(No Model.) 3 Sheets—Sheet 1.

# G. W. JOHNSTON.

## AIR WARMING FURNACE.

No. 501,604. Patented July 18, 1893.

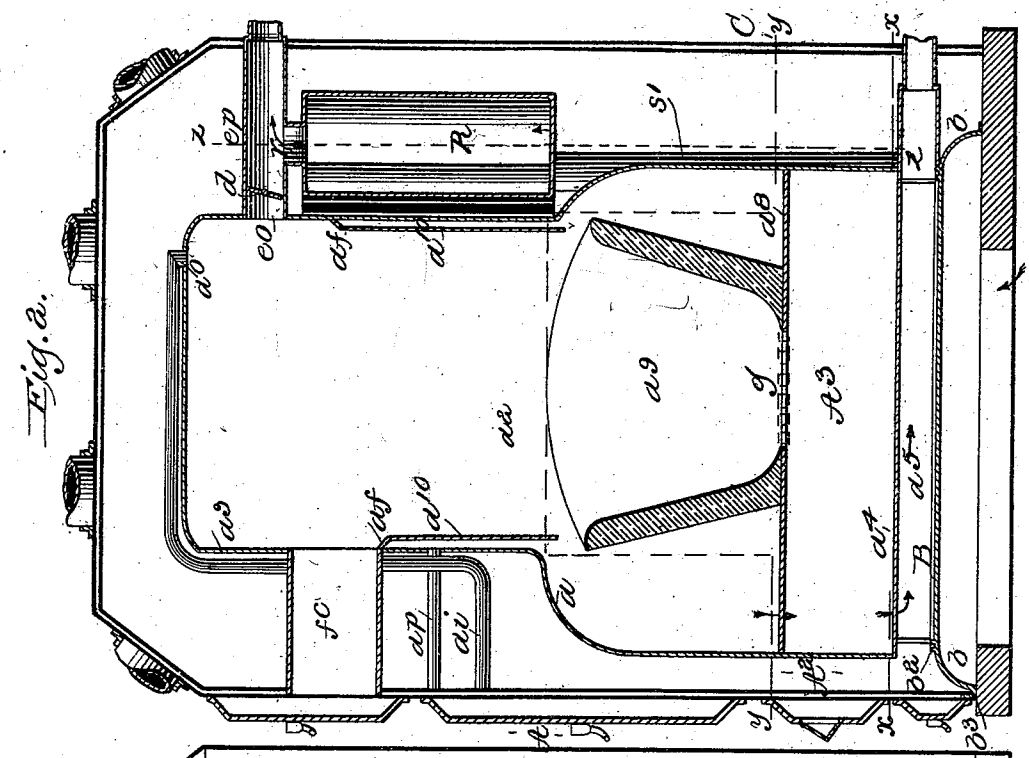

Fig. 2.

