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TURBINE APPARATUS

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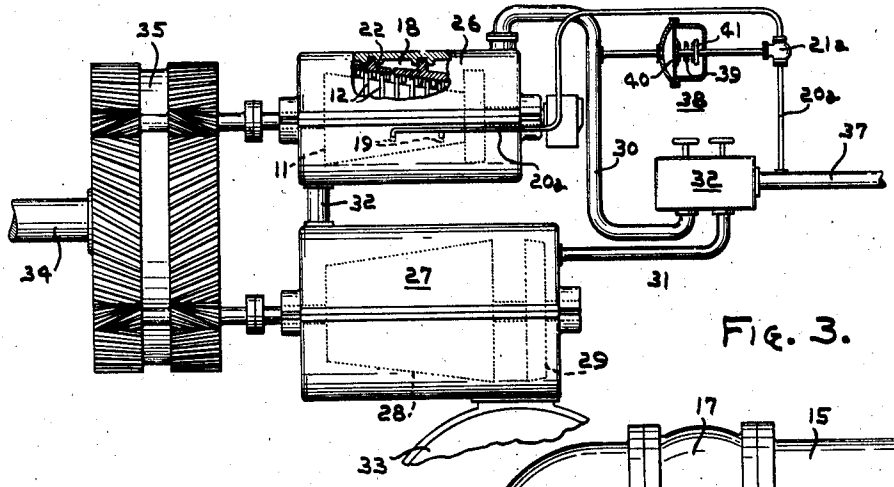
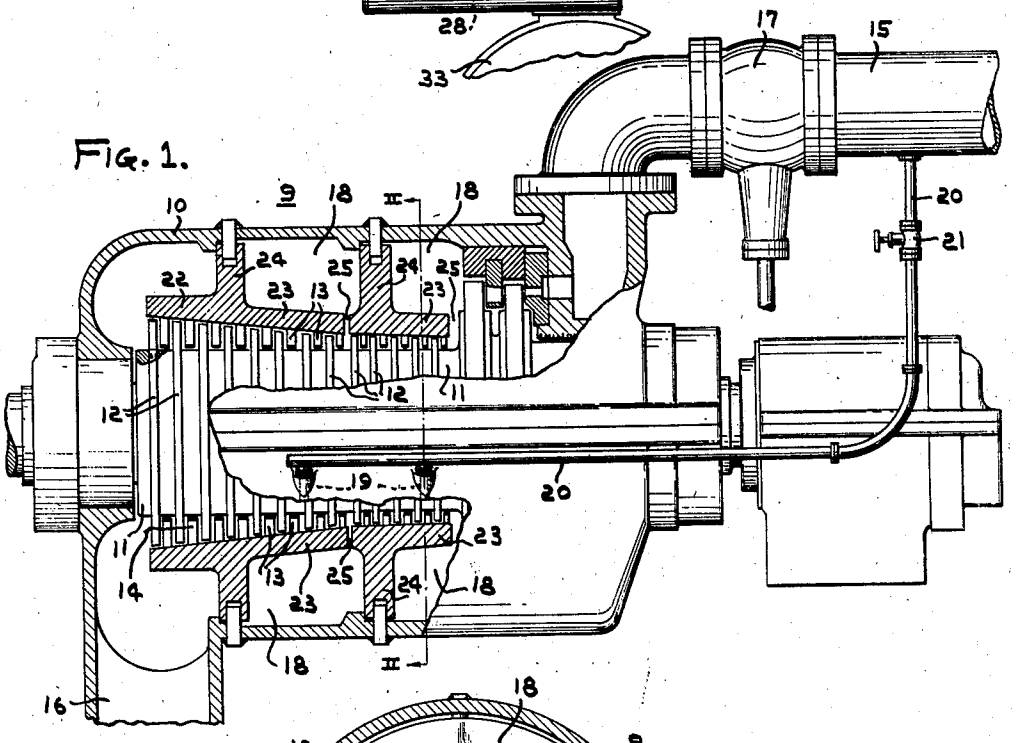


FIG. 3.

FIG. 1.



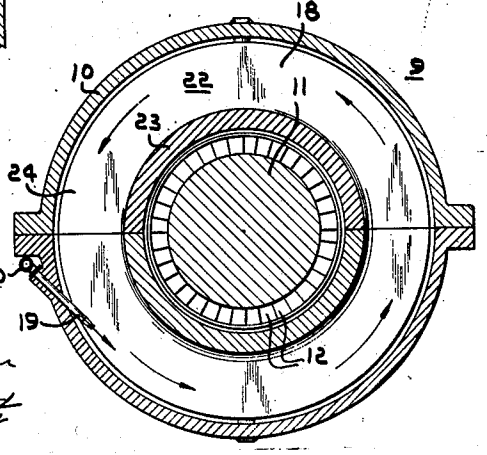


FIG. 2.

