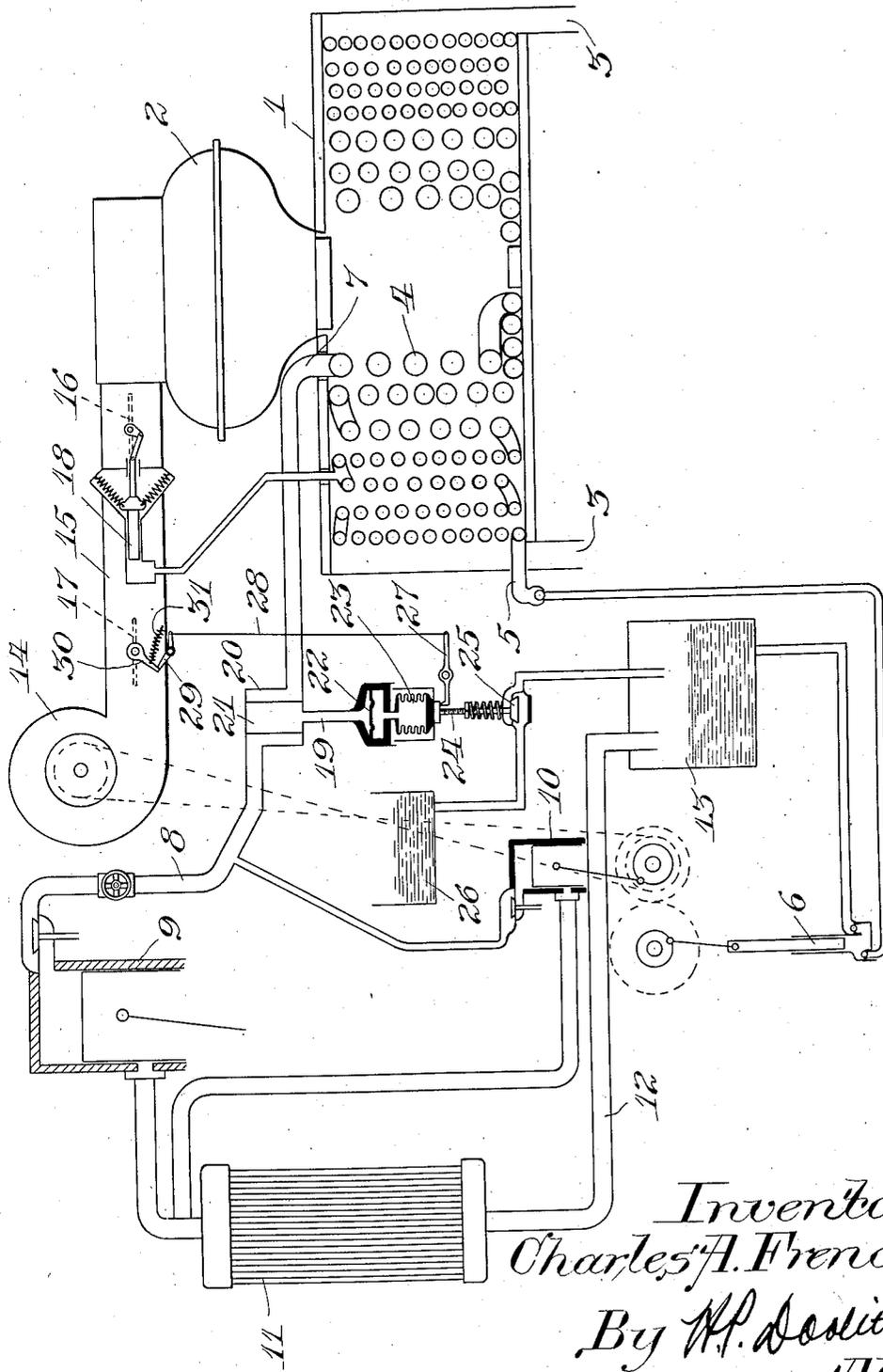


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C. A. FRENCH
AUTOMOTIVE BOILER SYSTEM

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AUTOMOTIVE BOILER SYSTEM

Application filed June 8, 1922. Serial No. 566,712.

