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L. A. COOPER.

ROTARY CUT-OFF VALVE.

(Application filed Oct. 27, 1899.)

(No Model.)

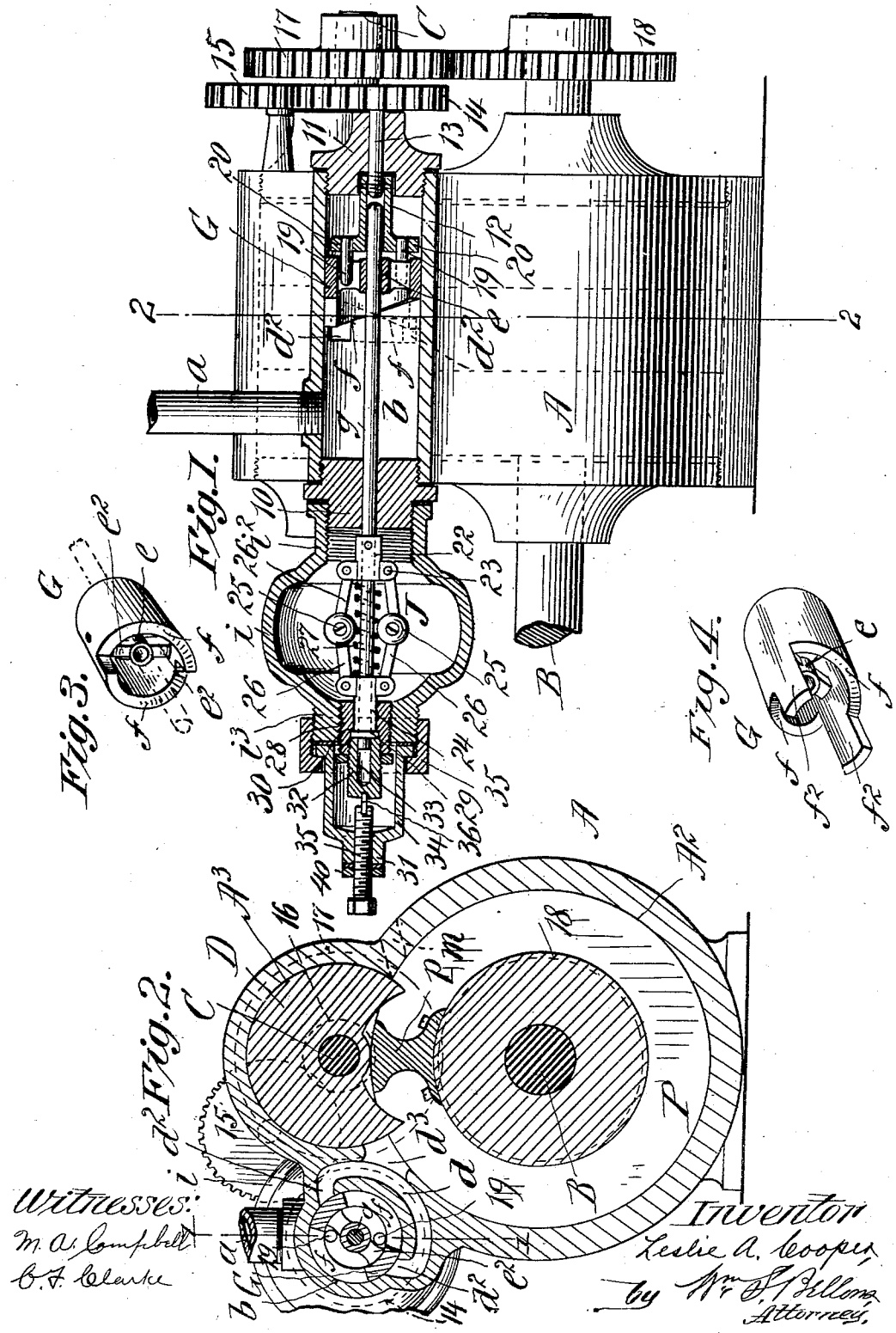


Fig. 1.

