P. OLIVIER.

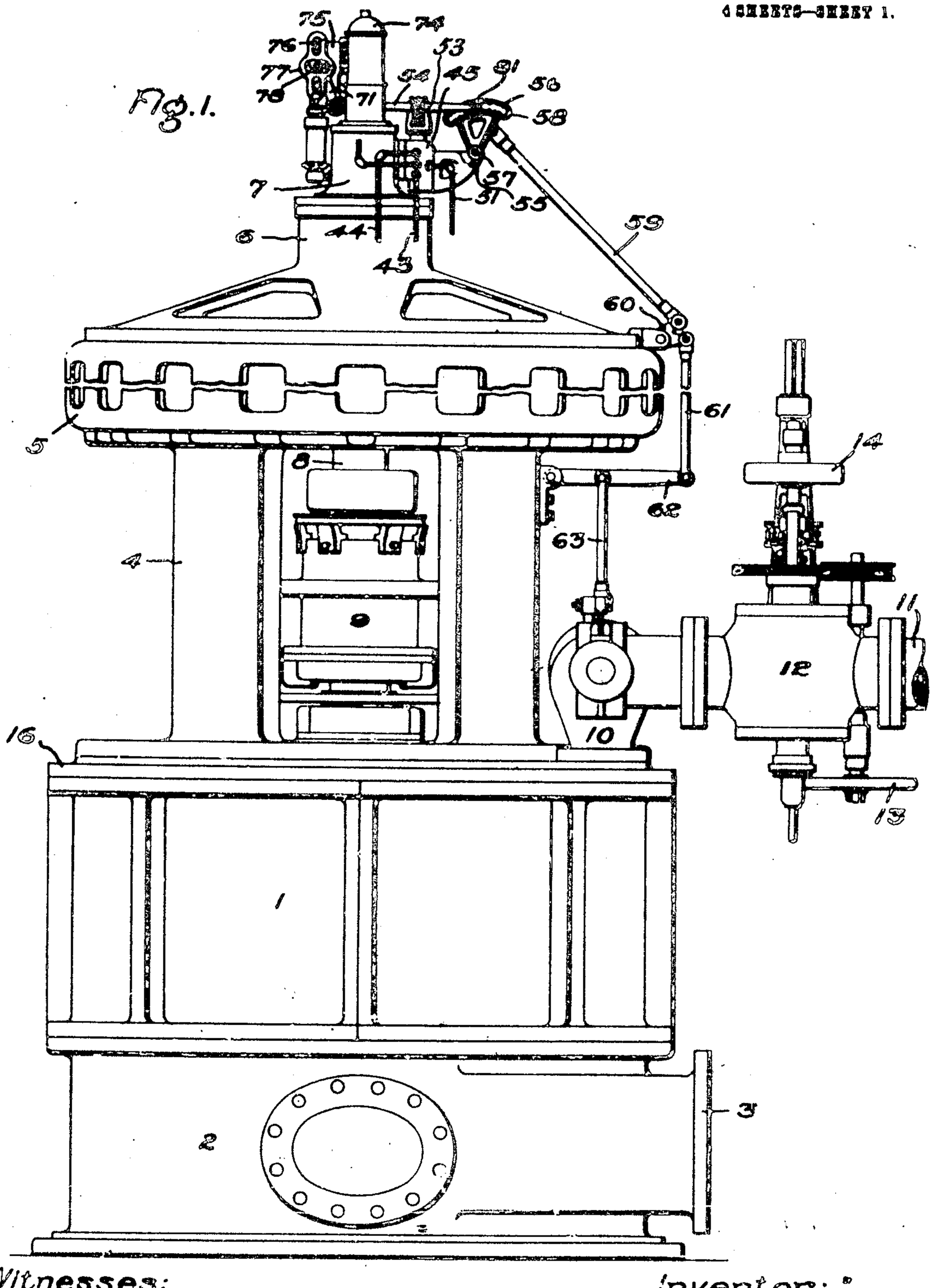
GOVERNING MECHANISM FOR ELASTIC FLUID TURBINES.

