(No Model.) 3 Sheets—Sheet 1.

J. CLARK.

OSCILLATING STEAM ENGINE.

No. 371,250. Patented Oct. 11, 1887.

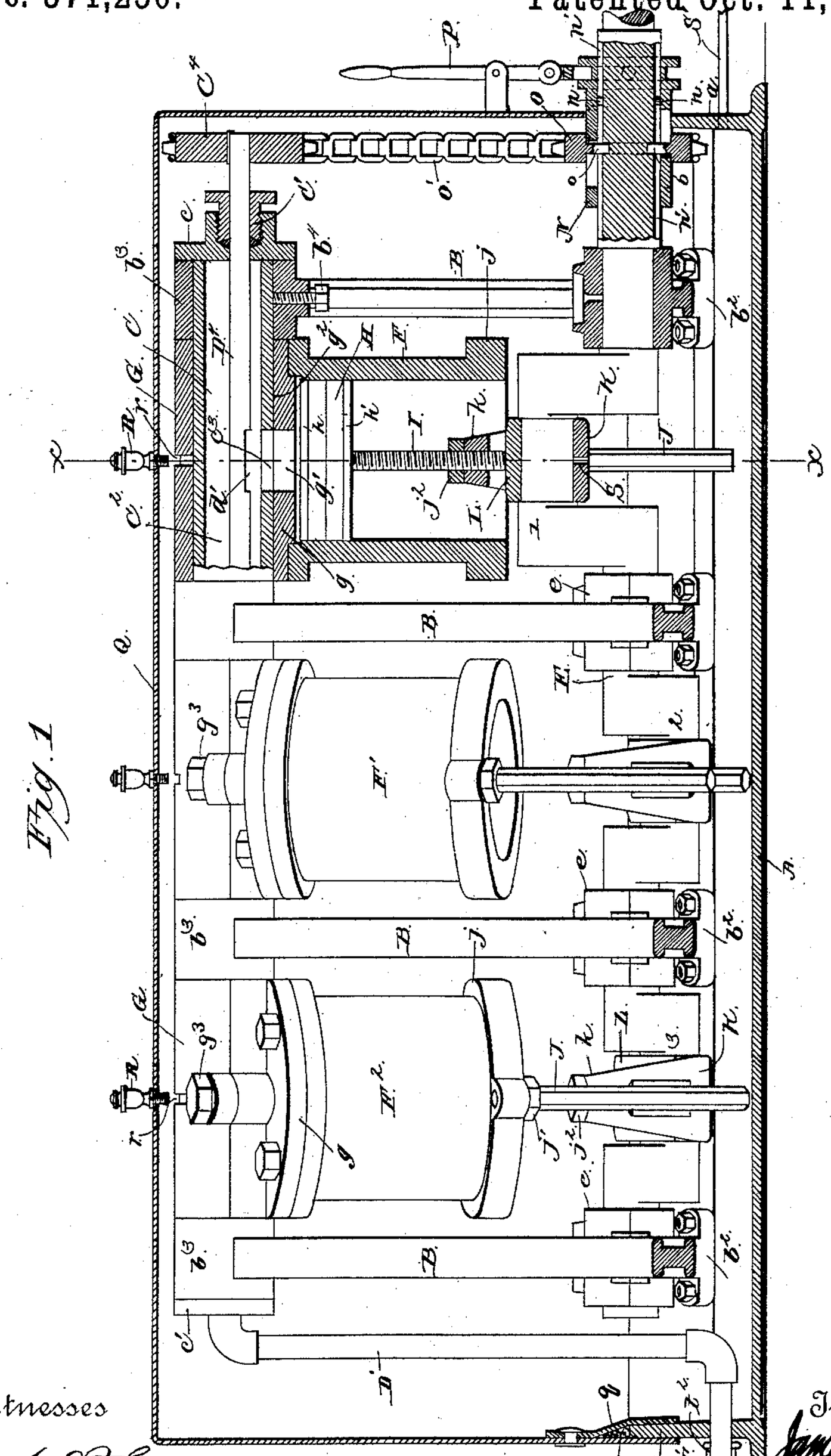

Fig. 1.

