No. 672,059. Patented Apr. 16, 1901.

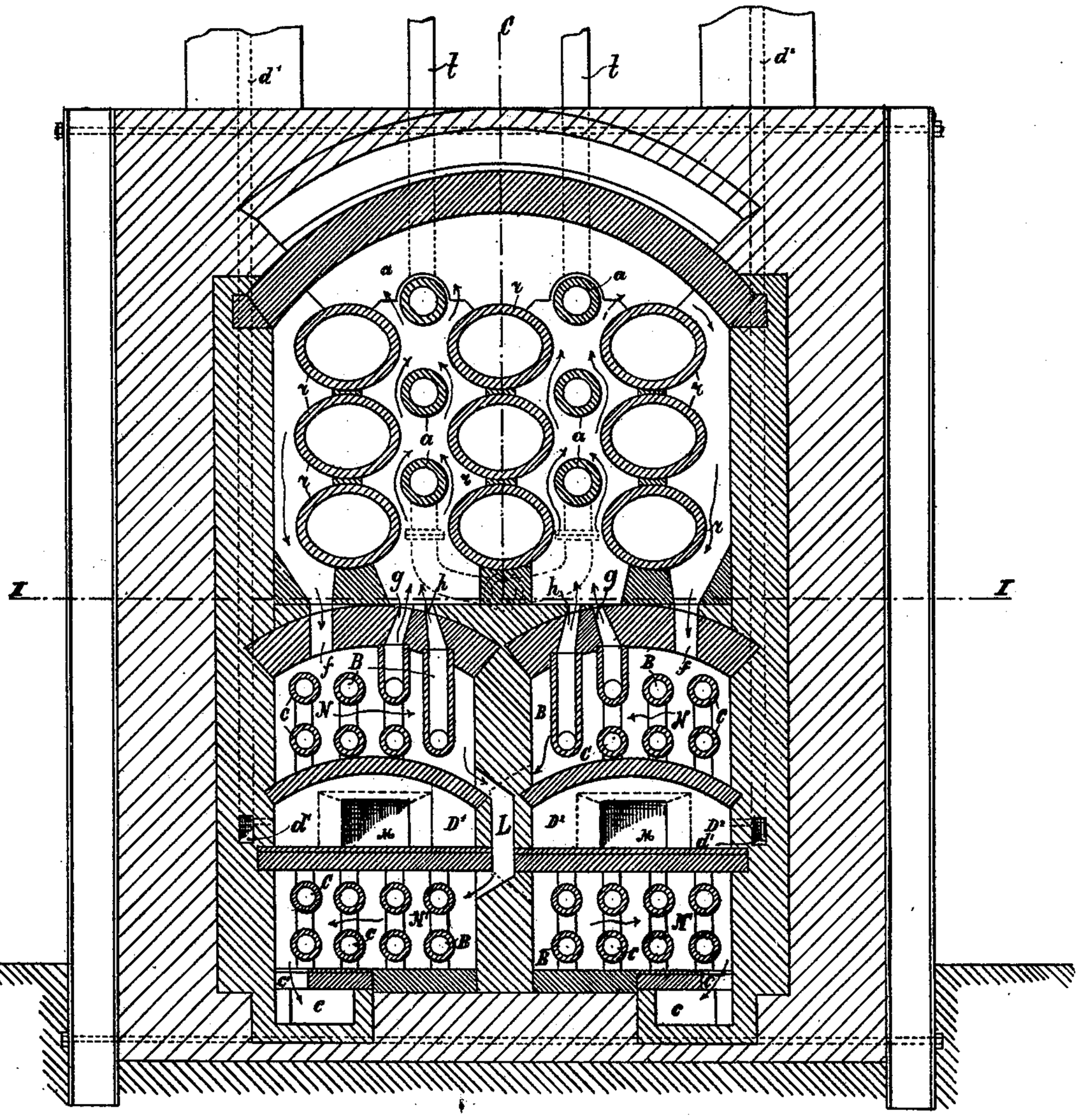
O. VON GIESE.

RETORT OVEN FOR RECOVERY OF AMMONIA.

(Application filed Dec. 14, 1898.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.