APPLICATION FILED JUNE 27, 1907.

957,898. Patented May 17, 1910.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
Benjamin B. Hines
Helen Orford

Inventor:
Paul Olivier,
by Allen H. Davis
Atty.

P. OLIVIER.

GOVERNING MECHANISM FOR ELASTIC FLUID TURBINES.

APPLICATION FILED JUNE 27, 1907.

957,898. Patented May 17, 1910.

4 SHEETS—SHEET 2.

Fig. 3

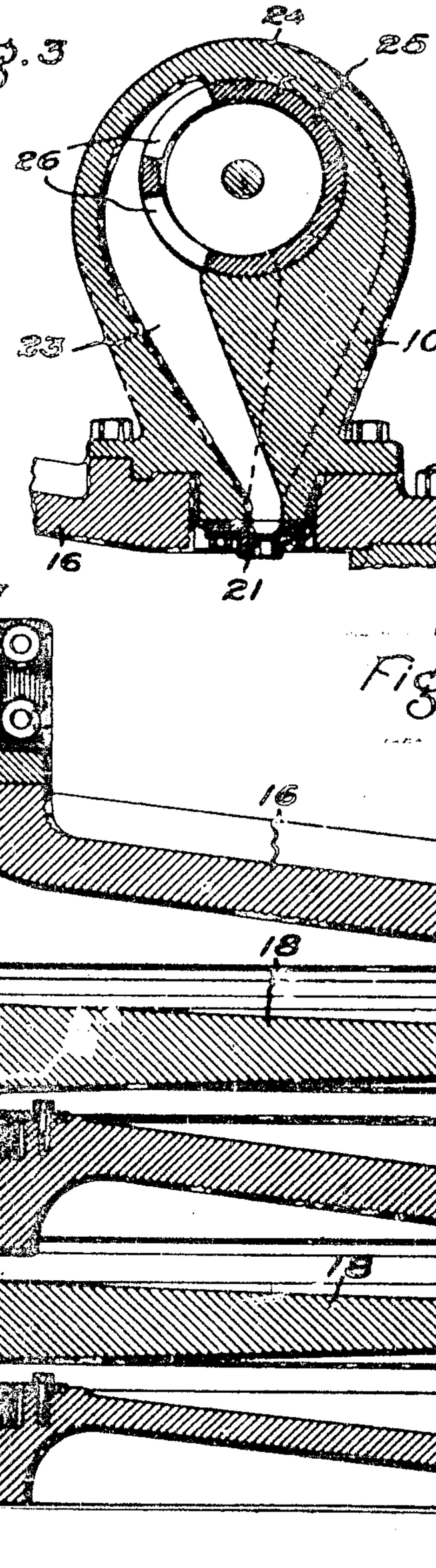


Fig. 2.

Witnesses:
Benjamin B. Hall
Helen Oxford

Inventor:
Paul Olivier,
by Albert G. Davis
Atty.

P. OLIVIER.

GOVERNING MECHANISM FOR ELASTIC FLUID TURBINES.

APPLICATION FILED JUNE 27, 1907.

957,898.

