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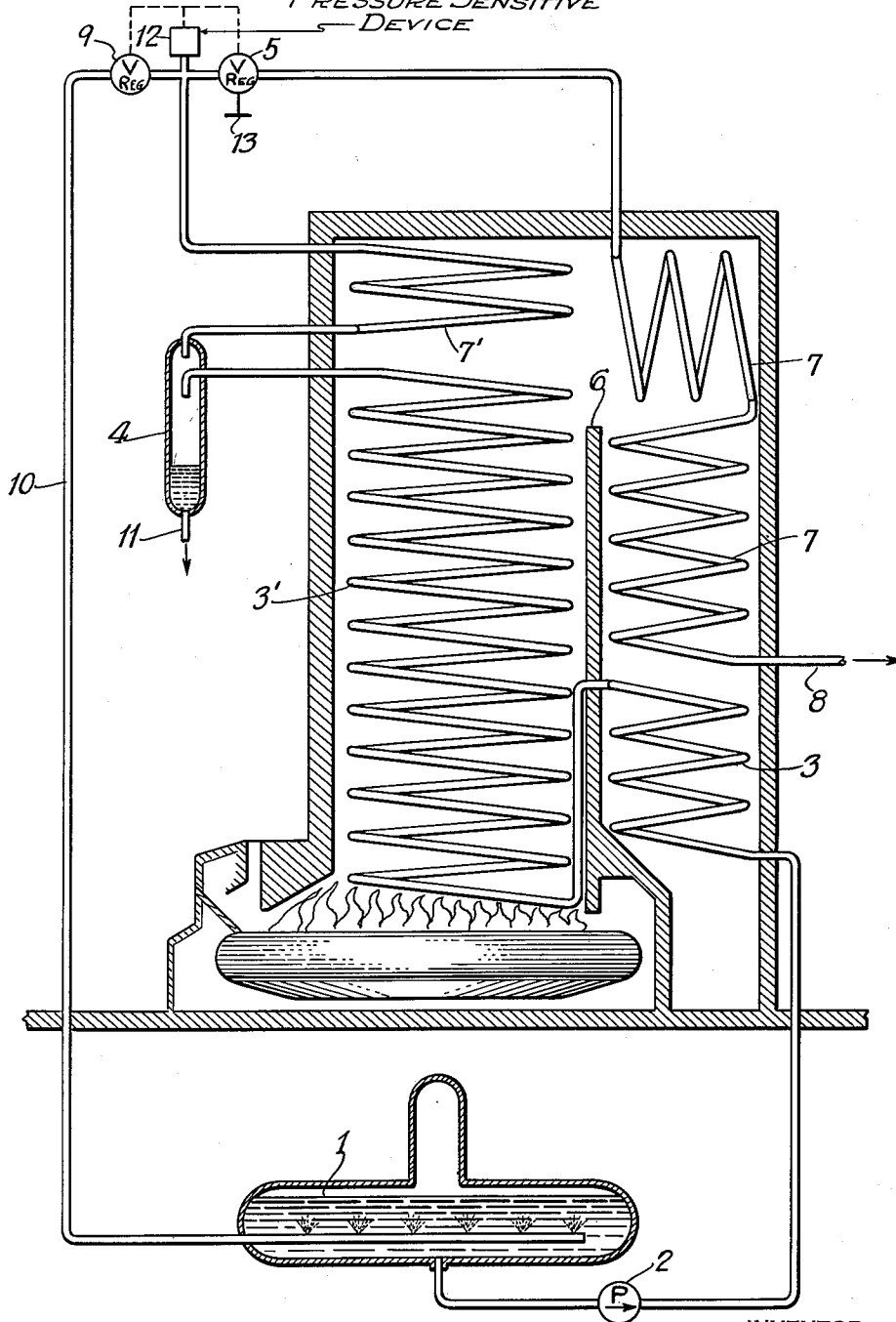
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2,985,150

FORCED FLOW STEAM OR VAPOR GENERATING PLANT

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PRESSURE SENSITIVE
DEVICE



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2,985,150

FORCED FLOW STEAM OR VAPOR GENERATING PLANT

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1 Claim. (Cl. 122-406)

The present invention relates to a forced flow steam or vapor generating plant including a steam generator of the once through type in which plant water or other operating liquid is circulated from a feed tank through a portion of the tube system of the generator and back into the tank during the heating-up period of the generator. A steam or vapor generator of this type is disclosed in the patent application of Arthur Lieberherr Serial No. 434,616, filed June 4, 1954, now Patent No. 2,869,517.

In the known steam or vapor generator referred to above a water or liquid separator is connected with the outlet of the evaporating section of the generator, a pipe, provided with a valve, connecting the steam or vapor space of the separator with the superheater section of the generator. This superheater section is shielded and protected against flame radiation as it occurs in the combustion chamber of the generator. A return conduit is connected with the aforesaid pipe upstream of the valve and terminates in the feed tank for returning operating medium thereto. A valve is interposed in the return conduit.

