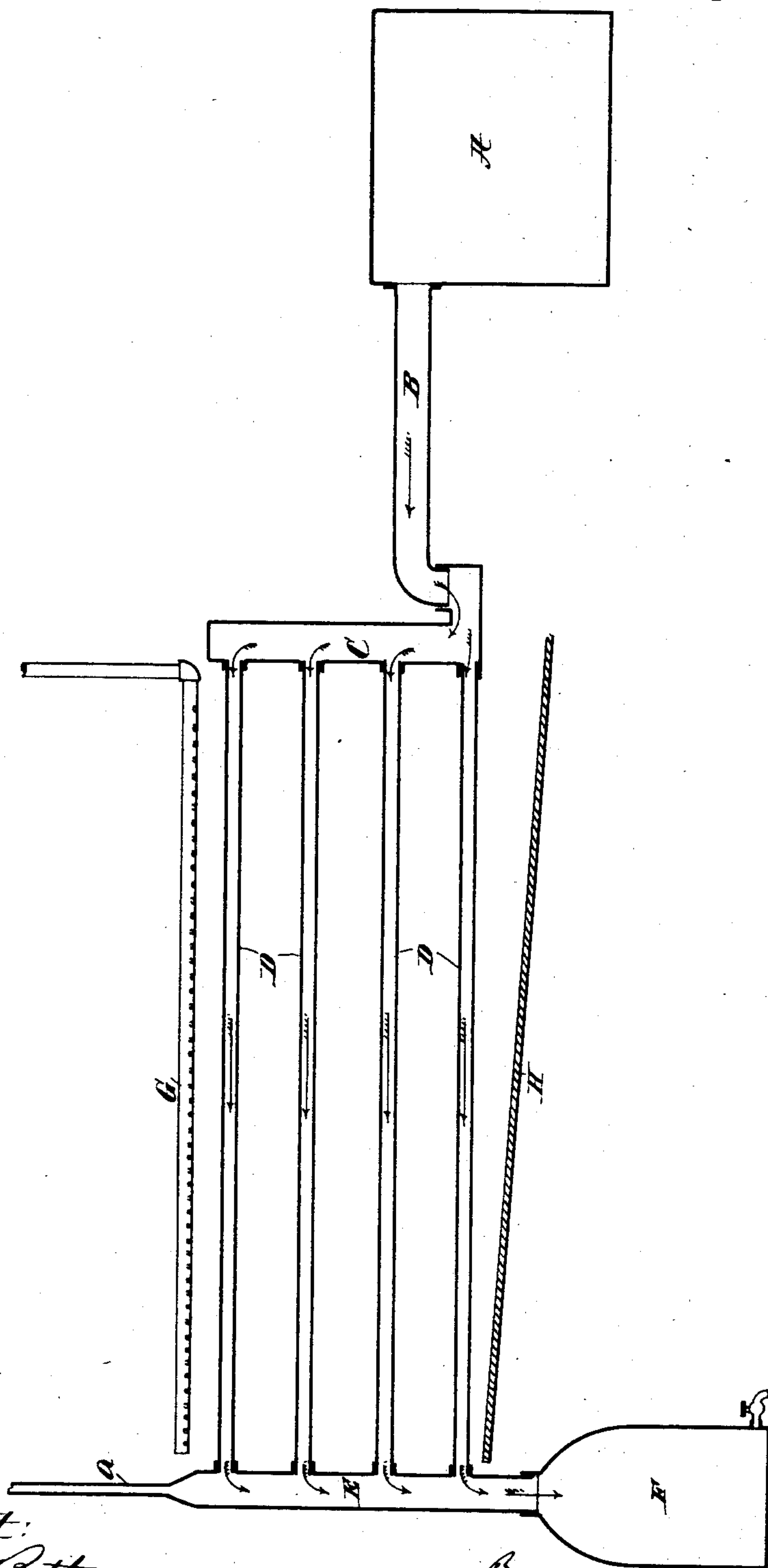


(No Model.)

E. HART.  
APPARATUS FOR CONDENSING NITRIC ACID, &c.  
No. 525,761. Patented Sept. 11, 1894.



Attest:  
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# UNITED STATES PATENT OFFICE.

EDWARD HART, OF EASTON, PENNSYLVANIA, ASSIGNOR TO HIMSELF, JOHN T. BAKER, AND GEORGE P. ADAMSON, OF SAME PLACE.

## APPARATUS FOR CONDENSING NITRIC ACID, &c.

SPECIFICATION forming part of Letters Patent No. 525,761, dated September 11, 1894.

