June 1, 1937. M. H. KUHNER 2,082,401

STEAM GENERATING APPARATUS

Filed Dec. 11, 1934 2 Sheets-Sheet 1

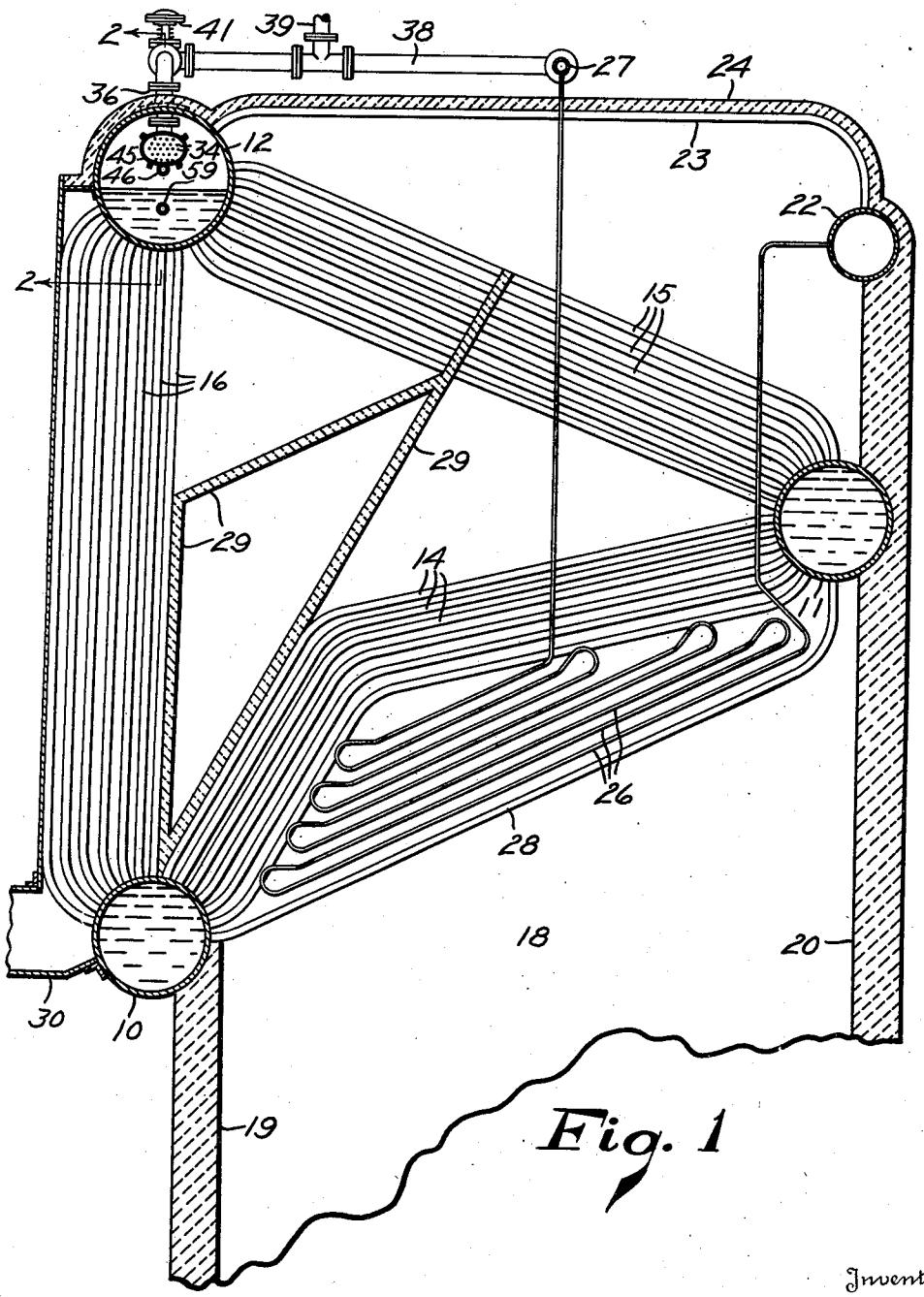

Fig. 1

Inventor

MAX H. KUHNER

By Albert G. Blodgett

Attorney

June 1, 1937. M. H. KUHNER 2,082,401

STEAM GENERATING APPARATUS

Filed Dec. 11, 1934 2 Sheets-Sheet 2

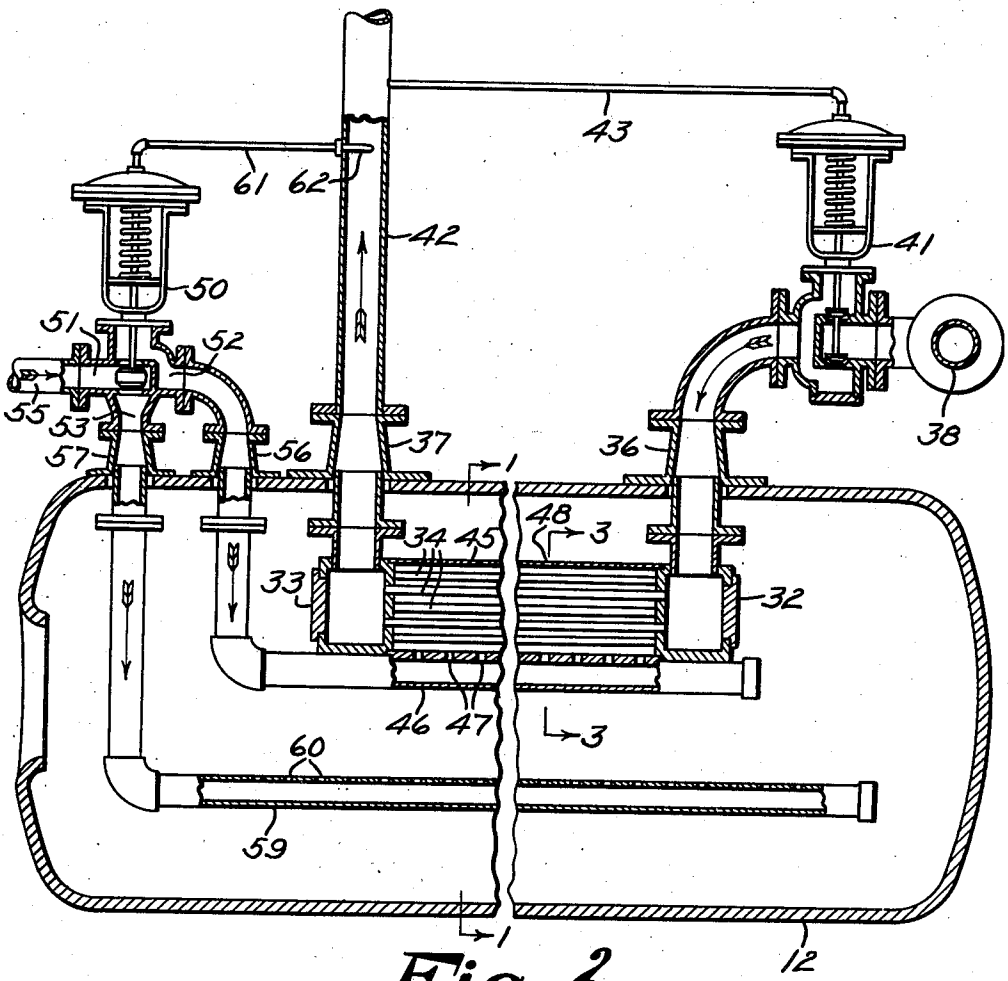

Fig. 2

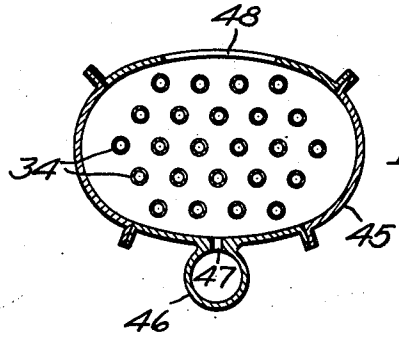

Fig. 3

Inventor

MAX H. KUHNER

By Albert G. Blodgett

Attorney

Patented June 1, 1937

2,082,401

UNITED STATES PATENT OFFICE

2,082,401

STEAM GENERATING APPARATUS

Max H. Kuhner, Worcester, Mass., assignor to Riley Stoker Corporation, Worcester, Mass., a corporation of Massachusetts

Application December 11, 1934, Serial No. 757,010

1 Claim. (Cl. 122—479)

This invention relates to steam generating apparatus, and more particularly to apparatus of this type having a desuperheater and means for controlling the temperature of the desuperheated steam.

