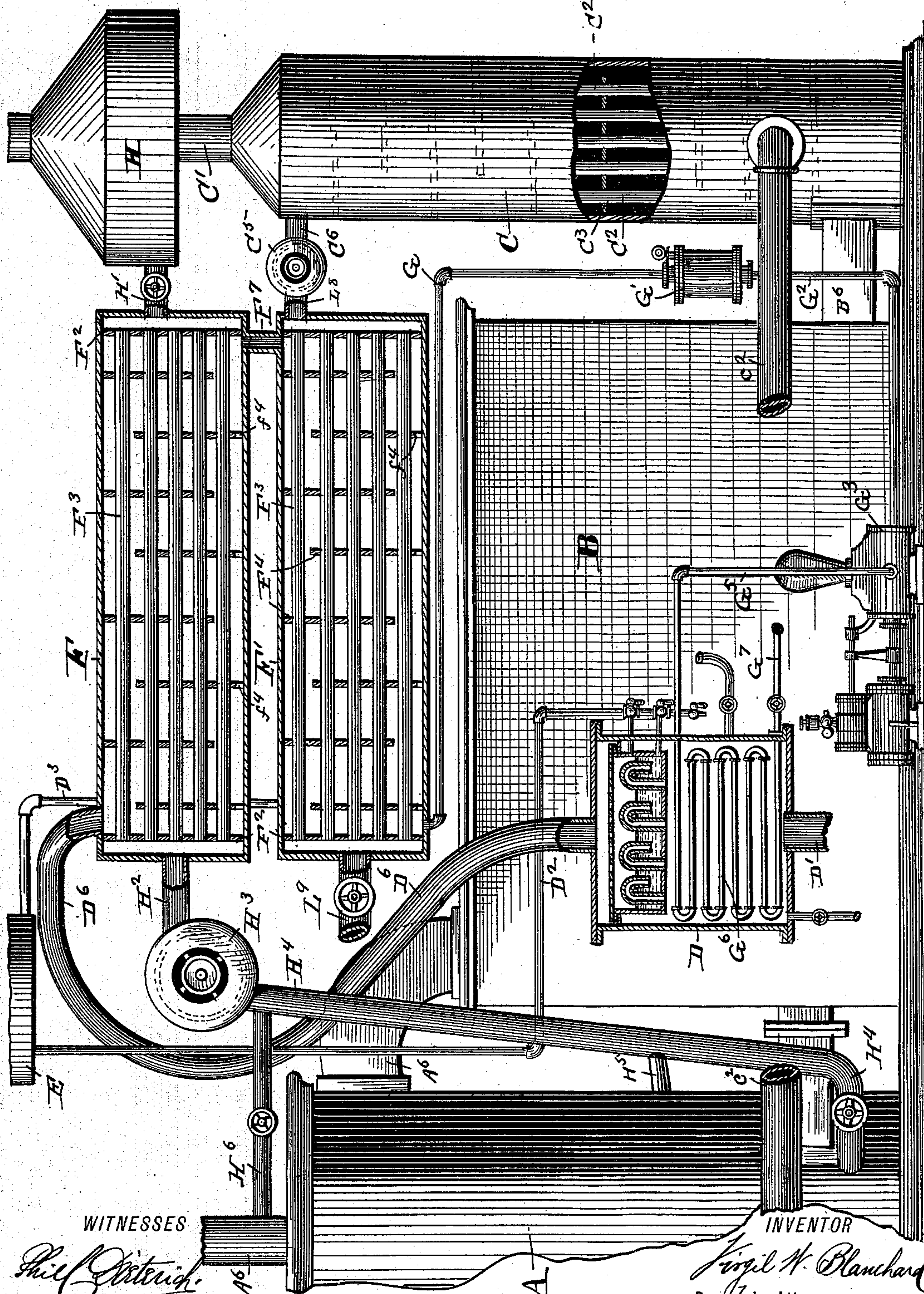


(No Model.)

V. W. BLANCHARD.  
GAS COOLER FOR FURNACES.

No. 413,901.

Patented Oct. 29, 1889.