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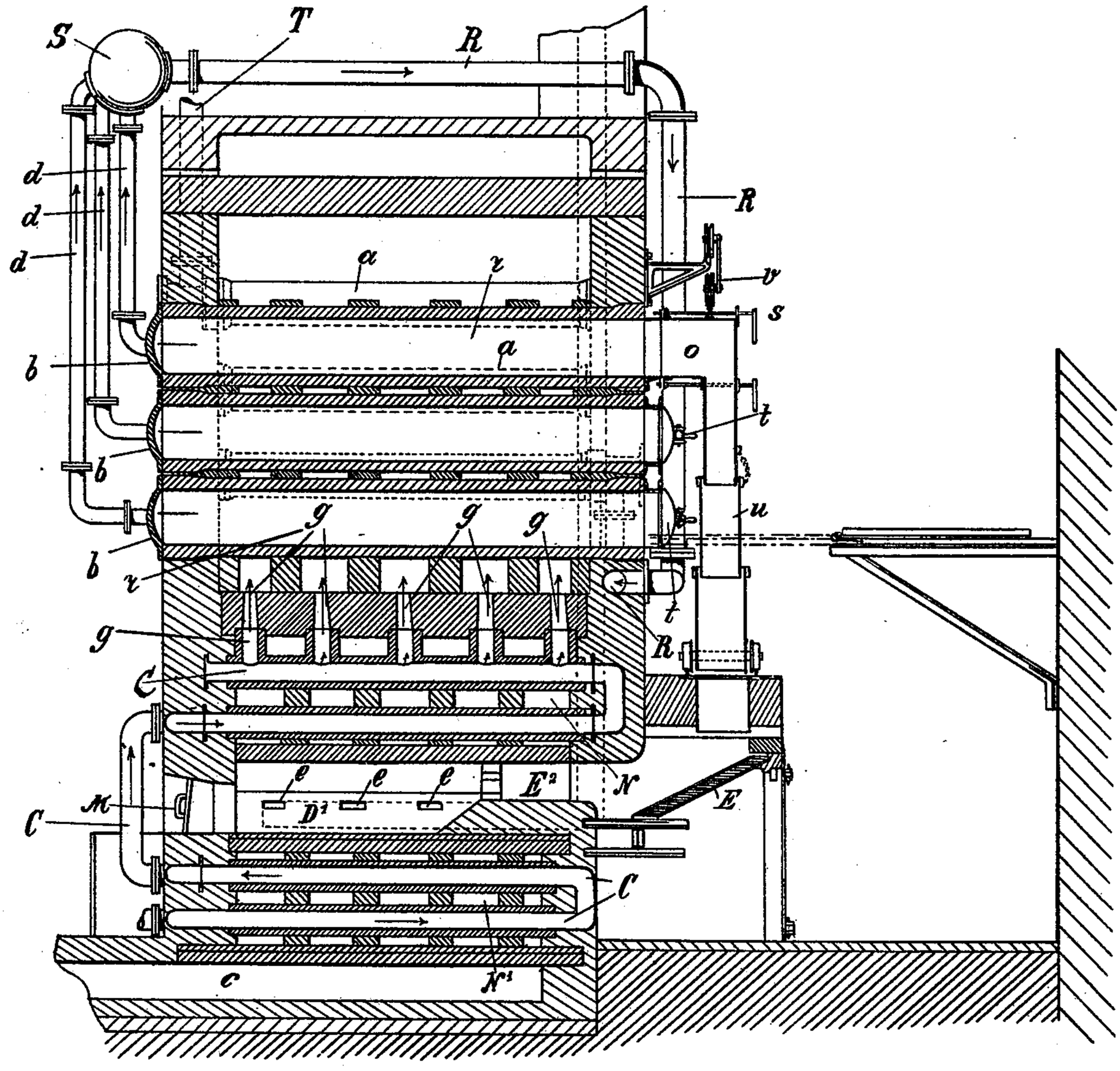
(No Model.) 5 Sheets—Sheet 2.

Fig. 2.



