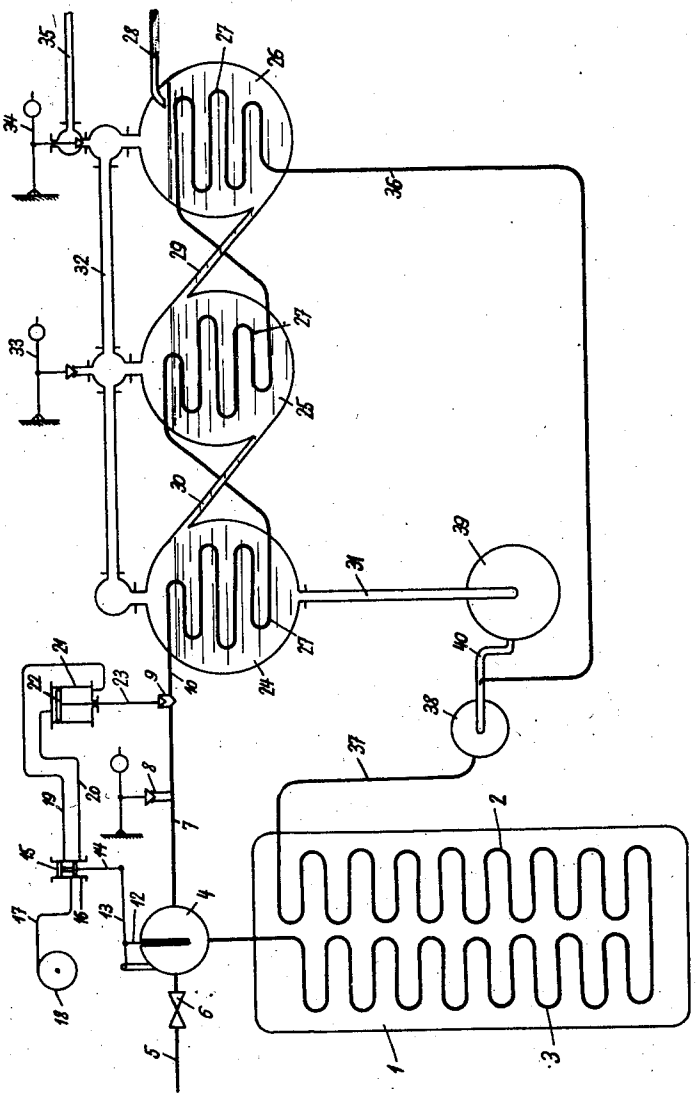
Sept. 6, 1932. W. HUNTEMÜLLER 1,875,608

STEAM BOILER

Filed June 19, 1930 2 Sheets-Sheet 1

Fig. 1



W. Huntemuller
INVENTOR

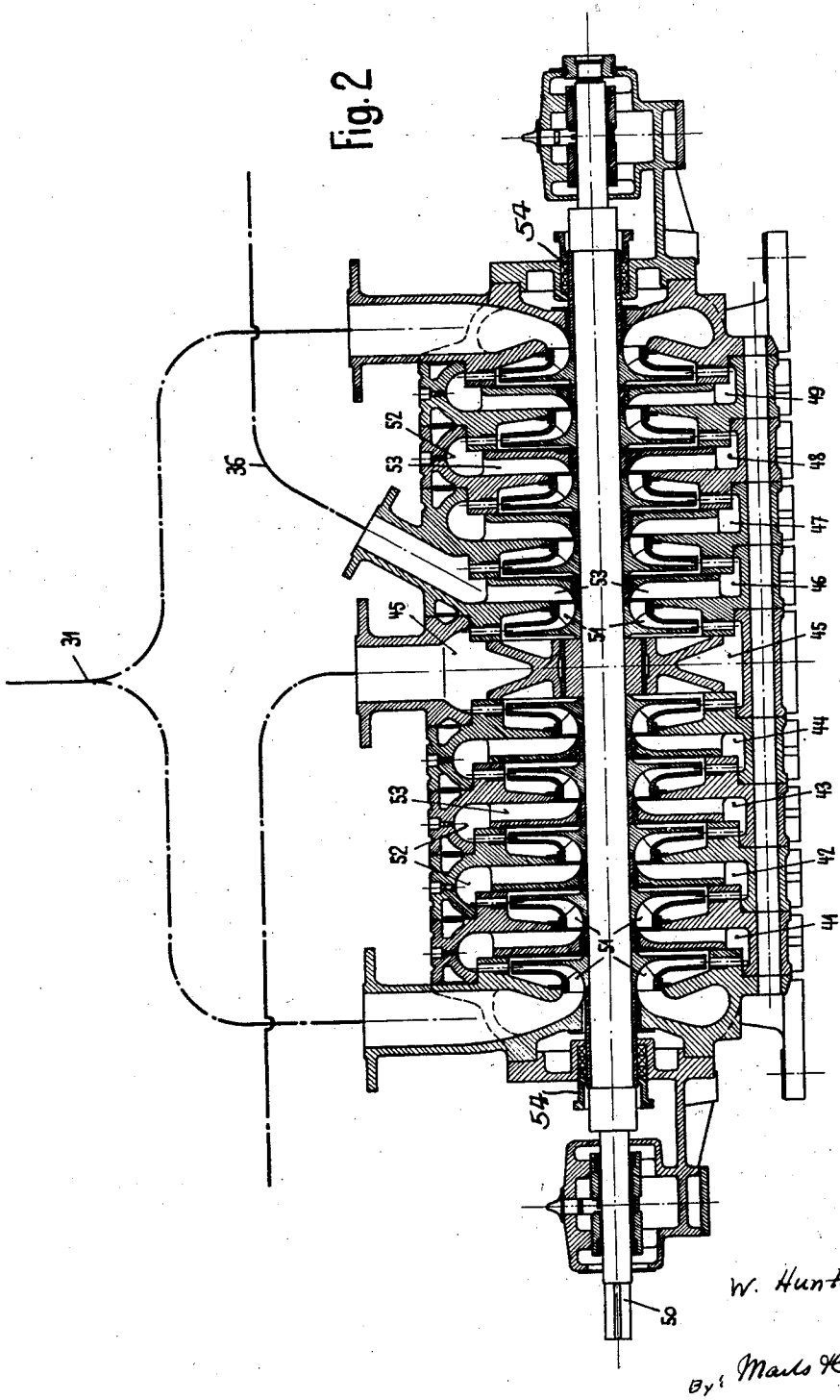
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STEAM BOILER

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Fig. 2



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Patented Sept. 6, 1932 1,875,608

UNITED STATES PATENT OFFICE

WOLF HUNTEMÜLLER, OF DUSSELDORF, GERMANY

STEAM BOILER

Application filed June 19, 1930, Serial No. 462,313, and in Germany July 2, 1929.

This invention relates to steam boilers for a working pressure in the neighborhood of the critical pressure at which a liquid and its vapor have the same density and therefore there is no difference between the liquid space and the vapor space. The wall of such a steam boiler must be of very great thickness, and the greater the diameter of the steam boiler, the greater the thickness of the walls must be. The object of my invention is to enable such a steam boiler to be constructed of tubes of comparatively small diameter.

For this purpose I remove from the steam boiler, consisting of tubes, the quantity of liquid which is not used by the steam engine or steam turbine fed from the steam boiler and place this liquid in a system of tubes in which heat is withdrawn from it by cooling. Owing to this cooling the vapor is condensed to liquid but the volume of the fluid, and therefore also its pressure, are not altered, since at the critical pressure the vapor and liquid have the same volume. I return the cooled liquid into the steam boiler, for which purpose I employ a circulating pump.

The liquid used for cooling the heated liquid takes up heat during this operation, and is preferably employed as feed liquid for the steam boiler, for which a further pump is required, which raises the pressure of this liquid to about the critical pressure. This pump is built as a unit with the first mentioned pump, and in this unit the pressure is raised in stages, in such a way that the lower pressure stages are located at the ends and the pressure rises towards the middle, the critical pressure being reached in the midmost stage. This central stage is the aforementioned circulating pump.

In the accompanying drawings,

Figure 1 is a diagrammatic view of the boiler plant as a whole, and

Figure 2 is a longitudinal sectional elevation of the pump.

