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BOILER CIRCULATING SYSTEM

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Fig. 1

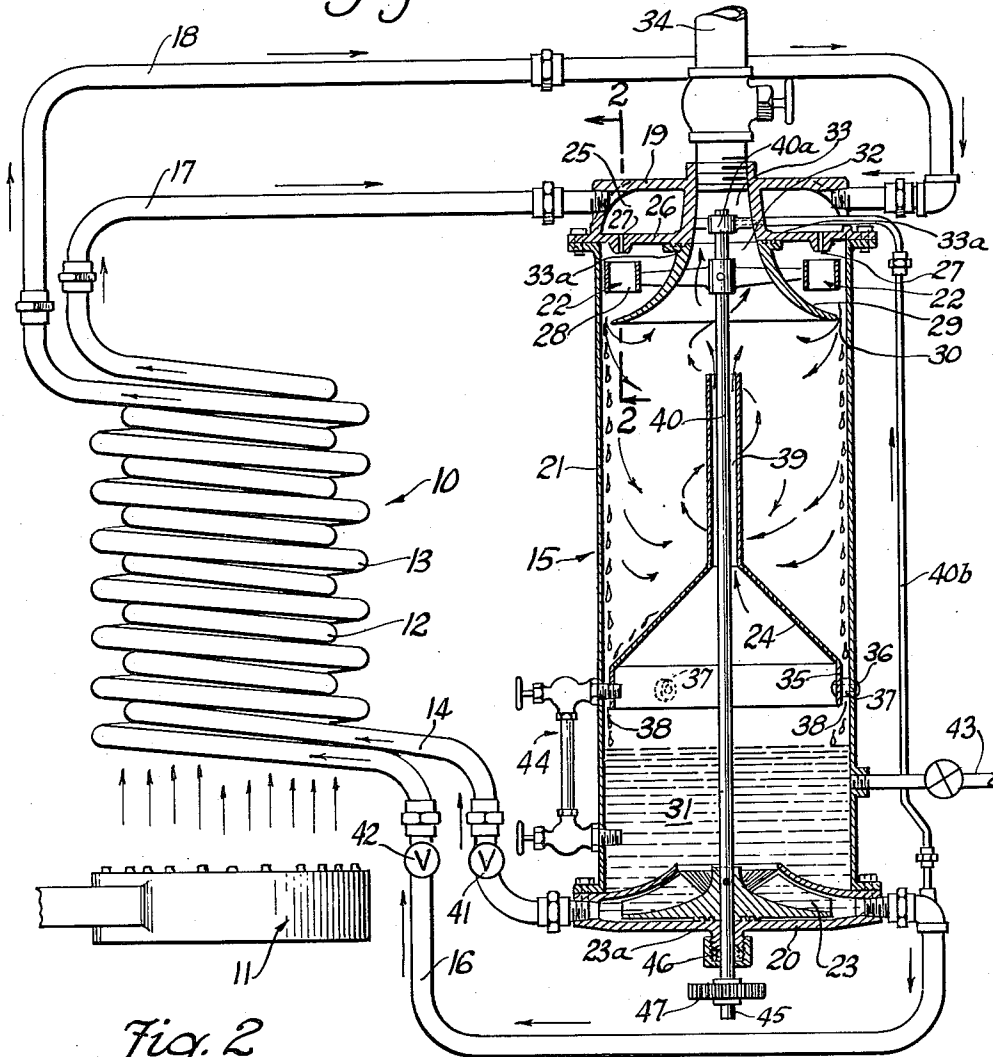
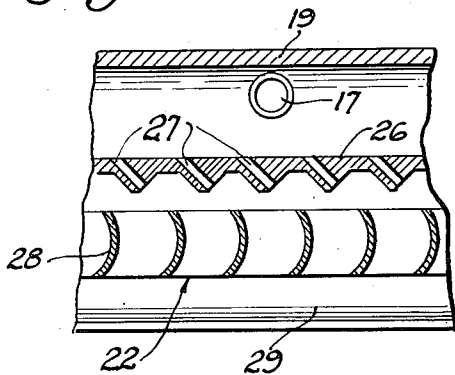


