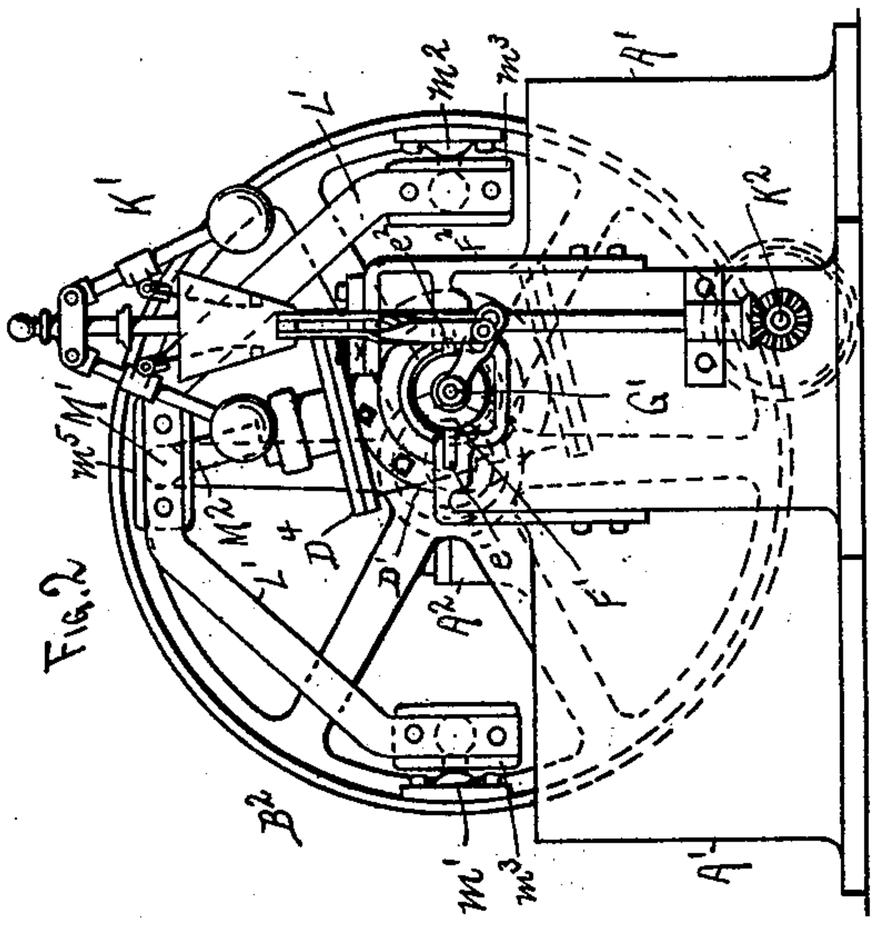
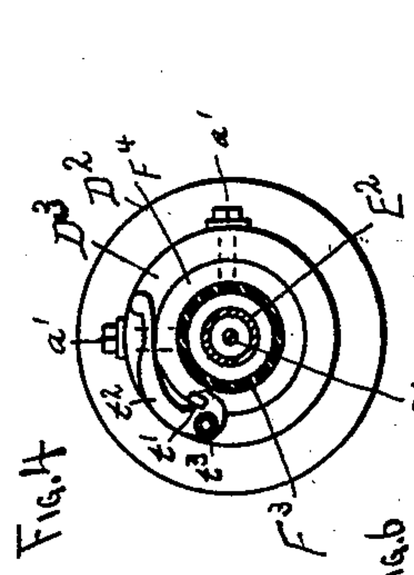
(No Model.) 3 Sheets—Sheet 1.

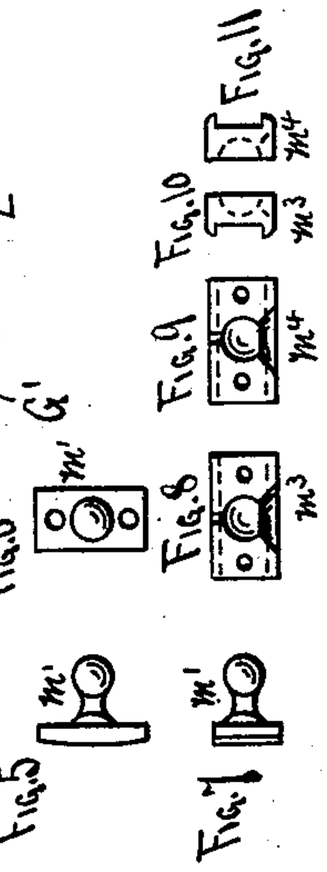
F. W. REEVES.

