C. W. DAKE.

GOVERNING MEANS FOR ELASTIC FLUID TURBINES.

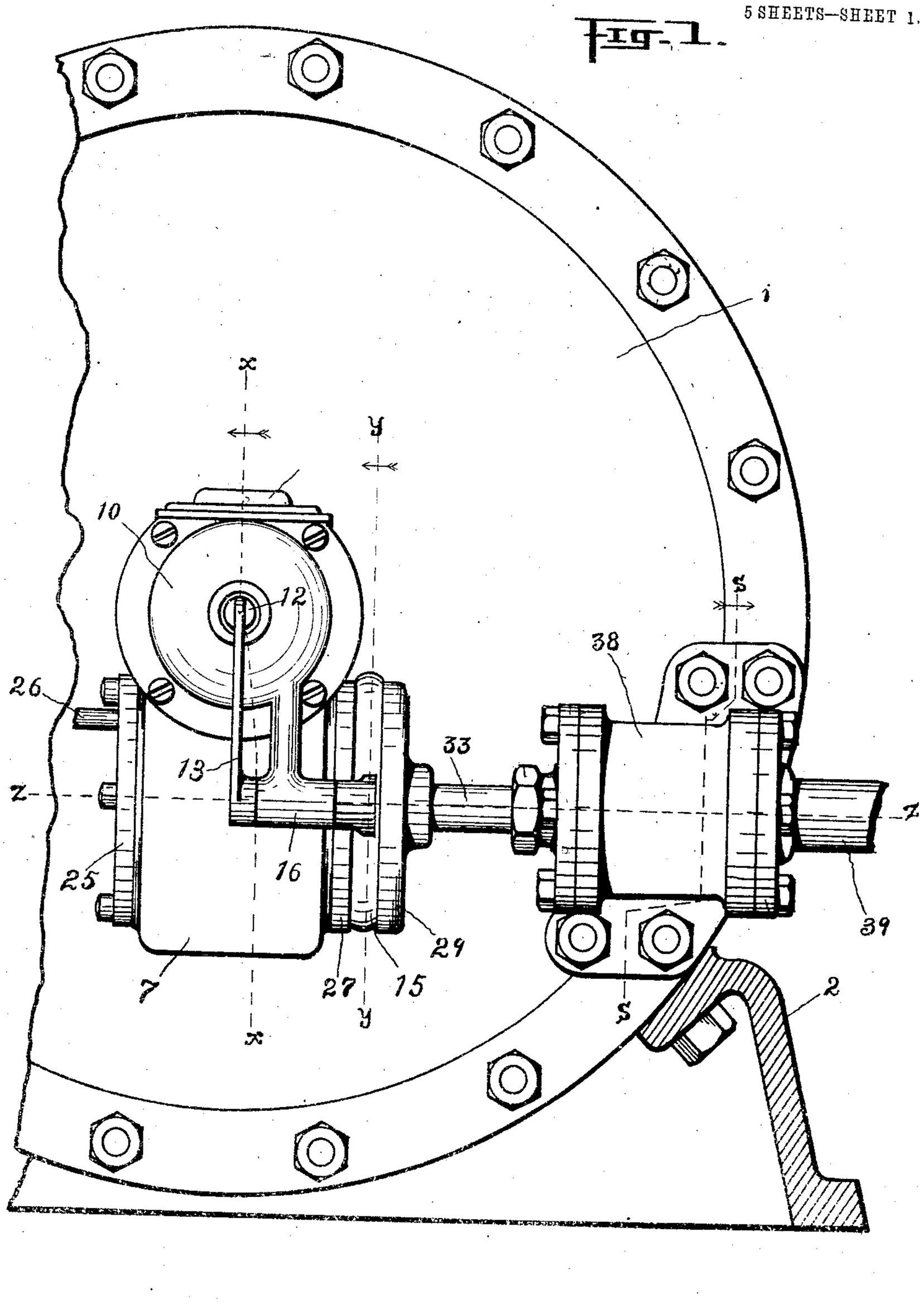
APPLICATION FILED DEC. 16, 1907.

930,048.

Patented Aug. 3, 1909.

5 SHEETS—SHEET 1.

Fig. 1.



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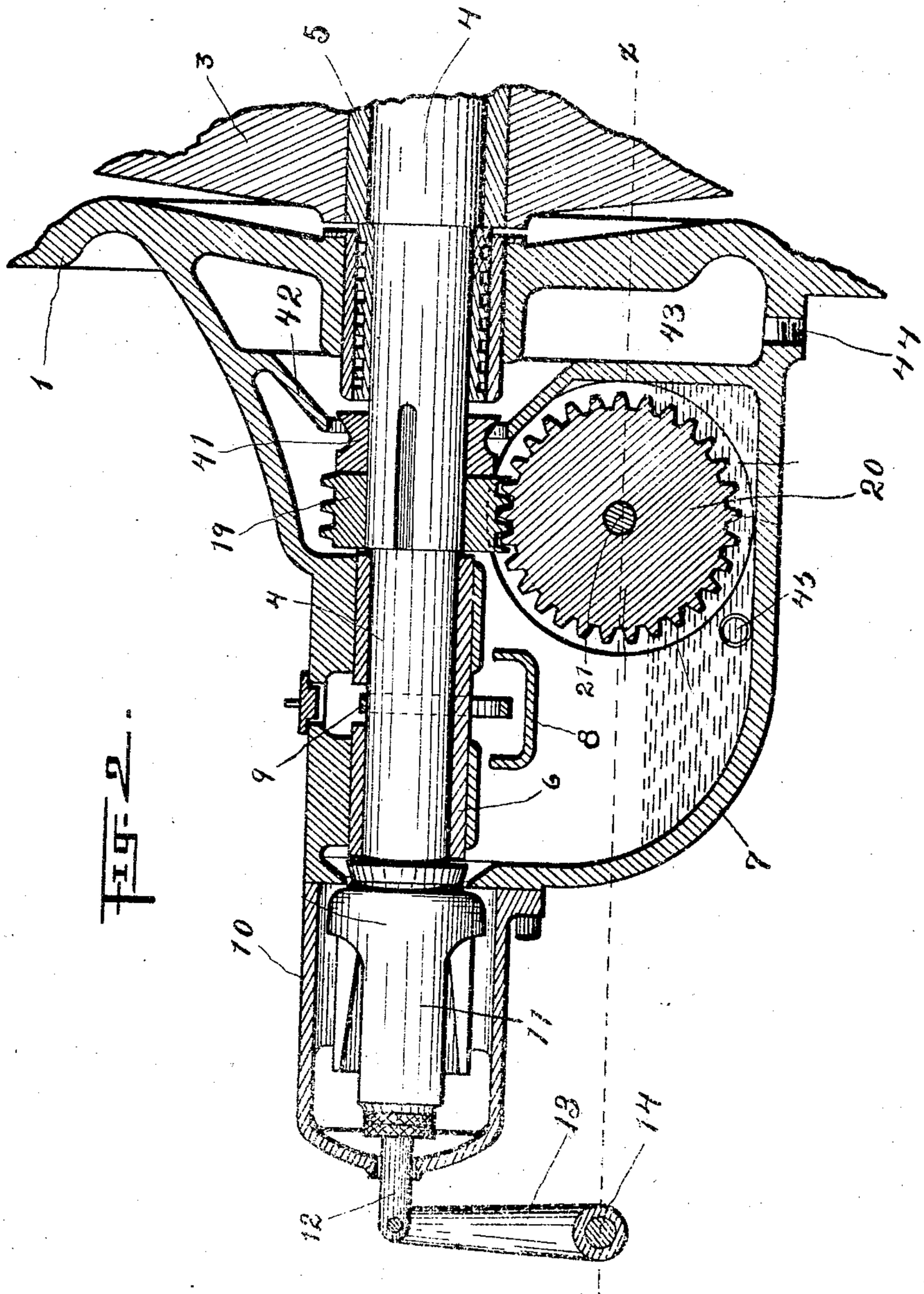

