(No Model.)

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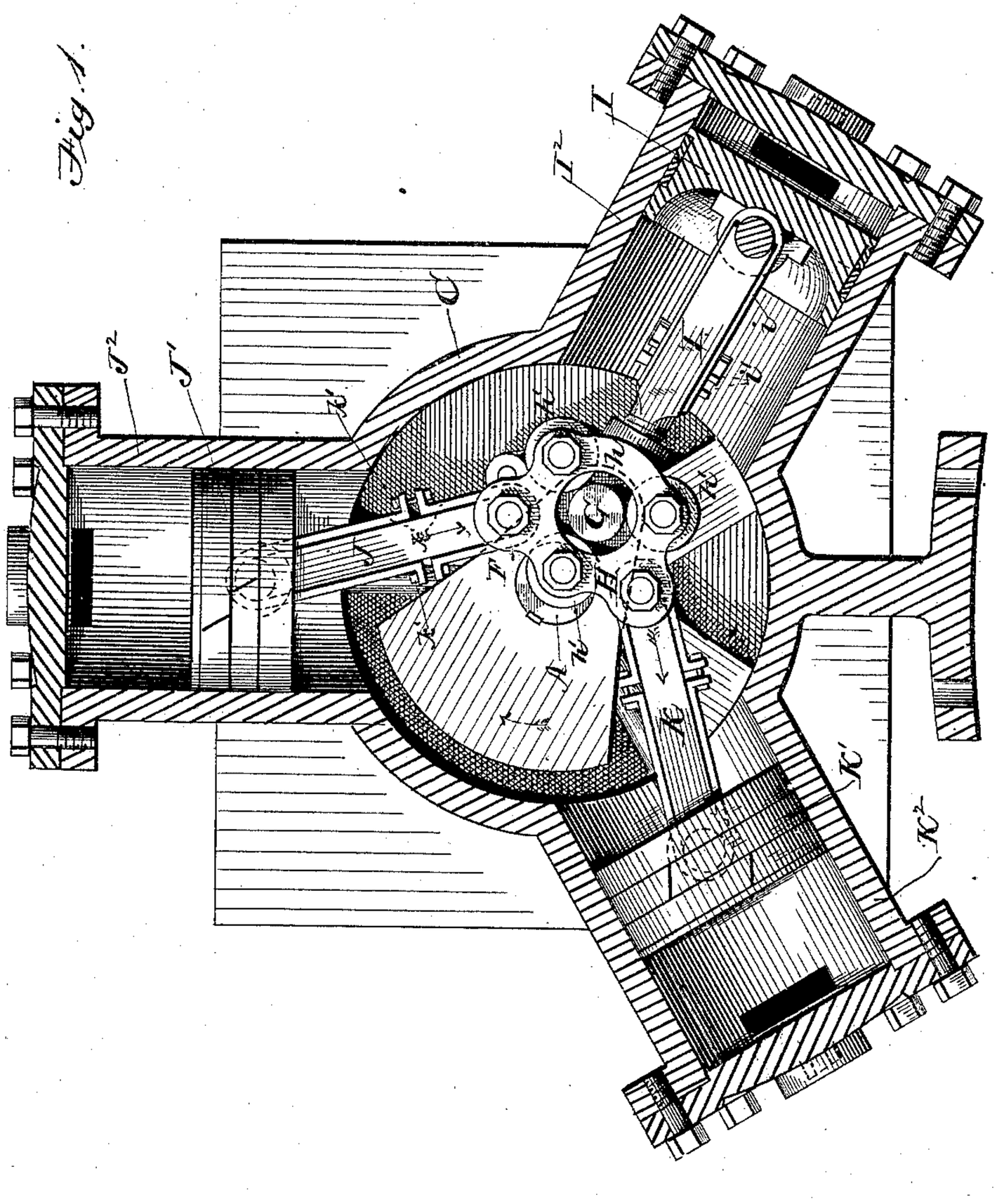
M. N. LYNN.

STEAM ENGINE.

No. 313,008. Patented Feb. 24, 1885.

Fig. 1.



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Inventor:

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His Attorneys

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STEAM ENGINE.

