

No. 726,374.

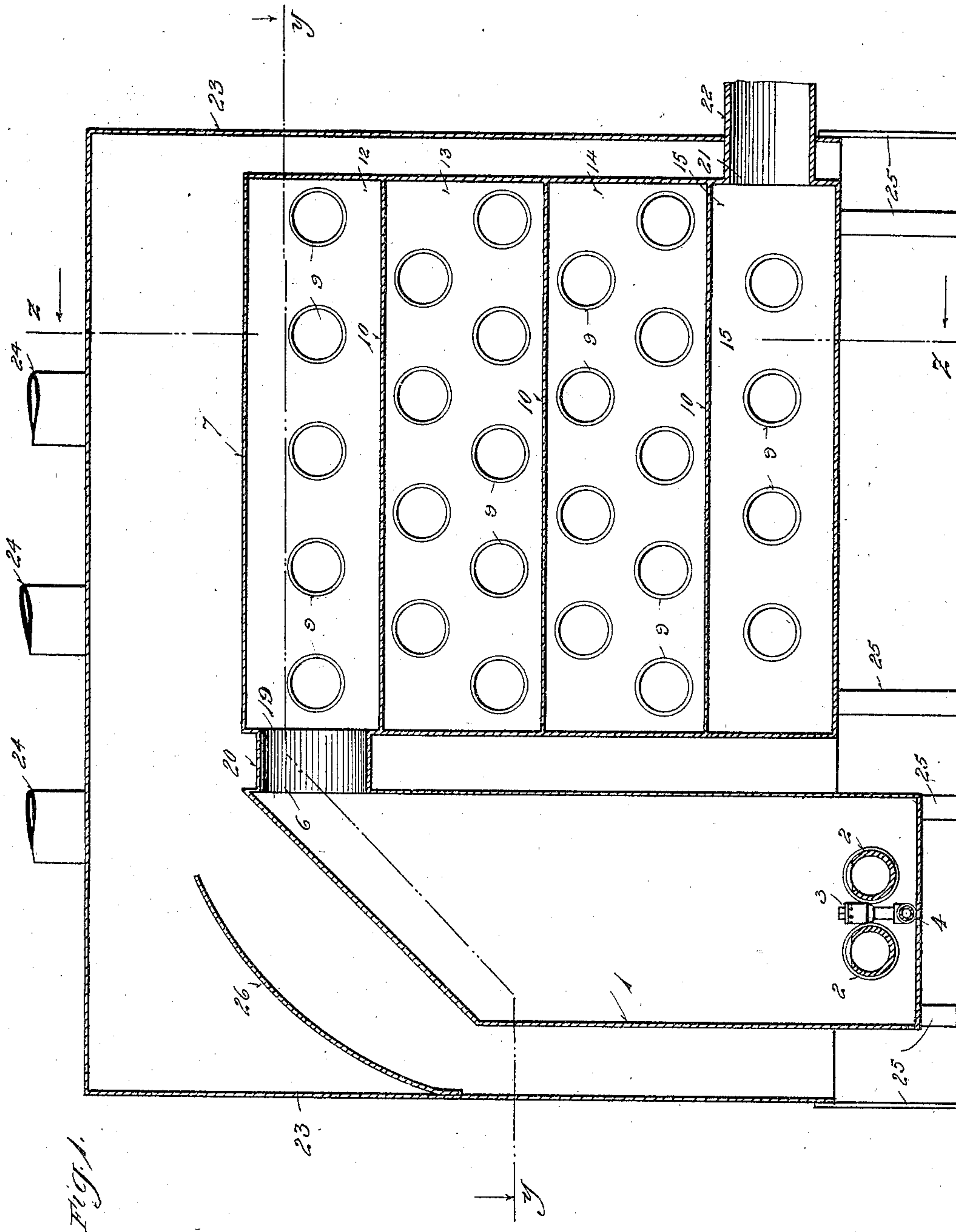
PATENTED APR. 28, 1903.

R. S. THOMPSON.
FURNACE.

APPLICATION FILED DEC. 26, 1901.

NO MODEL.

