

July 7, 1942.

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2,289,239

VALVE FOR GOVERNOR APPARATUS

Filed July 30, 1940

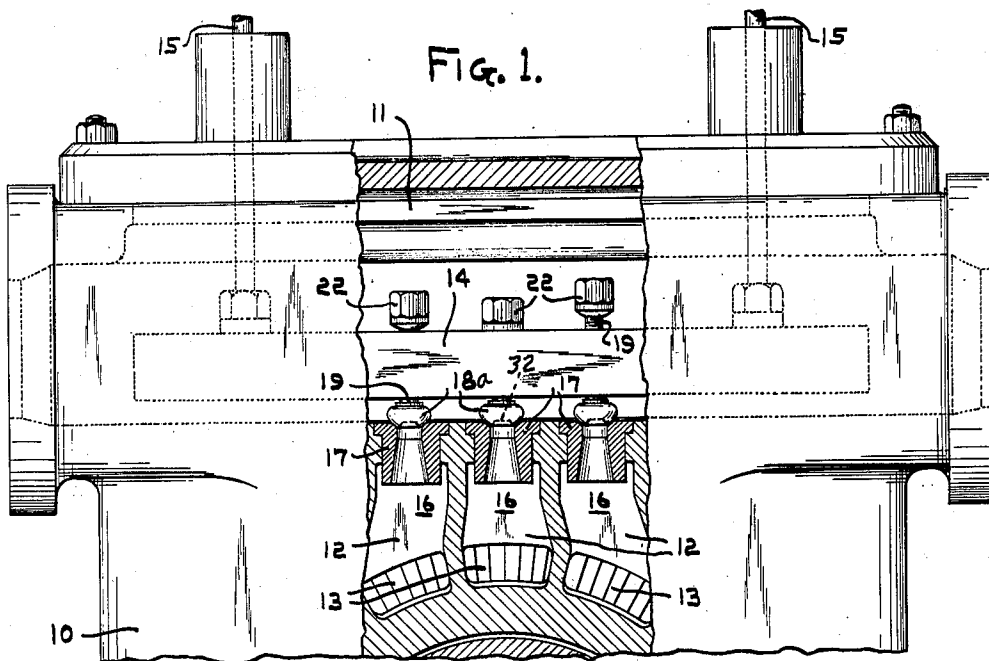
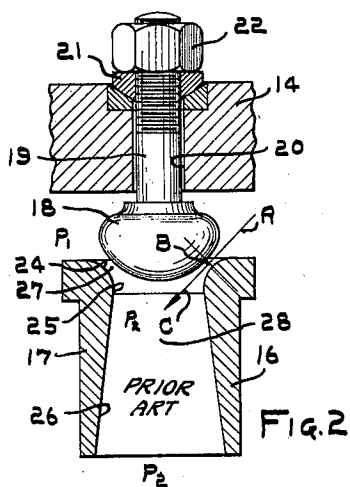
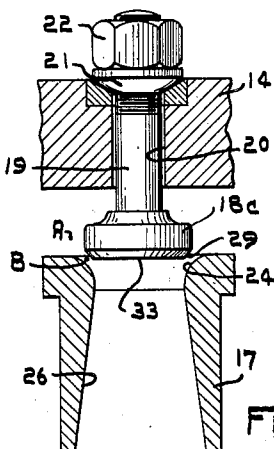
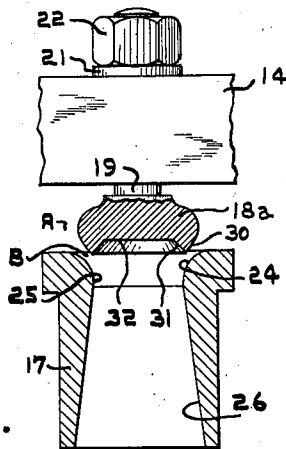
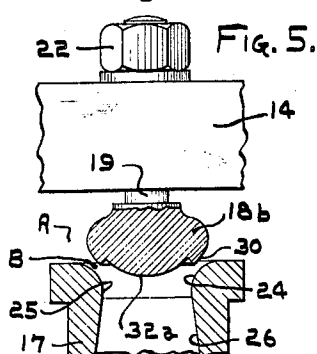
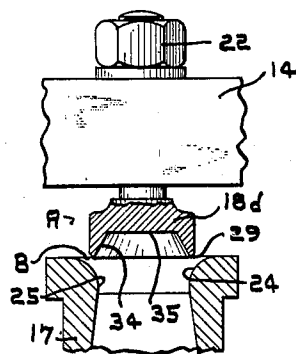


Fig. 4.

Fig. 6.

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2,289,239

VALVE FOR GOVERNOR APPARATUS

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Application July 30, 1940, Serial No. 348,362

5 Claims. (Cl. 251-27)

This invention relates to a governor-controlled admission valve organization for a prime mover, more particularly for an elastic fluid turbine, in which each of the valves is of the diffuser type, and it has for an object to provide apparatus of this character wherein the movable plug member of each valve shall be free of vibration under all operating conditions.

