No. 873,243. PATENTED DEC. 10, 1907.

O. JUNGGREN.

GOVERNING MECHANISM FOR TURBINES.

APPLICATION FILED MAY 7, 1906.

4 SHEETS—SHEET 1.

Fig. 1.

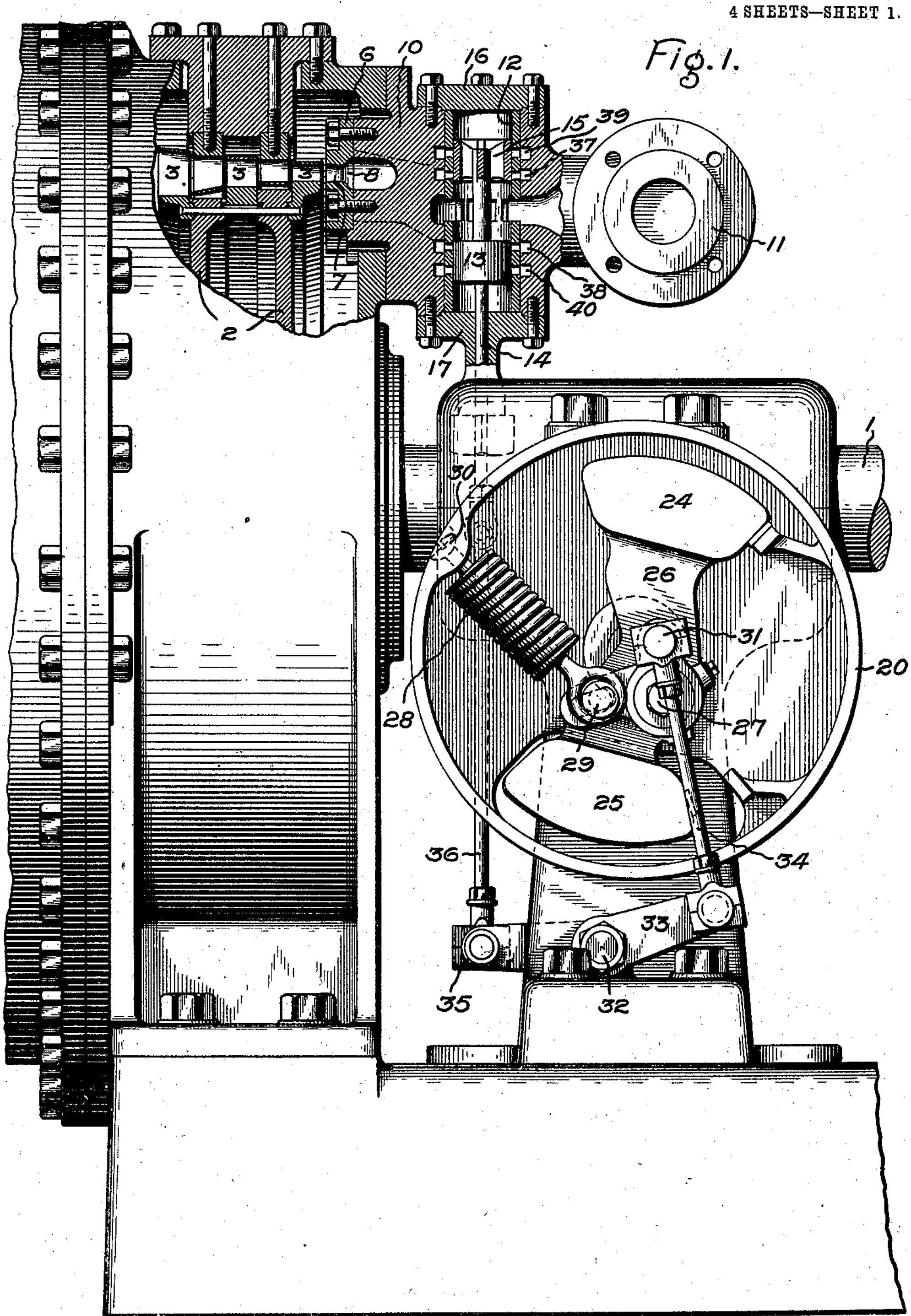

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Fig. 2.

