No. 848,106. PATENTED MAR. 26, 1907.

O. JUNGGREN.

GOVERNING MECHANISM FOR TURBINES.

APPLICATION FILED JULY 25, 1906.

5 SHEETS—SHEET 1.

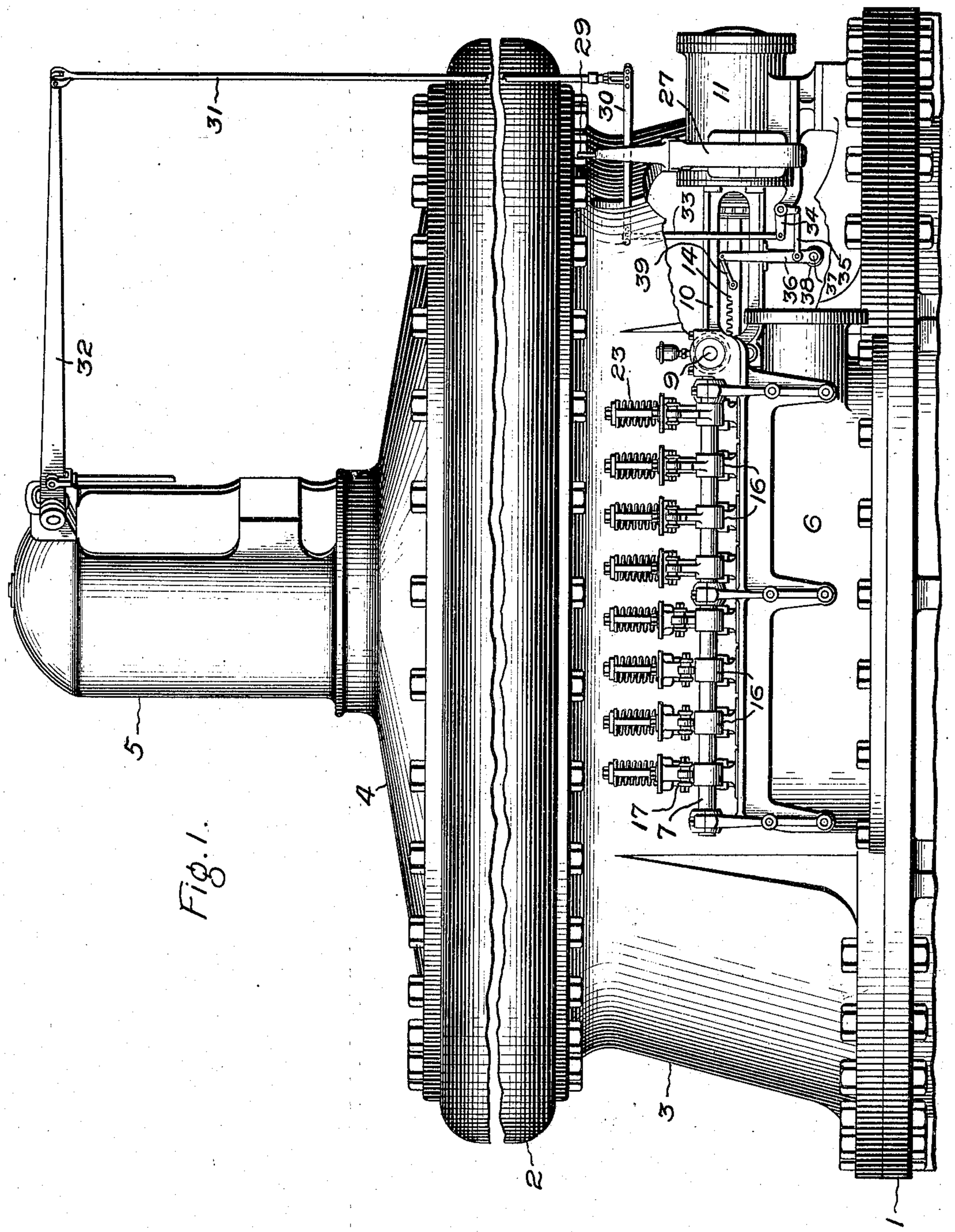

Fig. 1.

