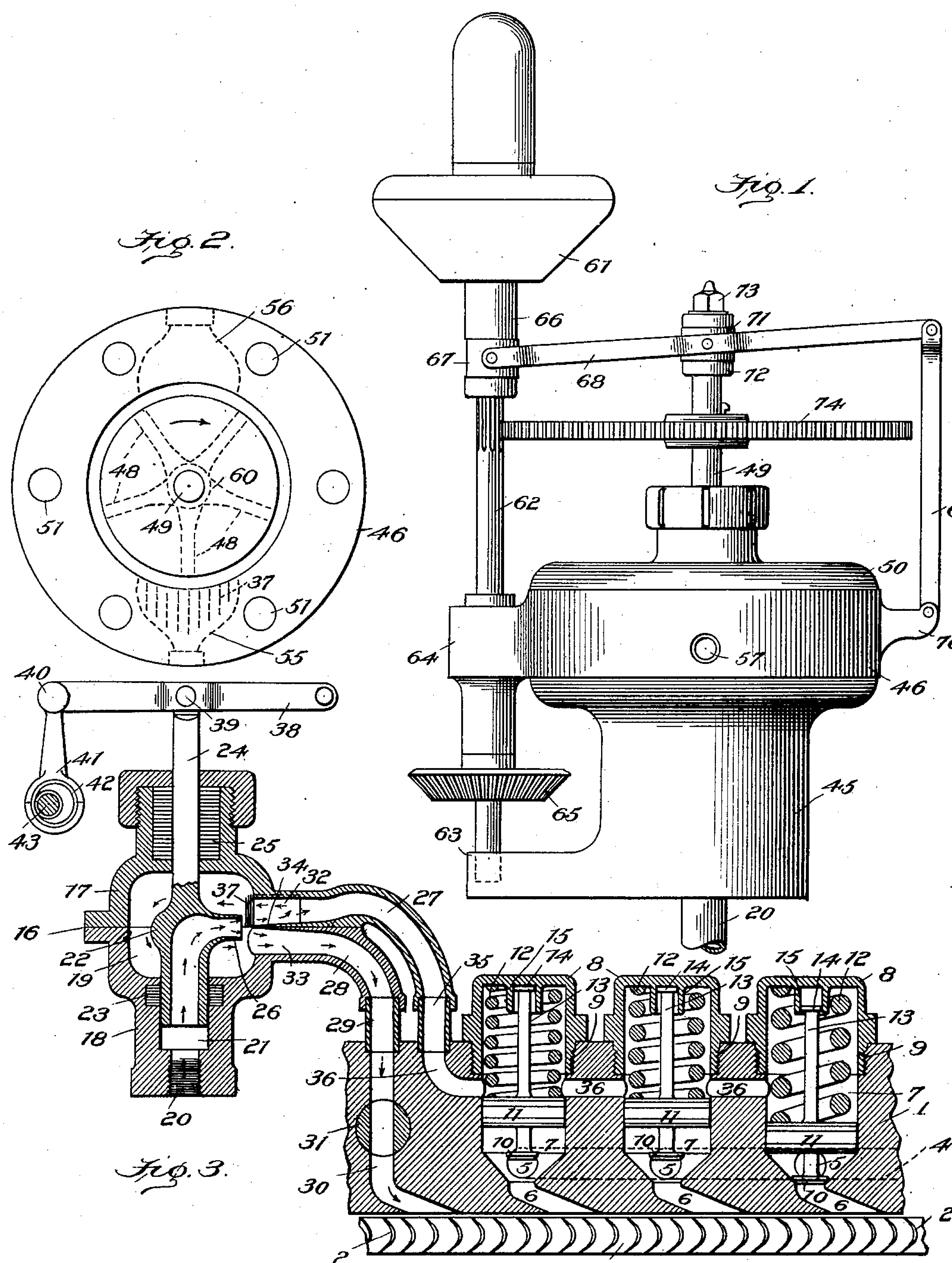
No. 753,773. PATENTED MAR. 1, 1904.

J. WILKINSON.

GOVERNING MECHANISM FOR TURBINES.

APPLICATION FILED JAN. 4, 1904.

NO MODEL. 2 SHEETS—SHEET 1.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 8.