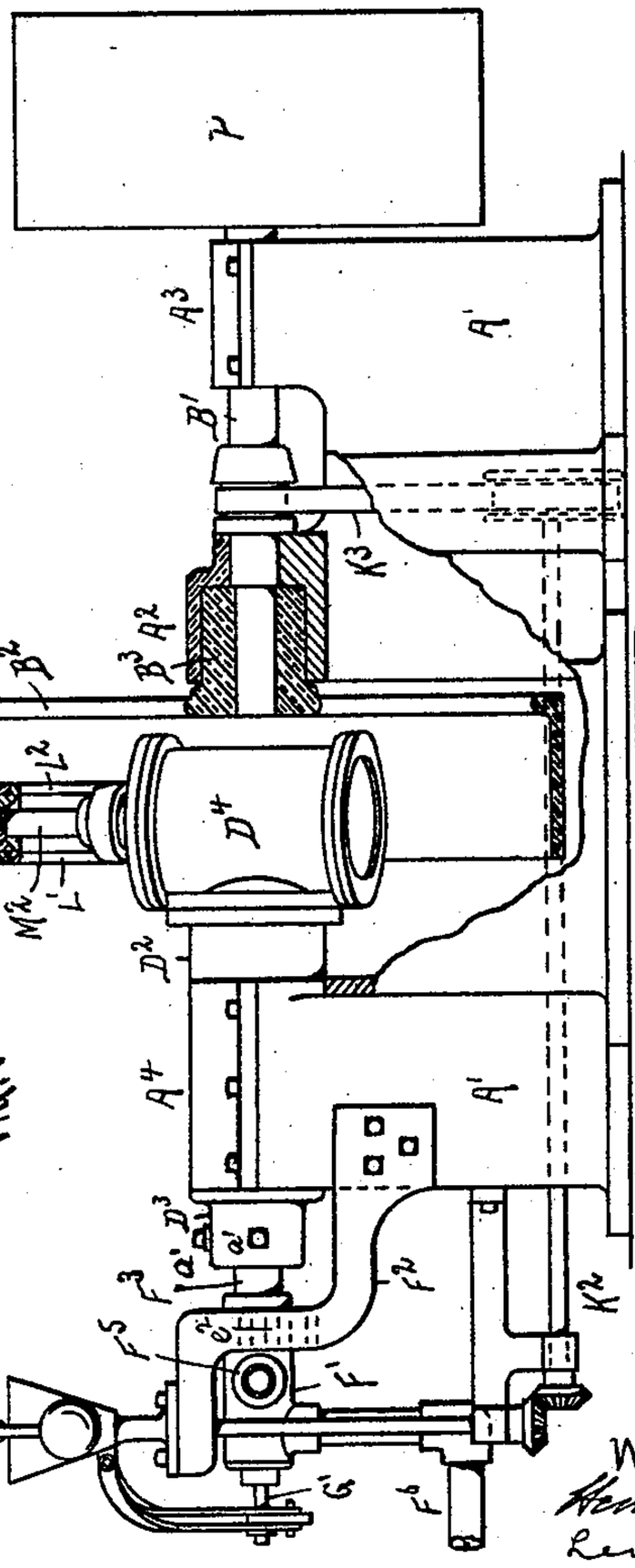
RECIPROCATING ROTARY STEAM ENGINE.

