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(54) **Steam turbine exhaust diffuser**

(57) An axial flow steam turbine includes an exhaust diffuser in the form of a volute (40) for diffusing the exhaust steam and turning the exhaust steam from a generally axial flow direction to a generally radial direction.

The volute exit (46) may be at the bottom or to one side of the steam turbine. The volute and casing are independently mounted relative to one another on a foundation with a flexible joint therebetween.

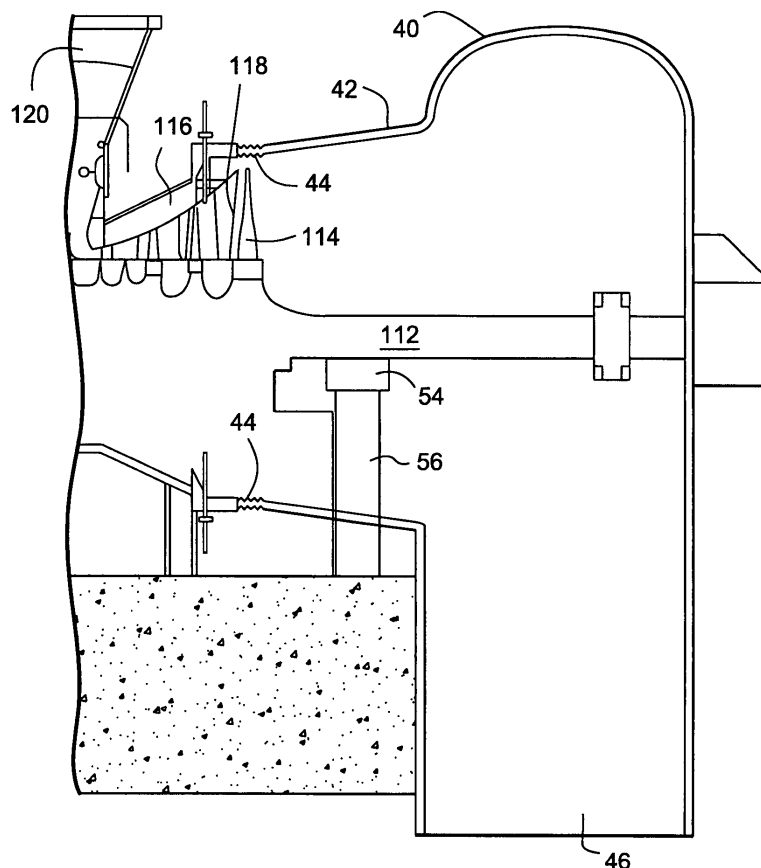


Fig. 2

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Description

[0001] The present invention relates to steam turbines and particularly relates to an exhaust diffuser in the shape of a volute.

BACKGROUND OF THE INVENTION

[0002] In prior steam turbines, the inner case of the steam turbine, for example a double flow down exhaust unit has an encompassing exhaust hood split vertically and extending along opposite sides and ends of the turbine. This large box-like structure houses the entire low pressure section of the turbine. The exhaust steam outlet from the turbine is generally conically shaped and the steam exhaust is redirected from a generally axial extending flow direction to a flow direction 90° relative to the axial flow direction. This 90° flow direction may be in any plane, downwardly, upwardly or transversely. Thus the prior exhaust hoods for steam turbines constitute a large rectilinear structure at the exit end of the conical section for turning and diffusing the steam flow at right angles. The steam flow path was thus tortuous resulting in losses and adverse pressure drop. It will also be appreciated that access to various parts of the turbine, for example, the bearing for maintenance purposes was difficult in that it necessitated the removal of the upper half of the exhaust hood. Further, it will be appreciated that the exhaust hood in conventional steam turbines typically supports the inner casing of the turbine and the associated steam path parts such as diaphragms and the like. Accordingly, there has been found a need to provide a new geometry to improve exhaust steam pressure recovery and overall performance of the turbine.

BRIEF DESCRIPTION OF THE INVENTION

[0003] In a preferred embodiment of the invention, there is provided an axial flow steam turbine flow path comprising: a rotor and a casing defining the axial steam flow path; and an exhaust diffuser for the turbine including a volute for diffusing the exhaust steam and turning the exhaust steam from a generally axial flow direction to a generally transverse and tangential direction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Embodiments of the present invention are described, by way of example only, with reference to the accompanying drawings, in which:

FIGURE 1 is a fragmentary schematic illustration of half of a double flow down exhaust steam turbine according to the prior art.