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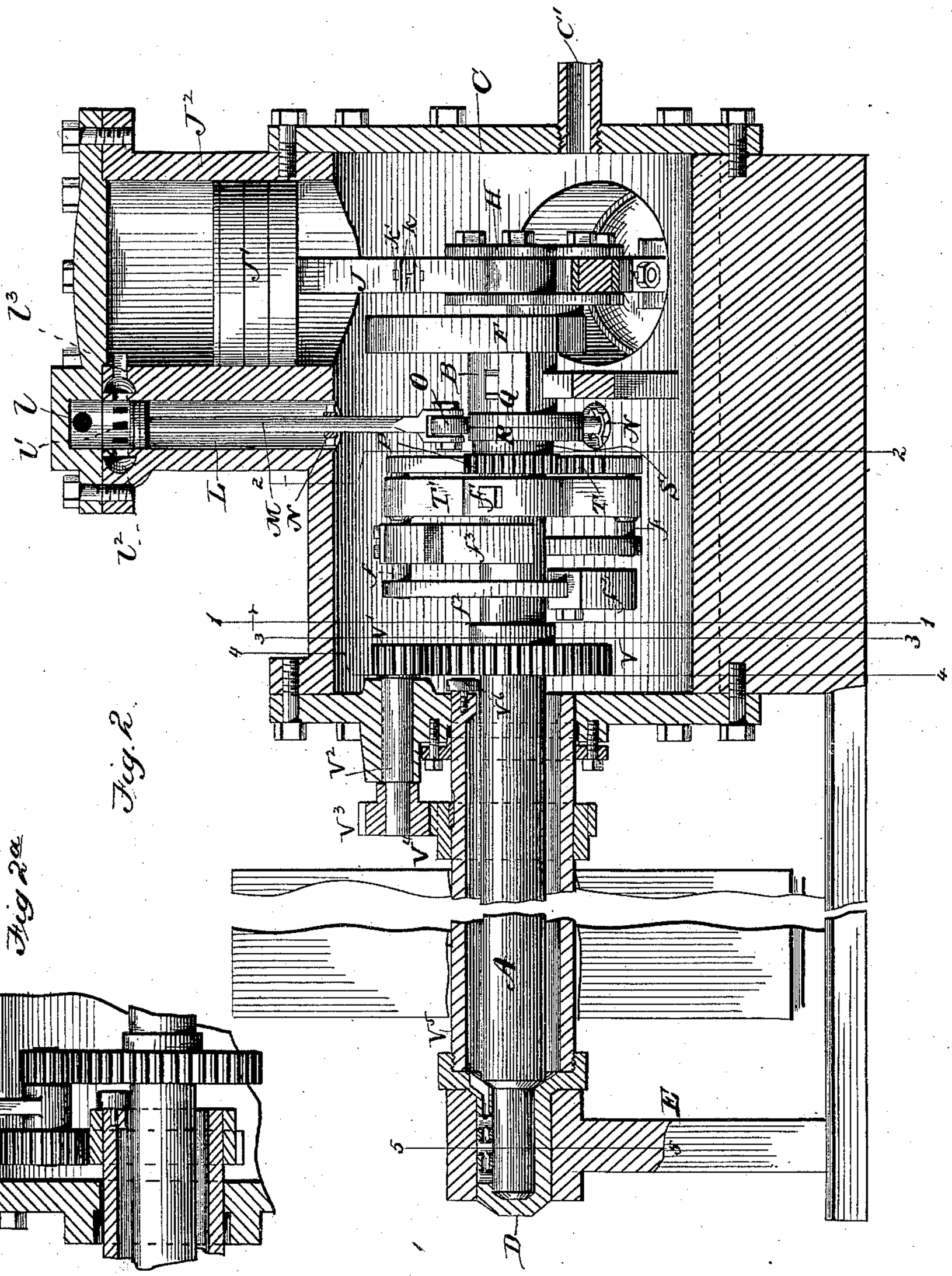

Fig. 2.

Fig 2a

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Fig. 3.