Witnesses

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(No Model.) 3 Sheets—Sheet 2.

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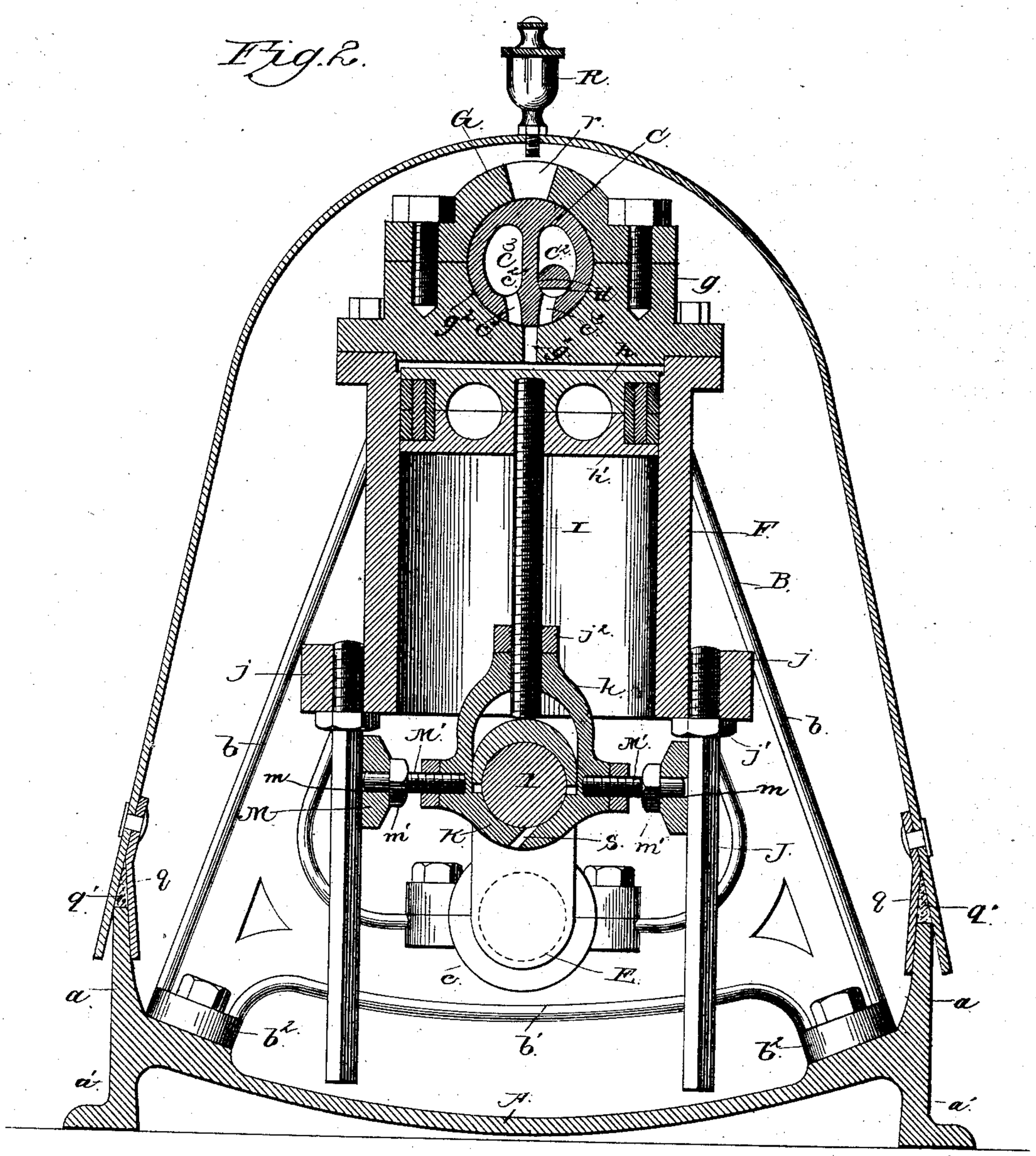
Fig. 2.