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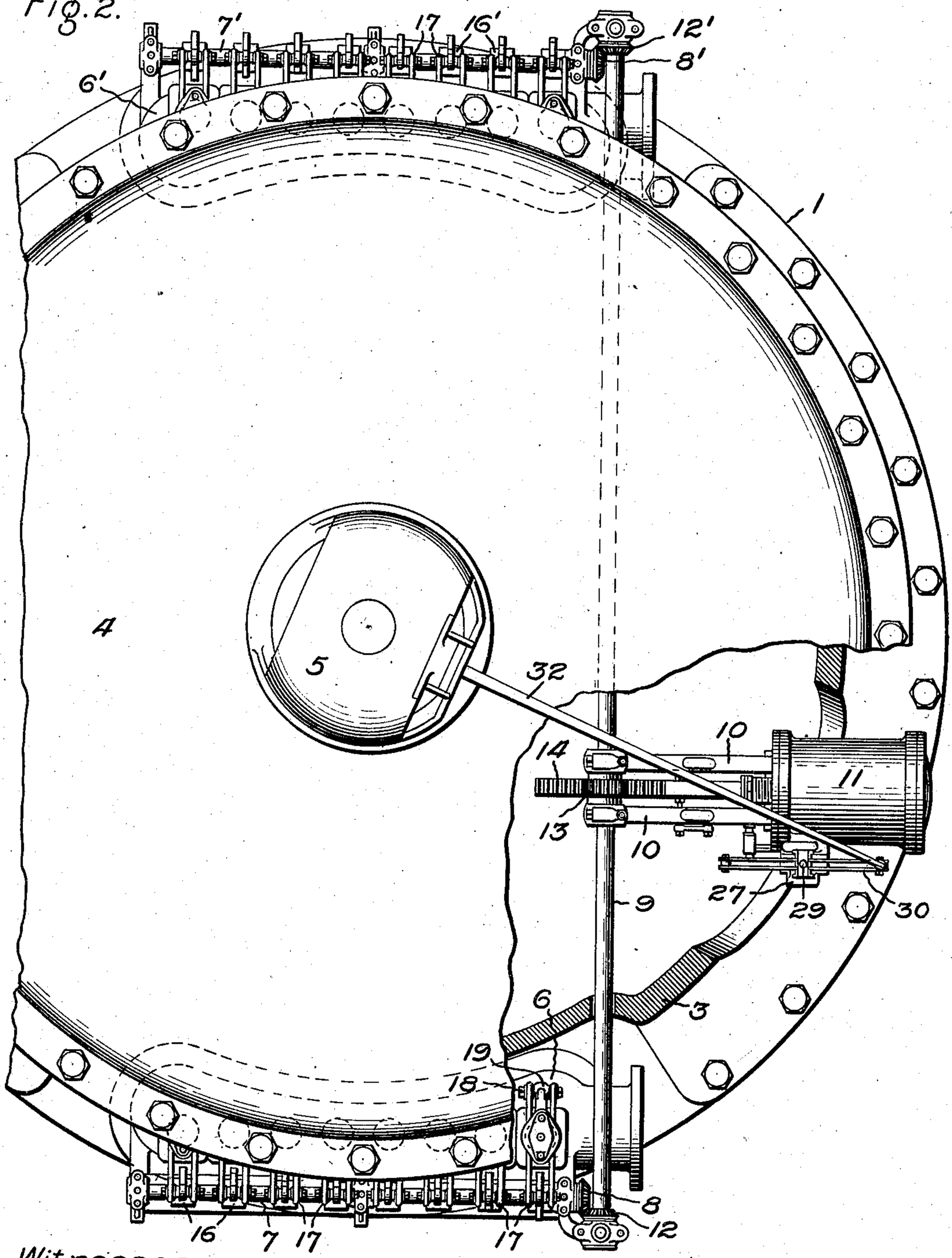
5 SHEETS—SHEET 2.

Fig. 2.



