Dec. 6, 1927.

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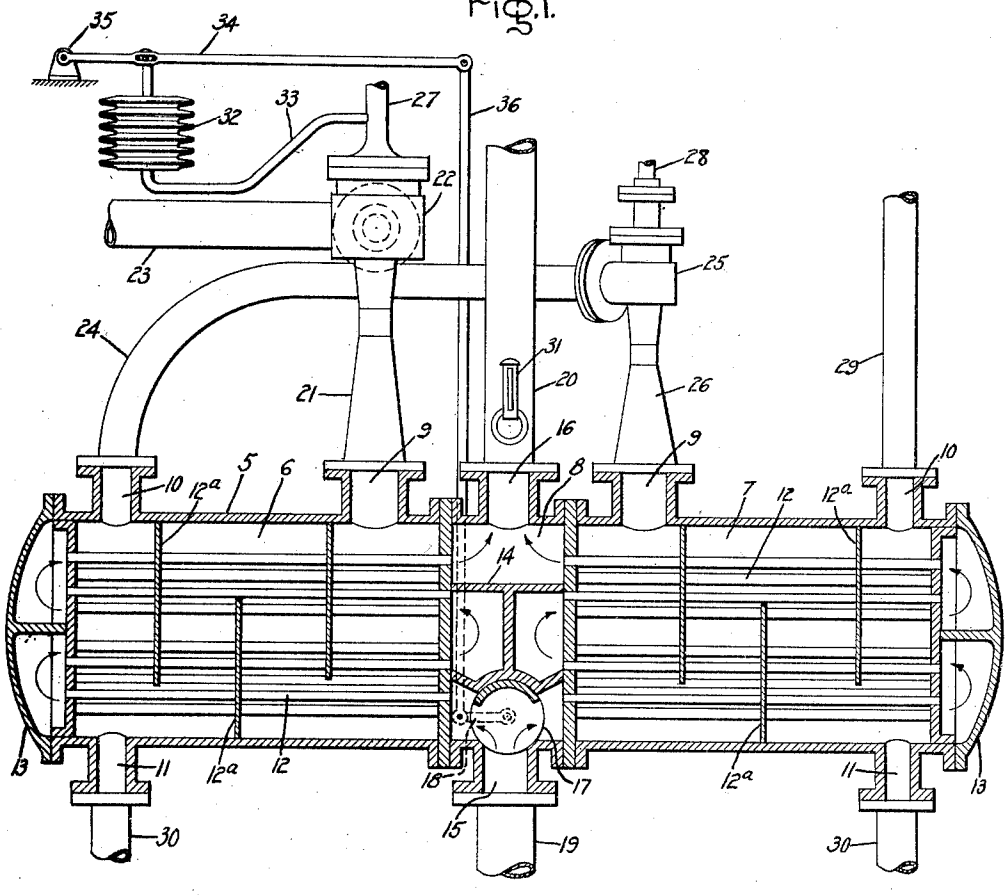
G. PAGEL

HEAT EXCHANGE DEVICE

Filed Nov. 9, 1926

2 Sheets-Sheet 1

Fig. 1.



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2 Sheets-Sheet 2

Fig. 2.

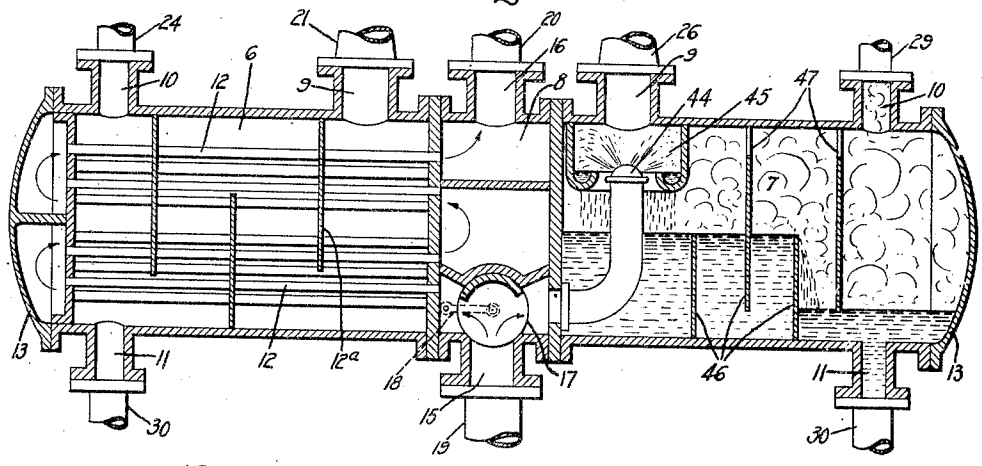
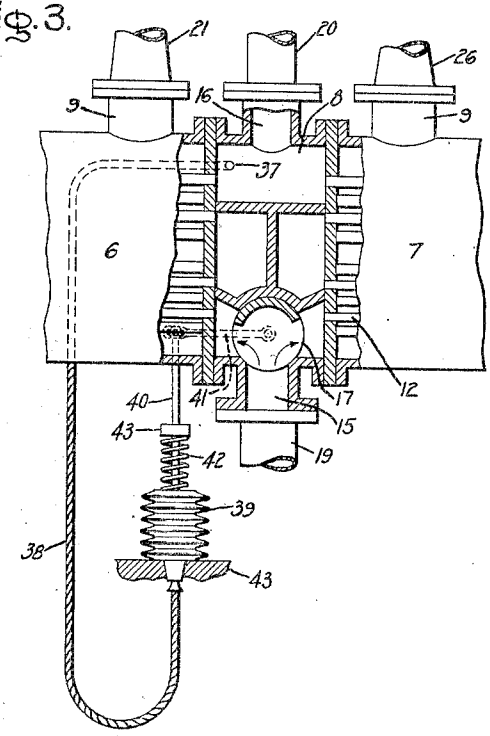


