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ELASTIC FLUID TURBINE POWER INSTALLATION

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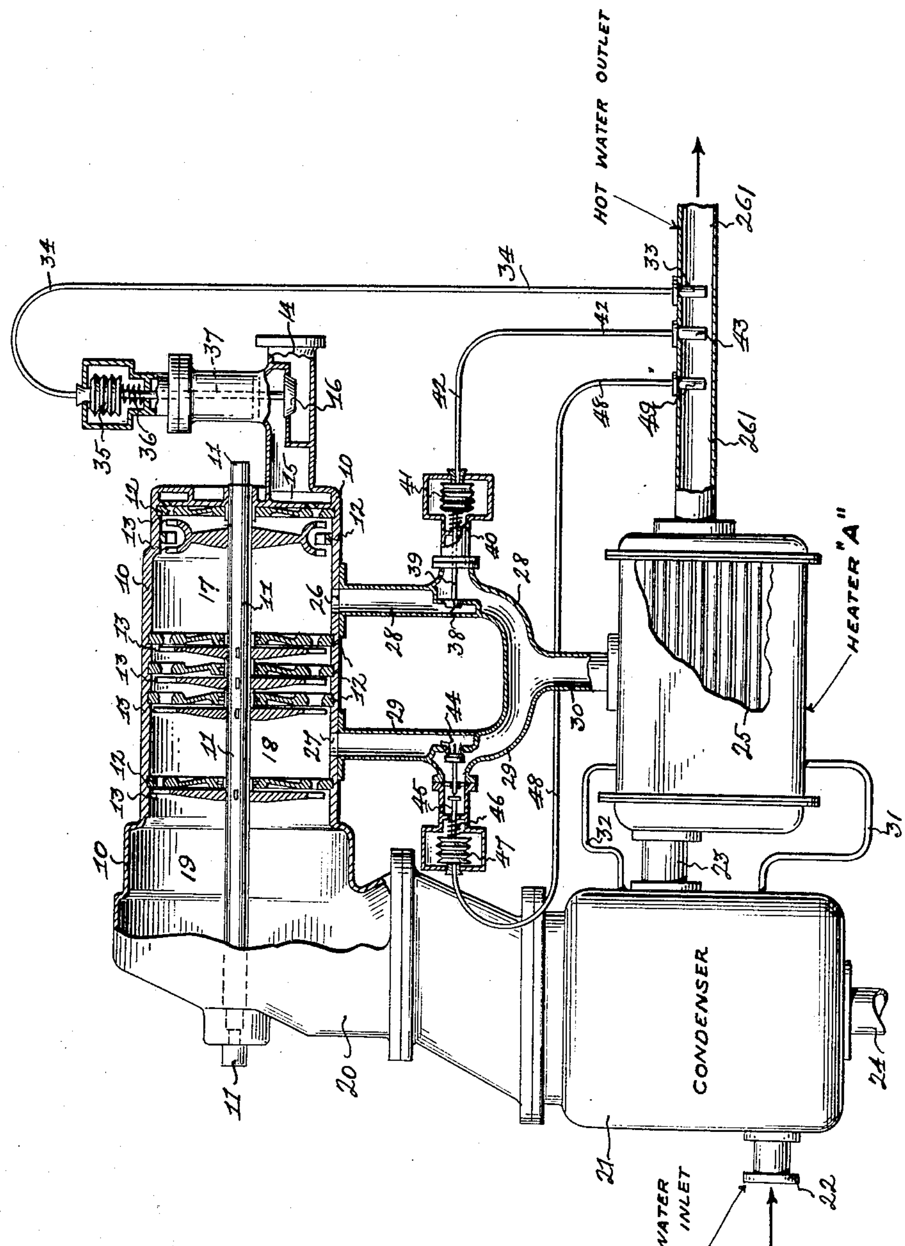

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ELASTIC FLUID TURBINE POWER INSTALLATION

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This invention relates to steam turbine installations in which heating of water in several steps is effected by means of bleeder steam and said heating is automatically controlled to regulate the temperature of the heated water issuing from the installation.