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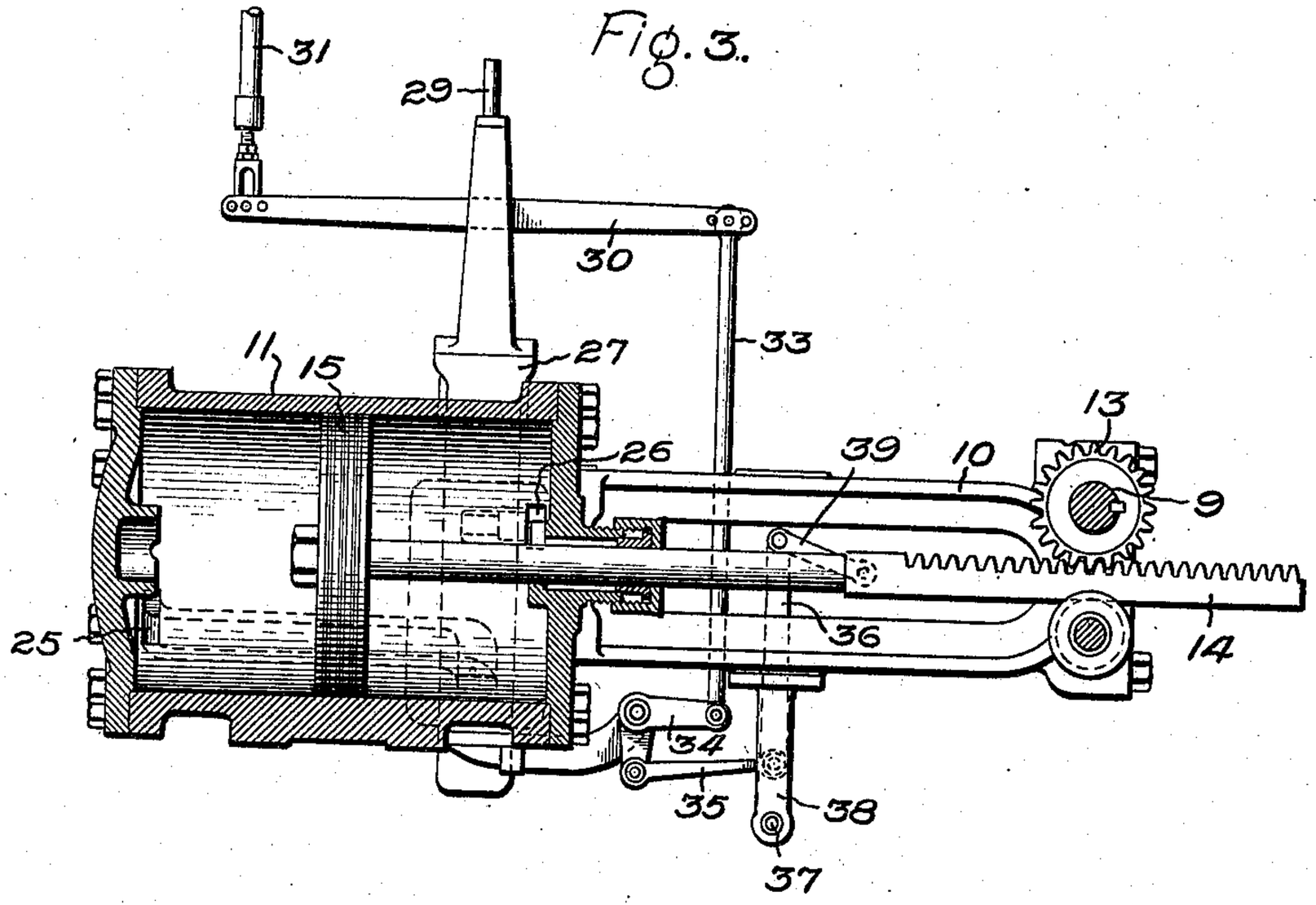
5 SHEETS—SHEET 3.

Fig. 3.