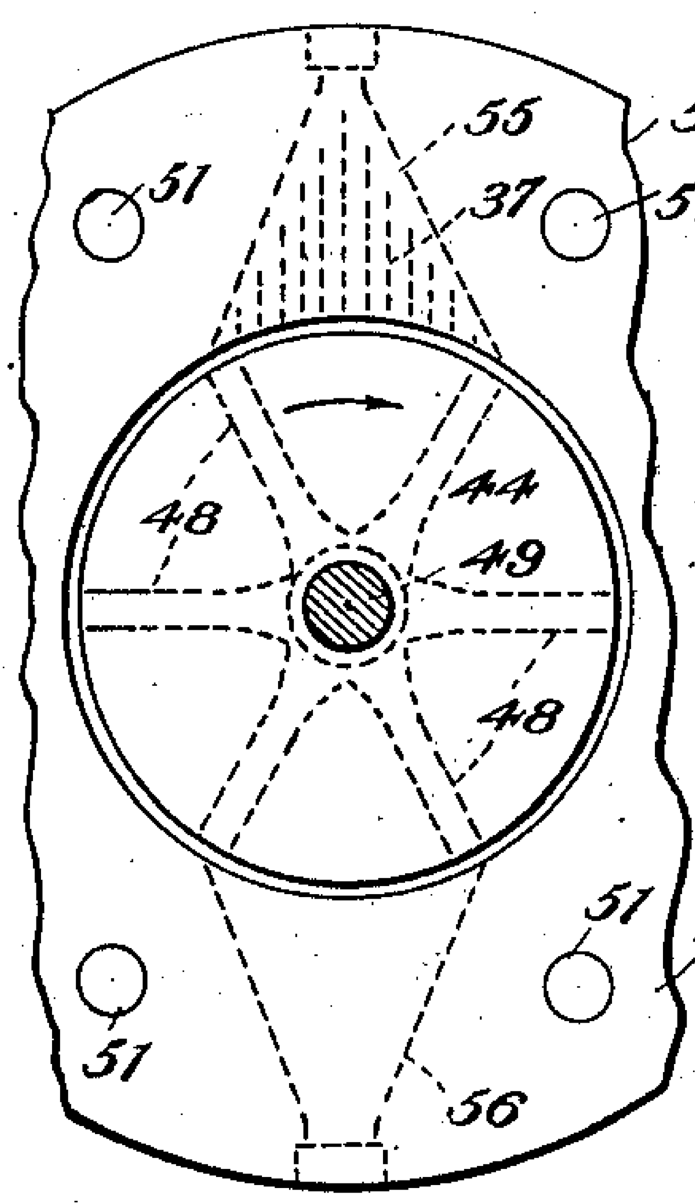


Fig. 4.

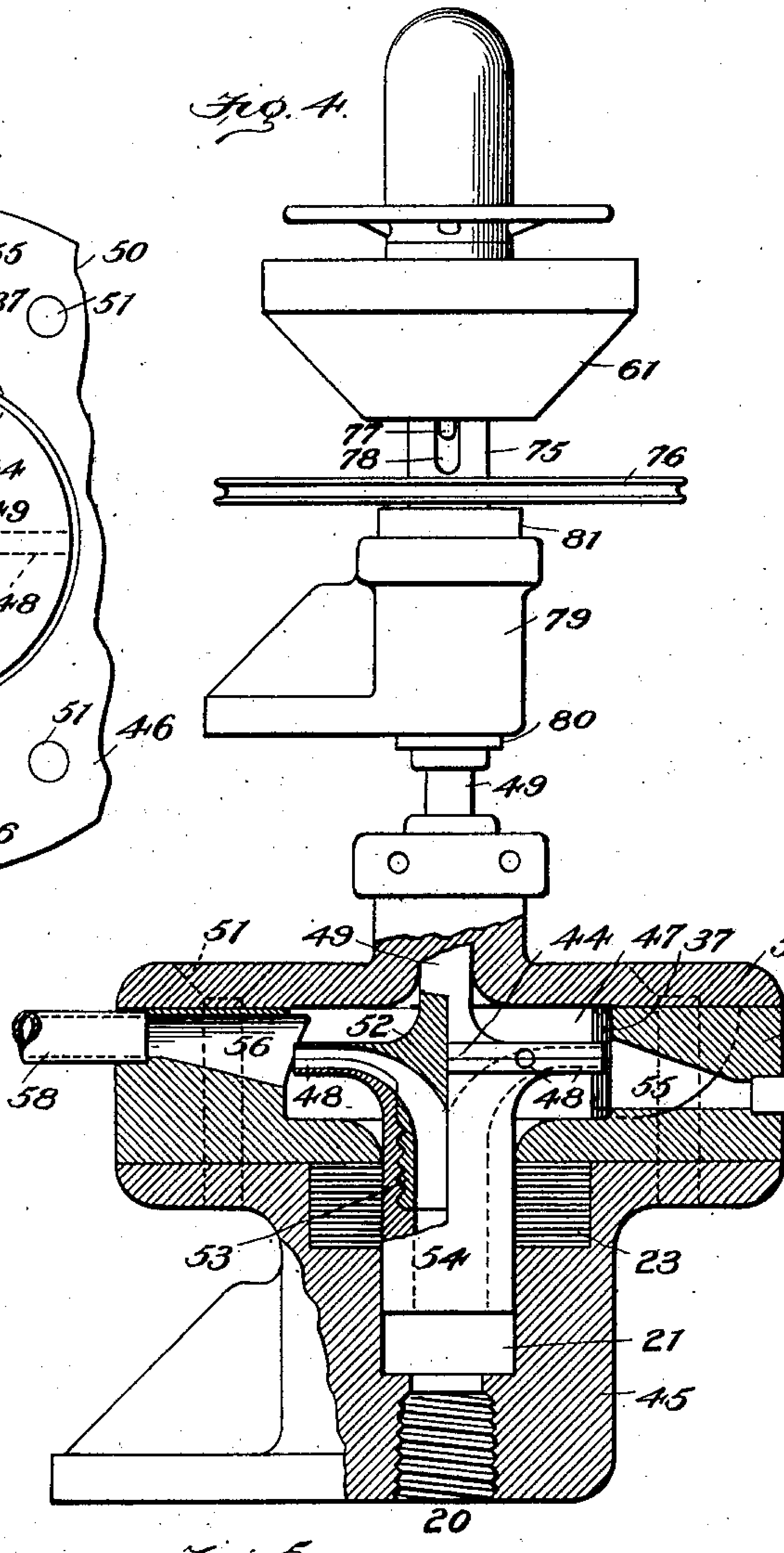


Fig. 6.

