(No Model.)

J. L. KESSLER.

APPARATUS FOR CONCENTRATING SULFURIC ACID BY MEANS OF HEATED GASES.

No. 520,994. Patented June 5, 1894.

FIG. 1.

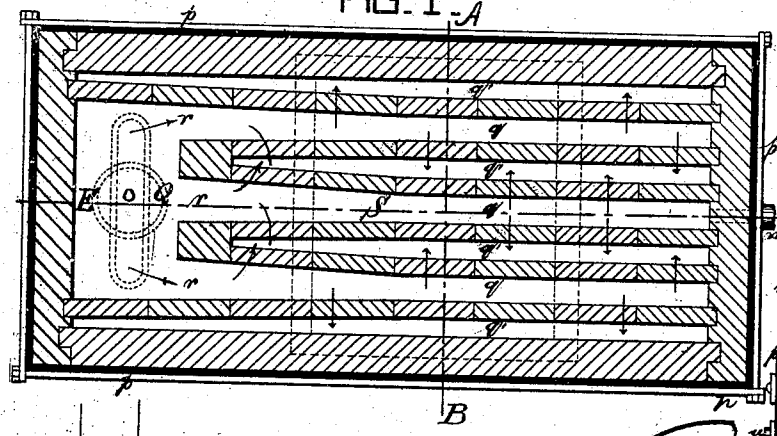


FIG. 2.

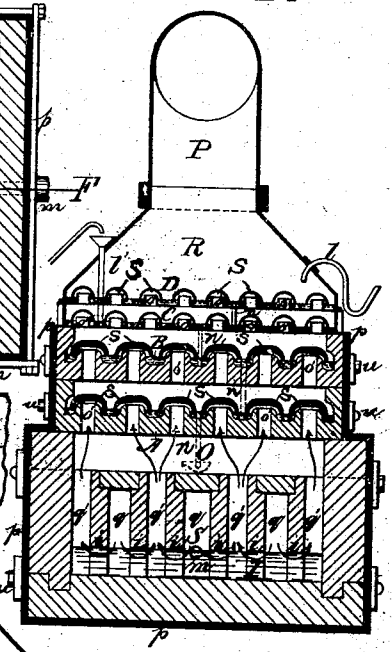


FIG. 4.

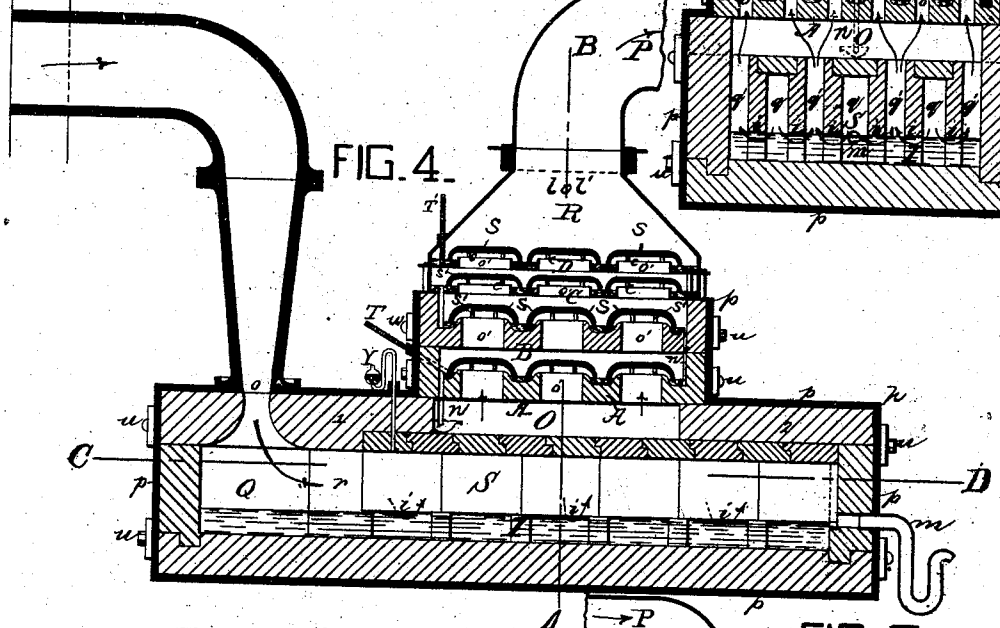


FIG. 3.

