(No Model.)

G. M. HULL.

ROTARY ENGINE.

No. 516,538. Patented Mar. 13, 1894.

Fig. 5.

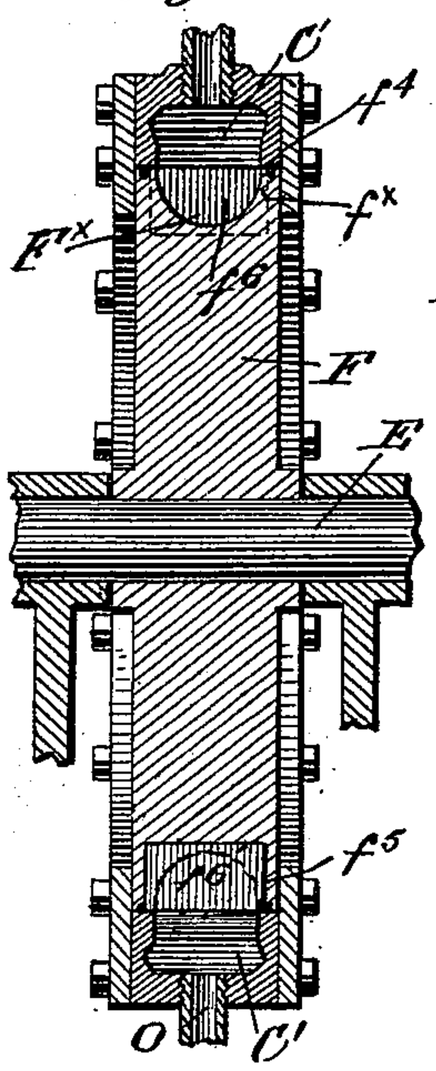


Fig. 1.

