

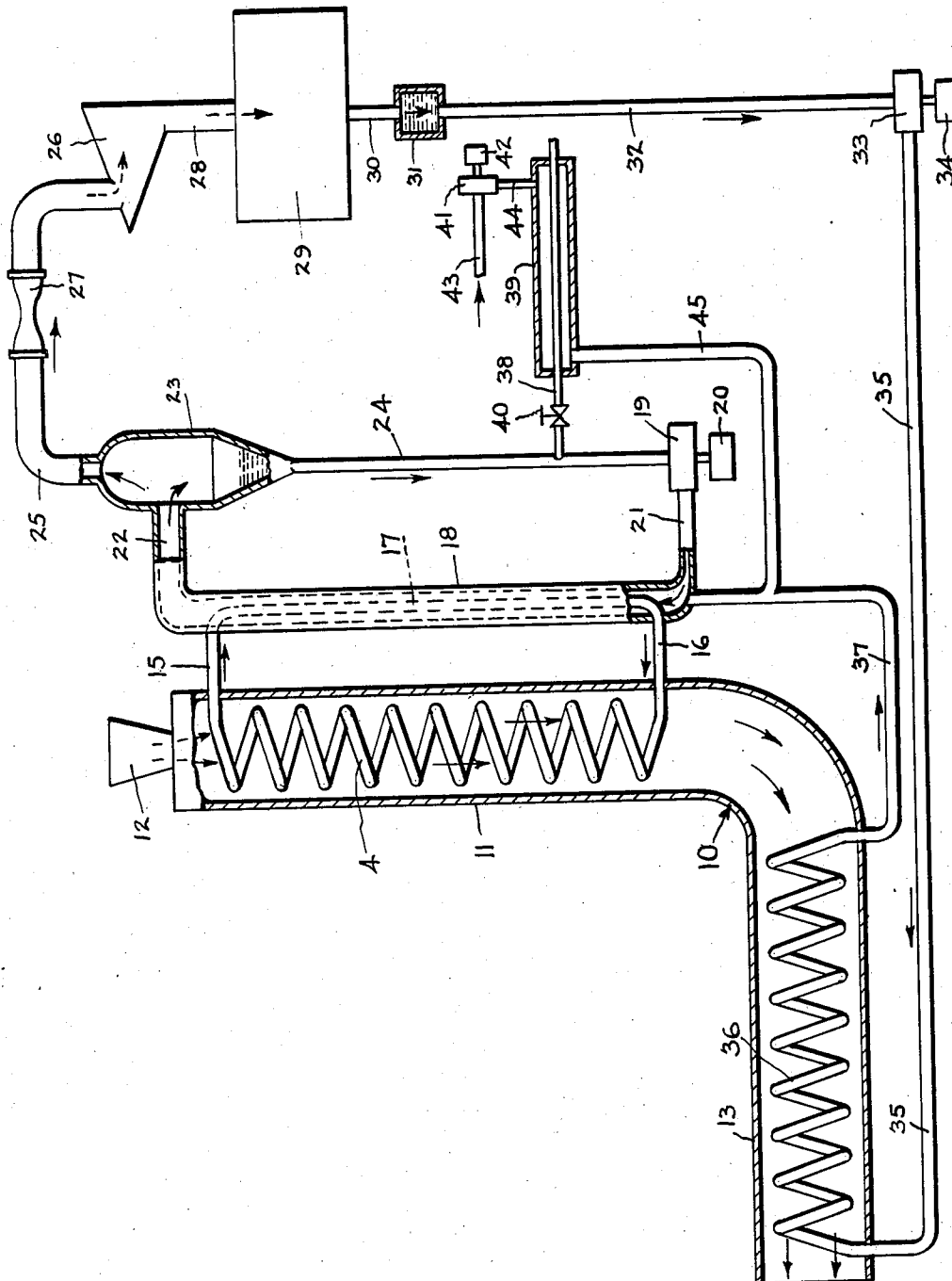
June 20, 1939.

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2,162,746

APPARATUS FOR GENERATING STEAM

Filed April 11, 1936



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2,162,746

APPARATUS FOR GENERATING STEAM

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Application April 11, 1936, Serial No. 73,892

4 Claims. (Cl. 122—33)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention relates to the generation of steam, and it has for its principal object the provision of an apparatus for generating steam by a fluid heating medium that is vaporized at a point remote from the boiler.

Another object of the invention is the provision of an apparatus in which the boiler parts, wherein the steam is generated, are not subjected to the deteriorating action of the hot gases of a furnace.

Still another object of the invention is the provision of an apparatus of the character described, wherein an intimate contact between the steam generating space and the heating space is obtained.

A further object is the provision of a steam generating apparatus wherein the water in the boiler is heated by a different fluid which is vaporized by a heat source in a primary generator located apart therefrom.

A still further object of the invention is the provision of a steam generating apparatus wherein the water is circulated with such rapidity as to render it possible to employ salt or hard water without the formation of scale or other deposits, or other injury to the contiguous parts.

