No. 875,033. PATENTED DEC. 31, 1907.

C. H. WORSEY.

GOVERNING MECHANISM FOR TURBINES.

APPLICATION FILED JUNE 22, 1906. RENEWED JULY 13, 1907.

4 SHEETS—SHEET 1.

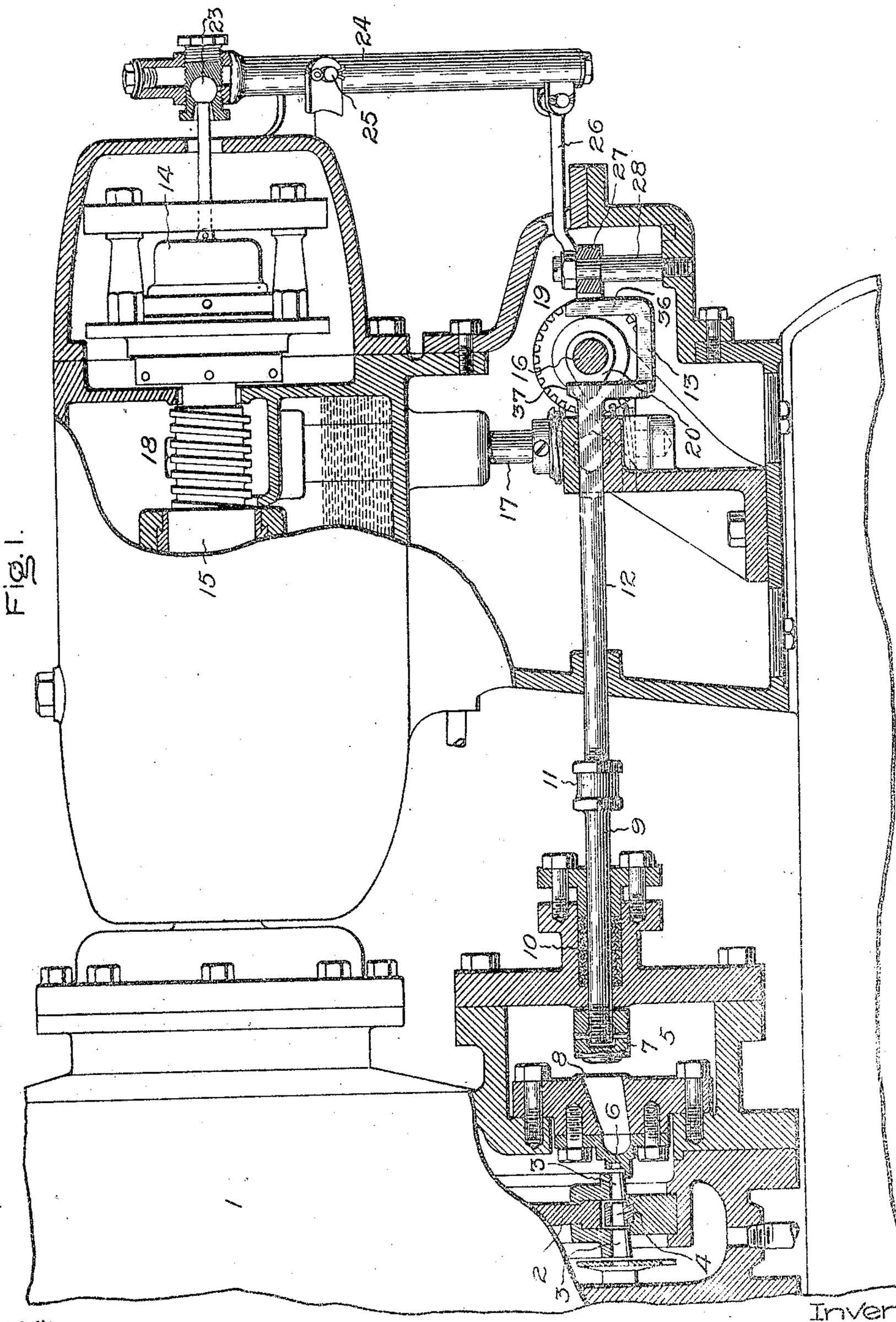

Fig. 1.