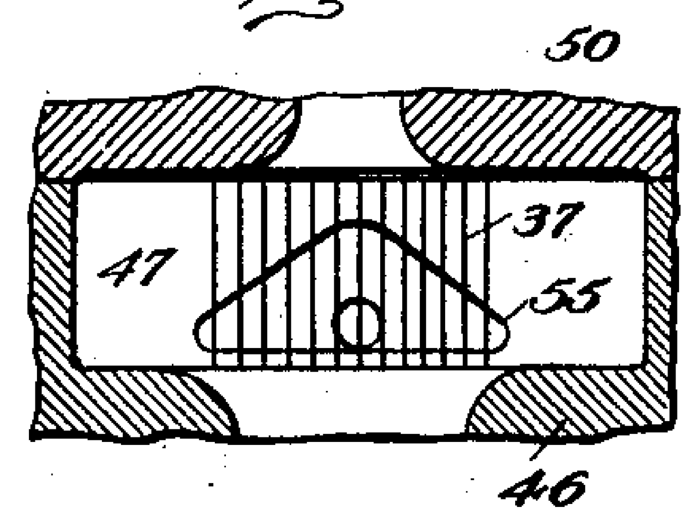


Fig. 7.

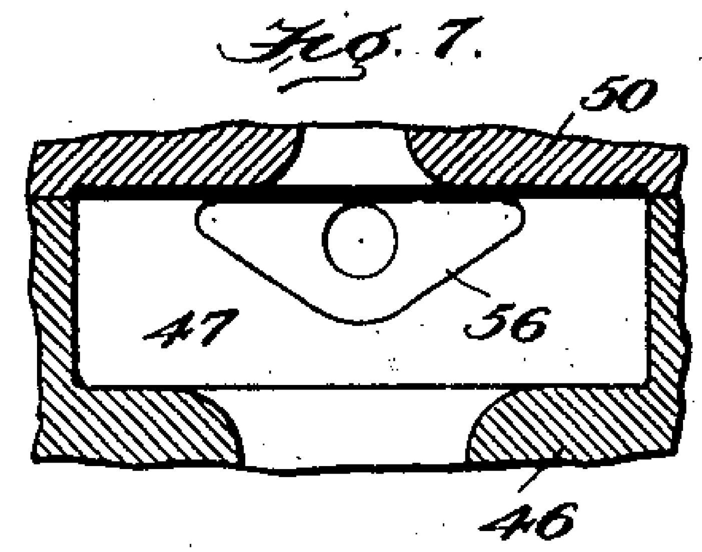
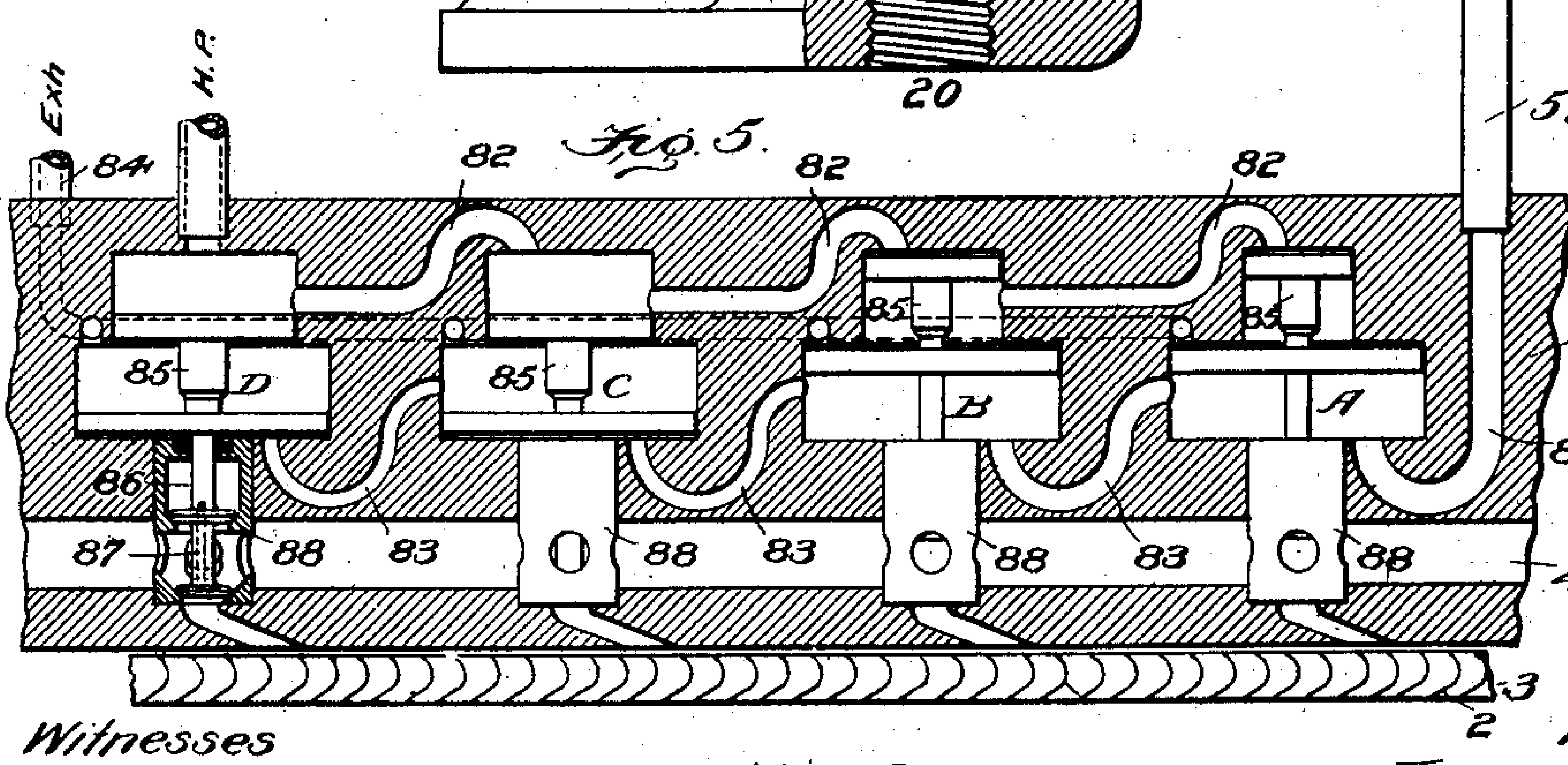


Fig. 5.