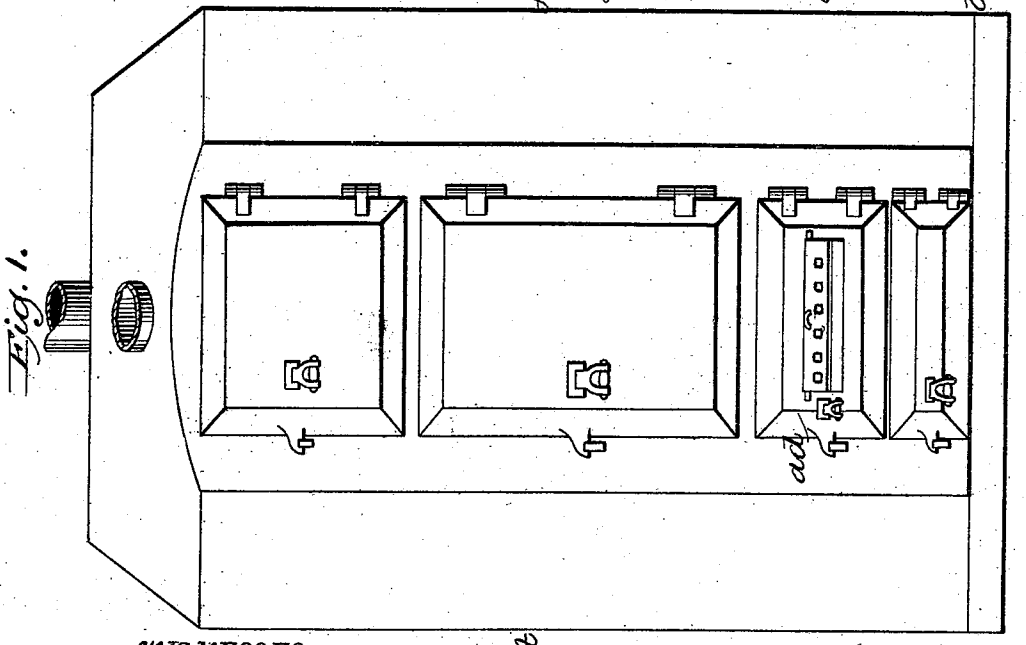

Fig. 1.

WITNESSES
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by
Attorney

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## AIR WARMING FURNACE.

No. 501,604. Patented July 18, 1893.

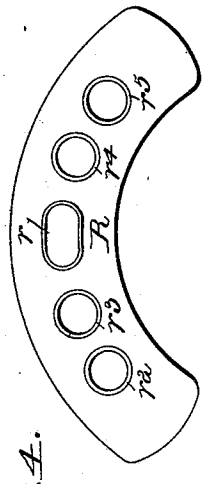


Fig. 4.

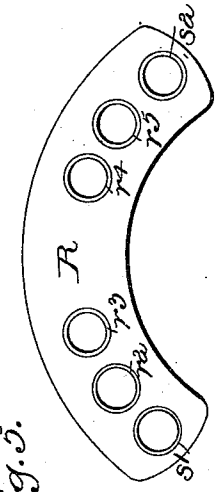


Fig. 5.

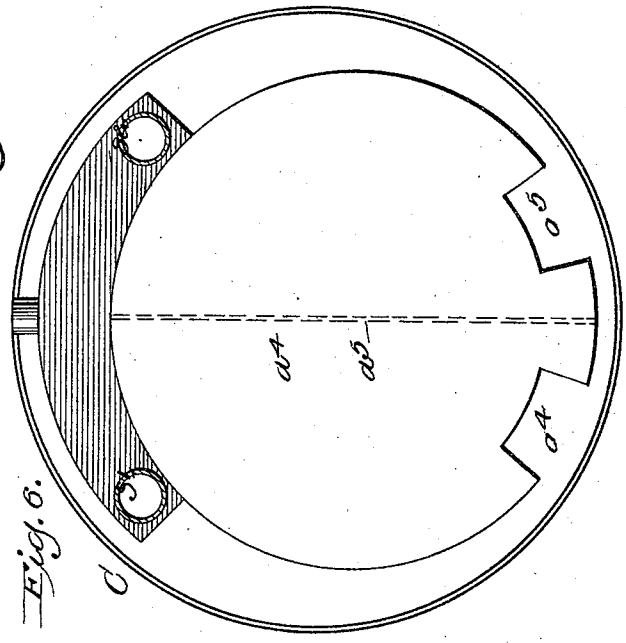


Fig. 6.