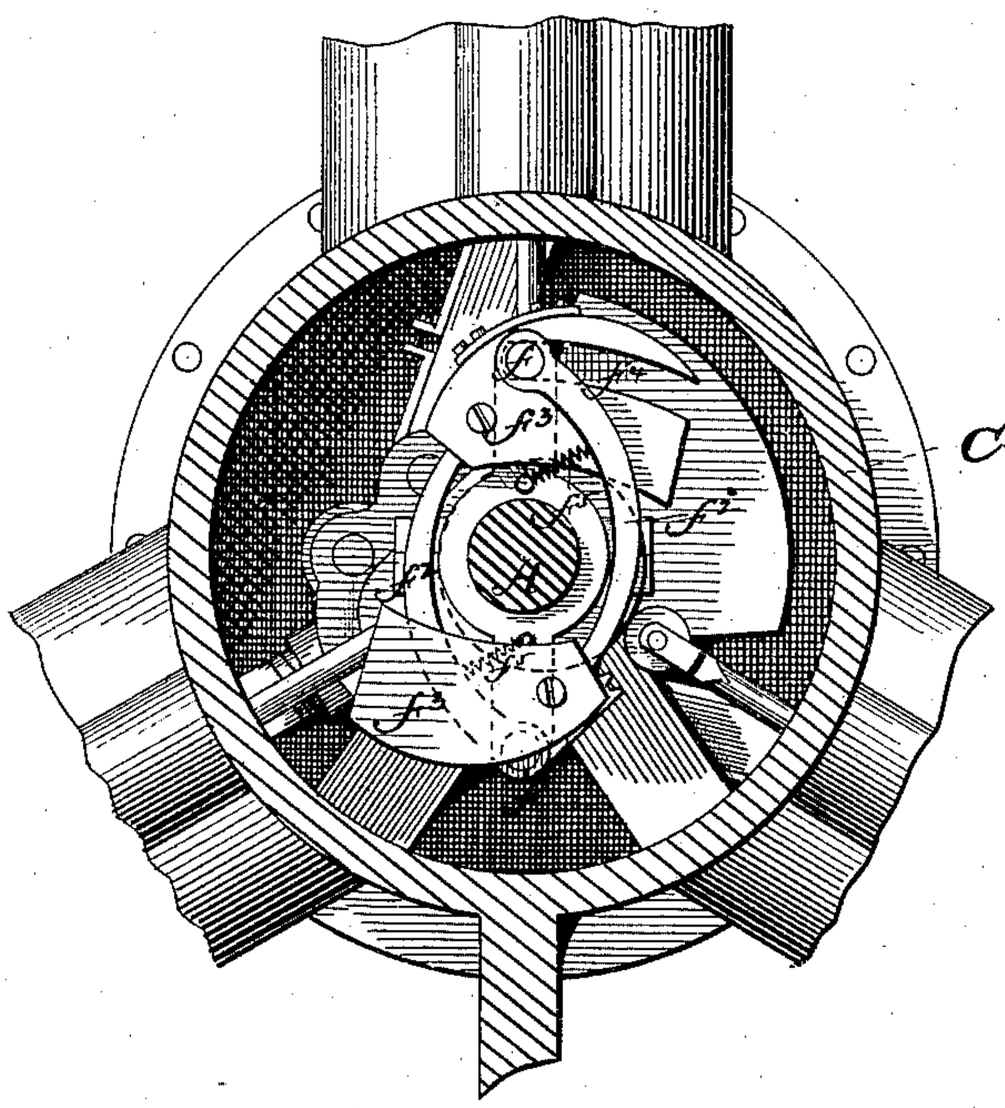


Fig. 4.

