

UNITED STATES PATENT OFFICE.

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EXHAUST-REGENERATING STEAM AND WATER HEATER COMBINED.

958,636.

Specification of Letters Patent. Patented May 17, 1910.

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To all whom it may concern:

Be it known that I, STEPHEN HUMPHREY HALE, a citizen of the United States, residing at St. Joseph, in the county of Buchanan and State of Missouri, have invented certain new and useful Improvements in Exhaust-Regenerating Steam and Water Heaters Combined; and I do 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, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

The object of my invention is to provide a means whereby steam that has been generated in a boiler and which has passed through a supply pipe and served the purpose for which generated may be returned through an exhaust or return pipe to an exhaust heater located in the smoke stack, at both ends, in the inside of the flues and through the fire box at the bottom of the boiler, thence passing up through the bottom and end of the boiler and connecting with the water heater inside thereof, thence returning through a pipe to the condenser inside of the condensing and boiler feeding tank where it is condensed back to water from which it passes into an open top tank from which it may be pumped back through the condensing and boiler feeding tank to the boiler.

I accomplish my object by the mechanism illustrated in the accompanying drawing, in which the figure shows a longitudinal sectional elevation of the entire device.

Similar letters refer to similar parts in the several views.

In the drawing A is a boiler.

A' is an engine.

B is a steam supply pipe for running an engine or for heating purposes.

C is an exhaust or return pipe.

D is the steam dome of the boiler.

Coils and tubes E E . . . represent the superheating feature of the device and are a part of the generator.

F F . . . are the headers with which a plurality of coils or tubes may be connected.

G is a smoke stack.

H H . . . are the flues inside of the boiler.

J is a grate and K a fire wall.

L is a water heater inside of the boiler.

M is the condenser and M' is a condensing tank.

O is an oil separating receiving tank from condenser M.

I is the exhaust pipe from the water heater in the boiler to the condenser in the tank.

B' is the boiler supply feed pipe.

B² is a steam supply pipe to pump P.

B³ is a supply pipe from the pump that supplies the condensing and boiler feeding tank.

B⁵ is a suction pipe between the pump and tank.

B⁶ is a feed pipe from the condenser to the receiving tank.

Q is a trap in the receiving tank to prevent the oil from passing from the receiving part of the tank to the part of the tank that supplies the boiler.

R is a partition to prevent the mixing of the oil with the water that is to be again used in the boiler.

S S are feed and ash pit doors and S' a soot door.

T is a flue cleaning door.

U U . . . are lock nuts by which to make tight joints between the water heating and condensing pipes leading into and out of the boiler and condensing tank.

V is a jacket covering the back and coils of the boiler.

W is a check valve in the supply pipe between the boiler feeding tank and the boiler.

The broken end of supply pipe B represents the end at which connection of the said supply pipe is made with the engine or radiator; the broken end of exhaust pipe C represents the end of said pipe with exhaust from the engine or return from the radiator.

Y is a fire box and Z is an ash pit.

E' E' . . . are straight arrows showing the travel of the exhaust steam and condensation as it passes through the heaters and condensers; the small crooked arrows show the travel of the gases through the heater.

The coils of the heater at the end of the boiler are in no way an obstruction to the cleaning of the flues as the flue cleaner can be passed through the flues and coils. The desired back pressure of the engine may be regulated by extending pipe B⁶ down into the water in the receiving tank.

To operate the device the boiler is first

supplied with water by any convenient means and heated in the usual manner. The steam generated by said heat passes out of the boiler through supply pipe B to any
 5 suitable engine. From said engine it is exhausted through pipe C and through the super-heating and steam generating heater to water heater L inside of boiler and then
 10 to steam condenser M in which it is condensed back into water and passes thence to receiving tank O. From said receiving tank it is pumped back into the bottom of the
 15 condensing tank M' and forced through the same into the boiler. The object of pumping in at the bottom is to force the hot water out
 of the top of the tank at a higher temperature than the steam pump would handle the same direct.

In constructing the heaters and condenser
 20 they may be constructed in either coil or straight form or both as shown without change in the spirit and purpose of the invention.

The device can be installed in any make
 25 of boiler, upright, horizontal or otherwise. The device as shown is in a tubular boiler. Where a single coil or tube is shown in the drawing I would in constructing the device
 ordinarily, construct a plurality of coils or
 30 tubes. The coils and tubes are constructed in sections with nipple connections between the same.

In operating this device it is found that the consumption of fuel is very greatly re-
 35 duced and that as much as 90 per cent. of the heat wasted with ordinary boilers in the smoke stack in front of the flues is saved by my device. It will be readily understood
 that after the steam has been generated in
 40 the boiler to a high temperature and served its purpose in the engine it is still at a high temperature and will not require very much heat in the super-heating heater to double
 the temperature before it enters the water
 45 heater inside of the boiler.

