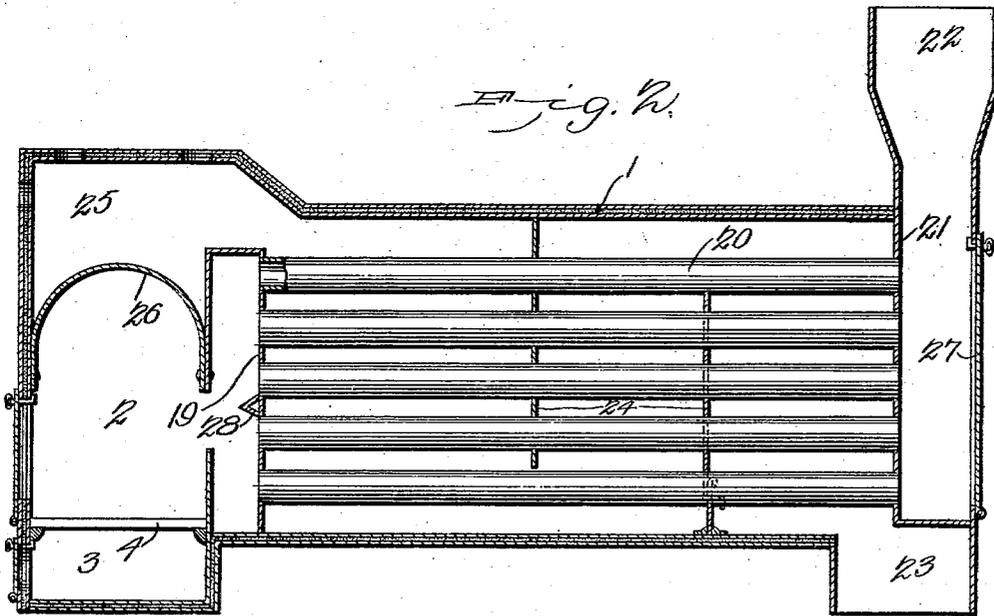
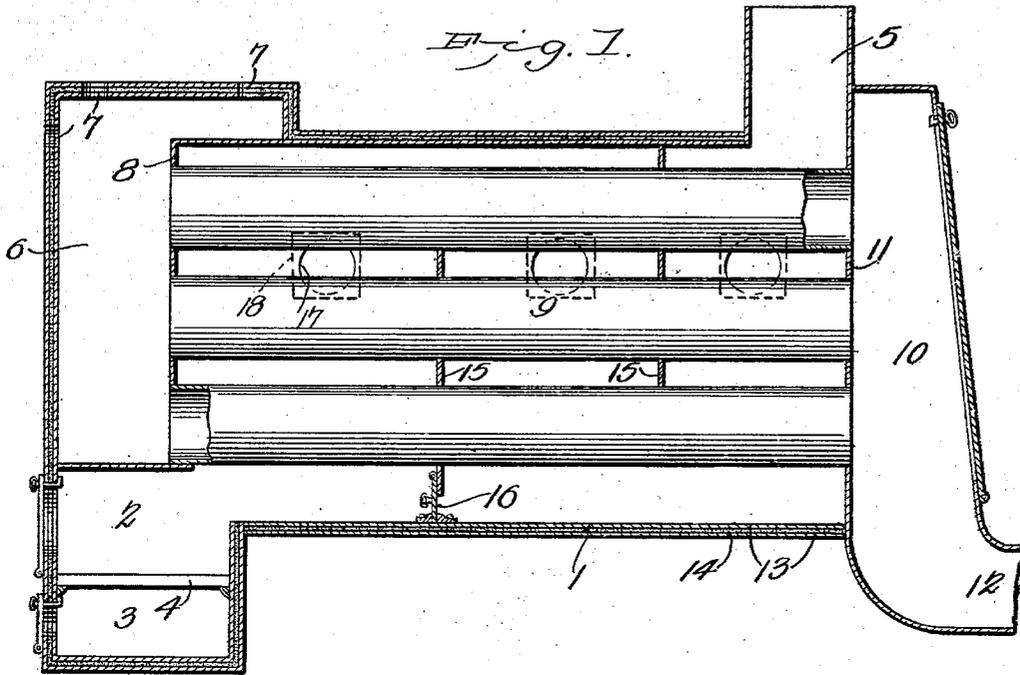


S. F. SHAFER.
HEATING APPARATUS.
APPLICATION FILED NOV. 24, 1902.

NO MODEL.