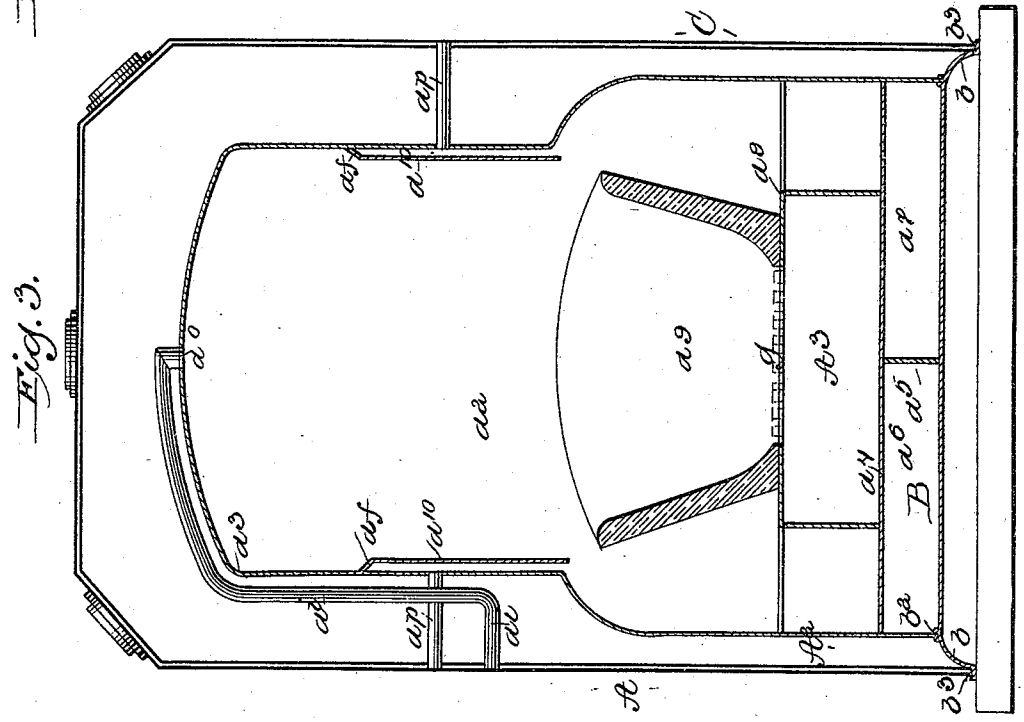


Fig. 3.

WITNESSES

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# G. W. JOHNSTON.

## AIR WARMING FURNACE.

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Fig. 8.

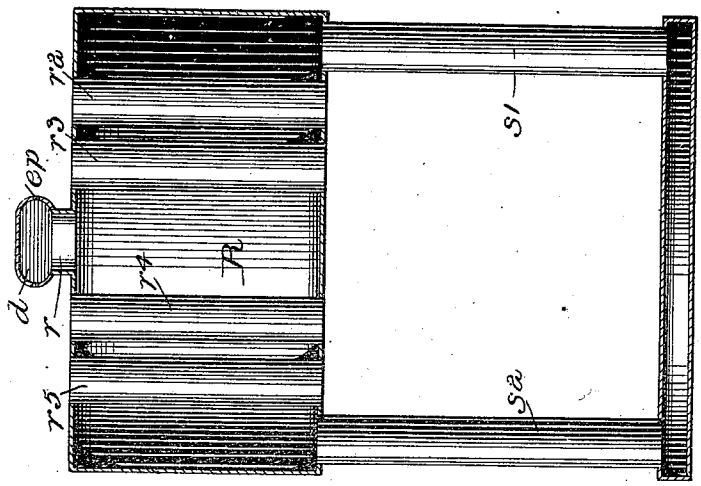
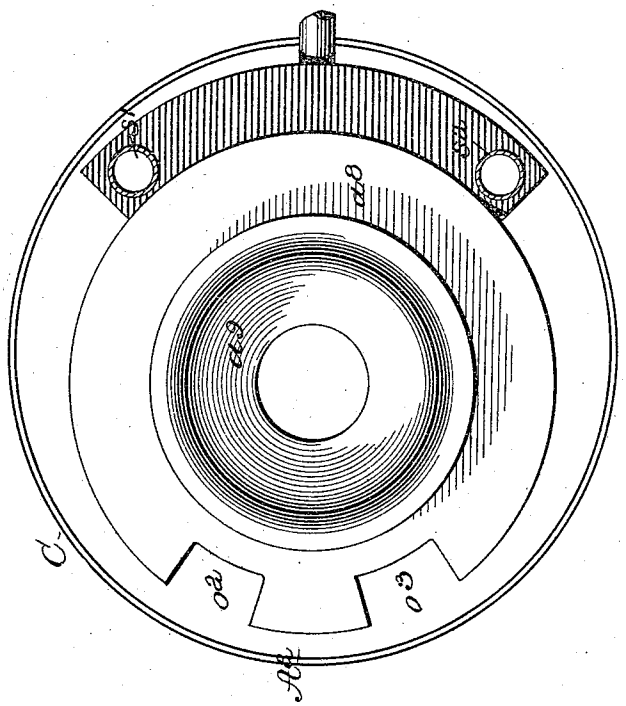



