(No Model.) 2 Sheets—Sheet 1.

W. O. & J. D. WORTH.

STEAM ENGINE.

No. 399,593. Patented Mar. 12, 1889.

Fig. 1.

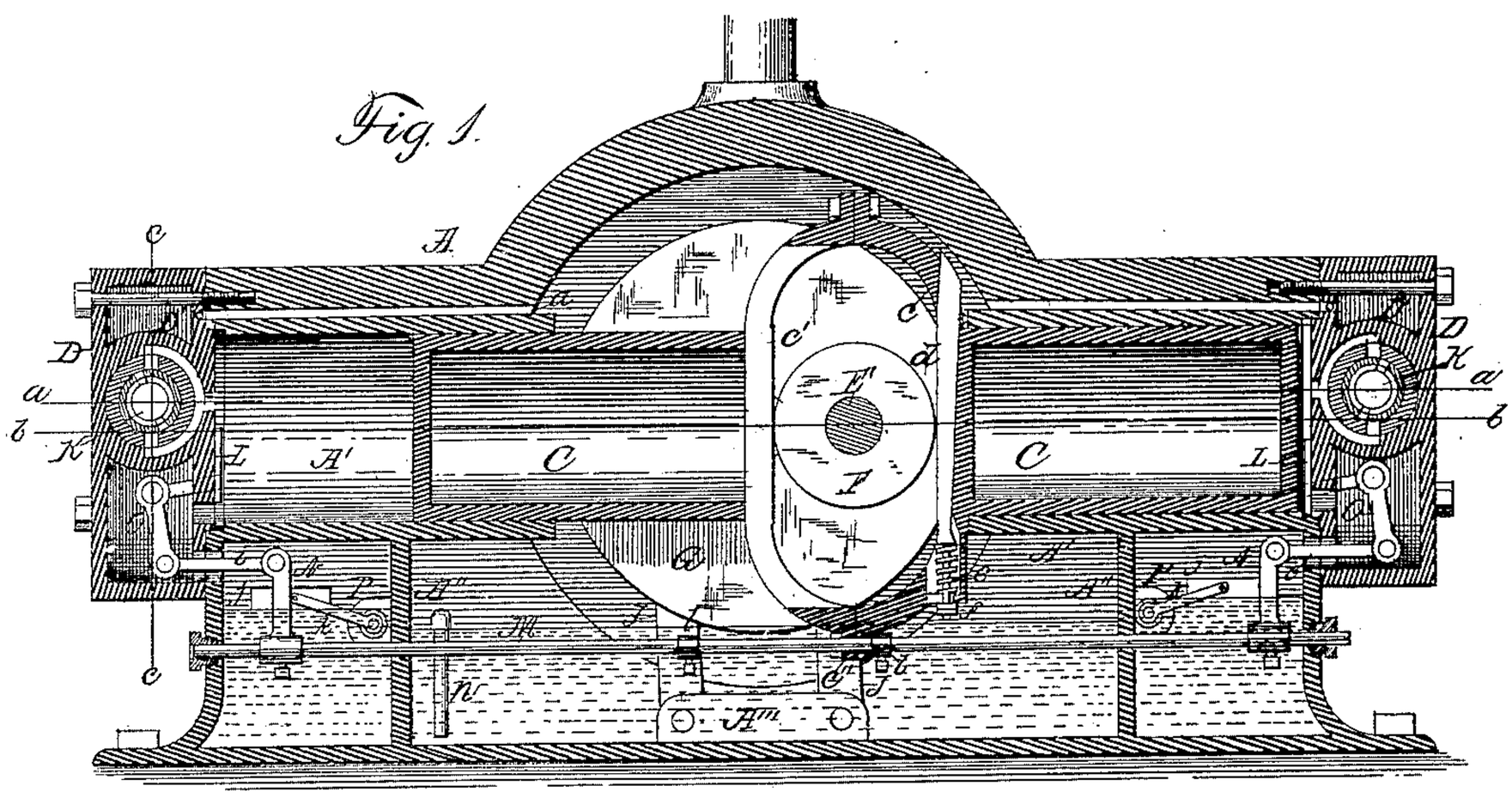


Fig. 3.