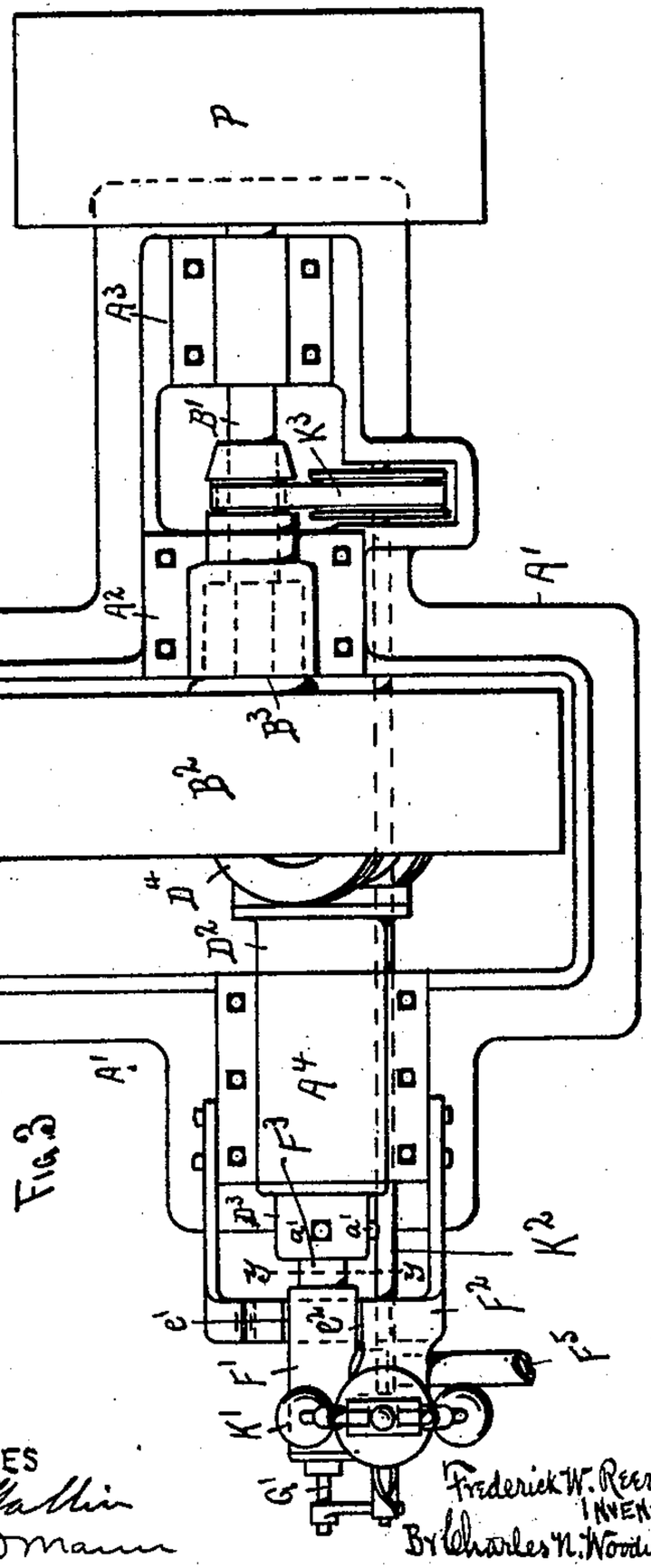
No. 587,402. Patented Aug. 3, 1897.











