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(54) **Steam Turbine Valve Having Integral Pressure Chamber**

(57) A steam turbine valve (10) having an integral pressure chamber (18) is disclosed. In one aspect of the invention, the valve (10) for supplying steam includes a

valve body (12); and a pressure chamber (18) substantially contained within a wall (14) of the valve body (12), the pressure chamber (18) having an inlet (24) for receiving a pressurized fluid.

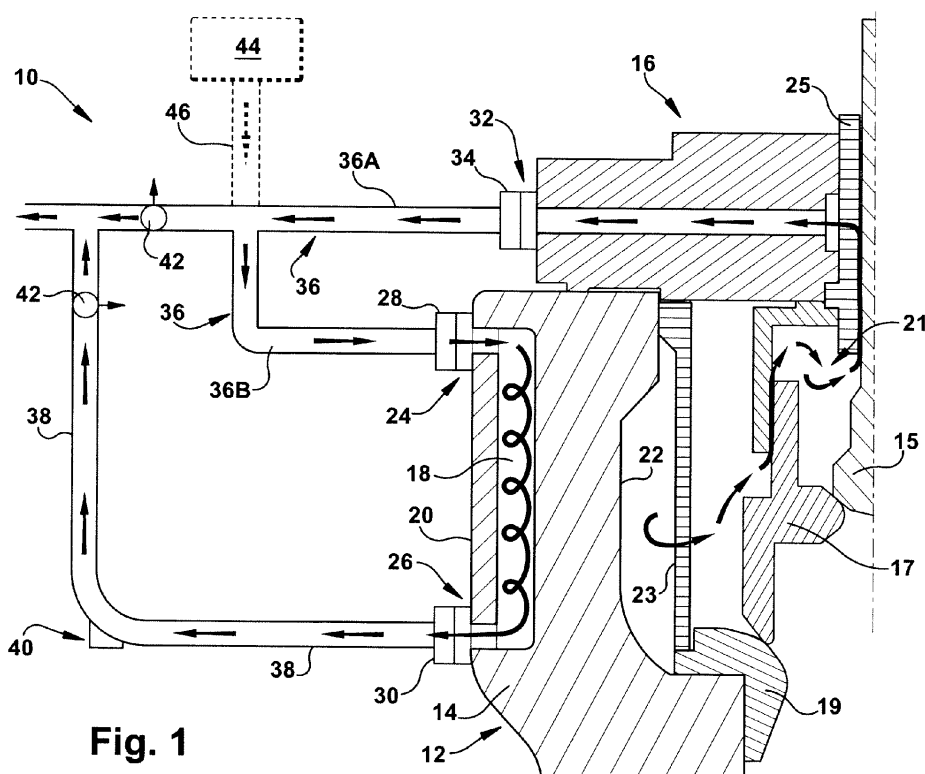


Fig. 1

Description

BACKGROUND OF THE INVENTION

[0001] The subject matter disclosed herein relates to a steam turbine valve. More specifically, the subject matter disclosed herein relates to a steam turbine valve including an integral pressure chamber, formed via, e.g., casting or fabrication.

[0002] During operation of a steam turbine system, various valves provide steam to the working portions of the system, allowing those working portions to perform mechanical work. However, the flow of steam through the valves may cause pressure and thermal-related stress on these valves, reducing their effective lifetimes and/or causing failure. Further, operating conditions for steam turbine systems are trending toward higher temperature, higher pressure applications, with faster starting and loading ramp rates, which may cause increased stresses on the valves within those systems.

BRIEF DESCRIPTION OF THE INVENTION

[0003] A steam turbine valve having an integral pressure chamber is disclosed. In one embodiment, a system for supplying steam is disclosed, the valve system comprising: a valve body; and a pressure chamber substantially contained within a wall of the valve body, the pressure chamber having an inlet for receiving a pressurized fluid.

[0004] A first aspect of the invention includes a valve system comprising: a valve body; and a pressure chamber substantially contained within a wall of the valve body, the pressure chamber having an inlet for receiving a pressurized fluid.

[0005] A second aspect of the invention includes a steam turbine system comprising: a steam turbine section; and valve system for supplying steam to the steam turbine section, the valve system comprising: a valve body; and a pressure chamber substantially contained within a wall of the valve body, the pressure chamber having an inlet for receiving a pressurized fluid.

[0006] A third aspect of the invention includes a valve for supplying steam comprising: a valve body; and a pressure chamber substantially contained within a wall of the valve body, the pressure chamber having an inlet for receiving a pressurized fluid.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] These and other features of this invention will be more readily understood from the following detailed description of the various aspects of the invention taken in conjunction with the accompanying drawings that depict various embodiments of the invention, in which:

FIG. 1 shows a cut-away cross-sectional schematic view of a valve system according to an embodiment

of the invention.