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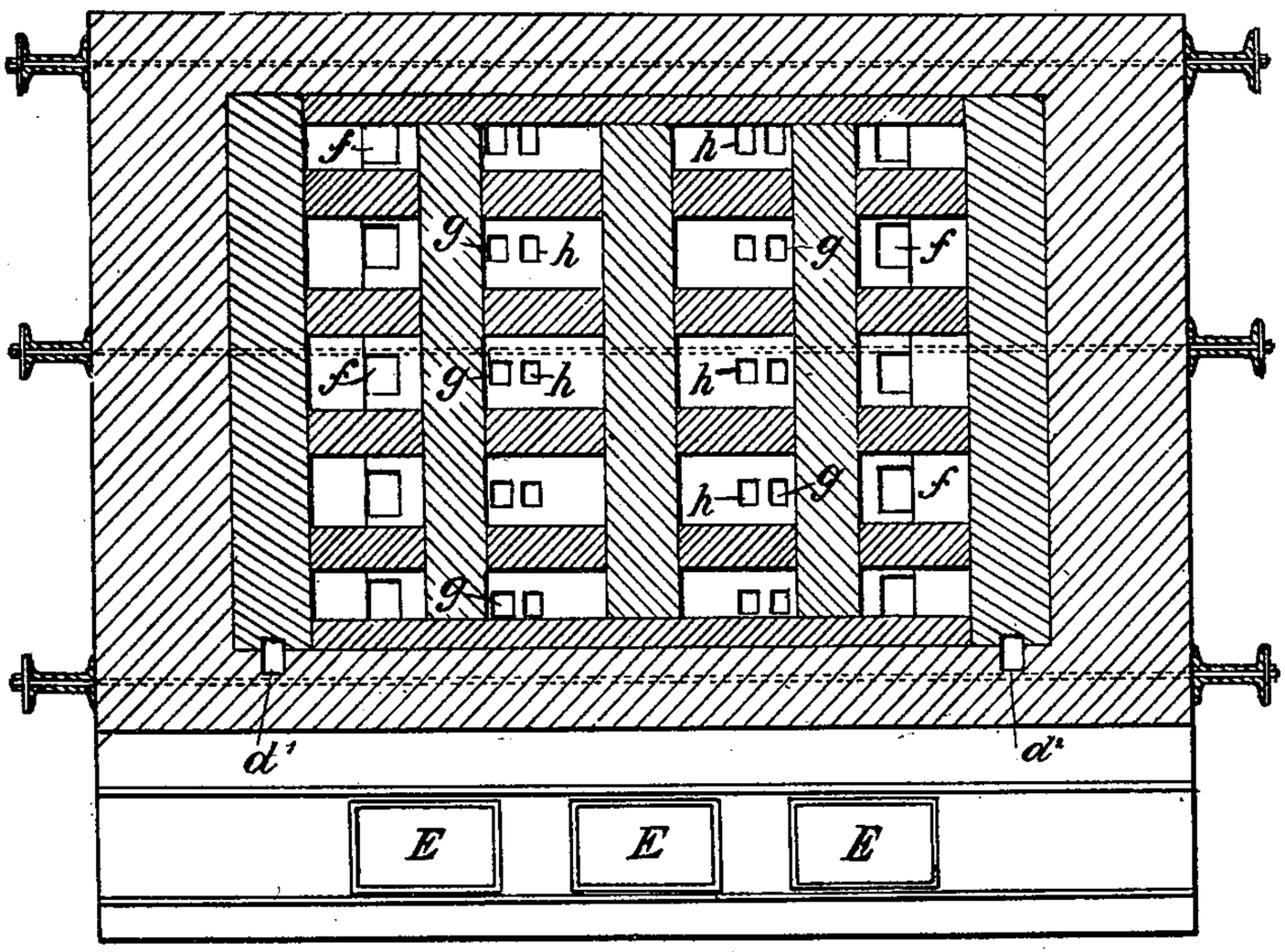
RETORT OVEN FOR RECOVERY OF AMMONIA.

(Application filed Dec. 14, 1898.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 3.



