Fluid flow control valves arranged in the valve chest of an elastic fluid turbine are formed with stems noncircular in cross section having slidable engagement with noncircular apertures formed in the valve lifting bar whereby the valves are prevented from spinning on their axes. The valve stems are formed with enlargements integrally united with the stems. The bar lifting rods are formed with enlargements integrally united therewith, the rod enlargements being spaced apart axially a distance equal to the vertical dimension of the lifting bar.

4 Claims, 7 Drawing Figures
TURBINE INLET VALVE STRUCTURE

BACKGROUND OF THE INVENTION

In elastic fluid operated turbines employing a linear series of valves controlling the admission of fluid to the turbine, valve failure occurs on occasion. The valve failure develops due to the magnitude of vibration set up in the valve structure by the high velocity flow of fluid through the valve chest during operation of the turbine and also due to the spinning of the valves about their axes.

Formerly the upper ends of the valve stems were threaded for the reception of nuts to provide enlargements engaged by the valve lifting bar for movement of the valves from their respective seats. The excessive vibration resulted in failure of the valve stems in the threaded area. That area of the problem is solved by the invention set forth in U.S. Pat. No. 3,625,241 to J. R. Shields, wherein the enlargements at the upper ends of the valve stems are integrally united with the stems. However, the construction of that patent does not deal with the problem of valve stem failure due to the spinning of the valves in the lifting bar.

In one conventional arrangement, the valve lifting bar was not restrained against vertical movement on the bar lifting rods, in that arrangement the bar vibrated relative to the lifting bar. In another arrangement, the lower or inner ends of the lifting rods were threaded for the reception of nuts for engagement with the lifting bar. In that arrangement, the threaded portions of the lifting rods developed failure.

SUMMARY OF THE INVENTION

This invention is directed to an admission valve structure for fluid turbines wherein the lifting bar is of two-piece construction. The pieces being clamped together in abutting relation, the abutting surfaces extending in a vertical plane. The lifting bar structure is formed with a linear series of noncircular apertures, preferably of rectangular form, and the valve stems are of cross sectional form comparable to the apertures in the lifting bar structure, whereby the valves are prevented from rotation. The lifting rods are formed with axially spaced apart enlargements which are integrally united with the rods. The valve stems and the lifting rods are inserted in the apertures of the lifting bar structure and the parts thereof are clamped together by fastening means, such as screws.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings,
FIG. 1 is a vertical sectional view of the valve chest with parts of the valve actuating mechanism shown in elevation, the view is taken on a line corresponding to line 1—1, FIG. 2;
FIG. 2 is a view taken on line 2—2, FIG. 1;
FIG. 3 is a view in perspective of one part of the valve lifting bar structure;
FIG. 4 is a view in perspective of the other mating part of the valve lifting structure;
FIG. 5 is a view taken on line 5—5, FIG. 1;
FIG. 6 is a view in perspective of one of the valves; and
FIG. 7 is a view in perspective of the lower portion of one of the lifting rods.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2, 10 designates a portion of the turbine casing having a surface 11 forming the bottom wall of the valve chest 12. The chest 12 is fixedly secured in fluid type relation to the casing 10 as by screws 13.

The bottom wall 11 of the valve chest is formed with a plurality of fluid passages 14—17. A valve seat 20 is positioned in each of the passages 14-17. The fluid passages and the valve seats are arranged in a linear series.

The top wall 23 of the valve chest is provided with guide bushings 25 in which sleeves 26 are mounted. Lifting rods 27 are slidably mounted in the sleeves 26 which may be replaced when they become worn. The upper ends of the rods 27 are threaded into rod ends 30, connected to actuating arms 31 pivotally mounted at 32 on supports 33, 34. The rod ends 30 are pivotally connected to the arms 31 by links 35.

The inner ends of the lifting rods 27 are connected to a lifting bar structure 40. The bar structure 40 consists of two mating parts 41, 43, FIGS. 3 and 4. These parts are of elongated configuration and are clamped together by screws 44 extending through apertures 45 formed in the bar part 43 and threaded into apertures 46 formed in the part 41.

The bar structure 40 is formed with vertically disposed apertures, each aperture being arranged in axial registration with a valve seat 20. In the arrangement shown in FIGS. 3 and 4, the lifting bar part 41 is formed with recesses 50, rectangular in cross section.

