No. 676,784. Patented June 18, 1901.

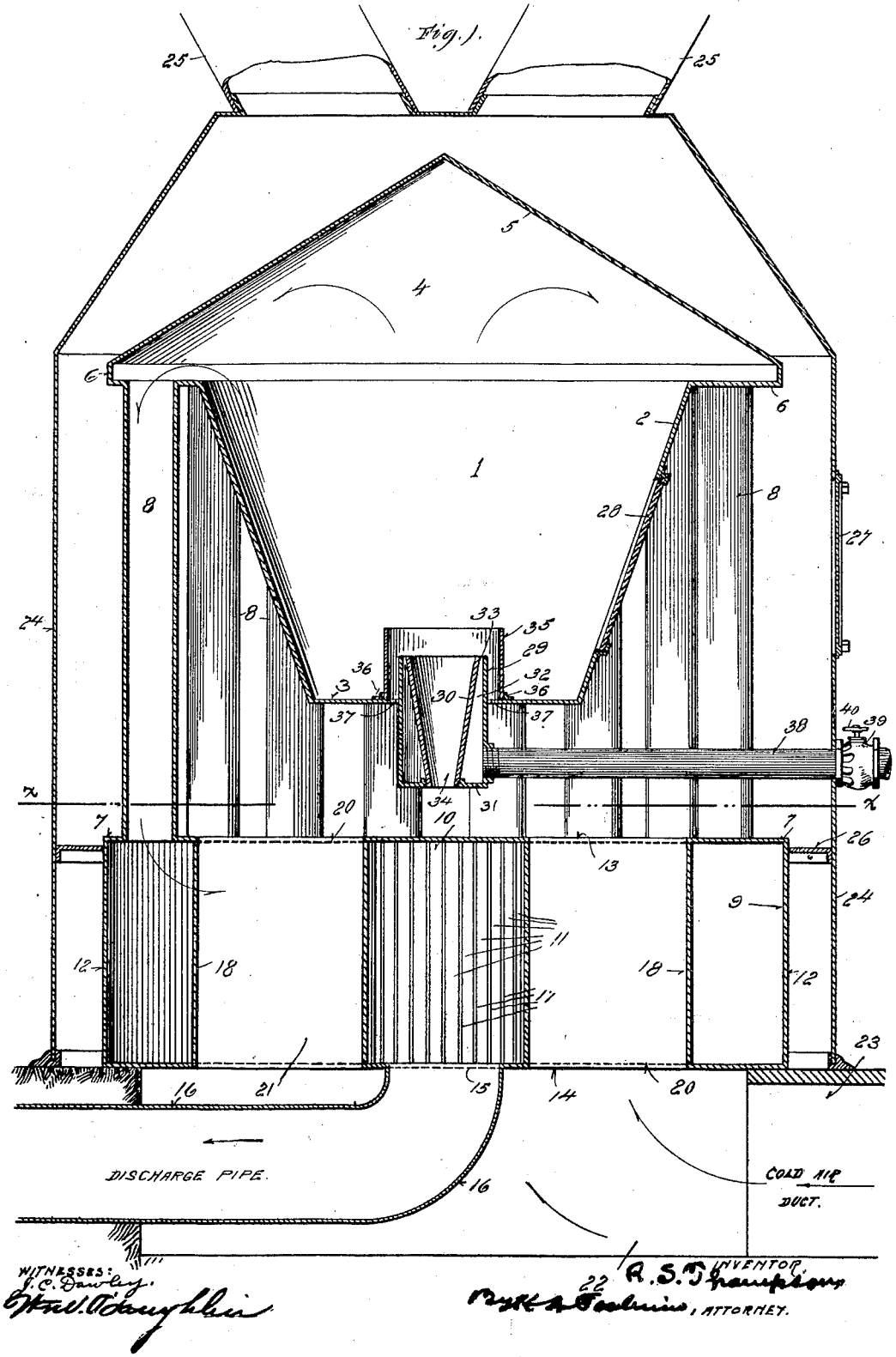
# R. S. THOMPSON.

## HOT AIR FURNACE.

(Application filed Mar. 20, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.




WITNESSES:
F. C. Dawley.
Wm. C. Loughlin

INVENTOR,
R. S. Thompson
By H. A. Toulmin, ATTORNEY.

No. 676,784. Patented June 18, 1901.

