(No Model.) 4 Sheets—Sheet 1.

# C. L. SNYDER.

## MULTIPLE CYLINDER ENGINE.

No. 423,398. Patented Mar. 11, 1890.

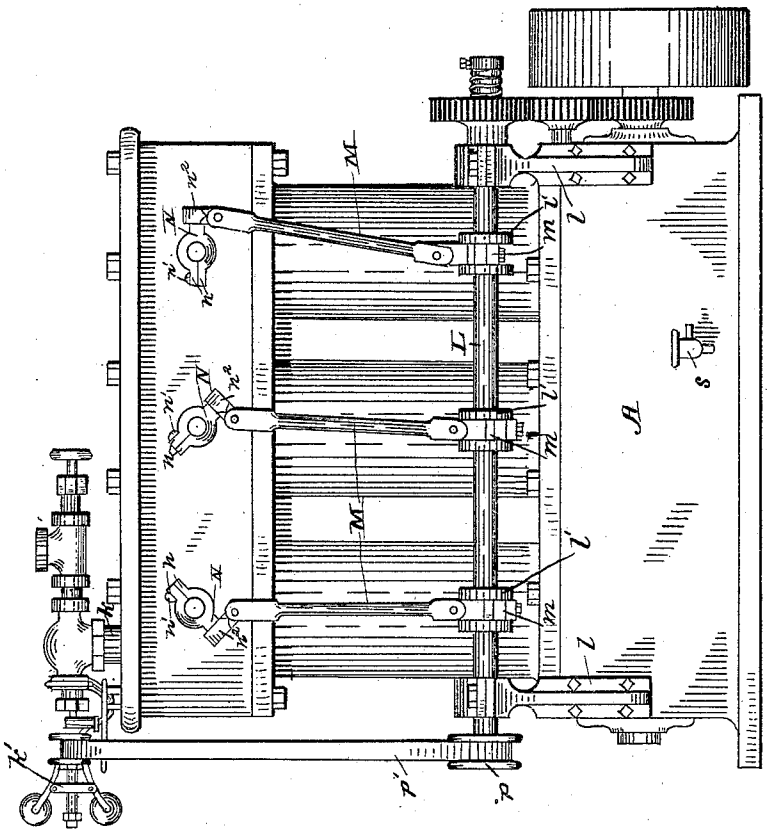


FIG. 2.

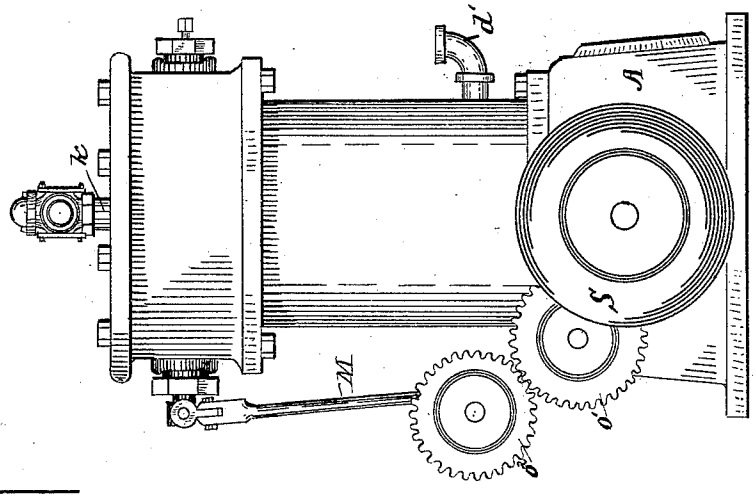


FIG. 1.

Witnesses—
R. B. Seward.
C. L. Stuntevant.

Inventor.
Chas L. Snyder
By E. C. Seward
his Attorney.

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.) 4 Sheets—Sheet 2.

# C. L. SNYDER.

## MULTIPLE CYLINDER ENGINE.

No. 423,398. Patented Mar. 11, 1890.