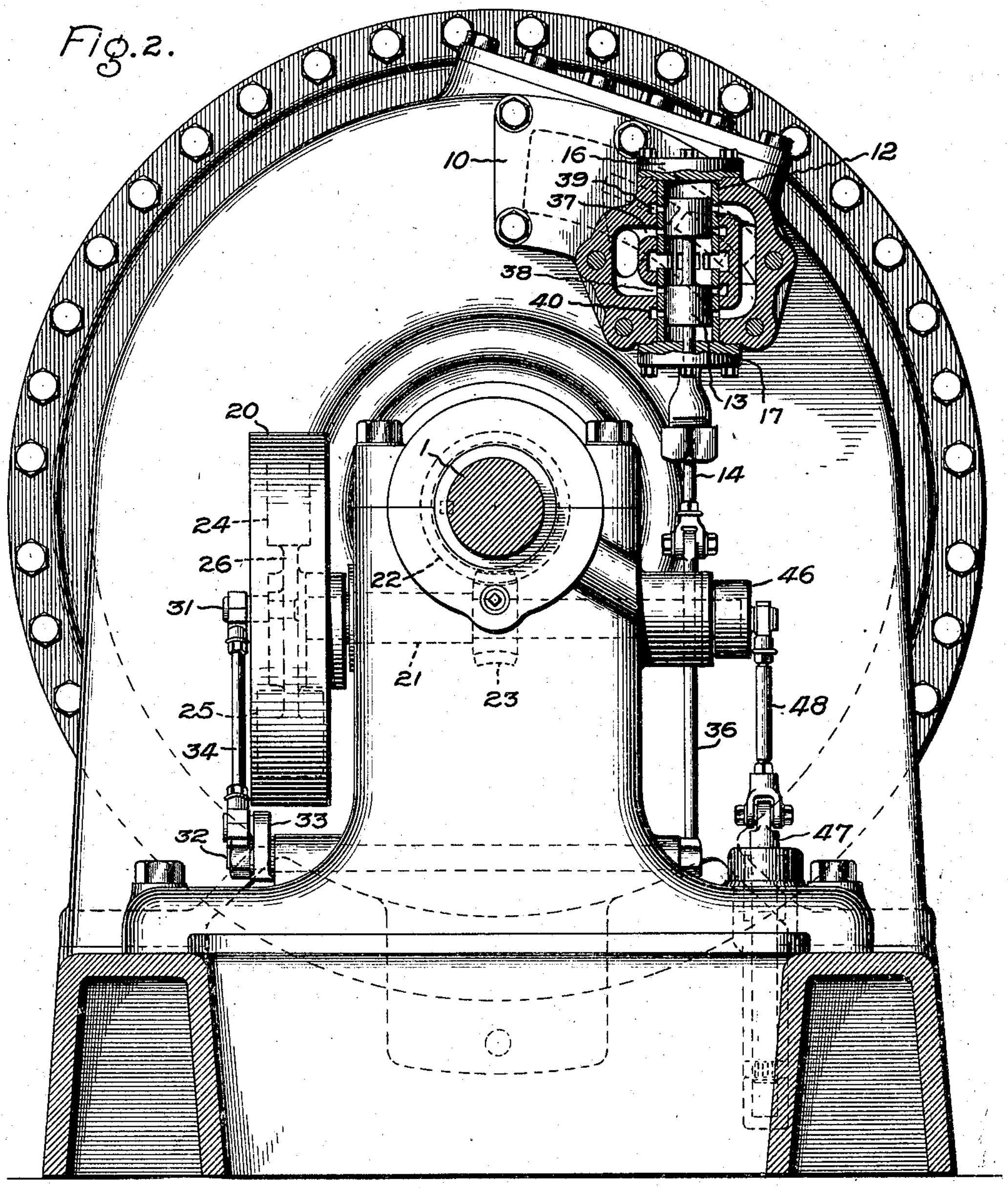

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Fig. 3.

