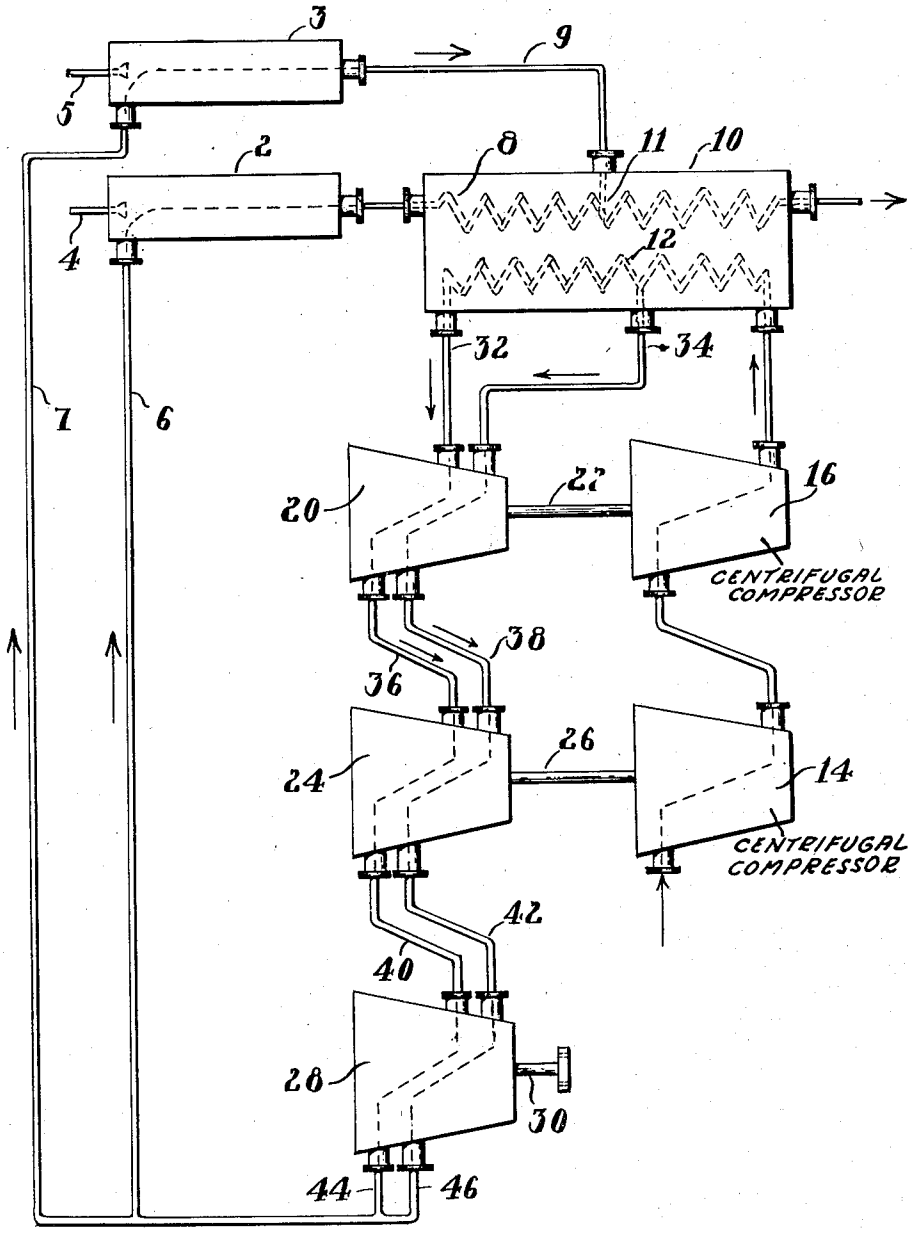
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HOT AIR TURBINE POWER PLANT

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INVENTOR.

John S. Haverstick

BY

Russell & Harding

ATTORNEYS

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HOT-AIR TURBINE POWER PLANT

John S. Haverstick, Kingwood Township, Hunterdon County, N. J., assignor to De Laval Steam Turbine Company, Trenton, N. J., a corporation of New Jersey

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2 Claims. (Cl. 60—59)

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This invention relates to turbine systems and particularly to systems utilizing hot driving gases.

This application is in part a continuation of my application Serial No. 501,101, filed September 3, 1943, and issued as Patent No. 2,438,635, March 30, 1948.

In the usual arrangement for driving a turbine by means of gases at high temperature, the air is first compressed, passed through a heat exchanger to receive heat from exhaust gases, and introduced into a combustion chamber in which fuel is burned therein. The products of combustion are then passed through one or more turbines and exhausted through the heat exchanger to pre-heat the compressed air. A serious drawback in any such system is that the products of combustion must pass through the turbine or turbines, wherein they may cause both corrosion and erosion with the result that only high grade fuels may be used, the use of coal, which gives rise to solid products, or the use of low grade fuels, which give rise to highly corrosive products, being thereby precluded.

In accordance with the present invention, systems may be provided in which not only are products of combustion excluded from the turbines, which are operated with highly heated air as the motive fluid, but the entire air exhausted from the turbines will pass to the combustion chamber or chambers to secure the most effective utilization of all of the heat energy available.

