

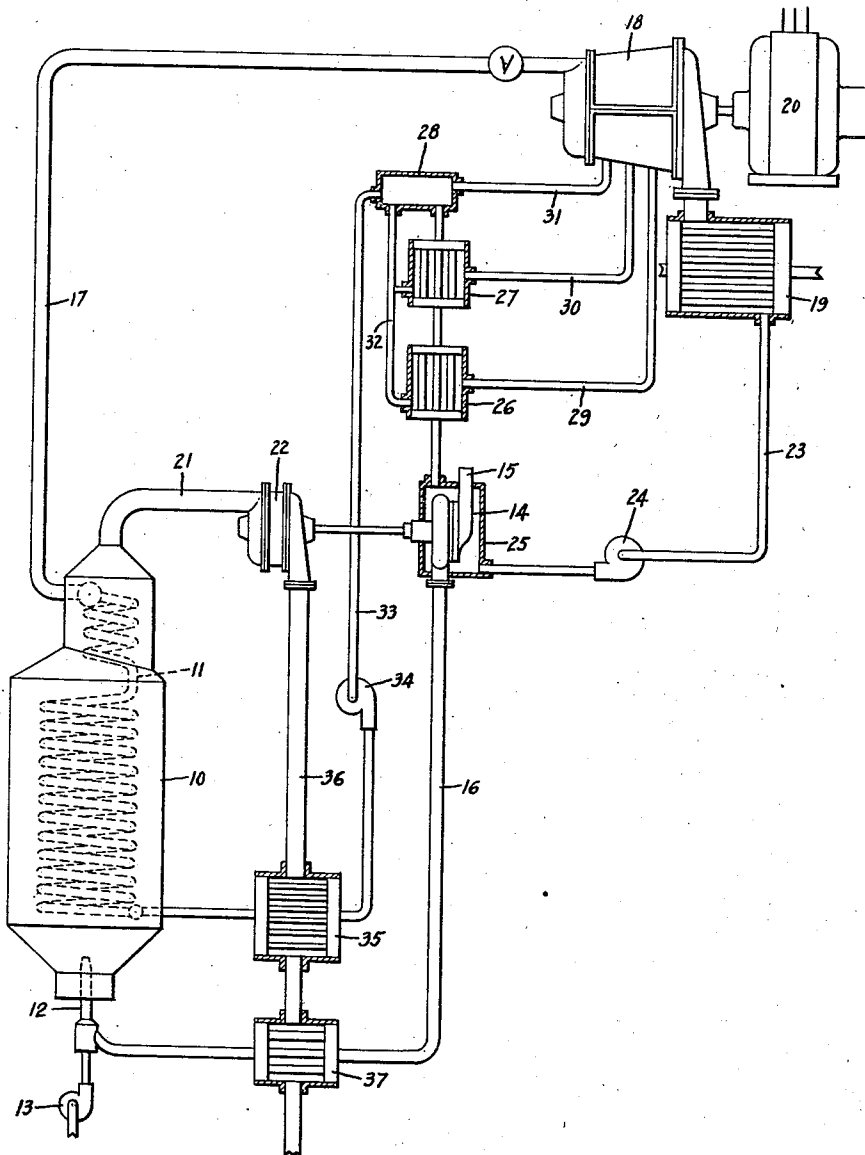
Sept. 1, 1942.

R. STROEHLEN

2,294,700

ELASTIC FLUID POWER PLANT

Filed Sept. 9, 1940



Inventor:
Richard Stroehlen,
by *Harry E. Dunham*
His Attorney.

Patented Sept. 1, 1942

2,294,700

UNITED STATES PATENT OFFICE

2,294,700

ELASTIC FLUID POWER PLANT

Richard Stroehlen, Berlin, Germany, assignor to
General Electric Company, a corporation of
New York

Application September 9, 1940, Serial No. 356,097
In Germany October 13, 1939

1 Claim. (Cl. 60-49)

The present invention relates to elastic fluid power plants, more particularly to the kind of plants which include a pressure combustion boiler for producing steam or like elastic fluid to be conducted to a steam or elastic fluid turbine and a gas turbine for receiving combustion gases from the boiler and for operating a compressor to furnish the necessary air for maintaining high pressure combustion in the combustion chamber of the boiler.