Fig. 2.

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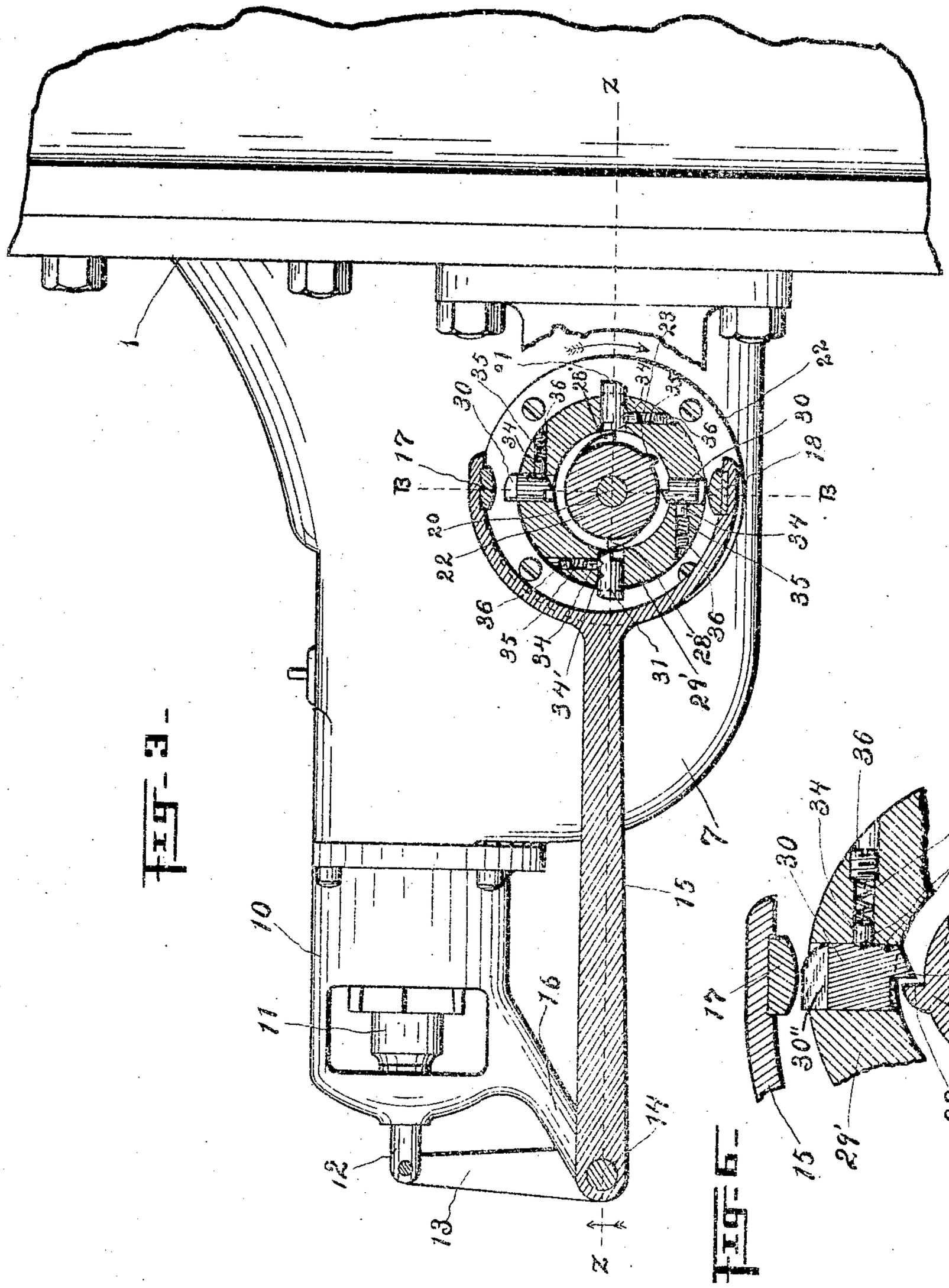

FIG. 3.

FIG. 5.

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5 SHEETS—SHEET 4.

Fig. 4.

