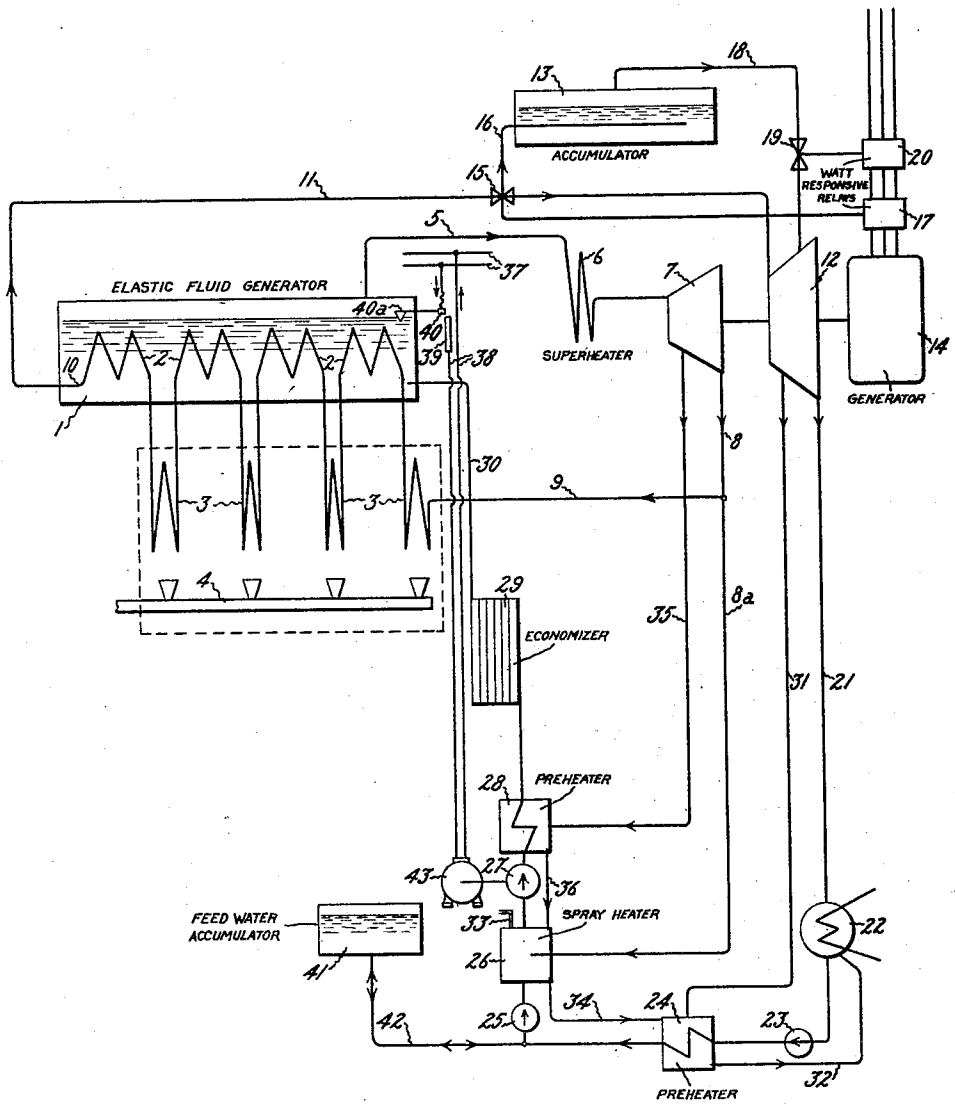
Feb. 14, 1933. C. OSENBERG 1,897,815

POWER PLANT

Filed Oct. 29, 1931



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Patented Feb. 14, 1933

1,897,815

UNITED STATES PATENT OFFICE

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POWER PLANT

Application filed October 29, 1931, Serial No. 571,925, and in Germany November 13, 1930.

The present invention relates to power plants in which an indirectly heated elastic fluid generator or evaporator is used for supplying elastic fluid to a consumer. The invention more specifically relates to an arrangement for circulating a heating fluid through an evaporator. It is known to those skilled in the art to arrange a plurality of heating elements in an evaporator and to connect these elements with external superheaters. If a heat-transferring medium is alternately passed through one of the superheaters and one of the heating elements its circulation will merely be affected by the difference in specific weight of the fluid heated in the superheaters and the fluid returned from the heating elements. Difficulties have been encountered in maintaining a good circulation of the heat-transferring medium.