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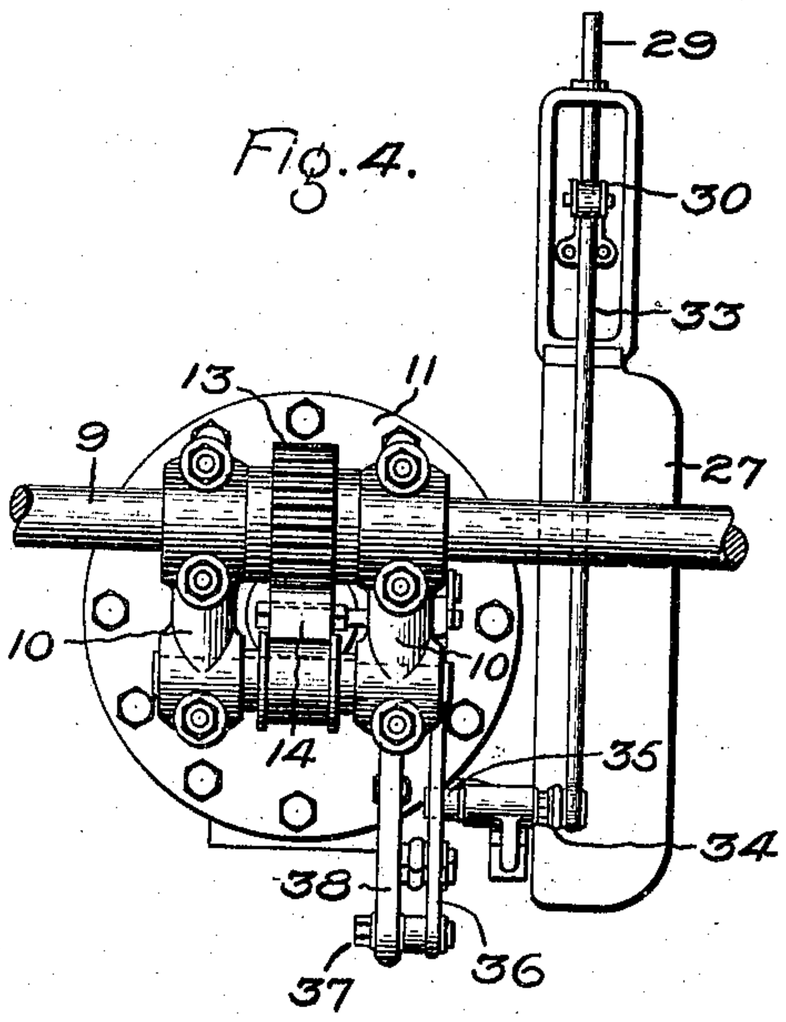
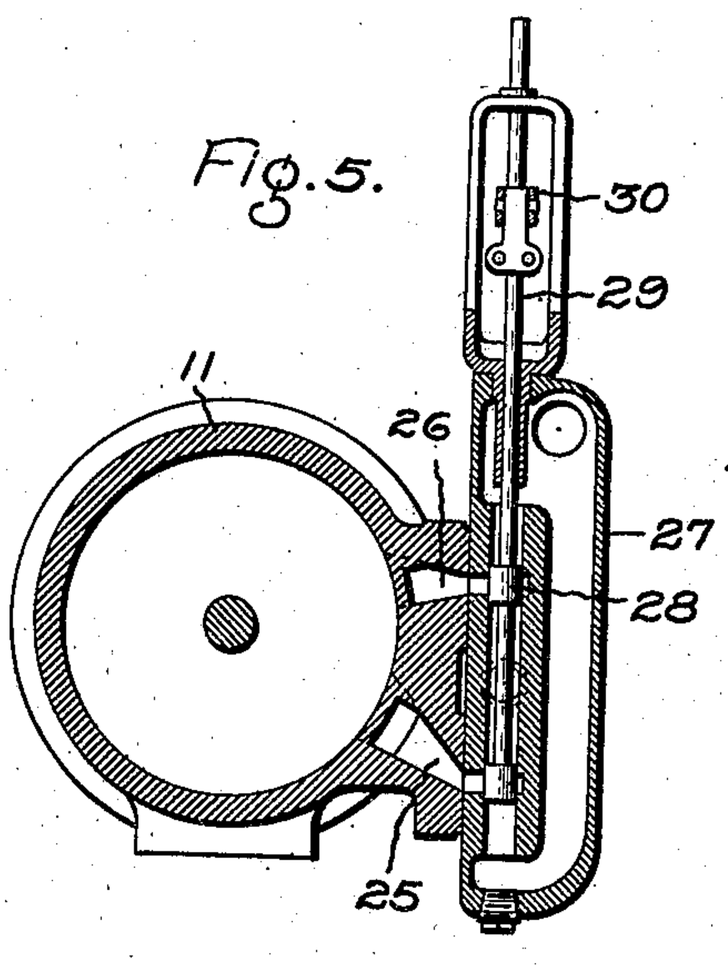


