

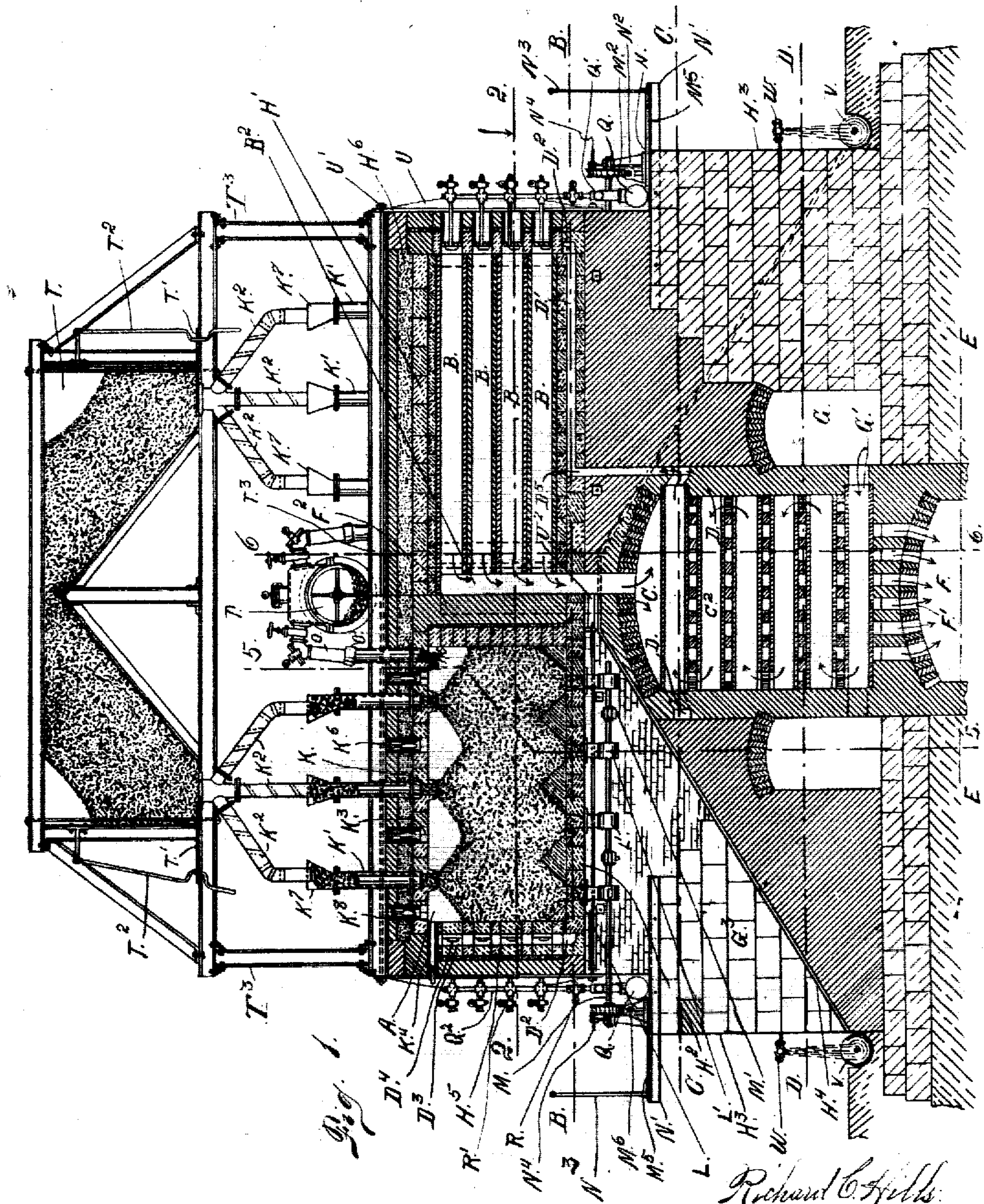
No. 825,536.

PATENTED JULY 10, 1906.

R. C. HILLS.  
CONTINUOUSLY OPERATING RETORT FURNACE.

APPLICATION FILED JULY 3, 1905.

6 SHEETS—SHEET 1



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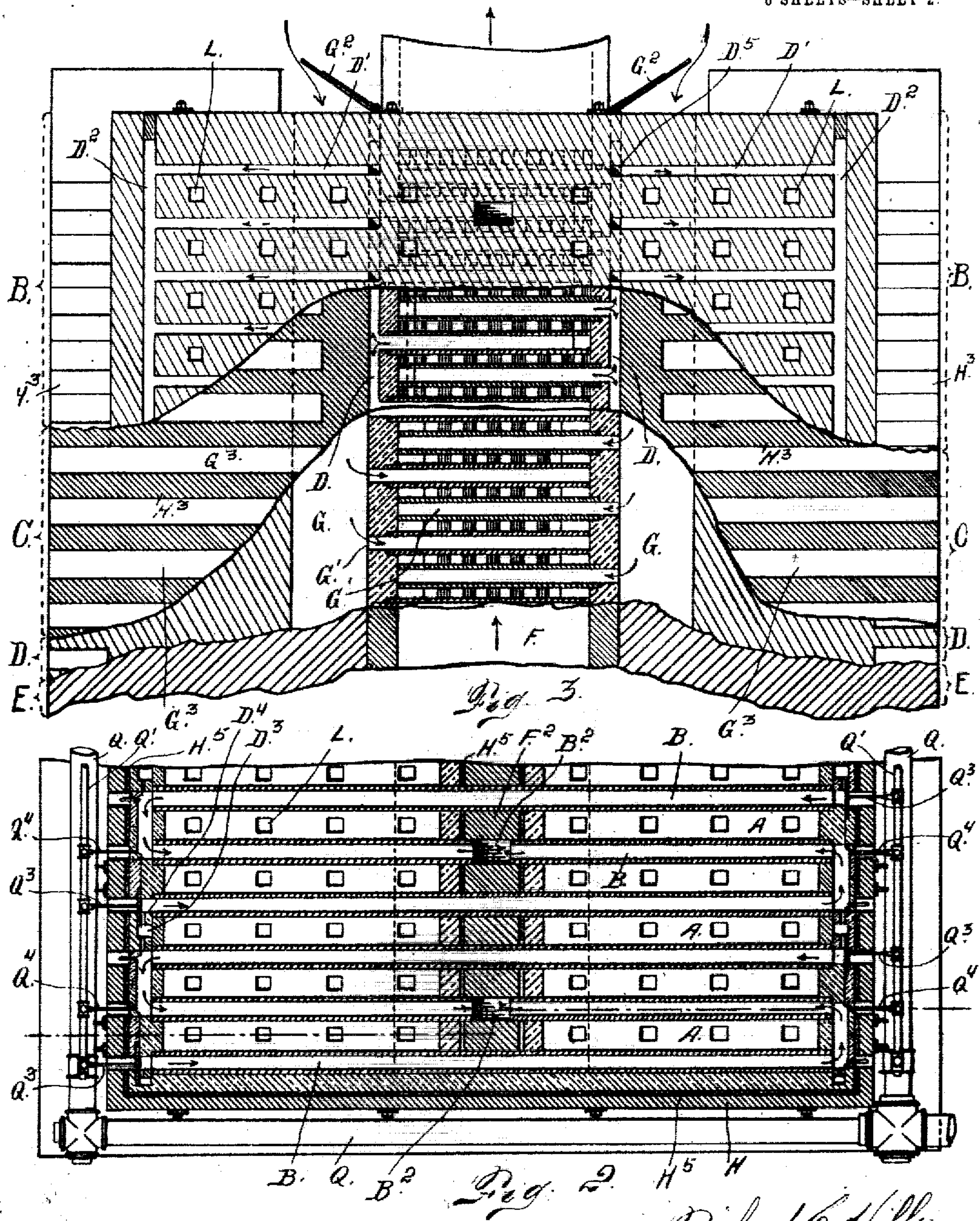
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6 SHEETS—SHEET 2.