Witnesses

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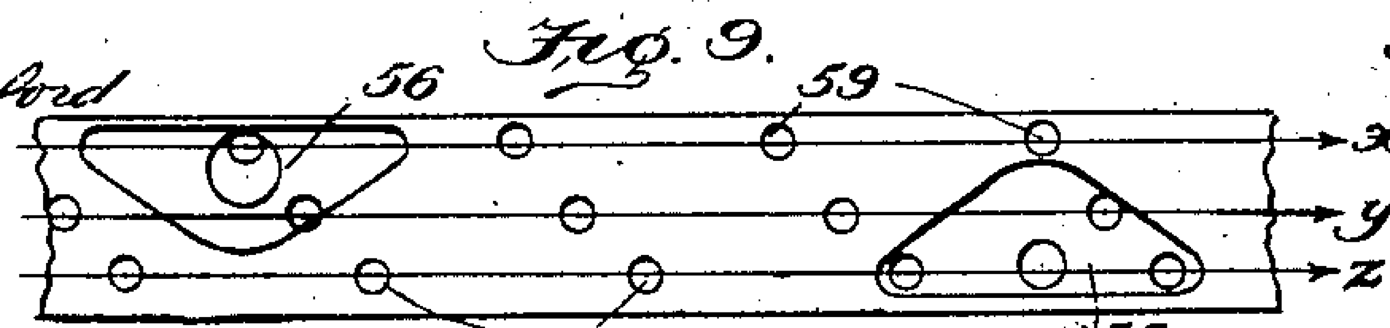
Fig. 9.



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UNITED STATES PATENT OFFICE.

JAMES WILKINSON, OF BIRMINGHAM, ALABAMA, ASSIGNOR TO THE WILKINSON STEAM TURBINE COMPANY, A CORPORATION OF ALABAMA.

GOVERNING MECHANISM FOR TURBINES.

SPECIFICATION forming part of Letters Patent No. 753,773, dated March 1, 1904.

Application filed January 4, 1904. Serial No. 187,601. (No model.)

To all whom it may concern:

Be it known that I, JAMES WILKINSON, a citizen of the United States, residing at Birmingham, in the county of Jefferson and State of Alabama, have invented new and useful Improvements in Governing Mechanism for Turbines, of which the following is a specification.

My invention relates to an improved governing mechanism for elastic-fluid turbines wherein a plurality of motor-fluid valves are controlled and successively actuated by a static pressure created by impact and regulated in a controller-passage by the injector action of a stream of fluid under the control of a governor-shifted nozzle, the position of which relatively to said passage determines the potential of the static pressure therein.

In utilizing fluid-pressure to control the operation of motor-fluid valves in turbines designed to operate with economy and at a uniform speed under varying loads the chief objects in view have been to simplify the construction to a point of economical practicability and to provide a governing mechanism which is capable of effecting a constant speed of shaft rotation during both uniform and variable loads without loss of economy in operation.

Where it has been the practice heretofore to lead separate fluid-conducting passages from the governing device to each turbine-valve in order to secure their successive operation, it is the object of my invention to use a single fluid-controller passage for any desired number of valves and to produce therein a valve-controlling fluid-pressure of varying potential and density by diverting more or less of a working stream of motor fluid thereinto without affecting its useful and efficient action in the turbine. This passage is open at but one end, where it leads from a controller-casing, from which another port discharges into a nozzle and within which a movable stream of fluid acts with an injector effect to raise by impact the pressure in the passage and with an ejector effect to lower the pressure, so that I secure a differential in the controller-pressure of the fluid approximately equal to the difference between the boiler-pressure and a vacuum. This is of importance in connection with turbines of large powers and operating by stage expansion, since it enables a great number of valves whose successive action depends upon variations in the pressure to be independently controlled, and at the same time there is no loss or waste of the controller fluid and its pressure and density in the controller-passage is varied without affecting the efficient action of the stream delivered to the turbine.

In adapting my governing mechanism to produce a constant speed of rotation under varying loads I provide for an intermittent raising and lowering of the pressure of the controller fluid sufficient to pulsate the valve or valves nearest the critical point of regulation to compensate variations in load between stated points of economy represented by the several nozzles and of a value corresponding to their horse-power capacity. If there be no wire-drawing action of the turbine-valves, it is not possible for the governing devices now in use when the nozzles are of fixed proportions to maintain a constant speed of shaft rotation, since they will have no movement whose controlling effect is capable of compensating variations in load between the stated points of economy under its control—*i. e.*, the successive opening or closing of valves having only open and closed positions. By intermittently opening the valve at the critical point of regulation for intervals of varying duration all load variations intermediate points of economy may be compensated. I effect this according to my present invention by rotating the controller-nozzle or oscillating it, so that the impact pressure of the fluid-stream in the controller-passage will be effected. This control being positive and independent of a time element constitutes an improvement on the mechanism described in a pending application for a method of governing turbines by a rotating valve action.

