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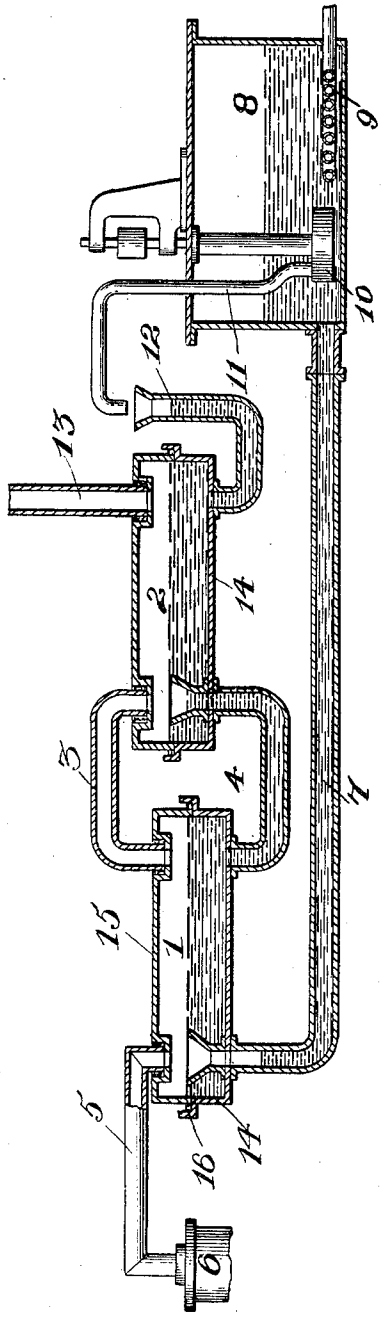
F. I. DU PONT.

APPARATUS FOR CONDENSING AND MIXING ACIDS.

APPLICATION FILED NOV. 3, 1902.

NO MODEL.



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No. 736,625. Patented August 18, 1903.

UNITED STATES PATENT OFFICE.

FRANCIS I. DU PONT, OF WILMINGTON, DELAWARE.

APPARATUS FOR CONDENSING AND MIXING ACIDS.

SPECIFICATION forming part of Letters Patent No. 736,625, dated August 18, 1903.

Application filed November 3, 1902. Serial No. 129,952. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS I. DU PONT, a citizen of the United States, residing at Wilmington, in the county of Newcastle and State of Delaware, have invented certain new and useful Apparatus for Condensing and Mixing Acids; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to apparatus for condensing acid fumes, such as nitric acid, and for mixing the same with liquids, such as sulfuric acid, and is especially intended for use in the making of the mixture of nitric and sulfuric acids employed in the manufacture of nitroglycerin, nitrocellulose, and other nitro explosives.

My invention consists in the novel construction of the apparatus employed for this purpose.

The objects of my invention are to facilitate the condensation of acid fumes and the mixing thereof with the liquid, to avoid destruction of the apparatus through the chemical action of the fumes thereon, and to make the apparatus simple, compact, and substantially automatic in its operation.

My apparatus consists, essentially, of a plurality of condensing-chambers arranged in series and connected together at the top and bottom, the first of which chambers is also connected with a retort or other apparatus for generating the acid fumes to be condensed, and of a cooling-tank connected to the said condensing vessels and provided with means for cooling the liquid within it and with means for inducing circulation.

In the accompanying drawing I show a longitudinal section of one form of apparatus embodying my invention.

In the said drawing, numerals 1 and 2 designate such condensing vessels, the upper portions of which are connected by a pipe or passage 3, and the lower portions of which are connected by a pipe or passage 4. The first vessel 1 is also connected by a pipe or passage 5 to the outlet 6 of a retort or other apparatus in which the acid fumes to be condensed are generated. Said vessel 1 is also connected by a pipe or passage 7 to a cooling-tank 8, within which are pipe-coils 9, through which water or other cooling medium may be circulated, and a pump 10, the discharge-pipe 11 of which is arranged to discharge into a pipe 12, connected with the lower portion of vessel 2. Any suitable form of pump may be used. Vessel 2 is also provided with a pipe 13, through which gases which are not condensed may escape.

In apparatus of this kind it is important that all parts exposed to the action of the acid liquids or vapors shall be formed of material which are not acted upon by such acid liquids or vapors. The apparatus herein illustrated and described is particularly intended, as above stated, for condensing nitric-acid fumes in sulfuric acid. Sulfuric acid or a mixture of sulfuric and nitric acids has relatively little action upon iron, while nitric acid alone or the fumes of nitric acid actively attack iron, but have substantially no action upon earthenware. For this reason each of the vessels 1 and 2 is formed in two parts, the lower part or pan 14 being of iron and the upper part or cover 15 being of earthenware. For the same reason the pipes 5, 3, and 13 are of earthenware and the pipes 4, 7, and 12 and also the parts of the cooling-tank and the circulating-pump are of iron. It is exceedingly desirable that the parts of the apparatus which contain the liquid shall be of strong metal, since the effects of accidental breakage of such parts and consequent liberation of the acid might well be serious.

Pipes 5, 3, and 13 are connected to the covers 15 by joints made with any suitable acid-resisting cement. Because much heat is generated in the process of condensing and mixing the nitric-acid fumes with the sulfuric acid and because earthenware has a rate of expansion different from that of iron the covers and pans of the vessels 1 and 2 are not cemented together; but, to the contrary, each pan 14 has a flange with a raised lip 16, upon which flange the cover 15 rests. The level of the acid in each of the vessels 1 and 2 is slightly above that of this flange 16, so that a liquid seal is formed and the escape of acid fumes through the joints is prevented.

