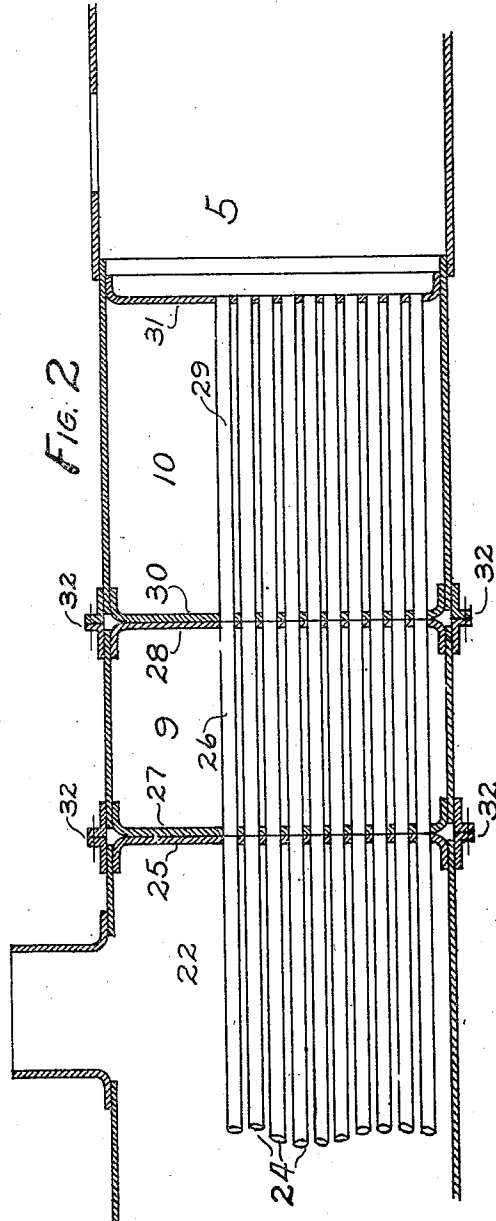
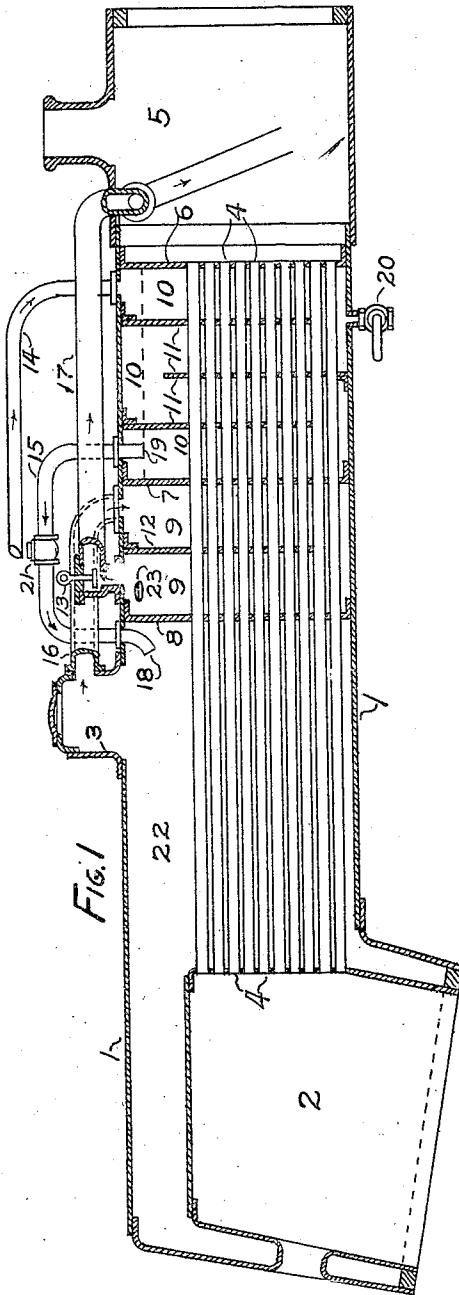


F. A. HAUGHTON.
 STEAM GENERATOR, SUPERHEATER, AND FEED WATER HEATER.
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Patented Dec. 14, 1909.



WITNESSES

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FRANK A. HAUGHTON, OF NEW YORK, N. Y.

STEAM-GENERATOR, SUPERHEATER, AND FEED-WATER HEATER.

943,189.

Specification of Letters Patent.

Patented Dec. 14, 1909.

Application filed March 13, 1909. Serial No. 483,146.

To all whom it may concern:

Be it known that I, FRANK A. HAUGHTON, a subject of the King of Great Britain, residing at Flushing, borough of Queens, city and State of New York, have invented certain new and useful Improvements in Steam-Generators, Superheaters, and Feed-Water Heaters, of which the following is a specification.

