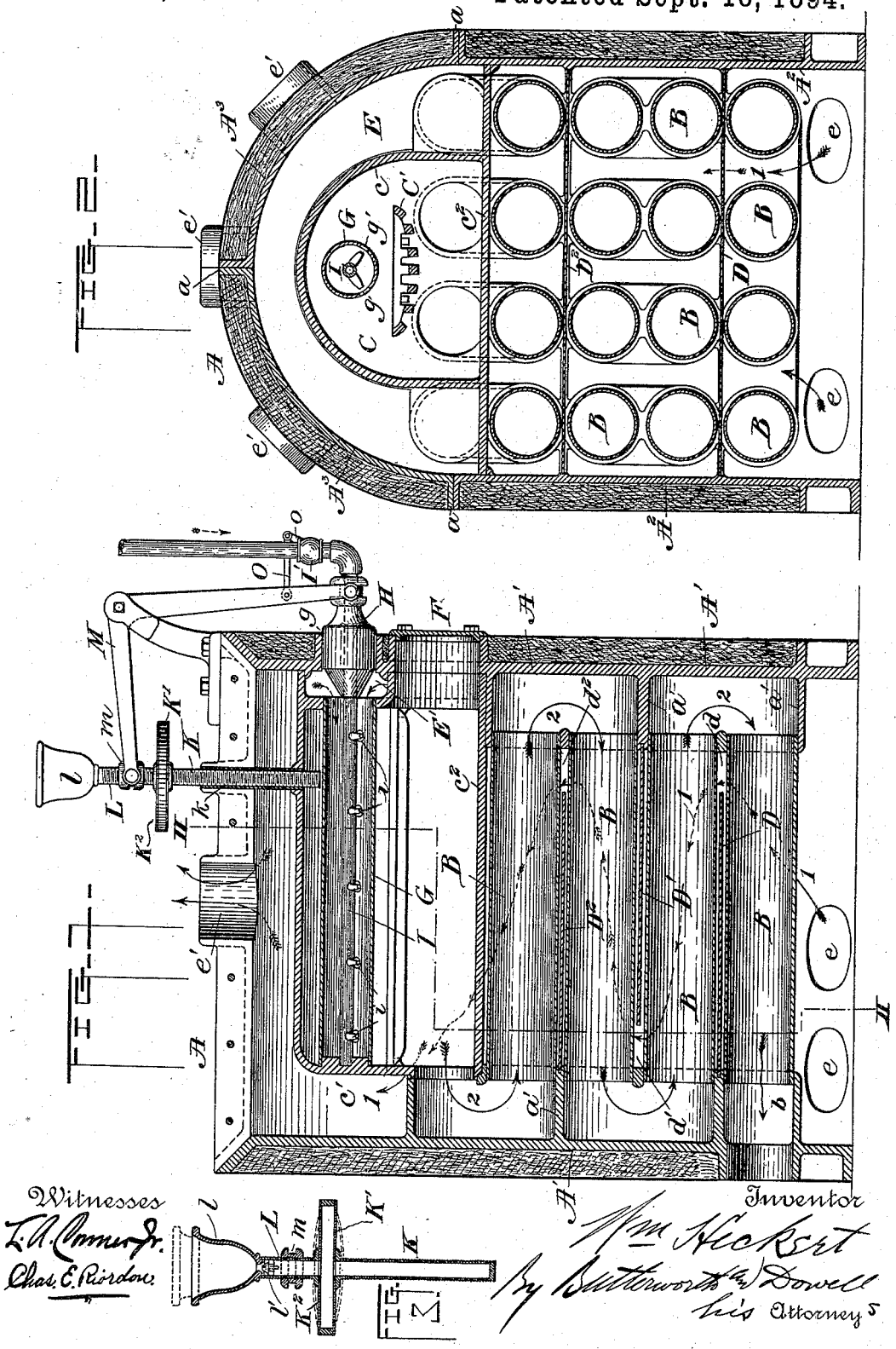
(No Model.)

W. HECKERT.

HOT AIR HEATER.

No. 526,316. Patented Sept. 18, 1894.



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UNITED STATES PATENT OFFICE.