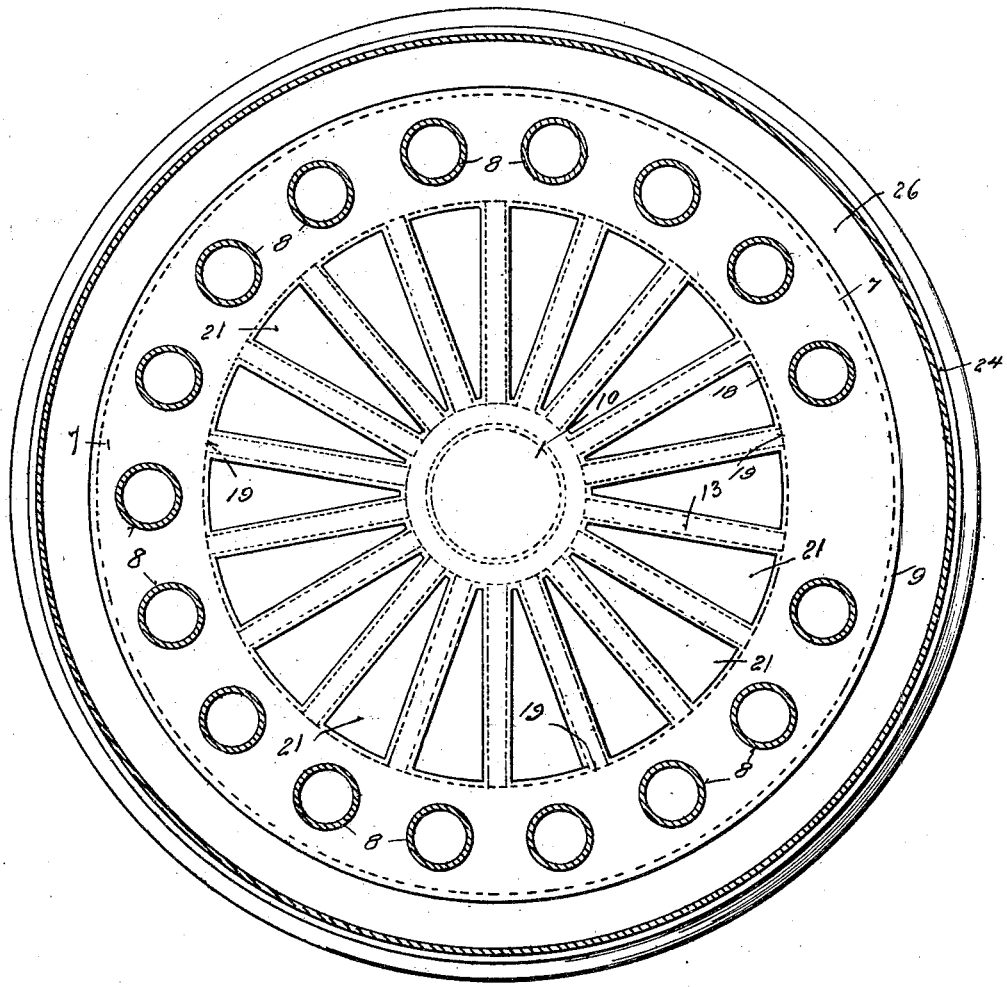
# R. S. THOMPSON.

## HOT AIR FURNACE.

(Application filed Mar. 20, 1901.)

(No Model.) 2 Sheets—Sheet 2.

Fig. 2.




WITNESSES:
J. C. Dawley.
Wm. A. Laughlin.

Ralph S. Thompson, INVENTOR,
By H. A. Toulmin,
ATTORNEY.

# UNITED STATES PATENT OFFICE.

RALPH S. THOMPSON, OF SPRINGFIELD, OHIO.

## HOT-AIR FURNACE.

SPECIFICATION forming part of Letters Patent No. 676,784, dated June 18, 1901.

Application filed March 20, 1901. Serial No. 52,066. (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 Hot-Air Furnaces, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to hot-air furnaces, and in the particular form shown in the accompanying drawings is more particularly designed for use in connection with fuel-gas, the general principles of construction involved being, however, equally applicable to other fuels, such as coal or coke.

The particular object of the invention is to produce a furnace having a maximum heating efficiency for a given amount of fuel, the heat being uniformly distributed throughout the entire body of air, which serves to convey it to the place or places to be heated without the overheating of any portion of said air.

To this and other ends the 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; and Fig. 2 is a plan section of the same, taken on the line *x x* of Fig. 1.