WITNESSES
Herrick Wallin
Lewis D. Mann

Frederick W. Reeves
INVENTOR,
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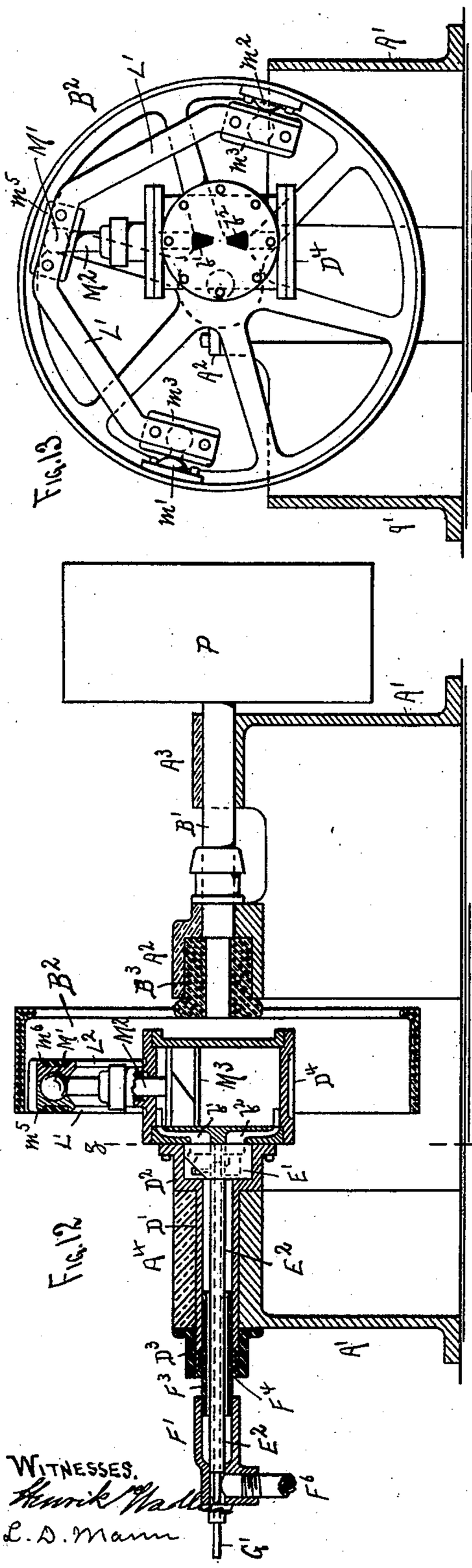
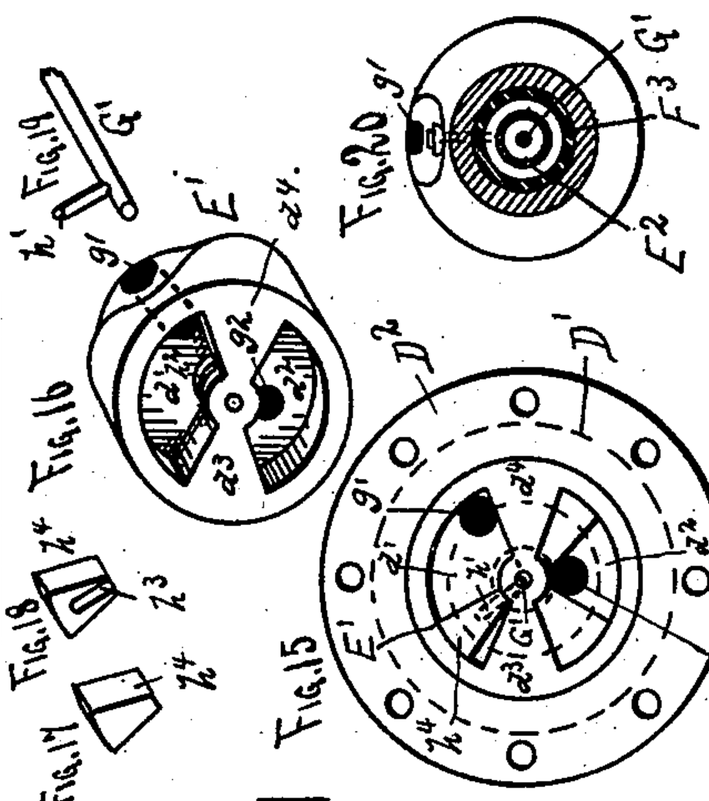
(No Model.) 3 Sheets—Sheet 2.

