(No Model.)

A., H. & W. WILDMAN.

WATER TUBE BOILER.

No. 544,474. Patented Aug. 13, 1895.

Fig. 1.

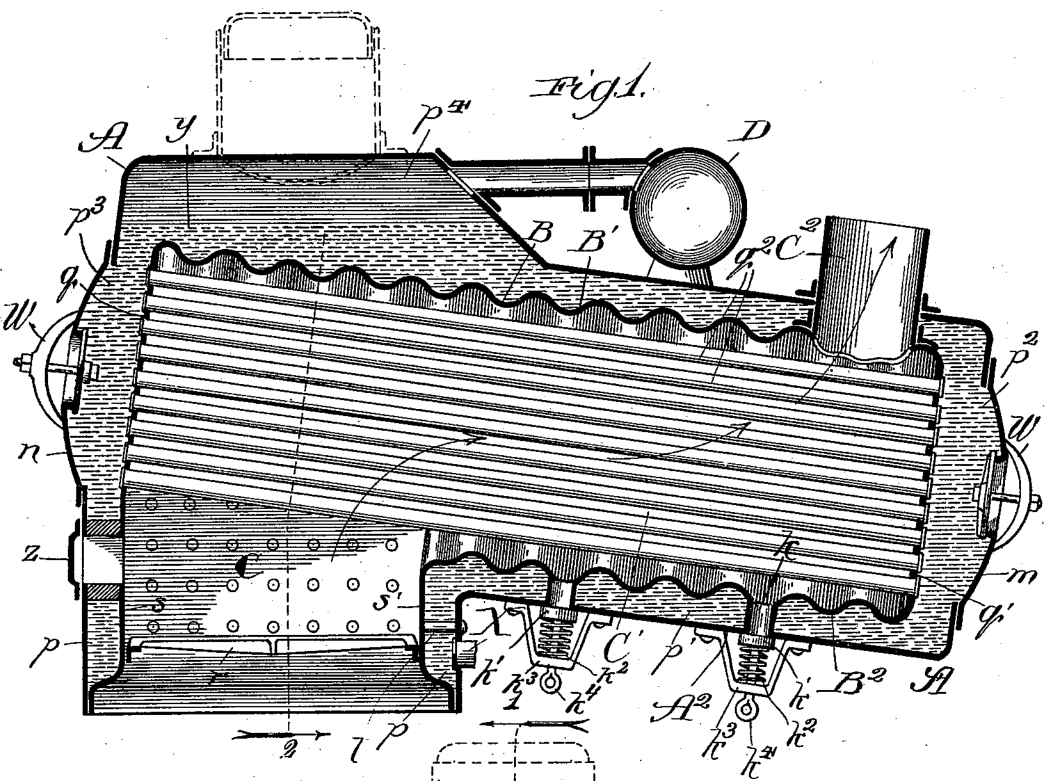
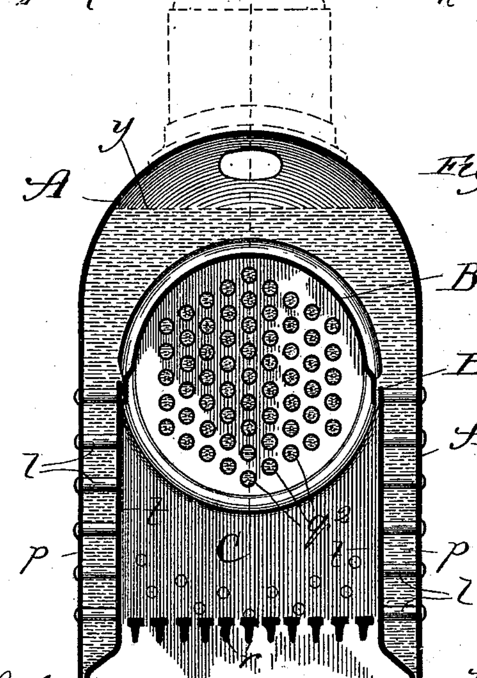


Fig. 2.



Witnesses:
Chas. E. Gaylord,
Lute S. Alter.

Inventors:
Andrew Wildman,
Henry Wildman, &
William Wildman,
By Dyrenforth & Dyrenforth
Att'ys.

