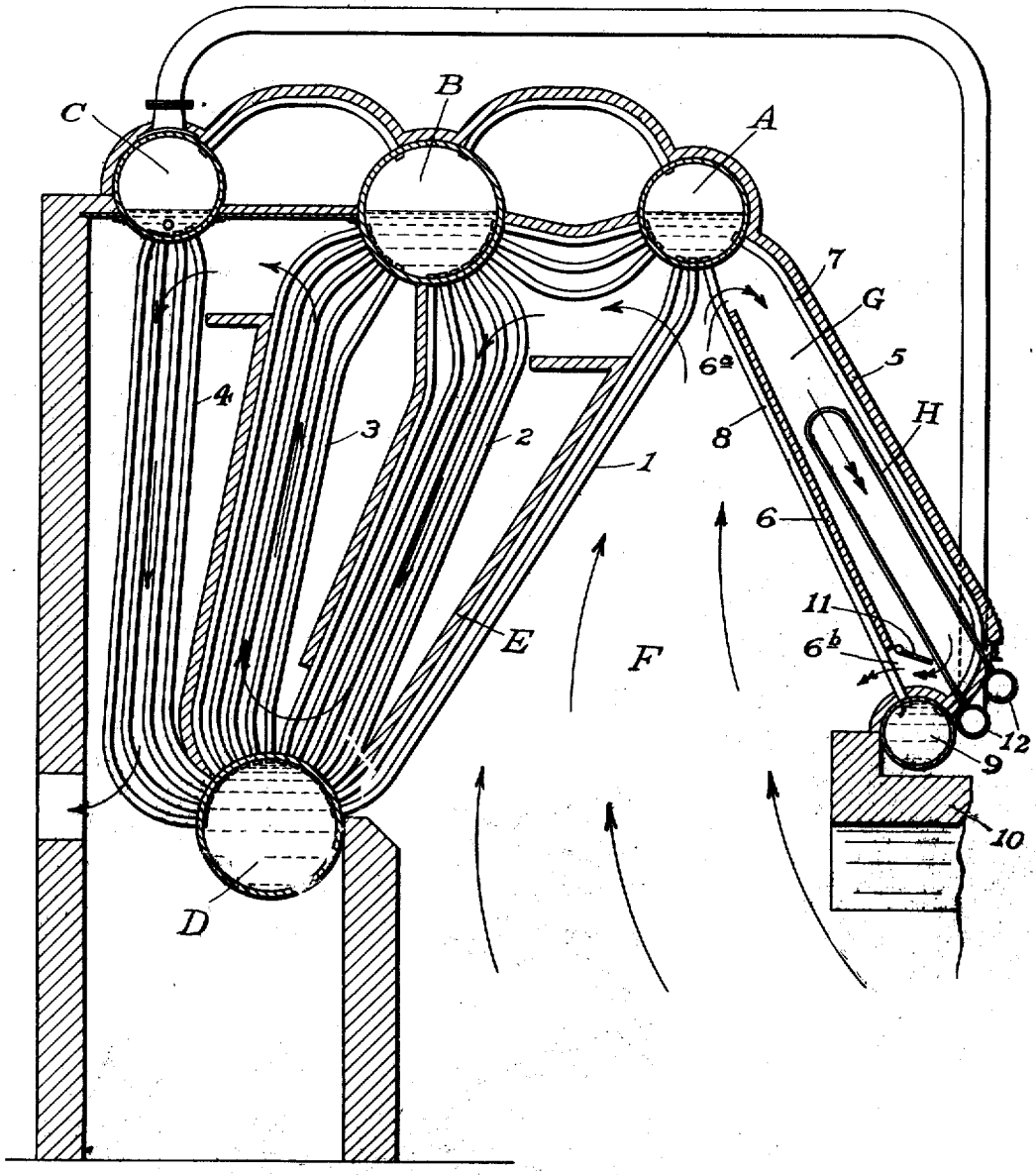
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STEAM SUPERHEATER

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# UNITED STATES PATENT OFFICE.