The chamber marked 1 constitutes a furnace chamber in which in a convenient manner two associated thick-walled pipe coils or groups of pipes 2 and 3 are lodged. The pipe coil 2 is the actual steam boiler, and the end 3 thereof is the superheater. The liquid raised to about the critical pressure in this pipe system accumulates in a thick-walled reservoir 4. From the latter one or more pipes 5 pass to the engines or turbines in which the vapor is to be used, which are not shown in the drawings. In each of these pipes a valve 6 is provided, which reduces the pressure. This valve does not form part of the invention.

From the reservoir there branches off a pipe 7, in which a safety valve 8 is provided. This pipe leads to a valve 9, which is controlled by a thermostat in dependence upon the temperature of the vapor, and which, in the event of the pressure rising above the critical pressure, which occurs if the engines do not take in all the vapor generated, allows the excess vapor to enter a pipe 10. This guards against an excessive rise of temperature in the tubes 2 and 3, and the burning of the said tubes.

An example of a thermostat for controlling the valve 9 is illustrated in Figure 1. In the wall of the reservoir 4 is inserted a metal tube 11, to the bottom of which is secured a rod 12, consisting of a metal which expands more under the influence of heat than the metal of the tube 11. This rod is attached to a lever 13 pivotally connected with the reservoir 4, the free end of the lever being connected by a link 14 with a control piston 15. The latter is displaceable in the small cylinder 16, into the centre of which a pressure liquid, oil for instance, is supplied through a pipe 17 by a pressure pump 18 driven by any suitable source of power. According to the position of the control piston 15, the pressure liquid is passed either into a pipe 19 or into a pipe 20, which are connected laterally to the cylinder 16. The pipes 19 and 20 open into the top and bottom respectively of a cylinder 21, the piston 22 of which is connected by its piston rod 23 with the valve 9. If the rod 12 expands more than the sleeve 11, the pressure liquid, as illustrated in the drawings, is passed through the pipe 19 to the under side of the piston 22, and the valve 9 is thereby opened. The pressure liquid above the piston 22, being thereby displaced, flows back through the pipe 20 to the cylinder 16, which is open at its ends, and falls out of the

latter into a vessel, not shown, from which it is drawn out again by suction by the pump 18. Upon the temperature of the vapor falling, the operation is reversed, whereby the valve 9 is closed again.

The excess vapor passes through the pipe 10 to a heat-exchanging device. The latter consists, in the example illustrated, of three boilers 24, 25 and 26, but more or fewer such boilers might be provided if preferred. The vapor or liquid passes through pipe coils 27, which extend in series through the boilers 24, 25 and 26. Into the last boiler 26, through a pipe 28, there passes liquid, which flows through pipes 29 and 30 from one boiler to the next, and leaves the first boiler 24 by a pipe 31. In doing so it withdraws heat from the vapor in the pipe 27, and is thereby warmed itself, and may be partially converted into steam. This vapor may be supplied through a pipe 32, which connects the boilers, and which is provided with a safety valve 33, and through a valve 34 which is opened by the vapor pressure, to a pipe 35, which conveys it away for use for any desired purpose. The latter arrangement is however not an essential feature of the invention.

From the liquid in the pipe 27, heat or energy is withdrawn by the cooling, and the vapor is converted into liquid, but its pressure does not thereby fall below the critical pressure, since at this pressure the liquid has the same density as vapor. The condensed liquid is returned by a pipe 36, 37 to the pipe coil 2. In this pipe is interposed a circulating pump 38. The latter need only raise the pressure of the fluid very little, if at all, being only for the purpose of effecting the circulation, since the fluid does not circulate of itself, owing to the liquid and the vapor being of the same density.

The liquid from the pipe 31 serves as feed liquid. It is raised by a pump 39 to a pressure equal to about the critical pressure, and is then passed through a pipe 40 into the pump 38, by which it is fed into the pipe 37 and the steam boiler 2, 3.