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TURBINE APPARATUS

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9 Claims. (Cl. 60—73)

The invention relates to steam turbines and it has for an object to minimize distortion of the turbine structure by providing for flow of heating steam therein independently of the motive steam for the purpose of maintaining a more uniform temperature condition of the structure.

As is well known, the structure of a turbine, more particularly the cylinder structure, may, under certain conditions, bow upwardly due to the tendency of the upper portion to be at a higher temperature than its lower portion. When the motive steam supply is cut off, cooling of the structure does not proceed uniformly, the lower half tending to cool faster than the upper half. Also, under low load conditions distortion may occur due to uneven heating. Accordingly, a further object of the invention is to construct the cylinder to provide heating space or spaces suitably located so that, with steam supplied thereto independently of the motive steam supply, the structure will be heated in such a way as to combat the tendency toward uneven temperature conditions and resultant distortion of the structure.

Operation or starting of the turbine with its structure distorted by being upwardly bowed is objectionable because of vibration and possible injury to the blading. In certain fields of turbine application, for example, locomotives and marine propulsion, distortion is very likely to occur because of stopping and starting or maneuvering; and, if distortion occurs, operation in the distorted condition is difficult to avoid. To guard against distortion, the turbine cylinder is constructed so as to provide one or more circumferential chambers or spaces to which heating steam may be admitted by means of one or more tangentially disposed jets. With steam supplied to the jets, the streams issuing tangentially from the latter are constrained by the interior cylinder wall to flow in a whirling path in each space before escaping from the latter and the steam so flowing tends to maintain the turbine structure at a more uniform temperature throughout its circumferential extent. A further object of the invention is to provide a turbine having these features of construction and arrangement to guard against distortion.

It is common turbine practice to have the stationary blades carried by blade rings supported from the interior of the cylinder, the axially-extending portions of such rings defining with respect to the interior of the cylinder, circumferential spaces; and it is a more particular object of the invention to utilize the spaces so formed as spaces to which steam is admitted for maintaining a more uniform temperature condition of the structure.

When a marine propulsion power plant is operated under maneuvering conditions, such as astern and standing by, or occasionally when developing very low power, bending or distortion of the structure of the high pressure unit, with consequent rough operation or even blade rubbing, may occur. To avoid this, the turbine cylinder structure is provided with one or more heating spaces to which heating steam is supplied, the heating spaces being so formed and located that the cylinder structure is heated in such a way as to avoid distortion which would otherwise occur. As the condenser is maintained in operation under maneuvering conditions, the blade passage may be conveniently used to conduct steam discharging from the space or spaces to the condenser. Therefore, a further object of the invention is to provide a marine installation wherein at least the high pressure turbine thereof has its cylinder formed with one or more heating spaces communicating with the blade passage and through which heating steam may be passed, the steam so flowing in the space or spaces maintaining a more uniform temperature condition of the turbine structure.

A further object of the invention is to provide a marine arrangement incorporating ahead and astern turbine sections, the ahead turbine section having its cylinder structure formed to provide one or more circumferentially-extended heating spaces in which circumferential flow of steam may be induced by tangentially-disposed jets, together with a maneuvering valve for controlling the supply of motive steam to the ahead and astern sections and a valve for controlling the supply of steam to the jet or jets, the arrangement being such that the last-named valve is closed when motive steam is supplied to the ahead section and is open when the supply of motive steam thereto is interrupted.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in accordance with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a view partly in section and partly in elevation showing a turbine with the improvement applied thereto;

Fig. 2 is a transverse sectional view taken along the line II—II of Fig. 1; and

Fig. 3 is a diagrammatic view of a marine power plant installation.

In Figs. 1 and 2, there is shown a turbine, at 9, comprising a cylinder 10, a rotor 11, and blading, including moving blades 12 carried by the rotor and stationary blades 13 carried by the cylinder, arranged in the blade passage 14. Motive steam is supplied to the turbine by the inlet conduit or passage 15 and steam exhausts from the turbine through any suitable connection 16. The inlet conduit or passage is provided with a suitable control valve 17.

The turbine has one or more chambers 18 formed at least in part by the cylinder. As shown, each of the chambers 18 extends circumferentially and is provided with one or more jets 19 to which steam is supplied by means of the conduit 20 having a control valve 21, the conduit 20 being preferably connected to the main conduit 15 at the upstream side of the valve 17. Upon opening the valve 21, steam is supplied to the jets 19, and, due to the tangential disposition of the latter, a circuitous flow is induced in each chamber 18.