4 SHEETS—SHEET 1.



WITNESSES:

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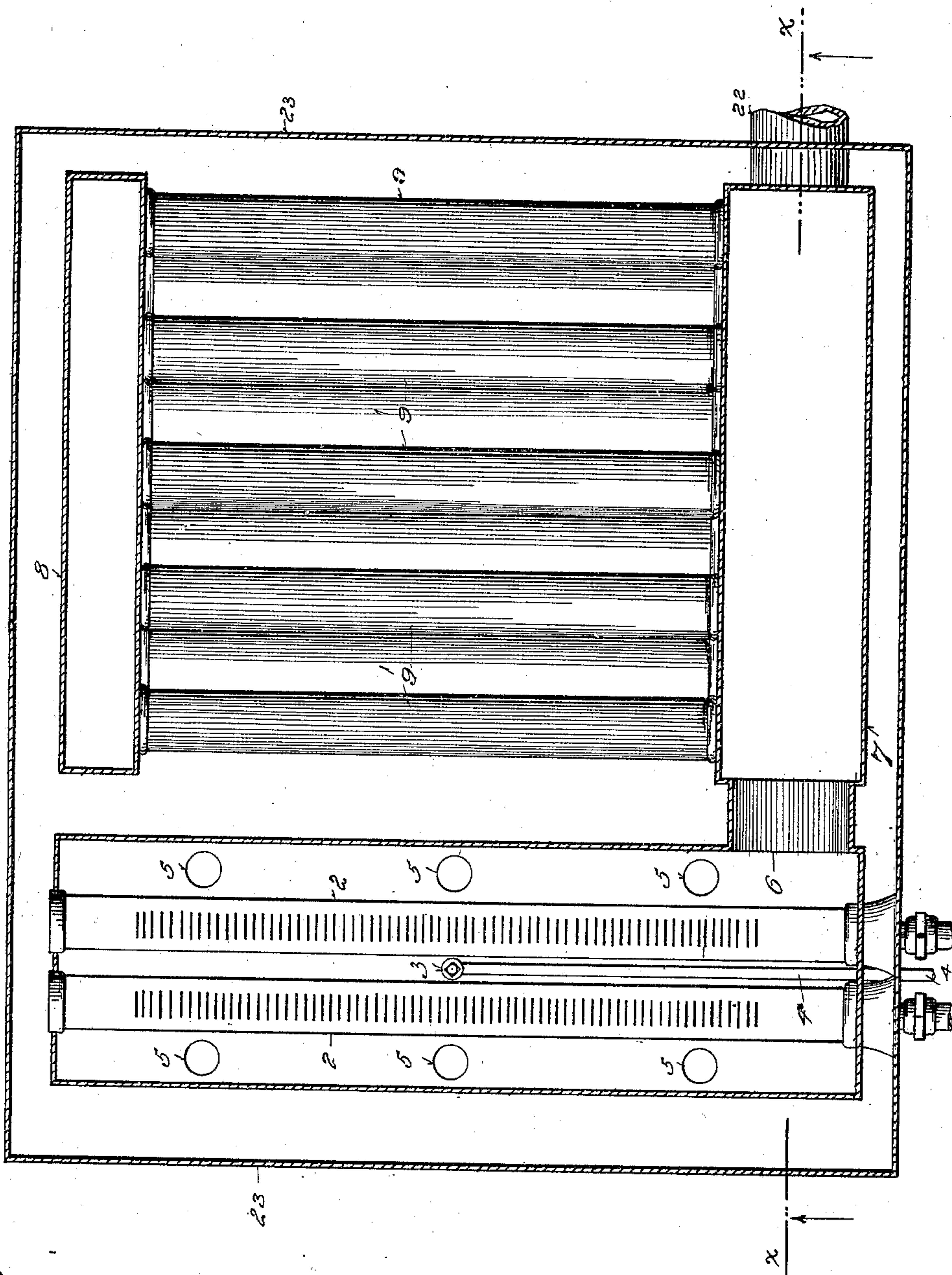
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4 SHEETS—SHEET 2.