2 SHEETS—SHEET 1.



Witnesses
E. F. Stewart
Wm. Bagger

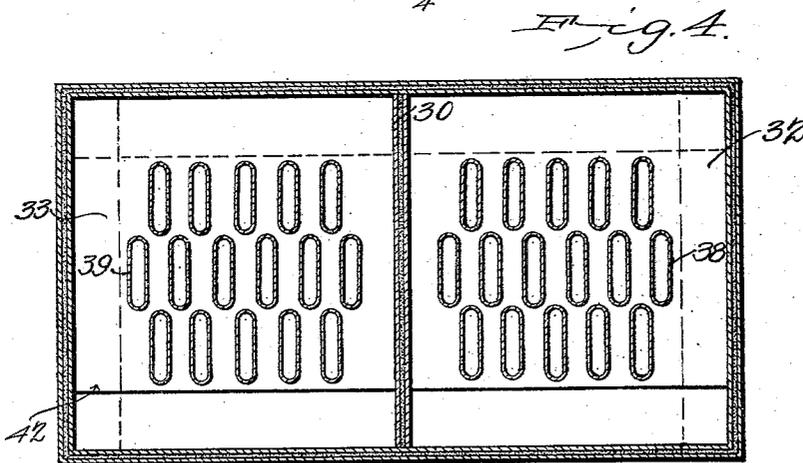
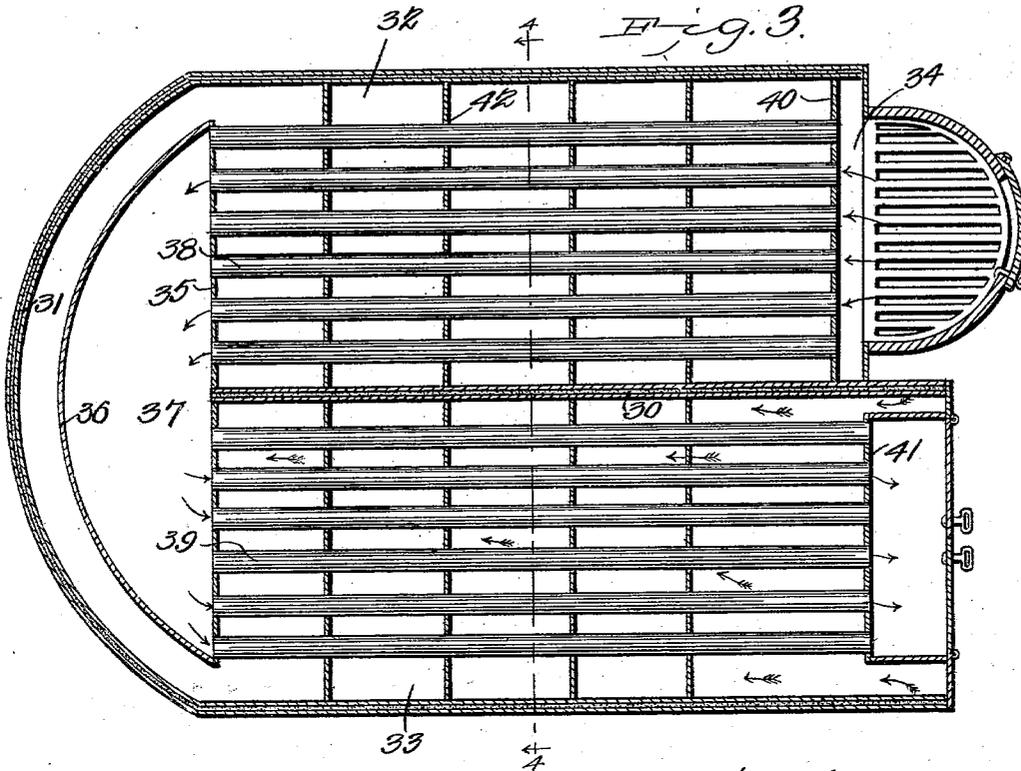
by *S. F. Shafer,* Inventor.
C. A. Snow & Co.
 Attorneys