The arrangement described above and disclosed in the patent application of Arthur Lieberherr facilitates construction and arrangement of the tubes of the superheater because the superheater can be left dry during the heating-up period of the generator and at other extraordinary situations and does not need to be cooled because it is not exposed to direct flame radiation. The disadvantage of locating a superheater in a zone of a generator where burning of the superheater tubes is not likely is counterbalanced by the advantage of preventing the formation of water or liquid pockets in the tube system of the superheater.

It has been found, however, that it is of great advantage to interpose a preliminary superheater in the pipe connecting the water or liquid separator and the main superheater, upstream of the connection of the return conduit with the pipe. This preliminary superheater is preferably in a zone of the generator in which uncooled tubes would be endangered by overheating. The preliminary superheater has a small heating surface compared with that of the main superheater which is protected against flame radiation. For this reason construction of the preliminary superheater is not very difficult although its tubes must be so arranged that water pockets are avoided. If this is not completely possible, the water remaining in the preliminary superheater after completion of the starting period of the generator will not pass beyond the superheating sections of the generator because sufficient heat is accumulated in the rather large main superheating tube system to evaporate these relatively small slugs of water or liquid.

The novel features which are considered characteristic of the invention are set forth with particularity in the appended claim. The invention itself, however, and additional objects and advantages thereof will best be understood from the following description of an embodi-

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ment thereof when read in connection with the accompanying drawing, the one figure of which is a diagrammatic illustration of a steam or vapor generating plant according to the invention.

During normal operation, the operating fluid of the steam or vapor generator is forced by a pump 2 from a feed water tank 1 into an economizer 3 and through an evaporator 3' tube system. The wet steam leaving the evaporator or steam generator part 3' of the tube system is conducted through a water separator or trap 4 from which saturated steam flows through a preliminary superheater 7' and an overflow valve 5 into a superheater 7 which is shielded by a baffle 6 against flame radiation, the superheated steam leaving the plant through an outlet conduit 8.

The valve 5 is closed during the heating-up period and the operating medium is returned from the preliminary superheater 7' and the separator 4 through a second overflow valve 9 and a by-pass or return conduit 10 to the feed water tank 1. During this period the circulated water is gradually heated, a steam-water mixture emerging from the outlet of the evaporating section of the steam generator after some time, the water content of the mixture gradually diminishing. The water separator 4, which is initially swamped with water, is able to separate water from the steam after a certain period of time. The separated water may be removed from the separator 4 through a conduit 11. When saturated steam emerges from the separator, the valve 5 may be opened. It is not necessary to wait until the medium at the outlet of the tube system 3' has attained normal dryness.

The valves 5 and 9 are constructed as pressure actuated overflow valves which are actuated by a conventional pressure responsive regulator 12 for maintaining the pressure at the valve inlets at a predetermined value. The valves 5 and 9 are opened whenever the pressure upstream of the valves exceeds a predetermined value. During the heating-up period the valve 5 is adjusted by means of an adjustment device 13 for closing the valve or for setting its reference value higher than that in valve 9, to produce, during the heating-up period, the circulation of the operating medium according to the invention. As soon as the water separator 4 is able to separate the entire water content from the steam-water mixture flowing through the separator, the valve 5 may be opened partially or entirely by means of the adjustment device 13, so that all or part of the saturated steam leaving the separator flows into the superheater 7. Partial opening of the valve 5 is desirable, for example, if a turbine receiving steam through a conduit 8 is to be warmed up or driven at low load. The aforescribed adjustment of the valve 5 may be performed automatically by conventional means.

The steam or vapor leaving the separator 4 may still contain some moisture which is evaporated in the preliminary superheater 7'. Therefore, substantially dry steam will enter the main superheater and undesired cooling of the latter by moisture is prevented which cooling is unavoidable if no preliminary superheater is provided. The arrangement according to the invention makes sure that under no circumstances will water droplets enter the turbine which receives steam from the generator.

I claim:

A forced flow steam generating plant of the once through type, comprising, in combination, a feed water reservoir, a combustion chamber, a steam generating tube system adapted to be heated by heat produced in said combustion chamber, a feed water pump connected with said reservoir and with said tube system for pumping feed water from the former into the latter, a preliminary superheater placed, at least in part, in said combustion chamber and exposed to radiant heat, a main superheater interposed in the path of the combustion gases produced

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in said combustion chamber, a conduit connecting said tube system with said preliminary superheater, a steam and water separator interposed in said conduit, said separator having a water outlet for removing the separated water from the plant, a pipe interconnecting said preliminary superheater and said main superheater, a first valve interposed in said pipe, actuating means connected to said first valve for varying the degree of opening of said first valve and for closing said first valve during the heating-up period of the plant, a return conduit connected to said pipe upstream of said first valve and connected to said reservoir for returning operating fluid to said reservoir during heating up of the plant, a second valve in said return conduit, actuating means connected to said second valve for varying the degree of opening of said second valve and for closing said

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second valve during normal operation of the plant, and means shielding said main superheater from flame radiation and preventing burning of said main superheater when no steam flows therethrough during the heating-up period of the plant.

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