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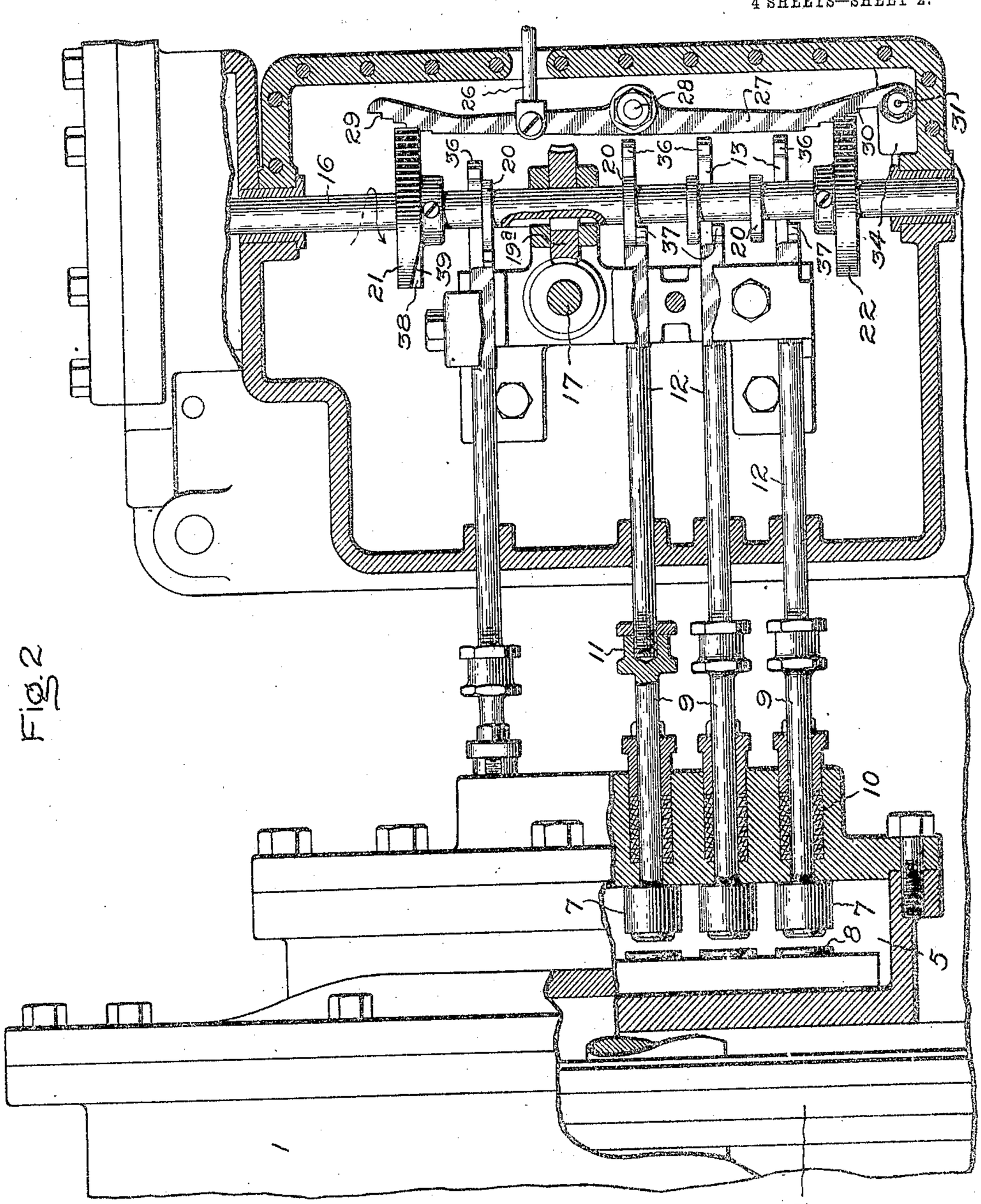

Fig. 2.

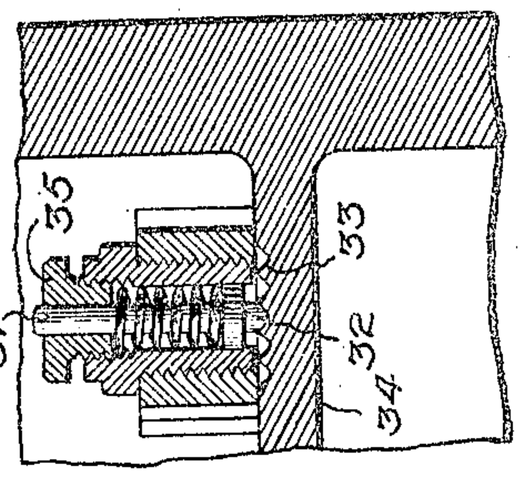

Fig. 3.