WITNESSES

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# UNITED STATES PATENT OFFICE.

VIRGIL W. BLANCHARD, OF NEW YORK, N. Y., ASSIGNOR TO JOSEPH A. DAVIS, OF SAME PLACE.

## GAS-COOLER FOR FURNACES.

SPECIFICATION forming part of Letters Patent No. 413,901, dated October 29, 1889.

Application filed April 5, 1889. Serial No. 306,070. (No model.)

*To all whom it may concern:*

Be it known that I, VIRGIL W. BLANCHARD, of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Gas-Coolers for Furnaces; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing, and to the letters of reference marked thereon, which form part of this specification, in which—

The drawing represents a diagram of a plant embodying my invention.

This invention is an improvement in steam-boiler furnaces; and its objects are to provide an improved apparatus for use in connection with the furnace and boiler, whereby the air supplied to the furnace is heated and the exhaust-steam from the engine condensed and returned as water to the boiler at a high heat; and a further object of the invention is to remove a portion of the carbonic acid and nitrogen gas from the terminal gases escaping through the chimney and employing these gases to condense the steam and to assist in tempering and regulating the heat of the furnace, and, finally, to recarbonize the carbonic acid element of the said gases and employ the resultant mixture in the production of intense heat in the furnace, all of which will be clearly understood from the following description and claims.

In the drawing illustrating my plant, A designates a furnace, which is preferably constructed like that described in my application for furnace filed April 17, 1889, Serial No. 307,614.

B designates the casing of a steam-boiler, which is preferably constructed like the one described and claimed in my application for steam-generators filed April 11, 1889, Serial No. 306,805. The gaseous products of combustion from the furnace enter one end of boiler B through a pipe A<sup>6</sup>, and from said boiler escape to an outlet B<sup>6</sup> into the lower end of a vertical air-heater C, which consists of an outer shell terminating in a contracted chimney C' and inclosing a number of vertically-arranged pipes C<sup>3</sup>, for the passage of the gases, and a number of horizontal diaphragms C<sup>3</sup>, which form a zigzag passage for the de-

scent of air, which is forced therein by a suitable air-forcing engine C<sup>5</sup>, connected to the top thereof by a pipe C<sup>6</sup>, the air being heated in its course through this passage by the gases rising through pipes C<sup>2</sup>, and is conducted off by a pipe c<sup>2</sup> to the furnace, for supporting combustion therein.

D designates a hot-water reheater and evaporator, which is constructed substantially as shown and described in my application for water-heaters, filed April 11, 1889, Serial No. 306,805. This heater communicates by a pipe D' with an exhaust-pipe from the main engine, (not shown in the drawing,) and also, by means of a pipe D<sup>2</sup>, with a water-cooler and condenser E.

F F' designate two vessels forming a steam-condenser and gas and air heater, located above the boiler, and vessel F lies above vessel F'. Each vessel has interior heads F<sup>2</sup> at its ends, into which are expanded the ends of horizontal tubes F<sup>3</sup>, dividing the interior of the vessels into two chambers, as is evident. The space between the heads F<sup>2</sup> in each vessel is divided by partitions F<sup>4</sup> into zigzag channels. The partitions F<sup>4</sup>, rising from the bottoms of the vessels, have perforations f<sup>4</sup> in them to permit escape of water thereunder. The zigzag chamber in vessel F communicates with the chamber in vessel F' by a short pipe F<sup>7</sup>, so that water of condensation can flow from one vessel to the other. The said chamber in vessel F also communicates, by means of a pipe D<sup>6</sup>, with the water heater and purifier D, as shown, while the chamber in vessel F' communicates with a pipe G, leading to an automatic water-alarm G', that communicates by a pipe G<sup>2</sup> with a water-pump G<sup>3</sup>, that in turn is connected by a pipe G<sup>5</sup> with the coiled pipe G<sup>6</sup> in the receptacle D, and said coil is connected to the feed-pipe G<sup>7</sup> of the boiler. The said pipe G<sup>7</sup> near its termination lies directly over the mouth of the exhaust-pipe from the engine, as shown.