Patented May 17, 1910

4 SHEETS—SHEET 3.

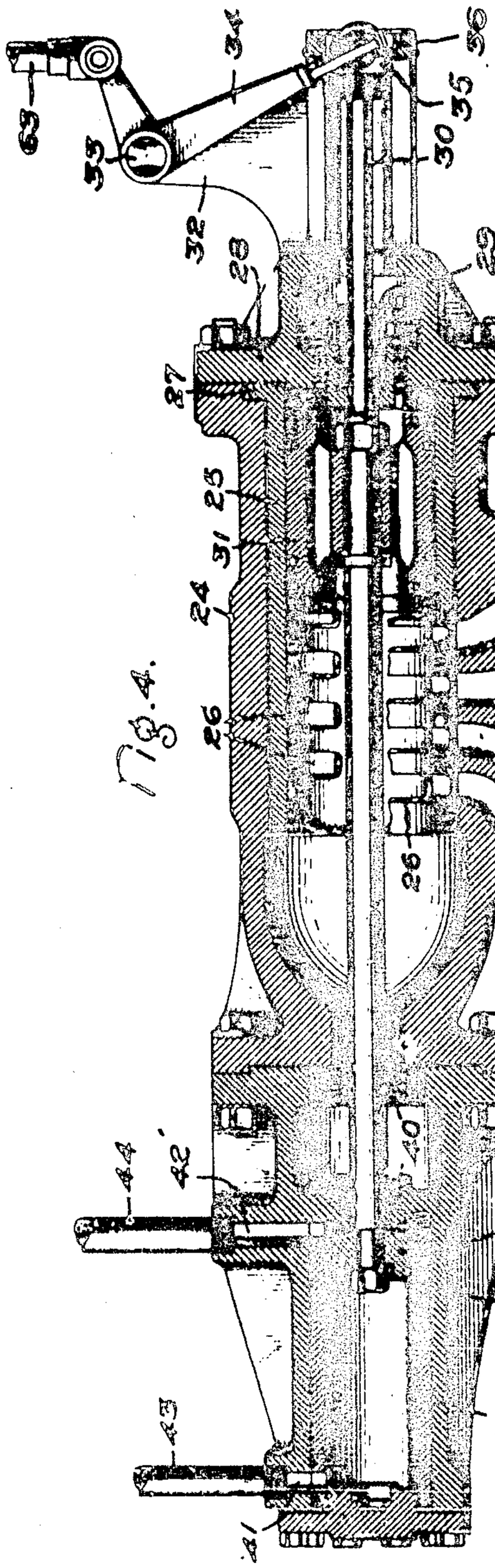


Fig. 4.

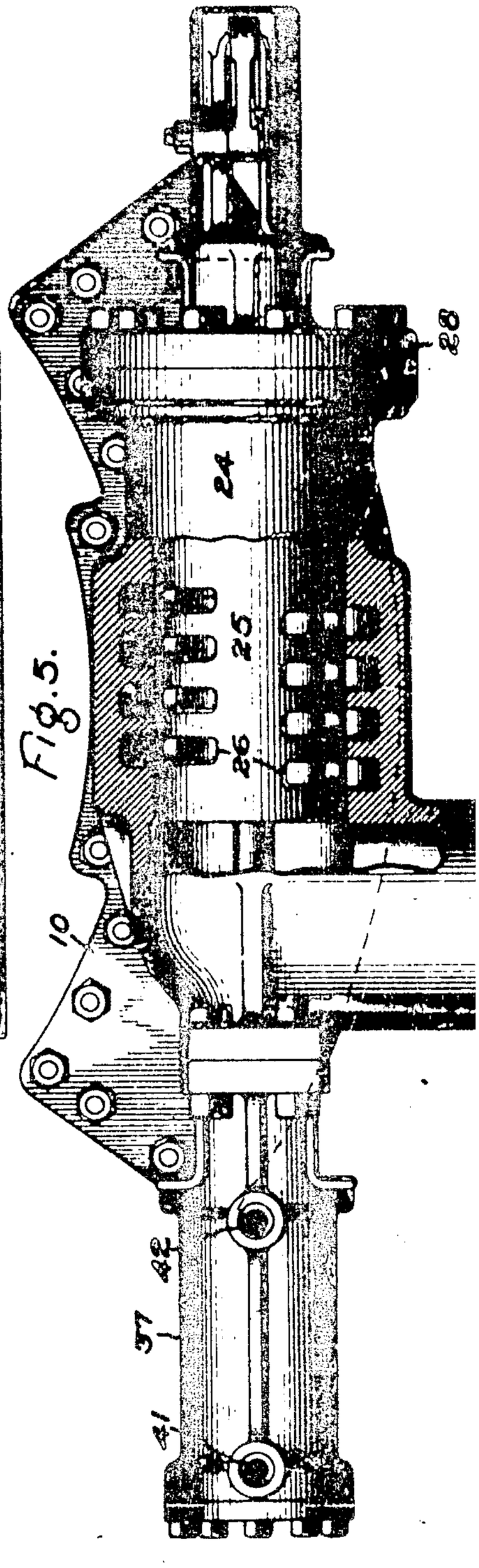


Fig. 5.