UNITED STATES PATENT OFFICE.

ANDREW WILDMAN, HENRY WILDMAN, AND WILLIAM WILDMAN, OF CHICAGO, ILLINOIS.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 544,474, dated August 13, 1895.

Application filed April 16, 1895. Serial No. 545,967. (No model.)

To all whom it may concern:

Be it known that we, ANDREW WILDMAN, HENRY WILDMAN, and WILLIAM WILDMAN, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Water-Tube Boilers, of which the following is a specification.

Our invention relates to improvement in water-tube boilers or boilers of the class wherein the water to be converted into steam is caused to circulate through tubes in the path of hot products of combustion from a fire-chamber.

Our objects are to improve the construction of boilers of this class generally, and more especially that described and claimed in United States Patent No. 528,352, granted October 30, 1894, to Robert Wildman, to the ends of providing a boiler of comparatively simple construction, possessing great strength and durability, and the quality in use of generating steam quickly at high pressure and in large quantity with a comparatively small expense of fuel. To attain the ends stated, it is necessary to provide for abundant and equal circulation of water through the flues; to so dispose the flues with relation to the path of the products of combustion that they will be subjected to the first or greatest heat of the latter at their eduction ends, and to provide durable and effective strengthening means for the parts exposed to steam-pressure which will not materially retard the circulation of the contained water.

To the above ends our invention consists in the general construction of our improved boiler, as well as in details of construction and combinations of parts, all as hereinafter set forth and claimed.

In the drawings, Figure 1 is a central vertical and longitudinal section of our improved boiler, the section being taken on line 1 of Fig. 2; and Fig. 2 a section on line 2 of Fig. 1, viewed in the direction of the arrow.

A is the outer shell of the structure, which may or may not be inclosed in the brick setting. While the latter may be desirable where the boiler is to be employed to generate steam at high pressure, it would not be necessary where the boiler is to generate steam at low pressure—as, for example, for steam-heating alone. The shell A comprises the enlarged forward portion A′ and reduced cylindrical backward inclined portion A^2.

B is an inner casing comprising the arched forward portion B′, having the vertical sides $t\ t$ and front and rear sides or flanges $s\ s'$ all within and conforming more or less to the shape of the portion A′ of the outer casing and inclosing a fire-chamber C, provided with the grate r, and the cylindrical backward inclined portion B^2, extending within and concentric with the portion A^2 of the outer casing. The shell B, above the chamber C, forms a backward-extending downward-inclined flue-chamber C′, and is provided at its rear upper end with an outlet-flue C^2, which extends therefrom through the inner and outer shells. The opposite ends of the shell B, which are inclined, as shown, to extend parallel with each other at right angles to the body of the shell, form tube-sheets $q\ q'$, and fastened at their opposite ends in the tube-sheets are the water-circulating tubes q^2, which extend longitudinally through the flue-chamber C′ and are inclined to extend parallel with the cylindrical sides of the shells. The space between the inner and outer shells forms a water-leg p around the fire-chamber, an annular water-jacket p' about the part B^2 of the inner shell, end circulating chambers $p^2\ p^3$, and a steam-compartment p^4 at the upper forward side. The boiler may be provided with the upright steam-dome shown in dotted lines or the horizontal steam-dome D, the latter construction being most desirable, particularly in connection with household steam-heating systems, where the ceiling of the boiler-room is low. It is desirable to increase the space between the tube-sheets and boiler ends over that between the cylindrical walls of the shells to provide end chambers $p^2\ p^3$, which shall have the desired capacity to insure ample circulation through all the tubes.