In an arrangement of this kind the combustion gases flow through the combustion chamber at high velocity. Thus the first pressure drop of the combustion gases is utilized to force them through the combustion chamber and the second pressure drop of the combustion gases is utilized in a gas turbine. In order to utilize to the fullest extent the available energy in the combustion gases it is necessary that the gases are cooled to a low temperature in the heat cycle of the plant. Heretofore it has been customary to this end to provide a feed water preheater for preheating the feed water to a high temperature, in some instances to the boiling point. Nowadays in normal boiler arrangements it is customary to provide air preheaters for cooling gases discharged from the gas turbine.

The object of my invention is to provide an improved arrangement of combined steam or elastic fluid and gas turbine power plants with pressure combustion firing of the kind above specified whereby great economy and efficiency of the plant are attained. This is accomplished in accordance with my invention by the provision of a preheater arrangement for feed water, or like operating fluid whereby feed water preheating is effected first by cooling of the compressed combustion air or the gases discharged from the gas turbine or both and thereafter by means of extraction or live steam or elastic fluid.

For a better understanding of what I believe to be novel and my invention, attention is directed to the following description and the claim appended thereto in connection with the accompanying drawing.

The single figure of the drawing shows a power plant embodying my invention.

The arrangement comprises a pressure combustion boiler 10 having an element 11 for producing elastic fluid such as steam and a burner 12 to which fuel is conducted by means of a fuel pump 13. Air to maintain combustion in the combustion chamber of the boiler is compressed by means of a compressor 14 with an inlet 15 and a discharge connected by means including a

conduit 16 to the burner 12. Steam produced in the boiler is conducted through a conduit 17 to a steam turbine 18 discharging into a condenser 19 and arranged to drive an electric generator 20. The combustion gases which pass along the heating element 11 with considerable velocity are conducted through a conduit 21 to a gas turbine 22 in the present instance arranged to drive the aforementioned compressor 14. The condensate discharged from the condenser 19 is returned as feed water to the heating element 11 of the boiler through a feed water preheating arrangement.

Generally the feed water preheating arrangement includes means for cooling the air compressor or compressor member and a surface type heat exchanging member connected to the discharge of the gas turbine as well as devices or apparatus for preheating the feed water by means of extraction steam from the turbine. According to my invention, as pointed out above, the condensate discharged from the condenser is preheated by first passing it through at least one of said members and thereafter through said apparatus.

In the present example the condensate is discharged from the condenser 19 through a conduit 23 and forced by a condensate pump 24 into a jacket 25 surrounding or enclosing the air compressor 14. In this manner the heat energy produced during the compression in the compressor is partly transferred to the condensate or feed water, thus improving the efficiency of the compressor. The feed water is then successively passed through three preheating devices or apparatus 26, 27 and 28 connected in series behind the jacket 25 as regards the direction of flow of feed water. The preheating devices 26, 27 are surface type heat exchangers connected to receive extraction steam from lower and intermediate stages respectively of the turbine through conduits 29 and 30 respectively. The preheating device 28 is a mixing type preheater connected to receive heating fluid from a higher turbine stage through an extraction conduit 31. This fluid is mixed with the preheated feed water received from the preheater 27 as well as with the condensate received from preheaters 26 and 27 through a conduit 32. The feed water is discharged from the mixing heater 28 through a conduit 33 and forced by means of a feed water or circulating pump 34 through another surface type preheater 35 into the heating element 11.

The surface type preheater 35 is connected by

a conduit 36 to the exhaust of the gas turbine 22 whereby part of the heat energy contained in the exhaust gases is transferred to the feed water in the preheater 35.

The gases discharged from the preheater 35 are passed through another preheater 37 located in the conduit 16 for conducting combustion air from the compressor to the burner 12 whereby available heat energy of the combustion gases discharged from the heater 35 is transferred to the combustion air in the heater 37. With this arrangement the compressor for furnishing combustion air may be operated at high efficiency and the gases discharged from the gas turbine are cooled to a minimum temperature or, from another viewpoint, the available energy in the gases discharged from the gas turbine is utilized to the fullest extent.

Having described the method of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

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

Power plant comprising a pressure combustion boiler having a heating element, means including a compressor for supplying air to the boiler to maintain combustion therein, an elastic fluid extraction turbine with a condenser connected to the heating element, a gas turbine for receiving combustion gases from the boiler, a feed water preheating arrangement including first, second and third devices connected in series between the condenser and the element, the first device being arranged in heat exchange relation with the compressor to receive heat of compression therefrom, the second device being connected to receive preheated feed water from the first device and heating fluid from the turbine and the third device being connected to receive preheated feed water from the second device and combustion gases from the gas turbine, and a surface type heat exchanger connected to receive compressed air from the compressor and combustion gases discharged from the third device.

RICHARD STROEHLEN.