The object of the invention is to provide an organization of instrumentalities in a multi-stage bleeder turbine installation in which the temperature of the heated water automatically controls and selects the stage of expansion from which the steam is bled.

A further object of the invention is to provide means combined in a bleeder turbine installation in which the temperature of the heated water will automatically control the admission of live steam at the first stage of the expansion, and thereby the quantity and temperature of the steam available for heating water in the condenser and heater.

Another object of the invention is to provide means for simultaneously and automatically controlling in a bleeder turbine installation the admission of live steam at the first stage of expansion and the bleeding of the steam from subsequent stages of expansion by the temperature of the heated water issuing from said installation.

Other objects and advantages of the invention will appear from the detailed disclosure of the construction and arrangement of the several instrumentalities and mode of operation.

The invention consists of structural characteristics and relative arrangements of the several elements and mechanical expedients, which will be hereinafter more fully disclosed and particularly pointed out in the appended claims.

In the drawings, which represent a diagrammatic view, partly in section, of one and the preferred form of the improved installation of bleeder multi-stage expansion turbine, 10 is the usual casing provided with a rotary shaft 11.

Secured to the casing are provided nozzle diaphragms 12, 12, which cooperate with the rotor elements of wheels 13, 13, fixed to shaft 11, as is usual in this type of turbines and needs no further explanation, and while I have shown, as illustrated, five rotor elements or wheels and five stages of expansion, said number of rotor elements or wheels and stages of expansion may be increased or decreased without in any way departing from the essential features of the present invention.

14 is the high pressure or live steam inlet leading to a chamber 15 communicating through a nozzle ring with the first stage rotor or wheel and said live steam being controlled by a high pressure valve 16, as shown, and to be hereinafter described.

17 is a chamber, preferably within the turbine casing, in which steam is received after having passed through the first expansion stage and is shown located between first and second stages of expansion.

18 is a chamber similar to chamber 17 and is shown between the fourth and fifth stages of expansion, and while this disposition of said chambers is herein shown, this particular arrangement could be varied in number and intermediate of any two stages of expansion depending upon the nature of work to be accomplished and conditions of service to be satisfied. More than two chambers could be used, if desired.

The final exhaust chamber 19 communicating with the last stage of expansion of the turbine is connected by means of the conduit 20 with the usual surface condenser or heater 21, having the cold water inlet 22 and outlet 23 and condensed steam outlet 24, as shown.

25 (heater A) is an auxiliary condenser or secondary heater which is connected to intermediate stages of expansion of the turbine by means of bleeder opening 26 communicating with the chamber 17, conduits 28 and 30, and bleeder opening 27, conduits 29 and 30, as shown, and while the heater 25 is connected through said openings 26 and 27 between the first and second stages and fourth and fifth stages of expansion.

The water to the heater passes through the water passages of the condenser 21 and condenser or heater 25 in succession or series. Cold water enters the condenser 21 through inlet 22, passes through the condenser or heater 21, enters the heater or condenser (A) 25, by conduit 23, passes through heater (A) 25, and the heated water leaves heater (A) 25 through conduit 261 for storage or selected application.

31 and 32 are pipes leading from and interconnecting the condenser 21 and heater (A) 25 for carrying the condensed steam and air within the heater 25 to the proper connections with the condenser 21, as will be readily understood and need no further disclosure.

Within the hot water outlet or conduit 261 is disposed a bulb 33 of a temperature responsive device, said bulb 33 containing a volatile liquid, such as ether, and is arranged in the path of the outgoing heated water, as shown. The interior of the bulb 33 is connected by means of a small tube 34 to a chamber formed within a collapsible diaphragm 35 of said temperature responsive device, said diaphragm 35 being loaded or resisted in its inflation by a spring 36 and is so connected by a rod 37 to the high pressure or live steam controlling valve 16 to regulate the position of said valve 16 with respect to its seat for purposes to be presently described. Within the conduit 28 connecting the bleeder opening 26 with the heater (A) 25 is provided a bleeder regulating valve 38 provided with and connected up with a similar arrangement of rod 39, spring 40, collapsible diaphragm 41, tube 42, and bulb 43 within the conduit 261, and operating in the same manner, as will be presently described with respect to the operation of valve 16.

