J. C. PIPER.

STEAM TURBINE.

APPLICATION FILED OCT. 4, 1906.

916,779.

Patented Mar. 30, 1909.

4 SHEETS—SHEET 1.

Fig. 1.

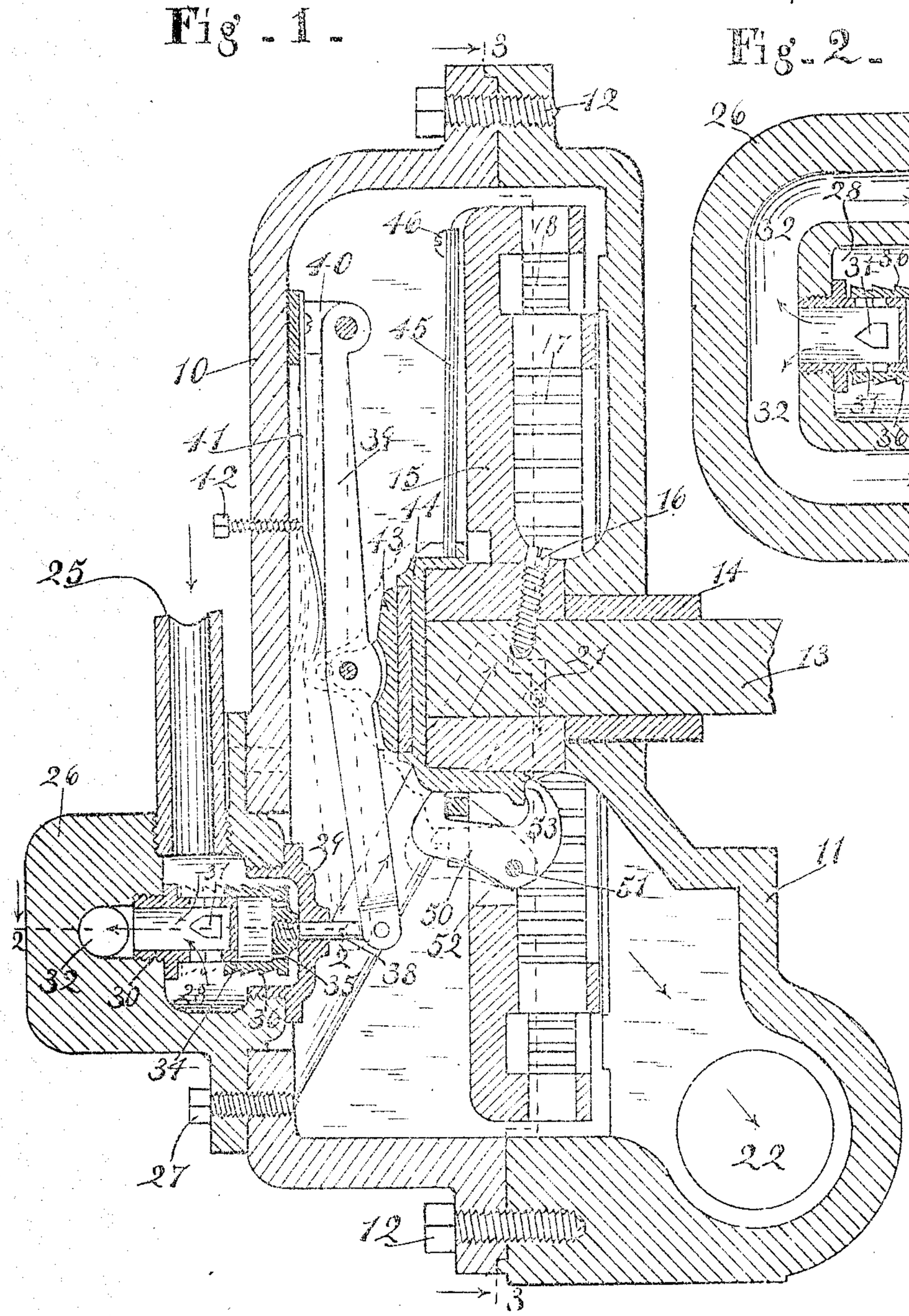

Fig. 2.

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4 SHEETS—SHEET 2.

Fig. 3.