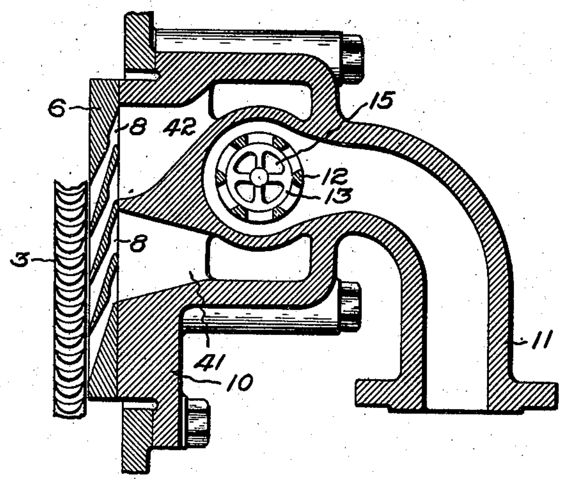

Fig. 4.

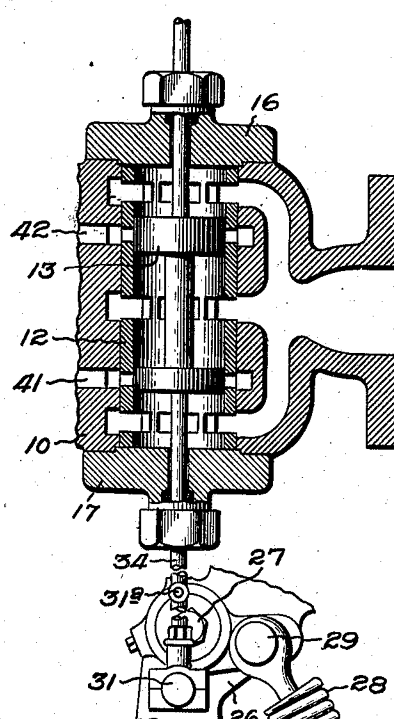

Fig. 5.

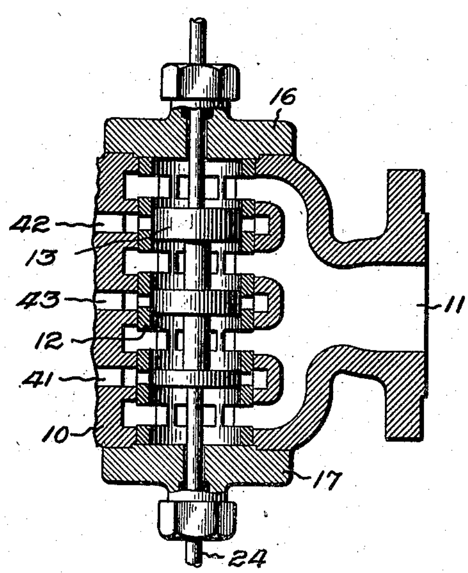

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Fig. 6.

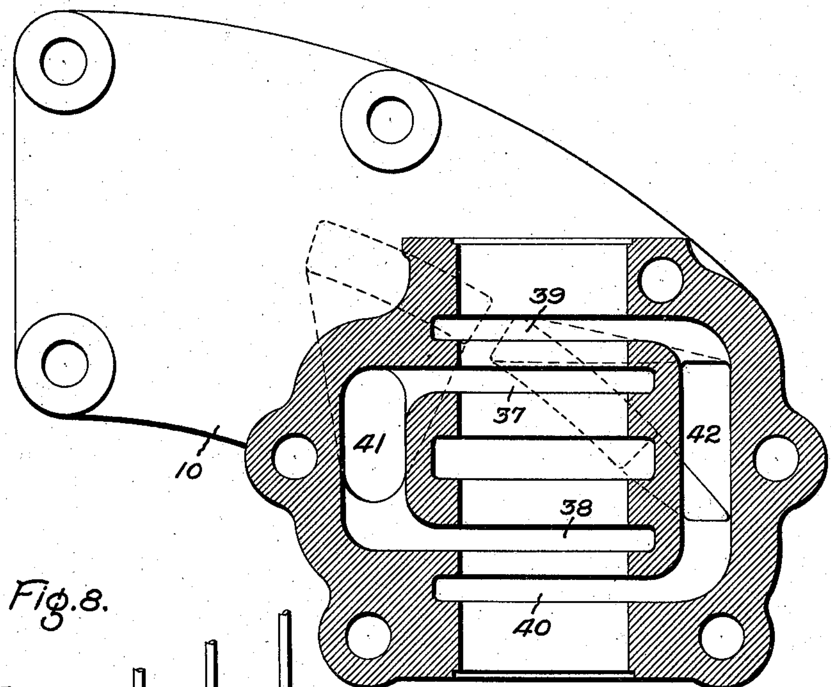


Fig. 8.