What I claim and desire to secure by Letters Patent, is:—

1. In an apparatus of the class described, the combination of a steam boiler, an engine
 50 connected to receive and utilize live steam direct from the boiler, a heater contained in the water space of said boiler and having a steam conducting passage which is free from
 boiler pressure, a superheater connected to
 55 receive and regenerate the exhaust steam from the engine and deliver the regenerated or superheated exhaust steam to the steam conducting passage of the heater within the
 water space of the boiler whereby the re-
 60 generated exhaust steam will transmit its heat to the water in the boiler to assist in the generation of steam therein, a feed water heating tank connected to receive exhaust
 steam from said heater within the boiler and
 65 having a feed water outlet communicating

with the boiler, and a pump for forcing feed water through the feed water tank and into the boiler.

2. In an apparatus of the class described, the combination of a steam boiler, a furnace
 70 therefor having a stack, an engine connected to receive and utilize steam from said boiler, a heater contained in the water space of said boiler and having a steam conducting pas-
 75 sage which is free from the boiler pressure, and a superheater mounted in the stack and composed of a plurality of helical coils of different diameters contained one within the
 other, the inlet ends of said coils being con-
 80 nected in common to receive the exhaust steam from the engine and the opposite or outlet ends of said coils being connected in
 common to the said heater within the water space of the boiler whereby exhaust steam
 85 from the engine will be regenerated in the superheater and such regenerated or superheated exhaust steam will be delivered to the water heater contained within the water
 space of the boiler.

3. In an apparatus of the class described, the combination of a steam boiler, a furnace
 90 therefor having a combustion chamber and discharge flue, an engine connected to receive steam from the boiler, a plurality of superheaters arranged in the combustion
 95 chamber and the gas discharge flue of the boiler, the superheater in the discharge flue being connected to first receive exhaust steam from the engine, and the superheater in the
 combustion chamber being connected to re-
 100 ceive such exhaust steam after traversing the superheater in the discharge flue of the furnace, and a heater arranged in the water space of the boiler and connected to receive
 the exhaust steam from said superheaters
 105 and serving to transmit the heat from the superheated exhaust steam to the water in the boiler, the exhaust steam in said heater being free from the boiler pressure.

4. In an apparatus of the class described, the combination of a steam boiler, a furnace
 110 therefor having a stack, an engine connected to receive steam from the boiler, a series of superheaters one arranged in the stack and connected to initially receive exhaust steam
 115 from the engine to regenerate such exhaust steam, other superheaters being arranged in alinement with the boiler flues and connected to receive the partially regenerated exhaust
 steam from the superheater in the stack to
 120 increase the superheat of such exhaust steam, and superheaters arranged in the combustion space of the boiler and connected to receive and further superheat the ex-
 125 haust steam from the superheaters first mentioned whereby the exhaust steam from the engine is progressively regenerated as it approaches the hottest portion of the fur-
 nace, and a water heater contained in the
 water space of the boiler and having a pas- 130

sage which is free from boiler pressure and is connected to receive regenerated exhaust steam from the superheater in the combustion space of the furnace whereby the re-
 5 generated exhaust steam will transmit its heat to the water in the boiler to assist in the generation of steam therein.

5. In an apparatus of the class described, the combination of a steam boiler, a furnace
 10 therefor, an engine connected to receive and utilize steam from the boiler, a heater contained in the water space of the boiler and having a steam conducting passage which is
 15 free from boiler pressure, the boiler having flues for conducting the heated gases of the furnace therethrough, and superheating
 20 coils having their axes arranged in alinement with the boiler flues whereby the latter may be cleaned with facility and the heated
 25 gases passing therethrough may continue through the coils, the superheating coils being connected to receive exhaust steam from the engine to regenerate it and to deliver the regenerated exhaust steam from
 the engine to the heater within the water space of the boiler.

6. In an apparatus of the class described, the combination of a steam boiler having
 30 flues, a furnace, an engine connected to receive and utilize steam from the boiler, a heater contained in the water space of the boiler and having a steam conducting passage which is free from boiler pressure, and

superheaters comprising series of coils arranged in rows and having their axes in
 35 alinement with the boiler flues, the coils of each row being connected by headers, the first row of coils being connected to receive exhaust steam from the engine and the last
 40 row of coils being connected to deliver regenerated exhaust steam to the steam conducting passage of the heater within the water space of the boiler.

7. In an apparatus of the class described, the combination of a steam boiler, a furnace
 45 therefor, an engine connected to receive and utilize steam from the boiler, a heater contained in the water space of said boiler and having a steam conducting passage which
 50 is free from boiler pressure, a plurality of sets of superheaters mounted in the furnace for progressively regenerating exhaust steam from the engine, said superheaters being
 55 connected to cause a flow of the exhaust steam in a direction opposite to the motion of the furnace gases, the superheaters being connected to deliver the regenerated exhaust steam to the heater in the water space of the boiler, and a feed water heater connected
 60 to the outlet of said heater within the boiler.

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

STEPHEN HUMPHREY HALE.

Witnesses:

EVANGELINE O. GIBBONS,
 WM. B. SNYDER.