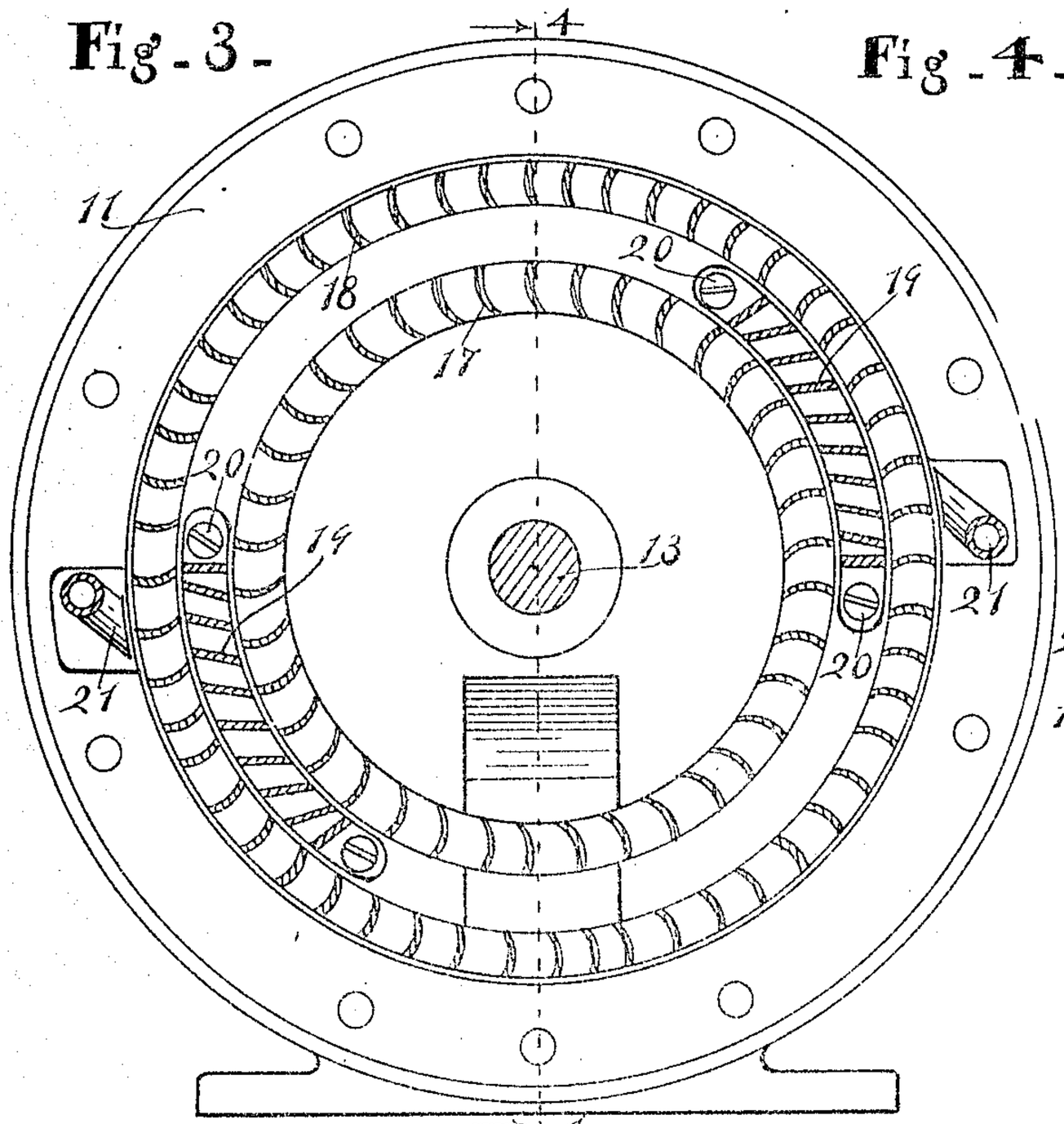


Fig. 4.