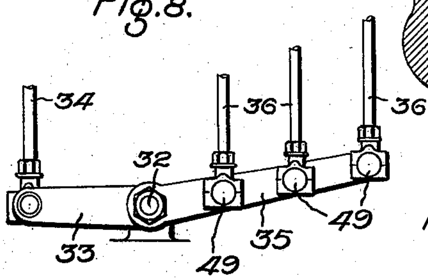
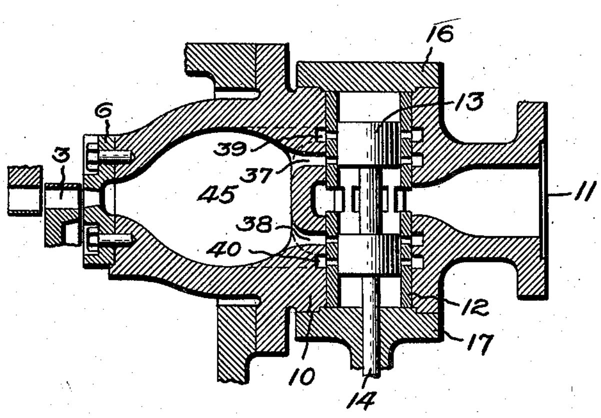


Fig. 7.



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UNITED STATES PATENT OFFICE.

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GOVERNING MECHANISM FOR TURBINES.

No. 873,243. Specification of Letters Patent. Patented Dec. 10, 1907.

Application filed May 7, 1906. Serial No. 315,523.

To all whom it may concern:

Be it known that I, OSCAR JUNGGREN, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Governing Mechanism for Turbines, of which the following is a specification.

The present invention has for its object to improve and simplify the construction of the governing mechanisms for elastic fluid turbines.

In carrying out my invention, the turbine may be of any suitable construction. As an example I have shown one of the jet type, but the invention is not necessarily so limited. Steam or other elastic fluid is admitted to the wheel buckets through one, two or more passages, depending upon the size and type of machine.

I have illustrated as embodiments of the invention a turbine having two admission ports in one case and three in the other, each port delivering elastic fluid to one, two or more sections of a sectionalized nozzle or other fluid-discharging device. These sections may be expanding or non-expanding in character as best suits the requirements. The valve controlling the ports is constantly moving to-and-fro, the length of its travel, varying with variations in load. For light loads the length of travel is slight, increasing with increasing loads. The valve is controlled and moved by a powerful governor, acting under the combined influence of centrifugal force and inertia, and of simple and rugged construction. As an example, the governor comprises a fly-wheel or other rotating support which is preferably driven from the main shaft of the turbine through suitable speed-reducing gearing. Where the speed of the turbine is low, the fly-wheel may be direct-driven. Mounted on and rotating with the fly-wheel is a weight opposed by a spring that assumes different positions with respect to the fly-wheel for different load conditions. Mounted in a manner to move with the weight is a member such as a wrist-pin, which has a definite orbit for a given load, the said orbit enlarging with increasing load and diminishing with decreasing load. Motion is transmitted from the said member to the valve through a suitable connection made as direct as possible to reduce the number of parts and cut down lost-motion, and as the former moves in its orbit due to the rotation of the fly-wheel, the valve is given a to-and-fro movement. The valve is balanced or substantially balanced as to fluid pressures, and the ports and the part of the valve are arranged to have different degrees of overlap with respect to each other. The object of this is to have one or more ports that are alternately opening and closing for certain load conditions, and one or more other ports that are only opened and closed when the load is greater. It will be seen that fluid will be admitted to the turbine in puffs of greater or less volume, and that the pressure on the bowls of the nozzle sections will momentarily be the same as that of the supply for each stroke of the valve, resulting in efficient use of the steam or other fluid.