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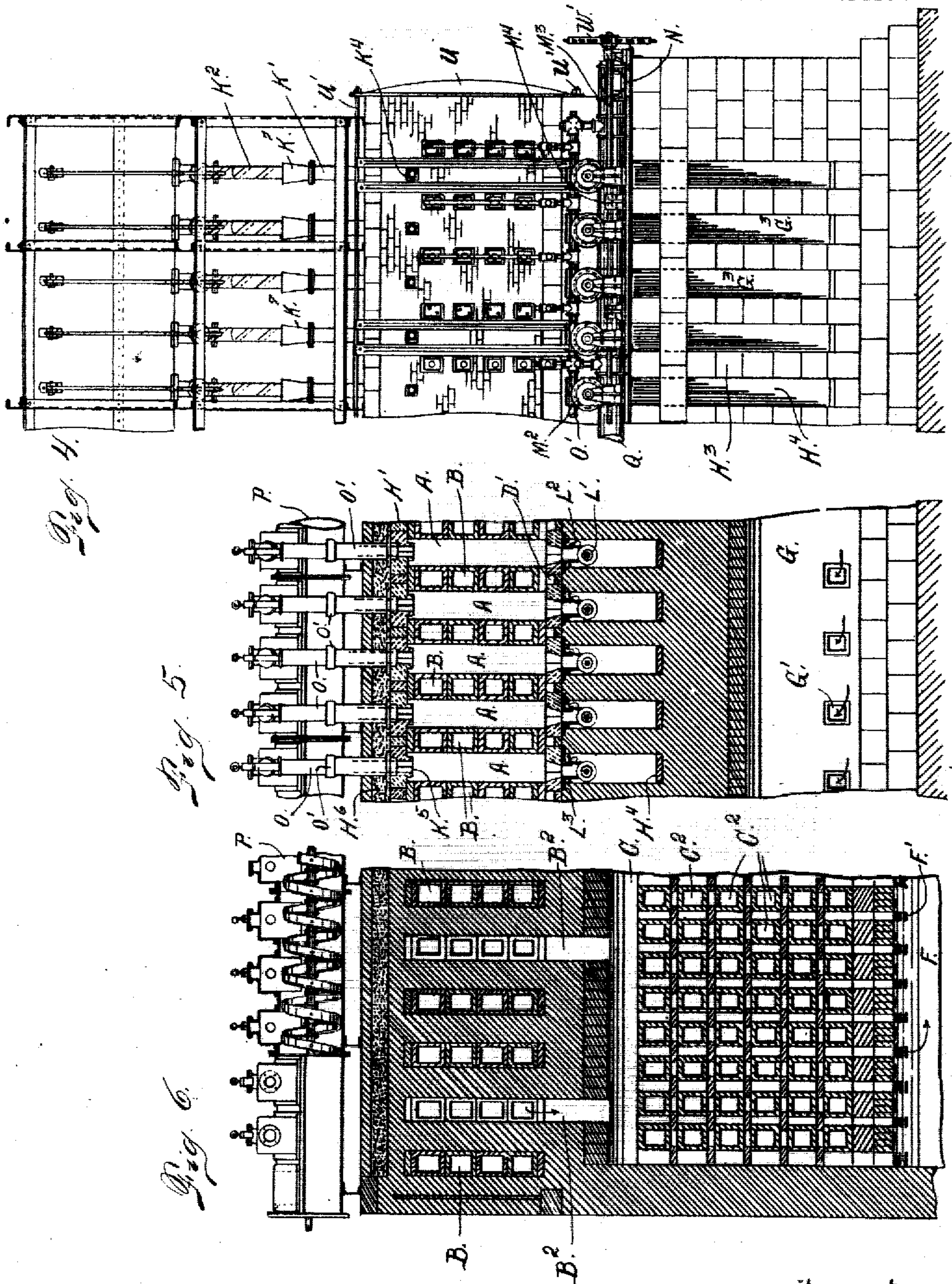
No. 82,536.

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6 SHEETS—SHEET 3.



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6 SHEETS—SHEET 4.