My invention relates to an improvement in steam generators of the fire tube type.

The principal objects of the invention are to increase the steam generating capacity of the boiler; to utilize the highest possible per cent. of heat from the gases of combustion and to furnish dry or highly superheated steam to the engine.

These and other objects of the invention are effected by means such as illustrated in the accompanying drawings, in which:

Figure 1 is a longitudinal section of a steam generator of the fire tube type embodying my improvements. Fig. 2 is a longitudinal section of a portion of a steam generator of the fire tube type showing the feed water heater, the steam heater, and the steam generator assembled in a manner to be readily separable from each other.

Referring now to Fig. 1; in the shell 1, of a fire tube boiler, is a fire box 2, the steam dome 3, the fire tubes 4, and the smoke box 5. A front tube sheet 6 and intermediate tube sheets 7 and 8 divide the shell into three separate chambers, to wit, a generator 22, a steam heater 9, and a feed water heater 10. The fire tubes pass through the several chambers and are expanded in the tube sheets. Diaphragms 11—11 in the feed water chamber 10, serve as baffle plates to direct the circulation of water around the tubes 4, which latter also pass through the baffle plates. A feed water pipe 14 delivers water to the preliminary water heater 10, and a pipe 15 delivers the water from the water heater 10 to the steam generator. A main steam pipe 16 connects the steam dome to the steam heater, and a main steam pipe 17, controlled by the throttle valve 13, connects the superheater 5 to the cylinders. In the bottom of the preliminary water heating chamber 10 is a blow-off cock 20, and in the delivery pipe 15, is a check valve 21, the latter preventing any back flow from the generator 22 to the preliminary water heater 10. In the shell of the steam heater is a hole 23 for the safety valve.

In the modification shown in Fig. 2, the generator chamber, the steam heating chamber, the preliminary water heating chamber, and the smoke box, are again designated by 22, 9, 10 and 5, respectively. 24 are the fire tubes in the generator terminating in a tube sheet 25. 26 are the fire tubes in the steam heating chamber secured to the tube sheets 27 and 28, and in line with tubes 25. 29 are the fire tubes in the preliminary water heater, secured to the tube sheets 30 and 31, and in line with the tubes 25 and 26. Flanged connections 32 hold together the generator, steam heater, and preliminary water heater, and permit the same to be readily separated.

Fig. 1 shows my invention in its simplest form. Steam is generated in the chamber 22 and is delivered by the pipe 16 to the steam heating chamber 9, with which the generator is in constant communication. The steam on entering the chamber 9 is directed down between the fire tubes 4 by the baffle plate 12, thus receiving a preliminary heating by contact with the highly heated fire tubes. The steam then passes under the baffle plate 12, upward again between the fire tubes, through the throttle valve 13, and the steam pipe 17 to the cylinders. It will be observed that in its passage through the chamber 9, the steam is first passed over the tubes of a lower and then of a higher temperature, for the reason that the temperature of the fire tubes is higher toward the fire box and lower toward the smoke box. The safety valve is located at some convenient point 23 near the outlet from the steam heater so as to cause a circulation of steam from the generator between the tubes in the steam heater when the throttle valve is closed and the steam pressure rises to the blowing off point, which usually occurs with a hot fire, immediately after closing the throttle valve thus contributing to the protection of the tubes in the steam heater from the high temperature of the fire in the tubes.

The feed water enters the preliminary heater 10, through the feed pipe 14, preferably at the top as shown, and is directed downward by a first baffle plate 11. Passing under this plate 11, the water is directed upward by a second baffle plate 11, to the top of the same, again downward by reason of a third baffle plate 11, under the latter, and finally upward to the outlet 19. In this passage through the chamber 10 the water has

successively engaged fire tubes of increasing degrees of temperature and has in consequence attained a high temperature when it reaches the outlet 19. The feed water entering the heater and becoming heated, will, in passing downward between the fire tubes, precipitate a large proportion of the lime or other impurities usually held in solution to a greater or less extent in most feed waters.

This precipitate will be deposited at the bottom of the heater and may be blown out by the blow-off cock 20. The reversal of downward to upward flow of the feed water in passing under the first baffle plate 11 will also cause a deposit of mud or sediment at the bottom of the heater which will also be blown out when the cock 20 operates. In this manner a large proportion of the scale making substances in the water are prevented from reaching the generator.

The feed water is forced from the heater by the pressure set up therein by the force of the injector or feed pump through the feed pipe 14, and it flows through the feed water delivery pipe 15 into the generator at the outlet 18 which is directed preferably away from the tube sheet 8, as shown. The delivery pipe is provided with the check valve 21 to prevent any back flow into the heater.