The object of my invention is to provide an improved arrangement for evaporators in connection with power plants whereby an improved circulation of the heat-transferring fluid is obtained.

For a consideration of what I believe to be novel and my invention, attention is directed to the following description and claims in connection with the accompanying drawing in which I have shown by way of example a diagrammatic view of a power plant embodying my invention.

Referring to the drawing, 1 designates an indirectly heated elastic fluid generator comprising a plurality of heating elements 2 which are connected to superheaters 3. 4 indicates a firing, such as a pulverized fuel firing. Elastic fluid generated in the evaporator is passed through a conduit 5 and a superheater 6 to a high pressure elastic fluid consumer, in the present instance shown as the high pressure part 7 of a turbine.

According to my invention the exhaust of the high pressure consumer is used as a heat-transferring means between the superheaters 3 and the evaporator 1. For this purpose the exhaust elastic fluid of the high pressure turbine is conveyed through conduits 8 and 9 to the inlet of one of the superheaters 3, whence it is alternately passed through one of the heating elements 2 and one of the other superheaters 3. Heat energy is thereby transferred from the superheaters to the evaporator and causes vaporization of the fluid contained therein. From the outlet 10 of the last heating element I convey according to my invention the heat-transferring fluid through a conduit 11 to the inlet of a low pressure consumer, in the present instance indicated as the low pressure part 12 of an elastic fluid turbine. Owing to the velocity of the elastic fluid leaving the exhaust of the high pressure turbine and due to the drop in pressure between the high pressure and the low pressure part of the turbine, a good circulation in the superheater heating system is secured. The elastic fluid behind the last heating element, as regards the direction of flow of fluid, is thereby sufficiently heated so that a further superheating is not necessary to avoid undesirable humidity of the elastic fluid in the last stages of the low pressure turbine.

In order to eliminate load fluctuations and the dangers caused thereby with respect to the superheating system it is preferable to operate the high pressure part of the plant with constant load and to transfer the load fluctuations to the low pressure part. The excess of low pressure steam at low load may be conveyed to an accumulator as indicated at 13. 14 represents an electric generator, in the present instance shown as being coupled with the low and high pressure turbines. 15 represents a valve means arranged in conduit 11 for regulating the amount of elastic fluid conveyed through conduit 16 to accumulator 13. The regulation may be performed in terms of load, for instance, by means of a watt-responsive relay, indicated at 17. If with such an arrangement the load on the electric generator decreases, it will cause through the watt-responsive relay 17 a partial closing movement of valve 15 whereby the excessive steam is conveyed to the accumulator. If the load increases, the valve 15 will be entirely opened whereby an increase of elastic fluid supplied to the low pressure

turbine takes place. 18 is a conduit having a valve means 19 and being provided between the accumulator and a lower stage of the low pressure turbine. The valve 19 may also be regulated by a watt-responsive relay as indicated at 20. After the valve 15 has been entirely opened, and a further increase in load takes place, elastic fluid may be supplied from the accumulator to the low pressure turbine 12 through conduit 18. It will be readily understood that in this manner the provision of the accumulator also permits a constant supply of the firing 4 for the superheaters 3. Whereas the exhaust of the low pressure turbine 12 may be used in any suitable manner, I have shown in the diagrammatic figure an arrangement by means of which the exhaust is conveyed through a conduit 21 to a condenser 22, whence it is passed by means of a pump 23, to a preheater 24, another pump 25, a spray heater 26, another pumping means 27, another preheater 28, an economizer 29, a conduit 30, to the evaporator. The preheater 24 has been shown in the present instance as being heated by elastic fluid extracted from an intermediate stage of the low pressure turbine through a conduit 31. This fluid is passed from the preheater through a conduit 32 to condenser 22. The spray heater has been shown as being supplied with heating fluid from the exhaust of the high pressure turbine through a conduit 8^a which in substance forms an extension of conduit 8. Spray heater 26 may also be used for separating air from the fluid as indicated by an open tube 33 provided on top of the spray heater through which air or like gases may escape. A part of the fluid may be returned from the spray heater 26 to the preheater 24 by means of a tube 34 and from there through tube 32 to the condenser 22. Preheater 28 has been shown by way of example as being heated by elastic fluid extracted from an intermediate stage of the high pressure part 7 of the turbine and conveyed to the preheater through a tube 35. 36 is a pipe arranged between preheater 28 and the spray heater for conveying heating fluid from the former to the latter.

