June 11, 1935. K. BASSLER 2,004,777

ELASTIC FLUID TURBINE

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Fig. 1.

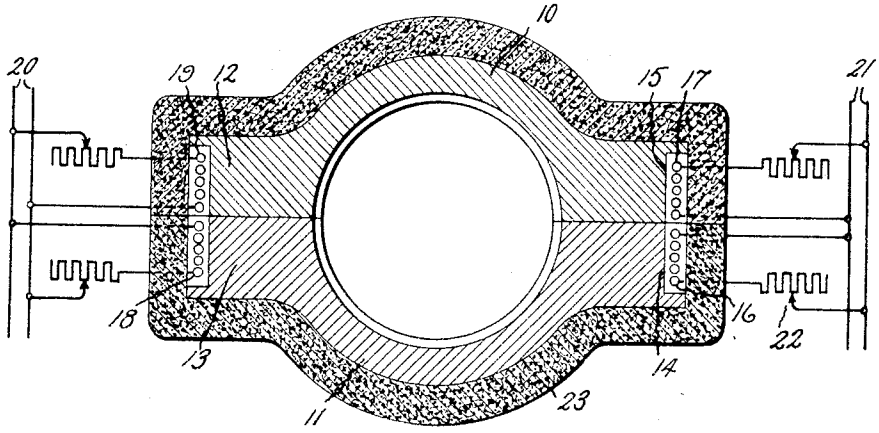
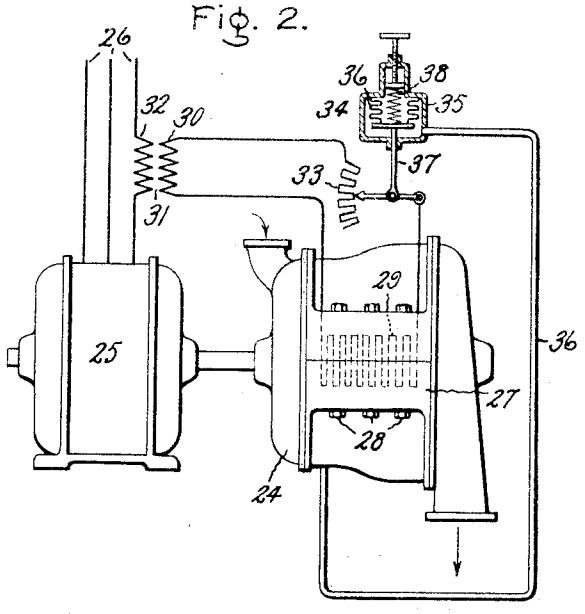


Fig. 2.



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ELASTIC FLUID TURBINE

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3 Claims. (Cl. 290—2)

The present invention relates to elastic fluid turbines, more particularly to an arrangement for heating turbine casings by means other than the actuating fluid. The heating which may be accomplished by conducting hot air or like heating substance through the turbine or by electric heating resistances provided on or near the casing is necessary where the turbine is used for intermittent operation to reduce the starting period and to prevent high stresses being set up in certain parts of the casing, particularly the flanges.

The object of my invention is to provide an improved arrangement for externally heating the turbine whereby the proper operating temperatures are maintained for the different parts of the turbine at varying load conditions. By "operating temperature" I mean the temperature condition which is reached after the turbine has been subject for a certain time to a constant load. It is well known that without the use of external or internal heating means to maintain certain temperatures of the casing it takes from one to several hours until the final temperature condition is attained. During the change in temperature condition the turbine should not be loaded heavily, as heavy loading would cause too high temperature gradients between the different parts, setting up excessive stresses and endangering the safety and operation of the turbine. The temperatures attained during final temperature condition are not alike but differ for the different parts of the turbine, that is, the temperature of the casing near the high pressure stages is higher than that near the exhaust stage. Furthermore, the final temperature condition of the turbine varies in accordance with changes in load, that is, during low load condition the temperatures are lower than during full or overload condition of the turbine.

In accordance with my invention I provide electric heating resistances for heating different parts of the turbine in accordance with their operating temperatures at varying loads. The resistances may be regulated by means of rheostats which latter may be adjusted manually or automatically in response to changes in load conditions of the turbine.

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

In the drawing, Fig. 1 illustrates a sectional view somewhat diagrammatic of an elastic fluid turbine embodying my invention, and Fig. 2 is a view illustrating a modification of my invention.