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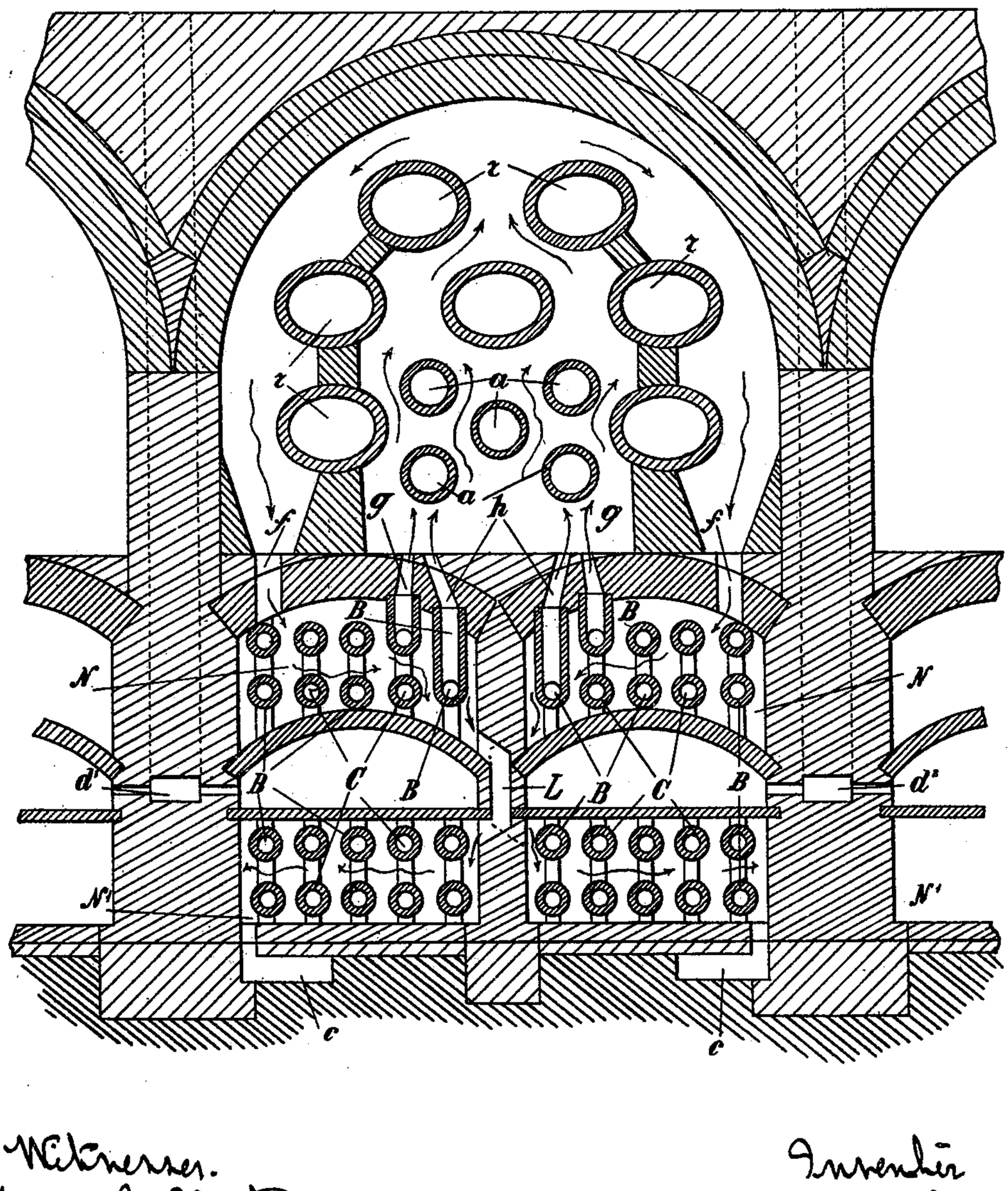
RETORT OVEN FOR RECOVERY OF AMMONIA.

(Application filed Dec. 14, 1898.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 4.



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No. 672,059. Patented Apr. 16, 1901.

