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TURBINE SYSTEM

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Fig. 1.

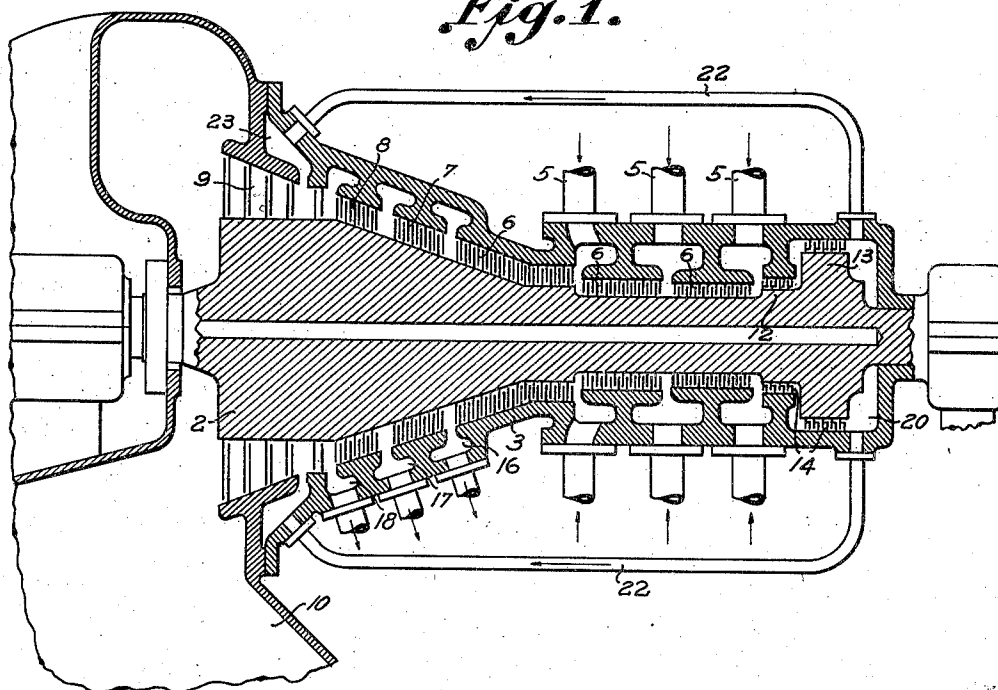


Fig. 2.

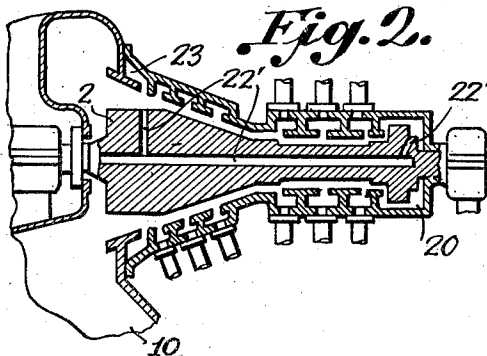
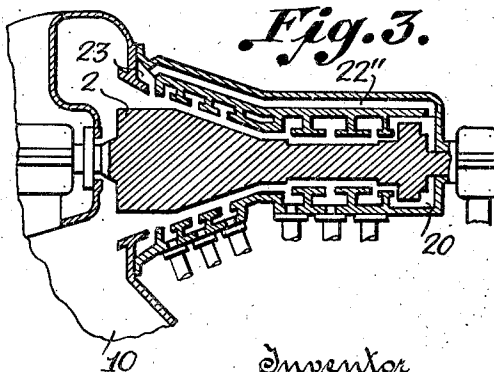


Fig. 3.



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TURBINE SYSTEM

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7 Claims. (Cl. 253—69)

This invention relates to an improvement in elastic fluid turbines and to a method for increasing the efficiency thereof and for eliminating undesirable blade erosion.

5 In elastic fluid turbines, the elastic fluid (hereinafter referred to as "steam") expands as it flows through the turbine and gives up its energy to the rotor. In the last or low pressure stages the steam begins to condense, and drops of moisture are formed. This moist steam has two disadvantages: (1) It reduces the efficiency of the turbine; and (2) Impingement of drops of moisture on the rapidly moving rotor blades causes erosion of the blades. This latter condition is quite serious since blade erosion is in some instances quite rapid and much expense and energy have been involved in counteracting it. Blades have been formed of very hard alloys or provided with shields of alloys such as "Stellite" or tungsten steel, to enable the blades to withstand the impact of such water particles.

10 It is an object of this invention to increase the efficiency of steam turbines and to reduce or eliminate blade erosion in the lower pressure stages thereof, by conducting balance piston leakage steam to the low pressure stages at a point beyond the point at which steam is extracted from the turbine.

15 Other objects will be apparent from the following description taken in combination with the drawing in which Fig. 1 shows a central sectional view of a turbine constructed in accordance with this invention.