Fig. 9.




WITNESSES
Arthur Ashley
Horace A. Dodge.

INVENTOR
George W. Johnston
by
Atty.

# UNITED STATES PATENT OFFICE.

GEORGE W. JOHNSTON, OF FARMINGTON, ILLINOIS.

## AIR-WARMING FURNACE.

SPECIFICATION forming part of Letters Patent No. 501,604, dated July 18, 1893.

Application filed March 13, 1893. Serial No. 465,777. (No model.)

*To all whom it may concern:*

Be it known that I, GEORGE W. JOHNSTON, a citizen of the United States, and a resident in the town of Farmington, in the county of Fulton, in the State of Illinois, have invented a new and useful Air-Warming Furnace, of which the following is a correct description.

The invention relates to that class of heating devices in which the furnace or fuel and combustion-chamber, proper, is inclosed within a jacket or casing,—which has air-inlet openings and air-outlet passages,—in such a manner that the space between the furnace and the jacket, constitutes a reservoir of warmed air, from which, through the air-outlet passages, the various apartments above the basement,—in which, ordinarily, the furnace is located,—are supplied with pure atmospheric air, of any desired temperature.

The leading object of the invention is to provide in an air-warming furnace, appliances whereby thorough utilization of the heat-producing properties of the fuel shall be insured. This is accomplished through the provision of air-warming chambers or passages, of such configuration, and in such location, relatively to the combustion-chamber and to the fuel-chamber of the apparatus, that the currents of air introduced through such chambers or passages, shall, as they issue therefrom, be of such temperature,—as they meet and mingle with the gases evolved through combustion of the fuel,—as to insure the complete combustion thereof, and the consequent thorough utilization of all the valuable properties of the fuel. This object is further promoted, and its accomplishment more certainly insured, through the provision instead of the thick and heavy cast or wrought metal cylinder and dome of the combustion-chamber of the furnace, as usually employed, of a cylinder and dome of sheet-metal; and it is additionally insured through the provision of a flue-system in the operation of which the volatile products of combustion are carried downward in two currents, or in a divided current which underlies the ash-pit chamber, and overspreads the entire base section of the furnace, and reaches the rear thereof through two distinct and independent horizontal base-flues.

The invention consists in various novel elements or combinations of elements in an air-warming furnace, as will appear from the following detailed description, and from the specific and distinct claims which succeed such description.

In the accompanying drawings, which constitute a part of this specification—Figure 1 represents a front perspective elevation of the furnace. Fig. 2 is a longitudinal vertical section, in a plane partially central of the furnace, and partially in a plane at a short distance from the center. Fig. 3 is a transverse central section of the furnace. Fig. 4 is a top plan view of the smoke-box and radiator. Fig. 5 is a bottom plan view of the smoke-box and radiator. Fig. 6 is a sectional plan view, in the line $x$—$x$ of Fig. 2. Fig. 7 is a sectional plan, in the irregular line $y$—$y$, of Fig. 2. Fig. 8 is a vertical section in the irregular plane indicated by the line $z$—$z$ in Fig. 2.