FIG. 2 shows a schematic view of a steam turbine system including a valve system according to an embodiment.

[0008] It is noted that the drawings of the invention may not be to scale. The drawings are intended to depict only typical aspects of the invention, and therefore should not be considered as limiting the scope of the invention. In the drawings, like numbering represents like elements between the drawings.

DETAILED DESCRIPTION OF THE INVENTION

[0009] As indicated above, aspects of the invention provide for a steam turbine valve having an integral pressure chamber. In particular, aspects of the invention provide for a steam turbine valve having an integrally cast or fabricated pressure chamber. The integral pressure chamber may be formed with an inlet and an outlet for allowing steam to flow therethrough. Steam may be supplied to the chamber as: a) a pre-warming agent to reduce thermally induced transient stresses; and/or b) a pressurizing agent during steady-state operation to reduce long-term membrane stress and peak stresses across load bearing valve walls.

[0010] While conventional approaches to reduce stress in steam turbine valves employ a double-shell valve casing, these approaches often require increased casting complexity and increased cost. In contrast to these conventional approaches, aspects of the invention provide for an integral pressure chamber in a single-casing design. The following may be realized through the teachings of aspects of the invention as compared with conventional approaches: a) manufacturing costs of the single-casing valves described herein may be less than the costs of a double-shell valve casing due to, among other things, a reduction in the materials needed; and b) startup time may be reduced when compared to conventional single-casing valves, as the integral chamber allows for pre-heating of the valves.

[0011] Turning to FIG. 1, a steam turbine valve system (or, valve system) 10 is shown according to an embodiment of the invention. As shown, valve system 10 may include a valve body 12 having a valve wall 14. Valve body 12 may further include a valve head 16, which, as is known in the art, may be used to control an amount of steam passed through the working portion of valve body 12. Other conventional components in a steam turbine valve include a valve stem 15, a control valve head 17, a valve seat 19, a balance chamber 21, a strainer 23, and a control valve bushing 25. These components have not been described herein for brevity, but it is understood that when considered in view of valve system 10, these components may perform substantially similarly as in a conventional steam turbine valve.

[0012] In contrast to conventional steam turbine

valves, valve system 10 may include a valve wall 14 having a pressure chamber (or, chamber) 18 substantially contained therein. That is, pressure chamber 18 may be formed within the valve wall 14, such that pressure chamber 18 is substantially contained between an outer surface 20 of valve wall 14 and an inner surface 22 of valve wall 14. Pressure chamber 18 may have an inlet 24 for receiving a pressurized fluid (e.g., steam) and an outlet 26 for exhausting the pressurized fluid. Inlet 24 may include, or be fluidly attached to an inlet port 28, and exhaust 26 may include, or be fluidly attached to an outlet port 30. Inlet port 28 and outlet port 30 may allow for ease of attachment and/or removal of one or more conduits with inlet 24 and outlet 26, respectively. Further inlet port 28 and outlet port 30 may allow for effective sealing of inlet 24 and outlet 26, respectively, when desired.

[0013] As shown and described herein, pressure chamber 18 may be integral with valve wall 14. That is, in one embodiment, pressure chamber 18 may be integrally cast with the single-wall (valve wall 14) design shown. For example, a mold (including e.g., a ceramic) may be formed including a coring substantially resembling the pressure chamber 18. After casting and solidifying the valve wall material (e.g., a metal such as steel, iron, etc.), the coring may be removed to form valve wall 14 including pressure chamber 18. In another embodiment, portions of valve wall 14 may be welded or otherwise adjoined (e.g., via forging, plating, etc.) to form pressure chamber 18 within.

[0014] With continuing reference to FIG. 1, valve head 16 may include a valve head exhaust 32, which may include, or be fluidly attached to a valve head exhaust port 34. Valve head exhaust port 34 may be fluidly connected to a leak-off conduit 36, which may allow for pressurized leak-off fluid (e.g., steam) to exit valve head 16 and reduce internal pressure inside the valve wall 14. Leak-off conduit 36 may have one or more portions (e.g., 36A, 36B), and one or more of the portions (e.g., 36B) may be configured to provide the pressurized fluid (e.g., steam) from valve head 16 (and specifically, from valve head exhaust port 34) to pressure chamber 18 (via inlet 24 and inlet port 28).