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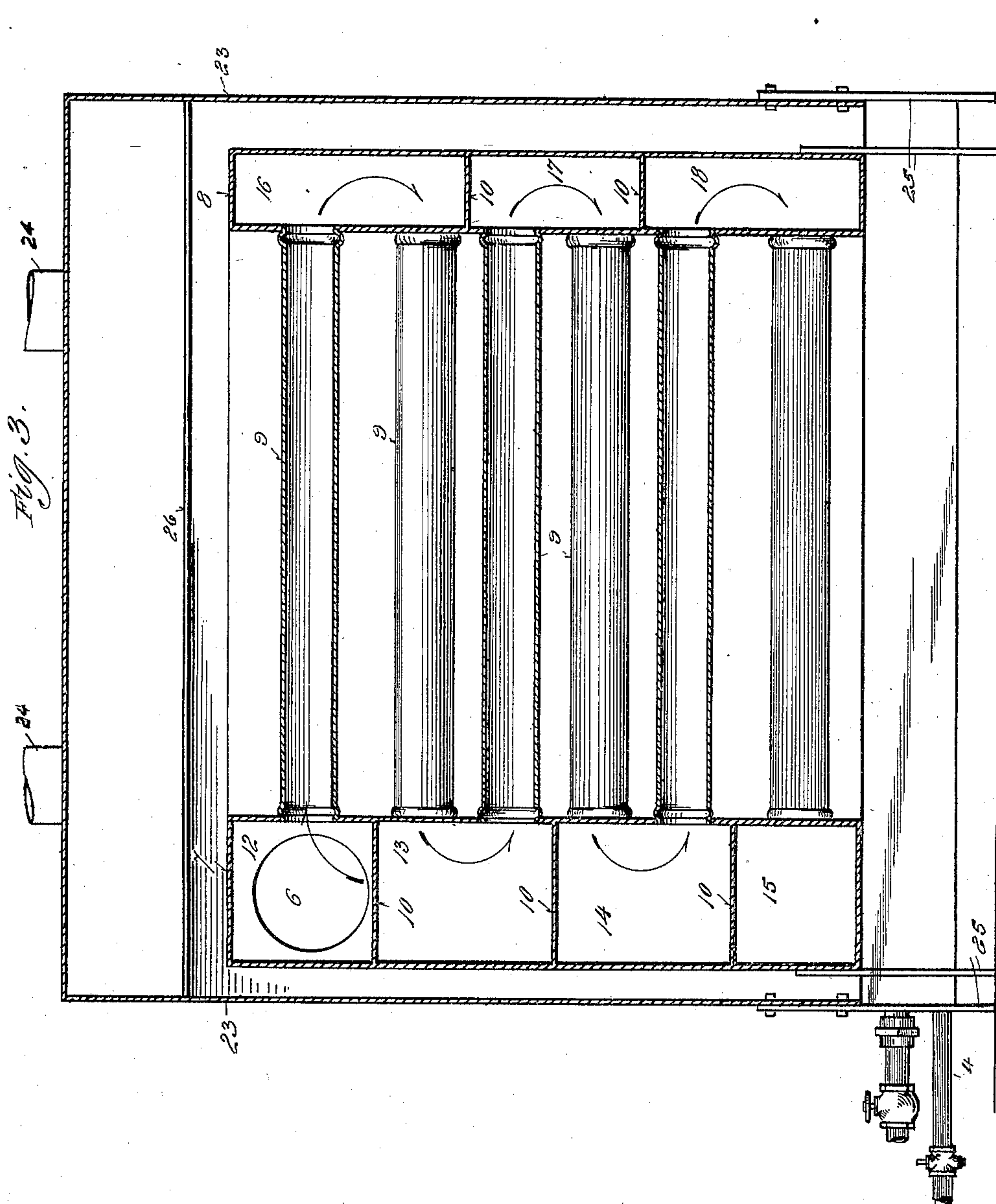
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NO MODEL.