H designates a gas-trap placed above the heater C, and into which the gases escaping from the furnace are conducted. The said trap is clearly described and claimed in my application for gas-traps, filed April 6, 1889, Serial No. 306,202, and it is so constructed that the carbonic-acid gas is directed toward



the floor thereof, and being heavier than the other gaseous products of combustion will rest mainly upon the floor of said trap.

H' designates a valve-pipe communicating with the bottom of said trap and with the vessel F, as shown, and H<sup>2</sup> is a pipe connecting the other end of vessel F with an air-engine H<sup>3</sup> of suitable construction, and this engine is connected to a pipe H<sup>4</sup>, leading into the ash-pit of the furnace A. By this means the carbonic-acid gas can be withdrawn from trap H through vessel F and forced into the furnace beneath the grate. The pipe H<sup>4</sup> is provided with branch pipes H<sup>5</sup>, leading into the furnace above the fuel-chamber, and with a pipe H<sup>6</sup>, leading into the fuel-supply pipe A<sup>6</sup> of the furnace, all of said pipes being provided with proper valves, so that the operator can direct the gases into any part of the furnace desired and in any quantities. Vessel F' communicates with the atmosphere at one end by a valved pipe L<sup>9</sup> for the attenuation of air, and at its opposite end by a pipe L<sup>8</sup> with the engine C<sup>5</sup>, so that air can be drawn through this vessel and forced into the heater C. The end of vessel F' also communicates by a pipe D<sup>3</sup> with the water-condenser E.

In operation, after the furnace has been fired, the gases escape through the boiler into heater C and rise into trap H. The air-engine C<sup>5</sup> being started, air is drawn through vessel F' and cooled by attenuation, if desired, and forced through heater C to the furnace. The cool air forced into and through heater C greatly reduces the heat of the gases rising therein, so that the same are of lower temperature than the steam entering vessel F. Engine H<sup>3</sup> being started and the proper valves opened, the carbonic-acid gas collecting in the bottom of trap H is drawn through vessel F and forced into the furnace at the desired points by regulating the valved pipes, as described. Steam being raised and the main engine started, the exhaust-steam is admitted into heater and water-purifier D, and after passing therethrough and losing a greater portion of its latent heat in said vessel escapes into the front end of the zigzag channel in vessel F, and passing through this channel in a tortuous course it loses another portion of its heat, which is absorbed by the gases passing in the opposite direction through the vessel, and the uncondensed steam then enters vessel F', and pursuing a contrary zigzag passage back to the front end thereof, being still further cooled and condensed by the cold air being drawn through vessel F' by the pump C<sup>5</sup>. The steam has by this time been almost entirely condensed, and the resultant water of condensation escapes through pipe G<sup>2</sup>, from whence it is drawn by the pump and forced through the coil in heater D, and, being delivered to the highest part of said coil, it becomes heated in its downward passage and passes therefrom at a temperature about equal to that of the incoming

exhaust-steam, this high heating of the water occurring after it has left the pump. Any steam uncondensed in vessel F' rises through pipe to condenser E, where it is condensed by the cold water, and a partial vacuum thus produced in the plant. I thus utilize the exhaust-steam to heat the gases and air supplied to the furnace for combustion, and I in turn utilize these gases and the air to condense the steam to water below the boiling-heat, which, after passing through the pump, is reheated in the vessel D to a temperature at or near the heat of the exhaust-steam at the point of its admission into vessel D. The carbonic-acid gas withdrawn from trap H is employed for two purposes—viz., by admitting it into the furnace it tempers the heat of the fire when it is desired to do this; but its chief and most valuable use is to aid in the production of more intense heat, and to do this it is admitted beneath the grate into the ash-pit under sufficient pressure to drive it up through the bed of incandescent fuel thereon, and in its passage therethrough each molecule of gas picks up another atom of carbon from the fuel, forming carbonic-oxide gas, which rises into the combustion-chamber in the upper part of the furnace, there to be mingled and mixed with oxygen forced into the furnace, and is there oxidized, creating a most intense heat, the carbonic-acid gas formed by this re-combustion of the carbonic oxide passing off to the chimney, from which a portion of it is collected in the trap and again recarbonized and burned. By attenuating (expanding) the air it will absorb a larger amount of heat in its passage through vessel F'. The steam-passage in said vessel F may be provided with a pipe communicating with the atmosphere to permit escape of any uncondensed steam; but if the parts are properly proportioned this will not be necessary.