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(No Model.)

3 Sheets—Sheet 3.

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OSCILLATING STEAM ENGINE.

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Fig. 3.

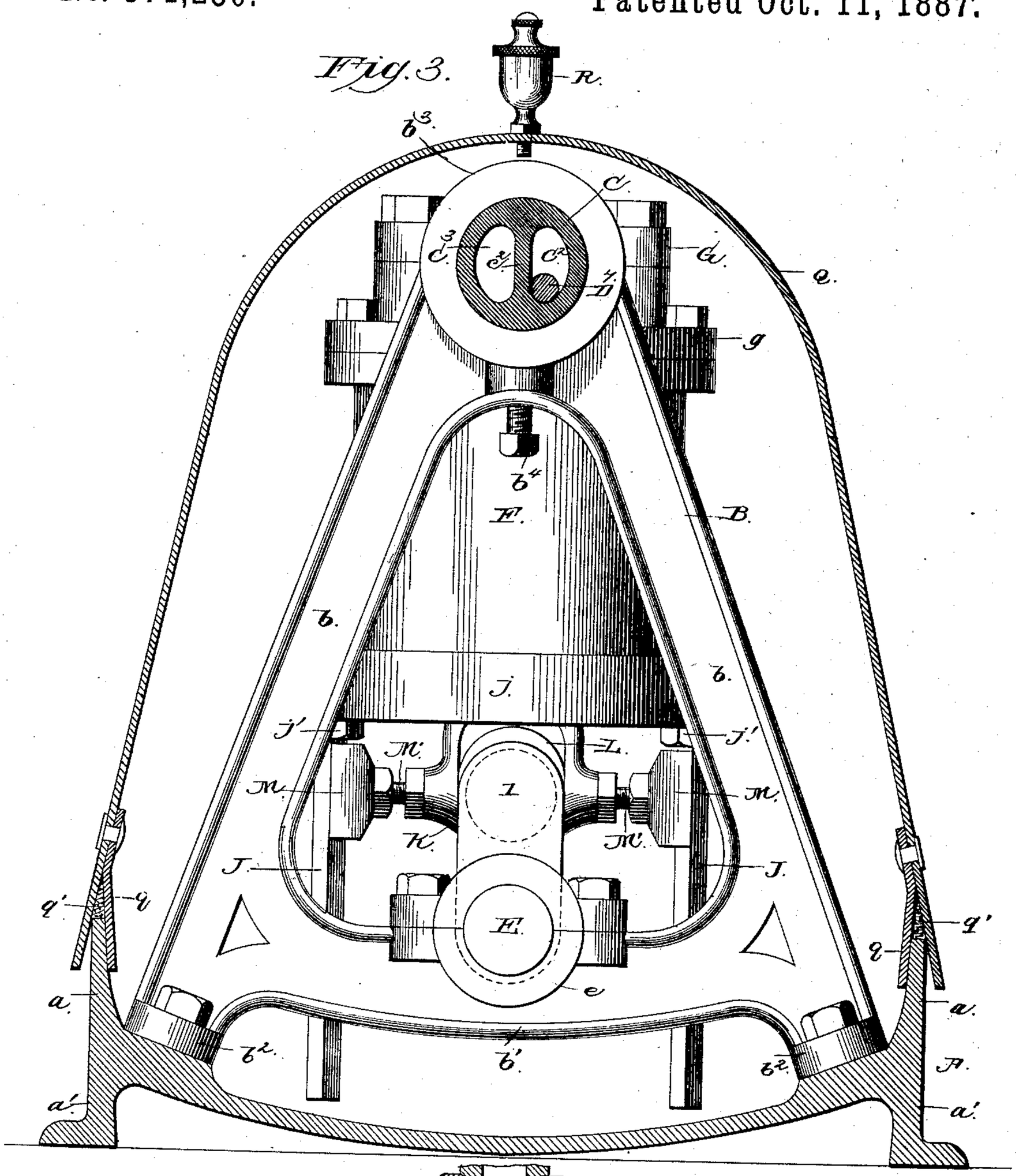
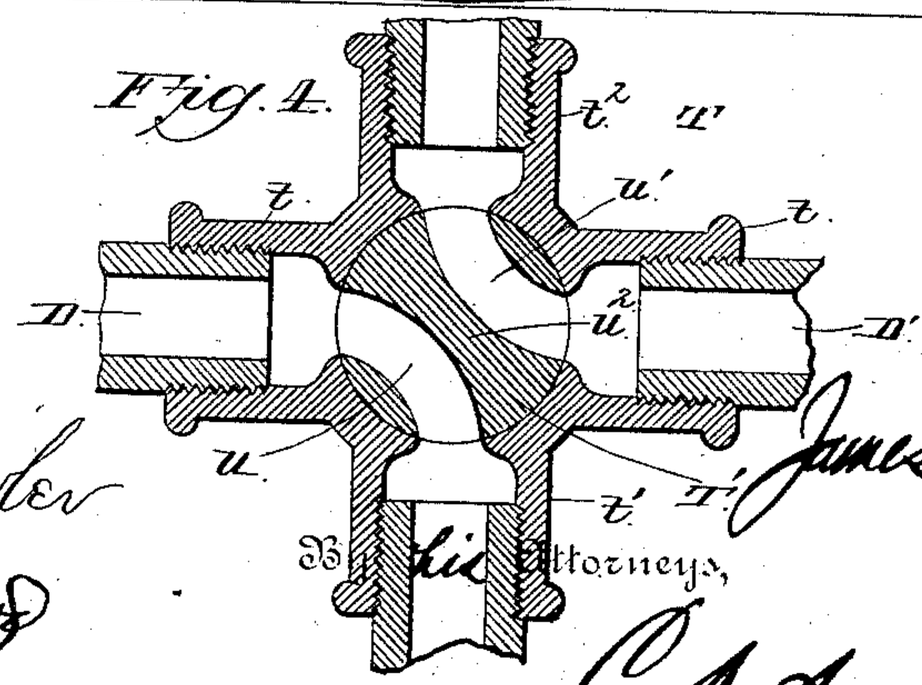


