No. 775,984. PATENTED NOV. 29, 1904.

F. J. MULLIGAN.

ROTARY STEAM ENGINE.

APPLICATION FILED MAY 7, 1904.

NO MODEL. 2 SHEETS—SHEET 1.

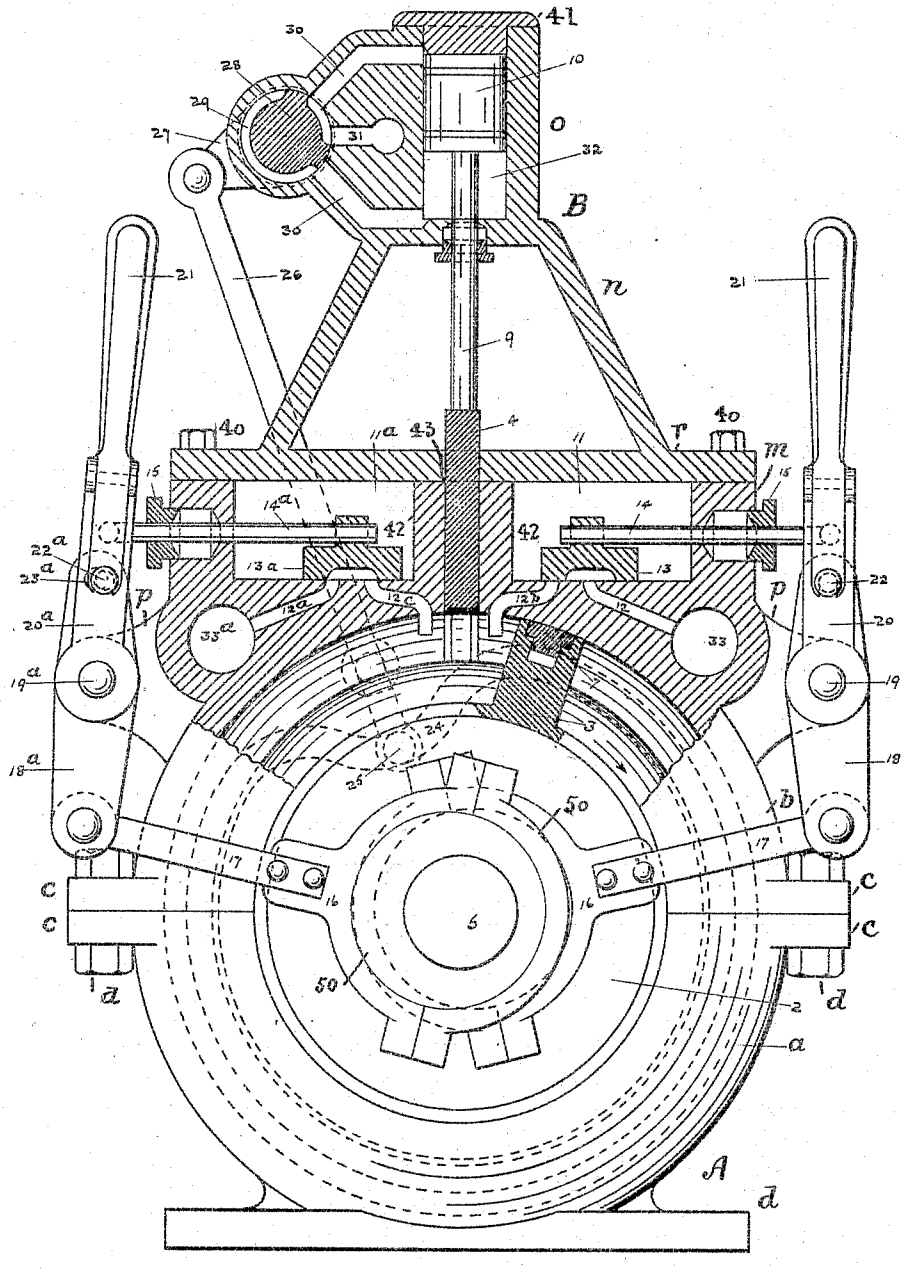

Fig. 1.