4 SHEETS—SHEET 3



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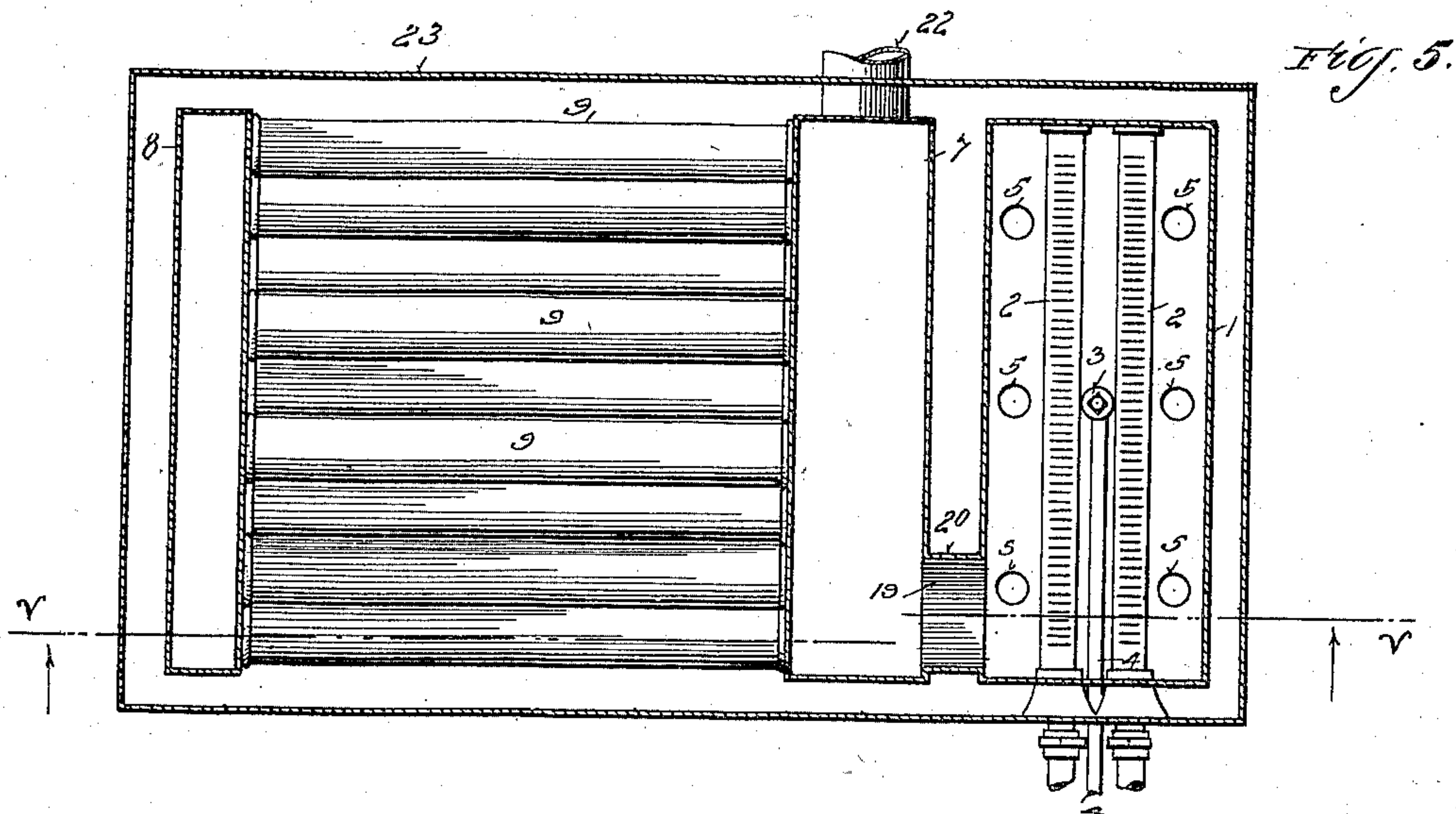
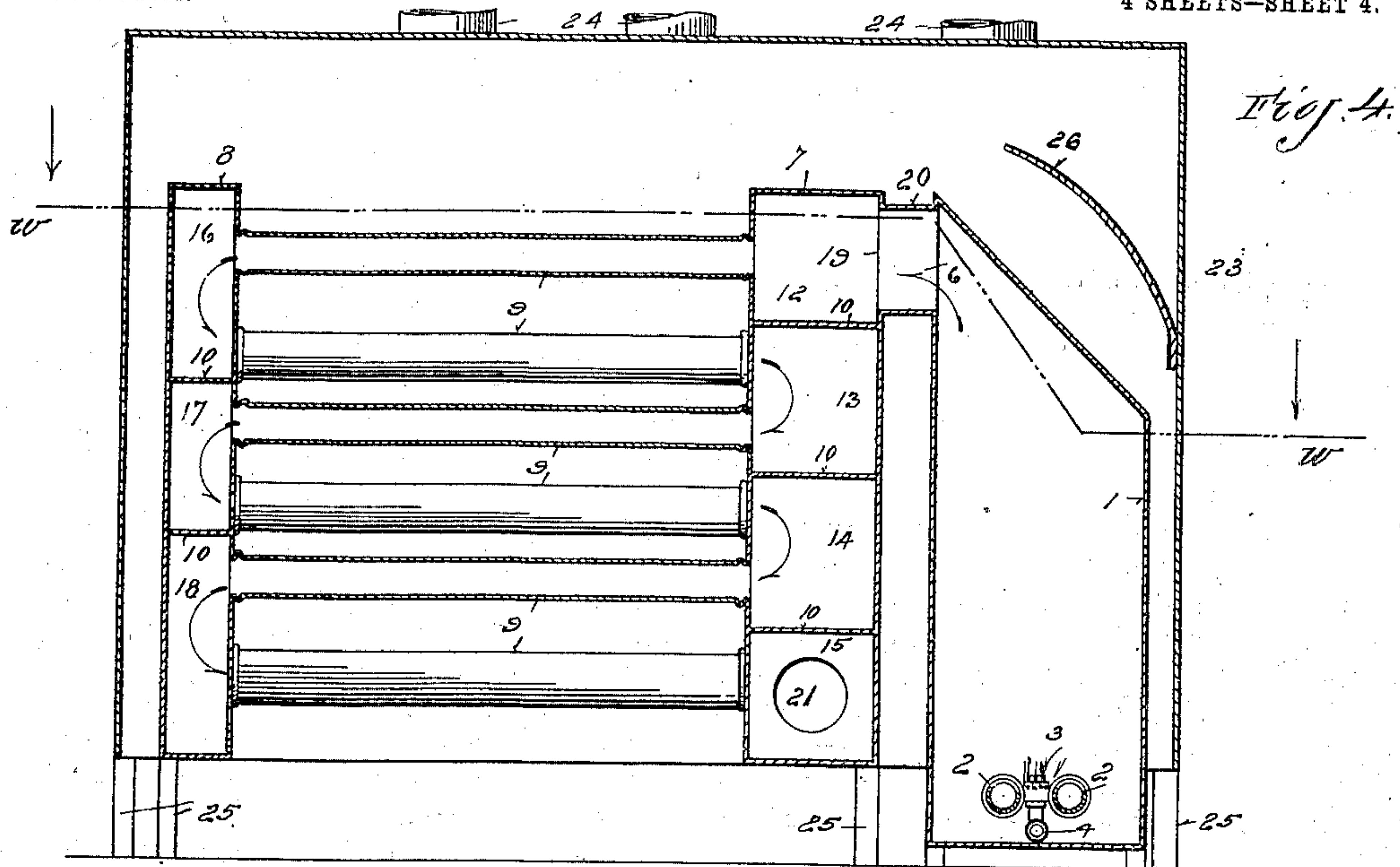
PATENTED APR. 28, 1903.