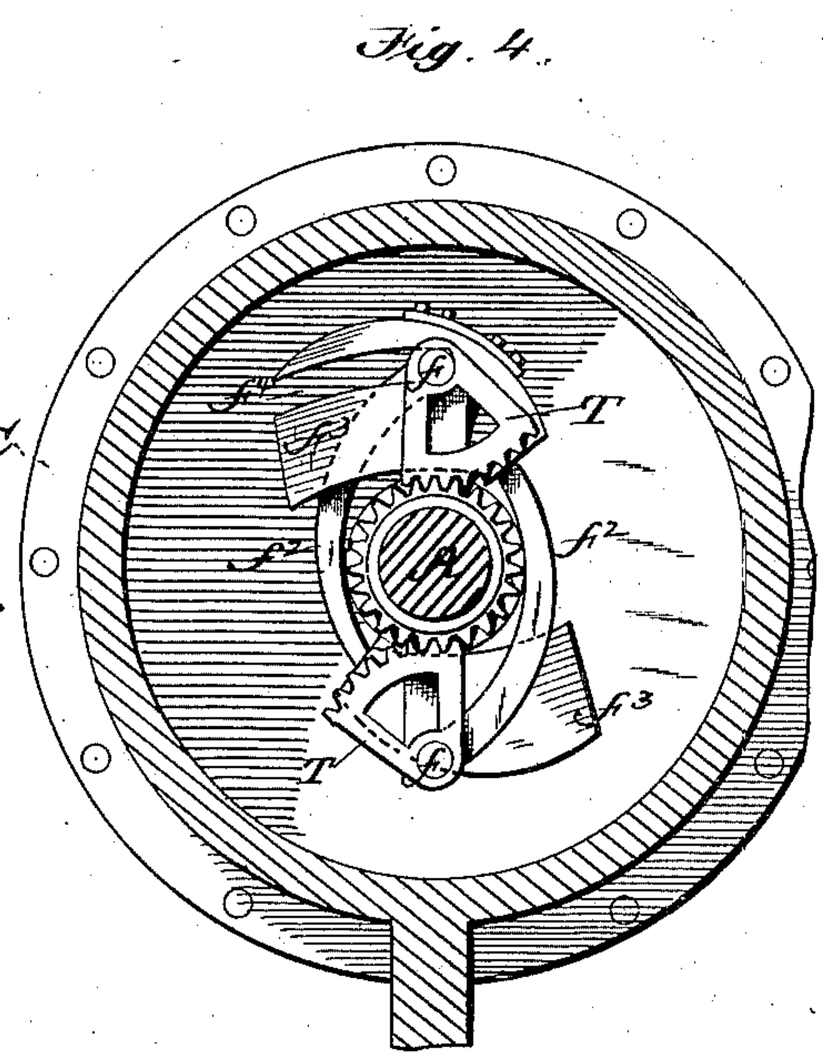


Fig. 5

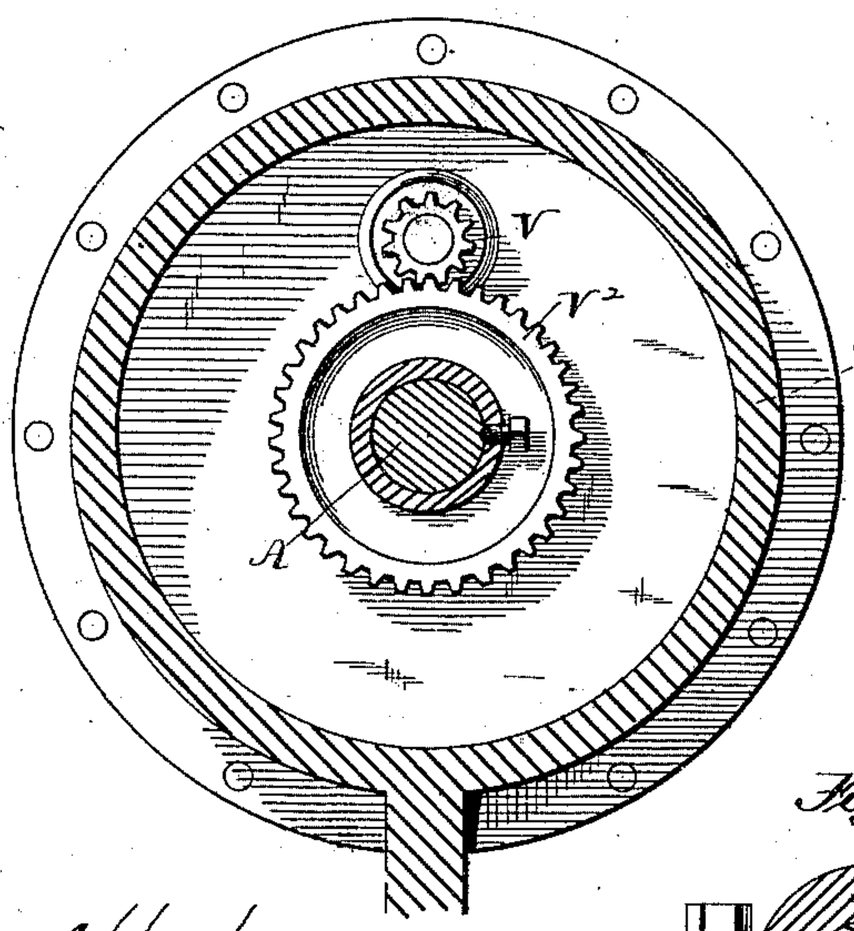


Fig. 6.

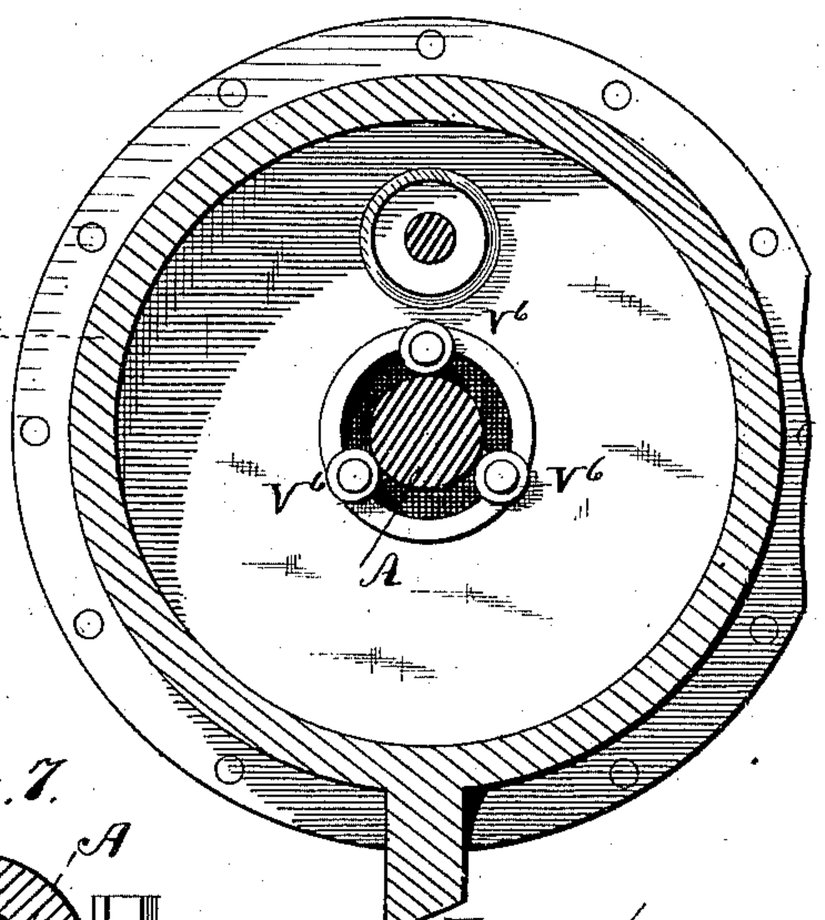
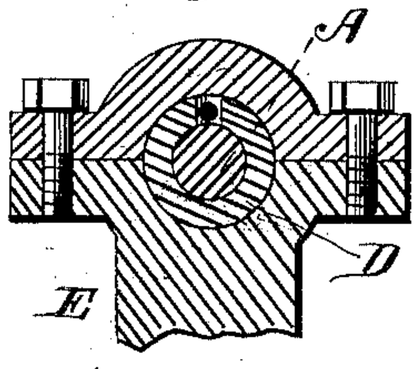


Fig. 7.