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## STEAM SUPERHEATER.

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*To all whom it may concern:*

Be it known that I, ALFRED COTTON, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Steam Superheaters, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to steam superheaters.

One object of my invention is to provide a steam superheater that will produce the amount of superheat desired with a moderate amount of heating surface and which is so constructed that the degree of superheat can be accurately controlled.

Another object is to provide a superheater boiler of novel construction, in which the superheater is easily accessible from the outside of the boiler, both for cleaning and for renewal of the superheater elements.

Another object is to provide a water tube boiler having a superheater chamber whose walls are supported in a novel manner that simplifies and reduces the cost of constructing the boiler.

Another object is to provide a front wall construction for water tube boilers that makes it possible to obtain a relatively large combustion chamber without the use of complicated arches or a suspended roof for the furnace of the boiler.

And still another object is to increase the heating surface of a water tube boiler without having a relatively great heat loss through the front wall of the boiler. Other objects and desirable features of my invention will be hereinafter pointed out.

To this end I have devised a superheater that comprises a chamber arranged in communication with a combustion chamber, a steam superheater in the chamber of the superheater, and a means separate and distinct from the superheater in said chamber for producing a vigorous draft or current of hot gases over the superheater. When my invention is embodied in a water tube boiler, as herein shown, the superheater chamber is preferably arranged between the combustion chamber and the front wall of the boiler in communication with said combustion chamber, and the means for producing a vigorous draft or current of hot gases through said superheater chamber consists of water tubes which cause the gases that enter the superheater chamber to cool rapidly and become of much greater density than the hot gases in the combustion chamber. The water tubes just referred to that are arranged in the superheater chamber cooperate with other water tubes arranged in the combustion chamber of the boiler to form an auxiliary water circulating path that is outside of the main water circulating path of the boiler, and said auxiliary water tubes are preferably used to support the front wall of the boiler and the wall or baffle which separates the superheater chamber from the combustion chamber. I have herein illustrated my invention embodied in a boiler of the type disclosed in my pending application Serial No. 366,286, filed March 16, 1920, which is provided with four banks of upright water tubes, but I wish it to be understood that my invention is applicable to various other types of water tube boilers such as the Stirling, Ladd, Badenhausen and Connelly boilers now in general use.

The figure of the drawings is a vertical longitudinal sectional view of a water tube boiler constructed in accordance with my invention.

Referring to the drawings, A, B and C designate the elevated steam-and-water drums of an upright, bent tube boiler. D designates the usual mud drum and 1, 2, 3 and 4 designate four banks of upright water tubes that co-operate with said mud drum and steam-and-water drums to form the main water circulatory path of the boiler. The boiler can be provided with any suitable system of baffling for causing the gases to circulate over the tube banks, but it is preferable to arrange a baffle E at the rear side of the front bank 1 so as to cause the gases to flow upwardly through the combustion chamber F, as indicated by the single headed arrows in the drawing.

The boiler comprises a superheater chamber G that is equipped with a superheater H, and in the form of my invention herein

illustrated said superheater chamber is arranged at the front side of the boiler and is formed by the front wall 5 of the boiler setting, and a baffle or partition wall 6 that separates the superheater chamber G from the combustion chamber F, said baffle 6 having gas inlet openings $6^a$ at the upper end of same that establish direct communication between the superheater chamber and the combustion chamber. At the lower end of the superheater chamber are gas outlets or discharge openings $6^b$ formed preferably in the lower end portion of the baffle 6. In order to produce a vigorous down draft through the superheater chamber G and also increase the heating surface of the boiler, I have provided the boiler with an auxiliary water circulatory system composed of a bank of water tubes 7 arranged inside of the superheater chamber, a bank of tubes 8 arranged inside of the combustion chamber F and a water drum 9 connected to the lower ends of the tubes 7 and 8 and arranged preferably just above the arch 10 over the stoker or other firing apparatus of the boiler, the upper ends of the tubes 7 and 8 being connected with the front steam-and-water drum A of the boiler when the boiler is of the type herein shown. It is immaterial, however, so far as my broad idea is concerned, what particular portion of the boiler the upper ends of the tubes 7 and 8 are connected with, so long as they are tapped onto the main water circulatory system of the boiler in such a way as to insure water circulating through said tubes when the boiler is in operation. The front wall 5 of the boiler setting is preferably supported by the bank of tubes 7, and the baffle or partition 6 that forms the inner wall of the superheater chamber G is preferably supported by the bank of tubes 8. A damper 11 is provided for controlling the exit of the gases from the superheater chamber, and while it is immaterial what particular type of superheater is used, I prefer to equip the boiler with a superheater H which comprises headers 12 arranged on the outside of the boiler setting.