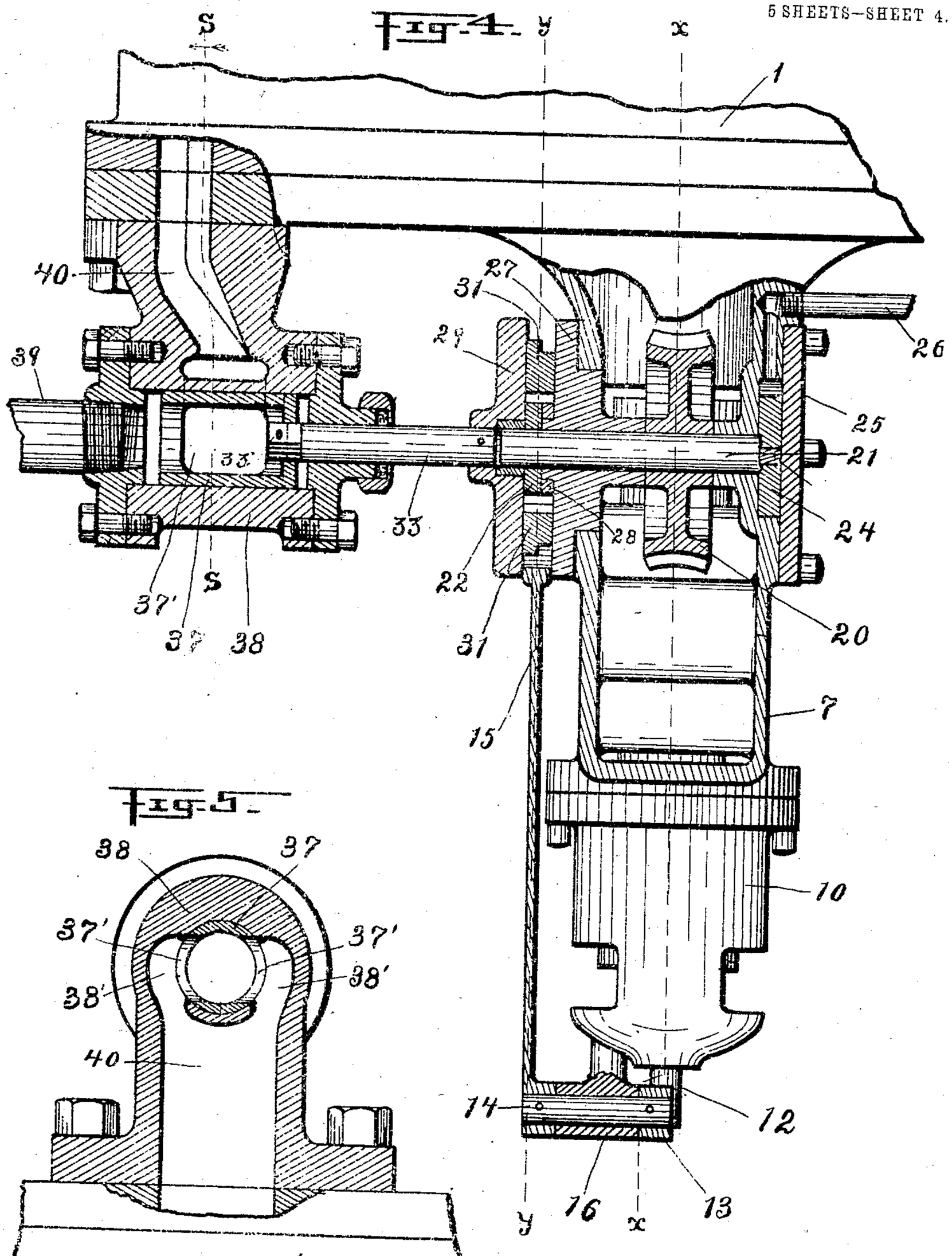

Fig. 5.

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5 SHEETS—SHEET 5.

Fig. 7.

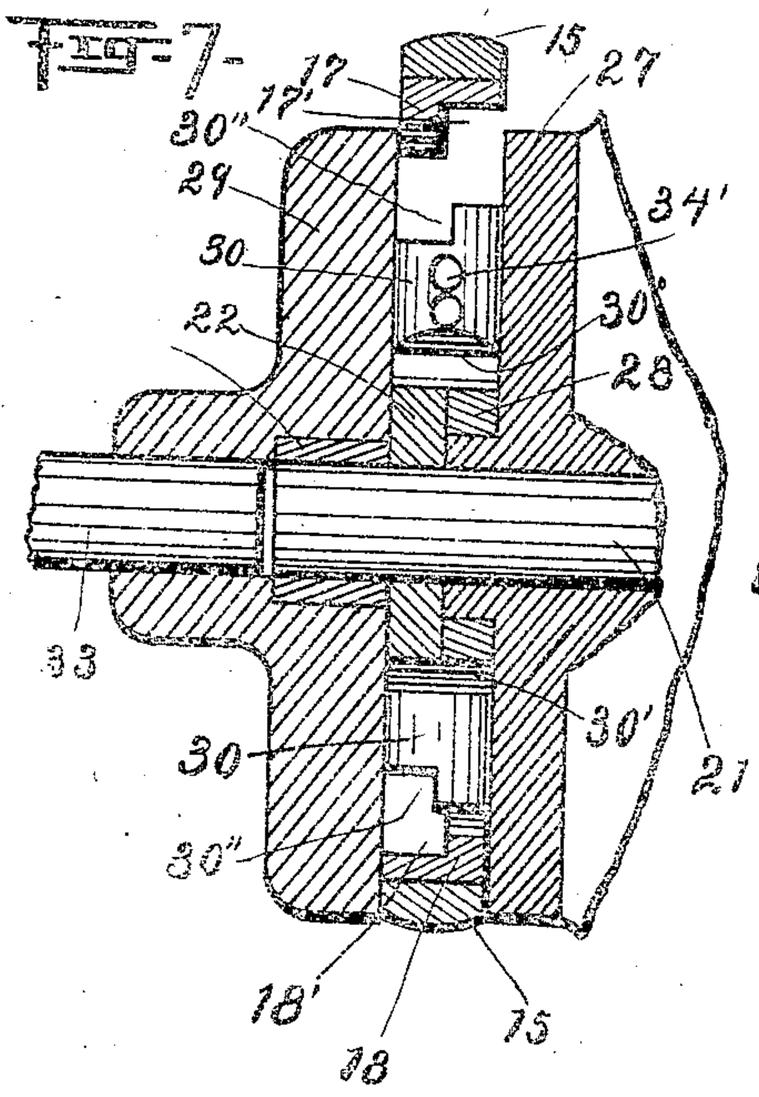


Fig. 8.