My invention further comprises the construction and arrangement of parts hereinafter described, and more particularly pointed out in the claims, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of the casing for a rotating controller-nozzle, showing a governor and speed-reducing gears to rotate the said nozzle. Fig. 2 is a plan view of a controller-casing with the driving mechanism removed and the nozzle and fluid-injector and ejector-ports shown in dotted lines. Fig. 3 is a vertical sectional view, through a modified form, of the controller-casing, showing means to oscillate the nozzle to deliver the jet of controller fluid to a passage leading to a series of turbine-valves shown in elevation in the supply-head of a turbine. Fig. 4 is a sectional view through the controller-casing, showing the rotatable nozzle and injector and ejector ports in elevation and also illustrating a modified form of governing mechanism. Fig. 5 shows a series of compound fluid-motors actuating balanced puppet-valves under the control of the governing mechanism in Fig. 4. Figs. 6 and 7 are sectional views of the interior of the fluid-pressure-controller casing shown in Fig. 4 and illustrate, respectively, the injector and ejector ports and the manner of inserting the director-plates in the former. Fig. 8 is a top plan view similar to Fig. 2, showing in dotted lines a modified construction of the multiported nozzle and passages. Fig. 9 is a view of the interior of the controller-casing broken away and shown in plan, with lines illustrating the position of the several fluid-jets delivered by the rotating multiple nozzle into the two ports when the nozzle is at different points of its governor-shifted travel.

Similar reference numerals refer to the same parts throughout the drawings.

The turbine-head 1 and the row of rotating buckets 2, carried by the wheel 3, may be of any desired construction, since they form no part of my present invention, which relates to a fluid-pressure-governing mechanism controlling and operating a plurality of supply or stage valves in case the turbine operates by stage expansion.

To describe the principle of operation upon which my invention is based in the simplest form, I refer to Fig. 3, in which a supply-passage 4 delivers motor fluid through ports 5 to a series of nozzles 6, which lead through said head and deliver fluid at an angle against the rotating buckets 2. The ports 5 are disposed at right angles to the nozzles 6 and open into the lower beveled ends of chambers 7, bored downwardly through the head and closed by screw-caps 8, which engage threaded countersunk shoulders 9 at the tops of said chambers. Puppet-valves 10, under the control of pistons 11, seat pressure-tight against the lower beveled portions of the chambers 7, which serve as valve-seats, and thus interrupt the flow of motor fluid from ports 5 through nozzles 6. The pistons 11, which are packed to fit pressure-tight within chambers 7, are normally exposed to the boiler-pressure through passages 5, which will tend to raise them and open valves 10 to admit motor fluid to the nozzles. To counteract this substantially constant pressure below the pistons and to cause a successive action of the several valves, I dispose within each of the caps 8 a coiled spring 12, and I increase the resistance strength of this spring in each succeeding casing, so that they offer a relatively and successively greater resistance to the constant pressure below the heads 11. To dash-pot the action of the valve-controlling pistons and limit their vertical movement, I provide each of them with a stem 13, having a head 14, which enters a cylindrical dash-pot 15, formed integral with and disposed within caps 8. The springs are not of themselves sufficiently powerful to seat the valves 10 against the pressure below pistons 11, and it is therefore the object of my invention to control the action of the valves by introducing above said pistons a valve-controlling fluid-pressure of varying potential, so that the combined effect of this pressure and the springs will cause the valves to move successively to a closed position. With this object in view I provide a fluid-controller casing 16, formed by two sections 17 and 18, suitably secured together and recessed to form a chamber 19, to which fluid-pressure is supplied by a port 20, entering a cylinder 21, formed in the head 18 and within which moves a nozzle 22, having an elongated body portion extending into the cylinder 21 and suitably packed at 23 to prevent leakage directly into chamber 19. A stem 24 for raising and lowering this nozzle passes through a suitably-packed stuffing-box 25, integral with section 17 of the casing. The nozzle 22 has a jet end 26, disposed at right angles to its body portion and adapted to deliver the stream of controller fluid into the controller-passage 27 or the conduit 28, connected by a nipple 29 with a nozzle-passage 30, leading through the turbine-head 1 and controlled by a valve 31. Injector-port 32 for the controller-passage 27 is preferably formed integral with section 17 of the casing, and the ejector-port 33 for the passage 28 is formed integral with section 18 and disposed in vertical alinement with port 32, being divided therefrom by a thin partition 34, formed by the adjoining tapering portions of said ports. The controller-passage 27 is connected by a nipple 35 with a conduit 36, leading through the head 1 and entering the first chamber 7 of a series at a point just above the position occupied by the piston 11 when the valve is fully open. This passage 36 leads from cylinder to cylinder of the series until it reaches the end cylinder, where it stops without any outlet being there provided. The several stems 13 limit the movement of the pistons 11, so that the fluid-pressure has access throughout the series at all times and is equal in all the cylinders. I provide director-plates 37, which are vertically-disposed in ejector-port 32 for dampening the impact effect of the jet of controller fluid to prevent heterogeneous motion and direct the outward flow of the fluid from the nozzle back into the chamber 19, as indicated by the arrows.