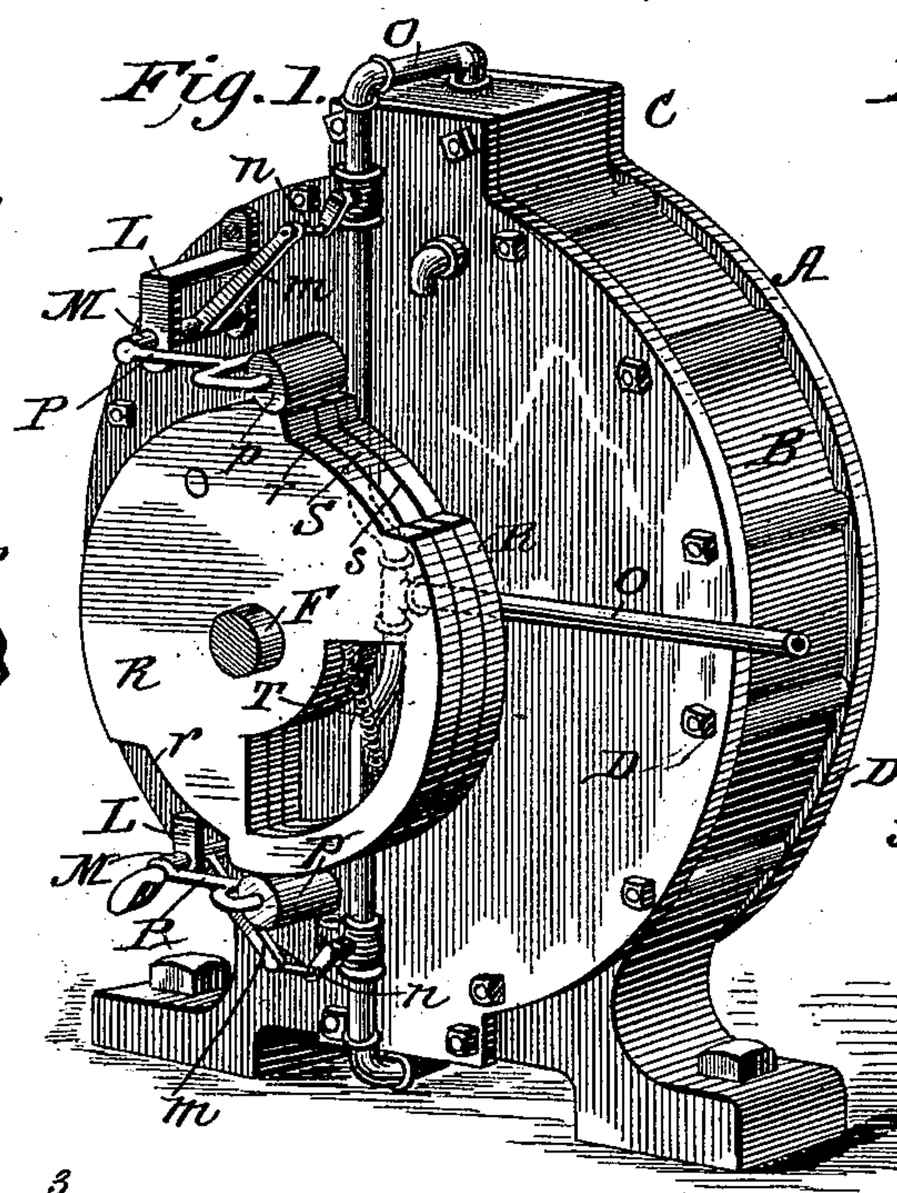


Fig. 3.

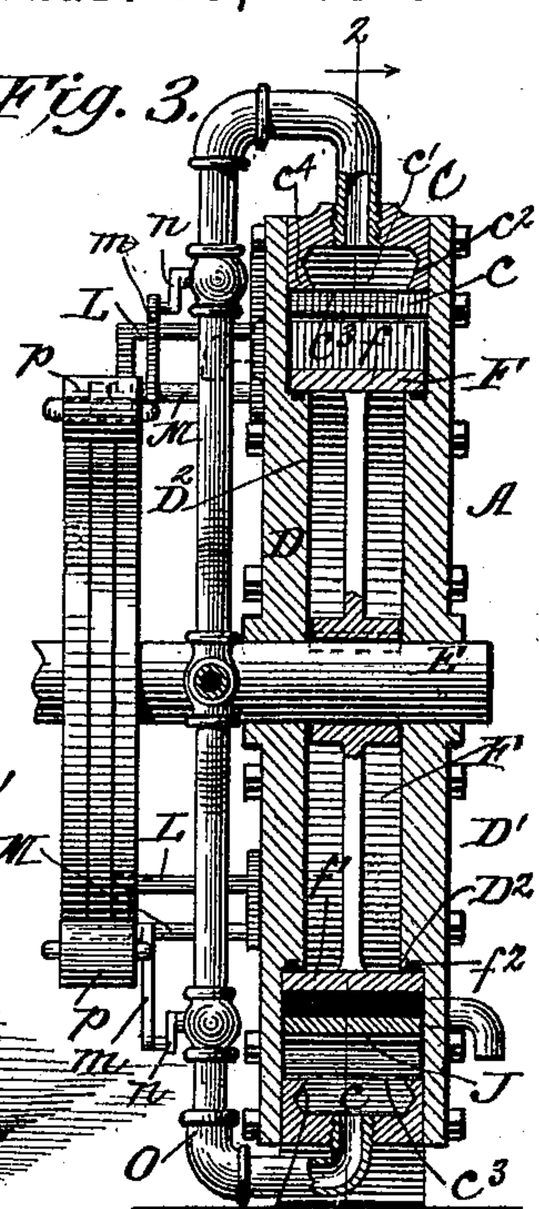


Fig. 2.