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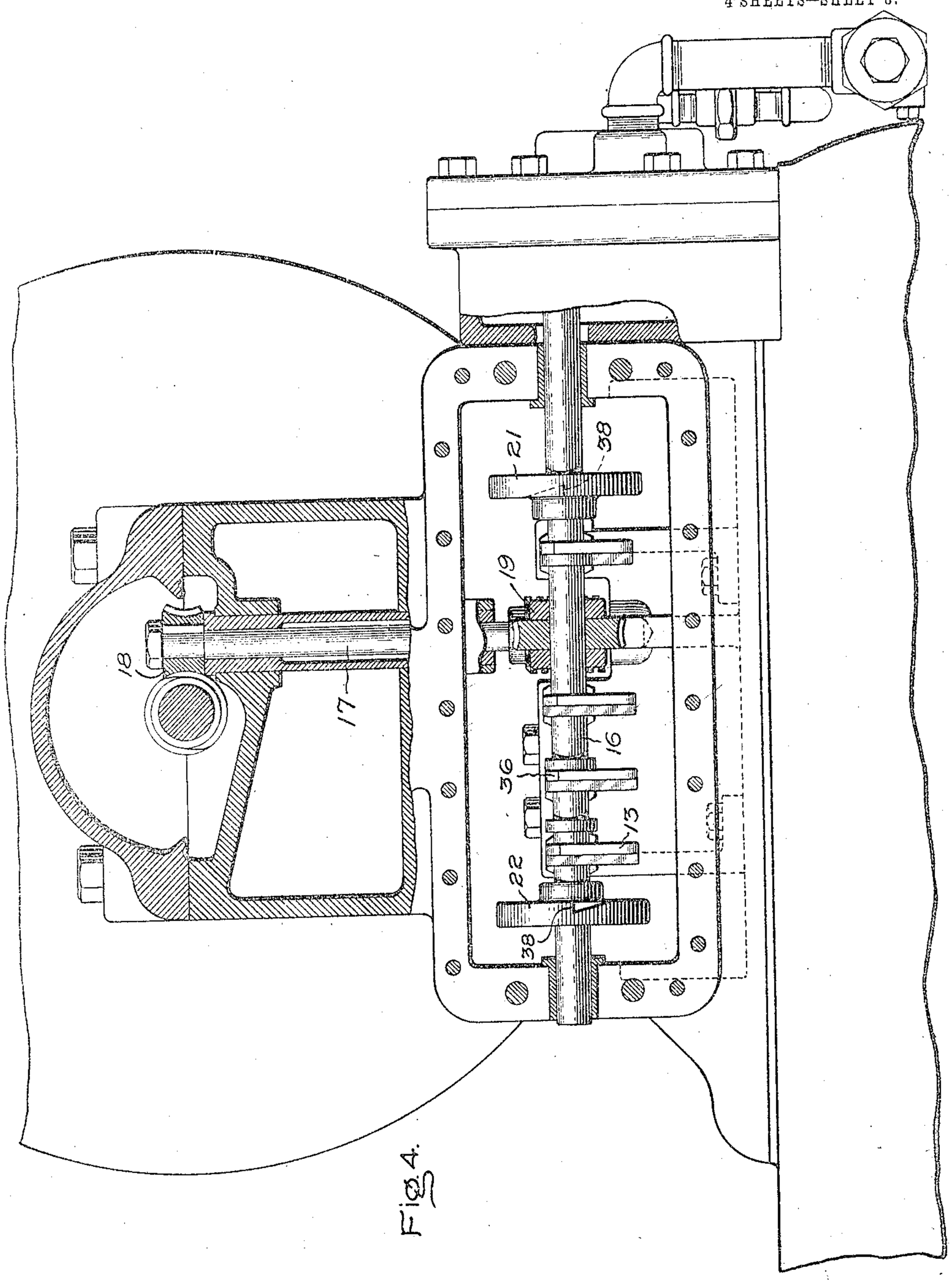

Fig. 4.