FIGURE 2 is a fragmentary side cross-sectional view of a steam turbine illustrating an exhaust diffuser having a volute configuration; and

FIGURES 3 and 4 are axial end views of two embodiments of volutes which may be employed to receive the exhaust steam from the steam turbine.

DETAILED DESCRIPTION OF THE INVENTION

[0005] Referring now to the drawings, particularly to Figure 1 there is illustrated a portion of a steam turbine, generally designated 10, including a rotor 12 mounting a plurality of turbine buckets 14. An inner casing 16 is also illustrated mounting a plurality of diaphragms 18. A centrally disposed generally radial steam inlet 20 applies steam to each of the turbine buckets and stator blades on opposite axial sides of the turbine to drive the rotor. The stator vanes of the diaphragms 18 and the axially adjacent buckets 14 form the various stages of the turbine forming a flow path and it will be appreciated that the steam is exhausted from the final stage of the turbine for flow into a condenser not shown.

[0006] Also illustrated in Figure 1 is an outer exhaust hood 22 which surrounds and supports the inner casing of the turbine as well as other parts such as the bearings. In the illustration of Figure 1, the turbine includes steam guides 24 for guiding the steam exhausting from the turbine into an outlet 26 for flow to one or more condensers. With the use of an exhaust hood supporting the turbine, bearings and ancillary parts, the exhaust steam path is tortuous and subject to pressure losses with consequent reduction in performance and efficiency.

[0007] Referring now to Figure 2, there is illustrated an aspect of the present invention wherein like reference numerals as in Figure 1 are applied to like parts preceded by the numeral 1. As illustrated, the exhaust hood 22 of the prior art is completely eliminated in favor of a volute diffuser 40. The diffuser 40 includes a diffusing conical section 42 coupled to the inner casing 116 by a flexible joint 44. The volute 40 has an axis parallel to the axis of rotation of the rotor 112. The axis of volute 40 is generally perpendicular to the direction of the general spiral flow about the axis and through the volute. Consequently, the exhaust steam flowing substantially in an axial direction from the final stage of the turbine flows into the volute 40 where it changes its flow direction by about 90°. Additionally, by using the volute 40, the geometry of the volute enables the steam to expand reducing its pressure. The volute 40 also guides the diffused steam through an outlet 46 coupled to one or more condensers, not shown. As illustrated in Figure 3, the volute 40 includes an internal passage 48 which increases in cross-sectional area in a direction toward the outlet 46 thereby diffusing the exhaust steam. It will be appreciated that the exit or outlet 46 need not be a down exhaust but can be a side or upwardly directed exhaust. In either configuration, a single volute can exhaust a single flow steam turbine or a pair of volutes may exhaust steam from double flow steam turbines. In Figure 4, a double walled volute is illustrated having a divider wall 50 forming a pair of diffuser exit passages.

[0008] Apart from the increased performance due to the diffusion of the steam in a volute on the steam exhaust side of the turbine, there are additional advantages. For example, the exhaust hood in prior conventional steam turbines is entirely eliminated and there is no longer a need to support the inner casing and associated steam path parts, such as diaphragms from the exhaust hood. Cost reduction is also realized because an exhaust hood is no longer used to enclose the inner casing. Also the overall dimensions of the turbine are reduced. Steam guides previously necessary are also entirely eliminated. Importantly, the inner casing and the volute of the turbine are each supported directly from the foundation of the turbine. To facilitate this, a flexible connection 44 (Figure 2) is provided between the inner casing and the volute 40. The flexible connection may be of many different types such as an expansion bellows to allow for differential thermal expansion. Further, the previously utilized exhaust hood is no longer necessary for the support of the turbine bearings. As illustrated in Figure 2, the bearings 54 may be supported on stanchions 56 in turn directly supported by the foundation of the turbine. Thus, the stanchions provide a rigid support for the bearings with improved turbine reliability as a result. The volute may be formed of a composite material, steel plate or pipe, structural steel, fiber-reinforced plastic or any combination of these materials to obtain the required structural integrity and desired steam flow diffusion characteristics.

