

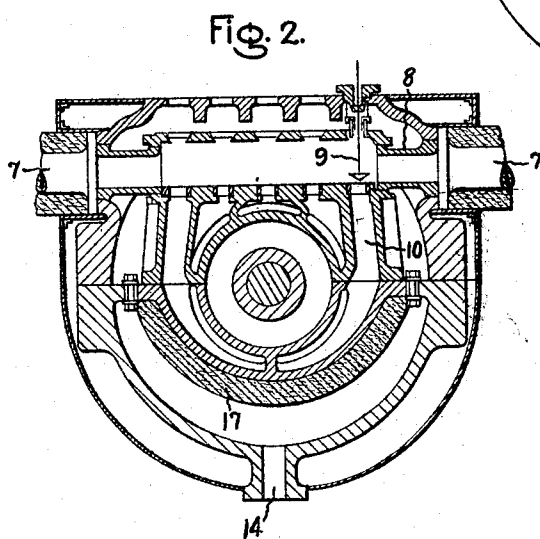
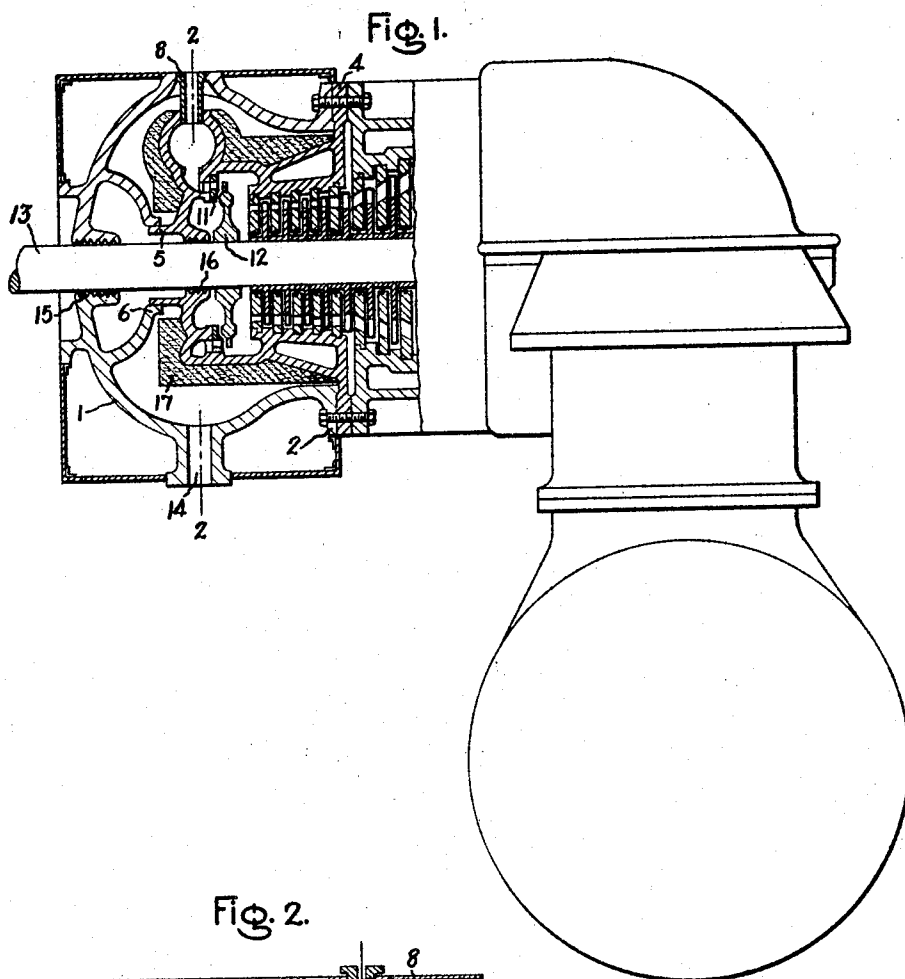
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ELASTIC FLUID TURBINE

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UNITED STATES PATENT OFFICE

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ELASTIC FLUID TURBINE

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The present invention relates to elastic fluid turbines and more particularly to turbines operating with a fluid of very high temperature. In such turbines the temperature may be such that even low stresses in the material of which the high pressure end is constructed may cause the phenomenon known as "creeping" in the material unless some special construction is adopted to prevent it. The object of the present invention is to provide an improved construction and arrangement which will overcome the above referred to difficulty, and for a consideration of what I believe to be novel and my invention, attention is directed to the following specification and the claims appended thereto.

