Nov. 28, 1950 L. E. TELBIZOFF 2,531,896

VARIABLE AREA NOZZLE

Filed Oct. 12, 1946

Fig. 1

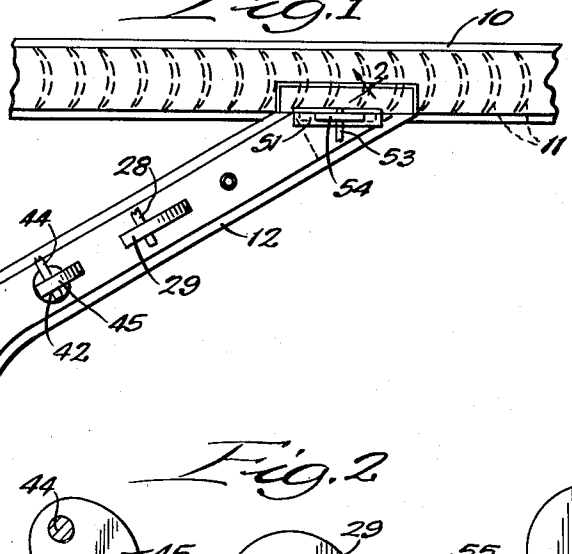


Fig. 2

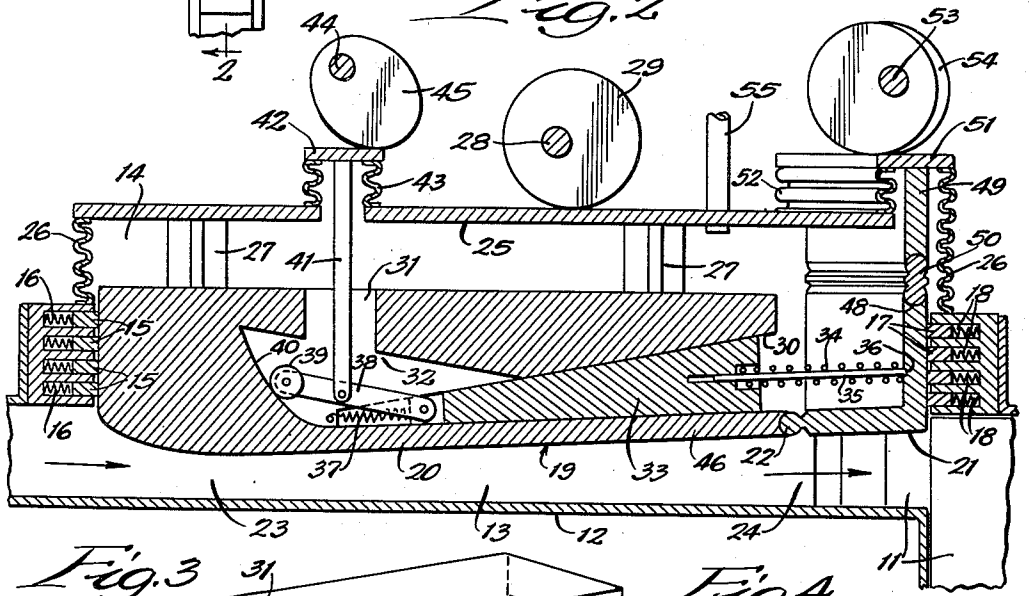


Fig. 3

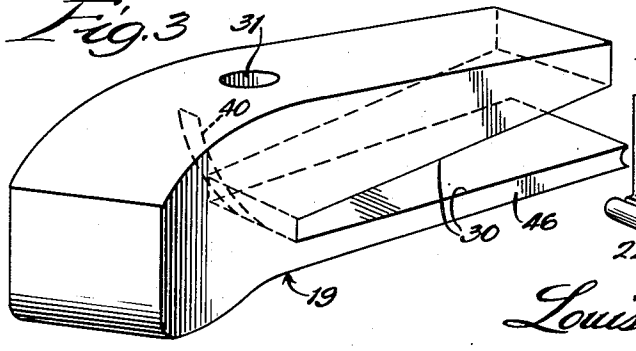
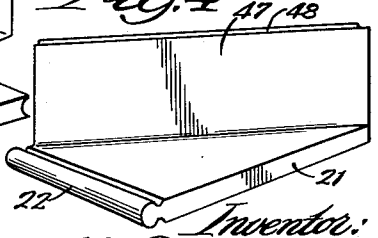


Fig. 4



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VARIABLE AREA NOZZLE

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6 Claims. (Cl. 138—45)

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This invention relates to a variable area nozzle or fluid passage control valve. The invention is particularly useful in controlling the flow of steam, gas, or other fluid directed against the blades of a turbine, etc.