Fig. 3.



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UNITED STATES PATENT OFFICE.

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HEAT-EXCHANGE DEVICE.

Application filed November 9, 1926, Serial No. 147,314, and in Germany December 31, 1925.

The present invention relates to a heat exchange device of the condenser or feed water heater type and more particularly to a device of this character for heating condensate or feed water by means of the exhaust steam from multistage steam ejector air pumps such as are used for withdrawing air and non-condensible gases from large surface condensers.

The object of the present invention is to provide an improved heat exchange device of the type and for the purpose above stated which operates to deliver heated feed water at a more uniform outlet temperature than has heretofore been possible with known heat exchange devices in the usual feed water heating arrangement and in connection with multistage steam ejector pumps.

The invention is herein described and illustrated, by way of example, in connection with a two-stage steam ejector air pump in the operation of which in connection with a surface condenser, the hot well condensate from the condenser is ordinarily used in an intermediate condenser to condense the working steam from the low pressure or first stage of the pump and other condensible vapors brought over from the surface condenser, and the heated condensate is then used as cooling water in a series connected feed water heater which receives exhaust steam from the high pressure or second stage of the pump. With this arrangement the temperature of the feed water or condensate delivered by the feed water heater is subject to fluctuations in accordance with fluctuations in the quantity of heating fluid supplied by the ejector pump stages, since the intermediate condenser and the feed water heater are connected in series relation on both the cooling or feed water and the steam sides.

In accordance with the invention, this undesirable fluctuation in feed water delivery temperature is avoided by providing a heat exchange device which in connection with a two-stage ejector pump, for example, serves as a combined intermediate condenser and feed water heater, with said condenser and heater connected in series on the steam side but in parallel on the cooling or feed water side. The distribution of the water or condensate to be heated, which also serves as cooling medium, is variable on the two sections of the heat exchange device. By means of the variable distribution of the cooling medium, a uniform outlet temperature of the cooling medium from the heat exchange device and a uniform loading of the cooling tubes therein are assured.

For a consideration of what is believed to be novel and the invention, attention is now directed to the accompanying drawing, the following description thereof, and the appended claims.

In the drawing, Fig. 1 is a sectional side view of a heat exchange device embodying the invention and connected with a two-stage steam ejector air pump; Fig. 2 is a similar view of a modification of the device shown in Fig. 1, and Fig. 3 is a detail of Fig. 1, partly in section, showing a modification of a control means.

Referring to Fig. 1, 5 is the casing of the heat exchange device which comprises two duplicate heat exchange sections 6 and 7 located on opposite sides of a cooling water chamber 8. Each section is provided with a steam inlet 9 and an outlet 10. Drain outlets for the removal of condensed steam are provided in the bottom of each section, as indicated at 11.

Each heat exchange section is provided with suitable cooling tubes 12 connected at their outer ends by partitioned end heads 13 and opening into the central water chamber 8 at their inner ends. The water chamber is suitably partitioned, as indicated at 14, to provide for the parallel flow of cooling water or condensate from a cooling water inlet 15 through the tubes and end heads to a cooling water outlet 16, as indicated by suitably placed arrows. Spaced baffle plates 12^a serve to distribute the heating medium about the cooling tubes.