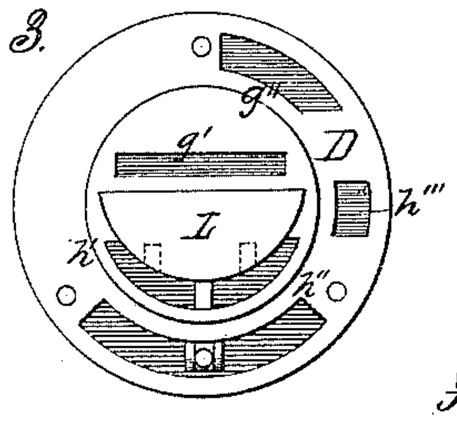


Fig. 4.

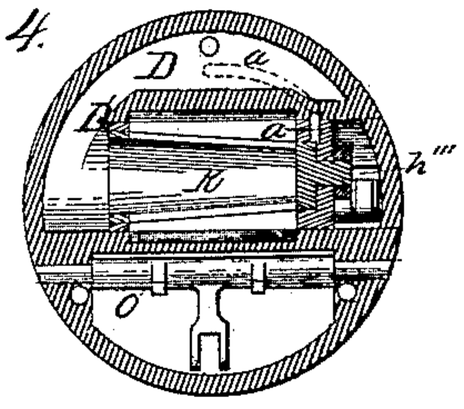
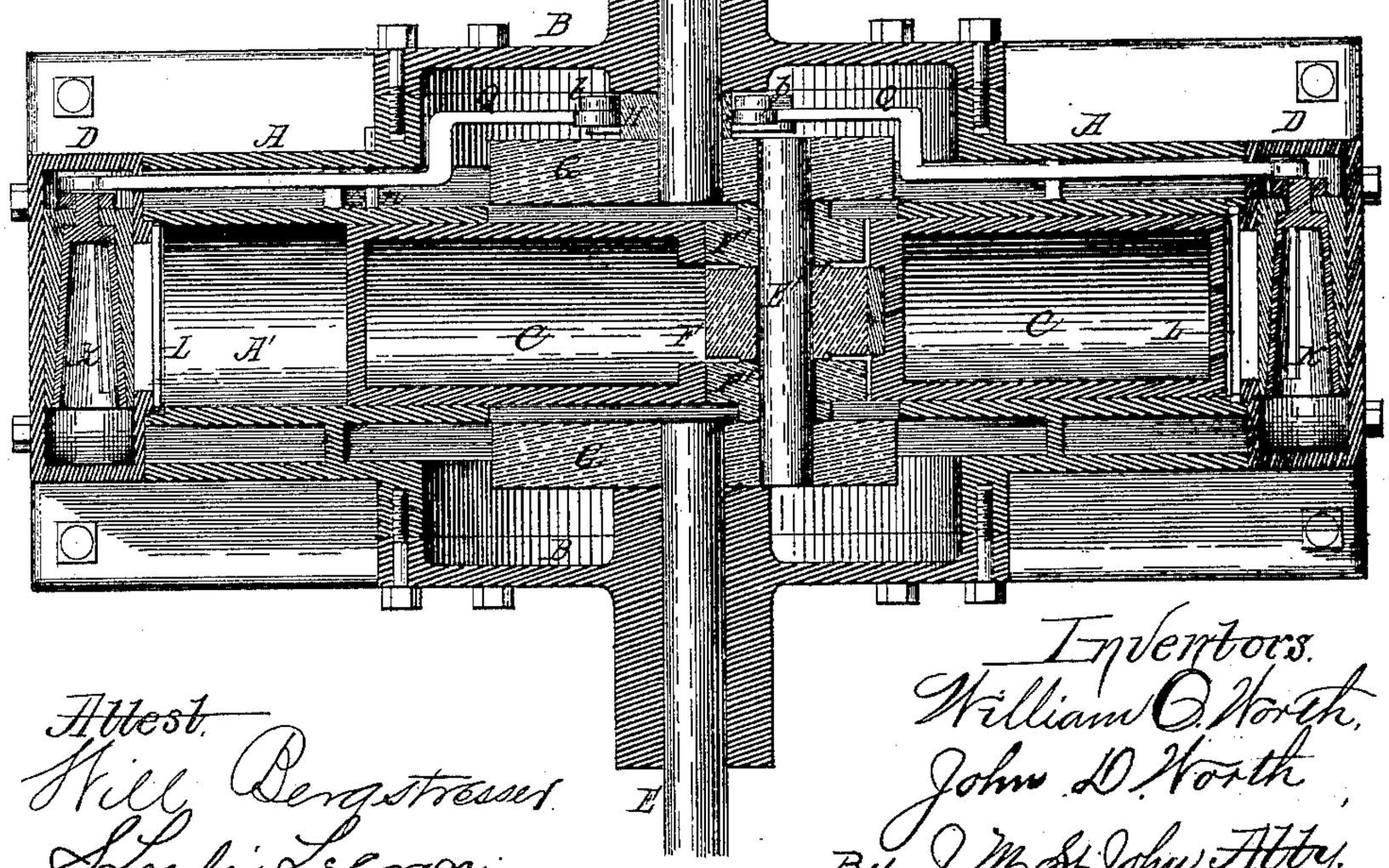