Witnesses.

Benjamin B. Hines

Helen A. Ford

Inventor:

Paul Olivier,

by Albert G. Davis

Atty.

P. OLIVIER.

GOVERNING MECHANISM FOR ELASTIC FLUID TURBINES.

APPLICATION FILED JUNE 27, 1907.

957,898. Patented May 17, 1910.

4 SHEETS—SHEET 4.

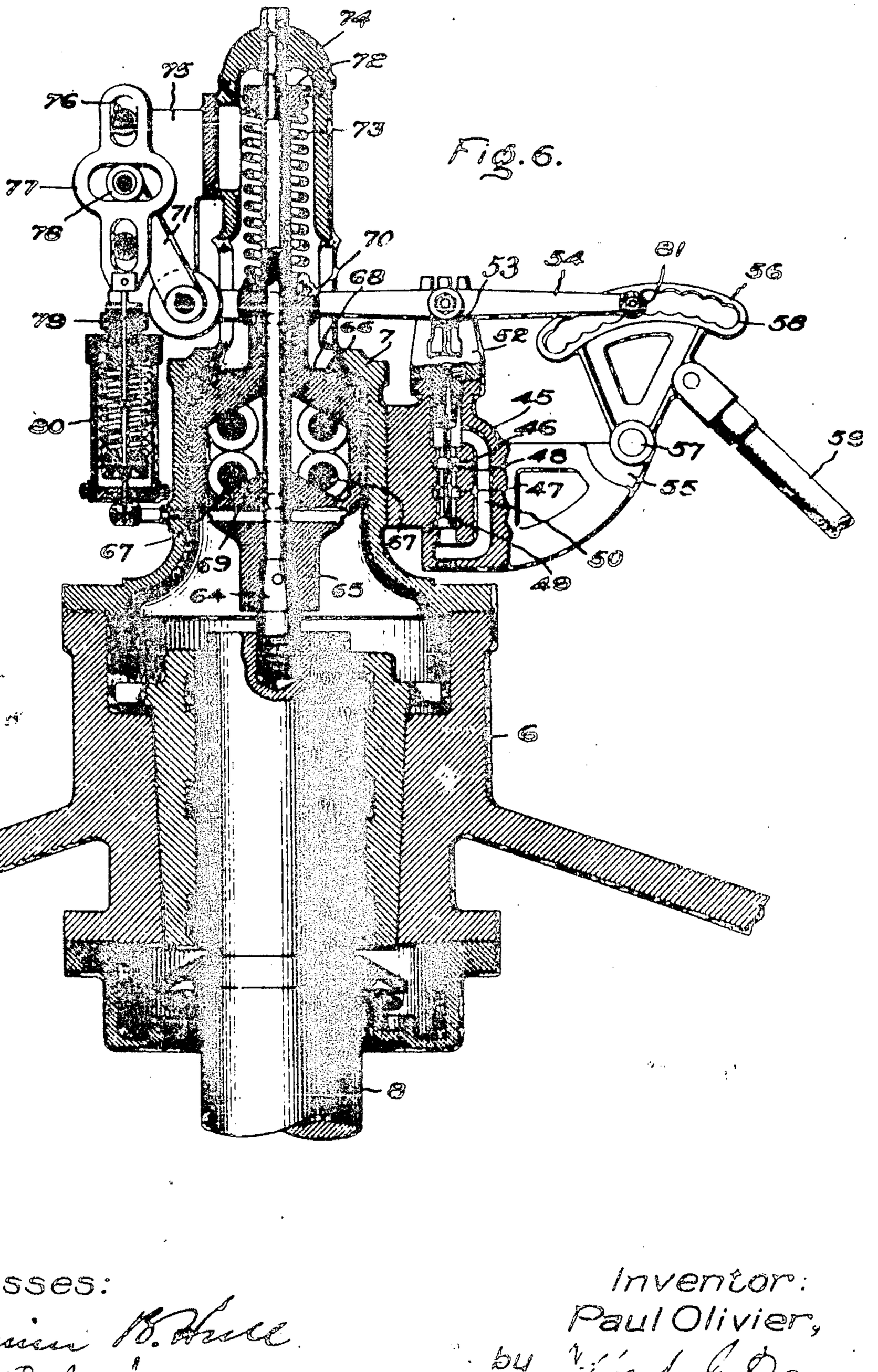


Fig. 6.