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HOT-AIR HEATER.

SPECIFICATION forming part of Letters Patent No. 526,316, dated September 18, 1894.

Application filed March 2, 1893. Serial No. 464,397. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HECKERT, a citizen of the United States, residing at Findlay, in the county of Hancock and State of Ohio, have invented certain new and useful Improvements in Hot-Air Heaters; and I do hereby 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.

This invention relates to hot air heaters. In an application filed February 1, 1893, Serial No. 460,527, I have shown and described a method and apparatus for heating hot water and steam, in which the principle involved is the same as in the present case, and hence the broad matter of invention covered by said case is not intended to be claimed herein, but the present application is designed to cover certain improved features of construction and combinations of parts comprising a heater or stove of peculiar construction operating upon the same principle as that disclosed in the heating apparatus described and shown in the aforesaid application. As stated in said prior application, it has been the common practice heretofore to place the fire-box or combustion chamber under the boiler, or as low as possible so as to cause the heat to act first upon the coldest stratum of water and permit the residue to pass off at a point where the temperature in the boiler is highest, that is, the point where the steam is located, and therefore at a higher temperature than that of the steam, the residue of heat being thus permitted to leave off its work at a point where it is most needed in order to intensify the heat of the steam and thus increase its pressure. The result is that the greater portion of the heat, instead of being put to useful work, is wasted.

The primary object of my present invention is to provide an improved hot air heater embodying the same principle or mode of operation as that involved in the boiler construction shown in my aforesaid application, so as to prevent any undue waste of heat and fuel, and to provide for the utilization of the heat developed to the fullest extent and to better advantage than is possible with heaters of the usual construction. It will be understood, of course, that this principle may be applied in a number of ways without adhering to any special form of apparatus, and hence I do not desire to be limited to the exact construction and arrangement of parts shown and described, as the same may be varied in a number of ways without departing from the spirit of the invention.

The invention will first be described with reference to the accompanying drawings, which form a part of this specification, and then particularly pointed out in the claims at the end of this description.

In the drawings, Figure 1 represents a vertical sectional elevation of an apparatus embodying my invention. Fig. 2 is a cross section of the same taken on the line II—II of Fig. 1, and Fig. 3 is a detail sectional view of the draft regulator which I preferably employ in practicing my invention.

Similar letters of reference are used to denote similar parts in each of the several views.

The letter A denotes the heater as a whole. It may consist essentially of end plates or frame pieces A′, A′, and side plates or frame pieces A^2, A^2, forming when properly connected, a box-like structure or casing with open top and bottom and having mounted thereon semi-circular cover or top composed of segmental plates or frame pieces A^3, A^3, which rest upon the side plates A^2, A^2; the said parts being connected or bolted together by bolts passing through flanges *a*, or in any proper manner. The end pieces A′, may extend above the side pieces A^2, and have their upper flanged ends rounded and bolted to similar flanges on the outer edges or ends of the segmental plates A^3, so as to close the semi-circular openings at the ends of the frame above said side pieces. The end pieces A′, may also be cast integrally with return portions or pipe ends *a*′, to receive the ends of common stove pipe or other tubular sections B, which form the heat flues connecting with the fire-box C, and extending therefrom downwardly in a zig-zag course to the outlet *b*, which may connect with a smoke stack or chimney.

D, D′, D^2, denote horizontal partitions or baffle-plates, which extend alternately from

opposite ends of the frame pieces A′, and terminate a suitable distance from the inner face of the opposite plate to provide an opening at such point for the passage of air, so as to form a zig-zag course or flue for the introduction of air to the air space E, surrounding the fire-box or combustion chamber.

e, *e*, denote air inlets at the base of the structure communicating with the space between the heat flues B, B, for the admission of air to be heated, and also to support combustion. The heat flues B, B, may be arranged in tiers as shown, and may consist of any desired number, with intervening baffle-plates between each horizontal series or row of flues; the baffle-plates being extended alternately only partially across the space within the heater so as to cause the air moving upward in contact with the pipes or heat flues to take a zig-zag upward course to the air chamber E. The heat flues are thus completely surrounded and enveloped by a volume of air within the space surrounding said flues, so that the residue of heat and volatile products of combustion issuing from the combustion chamber and passing through said heat flues shall impart heat to the column or columns of air surrounding said flues, and being thus gradually deprived of heat in moving from a point at which the air is hottest through successively reduced temperatures to a point of minimum temperature, may pass into and out of the stack in a cold condition.