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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STEAM ENGINE.

No. 399,593. Patented Mar. 12, 1889.

Fig. 5.

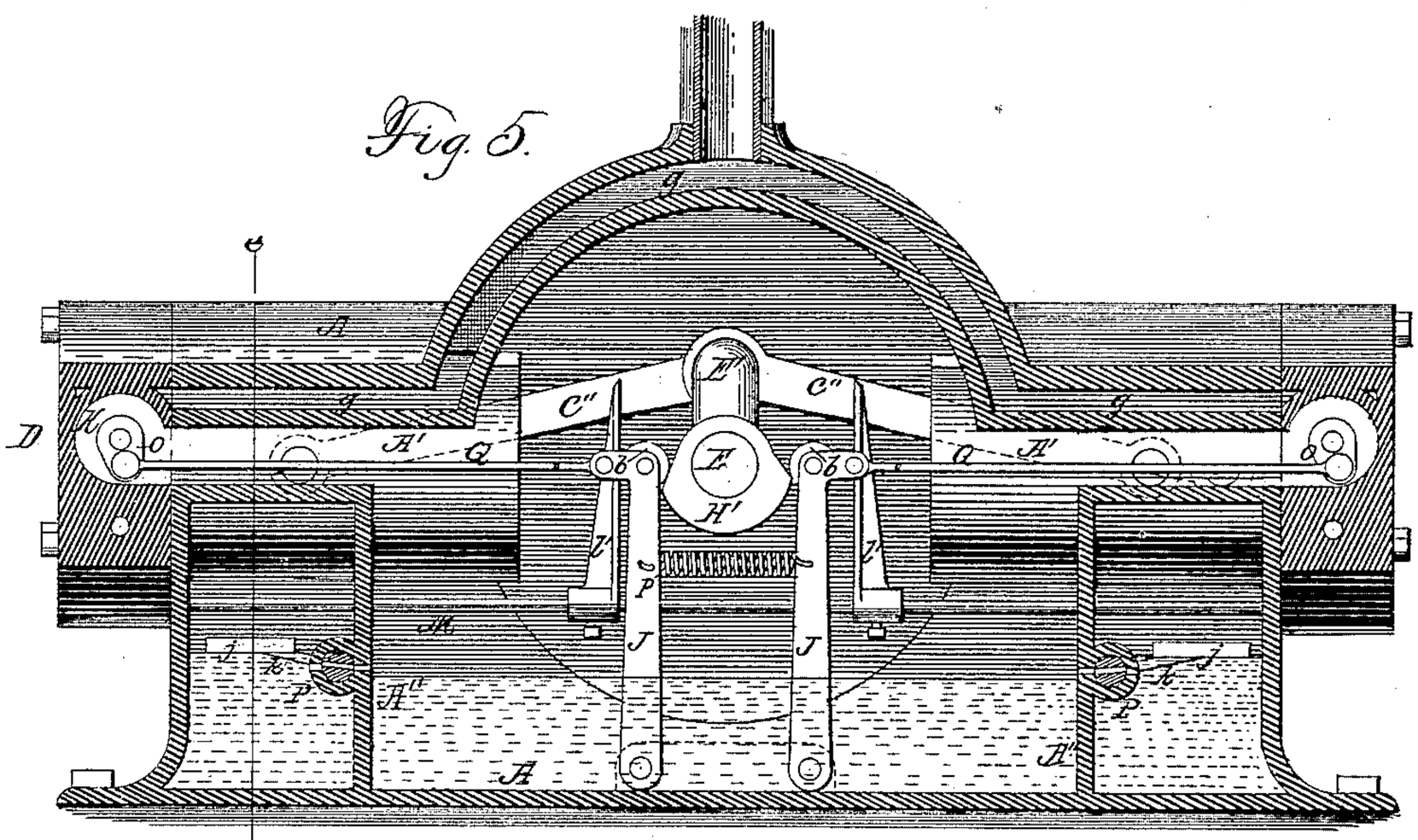

Fig. 7.

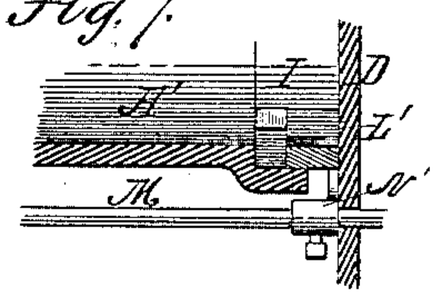

Fig. 6.

Fig. 8.

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UNITED STATES PATENT OFFICE.

WILLIAM O. WORTH AND JOHN D. WORTH, OF CEDAR RAPIDS, IOWA.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 399,593, dated March 12, 1889.

Application filed February 10, 1888. Serial No. 263,637. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM O. WORTH and JOHN D. WORTH, citizens of the United States, residing at Cedar Rapids, in the county of Linn and State of Iowa, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

This invention relates to steam-engines in which the operative mechanism is inclosed in a shell adapted to hold lubricating matter; and the object of the invention is to so construct engines of this class as to increase their efficiency, reduce the cost of manufacture, and improve their appearance.

The invention consists in the construction, combination, and adaptation of mechanism to its required functions in an engine, as hereinafter fully set forth and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1, Sheet 1, is a central longitudinal section of the engine transverse to the crank-shaft; Fig. 2, a horizontal section of the same below the line *a a* as to the heads and the line *b b* as to the rest; Fig. 3, a plan view of the head at the left hand of Figs. 1 and 2, as viewed from the side toward the cylinder, and Fig. 4 a vertical section of the same in the line *c c*, all of said lines being drawn on Fig. 1. Fig. 5, Sheet 2, is a longitudinal section of the engine on the line *d d* of Fig. 6, Fig. 6, an end elevation of the same, partly sectional, on the line *e e* of Fig. 5; Fig. 7, a fragmentary view showing a modification in the construction of the exhaust-valve, and Fig. 8 a fragmentary view showing the arrangement of the exhaust-pipe and a vent-pipe for the shell in connection therewith.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A is a shell having a suitable base, whereby it is mounted upon and attached to a floor or other foundation. In practice I make this shell in substantially the form shown in the various figures, with the central portion enlarged and circular in longitudinal section and with end portions semicircular in cross-section, as shown in Fig. 6. This construction gives the engine a symmetrical and attractive appearance, as will be seen, and also secures a simple and economical arrangement of steam-passages and other parts.