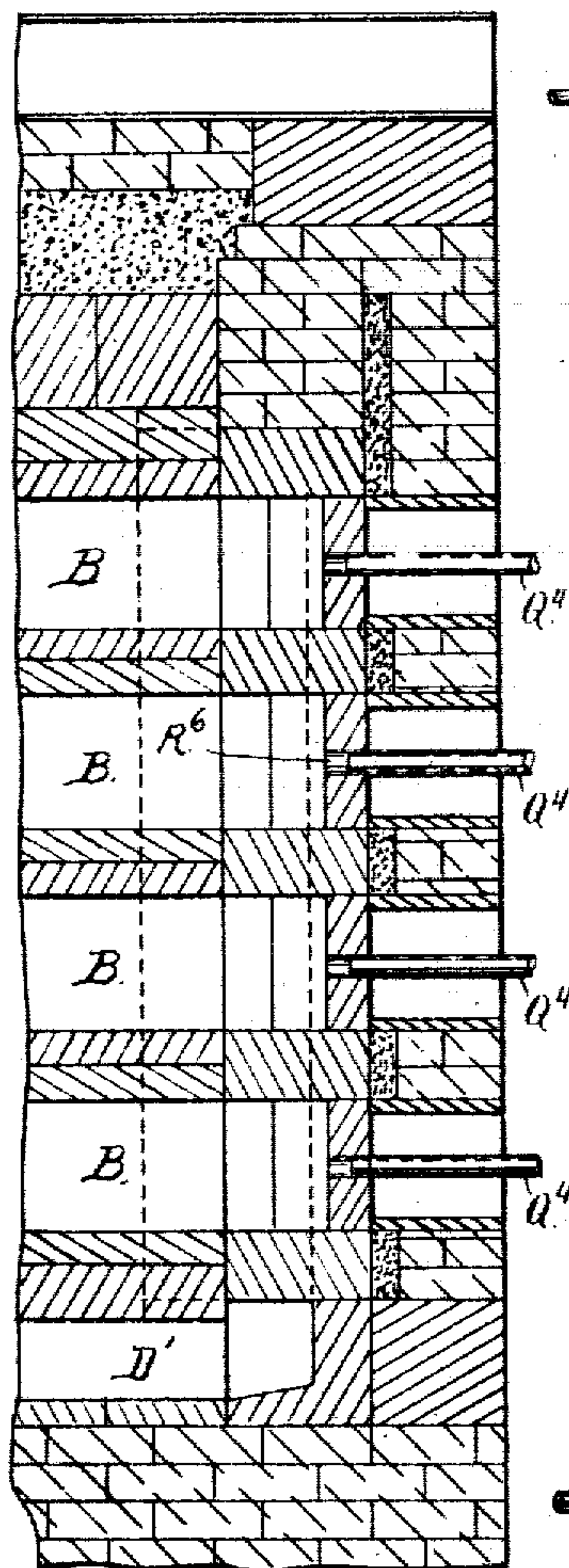


Fig. 8.

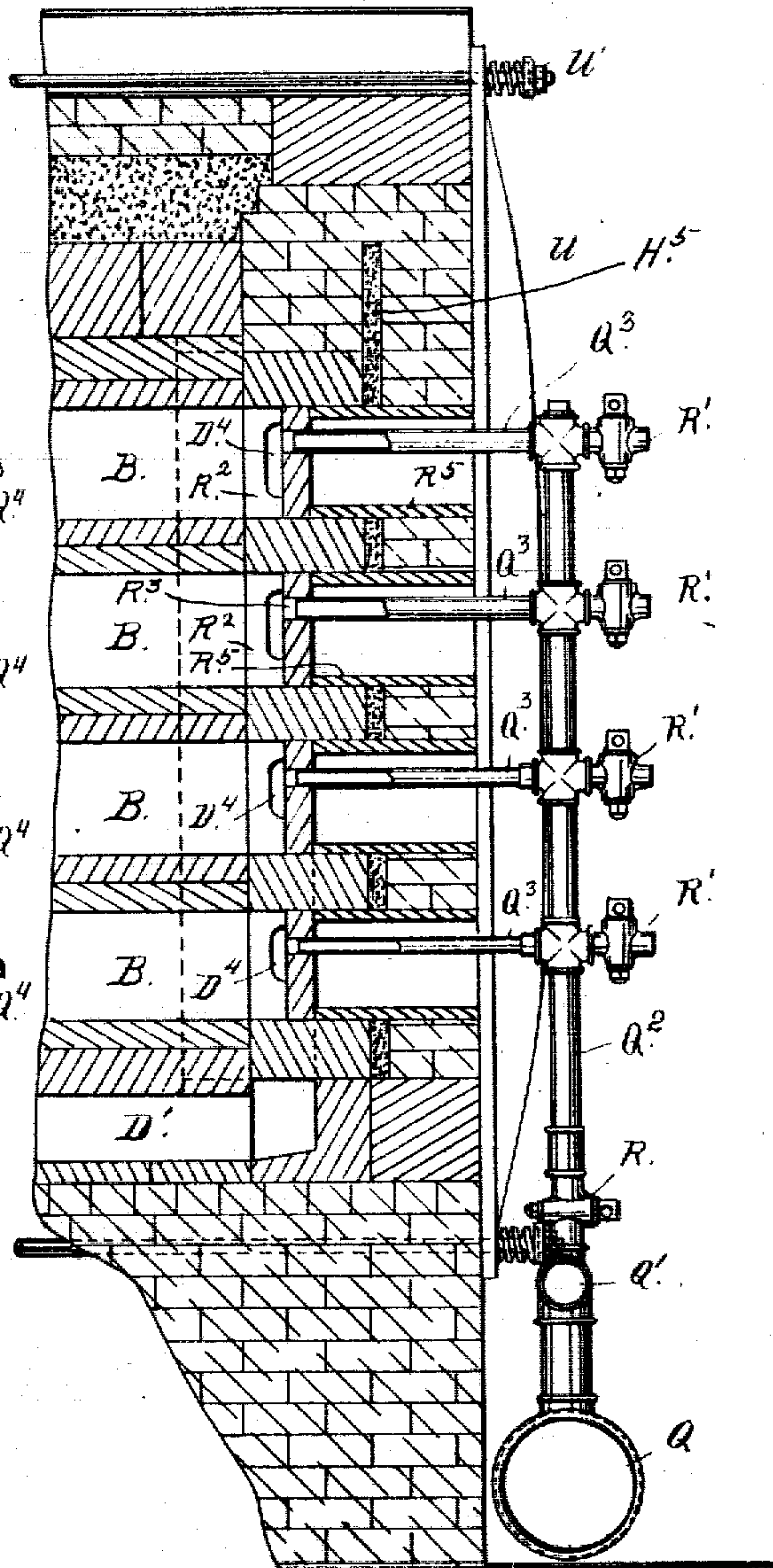


Fig. 7.