Fig. 4.



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UNITED STATES PATENT OFFICE.

JAMES CLARK, OF MEDINA, NEW YORK, ASSIGNOR TO HENRY W. CLARK, OF SAME PLACE.

OSCILLATING STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 371,250, dated October 11, 1887.

Application filed April 2, 1887. Serial No. 233,432. (No model.)

To all whom it may concern:

Be it known that I, JAMES CLARK, a citizen of the United States, residing at Medina, in the county of Orleans and State of New York, have invented certain new and useful Improvements in Oscillating Steam-Engines, of which the following is a specification.

This invention relates to improvements in oscillating steam-engines; and the novelty consists in the peculiar combination of devices and novel construction and arrangement of parts, substantially as hereinafter fully set forth and claimed.

In the accompanying drawings, Figure 1 is a side elevation showing an engine having three cylinders embodying my invention, one of the cylinders and the parts operating therewith being shown in section. Fig. 2 is a vertical sectional view on the line *x x* of Fig. 1. Fig. 3 is an end elevation with the inclosing shell or jacket and the bed-plate in transverse section. Fig. 4 is a detail sectional view of the four-way valve.

Referring to the drawings, in which like letters of reference denote corresponding parts in all the figures, A designates the bed-plate provided for an engine embodying my present invention. This bed-plate is cast or formed in a single piece of metal and of a length sufficient for three cylinders and their several parts. The bed-plate is made concavo-convex in cross-section, or it may be made V-shaped, so that the longitudinal center thereof will be depressed below its sides, to thereby cause the oil and water of condensation from the machinery to flow toward the middle of the bed-plate, which thus serves as a drip-pan, as will be readily understood. The sides of this bed-plate are provided with vertical flanges *a*, which extend upwardly from the bed-plate, and the latter is further provided with depending feet *a'*, which rest firmly and solidly on a suitable bed and are bolted or otherwise secured in place.

