

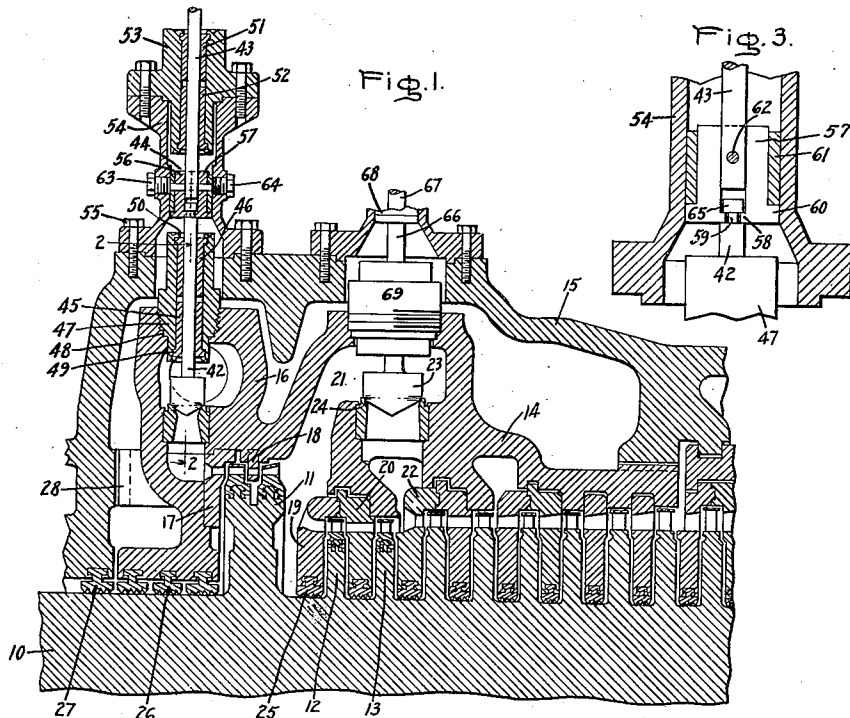
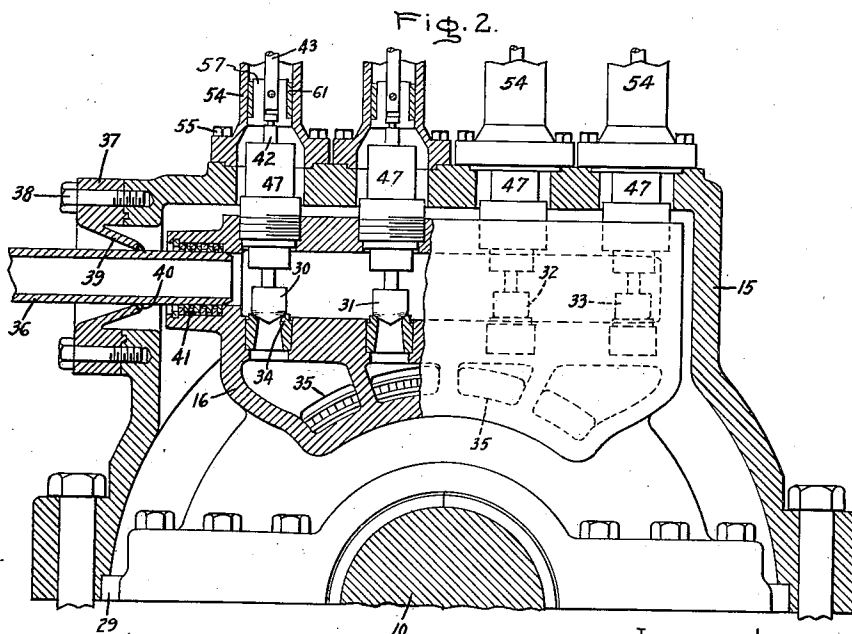
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DOUBLE SHELL ELASTIC FLUID TURBINE

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DOUBLE SHELL ELASTIC FLUID TURBINE

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The present invention relates to double shell elastic fluid turbines such as are used for operation with elastic fluid at an inlet temperature of the order of 900° F. and above. In such arrangements it is customary to provide an inner shell at least with regard to some of the high pressure stages and to connect the space formed between the inner and outer shells to a low pressure stage at which the temperature of the fluid is about one half of the inlet temperature. In this manner the temperature drop across the inner and outer casing is about one half the total temperature drop and the pressure drop across each shell is likewise substantially reduced.

Difficulties heretofore have been experienced in conducting live elastic fluid to the inner casing and in properly sealing the inlet valves to the casing and in assembling and dismantling these elements.