In the operation of turbines by steam or other fluid, it is common practice today to employ nozzles fixed around the periphery of the entrance to the turbine in such a way that the fluid upon leaving the nozzles strikes the first row of blades. The nozzles are all of the same size and do not vary in area. The throat and exit areas of the nozzles after installation remain fixed.

The nozzles are designed initially to give the correct amount of steam entering the turbine to give the maximum desired power, say, 500 kilowatts.

In the operation of the above structure, should it be desired or necessary to reduce the power output of the turbine, it is necessary to cut off some of the nozzles and allow less steam to strike the blades. This is a very inefficient process for a number of reasons. The use of a reduced number of nozzles results in the reduction of the effective working area of the blades and an inefficient utilization of the energy of the fluid. Actually when the load becomes less, the areas of the nozzles should change to allow less steam to enter and to maintain the highest efficiency at that load.

In such a structure employing steam, gas, or other fluid, there is found to be a certain most efficient throat area and exit area which a nozzle should have. These desired areas can be readily calculated. For a different load, there should be a different throat and exit area for most efficient operation. The ratio that should exist between the throat and exit area does not vary in direct proportion as the change of load, and for this reason the exit area should be varied to a different extent than the throat area.

An object of the present invention is to provide a nozzle which is adjustable as to its throat and exit areas to provide a relatively wide range of such adjustment areas. Yet another object is to provide a nozzle structure in which the throat and exit areas can be regulated so that a correct ratio exists between the throat and exit areas and corresponding to the different loads encountered. A further object is to provide a fluid passage controlled by a segmental valve body, with means whereby one portion of the body may be adjusted with respect to the other so that the area of the nozzle portion may be varied with respect to the area in the remaining portion or

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the area of the entrance portion. Yet another object is to provide in a fluid passage, a valve slidably mounted therein and having segmental parts in combination with adjustment mechanism whereby one part of the valve body may be moved relative to the other while at the same time providing means for moving the valve body as a whole in said passage. Other specific objects and advantages will appear as the specification proceeds.

The invention is illustrated, in a preferred embodiment, by the accompanying drawing, in which—

Figure 1 is a broken plan view of a turbine and a variable area nozzle structure communicating therewith and embodying my invention; Fig. 2, a broken enlarged vertical sectional view, the section being taken as indicated at line 2—2 of Fig. 1; Fig. 3, a perspective view of the regulator or main valve body; and Fig. 4, a perspective view of the compensator portion of the valve body.

In the illustration given, 10 designates a turbine casing and 11 the blades of the turbine therein. Communicating with the casing 10 and at an angle thereto is a casing 12 providing a flow passage 13 and a valve chamber 14 above the flow passage. Secured in the casing 12 is the entrance packing 15 urged by springs 16 inwardly. Similarly, exit packing 17 is employed, urged by springs 18.

Mounted in the valve chamber 14 is a valve body 19 comprising a regulator body portion 20 and a compensator portion 21. The portions 20 and 21 are hingedly connected together at 22. The valve body 19 provides a throat portion 23 in the passage and an exit portion 24.

Any suitable means for adjusting the valve body 19 or the separate components 20 and 21 may be employed. In the illustration given, I provide a top plate 25 which is suspended above the casing 12 by means of the spring bellows casing 26. Posts 27 connect the plate 25 to the regulator valve body 20, as shown more clearly in Fig. 2. An adjustment shaft 28 is provided with a cam 29 adapted to bear against the plate 25 and thus move the member 20 and thereby the compensator member 21 upwardly and downwardly.

In order to move the member 20 independently of the remaining structure 19, I provide means as follows. The member 20 is provided with a wedge opening 30, as shown more clearly in Fig. 3, and with a vertical passage 31 communicating with a central chamber 32. The chamber 32 communicates with the wedge pas-

sage 30. A wedge block 33 is mounted in the chamber 30 and extends forwardly into chamber 32. It is urged in a forward direction by spring 34. A second spring 37 within chamber 32 tends to draw the wedge 33 in a forward direction. Pivotally connected to the forward end of the wedge 33 is a lever 38 equipped at its forward end with a roller 39. The wall of the chamber 32 at the forward end thereof is inclined as indicated at 40 so as to guide the roller 39 along an inclined path. Pivotally connected to the lever 38 is a plunger 41 having at its top end a plate 42. The plate 42 is maintained at a spaced distance above the top 25 and in sealed relation therewith by the spring bellows 43. An adjustment shaft 44 is provided with an eccentric 45 for operating the plate 42 and plunger 41.

The valve body 19 may be formed of any suitable material, as, for example, steel, plastic, glass, etc., and the thickness of the lower wall 46 of the member 20 is such that it will be spread downwardly under the pressure exerted by wedge 33.