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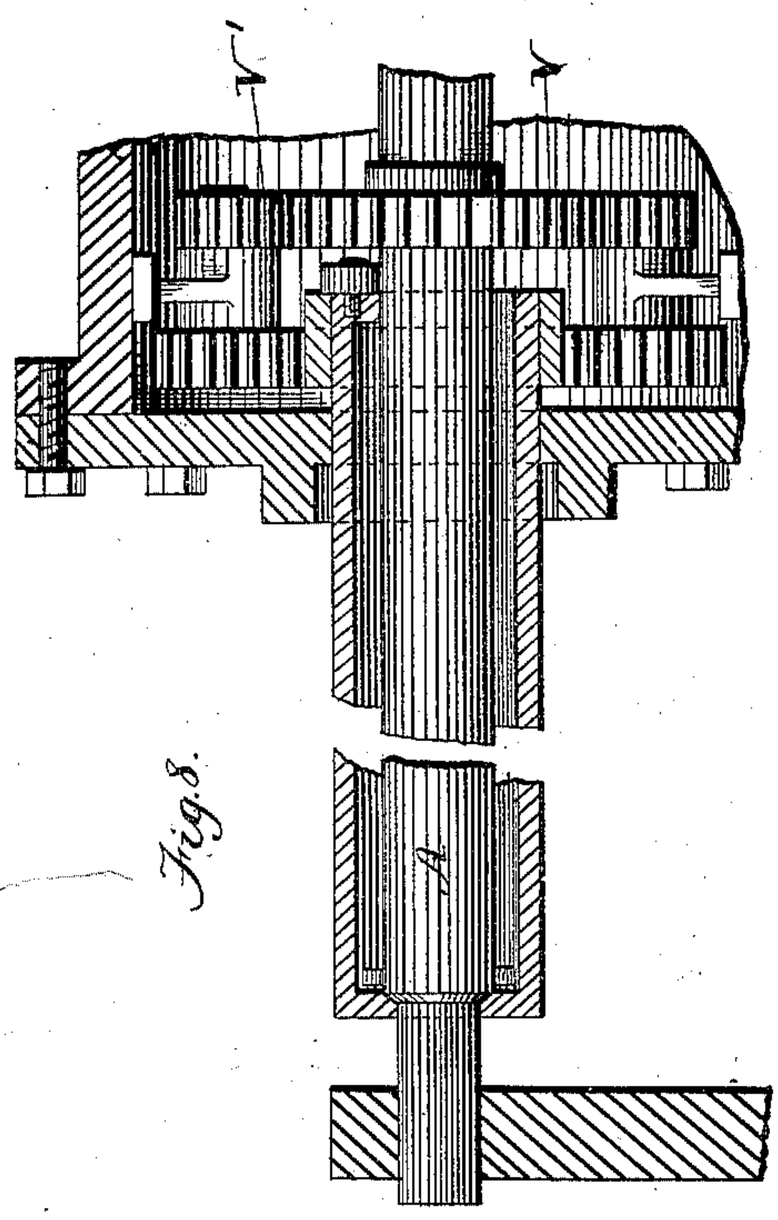

Fig. 8.

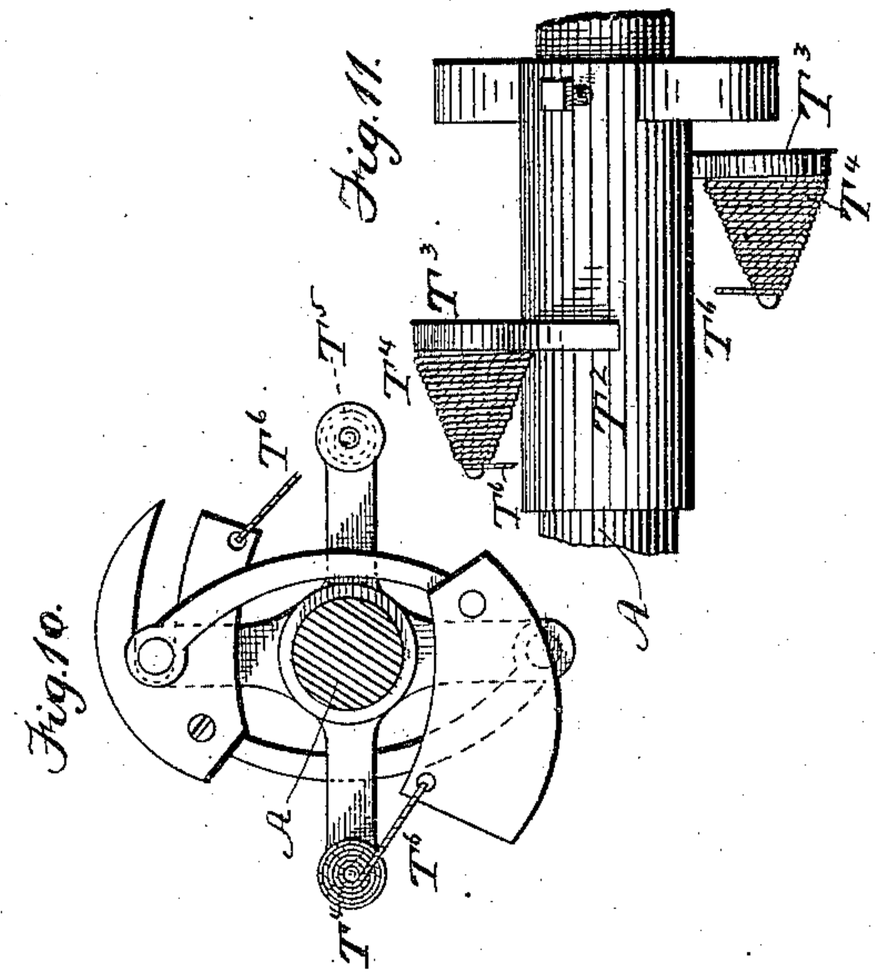

Fig. 10. Fig. 11.