[0015] Also shown in FIG. 1 is an exhaust conduit 38, fluidly connected to outlet 26 (via outlet port 30). Exhaust conduit 38 may allow for the pressurized fluid that enters chamber 18 to exit the chamber 18 and flow downstream (e.g., to an ambient exhaust or to a re-heater, not shown). Exhaust conduit 38 is shown including a drain 40, which may allow for condensate from the pressurized fluid to drain from exhaust conduit 38 and avoid build-up in exhaust conduit 38. Exhaust conduit 38 and leak-off conduit 36 may each include one or more isolation valves 42. In one embodiment, exhaust conduit 38 and leak-off conduit 36 may be fluidly connected at a location downstream of isolation valves 42.

[0016] In an alternate embodiment, as shown in phantom in FIG. 1, an external pressurized fluid source 44 (external to the valve system 10) may be fluidly connect-

ed to inlet 24 (e.g., via a supply conduit 46 fluidly connected to leak-off conduit 36B) of pressurized chamber 18. In one embodiment, external pressurized fluid source 44 may include an auxiliary boiler, a heat recovery steam generator (HRSG), or another source of pressurized fluid. While shown including leak-off conduit 36A, it is understood that embodiments employing external pressurized fluid source 44 and supply conduit 46 may not include a leak-off conduit. That is, valve leak-off steam may not be used as a fluid supply to pressurized chamber 18 in some embodiments. In other embodiments, both leak-off steam and the external pressurized fluid may be used (e.g., as a combined fluid) to supply pressurized chamber 18.

[0017] In practice, valve system 10 may allow for a reduction of the pressure imbalance across valve wall 14. That is, as the pressurized fluid provides a positive pressure inside valve body 12 (e.g., across inner surface 22), pressure chamber 18 may provide a positive pressure across valve wall 14, opposing the positive pressure applied to inner surface 22 from inside valve body 12. This counter-pressure may help to reduce the mechanical stress experienced by valve wall 14, which may provide advantages over conventional valve systems. For example, pressure chamber 18 may be utilized to provide pre-warming steam (e.g., as leak-off from valve head exhaust 32 or from external pressurized fluid source 42) through valve wall 14 during start-up of a steam turbine system including valve system 10. In this case, pre-warming steam may flow through pressure chamber 18 and allow for heating of valve wall 14. As valve wall 14 warms due to the flow of steam through pressure chamber 18, the internal temperature of the valve wall 14 will increase. This will allow the inner surface 22 (and outer surface 20) of valve wall 14 to sufficiently warm before higher temperature, higher pressure steam begins to flow through valve body 12 across that inner surface 22.

[0018] Where inner surface 22 is effectively pre-warmed, the thermally-induced transient stresses caused by high pressure, high temperature steam flowing through valve body 12 can be reduced. In some cases, this pre-warming effect can increase the operational lifetime of valve body 12. Further, pre-warming of valve wall 14 may allow for faster start-up of a steam turbine system including valve system 10, as higher temperature, higher pressure steam may be forced through valve body 12 more quickly than in conventional valves.

[0019] In contrast to conventional single-shell valve casings, valve system 10, and specifically, pressure chamber 18, allows for the introduction of positive pressure within valve wall 14 to counteract the internal fluid pressure applied to inner surface 22. This may allow for, among other things, an extended operational lifetime for the valve body 12. While the valve body 12 shown and described with reference to FIG. 1 requires the additional step(s) associated with forming pressure chamber 18 within valve wall 14 (via, e.g., casting or other fabrication methods), valve body 12 can be formed with less material

and complexity than conventional double-shell valve casings. As such, valve system 10 may allow for a reduction in costs as compared to the conventional double-shell valve casing, while improving the performance characteristics of the valve body as compared with the conventional single-shell valve casings.

[0020] It is understood that while FIG. 1 shows a valve system according to an embodiment, other configurations of valve system 10 are also possible. For example, pressure chamber 18 may be formed in any section of valve wall 14, and multiple pressure chambers 18 may be formed in one or more sections of valve wall 14. Where multiple pressure chambers 18 are formed in valve wall 14, one or more of those pressure chambers 18 may be fed by valve leak-off steam (e.g., from valve head 16) or an external pressurized fluid source 44. Further, where multiple pressure chambers 18 are formed in valve wall 14, at least one of those pressure chambers 18 may be fed by a distinct source than the other pressure chamber(s) 18.