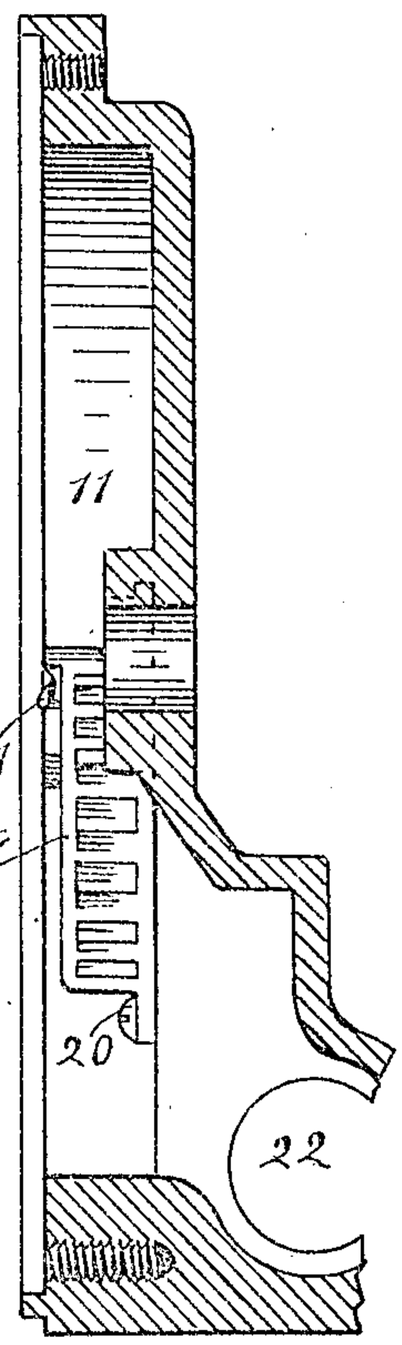


Fig. 5.

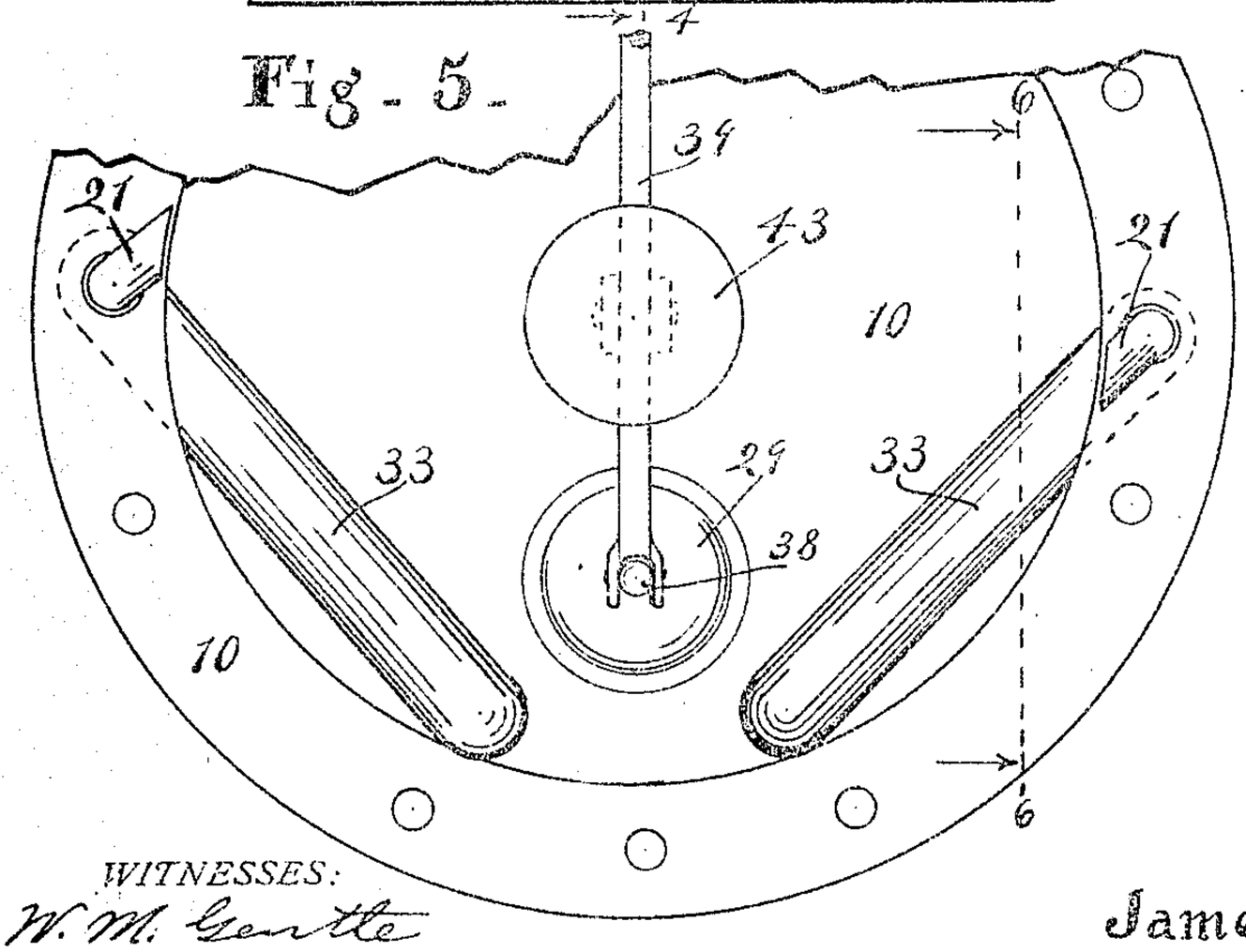
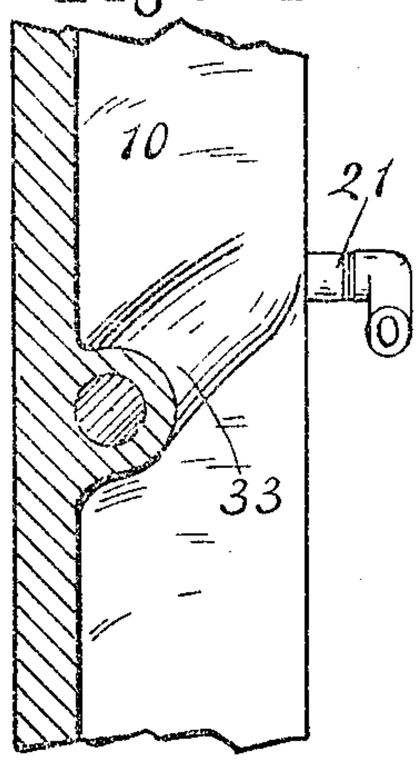


