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PLURAL SEQUENTIALLY OPENING AND CLOSING VALVE MECHANISM

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FIG.1

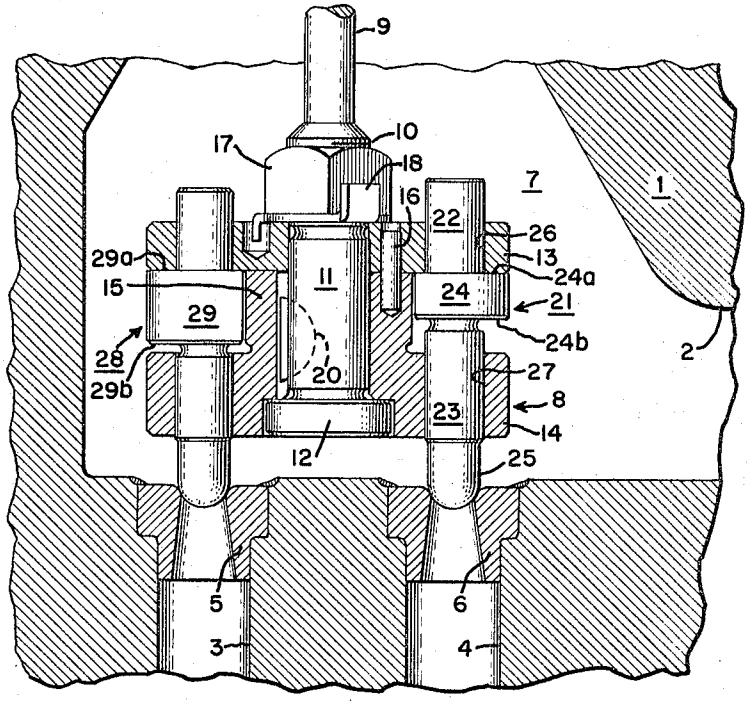
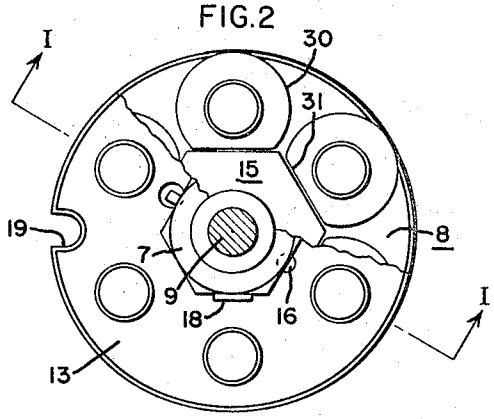


FIG.2



INVENTOR:
HERBERT N. HOFFMAN,
BY W. C. Crutcher
HIS ATTORNEY.

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PLURAL SEQUENTIALLY OPENING AND CLOSING VALVE MECHANISM

Herbert N. Hoffman, Lunenburg, Mass., assignor to General Electric Company, a corporation of New York

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This invention relates to valve mechanisms for controlling the flow of elastic fluid, particularly to valve arrangements in which a plurality of individual valves are arranged to be successively opened and closed to regulate the flow of fluid to a turbine.

In a typical high pressure steam turbine, the flow of steam through the turbine is controlled by a plurality of control valves which may be located "in line," as indicated in U.S. Patent 2,733,611—S. Jacobs et al., or in a circular array as disclosed in U.S. Patent 2,177,544—D. F. Warner. In those patents, the valves are sequentially lifted by a lift beam comprising a single plate member which successively exerts upward force on abutment members attached to the valve stems at different distances from the valves.

In a later U.S. Patent 2,777,466—Ericson, the lift beam was shown composed of two plate members clamping a longitudinally split bushing between them, in order that the lifting abutment could be made as an integral part of the valve. In all the foregoing arrangements, the lift beam, as well as being arranged to exert lifting forces on the valve lifting abutments in sequence, is also arranged to exert positive closing force on all the valves simultaneously after the valves are returned to their seats by pressing downward on the valve seating portion itself.

This results in a valve configuration of two masses (i.e. the lifting abutment and the valve seating portion) connected by a relatively slender stem that passes through a single "bearing hole" within the lift beam. Thus, when the valve is lifted off its seat by the lift beam, it resembles a vertical spindle having a center bearing and two overhung wheels. With a spindle configuration and mounting of this type (as compared to one having a single wheel located between two bearings), relatively low levels of unsymmetrical forces will usually cause the spindle to vibrate and precess within its mounting. In similar fashion, valves of this configuration are prone to rattle around and "precess" in the lift beam. This movement, in addition to objectionable noise, vibration and wear usually also results in a change in valve settings since wear rate is usually not the same on all the valves.

