No. 763,478. PATENTED JUNE 28, 1904.

G. GIN.

METHOD OF MAKING SULFATE OF COPPER,

APPLICATION FILED JULY 28, 1902. RENEWED MAR. 3, 1904.

NO MODEL.

Fig. 1.

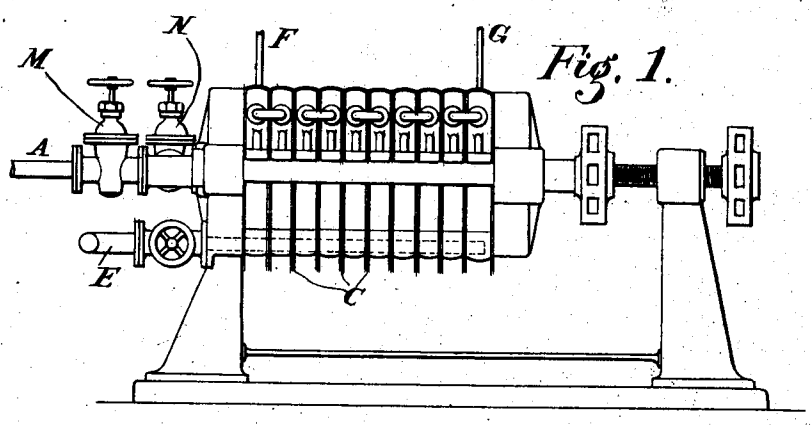


Fig. 2

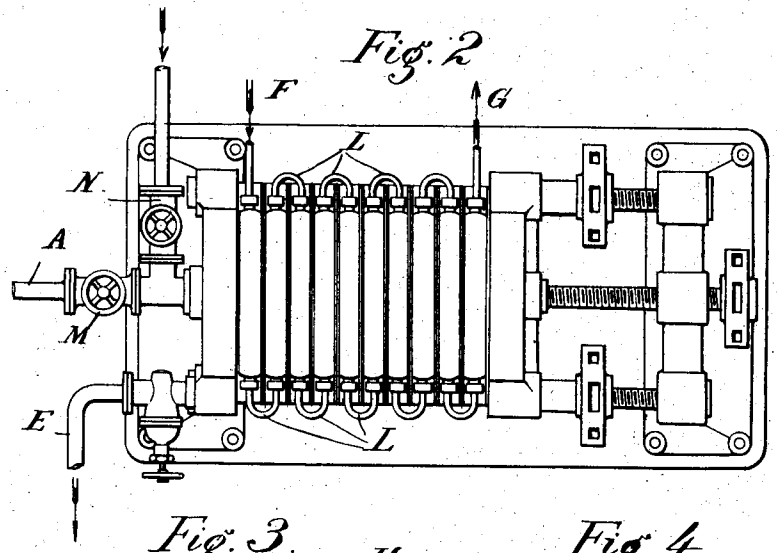


Fig. 3.

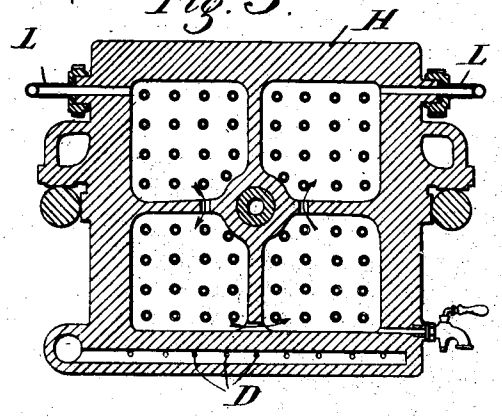
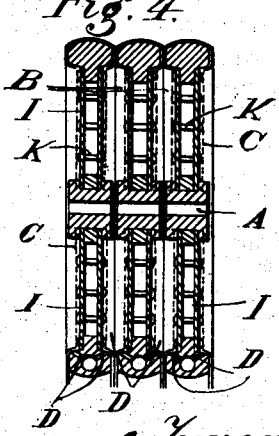


Fig. 4.



Witnesses.
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 763,478. Patented June 28, 1904.

UNITED STATES PATENT OFFICE.

GUSTAVE GIN, OF PARIS, FRANCE.

METHOD OF MAKING SULFATE OF COPPER.

SPECIFICATION forming part of Letters Patent No. 763,478, dated June 28, 1904.

Application filed July 28, 1902. Renewed March 3, 1904. Serial No. 196,322. (No specimens.)

To all whom it may concern:

Be it known that I, GUSTAVE GIN, a citizen of the French Republic, and a resident of Paris, France, have invented a certain new and useful Improvement in the Manufacture of Sulfate of Copper, of which the following is a specification.

The object of my invention is to produce sulfate-of-copper crystals free from impurities, particularly from sulfate of iron. For this purpose I use sulfurous ores or mattes of copper in which the sulfids of copper and of iron have been previously transformed into sulfates by any known means.