Fig. 5.



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5 SHEETS—SHEET 4.

Fig. 8

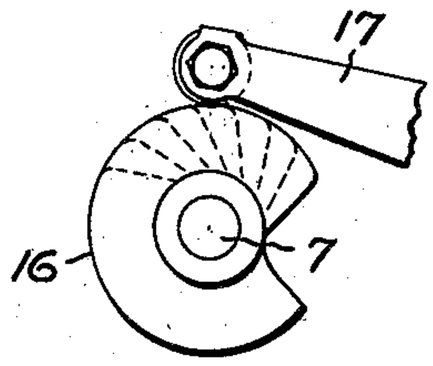


Fig. 9.

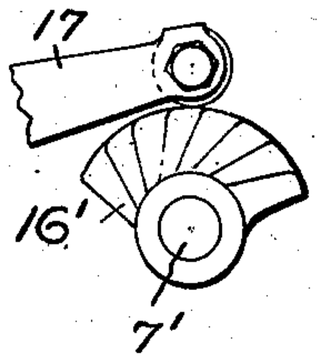


Fig. 6.

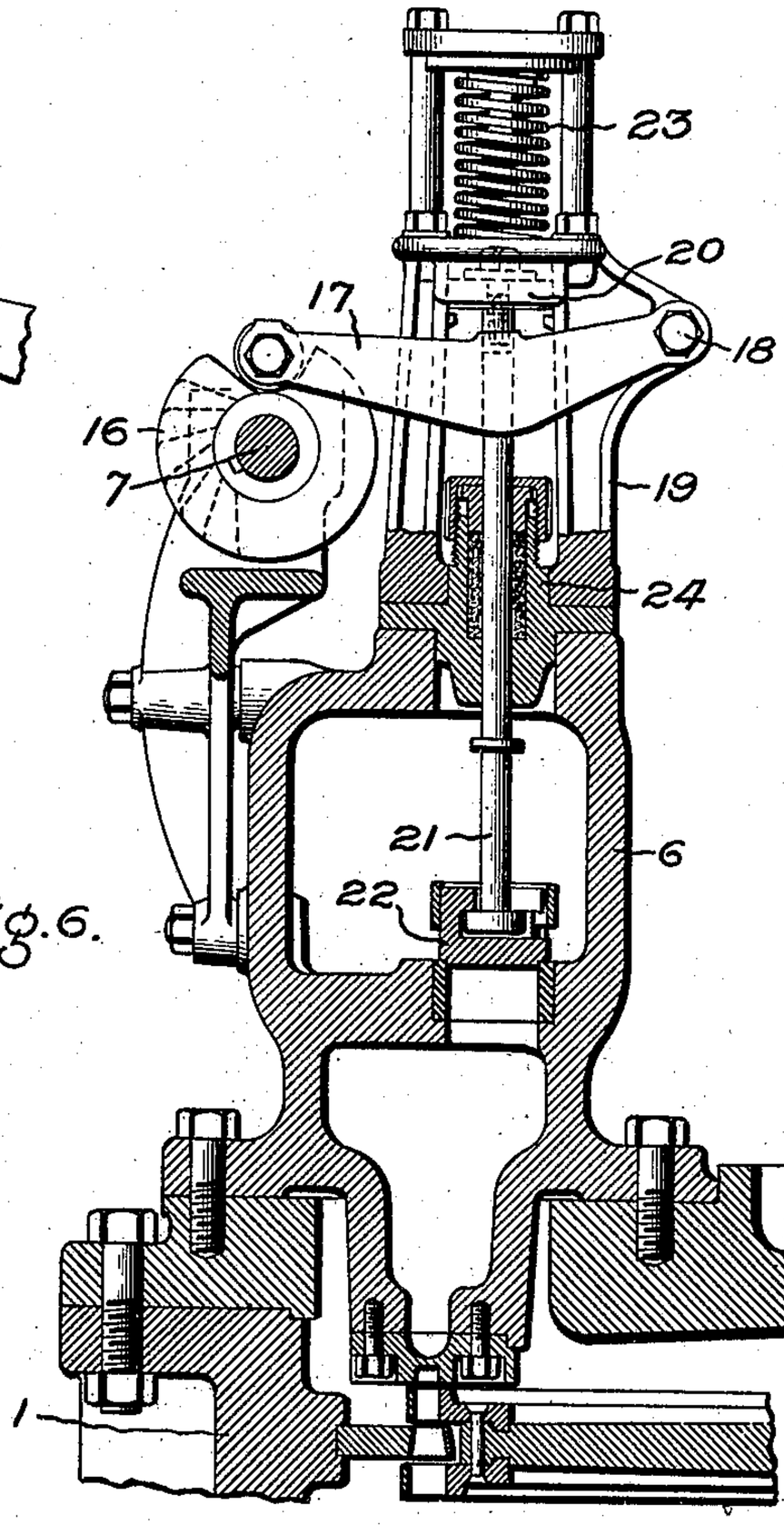
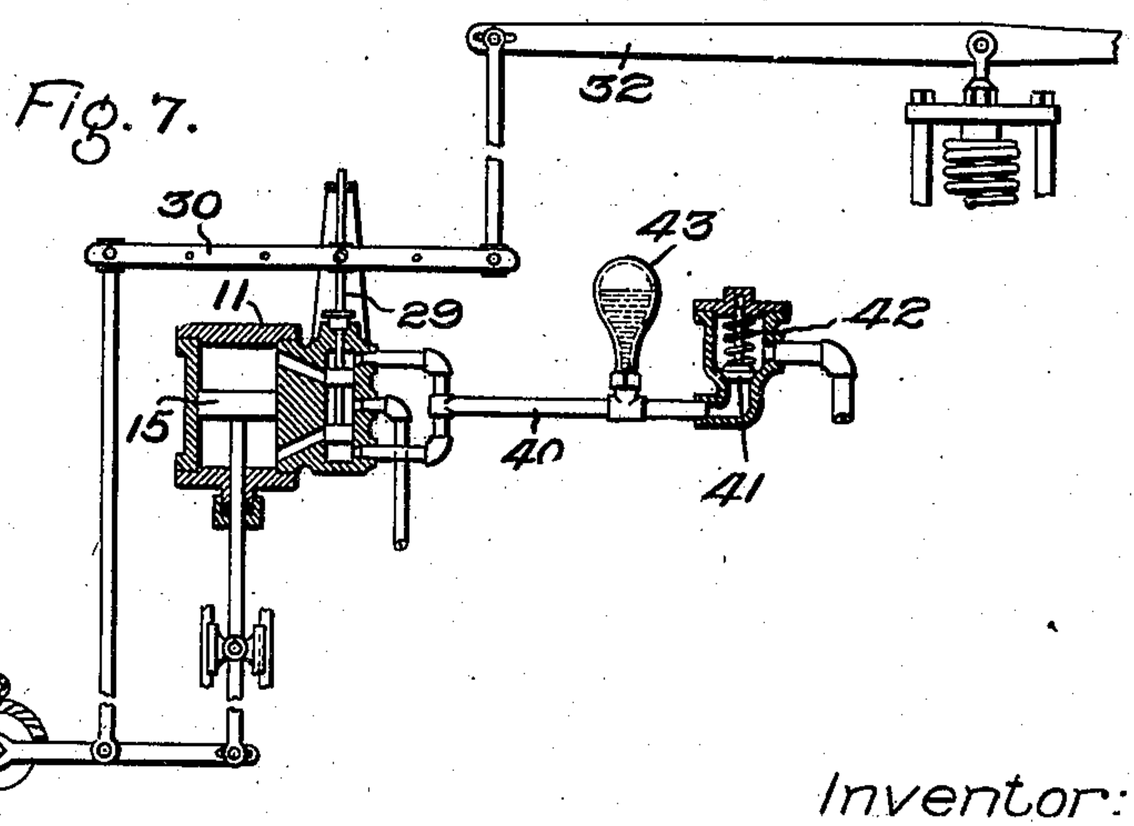


Fig. 7.



