June 24, 1930. O. H. HARTMANN ET AL 1,768,448

HIGH PRESSURE STEAM GENERATOR

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Fig.1.

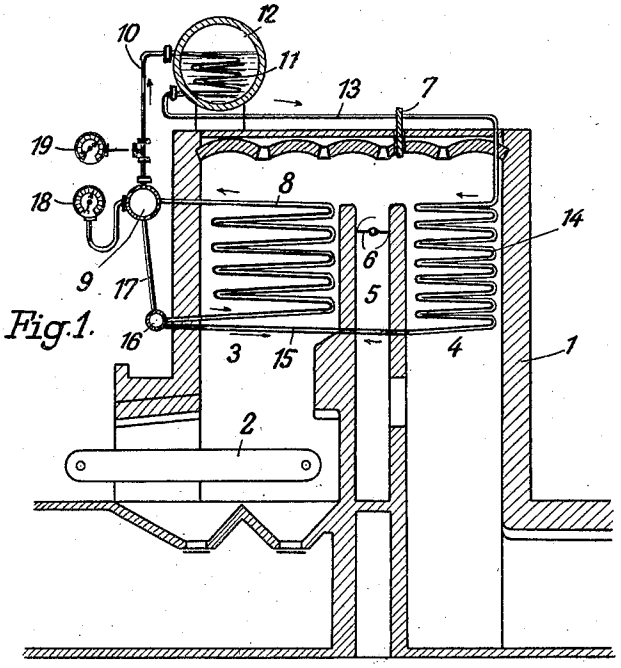
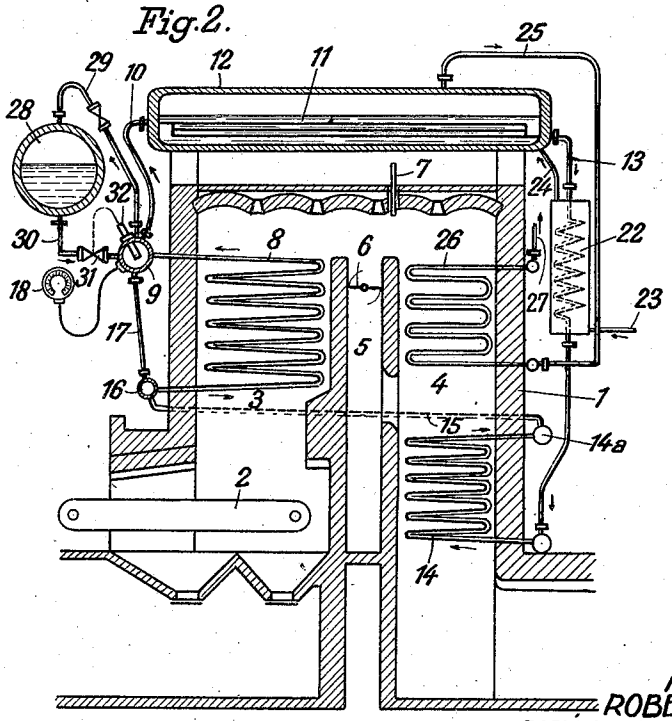


Fig.2.



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Fig. 3.