B designates a series of standards, which are located at suitable regular intervals on the bed-plate, and which constitute the framework of my improved engine, in which are mounted the steam-chest, cylinder, and other parts of the engine, as will more fully appear presently. Each of these standards is cast or formed of a single piece and of the same shape and construction as its fellow standards, and each standard has the inclined sides *b*, which are connected near their diverging ends by a transverse truss-brace, *b'*. The lower extremities of the sides of the standards are formed with perforated ears or lugs b^2, through which are passed bolts which secure the standards very firmly to the bed-plate, as shown, and the upper converging ends of the sides of the standards are formed with a circular bearing, b^3, in the lower side of which is formed an opening or openings, in which works a clamping-screw, b^4, which binds the steam-chest in place in the bearing and prevents the same from movement.

The bearings b^3 are arranged in line with each other, and through them is passed a longitudinal steam-chest, C, which is continuous throughout the engine and serves to supply all the cylinders with steam, instead of providing each cylinder with a separate steam-chest. This steam-chest is held in place against either endwise or rotary movement by the binding-screws b^4, and the ends thereof are closed by removable heads *c c'*, which are bolted thereto, the steam supply and exhaust pipes D D' (only one of which is shown) entering the steam-chest through the head *c'*, and the opposite head, *c*, having a bushing, C', for the passage therethrough of a rotary cut-off. This steam-chest is made circular in cross-section, its periphery being turned smooth and true, and the chest is provided with a longitudinal central partition, c^2, which divides its chamber into two separate or isolated chambers, C^2 C^3, the former of which constitutes a supply-chamber and the latter an exhaust-chamber, with which chambers the supply and exhaust pipes D D' communicate.

Vertical ports c^3 c^4 are formed in the lower side of the longitudinal steam-chest, which communicate with the supply and exhaust chambers C^2 C^3, respectively, and these ports are arranged on opposite sides of the lower end of the vertical partition c^2, as shown in Fig. 2. In the opposing faces of the steam-chest and the vertical partition c^2 of the supply-chamber C^2 are formed curved recesses *d*, in which is snugly fitted a rotary cut-off, D^7, the recesses thus serving as the bearings or

supports for the cut-off, as is obvious. The cut-off is made in the form of a round rod of suitable metal, and it extends continuously and longitudinally throughout the supply-chamber of the steam-chest. The cut-off or rod is arranged immediately over the outlet-port c^3 of the supply-chamber, so as to cut off the steam from the port when the port of the oscillating cylinder is in alignment with the inlet-port c^4 of the exhaust-chamber C^3, and the said cut-off is provided on one side with a notch or recess, d', which forms a steam-passage when the cut-off is in motion, said recess serving to permit steam to pass through the same and into the port c^3 when it faces either the wall of the steam-chest or the partition, as is obvious.

The rotary cut-off is provided with one of these notches for each of the three oscillating cylinders to admit the steam from the supply-chamber to the outlet-port of the chest at suitable intervals, and one end of the cut-off is extended or passed through the bushing C′ of the head c of the steam-chest, and has a sprocket-wheel, C^4, affixed thereto.

E designates a crank-shaft, which extends longitudinally above the bed-plate and the truss-bars of the upright standards B and between the sides b thereof. This crank-shaft is journaled at intermediate points of its length in suitable bearings or boxes, e, on the truss-bars of the uprights, and said shaft has three cranks, 1, 2, and 3, formed at intermediate points of its length, the said cranks being set at different angles to the shaft, as shown.

