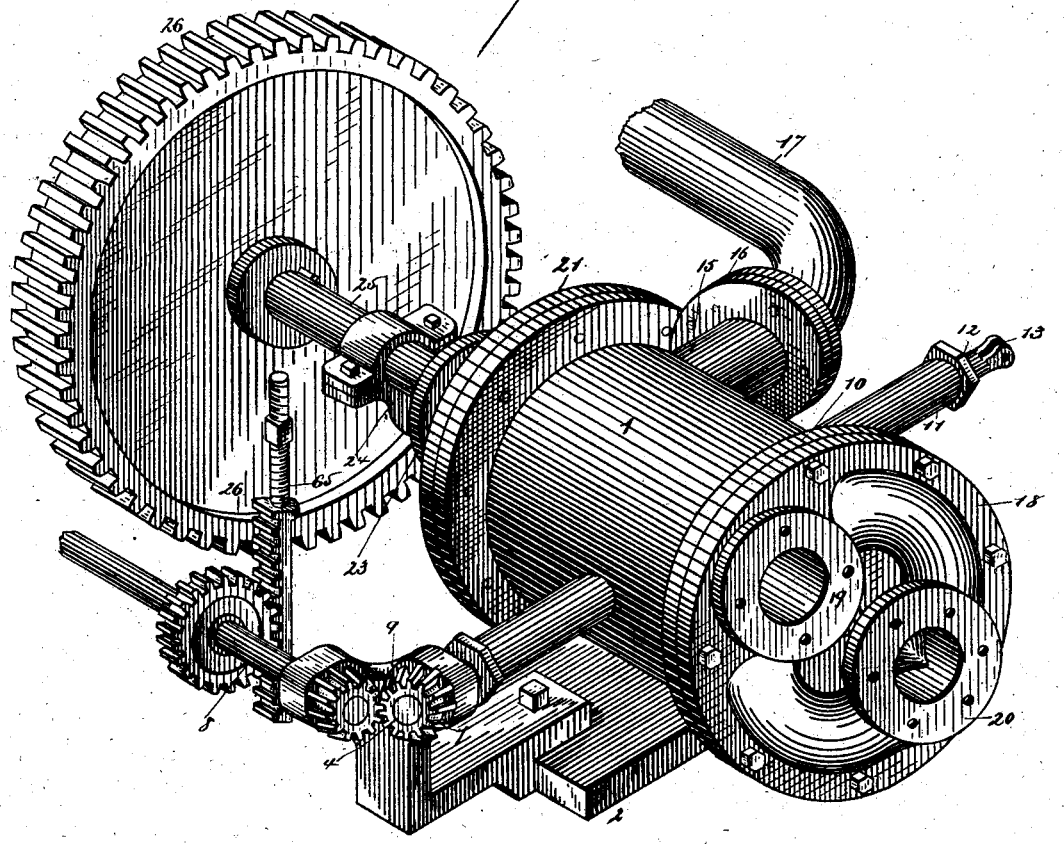
(No Model.) 3 Sheets—Sheet 1.

L. J. WING.

COMBINED ROTARY, CUT-OFF, AND GOVERNOR VALVE.

No. 259,963. Patented June 20, 1882.

Fig. 1.



Witnesses:

J. W. Garner

H. S. D. Haines

Inventor:

Leander J. Wing

(No Model.) 3 Sheets—Sheet 2.

L. J. WING.

COMBINED ROTARY, CUT-OFF, AND GOVERNOR VALVE.

No. 259,963. Patented June 20, 1882.

Fig. 2.