My invention relates to an automotive power plant and a boiler to be used therein and is an improvement on the power plant and boiler shown in my co-pending application Serial No. 566,710 filed June 8, 1922. In my co-pending application, the preheater, evaporator and superheater coils are all connected to a steam drum, the heating surfaces of the different zones being constant for all loads and rates of steaming and the burner which is controlled by boiler pressure is located beneath the boiler and discharges its hot gases into the center of the boiler from whence they flow radially outward over the several coils.

In the present application, the preheater, evaporator and superheater coils are continuous, one with the other, and the respective areas change with variations in the heat from the burner and the rate at which water is supplied and steam consumed. The burner is of a modified construction and is placed above the boiler where it is more effectively heated to vaporize the fuel and discharges its hot gases downward into the center of the boiler from where they flow radially outward over the coils.

My improved boiler has one continuous coil surrounding the fire which is at the center and there are no sharp bends in the tube. Water enters the outside coil and flows toward the center giving a counterflow of the water and hot gases so that the greatest possible amount of heat is extracted from the gases.

Water from the condenser is continuously being pumped into the outer coil and progresses steadily toward the fire at the center. At some variable point, steam begins to be formed and continues to do so until all the water is vaporized at another variable point. The steam continues to travel through the coils toward the burner with increasing superheat until it finally leaves the boiler through a water regulator on its way to the engine which exhausts into the condenser.

The pump is always returning the water to the boiler as fast as it is used so that there is practically always the same amount of water (liquid and steam) in the boiler and,

hence, there is no occasion for the water regulator to act except when leakage or a possible pump failure so reduces the amount of water in the boiler that the degree of superheat in the steam becomes too high.

The burner is of sufficient size to vaporize and superheat the maximum steam demanded and is automatically turned off when the boiler pressure rises to a predetermined maximum and automatically turned fully on when the pressure drops a definite amount below the maximum. At any load less than the maximum, water will be evaporated faster than it is pumped in as the pump supplies the water at approximately the same rate that steam is taken out of the boiler so that the steaming zone gradually moves away from the fire and the pressure and superheat increases. This is true because the water that evaporates to allow the steaming zone to recede is still in the boiler and occupies more space as steam than it did as water, consequently raising the boiler pressure. Before this process has continued very long, the pressure will reach that point at which the automatic pressure regulator operates to shut off the burner. The use of steam from the boiler now reduces the pressure and, since water is still being pumped into the boiler, the division between the steam and water advances toward the center until the pressure regulator operates to start the burner again. The pressure regulator is adjusted to operate within a comparatively short range (from 500 to 600 pounds boiler pressure), hence, the range of movement of the steaming zone in the boiler will be quite small.

If water is lost from the system, or, if for any other reason, the feed pump does not return as much water as is being taken out as steam, the steaming zone will recede faster than the steam pressure increases so that before the fire is shut off by the pressure regulator the superheating zone will have become large enough to give too high a temperature to the steam. When this occurs, the mercury vapor thermostat will operate to admit water to the system from a storage tank. When sufficient water has been added to the system to restore the steaming zone to its normal lo-

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cation, the superheat in the steam will have reduced, cooling the thermostat and closing the supply of water from the storage tank. In the event that there is no water in reserve
 5 or that the feed pump fails to deliver water to the boiler, the steam temperature will increase still further causing sufficient movement of the thermostat to shut off the burner through an emergency butterfly valve in the
 10 burner air supply pipe. The burner then remains shut off until the trouble has been corrected and the emergency butterfly valve reset by hand.

Having thus described my invention generally, reference will now be had to the drawing in which I have illustrated one embodiment thereof.

My improved boiler has an outer casing 1 into which a burner 2 discharges its hot gases,
 20 the gases leaving the casing through a downwardly discharging annular flue 3. Within the casing there is a continuous coil 4 having an inlet 5 at one end receiving water from a pump 6 and an outlet 7 at the other end discharging to the steam main 8 from which
 25 branches lead to the main engine 9 and auxiliary engine 10 driving the feed pump 6. Both engines exhaust into the condenser 11 water from which flows through pipe 12 into a
 30 reservoir or hot well 13 from which the feed pump draws its supply.