S. F. SHAFER.
HEATING APPARATUS.

APPLICATION FILED NOV. 24, 1902.

NO MODEL.

2 SHEETS—SHEET 2.



Witnesses
E. P. Stewart
Wm. P. Rogers

S. F. Shafer, Inventor.
 by *C. A. Snow & Co.*
 Attorneys

UNITED STATES PATENT OFFICE.

SAMUEL F. SHAFER, OF FINDLAY, OHIO.

HEATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 752,002, dated February 9, 1904.

Application filed November 24, 1902. Serial No. 132,607. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL F. SHAFER, a citizen of the United States, residing at Findlay, in the county of Hancock and State of Ohio, have invented a new and useful Heating Apparatus, of which the following is a specification.

This invention relates to heating apparatus, such as furnaces in which air is heated prior to its distribution to the apartments to be heated.

The object of my invention is to utilize the heat derived from the combustion of fuel to the fullest extent possible. It is well known that in most furnaces of ordinary construction a great loss of heat occurs by the passage of the products of combustion into the escape-flue in a highly-heated state, thereby involving a corresponding waste of fuel. By my invention I aim to utilize the heat energy contained in the products of combustion to the greatest possible extent, and this I accomplish in the manner which will be hereinafter described.

My invention then may be said to consist in the improved construction, arrangement, and combination of the parts constituting a heating apparatus, which will be hereinafter fully described, and particularly pointed out in the claims.

In the accompany drawings, Figure 1 is a longitudinal sectional view illustrating a simple form of my invention. Fig. 2 is a longitudinal sectional view illustrating a modification. Fig. 3 is a horizontal sectional view illustrating another modification. Fig. 4 is a transverse sectional view taken on the line 4 4 in Fig. 3.

Corresponding parts in the several figures are indicated by similar numerals of reference.

In the simple form of my invention illustrated in Fig. 1 of the drawings, 1 designates the furnace-casing, which is of elongated shape, having at its front end the combustion-chamber 2 and ash-pit 3, separated by the grate 4. The rear end of the furnace-casing has the smoke-exit 5. At the front end of the casing is a hot-air chamber 6, having open-

ing 7, which may be connected by flues or passages with the apartments to be heated. A flue-sheet 8, which separates the hot-air chamber 7 from the interior of the boiler-casing, is connected by means of flues 9 with an air-chamber 10 at the rear end of the boiler-casing and separated therefrom by a flue-sheet 11. The air-chamber 10 has an entrance 12 at its lower end. To avoid the waste of heat by radiation, it is preferred to construct the boiler-casing of two thicknesses 13, of sheet metal, separated by an intermediate layer 14, of asbestos or similar non-conducting material. Baffle-plates 15 are disposed at suitable intervals within the furnace-casing, such of the baffle-plates as rise from the bottom being provided at their lower ends with doors or slides 16, which may be removed when necessary to clean the casing. The flues 9 are preferably oblong or elliptical in cross-section and disposed edgewise in the casing, so as to leave little chance of soot and obstructions lodging thereon, such accumulations as occur being readily removed by providing suitable hand-holes 17 in the sides of the casing. These hand-holes, as shown, are preferably closed by external slides 18. (Indicated in dotted lines in Fig. 1.) In the operation of this form of my invention the products of combustion pass from the combustion-chamber or fire-box 2 through the furnace-casing and to the exit-flue, the course being a zigzag one owing to the position of the baffle-plates 15. The cold air, which enters at the lower end of the chamber 10, passes through the flues 9 and to the hot-air chamber 8, which is located above the combustion-chamber, where it receives the direct impact of the heat. It is obvious that during the passage through the pipes 9 the air will absorb a large percentage of the heat contained in the products of combustion, so that the latter will reach the exit-flue at a comparatively low temperature, which will be further reduced, even at the point of discharge, by the cold air contained in the chamber 10, which closely adjoins the exit-flue.