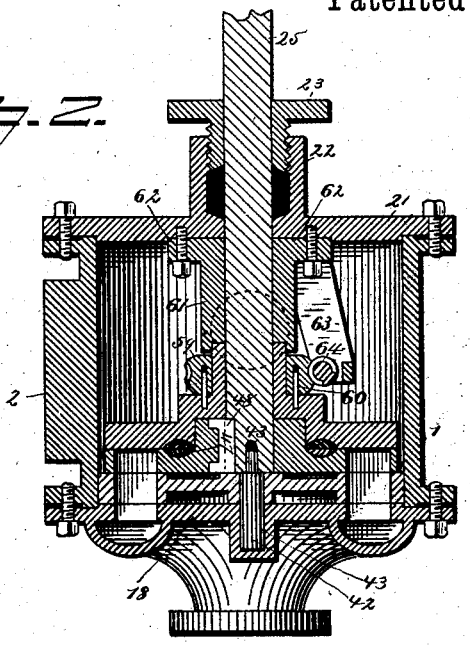


Fig. 4.

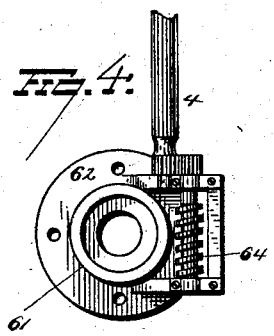
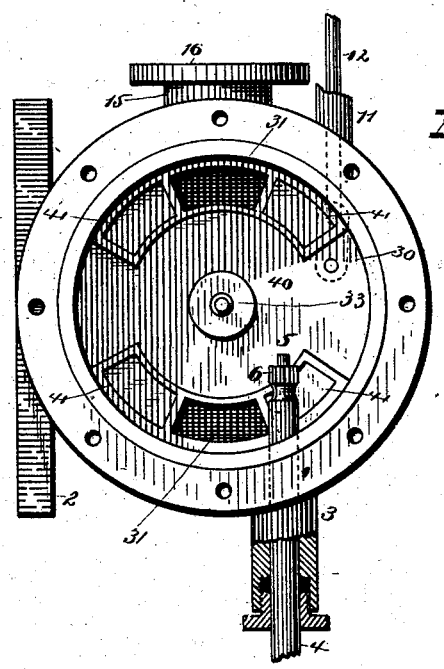


Fig. 3.



Witnesses:

J. W. Garner.

W. S. D. Haines.

Inventor:

Leander J. Wing

(No Model.) 3 Sheets—Sheet 3.

L. J. WING.

COMBINED ROTARY, CUT-OFF, AND GOVERNOR VALVE.

No. 259,963. Patented June 20, 1882

Fig. 6.

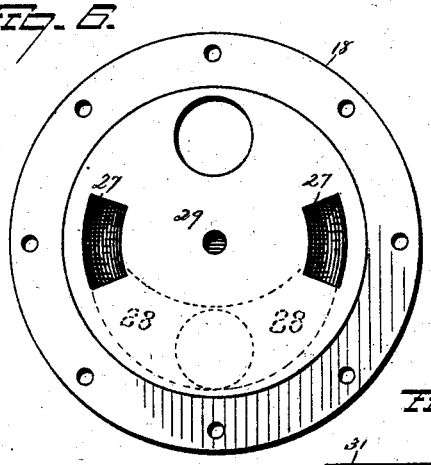


Fig. 5.

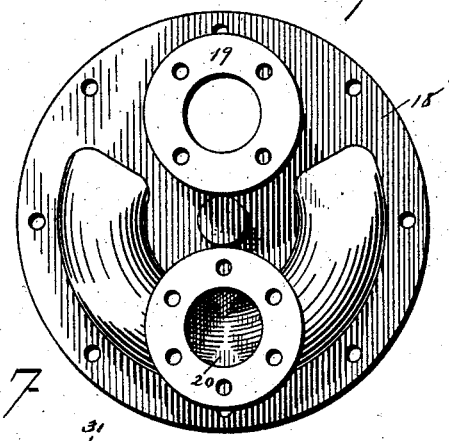


Fig. 7.

Fig. 8.

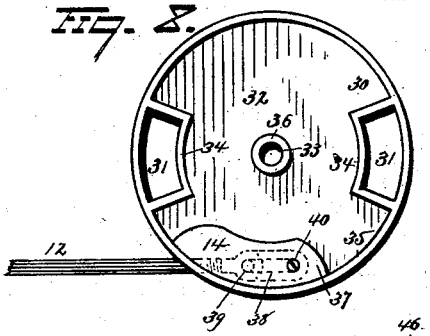


Fig. 9.