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6 SHEETS-SHEET 5.

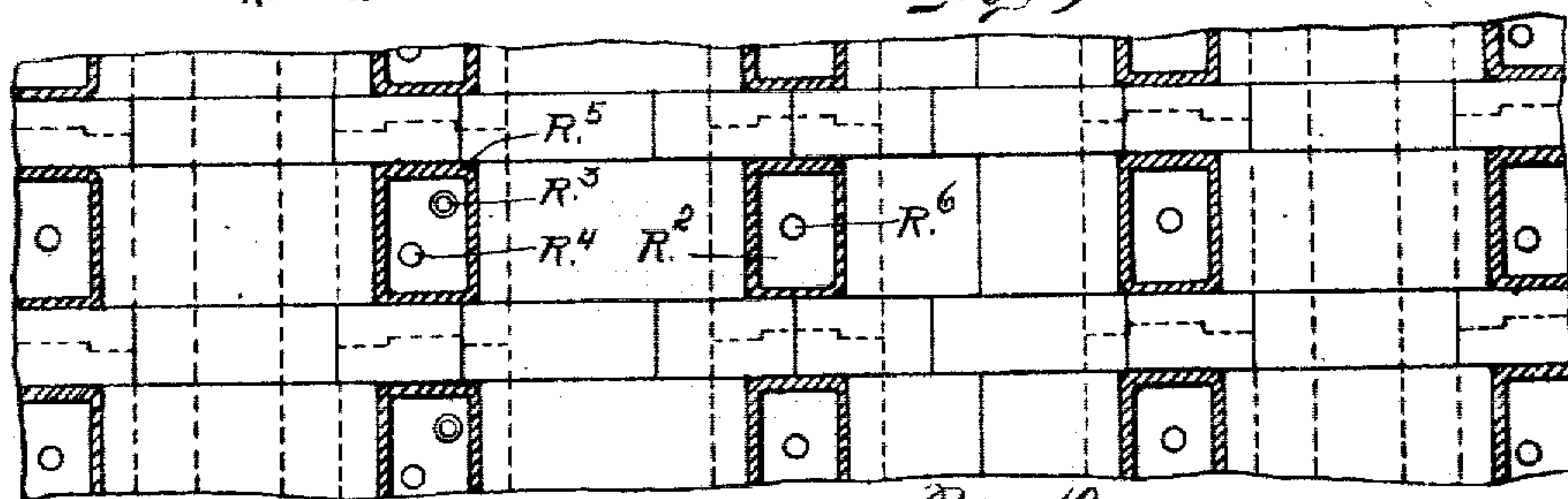
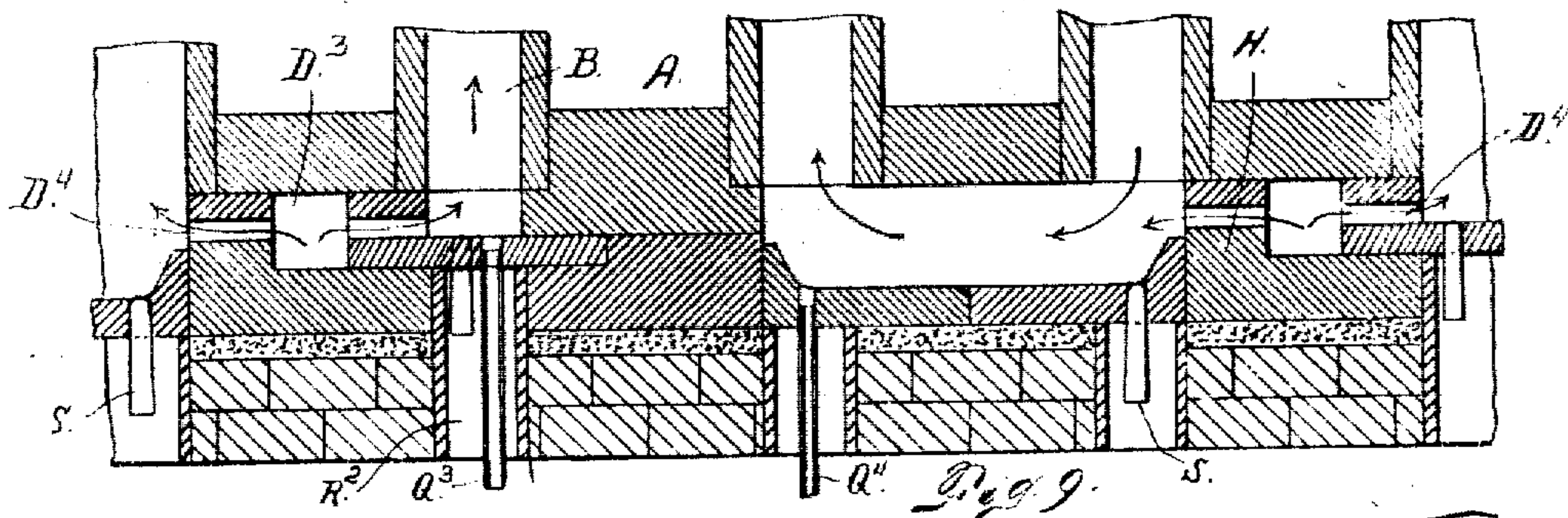


Fig. 10.