According to my invention, I construct the high pressure casing, that is, the portion of the casing at the high pressure end of the turbine, in two portions, the portion subjected to the very high temperature being under no tensile stress, any stress to which it is subjected being either negligible or compression stresses of very low value.

In the drawings, Fig. 1 is a sectional view of the high pressure end of a turbine embodying my invention, the low pressure end of the turbine being indicated in outline, and Fig. 2 is a section taken on line 2—2, Fig. 1.

Referring to the drawings, the high pressure and high temperature portion of the turbine casing consists of an external casing 1 provided with a circumferential flange 2, and an internal casing 3 provided with a circumferential flange 4 which is suitably fastened to flange 2 for fixing the internal casing 3 rigidly relative to the external casing 1. The internal casing 3 is provided with an annular extension piece 5 which extends into a corresponding annular portion 6 forming a part of external casing 1. A definite small clearance radially and circumferentially is provided between parts 5 and 6. The working fluid at the initially very high temperature is admitted to the internal casing 3 by pipes 7 which are provided with swivelling conduits 8 between the external and the internal casings to permit of differences in expansion between the two casings.

The working fluid is admitted by valves 9, only one of which is shown, to passages 10 leading to nozzles 11 which expand the fluid and direct it on to the first stage wheel 12 of the turbine rotor. The shaft of the rotor is indicated at 13 but the turbine wheels other than the wheel 12 and the diaphragms are omitted as their construction and arrangement form no part of the present invention. It will be understood that the turbine beyond the first stage nozzles and wheel comprises a usual or desired construction of diaphragms and wheels. Also the valve 9 is shown diagrammatically and only by way of example, it being understood that a usual or desired form of valve gear is utilized. Such valve gears are well known in the art and since the specific arrangement employed embodies no part of the present invention, the same has been indicated diagrammatically only.

The external casing 1 is provided with a conduit 14 through which working fluid at saturation temperature and at the same pressure or substantially the same pressure as the fluid flowing through pipes 7 to the internal casing is led into the space between the external casing 1 and the internal casing 3.

With the construction illustrated, a small flow of saturated or slightly superheated elastic fluid is obtained in the space between the external and internal casings through the clearance space between annular portions 5 and 6, and this flow is usefully employed for sealing the shaft 13 of the turbine where it passes through the packings 15 and 16 between the shaft and the casings 1 and 3 respectively. It is necessary to maintain a slight flow of the saturated fluid led in by the conduit 14 between the internal and external casings, in order to prevent this fluid from becoming too highly superheated. The internal casing is lagged with non-conducting material 17 to reduce to a minimum transference of heat to the initially saturated fluid circulating between casings 1 and 3.

Since the pressure of the saturated working fluid led in by conduit 14 to the space between the two casings is practically the same pressure as that of the very highly superheated fluid led in through pipes 7 and flexible

conduits 8, negligible stress exists in the portions of the internal casing carrying the initially very highly superheated fluid. As the fluid expands inside the internal casing 3, the temperature and the pressure fall simultaneously, and the pressure of the saturated or slightly superheated fluid in the space between the two casings is higher than that of the expanding fluid in the internal casing 3, which means that the stresses in the internal casing are compression stresses only. The external casing having to withstand the tensile stresses due to a saturated or slightly superheated fluid can be designed to carry these stresses without difficulty. The internal casing 3, as described above, has to withstand compression stresses only of a low value, and moreover at a portion of the casing where the initial very high temperature has fallen. The portion subjected to the very high initial temperature of the working fluid has to withstand negligible stress. The flexible or swivelling conduits 8 have to seal against temperature only, and not against pressure difference, and can therefore be a comparatively easy fit in the casings 1 and 3.

Thus it will be understood that the construction of elastic fluid turbines and the method of operating them according to my invention is adapted to successfully prevent substantial strains and stresses within the inner turbine casing and is also adapted to prevent strains within the outer casing thereof, as well as the creeping effect of this outer casing which heretofore was a great obstacle in the turbine art. To make this clear, attention is called to the fact that tests have shown that, for instance, bolts of the outer turbine casing which were applied with a tensile strength of 28,000 pounds lost about 70% of this strength after less than one year of operation at temperatures in the neighborhood of 750° F. These obstacles are overcome by supplying a fluid to the space between the inner and outer casing of a temperature which is lower than the temperature of the operative fluid within the inner casing. This may be performed by supplying the fluid to this space directly from the boiler, whereas the operative fluid is supplied from a superheater. The lower temperature of the fluid between the inner and outer casing furthermore permits the use of cheaper packing material and also has less wearing effect on this material, as would be the case if a fluid of high temperature were used, and finally, the low temperature necessitates less heat insulating material and causes less heat losses through the outer casing.