A valve 53 is provided for each of the valve seats 20. Each valve is formed with an integral stem 54 having a cross sectional form comparable to the cross sectional form of the apertures 50. As shown in FIG. 6, the stem 54 is rectangular in cross section and dimension for a sliding fit in the apertures 50 of like cross sectional form.

The upper ends of the valve stems 54 are provided with enlargements 57 which are integrally united with the stems. The valve structures may be formed integrally by drop forging, or machined from a workpiece, or the enlargements 57 may be joined to the stems as by welding. The spacing of the enlargements 57 from the valve 53 varies from one valve structure to another as is conventional practice, see FIG. 1, whereby the valves are lifted sequentially from the seats 20 upon upward movement of bar 40.

The lower or inner portions of the lifting rods 27 are formed with enlargements 60, 61, FIG. 7. These enlargements are also integrally united with the lifting rods and are spaced apart axially a distance comparable to the vertical dimension of the lifting bar.

As shown in FIGS. 5 and 7, the portion 63 of the lifting rods intermediate the enlargements 60, 61 are of circular cross section. Preferably the diameter of the rod portions 63 are a close fit in the recesses 50, and the enlargements 60, 61 are spaced apart axially such that they are situated in close proximity to the upper and lower sides of the bar structure 40.

With the bar structure illustrated, the portion 63 of the lifting bars are placed in a pair of the recesses 50 as illustrated in FIG. 1. The valve stems 54 are placed in the remaining recesses 50. The mating part 43 of the valve structure is then positioned on the part 41, overlapping the open sides of the recesses 50, the part 43 is
fixedly secured to the part 41 by the screws 44. The part 41 may be formed with ribbed portions 67, cooperable with a slot formed in the abutting surface of the part 43, and having upper and lower side walls 68, 69. With that arrangement vertical forces are not transmitted directly to the fastening screws 44, and the parts 41, 43 are maintained in proper alignment.

The arms 31 are joined, rearwardly of the pivot 32, by a vertically disposed web 71, the web 71 extends laterally from the support 33 and is integrally connected to upper and lower rearwardly extending webs 72, 73. The portions of the web 71, 72, 73 extending laterally from the support 33 are provided or formed with a bifurcated boss 75. A rod end 76 is pivotally connected to the boss 75 and is adjustably connected to the upper end of the actuating rod 77. Vertical reciprocation is imparted to the rod 77 by a servomotor device 80 attached to the turbine casing. With this arrangement, vertical reciprocation is transmitted to the lifting rods 27 to move the lifting bar structure 40 vertically for movement of the valves 53 into and out of engagement with the seats 20.

By the structure embodied in our invention, vibration in the lifting bar structure, the valves and the lifting rods is reduced to a negligible amount and fracture of the parts is eliminated.

While we have described a preferred embodiment of our invention, it is to be understood that the invention is not limited thereto, but may be otherwise embodied within the scope of the following claims.

We claim:

1. A fluid admission valve structure for elastic fluid turbines comprising a valve chest having a top wall and bottom wall, said bottom wall being formed with a linear series of vertically disposed passages, a valve seat in each of said passages, a valve lifting bar means extending above said series of passages, said lifting bar means being formed of two parts, fastener means detachably securing said parts together, said lifting bar means being formed with a noncircular aperture axially aligned with each of said passages, a valve cooperative with each of said seats, each of said valves having an integral stem slidably mounted in a aperture in said lifting bar means, said stems having a noncircular cross sectional form comparable to the noncircular form of said apertures, each of said stems being formed with an enlarged head portion integrally united thereto, said head portions being engageable by said lifting bar means upon upward movement thereof, a pair of bar lifting rods fixed to said lifting bar means and being slidably mounted in the top wall of said valve chest, said rods extending outwardly from said top wall and being connected to means operable to impart vertical reciprocation thereto for vertical movement of said lifting bar means and like movement of said valves into and out of engagement with said seats.

2. A valve structure as set forth in claim 1 wherein the stems of said valves are insertable in and removable from said apertures upon separation of the parts of said valve lifting bar means.

3. A valve structure as set forth in claim 1 wherein said apertures in said valve lifting bar means are rectangular in cross sectional form.

4. A valve structure as set forth in claim 1 wherein said valve lifting rods are formed with enlargements integrally united thereto and spaced apart axially a distance comparable to the vertical dimension of said lifting bar means.