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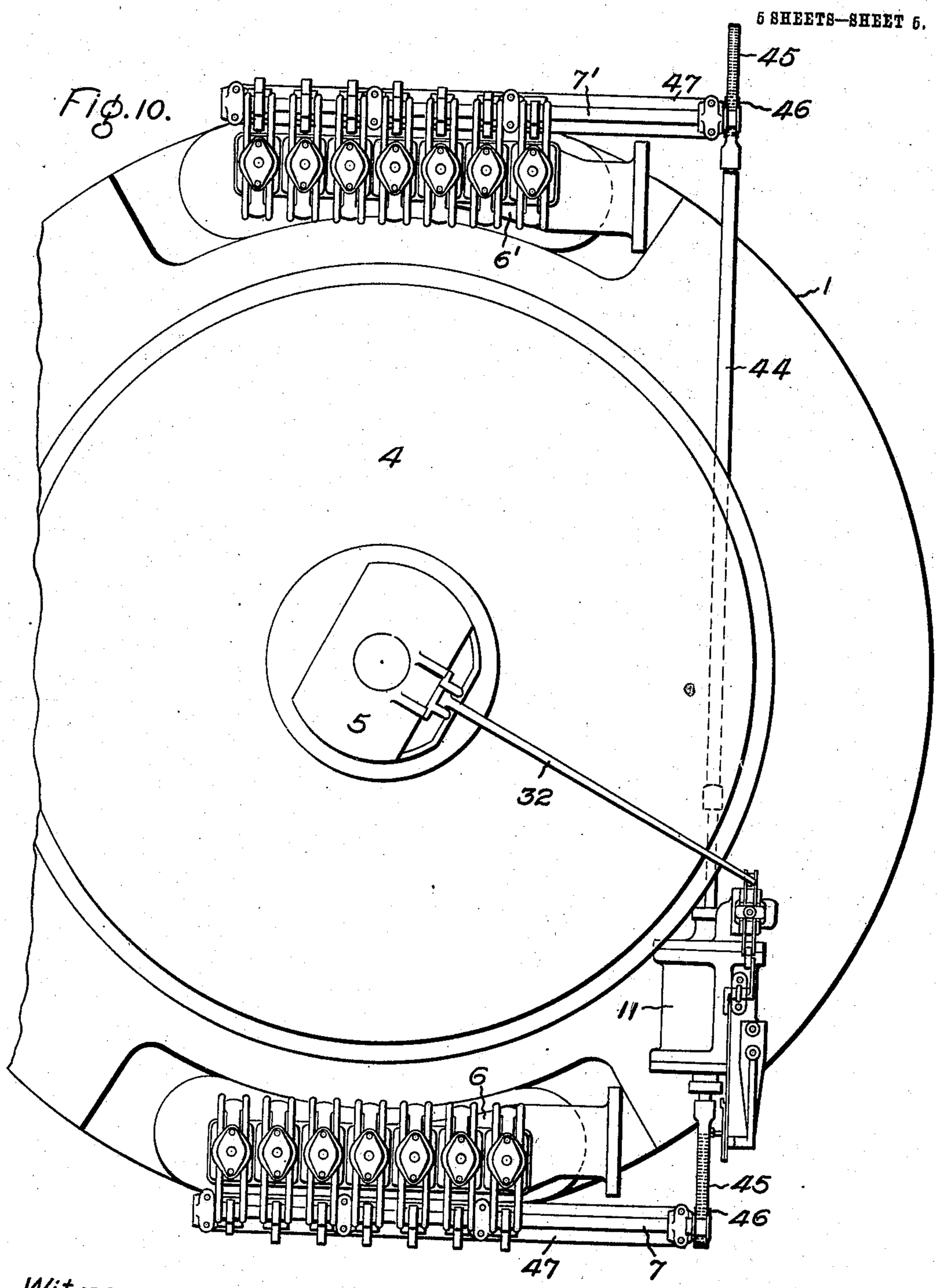
5 SHEETS—SHEET 5.

Fig. 10.



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UNITED STATES PATENT OFFICE.

OSCAR JUNGGREN, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

GOVERNING MECHANISM FOR TURBINES.

No. 848,106. Specification of Letters Patent. Patented March 26, 1907.

Application filed July 25, 1906. Serial No. 327,596.

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.