Fig. 6.



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4 SHEETS—SHEET 3.

Fig. 7.

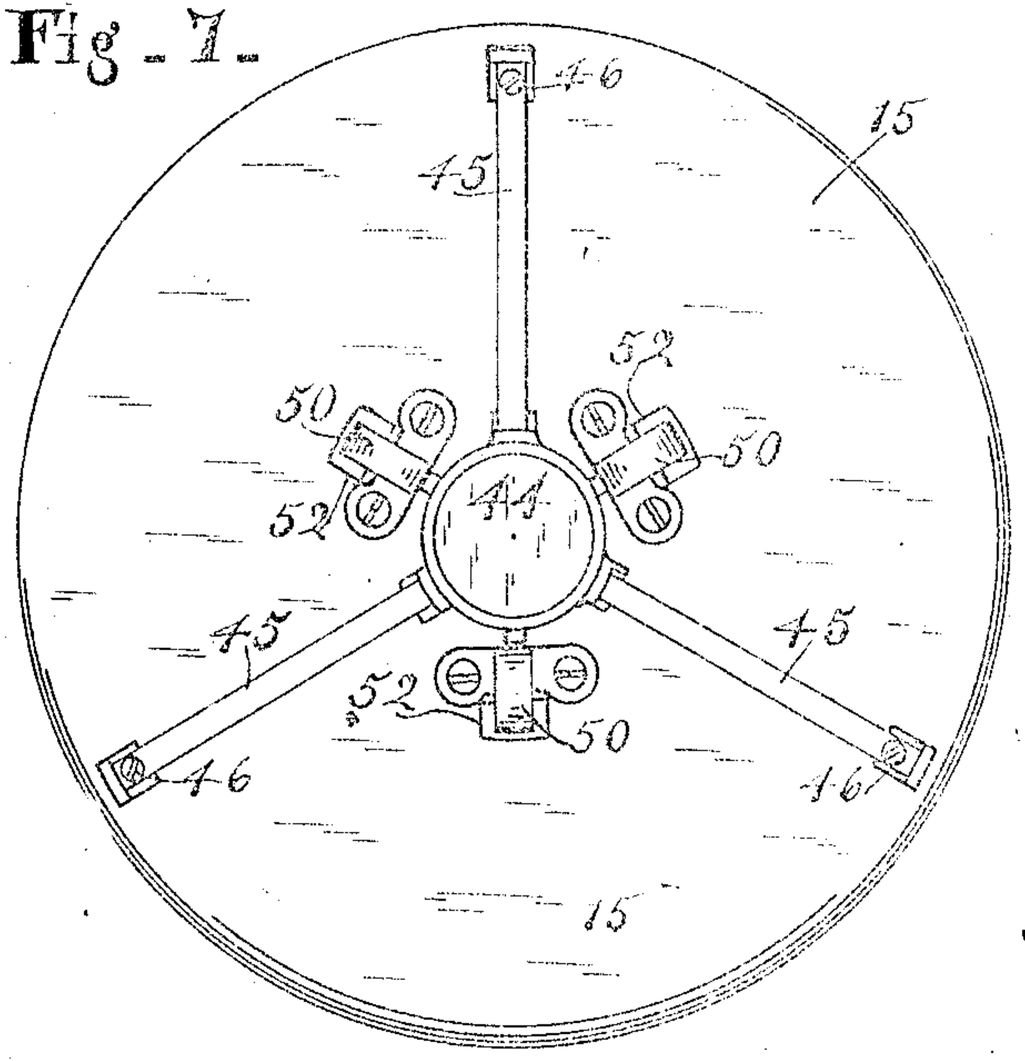


Fig. 8.