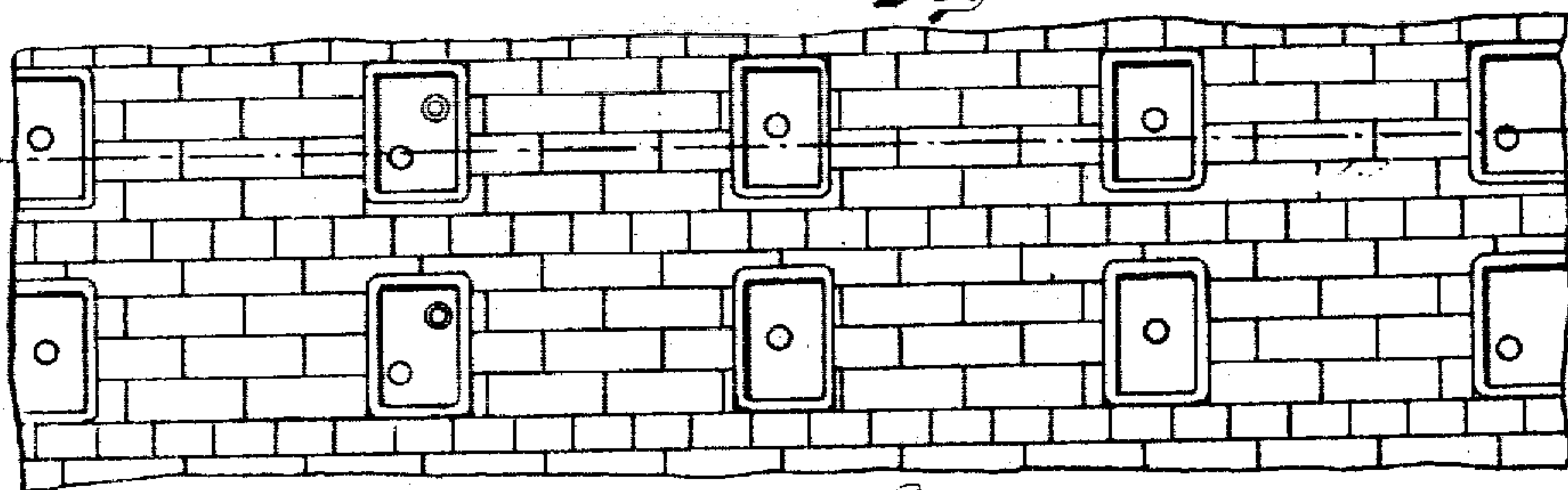


Fig. 10-A

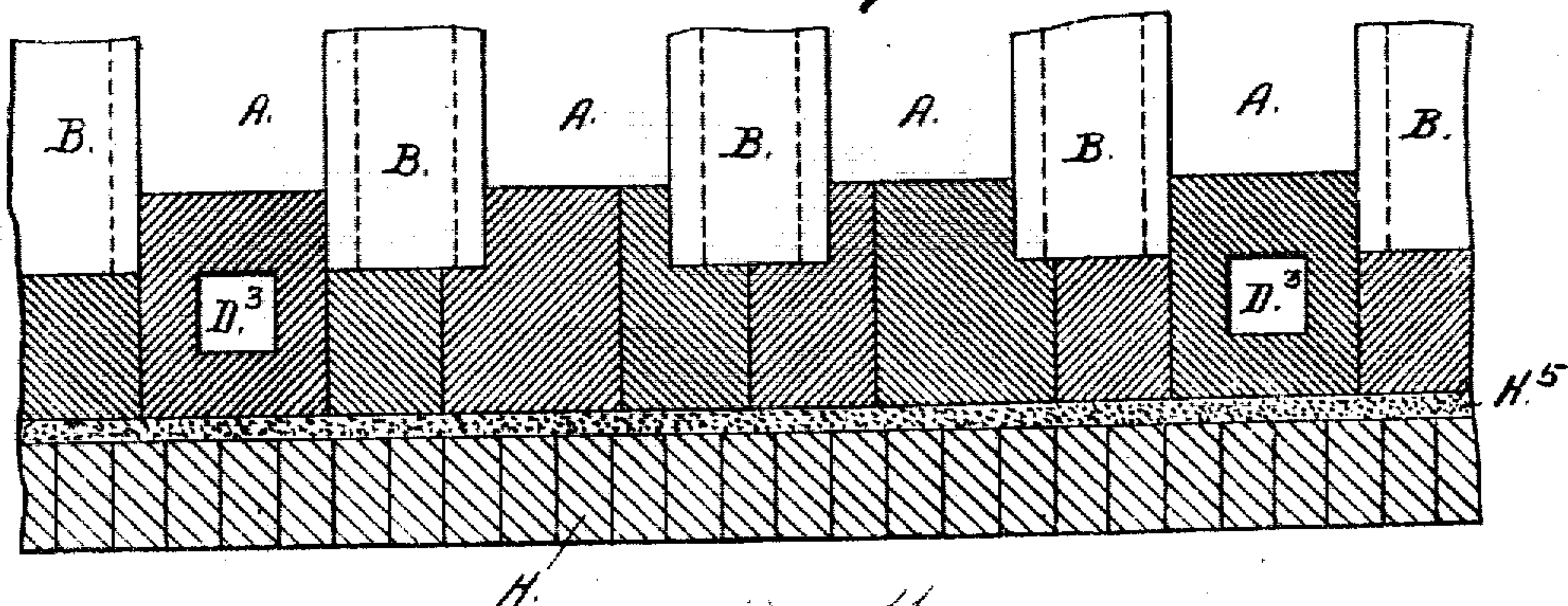


Fig. 11.

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# UNITED STATES PATENT OFFICE.

RICHARD C. HILLS, OF DENVER, COLORADO.

## CONTINUOUSLY-OPERATING RETORT-FURNACE.

No. 825,536.

Specification of Letters Patent.

Patented July 10, 1906.

Application filed July 3, 1905. Serial No. 268,258.

*To all whom it may concern:*

Be it known that I, RICHARD C. HILLS, a subject of the King of Great Britain, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Continuously-Operating Retort-Furnaces; and I do 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, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to retort-furnaces more especially adapted for the treatment of coal for the purpose of removing its volatile products, preparatory to the formation of briquets from the retorted coal by mixing therewith the condensed volatile products in the form of tar and pitch.

My present invention only has to do with the retorting of the coal and the removal of the volatile products therefrom. The means for carrying out the subsequent steps resulting in the final formation of briquets in a press or briquet-machine is or will be covered by other applications.