To produce end chambers of necessary size and at the same time give increased strength to the boiler, the heads $n\ m$ of the latter are dished in a manner to render them concave on their inner sides, as shown. The strength of the boiler-heads thus acquired makes it unnecessary to provide brace-rods between

the heads, which is an important advantage. Brace-rods are always an objection in water-flue boilers, because as they have to pass longitudinally through flues they tend to limit the capacity of and consequently the circulation of water through those flues, rendering the latter liable to burn out. Furthermore, the rods being always surrounded by water and subjected to the corrosive influence thereof, are apt in time to become so weakened as to be ineffective. The objection urged against water-tube boilers which involve the use of an inner shell, on the principle of the shell B, is that the resistance of a large cylinder against collapsing is relatively weak and necessitates the employment either of an inner cylinder of very heavy material, which is not practical, or else of numerous short tie-rods between the inner and outer shell, which make the construction expensive and tend to interfere with the free circulation of the water. In our construction we effectively overcome this objection, preferably by corrugating the inner shell B, as indicated. The strength thus gained renders the resistance of the inner shell against collapsing under the force of the steam sufficiently great to obviate all danger. In the forward portion B′ of the shell the corrugations may extend only over the arched portion and terminate at the side plates *t*, the latter being braced by stay-bolts *l* through the water-leg. As the circulation of the water in the water-leg is much slower than in the upper portion of the boiler, the presence of the stay-bolts is no objection, but rather an advantage, because, besides strengthening the side walls of the fire-chamber, they form heat-conductors, which aid materially in raising the temperature of the water in the water-leg.

In operation water may be fed into the water-leg, as through a pipe X, whence it rises throughout the water-leg, water-jacket p', chambers p^2 p^3, and flues q^2 to the water-line at *y*. Fuel is fed to the fire-chamber C through the usual door *z* and the products of combustion rise in the forward part of the flue-chamber and, passing backward about the flues, escape through the outlet C^2. The water as it enters at X is first heated in the water-leg by radiation from the fire-chamber wall and from the bolts *l*. As the tendency of the products of combustion is to pass directly to the top of the chamber, the flues are subjected at their end portions adjacent to the tube-sheet *q* to the first and, consequently, the greatest heat. In the backward and slightly-downward movement of the products of combustion substantially all the available heat thereof is absorbed through the tubes and water-jacket. As a result of this construction the tendency of the greater volume of water is to flow from the water-leg backward through the water-jacket to the chamber p^2 and thence through the tubes to the chamber *q*. Thus the greatest heat is brought to bear against the water at the eduction ends of the tubes, which is a decided advantage in steam-generation. The incline of the tubes greatly facilitates circulation and is a safeguard against the tubes being burned. It has been found that where the tubes extend horizontally and are subjected to a greater degree of heat at a certain part than at others the tendency is for the water to become vaporized at that part and by expanding in opposite directions to so retard the circulation as to cause burning of the tubes. In our improved boiler this danger is overcome by inclining the tubes and by affording the enlarged end chambers p^2 p^3, which prevent crowding, in the sense that they provide a free supply at the induction ends of the tubes and a free exit at the eduction ends thereof.

The man-heads W in the boiler-heads afford facilities for free access to the tubes, end chambers, and water-jacket when desired.

While the heat directly over the fire-box would in practice tend to keep the tubes there free from the accumulation of soot and ashes, there is danger that in the part of the flue-chamber back of the fire-box they will accumulate upon the tubes, and being non-heat conducting interfere with the heating of the water at the rear end portion of the boiler. In order that the tubes and flue-chamber may be cleared from time to time from the accumulations of ashes and soot, we provide one or more comparatively small tubes *k* through the lower part of the water-jacket and inner and outer shells to afford air-inlets to the flue-chamber. The tubes *k* may be closed normally by means of valves *k′*, which seat over their outer ends and are held seated preferably by means of springs k^2 about the valve-stems and confined between brackets k^3 on the outer shell and the outer faces of the valves. The stems may be provided with handles k^4, whereby the valves may be readily withdrawn from their seats against the resistance of the springs to open the passages and admit a gust of air. The air will enter with such force as to drive the accumulated ashes and soot from the base and sides of the flue-chamber and from the surfaces of the tubes through the outlet C^2. By opening one or both valves from time to time the boiler-tubes will be kept free from non-heat conducting accumulations.

The main advantages claimed for water-flue boilers over those of the smoke-flue type are, first, the more rapid production of steam due to the water's being subjected to the heat in comparatively small streams instead of in a body, and, second, on account of the quicker and greater absorption by the water of heat from the products of combustion, which tends to economy in the use of fuel. All the features of our improved construction contribute toward the obtaining of the advantages named in an enhanced degree, and furthermore toward making the boiler particularly strong, durable, and economical to manufacture.