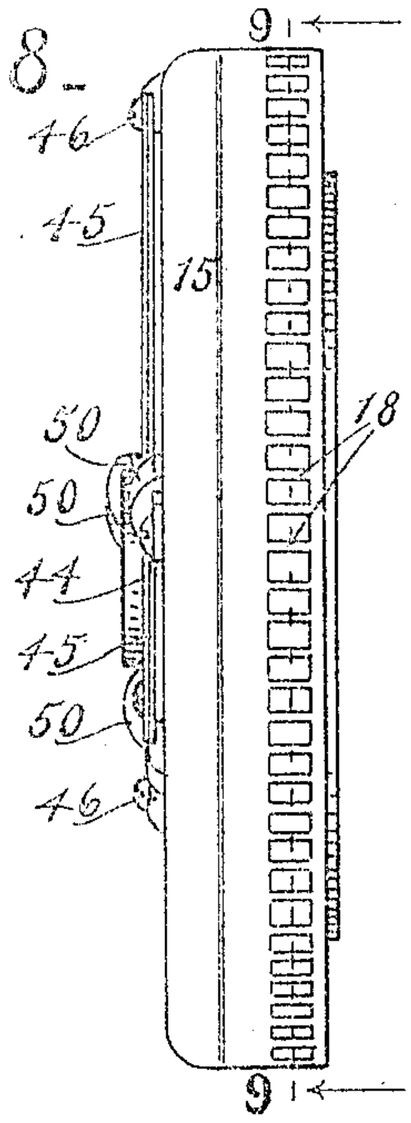


Fig. 9.

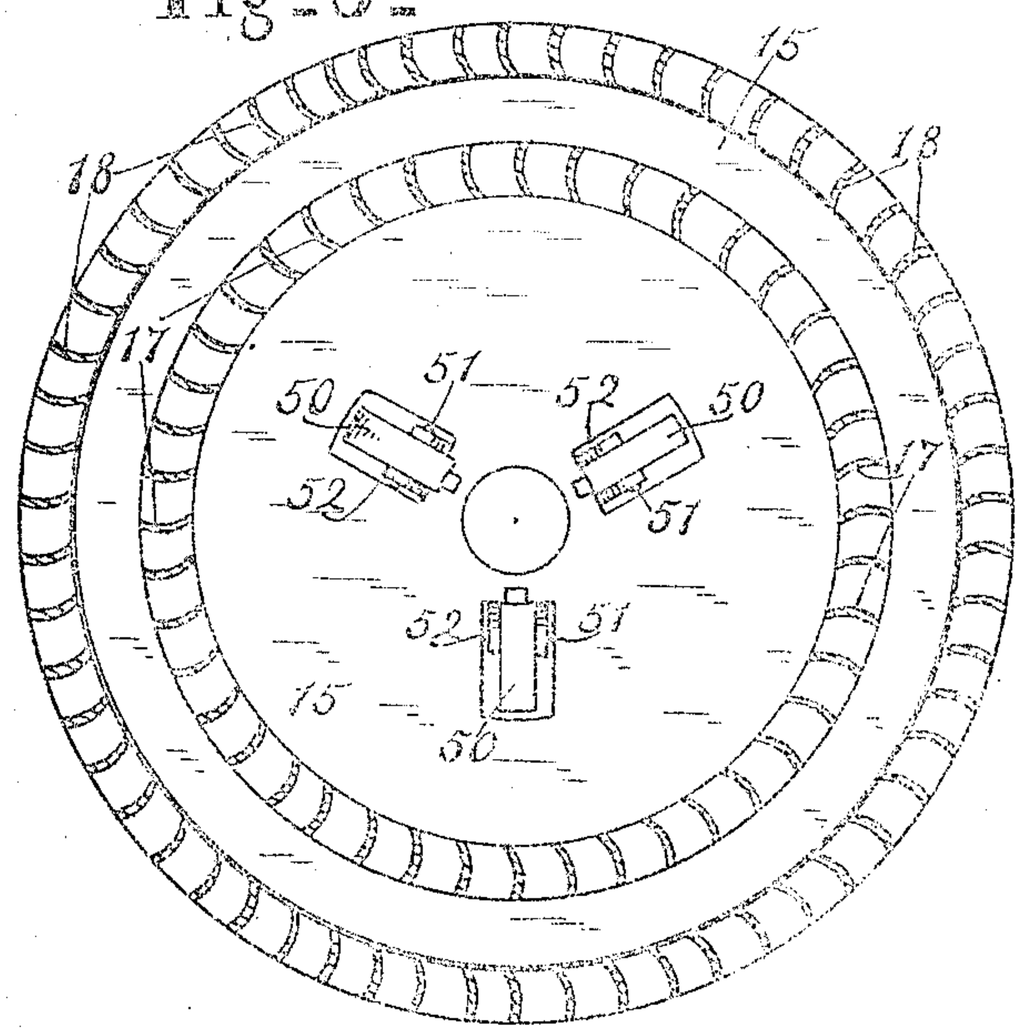
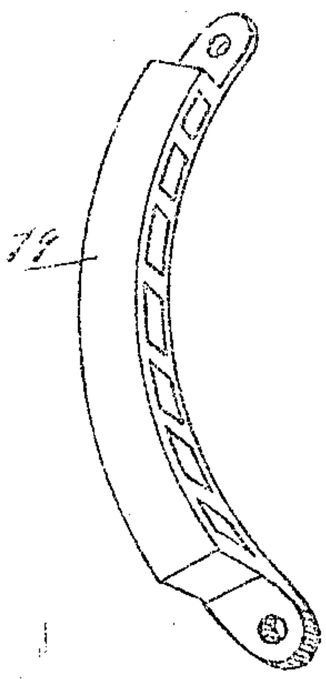


