March 5, 1929. F. W. ELLYSON 1,704,038

GENERATOR FOR SUPERHEATED STEAM

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Fig. 1.

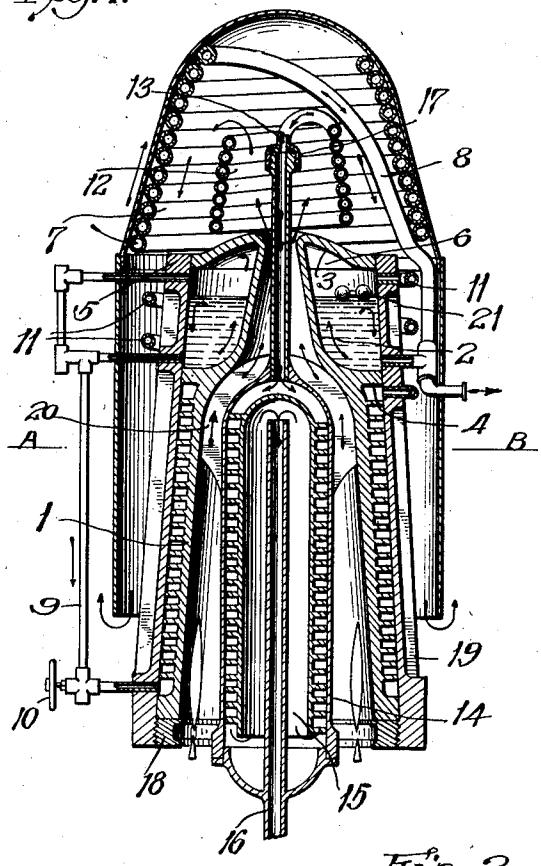
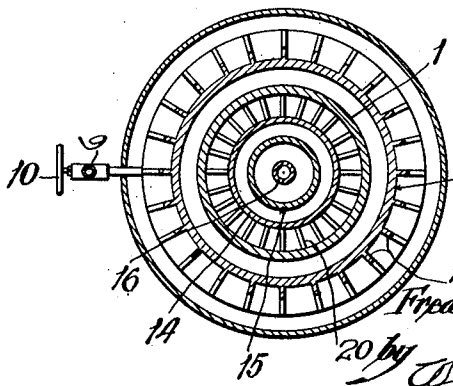


Fig. 2



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GENERATOR FOR SUPERHEATED STEAM.

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Steam generators composed of pipe coils, the so-called waterless steam generators, are disadvantageously subject to shocks and violent changes in pressure and changes in superheat during variations in steam output.

When the load upon an engine fed by such a generator becomes unduly high, the pressure and temperature in the generator drop away greatly and there is a resultant material fall in engine efficiency. On the other hand when the load is low both the temperature and pressure in the generator unduly rise, the coils in the evaporator perhaps becoming red hot, with a resultant deleterious effect upon the material of the coils and thereby on the life and efficiency of the generator.

Energy accumulators may be used but only partially correct this condition being able to avoid or greatly lessen rapid fluctuations in pressure and temperature but not able to avoid very low temperature and very low pressure during periods of prolonged high load nor able to avoid very high temperatures and pressures during periods of prolonged low load. In high loads the temperature and pressure fall as soon as the accumulator reaches equilibrium while in low loads the pressure and temperature unduly rise after the very short period has elapsed during which the accumulator is attaining its condition of equilibrium.

Steam generators of this type are disadvantageously subject to wide differences in temperature in different parts of the piping and until this condition is corrected it would seem that more or less violent shocks and changes in pressure and temperature can not be avoided.

One of the objects of my invention is to provide a greater uniformity in temperature throughout the generator by providing a feed chamber between a preliminary heating coil and an evaporating coil maintaining the water in the feed chamber at constant level to control the conditions in the generator and to avoid wide fluctuations in pressure and temperature.

I pass the feed water through a preliminary heater into the water chamber, which lies above and feeds the evaporating coil, and I automatically control the feed supply to the evaporating coil by maintaining the water level within the chamber substantially constant by suitable float-control valve.

From the feed chamber the preliminarily heated water flows to the bottom of the evaporating spiral which discharges at its upper end into the steam space above the water in the chamber.

Evaporation takes place along the spiral and any water discharging from the upper end of the evaporating spiral separates in the water chamber. The evaporation thus takes place along a thin moving stream in the evaporator coil, giving the high capacity for rapid evaporation that is characteristic of the pipe coil type of generator, and danger of undue heating of the evaporating coil is avoided by continuously flooding the coil with water.

I draw the steam supply from the steam space at the top of the feed chamber, passing it through superheating coils to a suitable delivery pipe.

A steam generator embodying my invention is illustrated, by way of example, in the accompanying drawings in which

Figure I shows a vertical section.