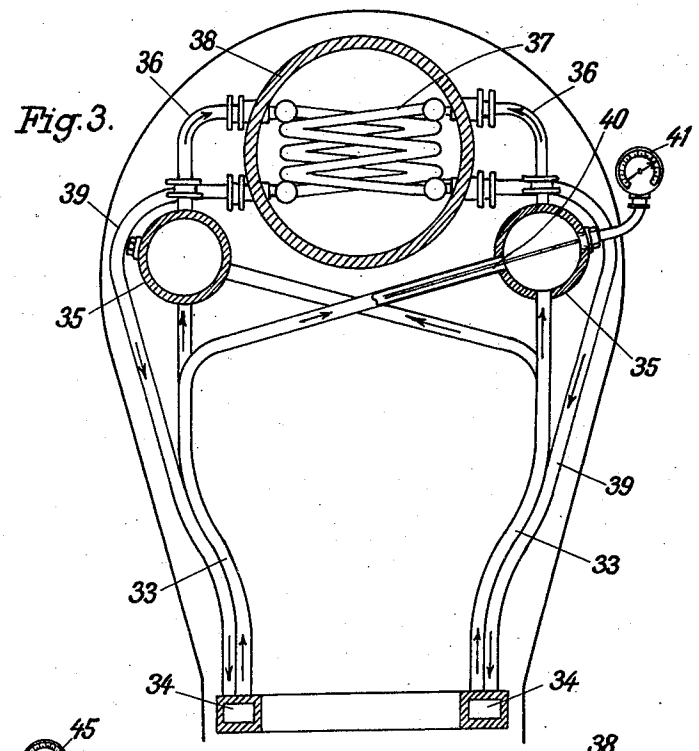
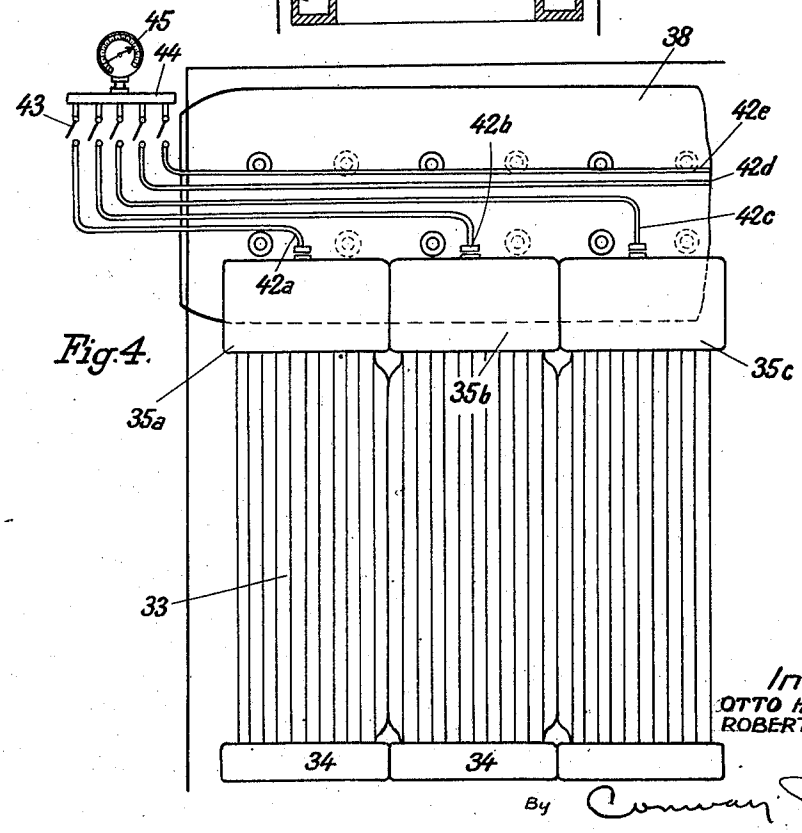


Fig. 4.



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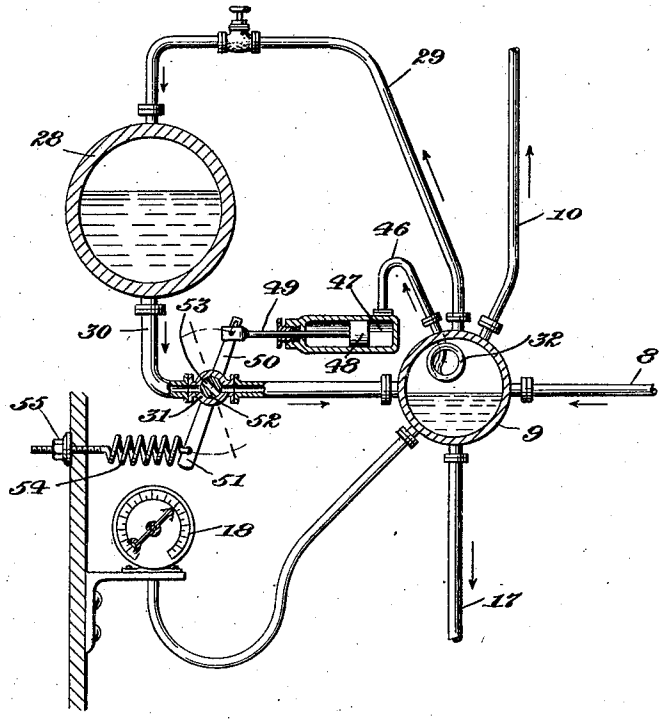
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Fig. 2a.



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UNITED STATES PATENT OFFICE

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HIGH-PRESSURE STEAM GENERATOR

Application filed June 8, 1927, Serial No. 197,428, and in Germany June 11, 1926.

Our invention relates to an arrangement for high pressure steam generators in which the high pressure working steam is generated indirectly by means of a high temperature medium. The arrangement is applicable both to stationary and to portable high pressure steam generating plants.