A more particular object of the invention is to provide a diffuser valve wherein the movable plug member cooperates with the converging wall portion of the diffuser to provide an initial annular passageway portion of the diffuser passageway, but in which the bottom surface of the plug diverges abruptly away from the diffuser convergent wall portion so as to minimize the diffuser or velocity-pressure conversion effect of the annular passageway portion and thereby prevent vibration of the plug member under certain conditions of operation.

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

Fig. 1 is a fragmentary view, partly in section, showing a governor valve arrangement for an elastic fluid turbine wherein each of the valves is of the diffuser type;

Fig. 2 is a detail section view showing a known type of diffuser valve; and

Figs. 3, 4, 5, and 6 show diffuser valves of the improved type wherein the movable plug element is modified to avoid vibration.

In Fig. 1, there is fragmentarily shown, at 10, a steam turbine having a steam chest 11 connected by passages 12 to suitable nozzle groups 13. A movable member, for example, a lifting bar 14, is arranged within the steam chest for movement upwardly and downwardly by means of rods 15 operated by suitable governor mechanism, not shown.

The steam chest communicates with each of the passages 12 through diffuser valves, at 16, each diffuser valve including a diffuser 17 secured in any suitable manner to the steam chest or turbine structure and a movable plug 18. The plugs 18 have stems 19 extending upwardly therefrom and through openings 20, provided in the bar 14. Nuts 21 and 22 carried by the upper end of each stem 19 provide abutments for contact by the upper surface of the bar.

By suitable variation of the effective lengths of the stems 19 between the plugs 18 and the abutments at the upper ends thereof a desired

sequence of operation of the valves may be secured. Assuming that all of the valves are closed and that the bar is moved upwardly, then the valves will be opened as it engages the abutments thereof, the abutments being ordinarily adjusted for sequential operation of the valves to supply steam to the different nozzle groups. Assuming the turbine to be carrying its maximum load with all of the valves open and that the load drops, then the governor moves the bar downwardly, permitting the valves to close sequentially under the influence of gravity. The valves open and close in sequence as determined by the distance of adjustment of the abutments from the plugs thereof, the one having the shortest distance being the first to open and the last to close and the one having the longest distance being the last to open and the first to close.

Diffuser valves have been made like Fig. 2 in which the diffuser 17 has an interior wall including a portion 24 which converges from the inlet to the throat 25 and a portion 26 which diverges from the latter to the outlet. The plug 18 cooperates with the diffuser to provide a passageway including the annular portion 27 merging into the portion 28 of circular section. The plug has had a convex surface providing an annular passageway portion converging from the inlet region at A to the annular throat at B and then diverging from the latter to the exit region at C. Valves of this type have operated satisfactorily except in instances where the diffuser exit pressure P_2 exceeds about 60% of the diffuser inlet pressure P_1 , when the valve begins to lift away from its seat. Under such conditions, the annular passageway between the plug 18 and the converging wall portion 24 acts as a diffuser or venturi so that the pressure at B is lower than the pressure P_1 at C. The valve is then in unstable equilibrium and often oscillates violently with a circular mode of vibration. With the valve vibrating in this way, the steam flow causes forced oscillation thereof which has broken valve stems and destroyed the seating surfaces.

It has been found that if this type of valve is constructed and arranged so that the annular passageway portion ABC has no diffuser effect or capacity for velocity-pressure conversion, it will not oscillate, and this is accomplished by having the valve surface diverge rather abruptly away from the diffuser converging surface at the downstream side of the annular throat at B so as to avoid a diffuser or velocity-pressure conversion effect from B to C sufficient to set up vibration.

Abrupt divergence of surface of the plug with

respect to the diffuser converging surface for the above purposes may be effected by plugs 18a and 18b of Figs. 4 and 5, which are similar to Fig. 2 so far as convergence from the inlet region A to the throat region B is concerned, or, by a plug of the disc type, as at 18c and 18d as in Figs. 3 and 6, in which case the plug has a beveled or annular surface 29 cooperating with the converging surface 24 to provide an orifice type annular passage joining the regions A and C.

In Fig. 4, the rounded annular surface element 30 cooperates with the converging surface 24 to provide for the converging portion of the annular passage from the inlet region at A to the throat region at B, where it joins the periphery of the reentrant conical or annular bottom surface element 31 diverging abruptly away from the converging surface 24 or extending substantially transversely with respect to the latter, the surface element 31 being joined to the bottom surface element 32. Fig. 5 shows a structure which is similar to Fig. 4 except that, instead of a flat bottom surface element 32, the plug 18b has a convex bottom surface element 32a.