The base-plate B, of the furnace A is, in its outer portion, formed with a peripheral downwardly and outwardly extending flange $b$, which at its top is provided with a groove $b^2$, and at its foot with a rim $b^3$,—which latter receives the lower extremity of the jacket or casing C,—both casing and flange being provided with necessary openings to permit inflow of air to the reservoir or hot-air chamber, and to the air-conducting pipes of the radiator or smoke-box.

The vertical lower portion of the body $A^2$ of the furnace rests, by its lower extremity, in the groove or channel $b^2$ of the base-plate; and at a point in a plane somewhat below the upper extremity of the fire-pot, is upwardly indrawn, and curved, to form a dome-like overhang $a$, upon the upper extremity of which rests the cylindrical body or shell $a^3$, of the combustion-chamber $a^2$ of the furnace.

At a short distance above the base-plate B, and parallel therewith, is the ash-pit or ash-chamber plate $a^4$, which in its central portion rests upon a vertical division-plate $a^5$, which extends from front to rear of the furnace, and separates the two right and left base-flues $a^6$ and $a^7$. The ash-pan or ash-drawer $A^3$ rests upon the central or intermediate portion of the supporting plate $a^4$, and is withdrawable bodily from its seat thereon, through the opening which is closed by the door $a\,d$.

Immediately above the plane of the ash-

drawer chamber is the annular plate $a^8$, within the open portion of which is supported a flaring fire-pot or fuel-chamber $a^9$, and, in connection therewith, any suitable grate or grate-bars $g$.

Within the lower and central portions of the cylindrical combustion-chamber $a^2$ of the furnace, is a deflecting-cylinder $a^{10}$, which at its upper extremity has an outwardly-projecting flange or rim $a\,f$, which at this point closes the narrow space between the two cylinders, and which extends perpendicularly downward to a point slightly below the plane of the upper extremity of the dome-like portion or overhang $a$, where it depends, curtain-like, to a point near the upper extremity of the fire-pot or fuel-receptacle $a^9$.

In a plane at about the midheight of the deflecting-cylinder $a^{10}$, openings, at suitable intervals, in the body or shell of the combustion-chamber, and in the body of the air-casing or jacket, are connected by corresponding air-inlet pipes $a\,p$, which, in practice, are at their outer extremity, provided with a register-damper, or other suitable means for total or partial exclusion of air.

At a point somewhat below the plane of the series of air-inlet pipes $a\,p$, are horizontal air-inlet pipes $a\,i$,—one at each side of the feed-chute $f\,c$,—and if desired, at other points in the same horizontal plane. The pipes $a\,i$ extend inwardly as shown, from the air-casing to a point near the wall or shell of the combustion-chamber, at which they are curved, and from which they extend upwardly, to the top of the furnace, across or partially across which they extend, and are connected to suitable openings $a\,o$, through which the currents of air, introduced at the outer extremity of the pipes, find entrance into the upper extremity of the combustion-chamber;—as represented in Figs. 2 and 3.

At the rear upper portion of the combustion-chamber (see Fig. 2), a smoke-exit opening $e\,o$, a horizontal, rearwardly-extending exit-pipe $e\,p$, and a damper $d$ are provided; while coincident therewith, at the front, in a slightly lower plane, is the fuel-supply passage or feed-chute $f\,c$.

Extending vertically upward from the ash-chamber plate $a^4$, are the smoke-conducting pipes $s'$ and $s^2$, which correspond respectively with the right and left base-flues $a^6$ and $a^7$. The flues or pipes $s'$ and $s^2$, extending vertically upward, as stated, are connected at their upper extremity to the lower extremity of the smoke-box or radiator R, which is in plane with the combustion-chamber of the furnace, and in a horizontal plane is of the segmental or crescent form seen in Figs. 4 and 5. At its upper extremity a central discharging-pipe $r$, connects it with the horizontal exit-pipe $e\,p$, at a point in rear of the damper $d$; and in its intermediate portions, between the planes of the pipes $s'$ and $s^2$, and the central discharge-pipe $r$, it is provided with the vertically-extending air-conducting pipes $r^2$, $r^3$, and $r^4$, $r^5$.