Although I have adopted purely physical agencies for separating the sulfate of copper from the sulfate of iron, the principle of my process is founded upon the following observed facts: The coefficient of solubility of pure copper sulfate is maximum at a temperature of about 110° centigrade and decreases slowly beyond that point. The solubility of ferrous sulfate is maximum at a little below 100° centigrade, but decreases rapidly, and ceases entirely at a temperature of about 160° centigrade. If the two salts are placed simultaneously in hot water, it will be observed that their respective solubilities follow laws quite different from those which correspond to the solution of either sulfate alone. The solubility of ferrous sulfate grows at first with the rising temperature more rapidly than that of the copper sulfate; but when the solution is heated above 100° the respective solubilities again follow the law governing solutions of the isolated salts, so that at about 160° centigrade sulfate of copper alone remains in the solution, while the ferrous sulfate is entirely precipitated. My process is deducted from these observations and is carried out in the following manner: The ores or mattes from which it is proposed to extract the sulfate of copper are first subjected to any known treatment which will transform the metallic sulfids present into sulfates. I then take these compound sulfates, there being present copper sulfate, with a certain proportion of ferric and ferrous sulfates, and I lixiviate them, so as to obtain saturated solutions of sulfates as hot as possible. I then boil them with copper ore which has been completely oxidized by high roasting or with cementation-copper. The sulfate of peroxid of iron reacts upon the oxid of copper, the resulting products being sulfate of copper and a precipitate of peroxid of iron, according to the formula

$$(SO_4)_3Fe_2+3CuO=3SO_4Cu+Fe_2O_3.$$

The sulfate of peroxid of iron remains untouched in the solution. The solution is maintained at about a boiling temperature and is then filtered, containing after filtration sulfate of copper and sulfate of protoxid of iron only. It is then injected by any suitable means into a copper boiler, preferably of the tubular variety, in which it is heated until the gage indicates a pressure of ten kilos, which corresponds to a temperature of about 180° centigrade. At this temperature the sulfate of protoxid of iron can no longer exist in the solution; but the copper sulfate is still very soluble. I preferably use concentrated solutions; but this concentration should not reach the maximum saturation of copper sulfate, for a certain quantity of this salt would be precipitated with the sulfate of protoxid of iron. I have found that a concentration of three hundred and fifty to four hundred grams of copper sulfate per litre of solution is favorable to the proper separation. The pressure exerted upon the solution in the boiler is used to force it into a filter-press, the compartments or chambers of which are heated by steam, so as to retard as much as possible the speed of cooling of the solution. In order to facilitate the understanding of this last part of the operation I show in the annexed drawings a filter-press which may be used to cause the separation of the two sulfates, wishing it to be understood that I can use any other mechanical arrangement which may cause this separation in a practical manner.

Figure 1 is a practical elevation of the apparatus. Fig. 2 is a plan view. Fig. 3 is a cross-section through a single plate. Fig. 4 is a longitudinal section through three plates.

The turbid solution enters the apparatus through a pipe A and passes into the chambers B. It is filtered through asbestos screens C, and all the sulfate of iron which is in sus-

pension is left between the asbestos screens, while the pure solution of sulfate of copper flows between the copper plates or diaphragms L and the screens C and escapes through the channels D to the discharge-pipe E. The solution passes through a collecting vessel and is finally discharged into a crystallizing-tank, where the sulfate of copper is subsequently gathered. While being filtered the liquid is heated by means of steam at a pressure of ten kilograms. It enters the apparatus at F and circulates from one chamber to the other by means of the U-shaped pipes L, making its escape at G. The chambers of the filter-press are formed by bronze frames H, closed by the plates or diaphragms L, braced by short stays K. When the spaces between the filter-screens are filled with the precipitated sulfate of iron, the supply-valve N is closed and the circulation of steam through the compartments is stopped. The incoming stream of the solution to be filtered is then directed to an additional filter-press, while pure water is applied to the first apparatus in use through the valve N, whereby the sulfate of iron is rapidly dissolved. The solution thus obtained is led to a special vessel for crystallization. As the filter-press has thus been perfectly cleaned, it may be used immediately for another operation, and thus the operation is rendered continuous by alternately using and cleaning each of the two filter-presses. It may also be remarked that as the filter-press is cleaned by simply washing it with water there will be no occasion for taking it apart except to replace defective asbestos screens.

What I claim is—

The herein-described process of manufacturing sulfate of copper consisting in boiling a mixed solution containing sulfate of copper, sulfate of protoxid of iron and sulfate of peroxid of iron with thoroughly-roasted copper ore or cementation-copper so that the peroxid contained in the sulfate of peroxid of iron will first be precipitated, then precipitating the sulfate of protoxid of iron remaining in the solution by raising the temperature to a point above 160° centigrade, and then filtering the solution.

In testimony whereof I have hereuuto set my hand in presence of two witnesses.

GUSTAVE GIN.

Witnesses:

ADOLPHE STURM,

EDWARD P. MCLEAN.