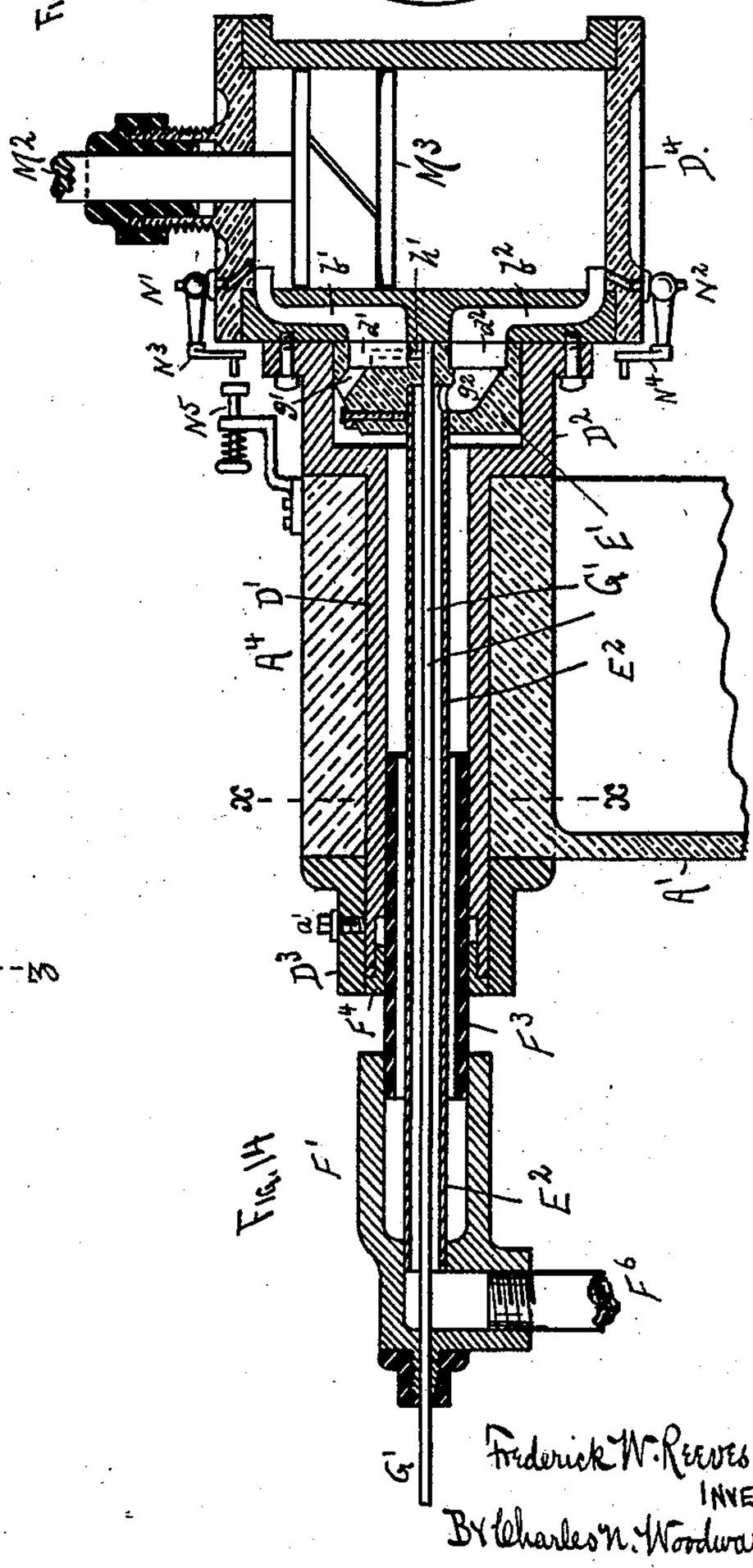
F. W. REEVES.

RECIPROCATING ROTARY STEAM ENGINE.

No. 587,402. Patented Aug. 3, 1897.







WITNESSES.
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(No Model.) 3 Sheets—Sheet 3.

F. W. REEVES.

RECIPROCATING ROTARY STEAM ENGINE.

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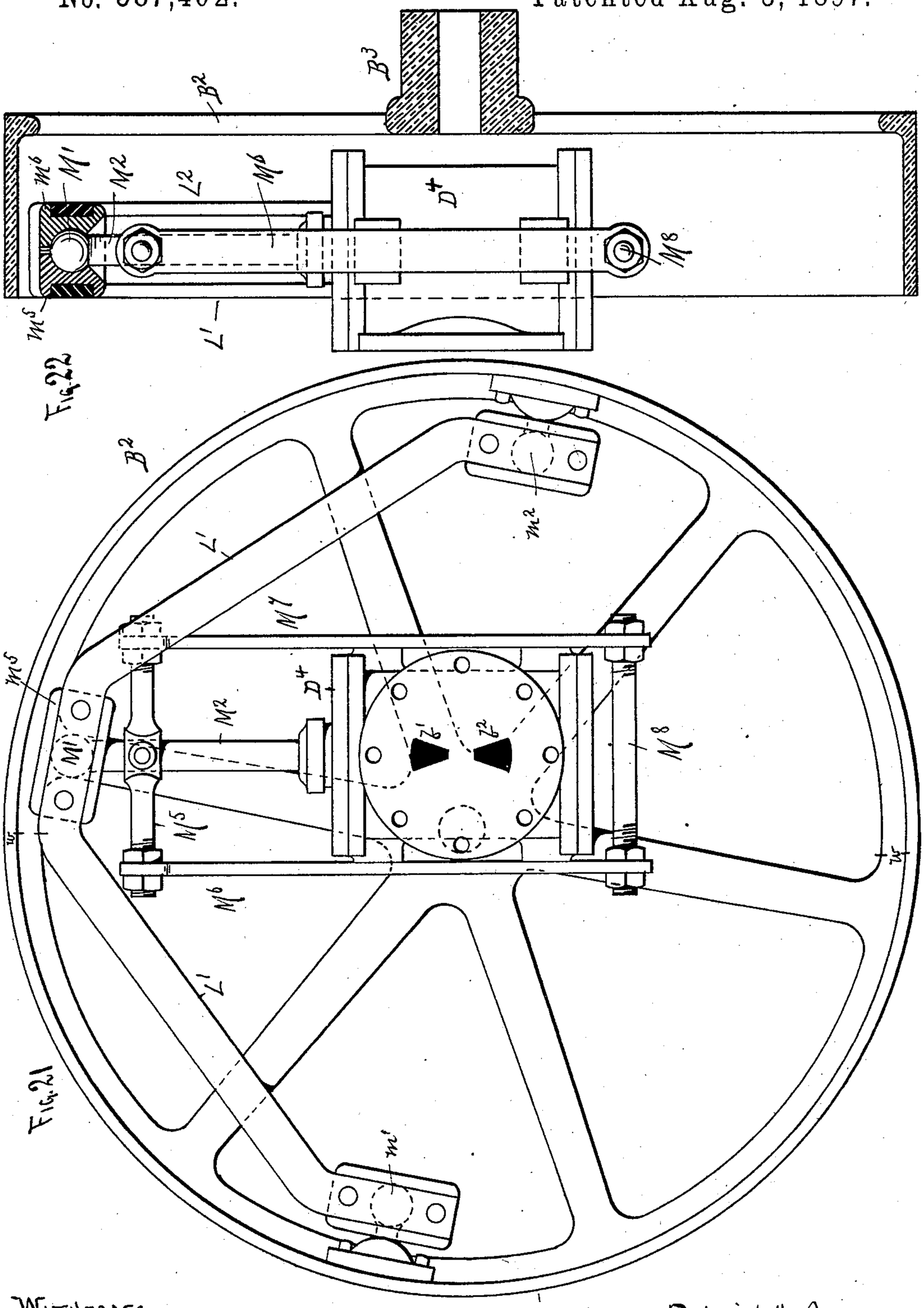