Witnesses:
Benjamin B. Hull
Helen Orford

Inventor:
Paul Olivier,
by Wood, Dalton & Dana
Atty's

UNITED STATES PATENT OFFICE.

PAUL OLIVIER, OF PARIS, FRANCE, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

GOVERNING MECHANISM FOR ELASTIC-FLUID TURBINES.

957,808. Specification of Letters Patent. Patented May 17, 1910.

Application filed June 27, 1907. Serial No. 381,111.

To all whom it may concern:

Be it known that I, PAUL OLIVIER, a citizen of the French Republic, residing at Paris, France, have invented certain new and useful Improvements in Governing Mechanisms for Elastic-Fluid Turbines, of which the following is a specification.

The present invention relates to governing mechanisms for elastic fluid turbines and has for its object to improve their construction and operation.

For a consideration of what I believe to be novel and my invention, attention is called to the accompanying description and claims appended thereto.

In the accompanying drawings which illustrate one of the embodiments of my invention, Figure 1 is a view in elevation of a turbo-generator fitted with my improved governing mechanism; Fig. 2 is an enlarged sectional view of a portion of the turbine; Fig. 3 is a cross section through the valve chest; Fig. 4 is a longitudinal section of the valve chest and the motor for operating the controlling valve; Fig. 5 is a plan view of the same with a portion of the valve casing broken away; and Fig. 6 is an enlarged vertical section through the speed governor and pilot valve.

1 indicates the turbine which is upon a base 2, the latter having a conduit 3 connected to a condenser or other exhaust. Situated on top of the turbine is a stool 4 supporting the electric generator 5. The generator is provided with a cover 6 having a dome 7 that incloses the speed governor. The rotating elements of the turbine and generator are mounted on a vertical shaft 8, the latter being provided with a suitable step bearing not shown and guide bearings 9. Mounted on the turbine is a valve chest 10. Steam is admitted to the valve chest by the conduit 11, and between the conduit and the valve chest is a shut-off valve 12 which can be operated by the hand wheel 13 or under emergency condition by the weight 14, the latter being under the control of an emergency speed governor.

Referring to Fig. 2, 1 indicates the casing of the turbine which is divided into compartments by the diaphragms 15 that rest upon internal shoulders formed on the casing. The top of the machine is provided with a head 16 which supports the valve chest 10 and also the packing 17 around the main shaft 8. Mounted on the shaft and located in the compartments or stages are wheels 18, each having two rows of buckets 19 and intermediate buckets 20 between the rows of wheel buckets, the latter receiving steam from one row of buckets and discharging it against the next at the proper angle. Steam is admitted to the first stage by a nozzle 21 that is bolted to the valve chest 10, and comprises a plurality of discharge orifices or passages located in a common plane concentric with the wheel axis. Between one stage and the next are stage nozzles 22 for converting the pressure of the steam into velocity and discharging it against the wheel buckets.

Referring to Fig. 4, 10 indicates the valve chest having a series of passages 23 communicating with the sections of the admission nozzle 21. The upper part of the valve chest is bored out to form a cylinder 24. In this is located a sleeve 25 having a series of ports 26 that register with the passages 23 in the lower portion of the chest. By providing a sleeve as shown the ports can be accurately and readily formed, and the same can be removed in case of trouble. The right hand end of the sleeve 25 is provided with a flange 27, which flange is located between the main body of the valve chest and a detachable head 28. In this head is located an adjustable packing 29 to prevent the escape of steam or other elastic fluid around the piston rod 30. The rod 30 is connected to a balanced piston valve 31 having an opening therethrough, which valve controls the passage of fluid from the inlet conduit 11 to the passages 23. Formed on the head 28 is a bracket 32 that carries the pivot 33 of the bell-crank lever 34. This lever is connected to the right hand end of the piston rod by means of a fork 35 in which is supported a trunnion block 36. The block is perforated to receive the cylindrical end of the lever 34. As the piston rod moves to and fro, the end of the lever will slide to and fro in the trunnion block. This lever forms a part of a follow-up device to prevent overtravel of the motor and the controlling valves. To the left hand end of the valve chest is bolted a cylinder 37 containing a lining 38. Mounted for movement in the cylinder is a piston 39 which is rigidly connected to the piston rod that actuates the piston valve. Where the rod passes through