To persons skilled in the art to which the invention relates, the operation of the apparatus will, in the main, be clearly apparent from the illustration thereof in the drawings, and from the foregoing description.

Fuel being suitably supplied and ignited, and the damper in the direct-exit pipe being opened, air admitted under the grate, through the draft-openings in the door $a\,d$, of the ash-chamber, will quickly cause active combustion of the fuel. This being thoroughly established, the direct-exit passage will be closed, and the course of the volatile products of combustion will thenceforward be downward at the front—but partly upon each quarter of the fire-pot,—to and through the openings $o^2$, and $o^3$, in the annular supporting-plate $a^8$, and to and through the openings $o^4$ and $o^5$, in the ash-chamber plate $a^4$, into the right and left base-flues $a^6$ and $a^7$,—through such base-flues to the vertically-placed pipes $s'$ and $s^2$, through the pipes $s'$ and $s^2$ into the smoke-box or radiator R, and through the radiator R, and its connecting-pipe $r$, into and through the exit-pipe $e\,p$. It should be understood that the fresh thoroughly-oxygenated air, introduced through the series of pipes $a\,p$, will be quickly and highly heated in the thin annular chamber $c$, which interiorly is exposed to the high temperature of the combustion-chamber; and that in this condition, it will be exactly adapted, as it is discharged from the lower extremity of its chamber, to meet and mingle with, and insure the thorough combustion of all the light carbonaceous matters, and all the inflammable gases evolved from the fuel, as they are carried by the force of the draft, from the inner portion of the fuel-chamber, to the upper and outer extremity thereof, in their passage to the exit-pipe. This is especially advantageous in the consumption of bituminous coals,—in which the proportions of carbon and of light, combustible gases are large; and which in great part escape unconsumed, under most constructions. Through the provision of the air-induction pipes $a\,i$, such light combustible substances, and such gases, as may reach the upper portion of the combustion-chamber, will be met therein by the incoming air-currents, and mingling with the oxygen thereof, will be utilized as fuel. Through the described system of diving-flues and base-flues, under which, in all ordinary circumstances, the draft is indirect, the flow of the volatile currents is steady and regular, and an equable distribution of the heat, through every portion of the furnace is insured,—the lower or base-section thereof receiving its full proportion. It will be observed that through the location of the vertical smoke-conducting pipes $s'$ and $s^2$, in plane with the outer extremity of the curved smoke-box or radiator R, and through the location of the discharging pipe $r$ at the center

of such radiator, the currents of smoke which are discharged into the radiator from such vertical pipes, are caused to pass transversely of the two pairs,—$r^2$ and $r^3$, and $r^4$ and $r^5$,—of intermediate vertical air-pipes,—enveloping the same on all sides, and imparting to the currents of air passing therethrough, nearly their own temperature.

Through the substitution for the heavy cast or wrought metal furnace-body, ordinarily employed, of the thin sheet-metal upper and lower cylinders which are provided in this construction, a reservoir of warm air is much more quickly produced,—the comparatively thin sheet-metal receiving and imparting the heat-particles with great rapidity.

Through the provision of the double-walled air-casing or jacket, and the non-conducting air-space between the two walls, undue heating of the apartment in which the furnace is situated is avoided, and the heat which would thus be conveyed away and wasted, is retained, for transmission to the upper stories of the structure.

It will be apparent that the advantages arising from the divided down-draft and double or twin base-flue construction, and from the smoke-box or radiator, which receives the smoke-currents at each end of its horizontally-curved chamber, and discharges them at its central or mid-length and upper extremity, are fully available independently of the presence of the air-casing or jacket.