Accordingly, one object of the present invention is to provide an improved multiple valve mechanism having a number of unitary valve members which are lifted successively, and held at any position without undue rattling, vibraiton, precession or wear.

Another object of the invention is to provide an improved multiple valve mechanism, in which the valves are prevented from rotating in the lift beam.

Still another object of the invention is to provide an improved multiple valve mechanism in which the valves are held more securely in the lift beam and which employ an abutment member providing the multiple functions of lifting, closing, and rotation-prevention for the valve.

The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of practice, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawing in which:

FIG. 1 is an elevation view, taken in cross section through the lift beam and valve housing, and

FIG. 2 is a plan view, partly in section, of the lift beam, omitting the valve housing.

Generally stated, the invention is practiced by providing a lift beam with provision for holding an array of unitary valve members to be opened and closed in sequence. The lift beam includes spaced upper and lower plates with valve stem portions slidably supported in aligned bearing holes in each of the plates. Each valve has an enlarged abutment of varying thickness separating the stem portions and disposed in the space between the plates to provide lifting and closing forces. The abutment cooperates with the lift beam so as to prevent rotation of the valves in the upper and lower stem bearing holes.

Referring now to FIG. 1 of the drawing, a valve housing 1 has an inlet passage 2 and a number of circumferentially spaced outlet passages such as 3, 4 in the bottom of housing 1. Each of the outlets 3, 4 has a valve seat such as 5, 6 disposed therein.

In an inlet chamber 7 of the valve housing, there is disposed a valve lift beam shown generally as 8, which is arranged to be raised and lowered by a lift rod 9. In a typical control valve, rod 9 passes through a steam seal in the top of housing 1 and has its upper end arranged for connection to some suitable governing or control mechanism (not shown). The lift rod 9 has a threaded portion 10, a lower stem portion 11, and an end flange 12.

The lift beam 8 is circular in shape in this case, as will be seen from FIG. 2, and comprises an upper circular plate member 13 and a lower circular plate member 14. Plate 14 has a central polygonal boss portion 15 which holds the plates 13, 14 vertically spaced apart from one another. Since there are six valve members in the valve shown, the boss portion has six flat sides or is hexagonal, but the number of sides may vary. Plates 13, 14 are prevented from rotating with respect to one another by means of pins such as 16, and are clamped together by means of a nut 17 on the threaded portion 10 of the lift rod. Nut 17 is used to pull the plates 13, 14 together and is then locked in place by bending up a tab on a lock washer 18.

Reference to FIG. 2 of the drawing illustrates that the plate members 13, 14 have cutout portions 19, in which is disposed a vertical rod (not shown) to keep the lift beam 8 in rotational alignment with the valve seats as it moves up and down in housing 1. A suitable key 20 (FIG. 1) may also be employed to prevent any rotation of the lift rod 9 with respect to the plate members 13, 14.

Circumferentially spaced around the lift beam 8 are six valve members shown generally as 21, although the number may vary with the application. Each of these comprise an upper stem portion 22, a lower stem portion 23, a disk-shaped enlargement or lifting abutment 24 disposed between the two stem portions, and a valve seating portion 25 which cooperates with the valve seat beneath it in the usual manner. The upper stem portions 22 of the valves are disposed in circumferentially spaced holes 26 in the upper plate 13, while the lower stem portions 23 are disposed in circumferentially spaced holes 27 in the lower plate member 14, holes 26, 27 being vertically aligned with one another.

The lifting abutments 24 between valve stem portions are of varying thickness as seen by a diametrically opposite valve 28 which has a relatively thick lifting abutment 29.

When the valves are all seated, as shown in FIG. 1, it will be noted that the upper surfaces 24*a*, 29*a* of abutments or disks 24, 29 are both contacted simultaneously by the underside of the upper plate member 13 to provide a positive closing force. It also will be observed that, since the abutments are of varying thickness, the undersides 24*b*, 29*b* of the lifting abutments are of varying

distance to the valve seat so that they are contacted in sequence by the upperside of the lower plate **14** as the lift beam **8** is raised, so as to provide sequential lifting and closing of the valves. Therefore, both sequential valve lifting and closing as well as a positive simultaneous valve closing force are accomplished by the lower and upper plate members respectively contacting the lower and upper surfaces of the abutment members respectively.

Referring to FIG. 2 of the drawing, it will be observed that, in the preferred embodiment shown, each of the abutment members corresponding to abutment portions **24, 29** in FIG. 1, is a disk-shaped flange **30** made integral with the valve and having a flat surface **31** machined onto it. The flat surface **31** is disposed closely adjacent one of the flat surfaces of the polygonal boss **15**. It will be seen that the abutment flange **30** cannot rotate, and hence the valve members themselves cannot rotate to cause wear and rattling.