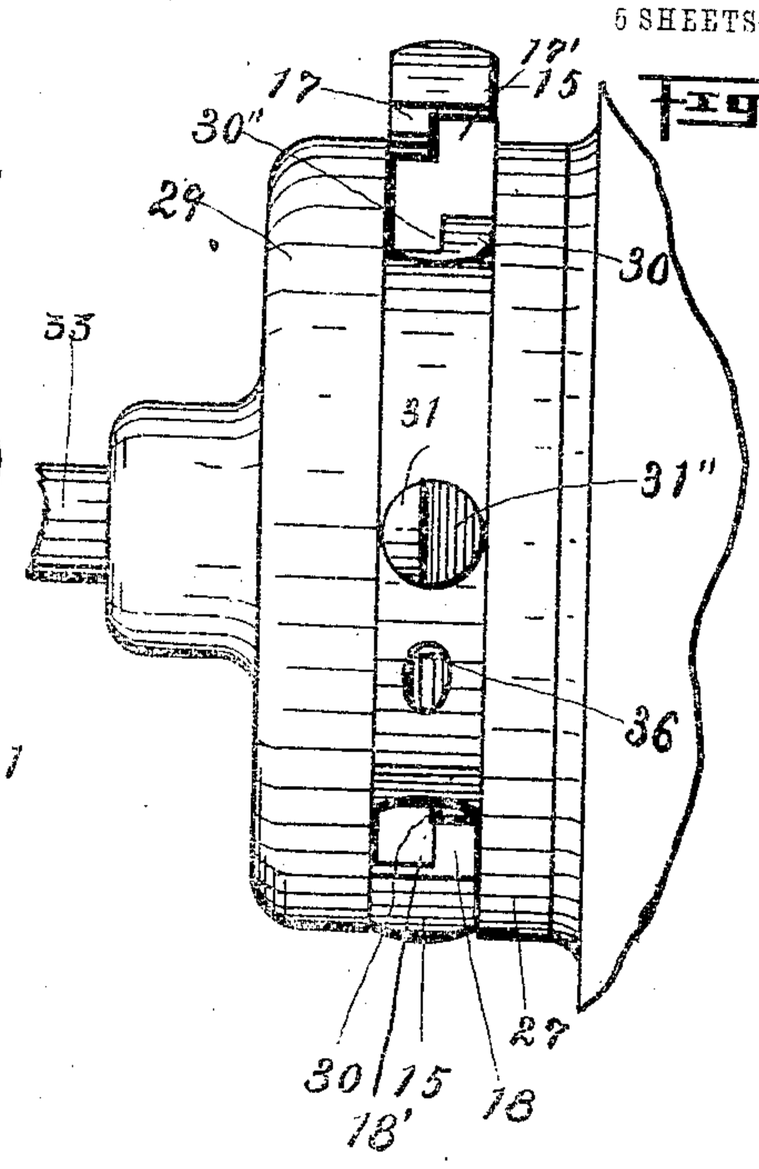


Fig. 9.

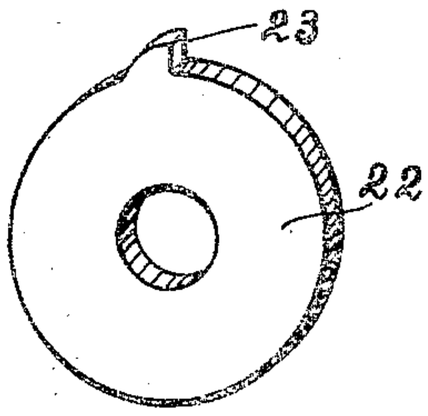


Fig. 10.

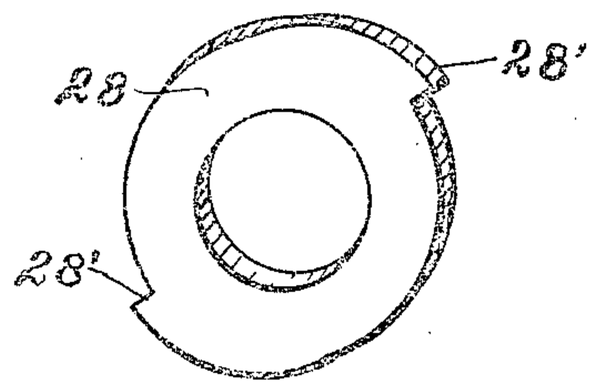


Fig. 11.

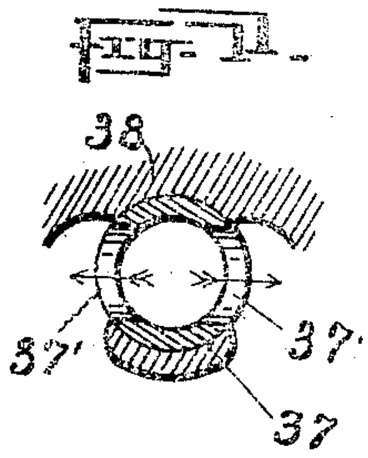


Fig. 12.

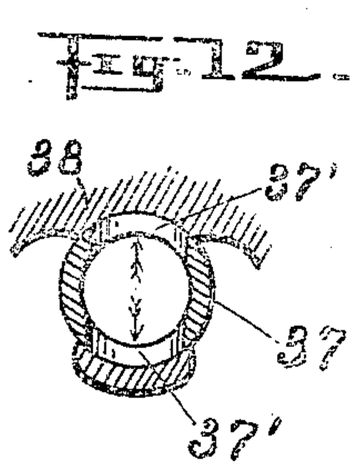


Fig. 13.

