

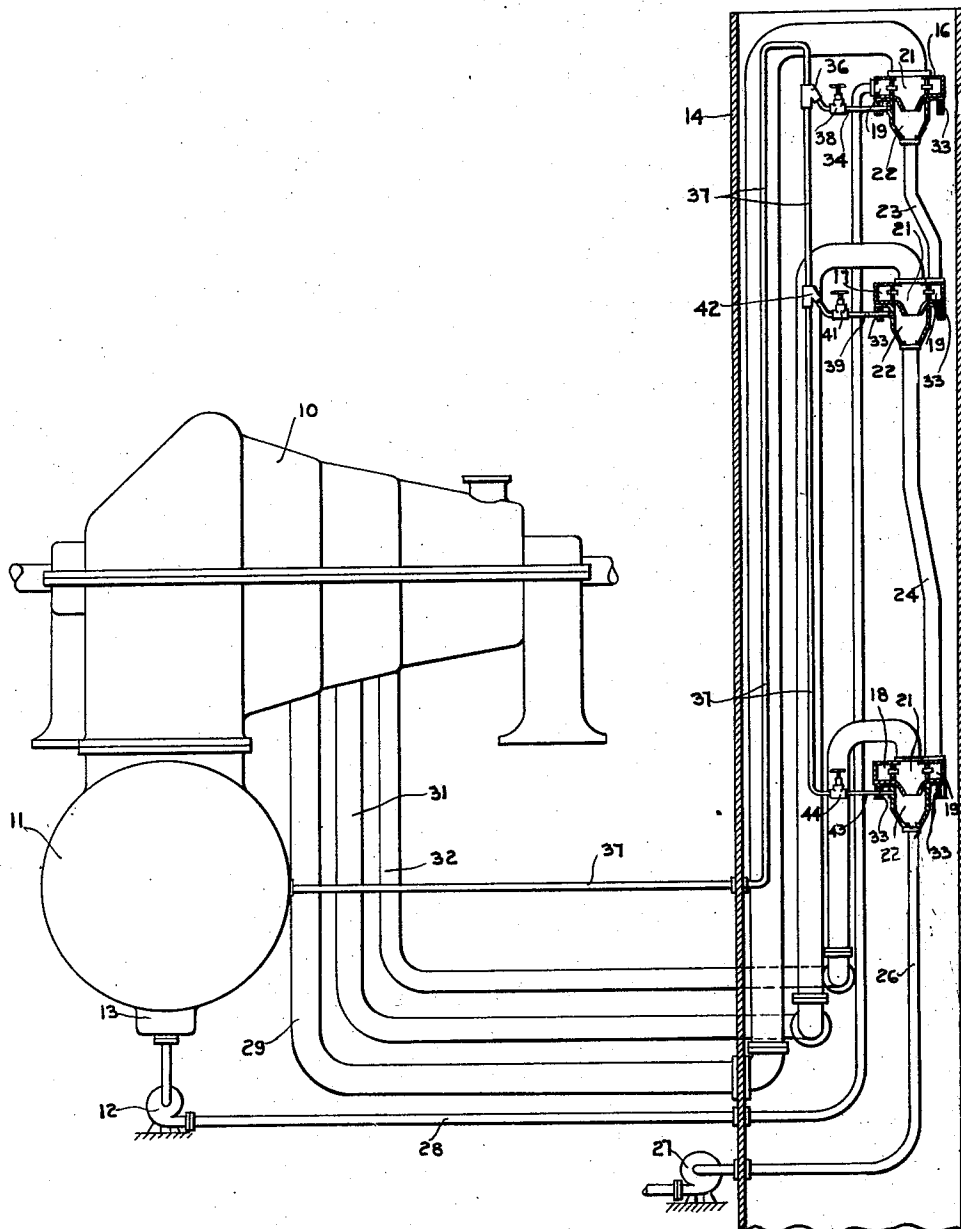
June 3, 1930.

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1,760,954

FEED WATER HEATER

Filed Jan. 18, 1928



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FEED-WATER HEATER

Application filed January 18, 1928. Serial No. 247,662.

My invention relates to feed water heating systems, and more particularly to multi-stage, progressive heating of feed water by means of regenerative heaters, and it has for an object, to improve the efficiency of systems of this character.

In the usual feed water heating system, a quantity of motive fluid is withdrawn from the prime mover after partial expansion and is passed to a heater where it is condensed to water at its own temperature, and thus, surrenders its latent heat to the feed water. In this way, a relatively small quantity of motive fluid can be used to heat the feed water in stages, and if the drains from the heaters are returned to the feed water, there is, theoretically, no thermal loss.

Of course, a certain additional amount of fuel is required, to generate the motive fluid which does the actual heating of the feed water; and, if even a portion of the heat for the feed water could be supplied from some source other than the fluid pressure generator, it will be clear that a saving in fuel could be effected.

It is well known that considerable quantities of heat pass up the stack in the flue gases and are never recovered. Furthermore, in the feed water heating systems of the prior art, mechanical energy is consumed in translating the feed water through the heaters. Consequently, there is, also, a loss on this account, due to the mechanical efficiency being less than 100 per cent. Hence, a more particular object of my invention is to provide a feed water heating system of the type described, which shall be adapted to facilitate a transfer of heat from the flue gases to the feed water and which shall be so constructed and arranged that no mechanical energy need be produced for translating the feed water between the heaters of the system.

Apparatus embodying the features of my invention is shown in the accompanying drawing, forming a part of this specification, and wherein the single figure is an elevation of a steam power installation equipped with a number of regenerative, feed water heaters, the heaters being shown in section for purposes of illustration.