e′, denotes the air outlets for the heated air issuing from the air space E. The fire-box C, may consist of a hollow casting having an arched portion *c*, with partially closed end *c*′, and base plate c^2, integral therewith; said arched portion being placed above the heat flues so as to provide a semi-circular air space partially surrounding the fire-box. The casting C, communicates at one end with the air space E, and is provided with a door F, below the air inlet, opening into the ash pit, and at the opposite end with an opening leading to the upper heat flues. Within the fire-box is placed a grate C′, above the base plate c^2, which latter forms the bottom of the ash pit, access to which may be had through the door F. The portions of the base plate which project at either side of the arch *c*, may be reticulated or cast with openings therethrough to permit the air to pass upward into the air space E.

G, denotes an air tube extending through the fire-box, and having its open end in communication with the air space E′, at the side or end of the heater; said open end of the air tube being controlled by a conical valve H, which regulates the admission of air to said tube.

I, denotes a gas pipe extending through the air tube and provided with a series of gas jets or injectors *i*, *i*, for supplying commingled gas and air to the combustion chamber. The valve H, is adapted to slide longitudinally along the gas tube I, upon which it is fitted for the purpose of varying the size of the air inlet end of the tube G.

g′, denotes openings in the air tube G, for the escape of air therefrom.

I′, denotes a stop-cock or valve controlling the supply of gas to the pipe I.

In order to automatically regulate the air and gas supply I provide a thermostatic regulating device which may be constructed as follows:—K, (Figs. 1 and 3) denotes an exteriorly screw-threaded tube projecting through an interiorly screw-threaded tube *k*, into the fire-box, and having its lower end sealed by welding or otherwise. The upper end of the tube K, is secured to a thin steel or other suitable plate or disk K′, upon which is fitted a second plate or disk K^2, the two disks being slightly separated and rigidly connected at their peripheries in any proper manner, so as to form an expansible steam-tight diaphragmatic chamber. The upper disk K^2, has secured thereto a corresponding exteriorly threaded tube L, at the upper end of which is a cup *l*, having a valve *l*′, seated therein, to prevent the escape of fluid under ordinary pressure, but so as to permit the tubes to be filled with water and properly closed. The two tubular sections K, L, have threads of the same pitch and on the upper section L, is fitted a traveling nut *m*, which is pivotally connected to the short arm of a bell-crank M, the long arm of which is pivoted to a nut or projection on the outer end or stem of the valve H. By this means, when the tubes K, L, are rotated, (the disks K′, K^2, being adapted to serve as a milled wheel for this purpose) the lower end of the tube K, will be projected to a greater or less extent within or withdrawn from the fire-box, according to the direction of rotation, and at the same time the valve H, will be moved in or out so as to increase or diminish the size of the air inlet *g*, thus mechanically adjusting and varying the size of the air inlet. O, denotes a rod connecting the bell-crank M, with an arm *o*, secured to the stem of the cock or valve I′, so that when the bell-crank is rocked upon its pivot said valve will be opened or closed according to the direction of motion. By these means, when the tubes K, L, are adjusted by rotating the disks or diaphragms K′, K^2, the valves H, and I′, will be simultaneously opened or closed to a greater or less extent according to the direction of rotation, while the lower end of the tube K, will be projected into or withdrawn from the fire-box to a greater or less extent for the purpose of exposing a greater or less portion of said tube to the heat within the fire-box. It is apparent that as said tube is filled with water steam will be formed so as to expand the diaphragms and cause the short arm of the bell-crank to be raised or lowered under the varying conditions of expansion and contraction, and thereby automatically regulate the supply of air and gas, so as to

reduce the fire and temperature of the air in the furnace when the heat is too great, and vice versa. It is also apparent that the greater the length of tube exposed within the fire-box, the more quickly will steam be formed and the supply of fuel cut off, so as to lower the temperature of the air within the furnace, and that the reverse movement of said tube, by decreasing the exposed surface, will require more fire and heat to generate steam and consequently maintain a higher temperature of air within the furnace.