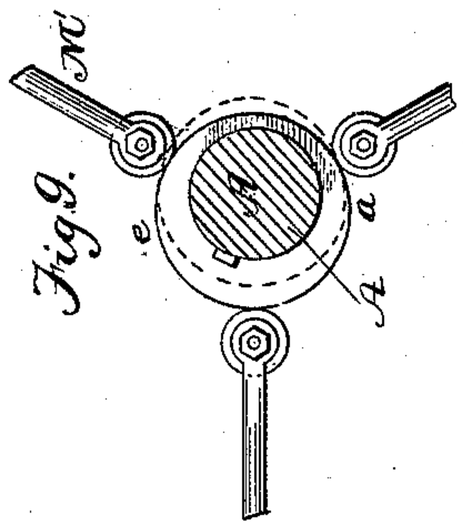

Fig. 9.

WITNESSES

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UNITED STATES PATENT OFFICE.

MIRABEAU N. LYNN, OF RISING SUN, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE AMERICAN ELECTRIC HEADLIGHT COMPANY, OF INDIANAPOLIS, INDIANA.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 313,008, dated February 24, 1885.

Application filed January 10, 1884. Renewed December 3, 1884. (No model.)

To all whom it may concern:

Be it known that I, MIRABEAU N. LYNN, of Rising Sun, in the county of Ohio and State of Indiana, have invented certain new and useful Improvements in Steam-Engines; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being made to the accompanying drawings, forming a part of this specification, and to the figures and letters of reference marked thereon.

My invention has for its object to provide a powerful engine capable of being run at a high rate of speed with the consumption of a minimum amount of steam; and to this end it consists in the novel construction of an engine of the three-cylinder type, which will be hereinafter fully described and claimed.

In the accompanying drawings of my engine, Figure 1 represents a transverse sectional elevation. Fig. 2 is a longitudinal sectional elevation; Fig. 2ª, a detail view of a modification of the speeding-up gearing; Fig. 3, a transverse section on the line 1 1, Fig. 2; Fig. 4, a transverse section on the line 2 2, Fig. 2; Fig. 5, a transverse section on the line 3 3, Fig. 2; Fig. 6, a transverse section on the line 4 4, Fig. 2; Fig. 7, a transverse section on the line 5 5, Fig. 2; Fig. 8, a detail view, showing a modification of the exterior bearing of the engine-shaft; Fig. 9, a detail view, showing the relative positions of the fixed and movable eccentrics of the valve-gearing. Figs. 10 and 11 are views illustrating a form of compensating-spring adapted to be applied to weighted arms of the cut-off regulator.

Similar letters in the several figures indicate the same parts.

The letter A indicates the main shaft of the engine, supported so as to freely revolve in an inner fixed bearing, B, provided within the main casing C and in an outer sleeve-bearing, D, sustained by a standard, E, as shown.

Keyed to the inner end of the main shaft A is a weighted crank-arm or block, F, provided with a crank-wrist, G, as shown in Fig. 1. This wrist projects through an opening, *h*, arranged about centrally of a yoke or frame, H, and to the latter are connected the pitmen or connecting-rods I J K of three pistons, I′ J′ K′, working in three independent cylinders, I^2 J^2 K^2, respectively, as also shown in Fig. 1. A series of friction-rollers, *h′*, three or more in number, are suitably mounted between the two plates of which the yoke or frame H is composed, and projecting into the opening *h*, through which the crank-wrist passes, serve as the bearings of the yoke upon the wrist. The inner end of the pitman I is firmly secured to the yoke H, preferably by a screw-connection, while its outer end is joined to the piston I′, being secured by means of a strap, *i*, and adjusting-wedges *i′*, as shown.

By reason of the yoke being fixed to the inner end of this pitman I, the latter operates to prevent it from turning laterally, and always insures the proper relation of its friction-bearings with respect to the crank-wrist. The pitman J is not only jointed to its piston, but is also jointed at its inner end to the yoke, and the same is true of the pitman K. I prefer to form the jointed connections of these two last-named pitmen by concaving both ends of each of the rods and fitting them to cross-bolts upon the piston and yoke, respectively, and then applying a separate strap, *k*, around each of the bolts and bringing both of the straps together and securing them by screw-bolts *k′ k′*, or other suitable means. This construction is found very desirable, as it enables both of the bearings of each pitman to be simultaneously tightened or loosened by a manipulation of the screw-bolts, and to maintain their positions of adjustment until, from wear of the parts or other cause, it becomes necessary to change them. The several pistons are properly packed, so as to closely fit their respective cylinders. Adjoining each piston-cylinder is arranged a valve-cylinder, L, having at its upper end a port or passage, *l*, leading directly to the boiler or source of steam-supply, and having also below the port *l* a series of other passages, *l′*, all communicating with an annular passage, l^2, which in turn communicates with the upper and of the adjoining piston-cylinder by a port or passage, l^3. Each of the valves L is connected to a rod or stem, M, which is centered by, but works freely through, a guide, N, arranged at the lower end of the valve-cylinder, as shown, but offering no material obstruction to the