Disposed within the conduit 29 connecting the bleeder opening 27 with the heater (A) 25 is provided a bleeder regulating valve 44 of the "stop-check" type which is capable of being closed either by the heat responsive or thermostatic device or by a reverse flow of steam through it, and said valve 44 is likewise connected up with the same series of instrumentalities, namely, rod 45, spring 46, diaphragm 47, tube 48, and bulb 49 within the conduit 261, as referred to in connection with valves 16 and 38.

Any of the common and well known heat responsive devices would be readily suggested and may be substituted for the means herein shown and described.

It will also be manifest and understood to be contemplated by the present invention to employ other motive fluids besides steam and increase or decrease the stages of expansion and number of bleeder openings, and heat other fluids than water, if so desired, and the invention may be applied to other forms of multi-expansion engines, although a turbine is herein shown and described, and by "high pressure steam" or "live steam", I mean any pressure of motive fluid suitable for operation of the engine.

The turbine installation being constructed and arranged as herein disclosed, and there being a supply of water caused to pass through the water passages of condenser 21 and heater (A) 25, the operation is as follows:

The turbine having been started by the proper pressure and supply of live steam or high pressure steam at the inlet valve 16, said live steam acts on the rotor members 13 of the first stage of expansion and its expanded steam enters the chamber 17 and a portion of said expanded steam passes through the second, third and fourth stages of expansion into chamber 18, and a portion passes or is bled through the opening 26, conduit 28, through valve 38 and conduit 30 into the heater (A) 25 and heats the water passing through said heater 25.

If the pressure within the chamber 18 is greater than the pressure in heater 25, a portion of the expanded steam flowing from the fourth stage of expansion into said chamber 18 will flow through bleeder opening 27, conduit 29, valve 44 and conduit 30 into heater (A) 25 where it will give up heat to the water passing through the heater, and be condensed.

If, however, the steam bled from chamber 17 causes the pressure within the heater (A) 25 to be higher than the pressure in chamber 18, then stop-check valve 44 will close and prevent flow into chamber 18 from heater (A) 25.

The expanded and reduced pressure steam, exhausted from the final stage of expansion into the final exhaust chamber 19 passes through the conduit 20 into the condenser or heater 21, and gives the cold fluid its initial heating and said fluid receives an additional and higher degree of heating in passing through the heater 25. The heated fluid emerges from said heater 25 into conduit 261 and comes in contact with said bulbs 49, 43 and 33, and if the temperature of said heated fluid is such as to expand the ether or other gas in said bulbs 49, 43 and 33 to such an extent and beyond the properly adjusted and desired pressures for the correct or desired operation of the installation, said pressures within the bulbs 49, 43 and 33 and their respective connected tubes 48, 42 and 34 will act on and inflate their respective collapsible diaphragms 47, 41 and 35, and accordingly actuate their rods 45, 39 and 37 as to seat, partially close and control the valves 44, 38 and 16 in such a manner as to so regulate, check and distribute the live steam admitted to the first stage of expansion and the steam bled from subsequent stages of expansion in order to restore the correct and efficient operation of the turbine installation, and at the same time properly and sufficiently heat the quantity of water or other fluid issuing from conduit 261 for the purposes intended.

The setting or adjustment of the three temperature responsive valves may be such that they will open in the desired sequence with decreasing water temperature and close in reverse order with increasing water temperature. It is evident that the temperature control of valve 44 could be omitted and this control system still be effective with certain limitations. Also the temperature control of valve 16 might be omitted and the control system be effective within limits. Either or both of these modifications may be made without departing from the scope of my invention.