Over the open central portion of the shell are secured heads B B, having hubs B′ B′, adapted to serve as boxes for the crank-shaft E. The inner ends of these boxes serve as a lateral bearing also, being opposed to the faces of the wheel G and eccentric H, or, in the absence of these, suitable collars on the shaft.

In the terminal portions of the shell are placed the cylinders A′ A′, which are open at both ends. These cylinders may be cast as a portion of the shell itself, as shown in Figs. 1 and 2, or made separately and inserted in the shell, as indicated in Fig. 6. In practice the latter construction is preferred, the shell being bored straight through, and the straight cylinders, turned to the proper size, being pressed into place. In this case the cylinders may be of common cast-iron, turned and bored in the usual way, or sections of drawn-steel pipe, which requires no fitting. Such cylinders may be not only much lighter than those of cast-iron, but are more durable, and of course more easily fitted than the former. To increase their durability they may be case-hardened.

The upper portion of the shell is double, the space between constituting the passages for the live steam *g* and for the exhaust-steam *h*. Suitable pipes communicate with these passages, respectively, at the upper and central portion of the shell. The passages terminate at the ends of the shell, where they are adapted to communicate with the interior of the heads D D through suitable openings, *g″* and *h″*, therein. The communication of the steam-passage with the head is direct, while that of the exhaust-passage is circuitous, as will be hereinafter more fully explained.

The central portion of the shell, within which the crank revolves, constitutes a chamber adapted to hold oil, or oil and water, for the lubrication of the working parts of the engine. In practice we use both oil and water, or, what amounts to the same thing, allow the products of condensation to pass into this chamber. The surface of the liquid is preferably kept at a level slightly above the bottom of the crank mechanism at its lowest

point, so that there is comparatively little agitation of the liquid, and the oil is permitted to remain on the surface of the water. This level is maintained by means of an overflow-pipe, *n*, opening outside the shell and having its lower end near the bottom of the chamber, whereby water only passes out of it. Any gases arising from the agitation and fomentation of the contents of this chamber are conveyed out through the exhaust-pipe R, being conducted thereto by an internal pipe, *m*, communicating with the interior of the chamber and with said exhaust-pipe, as shown in Fig. 8.

Near the ends of the lower portion of the shell other chambers are formed by the partition A″, and these chambers communicate directly with the exhaust-passage *h*. These chambers are also adapted to hold oil and water and, for the purpose of conducting the same into the central chamber, are provided with automatic valves P P. These are in the nature of simple water-cocks, the stem of the plug having an arm, *k*, connecting with a float, *j*. The action of the valve will be readily understood. As the water from condensation in these chambers rises, the float is carried upward and the valve opened, as indicated in Fig. 5. Naturally the level of the oil and water in these chambers will be somewhat higher than in the central one, and in practice the valve is adjusted to close with the water and oil considerably higher than that in the central chamber, so that there is no possibility of the exhaust-steam being forced through the valve at any time.

In the heads D D are arranged the steam and exhaust valves and their immediate connections. For the purpose of illustration we have shown a rotary steam-valve of peculiar construction adapted to take steam at one end and discharge it through its sides. We do not wish to be understood, however, as limiting the combination to this form of valve, since a simple slide-valve similar to the exhaust-valve L and actuated similarly will serve for the management of the live steam instead of the rotary valve K shown. In practice, however, we prefer a rotary valve for the live steam and a slide-valve for the exhaust-steam.