Fig. 3.

Fig. 4.

Fig. 2.

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ROTARY CUT-OFF VALVE.

SPECIFICATION forming part of Letters Patent No. 655,608, dated August 7, 1900.

Application filed October 27, 1899. Serial No. 734,903. (No model.)

To all whom it may concern:

Be it known that I, LESLIE A. COOPER, a citizen of the United States of America, and a resident of Springfield, in the county of Hampden and State of Massachusetts, have invented certain new and useful Improvements in Rotary Cut-Off Valves and Governing Mechanism Therefor, of which the following is a full, clear, and exact description.

This invention relates to an improved governing-valve for engines, the same having been designed more especially for rotary steam-engines of the concentric-piston and rotary-abutment type.

The invention more particularly relates to valve and automatic governing appliances in combination therewith to serve under normal running conditions of the engine to vary at each rotation of the valve the area of the steam-inlet-port opening, so that at each cycle or working stroke or impulse of the engine there will be the greater freedom of steam-admission into the steam chamber or cylinder at the initial portion of the working cycle or stroke, the steam-ingress lessening toward the end of the cycle or period in which the entering steam is active to drive the piston in its working direction, and, furthermore, so that when a centrifugal force is developed in the governing appliance by an excessive running of the engine the rotary valve will have its position varied to lessen the normal maximum of uncovered inlet-port opening or in extreme cases to entirely close the same.

An important object of the invention is to include in the governor and valve mechanism means whereby the position of the valve in relation to the steam-inlet port or ports may be regulated to give, as desired, a greater or lessened maximum initial uncovered port area, as circumstances may render desirable, and another object is to so adapt the means for adjusting the governor-controlled valve that the valve may be most easily and quickly adjusted while the engine is running.

Another object of the invention is to provide valve appliances constructed with relation to double ports both continued in a common uniting steam-passage which opens into the steam-chamber of the engine, so that the valve is at all times subject to an equilibrium of steam-pressures, and thus it will have a perfectly-balanced rotary motion without liability of being pressed harder against one side of the casing within which it rotates than against another. In the accomplishment of this object the wearing of the valve will be reduced to a minimum, and whatever slight wear does result from protracted use of the engine will be uniform at all parts of the periphery of the valve and the internal wall of the cylindrical chamber in which it is rotationally fitted; and another object of the invention is to so construct the novel mechanism that it will be so simple and practical and efficient as to be of unusual desirability for utilization on engines of various types.

The invention consists in the combinations and arrangements of parts and devices and the construction of certain of the parts, all substantially as hereinafter described, and set forth in the claims.

The valve and governing mechanism in its preferred form is illustrated in the accompanying drawings, in which—

Figure 1 is in part a side elevation of a rotary-piston steam-engine and in part a sectional longitudinal view through the portion of the casing in which is comprised the valve and governing mechanism and adjusting devices therefor. Fig. 2 is a vertical cross-section on line 2 2, Fig. 1. The section-line 1 1 on Fig. 2 indicates the plane on which the section Fig. 2 is taken. Fig. 3 is a perspective view of the valve. Fig. 4 is a perspective view of the valve constructed in a somewhat-modified form.

In the drawings, *a* represents the steam-inlet passage, which opens into the top or side portion of the cylindrical chamber *b*, which is formed in a part of the engine-casing or hollow body A, which comprises the two partially-cylindrical spaces A^2 and A^3, in which the rotary piston *p* on the piston-shaft B and the rotary abutment D on the abutment-shaft C are provided. Within the wall constituting the boundary of the chamber *b* is the passage *d*, the terminals of which constitute the ports $d^2 d^2$, opening at opposite or suitably-separated points into the said chamber *b*, while leading

from said chamber is the opening or passage d^3, which constitutes the inlet-port for the steam-chamber P within the engine-casing.