The general object of my invention is to provide an improved construction and arrangement of double shell turbines whereby the aforementioned drawbacks are substantially overcome and leakage of elastic fluid is reduced to a minimum. A more specific object of my invention is to provide an improved coupling and sealing arrangement for valve stems whereby such stems are effectively sealed and may be readily assembled and at least partly dismantled without requiring complete dismantling of a turbine casing.

For a consideration of what I believe to be novel and my invention, attention is directed to the following description and the claims appended thereto in connection with the accompanying drawing.

In the drawing Fig. 1 illustrates a sectional view of a double shell turbine embodying my invention; Fig. 2 is a section along line 2—2 of Fig. 1; and Fig. 3 is an enlarged view of a detail of Figs. 1 and 2.

The arrangement comprises a rotor having a shaft 10 and a plurality of bucket wheels 11, 12, 13 with disks integrally formed with the shaft 10. The rotor is enclosed within a casing which includes an inner shell 14 enclosing the high pressure portion of the rotor and an outer shell 15 enclosing the inner shell 14 and also the low pressure portion of the rotor. The inner shell 14 has an inlet portion forming a valve chest 16 from which elastic fluid may be conducted through a nozzle plate 17 to the first bucket wheel 11. This first stage wheel in the present instance has two rows of buckets and elastic fluid discharged from the first row is conducted to the second row by a diaphragm 18 supported

on the shell 16. The latter also serves as a support for other diaphragms 19, 20 for conducting elastic fluid to the stages 12, 13, etc.

Not all of the fluid discharged from the double row first stage wheel 11 is conducted through the diaphragm 19 to the second bucket wheel 12 but part of the fluid discharged from the first or high pressure stage may be bypassed through a channel 21 formed by the inner shell to a low pressure, in the present instance the third stage diaphragm 22. The bypassing of fluid through the channel 21 is controlled by a valve 23 having a movable element in cooperative relation with a valve seat 24 formed on or secured to the inner shell 14. Details of the sealing arrangement and the design of the valve 23 will be described hereinafter.

The diaphragms are sealed to the shaft by means of suitable known type labyrinth packings 25 to prevent leakage of fluid along the shaft between successive stages. End portions of the inner and outer shells are sealed to the shaft 10 by labyrinth packings 26 and 27 respectively to prevent leakage of fluid along the shaft to the atmosphere. The inner shell 14 has brackets 28 guided in slots of the outer shell. Side portions of the inner shell have brackets 29 engaging and supported in recesses of the outer shell.

The inlet chest 16 is integrally formed with the inner shell 14. The control of elastic fluid from the chest to the first stage nozzle plate 17 is accomplished by four valves 30, 31, 32 and 33. Each of these valves is arranged in cooperative relation with a valve seat 34 formed on the chest to control the flow of fluid to one of four sections 35 of the first stage nozzle blade. Thus the arrangement constitutes a partial admission arrangement whereby the flow of fluid to several sections of the first stage is controlled. Elastic fluid is conducted to the chest from a source of fluid by a conduit 36 secured to the outer casing and sealed to an opening in the chest. More specifically the conduit is supported by and fused to a ring 37 fastened to the outer shell by bolts 38. The ring has an inner conical projection 39 with an edge secured to the conduit 36 by a weld 40. The conical projection 39 forms a thin wall, thus reducing its stiffness to a minimum to permit slight movement of the conduit 36 relative to the outer shell. An inner end portion of the conduit 36 projects into a cylindrical opening or bore in the chest 16 and is sealed thereto by a known type of packing 41 comprising a stack of a plurality of pairs of rings adjacent each other with one ring of each pair engaging the wall of

the chest and forming a clearance with the conduit and the other ring of each pair engaging the conduit and forming a clearance with the wall or bore in the chest.

Each valve 30 to 33 and 23 has a stem consisting of two parts, a lower or inner stem 42 securely fastened to the valve disk and an outer stem portion 43 in substantial alignment with the inner stem and connected to the inner stem 42 by a coupling device 44. The inner stem is guided and sealed to the inner shell by aligned sleeves 45 and 46 held within a bushing 47, which latter is screwed into an opening 48 of the inner shell and has an upper portion concentrically spaced from a bore in the outer shell 15 to permit relative movement between them. As the inner stem 42 is of considerable length and in view of the difficulty to form such long packing and guide sleeves, two sleeves 45, 46 are provided which are inserted from opposite ends into the bushing 47. Each sleeve has a flanged end portion 49 seated in a recessed end portion 50 of the bushing 47 and in the present instance held in position by peening over the end portions 50 of the bushing 47. The upper stem 43 is similarly guided by guide and packing sleeves 51 and 52 securely held in a flanged cylinder 53. The latter projects into and is secured to the upper end of a clamp and guide casing 54 which has a lower flanged portion fastened to the outer shell by bolts 55. The clamp or coupling device 44 for connecting the lower and upper stems comprises a clamping cylinder having two halves 56 and 57 engaging each other along a plane through the center of the stems. The lower portion of the cylinder 56, 57 has an inwardly turned flange 58 projecting into an inner groove 59 in the upper end portion of the lower stem 42 and an outwardly turned flange 60 projecting towards the wall of the clamp casing 54. The cylinder 56, 57 is surrounded by another cylinder 61 resting on the outer flange 60. The cylinder 56, 57 and the upper stem 43 and the cylinder 61 are secured together by a pin 62. In order to permit dismantling of the clamping device, diametrically opposite portions of the cylinder 54 are provided with plugs or closing members 63 and 64 respectively. These plugs ordinarily prevent sidewise movement of the pin 62 and upon removal of the plugs 63, 64 the pin 62 may be driven out whereby the upper stem may be lifted and removed from the lower stem.