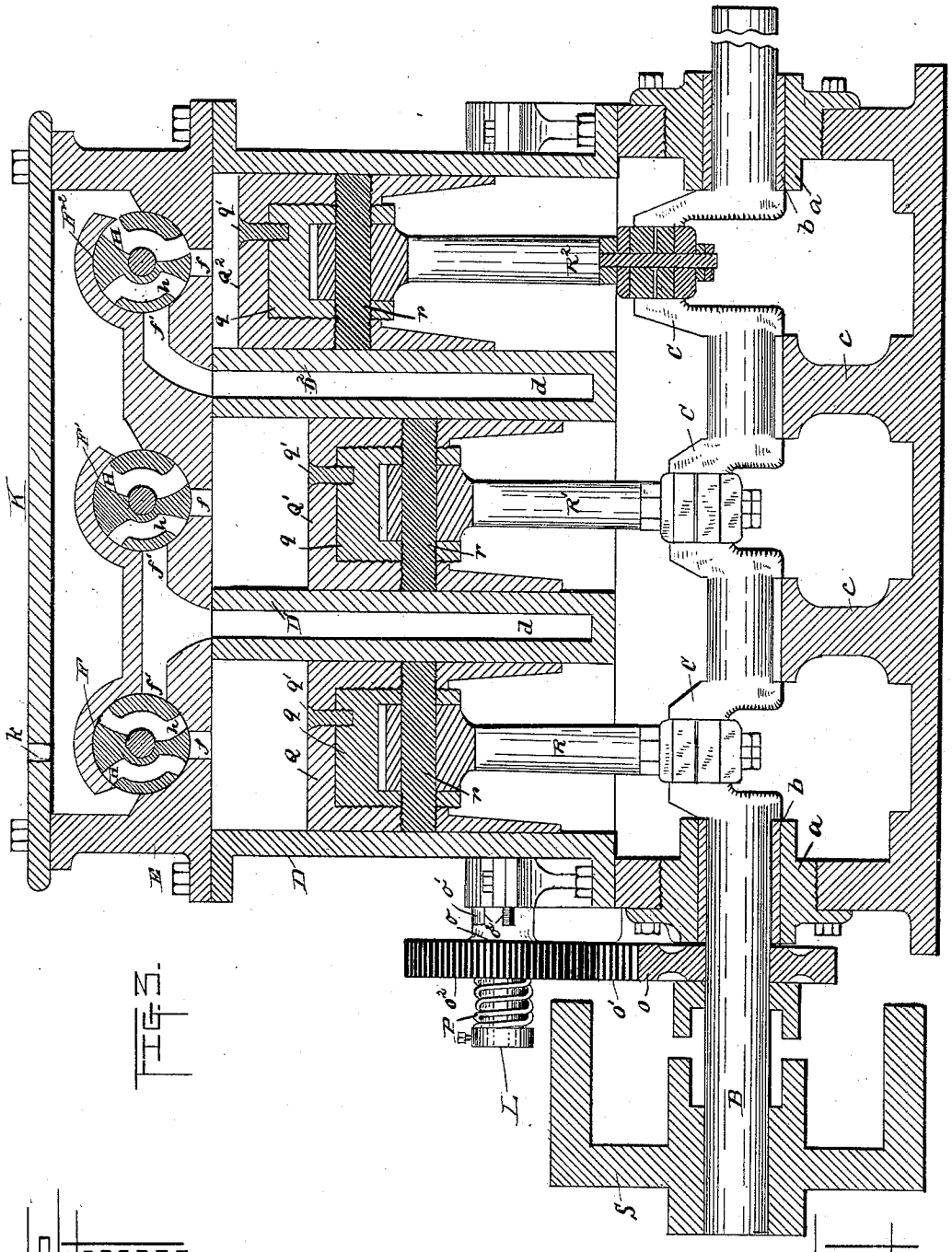


FIG. 2.

Witnesses
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(No Model.) 4 Sheets—Sheet 3.

# C. L. SNYDER.

## MULTIPLE CYLINDER ENGINE.

No. 423,398. Patented Mar. 11, 1890.