More particularly, as shown in Figs. 1 and 2, the chambers 18 are defined between the interior of the cylinder proper and blade rings, at 22, each blade ring including an axially-extending portion 23 and a radial portion 24 for attachment to the cylinder in the usual way. Steam escapes from each chamber 18 to the blade passage 14 through spaces 25 at ends of the blade rings. With this arrangement, upon opening the valve 21, steam issues from the jets 19 into the chambers 18 tangentially at high velocity and whirls or flows circuitously in the chambers before being discharged from the latter through the escape spaces 25 and the blade passage to the exhaust connection 16.

While each space 18 may be supplied with steam by jet or jets disposed at any suitable circumferential location, in Figs. 1 and 2, they are carried by the lower cylinder half and are inclined downwardly, such an arrangement providing for impingement of the hottest steam on the structure having the fastest cooling tendency.

In Fig. 3, there is shown a marine propulsion power plant installation including, for example, a high pressure ahead turbine unit, at 26, and a combined low pressure ahead and astern turbine unit, at 27, the latter having an ahead section 28 and an astern section 29. Conduits 30 and 31 are provided for supplying steam from the maneuvering valve, at 32, to the inlets of the high pressure ahead turbine unit, at 26, and of the astern section 29. Steam exhausting from the high pressure ahead turbine unit, at 26, is supplied by a conduit 32 to the inlet of the low pressure ahead section 27, and a condenser 33 serves to condense steam exhausting from the low pressure ahead section 28 and the astern section 29. The turbine units drive the propeller shaft 34 by means of reduction gearing, at 35, in the usual way.

At least the high pressure turbine unit, at 26, has its structure formed as shown in Fig. 1 in order to combat distortion, that is, the structure includes a cylinder and blade rings defining circumferential chambers, the latter having tangential jets to which steam is supplied by means of a conduit 20a.

As distortion of a marine propulsion turbine is most likely to occur when maneuvering, means actuated automatically in response to maneuvering valve operation is employed for controlling the supply of steam to the jet or jets. To this end, the conduit 20a is joined to the steam line 37 ahead of the maneuvering valve, at 32. A valve 21a serves to open and close the conduit 20a, and it is operated automatically so that steam is supplied through the conduit 20a to the jets whenever the supply of motive steam through the conduit 30 is interrupted.

If desired, the valve 21a may be opened and closed by a device, at 38, responsive to pressure of steam in the motive supply passage 30 to close the valve. As shown, the device, at 38, comprises a spring 39 whose force tends to open th valve 21a and a diaphragm 40 upon which may be exerted force due to pressure of steam supplied by the passage 30, the force of such steam acting on the diaphragm to close the valve 21a against the force of the spring 39. Preferably, the spring 39 is adjustable by any suitable means 41 so that the opening force exerted on the valve 21a may be varied. Assuming that the spring is effective to open the valve when the steam pressure in the conduit 30 declines below a predetermined value, for example, 10 or 15 lbs./sq. in. then it will be apparent that the valve 21a will be opened to establish the heating circuit for the high pressure turbine unit whenever flow through the conduit 30 is interrupted or the flow therethrough is restricted for very low power of the plant.

While the invention has been shown in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and it is desired, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What is claimed is:

1. The combination with a steam turbine provided with a steam supply passage, an exhaust connection and a valve for the supply passage and comprising a cylinder and a rotor defining a blade passage for the blading carried thereby, of means for maintaining a more uniform temperature condition of the turbine structure and comprising a circumferential space enclosed by the cylinder and communicating with the blade passage, a jet carried by the cylinder and directed so as to discharge substantially tangentially of the space, a conduit for supplying steam, other than that flowing through the supply passage valve, to the jet, and a control valve for the conduit.

2. The combination with a steam turbine provided with a steam supply passage, an exhaust connection and a valve for the supply passage and comprising a cylinder and a rotor defining a blade passage for the blading carried thereby and the cylinder including upper and lower halves, of means for maintaining a more uniform temperature condition of the turbine structure and comprising a circumferential space enclosed by the cylinder and communicating with the blade passage, a jet carried by the lower cylinder half and directed downwardly so that medium may issue therefrom substantially tangentially of the space, and a conduit for supplying steam to the jet.

3. The combination with a steam turbine provided with a steam supply passage, an exhaust connection and a valve for the supply passage and comprising a rotor, a cylinder construction including a housing and

blade rings supported thereby and spaced inwardly therefrom, said rotor and cylinder construction providing a blade passage, and blading disposed in the blade passage and carried by the rotor and by the blade rings; of means for maintaining a more uniform temperature condition of the structure comprising one or more circumferential spaces defined by the cylinder and by the blade rings and communicating with the blade passage, a jet for discharging steam tangentially of each space, and means for supplying steam to each jet.