When the boiler is in operation some of the gases that circulate upwardly through the combustion chamber F enter the superheater chamber G through the opening $6^a$ at the upper end of said chamber, and upon coming in contact with the water-tubes 7 in said superheater chamber, will cool rapidly and become of much greater density than the hot gases in the combustion chamber F. A siphon or negative chimney effect is thereby produced, which causes a vigorous down draft or current of hot gases through the superheater chamber. The superheater elements within said chamber are therefore exposed to a rapid flow of hot gases which have entered the upper end of said chamber from the combustion chamber, and which, after circulating over the superheater, return to the combustion chamber through the exit $6^b$ at the lower end of the superheater chamber, the damper 11 making it possible to control the return of the cool gases to the combustion chamber, and thereby regulate the degree of superheat attained. The two banks of tubes 7 and 8, together with the water drum 9, provide a circulatory path independent of the main water circulatory path of the boiler but sharing the front steam-and-water drum A with the main water circulatory path, the inner bank of tubes 8 constituting an upcomer bank that is subjected to radiant heat and the outer bank 7 constituting a downcomer bank that is subjected mainly to convected heat.

In view of the fact that the mean temperature of the gases in the superheater chamber G is much less than the temperature of the gases in the combustion chamber F, much less heat will be lost through the front wall of the boiler than would be the case if no chamber were interposed between the front wall of the boiler setting and the combustion chamber. Moreover, as the gases which leave the superheater chamber re-enter the main body of gases in the combustion chamber and pass over the boiler heating surface, said gases are thereby finally reduced to a lower temperature than the usual temperature of gases leaving a superheater, thus increasing the efficiency of the boiler. Owing to the vigorous down draft through the superheater chamber and among the down-comer tubes 7 in said chamber, the heating surface of these tubes is very effective, and accordingly, said tubes form a valuable addition to the heating surface of the boiler without increasing the floor space required for the boiler. The upcomer tubes 8 of the auxiliary water circulatory path may be substantially vertical when floor space is very valuable, but when said tubes are inclined downwardly and forwardly from the front steam-and-water drum A of the boiler, as herein shown, a considerable addition to the volume of the combustion chamber F is obtained and this improves the combustion and increases the efficiency of the boiler. As the superheater H is not exposed to radiant heat, it will not deteriorate or burn out rapidly, and as the headers 12 of the superheater are arranged outside of the superheater chamber in an accessible position at the front of the boiler, the superheater elements may be replaced very easily from the outside of the boiler.

I am aware of the fact that a water tube boiler has heretofore been devised in which a superheater is arranged in a chamber located between the combustion chamber and the front wall of the boiler setting, but in said prior boiler the flow of the gases through the superheater chamber is dependent upon