I have referred above to saturated and superheated working fluid, but it is to be understood that the invention is not confined only to fluid having a saturation point in the working cycle, such as steam, as obviously I could employ a compressed gas which

would be led at a very high temperature through pipes 7 into internal casing 3, and a supply of cooled gas at the same pressure as that initially supplied to the turbine pipes 7 would be led through conduit 14 into the space between casings 1 and 3, the temperature of the cooled gas being such that reasonably high tensile stresses could be carried in the external casing 1.

In accordance with the provisions of the patent statutes I have described the principle of operation of my invention together with the apparatus which I now consider to represent the best embodiment thereof, and it is to be understood that the arrangement 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. An elastic fluid turbine for use with elastic fluid at a very high initial temperature comprising an internal casing, inlet nozzles carried by the internal casing, means for conveying elastic fluid of high initial temperature to said nozzles, an external casing surrounding the internal casing in spaced relation thereto, and means whereby a fluid at a lower temperature, but of substantially the same pressure as that of the high temperature fluid may be circulated through the space between said casings.

2. An elastic fluid turbine for use with elastic fluid at a very high initial temperature comprising an internal casing, inlet nozzles carried by the internal casing, an external casing surrounding the internal casing in spaced relation thereto, flexibly mounted conduits for conveying high temperature elastic fluid to the internal casing, and means whereby a fluid at a lower temperature but of substantially the same pressure as that of the high temperature fluid may be circulated through the space between said casings.

3. An elastic fluid turbine for use with elastic fluid at a very high initial temperature comprising an internal casing, inlet nozzles carried by the internal casing, means for conveying elastic fluid of high initial temperature to said nozzles, an external casing surrounding the internal casing in spaced relation thereto, and means whereby a fluid at a lower temperature but of substantially the same pressure as that of the high temperature fluid may be circulated through the space between said casings, said internal casing being provided with a heat insulating covering to reduce the transference of heat from the fluid in the internal casing to the fluid in the external casing.

4. An elastic fluid turbine for use with elastic fluid at a very high initial temperature comprising an internal casing, inlet nozzles carried by the internal casing, means for conveying elastic fluid of high initial temperature to said nozzles, an external casing sur-

rounding the internal casing in spaced relation thereto, flanges on said casings defining an annular discharge passage from the space between said casings, and means whereby a fluid at a lower temperature but of substantially the same pressure as that of the high temperature fluid, may be circulated through the space between said casings and said annular discharge passage.

5. An elastic fluid turbine for use with elastic fluid at a very high initial temperature comprising an internal casing, inlet nozzles carried by the internal casing, means for conveying elastic fluid of high initial temperature to said nozzles, an external casing surrounding the internal casing in spaced relation thereto, a shaft which passes through said casings, packings between the casings and the shaft, walls defining an annular chamber between said packings which communicates with the space between the casings, and means whereby a fluid at a lower temperature but of substantially the same pressure as that of the high temperature fluid may be circulated through the space between said casing to the space between said packings whereby said fluid serves as a sealing means for the packings.

6. An elastic fluid turbine for use with elastic fluid at a very high initial temperature comprising an internal casing, inlet nozzles carried by the internal casing, means for conveying elastic fluid of high initial temperature to said nozzles, an external casing surrounding the internal casing in spaced relation thereto and means for circulating fluid, other than the said elastic fluid, through said space between the casings, said second mentioned fluid being of the same pressure as, but of a lower temperature than, said first mentioned fluid.

7. A method of operating elastic fluid turbines having an inner casing for carrying and surrounding diaphragms and bucket wheels respectively, an outer casing surrounding said inner casing, which comprises supplying elastic fluid to the inner turbine casing and supplying another elastic fluid of substantially the same pressure but lower temperature than the first named elastic fluid to the space formed between the inner and outer casing, whereby the elastic fluid supplied to said space is adapted to prevent strains and stresses of said inner casing and creeping effect with respect to said outer casing.

In witness whereof, I have hereunto set my hand this 2nd day of January, 1929.

ROBERT H. COLLINGHAM.