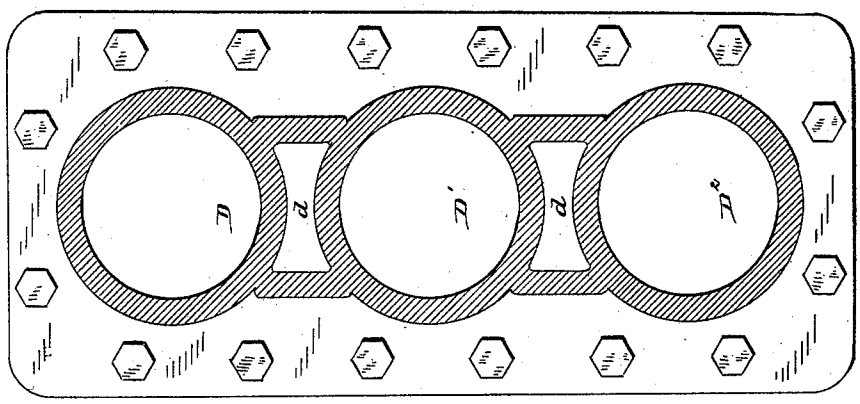



FIG. 5.

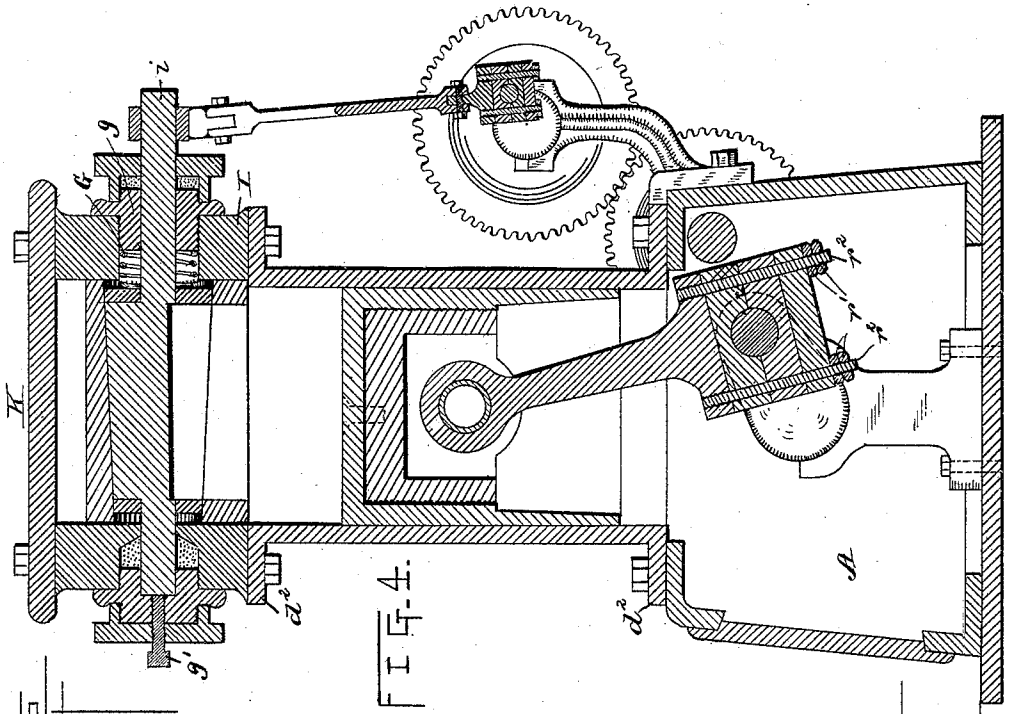



FIG. 4.

Witnesses.
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his Attorney.

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.) 4 Sheets—Sheet 4.

# C. L. SNYDER.

## MULTIPLE CYLINDER ENGINE.

No. 423,398. Patented Mar. 11, 1890.

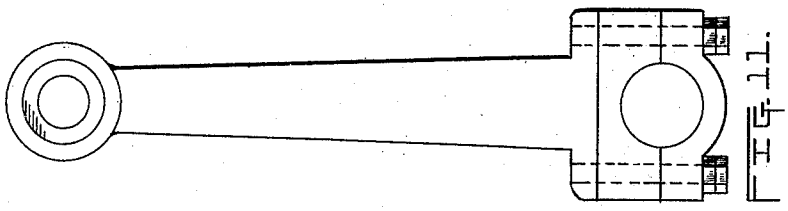


FIG. 11.