[0021] Turning to FIG. 2, a steam turbine system 110 is shown according to an embodiment. As shown, steam turbine system 110 may include a plurality of steam turbine sections e.g., a high-pressure/intermediate pressure (HP/IP) section 130, a double-flow low pressure steam turbine section 120 and one or more valve systems 10 for supplying steam to the steam turbine sections 120, 130. It is understood that low pressure section 120 and HP/IP section 130 may be any conventional HP/IP steam turbine sections or low pressure sections. Valve system 10 may supply steam to steam turbine sections 120, 130 from e.g., external pressurized fluid source 44 (such as an auxiliary boiler or HRSG). Additionally, valve system 10 may supply steam from HP/IP steam turbine 130 to external pressurized fluid source 44 (e.g., where external pressurized fluid source 44 is an HRSG, indicated by phantom conduit line), to a condenser 140 or to atmosphere (not shown). In any case, valve system 10 may allow steam turbine system 110 to perform more efficiently, by, among other things, improving the start-up time of steam turbine system 110 and improving the reliability and operational life of one or more valves employing the teachings described herein. It is understood that while steam turbine system 110 is shown including valve system(s) 10 connected to conduits for low pressure section 120 and HP/IP section 130, in one embodiment, valve system 10 may be primarily used in conduits for the HP/IP section 130 (and particularly, to the high-pressure section). It is further understood that additional conventional conduits and components may be omitted for clarity.

[0022] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the disclosure. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, in-

tegers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0023] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

20 Claims

1. A valve system (10) for supplying steam, comprising:
 - a valve body (12); and
 - a pressure chamber (18) substantially contained within a wall (14) of the valve body (12), the pressure chamber (18) having an inlet (24) for receiving a pressurized fluid.
2. The valve system (10) of claim 1, wherein the pressure chamber (18) further comprises an outlet (26) for exhausting the pressurized fluid.
3. The valve system (10) of claim 2, further comprising a valve head (16) including a valve head exhaust (32).
4. The valve system (10) of claim 3, further comprising a leak-off conduit (36) fluidly connected to the valve head exhaust (32) and the inlet (24), the leak-off conduit (36) configured to provide the pressurized fluid from the valve head (16) to the pressure chamber (18).
5. The valve system (10) of claim 4, wherein the pressurized fluid is leak-off steam.
6. The valve system (10) of claim 4, further comprising an exhaust conduit (38) fluidly connected to the outlet (26), the exhaust conduit (38) having a drain (40).
7. The valve system (10) of claim 6, wherein the leak-off conduit (36) and the exhaust conduit (38) each include an isolation valve (42), and wherein the leak-off conduit (36) is fluidly connected to the exhaust conduit (38) downstream of each of the isolation valves (42).

8. The valve system (10) of any of the preceding claims, further comprising an external pressurized fluid source (44) fluidly connected to the inlet (24).
9. The valve system of claim 8, further comprising a supply conduit for providing the pressurized fluid from the external pressurized fluid source to the inlet. 5
10. The valve system of claim 9, wherein the external pressurized fluid source is an auxiliary boiler system. 10
11. A steam turbine system (110) comprising:
- a steam turbine section (120, 130); and
- a valve system (10) according to any of the preceding claims. 15