I am aware that in a magazine-stove a "combustion-sleeve" has been applied around the lower extremity of the magazine to introduce air into the center of a combustion-chamber; but I believe that I am the first to provide within the cylindrical body or shell of an air-warming furnace, a slightly smaller cylinder which is closed at its top, at a distance below the upper extremity of the body or shell, and which forms in connection with such body or shell, a thin annular air-induction chamber which is supplied with air through pipes which extend from a point outside the exterior casing of the furnace, into and through the hot-air chamber, and through the body or shell of the furnace. It is also known to me that in a magazine hot-air furnace, an air-pipe has been extended horizontally into the combustion-chamber, and to the lower extremity of the magazine, thence upward along the rear exterior surface of the magazine, to a perforation in its wall, near the top thereof, through which its air is discharged for the purpose of forcing accumulations of gases, in the magazine, downwardly through the same, and out therefrom to a point in the combustion-chamber where they may be consumed. I believe however, that I am the first to provide in an air-warming furnace, air-inlet passages which extend from the air-casing of the furnace, horizontally inward, through the air-warming chamber to a point near the body of the combustion-chamber, thence upwardly along the outer surface of the combustion-chamber, to the top thereof, thence along the top of the furnace, and across, or partially across the same, to an opening therein, through which air is discharged into the upper extremity of the combustion-chamber, for the purpose of insuring the combustion of gases at that point. It is also within my knowledge that in an air-heating furnace a space which under some circumstances may be used as a combustion-chamber, has been inclosed by a cylinder of sheet-metal,—the air-warming chamber of such furnace being also inclosed by a single sheet of sheet-metal. In another furnace, a portion of the air-casing has been composed of two sheets of thin metal, which inclose a thin air-space;—the upper and more rapidly radiating portion of the casing being composed of a single sheet; and the combustion-chamber of the furnace being composed of cast-metal. It is my belief, however, that I am the first to combine in a single structure, a heater the walls of the fuel-chamber or fire-pot section and of the combustion-chamber section of which are composed of a single thickness of thin sheet-metal; and an air-casing or jacket which is composed, throughout, of double parallel walls of like sheet-metal, and an intermediate thin closed non-conducting air-chamber.

It will be understood that I make no claim, broadly, to a means for introducing fresh air into a combustion-chamber,—either at a point near the upper extremity of the fuel-chamber, or elsewhere; to a means for introducing air into, or at the mouth of a fuel-magazine, of any kind; to a combustion-chamber the walls of which are composed of sheet-metal; or to a furnace, a portion of the walls of the air-casing of which is composed of two parallel sheets of thin metal.

The nature and objects of the invention having been thus fully set forth and the preferred form of an apparatus in which the essential elements of the invention are embodied having been illustrated and described, what is claimed is—

1. An air-warming furnace in which are combined a fuel-chamber; a combustion-chamber the lower extremity of which is in near proximity to the upper extremity of the fuel-chamber; a deflecting-cylinder, within the cylinder of the combustion-chamber, and forming in connection therewith a thin annular air-induction chamber which is open at its lower and closed at its upper extremity; and a series of air-pipes or passages which extend from the air-casing and through the air chamber of the furnace, to the thin annular chamber within the combustion-chamber; whereby currents of fresh highly-heated air are supplied to the open space which is coincident with the lower extremity of the body of the combustion-chamber, and with the upper extremity of the fuel-chamber.

2. In an air-warming furnace, a fuel-chamber or fire-pot; a combustion-chamber, the lower extremity of which is in close proximity

to the upper extremity of the fuel-chamber or fire-pot; and air-induction passages which extend from the air-casing of the furnace, horizontally inward through the air-warming chamber to a point near the body of the combustion-chamber,—thence upwardly, along the outer surface of the combustion-chamber, to the top thereof,—thence along the top of the furnace and across or partially across the same, to an opening therein, through which air is discharged into the upper extremity of the combustion-chamber; substantially as and for the purposes set forth.