In many industrial steam generating plants there is a demand for steam at different pressures and temperatures. High pressure high temperature steam is required for the production of power in steam turbines or engines, and low pressure low temperature steam is needed in connection with various manufacturing processes. In some cases low pressure steam may be required at a temperature lower than the boiling point of water at the high pressure, so that it is impossible to obtain the desired result by using the high pressure boiler water as a desuperheating medium. For economical reasons it is undesirable to provide two separate boilers to operate at different pressures, and various prior constructions have accordingly been proposed to provide the required steam supplies from a single boiler. These prior arrangements have, however, been complicated, expensive, bulky, and subject to various difficulties in actual operation.

It is accordingly one object of the invention to provide a simple and inexpensive apparatus for producing steam at two different pressures and temperatures.

It is a further object of the invention to provide a simple and reliable apparatus for accurately controlling the temperature of superheated steam.

It is a further object of the invention to provide a simple and reliable apparatus for obtaining low pressure steam at a temperature below the boiling point of the water from which the steam is generated.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claim appended hereto.

Referring to the drawings illustrating one embodiment of the invention, and in which like reference numerals indicate like parts,

Fig. 1 is a longitudinal section through a steam generating apparatus, the section being taken on the line 1—1 of Fig. 2;

Fig. 2 is an enlarged section taken on the line 2—2 of Fig. 1; and

Fig. 3 is a section on the line 3—3 of Fig. 2.

In the drawings I have illustrated a water tube boiler of a well-known type, comprising a mud drum 10, a water drum 11, and a steam and water drum 12. Drums 10 and 11 are connected by an upwardly and forwardly sloping bank of tubes 14, and drums 11 and 12 are connected by an upwardly and rearwardly sloping bank of tubes 15. A substantially vertical bank of tubes 16 connects drums 10 and 12. With this construction a complete circulating system is provided for the water and steam through the drums and the interposed banks of tubes. A furnace or combustion chamber 18 is located beneath the tube bank 14, the rear wall 19 of the chamber being beneath the mud drum 10, and the front wall 20 of the chamber being adjacent to the water drum 11.

A steam drum 22 is mounted above the water drum 11, and a row of substantially horizontal tubes 23 leads from the steam and water drum 12 to the steam drum. The tubes 23 support refractory material 24 which forms a roof for the boiler.

The tubes of the first tube bank 14 are bent upwardly intermediate their lengths to provide a space for a superheater 26 therebeneath. The inlet ends of the superheater tubes are connected to the steam drum 22, and their outlet ends are connected to a horizontal header 27 located above the roof 24. A row of water tubes 28 extends between the drums 10 and 11 below the superheater, to protect the superheater tubes to some extent from the radiant heat of the furnace. Baffles of refractory material are arranged to direct the hot gases from the furnace over the superheater 26 and the tube banks 14, 15 and 16 in the order named to a gas outlet 30. It will be apparent that all the steam generated in the boiler will be delivered to the steam and water drum 12, and from this drum it will flow through the tubes 23 to the steam drum 22, and thence through the superheater 26 to the header 27.

In passing through the superheater the steam will be raised to a high temperature and hence will be suitable for use in a steam turbine for the generation of power. Many industrial plants however require steam for process work as well as power generation, and the process steam is usually needed at a lower temperature and pressure. Moreover, there is usually no definite relationship between the quantities required for the two purposes, and these quantities may vary entirely independently throughout the day.

In order to supply the process steam from the same boiler as the steam for power, I withdraw the quantity of steam needed for process work from the high pressure high temperature supply

and then reduce both the temperature and pressure of this steam to the desired value. This temperature reduction is preferably effected by bringing the steam into heat-exchange relation with flowing water at a lower temperature through heat-conducting walls.