In an arrangement of the character described the flow of fluid through the turbine is continuous and always from the high to the low pressure end, and therefore it is only necessary to control the admission. It is also clear that no particular relation has to exist between the positions of the governor parts and valve, and that of the bucket-wheel or wheels, as is the case with the valves and pistons of reciprocating engines, which is an important consideration. Where it is desired for any reason to reduce the puff-like effect of the motive fluid admitted to the turbine, it can be done by including a reservoir or chamber of suitable capacity between the controlling valve and the port, passage, nozzle or other device discharging fluid to the turbine. This reservoir or chamber will have the effect, so to speak, of smoothing out the pulsations in the fluid, and the latter will leave the reservoir at a reduced but nearly uniform pressure.

In carrying out the invention, where the volume of fluid to be handled is large I may use two, three or more valves and operate and control them in the manner specified, the laps of the valves in this case being so arranged that they operate successively. The valves may be mounted on the same or different stems and actuated directly or indirectly by the speed-responsive device.

In the accompanying drawings, which are illustrative of my invention, Figure 1 is a view of a turbine fitted with my improved governing mechanism, certain of the parts being broken away to more clearly show the parts; Fig. 2 is an end view of the turbine, with the valve casing in section; Fig. 3 is a detail sectional view through the valve and its inclosing chest; Fig. 4 is a longitudinal section through a slightly modified form of valve chest; Fig. 5 is a further modification taken longitudinally of the valve chest showing three sets of ports controlled by a piston valve; Fig. 6 is a sectional view on an enlarged scale through the valve casing and showing the location of the nozzle sections or other fluid discharging devices in dotted lines; Fig. 7 is a detail view showing a reservoir or chamber interposed between the controlling valve and the device or devices discharging fluid to the wheel buckets; and Fig. 8 shows an arrangement for obtaining successive operation of individual valves.

1 represents the main shaft of the turbine on which are mounted wheels 2 having buckets 3 suitably arranged thereon. Where more than a single row of wheel buckets is provided for each stage, intermediate buckets are provided between them for reversing the direction of the fluid and conveying it from one row of wheel buckets to another. I have shown only one stage of a multi-stage turbine, it being understood that I may employ as many stages as are desired or the machine may be provided with only one stage, depending upon the size of the machine and conditions of operation. Fluid is discharged against the bucket wheel by a nozzle 6 or other fluid-discharging device of suitable construction having one, two or more discharge passages 7, each passage having a bowl 8, the latter communicating with a supply passage or port. The nozzle or other fluid-discharging device is attached to and supported by the valve casing 10, the latter being bolted to the head of the turbine. Steam is admitted to the valve chest by the conduit 11. The valve chest is bored centrally to receive the sleeve 12 and is also provided with ports that communicate with corresponding ports in the sleeve. Mounted for movement within the sleeve is a balanced piston valve 13 having a stem 14. The valve is supported on the stem by means of a spider-like construction having orifices 15 (Figs. 1 and 3) so that steam has access to the space above and below the ends of the valve as well as to the intermediate portion. The upper end of the valve casing is closed by a head 16 and the lower end by a head 17 through which the valve stem extends.

The mechanism for actuating the valve will now be described. 20 represents a fly-wheel or support that is mounted upon a shaft 21 shown in dotted lines in Fig. 2, which shaft receives motion from the main shaft through the worm 22 and worm-wheel 23, the object of the worm gearing being to reduce the speed at which the governor runs. The governor is shown mounted on the side of the main shaft bearing opposite to the controlling valve, but under certain circumstances I may mount it on the same side as the valve, in which case the connection to the latter may be somewhat simplified. The governor comprises weights 24 and 25 that are connected by a bar 26, the latter being connected to the fly-wheel or support 20 by the pivot-pin 27. As the speed increases the weights and the bar tend to move about the pivot 27 as a center. This movement is opposed by the extension spring 28 connected at one end to the pin 29 and at the other end to a support 30 that passes through the rim of the fly-wheel. Mounted on the weight-connecting arm is a member such as a wrist-pin 31 that tends to move from the position shown toward the center of the low-speed shaft 21 under conditions of increased speed. The orbit of the wrist-pin is a circle, the diameter of which varies with changes in load, it being greatest when the load is heavy and gradually decreasing as the load becomes light and the speed of the main shaft increases. As shown the axis of the pin is capable of moving to a point where it coincides with that of the secondary shaft 21 in which case the valve 13 will remain stationary until the load changes, when it will again move to-and-fro. Situated in the base of the support for the main bearing is a rock-shaft 32 having a lever 33 on one end that is connected by the connecting-rod 34 with the wrist-pin. The opposite end of the rock-shaft is provided with a lever 35 connected by the connecting-rod 36 with the stem 14 of the controlling valve. For every revolution of the governor shaft 21 when steam is flowing into the turbine the rock-shaft 32 is oscillated through one complete cycle, the extent of this oscillation being governed by the position of the wrist-pin 31 with respect to the axis of the governor or secondary shaft 21.