Fig. 10.



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4 SHEETS—SHEET 4

Fig. 11.

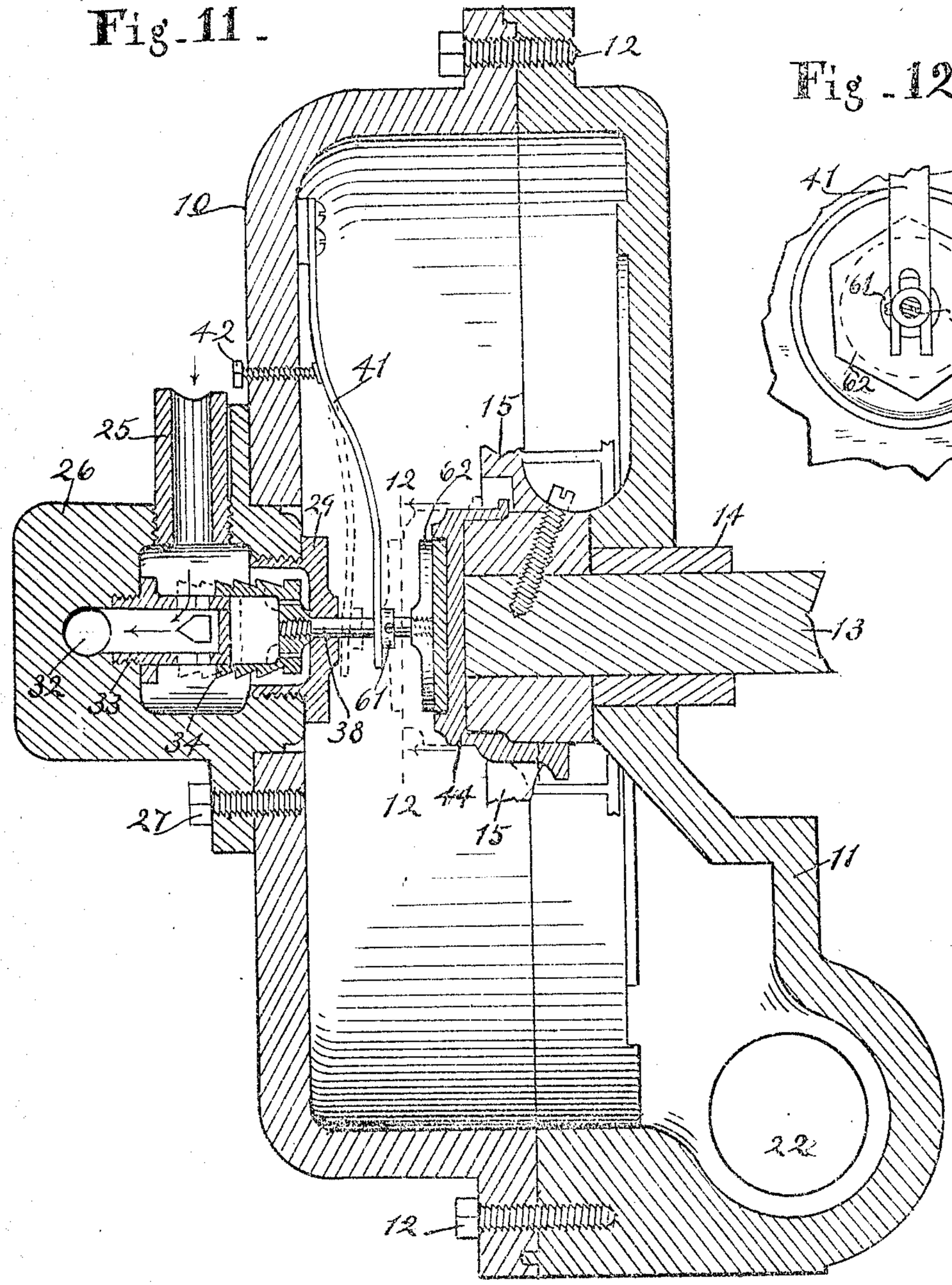

Fig. 12.

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UNITED STATES PATENT OFFICE.

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STEAM-TURBINE

No. 916,779. Specification of Letters Patent. Patented March 30, 1909.

Application filed October 4, 1906. Serial No. 337,372.

To all whom it may concern:

Be it known that I, JAMES C. PIPER, of Indianapolis, county of Marion, and State of Indiana, have invented a certain new and useful Steam-Turbine; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which like numerals refer to like parts.

The main object of this invention is to produce an improved governor-valve for steam turbines such that the valve has absolute control of the turbine under any variation of steam or varying pressure of steam, without the regulation of the steam supply by throttle or other shut-off valves.

One difficulty heretofore in the governing of steam turbines has been due to the introduction of the steam in direct opposition to the action of the regulating valve and also to the unbalanced character of said valve. In this invention that difficulty has been remedied by placing the valve in a steam chamber into which steam is initially admitted so that the steam will pass all about the valve and therefore the valve be balanced and so that the steam from said chamber will pass from the sides through the valve ports to a central passageway in line with the valve and out therefrom through suitable passageways to the wheel.

The nature of the invention will be more fully understood from the accompanying drawings and the following description and claims.

In the drawing herewith, Figure 1 is a central longitudinal section through the device with the shaft broken away and the parts in their position during normal operation. Fig. 2 is a section through a portion of the device on the line 2—2 of Fig. 1. Fig. 3 is a transverse section of the device on a line 3—3 of Fig. 1. Fig. 4 is a vertical central section of the rear half of the casing along the line 4—4 of Fig. 3. Fig. 5 is an inside elevation of the front wall of the casing, the upper part being broken away and the governor lever being shown in part. Fig. 6 is a section