R. S. THOMPSON.
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APPLICATION FILED DEC. 26, 1901.

NO MODEL.

4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

RALPH S. THOMPSON, OF SPRINGFIELD, OHIO.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 726,374, dated April 28, 1903.

Application filed December 26, 1901. Serial No. 87,156. (No model.)

To all whom it may concern:

Be it known that I, RALPH S. THOMPSON, a citizen of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Furnaces, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to furnaces, and more particularly to that class known as "hot-air" furnaces, by means of which air may be heated for distribution to such places as may be needed.

The particular object of my present invention is to produce a compact structure having a comparatively small height in proportion to its efficiency and adapted to give a maximum heating efficiency for a given amount of fuel.

To these ends my invention consists in certain novel features which I will now proceed to describe and will then particularly point out in the claims.

In the accompanying drawings, Figure 1 is a vertical sectional view of a furnace embodying my invention in one form, the same being in section upon the line *xx* of Fig. 2 and looking in the direction of the arrows. Fig. 2 is a plan section taken on the line *yy* of Fig. 1 and looking in the direction of the arrows. Fig. 3 is a vertical sectional view taken on the line *zz* of Fig. 1 and looking in the direction of the arrows. Fig. 4 is a vertical sectional view of a modified form, taken on the line *vv* of Fig. 5 and looking in the direction of the arrows; and Fig. 5 is a plan sectional view of the same, taken on the line *ww* of Fig. 4 and looking in the direction of the arrows.