Referring now to Figs. 1 and 4, it will be seen that the valve K is mounted in a suitable seat, D′, formed within the head D. The stem of the valve is provided with a suitable crank-arm, *o*, as shown in Fig. 5, and by a connecting-rod, Q, motion is communicated from a cam or eccentric on the crank-shaft. Evidently the valve may be actuated by a simple eccentric in the common and well-known manner; but in order that the valve-rods Q Q may move in lines as nearly straight as possible, I prefer to use the device illustrated in Fig. 5. Instead of an eccentric, a cam, H′, is mounted on the crank-shaft between two vertical pivoted arms, J J. The upper ends of these arms are provided with travelers *b b*, adapted to follow the periphery of the cam, and the arms are pivotally connected with the valve-rods Q Q. A spring, *p*, tends to draw these arms together and make the travelers follow the periphery of the cam. The steam passes from the valve into the cylinder through the aperture *g′* in the head D. Below the steam-valve is placed the exhaust-valve L. The construction of this device admits of considerable variation, and two forms are shown in the drawings. The construction illustrated in the figures of Sheet 1 is preferred, as it admits of the use of the straight cylinder above described, and also causes the exhaust-steam to pass out in a more circuitous course, thus causing the better deposition in the end chambers of the shell of any oil that may be mingled with the steam. The device consists of a simple slide-valve, L, mounted on the inner face of the head D, over the exhaust-port *h′*, and pivotally connected with the inwardly-extending arms of a bell-crank, O, mounted on a suitable pivot in the lower part of the head. A downwardly-extending arm of this bell-crank connects by a suitable rod, *i*, with an arm, N, on a reciprocating rod, M, which is actuated by the crank mechanism near the terminals of the stroke. In the case of the construction shown in Figs. 1 and 2 the rod M passes through a hole in the lower part of the yoke *c c′*, and at the proper points the lug *c″* engages with the collars *l l* on the rod M and moves the same back and forth.

In Fig. 5 the construction is varied to suit the change in the crank mechanism. In this case the rod M may be elevated, so as to connect directly with the bell-crank, and instead of the collars *l l* upwardly-extending arms *l′ l′* are secured to the rod, which is reciprocated by the action of the crank E′ impinging on said arms. It will be seen that the construction in either case is such as to give a sudden opening of the exhaust-port, and that the same remains open until the crank-shaft has completed nearly the half of a revolution, thus giving the engine ample and easy exhaust. As the exhaust-steam passes back into the head D, much of the oil commingled with it will be deposited in the bottom of said head, and will thence flow into the end chamber of the shell. From this chamber it is admitted into the central chamber, as already described.

A modification in the construction of the exhaust-valve is shown in Fig. 7. In this case the cylinder is enlarged at the end and counterbored. In the counterbore is fitted a partial ring, I, with an open space at the bottom to admit a valve, L′. Below this space is the exhaust-port, opening directly from the cylinder into the chamber in the shell. The valve has the same movement as the reciprocating rod M, being connected to it by an arm, N′.

Within the cylinders, between the inner ends of which the crank revolves, are placed straight, long, and, preferably, hollow pistons C C. These are acted upon by the steam only

at the outer ends of course, since the inner ends of the cylinders, open to the full size of the pistons, allow said pistons to pass in and out and serve as a guide for the same. These pistons may be connected to the crank by rods, as shown in Fig. 5, or by a yoke, as in Figs. 1 and 2. An improvement in the construction of this yoke mechanism consists in providing means whereby the lost motion caused by the wear of the traveler F on the crank-pin may be taken up and all "pounding" of the engine prevented. This I accomplish by providing the crank-pin with two or more travelers, preferably three, and giving these travelers a bearing only on one side of the yoke, respectively.

Referring to Fig. 1, it will be seen that the middle portion of the half-yoke *c'* is removed and the traveler bears only on the other side. The travelers F' F', each side, however, bear against this half of the yoke, but not against the opposite half, as shown in Fig. 2. By this arrangement it is possible to adjust the parts so as to run as tightly as may be desired without specially increasing the friction. The adjustment is effected by means of a wedge, *d*, seated in one half of the yoke, preferably opposite the central traveler, against the face of which it bears. The wedge is drawn down by nuts on the lower end, *f*, and a spring, *e*, holds in the opposite direction. In practice I make the yoke an integral part of the pistons.