on a line 6—6 of Fig. 5. Fig. 7 is a front elevation of a turbine wheel with the governor weights thereon. Fig. 8 is a side elevation thereof. Fig. 9 is a rear elevation thereof. Fig. 10 is a perspective view of the stationary buckets. Fig. 11 is a central vertical section of a modified construction, with all but the hub portion of the turbine wheel broken away. Fig. 12 is a section on the line 12—12 of Fig. 11.

The turbine consists of a forward casing 10 and a rear casing 11 secured together by bolts 12. The rear casing has a centrally located shaft 13 mounted in the bushing 14 and carrying on its inner end a turbine wheel 15 secured to said shaft by a screw 16. The turbine wheel 15 has secured to it on its rear surface two annular series of buckets 17 and 18 spaced apart so as to pass on each side of two stationary series of reversely arranged buckets 19 secured to the rear half of the casing by screws 20. The steam strikes the outer series of buckets 18 from a pair of oppositely located nozzles 21 secured to the front half of the casing 10, as appears in Figs. 3, 5 and 6. The steam passes from the outer series 18 through the stationary series 19 and thence through the inner series 17 and out through the exhaust port 22. In this manner the wheel is rotated and the shaft driven.

Steam is brought to the device through the pipe 25 that screws into a steam chest 26 which is secured by bolts 27 to the front wall 10 of the casing, the inner end of said steam chest fitting in a suitable hole made in the front wall 10 of the casing, as seen in Figs. 1 and 2. The steam from the pipe 25 enters to one side of the direction of movement of the valve into a chamber 28 in said steam chest surrounding said valve; said chamber being closed at its inner end by a screw cap 29. A tubular valve seat 30 is secured in the steam chest with one end extending into the chamber 28. It has a series of ports 31 that are contracted at their ends toward the outlet end of said valve seat 30, as shown in Fig. 1. The inner end of said valve seat 30 is closed and the outer end opens into the steam passage-way 32, as seen in Fig. 2, which leads in two directions to the passage-way or tubes 33 secured to the front wall of the casing and leading to the tubes 21. In this manner steam is conveyed to the turbine wheel.