F, F′, and F^2 designate the oscillating cylinders, one of which is provided for each crank of the shaft. Each cylinder is provided with open ends, as shown, and arranged in an upright position, as is usual in engines of this class, and the upper end of each cylinder is closed by a head, g, which has an annular flange, through which and a similar flange on the upper end of the cylinder are passed bolts that secure the head g to the cylinder. The head g is provided with a single central port, g', which is adapted to alternately align with the ports c^3 c^4 of the supply and exhaust chambers of the steam-chest as the cylinder oscillates back and forth. Each cylinder of the engine is suspended from the steam-chest and is adapted to oscillate back and forth thereon, the steam-chest being held stationary and made circular in cross-section for this purpose. The heads g of the cylinders are each provided with a semicircular groove or recess, g^2, in its upper side, and the port g' opens centrally through this groove or recess, the lower side of the cylindrical steam-chest fitting snugly and closely in the said groove or recess.

G designates a saddle, which is made semicircular on its lower or under side to fit very closely over the upper side of the cylindrical steam-chest, and this saddle is secured to the head g of the cylinder by through-bolts g^3, this curved side of the saddle and groove or recess in the head g forming a complete circular opening, in which the cylindrical steam-chest is snugly fitted. The cylinder is suspended from the steam-chest by the fixed connected head and saddle, and it is free to turn or oscillate back and forth, the steam-chest serving as the pivot or trunnion of the cylinder.

Each cylinder has a piston, H, operating therein, which is made in two parts or sections, h h', each in the form of a disk. Each of these sections is provided with a central threaded opening, which aligns with the corresponding opening in the other section, and through these aligned threaded openings of the sections is passed and fitted the upper end of a piston-rod, I, which is threaded continuously throughout its entire length. The disks or sections of the piston are securely connected to the piston-rod by the threads of the latter engaging the threads of the openings in the disks, and both the disks, or only the upper one, if deemed desirable, can be moved or adjusted over the rod toward the head g of the cylinder to compensate for wear and take up lost motion.

The lower end of the oscillating cylinder is provided with an integral annular flange, j, in diametrically-opposite points of which are formed transverse threaded apertures, in which are screwed the upper threaded ends of guide-rods J, jam-nuts j' being fitted on the threaded ends of the said guide rods and bearing against the annular flange j of the cylinder to prevent displacement of the said rods. The guide-rods are thus carried by the oscillating cylinder, and they depend therefrom on opposite sides of the lower open end of the same, said rods being made hexagonal or of any other preferred angular form in cross-section.

A cross-head, K, is fitted on each crank 1, 2, and 3 of the longitudinal shaft E, and each cross-head has an integral yoke, k, which is extended or projected above the upper side of the crank, so as to leave an intermediate space between the lower curved side of the yoke and the upper side of the crank. This yoke is provided in its upper end with a vertical central opening, which is interiorly threaded, and through which the lower end of the threaded piston-rod I is passed, so that the cross-head is adjustably connected to the piston-rod. A curved bearing-plate, L, is fitted very snugly over the upper side of the crank and between the lower ends of the arms of the yoke k, and the lower end of the piston-rod I bears or impinges upon this bearing-plate to prevent it from becoming displaced by the shock or motions of the engine.

The wear between the faces of the crank, the cross-head, and the bearing-plate, incident to the rubbing action and friction between these parts, can be readily taken up by merely turning the piston-rod in the yoke of the cross-head, and thus adjust the latter longitudinally of the piston-rod and cause the lower end of said rod to bear upon the bearing-plate, after which the joint-nut j^2 on the threaded piston-