[0009] While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

Claims

1. An axial flow steam turbine flow path comprising:

a rotor (12) and a casing (16) defining the axial steam flow path; and
an exhaust diffuser for the turbine including a volute (40) for diffusing the exhaust steam and turning the exhaust steam from a generally axial flow direction to a generally transverse and tangential direction.

2. A flow path according to claim 1 wherein said volute (40) has an axis generally parallel to an axis of the flow path.

3. A flow path according to claim 1 wherein said exhaust diffuser and said casing are independently mounted relative to one another on a foundation.

4. A flow path according to claim 1 including a flexible joint (44) between said exhaust diffuser and said casing (16).

5. A flow path according to claim 1 wherein said volute (40) has an axis generally parallel to an axis of the flow path, said volute terminating in an outlet (46) facing in a downward, upward or transverse direction.

6. A flow path according to claim 1 wherein said volute (40) has an axis generally parallel to an axis of the flow path, said exhaust diffuser and said casing being independently mounted relative to one another on a foundation.

7. A flow path according to claim 6 including a flexible joint (44) between said exhaust diffuser and said casing.

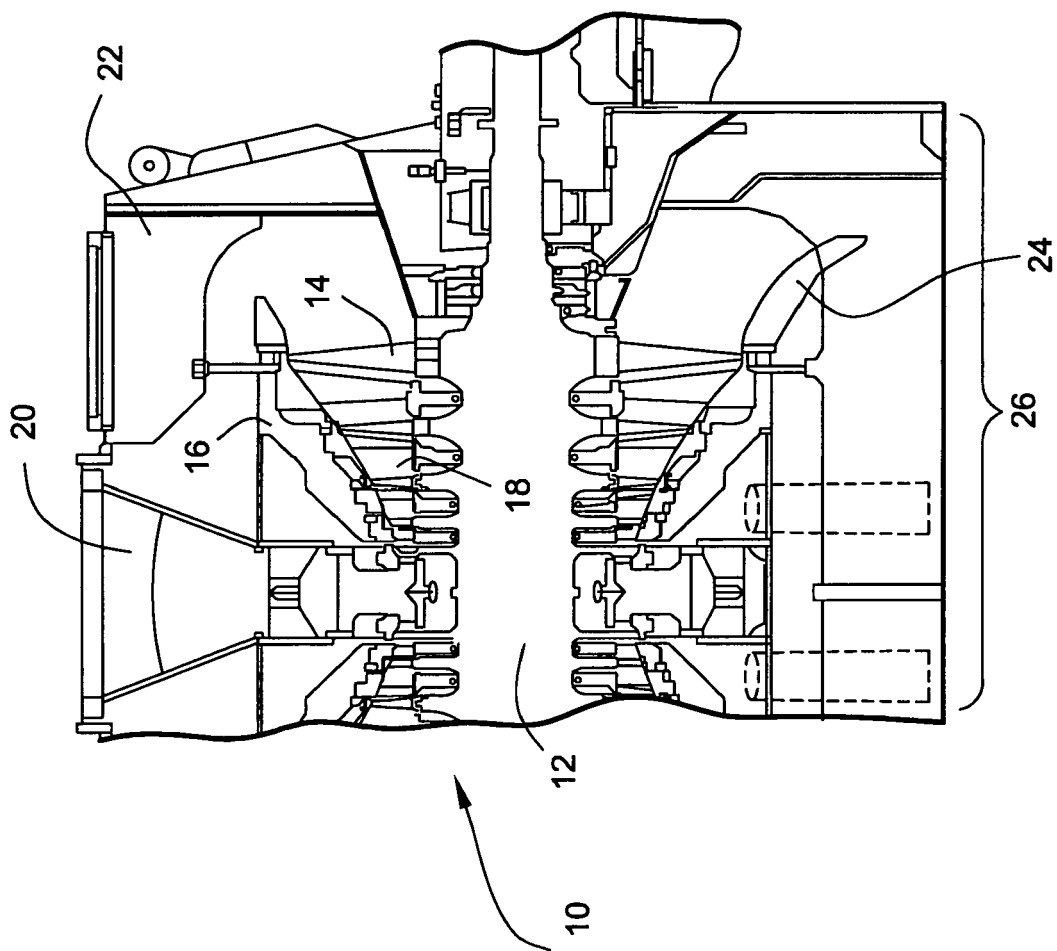


Fig. 1

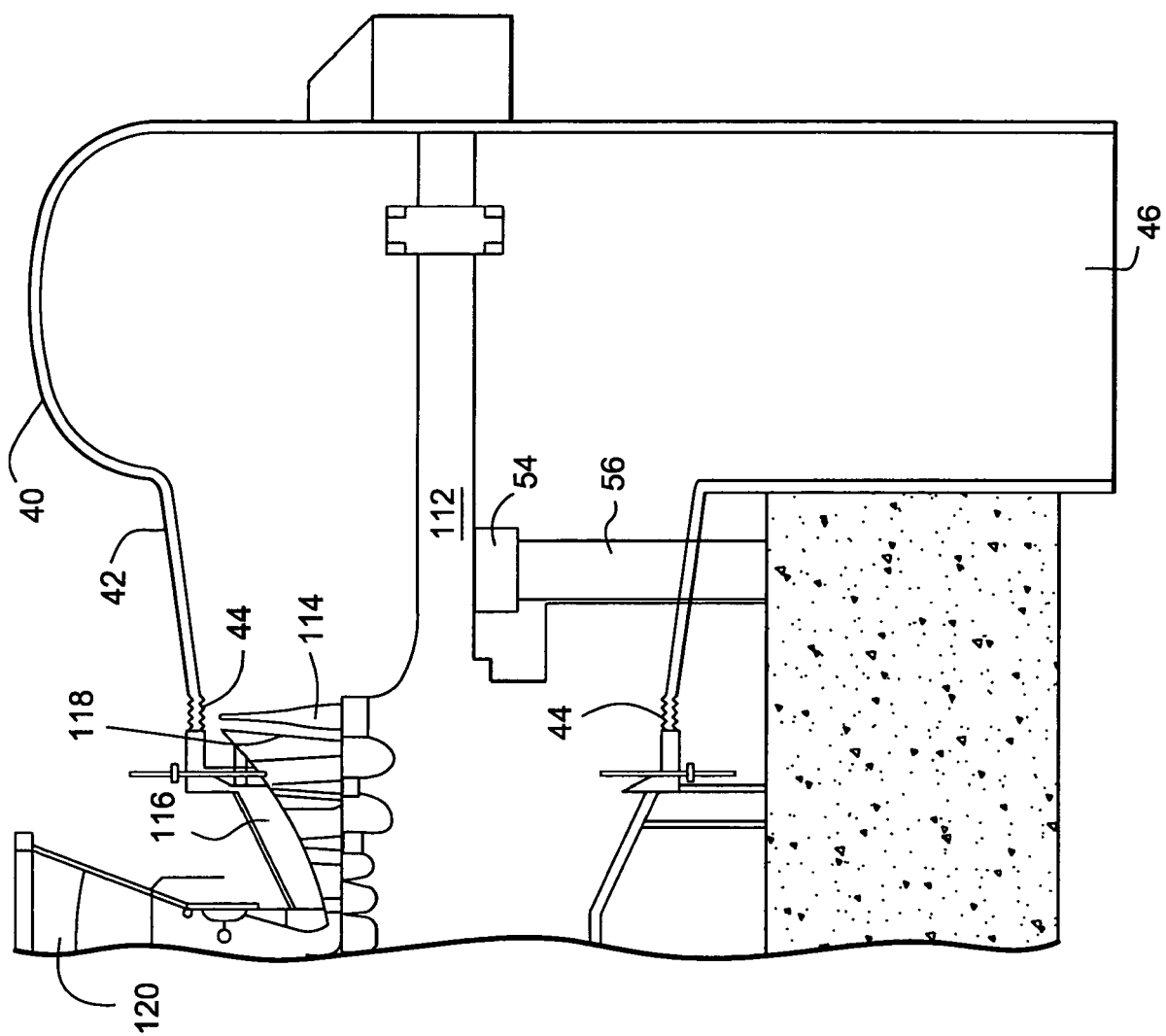


Fig. 2