The supply of feed water to the elastic fluid generator is performed in terms of level conditions in the elastic fluid generator. For this purpose I may provide an electric motor 43 for driving the feed water pump 27. Motor 43 is supplied from an electric source 37 through feed lines 38. Arranged in this feed line is a contact member 39 which normally is engaged by a brush 40 fastened to a level indicator 40^a. It will be readily seen from the drawing that as soon as the level reaches a certain height, as shown in the present instance, the brush 40 is separated from contact member 39 and thereby disconnects motor 36 from its source of supply. If the level of the elastic fluid generator has reached its maximum value, the exhaust of the low pressure turbine is condensed and conveyed to a feed water accumulator as indicated at 41 through conduit 42. If the demand for feed water reaches a certain value, additional feed water may be supplied to the evaporator from the feed water accumulator 41.

The flow of fluid through the different conduits has been indicated in the drawing by arrows.

The operation of the power plant is briefly as follows: Elastic fluid is generated in evaporator 1, passed through conduit 5 and superheater 6 to the inlet of the high pressure turbine 7 and from the exhaust thereof a part of the fluid is alternately passed through superheaters 3 and heating elements 2. From the outlet of the last heating element the elastic fluid is supplied through conduit 11 to the low pressure part 12 and from the exhaust thereof to condenser 22.

It will be readily seen that the high pressure turbine 7 is supplied with a constant amount of elastic fluid whereas the supply of fluid to the low pressure turbine is changed in terms of load conditions.

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

1. In a power plant, an evaporator for generating elastic fluid, a superheating means for the elastic fluid generated in the evaporator, a high pressure consumer supplied with elastic fluid from the superheating means, heating elements for the evaporator and a plurality of superheaters, the first of which being arranged between the exhaust of the high pressure consumer and the first heating element, the other superheaters being arranged between adjacent heating elements, a low pressure elastic fluid consumer, a conduit for conveying elastic fluid from the heating elements to the low pressure consumer, an accumulator arranged between the conduit and a lower stage of the low pressure elastic fluid consumer for maintaining the load on the high pressure consumer substantially constant, means for regulating the supply of elastic fluid to the accumulator, and means independent of the last named means for regulating the supply of elastic fluid from the accumulator to the low pressure consumer.

2. In a power plant, an evaporator for generating elastic fluid, a superheating means connected to the evaporator, an elastic fluid turbine having an inlet connected to the superheating means, heating elements for the evaporator and a plurality of superheaters, one of which being provided between the exhaust of the high pressure turbine and the inlet of one of said heating elements, the others of said last named super-

heaters being arranged between adjacent heating elements, a low pressure elastic fluid turbine, a conduit for conveying elastic fluid from the last heating element to the low pressure turbine, an accumulator having an inlet connected to the conduit, and an outlet connected to a lower stage of the low pressure elastic fluid turbine for maintaining the load on the high pressure turbine substantially constant, a condenser receiving exhaust fluid from the low pressure turbine, means for conveying feed water from the condenser to the evaporator, and a feed water accumulator between the condenser and the evaporator.

3. In a power plant, an evaporator for generating elastic fluid, means for feeding the evaporator, a superheating means connected to the evaporator, an elastic fluid turbine having an inlet connected to the superheating means, heating elements for the evaporator and a plurality of superheaters, one of which being connected between the exhaust of the high pressure turbine and the inlet of one of said heating elements, the others of said last named superheaters being arranged between adjacent heating elements, a low pressure elastic fluid turbine having its inlet connected to the last of said heating elements, an accumulator having an inlet connected to the last heating element and an outlet connected to a lower stage of the low pressure elastic fluid turbine, means for regulating the supply of elastic fluid to the accumulator, and means for supplying a lower stage of the low pressure turbine with elastic fluid from the accumulator in terms of load conditions and independent from the operation of the last named means whereby the high pressure turbine is not affected by external load fluctuations.

In witness whereof, I have hereunto set my hand.

CARL OSENBERG.