It is evident that the efficiency of the device will to some extent depend upon the length of the furnace-casing and the corresponding

length of the flues or air-ducts 9. Under all circumstances, however, it will be seen that the cold air enters practically at the point of discharge of the products of combustion and passes in the opposite direction from said products of combustion, the air-passages being entirely surrounded by said products, the heat of which is thus absorbed until the hot-air chamber is reached, from whence distribution is made. It is also evident that when this construction is carried out more air may be heated to a given temperature or the same amount of air may be heated to a higher temperature by a given amount of fuel than would be possible in any construction of a furnace where the products of combustion are permitted to escape into the chimney while yet in a highly-heated condition.

By the modification of my invention illustrated in Fig. 2 the combustion-chamber 2 at the front end of the furnace-casing 1 has a back wall or flue-sheet 19, connected by flues 20 with a flue-sheet 21, forming one of the walls of the exit-flues 22. The cold-air entrance 23 is in this instance at the lower rear end of the furnace-casing, which is provided with baffle-plates 24 to retard the passage of the air toward the front end of the casing, which constitutes the hot-air chamber 25, the latter being separated from the combustion-chamber by a dome 26 in the latter. In this form of my invention the products of combustion pass through the flues 20 to the exit 22, while the air admitted through the opening 22 passes in the opposite direction through the furnace-chamber. A door 27 in the rear side of the exit-pipe 22 enables access to be had to the interior of the flues 20 for the purpose of cleaning the latter. The front flue-sheet 19 is provided with a horizontally-disposed deflector 28 in order that a portion of the products of combustion may be deflected downwardly and compelled to pass through the lower flues. The tendency in the absence of some deflecting means would be for the products of combustion to seek an exit through the upper flues only. The operation of this modified form of my invention is practically the same as that of the form illustrated in Fig. 1, with the exception that products of combustion pass through the flues and the air in the opposite direction through the casing of the furnace.

It is obvious that in order to obtain the most satisfactory results it is desirable that the flues through which either the air or the products of combustion are caused to pass should be of considerable extent as to length in order that the products of combustion at the points of their discharge may be reduced as nearly as possible to the temperature of the cold air which enters at a point approximate to the point of discharge of said products of combustion. In order to accomplish this re-