Assuming a suitable governing mechanism is connected to the free end of link 38, which is pivoted at 39 to the stem 24, as the speed of the turbine increases under a decreasing load the stem 24 will be moved to raise jet end 26 of the nozzle and as the speed decreases under an increasing load to lower the jet end. Since no outlet or escape is provided for the fluid-pressure in passage 36 except at its port 32, it follows that a variable static pressure may be created therein by the injector and ejector action of the fluid-jet, which will vary between the maximum pressure of the stream itself and a partial vacuum produced by the full ejector action in passage 28. The nozzle 22 is moved by any suitable governing means which may automatically adjust it to a position when the action of its fluid-jet will produce in passage 27 a pressure calculated to control a sufficient number of valves to admit motor fluid proportioned to the load. Where a speed-governor is used, the greater the speed the higher the nozzle 22 will be lifted by its stem 24 and the greater the impact force of the fluid-stream in the passage 27, which impact force causes the pressure existing in the controller-passage to rise to its maximum point, when it will coöperate with the springs to close all the valves 10 and shut off the fluid-supply to the turbine through nozzles 6. As the nozzle 22 is lowered by the decreasing speed of the turbine, caused by an increase of the load, the impact effect of the stream upon the static pressure in the controller-passage will decrease in proportion to the diminishing volume of the stream which is delivered to said passage. In other words, the movement of the nozzle away from a position directly in front of port 32 weakens its injector effect in said passage while increasing the ejector effect through port 33 and causes the pressure throughout the controller-passage to decrease until one or more of valves 10 are opened by the pressure below pistons 11, and the supply of motor fluid is increased proportionately to the load. When the maximum load is on, the nozzle will assume a position opposite port 33 and by its ejector action will cause a partial vacuum in chamber 19 and controller-passage 36, so that all the pistons 11 will rise and open valves 10, and when the load is fully off the nozzle's position will be opposite port 32, where its full injector action will increase the pressure above pistons 11 and aid the springs to close valves 10. The flow of the fluid-stream from chamber 11 through conduit 28 and nozzle 30 is unaffected by the positions of the nozzle 22 and remains constant and may be of a volume sufficient to drive the turbine under its own friction load. This stream always does useful work at its highest efficiency, and since the controller-passage is closed it follows that there will be no loss in economy through waste of controller-fluid pressure, which is a serious objection to the majority of fluid-controller mechanisms. This is of particular advantage in connection with turbines acting under a continuously-varying load, where the valves are always opening and closing, and also with controller-means designed to pulsate the valve or valves at the critical point of regulation, since in both cases the exhausting of the fluid-passage and valve-cylinder would cause considerable loss of fluid-pressure. To effect this pulsatory control, I connect the link 38 at 40 to an eccentric-arm 41, moved by an eccentric 42, mounted on a shaft 43, driven in any suitable manner and at any desired speed. This will cause an oscillatory movement of nozzle 22 in all of its governor-shifted positions, which, except at the extremes of the nozzle's movement, will have the effect of varying the pressure of variations of the controller fluid sufficiently to cause the valve whose piston is nearest equilibrum between equal pressures to open as the pressure falls and close as it rises without any other valves having been affected. The uniform oscillatory stroke of the nozzle produces uniform pressure-waves in the controller-passage, whose mean value, determined by the governed position of the nozzle, controls the number of valves held constantly open or closed. As the pressure-waves rise above or fall below the critical or equilibrium pressure of the active valve, controlling intermediate load variations, it will intermittently close and open it for periods whose relative duration depends upon the length of time the pressure of each wave exceeds or falls below the critical valve-pressure. The wave-producing means may be operated at any desired speed, since the element of time is not of importance in regulating the pulsations. This oscillatory regulation may also be effected by the rotating multiple-nozzle 44, (shown in Fig. 4,) whose body portion extends into a cylinder 21, supplied with pressure through a port 20, as in Fig. 3. The packing 23 around the nozzle is seated in a recess in the top of the lower section 45 and retained therein by section 46 of the casing, having a central opening through which the nozzle passes and a recess forming a controller-chamber 47, within which the several jet-orifices 48 of the nozzle are disposed and rotated by a stem 49, passing through a top section 50 and suitably packed to prevent leakage from chamber 47. Bolts 51 secure the several sections firmly together. I preferably form the nozzle in sections, the upper of which comprises the body portion 52, integral with stem 49, and the tubular externally-threaded shank 53, which engages a threaded shouldered portion of the body 54 of the nozzle. From chamber 47 oppositely and inversely disposed flaring injector and ejector ports 55 and 56 lead, respectively, to conduits 57 and 58, corresponding to 27 and 28 of Fig. 3. Referring to Fig. 6, it will be seen that the injector-port 55 is triangular in cross-section where it enters chamber 47 and has its base adjacent to the bottom of the chamber, while its apex is a greater distance from the top of the chamber than the width of jet-orifices 48, so that the direct discharge of fluid into port 55 will not occur when nozzle 44 is moved to the raised position assumed when all load is off. In Fig. 7 the similarly-shaped but inversely-disposed ejector-port 56 is shown, it being noted that the circular opening from which the port flares is larger in diameter than is the case with the injector-opening. As shown in Fig. 9, where lines x and z represent the extremes of the nozzle's governor-controlled movements, with the load off (line x) none of the jets of fluid indicated by points 59 enter port 55, while one or more continuously enter port 56, and thus produce a continuous ejector effect which lowers the pressure in the chamber, and with the load full on (line z) one or more jets will be continuously delivered into port 55, while none enter port 56, through which the fluid-pressure merely flows to conduit 58. When the rotating nozzle 44 assumes intermediate positions under the control of governor 60, such as shown in line y, the jets of fluid will act with a combined injector and ejector effect to vary the potential of the controller fluid, and it will be noted that the flaring structure of ports 55 and 56 will cause a variation in the relative length of time during which the jets will be effective in said ports when moving in the same plane of rotation. This coöperates with the governor-controlled position of the nozzle and the intermittent action of its jets to effect the same control of the valves as has just been described. The director-plates 37 are shown more clearly in Fig. 6 and in dotted lines, Fig. 4, where it will be seen that they curve to correspond in shape with the slits preferably sawed from above through the section 46. The plates are all made of the same height for convenience; but they vary in depth, as shown in Fig. 8, being arranged to leave a clear passage along the sides of the flaring port 55. In this latter figure the nozzle 44 has six jet-orifices 48, which act with a combined injector and ejector effect, since one or more will be simultaneously opposite both ports. In Fig. 2 I show a nozzle 60 with five jet-orifices, which act with an alternate injector and ejector effect to produce waves of pressure whose sine value exceeds that produced by the nozzle 44. Ports 55 and 56 may be formed with straight or curved side walls, as shown in Figs. 2 and 8.