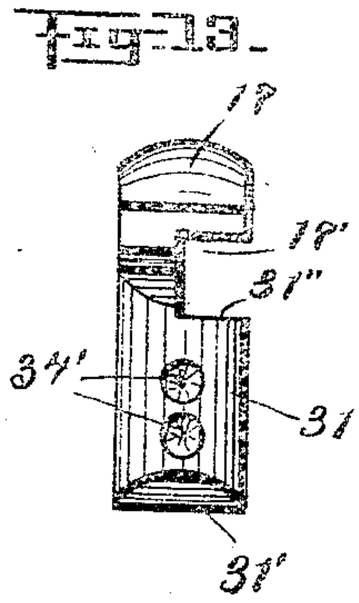
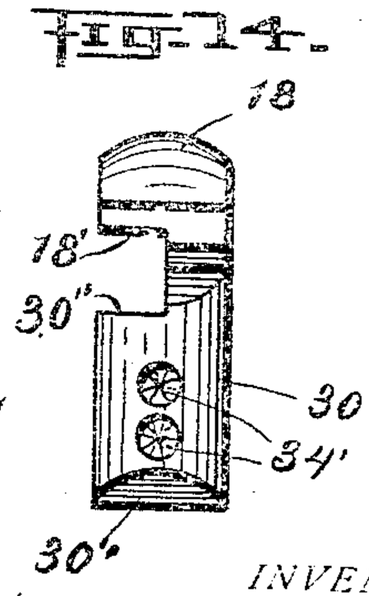


Fig. 14.



WITNESSES:

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ATTORNEYS

UNITED STATES PATENT OFFICE.

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GOVERNING MEANS FOR ELASTIC-FLUID TURBINES.

No. 930,048. Specification of Letters Patent. Patented Aug. 3, 1909.

Application filed December 16, 1907. Serial No. 406,723.

To all whom it may concern:

Be it known that I, CHARLES W. DAKE, a citizen of the United States, residing at Grand Rapids, in the county of Kent, State of Michigan, have invented certain new and useful Improvements in Governing Means for Elastic-Fluid Turbines, of which the following is a specification.

This invention relates to improvements in governing means for elastic fluid turbines, although the governor is well adapted for steam engines generally.

The objects of this invention are: first, to provide a governor which is simple, effective and reliable in operation; second, to provide an improved construction of governing means for the supply to the nozzles of elastic fluid turbine engines which will effectively cut off the nozzle and turn it on full capacity, thus avoiding the waste due to the inefficiency of operating such a nozzle with a partial supply of the steam or elastic fluid; third, to provide an effective means of controlling the admission of the motive to a turbine in jets or blasts of such duration as are required to give a constant predetermined speed to the turbine under varying conditions of load; and fourth, to provide an improved mechanism whereby a driving means is effectively controlled and regulated to cut off or turn on the full supply of steam or elastic fluid to a nozzle or series of nozzles.

Further objects, and objects pertaining to mere details, will be readily understood from the detailed description to follow.

I accomplish the objects of my invention by the devices and means described in the following specification.

The invention is clearly defined and pointed out in the claims.

A structure embodying the features of my invention is clearly illustrated in the accompanying drawing, forming a part of this specification, in which:

Figure 1 is an end elevation of an elastic fluid turbine, a portion of the same being broken away; Fig. 2 is a detail longitudinal sectional elevation view through the governing mechanism, portions of the case, and turbine rotor, taken on a line corresponding to line X—X of Figs. 1 and 4, showing the shaft and governor weights in full lines and the adjacent parts in section; Fig. 3 is a detail partial longitudinal sectional view taken on a line corresponding to line *y—y* of Figs. 1 and 4, showing details of the clutch mechanism; Fig. 4 is a detail partial sectional plan view taken on a line corresponding to line Z—Z of Figs. 1, 2 and 3, showing details of the governor mechanism, clutch and governor valve, and the connections between the same; Fig. 5 is a detail partial sectional view taken on a line corresponding to the irregular line S—S of Figs. 1 and 4, showing details of the governor valve; Fig. 6 is an enlarged detail sectional view, being a part of the clutch mechanism of Fig. 3, showing the details of construction of one of the dogs and adjacent parts; Fig. 7 is an enlarged detail sectional view taken on a line corresponding to line B—B of Fig. 3, showing further details of the clutch mechanism; Fig. 8 is a side elevation view of the clutch mechanism, which is sectioned in Fig. 7, the elevation being taken from the right-hand of the parts as they appear in Fig. 3; Fig. 9 is a perspective side view of the rotating plate 22 of the clutch mechanism with its actuating dog or tooth 23; Fig. 10 is a side perspective view of the disengaging cam plate 28 of the clutch mechanism; Fig. 11 is a detail transverse sectional view of the governor valve appearing in Figs. 4 and 5, in the open position; Fig. 12 is a similar detail transverse sectional view of the said governor valve, showing it in its closed position; Fig. 13 is a detail elevation view of one of the trip dogs 21 which actuates the clutch for closing the governor valve; and Fig. 14 is a detail elevation view of one of the trip dogs 30 which actuates the clutch in opening the governor valve.

In the drawing, the sectional views are taken looking in the direction of the little arrows at the ends of the section lines, and similar numerals of reference refer to similar parts throughout the several views.

Considering the numbered parts of the drawings: The casing 1 of the turbine is of any usual or satisfactory design and is supported on the base 2. Within this is any suitable design of rotor, which is secured to a shaft 4 by means of a sleeve 5. The shaft 4 is supported in a suitable bearing sleeve or bushing 6. A suitable casing 7 extends from the rotor case 1 to embrace this bearing, said casing being of such dimensions as to properly contain the various parts of the

driving means which controls the governor valve, and form an oil reservoir for the lubrication of the various parts of such driving means and for the lubrication of the shaft. An oil shelf 8 and an oil ring 9 are provided for the purpose of lubricating the shaft 4.

A casing 10 is secured to the casing 7, extending in axial line with the shaft 4, and its bearings, and within this casing are located the revoluble governor weights 11, which are adjusted to the particular speed desired. The stem 12 connected to the governor weights 11 is connected to an arm 13 by suitable pivot and actuates a rock shaft 14, on which is a rock shaft arm 15. The rock shaft 14 is supported by a bracket or hanger 16 on the casing 10. The lever 15 is bifurcated and embraces the clutch device and is the means of actuating the same, being provided with actuating blocks 17 and 18 for that purpose, which actuating blocks are made of hardened steel to withstand the wear. It will be seen that the action of the governor weights 11 will control effectively this lever mechanism and swing the lever 15 up or down as the speed varies from the predetermined point at which the governor weights are set.