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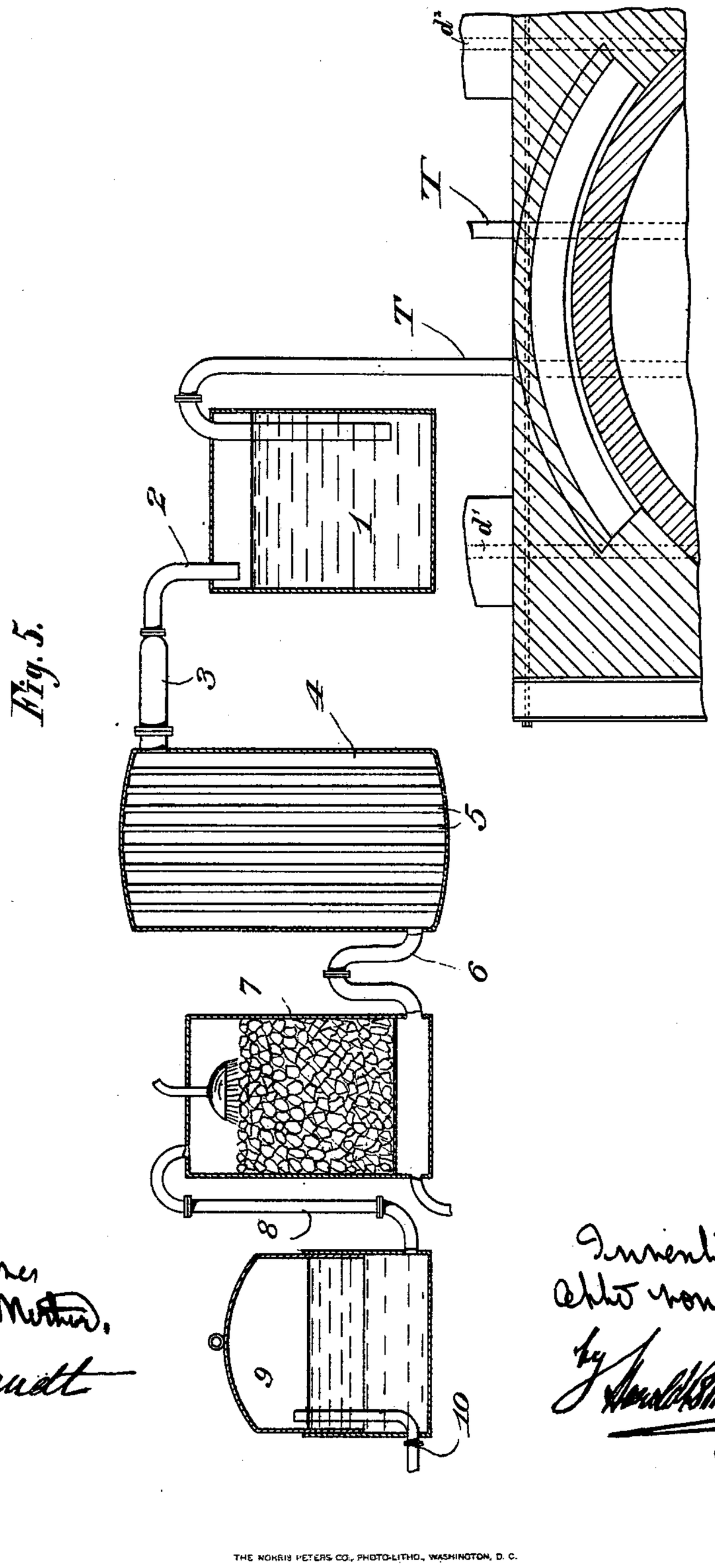
RETORT OVEN FOR RECOVERY OF AMMONIA.

(Application filed Dec. 14, 1898.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 5.



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UNITED STATES PATENT OFFICE.

OTTO VON GIESÈ, OF HAMBURG, GERMANY.

RETORT-OVEN FOR RECOVERY OF AMMONIA.

SPECIFICATION forming part of Letters Patent No. 672,059, dated April 16, 1901.

Application filed December 14, 1898. Serial No. 699,279. (No model.)

To all whom it may concern:

Be it known that I, OTTO VON GIESÈ, a citizen of the free city of Hamburg, residing at Hamburg, in the German Empire, have invented certain new and useful Improvements in Retort-Ovens for the Separation of Nitrogen, of which the following is a specification.