WITNESSES.
Henrik Wallin
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Frederick W. Reeves,
INVENTOR.
By Charles N. Woodward Attn

UNITED STATES PATENT OFFICE.

FREDERICK W. REEVES, OF ST. PAUL, MINNESOTA.

RECIPROCATING ROTARY STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 587,402, dated August 3, 1897.

Application filed June 5, 1896. Serial No. 594,424. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK W. REEVES, a citizen of the United States, residing at the city of St. Paul, in the county of Ramsey and State of Minnesota, have made certain new and useful Improvements in Reciprocating Rotary Steam-Engines, of which the following is a specification.

This invention relates to reciprocating rotary steam-engines; and it consists in the construction, combination, and arrangement of parts, as hereinafter shown and described, and specifically pointed out in the claims.

In the drawings, Figure 1 is a semisectional side elevation. Fig. 2 is an end elevation, and Fig. 3 is a plan view, of the engine complete. Fig. 4 is an enlarged view of the binding-collar of the steam-chamber in cross-section on the line *y y* of Fig. 3. Figs. 5, 6, and 7 are views of one of the spherical studs by which connection is made between the driving-wheel and the cylinder. Figs. 8, 9, 10, and 11 are views of one set of the clamps by which the arms are connected to the spherical studs on the inner rim of the drive-wheel. Fig. 12 is a longitudinal sectional side elevation of the engine. Fig. 13 is a cross-sectional view on the line *z z* of Fig. 12 with the steam-chamber and valve removed. Fig. 14 is an enlarged longitudinal section of the steam-cylinder and the steam-chamber and valve and its connection. Fig. 15 is an end view of the steam-chamber with the valve in place therein. Fig. 16 is a perspective view of the valve removed. Figs. 17 and 18 are perspective views of the governor-valve removed from the front and rear. Fig. 19 is a perspective view of a portion of the governor-valve-operating rod. Fig. 20 is a cross-section of the steam-chamber and its connections on the line *x x* of Fig. 14. Fig. 21 is a front elevation similar to Fig. 13, illustrating a modification in the construction. Fig. 22 is a cross-section on the line *w w* of Fig. 21.

A′ is the base, which will preferably be cast in one piece, with the bearings A^2 A^3 for the main shaft B′ and with a bearing A^4 for the steam-chamber, the center line of the steam-chamber being offset from the center line of the shaft B′ for a distance equal to one-half the stroke of the engine, the object to be hereinafter explained.

The steam-chamber is circular, as at D′, and arranged to be revolved in the bearing A^4 and held from end movement by an enlarged portion D^2 on one end and by a collar D^3 on the other end, the collar being firmly held in place upon the chamber by set-screws *a′*, as shown. Upon the outer end of the enlarged portion D^2 the cylinder D^4 is secured, as shown, with steam-ports *b′* b^2 leading from the ends of the cylinder toward the center of the steam-chamber and formed, as shown in Figs. 13 and 21, radiating from the center.