G represents the controlling-valve, the same consisting of an annular body of a size externally to fit and to move longitudinally along the inner wall of the said cylindrical chamber *b*. This valve has a rotary and also endwise motion imparted thereto by means hereinafter described. The end portion of the valve is constructed with the two half-helixes *f f*, arranged as shown in Fig. 3, and the valve is adjusted adjacent the ports d^2 d^2, somewhat as shown in Fig. 1. The steam entering the chamber *b* will pass out through the ports d^2 d^2 with a greater or less freedom, according to the rotational position of the said valve G—that is to say, when this valve has such a position in its turning that the less prominent portions of the half-helixes at the end are, next to the ports d^2 d^2, a greater portion of the port area, if not the whole thereof, will be uncovered by the valve and open for the admission of steam thereinto than when the valve has been so much farther turned as to bring the endwise prominent portions of the half-helixes opposite the ports, and of course it will be apparent that the valve may be so moved endwise as to give a greater or less normal maximum of open-port area, or when the valve is excessively bodily moved to the leftward, as viewed in Fig. 1, the ports may be covered and closed by the portion of the valve not penetrated by the end helixes during the entire rotation of the valve.

The principal object of providing two ports d^2, arranged in separation and correspondingly providing the end edge of the valve with two half-helixes (instead of providing one port and one helix at the end of the valve which might extend entirely around the latter) is to insure opposite outlets of the steam, so that there will be an avoidance of pressure which would preponderate at one side of the valve to crowd it against the wall of its casing, and thereby result in a very hard running and extensive wearing of the valve and the adjacent wall of the casing.

The rotary motion is imparted to the valve by means which do not interfere with its endwise automatic motions as imparted thereto by the centrifugal governor G.

The valve has the internal spider-supporting hub *e*, by which it is secured to the valve rod or stem *g*, which extends longitudinally within the chamber *b*, one end of the said stem playing through the axially-bored end head 10 for said chamber *b*, while the other end of the stem enters the sleeve or hollow hub 12, provided with the extension-shaft 13, which passes through the other end head 11 of the said casing *b*. The said shaft 13 has thereon the gear 14, which, through the intermediate gear 15, is in mesh with the pinion 16 on the rotary abutment-shaft C, which rotary abutment-shaft is, through its gear 17, driven by the gear 18 and caused to have its motion in unison with the gear 18. The pinion or small gear-wheel 16 being half the diameter of the gear-wheel 14 on the shaft 13 causes the shaft 13 to rotate once to two rotations of the rotary abutment-shaft and of the piston-shaft, and the connection between the shaft 13 and the valve is insured by the two longitudinally-extending studs or dowels 19 19, which project from the flange or extension 20 of the said part 12 and which engage the spider-arm e^2. The rotary motions of the shaft 13 and hub 12 impart corresponding rotary motions to the valve and its stem, the one end of the latter being journaled within the hub 12, and yet it is plain that the valve can have independent endwise motions.

The valve-stem has at its end portion which is projected outwardly beyond the casing-head 10 the fixed collar 22, having the ears 23 and suitably therebeyond the sleeve 24, through which the extremity of the valve-stem is passed and relatively to which it is unsecured.

25 25 are the governor balls or weights having the toggle-like arms or links 26 26, whereby they are connected to the ear-pieces of both the collar 22 and the sleeve 24. Between the sleeve and the collar is the spiral spring 27.

The centrifugal governor J is inclosed within the globular or other suitably-formed casing *i*, having hollow hub-like opposite extensions i^2 and i^3, the one, i^2, being internally threaded and screw engaging the threaded extremity at the outer end of the closing plug or head 10 for the aforesaid chamber *b*. The opposite hub-like end of the globular casing is internally screw-threaded, receiving therein the externally-screw-threaded sleeve 28, in which the sleeve 24 of the governor is rotatably fitted, but constrained against endwise motion.

The sleeve 24 has the flange 29, which rests on the seat 30 at the base or inner end of the threaded opening, formed axially within the outer end of the plug, in which screws the externally-threaded sleeve or thimble 32, having the central aperture 33 to permit the end play of the valve-stem *g*.