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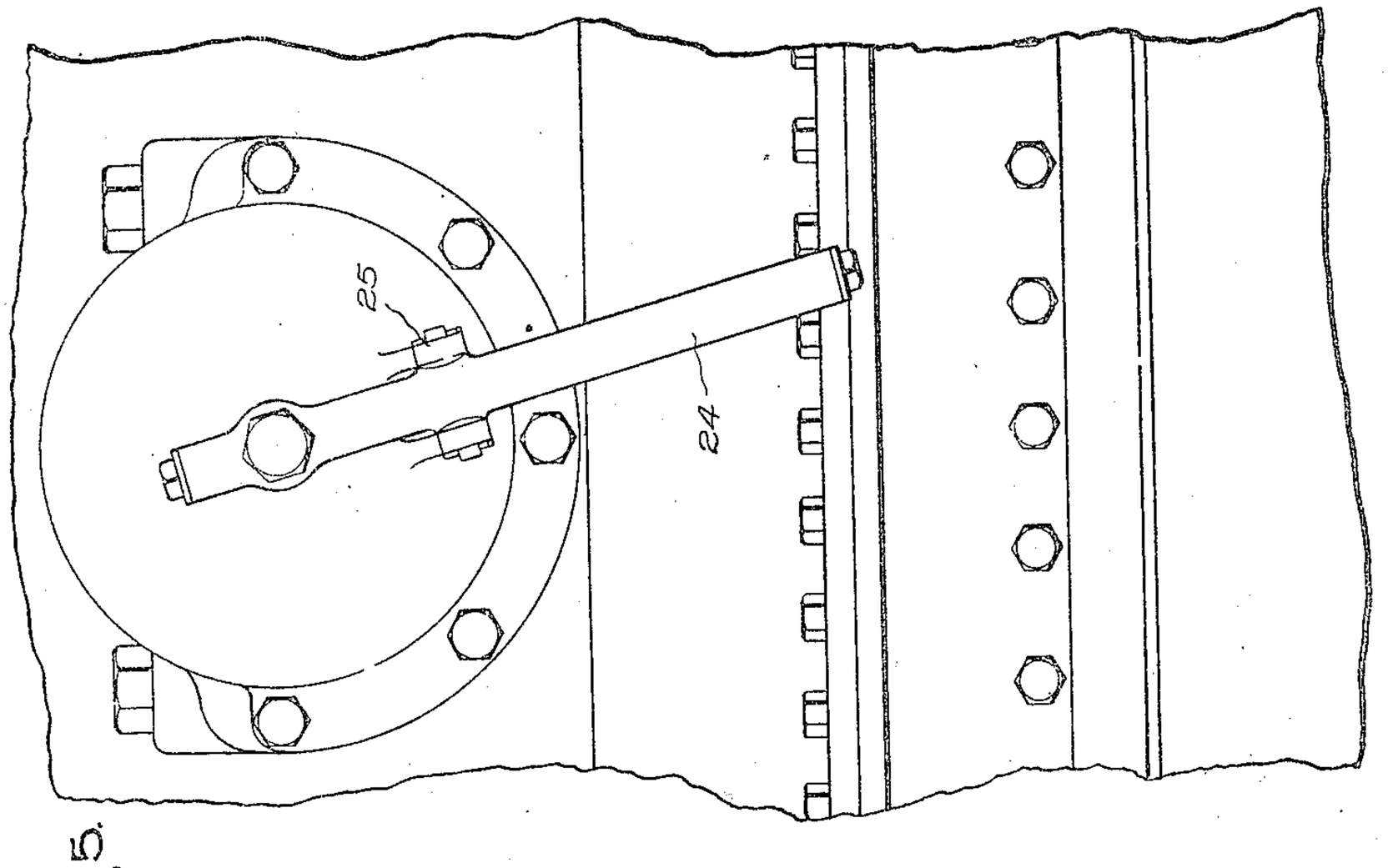

Fig. 5.