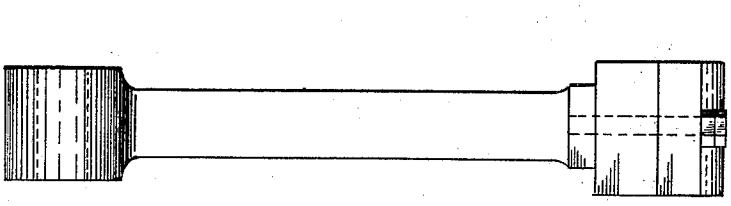


FIG. 10.

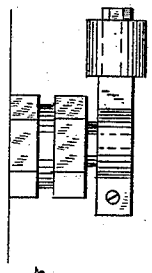


FIG. 8.

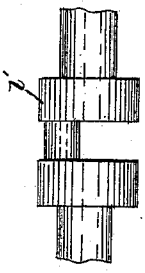


FIG. 9.

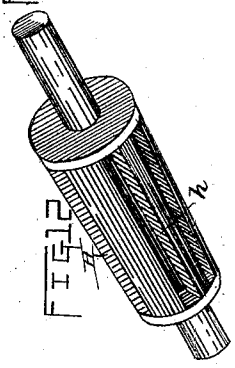


FIG. 12.

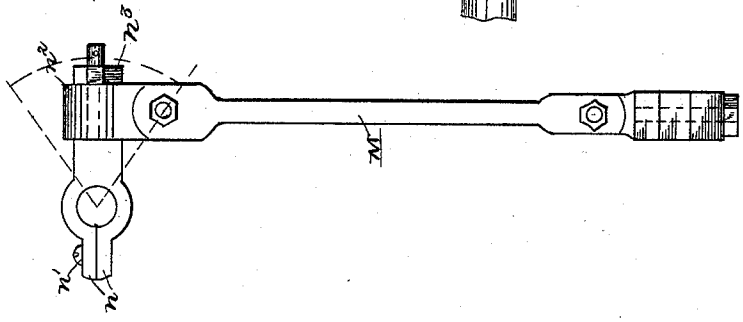


FIG. 7.

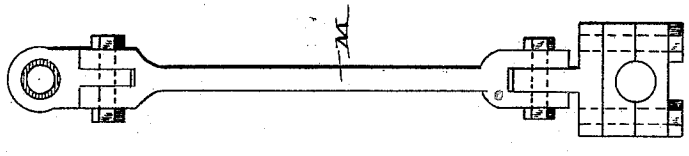


FIG. 6.

Witnesses
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C. L. Stuttevant.

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Chas L. Snyder
By E. C. Seward
his Attorney.

N. PETERS, Photo-Lithographer, Washington, D. C.

# UNITED STATES PATENT OFFICE.

CHARLES L. SNYDER, OF KANSAS CITY, MISSOURI, ASSIGNOR OF ONE-HALF TO ISAAC M. RIDGE, OF SAME PLACE.

## MULTIPLE-CYLINDER ENGINE.

SPECIFICATION forming part of Letters Patent No. 423,398, dated March 11, 1890.

Application filed April 20, 1889. Serial No. 308,020. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES L. SNYDER, of Kansas City, in the county of Jackson and State of Missouri, have invented certain new and useful Improvements in Multiple-Cylinder Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improvement in multiple-cylinder engines.

The object is to provide an engine which shall be very compact, perfectly balanced, and at the same time simple and economical.

With these ends in view my invention consists in certain features of construction and combinations of parts, as will be hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a view of the engine in end elevation. Fig. 2 is a view of the same in side elevation. Fig. 3 is a vertical longitudinal section through the cylinders and casing. Fig. 4 is a vertical transverse section through one of the cylinders and valves. Fig. 5 is a horizontal section through the cylinders, and Figs. 6, 7, 8, 9, 10, 11, and 12 are enlarged views of parts in detail.

A represents a hollow base, in the ends of which journal-boxes *a* are secured for the support of the engine-shaft B, journaled therein. The journal-boxes *a* are provided with bushings *b*, of brass or other suitable metal, which may be renewed from time to time as they become worn.

The engine-shaft B is provided with three cranks C, the shaft being further supported between the cranks by pillars *c*, fixed to or formed integral with the base A. The several bearings for the engine-shaft are bored true and are perfectly aligned.

To the top of the base A a casting comprising three upright cylinders D D′ D² is bolted. Chambers *d* are left between the cylinders, which serve as exhaust-chambers, the two communicating with a common exhaust-pipe *d′*.