I show two forms of governor mechanism for actuating nozzle 44, that shown in Fig. 1 being a reduced-speed governor 61, mounted on a pinion-shaft 62, having bearings 63 and 64, formed integral with sections 45 and 46, respectively, of the controller-casing and having a bevel-gear 65 keyed thereto and driven by the turbine or otherwise. The governor 61 moves a sleeve 66, provided with a slip-collar 67, connected to a rod 68, which is pivoted at its other end to a lever-arm 69, mounted on a lug 70 on the casing 46. The rod 68 is pivotally connected to a slip-collar 71, mounted on sleeve 72, secured by bolt 73 on the end of stem 49, to which is keyed a large gear-wheel 74, meshing with pinion-shaft 62, with respect to which it is vertically adjusted by the governor through rod 68. By this means the speed of rotation of the controller-nozzle is greatly reduced. In Fig. 4 I show a direct-connected two-speed governor 61, having a shaft 75, driven by a pulley 76 from the turbine or other source of power. Within this shaft the stem 49 telescopes and is rotated by a pin 77 thereon engaging an elongated slot 78 in the shaft to permit of the stem's vertical movement. The shaft 75 is mounted in a suitable bearing 79, provided with thrust-collars 80 and 81. Either of these methods of governing the valve-controlling pressure may be used in connection with the series of compound fluid-pressure motors A to D, connected to the turbine-valves and coupled up in a manner described in a pending application and illustrated in Fig. 5. Here passages 82 connect the several high-pressure cylinders of the series and passages 83 connect the low-pressure cylinders of the series, which are also in communication with an exhaust-passage 84. The compound pistons 85 in the cylinders are connected to the stems 86 of motor-fluid-supply valves 87. The stems 86 lead through suitably-packed openings into a casing 88, which is disposed across the supply-passage 4 and provided with seats for the balanced puppet-valve 87 and ports to admit the motor fluid of this valve to permit its flow through the casing. The controller fluid flows through a conduit 89 in the supply-head 1 into the series of cylinders, and it will be noted that the succeeding passages 83, conducting this fluid from cylinder to cylinder, are of relatively smaller area to reduce the loss of fluid-pressure by the exhausting of these passages through passage 84 when the pistons 85 are moved downwardly. The same arrangement is also true of the passages 82.

Though I have referred to the several valves as mounted in the supply-head, it is my intention to arrange them in substantially the same manner in the diaphragm-partition of a multiple-stage turbine or in any stationary portion of a compound turbine, and in the latter cases I will use preferably a governor-controlled nozzle for each series of valves, and any desired number of these nozzles may be so connected that they will move synchronously under the control of a single governor means.

Though I have referred at length to the construction of the governing mechanism, I do not desire to limit myself thereto, since any governing means which will effect the desired movement of the controller-nozzle may be substituted.

Instead of leading the fluid-controller stream to a nozzle, as shown in Fig. 3, the passage 58 in Fig. 4 may lead to a steam jacket or coils for superheating portions of the turbine or may be used to reciprocate the governor-nozzle mechanism or for any other desirable purpose.

This fluid-pressure control of motor-valves may be used with any character of motor, whether rotary or reciprocatory, and may operate solely on the injector or ejector principle or with the combination of the two effects, as has been described. It is also obvious that the port for the controller-passage may be moved relatively to a stationary or rotating nozzle and the same controlling effect will be obtained.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a motor, a plurality of valves for the motor fluid, and a fluid-pressure-controlling means adapted to divert a freely-flowing stream of fluid to control the operation of said valves.

2. In a motor, an intermittently-actuated valve delivering pulsations of fluid-pressure to said motor, and a fluid-pressure-controlling means which diverts a freely-flowing stream of fluid to control the oscillation of said valve.

3. In a motor, a fluid-pressure-operated valve, and means to control the operation of said valve by the impact action of a jet of freely-flowing fluid.

4. In a motor, fluid-pressure-operated valves, and means utilizing the impact effect of a freely-flowing stream of fluid to severally control the operation of said valves.

5. In a motor, a stream of fluid utilized to drive the motor, motor-fluid valves, and governor-controlled means to divert said stream to control the operation of said valves.

6. In a motor, the combination of rotating buckets, nozzle-passages delivering fluid thereto, valves for controlling the flow of fluid through the nozzle-passages and a governor-nozzle for controlling the action of said valves.

7. In a rotary motor, the combination with a rotary element, of a series of independent passages for conducting fluid into contact with said element, a series of fluid-actuated valves for severally controlling the supply of fluid to the passages and a governor-nozzle for controlling the operation of said valves.

8. In a motor, passages for the motor fluid, fluid-actuated valves therefor, a conduit for the valve-actuating fluid leading to one or more of said valves, a nozzle delivering a jet of fluid into said conduit, and means to control the potential of the fluid-pressure in said conduit by varying the relative position of said nozzle and conduit.

9. In a motor, passages for the motor fluid, fluid-actuated valves therefor, a conduit leading to a series of independently-acting valves, and means to control said valves by fluid-pressure in said conduit which is governed by the impact action of a jet of fluid.