sult as nearly as possible, and thus practically accomplishing the saving of every available heat unit, and in order at the same time to economize in space and in cost of construction, I have devised the modified form of my invention which has been illustrated more particularly in Figs. 3 and 4 of the drawings. In this form of my invention the furnace-casing is constructed with a central longitudinal partition 30 and with a curved back wall 31, the central partition dividing the furnace-casing into two separate compartments 32 and 33. At the front end of the former the combustion-chamber 34 is located, while the front end of the compartment 33 communicates with the exit-flue. A flue-sheet 35, which is disposed transversely across the rear ends of the compartments 32 and 33, is connected at its ends or edges with a curved partition 36 parallel to the back wall 31. It will be understood that this flue-sheet and partition connect the top and bottom of the furnace-casing, and thus combine to form a chamber 37. Flues 38 and 39, extending through the compartments 32 and 33, respectively, connect the flue-sheet 35 with a flue-sheet 40, forming the back wall of the combustion-chamber, and with a flue-sheet 41, which forms one of the walls of the exit-flue. Baffle-plates 42 are suitably disposed within the compartments of the casing. Cold air is admitted through a suitable inlet, which may be disposed at the front end of the compartment 33, preferably below the exit-flue. It is obvious that by this construction the products of combustion will pass from the combustion-chamber through the flues 38, chamber 37, and flues 39 to the exit, while the cold air entering the casing at the front end of the compartment 33 will pass to the rear end of said compartment, where it will be compelled to pass through the space or channel 42 between the back wall 31 and the partition-plate 36 to the rear end of the compartment 32 and through the latter to its front end, where the hot-air chamber is preferably disposed above the combustion-chamber. It is obvious that when this construction is carried out the products of combustion and the air to be heated are compelled to pass in opposite directions through an extended space, and it follows that the products of combustion at the point of their exit will be reduced more nearly to the temperature of the air entering at a point close to said exit-point of the products of combustion and that consequently, such being the case, the objects of my invention will be more nearly attained.

It will be readily understood that the structural details may be widely modified without departing from the spirit of my invention. The accompanying drawings, in fact, may be said to have been reduced to diagrams simply sufficient to illustrate my invention and the preferred modes of carrying the same into ef-

fect. It will be understood, therefore, that I do not limit myself with regard to details of construction, but reserve the right to all modifications within the scope of my invention.

I desire to state, furthermore, that the principle of my invention is capable of being applied to the heating of other fluids than air. Thus by making proper structural modifications the principle of my invention is capable of being applied with equal success to a water-heater as to an air-heater, the object being in each case to reduce the temperature of the products of combustion at the point of their exit to a degree approximating as nearly as possible to the temperature of the fluid, whether it be air or water, which enters at a point close to such point of exit.

Having thus described my invention I claim—

1. In a heating apparatus, a furnace-casing having compartments disposed contiguous to each other, a combustion-chamber at the front end of one of said compartments, an exit-flue at the front end of the other compartment, flue connections between the combustion-chamber and the exit-flue, an air-inlet below said exit-flue, a hot-air chamber contiguous to the combustion-chamber, and a connecting-passage between the air-inlet and the hot-air chamber.

2. In a heating apparatus, a furnace-casing having compartments disposed contiguous to each other, a combustion-chamber at the front end of one of said compartments, an exit-flue at the front end of the other compartment, a flue-sheet disposed transversely across the compartments of the furnace-casing, a partition connecting the ends of said flue-sheet at a distance from the back wall of the furnace-

casing, flues extending through the compartments of the casing and connecting the flue-sheet with the back wall of the combustion-chamber and with the exit-flue, air-inlets below the exit-flue and a hot-air chamber contiguous to the combustion-chamber.

3. In a heating apparatus, a furnace-casing having compartments disposed contiguous to each other, a combustion-chamber at the front end of one of said compartments, an exit-flue at the front end of the other compartment, a flue-sheet disposed transversely across the compartments of the furnace-casing, a partition connecting the ends of said flue-sheet at a distance from the side and back walls of the furnace-casing, flues extending through the compartments of the casing and connecting the flue-sheet with the back wall of the combustion-chamber and with the exit-flue, an air-inlet below the exit-flue, a hot-air chamber contiguous to the combustion-chamber and baffle-plates in the compartments of the casing.

4. In a heating apparatus, a furnace-casing, a combustion-chamber and an exit-flue spaced apart by extended flue-passages, and an air-intake and a hot-air chamber likewise spaced apart by the extent of the flue-passages, said air-intake being disposed contiguous to the exit-flue and said hot-air chamber contiguous to the combustion-chamber, the back wall or flue-sheet of the combustion-chamber being provided with a deflector to direct the products of combustion toward the lower flues.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

SAMUEL F. SHAFER.

Witnesses:

HARRY M. LINDSAY,
GEO. VELKEL.