The casting which comprises the cylinders and exhaust-chambers is provided at top and bottom with a laterally-projecting flange *d²*, which serves as a convenient means for its attachment to the adjacent parts.

To the top of the casting comprising the cylinders a casting E is secured, the same being provided with seats for three rotary valves F F′ F² and with ports *f* and *f′*, leading, respectively, to the cylinders and exhaust-chambers. The ports *f* and *f′* are in each instance separate from each other and lead from different portions of the valve-seat, the one to the end of the cylinder and the other to the exhaust-chamber between the cylinders. The two exhaust-ports *f′* from the seats of the valves F and F′ lead to the same exhaust-chamber, the one between the cylinders D and D′, and the exhaust-port *f′* from the seat of the valve F² leads to the exhaust-chamber between the cylinders D′ and D². The valves F F′ F² are slightly tapered and are pressed gently into their tapered seats by springs G, inserted between their heads and the inner ends of the male glands *g* of the stuffing-boxes, in which the valve-stems are seated, while too great pressure is guarded against by set-screws *g′*, which extend through the glands of the stuffing-boxes at the opposite ends of the valves and bear against the ends of the valve-stems. The valves are thus held in the most delicate adjustment and undue frictional wear is entirely avoided.

Each of the taper rotary valves F F′ F² is provided with a steam-inlet port H and steam-exhaust port *h*, extending transversely therethrough, as shown, and so located that as the valve is rocked in its seat the ports therethrough will alternately open communication between the steam chest and port leading to the cylinder and close the exhaust and open communication between the exhaust-chamber and port leading to the cylinder and close the steam-inlet.

The casting in which the valves are seated is inclosed within a side casing I, through which the valve-stems *i* extend and to which the stuffing-boxes are secured, and a top plate K is bolted to the casing I, forming a steam-chest common to all the valves. A steam-inlet pipe *k* enters the top plate K, and a valve under the influence of a governor *k′* of any well-known or approved construction is provided to control the admission of steam to the chest.

The valve-operating shaft L is journaled

in suitable brackets $l$, extending upwardly from the base, and is provided with three cranks $l'$, set in radial planes one hundred and twenty degrees apart. On the wrist-pins of the cranks $l'$ the heads $m$ of the connecting-rods M are journaled.

On the projecting ends of the valve-stem $i$ operating-arms N, terminating in a pair of curved clamping-jaws $n$, are secured by means of a set-screw $n'$, for drawing the jaws together snugly about the stems, and on the opposite ends of the arms N connecting-heads $n^2$ are mounted, preferably by lock-nuts $n^3$. The connecting-rods M have a loose connection at each end with the heads $m$ and $n^2$, to compensate for the varying positions which the rods assume as the valve-operating shaft L is rotated.

The engine-shaft communicates its revolutions to the valve-operating shaft by means of three intermeshing gear-wheels O O′ O², the wheels O O² being secured on the engine and valve-operating shafts, respectively, and the wheel O′ being mounted on a stud-axle fixed to the base. The gear-wheel O² is fixed to a sleeve-hub $o$, which is adapted to slide upon the shaft L, but which is locked against a rotary motion thereon by means of a lug $o'$ or other suitable locking device fixed to the shaft. The end of the sleeve-hub $o$ is provided with two slots or recesses $o^2$, adapted to receive the lugs $o'$ and located at such a distance apart that when the gear-wheel O² is turned from a position where one of the slots engages the lug to a position where the other of the slots engages the lug the relative positions of the valves and pistons will be such as to reverse the motion of the engine. The wheel O² is held in its normal position by means of a spring-cushion P on the outer end of the shaft L, and the engine may at any time be reversed by simply sliding the wheel O² out against the spring-cushion P, turning it to bring the other slot into engagement with the locking-lug, and allowing it to slide back. The opposite end of the valve-operating shaft is provided with a pulley $p$, from which a band $p'$ extends to the governor-shaft.

The pistons Q Q′ Q² in the respective cylinders D D′ D² are of cup form and have an extended bearing within the cylinders, their exterior surfaces extending nearly or quite two-thirds the length of the cylinder, thereby admitting of an effective steam-tight joint without great friction due to packing, and also effectually preventing a wabbling motion. Within the piston proper a cup-shaped bushing $q$ is screwed and locked by a small screw $q'$, tapped through the face of the piston.