The groove 59 in the upper part of the lower stem 42 defines shoulders engaged by the annular projection 58 of the cylinder 56, 57. An end portion 65 of the upper stem rests on the annular flange 58 acting as a support for the lower stem and the valve disk attached thereto. The end portion 65 and the necked-in portion of the lower stem 42 have slight radial clearance with the adjacent portions of the cylinder 56, 57 and substantially tight fit in axial direction, thus permitting angular displacement between the lower and upper stems 42, 43 respectively but substantially preventing relative axial movement between them.

During assembly the cylinder halves 56, 57 are assembled with the lower stem 42, and the cylinder 61 is slid over the cylinder halves 56, 57, thus holding the latter in position. Thereupon the clamp casing 54 is fastened to the outer shell by the bolts 55. Finally, the upper stem 43 with the flanged cylinder 53 are inserted into and secured to the clamp casing 54 by inserting the holding pin 62 through the plug openings to

connect the clamping device with the upper stem 43. Thereupon the plugs are screwed into the clamp casing 54.

For the purpose of dismantling, as pointed out above, the plugs are removed and the pin 62 is driven out of the clamping device. Upon removal of the bolts 55 the clamp casing together with the upper stem may be lifted and removed from the lower stem and the clamping device. Thus, with this improved coupling device it is no longer necessary completely to disassemble the entire valve arrangement to permit dismantling of the outer turbine casing. This is important in an arrangement as in the present instance in which the valve and the valve chest are associated with the inner shell of the turbine.

The by-pass valve 23 projects through and has a lower stem 66 and an upper stem 67 connected by a coupling device 68 corresponding to the coupling device 44 for the inlet valves 30 to 33. The lower stem 60 projects through a bushing 69 corresponding to the bushing 47 for the valves 30 to 33. The upper ends of the inlet valves and the by-pass valve may be controlled in known manner by any suitable control mechanism, not shown.

The clamping device for connecting the valve stems broadly constitutes an arrangement for connecting two substantially aligned stems or shafts within a casing whereby one stem may be connected to and disconnected from the other stem without requiring removal of the other stem and the clamping device from the casing. The only element of the clamping device that is to be removed is the crosspin projecting through openings in the split cylinder, the holding cylinder, and one of the stems. The other stem forms a shoulder engaging a projection on the split cylinder.

Having described the method of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that the apparatus 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. A valve stem coupling arrangement comprising a lower stem having a recessed end portion, an upper stem in substantial alignment with the lower stem, a cylinder split along a plane through its axis and having an end portion with an inner and an outer flange, the inner flange engaging the recessed end portion of the lower stem, the upper stem being slidable into the split cylinder, a holding cylinder surrounding the split cylinder and engaging the outer flange, and a pin connecting the upper stem to the split cylinder and the outer cylinder, disassembly of the pin permitting removal of the upper stem without necessitating disassembly of the holding and split cylinders.

2. A casing, two stems having aligned end portions enclosed within the casing, and means enclosed within the casing to connect the stems and to permit dismantling of one of them without requiring dismantling of the other and the casing, said means comprising a split cylinder having an intumed flange engaging a shoulder formed on one of the stems and forming an opening for receiving the other stem, a holding cylinder surrounding the split cylinder, a crosspin securing the other stem to the split cylinder and to the holding cylinder, and closing members in the

casing which upon removal permit insertion and removal of the pin.

3. A casing having an opening, two stems having aligned end portions enclosed within the casing, and coupling means enclosed within the casing to connect the stems and to permit dismantling of one of them without requiring dismantling of the other and the casing, said means comprising a split cylinder having an inturned flange engaging a shoulder formed on one of the 10

stems and forming an opening for receiving the other stem, a holding cylinder surrounding the split cylinder, and a crosspin accessible through said opening in the casing for securing the other stem to the split cylinder and to the holding cylinder, removal of the crosspin through said opening permitting dismantling of the other stem without necessitating dismantling of the split cylinder and the holding cylinder.

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