WITNESSES:

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Frank C. Lockwood.

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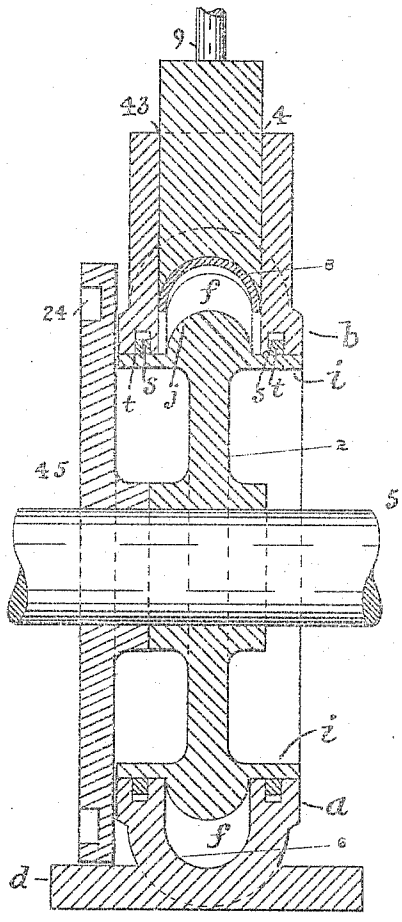

Fig. 2.

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No. 775,984. Patented November 29, 1904.

UNITED STATES PATENT OFFICE.

FREDERICK J. MULLIGAN, OF UTICA, NEW YORK.

ROTARY STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 775,984, dated November 29, 1904.

Application filed May 7, 1904. Serial No. 206,837. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK J. MULLIGAN, residing at Utica, in the county of Oneida and State of New York, have invented certain Improvements in Rotary Steam-Engines, of which the following is a specification.

The present invention relates to rotary steam-engines and to such improvements therein as to provide an engine of this type which corresponds mainly in its mode of operation and in the regulation of live and exhaust steam to the reciprocating engine.

The rotary engines as heretofore constructed, so far as I am aware, have not been able to utilize the expansive forces of the steam, as it is necessary to permit the steam to follow full strokes. The invention about to be described obviates this difficulty, for every advantage due to the regular D slide-valve is obtainable by my construction, as the variations of lap, lead, point of cut-off, ratio of expansion, exhaust opening and valve travel are all possible by my invention and readily accomplished.

In the drawings which illustrate the invention, Figure 1 is an end view of a rotary engine embodying the invention, portions of the parts being broken away to more readily show the construction, such broken parts being shown by hatched surfaces; and Fig. 2 is a vertical section of the lower portion of the engine.

Referring to the drawings, A represents the body of the rotary engine, consisting of two semi-annular sections *a* and *b*, provided with lugs *c c*, through which extend the bolts *d d* to hold them to each other. Each section has a chamber *f* semicircular in cross-section extending completely around the same, and upon the top of the upper section *b* is a rectangular steam-chest *m*, divided into two chambers 11 and 11ª by the central partitions 42, between which is a slot 43, extending into the chamber *f*. Each steam-chamber is provided with steam-passages 12ᵇ and 12ᶜ to the channel *f* and with exhaust-steam passages 12 and 12ª to the respective outlets 33 and 33ª and with D slide-valves 13 and 13ª, having stems 14 and 14ª extending through the usual stuffing-boxes and pivoted to levers 18, which are hinged to the lugs *p* on the sides of the steam-chest *m*.