The burner 2 is supplied with a mixture of fuel and air by means of blower 14 driven from the auxiliary engine. In the conduit
 35 15 connecting the blower and burner are two butterfly valves 16, 17 connected to a pressure regulator 18 and a water regulator 19 respectively. The pressure regulator is connected to the coil 4 preferably at a point about mid-
 40 way of its ends but any desired point of connection is suitable. The boiler normally works between minimum and maximum pressures of 500 and 600 pounds per square inch and the regulator is adjusted so that it will
 45 close the throttle 16 to shut off the burner when the pressure exceeds 600 pounds and open the throttle to turn on the burner when the pressure drops to 500 pounds.

The water regulator 19 has a chamber 20 through which the steam from the boiler flows and within which there is a bulb 21 filled with an expansible fluid, (preferably mercury which vaporizes without injury under the
 50 highest degree of superheat at which the boiler may work), which is free to expand against one side of a diaphragm 22, the other side of which is in contact with the liquid filling the corrugated tube 23. The tube 23
 55 is free to expand at its lower end and engages the stem 24 of a valve 25 controlling the flow of water from an auxiliary reservoir 26 to the hot well 13. One end of a lever 27 engages under the tube 23, the other end being
 60 connected by a link 28 to a trip lever 29 which

engages the arm 30 to hold the throttle 17 open against the tension of a spring 31.

When, through leakage or failure of the water supply for any reason, the pump 6 does not supply water to the boiler as fast as steam
 70 is being consumed, the temperature of the superheated steam will finally become so high that the mercury pressure in the bulb 21 will be increased and the expansion against the diaphragm will force additional liquid down
 75 into the corrugated tube expanding it and opening the valve 25 to supply additional water to the hot well 13. As soon as the normal amount of water is again supplied to the boiler, the degree of superheat returns to normal, the mercury vapor pressure becomes reduced and the valve 25 closes. If, however, the temperature of the steam continues to rise, the tube will continue to expand against the lever 27 which will rock the trip lever 29
 80 about its pivot until the arm 30 is released and the throttle 17 closed by the spring 31. The throttle remains closed and the burner shut off until the trouble is located and the trip again set.

The pressure regulator 18, burner 2 and water regulator 19 per se form no part of the present invention but are shown and described in the co-pending applications of G. W. Engstrom, Serial No. 524,568, filed Dec.
 85 24, 1921, for pressure regulator and my own applications for thermostat, Serial No. 566,885, filed June 8, 1922, and vaporizing burner Patent No. 1,466,709, issued Sept. 4, 1923.

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

1. In a steam power plant, the combination of a boiler, a burner, means for supplying
 90 combustible mixture to the burner, means for supplying water to the boiler, means for shutting off the burner when the boiler pressure rises to a predetermined maximum, and single
 95 means for supplying additional water to the boiler when the steam therein attains a predetermined temperature, and for shutting off the burner when the steam attains another predetermined but still higher temperature.

2. In a steam power plant the combination of a boiler, a burner, means for supplying
 100 water to the boiler, and means for supplying additional water to the boiler when a predetermined temperature is reached in the boiler due to a failure of the first water supplying
 105 means, the same means shutting off the burner when another predetermined but higher temperature is reached in the boiler.

3. In a steam power plant, the combination of a boiler, a burner, means for supplying
 110 water to the boiler, means for supplying combustible mixture to the burner, and a control member operable in one position of adjustment to supply additional water from another
 115 supply means to the boiler when the steam
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 125
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therein reaches a predetermined temperature
due to a failure of the first water supply
means and in another position of adjustment
to shut off the burner when the steam reaches
5 another but still higher temperature.

4. In a closed steam power plant system, a
boiler, a burner therefor, control means for
said burner, a main water supply for the
boiler, a reserve water supply connected with
10 said main water supply, and means in com-
munication with the boiler and controlling
said connection between the main and reserve
water supplies for causing the reserve supply
to replenish the main supply when the latter
15 fails, said means additionally operating said
burner control means for shutting off the
burner upon an extreme critical temperature
condition in the boiler.

20 In testimony whereof I affix my signature.
CHARLES A. FRENCH.

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