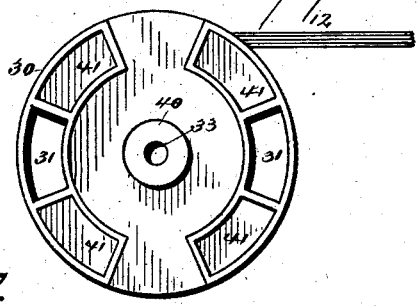


Fig. 10.

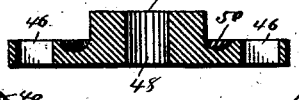


Fig. 11.

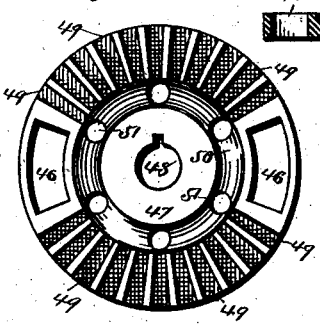


Fig. 12.

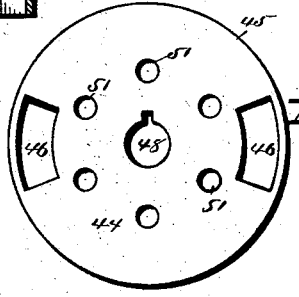


Fig. 13.

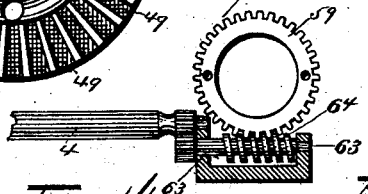


Fig. 14.

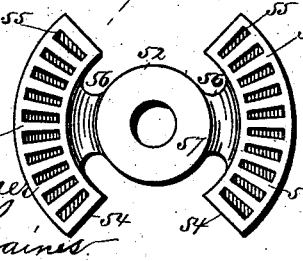
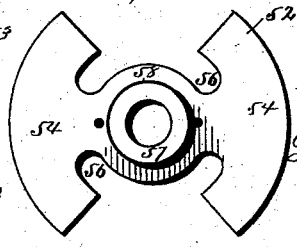


Fig. 15.



Witnesses:
J. W. Garner
W. S. D. Haines

Inventor:
Leander J. Wing

UNITED STATES PATENT OFFICE.

LEANDER J. WING, OF LEXINGTON, MASSACHUSETTS.

COMBINED ROTARY, CUT-OFF, AND GOVERNOR VALVE.

SPECIFICATION forming part of Letters Patent No. 259,963, dated June 20, 1882.

Application filed February 18, 1882. (No model.)

To all whom it may concern:

Be it known that I, LEANDER J. WING, of Lexington, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Combined Rotary, Cut-Off, and Governor Valves; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

My invention relates to a combined rotary valve, cut-off, and governor-valve, the object being to combine in a single casing or cylinder a rotary valve, cut-off, and governor-valve of such construction and relative arrangement that each valve will be steam-balanced, and hence enabled to be operated with the minimum outlay of power, and insure a sensitive action to the governor-valve for regulating the steam-supply to the valve, and features to insure the cutting off of steam at any desired point in the travel of the engine-piston, the cut-off valve being constructed so that it will be steam-balanced throughout its entire range of adjustment.

With these ends in view my invention consists in certain features of construction and combination of parts, as will hereinafter be disclosed, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a view in perspective of the valve-cylinder and the gearing for actuating the valves. Fig. 2 is a longitudinal section taken through the valve-cylinder. Fig. 3 is an end view of the valve-cylinder with the outer head removed. Fig. 4 is a detached view of the gearing for adjusting the position of the governor-valve. Fig. 5 is a rear plan view of the inner head of the valve-cylinder. Fig. 6 is a similar view of the front surface of the inner head of the cylinder. Figs. 7, 8, and 9 are views of the front and rear faces of the rotary valve and a transverse section of the same. Figs. 10, 11, and 12 are views of the front and rear faces of the cut-off valves and a transverse section of the same. Fig. 13 is a detached view of the worm and worm-gear for actuating the governor-valve. Figs. 14 and 15 are front and rear plan views of the governor-valve.