In the case of plants in which saturated steam is used in a closed circuit for indirectly generating the high pressure steam experiments have shown that the heating steam becomes superheated when the water content of the heating elements is insufficient. This may be the case, if, owing to leakage losses, however slight, water be lost in the course of time from the heating elements. For preventing damage which might occur through the heating steam being at too high a temperature, provision must therefore be made that the temperature of the heating steam shall not become excessive.

Hence, our invention provides means for keeping the temperature of the heating medium flowing to the heating elements lying in the indirectly heated working steam drum under observation. This may be effected by means of a temperature-measuring or indicating device connected to the tubular system in which the heating medium is circulating. In addition to this temperature-measuring or indicating device a pressure indicating device may be connected up to the said tubular system. When saturated steam is used as the heating medium, the pressure need not be measured, as the temperature is a function of the pressure.

The device for indicating the temperature may, for instance, be a thermometer or a thermostat, which indicates by an optical or acoustic signal that the permissible temperature has been reached or exceeded. In this case the circuit element should be filled up by hand. The temperature-indicating device may, however, also be so arranged that automatic filling means are put in operation. When, as is usually the case, the heating elements are divided into a plurality of sections each forming a separate circuit a separate temperature-indicating device is preferably provided for each separate section.

Several constructional examples of our invention are shown in the accompanying drawings, in which:—

Figures 1 and 2 show the arrangement as applied to stationary, indirectly heated steam generators, in two different constructional forms, and

Fig. 2^a is a detailed view of the temperature controlled apparatus at the left hand side of Fig. 2.

Figures 3 and 4 show the arrangement as applied to a locomotive having an indirectly heated high pressure fire box, Figure 3 being a cross section and Figure 4 a side elevation of a slightly modified form.

In Figure 1 the masonry 1 of the steam generator having a grate 2 surrounds two heating gas flues 3, 4 between which an empty flue 5 is provided. A swivel damper 6 in the flue 5 and sliding damper 7 regulate the flow of the gases through the heating gas flue 4 or the flue 5. In the flue 3 there are evaporator coils 8 which are connected up to water separators 9 lying outside the masonry 1. From the water separators pipes 10 lead to heating elements 11 which indirectly heat the water of a high pressure steam generating drum 12. The condensate of the heating steam flows out of the heating elements 11 through pipes 13 to coils 14 which lie in the heating flue 4 and in which the condensate is preliminarily heated. Through the pipe 15 the preheated condensate flows to collectors 16 which lie outside the masonry 1, and to which the lower ends of the coils 8 are connected. Connecting pipes 17 between the water separators 9 and the collectors 16 lead the water separated off in the containers 9 to the collectors 16 and back to the circulating system. The evaporator coils 8, a water separator 9, a pipe 10, a heating element 11, a pipe 13, a preheater coil 14, a connecting pipe 15 and a collector 16 form together a closed circuit system, in which the high pressure medium serving as a heat carrier for indirect heating circulates. In the present case the circulating medium is steam or

water. By arranging a number of such sets in parallel separate circuit systems can be produced.

For measuring the pressure of the heating steam a pressure gauge 18 is connected to the water separator 9, which pressure gauge, as already stated, can be omitted, when the temperature can be used for measuring the pressure. Additionally there is connected to the pipe 10 a temperature-measuring device which is connected to an indicating device 19. In the present case it is assumed that an electrical or a mercury pyrometer is provided in the pipe 10, for measuring the temperature of the heating steam flowing to the heating element 11. In place of the illustrated temperature indicator 19, an optical signal, for instance an incandescent lamp could be used, the glowing of which would indicate that the permissible temperature of the heating steam had been reached or exceeded.

In the stationary indirectly heated steam generator shown in Figure 2 there are also provided two heating gas flues 3 and 4, an empty flue 5, a regulating swivel damper 6 and a sliding damper 7. Evaporator coils 8 are in this case as well provided in the first heating gas flue 3 and led to the water separator 9, from which through the pipe 10 the heating elements 11 in the working steam drum 12 are fed. The condensate flows through the pipe 13 to coils 14, in which it is preheated and from which it flows through collectors 14^a and a pipe 15 to a collector 16. In the pipe 13 a so-called cooling preheater 22 is provided, in which a portion of the heat of the condensate is given off to the feed water for the working steam drum 12, which flows in through the pipe 23. The preheated feed water enters the drum 12 through the pipe 24. The working steam generated in the drum 12 flows through the pipe 25 to the superheater 26, also lying in the second heating flue, and thence through the pipe 27, to the place where it is to be used.