A driving means independent of the governor weights is provided for actuating the governor valve, which is thrown into gear by the action of the governor weights. This consists of a worm 19 on the rotor shaft 4, which acts on the worm gear 20, which is carried on a shaft 21. The worm gear 20 dips into the oil in the oil chamber and is constantly lubricated thereby. On the left-hand end of this shaft, as appears in Fig. 4, is a disk 22 provided with a dog or tooth 23, which constantly revolves with the said shaft whenever the turbine is in motion. On the opposite end of the shaft 21 is a rotary pump 24, acting in the pump casing 25 to circulate oil and deliver it out through the pipe 26 to the places where such lubricant may be needed. A plate 27 closes the opposite side of this motor case and affords a support for the fixed cam-plate 28, which has oppositely-arranged cams 28′ thereon.

A flange or disk 29, which carries the dogs 30 and 31, of the clutch mechanism, is supported on a shaft 33, which is arranged axially and end to end with the shaft 21. This clutch mechanism is for the purpose of intermittently coupling the shaft 21 to the shaft 33 for the purpose of actuating the governor valve. The dogs 30 and 31 are arranged in lateral apertures in the flange support for the said dogs, and there is provided for each of the said dogs a frictional block or pin 34, which is urged into engagement with the said blocks by the spring 35, the said spring being adjustable by a screw 36 which forms an abutment therefor. Little depressions 34′ are formed in the sides of each of the dogs for engagement by the respective friction blocks or pins 34.

A hollow balanced rotary governor valve 37 is provided on the shaft 33 and is secured thereto by a pin 33′, the end of the shaft 33 being squared to insert into the valve so that it will engage the same and cause it to rotate. This valve is provided with opposite ports 37′ and is located in a valve casing 38, where it is revolved by the mechanism heretofore described. A supply pipe 39 delivers steam or elastic fluid to the end of the casing, and the steam or elastic fluid is delivered through the ports 37′ of the valve through ports 38′ of the valve casing to the passage 40, leading to the turbine nozzles.

By referring to Figs. 11 and 12, it will be seen that as the valve is advanced one-quarter of a revolution at a step, it opens and closes successively, so that when the valve stands open if it is turned one-quarter way, it will be entirely shut off, and when entirely shut off, if turned another one-quarter, it will be thrown wide open. The actuating blocks 17 and 18 for actuating the clutch dogs are notched longitudinally, the block 17 being notched at 17′ on the right-hand side, as appears in Fig. 7, and the block 18 being notched on the left-hand side at 18′, as appears in the same figure, and as is also clearly illustrated in Figs. 8, 13 and 14. These blocks act upon the dogs 30 and 31 to force them inwardly, the inner ends of the dogs being formed into catches 30′ and 31′ respectively, to be engaged by the dog or tooth 23 on the disk 22, the said catches being beveled at the back so that they will readily travel up the cams 28′ on the cam plate 28. These dogs are notched oppositely to each other. The dogs 31 are notched on the right-hand side at 31″ and the dogs 30 are notched on the left-hand side at 30″, as clearly appears in Figs. 7, 8, 13 and 14. The bifurcations of the forked lever 15 are separated a distance somewhat in excess of the outside diameter of the clutch ring 29′ (Figs. 3 and 6) or flange 29, and are positioned and guided to act upon these dogs successively.

When the motive fluid is admitted to the turbine the wheel or rotor begins to revolve until it reaches the speed for which the weights of the governor are set. Then the centrifugal force developed by such weights carries the lever 13 back by means of the connection 12, which rocks the shaft 14 and causes the forked end of the lever 15 to rise. This causes the block 18 to contact with the dog 30, forcing it inwardly toward the center of the clutch mechanism, so that the catch 30′ on the inner end thereof projects into the path traversed by the rotating dog 23 in the disk 22. This dog 23 carries the

dog 30 forward with it up the stationary inclined cam 28′ of the cam disk 28, which causes these parts to disengage because of the action of the said cam. This carries the plate 29 a one-fourth revolution, turns the shaft 33 one-quarter way and, by so doing, closes the cut-off valve 37. The dogs 30 having traveled their full quarter distance and been released by the cam 28′, the dogs 31 will be brought into position. The opposite halves of these dogs 31 project, they being notched at 31′ as heretofore described, and they are in position to be acted upon by the wear trip or actuating block 17 of the bifurcated lever. When the speed of the turbine rotor decreases, the governor weights will reverse the motion of the lever 13, pulling it forward, which will cause the lever 15 to move downwardly, which causes the block 17 to engage the dog 31 and forces its catch 31′ into the path of the rotating dog 23. When the catch 31′ of this dog 31 is engaged by the dog 23, it will be carried up the incline of the cam 28′ one-quarter turn, until it is released. This will turn the shaft 33 one-quarter way over, which will rotate the governor valve 37 one-quarter way and open it again, so that the motive fluid again enters the turbine at full head. In this connection, I desire to remark that I have provided a deflecting collar 41 on the rotor shaft 4, coöperating with the flange 42 of the casing to collect any water that may pass along the shaft 4 and deliver it into a chamber 43 from which it may be drained through an aperture 44. This prevents the water passing over into the oil chamber. I provide a drainage aperture 45 for the oil chamber.

From this it will be seen that the operation of my improved governing means for turbines is very effective and that it entirely opens or closes the governor valve, so that for no material length of time will the nozzles be operating with the governor partially closed or restricted, and as the nozzles only operate with the greatest economy when under full pressure for which they are designed, the advantage of my improved governor is very clear.

The governor valve and the clutch mechanism might be designed to move a shorter distance than a one-fourth turn, or for any portion of a revolution, and be very effective for the purpose, but I believe that as designed they are simplest and best.

My improved clutch mechanism might also very well be connected to operate any kind of a governor valve, although clearly it is especially adapted to the rotary balanced valve which I have illustrated.