the head of the cylinder and where it enters the valve chest, packings 10 are provided to prevent the escape of fluid. Fluid, such as water or oil for operating the piston 39, is admitted to the cylinder by the ports 41 and 42 which are connected to the pilot valve. When fluid is admitted through the port 41 and is permitted to escape through the port 42, the piston 39 and its connected valve are caused to move to the right, and when fluid is admitted to the port 42 and permitted to escape through the port 41, the piston and its connected valve are caused to move to the left, thereby decreasing the number of ports 26 through which steam or other elastic fluid passes to the admission nozzles 21.

In Fig. 3 is shown in cross section the valve chest. Inside of the valve chest is the sleeve 25 having segmental ports 26 communicating with the passages 23 leading to the admission nozzles 21. It will be observed that one-half of the passages 23 extend from the left hand side of the center of the chest to the nozzles, while the remainder, as shown in dotted lines, extend from the right hand side. The discharge ends of the passages from opposite sides of the chest alternate, and the ports 26 are so formed that first a passage on one side of the chest is supplied with fluid and then one on the opposite side. These passages terminate in the same plane, which plane is concentric with the wheel axis. This means that one nozzle section will receive fluid from a passage on the right of the controlling valve, the next will receive fluid from a passage on the opposite side, and so on. By reason of this arrangement of parts I am able to make a valve chest of minimum size for a given amount of motive fluid. This arrangement also permits of walls of suitable thickness between the different passages.

In order to have the controlling device for the fluid actuated motor as near to the speed governor as possible, and thereby avoid in so far as possible troubles incident to lost motion in the moving parts, lack of alinement, etc., I mount the casing 45 for the pilot valve 46 on the side of the dome 7. This casing is provided with an admission port 47, a port 48 connected to the port 42 by a pipe 44 (Fig. 4) of the motor, also with a port 49 connected by a pipe 43 to the port 41 of the motor (Fig. 4). In addition to this is an exhaust port 50 communicating with the opposite ends of the pilot valve and discharging through the pipe 51 (Fig. 1) to a suitable receptacle. Owing to the fact that the valve 46 is of the piston type with the high pressure admitted to a point between the piston heads while the opposite sides are exposed to the same low pressure, the valve is balanced and has no tendency of itself to move in either direction. The valve heads and the ports 48 and 49 are arranged to have little or no overlap so that any movement of the valve will cause the fluid under pressure to be admitted to one side of the motor piston 39 or the other and thus actuate the main controlling valve 31. Mounted on top of the pilot valve casing is a head 52 having guides formed on the upper end to direct the movements of the sliding block 53, the latter being connected to the governor actuated lever 54. Mounted on a bracket 55 formed integral with the pilot valve casing is a sector 56 which is pivoted at 57. The sector is provided with a slot 58 having corrugated walls. This slot is non-concentric with respect to the axis of the sector, the distance from said axis gradually increasing from the left to the right hand side. The sector forms a part of the follow-up device to prevent overtravel of the controlling valve and is connected by the rod 59 with the bell-crank lever 60, Fig. 4. The lever 60 is connected by a rod 61, lever 62, and rod 63 with the bell-crank lever 31 (Fig. 4). It is to be noted that the lever 31 is supported solely by the governor and the sector, and that under certain conditions the fulcrum is at the sector and under other conditions at the governor. Owing to this connection it follows that as the motor piston 39 and its connected valve moves in one direction or the other from a given position, motion in one direction or the other will be imparted to the sector 56, and in so doing the end of the governor lever will be raised or lowered.

