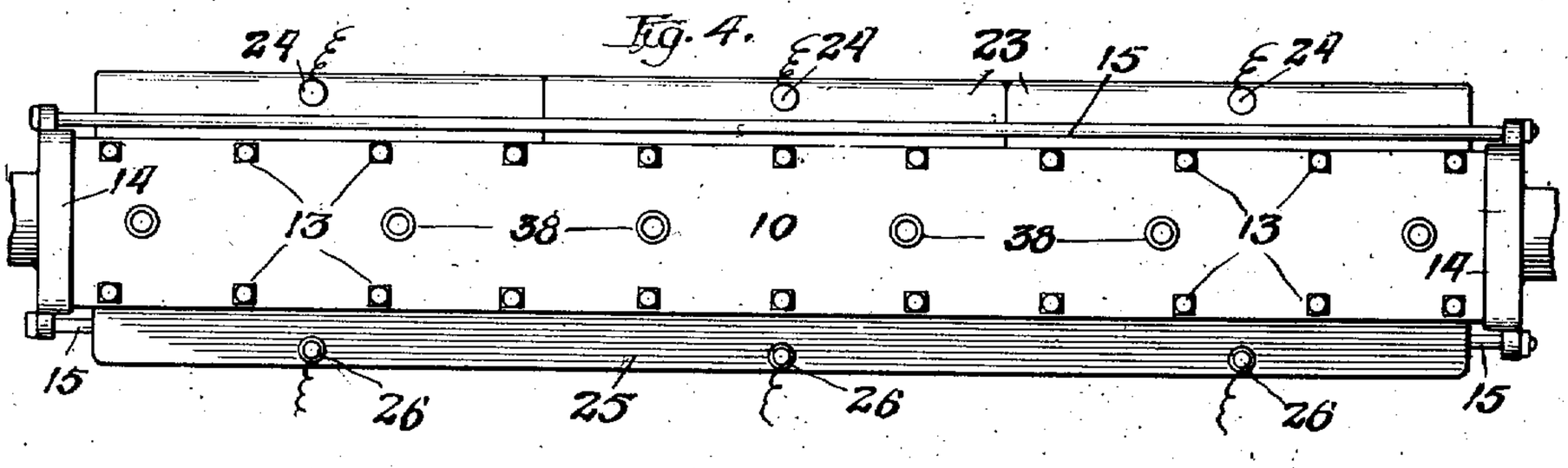
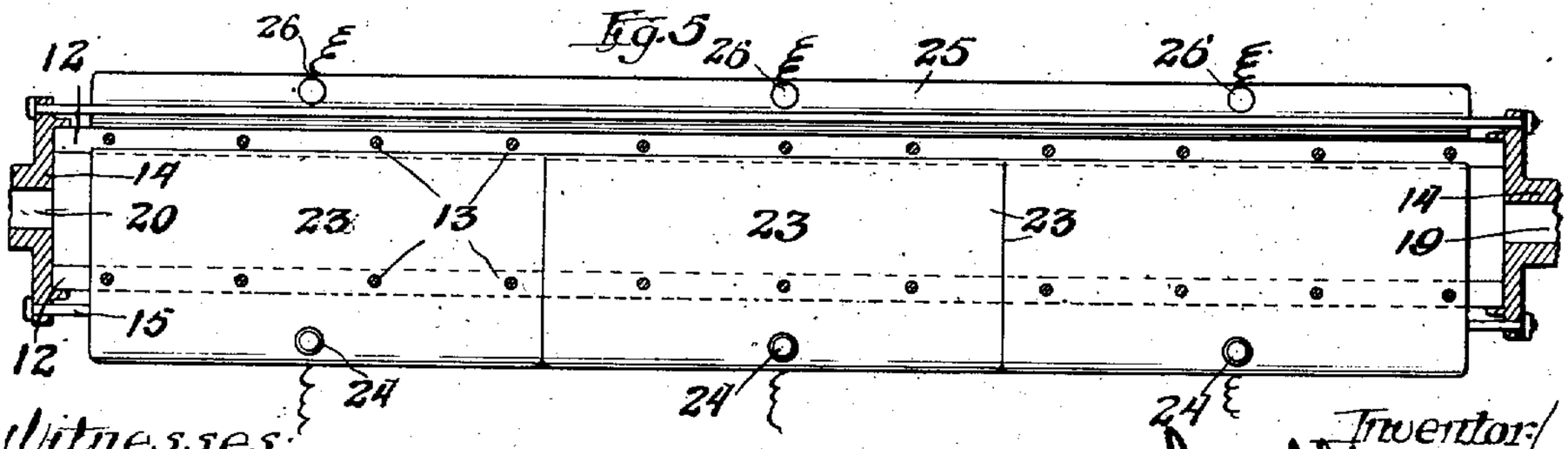


Fig. 5.