The foregoing objects of the invention, as well as other objects relating to details of arrangement and operation, will be apparent from the following description read in conjunction with the accompanying drawing in which the figure is a diagram showing a system provided in accordance with the present invention.

There is illustrated in the figure a combustion chamber 2 into which fuel is introduced at 4 to be burned in air admitted at 6. This combustion chamber may be of quite different types depending upon the fuel which is burned. If the fuel is oil or gas it may be injected in the form of a jet or spray. If the fuel is finely powdered coal it may be similarly injected in dispersed form. On the other hand, the combustion chamber may involve the introduction of coal or other solid fuel in relatively large pieces, in which case a stoker may be used. In all cases the products of combustion pass through the gas passages of a heat exchanger 10, which passages are collectively conventionalized at 8 as a coil though it will be understood that the heat exchanger will normally take a conventional form

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having multiple flow paths as, for example, straight parallel tubes extending therethrough. The products of combustion from which the heat is extracted in the heat exchanger to as great an extent as possible may be exhausted to the atmosphere.

Air passages in the heat exchanger 10, conventionalized as a coil 12, are provided with compressed air by the series arrangement of centrifugal compressors 14 and 16. By virtue of the counterflow in the heat exchanger, the compressed air passes therefrom in high temperature condition to flow successively through the turbines 20, 24 and 28 arranged in series. The flow takes place in a fashion hereafter described. The air exhausted from the last stage passes through the connections 6 and 7 to the combustion chamber 2 previously described and to a second combustion chamber 3 to which fuel is admitted at 5 and which delivers its products of combustion through the connection 9 to an intermediate point 11 of the gas flow passage 8.

The high pressure turbine 20 is shown as driving the compressor 16 through the shaft 22, while intermediate pressure turbine 24 drives the first stage compressor 14 through the shaft 26. Power is taken from the low pressure turbine 28 through its shaft 30. While this arrangement of the turbines is desirable since the high pressure turbine 20, operating at high speed, is properly suited to the driving of the second stage compressor, with the turbine 24, operating at lower speed, driving the first stage compressor, and with the low pressure turbine operating at still lower speed and adapted for the delivery of mechanical power, the arrangement of the turbines is subject to considerable variation. The arrangement illustrated is, furthermore, desirable because an element of control may be involved by adjustment of the nozzles of the low pressure turbine.

It will be noted that the arrangement described involves the absence of products of combustion from the turbines, while by reason of the series arrangement the entire exhaust air from the turbines will pass to the combustion chambers, giving a uniform exhaust condition not composed of independent streams as would be the case if the air was exhausted from two independently operating turbines.

The use of two combustion chambers as shown with one of them discharging combustion gases into an intermediate part of the heat exchanger, combined with counterflow with the air, results in effective heating of the air to a high tem-

perature. The combustion chamber 3 may be omitted, the exhaust air passing through the passage 7 being used without the additional heat to serve to heat incoming air from the compressors.

Preferably there are used multiflow turbines of the type described in my application Serial No. 501,102, filed September 3, 1943 now abandoned. As pointed out in said application a turbine for handling gases at high temperature may be desirably formed with two sets of blades and cooperating nozzles, one set being at a greater radius than the other. The turbines 20, 24 and 28 are of this character. Portions of the air at the respective higher and lower temperatures enter through the passages 32 and 34 and are discharged from the high pressure stage at 36 and 38 respectively, then entering the next stage from which they are discharged at 40 and 42 respectively. After passing through the final stage 28 these two portions of the air are mixed by the junction of the discharge passages 44 and 46 and flow together through the passages 6 and 7 to the combustion chambers.

As pointed out in my application referred to above the pressures at corresponding stages of the turbine or turbines are the same; i. e., the pressure at 32 is substantially that at 34, that at 36 is substantially that at 38, that at 40 is substantially that at 42, and the discharge pressures in the passages from the last stage turbine 28 are also substantially the same. This makes possible the segregation of flow of the higher and lower temperature gases throughout a series of turbines arranged as indicated, each of which may have a plurality of stages.

It will be clear that numerous changes may be made from the specific disclosure without departing from the scope of the invention.

What I claim and desire to protect by Letters Patent is:

1. A turbine system comprising a plurality of turbines arranged in series, means for compressing air driven by at least one of the turbines, means for heating the air, means for directing the heated air to the turbines to drive the same, and means for burning fuel in air exhausted from the turbines, the means for heating the air utilizing the products of said combustion, each of said turbines being constructed to handle a plurality of streams of heated air at substantially similar pressures but at different temperatures, and means providing such streams of heated air from the air heating means to the turbines.

2. A turbine system comprising a plurality of turbines arranged in series, means for compressing air driven by at least one of the turbines, means for heating the air, means for directing the heated air to the turbines to drive the same, and means for burning fuel in air exhausted from the turbines, the means for heating the air utilizing the products of said combustion, each of said turbines being constructed to handle a plurality of streams of heated air at substantially similar pressures but at different temperatures, means providing such streams of heated air from the air heating means to the turbines, and said means for heating the air involving an air passage, means for subjecting the air in counterflow arrangement to heat exchange with a stream of said products of combustion, and means for adding to the last mentioned stream at an intermediate point thereof an additional stream of said products of combustion.

JOHN S. HAVERSTICK.

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The following references are of record in the file of this patent:

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Number	Country	Date
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