passage of the exhaust-steam out through the said lower end of the valve-cylinder, as will be further on explained. Each valve-rod is provided at its inner end with a friction-roller, O, which bears upon two eccentrics, Q and R, on the main engine-shaft A, as shown in Figs. 2 and 9. The eccentric Q is keyed rigidly to the shaft A, and always sustains the same relation to it; but the eccentric R, though conforming in shape to the eccentric Q, and normally arranged to exactly coincide with it in position, is keyed to a sleeve, S, mounted loosely upon the shaft, said sleeve having formed with it or secured to it a pinion, P, with which engage two gear-sections, T T, secured, respectively, to the inner ends of two independent shafts, *f f*, which have bearings in opposite ends of a cross-bar, T′, secured rigidly to the shaft A by a screw, *f′*, as shown in Fig. 2, or otherwise. Upon the opposite end of each of the shafts *f* is secured a curved arm, f^2, which carries at its outer end a weight, f^3. Each of the curved arms f^2 is so shaped as to extend from its point of connection with its shaft *f* around and to the opposite side of the main shaft A, so that the weight carried by it will stand in a position exactly opposite the weight carried by the other curved arm, one of the weights being provided with a curved slot, f^4, to accommodate the shaft *f* of the opposite curved arm, as shown clearly in Figs. 3 and 4. A spiral spring, f^5, is secured at one end to each of the curved arms f^2, and at the opposite end to the fixed cross-bar T′, for the purpose of operating to normally hold the arms and the weight in the position shown in Figs. 3 and 4.

The pistons and connecting-rods of the several cylinders are so adjusted with relation to the yoke or frame H, by which power is applied to the crank on the main shaft, and also with relation to the valves, valve-rods, and operating-eccentrics, that, when one cylinder begins to take steam, the second cylinder will be working under full steam-pressure, while the third cylinder will be exhausting. When either of the cylinders is taking steam, the valve in the corresponding valve-cylinder is drawn inward, so as to permit the steam to enter the inlet-port *l* under full boiler-pressure and pass directly through the passages *l′* l^2 l^3 into the cylinder, and there operate upon the piston with full force, the motion of the piston being transferred, through the pitman, connecting-yoke, and crank, to the main engine-shaft A, and causing the rotation of the latter. As the piston of either cylinder nears the end of its stroke, the fixed cam Q on the main shaft, operating upon the roller on the inner end of the appropriate valve-stem, causes the valve to be thrust out till it passes the ports *l′*, thus cutting off the steam from the cylinder and permitting that remaining in the cylinder to exhaust out through the passages l^3 and l^2 and through the open valve-cylinder into the main casing C, lubricating all the parts located therein, and finally escaping through a passage, C′, as shown in Fig. 2. The arrangement of the valves is such that there is always an inward pressure of steam upon them, which causes the rollers on the inner ends of their stems to bear at all times uniformly upon the operating-eccentrics, and to run smoothly and evenly thereon without noise or jarring.

A clear idea of the action of the three pistons in co-operatively giving motion to the main engine-shaft may be gathered from inspection of Fig. 1. Here the piston I′ in cylinder I is just commencing to take steam, the piston J′ in cylinder J is operating under full steam-pressure, while the piston K′ in cylinder K has just completed its inward movement and is moving outward, the exhaust-steam passing out in front of it. During the entire operation of the engine the whole power of one piston and more or less than a half of the power of one of the other pistons under full boiler-pressure is exerted upon the main shaft, giving the latter very rapid and powerful rotation.

While the engine is running at a normal rate of speed, the weighted arms f^2 f^2, under the influence of the springs f^5 f^5, remain in substantially the position shown in Figs. 3 and 4, and both eccentrics Q and R operate uniformly and together upon the valve-stems and effect the periodic opening and closing of the valves. When, however, the speed of the engine is increased above the normal rate, the centrifugal force of the weighted arms overcomes the tension of the actuating-springs and causes the arms to be thrown outward, and the shafts *f f*, upon which they are mounted, to turn in their bearings. As the shafts *f f* turn, the gear-sectors T, connected to them, are also turned, and, operating upon the pinion P of the sleeve S, cause the sleeve and the attached cam R to be moved more or less out of center with the fixed cam Q, so as to bring said movable cam R into position to more or less quickly return the valves into position to close the ports *l′*, after the steam has been admitted through said ports to the respective piston-cylinders, and keep said ports closed, while the steam in the piston-cylinders is operating upon the pistons by its expansive force only. In this way the movable eccentric and its connections are made instrumental in regulating and governing the speed of the engine, as well as in economizing steam. The diagram, Fig. 9, will serve to illustrate this feature of my invention more clearly. The fixed eccentric is represented in full lines and the movable eccentric in dotted lines. Of the three valves shown, let the one marked M represent the valve to be operated upon. While the engine is running at a normal rate of speed, the fixed eccentric will cause the valve M′ to admit steam to the cylinder when the point *a* of the eccentric is under the valve-stem, and to commence the exhaust when the point *e* is under said stem. Upon the speed of the engine being increased, however, the shifting of

the movable eccentric into the position represented by the dotted lines will obviously cause the movement of the valve in the direction of exhaust to be accelerated up to point where the valve covers the ports leading from the piston-cylinder, where the valve will retard till the steam in the cylinder shall have had time to operate upon the piston by expansion, and then the exhaust movement will be continued until the exhaust-ports are wholly opened by the fixed eccentric.