E′ is the valve, which is in the form of a cylinder fitting the interior of the portion D^2 of the steam-chamber and also fitting steam-tight against the side of the cylinder. Within the face of the valve two cavities *d′* d^2 are formed and separated by division-walls d^3 d^4, the division-walls exceeding slightly the width of the entrances to the ports *b′* b^2, so that as the cylinder is revolved the division-walls cut off the steam at two points, as hereinafter shown.

Firmly secured by one end in the valve E′ is a tube E^2, leading out through the interior of the steam-cylinder and secured by its other end in a hollow head F′, the latter supported by a bracket F^2, attached to the frame A′ and held from turning by wings *e′* e^2, fitting in ways made for them in the bracket F^2, as shown in Figs. 2 and 3.

F^3 is a section of tubing secured by one end in the hollow casing F′ and projecting for a suitable distance into the steam-chamber and made steam-tight by a gland F^4. The tube F^3 thus forms a "bridge" or conduit to convey the steam from the head F′ to the steam-chamber.

The tubes E^2 and F^3 being secured in the head F′ and the head F′ being slidable in the bracket F^2 and the tube F^3 being likewise slidable in the chamber D′ the valve E′ is free to be held by the steam-pressure in the steam-chamber against its face upon the cylinder. There is also a certain degree of back pressure against the head F′, which serves to counteract the pressure upon the valve to an extent sufficient to perfectly "balance" the valve. This is a very important feature of my invention and insures the easy operation of the valve without allowing any leakage of steam. The steam-inlet port *g′* is formed

through the valve into the cavity d', while the steam-exhaust port g^2 is formed to lead from the cavity d^2 into the tube E^2, as shown in Fig. 14.

The steam-feed pipe F^5 enters the head F' between the adjacent ends of the tubes E^2 and F^3 and is free to pass thence around the tube E^2 to the port g', at the same time exerting its pressure upon the rear of the valve to hold it to its seat, while the steam-exhaust pipe F^6 leads from the head F' outside the outer end of the tube F^3, as shown.

G' is a rod passing through the outer end of the head F' and throughout the length of the tube F^3 and seated by its inner end in the center of the valve E', as shown. This rod G' has a stud h' projecting at right angles therefrom outward through a slot h^2 in the center of the valve and is adapted to fit into a slot h^3 in a segment h^4, the latter fitting into the cavity d', as shown in Fig. 15. The segment h^4 completely fills the cavity d' in cross-section, so that when the rod G' is oscillated the segment will be moved nearer to or farther away from the steam-port g', and thereby increase or decrease the area of the cavity d'. The cavity d', as will be understood, is the steam-admission chamber, while the cavity d^2 is the steam-exhaust chamber. If, therefore, a governor be so connected to the rod G' that its action will oscillate the rod to the right or left, according as the speed is increased or decreased, the segment h^4 will be correspondingly moved to increase or decrease the steam area and thus regulate the amount of steam admitted at each stroke. In the drawings I have shown such a governor K', connected to the rod G' and adapted to be actuated from a counter-shaft K^2, which is driven by a belt K^3 from the main shaft B', as shown.

Upon the inner end of the main shaft B' is secured the drive-wheel B^2, with enlarged hub B^3, fitting into the bearing A^2, to secure additional support to the wheel, and with the drive-pulley P, by which the power is to be transmitted, upon the outer end of the shaft, as shown. Attached to the interior of the rim of the wheel B^2, at two opposite points, are studs m' m^2, the studs being spherical in form and adapted to be enclasped by clamp-plates m^3 m^4, the clamp-plates having internal cavities corresponding to the spherical studs m' m^2, so that when the two halves of the clamps are secured in place they will have free play in all directions upon the studs.

Attached by their ends to the sides of the clamp-plates m^3 m^4 are two bars L' L^2, bent, as shown, to cause their central points to come near the rim of the wheel and provided at their central points with two clamp-plates m^5 m^6, similar to the clamp-plates m^3 m^4 and having semispherical cavities adapted to fit over the spherical head M' on the outer end of the piston-rod M^2.