4. The combination with a marine propulsion power plant comprising ahead and astern turbines exhausting to a condenser and the ahead turbine including a high pressure unit incorporating a rotor and a cylinder construction, said rotor and cylinder construction defining a blade passage, and blading in the blade passage and carried by the rotor and by the cylinder construction; of means for maintaining a more uniform temperature condition of the structure of the high pressure unit comprising one or more circumferentially-extending spaces enclosed by the cylinder construction and communicating with the blade passage, a jet for discharging steam tangentially into each space, and means for supplying steam to each jet.

5. The combination with a marine propulsion power plant comprising ahead and astern turbines exhausting to a condenser and the ahead turbine including a high pressure unit incorporating a rotor, a cylinder construction including a housing and blade rings supported thereby and spaced inwardly therefrom, said rotor and cylinder construction providing a blade passage, and blading disposed in the blade passage and carried by the rotor and by the blade rings; of means for maintaining a more uniform temperature condition of the structure of the high pressure unit comprising one or more circumferential spaces defined by the cylinder and by the blade rings and communicating with the blade passage, a jet for discharging steam tangentially of each space, and means for supplying steam to each jet.

6. The combination with a marine propulsion power plant comprising ahead and astern turbines exhausting to a condenser and having the admission of steam thereto controlled by a maneuvering valve and the ahead turbine including a high pressure unit incorporating a rotor, a cylinder construction, said rotor and cylinder construction providing a blade passage, and blading disposed in the blade passage and carried by the rotor and by the cylinder construction: of means for maintaining a more uniform temperature condition of the structure of the high pressure unit comprising a circumferential space enclosed by the cylinder structure and communicating with said blade passage; a jet for supplying steam tangentially of the space; a conduit for supplying steam to the jet; a valve for opening and closing the conduit; and means responsive to operation of said maneuvering valve for controlling the last-named valve.

7. The combination with a marine propulsion power plant comprising ahead and astern turbines exhausting to a condenser and having the admission of steam thereto controlled by a maneuvering valve and the ahead turbine including a high pressure unit incorporating a rotor, a cylinder construction, said rotor and cylinder construction providing a blade passage, and blading disposed in the blade passage and carried by the rotor and by the cylinder construction: of means for maintaining a more uniform temperature condition of the structure of the high pressure unit comprising a circumferential space enclosed by the cylinder structure and communicating with said blade passage; a jet for supplying steam tangentially of the space; a conduit for supplying steam to the jet; a valve for opening and closing the conduit; means for exerting biasing force on the valve to open the latter; and means responsive to pressure of steam supplied from the maneuvering valve to the ahead turbine for exerting closing force on the valve in opposition to the biasing means.

8. The combination with a marine propulsion power plant comprising ahead and astern turbines exhausting to a condenser and having the admission of steam thereto controlled by a menauvering valve and the ahead turbine including a high-pressure unit incorporating a rotor, a cylinder construction, said rotor and cylinder construction providing a blade passage, and blading disposed in the blade passage and carried by the rotor and by the cylinder construction: of means for maintaining a more uniform temperature condition of the structure of the high-pressure unit comprising a circumferential space enclosed by the cylinder structure and communicating with said blade passage; a jet for supplying steam tangentially of the space; a conduit for supplying steam to the jet; a valve for opening and closing the conduit; a spring for exerting opening force on the valve; means responsive to pressure of steam supplied from the maneuvering valve to the ahead turbine for exerting closing force on the valve; and means for adjusting said spring to vary the opening force thereof.

9. The combination with a marine propulsion power plant comprising ahead and astern turbines exhausting to a condenser and having the admission of steam thereto controlled by a maneuvering valve and the ahead turbine including a high-pressure unit incorporating a rotor, a cylinder construction including a housing and blade rings supported thereby and spaced inwardly therefrom, said rotor and housing providing a blade passage, and blading disposed in the blade passage and carried by the rotor and by the blade rings: of means for maintaining a more uniform temperature condition of the structure of the high-pressure unit comprising one or more circumferential spaces defined by the cylinder and by the blade rings and communicating with the blade passage; a jet for discharging steam tangentially of each space; a conduit for supplying steam to each jet; a valve for opening and closing the conduit; biasing means for exerting opening force on the valve; and means responsive to pressure of steam supplied from the maneuvering valve to the ahead turbine for exerting closing force on the valve.

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