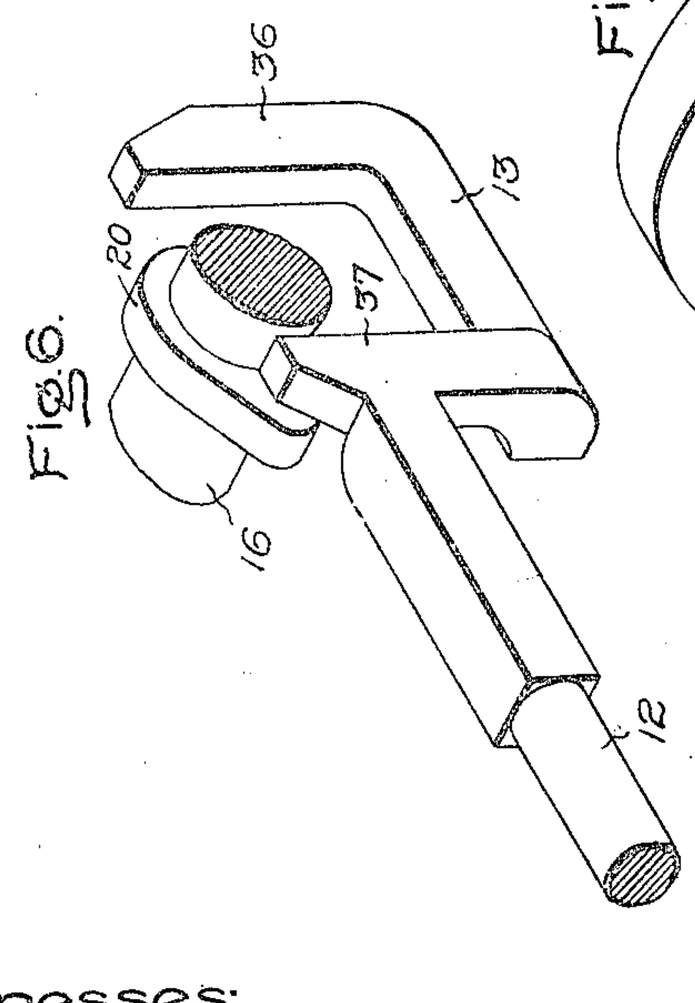

Fig. 6.

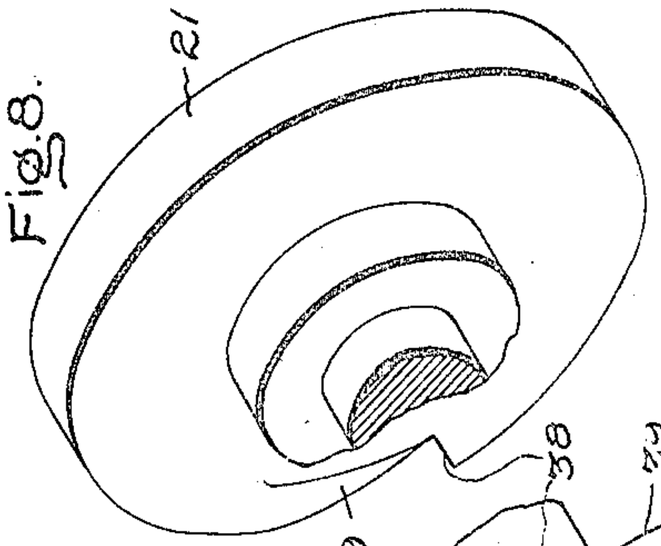

Fig. 8.

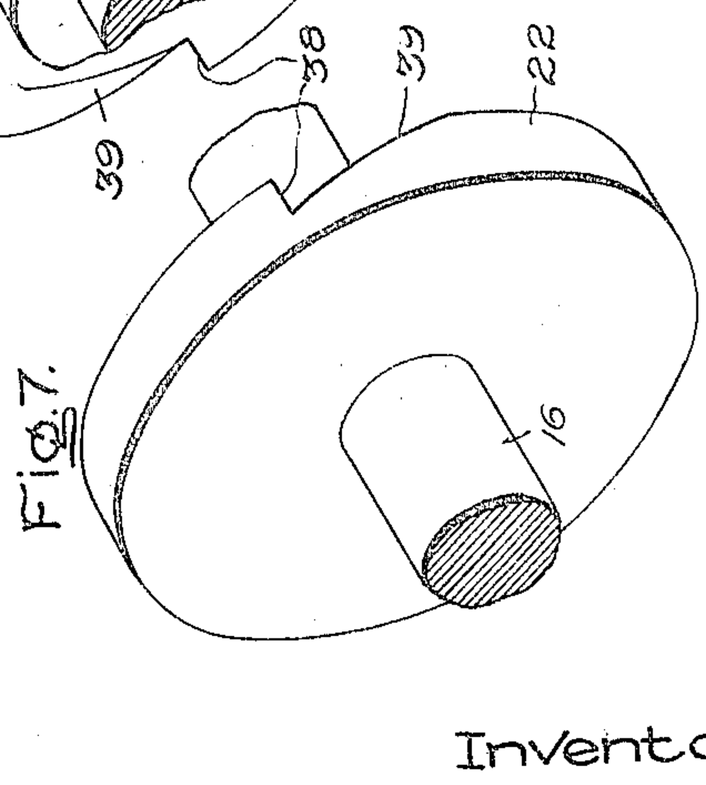

Fig. 7.