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3 SHEETS—SHEET 3.

Fig. 6.

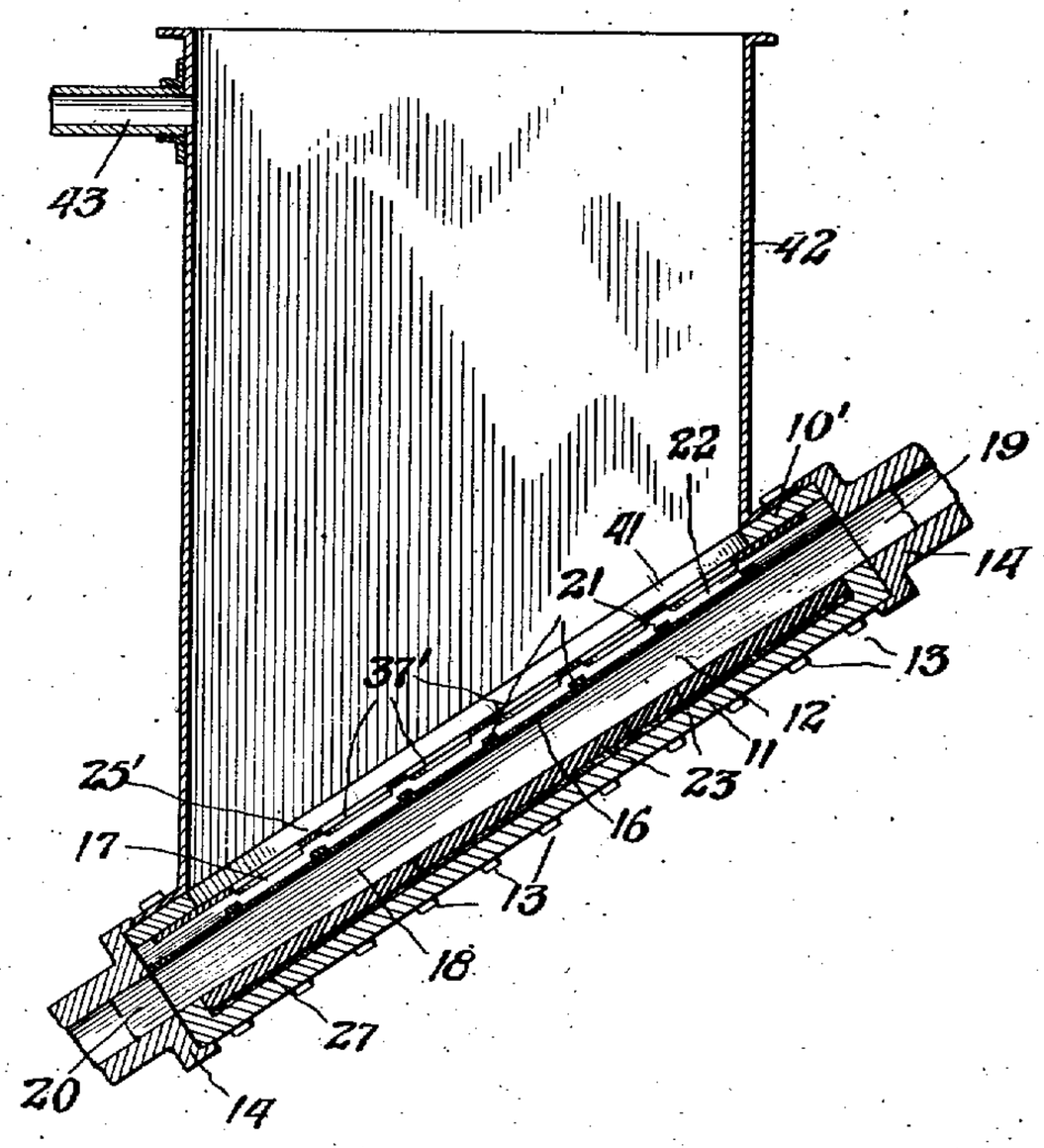
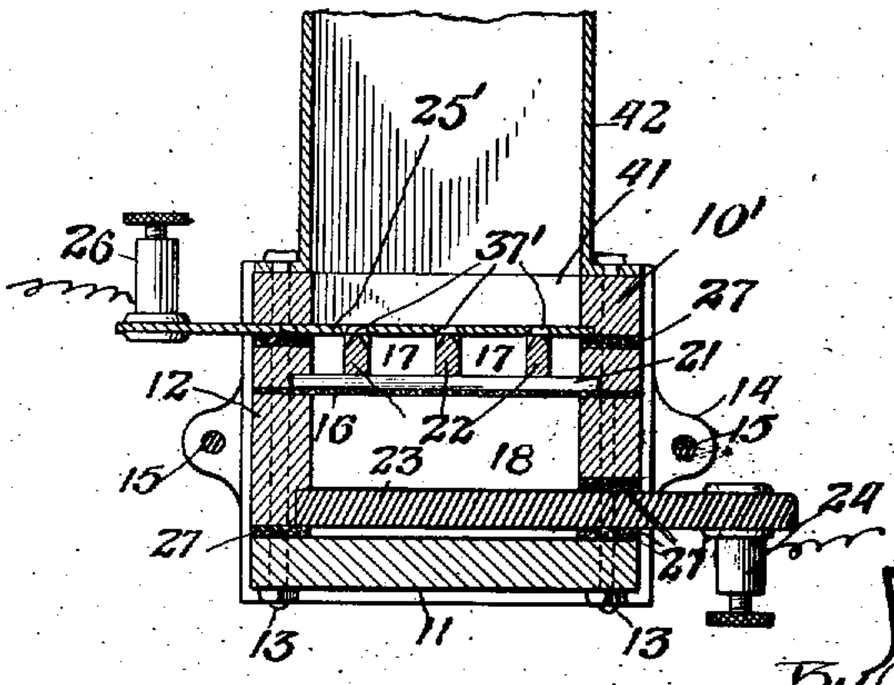