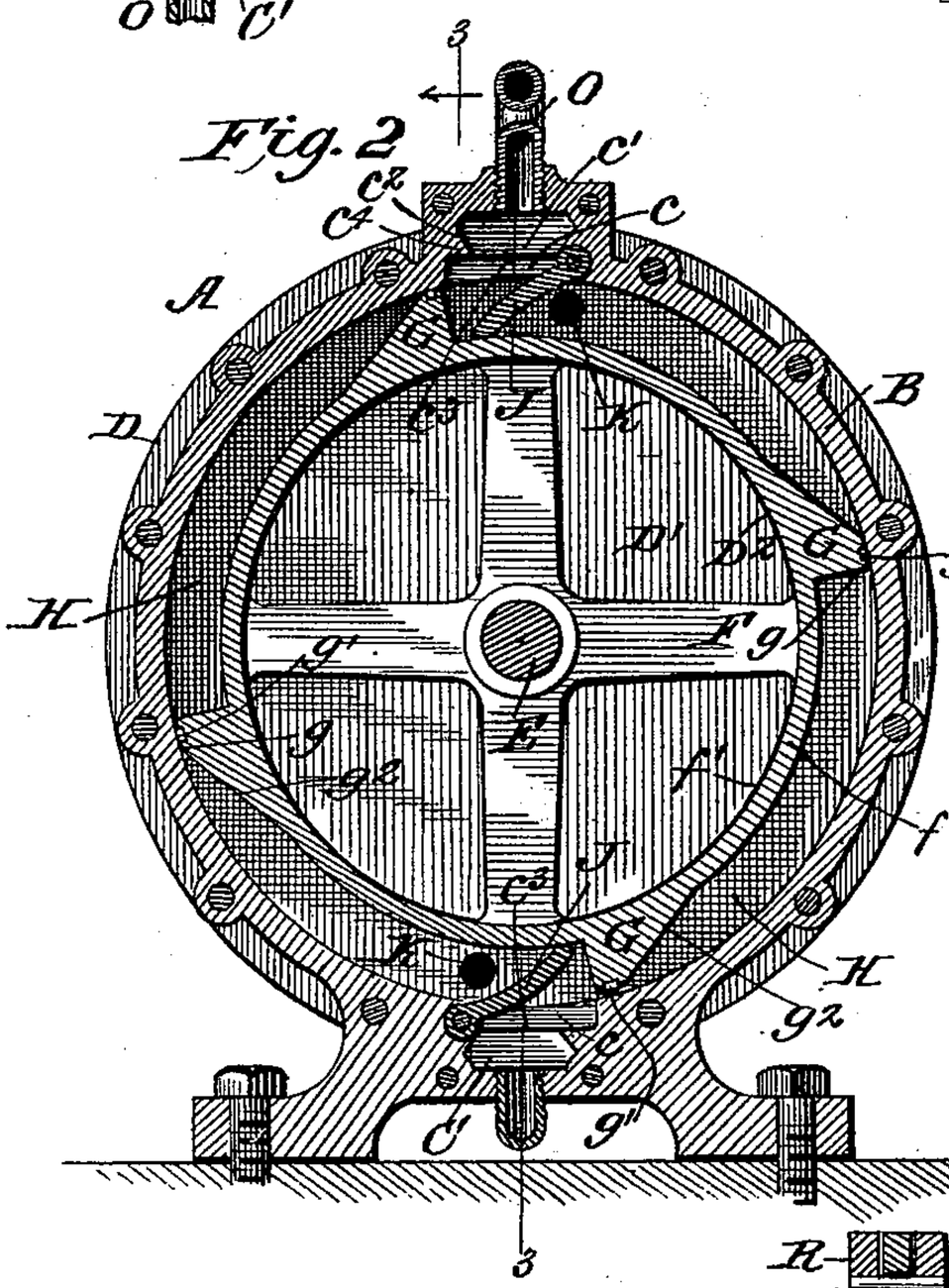


Fig. 4.