In accordance with my invention, a series of jet heaters of the barometric type are arranged at successively greater elevations in the stack of a power plant. Preferably, in each case, the barometric legs of the respective heaters are of sufficient length to balance the pressures between the bleed points and thus, no valves are required.

By virtue of the arrangement of the heating system in the stack, a considerable quantity of the heat of the flue gases is transferred to the feed water and in this way a saving in fuel is effected. Also, the barometric type of heater will create a sufficient vacuum to draw steam from a turbine, even under very light loads, so that efficient heating is assured for all conditions of operation.

Referring now to the drawings for a better understanding of my invention, I show a prime mover, such as the bleeder turbine 10, arranged to exhaust to the surface condenser 11, and the condensate extraction pump 12 is connected to the hotwell 13 for removing condensate from the latter in the manner well understood in the art. An off-take for flue gases, such as the furnace stack, is indicated at 14; and, in order to provide for recovering heat from the gases which pass up the stack 14, I arrange a suitable number of heaters 16, 17 and 18 within this offtake structure.

The heaters 16, 17 and 18 are preferably jet heaters of the barometric type and are similar in all respects. Each heater comprises a nozzle chamber 19, a mixing chamber 21 and a discharge chamber 22. The discharge chamber 22 of the uppermost heater 16 is connected to the nozzle chamber 19 of the heater 17 by the tail pipe 23, while the discharge chamber 22 of the heater 17 is connected to the nozzle chamber 19 of the heater 18 by the tail pipe 24. Likewise, the discharge chamber 22 of the heater 18 is connected to the tail pipe 26, and the latter may be connected to the suction of the boiler feed pump 27.

In order to provide for passing the feed water through these heaters, the condensate extraction pump 12 is arranged to discharge into the line 28, which is connected to the

nozzle chamber 19 of the uppermost heater 16, and relatively low pressure steam is bled from the turbine 10, through the connection 29, to the mixing chamber 21 of the heater 16. Likewise, steam at successively higher pressures is bled through the connections 31 and 32 to the mixing chambers of the heaters 17 and 18, respectively.

The various heaters are arranged respectively at successively greater elevations and it will be observed that the tail pipes 23 and 24 between the respective heaters are of unequal lengths. The tail pipe 23 is made of sufficient length to maintain an adequate column of liquid to balance the pressures between the bleed points of the turbine which serve the connections 29 and 31, respectively, while the tail pipe 24 is made of sufficient length to provide a column of liquid of proper height to balance the pressures between the bleed points which are served by the connections 31 and 32, respectively. In a similar manner, the tail pipe 26 of the heater 18 may be of sufficient length to maintain the proper pressure at the suction of the boiler feed pump 27, or if the space is not available to permit this, the pump 27 may be a booster pump which merely takes the feed water from the tail pipe 26 and passes it on to the boiler feed pump.

The various heaters are preferably supported from the stack 14 by means of suitable brackets or the like 33. This is a desirable feature, inasmuch as where relatively high pressures are encountered a system of this kind may attain a considerable height, and the stack 14 provides an economical arrangement for supporting the various heaters and, at the same time, some of the heat of the flue gases may be recovered by the feed water.

In order to preclude the possibility of having the heaters become air bound, each of the higher pressure heaters is vented to the heater having the next lower pressure, and the lowest pressure heater is vented to the condenser. The low pressure heater 16 is vented by means of the vent pipe 34, which is connected to the discharge chamber of this heater, through the angle T 36 and the connection 37 to the vacuum chamber of the condenser 11. The flow through the vent 34 is controlled by means of the valve 38.

In a like manner, the heater 17 is provided with a vent 39, which is controlled by a valve 41, and connected to the line 37 by the angle T 42, and the heater 18 is similarly provided with a vent 43, which is controlled by the valve 44, and, in this latter case, the vent pipe 43 is merely a continuation of the line 37.

It will thus be seen that I have provided a simple and efficient arrangement for effecting a transfer of heat from the flue gases to the feed water and thus, for effecting a saving in fuel. By arranging the heaters at

successively greater elevations, it is possible to avoid the use of valves and thus, to effect an economy in this respect. It will also be observed that due to the arrangement of the heaters that the feed water may gravitate through the various heaters of its own accord and that jet heaters of this type are capable of withdrawing steam from the turbine under various conditions of load so that it is assured that proper heating of the feed water will take place during conditions of light, as well as of heavy load on the turbine.

While I have shown my invention in but one form, it will be obvious that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:—

1. The combination with a stack for combustion gases, of jet heaters disposed at different elevations and at least one of said heaters being arranged in the stack, each heater including a heating medium inlet, a water supply inlet, and a heated water outlet; means providing for the supply of heating media at different pressures to said heating medium inlets, the pressures varying inversely with the elevations of the heaters; a tail pipe connecting the outlet of each heater except the last to the water inlet of the succeeding heater, said tail pipe being of sufficient length to provide a barometric column producing flow of water from one heater to the succeeding heater, said succeeding heater being at a higher pressure; and means providing for the withdrawal of heated water from the lowermost heater.

2. The combination with a stack for combustion gases, of supporting means arranged interiorly of the stack; a plurality of jet heaters, at least one of which is arranged interiorly of the stack and carried by said supporting means, each heater including a heating medium inlet, a water supply inlet, and a heated water outlet; means providing for the supply of heating medium at different pressures to said heating medium inlets, the pressures of the heating medium varying inversely with the elevations of the heaters; and tail pipes for connecting the heated water outlet of the preceding relatively low pressure heater to the inlet of the succeeding relatively high pressure heater, said tail pipe being of sufficient height to effect circulation of water between the heaters.

In testimony whereof, I have hereunto subscribed my name this 17th day of January, 1928.

DAVID W. R. MORGAN.