The level of the liquid in vessels 1 and 2 is regulated by reason of the fact that the overflow-pipes 4 and 7 project upward through

the bottoms of vessels 1 and 2, their mouths being slightly above the level of the flanges 16, so that the liquid in said vessels must always be above said flanges.

I will describe the use of my apparatus as applied to the condensation of nitric-oxid fumes in sulfuric acid. Vessels 1 and 2 being filled with sulfuric acid or a mixture of nitric and sulfuric acids to the level of the mouths of the said overflow-pipes, acid fumes generated in the retort 6 pass through the pipe 5, and encountering the relatively cool surface of the liquid in vessel 1 the greater portion of these fumes are condensed and mixed with the said acid. Such portion of the fumes as do not condense pass off through pipe 3 and are projected against the surface of the similar liquid in vessel 2, by which second treatment practically all of the condensable gases are condensed. Such portion of the gases as do not condense passes off through pipe 13. At the same time the liquid in vessel 1 continuously overflows into pipe 7 and passing into cooling-tank 8 is cooled by the water or other cooling medium circulating through the pipe-coils 9 and thence is lifted by the pump 10 and discharged into the pipe 12, by which the cooled acid is caused to flow into vessel 2. The overflow from vessel 2 passes into vessel 1. It will be seen, therefore, that in the operation of my apparatus there is a continuous condensation of practically all of the condensable acid vapors in vessels 1 and 2 through the contact of such vapors with the cool acid in said vessels and a continuous circulation of said acid from vessel 1 through the cooling-tank and thence into vessel 2 and back into vessel 1.

It is obvious that the number of condensing vessels connected in series may be increased if this be found necessary or desirable in any particular case.

It is obvious that the apparatus above described may be modified considerably without departing from the essential features of my invention, and therefore I do not limit myself to the particular details of construction herein illustrated and described.

What I claim is—

1. In an apparatus of the type described, the combination with a vessel containing an acid adapted to act as a condensing agent, said vessel provided with means for admitting vapors to be condensed to the space above the acid, of a cooling-tank provided with cooling-coils, discharge and return passages connecting the cooling-tank and said vessel, and a circulating-pump for maintaining circulation between the condensing vessel and the cooling-tank.

2. In an apparatus of the type described, the combination with a plurality of condensing vessels arranged in series, each containing an acid adapted to act as a condensing agent, both the liquid and the gas spaces of such vessels being connected in series, of means for withdrawing the acid from one end of said series, cooling the same, and returning the cooled acid to the series at the other end thereof, and means for admitting acid fumes to be condensed at one end of the series.

3. In an apparatus of the type described, the combination with a plurality of condensing vessels, said vessels arranged in series and provided with means for connecting the gas-spaces of said vessels and also with means, connecting the liquid-spaces of said vessels, arranged to permit overflow of liquid from one vessel of the series to another, of means for withdrawing the acid from one end of said series for cooling the same, and for returning the cooled acid to the other end thereof, and means for admitting acid fumes to be condensed at one end of the series.

4. In an apparatus of the type described, a condensing vessel comprising a tray composed of a metal substantially unaffected by the acid contents of the vessel, and a cover therefor composed of material substantially unaffected by the vapors to be condensed, said tray or pan having an overflow-pipe the mouth of which is below the top of the tray, and said cover resting upon the tray at points below the mouth of said overflow-pipe.

5. In an apparatus of the class described, the combination of a plurality of condensing vessels arranged in series, each comprising a tray or pan adapted to contain a condensing liquid, having an overflow-pipe the mouth of which is below the top of said tray or pan, and a cover resting upon said tray or pan at points below the mouth of said overflow-pipe, said overflow-pipes arranged to permit flow of liquid from one vessel to another and thence out of said series of vessels; and means connecting the gas-spaces of said vessels, adapted to permit flow of gas from one vessel to another.

6. In an apparatus of the type described, the combination of a plurality of condensing vessels arranged in series, each comprising a tray or pan adapted to contain a condensing liquid, having an overflow-pipe the mouth of which is below the top of said tray or pan, and a cover resting upon said tray or pan at points below the mouth of said overflow-pipe, the mouths of the said overflow-pipes being at different levels in the different vessels; said overflow-pipes arranged to permit overflow from one vessel to another and thence out of the series; the gas-spaces of said vessels being connected to permit the flow of gas from one vessel to another.

7. In an apparatus of the type described, a condensing vessel comprising an iron tray or pan adapted to contain a condensing liquid, having an overflow-pipe the mouth of which is below the top of said tray or pan, and an earthenware cover resting upon said tray or pan at points below the mouth of said overflow-pipe.

8. In an apparatus for condensing nitric-acid fumes in sulfuric acid, a condensing ves-

sel comprising an iron tray or pan adapted to contain sulfuric acid, having an overflow-pipe projecting from the bottom upward, the mouth of which is below the top of said tray or pan, and an earthenware cover resting upon said tray or pan at points below the top of said overflow-pipe.

9. In an apparatus for condensing nitric-acid fumes in sulfuric acid, the combination of a plurality of condensing vessels each comprising an iron tray or pan adapted to contain sulfuric acid, having an overflow-pipe the mouth of which is below the top of said tray or pan, and an earthenware cover resting upon said tray or pan at points below the top of said overflow-pipe, said overflow-pipes arranged to permit the overflow of acid from one vessel to another and then out of the series, the said covers being provided with earthenware pipes for delivering acid fumes to one vessel of the series and for connecting the gas-spaces of said vessels.

In testimony whereof I affix my signature in the presence of two witnesses.

FRANCIS I. DU PONT.

Witnesses:

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