C. E. LITTLE.

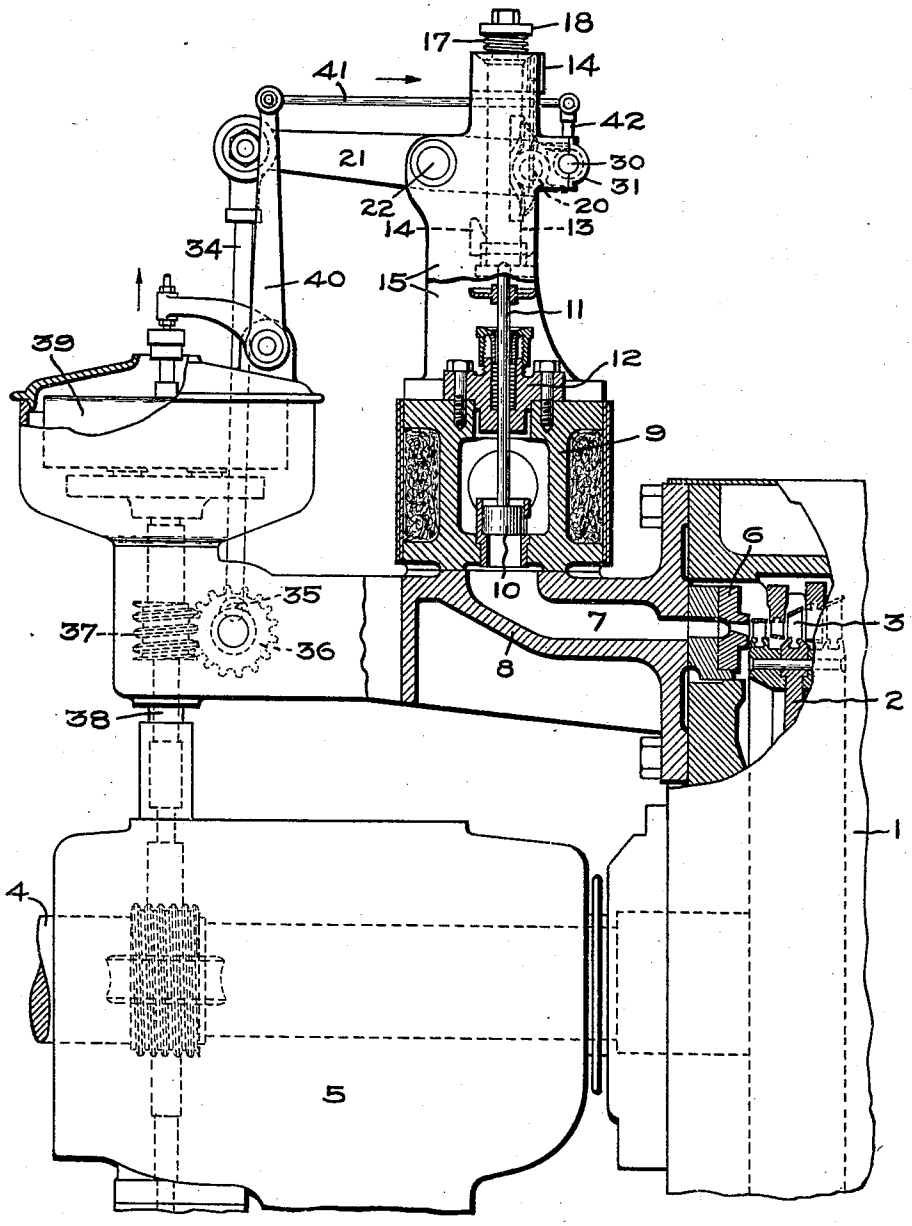
VALVE GEAR FOR TURBINES.

APPLICATION FILED SEPT. 22, 1909.

992,432. Patented May 16, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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3 SHEETS—SHEET 2.