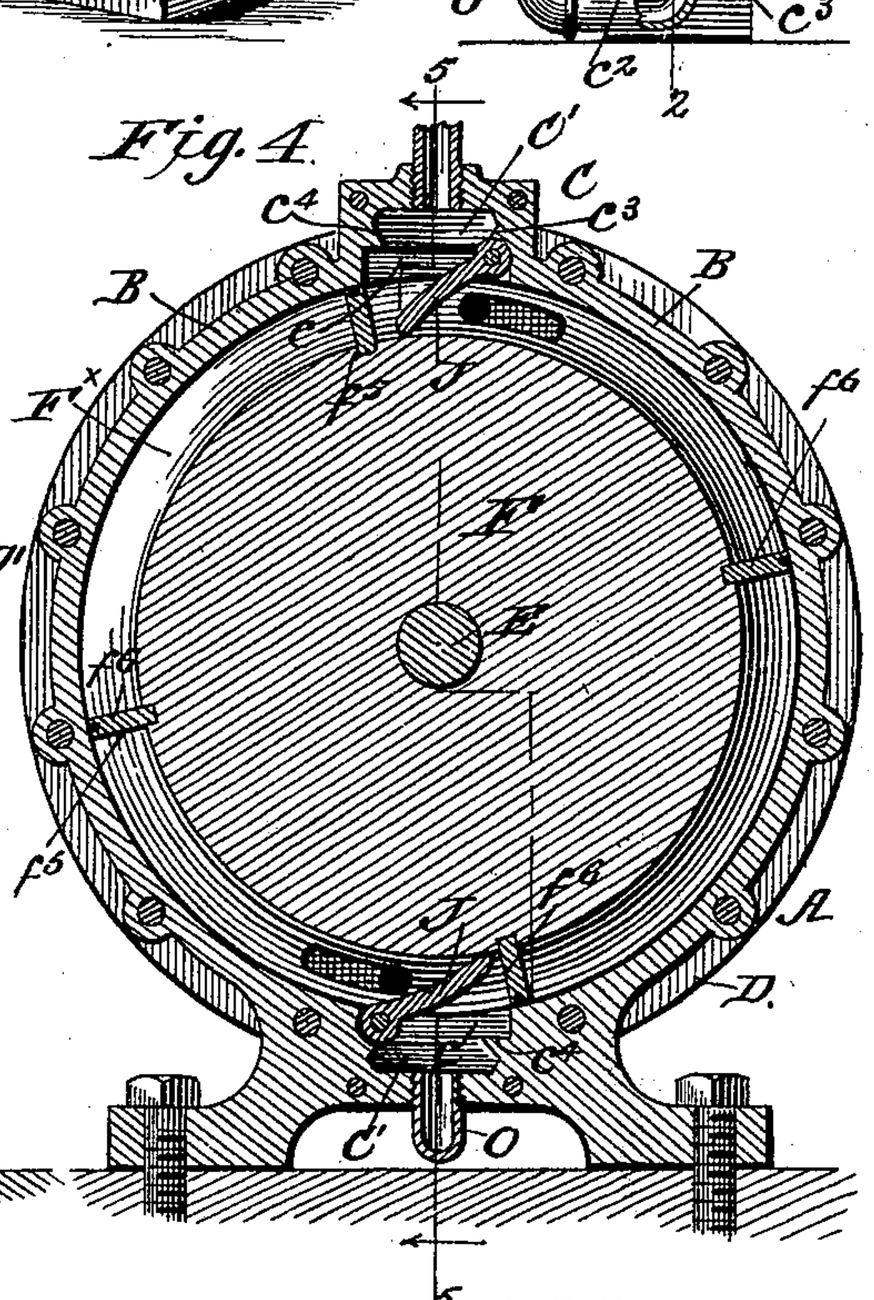
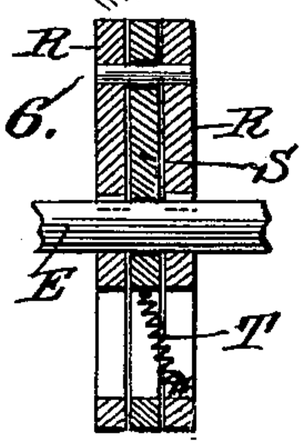


Fig. 6.



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GEORGE M. HULL, OF KEARNEY, NEBRASKA, ASSIGNOR OF ONE-HALF TO CHARLES M. HULL, OF SAME PLACE.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 516,538, dated March 13, 1894.

Application filed May 16, 1893. Serial No. 474,387. (No model.)

To all whom it may concern:

Be it known that I, GEORGE M. HULL, residing at Kearney, in the county of Buffalo and State of Nebraska, have made certain new and useful Improvements in Rotary Engines, of which the following is a specification.

My invention has for its object to provide a rotary engine of simple and inexpensive construction, in which the rotary motion is maintained at a uniform speed at all times and which will effectually and positively operate for its intended purpose.