In Fig. 1 the piston valve 13 is shown as controlling four sets of ports, the adjacent or inside ports 37 and 38 controlling the admission to the turbine for conditions of normal loads, and the outside ports 39 and 40 controlling the admission of fluid for conditions of greater load or overload. Under certain conditions the valve 13 will expose first the port 37 on its up stroke and the port 38 on its down stroke. When the load conditions are greater the valve will expose the ports 37 and 39 on the upward stroke and ports 38 and 40 on the downward stroke. For intermediate load conditions the ports above referred to will be throttled to a greater or less extent. If the lap on one end of the valve is less than on the other, it will be seen that one port will admit steam to the nozzle without any flowing through the other. For example, it may be so arranged that one end of the valve admits sufficient steam for full load or any percentage that may be deemed advisable, and the other for overload.

Referring to Fig. 3, the ports 37 and 38 are connected to the passage 41, the latter discharging steam to the bowls 8 of the expansion nozzle 6. The ports 39 and 40 are arranged to discharge steam to the passage 42, the latter supplying steam to the bowls 8 of the overload nozzle sections. For simplicity in description I have mentioned the ports 37 and 38 and passage 41 as being used for normal load conditions and ports 39 and 40 and passage 42 for overload conditions, but these terms are to be understood as being only relative.

In Fig. 4 is shown a construction wherein steam from the supply conduit 11 is admitted above and below the valve 13 and also to the space between the heads of the valve. In this figure 41 represents the passage to the normal-load nozzles and 42 the passage to the overload nozzles. It is to be observed that the width of the lower head of the valve is less than that of the upper head so that under moderate reciprocations of the valve the port 41 only will be exposed, while under conditions of overload both ports 41 and 42 will be exposed for each reciprocation of the valve. For the purpose of illustration the relative width or overlap of the different heads of the valve have been somewhat exaggerated.

Instead of actuating the valve 13 through the intermediary of the rock-shaft 32 and the attached levers and connecting rods, it is actuated directly from the member 31 carried by the governor, thereby still further simplifying the construction and eliminating a number of parts and reducing the chance for wear and the troubles incident to lost-motion in the joints. The member 31 is mounted on the bar 26 connecting the weights as before. The connecting rod 34 is united with the valve stem 14 by the pivot 31[a]. The packing gland on the under side of the valve casing can be utilized as a guide, or a separate guide and cross-head may be provided.

In Fig. 5 is shown an arrangement intended for use with a greater number of nozzles or nozzle sections or other fluid-discharging devices. In this case 41 represents the passage leading to the normal-load nozzles, 43 the passage leading to the full-load nozzles, and 42 the passage leading to the overload nozzles. It is to be noted that the overlap on the heads of the valve successively increases from the bottom toward the top. This is so that a slight movement of the valve will expose only the port 41, and a greater movement will expose the port 43 as well as 41, and a still greater movement will expose all three ports for each rotation of the governor or low-speed shaft 21.

In Fig. 6 is shown a sectional view of the valve casing on a large scale for the purpose of illustration. 41 represents the passage leading to the normal load nozzles, shown in dotted lines, and 42 the passage leading to the overload nozzles, also shown in dotted lines.

In Fig. 7 is shown a reservoir or chamber 45 interposed between the controlling valve 13 and the nozzle 6, this reservoir having sufficient capacity to reduce or to prevent the puff-like action of the steam due to the alternate opening and closing of the controlling valve.