From the foregoing disclosure of the construction and arrangement of the different cooperating instrumentalities of the installation and their mode of action, it will be seen that all the objects and advantages indicated in the statement of invention have been most efficiently carried out and an installation of a multi-stage bleeder turbine has been devised in which a turbine is efficiently operated and automatically controlled to produce power efficiently with the same steam which is used to heat a fluid to a constant and predetermined temperature, and it will be self evident to any one skilled in the art that the particular arrangement or disposition of the bleeder openings with respect to the stages of expansion may be varied, and other types of apparatus for the interchange of heat from the exhaust or bleeder steam to the fluid to be heated may be substituted, and would readily suggest themselves from the present installation without in any way changing the essential and material elements of the present invention or evading the terms of the claims.

What I claim is:

1. A multi-expansion turbine comprising a plurality of expansion stages, means for supplying high pressure steam to the first stage, a final exhaust passage connected to the last stage of expansion, a primary condenser connected to said final exhaust, secondary exhaust passages connected to a plurality of stages of expansion subsequent to the first stage of expansion and in advance of the last stage of expansion, a secondary heater connected to said secondary exhaust passages, said primary condenser and secondary heater connected in series and arranged to permit a fluid to pass first through the primary condenser and later the secondary heater, a heated fluid passage connected with the outlet of said secondary heater, and independent means controlled by the temperature of the heated fluid passing from the secondary heater to regulate the temperature and pressure of the exhaust steam passing from said plurality of stages of expansion into the secondary heater.

2. A multi-expansion turbine comprising a plurality of expansion stages, means for supplying high pressure steam to the first stage, a final exhaust passage connected to the last stage of expansion, a primary condenser connected to said final exhaust, secondary exhaust passages connected to a plurality of stages of expansion subsequent to the first stage of expansion and in advance of the last stage of expansion, a secondary heater connected to said secondary exhaust passages, said primary condenser and secondary heater connected in series and arranged to permit a fluid to pass first through the primary condenser and later the secondary heater, a heated fluid passage connected with the outlet of said secondary heater, and separate and independent means controlled by the temperature of the heated fluid passing from the secondary heater to regulate the supply of high pressure steam to the first stage of expansion and the temperature and pressure of the exhaust steam passing from said plurality of stages of expansion into the secondary heater.

3. A multi-expansion turbine comprising a plurality of expansion stages, means for supplying high pressure steam to the first stage, a final exhaust passage connected to the last stage of expansion, a primary condenser connected to said final exhaust, secondary exhaust passages connected to a plurality of stages of expansion subsequent to the first stage of expansion and in advance of the last stage of expansion, a secondary heater connected to said secondary exhaust passages, said primary condenser and secondary heater connected in series and arranged to permit a fluid to pass first through the primary condenser and later the secondary heater, a heated fluid passage connected with the outlet of said secondary heater, and separate and independent automatic means controlled by the temperature of the heated fluid passing from the secondary heater to simultaneously regulate the temperature and pressure of the exhaust stem supplied by and passing from said plurality of stages of expansion into the secondary heater.

4. A multi-expansion turbine comprising a plurality of expansion stages, means for supplying high pressure steam to the first stage, a final exhaust passage connected to the last stage of expansion, a primary condenser connected to said final exhaust, secondary exhaust passages connected to a plurality of stages of expansion subsequent to the first stage of expansion and in advance of the last stage of expansion, a secondary heater connected to said secondary exhaust passages, said primary condenser and secondary heater connected in series and arranged to permit a fluid to pass first through the primary condenser and later the secondary heater, a heated fluid passage connected with the outlet of said secondary heater, and separate and independent automatic means

controlled by the temperature of the heated fluid passing from the secondary heater to simultaneously regulate the supply of high pressure steam to the first stage of expansion and the temperature and pressure of the exhaust steam supplied by and passing from said plurality of stages of expansion into the secondary heater.

In testimony whereof, I have hereunto affixed my signature.

MAYNARD D. CHURCH.