Referring more particularly first to the construction shown in Figs. 1, 2, and 3, 1 indicates the fire-box or combustion-chamber, which is preferably rectangular in horizontal cross-section, as shown, and having its top inclined from front to back at an angle of about forty-five degrees. This fire-box may be of any suitable construction; but where gaseous fuel is employed, as is preferred, it will be ordinarily constructed of sheet metal. In the present instance I have shown this fire-box as adapted for use with gas as the heating medium, although it will be understood that any suitable fuel may be employed. In the con-

struction illustrated I have shown a burner consisting of two pipes 2, extending the length of the bottom of the fire-box and having jet-openings formed therein, the gaseous fuel being conducted to the pipes in any suitable manner and consisting ordinarily of a mixture of gas and air. I have also shown located between the two pipes a pilot-burner or automatic lighter 3, supplied by a pipe 4, such a device being commonly used in connection with gas-burners for heating purposes. Air to support combustion is admitted to the combustion-chamber or fire-box in any suitable manner—as, for instance, by holes 5 in the bottom thereof. At the top of the fire-box and in the present construction in the back thereof near one end is formed an opening 6, which constitutes an outlet for the heated gases and products of combustion.

Back of the fire-box or combustion-chamber is located the air-heater proper, consisting of two flue-boxes 7 and 8, situated a suitable distance apart and connected by flues in the manner hereinafter described. Each flue-box is subdivided by diaphragms 10 into a number of chambers or compartments, the number being as great as may be required and being equal in the two boxes or unequal, as may be desired. In the present instance I have shown the flue-box 7 as divided into four compartments 12, 13, 14, and 15, while the flue-box 8 is divided into three compartments 16, 17, and 18. The flues are arranged in tiers or horizontal rows placed one above the other, and the flues of the uppermost tier extend from the uppermost compartment 12 of the flue-box 7 to the uppermost compartment 16 of the flue-box 8. The second row of flues from the top extend from the uppermost compartment 16 of the flue-box 8 to the second compartment 13 from the top of the flue-box 7. In like manner the third row of flues extend from the second compartment 13 of the flue-box 7 to the second compartment 17 of the flue-box 8, while the fourth row of flues are return-flues, connecting said compartment 17 with the third compartment 14 of the flue-box 7. The fifth row of flues extend from the compartment 14 to the lowermost compartment 18 of the flue-box 8, while the sixth row of flues are return-flues, extending from the compartment 18 to the

lowermost compartment 15 of the flue-box 7. It will be seen from an examination of Fig. 1 that the flues of each tier or horizontal row are so arranged as to be above the spaces between the flues of the row or tier next below or, in other words, are staggered, and this is my preferred arrangement. I also prefer to make the flues of such a diameter and to locate them at such a distance apart that the distance separating two adjacent flues of any row is equal or substantially equal to the diameter of the flues. It will be obvious, however, that the number and size of the flues may be varied according to circumstances.

One of the flue-boxes—in the present instance the flue-box 7—is provided with an inlet-opening 19 for the heated gases and products of combustion, and in the present instance I have shown in Figs. 1, 2, and 3 a construction in which this opening is in the front end of the flue-box and is connected with the outlet-opening 6 of the fire-box by means of a pipe or flue 20. That one of the two flue-boxes which contains the last compartment into which the products of combustion enter is provided with a discharge or outlet-opening 21, opening into said compartment, and in the present instance, in which a construction having an even number of rows of flues and an unequal number of compartments in the two flue-boxes is shown, this opening 21 communicates with the compartment 15 of the flue-box 7. This opening 21 is formed in the end of the flue-box opposite to that which communicates with the fire-box and is provided with an outlet or discharge pipe 22, which is preferably connected with a chimney. It will be observed that the bottom of the outlet-opening 21 is higher than the burners in the fire-box or, in the case of a construction in which solid fuel is employed, higher than the lowest part of the fire.

The entire heater, comprising the fire-box and air-heater proper, is inclosed in a suitable casing 23, open at the bottom and closed at the sides and top and provided with heating-pipes or hot-air flues 24, leading from its top to the place or places where the heated air is to be utilized. Preferably the lower end of the fire-box containing the burners is below the bottom of the casing, so as to give ready access to the burners, and the fire-box, heater proper, and casing may be supported on legs 25 or in any other suitable manner. The casing may be constructed of any suitable material, while the heater proper comprising the flue-boxes and flues is preferably constructed of sheet metal. I have sometimes found it advisable to arrange within the casing and over the fire-box an inclined deflecting-plate 26 for the purpose hereinafter set forth, although this deflecting-plate may be dispensed with.