Referring again to Fig. 6, a spindle 64 is threaded to the upper end of the main shaft 8 and pinned thereto is a piece 65 having a forked end which embraces a frame 66, the latter being adapted to slide up and down on the spindle 64. Mounted in slots in the arms of part 65 are four centrifugal weights and rollers 67. These rollers are acted upon by centrifugal force and as they are forced outward away from the axis of rotation, due to an increase in speed, the frame 66 is caused to move upward by reason of the upper rollers pressing on the inclined surfaces 68. The inclined surfaces 69 at the lower end of the frame being slanted in the same direction permit this action to take place. On the other hand as the speed decreases the rollers move toward the axis, the inclined surfaces 68 and 69 causing the frame to move downward. Mounted on the upper end of the frame is a collar 70 to which is connected by a suitable joint the left hand end of the governor lever 54. To this collar is also connected the right hand end of the bell-crank lever 71. Surrounding the spindle 64 and seated on a nut 72 at one end and on the collar at the other is a compression spring 73, which spring acts in opposition to the centrifugal force exerted by the weights. The upper end of the spin-

dle 64 passes through a bearing formed in the cap 74 of the dome. Mounted on a bracket 75 on the left hand side of the dome are rollers 76 which guide the yoke 77 in its vertical movements. This yoke is provided with a horizontal slot containing a roller 78 that is carried by the upper end of the bell-crank lever 71. The lower end of the yoke is provided with a spindle 79 which is guided at the bottom by a suitable bracket attached to the dome. Surrounding this rod is an auxiliary compression spring 80 which normally tends to pull the rod and its attached yoke downward, thereby cooperating with the main spring 73. Surrounding the spring 80 is a suitable casing to protect the same from injury.

The operation of my improved mechanism is as follows: Assuming that the main controlling valve 81 is in a mid position and there is an increase in speed due to a decrease in load, the weights 67 will move outwardly and in so doing raise the frame 66 against the stress of the spring 73. Under these conditions, the collar 81, carried by the right hand end of the governor lever 54 and seated in one of the notches in the segment 56, acts as a pivot and the pilot valve 51 is raised a certain amount. This permits fluid under pressure to pass from the admission port 47, Fig. 6, to the port 48 and thence to port 42 in the cylinder of the motor (Fig. 4) and start the piston into operation in a direction to decrease the ported area of the turbine. Just as soon as the motor piston starts into operation, the follow-up device commences to operate. Under the conditions specified the rods 63, 61 and 59 are in tension and will pull the segment 56 a certain distance to the right. Assuming the load change to be small, the segment will be pulled a distance corresponding to one notch, and the roller 81 will drop into the notch now situated at the left. This will permit the outer end of the lever to drop a certain amount and in so doing will restore the pilot valve 51 to its initial position, thereby shutting off the admission of fluid to the motor cylinder and at the same time stopping the exhaust therefrom so that the piston will be locked between two bodies of liquid. Assuming the same condition of affairs, as the frame 66 is moved upward by the centrifugal acting weights, the bell-crank lever 71 forces the yoke 77 downward by a slight amount.

Upon an increase in load, the reverse of the above operation takes place. The weights moving inward permit the frame 66 to drop a slight amount due to the downward pressure of the spring 73, and in so doing the spring depresses the collar 70, the left hand end of governor lever 54 and the pilot valve 46, thus admitting liquid to the motor cylinder at the opposite end causing the controlling valve to move to the right. This same action causes the upper end of the bell-crank lever 71, Fig. 6, to swing to the right, and in so doing increases the stress on the spring 80. The follow-up device comes into service again but this time it pushes the rods 63, 61 and 59 upward and causes the roller 81 on the governor lever to enter a notch on the right of the one formerly occupied by it, which restores the pilot valve to its initial position.

Under normal conditions some of the ports 23 in the valve chest will be open and one or more closed, and under certain load conditions, the flow through one of the ports will be throttled to a greater or less extent.