Another object of the invention is the provision of an apparatus of the type referred to wherein the feed water is preheated by the waste flue gases.

With these and other objects in view, as well as other advantages that may be incident to the use of the improvements, the invention consists in the parts and combinations thereof herein-after set forth and claimed, and with the understanding that the several necessary elements constituting the same may be varied in proportion and arrangement without departing from the nature and scope of the invention, as defined in the appended claims.

In order to make the invention more clearly understood, there are shown in the accompanying drawing, means for carrying the invention into practical use, without limiting the improvements in their useful application to the particular construction, which, for the purpose of explanation, have been made the subject of illustration.

The single figure of the accompanying drawing is a diagrammatic view of an apparatus embodying my invention.

Referring to the drawing, a steam generating apparatus constructed and assembled in accordance with the present invention is shown as comprising a primary heater or furnace 10 having a vertical portion 11 into which hot gases are introduced from an oil burner or other heat producing

means 12, and a horizontal portion 13 through which the waste flue gases are exhausted. A heating coil 14 containing a liquid having high vapor temperature and low vapor pressure characteristics, such as mercury, is disposed within the portion 11 of the furnace 10 and communicates at its upper and lower ends through pipes 15 and 16, respectively, with the upper and lower ends of a tube 17. Thus, a closed circulation of the primary heating medium is obtained. The tube 17 extends longitudinally through a boiler tube 18 which contains the water to be converted into steam and which communicates at its lower end with a pump 19 driven by a motor 20 through a pipe 21, and at its upper end through a pipe 22 with a steam separator 23, the lower portion of which communicates with the pump 19 through a pipe 24. Thus, a closed circulation of water to be transformed into steam is also obtained. The boiler tube 18 may be one long single tube or a plurality of tubes connected in parallel. The mercury or other medium in the coil 14 is vaporized by the heat from the hot gases in the furnace 11 and passes through the pipe 15 into the tube 17 through which it passes downwardly giving up its heat to the water in the boiler 18. The condensed mercury flows back to the coil 14 through the pipe 16. A counterflow of the mercury and heating gases is obtained by this arrangement, the mercury flowing upwardly through the coil 14 and the hot gases flowing downwardly through the furnace 11, thus imparting to the vaporized mercury passing to the tube 17 its maximum temperature.

The steam generated in the boiler 18 flows through the pipe 22 into the separator 23 which extracts any moisture of condensation therefrom and returns it to the lower end of the boiler 18 through the pipe 14, pump 19 and pipe 21. It will be noted that the flow of mercury and the flow of water are in opposite directions, the vaporized mercury flowing downwardly through the tube 17 and the water flowing upwardly through the boiler 18, thus imparting to the steam passing to the separator 23 its maximum temperature.

From the separator 23 the dry steam passes through a pipe 25 to a turbine, reciprocating engine or other apparatus 26, where useful work is done. If desired, an expansion element, or other suitable means 27, may be inserted in the pipe 25 to lower the pressure of the steam sufficiently to produce superheated steam. The steam discharging from the turbine 26 passes through a pipe 28 to a condenser 29 from which the condensate passes through a pipe 30 to a hot well

31 where it collects. From the well 31 the water passes through a pipe 32 to a pump 33 driven by a motor 34, which forces it through a pipe 35 into one end of a coil 36 disposed within the portion 13 of the furnace 10 where it is preheated by the waste flue gases. The preheated water then flows through a pipe 37 into the lower end of the boiler 18.

It will be apparent from the foregoing that the arrangement provides for the water being circulated through the system with such rapidity that the chance for the formation of scale or the accumulation of deposits in the boiler is very materially reduced. Also, it will be noted that the flame or hot gases do not impinge upon the tube or tubes of the steam boiler that are inaccessible, subject to high pressure, and are hard to keep clean, thus eliminating deterioration from this cause. Salt water may therefore be used, but in this event certain purging of the water should be made, either periodically or continuously, so as to remove the concentrated water.

In the present instance such purging is effected by permitting the concentrated water in the pipe 24 to escape from the system through a pipe 38 which in the interest of economy of heat units extends through a heat exchanger 39. The escape of this condensate water is controlled by a valve 40 provided in the pipe 38.

A new supply of water equal in volume to that drained off through the pipe 38 is drawn by a pump 41 driven by a motor 42, through a pipe 43 communicating with a suitable source, and is forced thereby through a pipe 44 into the heat exchanger 39, where it is preheated by the heated water escaping through the pipe 38. This preheated water is then forced into the lower portion of the boiler 18 through a pipe 45 communicating with the pipe 37.

A boiler constructed and operated in the manner described is suitable especially for high pressure work. Assuming a temperature of 680° F. of the mercury and a 100 per cent heat transfer, the pressure in the water boiler will be approximately 2700 lbs. At the same time the pressure in the mercury boiler or coil 14 will only be about atmospheric.