Fig. 7.



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UNITED STATES PATENT OFFICE.

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ELECTROLYTIC CELL.

No. 884,015. Specification of Letters Patent. Patented April 7, 1908.

Application filed March 15, 1906. Serial No. 306,164.

To all whom it may concern:

Be it known that I, ALBERT S. GRAY, a citizen of the United States, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Electrolytic Cells, of which the following is declared to be a full, clear, and exact description.

The invention relates to improved electrolytic cells more especially adapted for the treatment of ores, and the invention seeks to provide for the rapid escape of the gases evolved at the cathode element of the cell that would otherwise prevent the proper passage of the current through the cell and the charge therein under treatment.

The nature of the invention will appear in detail from the description following and be more particularly pointed out by the appended claims.

The drawings display the preferred form of the improved cell.

Figure 1 is a view in elevation of an apparatus to which the improved cell is employed, with parts shown in section. Fig. 2 is a cross section of the improved cell taken on line 2—2 of Fig. 3. Fig. 3 is a longitudinal section thereof with one end of the cell shown in side elevation. Fig. 4 is a plan view of the improved cell. Fig. 5 is a longitudinal section thereof taken on line 5—5 of Fig. 2. Fig. 6 is a longitudinal section of a modified form of the cell. Fig. 7 is a cross section of the cell shown in Fig. 6.

The improved cell is an elongated hollow structure preferably formed of wood planking and in the form shown, comprises the top and bottom sections 10 and 11 and side portions 12 that are securely bound together by through bolts 13. Cap pieces 14 fit over the ends of the wooden body portion of the cell and are connected together by longitudinally extending brace rods 15.

The cell is provided with a longitudinally extending diaphragm 16 of cotton duck or canvas, the edges of which (see Fig. 2) extend, and are securely clamped, between sections of the side walls 12. The diaphragm divides the cell into an upper cathode chamber 17 and into a lower anode chamber 18. The cap pieces 14 are provided respectively with an inlet 19 and an outlet 20 that open into the anode chamber 18 beneath the diaphragm for the circulation of the charge under treatment through the cell. Suitable transverse and longitudinal brace bars 20 and 21 are arranged in the cell above the diaphragm 16 so that the latter is held by these bars in its proper position against the pressure of the charge circulating in the anode chamber.

The cell is provided with anode and cathode elements arranged in the respective chambers. The anode element preferably comprises plates or blocks 23 of a hard carbon. These blocks are arranged in the lower portion of the anode chamber and project through one of the side walls of the cell, the outer portions of the blocks being provided with suitable binding posts 24. The cathode element is formed of one or more plates 25 of lead or copper and are arranged within the upper portion of the cathode chamber 17 just beneath the top wall 10 of the cell. These metal sheets or plates forming the cathode element project through one of the side walls of the cell and are provided with suitable binding posts 26.