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. In a governing mechanism for turbines, the combination of a ported valve chest, a controlling valve therein which moves over the ports, a motor for actuating the valve, a speed governor driven by the turbine shaft, a pivoted sector having an eccentric cam slot therein, a lever which is supported by the governor at one end and by the cam slot at the other, a pilot valve that is attached to the lever and is held in position thereby, a casing for the valve, and a connection that is attached to the sector and the motor piston so that the movements of the piston are transmitted to the sector and through it to the lever and pilot valve.

2. In a governing mechanism for turbines, the combination of a valve chest, a controlling valve therein, a fluid actuated motor for moving the valve, a speed governor driven by the turbine shaft, a pivoted sector having an eccentric cam slot therein and forming a part of a follow-up device, a lever supported by the governor at one end and by the cam slot in the sector at the other, a pilot valve for controlling the motor which is attached to the lever intermediate its ends and is held in position thereby, a lever moved by the motor piston, and a connection between the last mentioned lever and the sector for moving the latter to change the effective action of the cam slot on the governor supported lever.

3. In a governing mechanism for turbines, the combination of a valve chest, a controlling valve therein, a fluid actuated motor for moving the valve, a speed governor driven by the turbine shaft, a support adjacent the governor, a pilot valve and its

casing mounted on the support, a pivoted sector having an eccentric cam slot therein and forming a part of a follow-up device, a bracket for supporting it, a lever supported by the governor at one end and by the cam-slot in the sector at the other and both the governor and the cam slot acting to move the lever, the said lever being pivotally connected to the pilot valve for supporting and moving it, and a connection between the motor and controlling valve and the sector for moving the latter to change the position of the cam slot.

4. In a governing mechanism for turbines, the combination of a valve chest, a controlling valve therein, a fluid actuated motor for moving the valve, a speed governor driven by the turbine shaft, a pivoted sector forming a part of a follow-up device, a lever supported by the governor at one end and the sector at the other, a pilot valve for controlling the motor which is attached to the lever intermediate its ends, an auxiliary spring which acts on the governor end of the lever, and a means uniting the controlling valve and the sector for moving the latter.

5. In a governing mechanism for turbines, the combination of a valve chest, a controlling valve therein, a fluid actuated motor for moving the valve, a speed governor driven by the turbine shaft, a pivoted sector forming a part of a follow-up device, a lever supported by the governor at one end and the sector at the other, a pilot valve for controlling the motor which is attached to the lever, an auxiliary spring, a means for transmitting its effect to the governor actuated lever, a lever moved by the controlling valve, and a connection between the lever and the sector for moving the latter.

6. In a governing mechanism, the combination of a governor, a controlling valve of the piston type, a casing in which the piston valve travels for controlling the passage of fluid, ports in the casing which extend from opposite side of the valve to the points of discharge, a fluid actuated motor for moving the valve, a speed governor, a sector forming a part of a follow-up device, a lever moved by the governor at one end and by the sector at the other, and a connection between the motor and the sector for moving the latter to change the position of one end of the lever.

7. In a governing mechanism, the combination of a chest, a controlling valve therein, ports in the chest over which the valve travels to vary the passage of motive fluid, a fluid actuated motor located on one side of the chest, a lever located at the opposite end forming a part of a follow-up device, a governor, a pilot valve for the motor controlled by the governor, and a means acting on the pilot valve which receives its motion from said lever.

8. In a governing mechanism, the combination of a chest, a controlling valve therein, ports in the chest over which the valve travels to vary the passage of motive fluid, a fluid actuated motor located on one side of the chest, a lever located on the other and forming a part of a follow-up device, a piston rod which is common to the motor piston, valve and lever, a governor, a pilot valve for the motor, a lever actuated by the governor for moving the pilot valve, a device for restoring the pilot valve to its initial position after it is moved by the governor, and a connection between the lever and said device.

In witness whereof, I have hereunto set my hand this 12th day of June, 1907.

PAUL OLIVIER.

Witnesses:
GEO. MYRMIRIAN,
HANSON C. COXE.