In connection with the cooling water inlet is provided a suitable cooling water distributing or apportioning means which, in the present example, is located within the cooling water chamber adjacent the cooling water inlet and is in the form of a valve member 17 controlled by a lever 18. The valve member is moved by the lever to increase or decrease the flow of cooling water through one section and to correspondingly decrease or increase the flow of cooling water through the other section as is obvious from an inspection of the drawings, whereby the cooling water is distributed or apportioned to the sections of the heat exchange device as desired.

The cooling water inlet 15 is connected with a suitable cooling water supply conduit 19 through which condensate or other cooling medium is supplied to the heat exchange device and is provided with a delivery conduit 20 in connection with the cooling water outlet 16 through which conduit the heated cooling water is discharged for use as feed water for example.

In the present example, section 6 of the heat exchange device serves as the intermediate condenser and is connected at its inlet 9 with the discharge outlet 21 of the first stage 22 of a steam ejector air pump, which, on its suction end, is connected with a suction conduit 23 leading from any suitable apparatus, such as a surface condenser (not shown). The outlet 10 of section 6 is connected by a conduit 24 with the suction end of the second stage 25 of the steam ejector air pump. This latter in turn is connected at its discharge end 26 with the inlet 9 of section 7 of the heat exchange device which serves as a feed water heater in the arrangement of the present example. Operating steam is supplied to the first stage of the pump through a pipe 27 and to the second stage through a pipe 28.

The exhaust steam discharged from the first stage 22 of the pump which is the low pressure stage, is condensed in the intermediate condenser provided by section 6 and at the same time the air and non-condensible gases taken through conduit 23 are cooled. The resulting condensate is taken from the intermediate condenser through drain outlet 11, while the remaining cooled non-condensed mixture is pumped out through outlet 10 and conduit 24 by the second stage of the pump which is the high pressure stage, and delivered to section 7 of the feed water heater, wherein steam not condensed in the intermediate condenser, together with the exhaust steam of the high pressure or second pump stage, is condensed. Non-condensible vapors and air are finally discharged through the outlet 10 of the feed water heater and a conduit 29 connected therewith which leads to atmosphere. The resulting condensate is conducted from the feed water heater through the drain outlet 11 and a conduit 30 connected therewith. A similar conduit is indicated at 30 in connection with the drain outlet of the intermediate condenser or section 6.

By means of the distributing or apportioning valve member 17, the flow of water through the intermediate condenser and feed water heater may be adjusted or apportioned in accordance with fluctuations in the quantity of exhaust steam supplied by the ejector pump stages, so that the cooling water or condensate may leave each of these heat exchange sections at approximately the same temperature thereby resulting in a greater heat transfer and more uniform efficiency in other apparatus supplied thereby. For example, if the low pressure stage supplies an increasing quantity of exhaust steam, member 17 may be turned clockwise to increase the flow of cooling water through section 6 and to correspondingly decrease the flow of cooling water through section 7, thereby compensating for the unbalanced condition of the supply of heating medium to two sections of the heat exchange device.

This arrangement thus provides for the uniform loading of the cooling tubes and also provides for completely cutting out one of the heat exchange sections to maintain operation with the other alone. A thermometer or other thermal indicator may be provided in the cooling water outlet 20, as indicated at 31. By means of the thermometer, an operator may observe the temperature of the cooling water as discharged from the heat exchange device and correct any tendency of said temperature to fluctuate by moving the apportioning member 17 by means of lever 18 to meet an increased supply of heating medium in one section or the other with an increased flow of cooling medium.

The distributing member may be automatically as well as manually controlled if desired. For example, member 17 may be automatically controlled in dependence upon changes in a variable quantity or value, variations in which affect the outlet temperature of the cooling water, such as the pressure or temperature of the operating steam supplied to low pressure stage 22 of the pump. In the present example, an automatic control means of this character is indicated at 32 and operates as a pressure regulator in connection with supply conduit 28 with which it is connected by a pressure pipe 33. The pressure regulator is operatively connected with a lever 34 which is in turn provided with a fixed fulcrum at 35. The lever is also connected by a link 36 with lever 18 of the cooling water distributing or apportioning member 17.

The operation of this arrangement is such that an increase in the pressure of the steam supply to ejector stage 22 causes the pressure regulator to move member 17 in a direction to cause a corresponding increase in the flow of cooling water through the section of the heat exchange device supplied by said stage and, similarly, a decrease in the steam pressure causes a corresponding decrease in the flow of said cooling water through said section of the heat exchange device.