Application filed September 5, 1893. Serial No. 484,814. (No model.)

*To all whom it may concern:*

Be it known that I, EDWARD HART, a citizen of the United States, residing at Easton, county of Northampton, and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Condensing Nitric Acid and other Vapors, fully described and represented in the following specification and the accompanying drawing, forming a part of the same.

This invention relates to an improved apparatus for the concentration of vapors and especially for the condensation of nitric and similar acids from gaseous into liquid form. The improved apparatus depends upon the principle of the division of the current of vapor so as to secure a large cooling surface and diminish the friction of the gases, and that of the high degree of refrigeration secured by the evaporation of liquid from the surface of pipes or equivalent conveyers through which the gases are passed.

For a full understanding of the invention a detailed description of an apparatus for condensing nitric acid embodying the invention in the preferred form will now be given in connection with the accompanying drawing showing the apparatus in diagrammatic side elevation, and the features forming the invention then specifically pointed out in the claims.

In the drawing, A is the retort which may be of any suitable form and from which the gaseous nitric acid passes through the pipe B into the vertical pipe C which communicates by a series of horizontal pipes D with a second vertical pipe E opening at its base into the receiver F, which may be of any suitable form and is preferably provided at its upper end with the vent pipe *a* for non-condensable gases. Above the pipes D is the water supply pipe G perforated or slit in any suitable manner to supply the amount of cold water required by sprinkling the same over the pipes D. As the pipes D are quite hot the water is evaporated therefrom, and by constructing the pipe G so as to properly regulate the water supply, all, or substantially all, of the water may be evaporated from the pipes so as not to necessitate provision for carrying off the surplus water. It will be understood, however, that it is not essential that all the

water should be evaporated, and a trough H may be used below the pipes B, as shown, to carry off any surplus water, or other suitable provision be made for this purpose.

The vertical pipes C, E are preferably made of stoneware or other similar material suitable to resist the attack of the acid, and the pipes D are preferably made of glass or other material suitable to resist the attack of the acid and at the same time conduct the heat from the gas quickly so as to secure the proper cooling action.

The number, size and length of the pipes C, D, E and other parts of the apparatus will be varied as is necessary in order to secure perfect condensation of the gas, it being obvious that this will depend somewhat upon the size of the retort and other circumstances, and such variation being within the knowledge of those skilled in the art.

A construction which has been found efficient is produced by making the vertical pipes C, E about three inches in diameter and the pipes D about one inch in diameter and six feet or more in length. It will be seen that by thus dividing the current of vapor, I secure large cooling surfaces and diminish the friction of the gas and by the evaporation of the water I secure a large and rapid absorption of heat, and am thus enabled to provide a very efficient apparatus.

It will be understood that the term "horizontal" as herein used in connection with pipes D does not mean that these pipes must be absolutely horizontal, as they may be inclined somewhat toward either the retort or receiver. By the term "horizontal," therefore, I mean only that they should be horizontal or approximately horizontal, so as to expose the pipes throughout their length to the action of a sprinkler placed above them and to secure the prolonged cooling action which results from a slow current of the condensed or partially condensed liquid.

While the invention has been described in connection with water as the cooling medium, as this is the liquid commonly used, it will be understood that any other suitable liquid may be used for this purpose. The apparatus has been described in connection with the preparation of nitric acid, but it will be un-



derstood that the apparatus is applicable also to the condensation of other similar gases.

What I claim is—

1. The combination with a retort and receiver, of a series of pipes between which the vapor is divided on its path from the retort to the receiver, and means for sprinkling liquid upon said pipes, substantially as described.
2. The combination with a retort and receiver, of horizontal pipes arranged one above the other between which the vapor is divided on its path from the retort to the receiver, and a perforated liquid supply pipe above said pipes, substantially as described.
3. The combination with a retort and receiver, of two vertical pipes connected at their bases respectively to the retort and receiver, horizontal pipes arranged one above the other connecting said pipes, and between which horizontal pipes the vapor is divided on its

path from the retort to the receiver and a perforated liquid supply pipe above said horizontal pipes, substantially as described.

4. The combination with retort A, of the vertical pipe C connected at its base with said retort, vertical pipe E having receiver F at its base, horizontal pipes D arranged one above the other and connecting said vertical pipes, and between which horizontal pipes the vapor is divided on its path from the retort to the receiver and perforated liquid supply pipe G above said horizontal pipes, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

EDWARD HART.

Witnesses:

THEO. R. RICKER,  
JOHN S. NOBLE.