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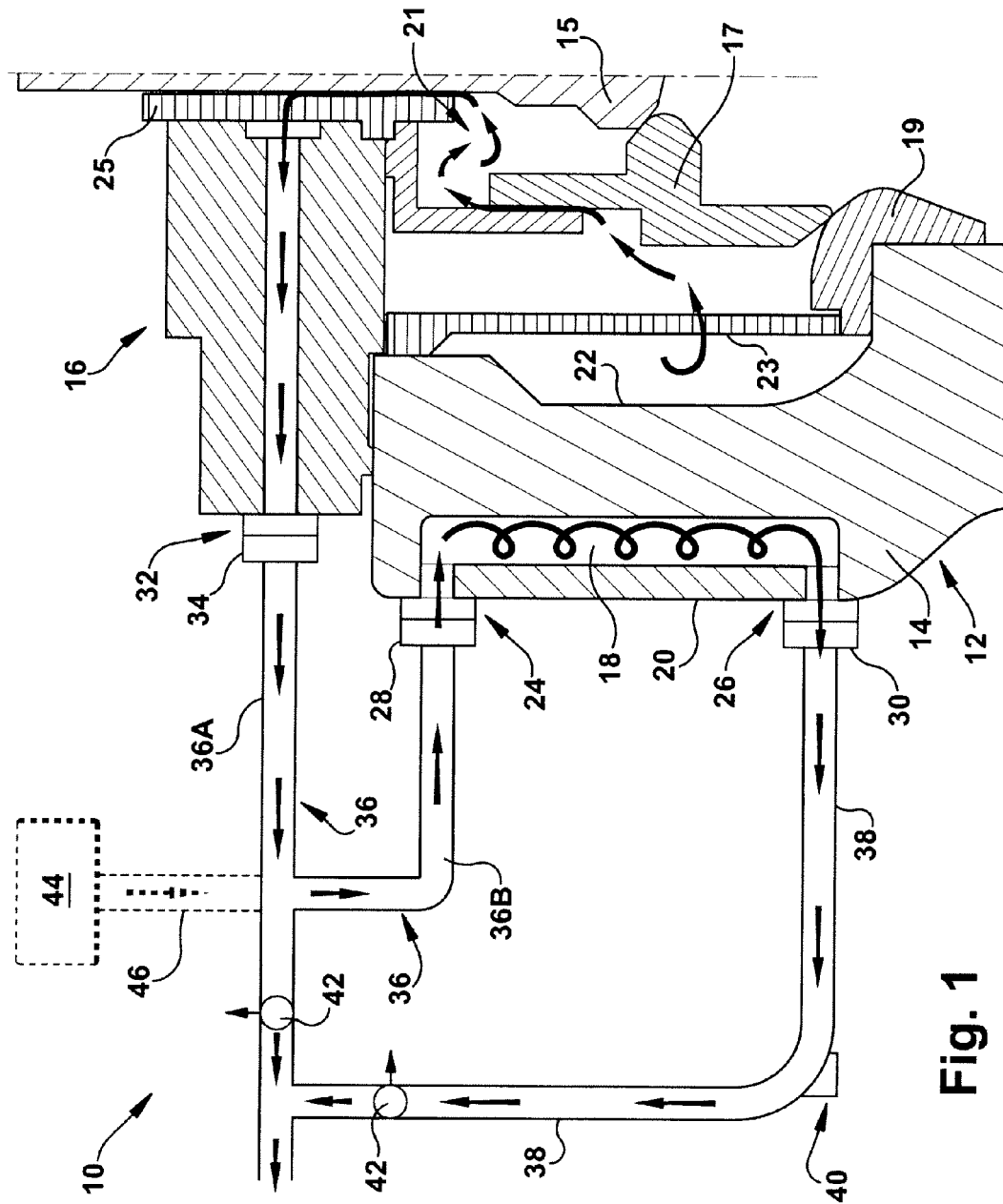
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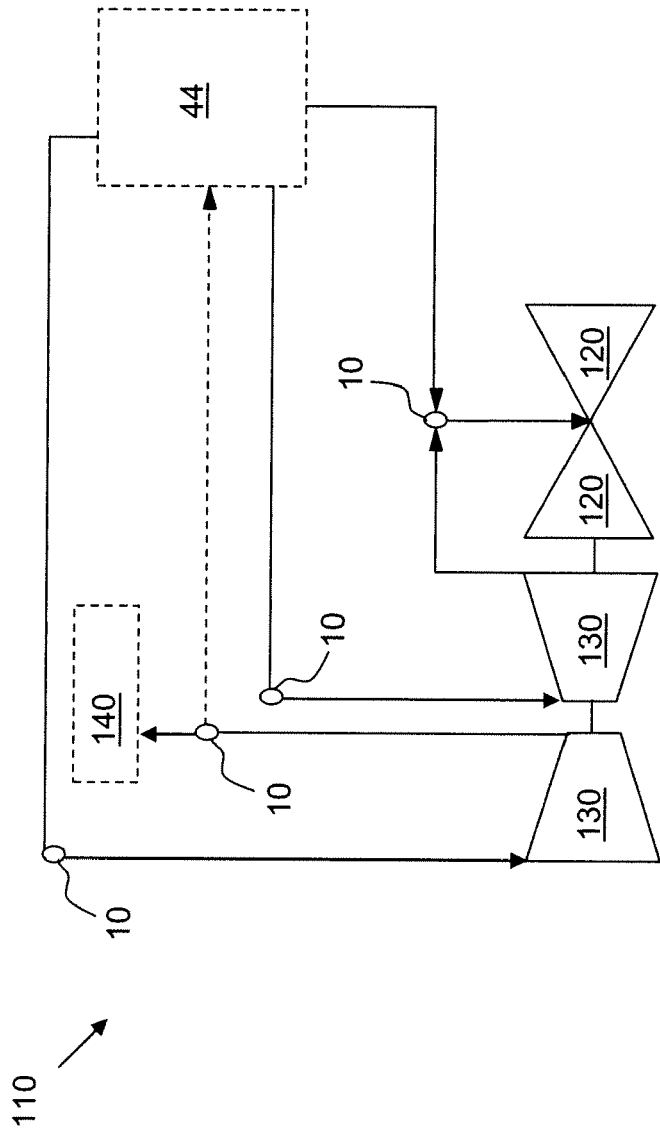


FIG. 2