the small amount of cooling of the gases by the superheater elements. Consequently, as very little cooling of the gases can be effected by the superheater elements, very little siphon or negative chimney effect is obtained. In fact, the gas circulation through a superheater chamber that is equipped merely with a superheater is very sluggish as compared with the vigorous circulation through the superheater chamber of my improved boiler, caused by the bank of water tubes 7 in said superheater chamber. In the prior boiler just referred to the wall between the combustion chamber and the superheater chamber is of the self-supporting type, and as it is exposed to hot gases on both sides, it deteriorates rapidly. In my boiler the wall or baffle 6 that separates the combustion chamber from the superheater chamber is supported throughout its entire area by a bank of water tubes 8, and accordingly, it is very substantial and rigid. This, coupled with the fact that my boiler has an extra tube bank which does not increase the floor space required for the boiler and is provided with a relatively large combustion chamber, makes my boiler a decided improvement on prior boilers of the kind in which a superheater chamber at the front side of the boiler is merely equipped with a superheater.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a water tube boiler, the combination of a combustion chamber, a superheater chamber provided with a superheater, means for establishing communication between said combustion chamber and the upper end of said superheater chamber, and means within said superheater chamber, separate and distinct from said superheater, for cooling the gases and causing them to flow downwardly through said chamber, thus inducing hot gases to enter said superheater chamber from the combustion chamber and flow downwardly through said chamber, at a high rate, over the superheater therein.

2. A water tube boiler provided with a superheater chamber arranged in such a manner that gases will enter the upper end of same from the combustion chamber, circulate downwardly through said chamber and then return to the combustion chamber, a superheater in said superheater chamber, and water tubes in said superheater chamber that cool the gases and cause a rapid down flow of hot gases through said superheater chamber.

3. A water tube boiler provided with an upright superheater chamber arranged so that gases from the combustion chamber of the boiler will enter the upper end of same, circulate downwardly through said superheater chamber and then return to the combustion chamber, a superheater in said superheater chamber, and water tubes in said superheater chamber that form part of the heating surface of the boiler and which cause the gases that enter said chamber to rapidly cool, contract and become of much greater density than the hot gases of the combustion chamber.

4. A water tube boiler provided with a combustion chamber, an upright superheater chamber provided at its upper end with an inlet through which gases enter from the combustion chamber and provided at its lower end with an exit through which the gases return to the combustion chamber, a superheater in said superheater chamber, means in said superheater chamber forming part of the heating surface of the boiler that causes a rapid down draft of the gases over the superheater, and means for controlling the return of the cool gases to the combustion chamber.

5. A water tube boiler of the upright tube type having a front wall, a superheater chamber interposed between said front wall and the combustion chamber of the boiler, a superheater in said superheater chamber, and water tubes in said superheater chamber that support the front wall of the boiler.

6. A water tube boiler of the upright tube type provided with a front wall, a baffle or partition that co-operates with said front wall to form a superheater chamber, a superheater in said chamber, and water tubes in the superheater chamber and the combustion chamber that support said front wall and said baffle.

7. A water tube boiler having a main water circulatory path, a superheater chamber arranged so that gases from the combustion chamber will enter same, circulate downwardly therethrough and then return to the combustion chamber, a superheater in said superheater chamber, and an auxiliary water circulatory path comprising water tubes in the superheater chamber through which the water flows in one direction and also water tubes in the combustion chamber through which the water flows in the opposite direction.

8. In a water tube boiler of the upright tube type, the combination of a combustion chamber, a superheater chamber arranged outside of the path of the gases flowing through said combustion chamber and provided at its upper and lower ends with openings that permit gases to pass from said combustion chamber into said superheater chamber, circulate downwardly through same and then return to the combustion chamber, a superheater in said superheater chamber, and an auxiliary water circulatory path through which water flows in opposite directions comprising water tubes in said superheater chamber that cool the gases and

cause a down draft through said superheater chamber.

9. In a water tube boiler of the upright tube type, a combustion chamber, a superheater chamber, a baffle that separates said chambers and provided at its upper and lower ends with gas inlets and outlets, respectively, that establish communication between said chambers, a complete auxiliary water circulatory path through which water flows in opposite directions comprising water tubes in said combustion chamber arranged outside of the main path of the gases flowing through same and serving as a supporting means for said baffle, a superheater in said superheater chamber, and water tubes in said superheater chamber that form part of said auxiliary circulatory path and which cause a down draft through said superheater chamber by cooling the gases that enter said superheater chamber.