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

1. In a governing means for elastic fluid turbines, the combination of the casing 1; a turbine wheel 3; a turbine shaft 4 supported in suitable bearings; a speed responsive device, connected to be driven by the said turbine; a rock shaft 14; a worm on the said turbine shaft; a worm gear 20 meshing with the worm 19 on said turbine shaft; a suitable shaft 21 for supporting the said worm gear; a cylindrical rotary balanced governor valve 37, having a central stem 33; suitable passages leading therefrom to the turbine nozzles; a clutch mechanism interposed between the shaft 21 of the said worm gear and the central stem 33 to the said rotary valve 37; double sets of dogs 30 and 31 located in different positions in said clutch mechanism, arranged to throw the said clutch into gear, one set of dogs being arranged to move the governor valve to the closed position and the other set being arranged to move it to the open position; a bifurcated arm 15 on the said rock shaft 14, embracing the said clutch mechanism, arranged to act on one set of dogs when moved in one direction and on the other set of dogs when moved in the opposite direction, whereby the governor weights control said arm and move it up and down; and stationary cams for acting upon said dogs to withdraw the same at a predetermined point after they have been acted upon by the governor weights connected to release the said clutch, whereby the governor valve is opened and closed alternately in governing the engine, for the purpose specified.

2. In a governing means for elastic fluid turbines, the combination of the casing 1; a turbine wheel 3; a turbine shaft 4 supported in suitable bearings; a speed responsive device connected to be driven by the said turbine; a worm on said turbine shaft; a worm gear supported on a suitable shaft and revoluble in one direction only, meshing with the worm on said turbine shaft; a cylindrical rotary balanced governor valve 37 having a central stem 33; suitable passages leading therefrom to the turbine nozzles; a clutch mechanism on the shaft of said worm gear interposed between the said worm gear and the said rotary valve 37 to drive it in one direction only; and connections to the governor weights for throwing the said clutch mechanism into gear for governing the governor valve, for the purpose specified.

3. In a governing means for elastic fluid turbines, the combination of the casing 1; a turbine wheel 3; a turbine shaft 4 supported in suitable bearings; a speed responsive device connected to be driven by the said turbine; a worm on the said turbine shaft; a worm gear meshing with the worm on the said turbine shaft; a governor valve for controlling the passages leading to the turbine nozzles, arranged to be acted upon by the said worm gear; a clutch mechanism interposed between the said worm gear and

the said rotary valve 37; double sets of dogs 30 and 31 located in different positions in said clutch mechanism, arranged to throw the said clutch into gear, one set of dogs being arranged to move the governor valve to the closed position and the other set being arranged to move it to the open position; a bifurcated arm 15 on the said rock shaft 14, embracing the said clutch mechanism, arranged to act on one set of dogs when moved in one direction and on the other set of dogs when moved in the opposite direction, whereby the governor weights control said arm and move it up and down; and station-arm cams for acting upon said dogs to withdraw the same at a predetermined point after they have been acted upon by the governor weights, connected to release the said clutch, whereby the governor valve is opened and closed alternately to govern the engine, for the purpose specified.

4. In a governing means for elastic fluid turbines, the combination of the casing 1; a turbine wheel 3; a turbine shaft 4 supported in suitable bearings; a speed responsive device, connected to be driven by the said turbine; a worm on the said turbine shaft; a worm gear 20, supported on a suitable shaft and revoluble in one direction only, meshing with the worm on said turbine shaft; a governor valve for controlling the passages leading to the turbine nozzles, arranged to be acted upon by the said worm gear; a clutch mechanism on the shaft of said worm gear, interposed between the said worm gear and the said rotary valve 37 to drive it in one direction only; and connections to the governor weights for throwing the said clutch mechanism into gear for governing the governor valve, for the purpose specified.

5. In a governing means for elastic fluid turbines, the combination with a casing of a turbine wheel and suitable shaft; a speed responsive device connected to be driven by the said turbine; a gearing on said shaft; a governor valve; a clutch mechanism between the said gearing and the said governor valve for actuating the valve; connections from the governor weights to the said clutch mechanism; a plurality of dog devices for the clutch mechanism; and connections to the governor weights to act upon one set of the said dogs for throwing the clutch into gear to move the valve to the open and on the other set of dogs to throw the clutch into gear to throw the valve to the closed position in response to the action of the governor weights, coacting substantially as described and for the purpose specified.

6. In a governing means for elastic fluid turbines, the combination of the casing; a turbine wheel 3 therein; a turbine shaft 4 supported in suitable bearings; a speed responsive device connected to be driven by the said turbine; a governor valve; means for connecting said governor valve with the turbine shaft, a clutch mechanism being interposed in the connections between the said turbine shaft and the governor valve; a rock shaft 14; connections from the governor weights to the said rock shaft; a bifurcated rock shaft arm carried by the said rock shaft to be moved up and down by the action of the governor weights, the said bifurcations embracing the clutch mechanism to control the same for regulating the governor valve, for the purpose specified.

7. In a governing means for elastic fluid turbines, the combination of the casing; a turbine wheel within the same; a turbine shaft supported in suitable bearings; a speed responsive device actuated by the said shaft; a worm on the said shaft; a worm gear meshing with said worm and supported on a suitable shaft; a governor valve controlled from the shaft of the said worm gear; a clutch mechanism on the shaft of said worm gear and interposed between the said worm gear and the governor valve; and connections from the said clutch to the said governor weights whereby the governor valve is controlled, as specified.