The apparatus thus organized operates in the following manner: The heated gases and products of combustion in the fire-box ascend to the top thereof, being deflected by the in-

clined top to the outlet-opening 6, from which they pass into the uppermost compartment to the first flue-box. They then pass through the upper row of flues into the upper compartment of the second flue-box, and so on backward and forward through the successive rows of flues to the successive compartments of the two boxes, finally passing out through the opening 21. It will be observed that the distance in the heater proper from the inlet-opening 19 to the outlet-opening 21 is the same through any vertical set of flues. In other words, assuming that a portion of the heated products in passing down through the heater travels through those flues nearest the fire-box it will still have to travel the entire length of the last compartment 15, so that its total length of travel is no greater nor less than a portion which travels down through the flues nearest the outlet end of the casing. It arises from this construction that all those portions of the heater proper lying in a given horizontal plane are equally heated, and the draft being equal the flow of the products of combustion is even throughout the entire heater. It should be noted in this connection that since the outlet-opening is above the lowest part of the fire a draft through the entire system is insured independent of the chimney connection. It will be understood, however, that where a reliable chimney connection is provided the outlet may be correspondingly lowered. With either construction, however, a draft is created as soon as the fire is lighted, so that the products of combustion are carried out and combustion is continuously maintained in the fire-box after the fire is started. The air to be heated enters from below, a portion of it passing up around the fire-box, between the same and the casing and heater proper, and a portion passing up around the heater proper, between it and the casing; but by far the greater portion of incoming air passes upward within the heater proper, between the flue-boxes thereof and between the connecting-flues. The entering cold air first comes into contact with the lowest flues and the lower portions of the flue-boxes, in which the products of combustion are at the lowest temperature, having already parted with a large portion of their heat. The incoming cold air is able to reduce the products of combustion in this part of the heater to as low a point as is consistent with sufficient warmth in the chimney to maintain a reasonable draft. The air thus partly warmed by the first tier of flues takes an increment of heat from the flues in the next tier above, which are necessarily warmer than the air and than the flues below, and this is repeated until the air reaches the top of the heater, securing an increment of heat from each successive tier of flues and from the correspondingly-heated sections of the flue-boxes. As the air is always at a lower temperature than the tier of flues which it

next meets, it can take heat successively from each tier and reaches the top of the furnace in a thoroughly-heated condition, from which it is distributed to the points of discharge through the pipes 24 in the usual manner. The staggered arrangement of the flues is such as to cause the air which passes between the flues in one tier without actually coming into contact with those flues to impinge upon the flue above the space through which it has passed, thus making it certain that all of the air which passes through the heater will come into direct contact with the flues. When the deflecting-plate 26 is employed, it serves to cause the air which comes into direct contact with the fire-box, and which may therefore be more highly heated than the air which passes up through the heater, to be deflected, so as to mingle with this latter air, and thus equalize the temperature of the whole body of air in the upper part of the casing.

By reason of the construction which I have described there is a constant lowering of temperature of the products of combustion in the heater proper from the inlet at the top thereof to the outlet at the bottom thereof, and there is a corresponding and proportionate increase in the temperature of the incoming air from the lower portion of the heater to the upper portion. The air is thus thoroughly heated, while at the same time the heat of the products of combustion is thoroughly extracted, so that the fuel is thoroughly utilized in heating the air.

The particular construction and arrangement which I have described is especially adapted for use in places of limited height, such as cellars or the like, where furnaces are frequently located, and said construction is obviously valuable, because it enables me to obtain a very large area of heating-surface of great efficiency without any undue extension in a vertical direction or, in other words, enables me to produce a low furnace of great heating capacity.