34 represents the supplemental shell or casing held by the coupling 35 at the end of the hubbed portion i^3 of the governor-inclosing case *i*, and through the end hub 31 of the said casing-section 34 is screw-engaged the threaded shaft or screw 35, which is constructed with a polygonal or any suitable form of head, whereby to easily turn it.

The inner kerfed end of the screw 35 receives therein the flat block or blade 36, which also similarly engages in the kerfed end of the sleeve 32, so that when the said screw 35 is turned it, threading through the part 31, will cause an endwise motion of the screw-united parts 28 and 32, which constitute an adjustable journal for the rotatable sleeve 24 of the centrifugal governor.

Steam admitted through the pipe *a* into the chamber *b* will pass out of the ports d^2 d^2 to

the connecting-passage d in common thereto and through the inlet-port b^2 of the cylinder or pressure chamber P' and drive the piston-wing around. The valve rotating once to every two cycles of the piston-wing will in every half-rotation thereof, (it being assumed that the valve is properly adjusted relatively to the piston-wing,) immediately the most longitudinally-extended portion of the inclines f have passed the ports d^2 d^2, insure the most unrestricted passage of the steam into the engine-chamber P at the instant the piston-wing passes the inlet-port d^3, and as the piston-wing revolves in the continuation of the circular stroke thereof the steam-ingress into the engine-chamber will be lessened, and such ingress will be the least or will be momentarily discontinued while the piston-wing is passing from the exhaust-port (indicated at m) around past the inlet-port d^3. This insures that while the wing is passing from the exhaust around to a position past the inlet-port, there will be an avoidance of a reversing pressure against the piston, and, furthermore, there will be a lessened liability or a prevention of the steam entering the engine-chamber P being dissipated, without action on the piston, by passing through the exhaust-port in the time of the passage of the wing from said latter port around to the steam-inlet port, and the valve opening to the maximum and then gradually lessening the area of the openings of the said ports d^2 d^2 also establishes the conditions for the most efficient as well as economical action of the steam for expansive use in the engine-chamber against the wing.

Although in Fig. 2 the valve is shown as with its left-hand extremity to the right of the left-hand end of the ports d^2, it is to be understood that the rotary motions of the running parts developing a centrifugal action of the governor will cause, under normal running conditions of the engine, the valve to have a position somewhat farther endwise to the leftward than that indicated, so that there may be an absolute cut off of the steam at the proper stage in each cycle of the piston-wing.

Excessive speeding of the engine will so automatically regulate the position of the valve as to derive the cutting off of the steam from entrance into the engine-chamber or the restriction of its entrance thereinto in such manner as to reëstablish the normal running conditions.

It will be manifest that the position of the valve may be adjusted longitudinally independently of the automatic regulating movements thereof as imparted thereto by the governor. This may be done by loosening the lock-nut 40 and turning the screw 35, which insures also the corresponding turning of the screw-united parts 28 and 32, rotatably connected with which and constrained for endwise movement therewith is the sleeve 24 of the governor; the endwise motion of the governor-sleeve will, through the governor-arms or links, correspondingly endwise move the other governor-sleeve 22, which is pinned to the valve-stem, and will thereby similarly move the valve. The valve G being constructed with an opening leading through it from end to end insures that it will always remain in an equilibrium of the steam-pressure within the valve-chamber b, and thus the valve is relieved of having any end thrust imparted thereto by the steam, whereby the delicacy of its controlling action, as explained, will be affected, and the valve constructed as shown is relieved of the liability of having steam-pressure brought against it in any direction, whereby it would be crowded to create friction against any part of the wall of the chambers in which it is located.