This invention relates to mechanism for governing the speed of steam-turbines; and its object is to modify existing structures with a view to securing greater compactness and readiness of access and also to lessen the weight.

A further object is to correct a tendency to "hunt," which has been observed in prior structures of this kind.

In carrying out my invention I provide one or more sets of nozzle-valves, each valve arranged to be operated by its own individual cam and the cams for each set arranged to operate in succession. A fluid-pressure motor actuates the cams and a pilot-valve controls the motor, said valve being itself under the control of a speed-responsive device driven by the turbine. Follow-up mechanism restores the pilot-valve to its normally closed position to prevent the turbine from surging above or below normal speed.

In the present invention there are two sets of nozzle-valves arranged, preferably, on opposite sides of the turbine and actuated by a single motor, one set remaining idle until the other set has been operated, or, if preferred, one or more valves in one set may operate alternately with one or more valves in the other set. The motor consists of a cylinder and piston, the cylinder being preferably horizontal and arranged substantially on a level with the valve-chests. The exhaust from the pilot-valve is controlled by an interrupting device—such, for example, as a spring-closed pop-valve—preferably in conjunction with an air-chamber, in order to prevent too rapid an escape of the fluid, and thus overcome any tendency of the motor to hunt. The interrupting device causes the fluid to be discharged in periodical increments, thereby keeping the motor system in a slight tremble.

In the accompanying drawings, Figure 1 is a side elevation of an upright turbine embodying my invention, the casing being broken away in order to show the parts on a large scale. Fig. 2 is a top plan view of the same, partly in section. Fig. 3 is a longitudinal section of the motor for operating the nozzle-valves. Fig. 4 is an end elevation of the same. Fig. 5 is a cross-section of the same through the pilot-valve. Fig. 6 is a vertical section of a nozzle-valve and its operating parts. Fig. 7 shows the antihunting devices. Figs. 8 and 9 show the two sets of cams in end view, and Fig. 10 is a top plan view of a modification.

Only the upper part of the casing 1 of the turbine is shown. Located above it and supporting the generator 2 is a stool 3. The upper end of the generator is closed in by a head 4, which is provided with a dome 5, that surrounds the shaft-governor and supports the lever for transmitting motion from the speed-responsive device to the controlling or pilot valve or regulator of the hydraulic or fluid-pressure motor. Situated at convenient points on the turbine-casing are the valve-chests. There are preferably two of these chests 6 6′, located diametrically opposite to each other. Supported in suitable bearings on each chest is a rock-shaft 7 7′, to which is secured a bevel-gear 8 8′. A shaft 9 extends across the machine, passing through openings in the walls of the stool 3 and journaled in bearings on the valve-chests and in brackets 10, extending from the rear end of the motor-cylinder 11. The cross-shaft carries bevel-gears 12 12′, meshing with the gears 8 8′. A spur-gear 13 is secured to the shaft between the brackets 10 and meshes with a rack 14, which can be reciprocated by the piston 15, working in the cylinder 11, and thereby causes the shafts 9 7 7′ to rotate.

On each shaft is a set of cams 16 16′, disposed one slightly behind the other. Each cam engages with a lever 17, fulcrumed at 18 in a frame 19, erected on the valve-chest, and engaging with a cross-head 20 on the stem 21 of a nozzle-valve 22, which is held to its seat in the chest by a compression-spring 23, mounted in the upper part of the frame 19. The stem 21 passes through a suitable stuffing-box 24 in the removable top of the chest.

When a valve is in the closed position, its lever rests in the cut-away portion of its cam, the walls of which are substantially tangential to the hub of the cam, so as to give a quick opening movement to the valve. The

cams 16′ are cut away much more than the cams 16, so that none of the former will operate until all of the latter have opened their respective valves, the two sets operating in succession and not simultaneously. If preferred, however, the cams may be so cut and arranged that the valves will operate alternately on opposite sides of the machine.

The piston 15 in the motor-cylinder 11 is actuated, preferably, by liquid-pressure from any suitable source, such as that which supplies lubricant to the bearings. The liquid fills the cylinder on both sides of the piston, so that the latter is locked and cannot move unless the liquid is allowed to escape from one end or the other of the cylinder. Ports 25 26 connect the ends of the cylinder with a valve-chest 27, in which is a pilot-valve 28, controlling said ports. The valve is actuated by a rod 29, pivotally connected to a floating lever 30, whose front end is connected by a rod 31 with the free end of the governor-operated lever 32. The rear end of the floating lever is adjustably pivoted to a rod 33, by which it is connected through a bell-crank lever 34 and link 35 with the follow-up lever 36. This latter is fulcrumed at 37 on a hanger 38, depending from a bracket 10, and its upper end is connected by a link 39 with the piston-rod or rack 14 of the motor.