In place of the spiral spring f^5, I may, and preferably, do employ a compensating-spring arrangement, such as shown in Figs. 10 and 11. To provide such, the cross-bar T′ is formed with an elongated hub, T^2, which extends along the main shaft under the weighted arms f^2 f^2. Opposite each of said weighted arms the said hub is provided with short lugs T^3 T^3, and to each of these lugs is connected a small spirally-grooved conical pulley, T^4, connected at one end to a helical spring, T^5, the other end of the said spring being fixed to the lug. A chain, T^6, is fastened to the longest end of the pulley, and extends thence to the weight on the arm f^2, which is opposite. When the weighted arms are in their normal positions, the chains T^6 are wound up on their respective spiral pulleys, from the larger to the smaller part of said pulleys, by the action of the helical springs; but, as the weighted arms are thrown out by centrifugal force, the chains are unwound, and, as the unwinding proceeds, the leverage exerted by the chains on the larger parts of the pulleys overcomes the tension of the helical springs to such an extent as to diminish the resistance to the outward throw of the arms in proportion to the extent of such throw, and thus render the contrivance more sensitive than if there were a direct application of simple springs which increased in force as they were stretched.

Rigidly keyed to the main shaft A within the casing C is a gear-wheel, V, with which meshes a pinion, V′, fixed to a short shaft, V^2, having its bearings in the casing C. On the outer end of the shaft V^2 is fixed another pinion, V^3, which meshes with a gear-wheel, V^4, secured to a tubular shaft or sleeve, V^5. This tubular shaft V^5 is provided at its inner end with three (more or less) friction-rollers, V^6, which bear upon the main shaft A, and serve as well to center as to support the inner end of said tubular shaft, while at its outer end said tubular shaft has connected to it the cap or bearing D, before referred to as constituting the outer sleeve-bearing of the main shaft. The exhaust-steam, carrying, as it does, in the form of vapor, the lubricating-oil fed in with the steam-supply, is discharged into the casing C, and, having access to all the operative parts of the machinery therein located, keeps them, as well as the bearings between the main shaft and tubular shaft, all the time thoroughly lubricated in the most completely automatic manner, and saving much time and special attention on the part of the engineer.

Instead of locating the pinion V^3 and gear-wheel V^4 outside of the casing, as shown in Fig. 2, I, by preference, arrange them both, as well as the pinion V′, within the casing, as shown in Fig. 2^a, so that all of the gears may have the advantage of the lubricating and noise-deadening effects due to their operation in the exhaust-steam of the engine.

The power of the engine may be applied through the instrumentality of a pulley fixed to the tubular shaft V^5, and utilized for any desired purpose; but, as I have specially designed my engine for the driving of a dynamo-electric machine, it is perhaps best adapted for that use, the armature of the dynamo being mounted upon, so as to turn with, the hollow shaft V^5.

In order to get the best effects from the dynamo-machine, it is necessary that it be run at an exceedingly high velocity, and, from the difficulty experienced in getting an engine that could run with speed enough to perform the work required, all attempts at direct applications of steam-engines to dynamos have hitherto been unsuccessful.

All these things I have had in view in the production of my invention; and to that end I have so balanced and inclosed the operative parts of the machinery and provided for the using steam at nearly or quite boiler temperature as to enable the main shaft A to be given a normal rotation of about six hundred turns per minute; and then I have so geared up the tubular shaft upon which the armature of the dynamo is to be mounted as to impart to the latter about twelve hundred revolutions a minute, and have thus, I think, succeeded in making a practical improvement in the art of electric lighting.

I intend, among other applications of my engine, to mount it and its accompanying dynamo upon the boiler of a railway-locomotive for train-lighting, taking steam directly from the locomotive-boiler.

No special attention is to be given to the engine after once being set up and adjusted, the engineer being able to start or stop it by simply turning on or off the steam-supply from his position in the cab.

In order to decrease the friction in the outer bearings of the main and tubular shafts, I preferably, in lieu of the construction shown in Fig. 2, employ that shown in Fig. 5, wherein the main shaft is given a separate bearing in the standard E, and the tubular shaft is provided with friction-rollers which bear upon the main shaft, the same as at the inner end of the said tubular shaft, as before described.

Having thus described my invention, I claim as new—

1. The combination of the three cylinders and their pistons, the main shaft and its crank, the pitmen connected to the pistons and the yoke connected to the crank of the main shaft by roller-bearings, substantially as described.

2. The combination of the three cylinders and their pistons, the main shaft and its crank, the yoke and the pitmen connecting the pis-

tons to the yoke, one of said pitmen being rigidly connected to said yoke and serving as a guide to the same, substantially as described.

3. The combination of the three cylinders, their pistons and pitmen, the yoke, the main engine-shaft and its crank and counter-weight, substantially as described.

4. The combination, with the main engine-shaft, of the tubular shaft supported by frictional bearings upon the said main shaft, and the gearing by which one shaft is driven from the other, substantially as described.

5. The combination, with the main casing into which the exhaust-steam is taken, of the main shaft and the tubular shaft having frictional bearings which are subject to the lubricating effect of the exhaust, substantially as described.

6. The combination, with the pistons and the yoke, of the pitmen, the straps about both their ends, and the means for simultaneously adjusting both straps, substantially as described.

MIRABEAU N. LYNN.

Witnesses:
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