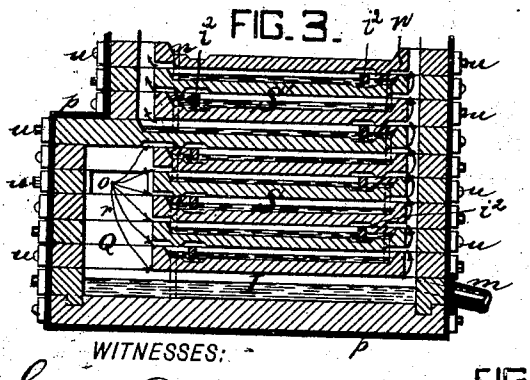


FIG. 5.

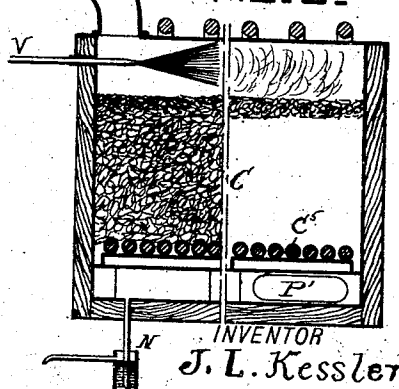
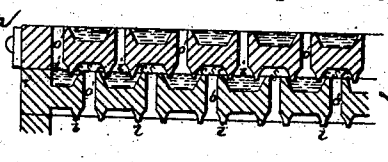


FIG. 6.



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JACQUES LOUIS KESSLER, OF CLERMONT-FERRAND, FRANCE.

APPARATUS FOR CONCENTRATING SULFURIC ACID BY MEANS OF HEATED GASES.

SPECIFICATION forming part of Letters Patent No. 520,994, dated June 5, 1894.

Application filed December 9, 1891. Serial No. 414,535. (No model.)

To all whom it may concern:

Be it known that I, JACQUES LOUIS KESSLER, a citizen of the Republic of France, residing in Clermont-Ferrand, (Puy-de-Dôme,) France, have invented certain Improvements in and Apparatus for the Concentration of Sulfuric Acid by Means of Heated Gases, of which the following is a specification.

The apparatus is specially arranged for employing hot gases for evaporating the sulfuric acid by direct contact, employing by prefererence gases charged with sulfurous acid. In addition to the parts employed for effecting the production and movement of the hot gases and which present no novelty except in their connection, and the refrigerator for the escaping acid, this apparatus is composed of three parts, each forming the complement of the other, but which can be employed separately either by employing the first part without either of the two following parts or by employing the first two parts without the last. These parts are, first, the compartment or chamber in which the gases are saturated; secondly, the recovery column; thirdly, the condenser acting by filtration.

In the annexed drawings, Figure 1 is a sectional plan view of the apparatus, taken on the line C D of Fig. 4; Fig. 2 an elevation, being a vertical section on the line B A of Fig. 1. Figs. 3 and 6 are sectional views of modifications in the form of the preceding construction as hereinafter described. Fig. 4 is a vertical longitudinal section in elevation on the line E—F of Fig. 1. Fig. 5 is a diagram illustrating the filtering condenser in vertical section.

