No. 887,266. PATENTED MAY 12, 1908.

H. PAULING.

PROCESS FOR CONCENTRATING NITRIC ACID.

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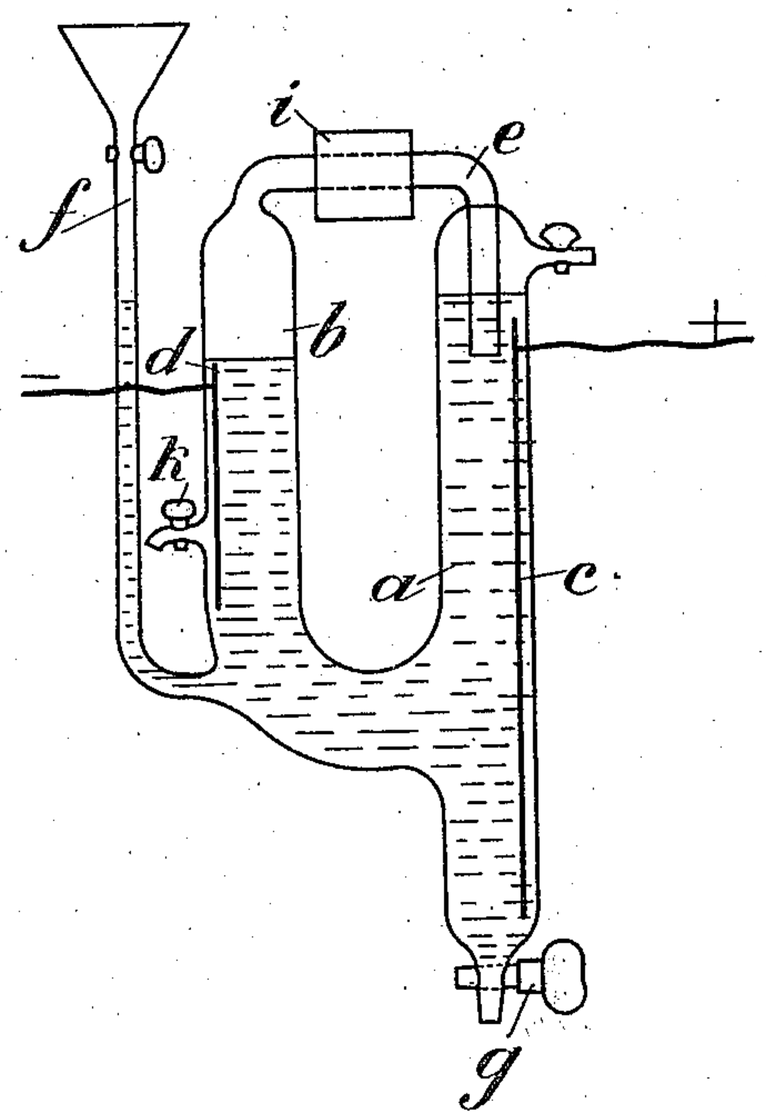

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PROCESS FOR CONCENTRATING NITRIC ACID.

No. 887,266. Specification of Letters Patent. Patented May 12, 1908.

Application filed August 13, 1906. Serial No. 330,387.

To all whom it may concern:

Be it known that I, HARRY PAULING, a subject of the German Emperor, and resident of 84 Wilhelmstrasse, in Gelsenkirchen, in the Kingdom of Prussia, German Empire, have invented certain new and useful Improvements in Processes for Concentrating Nitric Acid, of which the following is a specification.

Attempts have been made to concentrate aqueous nitric acid by subjecting it to a sort of electrolysis with a view to concentrating it at the anode or positive pole; but it has been ascertained by accurate experiments that the increase in concentration obtained in such case only amounted to a slight percentage over the original concentration, while by continuing the electrolysis the acid under treatment became decomposed, that is to say, converted into oxygen and nitric oxids.

The present invention relates to processes of this nature, and it is such that any desired degree of concentration, up to pure monohydratic acid (HNO_3), can be obtained.