B is a casting upon the steam-chest, consisting of a base-plate *r*, which serves as the cover for the steam-chest, to which it is secured by the bolts 40. From the plate *r* there rises a hollow column *n*, which terminates in an auxiliary steam chest and cylinder *o*. The latter is closed by an end cap 41, preferably screwed into the same, but may be secured in any suitable manner. There are steam-passages 30 and 30ª from the cylinder to the rotating valve 28 and also an exhaust-passage 31. The valve 28 has its surface cut away to allow the steam to enter and leave the steam-passages, as is usual, and an arm 27, connected with the valve, is pivoted to a rod 26, whose opposite end is provided with a roller 25, which rests in and is adapted to play in a cam-groove 24, as will be explained farther on.

A shaft 5 extends through the center of the engine and is supported in suitable bearings, (which are not, however, shown,) and 2 is a wheel or disk secured to the shaft, provided with a rim *i*, which fits snugly into the sides of the annulus-sections *a* and *b*, and in the center of the rim *i* is a circular projection *j*, which extends into the channel *f*. Grooves *s s* are cut in each side of the annulus-sections, in which are located spring packing-rings *t t* to insure that the channel *f* be steam-tight. A projection 3, of the same shape in cross-section as the channel *f*, extends from the wheel 2 and is preferably integral with it and constitutes a piston, and 7 is any suitable movable packing inserted in its hollowed face to bear upon the contour of the channel *f*. Two eccentrics 50 are secured to the shaft 5 on one side of the engine, to which eccentric-straps 16 are fitted, and provided with rods 17, which are pivoted to the lower ends of the levers 18.

Pivoted on studs 19 and separate from the levers 18 are hand-levers 20, provided with spring latching devices 21, by the use of which the levers 20 can be rigidly connected with the levers 18 and made to partake of their motion or can be disconnected therefrom to allow the levers 20 to remain quiescent, regardless of the movements of the levers 18. The latching device consists of the retractile pin 22, operated by the lever 21 to engage or dis-

engage with the hole 23 by the operation of lever 21, all in a manner well understood.

Fixed to the shaft 5 is a cam-disk 45, (shown in Fig. 2,) having in one side a groove 24, the development of which is such as to impart, through the medium of the cam-roller 25, an intermittent reciprocating movement to the valve-rod 26, which in turn through the medium of the crank 27 intermittently partially rotates the valve 28 and introduces and cuts off steam to and from the steam-passages. But one eccentric is in use at a time, depending upon the direction the wheel 2 is rotating. If in the direction of the arrow, the valve 13^a is by the disconnection of the latching device pushed forward into the position shown, where it remains at rest and opens the exhaust communication to the opening 33^a via the passages 12^a and 12^c. Should it be desired to rotate the engine in the opposite direction, the valve 13^a is connected to its eccentric and the valve 13 detached from its eccentric.

The operation of the invention is as follows: The direction of rotation is indicated by the arrow, Fig. 1. As it makes no difference in what part of the cycle of operation the description commences, let it be understood that steam has been admitted to cylinder 32 and forced the piston 10 to its upper end. The piston-rod 10 passes through its stuffing-box and continues as rod *g*, which is joined to a sliding abutment or valve 4, which passes through the lid of the steam-chest and through the passage between the partitions 42. The end of the valve 4 is hollowed out and conforms to the shape of the projecting surface of the wheel 2, and said surface has a lining 8, which serves as a steam-tight packing when the valve rests upon said surface. The piston is forced upward, carrying with it the valve 8 just as the piston 3 reaches it, and thus permits the piston to pass on and continue its rotation. As the wheel 2 continues to rotate the operation of the cam 45 changes the position of the valve 28 and admits steam above the piston 10 and forces it downward, and with it the valve 4, into contact with the periphery of the wheel 2. At the same time the valve 13 is opened by means of its eccentrics and connections and steam admitted between the valve 4 and the piston 3, and the latter is forced around its circular path. When the piston has nearly completed its revolution, valve 28 is again operated by the cam 24 and its position reversed, and the valve 4 retracted to permit the passage of the piston 3. The exhaust-steam is thus taken care of in a manner well understood to those familiar with the D-slide valve and will be apparent from the drawings. In the positions shown the valve 13^a is immovable and permits the exhaust-steam to escape, the valve 4 is about to close, and the D-valve 13 will open to allow steam to enter, as described, between the valve 4 and the piston 3. Some latitude has been taken with the drawings in placing the moving parts so that they will be readily seen and understood without confusion.