10. In a water tube boiler of the upright tube type, a combustion chamber, a superheater chamber, a baffle that separates said chambers and provided at its upper and lower ends with gas inlets and outlets, respectively, that establish communication between said chambers, upcomer water tubes in said combustion chamber forming part of an auxiliary water circulatory path and arranged outside of the main path of the gases flowing through the combustion chamber, a superheater in said superheater chamber, downcomer water tubes in said superheater chamber forming part of said auxiliary water circulatory path, that cause a down draft through the superheater chamber by cooling the gases that enter said superheater chamber, and means to control the flow of gases from said superheater chamber back to said combustion chamber.

11. A water tube boiler of the upright tube type provided with an elevated drum forming part of the main water circulatory path of the boiler, an auxiliary water circulatory path comprising a lower water drum arranged at the front side of the boiler, a bank of upflow tubes leading from said lower drum to said elevated drum and arranged so that they will be exposed to the radiant heat of the gases in the combustion chamber and a bank of downflow tubes arranged in front of said bank of upflow tubes and having their opposite ends connected to said drums, a baffle supported on said bank of upflow tubes, a wall supported on said bank of downflow tubes and co-operating with said baffle to form a superheater chamber, said baffle having gas inlets at its upper and gas outlets at its lower end which establish communication between said superheater chamber and the combustion chamber of the boiler, and a superheater in said superheater chamber.

12. A water tube boiler of the upright tube type provided with a combustion chamber that converges towards its upper end, a superheater chamber arranged between said combustion chamber and the front wall of the boiler setting and having an inlet at its upper end through which gases enter from the combustion chamber and an exit at its lower end through which the gases return to the combustion chamber, a superheater in said superheater chamber, and downcomer water tubes in said superheater chamber that form part of the water heating surface of the boiler and which cool the gases that enter the superheater chamber and thus cause a vigorous down draft of the gases through the superheater chamber.

13. A water tube boiler, comprising a front steam-and-water drum that forms part of the main water circulatory path of the boiler, a lower drum arranged at a point in advance of said steam-and-water drum and forming part of an auxiliary water circulatory path, a bank of downcomer tubes and a bank of upcomer tubes forming part of said auxiliary circulatory path and connected at their upper and lower ends to said steam-and-water drum and to said lower water drum, respectively, a front wall for the boiler setting supported by one of said banks of tubes, a baffle supported by said other bank of tubes and co-operating with said front wall to form a superheater chamber which communicates at its upper and lower ends with the combustion chamber at the rear side of said baffle, and a superheater arranged in said superheater chamber.

14. A steam superheater, comprising a superheater chamber, means for establishing communication between the upper end of said superheater chamber and a combustion chamber, a superheater in said superheater chamber, and means inside of said superheater chamber, separate and distinct from the superheater therein, for cooling the gases and causing them to flow downwardly through said chamber, thus inducing hot gases to enter the upper end of said superheater chamber from the combustion chamber and circulate rapidly down through same over the superheater.

15. A steam superheater, comprising a chamber arranged in such a way with relation to a combustion chamber that gases will pass from the combustion chamber into the upper end of said superheater chamber, circulate downwardly through same and then return to the combustion chamber, a superheater in said superheater chamber, and downcomer water tubes in said superheater chamber that cool the gases and cause a rapid downflow of hot gases through said superheater chamber.

16. A steam superheater, comprising a chamber arranged in such a way with rela-

tion to a combustion chamber that gases will pass from the combustion chamber into the upper end of said superheater chamber, circulate downwardly through same and then return to the combustion chamber, a superheater in said superheater chamber, downcomer water tubes in said superheater chamber that cool the gases and cause a rapid downflow of hot gases through said superheater chamber, and means for controlling the return of the cool gases to the combustion chamber.

ALFRED COTTON.