The compensator portion 21 is preferably formed as illustrated more clearly in Fig. 4. The member 21 is provided with an integral vertical wall 47 extending obliquely across the portion 21 and provided at its top with a recess 48. A second vertical wall member 49 is pivotally connected to the wall 47 by means of the pivotal connector 50. A plate 51 extends across the top of member 49 and is supported above the top 25 and the casing 12 by a bellows casing 52. To adjust the compensator plate 51, I provide a control shaft 53 fixed to a cam member 54.

The casing 12, top 25, and the spring bellows provide a substantially airtight enclosure which will prevent the leakage of steam or other medium which rises into the chamber 14 above the valve body 19. To prevent the trapping of medium within this area, I provide a vent tube 55.

Operation

In the operation of the structure, any medium, such as, for example, steam, passes from a steam chest or other source through the passage 13 in the direction of the arrows and toward the blades 11 of the turbine. When the load changes and it is desired to change the relative area at the throat and exit portions, I make the following adjustments. The shaft 28 may be rotated to give a desired vertical movement of the valve body 19. The adjustment shaft 44 may be rotated to move the plunger 41 upwardly or downwardly. Upward movement of the plunger 41 causes the wedge 33 to be pressed inwardly under the force of spring 34, and this moves the spring floor 46 downwardly, thus decreasing the exit area. Downward movement of the plunger 41 causes the roller 39 and lever 38 to move downwardly and to press the wedge 33 toward the right and against the force of compression spring 34 and tension spring 37. This releases the pressure upon the spring floor portion 46 and it rises to a relatively horizontal position shown.

In order to obtain a fine adjustment for the exit opening, I may independently move the member 21 downwardly or upwardly through rotating shaft 53 and the cam 54 carried thereby. Downward movement of the member 49 and member 21 decreases the area at the exit portion of the nozzle.

It will be noted that the valve structure thus provided permits extremely accurate control of the throat and exit areas of the nozzle passage and by different adjustment mechanisms. The valve body operates not only as a segmental valve, but as a variable valve by reason of spring construction. The wedge is effective in changing the rear portion of the valve body with respect to the forward portion, while at the same time the rear portion may be adjusted independently of the spring portion by movement of the compensator 21. Thus great flexibility is provided, giving a nicety of adjustment in the control of the relative areas at the throat and exit portions of the nozzle passage.

While I have described, for the purpose of clearness, the invention as employed in connection with the control of steam passing from a steam chest into the blades of a turbine, it will be understood that the structure is useful as a control means in the passage of any fluid medium toward a turbine employed for any purpose. Further, while I have described the embodiment illustrated in great detail, it will be understood that such details may be varied widely by those skilled in the art without departing from the spirit of my invention.

I claim:

1. A variable area nozzle comprising a casing providing a fluid passage and a valve chamber communicating with the passage, a segmental valve body slidably mounted in said casing for movement into said passage to vary the area thereof, said body having at least one end portion thereof movable relative to the other portion, means for moving said body as a whole, and means for moving the one end portion of the valve body independently of the other.

2. A variable area nozzle comprising a casing providing a fluid passage and a valve chamber communicating with the passage, a segmental valve body slidably mounted in said chamber and movable into said passage to vary the area thereof, said valve body and casing providing a throat portion and an exit portion in said passage, and means for moving said valve body to control the throat area and means for moving independently one segment of said valve body to control the exit area of said passage.

3. A variable area nozzle comprising a casing providing a fluid passage and a valve chamber communicating with the passage, a valve body in said chamber and vertically slidable therein to control the area of said flow passage, said valve body being divided at one end, means for moving said valve body as a whole, and means for spreading said valve body and said divided end to cause the latter portion of said valve body to move vertically relative to the other and thus vary the cross sectional area of the passage at one point thereof relative to the area at another point thereof.

4. A variable area nozzle comprising a casing providing a fluid passage and a valve chamber communicating with the passage, a valve body in said chamber and slidable vertically therein to control the area of said flow passage, said valve body being divided at one end, means for moving said valve body as a whole, and means for spreading said valve body and said divided end to cause the latter portion of said valve body to move vertically relative to the other and thus vary the cross sectional area of the passage at one point thereof relative to the area at another point thereof, said last-mentioned means comprising a wedge and control means for moving said wedge to move a resilient portion of the

valve relative to said fluid passage and said main valve body.

5. In a fluid passage, a valve body movable therein to vary the area of the fluid passage, said valve body having a resilient lower portion separated from an upper portion by a wedge opening, a wedge block within said opening, and means for moving said wedge block to move the resilient portion of the valve body therebelow relative to the remaining portion of the valve body.

6. In combination, a casing providing a fluid passage and a valve chamber thereabove, a valve body composed of portions relatively movable with respect to each other and slidably mounted in said chamber, members engaging said relatively movable valve portions and extending through said casing, flexible means sealing said members with respect to said casing to prevent the escape of fluid, and means engaging said members for adjusting the relative position of the valve body portions within said casing so

as to vary the cross sectional area of the valve passage at different points.

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