It will be understood that by this arrangement a rotary steam-engine is produced in which advantage is taken of the means used in reciprocating engines to use live steam expansively and with all the economy that is obtained in the latter engines and that means are provided for permitting the shaft to be rotated in either direction, as is frequently desirable, and to this end one steam-chamber is utilized to introduce and cut off the live steam, while the other chamber is employed in taking care of the exhaust-steam.

I claim as my invention—

1. A rotary engine comprising a steam-chamber, a rotating piston working therein, slide-valves controlling the steam inlet and exhaust, and means for normally holding one or the other of said valves normally at rest.

2. A rotary engine comprising a steam-chamber, a rotating piston working therein, slide-valves controlling the steam supply and exhaust, means operated by said piston for reciprocating said valves, and means for throwing either of said valves normally out of operation.

3. A rotary engine comprising a steam-chamber, a rotating piston working therein, a steam-chest divided into compartments each provided with steam supply and exhaust channels leading therefrom, slide-valves controlling said channels, and means for holding one or the other of said valves normally at rest.

4. A rotary engine comprising a steam-chamber, a rotating piston working therein, a steam-chest divided into compartments each provided with steam supply and exhaust channels leading therefrom, slide-valves controlling said channels, means operated by said piston for operating said valves, and means for throwing either of said valves normally out of operation.

5. A rotary engine comprising a steam-chamber, a rotating piston working therein, slide-valves controlling the steam supply and exhaust, pivoted levers connected to said valves, means operated by said piston for rocking said levers, and means for normally holding either of said levers from movement.

6. A rotary engine comprising a steam-chamber, a rotating piston working therein, slide-valves controlling the steam supply and exhaust, pivotally-mounted levers connected to said slide-valves, means operated by said piston for rocking said levers, and hand-levers connected to said former levers and provided with means for holding either of said valves from movement.

7. A rotary engine comprising a steam-chamber, a rotating piston working therein, slide-valves controlling the steam supply and exhaust, pivoted levers connected to said valves, means operated by said piston for rock-

ing said levers, hand-levers pivotally mounted adjacent said valve-levers, and latches carried by said hand-levers and adapted to engage said valve-levers.

8. A rotary engine comprising a steam-chamber, a rotating piston working therein, a steam-chest divided into compartments each provided with steam supply and exhaust channels leading therefrom, valves controlling said channels, and an abutment-valve working in the division-wall of said steam-chest.

9. A rotary engine comprising a steam-chamber, a rotating piston working therein, a steam-chest provided with a central division-wall dividing the same into compartments, each compartment being provided with steam supply and exhaust channels leading therefrom, the terminals of said supply-channels being adjacent said division-wall, valves controlling said channels, and an abutment-valve working in said division-wall and between the terminals of said supply-channels.

10. A rotary engine comprising a steam-chamber, a rotating piston working therein, a steam-chest divided into compartments each provided with steam supply and exhaust channels leading therefrom, valves controlling said channels, an abutment-valve working in the division-wall of said steam-chest, and means operated by said piston for controlling the operation of said abutment-valve.

11. The combination, in a steam-engine, of a steam-chamber, a revolving disk with a piston running in contact with the inner walls of the chamber, and a steam-tight reciprocating abutment provided with a steam-piston working in an auxiliary steam-cylinder, a rotating valve and cam-disk, and valve-rod connected with the rotating valve and the cam combined, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 7th day of April, 1904.

FREDERICK J. MULLIGAN.

Witnesses:
JOSEPH R. HORIGAN,
THEODORE L. CROSS.