What we claim as new, and desire to secure by Letters Patent, is—

1. In a water-tube boiler, the combination with the fire-chamber of inner and outer shells inclined downward in the backward direction and forming between them an inclined water-jacket, end circulating-chambers, and an upper steam chamber, the inner-shell forming the casing of a longitudinally extending flue chamber, inclined downward in the backward direction, which is in open communication at its lower forward end portion with the fire chamber, closed at opposite ends with tube sheets and having an outlet at its upper rear-end portion extending through the water-jacket, and tubes in the flue-chamber inclined downward in the backward direction and fastened at opposite ends in the tube-sheets to extend at their higher end-portions over the fire-chamber, substantially as and for the purpose set forth.

2. In a water-tube boiler, the combination with the fire chamber of inner and outer shells forming between them a water-leg about the fire-chamber, an inclined water-jacket and end circulating chambers, the inner-shell forming the casing of a longitudinally inclined flue chamber which is in open communication at its lower forward end-portion with the fire chamber, closed at opposite ends with tube-sheets and having an outlet at its upper rear-end portion extending through the water-jacket, and inclined tubes in the flue-chamber fastened at opposite ends in the tube-sheets to extend at their higher end-portions over the fire-chamber, substantially as and for the purpose set forth.

3. In a water-tube boiler, the combination with the fire chamber of inner and outer shells forming between them an inclined water-jacket and end circulating chambers, the inner-shell being cylindrical and provided with annular corrugations and forming the casing of a longitudinally inclined flue chamber which is in open communication at its lower forward end-portion with the fire chamber, closed at opposite ends with tube-sheets and having an outlet at its upper rear-end portion extending through the water-jacket, and inclined tubes in the flue-chamber fastened at opposite ends in the tube-sheets to extend at their higher end-portions over the fire-chamber, substantially as and for the purpose set forth.

4. In a water-tube boiler, the combination with the fire chamber of inner and outer shells forming between them an inclined water-jacket and end circulating-chambers, the inner-shell forming the casing of a longitudinally inclined flue chamber which is in open communication at its lower forward end-portion with the fire chamber, closed at opposite ends with tube-sheets and having an outlet at its upper rear-end portion extending through the water-jacket, and the heads of the outer shell being dished to present concave inner sides, and inclined tubes in the flue-chamber fastened at opposite ends in the tube-sheets to extend at their higher end-portions over the fire-chamber, substantially as and for the purpose set forth.

5. In a water-tube boiler, the combination of the outer shell having the enlarged forward portion and reduced and cylindrical downward inclined rear portion and provided at opposite ends with heads having concave inner faces, an inner shell forming a flue-chamber closed at opposite ends with tube-sheets and having the enlarged forward portion corrugated at its upper side and shaped at its lower part to afford a fire-chamber and reduced and cylindrical downward inclined and circumferentially corrugated rear-portion, within and concentric with the outer shell, and having an outlet flue, the shells forming between them a water-leg about the fire-chamber, a water-jacket, enlarged end-chambers, and a steam-chamber in the enlarged forward portion, and tubes in the flue-chamber inclined downward in the backward direction and fastened at opposite ends in the tube-sheets to extend at their higher end-portions over the fire-chamber, all constructed and arranged to operate substantially as and for the purpose set forth.

6. In a water-tube boiler, the combination with the flue-chamber, for the passage of hot products of combustion, and water tubes therein, and water jacket about the said chamber of an air-inlet passage extending through the water jacket to the lower part of the flue-chamber, a valve normally closing said passage and operative to open and admit air through said passage to the flue-chamber, substantially as and for the purpose set forth.

7. In a water-tube boiler, the combination with the flue-chamber, for the passage of hot products of combustion, and water tubes therein, of an air-inlet passage through the shell of the flue-chamber, a spring seated valve normally closing said passage, and a stem on the valve forming a handle by means of which the valve may be opened against the resistance of the spring to admit air to the flue-chamber, substantially as and for the purpose set forth.

ANDREW WILDMAN.
HENRY WILDMAN.
WILLIAM WILDMAN.

In presence of—
J. H. LEE,
J. N. HANSON.