It will be understood that the drawing is only schematic and that the several parts constituting the invention may be varied in construction, proportions and arrangement of the parts by those skilled in the art, without departing from the nature and scope of the invention as defined in the appended claims.

In the above description of the invention, it is stated that the heating medium is vaporized, and that this vapor is then passed over to the boiler to condense and transfer its heat to water. It is, however, not necessary to vaporize the heating medium. This medium may be a fluid which remains in liquid state in both the heater and the boiler, circulating as a liquid and not as a vapor. In this arrangement a pump may be inserted either in the pipe 15 or in the pipe 16 so as to cause very rapid circulation of the medium.

The object of this arrangement is, first, some liquids as for instance a solution of salt in water will have considerably higher temperature in the liquid state than the vapor. A solution of calcium chloride in water will vaporize at, say, atmospheric pressure under a temperature considerably over 212° F. but the vapor produced will be only 212° F. in temperature no matter how high is the temperature of the solution. In this

case it would thus be preferable to circulate the liquid and not the vapor.

A second object would be that the hot gases will touch tubes or parts filled with liquid and not vapor thus lengthening the life of the same and a third object would be that heat will pass faster from a liquid to a liquid than a vapor to a liquid.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. A system for generating steam comprising a conduit through which heated gases are adapted to flow, a boiler for containing a supply of water, a continuous passageway extending through said conduit and through said boiler and in heat exchanging relation therewith for containing a vaporizable heating medium having a high vapor temperature and a low vapor pressure, said heating medium being adapted to flow through that portion of said passageway located in said conduit in a direction opposite to and parallel with the direction of flow of the heated gases therein to absorb heat therefrom and be vaporized thereby, thence through that portion of said passageway located in said boiler to transfer its heat to the water therein to generate steam therefrom, and thence back through said conduit, the circulation of said heating medium through said passageway being effected by the differential temperatures of said medium existing at points within said conduit and said boiler, means communicating with said boiler for separating moisture of condensation from said steam and for returning the same to said boiler; and means located in said conduit for preheating the water supplied to said boiler.

2. A system for generating steam comprising a conduit through which heated gases are adapted to flow, a boiler for containing a supply of water, a continuous passageway extending through said conduit and through said boiler and in heat exchanging relation therewith for containing a vaporizable heating medium having a high vapor temperature and a low vapor pressure, said heating medium being adapted to flow through that portion of said passageway located in said conduit in a direction opposite to and parallel with the direction of flow of the heated gases therein to absorb heat therefrom and be vaporized thereby, thence through that portion of said passageway located in said boiler to transfer its heat to the water therein to generate steam therefrom, and thence back through said conduit, the circulation of said heating medium through said passageway being effected by the differential temperatures of said medium existing at points within said conduit and said boiler, means communicating with said boiler for separating moisture of condensation from said steam and for returning the same to said boiler; means for withdrawing concentrated water from said separating means; means for supplying to said boiler a volume of replacement water equal to that withdrawn from said separating means; and means located in said conduit for preheating the water supplied to said boiler.

3. A system for generating steam comprising a conduit through which heated gases are adapted to flow, a boiler for containing a supply of water, a continuous passageway extending through said conduit and through said boiler and

in heat exchanging relation therewith for containing a vaporizable heating medium having a high vapor temperature and a low vapor pressure, said heating medium being adapted to flow through that portion of said passageway located in said conduit in a direction opposite to and parallel with the direction of flow of the heated gases therein to absorb heat therefrom and be vaporized thereby, thence through that portion of said passageway located in said boiler to transfer its heat to the water therein to generate steam therefrom, and thence back through said conduit, the circulation of said heating medium through said passageway being effected by the differential temperatures of said medium existing at points within said conduit and said boiler, means communicating with said boiler for separating moisture of condensation from said steam and for returning the same to said boiler; means for withdrawing concentrated water from said separating means; means for supplying to said boiler a volume of replacement water equal to that withdrawn from said separating means; means for preheating said replacement water; and means located in said conduit for preheating the water supplied to said boiler.

4. A system for generating steam comprising a conduit through which heated gases are adapted to flow, a boiler for containing a supply of water, a continuous passageway extending through said

conduit and through said boiler and in heat exchanging relation therewith for containing a vaporizable heating medium having a high vapor temperature and a low vapor pressure, said heating medium being adapted to flow through that portion of said passageway located in said conduit in a direction opposite to and parallel with the direction of flow of the heated gases therein to absorb heat therefrom and be vaporized thereby, thence through that portion of said passageway located in said boiler to transfer its heat to the water therein to generate steam therefrom, and thence back through said conduit, the circulation of said heating medium through said passageway being effected by the differential temperatures of said medium existing at points within said conduit and said boiler, means communicating with said boiler for separating moisture of condensation from said steam, a pump for returning the water of condensation to said boiler; means for withdrawing concentrated water from said separating means; means for supplying to said boiler a volume of replacement water equal to that withdrawn from said separating means; means for preheating said replacement water; a pump for supplying water to said boiler; and means located in said conduit for preheating the water supplied to said boiler by said pump.