Figure II is a horizontal section on line A—B of Figure I.

The construction and operation there shown are as follows:

The hollow body of the evaporator 1, has an outer web spiralling up its lower portion, and at its top end a tubular, preferably tapering extension 2 with flanges 3 and 4, said extension forming, so to say, the outlet chimney of the heating chamber.

The parts 1, 3 and 4 are enclosed and externally sealed by an envelope 5 forming an annular chamber 6 around the chimney and a spiral evaporating passage with the upwardly spiraling web of the part 1. The chamber 6 serves as feeding space and as space for the separation of water from steam generated in the evaporating passage, the flanges 3 and 4 forming the ceiling and bottom respectively of the chamber.

While the chamber 6 as described is tra-

versed by a single flue from the heating chamber, obviously several flues, similar to those of vertical fire-tube boilers, may be substituted for the central chimney 2, the flanges 3 and 4 forming the ceiling and bottom of the water chamber as before.

The water chamber and the flue tubes in the same and also the spiraling evaporator passage can be easily cleaned from scale deposits and the like after removing the body 1 from its envelope 5. This is accomplished by unscrewing connection 18 at the bottom of the envelope.

The feed tube 8 comes from the preliminary heating envelope 7, traverses the envelope 5 and discharges into the chamber 6 a short distance above the bottom of the chamber. The water in the chamber 6 is heated additionally by the central flue and due to this additional heating circulates in the direction of the arrows.

The flow of water from the pipe 8 into the feed chamber is automatically controlled by means of a float 21 or the like acting upon a suitable valve not shown, so that the water level in the water chamber 6 can be automatically and constantly maintained at the same height. A water-gauge or the like is preferably mounted in the envelope 5 for use in setting the water level and to note that the float control correctly maintains the level substantially constant.

The water which has had considerable preliminary heating in envelope 7 and in chamber 6 flows from the chamber 6 through a downcomer 9 into the lowest hollow spiral of the evaporator proper 1, admission from the downcomer into the evaporator being controlled by a regulating valve 10, preferably constructed like a nozzle. This valve makes it possible to accurately adjust and regulate the generation of steam, qualitatively as well as quantitatively.

The steam generated in the ascending spiral 1 passes from this spiral into the space above the water level in 6. With this object in view a tubular outflow is arranged in the envelope 5 near the top of the envelope which is connected to the slightly enlarged upper end of the evaporator by a more or less steeply wound pipe coil 11 which, traversing the envelope 5, terminates in the chamber 6 underneath the ceiling.

The coil 11 is exposed to the heating action of the descending flue gases in the outer envelope so that the steam from this pipe coil has been preliminarily dried when it flows into the chamber 6. The coil 11 is preferably of smaller pipe than the coil envelope 7 for preliminary heating, the smallness of pipe diameter when struck by the flue gases being more favorable for effective heating. Any particles of water delivered into the chamber 6 with the stream of steam from the evaporator, separate, and dry steam, flows from the ceiling of chamber 6 through a pipe coil 12 and a pipe 13 into the superheater proper 14.

The pipe coil 12 may be considered part of the superheater 14, and is heated by the hot gases from the central chimney. These gases flow up the inside and down the outside of the coil 12, as indicated by the curved arrows. The steam, after entering the lower portion 14 of the superheater is led downwardly along an external spiral channel of a hollow body 15 and inside a casing 14 to enter the lower end of the hollow member 15. The member 15 is closed at the top end, and represents the steam collecting space proper. The steam delivery pipe 16 is vertically mounted in the center of the member 15 which has open inlet at the top underneath the cover of the body 15.

When a screw connection 17 has been unscrewed the super-heater and the steam collector can be pulled out in downward direction to be cleaned. The threaded body 15 can also be removed after the lower cover of 14 which carries the steam delivering pipe 16 has been removed.

All the pipe joints are preferably in the outer envelope 5, which makes assembly and disassembly relative easy.

The outer envelope 5 has preferably a great number of radially extending vertical ribs 19. These ribs materially increase the rigidity and strength of the structure and greatly increase the heating surface.

The casing member 14 of the lower superheater and steam collector has similar radial ribs 20.

The operation of the steam generator is as follows:—

The feed water is forced by a pump or the like into the preliminary heater 7 (of known construction) and spirals upwardly through the coil 7 counter-current to the descending flue gases, and being thus given an effective preliminary heating, flows downwardly through pipe 8 into the chamber 6.

The water in chamber 6 is maintained at constant level by float control 21, and flows from chamber 6 downwardly through the pipe 9 and regulating valve 10 into the hollow spirals of the evaporator. The valve 10 regulates the speed of the steam generation. With this valve closed and the burner with full flame, the chamber 6 may first be filled with hot water and the evaporator spirals strongly heated. The valve 10 is then gradually opened, admitting a small stream of water into the evaporator spirals which evaporates instantaneously. The evaporation is then permanently adjusted by further opening the valve.