Fig. 2

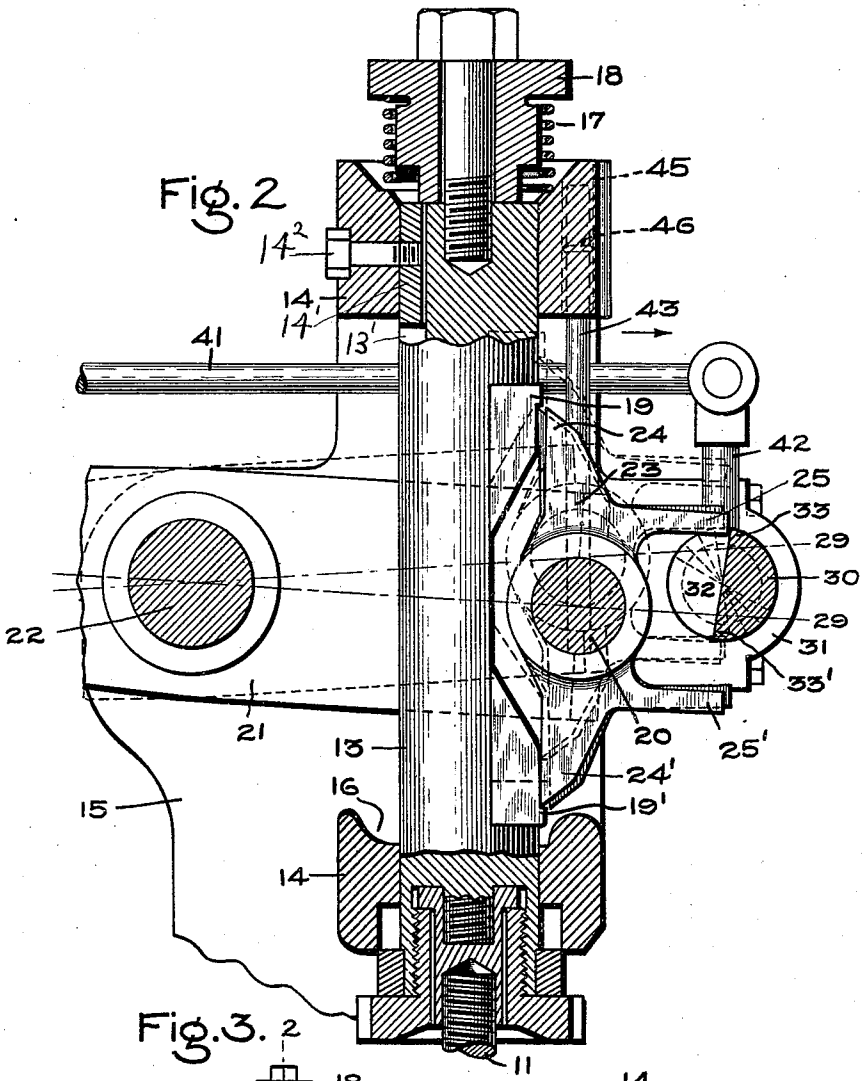
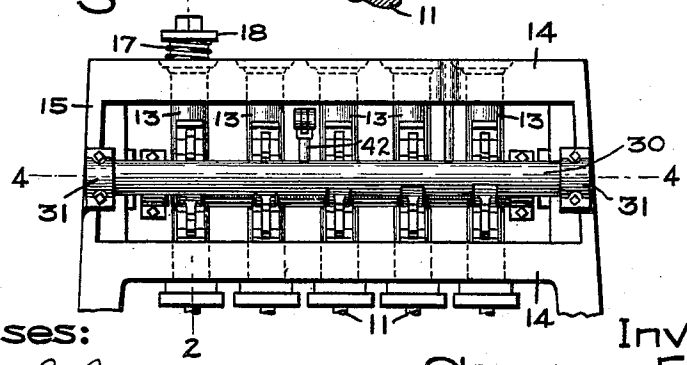


Fig. 3.



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3 SHEETS—SHEET 3.