The valve shown in Figs. 1 and 3 is constructed in the preferred form when employed in an engine of the general class indicated, but of a compound or double-expansion type, for under ordinary running conditions it is not considered essential or preferable to absolutely cut off the steam at the latter part of the stroke, for the reason that the incoming steam entering the primary chamber at the interval in which the piston-wing is passing from the exhaust-port around by the inlet-port if permitted to freely pass out of the exhaust-port for the primary chamber will only have the effect to augment the pressure in the secondary steam-chamber of the engine, and this valve of the preferred form shown in Fig. 3 is therefore especially applicable in the compound rotary engine which forms the subject-matter of an application for patent filed by me simultaneously herewith under Serial No. 734,902; but where the engine of the rotary-abutment and concentric-piston class comprise but a single steam-pressure or steam-expansion chamber and in order to assure the positive cut-off in the interval during which the piston-wing is passing from the exhaust-port m around past the inlet-port d^3 I prefer to provide the valve with a longitudinal projection f^2, corresponding to each port d^2, leading into the valve-chamber, which projection has a width sufficient to close the inlet-port adjacent to which it has its location in the stated interval intervening between the exhausting and the next intake of steam.

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

1. The combination with a cylindrical chamber having a steam-inlet and a port leading therefrom, of a valve rotatably fitted in said chamber and endwise adjustable therein, having a cylindrical periphery and constructed at its end which is adjacent the said port with portions which at different places around the valve have different degrees of longitudinal extension, non-automatic means

which is accessible for operation at the exterior of the apparatus for longitudinally adjusting, and means for rotating the said valve.

2. The combination with a cylindrical chamber having a steam-inlet, and a port leading therefrom, of a valve rotatably fitted in said chamber and endwise movable therein, having a cylindrical periphery and constructed at its end which is adjacent the said port with portions which at different places around the valve have different degrees of longitudinal extension, non-automatic means for longitudinally adjusting said valve, for giving it any given normal relation to said port which non-automatic means is accessible for manual operation at the exterior of the apparatus, an automatic governing device operating to change the position longitudinally of said valve, and means for rotating the said valve and the governing device which coöperates therewith.

3. The combination with a cylindrical chamber having a steam-inlet, and a port leading therefrom, of an externally-cylindrical valve rotatably fitted and endwise movable in said chamber, non-automatic means for longitudinally adjusting said valve for giving it any desired normal relation to said port, an automatic centrifugal governing device operative to change the position longitudinally of said valve, and means for rotating said valve and said governing device.

4. The combination with the valve-chamber b having an inlet-opening, and having a port as d^2, of the valve rotatably mounted in said chamber and having its end formed with portions which at different points around it have varied degrees of endwise extension and provided with an axial stem fitted to move endwise, a centrifugal governor arranged about and also connected with said stem, means for endwise adjusting and restraining in its adjustment said valve-stem, and means for rotating said valve and its stem and the therewith-connected governor.

5. The combination with the valve-chamber b having an inlet-opening and a port d^2 leading outwardly therefrom, of the valve having its end constructed inclined and operating adjacent said port d^2 and comprising a valve-stem with which coöperates a centriful governor, a rotatable part, having a rotating engagement with the valve, and relative to which the valve may independently longitudinally move, and means for rotating said rotatable part, substantially as described.

6. The combination with the valve-chamber b having an inlet-opening and port d^2, of the valve having its end formed inclined and operating adjacent said port, and comprising a valve-stem with which coöperates a cylindrical governor, the rotatable shaft 13 with which is united the sleeve-section 12 having radially-located endwise-extending projections 19 engaging to rotate and endwise movable relatively to the valve, and means for rotating the said shaft 13, substantially as described.

7. The combination with the chamber b having the inlet-port and one or more outlet-ports, and having closing appliances in its opposite ends, of the valve G having the stem g projecting to play endwise through the one end-closing wall of said chamber, the inclosing device i and the governor therein having a connection with the valve-stem and having the sleeve 24 provided with the shoulder 35, the screw-united parts 28 and 32 in which the governor-sleeve has a shoulder engagement whereby it may rotate independently of, but move in unison with said screw-united parts, devices for imparting a longitudinal adjusting motion to said screw-united parts, and means for rotating the valve.

Signed by me at Springfield, Massachusetts, this 23d day of October, 1899.

LESLIE A. COOPER.

Witnesses:
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