This invention relates to an oven for the separation of nitrogen from industrial waste—for instance, from distillers' waste. The chief features of the oven are that it has besides the gasifying-retorts decomposing-retorts which are considerably smaller than the former and are preferably also tube-shaped and calcining-furnaces arranged below the retorts, besides tubes serving for the preliminary heating of the air and gas for heating the retorts. The decomposing-retorts are arranged in the oven in such a manner that they are exposed to the hottest part of the flame and are heated more than the gasifying-retorts. The calcining-furnaces and the tubes for heating the air and gas are situated below the base of the retort part of the oven. In consequence the space required for the erection of the oven is as small as it can possibly be and the surfaces of the stone or brick walls, which have to be passed by the hot gases traveling through the oven from top to bottom and which absorb heat, are also limited as much as possible. As the calcining-furnaces are situated directly below the retorts, the solid residue from the coking or gasifying retorts, which is suitable for burning in the calcining-furnaces, can be fed to the grates of the latter with the least amount of labor.

In order that this invention may be the better understood, I now proceed to describe the same with reference to the accompanying drawings and to the letters and figures marked thereon.

Figures 1 to 3 illustrate, as an example, one construction of the oven, Fig. 1 showing by a vertical transverse section through the oven the essential features of this construction, Fig. 2 being a vertical longitudinal section on the broken line C D, Fig. 1, and Fig. 3 a horizontal section on the line E F, Fig. 1, showing the position of the orifices for admitting the air and gas into the retort-chamber. Fig. 4 shows a vertical section, similar to Fig. 1, of a modified construction of the oven in which the arrangement of the gas-decomposing tubes is different. Fig. 5 is a detail vertical sectional view of the top of the oven and the apparatus for separating the valuable components of the gases as they pass from the decomposing-retorts.

r indicates the coking or gasifying retorts, having tightly-fitting detachable doors or covers, through which the distillers' wash or other waste material is fed after it has been thickened with calcined material from the calcining-furnace. These doors *b* and *t*, Fig. 2, fit tight to the retorts *r*. From each of the latter branches off a tube *d*, all tubes *d* leading to a common collecting vessel S, which receives the gas developed in the retorts *r*. The tubes *d* may be attached to the doors or covers *b* and the latter to the retorts *r* in any suitable manner, so that the doors *b* close the retorts tightly and can be easily removed to allow of feeding the retorts *r* and that the connection of the tubes *d* with the covers or doors *b* is secure and tight. In the construction shown in Figs. 1 to 3 the gases are conducted from the collecting vessel S to retorts *a* for decomposing the gases through pipes R. (See Figs. 1 and 2.) The tube R conducts the gases to the lowest retorts *a*, as shown in dotted lines in Fig. 1. The gases pass then from the lowest decomposing-retorts *a* to the middle retorts *a* through a pipe or pipes, kept as short as possible, conveniently situated in the front wall of the oven, but not shown in the drawings. From the middle retorts *a* the gases pass in a similar manner to the upper retorts *a*. In these decomposing-retorts *a* the nitrogenous gases are decomposed—that is to say, the nitrogen is changed into ammonia. The gases pass from these retorts through the tube T into the pitch-receiver 1, Fig. 5, which is a closed water-receiver that retains the accompanying particles of pitch and by reason of its water seal renders any explosions that might take place in the oven non-injurious. From thence the gases are conducted, through the tubes 2 and 3, into a cooler 4, through the tubes 5 of which cold water is caused to flow, and then through the stand-pipe 6 into the washer or absorber 7, in which the ammonia is absorbed. The remaining gases, which are composed of combustible compounds containing carbon, pass through the pipe 8 and are collected in the gasometer

9. This apparatus is designed for the purpose of absorbing such constituents containing nitrogen as are of value in practice and for the regeneration of the remaining combustible gases. From the gasometer 9 the gases pass through tube 10 into the tubes C, in which they are heated by the waste gases of combustion of the retort part on the oven, Fig. 1. The manner in which the tubes C may be arranged—for instance, in the lower part of the whole oven—is clearly shown in Figs. 1 and 2. The gases enter the tubes C as low as possible, Fig. 2, and pass upward in the manner shown in the same figure until they enter the combustion-chamber of the retorts through nozzles *g*, Fig. 1.