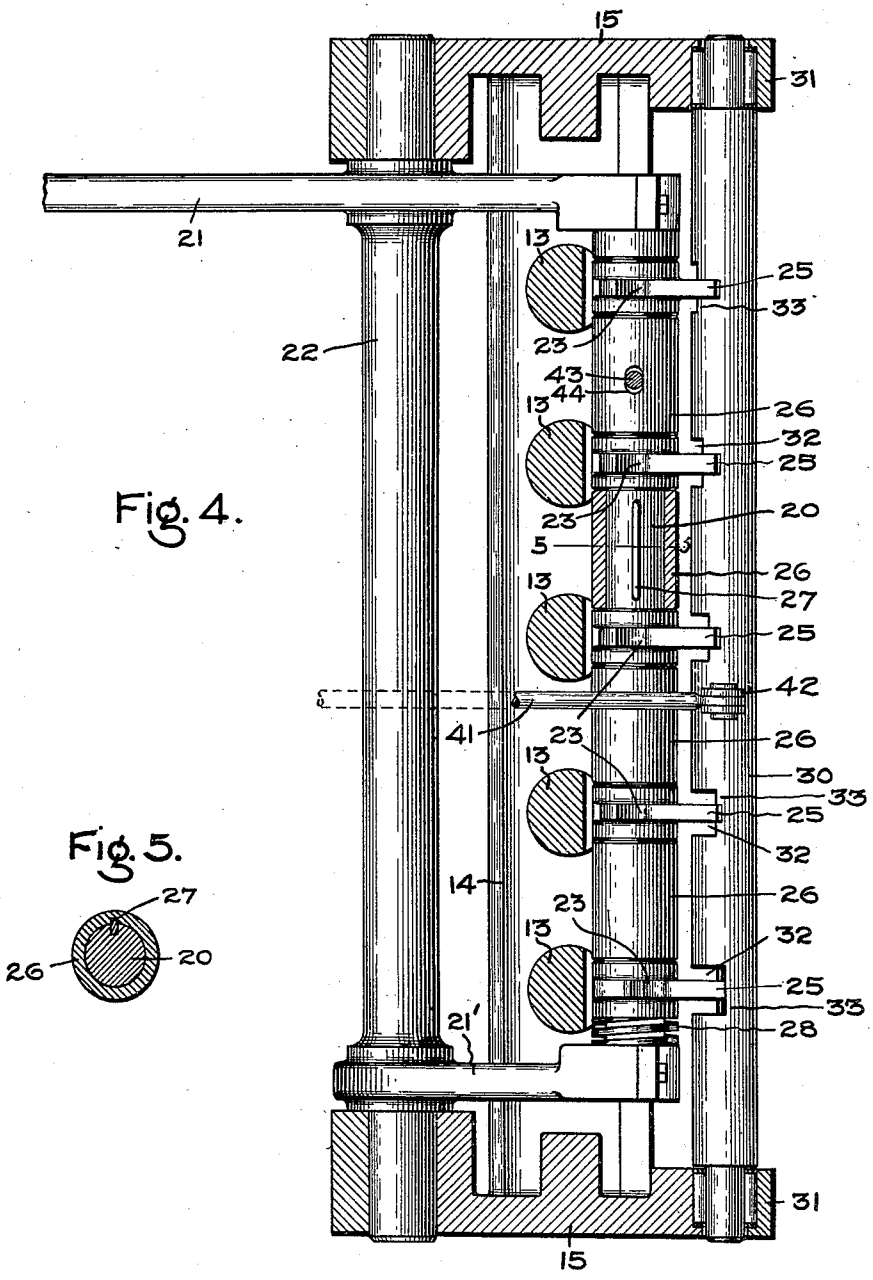

Fig. 4.

Fig. 5.

Witnesses.

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UNITED STATES PATENT OFFICE.

CLARENCE E. LITTLE, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

VALVE-GEAR FOR TURBINES.

992,432. Specification of Letters Patent. Patented May 16, 1911.

Application filed September 22, 1909. Serial No. 518,996.

To all whom it may concern:

Be it known that I, CLARENCE E. LITTLE, a citizen of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Valve-Gear for Turbines, of which the following is a specification.

This invention relates to mechanism for operating the nozzle valves of elastic fluid turbines, and has especial reference to turbines wherein the nozzle valves are mechanically and directly actuated, both in opening and closing, as the demand for energy increases or decreases.

The object of the invention is to improve the valve mechanism shown in the patent to R. H. Rice, March 20, 1906, No. 815,743, by simplifying the construction, decreasing the number of parts, and relieving the governor of the work of moving the dogs into and out of actuating position.

In the mechanism embodying my invention, the nozzle valves are each provided with a cross-head, moving vertically in guides, and provided with upper and lower shoulders for the engagement of an actuating dog by means of which the valve is opened and closed. The dogs are carried on a shaft which is mounted on a carrier, preferably rock arms, so that it can be moved up and down. Adjacent to each cross-head is a cam by means of which the corresponding dog can be thrown into operative position. The several cams are all grouped on one shaft, which can be oscillated by the turbine speed-governor in order to bring more or less of the dogs into action in accordance with the demands upon the turbine.

Details of construction will appear from the following extended description, taken in connection with the accompanying drawings, in which—

Figure 1 is a side elevation, partly in section, showing part of a turbine with the valve gear in position; Fig. 2 is a vertical sectional elevation taken on the line 2—2, Fig. 3, and showing the valve-operating parts on a larger scale; Fig. 3 is a rear elevation of the valve gear; Fig. 4 is a plan view, partly in section, on the line 4—4, Fig. 3, but on a larger scale; and Fig. 5 is a cross section of the dog shaft and spacing sleeve, taken on the line 5—5, Fig. 4.