On the right-hand end of the secondary shaft 21, Fig. 2, is a crank 46 that actuates the plunger of the lubricating pump 47 through the connecting rod 48. The pump is arranged to supply lubricant to the bearings of the main shaft and also those of the secondary shaft.

The action of my improved mechanism is as follows: Steam on being admitted to the turbine starts the bucket wheel into motion and with it the main and secondary shafts. This causes the member 31 of the governor to rotate in an orbit determined by the load conditions. This will oscillate the rock-shaft back and forth through a predetermined number of degrees and the travel of the piston valve 13 will be governed accordingly. As the speed increases the orbit of the member 31 will diminish and the travel of the valve will decrease, and thereby reduce the amount of steam admitted to the turbine. Conversely, as the speed decreases the orbit of the member 31 will increase, thereby increasing the amplitude of the oscillation of the rock-shaft and the travel of the valve, and increasing the amount of steam admitted.

By properly arranging the ports and the parts of the valve or valves and the ports, it is evident that steam can be admitted to one nozzle or fluid discharging device when the demand for motive fluid is light, the valve moving to-and-fro with a given travel; that when the load is greater the valve or valves will have a greater travel and expose two ports; and that as the load further increases still more ports may be included within the range of travel of the valve or valves, and so on.

Where individual valves are employed they may be actuated by separate levers 35, or they may all be actuated by the same lever, the pivots 49 being mounted at different distances from the axis of the shaft 32, as shown in Fig. 8. Other arrangements to accomplish this result will readily suggest themselves to those skilled in the art.

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 consider to represent the best embodiment thereof; but I desire to have it 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. A turbine through which the flow of motive fluid is from the high to the low pressure end, in combination with a valve for regulating the admission of motive fluid, and a governor-controlled member whose orbit varies with load changes and which moves the valve to-and-fro to regulate the passage of motive fluid, the stroke of the valve changing with changes in the orbit of said member.

2. An elastic-fluid turbine comprising a casing and relatively rotatable elements, in combination with a valve for regulating the passage of motive fluid through said elements, a speed-responsive device, a member rotating with said device for moving the valve to-and-fro whose orbit varies in size with load changes to vary the travel of the valve.

3. An elastic-fluid turbine having wheel buckets and a fluid-admitting device, in combination with a valve that regulates the passage of motive fluid to the device and is interposed between it and the source of supply, a speed governor, a member carried by and rotating with the governor whose orbit changes in size with the load, and a connection that transforms the rotary motion of said member into to-and-fro movement of the valve.

4. An elastic-fluid turbine having wheel buckets and independent fluid-admitting devices, in combination with a valve having a constant to-and-fro movement varying in amplitude with the load, that is common to the devices to regulate the passage of motive fluid to the devices and is interposed between them and the source of fluid supply, a governor responding to changes in load on the turbine, a member carried by and rotating with the governor weight whose orbit enlarges and diminishes as the load changes, and a connection which transforms the rotary motion of the said member into a to-and-fro motion of the valve and also changes the amplitude of its movement with changes in size of the orbit of the said member.

5. An elastic-fluid turbine having wheel buckets and a fluid-admitting device, in combination with a valve for regulating the passage of fluid to the device that has a to-and-fro movement, a fly-wheel driven by the turbine, a weight pivotally mounted on the fly-wheel, the wheel and weight changing their relative positions with changes in speed, a member mounted on and moving with the weight whose orbit enlarges and diminishes as the relative positions of the weight and fly-wheel change, and a mechanical connection uniting the valve and said member so that the rotary movement of the latter is transformed into a to-and-fro movement of the valve whose amplitude of stroke varies with changes in the orbit of the said member.

6. A turbine through which the flow of elastic fluid is constantly from the high to the low pressure end, comprising wheel buckets and fluid-discharging devices, in combination with a valve which moves to-and-fro to expose a port connected to one of said devices under certain load conditions, and to expose another port under different load conditions, a governor carrying a member which rotates therewith and whose orbit varies with changes in load, and a connection between the member and the valve for moving the latter.