The admission of steam to the turbine is controlled as follows: A sliding valve 34 operates on the valve seat 30 to open and close the ports 31. It is cap-shaped and has holes 35 in the head thereof. It is cylindrical and provided with corrugations 36 arranged peripherally, each corrugation hav-

ing a radial surface facing the ports in the valve seat and the other surface thereof inclined away from the ports in the valve seat. The function of these corrugations is to contribute to balancing the valve while the turbine is in motion and the valve is working on a closed cut-off. Then the velocity of the steam passing through the ports is so great that the tendency is to create a suction that acts on the valve. This action, however, is counteracted by the initial pressure of the incoming steam acting against the straight or radial surfaces of the corrugations. This allows the valve to almost close the ports and yet be balanced. It is mounted wholly in the chamber 28 and arranged so that the steam can pass in and around it and make it perfectly balanced. Therefore, the ports 31 can be gradually closed and by reason of the conical ends thereof the steam may be even more gradual and sensitively controlled and shut off than if said ports were otherwise formed. The sliding valve 34 is actuated through the stem 38 on the lever 39 fulcrumed at its upper end to a bracket 40 and held inward by a spring 41 the tension of which is adjusted by a screw 42. A flat plate 43 is centrally pivoted to said lever 39 and sets in an annular recess in a sliding cap 44 mounted loosely over the end of what may be termed the hub of the turbine wheel. Said cap 44 is held inward by flat springs 45 fastened at their upper ends by screws 46 to the turbine wheel. Said sliding cap 44 is actuated and moved outward by three centrifugal weights 50 that are fulcrumed at 51 in openings 52 through the turbine wheel so that the inner ends 53 of said weights will bear against the inner edge of said sliding cap 44. When the speed becomes too great the weights 50 will be actuated by centrifugal force to the dotted line position shown in Fig. 1, which will cause the inner ends 53 of said weights to force the sliding cap 44 outward and actuate the sliding valve 34 to diminish or close the ports 31 and the supply of steam. Said valve 34, therefore, moves in either direction according to the speed of the turbine wheel and the action of the governor weights 50. This makes a very sensitive and well regulated steam turbine. If the governor shuts the steam off too readily or not readily enough it may be adjusted by the screw 42 while the turbine is in operation.

Figs. 11 and 12 illustrate a slightly modified form of my invention wherein the steam chamber and valve mechanism are in line with the axis of the turbine wheel instead of being to one side as shown in Fig. 1. With this construction the lever 39 is dispensed with, the spring 41 acting against a nut 61 on the valve stem 38 to hold the valve in an open position and resist the action of the governor weights 50. The lower end of the spring 41 in this modified form is slotted as shown in Fig. 12 so as to fit astride the valve stem 38. A plate 62 corresponds with the plate 43 but is screwed upon the inner end of the valve stem 38. The operation of the modified form is substantially the same as that of the other.

The steam is taken by the engine from the chamber in the steam chest at all times, and into that chest steam is initially and directly conveyed from the boiler so that the steam in said steam chest is under the boiler pressure.

What I claim as my invention and desire to secure by Letters Patent is:

1. In a steam turbine having a turbine wheel, mechanism for controlling the admission of steam including a steam chest having a chamber into which the steam is initially conveyed, a tubular valve seat extending into said chamber provided with ports in the side thereof, through which the steam passes from said steam chest, a perforated tubular sliding valve surrounding said valve seat for controlling said ports and located wholly within said steam chest with one surface of each corrugation facing the ports in the valve seat and the other surface inclined away from said ports, whereby said valve will be balanced, means controlled by the speed of the turbine wheel for moving said valve, and a steam passage way leading from the interior of said valve seat to the turbine wheel.

2. In a steam turbine wheel, a cylindrical casing, a turbine wheel mounted therein, a steam chest located in the wall of said casing out of alinement with the axis of the turbine wheel, valve mechanism in said steam chest for controlling the admission of steam, a lever pivotally connected at one end to the valve in said valve mechanism and extending across the axial line through said turbine wheel and pivoted to the casing, a plate pivoted to said lever at a point in line with the axis of said turbine wheel, a spring held cap on the hub of the turbine wheel engaging the plate pivoted to said lever, and centrifugally controlled weights pivoted to said turbine wheel that act to actuate said cap, substantially as set forth.

In witness whereof, I have hereunto affixed my signature in the presence of the witnesses herein named.

JAMES C. PIPER.

Witnesses:
N. ALLEMONG,
HELEN B. MCCORD.