In the said drawings, 1 indicates the combustion-chamber or fire-box, which is preferably of the truncated conical form shown, being inclosed by a conical side wall 2 and a bottom 3. This combustion-chamber as thus constructed is of increasing diameter upward, its open upper end communicating directly with a heating-chamber 4, located at the top of the furnace and having, preferably, a conical top 5 and a body portion 6, which extends outward some distance beyond the upper edge of the wall 2 of the combustion-chamber, thereby forming an overhang. In the lower portion of the furnace is located a second heating-chamber 7, preferably of a diameter substantially equal to or greater than the body portion 6 of the upper heating-chamber 4, being connected therewith by a series of vertical pipes 7. The lower heating-chamber 7 comprises an annular portion 9, into which the pipes open directly, a central space 10, and a plurality of radial passages 11, extending from the annular space 9 to the central space 10. This lower heating-chamber is inclosed by an outer wall 12, preferably cylindrical in form, a top 13, which closes the upper end of the central space 10, and a bottom 14, provided with an opening 15, by means of which the central space 10 communicates with the discharge-pipe 16, by means of which the products of combustion are conducted to the chimney or flue. Radial partitions 17, united at their inner ends, extend from the central space 10 to the annular space 9, which latter has an inner wall 18 concentric with the outer wall 12 and having openings 19, by which the radial passages 11 communicate with the annular space 9. Between the partitions 17 of the adjacent passage-ways 11 there are formed in the top and bottom plates 13 and 14 openings 20, there being thus formed through the lower heating-chamber 7 vertical passage-ways 21, connecting the spaces above and below said heating-chamber and not in communication with the interior of said chamber. These vertical passage-ways 21 are in communication at their lower ends with an air-chamber 22, which is in turn connected with the cold-air duct 23.

24 indicates an outer casing inclosing the structure thus described and having connected to it at the top a heating-flue 25. A diaphragm 26 may be employed to close the space between the heating-chamber 7 and this outer casing to prevent entrance of air between the two. The casing will be provided with a door 27, while the combustion-chamber 1 is provided with a corresponding door 28, so that access may be had to the interior of said chamber. One of the vertical pipes 8 is omitted between these two doors in order to avoid obstruction between the two.

In the particular construction shown, in which a furnace adapted to be heated by fuel-gas is illustrated, I have shown a burner adapted for such use comprising an outer cylindrical tubular portion 29 and an inner tapering tubular portion 30, the space between the two being closed at the bottom, as indicated at 31, and the gas-chamber 32 thus formed between the two being of decreasing width and annular form, terminating at the

top in a comparatively narrow annular jet-aperture 33. The inner tapering tubular portion 30 is open at the bottom, thus forming a central air-inlet tube 34, by means of which air is supplied centrally to the flame. This burner extends upward through an opening in the bottom 3 of the combustion-chamber and is surrounded within said chamber by a tubular chimney 35, preferably of cast-iron, as are also preferably the portions of the burner just described. I prefer to have the chimney 35 extend somewhat above the top of the burner proper, and in order to render it readily removable it may rest upon the bottom of the combustion-chamber without being secured thereto, being centered or held in position laterally by means of lugs 36 on the upper side of said bottom. Apertures 37, formed through the bottom of the combustion-chamber between the chimney and burner, serve to supply air to the flame externally. The burner is connected with a supply-pipe 38, which opens laterally into the chamber 32 and which is connected with a suitable mixer 39 and provided with a controlling-valve 40. It will be observed that the burner is of less height than the space between the bottom of the combustion-chamber and the top of the lower heating-chamber, so that the burner, along with its pipe, may be introduced through the door of the casing, and after being brought into proper position the burner may be inserted upward through the opening provided therefor in the bottom of the combustion-chamber, being supported in this position in any suitable manner.

The furnace thus constructed operates in the following manner: The products of combustion at their highest temperature rise into the upper heating-chamber and are carried thence downward through the vertical pipes 8 to the second heating-chamber, entering the annular space 9 therein and passing through the radial passages 11 to the central space 10, from which they are conducted by the discharge-pipe to the flue or chimney. It will be observed that the distance from the combustion-chamber to the discharge-pipe is the same all around the structure, so that the heated products of combustion flow equally through all the pipes 8 and also through all of the annular space 9 and the radial passages 11 to the central space. The heating-surfaces of the furnace are therefore at an equal temperature throughout the corresponding portions thereof equidistant from the source of heat. The cold air enters the furnace through the vertical passages 21 of the second or lower heating-chamber and passing thence upward and outward between and around the pipes 8 are finally conducted over the highly-heated top of the upper heating-chamber 4 and thence to the heating-flue. It will be observed in this connection that the cold air when it first enters the furnace is first warmed by the spent gases, which would otherwise be wasted, and that the air thus warmed flowing into the furnace spreads out immediately and passes between the more highly heated vertical pipes into the space between said pipes and the casing. As these pipes are necessarily at a higher temperature than the lower heating-chamber, the air already warmed by said chamber can receive and does receive an additional increment of heat from these pipes. The air thus further heated ascends around the outer edge of the upper heating-chamber and receives its final increment of heat from the top thereof, which is the hottest part of the heating-surface of the furnace.