The invention is shown as applied to a horizontal turbine of the Curtis type, but any make of turbine, either horizontal or vertical, may be used.

The casing 1 incloses the bucket wheel 2, which carries buckets 3 and is mounted on a shaft 4 journaled in suitable bearings, one of which is shown at 5. The turbine is supplied with steam through the nozzles 6 which connect with the steam passages 7 formed in the projection 8 on the head of the casing. Mounted on said projection is the steam chest 9 in which are the nozzle-valves 10, each controlling a steam passage 7. The stems 11 of said valves pass up through stuffing boxes 12 and are rigidly but detachably connected with the lower ends of the upright cross-heads 13, which have a sliding fit in guides 14 forming part of a frame 15 erected on the steam chest. In order to maintain the proper alinement of the cross heads 13 and keep them from turning, each cross head is provided with a longitudinal key-way 13′, with which engages a key 14′ secured to the stationary guide 14 by a screw bolt 14^2. The top of the lower guide is recessed to form a shallow tray 16 for lubricant. Normally, the valves are all closed, except one at one end of the gang, which is held normally open by a spring 17 compressed between the upper guide and a flanged head 18 on the cross-head of said valve. This spring tends to open said valve at every stroke of the dog-shaft and to hold it open when the turbine stops, so that it will start promptly when the steam is again turned on.

The rear of each cross-head is cut away or flattened between the guides 14, and at each end of this cut-away portion is a hardened steel block forming a shoulder 19, 19′ for a purpose about to be explained.

Extending horizontally across in the rear of all the cross-heads is a shaft 20 journaled in the ends of a lever 21 and a rock arm 21′, both mounted on a rock-shaft 22 journaled in the frame 15. Suitable mechanism, hereinafter described, rocks said shaft 22 and swings the shaft 20 up and down adjacent to the cross-heads 13. A number of dogs 23, corresponding in number with the cross-heads, is carried on said shaft 20 each having an upper nose 24, a lower nose 24′, an upper tail 25 and a lower tail 25′. The dogs are loose on the shaft and are spaced apart by sleeves 26, each of which is preferably

splined on the shaft by a groove and feather 27. A helical compression spring 28, abutting between the rock arm 21′ and the end of the adjacent sleeve, causes said sleeves to exert a frictional pressure on the hubs of the dogs so that each dog will remain in any position to which it may be turned. The dogs are preferably of about the same length as the distance between the shoulders 19, 19′ with which they may be engaged by tilting them one way or the other. When the upper nose 24 of a dog takes against the upper shoulder 19 of its respective cross-head and the lever 21 is moved to lift the dog-shaft 20, said cross-head will be lifted with it, and the corresponding nozzle valve will be opened. Conversely, if the lower nose engages the lower shoulder, the valve will be closed when the dog-shaft 20 moves down. Said shaft swings up and down between the radii 29 drawn from the axis of the rock-shaft 22. In order to tilt the dogs at the proper time, a cam-shaft 30 is arranged in the rear of the dog-shaft, journaled in bearings 31 on the frame 15, and lying between the tails 25, 25′ on the dogs. In the plane of each dog the cam-shaft is cut away, preferably to a diametrical line, forming notches 32 having upper and lower shoulders 33, 33′ on which the tails 25, 25′ are adapted to strike when said shaft is turned to bring them into operative position; the upper one being out of service when the lower one is operative, and vice versa. The cut-away portions or notches 32 are not all in the same plane, but, beginning at one end of the cam-shaft, the second notch is angularly advanced with reference to the first, the third is similarly displaced with reference to the second, and so on; the relative positions of the several notches being indicated by the dotted radial lines on the cross section of the cam-shaft in Fig. 2. The result is that the dogs are thrown into operation one after the other and withdrawn in reverse order, by oscillating the cam-shaft.

Any suitable mechanism may be employed for swinging the dog-shaft up and down, and for oscillating the cam-shaft, but I prefer that shown in the drawings, wherein the lever 21 carrying one end of the dog-shaft is connected by a pitman 34 with a wrist-pin 35 on a worm-wheel 36 driven by a worm 37 on an upright shaft 38 geared to the turbine shaft 4. This mechanism imparts a steady vibrating movement to the lever 21. The shaft 38 carries at its upper end a speed-responsive device 39 which operates to rock an elbow-lever 40 connected by a rod 41 with an arm 42 on the cam-shaft. Any change in the speed of the turbine produces a change in the position of the cam-shaft, and a consequent change in the number of dogs in operation, thereby altering the number of nozzle valves in service, in order to bring the speed of the turbine back to normal.