I will first give a brief description of the invention without mentioning reference characters and subsequently describe the construction in detail by the use of reference characters for the different figures in the case.

My improved construction, generally speaking, consists of a furnace having two banks or series of vertically-disposed retorts arranged on opposite sides of the central part of the furnace. These retorts are relatively narrow parallel chambers, and the necessary heat is supplied through the instrumentality of combustion-flues, which are arranged in vertical series intermediate the retorts. Each of these combustion-flues passes between two retorts on both sides of the furnace, passes around one of these retorts, and returns on the opposite side of the same as far as the central part of the furnace, where it joins a vertically-disposed flue leading downwardly to a recuperator or regenerating-chamber, finally passing to a main flue at the bottom and thence to the stack, through the instrumentality of a blower or exhaust fan, (not shown,) whereby sufficient draft is maintained to cause the products of combustion to take the

course indicated. Each vertically-disposed flue for carrying the products of combustion downwardly to the regenerating-chamber receives these products from two series of combustion-flues. One series of combustion-flues commences on one side of the furnaces, passes the entire length of both banks of retorts, returns half the width of the furnace on the opposite side of the retort, and terminates at the vertically-disposed or downcast flue leading to the regenerating-chamber, while another series of flues may be said to commence on the opposite side of the furnace, passing between two retorts of the two banks, around one retort, and back to the same vertically-disposed or downcast flue. By virtue of this construction the said downcast or vertical flue leading to the regenerating-chamber is common to two series of combustion-flues each series extending the entire length of both banks of retorts around the end of one of the retorts and back to the center, where the downcast flue is located.

The regenerating-chamber contains flues through which is passed air to be heated to supply the combustion-flues, the said air being carried upwardly and delivered to the said chambers, whereby it is caused to mingle with the gas from the burners, thus supplying the necessary oxygen for approximately perfect combustion.

Mounted above the retorts of the furnace is a bin, connected with which are depending feed-pipes or conduits, which pass through openings in what I will term the "roof" of the furnace, whereby each retort is continually supplied with coal. The bottom of each retort is provided with a number of discharge-openings, below which are located pocket-wheels mounted upon a continuously-rotating shaft, each wheel having a pocket to receive the retorted coal, and by virtue of the rotation of the wheel a quantity of coal is intermittently discharged from each discharge-opening of the retort. The pockets of the various wheels are preferably out of line, whereby they do not simultaneously but successively discharge the coal from the retorts. This discharge from each retort passes downwardly to a steeply-inclined hearth, the discharge from which passes to screw conveyers through the instrumentality of which the retorted product may be carried to any desired location.

Communicating with each retort is a con-



duit, leading upwardly, for carrying off the volatile by-products of the coal, which are delivered to a mixing-scrubber, which, as heretofore indicated, forms subject-matter for a separate application.

The invention will now be described in detail, reference being made to the accompanying drawings, in which—

Figure 1 is a vertical section taken through the furnace lengthwise of the retorts. This section is taken in two planes, the portion of the view at the left being taken through a retort, while that at the right is taken through the shorter portion of a series of combustion-flues between the retorts. Fig. 2 is a horizontal section taken through the furnace on the line 2 2, Fig. 1. Fig. 3 is a horizontal section taken through the furnace in four different planes, the sectionized parts of the view in the various planes being designated as B, C, D, and E, and the sections being taken on lines B B, C C, D D, and E E, respectively, of Fig. 1. Fig. 4 is a fragmentary side elevation of the furnace, the term "side" referring to the right and left portions of the furnace as disclosed in Fig. 1. Figs. 5 and 6 are vertical sections taken on the lines 5 5 and 6 6, respectively, of Fig. 1. Figs. 7 and 8 are fragmentary vertical sections taken through the sides of the furnace in two different planes, Fig. 7 being in the plane of the main burners, and Fig. 8 in the plane of the supplemental or auxiliary burners, the parts being shown on a larger scale. Fig. 9 is a horizontal section taken through the furnace in the plane of the burners and a horizontal series of combustion-flues. Fig. 10 is a fragmentary front elevation, partly in section, showing the openings in which the burners are located, as well as the peep and observation holes. Fig. 10<sup>a</sup> is a fragmentary view similar to Fig. 10, except that it is in elevation proper. Fig. 11 is a horizontal section taken through the side wall of the furnace, cutting the vertical flues through which the hot air is supplied to the burners. This section is taken between two horizontal series of combustion-flues, but of course cuts a series of vertically-disposed parallel retorts. Fig. 12 is a fragmentary vertical section taken through the roof of the furnace in the plane of the supply-pipes. This section is virtually the same as that shown at the left of Fig. 1, being the portion thereof above the retort, the parts being shown on a larger scale. Fig. 13 is a fragmentary section taken at right angles to Fig. 12 and cutting the opening through which a feed-pipe passes. Fig. 14 is an underneath view of the roof-bricks, having an opening with which the feed-pipe communicates. Fig. 15 is a fragmentary section taken through a discharge-opening of a retort and cutting a pocket-wheel mounted on a shaft below the retort. Fig. 16 is a fragmentary section at right angles to Fig. 15, a pocket-wheel and

its shaft being shown in elevation. Fig. 17 is a detail view of the feed-pipe construction, illustrated partly in section.

The same reference characters indicate the same parts in all the views.

Referring now to the drawings, let A designate the retort-chambers, through which when in operation the coal is continuously passing.

B designates the combustion-flues, arranged one above another and so disposed horizontally that each one passes from one side of the bank or series of retorts to the other side, passing between two retorts of each bank, the retorts of the opposite bank being arranged end to end. These combustion-flues pass around one end of one retort and return on the opposite side of the retort to the downcast or vertically-disposed flue B<sup>2</sup>, formed in the central wall F<sup>2</sup> and leading to the recuperator or regenerating-chamber C, in which the air-flues C<sup>2</sup> are heated by the products of combustion, the latter passing finally down through the small flues F<sup>3</sup> to the main flue F below and thence to the stack through the instrumentality of an exhaust-fan. (Not shown.)