The construction of the engine described is such that nearly every part may be finished on the lathe, the amount of planing being reduced to the minimum. The result of this is to greatly reduce the cost of manufacture.

It will be understood that when separate cylinders are used in connection with the shell their sides form a part of the wall of the steam-passages and of the chambers described, and thus the operation of coring the shell is made very simple and easy. A further advantage in using removable cylinders is that when worn they may be pressed out of the shell and new ones inserted, thus preserving the shell indefinitely.

It will be noticed that the reciprocating rod M in Fig. 1 is below the surface of the liquid. The effect of this arrangement is to deaden the sound caused by the contact of the lug *c''* with the collars *l l*.

Though we have shown one device for actuating the steam-valve and another for actuating the exhaust-valve, it will be understood that either device may be used in connection with either valve.

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

1. In an engine of the class described, a shell having cylinders in opposite ends thereof, lateral heads adapted to close the central portion of the shell and having boxes for the crank-shaft, steam-passages along the upper portion of said shell, a central chamber within which the crank and its connections operate and adapted to hold oil, and chambers near the ends of said shell communicating with the exhaust-steam passages, substantially as specified.

2. In an engine, substantially as described, a shell having a central chamber isolated from the steam-passages and adapted to hold oil, and chambers near the ends communicating with the exhaust-steam passages and by a suitable valve with the central chamber, whereby the oil from the exhaust-steam deposited in said end chambers may be conveyed to the central chamber, substantially as set forth.

3. In an engine of the class described, the combination of a shell having a central chamber adapted to hold oil, end chambers communicating with the exhaust-steam passages and also adapted to hold oil, and valves, substantially as described, adapted to be automatically operated by a float, whereby the surplus oil from the end chambers is conveyed to the central chamber, as specified.

4. In an engine, substantially as described, the combination of a shell having a central chamber adapted to hold oil, terminal chambers adapted to catch oil from the exhaust-steam, an automatic valve adapted to allow the surplus oil from the terminal chambers to flow into the central one, and an overflow-pipe communicating with the central chamber and adapted to keep the oil at a uniform level, substantially as set forth.

5. In an engine, the combination, with a shell, substantially as described, having terminal heads with steam-valves therein, of a cylinder having an exhaust-port in one side and adjacent to said head, a valve having a convex face fitting the bore of said cylinder and adapted to slide reciprocally in the same direction as the piston, a reciprocating valve-rod connecting with said valve by an arm extending through said port, and mechanism adapted to actuate said valve-rod, substantially as described, and for the purpose set forth.

6. In an engine, the combination of a crank-shaft having two or more travelers mounted on the crank-pin and a piston having a yoke to receive said travelers and allow for the revolution of the crank, said yoke being adapted to bear on opposite sides of the respective travelers, but on only one side of any one traveler, substantially as and for the purpose set forth.

7. The combination, in an engine, of the crank-shaft having two or more travelers mounted on its crank-pin, and a yoke bearing against said travelers from opposite sides, but upon only one side of any traveler, and having for one of its bearing-faces an adjustable wedge, whereby the lost motion due to wear may be taken up, substantially as specified.

8. In an engine of the class specified, the combination, with a cam or eccentric oscillating arms and valves, substantially as described, of a reciprocating rod adapted to act-

uate the steam or exhaust valves, said rod being placed below the surface of the oil or water within the shell of the engine, whereby the sound caused by actuating said rod is muffled, substantially as set forth.

9. In an engine of the class described, the combination of the valve-rods Q Q, the pivoted arms J J, having travelers *b b*, the spring *p*, and the cam or eccentric mounted on the crank-shaft, substantially as and for the purpose set forth.

In testimony whereof we affix our signatures in presence of two witnesses.

WILLIAM O. WORTH.
JOHN D. WORTH.

Witnesses:
W. H. REMSEN,
FRANK G. CLARK.