The longitudinal extending brace bars 22 are preferably formed of wood and their upper edges are in engagement with the cathode element or terminal 25. The cross strips 21 are of less width than the longitudinal strips 22 and are preferably rabbeted into the lower edges thereof and into the side walls of the cells. The diaphragm 16 is held by the transverse and longitudinal bars 21 and 22 in position against the upward pressure exerted by the charge circulating in the anode chamber 18.

Packing strips 27 of suitable material are arranged between the separate portions of the cell so that the latter will be liquid tight. The cell is preferably disposed in inclined position in use, as shown in Fig. 1. The circulation of the charge may be maintained therethrough in any suitable manner. In the apparatus shown, the inlet cap piece 14 is connected to a pipe 28 that leads from the lower portion of a suitable mixing tank or receptacle 30. The latter is provided with a valve inlet pipe 31 through which the charge to be treated may be admitted.

In the apparatus shown, the outlet cap piece 14 of the cell is connected to a suitable ejector 32, which in turn communicates with a pipe 33 leading upwardly therefrom and having at its upper end a valved discharge branch 35 and a valved return branch 34 that communicates with the inlet pipe 31 of the

tank. The ejector 32 is provided with a pipe 36 for the introduction of steam or other fluid under pressure for maintaining the circulation of the charge.

The apparatus has been chiefly employed for the decomposition of gold and silver ores. The finely ground ore mixed with water sufficient to form a pulp, is introduced into the mixing tank or receptacle 30. In the case of acid ores, a certain amount of lime is preferably added. Steam is introduced into the pipe 36 of the ejector 32 and the charge is circulated through the cell where it is exposed to the action of the electric current passing between the anode and cathode elements.

To provide for the quick escape of the hydrogen and other gas evolved at the cathode terminal, a plurality of vent openings 37 are provided that preferably extend through the cathode terminal and communicate with a number of outwardly extending pipes 38. The central diaphragm supporting strip 22 is cut away at its upper edge (see Figs. 2 and 3) opposite the vent openings 37 and the upper edges of the other longitudinally supporting strips 22 are also notched so that the hydrogen gas that accumulates on the under surface of the cathode may easily escape from all portions of the cathode element as soon as it is generated. For effective treatment it has been found highly necessary to thus provide for the quick escape of the hydrogen gas which would otherwise interfere with the proper passage of the current through the cell. The inclined position of the cell prevents the evolved gas from being trapped beneath any portion of the cathode terminal and also materially aids in its escape through the vent openings.

The pipes 38 from the vent openings lead upwardly (see Fig. 1) to a common level and are of sufficient height to overcome the hydrostatic pressure within the cathode chamber so that the liquid passing through the vent openings 37 cannot escape in any material amount. It is desirable that the liquid should rise to a certain extent within the pipes 38 in order that the cathode element shall be at all times completely submerged in liquid and thus permit the ready passage of the current between the cell terminals and through the charge under treatment therein. To further insure the complete submersion of the cathode element, the lowest vent opening is preferably provided with an inlet 39 and the upper vent pipe is provided with an outlet 40. By forcing water under slight pressure through the inlet 39 and discharging the same at the outlet 40, a separate circulation is maintained in the cathode chamber 17 independent of that of the charge through the anode chamber 18. In this way, the cathode element of the cell is at all times kept submerged in liquid so that the electric current may readily pass through the cell and such circulation also aids in carrying the evolved gas collecting on the under surface of the cathode out through the vents 37.

In the modified form of cell shown in Figs. 6 and 7, the series of vent pipes 37 are dispensed with and the greater part of the top portion 10′ of the cell is cut away, and a larger number of vent openings 37′ are provided in the cathode element 25′. That is to say, in the form shown in Figs. 1 to 5 inclusive, only a single row of vent openings are employed while in the form shown in Fig. 7, there are three of these rows and the openings are considerably elongated, as shown. These openings are located over the strips 22′, the upper edges of which are cut away or beveled (see Fig. 7) to permit the ready exit of the evolved gas from all portions of the under surface of the cathode element 25′ through the vent openings 37′. In place of the pipes 38, a liquid holding receptacle 42 is secured at its lower edge about the edge of the opening 41 in the upper portion 10′ of the cell. This receptacle extends upwardly to a sufficient height to balance the pressure within the anode chamber of the cell and to prevent the escape of the liquid that passes through the vent openings 37′. In this form, the number of vent openings may be larger and the escape of the evolved gas is more readily and rapidly effected since the gas does not have to pass through small vent pipes, but readily passes up through the liquid in the receptacle 42 and through the open, upper end thereof. Receptacle 42 may be provided at its upper end with an overflow pipe 43 leading to a suitable receiving tank.