It has also for its object to provide a rotary engine in which the cut off devices which are combined with and operated by the rotary piston shaft, are so constructed and arranged to serve as automatic governor means whereby to regulate and adjust such cut off devices relatively to the speed of the rotation of such shaft.

With other minor objects in view which hereinafter will be referred to my invention consists in such details and combinations of parts as will be first described and then particularly set out in the claims, reference being had to the accompanying drawings in which—

Figure 1, is a perspective view of my improved rotary engine. Fig. 2, is a vertical longitudinal section of the same on the line 2—2 Fig. 3. Fig. 3, is a transverse section of the same on line 3—3 Fig. 2. Fig. 4, is a vertical longitudinal section of a modified construction of piston. Fig. 5, is a transverse section of the same on the line 5—5 Fig. 4 and Fig. 6, is a detail view of the combined cut-off and governor devices hereinafter referred to.

Referring to the accompanying drawings A, indicates the shell or casing of my improved engine, which in the construction shown in Figs. 1, 2 and 3 comprises the annular ring like portion B, having one or more radial extensions C which form the steam inlet chambers, the special construction of which will be hereinafter referred to, and the front and back end disks D D′ centrally apertured to fit over the drive shaft E, and provided with circular projections or flanged portions D^2 D^2.

In the construction shown in the figures above referred to, the rotary piston F, is in the nature of a spoke like wheel held to rotate with the shaft E its annular rim *f* being arranged to fit snugly between the end disks D—D′ with its under face *f*, resting on the flanged portions D^2 as clearly shown in Fig. 3 packing rings f^2 being arranged between such rim and flanges to form steam tight joints.

By referring now more particularly to Fig. 2 it will be noticed that the rim *f* of the piston F has a number of radial abutments G, in practice arranged in pairs, and at diametrically opposite points, but one pair being used when the engine is a single acting one, two pair being, however, preferably employed as shown. These abutments have their bearing faces *g* formed with transverse packing strips *g′*, and their rear faces inclined or tapered down to the rim as at g^2. These abutments G serve to transversely divide the annular steam chamber H formed between the cylinder body B and the rim *f*.

In each of the extensions C is formed the steam receiving or inlet chamber C′, which consists of a transverse seat portion *c* and a reduced portion *c′* above such seat portion *c*, the side walls of which taper inward as at c^2 to lead the steam centrally through the way c^3. In the seat portion *c* is pivotally held, at one end a flap valve abutment J which when raised up by the passing piston abutment, fits in the seat portion *c* the shoulders c^4 holding it from being thrown too far upward, it being normally held down by gravity and steam pressure against the periphery of the piston run *f*.

K indicates the exhaust ports which are arranged just in advance of the valve abutments J as shown.

So far as described it will be readily understood that by providing a double pair of piston abutments, one abutment of each pair will be drawn forward by live steam while the other set will be forced forward under steam expansion.

To provide means for imparting to the rotary piston a uniform speed of great power, with a minimum amount of steam, I connect to the drive shaft an automatic governor device which also serves to directly operate cut-offs. To this end I mount in brackets L L on the

front face of the engine casing rock shafts M, from which project crank arms *m m* connected with the arms *n n* of the cut-off valves in the supply pipe O. (See Fig. 1.) From these rock shafts project a second set of crank arms P in the outer ends of which are journaled trolley rollers *p* which are held to traverse the periphery of cam disks R and S mounted on the shaft C to turn therewith. These disks have their peripheral edges formed with cam portions *r* and *s*, which portions in practice, when two sets of piston abutments are used, extend approximately one sixth their circumference. Thus it will be observed that by such construction the cut-offs will be automatically operated to open up the live steam ports to force the piston abutments one third their thrust movement *i. e.* (the movement between the two steam inlets) by live steam under full head, while the remaining portion of thrust movement will be carried forward by expansion, it being manifest, however, that when but one steam inlet port is provided a single cam recess in the disks R and S is used extending one third the circumference thereof.

While I prefer to arrange the cam disks so the pistons will travel one third their thrust movement under live steam it is obvious the cams may be adjusted to drive the piston a greater or less distance forward under live steam.