D, D', D<sup>2</sup>, D<sup>3</sup>, and D<sup>4</sup> are ducts for the distribution of hot air through the ports D<sup>4</sup> into the combustion-flues B.

G designates cold-air flues regulated by ports G<sup>2</sup> and connected with the recuperator or regenerating-flues by the openings G', which alternate regularly from side to side, one flue taking air on one side and the next flue on the opposite side.

G<sup>3</sup> designates spaces situated immediately under the retorts and separated from one another by partitions H<sup>2</sup>. Below each of these spaces G<sup>2</sup> and forming the bottom thereof is a steeply-inclined hearth H<sup>4</sup>, over which the material discharged from the retort slides to a screw conveyer V. These hearths are inclined downwardly in opposite directions on both sides of the furnace. They commence at the center and pass downwardly and outwardly to the screw conveyers, one of the latter being located on each side of the furnace.

H designates the front wall of the furnace, which has a narrow vertical expansion-space H<sup>5</sup>, filled with loose sand, and in which are formed openings R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, and K<sup>4</sup>. The openings R<sup>2</sup> are lined with castings R<sup>5</sup> and accommodate the main burners Q<sup>2</sup>, which enter the combustion-flues through the holes R<sup>3</sup>. The supplemental burners Q<sup>4</sup> enter the combustion-flues through the holes R<sup>4</sup>. The openings R<sup>4</sup>, I term "peep-holes," while K<sup>4</sup> designates observation-ports communicating with the retorts. Through these openings the material within the retorts may be observed. The openings R<sup>4</sup> and K<sup>4</sup> are both normally stopped by plugs S.

H' designates bricks of special form in which are formed the feed-openings K, which



receive the flanged portions of the feed-pipes K'. On the under side of the bricks H' there are downward projections intended to insure a free passage at H' of gases and vapors above the charge.

H<sup>2</sup> designates special floor-bricks for the discharge-openings L, while H<sup>3</sup> designates supporting-pillars, which also serve as partitions located between the separating or sloping hearths H<sup>4</sup> and the spaces G<sup>3</sup>, through which the retorted material passes after leaving the retorts.

H<sup>5</sup> designates a tamping of loam placed between the upper and lower layers of roof-bricks and intended to render the roof practically gas-tight.

Distributing-pipes K<sup>2</sup> lead from the bin T to the feed-pipes K', the latter being provided with hopper-shaped tops K' to permit of the insertion of a rod in case the feed in K' should clog up.

K<sup>3</sup> designates barring-down openings, which are normally closed by plugs K<sup>4</sup>.

K<sup>5</sup> designates a gas-discharge opening in which is inserted a cast-iron pipe O', which in turn receives the lower end of a pipe O.

L' is the pocket-wheel attached to the shaft M. There is a series of these wheels, all mounted on the same shaft and each having a pocket L<sup>4</sup>, which at each revolution of the wheel discharges a given quantity of the retorted product. The shaft M is journaled in supports M' and standards N<sup>2</sup>. This shaft is driven by a spur-wheel M<sup>2</sup>, which is actuated by a worm M<sup>6</sup>, attached to a shaft M<sup>3</sup>, journaled in supports M<sup>4</sup> and connected with suitable power by a sprocket-wheel W'.

L<sup>2</sup> designates a safety-gate adjacent the discharge-opening L<sup>5</sup>. This gate is kept closed until some obstruction—a wrench, for instance—gets into the pocket of the wheel L', in which event the gate is forced open to prevent injury to the structure and closes again automatically by gravity when the obstruction is removed.

L<sup>3</sup> designates an iron casting under the discharge-opening L and to which the gate L<sup>2</sup> is attached.

M<sup>5</sup> designates platforms located on opposite sides of the furnace, each having a rail N<sup>3</sup> and being supported by angle-irons N', which are secured by bolts or in any other suitable manner to the partitions H<sup>3</sup>.

N designates an iron plate secured to the angle-irons N' and extending along the entire length of a bank of retorts to form a base of attachment for the standards N<sup>3</sup> and the journal-supports M<sup>4</sup>.

N<sup>4</sup> designates a foot-plate for convenience in making observations through the upper observation-ports.

P designates a mixing-scrubber described in a simultaneously-pending application. This scrubber contains a screw and receives the gas and tarry matter from the retorts

through pipes O and O', the tar being there incorporated with the crushed coal and coke in carrying out the process described in United States Letters Patent No. 678,296.

Q designates a gas-main extending across one end and along both sides of a bank of retorts. It is connected at intervals by nipples with a distributing-main Q', which supports the upright gas-pipes Q<sup>2</sup>, to which the burners Q<sup>3</sup> and Q<sup>4</sup> are attached. The object of the distributing-main is to avoid the use of too many large T's on the main below it.

R designates gas-cocks on the upright gas-pipes, while R' designates plug-cocks for convenience of clearing out the burners when clogged with gas-carbon.

T designates the overhead storage-bin, which is supplied with fine coal by a conveyor. (Not shown.) This bin is supported by a framework of structural steel T<sup>3</sup> and is connected with distributing-pipes K<sup>2</sup> by the gate T', actuated by the lever T<sup>2</sup>.

U represents buck-staves supporting the walls by means of tight rods U', which pass through holes U<sup>2</sup> in the masonry.

W designates a water-sprayer for cooling the retort product passing through the screw conveyers V.

When in operation, the requisite heat is maintained by the combustion in the flues B of scrubbed gas (itself a product of the retorts) mixed with hot air from the recuperator or regenerating-chambers in which the flues C<sup>2</sup> are located, as heretofore described. These flues are continuously heated by the products of combustion passing down through the flues B<sup>2</sup> into the chamber C and thence down around the flues C<sup>2</sup> into the main flue F and thence through the small flues F', the requisite draft being maintained by an exhaust-fan, (not shown,) as heretofore explained. The coal being fed into the retorts A through the feed-pipes K', the same is subjected to distillation as it passes continually through the retorts and by the time it reaches the discharge-opening L is practically deprived of all its original volatile constituents. In this condition it is discharged by the revolution of the pocket-wheel L', of which there are four for each retort. All the wheels are fastened to the same shaft M and driven by the worm-gear M<sup>2</sup> and M<sup>6</sup>. The pockets L<sup>4</sup> preferably do not discharge simultaneously, but in rotation and succession, so as to maintain, as nearly as practicable, an even stream of material passing down an inclined hearth H<sup>4</sup> to the screw conveyer V. The volatile products as distilled pass over to the mixing-scrubber P through the pipes O and O'. Such products as are not caught by the scrubber P are carried on to other scrubbers, (not shown,) where they are intercepted. If by observations conducted through the ports K<sup>4</sup> any of the retorts appear to be clogged,



recourse is had to barring down through the openings K' in the roof. This operation goes on continually until for some cause, such as repairs or shortage of material, it becomes necessary to close down.