7. A turbine through which the flow of motive fluid is constantly from the high to the low pressure end, comprising wheel buckets and a fluid-discharging device, in combination with ports that admit fluid to the device, a valve that opens first one port and then another, a governor responsive to speed changes, a member carried by the governor which rotates therewith and has its orbit changed with changes in load, and a connection uniting the said member and valve so that the latter will be moved to and fro to open and close the ports, the extent of said movement being determined by the variations in the size of the orbit of said member.

8. A turbine through which the flow of motive fluid is constantly from the high to the low pressure end, comprising wheel buckets and a fluid-discharging device, in combination with ports arranged in sets that admit motive fluid to the different devices, one set receiving fluid for light load conditions and another for heavier load conditions, a speed-responsive device, a member moving with said device whose orbit varies with the load for changing the stroke of the valve in a manner to cause it to cover and uncover one set of ports for light load conditions and cover and uncover all the ports for heavier load conditions.

9. A turbine through which the flow of motive fluid is constantly from the high to the low pressure end, comprising wheel buckets, devices discharging motive fluid against the buckets, and passages conveying fluid to the devices, in combination with a valve having a variable stroke arranged to cover and uncover ports communicating with the passages, a rotary means for imparting a to-and-fro movement to the valve, a weight for varying the orbit of said means in accordance with load changes to vary the stroke of the valve, and a spring opposing the movements of the weight.

10. A turbine comprising wheel buckets, a casing therefor, and fluid-discharging devices, in combination with a valve which is constantly moved to and fro with a given travel for a given load to admit motive fluid

to one or more of said devices and is moved in a similar manner but with a greater travel for an increased load, a speed-responsive device, a member mounted thereon and rotating therewith whose orbit changes with changes in speed, and a mechanical connection for directly transforming and transmitting the orbital movement of the said member into a to-and-fro movement of the valve.

11. A turbine comprising wheel buckets, a casing therefor and fluid discharging devices, a plurality of ports connecting with the devices, a valve arranged to move to and fro over the ports, the parts of the valve and the ports having a progressive overlap to successively cut the said devices into and out of service, a speed-responsive device, a member carried thereby whose orbit changes in size with changes in load on the turbine, and a mechanical connection secured to said member that vibrates the valve and changes its travel in accordance with changes in size of the orbit of said member.

12. In combination, a turbine with a governing mechanism therefor comprising a speed-responsive device, a member carried thereby whose orbit enlarges and diminishes with changes in load, a valve for controlling the admission of fluid to the turbine which is directly vibrated by the said member, the extent of said vibrations varying with variations in size of the orbit of said member, and a reservoir interposed between the valve and the turbine to decrease the pulsatory effects of the motive fluid.

13. In combination, a turbine with a governing mechanism therefor comprising a speed-responsive device, a secondary shaft for the governor, gearing between the main and secondary shaft to reduce the speed of the latter, a member carried by the speed-responsive device whose orbit enlarges with an increase in load and diminishes with a decrease in load, a controlling valve, and a connection between the said member and the valve for moving the latter to and fro and changing its travel in accordance with changes in size of the orbit of said member.

14. A turbine, in combination with ports through which the motive fluid passes, independent fluid-discharging devices communicating with the ports, a valve balanced as to fluid pressures having portions of varying widths arranged to cover and uncover the ports to successively cut the discharging devices into and out of service, and a governor-controlled member whose orbit changes in size with load changes for moving the valve to-and-fro and also change the extent of its travel.

15. A turbine, in combination with means for regulating the passage of motive fluid therethrough, a governor acting by centrifugal force and inertia, a member rotating with the governor whose orbit changes in size with the changes in load, and a device connecting the said means and the member for transforming the rotary movement of the latter into a to-and-fro movement of the former.

16. A turbine, in combination with a valve which controls the passage of motive fluid through the turbine, a governor driven by the turbine, a member rotating with the governor whose position changes with changes in load, and a connection that unites the valve and the member so that as the latter rotates it will keep the valve constantly in motion and at the same time adjust it to vary the amount of motive fluid flowing in the turbine.

In witness whereof, I have hereunto set my hand this 5th day of May, 1906.

OSCAR JUNGGREN.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.