Fig. 2



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## BOILER CIRCULATING SYSTEM

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6 Claims. (Cl. 122—411)

1

This invention relates to improvements in steam generating systems of the general class in which an amount of water, in excess of that which is converted into steam, is forced through the generator. In systems of this character, a mixture of steam and water is discharged from the generator into a separator, wherein the steam is separated from the water and the water is returned to the generator or is utilized to preheat the feed water supplied to the generator.

A principal object of the invention is to provide, in a steam generating system of the above class, improved means for maintaining the desired circulation of water through the generator and to utilize, as an operating force for said means, the pressure of the steam and water mixture discharged from the generator when steam is discharged from the system.

Another object is to provide improved water circulating means, operated in the manner above indicated, which is so constructed that power developed in excess of that required to operate the water circulator pump means, may be utilized for other uses.

The invention has for further objects, the novel arrangements and combinations of parts hereinafter described for attaining the above stated objects and such other objects as will appear from the following disclosure.

The invention is illustrated in the accompanying drawing wherein:

Fig. 1 is a diagrammatic view, in vertical section, of a steam generator and a combined separator and water circulating pump connected therewith.

Fig. 2 is a fragmentary sectional view taken on line 2—2 of Fig. 1 and showing a series of nozzles and a portion of turbine operated by fluid discharged from said nozzles.

The improved boiler circulating system includes a generator of the water tube type composed of coiled or bent tubes 10 which are heated by means of a suitable burner designated 11. The water tubes 10, for the purpose of illustration, are arranged to provide two separate coils 12, 13, although any larger or smaller number of coils may be used. The burner 11 is intended to represent a heating means of any approved construction adapted for use with a selected kind of fuel.

The water is supplied to the inner coil 12 of the generator through an inlet pipe 14 leading from the lower end of a device 15 to the lower end of said coil. A similar inlet pipe 16 leading from the lower end of said device 15, but at a different

2

location, supplies water to the lower end of the outer coil 13 of the generator. The mixture of steam and water is discharged, from the upper end of both coils 12, 13, through delivery pipes 17 and 18, into the upper portion of the device 15.

The said device 15 is a combined steam separator and water circulating pump. It comprises a casing including a top section 19, a lower section 20, an intermediate cylindrical section 21, a turbine 22, centrifugal water pump 23 and a cone-shaped baffle 24. The upper section 19 of the casing defines a receiving chamber 25 for the mixture of water and steam delivered from the generator coils 12 and 13, the lower wall 26 of the chamber being provided with a large number of downwardly inclined nozzles 27 adapted to impinge the mixture of steam and hot water against inclined blades 28 of the turbine 22. It will be observed that the turbine 22 is positioned in the flow path of the mixture of water and steam and is operated thereby, before complete separation of the steam and water is effected, when steam is discharged from the system. The turbine includes, in addition to the impeller blades 28, a bell-shaped skirt 29 which rotates with the turbine and serves to throw the water outwardly toward the inner surface of the intermediate casing 21. This bell-shaped skirt is formed with an open upper end 32 which registers with a steam outlet passage 33 and is sealed, by a labyrinth seal 33a, at its junction with upper section 19 of the casing. Consequently, the steam separated from the water rises upwardly from the separator into the interior of said skirt and passes out of the separator through passage 33 and valved outlet pipe 34.

The water, discharged through the space 30 at the lower edge of the bell-shaped skirt 29, passes around the cone-shaped baffle 24 into a collecting chamber 31. The said baffle 24 is formed at its lower end with a cylindrical flange 35 of less diameter than the inner diameter of the casing section 21 and is secured to the casing by rivets 36. Spacers 37 are interposed between the cylindrical flange 35 and the wall of the casing so as to provide passages 38 for said water. The upper end of the cone 24 is truncated and is provided with a vent pipe 39 through which extends a shaft 40 for operatively connecting a turbine 22 with the centrifugal pump 23.