Having thus described my invention, what I claim is—

1. A retort-furnace provided with two banks or series of horizontally-disposed retorts located on opposite sides of the central part of the furnace in which are located downwardly-extending exhaust-flues communicating with the stack, and combustion-flues interposed between the retorts and extending the entire length of both banks of retorts on one side of the latter, passing around the end of one retort on one side of the furnace and extending in the reverse direction on the opposite side of one retort and finally communicating with the said downwardly extending exhaust-flues.

2. A retort-furnace provided with double banks or series of horizontally-disposed retorts located on opposite sides of the furnace, the furnace being centrally provided with downwardly-extending exhaust-flues, and combustion-flues interposed between the retorts and extending the entire length of both banks of retorts on one side of the latter, passing around the end of one retort and returning in the reverse direction on the opposite side of one of the retorts, and terminating at the downwardly-extending exhaust-flues, the two adjacent vertically-disposed series of combustion-flues, commencing on opposite sides of the furnace and communicating with a common downwardly-extending exhaust-flue.

3. A retort-furnace provided with double banks or series of horizontally-disposed retorts, the individual retorts of each bank being parallel, and the retorts of the two banks being arranged end to end, the furnace being provided with downwardly-extending centrally-located exhaust-flues, and combustion-flues interposed between the retorts and extending the entire length of both banks of retorts on one side of the latter, passing around the end of one retort on one side of the furnace and extending in the reverse direction on the opposite side of one of the retorts, and communicating finally with the said downwardly-extending centrally-located exhaust-flues, a regenerating-chamber with which the exhaust-flues communicate, the regenerating-chamber being provided with flues communicating with the combustion-flues and through which the necessary air for combustion purposes is passed.

4. A retort-furnace provided with double banks of horizontally-disposed parallel retorts arranged end to end on opposite sides of the furnace, horizontally-disposed combustion-flues arranged in vertical series between the retorts, one series of two adjacent series of

flues commencing on one side of the furnace, passing the entire length of the retorts, around the end of one retort, and returning to the central part of the furnace on the opposite side of the last-named retort; while the other series of combustion-flues commences on the opposite side of the furnace, takes a similar course but in an opposite direction finally leading to the central part of the furnace which is provided with a downwardly-extending exhaust-flue with which both series of combustion-flues communicate, the longer portions of each series of combustion-flues being provided with main burners on one side of the furnace and their shorter portions with supplemental burners on the opposite side of the furnace.

5. In a furnace of the class described, the combination of horizontally-disposed retorts arranged in parallel series end to end on opposite sides of the central part of the furnace in which are located downwardly-extending exhaust-flues communicating with the stack, a series of horizontally-disposed combustion-flues extending the entire length of two end-to-end retorts, around the end of one retort and returning to one of the series of downwardly-extending centrally-located flues, on the opposite side of the last-named retort, while the adjacent series of combustion-flues on one side takes a similar course but in the opposite direction, finally leading to the next flue of the downwardly-extending series, means for automatically removing the retorted material from the bottom of the retort, and means for feeding said material into the top of the retorts by gravity alone, as fast as it is removed from below.

6. In a furnace of the class described, the combination of relatively narrow, horizontally-disposed retorts arranged in parallel series in double banks end to end on opposite sides of the central part of the furnace in which are located downwardly-extending flues communicating with the stack, horizontally-disposed combustion-flues extending the entire length of two end-to-end retorts one in each of the opposite banks and returning on the opposite side to one of the said downwardly-extending flues, means for producing an automatic, continuous unobstructed discharge of retorted material at the bottom of the retorts, means for allowing the raw material to feed into the top of the retorts by gravity alone as fast as it is removed from below, and compartments for receiving the material discharged from said retorts, said compartments having downwardly-inclined bottoms sufficiently steep to cause the retorted material of its own gravity to be discharged on the outside of the furnace.

7. In a furnace of the class described, the combination of double banks of horizontally-disposed retorts arranged in parallel series on opposite sides of the furnace, the retorts on



opposite sides of the furnace being arranged end to end, interposed combustion-flues for supplying the necessary heat to the retorts, means for feeding the material into the top 5 of the retorts, means for automatically discharging the material at the bottoms of the retorts as it is fed into the top thereof, separate compartments located below the respective retorts on the opposite sides of the 10 furnace, each compartment having a bottom inclined downwardly and outwardly from the central part of the furnace whereby the retorted material is discharged at the opposite sides thereof, and conveyers located at 15 the opposite sides of the furnace for receiving the retorted material, substantially as described.

8. In a furnace of the class described, the combination of horizontally-disposed retorts 20 arranged in parallel series in double banks arranged end to end on opposite sides of the furnace, means for automatically discharging the retorted material from the bottom of the retorts, said means comprising pocket-wheels 25 and hinged relief-gates operating conjointly below the discharge-openings of the retorts,

and means for allowing the raw material to enter the top of the retorts by gravity alone as fast as the retorted material is removed from below.

9. In a furnace of the class described, the combination of horizontally-disposed retorts arranged in parallel series in double banks arranged end to end on opposite sides of the furnace, means for removing the retorted 35 material from the bottom of the retorts including revolvably-mounted pocket-wheels and hinged relief-gates, means for allowing the raw material to enter the top of the retorts by gravity alone as fast as it is removed 40 from the bottom, the roofs of the retorts having feed-openings and barring-down or working ports situated intermediate the feed-openings, and gas-escape pipes connected with the retorts for the purpose set forth. 45

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

RICHARD C. HILLS.

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