The automatic temperature regulating device is not claimed herein as a part of my present invention, but will form the subject-matter of a separate application.

The operation of the invention will be readily understood from the foregoing description, taken in connection with the drawings. The cold air entering at the base of the heater through the inlets *e*, *e*, and moving in the direction of the arrows 1, Fig. 1, passes the horizontal partition or baffle-plate D, above the lower flue or flues at the open end *d*, of said plate, and then along the next tube or series of tubes and the partition D′, past the open end *d*′, thereof, and so on until it finally reaches the air space E, over the fire-box, communicating with the air space E′, at the end of said box. Air from the space E′, may enter the air tube or tubes G, for supporting combustion. The heated air may pass from the chamber E, through outlets *e*′, into the the building or apartment to be heated, or into suitable conduits as may be desired. The current of cold air is thus (in its course from the base of the heater to the hot air space at the top thereof) gradually heated as it ascends, by contact with the heat flues between the successive horizontal partitions or baffle-plates, and at each upward move or step reaches a point of higher temperature until it finally enters the air space E, which is the point of highest temperature about the fire-box and which it enters in a highly heated condition. The heat of the fire-box is thus applied directly to the hottest part of the super-heated air, and gives off heat of the highest temperature at the point where it is most needed. From this point the residue of heat and volatile products of combustion pass downward, as indicated by the arrows 2, through the heat flues and the volume or body of air moving upward in the space or spaces surrounding said flues, gradually imparting heat to the ascending current of air at each descending step. The column or columns of heat and volatile products of combustion being thus caused to move downward in an opposite direction to the ascending enveloping column or columns of air, is caused to meet colder air at each lower turn or step, so that its volume is gradually contracted and its specific gravity correspondingly increased in its downward movement, so as to bring about those conditions which permit the heat to pass from a higher to a lower temperature until all the heat is expended. On the other hand the ascending current of air, in receiving the heat from the heat flues, is gradually heated and expended, and rises through gradually increasing temperatures until the highest point is attained. By these means the entire heat resulting from the combustion of fuel is utilized to the fullest extent, the fire-box being placed above the heat flues or at the top of the heater and under the partially surrounding hot air space so as to impart the highest degree of heat to the hottest part of the super-heated air. It may be desirable in some cases to disconnect the stop-cock I′, from the bell-crank lever and regulate the supply of gas by hand or other means; the conical valve only being connected to the thermostatic regulator. It may also be desirable in some cases to form the hollow rods or tubes K, L, with plain exterior surfaces and secure the desired mechanical adjustment thereof, by means of set screws or other devices without rotating the tubes, but I preferably use the described construction.

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

1. In a hot air heater, a heat flue or flues extending downwardly from the fire-box to the base of the heater, in combination with an air flue or flues extending upwardly from the base of the heater to an air space surrounding said fire-box, discharge openings for said heat flues and inlets for said air flues located at the base of the heater, outlets for the heated air leading from said air space, and a fire-box arranged over said heat and air flues at the top of the heater, whereby the incoming air is caused to ascend through gradually increasing temperatures in contact with the heat flues to a point of highest temperature, while the residue of heat and waste products of combustion are made to descend through gradually decreasing temperatures to a point of lowest temperature, gradually imparting heat to the rising column of air, substantially as described.

2. A hot air heater comprising a casing provided with a fire-box at the top thereof, and a hot air chamber partially surrounding said box, in combination with a descending heat flue communicating with and extending from said fire-box to the base of the casing and discharging through an opening at said point, and an ascending air flue extending from the base of the casing to said air chamber and enveloping the heat flue, and suitable air inlet and outlet openings; whereby the rising column of air is gradually heated while approaching the point of highest temperature, while the descending column of heat and volatile products of combustion within the heat flues is gradually cooled while approaching the point of lowest temperature, substantially as described.