It is obvious that various modifications in the details of construction and arrangement of the parts may be made without departing from the principle of my invention. For instance, as already stated, the number of rows of flues and their relative size and arrangement may be varied, as well as the number of compartments into which the flue-boxes are divided, the position of the outlet varying accordingly. Moreover, the relative arrangement of the fire-box and heater proper may be varied, and in Figs. 4 and 5 I have shown a construction in which the fire-box is arranged parallel with one of the flue-boxes instead of at right angles to the same. In this construction the opening 19 is in the front or face of the flue-box instead of at the end thereof, as in the construction shown in Figs. 1, 2, and 3. In other respects the construction is the same as that already described. Various other modifications will readily suggest themselves, and I therefore do not wish

to be limited to the precise details hereinbefore described, and shown in the accompanying drawings.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a hot-air furnace, the combination, with a casing having a cold-air inlet at the bottom and a hot-air outlet at the top, of an inclosed heater comprising a fire-box and a heater proper having flue-boxes divided into superposed compartments, groups of flues extending between each pair of boxes in the same horizontal plane and connecting all of the compartments in a continuous alternating series, the first compartment being at the top of the heater proper and connected with the fire-box at one end of the heater proper, adjacent to the first vertical row of flues, and the last compartment being at the bottom of the heater proper and provided at the other end of the heater proper, adjacent to the last vertical row of flues, with an outlet connected with the chimney or draft-flue, whereby the distance between the inlet and outlet through any set of flues is substantially equal, substantially as described.

2. In a hot-air furnace, the combination, with a casing having a cold-air inlet at the bottom and a hot-air outlet at the top, of an inclosed heater comprising a fire-box and a heater proper having flue-boxes divided into superposed compartments, groups of flues extending between each pair of boxes in the same horizontal plane and connecting all of the compartments in a continuous alternating series, the first compartment being at the top of the heater proper and connected with the fire-box at one end of the heater proper, adjacent to the first vertical row of flues, and the last compartment being at the bottom of the heater proper and provided at the other end of the heater proper, adjacent to the last vertical row of flues, with an outlet connected with the chimney or draft-flue, whereby the distance between the inlet and outlet through any set of flues is substantially equal, the flues of each horizontal row or group being located above the spaces between the flues of the row beneath, substantially as described.

3. In a hot-air furnace, the combination, with a casing having a cold-air inlet at the bottom and a hot-air outlet at the top, of an inclosed heater comprising a fire-box and a heater proper having flue-boxes divided into superposed compartments, groups of flues extending between each pair of boxes in the same horizontal plane and connecting all of the compartments in a continuous alternating series, the first compartment being at the top of the heater proper and connected with the fire-box at one end of the heater proper, adjacent to the first vertical row of flues, and the last compartment being at the bottom of the heater proper and provided at the other end of the heater proper, adjacent to the last vertical row of flues, with an outlet connected

- with the chimney or draft-flue, whereby the distance between the inlet and outlet through any set of flues is substantially equal, the flues of each horizontal row or group being located above the spaces between the flues of the row beneath, and the fire-box and heater proper being closed from all communication with the air-space within the casing, substantially as described.
4. In a hot-air furnace, the combination, with a casing having a cold-air inlet at the bottom and a hot-air outlet at the top, of an inclosed heater comprising a fire-box and a heater proper having flue-boxes divided into compartments, and flues extending between the boxes and connecting the compartments thereof in a continuous alternating series, the first compartment being connected with the fire-box at one end of the heater proper, and the last compartment being provided at the other end of the heater proper with an outlet connected with the chimney or draft-flue, the casing being provided with a deflecting-plate extending from the wall of the casing over the fire-box and toward the heater proper, substantially as described.
5. In a hot-air furnace, the combination, with a casing having a cold-air inlet at the bottom and a hot-air outlet at the top, of an inclosed heater comprising a fire-box having an inclined top and an outlet-opening near the higher portion of said inclined top, and

a heater proper having flue-boxes divided into compartments, and flues extending between the boxes and connecting the compartments thereof in a continuous alternating series, the first compartment being connected with the outlet of the fire-box at one end of the heater proper, and the last compartment being provided at the other end of the heater proper with an outlet connected with the chimney or draft-flue, substantially as described.

6. In a hot-air furnace, the combination, with a casing having a cold-air inlet at the bottom and a hot-air outlet at the top, of an inclosed heater comprising a fire-box and a heater proper having flue-boxes divided into compartments, and flues extending between the boxes and connecting the compartments thereof in a continuous alternating series, the first compartment being connected with the fire-box at one end of the heater proper, and the last compartment being provided at the other end of the heater proper with an outlet connected with the chimney or draft-flue, and having its lower portion higher than the lowest part of the fire, substantially as described.

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

RALPH S. THOMPSON.

Witnesses:

E. O. HAGAN,
IRVINE MILLER.