A pressure gauge 18 may, as in the previous case, be connected to the water separator 9. A distillate container 28 is connected to the water separator 9 by pipes 29 and 30 capable of being closed by valves. The valve 31 in the pipe 30 is controlled by a thermostat or thermoelement 32 in the water separator 9. This thermostat 32 comprises a coil filled with an expansible substance and located in the intermediate container 9. The part 46 which projects beyond container 9 is connected to a cylinder 47 provided with piston 48. A piston rod 49 is linked with an arm 50 of a double armed lever. The latter engages the stem of a valve 31 at an intermediate point and its lower arm 51 is attached to a spring 54 which is fastened to a frame by thread and nut device 55. As seen in Fig. 2^a, the spring normally acts to hold the valve closed, that is, with its passage 53 out of alignment with the opening in pipe 30. However, when the liquid level falls in container 9 and its associated pipes of the closed system, the resulting tendency toward superheating causes the liquid in coil 32 to expand and force piston 48 to the left against the resistance of spring 54. The valve 31 is thus opened to permit liquid to pass from container 28 into container 9, and when sufficient liquid has passed into the latter to lower the temperature in the closed circuit to the proper point, the valve is closed.

In this constructional form as well as that shown in Figure 1 a plurality of independent circulating systems for the heat carrier may be provided. In this case it is preferable to provide each separate circulating system with a separate temperature-measuring device. Additionally a pressure-measuring device may be provided for each circulating system. A single distillate container 28 might be provided for the separate circulating systems. In this case it is only necessary to provide separate pipes 29 and 30 and separate thermostats or thermoelements for each separate circulating system.

The indirectly heated locomotive fire box shown in cross section in Figure 3 contains water tubes 33 which are fixed at the bottom into headers 34 and at the top into intermediate drums 35. From the drums 35 pipes 36 lead to heating elements 37 which are mounted in the steam generating drum 38 and indirectly heat the water of this drum. The condensate from the circulating heat carrier passes through down-comers 39 back to the headers 34. In the constructional form shown in Figure 3 a temperature-measuring device or thermo-element 40 with an indicating device 41 are provided in the upper part of one of the tubes 33 leading below the drum 38 from one side of the fire box to the drum 35 lying on the other side of the fire box. In this case the temperature of the circulating heat carrier is measured before it enters the intermediate drums 35, which fulfill the same purpose of the water separators 9 in the stationary plant.

In Figure 4 it is assumed that five separate circulating systems for the circulating heat carrier are provided, so that the drums 35 on each side are divided into five parts and similarly the headers 34 into five parts and the corresponding water tubes into the same number of groups. In this case it will be necessary to keep the temperature of the heating steam in each separate circulating system under observation. For this reason

five connections 42^a, 42^b, 42^c, 42^d and 42^e are provided for the drum elements which in this case measure the temperature of the heating steam within the drums 35. These connections are connected through switches 43 and intermediate piece 44 to an indicating device 45 common to them all. By closing one of the switches 43 it is thus possible with this indicating device to ascertain the temperature prevailing in each separate circulating system of the heat carrier. In this case as well pressure gauges (not shown) may be provided for each circulating system.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Means for keeping under observation the fluid contents of a closed circulating system for heating a high pressure steam generator, said fluid contents consisting partially of liquid and partially of vapor which comprises a temperature responsive device in the closed heating system between the evaporator and condenser units thereof, whereby to indicate to an observer, when a predetermined temperature has been reached, that replenishment of the fluid in said closed system is necessary.

2. In a high pressure steam generator in which the high pressure working steam is generated indirectly by means of a high temperature medium, an arrangement including a working steam generator, a closed system in which the medium for indirectly generating the steam is circulating, said system having heat receiving and heat emitting parts, the latter lying in the working steam generator, a distillate container connected by pipes to the closed heating system, valves provided in said connecting pipes, a temperature-responsive device connected in said closed system, and means operative by the temperature-responsive device for controlling the valve in one of the pipes leading from the distillate container to the closed system.

3. In combination, a high pressure steam generator in which high pressure steam is generated indirectly, a closed system in which the medium for indirectly generating the steam circulates, said system having heat receiving and heat emitting parts, the latter lying in the working steam generator, the circulating medium in said closed system normally comprising part water and part saturated steam, and a temperature responsive device in the closed heating system between the evaporator and condenser units thereof to indicate to an observer when the saturated steam of the circulating medium has been changed to superheated steam, upon the arising of which condition replenishment of water in the closed system is necessary.

In testimony whereof we have affixed our signature.

OTTO H. HARTMANN.
ROBERT UHDE.