3. In an air-warming furnace, a combustion-chamber the lower extremity of which is in near proximity to the upper extremity of the fuel-chamber; a thin annular air-induction chamber, within the lower and middle portion of the combustion-chamber; a series of air-induction flues which lead from a point outside the air-casing of the furnace into such thin annular air-induction chamber; and a series of air-induction flues which lead from the air-casing of the furnace inwardly to the body of such combustion-chamber,—upwardly along such body to the upper extremity thereof, and thence along and overlying the top of such body, to an opening therein through which air is discharged directly into the upper extremity of the combustion-chamber,—in combination; substantially as and for the purposes specified.

4. In an air-warming furnace, an annular supporting-plate, in a horizontal plane immediately above the ash-chamber of the furnace, and having in its front portion a left smoke-opening and a right smoke-opening; a fire-pot or fuel-chamber, resting by its lower extremity in the opening of such annular supporting-plate; independent left and right horizontal smoke-passages, in the base of the furnace, below the ash-chamber of the same; an ash-chamber in which a left and a right smoke-opening are provided in the front portion of the bottom-plate of the chamber; and a smoke-box or radiator, in rear of the combustion-chamber of the furnace, which receives the products of combustion from both of the horizontal smoke-passages, and discharges the same into the single exit-pipe of the furnace,—in combination; substantially as described and shown.

5. In an air-warming furnace, an outstanding fuel-chamber or fire-pot; combined with independent left and right base-flues, below the ash-chamber of the furnace, and overspreading the bottom surface of the same; a smoke-box or radiator, in rear of the combustion-chamber of the furnace, provided with vertical air-pipes, and with a central top smoke-opening; and vertical smoke-flues one of which extends from the rear portion of each of the independent base-flues to one extremity of the smoke-box or radiator;—whereby the volatile products of combustion are caused to pass in opposite directions, within the body of the radiator.

6. In an air-warming furnace, a heater the walls of the fuel-chamber or fire-pot section and of the combustion-chamber section of which are composed of a single thickness of thin sheet-metal, to insure quick heating of the same, and rapid radiation therefrom; in combination with an air-casing or jacket which is composed throughout of double parallel walls of like thin sheet metal and an intermediate thin closed non-conducting air-chamber, to insure retention of the heat within the air-reservoir of the furnace, and to permit the same to be conveyed to the apartments which are to be warmed.

7. In an air-warming furnace, a heater the walls of the fuel-chamber or fire-pot section and of the combustion-chamber section of which are composed of a single thickness of thin sheet-metal, to insure quick heating of the same, and rapid radiation therefrom, and in which the products of combustion ordinarily pass from the front upper extremity of the fuel-chamber, downwardly, into and through flues in the base thereof; in combination with an air-casing or jacket which from bottom to top is composed of double parallel walls, of like thin sheet metal, embracing an intermediate thin closed non-conducting air-chamber, to insure retention of the heat, within the air-reservoir of the furnace, and to permit the same to be conveyed to the apartments which are to be warmed.

8. In an air-warming furnace, a combustion-chamber which is provided in its middle and lower portion with a cylindrical deflecting sheet which forms, in connection with the wall of the combustion-chamber, an air-induction chamber or flue which is in communication with a source of fresh air, and which in its rear upper portion is provided with a dampered direct-exit pipe; combined with an isolated or outstanding fuel-chamber, below the plane of the shell of the combustion-chamber; horizontal plates which constitute the top and bottom of the ash-chamber, each provided with a left smoke-opening and a right smoke-opening; left and right smoke-flues, beneath the ash-chamber, extending from the front of the base portion of the furnace to a point in rear of the same; vertical smoke-passages which extend upwardly from the rear extremity of the underlying left and right smoke-flues; and a smoke-box or radiator, behind the combustion-chamber of the furnace, which receives the smoke-currents from the vertical smoke-passages, and discharges the same, through a single outlet, into the dampered direct-exit pipe; substantially as specified.

In testimony whereof I hereunto set my hand, this 13th day of February, 1893, in the presence of two subscribing witnesses.

GEORGE W. JOHNSTON.

Witnesses:
F. E. CRANE,
J. L. KEELING.