3. A hot air heater comprising a casing, a fire-box located at the top of the casing, an

air chamber arranged directly over said fire-box, a series of heat flues extending downwardly from the fire-box and connecting with discharge openings located at the base of the heater, a series of air flues extending upwardly from said base to said superimposed air chamber and inclosing the heat flues, and suitable air inlet and outlet openings at the base and top, respectively, of the heater, substantially as described,

4. A hot air heater comprising a casing a fire-box located at the top of the casing, a semi-circular air chamber arranged over said fire-box, a series of heat flues extending downwardly in a zig-zag course from said fire-box to outlet openings located at the base of the heater, a corresponding series of zig-zag air flues extending upwardly from said base to said air chamber and inclosing the heat flues, and suitable air inlet and outlet openings at the base and top of the heater, substantially as described.

5. In combination with the fire-box located at the top of the heater, and the air chamber above and partially encircling the fire-box, a series of heat flues extending downwardly in a zig-zag course from the fire-box to the base of the heater, and a series of baffle-plates or partitions extending alternately from opposite sides or ends of the heater inclosing casing and terminating a short distance from the opposite wall thereof so as to provide an upwardly extending zig-zag air flue or series of air flues inclosing the heat flues, substantially as described.

6. In a heater, the combination with the fire-box located at the top thereof, of the downwardly extending heat flues, the upwardly extending air flues inclosing said heat flues, and a thermostatic regulating device, substantially as described.

7. In a hot air heater, the combination with the casing inclosing the heat flues and provided with an air space at the top thereof, of the fire-box partially surrounded by said air space, the air tube supported within said fire-box and communicating with said air space, and a valve for controlling the air supply, substantially as described.

8. In a hot air heater, the combination with the casing inclosing the heat flues and provided with an air space at the top thereof, of the fire-box partially surrounded by said air space, the air tube supported within said fire-box and communicating with said air space, a gas pipe extending through said air tube, and valves for controlling the air and gas supply, substantially as described.

9. A hot air heater comprising essentially a casing composed of side and end plates forming a box-like structure with open top and bottom; one set of plates being provided on their inner sides with return portions or pipe ends; pipe sections inserted in said pipe ends so as to form a zig-zag descending heat flue or flues extending from top to bottom of the casing, baffle plates between said pipe sections projecting alternately from opposite sides of the casing nearly across the space within the same, so as to form a zig-zag ascending air flue or flues enveloping the heat flues, a top or cover for the casing, and a fire-box within said cover with an intervening air space about and over the fire-box; said air space communicating with said air flues and said fire-box communicating with said heat flues; and suitable inlet and discharge openings, substantially as described.

10. A hot air heater comprising essentially a casing composed of side and end plates forming a box-like structure with open top and bottom; one set of plates being provided on their inner sides with return portions or pipe ends; pipe sections inserted in said pipe ends, so as to form a zig-zag descending heat flue or flues extending from top to bottom of the casing, baffle plates between said pipe sections projecting alternately from opposite sides of the casing nearly across the space within the same, so as to form a zig-zag ascending air flue or flues enveloping the heat flues, a semi-circular top or cover for the casing, and an arched fire-box within said cover with an intervening semi-circular air space above and partially surrounding the fire-box; said air space communicating with said air flues and said fire-box communicating with said heat flues; and suitable inlet and discharge openings, substantially as described.

11. A hot air heater comprising essentially a casing composed of side and end plates forming a box-like structure with open top and bottom; one set of plates being provided on their inner sides with return portions or pipe ends; pipe sections inserted in said pipe ends, so as to form a zig-zag descending heat flue or flues extending from top to bottom of the casing, baffle plates between said pipe sections projecting alternately from opposite sides of the casing nearly across the space within the same, so as to form a zig-zag ascending air flue or flues enveloping the heat flues, a semi-circular top or cover for the casing, and an arched fire-box within said cover, with an intervening semi-circular air space above and partially surrounding the fire-box; said air space communicating with said air flues and said fire-box communicating with said heat flues; an air tube within the fire-box communicating with said air space, and a valve for controlling the air supply, together with suitable inlet and discharge openings, substantially as described.

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

WILLIAM HECKERT.

Witnesses:
LAURA A. HECKERT,
GEORGE B. CRANE.