To maintain a uniform speed of such engine, the central disk S is mounted loosely upon the shaft E for a limited rearward or lag movement thereon while the two others R are fixedly secured thereto, as shown in Fig. 6, and such loose disk has a movable connection with the said fixed disks preferably by means of a tension spring T, the tension of which, it should be stated, must be of a degree sufficient to hold the loose disk up to a coincident position with the fixed disks, to make it rotate in unison therewith up to a certain or predetermined speed of the shaft E. By arranging the loose disks in the manner stated, it will be manifest that so soon as the shaft rotates at a speed above the predetermined point, the inertia of the shaft will overcome the tension of such spring T, and thereby cause the loose disk to lag back and fail to rotate in unison with the fixed disks, and as it thus lags behind its cam portions *s* will move over the corresponding recess *r* in disks R and proportionately reduce the length of the cam or cut-off portion, and in consequence cut off the extent or length of live steam stroke, of piston, and as the live steam stroke is thus reduced it is obvious the speed of the piston will be correspondingly reduced allowing the spring T to again draw the disk S back to its normal position to bring the steam feed back to its normal condition.

From the above it will be noticed, that by a simple construction of parts I am enabled to utilize the full power of live steam, and yet provide means for cutting off such supply automatically proportionately to the speed.

In Figs. 4 and 5 I have shown a somewhat modified arrangement of the piston, in this case the piston is made in the nature of a solid sheave, the grooved periphery $F^{\times}$ terminating at the straight peripheral side edges $f^{\times}$ which alone form the bearing faces on the casing member B, packing rings being interposed between such member and casing edges f^4 as shown. At proper distances this sheave like piston has radial grooves f^5 in which are dropped and fitted radial blades f^6, the outer edges of which are flush with the edges $f^{\times}$, such blades forming the piston abutments.

From the foregoing description taken in connection with the drawings the complete operation of my improved engine will be readily understood. By combining with the piston the peculiarly arranged cut-off and governor devices and constructing the inlet chambers in the manner stated, an easy operation of the pivotal valves is effected in that no steam pressure is on same when the piston abutments lift same, but so soon as such abutments pass from under, and the cut-off is adjusted to supply, the steam, as it enters the chamber, will be concentrated, owing to the flared sides, directly against the central part of the back of such valves which then become the fixed abutments during the application of live steam.

It is obvious that in the practical construction the cut off valves may be so adjusted that when turned to their cut-off position a small jet of live steam will be fed into the chamber C′ to cushion the pivotal valves and prevent hammering when they are thrown up to their seats.

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

1. A rotary engine comprising an annular steam chamber, a drive shaft and rotary piston movable in such chamber, said piston having diametrically opposite abutments, steam inlets opening into such chamber at diametrically opposite points, said drive shaft projected beyond the steam chamber casing, a fixed disk on such projected shaft portion having diametrically opposite peripheral recesses, a second disk loosely mounted on such shaft, having peripheral recesses, means for holding such loose disk with its recesses coincident with the recesses in the fixed disk, valved supply pipes connected to the steam inlets, and rocker arms connected to the valve stems and arranged to engage the peripheral edges of the loose and fixed disks, all arranged substantially as shown and for the purposes described.

2. A rotary engine comprising an annular steam chamber, a drive shaft having a rotary piston provided with radial abutments, a steam chamber opening into the annular chamber having a contracted discharge

mouth, a flap valve abutment pivoted over such mouth, the feed pipes. and cut off devices operated by the shaft, all arranged substantially as and for the purposes described.

3. In a rotary engine the combination of the annular casing B, having one or more radial enlargements or chambers formed with contracted or flared sides, and a seat portion c', valves J pivoted in such seats, the disks D, D′, having annular internal flanges D^2, the shaft E, the piston F, having an annular rim f' fitting over the flanges D^2, said rim having radial abutments arranged in pairs and at diametrically opposite points, exhausts in the annular steam spaces arranged in advance of the valves J, the inlet pipes O, and cut-off mechanism operated by the drive shaft arranged substantially as shown and for the purposes set forth.

GEORGE M. HULL.

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