10. In a motor, passages for the motor fluid, valves therefor and fluid-pressure-controlling means for said valves comprising a conduit for the valve-actuating fluid leading from a chamber to one or more of said valves, and closed at its other end, a port in said chamber into which a jet of fluid is delivered, and means to vary the ejector effect of said jet.

11. In a motor, a fluid-pressure-actuated valve, and fluid-impact means operating with a variable-ejector effect to control the actuation of said valve.

12. In a motor, passages for the motor fluid with separate valves, a fluid-conduit leading to several valves, and means to control the operation of said valves comprising a chamber from which said conduit and an eduction-passage lead, means within the said chamber to eject the pressure out of said conduit, and means to oppose said controlling pressure and move said valves.

13. In a motor, a plurality of valves, a fluid-controlling means therefor comprising a passage common to a number of said valves, a governor means compressing, by fluid impact, the fluid in said passage to vary its actuating pressure on said valves and cause them to operate successively, and a pressure opposing said governed pressure to move said valves.

14. In a motor, a fluid-pressure-controlled valve, and fluid-impact means operating with an ejector effect to govern the controlling fluid-pressure for said valve.

15. In a turbine, nozzle-passages having separate fluid-actuated valves, a controller-passage closed at one end leading to a plurality of said valves, means to divert all or part of a freely-flowing stream of fluid into said passage and means to conduct said stream into the turbine after it has exerted its controller effect.

16. In a motor, means to vary the potential of fluid-pressure in a controller-passage for one or more valves comprising inlet-port for

said passage, a nozzle delivering a jet of fluid into said port and means in said port to subdivide the jet at the point of impact.

17. In a motor, means to vary the potential of fluid-pressure in a controller-passage for one or more valves comprising a nozzle delivering a jet of fluid into said passage, and director-plates disposed in said passage at the point of impact of the fluid-jet.

18. In an elastic-fluid turbine, the combination of induction-nozzles with separate valves, a controller-passage common to a plurality of valves, governor-controlled variable static fluid-pressure in said passage, and means independently controlling the action of said valves to move them sensitive to said varying pressure.

19. In an elastic-fluid turbine, a row of supply-nozzles, supply-valves therefor requiring different actuating pressures to move them, a fluid-conducting passage leading to a plurality of said valves and means to separately actuate said valves comprising a variable static pressure within said passage, and an impact-nozzle to vary the pressure.

20. In an elastic-fluid turbine, the combination of a revolving row of buckets, nozzles delivering fluid thereto, a valve for each nozzle movable sensitive to fluid-pressure, a fluid-conducting passage leading to the several valves and a governor-shifted nozzle compressing the fluid in said passage to control the operation of said valves.

21. In an elastic-fluid turbine, the combination of induction-nozzles with separate valves opened by the motor-fluid pressure, a revolving row or rows of buckets, a fluid-conducting passage leading to several valves, and means to close said valves comprising a movable nozzle, a fluid stream therein acting by induction impact to create a fluid-pressure within said passage.

22. In a motor, a fluid-pressure-controlled valve, and fluid-pressure means operating with a combined injector and ejector effect to govern the controlling fluid for said valve.

23. In a motor, a passage delivering motor fluid thereto, a conduit for fluid controlling the operation of a motor-fluid valve or valves which communicates with said passage, and a movable intermediate portion of said passage whose position determines the pressure in said conduit and controls said valve or valves.

24. In a motor, a passage delivering fluid-pressure thereto, a valve-controller fluid-conduit leading therefrom, and a nozzle controlling the diversion of said fluid into said conduit.

25. In an elastic-fluid turbine, a passage for motor fluid, and a compound differential piston-valve movable between different pressures and acting to interrupt the flow of fluid through said passage.

26. In a governing mechanism for motors, a chamber from which lead a closed and a normally open conduit, means to direct more or less of a stream of fluid supplied to said chamber into the ports for said conduits, and motor-fluid valves whose operation is controlled by the pressure in said closed conduit.

27. In a governing mechanism for motors, a controller-chamber through which a freely-flowing stream of fluid passes and enters a normally open passage, a controller-conduit for one or more motor-valves, and means to change the course of said stream to control the operation of said valves.

28. In a fluid-pressure governing mechanism for motor-fluid valves, a rotatable shiftable controller-nozzle, and means to supply fluid-pressure to said nozzle which controls the operation of said valves.

29. In a motor, a fluid-pressure-controlled valve, and means comprising a rotating nozzle to control the operation of said valve by the impact action of a jet of fluid.

30. In a motor, a fluid-pressure-controlled valve, and means comprising a rotating multiple nozzle to control the operation of said valve by the impact action of jets of fluid.

31. In a motor, the combination of rotating buckets, a valve for controlling the flow of motor fluid against said buckets, and a movable nozzle for controlling the operation of said valve.

32. In a motor, a motor-fluid nozzle, a fluid-pressure-controlled valve therefor, and a movable nozzle controlling the intermittent operation of said valve.

33. In a motor, motor-fluid nozzles, fluid-pressure-controlled valves therefor, and a movable nozzle controlling the intermittent operation of part of said valves.

34. In a motor, valves therefor, and a fluid-pressure-controller means for said valves comprising a chamber, conduits therefrom one of which controls said valves, inversely-disposed flaring ports for said conduits, and a governor-shifted rotating nozzle which intermittently directs a jet or jets of fluid into said ports.

35. In a turbine, a plurality of motor-fluid valves serially connected by passages of varying dimensions, and fluid-pressure-controller means for said valves.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JAMES WILKINSON.

Witnesses:
H. M. Harton,
R. D. Johnston.