Any material lowering of the water level in chamber 6 from opening of the adjusting valve 10 is prevented by further admission from the preliminary heater by the action of

the float valve 21. The valve element of the control member 21 is not shown, but is mounted on the pipe 8 and may operate to return any excess of water supplied by the feed pump to a hot water reservoir, also not shown, until sinking of the water level causes fresh admission of the feed water into the chamber 6.

Another way of starting the evaporator is to fill the water chamber 6 and the hollow spirals of the evaporator with hot water to the normal water level in chamber 6 and with the regulating valve 10 open. In this method a somewhat longer time is required for the generation of steam than in the first method, as a greater quantity of water has to be heated, but the generation of steam can be subsequently regulated as in the first method.

I claim:—

1. A generator for superheated steam comprising in combination, an evaporator consisting of a hollow annular body enclosing a heating chamber, said annular body having a restricted portion at the top providing a flue for said heating chamber, two spaced flanges extending outwardly from said restricted portion and contacting with the outer wall of said evaporator to form a steam and water chamber, a preliminary water heater for feed water spaced above said steam and water chamber above said flue, said preliminary water heater being connected to the space within said steam and water chamber below the normal water level thereof, a downcomer connection between said steam and water chamber and the lower end of said evaporator, a pipe spiral connecting the top of said evaporator with the steam and water chamber above the water level thereof, a superheater extending within said heating chamber, a spiral-shaped pipe leading from the top of said steam and water chamber to said superheater and forming a part of the said superheater, said spiral-shaped pipe being exposed to the flue gases, said superheater having a central off-take pipe extending downwardly through the bottom of said evaporator.

2. A generator for superheated steam comprising in combination, an evaporator consisting of a hollow annular body enclosing a heating chamber, said annular body having a restricted portion at the top providing a flue for said heating chamber, two spaced flanges extending outwardly from said restricted portion and contacting with the outer wall of said evaporator to form a steam and water chamber, a preliminary water heater for feed water spaced above said steam and water chamber above said flue, said preliminary water heater being connected to the space within said steam and water chamber below the normal water level thereof, a downcomer connection between said steam and water chamber and the lower end of said evaporator, a pipe spiral connecting the top of said evaporator with the steam and water chamber above the water level thereof, a superheater extending within said heating chamber, a spiral-shaped pipe leading from the top of said steam and water chamber to said superheater and forming a part of the said superheater, said spiral-shaped pipe being exposed to the flue gases and spiralling countercurrent to the flue gases, said superheater having a central off-take pipe extending downwardly through the bottom of said evaporator.

3. A generator for superheated steam comprising an annular evaporator, an envelope about said evaporator radially spaced therefrom to provide a flue outside the evaporator, an annular water and steam chamber at the top end of said evaporator, a combustion chamber inside the evaporator, a heater and superheater inside the combustion chamber, a water container forming the top end of said generator and effective as a water heater, a steam coil above the water chamber acting as a superheater and enclosed by the water container, and connecting pipes respectively from the top of the evaporator to the upper portion of the water chamber, from the water chamber to the bottom of the evaporator and from the upper portion of the water and steam chamber to the steam coil.

4. A superheated-steam generator comprising an upwardly extending envelope having an internal upward taper, and a hollow plug fastened therein adapted to be removed therefrom axially downward, having an upper, a lower and an intermediate flange each sealing circumferentially against the envelope and having a laterally extending spiral flange between the lower and intermediate flange sealing circumferentially against the inside of the envelope and cooperating therewith to form a spiral evaporator along a lower portion of the envelope, and the upper and intermediate flanges and the portion of the outside wall of the plug extending between these flanges cooperating with the upper portion of the envelope to form a water and steam chamber along an upper portion of the plug, and the inside of the plug forming a combustion chamber having a contracted outlet flue encased by the inside wall of the water and steam chamber.

5. A superheated-steam generator comprising an upwardly extending envelope having an internal upward taper, a hollow plug therein with a spirally extending flange on its exterior and, having a lower portion forming the wall of a heating chamber and externally cooperating with the envelope to form an upwardly spiraling evap-

orator, and having an upper portion internally contracted to form a flue from the heating chamber and externally flanged at the ends of the contraction against the envelope to form with the cooperating envelope a water and steam reservoir the top of said evaporator being in communication with the top of said reservoir, a superheater coil from the steam reservoir to a delivery pipe and having coil portions respectively above the reservoir and inside the chamber, and an external cover spaced above the coil and extending downwardly to form a flue jacket around the evaporator.

In testimony whereof I affix my signature.

FREDERICK W. ELLYSON.