It will be noted in this connection that the passages through which the products of combustion travel on their way through the furnace present successively-increasing areas of heated surface, these areas being increased in proportion to the reduction of temperature of the products of combustion. It will also be observed that the incoming air is first subdivided, so as to travel over these larger areas of heated surface and be thoroughly exposed thereto, so that the heating of the air is gradual and uniform throughout the entire body thereof. In furnaces so constructed that only a portion of the air is directly exposed to the heating-surface it becomes necessary in order to obtain the desired temperature for the whole body of air that the portion thus exposed should be very highly heated in order that when subsequently mixed with the cold or unheated portion the desired temperature may be obtained. This involves the raising of the heating-surface or a portion thereof to a red heat, which burns the organic dust in the air and gives rise to objectionable gases and odors. These objectionable features are avoided by the construction hereinbefore described, since the entire body of air admitted to the furnace passing through the comparatively narrow openings bounded by extensive heating-surfaces will be warmed as an entirety, and this warming as a whole will continue throughout the entire course of the air through the furnace.

It is obvious that the particular details of construction hereinbefore set forth may be varied. For instance, the furnace may have a form other than the circular form shown. The number and size of the vertical pipes may be varied, the important point being that they shall be of such size that they will permit the reduction of the temperature of the products of combustion passing through them nearly to that of the warm air which flows out between them and that they shall be close enough together to cause all of the air which flows out between them to be raised nearly to the temperature of the products of combustion in the pipes. Similarly, the number of passages 11 and 21 may be similarly varied. Moreover, as already stated, although the particular form of construction shown is especially adapted for use with fuel-gas as a heating medium suitable modifications in the

combustion-chamber, obvious to one skilled in the art, will adapt the furnace for use with other fuel. I therefore do not wish to be understood as limiting my invention strictly to the precise details of construction hereinbefore set forth, 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 combustion-chamber, a heating-chamber at the top of the furnace in connection therewith, a second heating-chamber at the bottom of the furnace, and pipes or flues connecting said heating-chambers and having air-passages between them, said second heating-chamber being subdivided to form a plurality of passages for the products of combustion, and a corresponding plurality of passages for the incoming air, and being connected with the chimney or draft-flue, 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 combustion-chamber, a heating-chamber at the top of the furnace in connection therewith, a second heating-chamber at the bottom of the furnace, and pipes or flues connecting said heating-chambers and having air-passages between them, said second heating-chamber being subdivided to form a plurality of passages for the products of combustion, and a corresponding plurality of passages for the incoming air, and being connected with the chimney or draft-flue, and said heating-chambers and pipes presenting increasing areas of heating-surface from the combustion-chamber to the point of discharge of the products of combustion, 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 combustion-chamber and a heating-chamber in connection therewith in the upper part of the furnace, a second heating-chamber at the bottom of the furnace, and pipes or flues connecting said heating-chambers and having air-passages between them, said second heating-chamber comprising an outer annular space into which said pipes or flues open, a central space closed at the top and connected at the bottom with the chimney or draft-flue, and a plurality of radial passages connecting said spaces and having formed between them air-passages for the incoming air, substantially as described.

4. In a hot-air furnace, the combination, with an inclosing casing, of a heater comprising a combustion-chamber and a heating-chamber in the upper portion of the furnace, a second heating-chamber in the lower portion of the furnace, and vertical pipes or flues connecting said heating-chambers, the bottom of the combustion-chamber being above the second heating-chamber and being provided with an aperture surrounded by a chimney, and a burner extending through said aperture and comprising an annular gas-chamber having a similarly-shaped jet-orifice and a central air-inlet, the bottom of the combustion-chamber being provided with air-inlet apertures between the burner and chimney, substantially as described.

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

RALPH S. THOMPSON.

Witnesses:
IRVINE MILLER,
AL. H. KUNKLE.