In Figs. 1, 2 and 4 the first part or chamber in which the gases are saturated is marked with the letter S. It is made of natural cut stone or earthenware, proof against the action of acids at a temperature of about 500° centigrade. A chamber Q in this casing is connected by a hermetically closed joint with an inlet *o* for the admission of the gases. Leading from the chamber Q is a series of branching passages *q* closed at the top and at the sides in the same way as the chamber Q but open at the lower part so as to allow the gases to escape at about the level of a layer of acid of any desired depth in the lower part of the chamber. The gases escape under the lower edges of the sides of the passages *q* into the passages *q'*, which lead to the recovery column, at the bottom of which is a chamber O. The recovery column is formed of a combination of superposed plates A, B, C, D, the lower ones being composed of natural or artificial stone, while the upper ones may be made of similar material or of lead; the said plates are perforated with orifices *o'* surrounded with raised edges or rims *c* which retain on the plates a layer of acid of a certain depth. Over these rims *c*, there are placed caps *s*, which are supported on pins *s'* and deflect the gases passing through the orifices *o'*, provided with rims, and direct them on to the surface of the liquid in the same way as in the plates of a Derosne column for distilling alcohol. Overflow passages *n* lead the acid from one plate to the next lower one, and from the bottom plate to the chamber S. In like manner as in the said Derosne column, the orifices of the overflow passages *n* for the acid, the heights of which determine or regulate its level, are provided with hydraulic joints to prevent the gases from passing along the same passages as the liquids. The lower plates of the recovery column and the chamber S are surrounded externally with a tight casing *p* of lead or cast iron in order to prevent leakage of the acid. The edges of the casings of these several parts are hermetically joined and soldered together. Outside this continuous lead casing each plate is separately surrounded by a strong framing or casing *u* of wood or metal, which as the lead wears or becomes unsoldered permits of the plates being raised separately and holds their parts together. Over these stone plates, other plates of lead may be similarly arranged and upon the last or top plate D is placed a dome R of the same metal conducting the gases to the exterior. While the hot gases rise in these two parts of the apparatus from the chamber O to the dome R through the orifices *o'*, the acid entering at *l'* descends through the passages *n*, with the hydraulic joints, until it enters the chamber S and thence passes to the exterior through the inverted siphon or trap *m* of stone ware, porcelain or platinum, whence it passes into a refrigerator of known construction. During this passage the acid becomes more and more concentrated and at

the conclusion is cooled. Its introduction is regulated at the inlet l' by known means in such a manner as to obtain it at the required degree at the outlet m. With this object the thermometers T and T′ may be consulted.

Fig. 3 represents an arrangement of the same nature as that illustrated in Figs. 1, 2 and 4, with the sole difference that the current of gases in place of branching or ramifying laterally as in passages Q q is caused to branch off at different levels.

In Fig. 3, i^2, i^2 indicate dams designed to arrest the upper part of the acid and allow only the lower part of the layer of liquid which is most concentrated to pass to the overflow passages n.

Fig. 6 represents a slightly different construction of the plates of the recovery column, the under side or bottom of one plate forming the cap of the one below. Moreover I do not limit myself to the specific constructions shown but can use any modifications in form which will operate as hereinbefore described.

Fig. 5 shows the third part of my apparatus which corresponds with the worm or serpentine of an ordinary alembic. This apparatus is constructed with a lead casing C completely closed and into which a pipe P conducts the gases through the cover while another pipe P′ enables them to escape through the bottom or vice versa. Above the bottom there is a false bottom C^5 made of lead pipes spaced sufficiently near together to retain grains about the size of rice, of a substance such as coke, powdered glass, pumice stone, earthenware or quartz, for example, which is not liable to be attacked by the acids which fill the casing. V is a steam pipe.