In the preferred construction illustrated I have provided a desuperheater comprising an inlet manifold 32 and an outlet manifold 33 connected by a group of horizontal tubes 34. These parts are shown mounted in the upper portion of the drum 12 above the axis of the drum and thus above the normal water level therein. The manifolds 32 and 33 are connected to nozzles 36 and 37 respectively, which are secured to the upper wall of the drum 12. Steam is delivered to the nozzle 36 from the superheater outlet header 27 through a pipe 38, which is provided with a branch pipe 39 (Fig. 1) for delivery of high pressure high temperature steam to a steam turbine or other apparatus. A pressure reducing valve 41 is mounted in the pipe 38 between the branch 39 and the nozzle 36, this valve being of the well-known diaphragm-operated type. A pipe 42 is connected to the nozzle 37 for the delivery of low pressure low temperature steam to apparatus requiring the same, and the pressure in this pipe is transmitted to the diaphragm of the valve 41 through a small control pipe 43.

In order to reduce the temperature of the steam as it flows through the tubes 34, water at a comparatively low temperature is caused to flow in contact with the outside of the tubes. For this purpose I preferably utilize the feed water which is supplied to the boiler to replenish the water which has been changed to steam. In the drawings there is shown a casing 45 enclosing the tubes 34. A horizontal pipe 46 is welded to the bottom of the casing, and a row of openings 47 is provided in the upper wall of the pipe for the discharge of water therefrom into the interior of the casing. Slots 48 are provided in the upper wall of the casing so that the water may escape and thereafter mix with the boiler water.

The temperature of the steam as it leaves the desuperheater is regulated by controlling the effectiveness of the heat exchange, and this is preferably accomplished by delivering a portion only of the feed water to the pipe 46 and controlling the amount so delivered. In the embodiment illustrated I have provided a proportioning valve 50 of the well-known diaphragm-operated type having an inlet 51 and two outlets 52 and 53. The boiler feed water is delivered to the inlet 51 by a pipe 55, and the outlets 52 and 53 are connected to nozzles 56 and 57 respectively, which are secured to the upper wall of the drum 12. The nozzle 56 is connected to the pipe 46 leading to the desuperheater, and the nozzle 57 is connected to a horizontal pipe 59 extending longitudinally within the drum and provided with a row of openings 60 for the discharge of the feed water. The proportioning valve 50 is regulated automatically in accordance with the temperature of the steam in the delivery pipe 42. For this purpose the valve is connected by a small tube 61 with a temperature responsive bulb 62 located in the pipe 42.

The operation of the invention will now be apparent from the above disclosure. Hot gases from the furnace 18 pass through the boiler and generate steam at a comparatively high pressure, all of which flows through the superheater 26 and is raised to a high temperature. The superheated steam flows through the header 27 and pipe 38, a portion being withdrawn through the branch pipe 39 for use in a turbine or other apparatus. The remainder of the steam flows through the valve 41, where its pressure is reduced, and enters the tubes 34 where its temperature is reduced by the transfer of heat to the surrounding feed water in the casing 45. The steam then travels through the pipe 42 to a place of use. The valve 41 operates automatically to maintain a substantially constant pressure in the pipe 42. The feed water, which is ordinarily at a comparatively low temperature, is supplied by the pipe 55, and the valve 50 serves to proportion the water between the pipes 46 and 59 in accordance with the temperature of the steam in the pipe 42. If the steam temperature rises slightly, the valve will deliver a larger proportion of the water to the pipe 46, thus causing a more effective desuperheating action and maintaining a substantially constant steam temperature. A reduction in steam temperature will cause a similar action in the reverse direction. It will be noted that the area of wetted wall surface in the desuperheater remains constant, the steam temperature being controlled by varying the rate of flow of the feed-water through the interior of the casing 45.

By arranging the various parts in the manner disclosed, I have reduced the space requirements and heat radiation losses to a minimum. The use of feed water in the desuperheater makes it possible to reduce the steam temperature if desired to a value below the boiling temperature of the water corresponding to the boiler pressure. This is of great importance in many plants.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

Steam generating apparatus comprising a boiler having a horizontal cylindrical steam-and-water drum, tubes connected to the drum and arranged to deliver a mixture of steam and water thereto, additional tubes connected to the drum and arranged to withdraw water therefrom, a superheater arranged to receive steam from the drum, a desuperheater located within the drum and above the normal water level thereof, means to deliver steam from the superheater to the desuperheater, and means to deliver boiler feed water to the desuperheater, the desuperheater having an outlet for the discharge of the feed water therefrom into the drum.

MAX H. KUHNER.