The operation may be briefly recapitulated as follows: The constant vibration of the lever 21 causes the dog-shaft 20 to swing up and down in an arc of a circle. The dogs 23, however, are caused to move in substantially straight lines parallel with the cross-heads by means of a vertical rod 43 which is rigidly fixed in the shaft 20 and extends up through a slot 44 in the spacing sleeve 26 and into a hole 45 in the upper guide 14. The hole is larger than the rod, but a rounded bead 46 on said rod gives a kind of ball joint action; preventing the rod from binding. This rod prevents the shaft 20 from rotating with reference to the cross-heads 13 although it necessarily turns slightly in its bearings in the lever 21 and rock arm 21′. With a change of speed of the turbine the speed-responsive device 39 oscillates the cam-shaft 30 and when one of the tails 25, 25′ of a dog comes into contact with a shoulder 33, 33′ on said shaft said shoulder will tilt the dog into position to engage with a shoulder 19, 19′ on the cross-head 13 and thereby open or close the nozzle valve 10 attached to said cross-head. The frictional contact between the dog and the spacing sleeves 26 on each side of it will retain it in operative position until a reverse movement of the cam-shaft occurs, which will tilt the dog in the opposite direction and operate the valve in the other direction. All the valves, except the first or "regulating" valve, remain either open or closed after their initial actuation by their dogs so long as the cam-shaft does not reverse.

The only work the speed-responsive device has to do is to oscillate the cam-shaft. The tilting of the dogs and the actuation of the valves is done by the turbine shaft. The valve gear is therefore quite sensitive and operates easily and promptly and with but little wear.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention together with the apparatus which I now believe to represent the best embodiment thereof; but I desire it to be understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

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

1. In valve gear for turbines, the combination with a valve, of a carrier which is constantly in motion, a double nosed dog on said carrier, and a cam-shaft arranged to tilt said dog so as to bring one end or the other into engagement with the valve.

2. In valve gear for turbines, the combination with a valve, of a carrier driven by the turbine and having a constant movement to and fro, a double nosed dog on said car-

rier, a cam-shaft arranged to tilt said dog so as to bring one end or the other into engagement with the valve, and a speed-responsive device for oscillating said cam-shaft.

3. In valve gear for turbines, the combination with a valve having a cross-head furnished with shoulders, of a shaft, means driven by the turbine for swinging said shaft up and down, a dog on said shaft, a cam-shaft adapted to tilt said dog into engagement with said shoulders, and a speed governor connected with said cam-shaft.

4. In valve gear for turbines, the combination with a gang of valves, each having a cross-head provided with shoulders, of a shaft adjacent to said cross-heads, means for swinging said shaft up and down, dogs on said shaft having projecting tails, a cam-shaft between said tails, and a speed governor adapted to oscillate said cam-shaft to tilt said dogs into engagement with said shoulders.

5. In valve gear for turbines, the combination with a gang of valves each having a cross-head provided with shoulders, of a shaft adjacent to said cross-heads, means for swinging said shaft up and down, dogs on said shaft having two noses and two tails, movable abutments between said tails, a speed governor, and means whereby said speed governor operates to move said abutments into and out of the paths of said tails.

6. In valve gear for turbines, the combination with a gang of valves each having a cross-head provided with shoulders, of dogs adapted to engage said shoulders, means for carrying said dogs up and down, tails projecting from said dogs, a shaft having notches coöperating with said tails, and a speed governor for oscillating said shaft.

7. In valve gear for turbines, the combination with a gang of valves each having a cross-head provided with shoulders, of dogs adapted to engage with said shoulders, means for carrying said dogs up and down in paths parallel with said cross-heads, a shaft journaled in stationary bearings adjacent to said dogs, a speed governor connected with said shaft, and shoulders on said shaft adapted to engage with said dogs and formed by notches which are angularly displaced one from the other.

8. In valve gear for turbines, the combination with a gang of valves, of double-ended dogs for operating them, a shaft on which said dogs are loosely mounted, spacing sleeves between said dogs, and means for pressing the dogs and sleeves into frictional contact.

9. In valve gear for turbines, the combination with a gang of valves, each having a cross-head, guides for said cross-heads, a shaft movable up and down adjacent to said cross-heads, dogs on said shaft for engagement with said cross-heads, and a rod engaging with said shaft and causing said dogs to move in paths parallel with said cross-heads.

In witness whereof, I have hereunto set my hand this twentieth day of September, 1909.

CLARENCE E. LITTLE.

Witnesses:
JOHN A. McMANUS, Jr.,
ALEXANDER M. GILBERT.