By the manner shown of connecting the yoke-frames L' L^2 to the cylinder D^4 and to the drive-wheel B^2 with the ball-and-socket joints any slight irregularity of adjustment or lack of perfect alinement is compensated for and is not transmitted to the other working parts. By this simple arrangement of the cylinder and drive-wheel when steam is admitted to the cylinder its action upon the piston M^3 causes the piston-rod M^2 to exert a leverage force upon the drive-wheel B^2 through the yoke-bars L' L^2 equal in length to one-half the stroke of the engine or to the offset of the shaft B'.

The gland F^4 is formed with a small stud t', behind which a stop-lever t^2, pivoted at t^3 upon the end of the collar D^3, is adapted to rest after the gland is screwed "home" to prevent the gland from being unscrewed and released by the revolution of the collar D^3.

N' N^2 are the cylinder-cocks, each provided with a depending arm N^3 N^4 from their plugs, and N^5 is a spring-bolt adapted to be pushed into the paths of the depending arms to cause the cocks to be closed without stopping the engine.

When first starting the engine, the cylinder-cocks are opened, and after the engine has run long enough to discharge the accumulated water of condensation and to be sufficiently heated to prevent further condensation the bolt N^5 is pushed inward until the depending arms N^3 N^4 strike it and the plugs thereby turned and the cocks closed without stopping the engine. By this arrangement also with the governor-valve within the steam-valve the steam is admitted to the cylinder at full boiler-pressure, which is not the case where the governor-valve is at or near the throttle, as the steam after being checked by the governor-valve loses some of its force before reaching the cylinder.

With my arrangement the steam is under full boiler-pressure when it enters the steam-chamber and exerts that pressure upon the valve to keep it upon its seat and enters the cylinder, as before stated, under full boiler-pressure, thereby using it to its full capacity and increasing the percentage of economy.

In Figs. 21 and 22 I have shown a slight modification in the construction, consisting in attaching across the piston-rod M^2, just beneath the end M', a cross-bar M^5, and coupling the outer ends of this bar to side rods M^6 M^7, passing down alongside of and adapted to run in contact with the sides of the cylinder and connected at their lower ends by a cross-bar M^8. This construction serves to support the piston-rod and renders it possible to employ a lighter piston-rod than when the side bars are not used.

Having thus described my invention, what I claim as new is—

1. In a reciprocating rotary steam-engine, a steam-cylinder attached to and adapted to be revolved with a steam-chamber, and having steam-ports leading from said steam-chamber to the interior of the cylinder and with a piston-head and piston-rod connected

to transmit motion to a drum and shaft, a hollow head into which the live steam is fed and from which the exhaust-steam leads, a tube connected into said hollow head and fitting steam-tight into the rear of said steam-chamber, a valve within said steam-chamber and adapted to alternately admit and exhaust the steam to and from said cylinder, a hollow stem connected into said valve by one end and into said hollow head by the other end, and means whereby said hollow head is held from turning and left free to move toward and away from said steam-chamber, whereby the steam-pressure is utilized to hold the valve against its seat and also to balance the valve by the back pressure within the hollow head, substantially as and for the purpose set forth.

2. In a reciprocating rotary steam-engine, a steam-cylinder attached to a steam-chamber and revoluble therewith and provided with piston-head and piston-rod, and with steam-ports opening into said steam-chamber and segmentally arranged with relation to the center of said chamber, a valve fitting said chamber and held from turning therein, and with recesses in its face communicating with said ports, with the steam-inlet entering one of said recesses, and the exhaust-port leading from the other of said recesses, said valve being free to move lengthwise of said steam-chamber, whereby the steam-pressure is utilized to keep the valve upon its seat, a segmental plate fitting into said steam-inlet recess, and a governor connected to oscillate said segmental plate, whereby said plate is automatically adjusted to reduce or increase the area of said steam-inlet recess, as the speed is increased or decreased, substantially as hereinbefore set forth.

3. In a reciprocating rotary steam-engine, a steam-cylinder attached to a steam-chamber and revoluble therewith and provided with piston-head and piston-rod, a valve adapted to alternately admit and exhaust the steam to and from said cylinder, a shaft journaled out of line with but parallel to the axial line of said cylinder, and carrying a drum concentric to said shaft, an angular connecting-bar connected by its ends to opposite sides of the rim of said drum and at its central point to the free end of said piston-rod, side bars coupled by one end to said piston-rod and to each other at their other ends, and adapted to run in contact with the sides of said cylinder and assist in supporting it, substantially as hereinbefore set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

FREDERICK W. REEVES.

Witnesses:
C. N. WOODWARD,
C. F. MILLER.