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UNITED STATES PATENT OFFICE.

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GOVERNING MECHANISM FOR TURBINES.

No. 875,033. Specification of Letters Patent. Patented Dec. 31, 1907.

Application filed June 22, 1906, Serial No. 322,312. Renewed July 13, 1907. Serial No. 383,624.

To all whom it may concern:

Be it known that I, CHARLES H. WORSEY, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful improvements in Governing Mechanisms for Turbines, of which the following is a specification.

The object of the present invention is to provide a governing mechanism for elastic fluid turbines which is of improved construction and reliable and efficient in operation, reducing friction to a minimum and placing an extremely light load on the governor, the energy for varying the effective position of the valve actuating mechanism being transmitted directly from the main turbine shaft to said mechanism and not from the governor.

The invention relates more particularly to that type of turbines in which a plurality of separate and successively actuated valves are used to control the admission of steam or other elastic fluid to the nozzles or other discharging devices.

In the accompanying drawings, illustrating one of the embodiments of my invention, Figure 1 is a partial sectional elevation of a turbine showing the governing mechanism and valve gear; Fig. 2 is a partial horizontal section of the same; Fig. 3 is a detail view of a steadying device; Fig. 4 is a partial end view and section with the cover plate removed; Fig. 5 is an end view showing particularly the governor lever; Fig. 6 is a perspective view of a cam and its yoke or crosshead; and Figs. 7 and 8 are perspective views of the shifting cam disks.

The casing 1 of the turbine contains one or more wheels 2 each carrying one or more rows of buckets 3. Between each two rows of wheel buckets are located more or less complete rows of intermediate buckets4. Steam or other elastic fluid from a suitable source of supply passes from the steam chest 5, through expanding or non-expanding nozzles or other fluid discharging devices 6, to said buckets. The passage of steam to the nozzles is regulated by a plurality of valves 7 having seats 8. The valve stems 9 pass through stuffing-boxes 10 in the steam chest cover and are adjustably coupled at 11 to rods 12 mounted to slide in suitable bearings and having yokes or cross heads 13 at one end. The portion of the rod 12 engaging the bearings adjacent the yokes is made square in cross section to maintain said yokes in an upright position. The valves 7 are unbalanced. The pressure in the steam chest holds them in open or closed position after they are moved by the cams to be described.

14 represents a speed-responsive device or governor of any suitable construction mounted upon the end of the main turbine shaft 15 to rotate therewith, but it might be driven from said shaft by intermediate connections, if desired.

The cam shaft 16, mounted to rotate in bearings in the turbine frame or casing, is driven from the turbine shaft 15 by means of a vertical shaft 17 and worm gearing 18, 19 or in some other well-known manner. Upon the cam shaft 16 is secured a series of valve actuating cams 20 and the shifting cam disks 21, 22. The cams 20 may be brought into engagement with the yokes 13 under proper conditions to open or close the valves 7 in a manner to be described.

The governor 14 has a swivel connection 23 with one end of a lever 24, pivoted at 25 on the casing inclosing said governor. A link 26 connects the other end of the lever 24 to the stepped and tilting lever 27, pivotally mounted on a stud 28 adjacent the cam shaft and within its casing. The ends of said lever are stepped at 29, 30, and these steps may engage the shifting cam disks 21, 22.

One end of the stepped lever 27 carries a positioning device which consists of a spring-pressed plunger 31 having a rounded end 32 engaging one of a series of correspondingly shaped recesses 33 in a projecting portion 34 of the casing. The tension of the plunger spring may be adjusted by means of a nut 35. By means of this arrangement the lever 27 is moved in a step-by-step manner and the proper relation of the parts insured.

The shaft 16 and its cams are rotated constantly in the direction of the arrow, Fig. 2. The cams 20 are so located on shaft 16 that no two of the valves can be opened or closed at the same time but the cams may be made to successively engage the yokes 13 to open or close the valves 7 by longitudinally shifting shaft 16 in a manner to be described. The ends 36, 37 of the yokes are offset Figs. 2 and 6, so that the cam 20 may in one position engage the part 36 to open a valve 7, or, on

being suitably shifted, the cam may engage the part 37 to close the valve, or further shifting may place it in a position where it can engage neither 36 nor 37. Thus, in Fig. 2, the cam 20 nearest the shifting cam disk 21 is in a position to close its valve while the cam 20 next beyond is positioned to engage the part 36 to open its valve, and the other cams 20 are so positioned as to have no effect on the valves. The valves are moved solely by the cams and remain either open or closed until their position is changed by the action of the cams.