1 represents a cylinder, at the base of which is a foot, 2, by which it is secured to the engine-frame. Near the center of the cylinder 1, in front and forming a part of it, is a hollow projection or pipe, 3, through which pipe is a shaft, 4, extending nearly to the center of the cylinder 1. The inner end of such shaft 4 is provided with a small bearing, 5, which is located just beyond a spur-gear, 6, whose outer diameter is not greater than the diameter of the shaft itself. To the outer end of the shaft 4 is secured a miter-gear, 7, which engages with a similar gear, 9, secured to the end of the shaft 8, running in a line parallel with the length of the cylinder 1 and at right angles to the pipe 3, for a purpose hereinafter explained.

Nearly opposite the pipe 3 on the cylinder 1, but close to the flange 10, is a like pipe, 11, provided with a rod, 12, the outer end of which forms a yoke, 13, and the inner end of which is screw-threaded at 14 for the attachment of the rod to a yoke, for a purpose hereinafter described. On the opposite side of the cylinder 1, but near the center of the same, is the steam-pipe 15, provided with a flange, 16, by which it is connected with the supply-pipe 17. The cylinder 1 is further provided with two detachable heads, the inner head, 18, being provided with pipe projections and flanges 19 and 20. 19 is the exhaust-pipe, and 20 is the supply-pipe, which conducts the supply of steam from the valve to the engine-cylinder, to which it is secured by bolts passing through openings in the flange of pipe 20, provided for that purpose. The opposite or front head, 21, of the cylinder 1 is provided with a stuffing-box, 22, and gland 23, together with a bearing, 24, to support the valve-shaft 25.

Beyond the bearing on the shaft is secured the large spur-gear 26, which revolves the shaft 25. In Fig. 5 the outside of the head 18 is shown, while Fig. 6 shows its inside form of construction. It is provided with two ports, 27 27, which in form are segments of a circular groove, and are directly opposite each other and of uniform size. On one side of the head 18 is the opening 19 into the exhaust-pipe, while a chamber, 28, from the ports 27 27 communicates directly to the supply-pipe 20. The chamber 28 is arc-shaped, extending partly

around the head, the outer wall being cast on the outer surface of the head, so as to project therefrom, while the inner wall is on a plane with the inner surface of the cylinder-head. The inner wall is provided with openings forming the ports 27 27.

Resting upon the finished inner face, 29, of the head 18 is the oscillating reversing-valve 30, which is also provided with two ports, 31 31, identical in form, size, and position with ports 27 27 in head 18. The flange or projections in the face 32 of the reversing-valve 30 engage with the finished face 29 of the head 18.

Extending around the periphery of the valve 30 on the face 32, and also surrounding the ports 31 31, and surrounding the hole 33 in the center of the valve 30, are the raised rims, flanges, or projections 34 35 36, which are made to fit steam-tight against the face 29 of the head 18. In the periphery of the valve 30 is formed a cavity, 37, (see Fig. 8,) in which is fastened a suitable device in the form of a link, 38, yoke 39, and screw 40, the latter extending through the valve and link. The rod 12 is screwed into the yoke 39. By reciprocating the rod 12 a partial rotary movement is imparted to the valve 30. Upon the face 40 of the valve 30 are seen the ports 31 31 and the central hole, 33.

On each side of each one of the ports 31 31 is located a recess or concavity, 41, of the same size of the ports 31 31, which recesses or concavities are formed by a rim or projection identical in form with the rim surrounding the ports 31 31 on the face 40 of the valve 30. A like projection or flange surrounds the hole 33 in the center of the valve 30. In the hole 33 is nicely fitted the short stationary arbor or pivot 42, which, being tightly fitted within the central socket, 43, of the head 18, furnishes a suitable pivot upon which the valve 30 turns when it is partly revolved. The outer end of the stationary arbor 42 is made to fit within the hole 43 in the end of the valve-shaft 25, and furnishes a suitable end bearing for the same.