rod is adjusted to bear firmly against the upper side of the yoke and thus prevent the parts from becoming easily displaced relatively of each other. Guide-boxes M are fitted snugly around the guide-rods J on the oscillating cylinder, and these guide-boxes are connected with the cross-head by intermediate bolts or screws, M′. The outer ends of these bolts are made smooth and plane and fitted in smooth apertures *m* in the guide-boxes, to serve as trunnions or pivots, and the inner threaded ends of the bolts are fitted in like openings in opposite sides of the cross-head, adjustable binding-nuts *m′* being fitted on opposite ends of the threaded bolts and bearing against the opposing sides of the cross-head and the guide-boxes. By turning these bolts in the threaded openings in the cross-head and moving the nuts *m′* thereon in the proper direction the wear on the guide rods and boxes can be readily taken up and the motion of the parts rendered easy and smooth. One end of the crank-shaft is extended beyond the bearing provided therefor in one of the end standards, B, as shown in Fig. 1, and on this extended end of the crank-shaft is fitted an endwise-movable sleeve, N. This sleeve is provided with pins *n n*, which project into straight longitudinal grooves *n′* in the extended end of the crank-shaft, so that while it is capable of an endwise or sliding movement on the crank-shaft it is also adapted to rotate or turn therewith. The crank-shaft is further provided with an annular groove, and the sleeve has diametrically-opposite inclined slots, through which project guide-pins *o*, that are fixed to the hub of a sprocket-wheel, O, said pins extending into the annular grooves in the crank-shaft. It will be seen that as the shaft rotates, the sleeve and the sprocket-wheel rotate therewith, the sprocket-wheel being held from lateral movement on the shaft, and thereby retained in line with the other sprocket-wheel, C^4, by its pins fitting in the annular groove, while the sleeve is capable of an endwise movement on the shaft independently of the latter in order to rotate the sprocket-wheel a one-half revolution, and thereby change the advanced relative movement of the rotary cut-off to the crank-shaft.

The sprocket-wheel O is connected by an intermediate sprocket-chain, O′, with the sprocket-wheel C^4 on the rotary cut-off, so that the latter is positively driven from the crank-shaft and is controlled by the sprocket-wheels and chain. The outer end of the sliding sleeve has an annular groove, in which is fitted the bifurcated end of an operating-lever, P. By means of this adjustable sleeve and hand-lever the rotary cut-off can be readily controlled to cut off the steam at any given point of stroke and while the engine is in motion.

Q designates the removable inclosing jacket or shell, which is curved, as shown, to fit over the engine, and to the lower free edges of the said shell are riveted inclined plates *q*, which form crotches in the lower edges of the shell. In the apex of these crotches is placed a suitable packing, *q′*, and the upper edges of the vertical flanges *a* of the bed-plate are fitted in the crotches and against the packings therein, to thereby removably support the shell or jacket in place. This shell or jacket serves to conceal the machinery from view and to protect it from dirt, &c., and it can be lifted out of place with ease and facility when it is desired to have access to the same for repairs or other purposes.

R designates lubricating or oil cups, which are fixed in the upper portion of the inclosing shell or jacket, said cups being of any preferred pattern or style. One of these cups is arranged immediately over each cylinder, and the saddle of the latter is provided with an aperture or slot, *r*, which is in line with the outlet-nozzle of the oil-cup during a part or the whole of each vibration or oscillation of the cylinder, so that the oil will be free to enter between the steam-chest and saddle, and thereby lubricate the said parts. A portion of the lubricant supplied to the saddle will find its way around the steam-chest and pass down through the port *g′* into the cylinder on the inner sides of the latter, to lubricate the piston, and thence drip into the bed-plate, and a part of the oil will drip from the bearing g^2 into the bearing *e* of the crank-shaft to lubricate the latter, the bearing *e* being arranged immediately below the bearing g^2. During the oscillations of the cylinder the lower ends of the guide-rods dip in the oil in the bed-plate, and the sliding guide-boxes take the oil from the lower ends of the rods, and are thereby lubricated.

The cross-head K is provided in its lower side with an opening or passage, S, which is inclined, as shown, and the cross-head is adapted to sweep in close proximity to the curved side of the bed-plate during the rotations of the crank, so that the oil or lubricant in the bed-plate will be forced through the inclined passage S, and thus lubricate the crank and cross-head. It will thus be seen that all of the working parts of each cylinder of the engine are thoroughly and effectively lubricated from a single oil-cup.

A tube, S′, passes through one side of the bed-plate, and enters the chamber of the latter a short distance below the line of the oil-level, so that the water of condensation can be readily drawn off without disturbing or wasting the oil.

The operation of my invention will be readily understood by those skilled in the art to which it relates from the foregoing description, taken in connection with the drawings.