In Fig. 3, the disc plug 18c has a flat bottom surface 33 which diverges abruptly away from the diffuser converging surface 24, and Fig. 6 is similar except that the plug 18d has a reentrant annular bottom surface element 34 providing more abrupt divergence, the surface element 34 joining the bottom surface element 35.

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. In a valve of the diffuser type for controlling the flow of elastic fluid for a prime mover, a tubular member providing a passageway defined by a continuous and unbroken boundary surface including a convergent portion joined by a throat portion to a divergent portion, the divergent portion merging into the throat portion and the latter and the convergent portion being convexly curved in the direction of flow, said convergent portion of the boundary surface providing an annular valve seat, a plug valve member cooperating with the seat, means for moving the plug valve member toward and away from the seat to vary the valve flow area and providing for lateral movement thereof to insure of its being fully seated with the seat when the valve is closed, said plug valve member having an annular surface element cooperating with the convergent portion to provide an initial portion of said passageway which is annular and having a bottom surface element peripherally joining the annular surface element and diverging abruptly away from the convergent portion of the boundary surface so as to minimize the diffuser or velocity pressure conversion effect of the annular passageway portion and consequent plug valve member vibration when the outlet pressure of the passageway is in excess of about 60 per cent of its inlet pressure.

2. In a valve of the diffuser type for controlling the flow of elastic fluid for a prime mover, a tubular member providing a passageway defined by a continuous and unbroken boundary surface converging convexly from the inlet end to a throat and then diverging from the latter

to the outlet end, said convergent portion of the boundary surface providing a valve seat, a movable plug valve member cooperating with said valve seat, means for moving the plug valve member toward and away from the seat to vary the valve flow area and providing for movement thereof radially of the axis of the passageway to insure of its being fully seated with the seat when the valve is closed, said plug having a convexly-curved annular surface element cooperating with the convexly-curved convergent portion of the boundary surface to provide an initial portion of said passageway which is annular and which converges in the direction of flow and having a bottom surface element peripherally joining the annular surface element and diverging abruptly away from the convergent portion on the boundary surface so as to avoid vibration of the valve member when the outlet pressure of said passageway is in excess of about 60 per cent of its inlet pressure.

3. In a valve of the diffuser type for controlling the flow of elastic fluid for a prime mover, a tubular member providing a passageway defined by a continuous and unbroken boundary surface converging convexly from the inlet end to a throat and then diverging from the latter to the outlet end, said convergent portion of the boundary surface providing a valve seat, a movable plug valve member cooperating with said valve seat means for moving the plug valve member toward and away from the seat to vary the valve flow area and providing for movement thereof radially of the axis of the passageway to insure of its being fully seated with the seat when the valve is closed, said plug valve member having an annular surface element cooperating with the convexly-curved convergent portion of the boundary surface to provide an initial portion of said passageway which is annular and which converges in the direction of flow and having a first reentrant and conical bottom surface element having its periphery joined to the annular surface element and joined to the periphery of a second bottom surface element and said reentrant bottom surface element diverging abruptly away from the bottom wall portion so as to avoid vibration of the plug valve member when the outlet pressure of said passageway is in excess of about 60 per cent of its inlet pressure.

4. In a valve of the diffuser type for controlling the flow of elastic fluid for a prime mover, a tubular member providing a passageway defined by a continuous and unbroken boundary surface converging from the inlet end to a throat and then diverging from the latter to the outlet end, said convergent portion of the boundary surface providing a valve seat, a movable plug valve member cooperating with said seat means for moving the plug valve member toward and away from the seat to vary the valve flow area and providing movement thereof radially of the axis of the passageway to insure of its being fully seated with its seat when the valve is closed, said plug valve member being of the disc type and having a peripheral surface element joined by a beveled or conical surface element to a bottom surface element, said conical or beveled surface element cooperating with said convergent portion of the boundary surface to provide an initial annular portion of said passageway and said bottom surface element diverging abruptly away from the convergent portion of the boundary surface so as to avoid valve member vibra-

tion when the outlet pressure of said passageway is in excess of about 60 per cent of its inlet pressure.

5. In a valve of the diffuser type for controlling the flow of elastic fluid for a prime mover, a tubular member providing a passageway defined by a boundary surface converging from the inlet end to a throat and then diverging from the latter to the outlet end, said convergent portion of the boundary surface providing a valve seat, a movable plug valve member cooperating with said seat, means for moving the plug valve member toward and away from the seat to vary the valve flow area and providing for movement thereof radially of the axis of the passageway to insure of its being fully seated with the seat

when the valve is closed, said plug being of the disc type and having a cylindrical surface element joined by a conical or beveled surface element to a reentrant conical bottom surface element joined to the periphery of a bottom surface element, said conical or beveled surface element cooperating with said convergent portion of the boundary surface to provide an initial annular portion of said passageway and the reentrant bottom surface element diverging abruptly away from said convergent portion of the boundary surface so as to avoid valve vibration when the outlet pressure of said passageway is in excess of 60 per cent of its inlet pressure.

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