The delivery pipe is extended downward from the top of the shell into the heater at 19 thereby "trapping" any steam or air above the level of the bottom of the pipe. This steam or air acts as a cushion when the injector or pump is in operation. Any steam generated in the feed water heater will flow into the generator through the delivery pipe 15 whenever the pressure in the heater rises above that of the generator, and such connection therefore acts as an automatic safety relief from excessive pressure in the heater.

It will be observed that the fire tubes extend continuously from the fire box 2 to the smoke box 5. The hot gases in the tubes gradually give up their heat during their flow, finally emerging into the smoke box at a greatly reduced temperature. It is well known that the thermal efficiency of any boiler is dependent on the quantity of heat absorbed from the products of combustion. Any means therefore which provides for the absorption of additional heat from the products of combustion, by the feed water, by the generation of steam, or by the superheating thereof, will increase the economy of the apparatus. With this in mind, I have combined in my invention a feed water heater, a superheater, and a generator, in sequence or tandem with each other, the feed water heater being located at the coldest end of the fire tubes, the superheater next, and the generator next in succession. Furthermore, I have arranged for the cold feed water to enter the water heater at its

coldest end adjacent the smoke box, thereby reducing the temperature of the gases emerging into the smoke box to the lowest possible temperature.

In Fig. 1, I have shown the fire tubes continuous from the fire box throughout the generator, superheater, and feed water heater, as the simplest form of the invention.

In Fig. 2, I show the superheater and feed water heater separable from each other, and from the generator, for convenience in construction and facility in making repairs.

In the structure of Fig. 2; 25, 27, 28, 30 and 31 are separate tube sheets into which the tubes 24 of the generator, 26 of the superheater, and 29 of the feed water heater, are expanded steamtight; the tubes in each chamber being independent of each other, and registering with one another at the points of separation so that the gases of combustion may pass continuously from the fire box to the smoke box without interruption or obstruction.

I am aware that fire tube superheaters combined with fire tube boilers are already known in the art, and I am also aware that feed water heaters obtaining their heat from the flue gases are not new, but I am not aware that a superheater or a feed water heater of the type hereinbefore described has ever been used, or that a superheater and a feed water heater have been combined in a fire tube boiler as hereinbefore set forth.

What I claim is:

1. In a fire tube boiler, the steam generator, a feed water preheater, a steam superheater, connections from the feed water preheater to the steam generator and from the latter to the steam superheater, and fire tubes in the generator, superheater and feed water heater forming passages substantially continuous through all three of the same for the products of combustion.

2. In a fire tube boiler, a steam generator, a feed water preheater, and a steam superheater, each of these parts separable from the other and having means whereby each may be attached to the adjacent part, tube heads and fire tubes for each of the parts, the tubes being so positioned in each part as to register with the tubes of the next part to form continuous passages through the several parts when the same are assembled, connections from the feed water preheater to the steam generator, and from the latter to the steam superheater.

3. In a fire tube boiler, the steam generator, a feed water preheater, and a steam superheater intermediate the generator and the water preheater, an inlet to the water preheater remote from the generator, a water connection to the generator from a point of the water preheater intermediate the in-

let thereof and the generator, a steam connection from the generator to a point of the superheater remote therefrom and a steam outlet to the cylinders from a point of the superheater intermediate the inlet thereof and generator.

4. In a fire tube boiler, transverse diaphragms dividing the boiler into three chambers arranged in tandem longitudinally of the boiler, one of said chambers being a steam generator, another a steam superheater, and a third a water preheater, and fire tubes in each of said chambers forming passages continuous through the three chambers for the products of combustion.

5. In a fire tube boiler, transverse diaphragms dividing the boiler into three chambers arranged in tandem longitudinally of the boiler, one of said chambers being a steam generator, another a steam superheater, and a third a water preheater, fire tubes in each of said chambers forming passages continuous through the three chambers for the products of combustion, and means in the steam superheater and in the water preheater for providing a circuitous path for the fluids passing therethrough.

6. In a fire tube boiler, a steam generator, a feed water preheater, a steam superheater, fire tubes in the generator, superheater and preheater forming passages substantially continuous through all of the same for the products of combustion, a pipe depending at one end into the upper part of the water preheater and opening at its other end in the steam space of the generator, and a connection from the generator to the superheater.

7. In a fire tube boiler, a steam generator, a feed water preheater, and a steam superheater, the intermediate of said elements being the steam superheater, connections from the feed water preheater to the steam generator, and from the latter to the steam superheater, and fire tubes in the generator, the superheater and the feed water preheater forming passages substantially continuous through all three of the same for the products of combustion.

Signed by me at New York, N. Y. this 8th day of March 1909.

FRANK A. HAUGHTON.

Witnesses:

W. H. HEAGERTY,
F. J. ERWIN.