The piston-rods R R′ R² are loosely mounted at their upper ends on pins $r$, which extend through the walls of the pistons and bushings, the opposite sides of the piston-rod about the pins having a close fit against the inner walls of the bushings. The wear may thus be taken up by renewing the bushings $q$, and the pistons, being driven from points at or above the centers of their bearing-faces, are entirely free from any tendency to cramp. The lower ends of the piston-rods are fastened to the wrist-pins on the cranks by half-bearings held together and to the main rod by clamp-nuts $r'$ on the threaded ends of stay-rods or pins $r^2$.

A balance-wheel S is secured to the end of the engine-shaft, as is usual.

An outlet $s$ is provided in the base for the overflow of the drip.

The three valves arranged to follow one anothers' motions at one-third of a revolution apart will cause one of the three pistons to be receiving the full effect of the live steam, another to be receiving the effect of the steam working expansively, the live steam having been cut off, and the third to be returning with exhaust full open, and this will be the constant condition of the three, with but slight variations, so long as the engine is run, for, as soon as the steam has been cut off from the piston mentioned above as working under live steam, the piston returning and exhausting will have begun to receive live steam, and the piston working under expansion will have begun to return and exhaust, and so on.

The engine as thus constructed is well adapted as a street-car motor, or whenever compactness and high power combined with perfect balancing and durability are desirable.

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

1. The combination, with several cylinders placed side by side, and exhaust-chambers between them, of a casting secured over the ends of the cylinders, valve-seats formed in the casting, one for each cylinder, independent ports leading from the valve-seats to the cylinders and exhaust-chambers, steam-inlet ports leading from without into the valve-seats, and the rotary valves provided with steam-inlet and steam-exhaust ports, substantially as set forth.

2. The combination, with several cylinders placed side by side, and exhaust-chambers located between the cylinders, of a casting secured over the ends of the cylinders, taper valve-seats within the casting, taper rotary valves fitted to the seats, a steam-tight casing inclosing the said casting, independent ports leading from the valve-seats to the cylinder and exhaust-chambers, independent ports through each of the valves, and ports from without through the casting to the valve-seats, substantially as set forth.

3. The combination, with several cylinders placed side by side, and exhaust-chambers located between the cylinders, of a casting secured over the ends of the cylinders, taper valve-seats within the casting, tapered valves seated therein, pressure mechanism tending

to force the valve into its seat, and adjusting mechanism bearing against the opposite ends of the valves against said pressure, substantially as set forth.

4. The combination, with the several cylinders, the engine-shaft, and the pistons connected with the shafts, of a series of rotary valves seated over the heads of the cylinders, a valve-operating shaft geared with the engine-shaft, cranks on the valve-operating shaft radiating therefrom, arms on the valve-stems, and connecting-rods loosely connected with the cranks and valve-stems, whereby the valves are rocked at regular intervals during the rotation of the valve-operating shaft, substantially as set forth.

5. The combination, with the several cylinders, their piston, and the engine-shaft, of the several valves, the valve-operating shaft connected with the valves and a sliding gear-wheel on the valve-operating shaft in gear with the engine-shaft, the said sliding gear-wheel having a rotary and longitudinally-sliding movement on the shaft, and means for locking the wheel to the shaft in different rotary adjustments relatively thereto to reverse the engine, substantially as set forth.

6. The combination, with the cylinder and the engine-shaft, of a piston provided with an interior cup-bushing, a cross-pin extending centrally through the piston about midway between its ends, and a piston-rod journaled on the pin at one end and on the engine-shaft at the opposite end, substantially as set forth.

7. The herein-described engine, consisting, essentially, of the hollow base provided with an outlet-overflow, the series of cylinders supported upon the base with the exhaust-chambers between them, the casting containing the valve-seats and ports secured to the tops of the cylinders, the steam-chest inclosing the said casting, the engine-shaft journaled on the base and supported between the cranks, the valve-operating shaft geared to the engine-shaft, and the valves connected with cranks on the valve-operating shaft, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHARLES L. SNYDER.

Witnesses:
M. H. BROWN,
A. H. NIESS.