The shifting of the cam shaft is controlled by the action of the governor upon the stepped lever 27. When the speed is decreasing below the normal, the governor, by means of the connections 23, 24 and 26, presses the end 29 of the lever 27 toward the shifting cam disk 21. One of the steps is pressed against the edge of disk 21 as that disk rotates, and drops into the recess 38 when it comes opposite said step, causing the lever 27 to swing on its pivot and move a corresponding step at the end 30 from contact with the disk 22. At the same time the end 32 of the yielding plunger of the positioning device rides over the intervening ridge from one recess 33 to the next and retains the lever in position.

The depth of the recess 38, Figs. 2 and 8, is such that the outer edge of the step engages the inclined cam surface 39 and further rotation of the shaft 16 forces it and the cams carried thereby longitudinally until the edge of disk 22 engages the next step at 30. The energy for effecting the longitudinal movement is transmitted from the shaft 15, thus relieving the governor of all load incident to the movement. This movement is sufficient to move the cam 20 nearest pivot 28 out of engagement with its yoke and to place the cam 20 next disk 21 in position to open its valve. The worm-gear 19[a] is splined on the cam shaft 16 to permit the shaft to slide through said gear. Similarly, when the speed is increased above the normal, the steps at the end 30 of the lever 27 are forced against the disk 22 to shift the cam shaft in the opposite direction to effect the successive closing of as many valves as is necessary to maintain proper regulation of the speed. When the speed is normal, neither of the ends of the lever is forced against the disks and the position of the valves remains unchanged.

The relative location of the cams 20 and the cam surfaces 39 is such that the shifting of the cam shaft 16 occurs when the cams 20 are in position to clear the yokes 13.

This form of governing mechanism places an extremely light load upon the governor which has merely to move the lever 27 into position to engage the shifting cams. When so positioned, the force necessary to shift the cam shaft is transmitted from the main turbine shaft through the parts 17, 18, 19 and 19[a] and the thrust of the shifting cams is taken by the stud 28. The governor itself is thus relieved of all the load incident to the bodily movement of the shaft and its cams. A further advantage lies in the avoidance of any frictional contact in the valve-operating and cam-shifting mechanism except at the moment of operation, thus reducing friction losses to a minimum.

While the mechanism has been described as operating on a series of valves it is to be understood that the number of valves in the series may be varied to suit the requirements of any given machine and that but one valve may be used if desired. The mechanism may also be used to control the operation of stage valves instead of admission valves as shown.

In accordance with the provisions of the patent statutes, I have described the principles 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. The combination with a regulator of a shiftable device for opening and closing the regulator, an actuator for the device, a governor, and means positioned by the governor for causing the movements of said actuator to shift the device into positions in which it will open or close the regulator to satisfy load requirements.

2. The combination with a valve of a shiftable cam for opening and closing the valve, an actuator for the cam, a governor, and a device positioned by the governor which causes the actuator to shift the cam laterally to open or close the valve to satisfy load requirements.

3. The combination with a driving shaft and a cam shaft driven thereby, of a cam on the latter shaft, a valve, means for transmitting motion from the cam to the valve, a speed responsive device, and means positioned by the device which causes the driving shaft to shift the cam shaft longitudinally to vary the action of the cam on the valve to satisfy load requirements.

4. In a governing mechanism, the combination of a regulator, means for moving the regulator in one direction or the other, and a load-responsive device for controlling the operation of said regulator including a lever having stepped ends.

5. In a governing mechanism, the combination of a plurality of regulators, means for opening and closing said regulators, and

a load-responsive device for controlling the operation of said regulators including a tilting lever having stepped ends.

6. In a governing mechanism, the combination of a valve, means for opening and closing said valve, a device responsive to changes in the load for controlling the operation of said valve including a lever having stepped ends and a positioning device for said lever.

7. In a governing mechanism, the combination of a valve, means for opening and closing said valve, a load-responsive device controlling the operation of said valve including a lever and a positioning device for said lever comprising a spring-pressed plunger and a fixed abutment having recesses with which the end of said plunger yieldingly engages.