It is not essential that the charge shall be circulated repeatedly through the same cell as in the form shown in Fig. 1, but the circulation may be through a number of cells arranged in series. After sufficient electrolytic treatment with water alone, salt may be added to the charge so that the generation of nascent chlorin gas by the electric current will dissolve the gold and silver in the form of chlorids. It has been found in practice that the present improved apparatus will effect an extraction as high as 78% with a sulfid ore which, with the old preliminary roasting and cyanid treatment will not give an extraction of above 50%. In the employment of the present apparatus with such sulfid ores no preliminary roasting is essential, the decomposing action of the current being such as to break up the sulfids and render the precious metals present readily soluble.

The cell may also be advantageously used for the bleaching of wood pulp or other materials by the circulation of a salt solution, either with or without the addition of the

wood pulp or other substance to be bleached through the cell for the generation of a nascent chlorin by the electrolytic action of the current upon the salt solution. If the substance to be bleached is not mixed with the salt solution the electrolyzed solution is run into a vat containing such material. Under such circumstances the chlorin gas is generated at the anode element of the cell, while the hydrogen gas generated at the cathode finds a ready exit through the vents so that it does not prevent the proper passage of the current through the cell.

It is obvious that numerous changes may be made in the details set forth without departure from the essentials of the invention.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. An electrolytic cell provided with upper cathode and lower anode elements a diaphragm separating the same and inlet and outlet openings for the circulation of the charge under treatment through the cell between the anode and cathode elements, said cell having multiple vents for the escape of evolved gases leading from the under surface of the cathode element, substantially as described.

2. An electrolytic cell provided with upper cathode and lower anode elements a diaphragm separating the same and inlet and outlet openings for the circulation of the charge under treatment through the cell between the anode and cathode elements, said cell having multiple vents for the escape of evolved gases, leading from the under surface of the cathode element and liquid holding means about the exits of said vents, substantially as described.

3. An electrolytic cell provided with a diaphragm dividing the same into cathode and anode chambers, cathode and anode elements in said chambers respectively, said cell having an inlet and an outlet for the circulation of the charge under treatment opening into the anode chamber, and multiple vents for the escape of evolved gases from said cathode chamber, substantially as described.

4. An electrolytic cell provided with a diaphragm dividing the same into cathode and anode chambers, cathode and anode elements in said chambers respectively, said cell having an inlet and an outlet for the circulation of the charge under treatment opening into the anode chamber, and multiple vents for the escape of evolved gases from said cathode chamber and means for maintaining said cathode element submerged, substantially as described.

5. An electrolytic cell provided with a diaphragm dividing the same into cathode and anode chambers, cathode and anode elements in said chambers respectively, said cell having an inlet and an outlet for the circulation of the charge under treatment opening into the anode chamber, and multiple vents for the escape of evolved gases from said cathode chamber and means for maintaining a separate circulation of liquid through said cathode chamber, substantially as described.

6. An electrolytic cell provided with a diaphragm dividing the same into upper cathode and lower anode chambers, cathode and anode elements in said chambers respectively, said cell having multiple vents for escape of evolved gases leading from the under surface of the cathode element and liquid-holding means about the exits of said vents; substantially as described.

7. An electrolytic cell provided with a diaphragm dividing the same into upper cathode and lower annode chambers, cathode and anode elements in said chambers respectively, said cell having an inlet and an outlet opening into said anode chamber for the circulation of the charge under treatment through the cell, multiple vents leading upwardly from the cathode chamber through the cell element therein and means for maintaining liquid about the exits of said vents, substantially as described.

8. An electrolytic cell provided with a diaphragm dividing the same into upper cathode and lower anode chambers, cathode and anode elements in said chambers respectively, said cell having an inlet and an outlet opening into said anode chamber for the circulation of the charge under treatment through the cell, multiple vents leading upwardly from the cathode chamber through the cathode element therein and an inlet and outlet for separate circulation of liquid through said cathode chamber, substantially as described.

9. An electrolytic cell arranged in inclined position, provided with a diaphragm dividing the same into upper cathode and lower anode elements and having an inlet and an outlet for the circulation of the charge under treatment opening into said anode chamber, and cathode and anode elements in said respective chambers, said cell having multiple vents leading from the under surface of the cathode element for the escape of the gases there evolved and means for maintaining liquid in said cathode chamber and about the exits of said vents, substantially as described.

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