Upon the face 40 of the valve 30 revolves the face 44 of the rotating valve 45, which latter is provided with ports 46 46, identical in form, size, and position with the ports 31 31 of the valve 30 and ports 27 27 of the head 18.

The valve 45 is provided with a central opening, 48, in which is cut a slot for the reception of the feather 47, which fits within the groove 48 of the shaft 25. When the shaft is inserted in the opening 48 and power is applied to the spur-gear 26 the valve 45 is caused to revolve.

Around the center of the valve 45, between the ports 46 46 and central opening, 48, are six openings, 51, more or less, through the valve, the purpose of which will be hereinafter explained. The face 44 of the valve 45 is finished to a fine true surface. On the upper face, 47, of the revolving valve 45 will be seen the ports 46 46, each of which is surrounded by a rim or projection similar to ports 31 31 in face 32 of valve 30. The face 47 of the valve 45 is also provided with radially-formed grooves 49, as long as the width of the ports 46 46 and their surrounding projections, and occupying all that part of the valve-face 47 situated between the adjacent ends of the ports 46 46 an annular groove, 50, is formed in the face 47 of the valve 45, and is located within the outer raised portion of this face. The radial grooves 49 communicate at their inner ends with the annular groove 50. In the bottom of the annular groove 50 are formed the openings 51. The intervening metal between the radially-formed grooves 49 is on a plane with the projections or flanges surrounding the ports 46 46, and, with such projections, is finished to a fine surface.

Upon the top of the face 47 of the rotating valve 45 is the cut-off valve 52, with its face 53 resting on the face 47, said cut-off valve being formed with two segmental sections, 54, adapted to cover the ports 46 46 of the valve 45. On the face 53 of the segmental sections 54 are formed radial cavities or recesses 55, which correspond in length to the width of the ports 46 46, and in width are adapted to be entirely covered by the metal projections at each end of the ports 46 46, when said projections are made to pass beneath the same. The metal extending between the segmental sections and the hub of the valve 52 is cut away at 56 to allow a free circulation of steam underneath such part. The hub 57 in the face 53 of valve 52 is adapted to fit over the hub of valve 45 and allow the same to freely rotate therein. On the face 58 of the valve 52 the hub 57 is adapted to receive over it the worm-gear 59, being secured in position by the pins 60 60. The end of the hub fits within the end of the socket 61 of the foot 62, which in turn furnishes the bearing 63 for the worm 64 and the gear-shaft 4. The foot 62 of the socket 61 is secured within a recess, 64, on the head 21 by bolts suited to that purpose.

Having explained the construction of the valve, of which I use one on each side of the abutment, I will now describe its method of operation.

This particular construction is especially adapted to be used in connection with a rotary engine. The flange of the pipe 20 is bolted to a like flange on the annular cylinder of the engine, and the foot 2 is secured to the engine-frame, while a spur-gear on the main shaft of the engine, of one-half the diameter of the valve-gear 26, is made to engage with the gear 26, by which means a revolving motion is communicated to the gear-shaft 25 and the rotary valve 45. Owing to the relative sizes between the gear 26 and the driving gear on the main shaft which actuates it, it will be seen that the valve is caused to revolve only one-half as fast as the main shaft; but owing to there being two ports, 46 46, on the rotary valve 45 and two ports, 31 31, on the reversing-valve 30, the valve 45 is only required to make one-half of

a revolution to open and close the ports, which insures a fast revolution of the piston of the engine and a comparatively slow motion of the valve 45. A greater number of ports may be used and still greater difference of speed attained between the main shaft of the engine and the valve 45. The ports 46 46 and 31 31 are of such size that when the former are revolved over the latter the cut-off 52, being adjusted so as not to operate to cut off steam, would be admitted to the cylinder of the engine during one-half of a revolution of the piston, and in a double engine or a single cylinder with two abutments and one piston, in which case two valves would be needed, they being so arranged on the valve-shaft 25 that they would open and close alternately, a constant application of live steam would take place during the entire revolution of the main shaft. Hence the cut-off, being located in any desired position over the ports 31 31 of the reversing-valve 30, causes the steam to be cut off at pleasure at any point in the rotation of the valve 45, which latter is located between the cut-off 52 and reversing-valve 30, whose upper face, 40, constitutes the valve-seat.