It will be observed that the rotation of the turbine imparts corresponding movement to the centrifugal pump 23 and thereby forces water from the collecting chamber 31 into the inlet pipes 14 and 16 leading to the water coils 12 and

11, respectively. The numerals 41, 42 designate check valves positioned in the inlet pipes 14 and 16 to prevent backflow of water.

In order to maintain an adequate head of pre-heated water for delivery into the heater coils 12 and 13, the collecting chamber 31 is connected with a valved supply pipe 43 leading from a feed pump (not shown). The water feed pump is not shown, since any conventional feed pump may be used together with known controls therefor, whereby an amount of water corresponding to the water evaporated will be delivered through pipe 42 into the water collecting chamber 31 of the separator. A conventional water gauge 44 is shown at a suitable location for indicating the normal head of water maintained in said collecting chamber 31.

The lower end 45 of shaft 40 extends through a packing gland 46 to the outside of the casing. Consequently, the lower end of the said shaft may be provided with power transmitting means 47, whereby power developed by the turbine in excess of that required to drive the circulating pump 23 may be utilized for other uses. In order to relieve the packing gland 46 from the internal pressure within the separator 15, a labyrinth seal 23a is provided between the pump rotor and the lower section 20 of the separator.

In order to suitably lubricate the bearing 40a at the upper end of the shaft 40, a tube 40b leading from a fitting in feed pipe 16 delivers a quantity of water under pressure to the bearing surface of said bearing 40a.

While the invention is disclosed in connection with certain specific constructions, it will be obvious that modified structure including multi-stage pumps and/or turbines may be provided whereby the water separated from a forced circulation generator is returned to the generator by means of such pumps operated by the pressure of the water and steam mixture discharged from the generator. It will, therefore, be understood that the present invention contemplates all such changes of structure for accomplishing the above purpose which come within the scope of the appended claims.

I claim:

1. In a steam generating system in which an excess of water is circulated through a generator, the combination of the generator, a separator structure comprising a receiving chamber located in the upper portion thereof, a water storage chamber located in the lower portion of the separator structure, means defining a separating chamber for separating the steam from the water in a location intermediate said receiving and storing chambers, means communicating with said separator chamber and defining a steam outlet from the system, a conduit for delivering a mixture of water and steam from the generator into said receiving chamber, a turbine rotor positioned in said separating chamber at a location adjacent said receiving chamber, means defining a nozzle for directing the mixed water and steam from the receiving chamber against said turbine rotor to operate the same when the steam outlet is open, a centrifugal pump positioned in the water storage chamber, a conduit connecting the storage chamber with the water inlet to the generator, and means operatively connecting the turbine rotor with said pump, whereby operation of said turbine and pump forcibly recirculates the water from the storage chamber through the generator.

2. In a steam generating system in which an

excess of water is circulated through a generator, the combination of the generator, a separator comprising a receiving chamber, a steam outlet from the system and a water storage chamber, a conduit for delivering a mixture of water and steam from the generator into said receiving chamber, a turbine rotor positioned adjacent said receiving chamber, means defining a plurality of angularly disposed nozzles for directing the mixed water and steam from the receiving chamber against said turbine rotor to operate the same when steam is discharged from the system, a bell-shaped skirt partially defining a separating chamber for separating the steam from the water and arranged with its lower edge in close relation, but spaced from the inner wall of the separator, a centrifugal pump positioned in the water storage chamber, a conduit connecting this chamber with the inlet end of the generator, and means operatively connecting the turbine rotor with said pump, whereby operation of said turbine and pump forcibly recirculates the water from the storage chamber through said generator.