8. The combination of a regulator with a constantly rotating cam for actuating said regulator, means for transmitting motion from the cam to the regulator, a means acting upon opposite ends of the cam shaft for shifting the cam to a given position to move the regulator in one direction and for shifting it to another position to move the regulator in the opposite direction.

9. In a governing mechanism, the combination of a main driving shaft, a regulator, a constantly rotating cam for actuating said regulator, means for transmitting motion from the cam to the regulator, a means energized by the shaft for shifting the cam to a given position to move the regulator in one direction and for shifting it to another position to move the regulator in the opposite direction, and a speed-responsive device for controlling said shifting means.

10. The combination of a regulator, a constantly rotating cam for actuating the regulator, means for transmitting motion from the cam to the regulator, and a means acting upon opposite ends of the cam shaft for shifting the cam to one side of a given position to move the regulator in one direction and for shifting it further in the same direction to move the regulator in the opposite direction and for shifting it still further in said direction to release the regulator from the cam.

11. In a governing mechanism, the combination of a main shaft, a valve, a constantly rotating cam for actuating the valve, means for transmitting motion from the cam to the valve, a means energized by the main shaft for shifting the cam to one side of a given position to move the valve in one direction and for shifting it further in the same direction to move the valve in the opposite direction and for shifting it still further in said direction to release the valve from the cam, and a speed-responsive device controlling said shifting means.

12. In a governing mechanism, the combination of a plurality of valves, means for actuating said valves, a device for shifting said actuating means including a lever having stepped ends, and a speed-responsive mechanism which positions said lever to shift said actuating means.

13. In a governing mechanism, the combination of a plurality of valves, connections spaced apart for moving said valves, a main shaft, a rotating cam shaft, a plurality of cams on the shaft so spaced apart that they can engage the connections to open or close but one valve at a time, means energized by the main shaft for shifting the cams longitudinally to actuate the valves in successive order in either direction, and a speed-responsive device to control the shifting means.

14. In a governing mechanism, the combination of a plurality of valves, a shaft, a series of valve-actuating devices mounted on said shaft and receiving their motion therefrom, means for transmitting motion from the devices to the valves, shifting means moving with said shaft, a device adjacent said shaft which may be moved into engagement with said shifting means, a load-responsive mechanism which moves said device into or out of operative engagement with the shifting means to shift said series of devices longitudinally in either direction to engage said transmitting means and control the operation of the valves.

15. In a governing mechanism, the combination of a plurality of valves, a shaft, a series of actuating devices for the valves mounted upon the shaft and receiving their motion therefrom, means for transmitting motion from the devices to the valves, shifting means on the shaft, a lever adjacent the shaft having means at its ends to engage the shifting means, and a speed or load-responsive device controlling the position of said lever and moving its ends into or out of operative engagement with the shifting means to shift the series of devices in either direction to engage the transmitting means and to open or close the valves in successive order.

16. In a governing mechanism, the combination of a plurality of regulators, a rotating shaft, a series of actuating devices for the regulators mounted upon the shaft, means for transmitting motion from the devices to the valves, a shifting cam on the shaft adjacent each end of said series, a lever pivoted at a point between the cams adjacent the shaft and having stepped ends, and a load-responsive device having a connection with said lever to move its ends into or out of operative engagement with the shifting cams to move said series of devices longitudinally in either direction to engage the transmitting means and to open or close the regulators in successive order.

17. In a governing mechanism, the combination of a series of shiftable valve-actuating devices, means for shifting the devices in-

cluding a lever, a speed-responsive mechanism having a connection with the lever, and a pivot for the lever which is located to receive the thrust of said shifting means to prevent load upon said mechanism.

18. In a governing mechanism, the combination of a series of shiftable cams, means for rotating the cams, means for shifting the cams including a lever, a speed-responsive device having a connection with a lever, and a pivot for the lever which is located to receive the thrust of said shifting means to prevent load upon said device.

19. In a governing mechanism, the combination of one or more regulators, means for operating said regulators including a shaft, means for shifting the shaft in either direction comprising two disks mounted thereon and having oppositely-disposed cam surfaces, a lever pivoted adjacent said shaft having stepped ends, and a load-responsive device having a connection with the lever to move its ends into or out of operative engagement with the cam surfaces.

In witness whereof, I have hereunto set my hand this twentieth day of June, 1906.

CHARLES H. WORSEY.

Witnesses:

JOHN A. MCMANUS, Jr.,

PHILIP F. HARRINGTON.