By suspending the cylinder from the steam-chest and arranging the ports so that the cylinder will take steam from the chest at its suspended end the pressure of the steam between the piston and the cylinder-head makes the pivotal joint of the cylinder with the steam-chest self-packing. The cylinder is also perfectly balanced of itself without the addition

of auxiliary "balances," and is therefore capable of running at a high rate of speed.

The engine is easily controlled by a slight movement of the operating-lever P, and, as it is composed of comparatively few parts, it is simple and light in construction, and cheap.

T designates a four-way valve or cock having its shell provided with the four radial nozzles *t*, and to two opposite nozzles the supply and exhaust pipes D D′ are connected, and with one of the other nozzles, *t′*, the supply-pipe from the boiler is connected, while the remaining nozzle, t^2, serves as the exhaust from the pipe D′. The turning plug T′ has two segmental passages, U U′, with intermediate solid portions, U^2, for closing the nozzles. When the plug is turned so that the passage U′ opens into the supply-nozzles *t t′*, the steam is admitted to the supply-chamber C^2 of the steam-chest to move the crank-shaft in one direction, and when the plug is turned to cause the passage U′ to communicate with the nozzle *t* and the nozzle t^2, or the one to which the exhaust-pipe D′ is connected, the live steam enters the exhaust-chamber C^3, to drive the engines and rotate the crank-shaft in the reverse directions. The engine can thus be driven in either direction by simply turning the plug of the four-way valve or cock.

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

1. The combination, with an oscillating cylinder and a crank-shaft, of a cross-head fitted on the crank-shaft and having a vertical yoke, a piston having a threaded piston rod adjustably connected to the yoke, and a bearing-plate fitted between the arms of the yoke and having the lower end of the piston-rod bearing on the same, as and for the purpose described.

2. The combination, with an engine and its bed-plate, the latter being provided with vertical flanges, of a cover or jacket for said engine, comprising the curved shell and the independent inclined plates secured at one edge to the shell to embrace said flanges and thereby form a crotch for the same, substantially as described.

3. A steam-chest and a continuously-rotating cut-off located in the supply-chamber therein, in combination with two cylinders suspended from said chest, as and for the purpose described.

4. A steam-chest and a rotary cut-off located in the supply-chamber thereof, immediately over the inlet-port, and having a notch on one side thereof, in combination with two piston-cylinders suspended from said chest, as and for the purpose described.

5. The combination of a fixed cylindrical steam-chest, a series of oscillating cylinders pivotally suspended from the steam-chest and each having a single port adapted to alternately align with inlet and exhaust ports of the steam-chest, a crank-shaft, and the pistons operating in the cylinders and the rotary cut-off extending longitudinally through the supply-chamber of the steam-chest and geared to the crank-shaft to be rotated continuously thereby when the engine is in operation, as and for the purpose described.

6. The combination, with the suspended oscillating piston-cylinder, of a rotary crank-shaft having an annular groove, a sliding sleeve fitted thereon, having the diagonal slots, a sprocket-wheel having pins fitting in slots of the sleeve and the groove of the shaft, a rotary cut-off connected to the wheel by an intermediate chain, and a hand-lever connected to the sleeve for controlling the latter, as and for the purpose described.

7. The combination, with the suspended oscillating piston-cylinder, of a crank-shaft, a rotary cut-off geared to the shaft, to be driven thereby, and mechanism for imparting a slight rotary movement to one of the wheels of the gearing, and thereby vary the relative movement of the cut-off to the shaft, as and for the purpose described.

8. The combination, with the suspended oscillating piston-cylinder, of a crank-shaft, a rotary cut-off, a sliding sleeve connected to the shaft to be capable of a rotary motion therewith, a rotary wheel geared to the cut-off and carried by the sleeve and adapted to be turned or rotated for a portion of a revolution when the sleeve is moved endwise, and a lever for moving the sleeve, as and for the purpose described.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in presence of two witnesses.

JAMES CLARK.

Witnesses:
JOHN H. SIGGERS,
R. W. BISHOP.