20 Figs. 2 and 3 show similar views of turbines disclosing modified forms of the invention.

25 A multistage turbine of the extraction type is shown as being provided with a central shaft or spindle 2 mounted on suitable bearings and located within casing 3. The spindle and casing are provided with the usual cooperating, rotating and stationary blades. Steam is admitted at the high pressure end through one or more inlet ports 5, and passes thence through high pressure stages 6, intermediate pressure stages 7 and 8, and finally through low pressure stage 9 and out to exhaust at 10.

30 The spindle is provided at its high pressure end with the usual balance pistons 12 and 13 which balance the thrust on the spindle due to the pressure of steam on the blading of the spindle. These balance pistons are usually provided with labyrinth seals shown at 14.

35 Steam at different pressures for feedwater heating or other purposes is bled off at extraction points 16, 17 and 18, located between the various

pressure stages. In the normal operation of the turbine the expansion of steam through low pressure stage 9 is below the saturation line, and particles of water form therein. Moist steam does not make for best efficiency. Moreover, the moving blades, striking these water particles at high speed, become eroded, necessitating expensive protection or frequent replacement.

40 In accordance with this invention, however, formation of water particles is prevented or minimized by the introduction of superheated steam into the low pressure stage 9. While this may be accomplished by using boiler steam reduced to an appropriate pressure, the preferred source of such superheated steam is the leakage steam chamber 20 at the low pressure side of balance piston 13.

45 It will be understood that balance piston leakage steam may be conducted to low pressure stage 9 by any preferred means, such as a passage 22' (Fig. 2) through the spindle of the turbine or through a port 22'' (Fig. 3) in casing 3. The preferred form, however, is a conduit external to the turbine casing, as shown at 22, through which balance piston leakage steam flows from chamber 20 to low pressure stage 9 at leakage steam inlet 23. Any desired number of such conduits may be used. It will be noted that leakage steam inlet 23 is spaced from low pressure bleeder 18 by at least one row of stationary blades. This is important, since with this construction all of the balance piston leakage steam will pass through the remainder of the low pressure stage instead of being diverted by bleeder 18. Thus all of the balance piston leakage steam does useful work in passing through low pressure stage 9, and also serves to vaporize moisture that may be present in said low pressure stage. This minimizes or eliminates erosion of the blades in the low pressure stage.

50 While the above description refers in detail to a preferred form of this invention and the method of performing same, it is to be understood that the invention comprehends such additions and modifications within the scope of the appended claims as may occur to persons skilled in the art.

55 It is claimed and desired to secure by Letters Patent:

1. The method of reducing erosion of low pressure blading in a steam turbine provided with means for extracting steam adjacent to a low pressure stage thereof which comprises introducing superheated balance piston leakage steam into said low pressure stage at a point beyond

said extraction point, whereby said leakage steam performs useful work in passing through said low pressure stage.

2. The method of reducing erosion of low pressure blading in a steam turbine of the extraction type in which steam is extracted at a point adjacent to the low pressure stage of the turbine comprising conducting superheated steam which has leaked past the balance piston thereof to a point in said low pressure stage spaced by at least one row of blading beyond said extraction point, whereby all of said leakage steam is directed through the low pressure working zone of the turbine and the moisture in said zone is evaporated.

3. The method of increasing the efficiency of a steam turbine of the extraction type and eliminating erosion of the low pressure blades thereof which comprises conducting superheated balance piston leakage steam to a point in the low pressure stage thereof at which the pressure is lower than that of any point of steam extraction, whereby said balance piston leakage steam is caused to pass through the working area in said low pressure stage and causes evaporation of moisture therein.

4. In a steam turbine having stages of different steam pressures and which is provided with a spindle and balance pistons, means for extracting steam at a point between the lowest pressure stage and the next adjacent stage, and means for conducting steam which has leaked past the

last of said balance pistons to a point at said lowest pressure stage adjacent to said extraction point but spaced therefrom by at least one row of stationary blades, whereby the moisture content of the steam at the lowest pressure stage of said turbine is reduced.

5. In a steam turbine having high and low pressure stages, means for extracting steam from the turbine at a point intermediate said stages, a balance piston in said turbine and a steam conduit directly connecting the low pressure side of said balance piston with the low pressure stage at a point having a steam pressure lower than that of the extraction point, whereby the moisture content of the steam at the lowest pressure stage of said turbine is reduced.

6. In a steam turbine having high and low pressure stages, a spindle, means for extracting steam from the turbine at a point preceding and adjacent said low pressure stage, a balance piston on said spindle provided with a labyrinth seal, and means for conducting superheated steam leaking past said seal directly to said low pressure stage at a point adjacent said extraction point but separated therefrom by at least one row of stationary blades.

7. A steam turbine as defined in claim 6 wherein the means for conducting balance piston steam comprises a steam conduit located outside of the turbine casing and connected thereto.

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