As already indicated, the cut-off 52 is operated by the worm 64 revolving the worm-gear 59 on the hub of the cut-off 52, which worm-gear 59 is actuated by the shafts 4 and 8, which latter is provided with a rack and pinion, the rack being secured by means of a right-and-left-hand-threaded screw, 65, to the rod of revolving governor-balls, (not shown,) which automatically operate the movement of the cut-off 52.

By uniting with this a device for connecting or disconnecting the rack and pinion the cut-off may be made adjustable instead of automatic, a hand-wheel being secured to the shaft 8 for that purpose. The right-and-left-hand-threaded screw 65 is for the purpose of adjusting the cut-off to secure any desired speed of the main shaft of the engine.

It will be seen that the face 44 of the rotary valve 45, which is finished to a fine surface, revolves in contact with the face 40 of the reversing-valve 30; but, owing to the rim or projections around the ports and central hole, a space is left between the main body of the valve 30 and the face 44 of the valve 45, which space is constantly filled with steam when the valve is in operation, which steam passes through the openings 51 and counteracts the pressure of steam upon the face 47 of the valve 45, except the space occupied by the ports 31 31 and surrounding projections or rims, and also except the hub-projections. When the end of the ports 46 46, in revolving, approaches the near end of the ports 31 31 of the valve-seat so far as to make an opening, steam would enter underneath the valve 45 into the ports 31, and would prevent cutting off steam before the rear parts of the ports 46 46 had reached the front part of the ports 31 31 were it not for the projections or rims around the recesses 41 41. These recesses being filled with steam at each half-revolution of the valve 45 not only counteracts the pressure of steam on the face 47 of the valve 45, but renders it possible to cut off steam at any desired point of the revolution without detriment to the balancing of the valve 45.

It will be seen in Fig. 3 that the ports 31 31 of the reversing-valve 30 are exactly coincident with the ports 27 27 of the valve-head 18, so that steam passing through the ports 31 31 will pass along the passage 28 to the supply-pipe port 20 into the engine-cylinder, thus forming a continuous passage from the valve-cylinder 1 to the engine-cylinder.

As the direction of the rotary piston is determined by the application of steam on one or the other side of the abutment, when it is desired to reverse the engine it is only necessary to so far oscillate or revolve the reversing-valve 30 as to cause the ports 31 31 to pass out of range with the ports 27 27 of valve-cylinder head 18, by which means the projections around the ports 31 31 on the face 32 of the valve 30 will be brought in contact with the finished surface of the face 29 of head 18, out of range with the ports 27 27. Hence no steam can pass through the ports 31 31, which are transformed into cavities or chambers, which, being filled with steam, very nearly balance the steam-pressure on the face 47 of the valve 45, so that, while it continues to revolve, it is relieved of friction or wear. By thus partly revolving the reversing-valve 30 the recessed section on the face 32 is brought over the ports 27 27 of the head 18, causing a continuous passage from the engine-cylinder through the pipe 20, passage 28, ports 27 27, recessed sections on the face 32 of the valve 30, into the exhaust-pipe 19, furnishing a means of continual exhaust. While these changes are effected in the valve on one side of the abutment of the engine, by which an inlet-port is transformed into an exhaust-port, the same movement changes an exhaust-port into an inlet-port on the opposite side of the abutment.

If it is desired to run the engine in either direction, the valves on each side of the abutment are provided with suitable devices, and suitable devices employed by which both valves may be operated at the same time and by the same movement. Hence the valves will alternately become supply or exhaust valves, and the engine can be run in either direction without interfering with the working of the automatic cut-off, if such is needed in both sides.

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

1. The combination, with a rotary cut-off valve, of a rotary valve, seated upon the cut-off valve, the adjacent faces of the two valves being constructed to form intervening steam-spaces for balancing the rotary valve, substantially as shown and described, and for the purposes herein set forth.