The arrangement shown in Fig. 1 comprises a turbine casing having an upper part or casing half 10 and a lower part or casing half 11, held together by means of heavy flanged portions 12 and 13 respectively along a horizontal plane through the axis of the turbine. From the massive character of the flanges it becomes apparent that without any means for externally heating the flanges their inner portions would heat up more rapidly during the starting of the turbine than their outer portions, causing their inner joint surfaces to move away from each other, thus effecting leakage and in addition setting up very high stresses in bolts or the like holding the flanges together. The outer portions of the flanges in accordance with my invention have recesses 14 and 15 respectively for accommodating electric resistances 16, 17, 18 and 19 respectively. The resistances, as pointed out above, are dimensioned in accordance with the normal operating temperatures of the corresponding parts. They are connected to an electric line or lines 20 and 21 through rheostats 22 for adjusting the heating temperatures in response to fluctuations in load conditions of the turbine.

To minimize the loss of heating energy by radiation from the recessed flanged portions containing the heating resistances, these flanged portions are covered by heat insulating material. In the present instance I have shown the flanged portions together with other casing portions being covered by a heat insulating material 23.

The resistances near the higher stages, that is, near the inlet of the turbine are adjusted to effect a higher temperature than the resistances provided near the exhaust end of the turbine. These different temperatures are attained first by properly dimensioning the different resistances and secondly by adjustment of the rheostats. The latter in addition serve to vary the heating in accordance with the load changes of the turbine to attain higher temperatures of the different parts at high load, and lower temperatures at low load on the turbine or a part thereof.

Varying of the heating effect in accordance with fluctuating load conditions may be attained manually as just described or automatically as illustrated in connection with Fig. 2 which shows an arrangement in which the current flowing through the heating resistance is varied in response to changes in load conditions. More spe-

cifically, the arrangement comprises an elastic fluid turbine 24 which is coupled with and drives an electric generator 25 connected to a line 26. The turbine casing comprises two halves having flanged portions 27 fastened together by bolts 28. The flanged portions are heated by means of a resistance 29 which is connected to a secondary coil 30 of a series transformer 31 having its primary 32 connected in series with the generator. The electric circuit also includes a rheostat 33. With this arrangement the current flowing through the heating resistance 29 changes automatically in response to the current supplied by the generator 25 to the line 26. As this current is proportional to the load of the turbine the heating of the latter is automatically varied in accordance with its load.

The automatic variation of the heating effect in response to load changes of the turbine may be accomplished in other ways, such as by the provision of means for automatically adjusting the rheostat 33 in response to a condition of the elastic fluid supplied to the turbine. In the present instance I have shown a pressure responsive device 34 having an outer casing 35 connected by a pipe 36 to one of the first turbine stages. Provided within the casing 35 is a bellows 36 having a bottom plate connected by a rod 37 to the movable contact of the rheostat 33. An adjustable spring 38 is provided within the bellows for biasing the bellows downward against the elastic fluid pressure of the turbine. During operation an increase in turbine load causes an increase in pressure which effects collapsing of the bellows, that is, upward movement of its bottom plate. The latter thereby carries the movable contact in upward direction and thus cuts out a part of the resistance 33, resulting in an increase in heating current flowing through the resistance 29. The series transformer arrangement and the pressure responsive device for automatically adjusting the rheostat 33 may be used together or individually.

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,—

1. In an elastic fluid turbine with a casing having heavy flanged portions subject to different varying temperatures, means for externally heating the casing comprising resistances provided in recesses of the flanges, and a source of electric energy for supplying current to the resistances in accordance with the load on the turbine.

2. In an elastic fluid turbine with a casing having heavy flanged portions bolted together, means for heating the bolted flanges in response to load changes on the turbine comprising a heating resistance provided in a recess of the flanges, a rheostat and an electric line, and means for automatically adjusting the rheostat in response to an elastic fluid condition in the turbine.

3. The combination of an elastic fluid turbine having heavy flanged casing portions bolted together, a generator driven by the turbine, an electric line connected to the generator, means including a resistance provided in a recess of the flanged casing portions for heating said portions in response to load changes on the turbine, and a series transformer having a primary in the line and a secondary connected to the resistance for automatically varying the heating current flowing through the resistance in response to load changes of the generator.

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