8. In a governing means for elastic fluid turbines, the combination with a casing; a turbine wheel and suitable shaft; a speed responsive device connected to be driven by said turbine; a gearing on said shaft; a governor valve; a clutch mechanism between the said gearing and the said governor valve, for actuating the valve intermittently, consisting of the driving shaft 21, the disk 22 with a tooth 23 thereon, secured to the said shaft, a stationary plate bearing a cam-plate 28 with the opposite cams 28′ thereon, said cam-plate being arranged parallel to the revolving disk 22, a shaft 33 bearing the disk 29 supporting a ring 29′ on its face, for controlling said governor valve, radially arranged sets of dogs 30 and 31 in said ring, the dogs 30 being provided with teeth 30′ on the inner end for engaging with the tooth 23 on the disk 22 and having its left-hand outer end portion cut away at 30″, the function of said dogs being to close the governor valve, the dogs 31 being provided with teeth 31′ at their outer ends to be engaged by the tooth 23 of the disk 22 for opening the governor valve, the said dogs being cut away on the right-hand side at 31″ at their outer ends, the said teeth 30′ and 31′ being beveled on their backs to be acted upon by cams 28′ 28′ for disengaging them from the tooth 23 after a quarter revolution; a bifurcated member 15 having actuating blocks 17 and 18, the one cut away on the right-hand side at 17′ and the other on the left-hand at 18′ and embracing the clutch mechanism to act upon the said dogs alternately; and connections from the bifurcated memb to the gov-

ernor weight mechanism for controlling the said bifurcated member to act upon the said dogs to throw them into gear for the transmission of power from the driving shaft to control the governor valve, and a friction pin 34 to engage a depression 34′ in the side of each of the dog members 30 and 31 to hold them yieldingly in position, all coacting for the purpose specified.

9. In a governing means for elastic fluid turbines, the combination with a casing; a turbine wheel and suitable shaft; a speed responsive device connected to be driven by said turbine; a gearing on said shaft; a governor valve; a clutch mechanism between the said gearing and the said governor valve, for actuating the valve intermittently, consisting of the driving shaft 21, the disk 22 with a tooth 23 thereon, secured to the said shaft, a stationary plate bearing a cam-plate 28 with the opposite cams 28′ thereon, said cam-plate being arranged parallel to the revolving disk 22, a shaft 33 bearing the disk 29 supporting a ring 29′ on its face, for controlling said governor valve, radially arranged sets of dogs 30 and 31 in said ring, the dogs 30 being provided with teeth 30′ on the inner end for engaging with the tooth 23 on the disk 22 and having its left-hand outer end portion cut away at 30″, the function of said dogs being to close the governor valve, the dogs 31 being provided with teeth 31′ to be engaged by the tooth 23 of the disk 22 for opening the governor valve, the said dogs being cut away on the right-hand side at 31″ at their outer ends, the said teeth 30′ and 31′ being beveled on their backs to be acted upon by cams 28′ 28′ for disengaging them from the tooth 23 after a quarter revolution; a bifurcated member 15 having actuating blocks 17 and 18, the one cut away on the right-hand side at 17′ and the other on the left-hand at 18′ and embracing the clutch mechanism to act upon the said dogs alternately, and connections from the bifurcated member to the governor weight mechanism for controlling the said bifurcated member to act upon the said dogs to throw them into gear for the transmission of power from the driving shaft to control the governor valve, all co-acting for the purpose specified.

10. In a governing means for elastic fluid turbines, the combination with a casing of a turbine wheel and suitable shaft; a speed responsive device connected to be driven by said turbine; a gearing on said shaft; a governor valve; a clutch mechanism between the said gearing and the said governor valve for actuating the valve intermittently, consisting of the driving shaft bearing a disk with a tooth thereon, a stationary cam-plate arranged to disengage the dog members from said tooth, a shaft for controlling said governor valve, and a plate bearing sets of dogs positioned and arranged to be engaged by the tooth on said shaft; a bifurcated member arranged to embrace the said clutch mechanism and act when moved in one direction on one set of dogs and when moved in the opposite direction on the other set of dogs, one set of dogs being engaged by the said shaft for closing the governor valve and the other being engaged by the said toothed member for opening the said governor valve; and connections from the bifurcated member to the governor weight mechanism for controlling the said bifurcated member to act upon the said dogs to throw them into gear for the transmission of power from the driving shaft to control the governor valve, for the purpose specified.

11. In a governing means for elastic fluid turbines, the combination with a casing of a turbine wheel and suitable shaft; a speed responsive device connected to be driven by said turbine; a gearing on said shaft; a governor valve; a clutch mechanism between the said gearing and the said governor valve for actuating the valve intermittently, consisting of the driving shaft bearing a disk with a tooth thereon, a stationary cam-plate arranged to disengage the dog members from said tooth, a shaft for controlling said governor valve, and a plate bearing sets of dogs positioned and arranged to be engaged by the tooth on said shaft; a shifting device to act upon the said sets of dogs alternately; and connections from the said shifting device to the governor weight mechanism for controlling the said shifting device to act upon the said dogs to throw them into gear for the transmission of power from the driving shaft to control the governor valve, for the purpose specified.

12. In a governing means for elastic fluid turbines, the combination of a suitable casing; a turbine wheel therein; a turbine shaft supported to revolve in suitable bearings; a governor connected to be driven by said turbine shaft; a governor valve; a valve stem connected to said governor valve; a worm on said turbine shaft; a worm gear to be driven by said worm, the said worm gear being mounted on a suitable shaft; a clutch mechanism arranged to connect the said worm gear shaft to the said valve stem and drive the same in one direction only; and means actuated by said governor for operating said clutch mechanism.

13. In a governing means for elastic fluid turbines, the combination of a suitable casing; a turbine wheel within the casing; a turbine shaft supported in suitable bearings; a speed responsive device connected to be driven by said turbine shaft; a governor valve; a revoluble stem connected to operate said governor valve; a gear on a suitable shaft driven from said turbine shaft; a clutch mechanism arranged to connect the

said shaft to the said stem and drive the same in one direction only; means connecting with the said speed responsive device to operate the said clutch mechanism.

14. In a governing mechanism for motors, the combination of a clutch mechanism having a rotary actuating member continuously driven by said motor and a member connected with means controlling a supply of power to said motor adapted to be coupled to said actuating member and rotated thereby in one direction only, means for automatically causing the coupling of said clutch members whenever the demand of said motor for power requires an alteration in the supply, and means for automatically uncoupling said members when said power controlling means has been moved sufficiently to cut off or turn on said supply of power.

In witness whereof, I have hereunto set my hand and seal in the presence of two witnesses.

CHARLES W. DAKE. [L. S.].

Witnesses:

LULU GREENFIELD,

GERTRUDE TALLMAN.