In a similar manner member 17 may be automatically controlled in accordance with changes in the temperature of the cooling water discharged by either of the sections of the heat exchange device. Referring to Fig. 3, in which the same reference numerals as used in Fig. 1 are used for the same parts, an

automatic arrangement of this character is indicated in connection with the intermediate condenser or section 6. This comprises a temperature-responsive device 37 positioned adjacent the discharge outlet of the tubes in section 6, and connected by a flexible conduit 38 with a pressure-responsive device 39, which in turn is provided with an operating rod 40 connected with a lever 41 for operating member 17. The temperature-responsive device, conduit 38 and pressure-responsive device 39 are filled with a suitable operating fluid which expands when heated and which moves the rod 40 against the action of a spring 42. The latter is held under compression against the pressure-responsive device by fixed abutments 43. Any other suitable means may be employed in connection with distributing or apportioning member 17 to provide an even or uniform cooling water outlet temperature.

Referring now to Fig. 2, in which the reference numerals are the same as used in Fig. 1 for the same parts, the interior of section 7 is arranged to provide a mixing feed water heater having a spray nozzle 44 through which the cooling water is delivered into a mixing chamber 45 surrounding the nozzle adjacent the steam inlet 9. A series of baffles 46 are suitably arranged in the casing to provide a storage of heated liquid, which is withdrawn as required through conduit 11 and from which vapors and non-condensible gases escape through openings 47 in the baffle plates and outlet conduit 10. With this arrangement the quantity of cooling water sprayed into section 6 may be varied to provide any desired condition of saturation therein and may be automatcially controlled by any suitable means after the manner of the arrangement shown in Figs. 1 and 3.

While the cooling water for the heat exchange device taken through inlet 15 may be supplied from any suitable source, for purposes of understanding the invention more fully, the cooling water supply conduit 19 which is connected with inlet 15 may be considered to be connected with a condenser hot well (not shown). Also outlets 11 of both sections may be considered to be connected to a common condensate collecting means (not shown).

From the foregoing description, it will be seen that the device in the present invention provides a heat exchange device which provides in one casing a combined condenser and feed water heater with means for distributing or apportioning the cooling medium thereto in accordance with the supply of heating medium, whereby a uniform outlet temperature of the cooling medium and a uniform loading of the cooling tubes in the heat exchange sections may be maintained.

While the invention has been illustrated and described in connection with a two-stage ejector pump, it should be understood that it is not limited thereto, but may be used with steam ejector pumps having more than two stages.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a heat exchange device of the condenser type having a plurality of separate heating sections, the combination of means for supplying a heating medium to each of said sections separately, means for supplying cooling medium to said sections in parallel, and a common means for apportioning the cooling medium to said sections.

2. A heat exchange device of the condenser type having a plurality of heating sections, means for supplying heating medium to said sections, means for supplying cooling medium to said sections in parallel, said means including a chamber located between a pair of said heating sections, said chamber having a cooling medium inlet and a cooling medium outlet, and means for apportioning the cooling medium to said sections comprising a movable valve member located in said chamber.

3. A heat exchange device of the condenser type having a plurality of heating sections, means for supplying heating medium to said sections, means for supplying cooling medium to said sections in parallel, said means including a chamber located between a pair of said heating sections, said chamber having a cooling medium inlet and a cooling medium outlet, means for apportioning the cooling medium to said sections comprising a valve member located in said chamber, and means connected with the valve member for automatically controlling the same in accordance with changes in a variable quantity affecting the outlet temperature of the cooling medium from said heat exchange device.

4. A heat exchange device of the condenser type having a plurality of heating sections, means for supplying heating medium to said sections, means for supplying cooling medium to said sections in parallel, and means for apportioning the cooling medium to said sections in accordance with changes in the temperature of the cooling medium discharged from one of said heating sections.

5. A heat exchange device comprising a pair of duplicate surface condensers and a cooling water chamber located in a common casing, said cooling water chamber being located between adjacent ends of said surface condensers and having a cooling water inlet and a cooling water outlet, a cooling water distributing member located in the cooling water chamber adjacent the cooling water inlet, said member being movable to vary the distribution of cooling water to said

surface condensers, and means for moving said distributing member.

6. A heat exchange device comprising a pair of duplicate surface condensers and a cooling water chamber located in a common casing, said cooling water chamber being located between adjacent ends of said surface condensers and having a cooling water inlet and a cooling water outlet, a cooling water distributing member located in the cooling water chamber adjacent the cooling water inlet, said member being movable to vary the distribution of cooling water to said surface condensers, means for moving said distributing member, and a two-stage steam ejector air pump connected with said surface condenser sections to supply heating medium thereto.

In witness whereof, I have hereunto set my hand this 22nd day of October, 1926.

GUSTAV PAGEL.