2. The combination, with a rotary valve provided with a steam-space between its lower face and seat, of a rotary governor-valve seated on the rotary valve, the adjacent faces of the two valves being constructed to provide an intervening steam-space, substantially as shown and described, and for the purposes herein set forth.

3. The combination, with a rotary valve, of a rotary governor-valve seated on the rotary valve, the adjacent faces of the two valves being recessed or grooved to provide an intervening steam-space, and suitable devices for automatically actuating the governor-valve, substantially as shown and described, and for the purposes herein set forth.

4. The combination, with a steam-balanced rotary valve, of a steam-balanced cut-off valve serving as a seat for the rotary valve, and a steam-balanced governor valve seated on the upper face of the rotary valve, substantially as shown and described, and for the purposes herein set forth.

5. The combination, with the head of the valve-cylinder, having ports formed therein communicating with a steam pipe or passage leading to the engine-cylinder, of a cut-off valve seated on the inner face of the valve-cylinder head, such cut-off valve being constructed with outwardly-projecting flanges or ribs which encircle the cut-off valve and the ports formed therein, substantially as shown and described, and for the purposes herein set forth.

6. The valve-cylinder head constructed with a steam-passage cast on the outer portion of the head, the ends of the steam-passage extending through the head and forming steam-ports on opposite sides thereof, substantially as shown and described, and for the purposes herein set forth.

7. The cut-off valve constructed with steam recesses or cavities on opposite sides of its ports, and of substantially the same size and form as said ports, substantially as shown and described, and for the purposes herein set forth.

8. The combination, with the rotary valve provided with through-ports, of the cut-off valve constructed with ports and with steam cavities or recesses on opposite sides of said ports, the construction being substantially as described, whereby the rotary valve is balanced and steam cut off at any point of its rotation, substantially as shown and described, and for the purposes herein set forth.

9. The combination, with the rotary valve provided with radial grooves or steam-passages and an annular steam-chamber connecting said grooves or passages, of a governor-valve provided with radial recesses or grooves closed at opposite ends, substantially as shown and described, and for the purposes herein set forth.

10. The combination, with the rotary valve provided with a number of holes for the passage of steam through the valve, and an annular groove on the opposite side with which said holes connect, of the rotary governor-valve having a groove or recessed portion formed therein that registers with said annular groove, substantially as shown and described, and for the purposes herein set forth.

11. The combination, with the governor-valve, of a worm-gear connected thereto by pins, and a worm engaging said gear, substantially as shown and described, and for the purposes herein set forth.

12. The combination, with the governor-valve provided with a hub, of a worm-gear mounted on said hub and attached to the governor-valve by pins, and a worm for actuating the valve, substantially as shown and described, and for the purposes herein set forth.

13. The combination, with the governor-valve provided with a hub, of a step secured to the head of the valve cylinder and provided with a recess for receiving the hub of the valve, substantially as shown and described, and for the purposes herein set forth.

14. The combination, with the rotary valve having radial bearing-surfaces on the back of the valve surrounding the ports therein, of a governor-valve provided with radial grooves of less width than the width of the bearing-surfaces at the ends of the steam-ports in the rotary valve, substantially as shown and described, and for the purposes herein set forth.

15. A rotary valve constructed with outwardly-projecting flanges around its central opening and around its ports and on each end of the ports, to form steam cavities or recesses on opposite sides of the ports and a steam-chamber in the central portion of the valve, substantially as shown and described, and for the purposes herein set forth.

16. The combination, with a rotary valve having a recess formed in its periphery, of a link and yoke secured within said recess by a screw, and a rod secured to the yoke, substantially as shown and described, and for the purposes herein set forth.

17. The combination, with the rotary valve and revolving shaft connected therewith by spline and feather, of the cut-off valve and arbor or pivot extending through the cut-off valve and entering the end of said shaft, substantially as shown and described, and for the purposes herein set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

LEANDER J. WING.

Witnesses:

CHARLES P. WEBSTER,

JOHN J. BYRNE.