The operation of my apparatus is as follows: The gases entering at o pass into the chamber Q and passage q, and in order to escape therefrom the gases are compelled to rub against the surface of the liquid in a very thin layer of considerable lineal extent. By raising the level of the orifice for the escape of the acid by the pipe m, the lower edges i of the sides of the passages may be immersed in the liquid so as to compel the gases to pass through the latter. In order to economize the power required for moving the gases, and the fuel employed to produce the said power, it is preferable to limit the extent to which the gases penetrate into the liquid to one or two centimeters in a vertical direction. This depth is the best in case the lower edges i are not wetted except when the acid flows at its normal speed and the flow of gases is fully regulated. Although these gases are usually supplied at from about 400 to 500 centesimal degrees they never cause the liquid to boil but become charged with its vapors. It is a very important condition for the proper working that the gases are saturated with the vapors immediately on their arrival in such a manner that they are unable to take up all the acid, with which they come in contact at the other parts of the apparatus. In order to produce this saturation with the smallest possible expenditure of power the lower edges of the sides of the passages Q q at i are made of considerable length. This complete saturation is further most important for another reason. In becoming saturated with vapor the gases immediately cool down, losing from 200° to 300° centigrade, so that it is possible to bring the acid to a maximum degree of concentration (66° Baumé) without subjecting the apparatus to a heat exceeding 170° centigrade, this being a result hitherto unknown. The gases consequently do not retain more than from about 170° to 200° centigrade at the most and this relatively low temperature greatly contributes to the preservation of the apparatus. On leaving the chamber S, the gases proceeding from the passages q' pass into the second part, namely, the recovery column. As indicated by its name, it serves to recover and retain in the fresh acid, a portion of the sulfuric acid vapors with which the gases have been saturated in the passages q.

The gases employed for the evaporation may consist of air superheated in a stove. Nevertheless I can employ air which has been employed for burning coke, and owing to the sulfur which it contains, this air is especially advantageous from a special point of view. It converts the nitrous gases into sulfuric acid and the arsenic acid into arsenious acid which products are eliminated by the gaseous current so that the acid produced is purified from arsenic and nitrous compounds.

To cause the suction of the gases and aqueous vapor through the apparatus, I employ a jet of steam under pressure in the tube P, beyond the recovery column, because the exhaust prevents leakage of acid and causes the lead casing to be pressed against the apparatus. This exhausting action was not practicable before I discovered the means for separating the acid from the steam without condensing it by cooling. The gases escaping at P still contain sulfuric acid. They may be employed for various manufacturing purposes for which they may be required. If not so employed I pass them to the third part of my apparatus.

The sulfuric acid contained in the gases entering the condenser at P is not volatile at its temperature and is held suspended in the form of microscopic drops in the gases. As the gases filter through the granular contents of the condenser to the escape at P′, the little drops of acid adhere to the grains, trickle down to the bottom of the condenser and escape through the pipe N by which they may be conducted to the upper part of the recovery column at l.

The condensation is more effectually performed when the gases are heated by a jet of steam V at any convenient temperature and pressure so long as it does not cool the gases. The vapors and gases deprived of acid are discharged into the air without it being nec-

essary to cool them or sprinkle the grains of the filter with water.

I claim as my invention—

1. An apparatus for concentrating sulfuric acid by means of hot gases, consisting of a chamber S, provided with channels q closed at the top and open at the lower part, the said channels adapted to divide the gases entering at the end of the chamber, channels q', leading from the channels q open at the top, and means for passing sulfuric acid through the channels in the chamber in the opposite direction from that taken by the gases, and maintaining the acid in sheets or layers of a desired depth whereby the gases pass through the sheets of acid and become saturated with acid vapors at the first contact with the acid to be treated.

2. In an apparatus for concentrating sulfuric acid by means of hot gases, the combination of a chamber provided with an inlet for hot gases, channels q closed at the top but having openings at the lower part, and channels q' leading from the channels q, the said channels q' being open at the top with a recovery column provided with plates adapted to hold acid and having perforations for passage of the gases, and with a discharge pipe P, and means for maintaining the acid in layers throughout the apparatus, substantially as and for the purpose set forth.

3. In an apparatus for concentrating sulfuric acid by means of hot gases, the combination of a chamber S adapted to hold a layer of sulfuric acid, and provided with channels q closed at the top, but having openings in the lower part and channels q' leading from the channels q and open at the top, and a recovery column provided with plates adapted to hold layers of acid and having perforations for the passage of the gases from the channels q', and with a discharge pipe P, with a chest to contain coke or its equivalent provided with an inlet connected to the said pipe P and outlet for the gases, and an outlet for the acid the latter outlet leading back to the recovery column substantially as and for the purposes set forth.

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

JACQUES LOUIS KESSLER.

Witnesses:
LÉON FRANCKEN,
ROBT. M. HOOPER.