The pipes B for conducting the air required for the combustion of the gas passing through the pipes C are arranged in the same manner as the latter, Fig. 1. The air also enters into the lowermost tubes B, which are acted on last by the waste gases of combustion-chamber surrounding the retorts. The air rises in the pipes B, as shown in Fig. 1, in order to enter also into the combustion-chamber through nozzles *h*. When the gas and air enter into the combustion-chamber through the nozzles *g h*, as described, they mix immediately and form long flames, which completely surround the decomposing-retorts *a* and act on them. In this manner the decomposing-retorts *a* are exposed to the greatest heat, while the larger coking or gasifying retorts *r*, situated outside the retorts *a*, are heated to a less extent by flames of decreasing temperature. (See Fig. 1.) In this figure arrows indicate the way taken by the flames acting on the retorts *r* and *a*. It will be seen from the figure that the hot gases after having heated the retorts in the combustion-chamber pass through orifices *f* into the upper tube-chambers N, which contain the upper parts of the air-pipes B and gas-pipes C. These pipes C B are acted on in the transverse direction of the oven by the hot gases entering through the orifices *f*, and thus become heated to a high temperature. This heat passes into the air and gas passing through the tubes C B, respectively. Such air and gas are therefore sufficiently heated to ignite when leaving the nozzles *g* and *h*. The waste gases pass from the chamber N, through channels L, Fig. 1, into chambers N′, situated below the calcining-ovens D′ D² and containing the lower part of the tubes C D. The latter are also acted on by the waste gases, which finally escape through the orifices *c′* into the channels *c* and to the chimney. As shown in Fig. 1, the waste gases of combustion entering the chambers N through orifices *f* pass to the lower chambers N′ in such a manner as to heat the calcining ovens or furnaces D′ D² very effectively.

The calcining ovens or furnaces D′ D² are further heated from inside. The solid residue remaining in the retorts *r* serves for this purpose. This residue is fed to the grates E of the calcining-furnaces D′ D², Figs. 2 and 3, in the following manner: An upright telescopic pipe or flue *u* has its upper end bent at a right angle toward the retorts *r* and is arranged so that its bent end can be easily moved before each retort *r*, from which the residue is removed into the tube by suitable tools or mechanical devices. The residue falls through the telescopic tube *u* onto the before-mentioned grates E, on which it is burned, and develop the heat necessary for the inside of the calcining-furnaces D′ D². The gases developed on the grate or grates E pass through openings E², Fig. 2, into the calcining ovens or furnaces D′ D². These gases and the vapors and gases developed in the ovens and furnaces D′ D² pass through orifices *e*, Figs. 1 and 2, into exit-channels *d′ d²*, Fig. 1. The arrangement of the channels *d′* and *d²* in the brickwork is shown by dotted lines, Fig. 2. Fig. 3 shows a horizontal section of these two channels *d′ d²*.

The telescopic tube *u* is suspended, as shown in Fig. 2, from a running device *v*, and the lower end travels on rails, also shown in Fig. 2, so that the tube *u* can be moved in the transverse direction of the oven in order to be placed alternatively before the three vertical rows of retorts shown in Fig. 1. As the tube *u* is telescopic, its upper orifice *o*, which is bent toward the retorts *r*, as before mentioned, can be raised or lowered, so as to be placed before any of the three rows of retorts *r* above one another. It will be obvious from the foregoing description and from the drawings that the orifice *o* of the tube *u* can be placed in front of each of the retorts *r* and that therefore the solid contents of each retort *r* can be removed through the tube *u* to one or other of the grates E. In Fig. 3 three grates E are shown corresponding to the three vertical rows of retorts *r*. The flues E² from the three grates E are arranged so that the entire heat developed on the grates E is distributed equally to the two calcining ovens or furnaces D′ D². The particular construction of the channels E² is not shown in the drawings, because it is not essential to the invention. M indicates doors, Figs. 1 and 2, through which the material to be calcined can be fed into the ovens or furnaces D′ D² and the calcined material removed therefrom.