It will be apparent that many other equivalent forms of the abutment member **30** would be possible to prevent its rotation. For example, the boss **15** could be circular and the abutment flange could have a "scallop" machined in it to cooperate with the lift beam to prevent rotation.

It will be observed that since the aforementioned positive valve closing force is exerted upon the abutment members **24, 29, 30** rather than on the valve seating portions **25** themselves, the valve stems can be of relatively large diameter, Also, since the valves are supported at two spaced locations, i.e. in bearing holes **26, 27**, they are firmly held against transverse twisting or cocking with respect to the lift rod **9**. By supporting the lifting abutment by means of stems in two spaced holes rather than in a single hole, a very secure and stable arrangement is achieved.

While a single embodiment of the invention has been described in detail herein, it will be obvious to those skilled in the art that many changes and substitutions of equivalents might be made. For instance, the valves could be arranged in line, as in U.S. Patent 2,613,542, wherein the upper and lower plate members would be straight rather than circular, with a suitable spacer therebetween representing boss **15**. While modifications of the lifting mechanism itself would be necessary, the functioning and basic shapes of the individual valves themselves, including disposition of lifting abutments between spaced plate members, would be substantially the same as disclosed and recited herein.

It is of course desired to cover by the appended claims all such modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A multiple valve mechanism comprising:

a housing defining a valve inlet chamber and defining a plurality of discharge outlets having valve seats disposed therein,

a lift beam comprising upper and lower vertically spaced plate members defining respectively a plurality of, upper and lower vertically aligned openings,

a plurality of valve members each having an upper stem portion disposed in one of said upper openings, a lower stem portion disposed in one of said lower openings, a seating portion arranged to cooperate with one of said valve seats, and an enlarged abutment portion separating said stem portions and disposed in the space between said plate members, the undersides of said abutment portions being of varying distances from the respective seating portions when all the seating portions are disposed in the valve seats so as to have their undersides sequentially contacted by the lower plate member as the lift beam is raised.

2. The combination according to claim **1**, where said abutment portions are of varying thicknesses and arranged so as to have their uppersides simultaneously contacted by said upper plate member when all the seating portions are disposed in the valve seats, whereby a positive closing force is exerted by means of said abutment portions.

3. The combination according to claim **1**, wherein said valve abutment portions include additional portions cooperating with transversely adjacent portions of the lift beam so as to prevent rotation of the valves in the lift beam openings.

4. A multiple valve mechanism comprising:

a housing defining a valve inlet chamber and also defining a plurality of downwardly opening discharge outlets having valve seats disposed therein,

a lift beam comprising upper and lower separable plate members vertically spaced from one another by a central boss and defining a plurality of upper and lower uniformly spaced openings respectively, said upper and lower openings being vertically aligned with one another,

a plurality of valve members each disposed in one of said pairs of holes and each comprising a valve seating portion cooperating with one of said valve seats, a lower stem portion disposed in a lower opening, an upper stem portion disposed in an upper opening, and an enlarged abutment portion separating said stem portions and disposed in the space between plate members, being of nonuniform radial dimension and closely spaced transversely with said boss of the lift beam to prevent rotation of the valve members in the openings, said abutment portions also being of varying longitudinal thickness between stem portions to provide sequential operation of the valves, the upper surfaces of the abutment portions being uniformly spaced from the valve seating portions so as to be contacted uniformly by the upper plate member when the valves are in a closed position.

5. A multiple valve mechanism comprising:

a housing defining a valve inlet chamber and defining a plurality of circumferentially spaced discharge outlets having valve seats disposed therein,

a lift beam comprising upper and lower circular plate members each defining a central aperture and a plurality of circumferentially spaced upper and lower holes respectively,

polygonal spacer means defining a central aperture and a plurality of uniformly spaced flat surfaces around its periphery,

a lift rod passing through said central apertures in said spacer means and plate members with means to secure said plate members in spaced relationship,

a plurality of unitary valve members disposed in the openings of said lift beam, each of said valve members comprising a seating portion cooperating with the valve seat, upper and lower stem portion slidably disposed in the upper and lower plate openings respectively, and an abutment portion separating said stem portions and disposed between plate members, said abutment members comprising flanges having flat surfaces thereon cooperating with the flat surfaces on the polygonal spacer means to prevent rotation, said abutment members being of varying thicknesses and arranged to have the upper surfaces contacted simultaneously by the upper plate member when the valves are closed, and to have their lower portions contacted sequentially by the lower plate member as the valves are opened.

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CLARENCE R. GORDON, *Primary Examiner.*