3. In a steam generating system in which an excess of water is circulated through a generator, the combination of the generator, a separator comprising a receiving chamber, a steam outlet from the system and a water storage chamber, a conduit for delivering a mixture of water and steam from the generator into said receiving chamber, a turbine rotor positioned adjacent said receiving chamber, means defining a plurality of angularly disposed nozzles for directing the mixed water and steam from the receiving chamber against said turbine rotor to operate the same when the steam outlet is open, a bell-shaped skirt partially defining a separating chamber and arranged with its lower edge in close relation but spaced from the inner wall of the separator and with its upper end communicating with the steam outlet, whereby the separated water is thrown outwardly toward the wall of the separator chamber by centrifugal force, and the steam passing around the lower edge of said skirt rises upwardly to said outlet, a centrifugal pump positioned in the water storage chamber, a conduit connecting the water storage chamber with the water inlet to the generator, and means operatively connecting the turbine rotor with said pump, for forcibly circulating the water from the storage chamber through said generator.

4. In a steam generating system in which an excess of water is circulated through a generator, the combination of the generator, a separator comprising a receiving chamber, a steam outlet from the system and a water storage chamber, a conduit for delivering a mixture of water and steam from the generator into said receiving chamber, a turbine rotor positioned adjacent said receiving chamber, means defining a plurality of angularly disposed nozzles for directing the mixed water and steam from the receiving chamber against said turbine rotor to operate the same when steam is discharged from the system, a bell-shaped skirt fixed to the turbine so as to rotate therewith and having its lower edge in close relation but spaced from the inner wall of the separator and with its upper end communicating with the steam outlet, whereby the separated water is thrown outwardly toward the wall of the separator chamber by centrifugal force, and the steam passing around the lower edge of said skirt rises upwardly to said outlet, a centrifugal pump positioned in the water storage chamber,

5

a conduit connecting the water storage chamber with the water inlet to the generator, and means operatively connecting the turbine rotor with said pump, for forcibly circulating the water from the storage chamber through said generator.

5. In a steam generating system in which an excess of water is circulated through a generator, the combination of the generator, a separator comprising a receiving chamber, a steam outlet and a water storage chamber, a conduit for delivering a mixture of water and steam from the generator into said receiving chamber, a turbine rotor positioned adjacent said receiving chamber, means defining a plurality of angularly disposed nozzles for directing the mixed water and steam from the receiving chamber against said turbine rotor to operate the same when steam is discharged from the system, a bell-shaped skirt fixed to the turbine so as to rotate therewith and having its lower edge in close relation but spaced from the inner wall of the separator and with its upper end communicating with the steam outlet, whereby the separated water is thrown outwardly toward the wall of the separator chamber by centrifugal force, and the steam passing around the lower edge of said skirt rises upwardly to said outlet, a centrifugal pump positioned in the water storage chamber, a conduit connecting the water storage chamber with the water inlet to the generator, means operatively connecting the turbine rotor with said pump, for forcibly circulating the water from the storage chamber through the generator, and means for delivering external water into the storage chamber.

6. In a steam generating system in which an excess of water is forcibly circulated through a generator, the combination with a coil pipe generator composed of a plurality of coils each comprising a series of convolutions leading from an inlet to a discharge end of the individual coils,

6

a separator provided with a portion defining a receiving chamber having a plurality of receiving ports, separate discharge conduits leading from the discharge ends of the individual coils to separate inlet ports of the receiving chamber, a turbine positioned adjacent said receiving chamber, means defining a plurality of angularly disposed nozzles defining outlets from said receiving chamber and positioned to project the steam and water mixture against said turbine rotor when steam is discharged from the system, means connected with said turbine rotor defining a portion of a separating chamber and a portion of a steam outlet, means defining a collecting chamber for the water separated from said steam, a centrifugal pump communicating with said water collecting chamber and including a pump housing having a plurality of outlet ports, separate conduits connecting the individual outlet ports to the inlet ends of separate coils of the generator and means connecting the turbine rotor with said pump, whereby operation of the turbine imparts rotational movement to the pump.

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