The invention consists, broadly, in passing the nitric oxids, formed at the cathode or negative pole by electrolyzing the aqueous nitric acid to be concentrated, into the acid surrounding the anode or positive pole, where they dissolve and are oxidized by the oxygen generated at the anode, so as to form nitric acid, thus increasing the concentration of the anode compartment.

Other features will be understood from the following description, reference being had to the accompanying drawing, which is a diagrammatical view of an apparatus adapted for effecting the new process.

The apparatus represented consists, in substance, of a U-tube *a*, *b*, a cross tube *e* establishing communication between the two legs thereof, and in such a manner that one end of this tube extends into the interior of the leg *a*, as shown, a feed tube *f*, and drain cocks *g* and *k*. *c* is the anode and *d* the cathode.

The operation of this device is as follows. At the beginning of the process such an amount of the acid to be concentrated is supplied to the apparatus that the levels of the liquid are just above the electrodes *c*, *d*, or nearly so. Hereupon an electric current is passed through the liquid, with the result that at the anode *c* oxygen is formed, while at the cathode *d* nitric oxids are generated. The latter pass through the tube *e* into the leg *a*, where they dissolve in the nitric acid surrounding the anode, so as to be converted into nitric acid by the action of the oxygen set free at the anode. After in the leg *a* a suitable or desired degree of concentration has been obtained, then the dilute nitric acid contained in the leg *b* is discharged through a cock *k*. This acid, which still contains a certain amount of nitric oxids, is thus separated from the oxidized concentrated one. It will be seen that in this way it is possible to produce an acid free of nitric oxids and in any desired concentration, and without the necessity of any extra manipulations. The said dilute acid may be got rid of the nitric oxids, contained therein, by heating it, and may be reconducted to its original degree of concentration by distilling it. Precaution should be taken that on the one hand the degree of concentration at the cathode become not so low, and that on the other hand the current strength employed be not so high, that hydrogen is formed; on the contrary the mode of working must be such that only nitric dioxid and nitric oxid are set free.

The acid to be concentrated should by preference be subjected to a preliminary saturation with nitric oxids in order that there may be some oxidizable matter for the oxygen formed at the cathode, the object being to prevent such oxygen from escaping, through the tube *e*, toward the cathode in case the nitric acid at the latter be not yet saturated with nitric oxids to a degree sufficient to enable these to escape, owing to their pressure, toward the anode, in the manner described. To aid in the production of nitric oxids the leg *b* may be heated a little.

It has been found that it is advantageous to conduct the nitric oxids into the acid, surrounding the anode, not in their gaseous condition, but in a liquefied state, because in the latter condition they readily mix with the liquid at the anode, whereas gaseous nitric oxid is found to dissolve therein but with a relatively great difficulty. In view of this fact it is advantageous to provide a cooling device *i* of any suitable construction, which the nitric oxids on their passage along the tube *e* are caused to pass through so as to drop into the leg *a*. It is of advantage in

this case to maintain the leg *b* at a constant temperature, such as some 30 or 60 degrees centigrade.

The chemical reaction accomplished in effecting the described process may be expressed by an equation such as the following:

$$N_2O_5 + H_2O = 2HNO_3.$$

N_2O_5 is set free at the cathode, while H_2O is taken from the acid under treatment, this acid being an aqueous one, as stated.

What is claimed is:

1. The herein described process, consisting in electrolyzing aqueous nitric acid and passing the nitric oxids, formed at the cathode, into the acid surrounding the anode, substantially as and for the purpose specified.

2. The herein described process, consisting in electrolyzing aqueous nitric acid, liquefying the nitric oxids originated at the cathode, and in passing such liquefied gases into the acid surrounding the anode, substantially as and for the purpose set forth.

In witness whereof I have hereunto signed my name this 23rd day of June 1906, in the presence of two subscribing witnesses.

HARRY PAULING.

Witnesses:

HENRY HASPER,

WOLDEMAR HAUPT.