The representation of the two pumps 38 and 39 in Figure 1 is only diagrammatic. Instead of two separate pumps, I employ a rotary pump of the kind illustrated in Figure 2. In the constructional example illustrated this pump has nine compartments numbered 41 to 49, each of which has a rotor 51, these rotors being mounted upon a common shaft. It would however also be possible to provide more or fewer compartments. The shaft 50 is driven by any convenient source of power, not shown. Each of these compartments corresponds to one pressure stage, and its rotor 51 delivers the pressure liquid into an external annular passage 52, from which it flows through a radial passage 43 to the centre of the rotor 51 of the next higher pressure stage. The lowest pressure stages 41 and 49 are located at the ends of the pump, and the highest pressure stage 45 is located in the centre and corresponds to the pump 38 in Figure 1. The remaining compartments collectively correspond to the pump 39 in Figure 1. The stuffing boxes 54 at the ends of the pump need only be packed for a low pressure with this arrangement. The pipe 31 is branched and leads to both the compartments 41 and 49. The pipe 36 leads to the radial passages 53 of one or both of the compartments 44, 46, so that from it the liquid passes directly to the rotor 51 of the compartment 45. From the annular passage 52 of the compartment 45 the pipe 37 conveys all the liquid into the steam boiler.

What I claim is:—

1. A steam boiler plant, comprising the combination with a steam boiler comprising steam generating tubes, means for forcing liquid into said boiler at about critical pressure, means for heating the liquid in the tubes to raise the pressure thereof and a pipe connected to said boiler for supplying steam to a steam consumer, of a second pipe connected to the boiler, a valve in said second pipe for controlling the admission of steam thereto from the boiler, actuating means for said valve controlled by the temperature of the steam in the boiler and operating to open the valve on the temperature of the steam rising and to close the valve on the temperature falling, means for cooling the steam in said second pipe and means connected to the second pipe and to the boiler for returning the cooled fluid to the boiler.

2. A steam boiler plant, comprising the combination with a steam boiler comprising steam generating tubes, means for heating the liquid in the tubes to raise the pressure thereof and a pipe connected to said boiler for supplying steam to a steam consumer, of a second pipe connected to the boiler, a valve in said second pipe for controlling the admission of steam thereto from the boiler, actuating means for said valve controlled by the temperature of the steam in the boiler and operating to open the valve on the temperature of the steam rising and to close the valve on the temperature falling, vessels surrounding said second pipe, means for supplying water to said vessels, a pump connected to said second pipe and to the boiler for returning liquid from said pipe to the boiler and a second pump connected to said vessels and to the first-mentioned pump for withdrawing water from said vessels and forcing it into the first-mentioned pump at about critical pressure.

3. A steam boiler plant, comprising the combination with a steam boiler comprising steam generating tubes, means for heating the liquid in the tubes to raise the pressure thereof and a pipe connected to said boiler for supplying steam to a steam consumer, of a second pipe connected to the boiler a valve

in said second pipe for controlling the admission of steam thereto from the boiler, actuating means for said valve controlled by the temperature of the steam in the boiler and operating to open the valve on the temperature of the steam rising and to close the valve on the temperature falling, vessels surrounding said second pipe, means for supplying water to said vessels, a pump connected to said second pipe and to the boiler for returning liquid from said pipe to the boiler, steam withdrawal means connected to said vessels, and a second pump connected to said vessels and to the first-mentioned pump for withdrawing water from said vessels and forcing it into the first-mentioned pump at about critical pressure.

4. A steam boiler plant, comprising the combination with a steam boiler comprising steam generating tubes, means for heating the liquid in the tubes to raise the pressure thereof and a pipe connected to said boiler for supplying steam to a steam consumer, of a second pipe connected to the boiler, a valve in said second pipe for controlling the admission of steam thereto from the boiler, actuating means for said valve controlled by the temperature of the steam in the boiler and operating to open the valve on the temperature of the steam rising and to close the valve on the temperature falling, vessels surrounding said second pipe, means for supplying water to said vessels, a rotary pump comprising a plurality of adjacent pressure stage compartments with the highest pressure stage intermediate the ends of the pump and the initial low pressure stages at the ends of the pump, so that each stage is adapted to deliver to the adjacent stage further inwards, said high pressure stage operating at about critical pressure, said second pipe being connected to the inlet of the highest pressure stage, a pipe connected to said vessels and to the inlets of the initial low pressure stages at the ends of the pump and a pipe connected to the outlet of the highest pressure stage and to the boiler, for the purposes set forth.

In testimony whereof I have signed my name to this specification.

WOLF HUNTEMÜLLER.