The reasons for the before-described separate arrangement of the decomposing-retorts *a* are as follows: In order to decompose the gases developed in the retorts *r*, so that the nitrogen can be separated therefrom chemically by glowing contact bodies—such as aluminates, bauxite, lime, and similar materials—a considerably greater heat is required than for driving off the gases from the waste—for instance, distillers' wash—fed into the retorts *r*. If the decomposition of these driven-off gases were effected in the retorts *r*, the latter would have to be heated much more strongly than would be necessary for only driving off the gases from the waste, and consequently a much greater amount of fuel would be nec-

essary. To overcome this disadvantage, to keep the temperature in the oven as low as convenient, and to utilize the heat produced to the best advantage, so that the waste gases enter the channels *c* at a temperature of not more than 350° to 400° centigrade, the small decomposing-retorts *a* are arranged, through which pass the gases produced in the large retorts *r*. These retorts *a* are surrounded by the greatest heat of the combustion-chamber, as shown in Fig. 1, so that their temperature rises to the highest of the whole oven. In order to change the nitrogen from the retort-gases into ammonia, a temperature of from 800° to 900° centigrade is required; but a temperature of from 300° to 600° centigrade is sufficient to gasify the materials in the retorts *r*, which can be formed into gas. When the gases or flames have played around the decomposing-retorts *a*, their temperature is such that it is sufficient to heat the large retorts *r*, but not to heat the decomposing-retorts *a* sufficiently. Thus heat is extracted from the flames or heating-gases gradually and gas is produced at low temperature in retorts *r* and decomposed at high temperature in separate retorts *a* to obtain the nitrogen as a valuable product. This gradation of work of the retort part of the oven forms the principal part of this invention. A second part of the invention, which is also of importance, is the special construction of the oven, as shown in Figs. 1 and 2. It will be seen from Fig. 1 that the fire-gases after having left the retort or combustion-chamber through the orifices *f* pass to the exit-channels *c* by a very short way, but that they nevertheless play on a very considerable heating-surface on the pipes B C and the calcining-ovens. It will also be seen from Fig. 1 that those surfaces of the oven which extract heat uselessly from the fire-gases after the latter have left the combustion-chamber through exits *f* are very small, and that therefore the loss of heat by conduction through the brickwork is also very small. This is a great improvement on old constructions, the gas-channels of which are always long and narrow, so that they have a very large surface giving off heat uselessly to the outside. It is also of great importance that this construction and arrangement of the chambers N N′ for the preliminary heating of the air and gas obviates explosion, even if the gas-pipes and air-pipes should leak. Any air and combustible gas escaping will mix with much greater quantities of completely-burned gases which surround the pipes B and C in which the air and gas for combustion are preliminarily heated, so that a combustible mixture cannot be formed. Therefore the possibility of an explosion must be excluded.

The temperature of the flame playing on the four lower decomposing-retorts in Fig. 1 may reach from 1,000° to 1,500° centigrade. In the upper part of the combustion-chamber, where the flames spread to both sides, the temperature is from 200° to 300° centigrade less, therefore from 800° to 1,200° centigrade. When entering the orifices *f*, the temperature of the gases of combustion is still about from 500° to 700° centigrade, and during the passage through the chambers N N′ the temperature of such gases falls to about 400° centigrade, so that the gases when passing through the exit-channels *c* are still from 350° to 380° centigrade.

The modified construction shown in Fig. 4 will be easily understood without further description. The essential difference which should be mentioned is that only seven gasifying-retorts *r* and five decomposing-retorts *a* are used. However, the number of such gasifying-retorts and decomposing-retorts will be arranged according to requirement.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a retort-oven, the combination with an upper chamber containing decomposing-retorts and gasifying-retorts, of a lower chamber containing air and gas tubes for supplying a combustible mixture to said upper chamber, and means for carrying the products of combustion back through said lower chamber to heat said air and gas tubes.

2. In a retort-oven, the combination with an upper chamber containing decomposing-retorts and gasifying-retorts, of a lower chamber containing air and gas tubes for supplying a combustible mixture to said upper chamber, a calcining-furnace located in said lower chamber and dividing it into an upper and a lower section, and means for carrying the products of combustion back through the sections of said lower chamber and past said calcining-furnace.

3. In a retort-oven, the combination with an upper chamber containing a plurality of retorts for receiving material to be gasified, and one or more calcining-furnaces located below said upper chamber, of a vertically-telescopic and longitudinally-movable feed tube or flue adapted to form a means of communication between any one of said retorts and the calcining furnace or furnaces, whereby the residue in said retorts may be fed into said calcining furnace or furnaces.

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

OTTO VON GIESÈ.

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