The alarm in pipe G is placed at such a height that if for any reason the pump should not act properly and the flow of water be stopped the water collecting in the pipes will rise and release a float in said alarm, which will then sound a whistle, if properly connected thereto, thus calling the attention of the engineer to the danger.

Having thus described my invention, what I claim is—

1. The combination of a steam-boiler furnace with a steam-condensing vessel and means, substantially as described, for withdrawing gases from the chimney and returning them through said vessel to the furnace, substantially as set forth.

2. The combination, in a steam-boiler furnace, of a gas-collecting trap, a steam-condenser, and means, substantially as described, for withdrawing the gases from the trap and directing them through said condenser to the furnace, for the purpose specified.

3. The combination, in a steam-boiler furnace, of an air-heater in the uptake and a steam-condenser with means, substantially



as described, for directing a current of air through said condenser into the air-heater, and from thence to the furnace, as specified.

4. The combination, in a steam-boiler furnace, of a steam-condenser with means, substantially as described, for withdrawing gases from the chimney and directing them through a part of said condenser to the furnace, and means for directing a current of air through the other portion of the condenser to the furnace, all substantially as specified.

5. The combination of the steam-condenser and water-heater with the exhaust-steam pipe leading to said heater, the pipes connecting said heater and condenser, the pump communicating with said condenser and with a coil in said heater, and the connection between said coil and boiler, all constructed as and for the purpose set forth.

6. In a steam-boiler furnace, the combination of the air-heater and gas-trap communicating with the chimney with the steam-condensing vessels and the connections between said vessels and the gas-trap and air-heater, respectively, all substantially as specified.

7. The combination, in a steam-boiler furnace, of a steam-condenser and a gas-trap communicating with the chimney with the air-forcing engine and pipes, whereby the gases are withdrawn from the trap and through the condenser and directed into the furnace, all as and for the purpose described.

8. The combination of the furnace and the air-heater located in the chimney, and the steam-condenser, with the air-forcing engine, the pipes connecting the condenser with the air-heater and the heater with the furnace, as and for the purpose specified.

9. The combination, in a steam-boiler furnace, of the gas-trap and air-heater connected to the chimney and the steam-condensing vessels communicating with the exhaust of an engine with the air engines and pipes connecting said vessels respectively with the gas-trap and air-heater and with the furnace, whereby gases and air may be drawn through said vessels and carried to the furnace, substantially as described.

10. The combination, with the water heater and purifier D and the condensing-vessel E, of the air-heater C, the pipes connecting the condenser and heater, the alarm, and the air engine and pump, all substantially as set forth.

11. The combination of the condenser F F', the air-heater C, and the furnace and pipe connections between said condenser and furnace and the air-engines, all substantially as and for the purpose specified.

12. The combination, in a steam-boiler furnace, of the condenser F F', the water heater and purifier D, and the connections between said heater and purifier with the air-heater C and gas-trap H, all as and for the purpose described.

13. The combination, with the steam-condenser and air-heater, substantially as described, provided with an air-inlet pipe having a regulating-valve, with an air-forcing engine connected to said condenser, whereby the air may be attenuated in its passage there-through, substantially as and for the purpose specified.

14. The combination, in a steam-boiler and furnace, of the vessels F F', connected and constructed substantially as described, with the gas-trap H, the air-heater C, the air-forcing engines, water-pump, and cold-water condenser, all substantially as specified.

15. The combination, in a steam-boiler furnace, of the water heater and condenser D, the steam-condensing vessels F F', and the cold-water condenser E with the gas-trap G, air-heater C, alarm, and the air and water pumps, all constructed and arranged to operate substantially as specified.

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

VIRGIL W. BLANCHARD.

Witnesses:

W. R. KEYWORTH,  
F. O. MCCLEARY.