When the speed-responsive device actuates the lever 32, it moves the floating lever, which fulcrums on the upper end of the rod 33. This rod is at that instant immovable because the parts to which it is connected are locked by the liquid in the cylinder. The movement of the floating lever opens the pilot-valve, thereby admitting liquid-pressure to one side of the piston and allowing it to escape from the other. The consequent movement of the piston rotates the shafts 9 7 7′ and operates one or more of the nozzle-valves, thereby varying the supply of steam to the turbine to correct the abnormal speed which caused the governor to operate. This in itself would cause the pilot-valve to close again, but not until the turbine had passed to a condition of speed on the other side of the normal. To avoid this hunting action, the follow-up device operates to close the pilot-valve in advance of too much change in the speed of the turbine. As soon as the piston 15 begins to move the follow-up lever 36 is carried with it, and through the link 35 and bell-crank 34 moves the rod 33 lengthwise, which in turn actuates the floating lever and causes it to return the pilot-valve to its normal closed position, thereby stopping the piston 15. By this device only so many of the nozzle-valves will be operated as are necessary to effect the proper regulation of the speed of the turbine. In order to control these operations still further and prevent any hunting of the piston owing to too sudden a release of the pressure on one side of it, I provide an interrupting device in the escape-pipe 40, whereby the liquid is compelled to escape in spurts instead of continuously. One mode of producing this effect is shown in Fig. 7, which is merely a diagram and does not represent the actual construction or arrangement of the parts. A valve 41 is interposed in the escape-pipe with a spring 42, holding it normally closed. An air-chamber 43 is connected with the pipe between the spring-valve and the motor. The valve is constructed like a pop safety-valve, so that when it opens it will remain open for an appreciable time until the pressure due to the air compressed in the air-chamber has been considerably reduced. The valve will then close and remain closed until the liquid-pressure has compressed the air in the chamber to a point where the valve will open again. In place of the pop-valve I may use any other equivalent device in which the valve is operated by inertia—such, for instance, as the well-known clack-valve of the hydraulic ram. In any event the result is an intermittent flow of liquid through the escape-pipe, keeping the system "in a tremble," so to speak, and preventing the motor from overrunning in either direction by causing the piston to move in a series of short steps instead of continuously.

Fig. 10 shows a modified arrangement in which the motor-cylinder is placed at right angles to the valve-chests with its piston-rod 44 passing through both ends and extended at each end to carry a rack 45, meshing directly with a pinion 46 on the cam-shaft, which is lengthened out and supported in a bracket 47. This is a somewhat simpler construction than the other, though both have been found satisfactory in actual practice. One advantage of these is that all the working parts are on the same level as the valves, and therefore within easy range of inspection and accessible for adjustment and repair. Another advantage is that there are no working parts above or near the generator-casing, so that the latter is not disfigured by the oil and dirt, which to a certain extent are inevitably present on the working parts.

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 elastic-fluid turbines, the combination with the turbine, of sets of nozzle-valves, a cam-shaft for actuating each set of valves, a liquid-pressure motor located at about the level of said valves, connections between said motor and

said cam-shafts, and speed-responsive devices controlling said motor.

2. In a governing device for elastic-fluid turbines, the combination with the turbine, of sets of nozzle-valves, a cam-shaft for actuating each set of valves, a horizontal cylinder located at about the level of said valves, a piston in said cylinder actuated by liquid-pressure, connections between said piston and said cam-shafts, and speed-responsive devices controlling the admission of liquid to said cylinder.

3. In a governing mechanism for elastic-fluid turbines, the combination with the turbine, of sets of nozzle-valves, a cam-shaft for actuating each set of valves, a transverse shaft geared to said cam-shafts, a liquid-pressure motor for rotating said transverse shaft, and controlling devices for said motor responsive to speed changes of the turbine.

4. In a governing mechanism for elastic-fluid turbines, the combination with the turbine-casing and the generator, of a stool interposed between them, two valve-chests on opposite sides of said stool, a cam-shaft on each chest, a transverse shaft geared to said cam-shafts and passing through said stool, a hydraulic motor mounted outside of and extending into said stool and connected with said transverse shaft, and controlling devices for said motor connected to the speed-governor of the turbine.

5. In a governing mechanism for elastic-fluid turbines, the combination with mechanically-operated nozzle-valves, of a liquid-pressure motor for operating them and means for causing said motor to operate by an intermittent motion instead of continuously.

6. In a governing mechanism for elastic-fluid turbines, the combination with mechanically-operated nozzle-valves, of a liquid-pressure motor for operating them, and means for periodically interrupting the escape of the liquid from the motor when working.

7. In a governing mechanism for elastic-fluid turbines, the combination with mechanically-operated nozzle-valves, of a liquid-pressure motor for operating them, means for causing said motor to operate by an intermittent motion instead of continuously, comprising a valve offering a predetermined resistance to movement, and an air-chamber.

In witness whereof I have hereunto set my hand this 23d day of July, 1906.

OSCAR JUNGGREN.

Witnesses:

BENJAMIN B. HULL,

FRANK J. DORE.