No. 622,577. Patented Apr. 4, 1899.

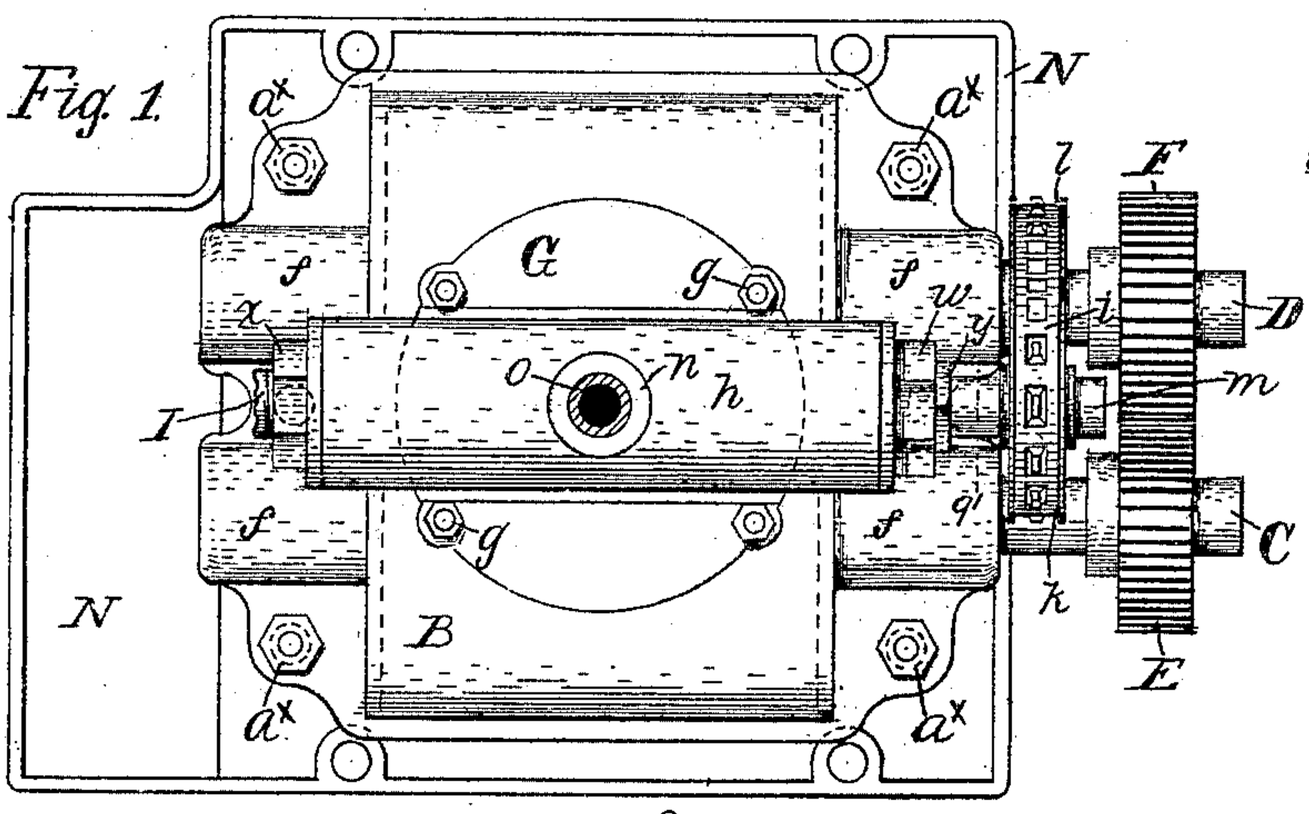
J. B. WEST.

STEAM ENGINE.

(Application filed Nov. 5, 1897.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



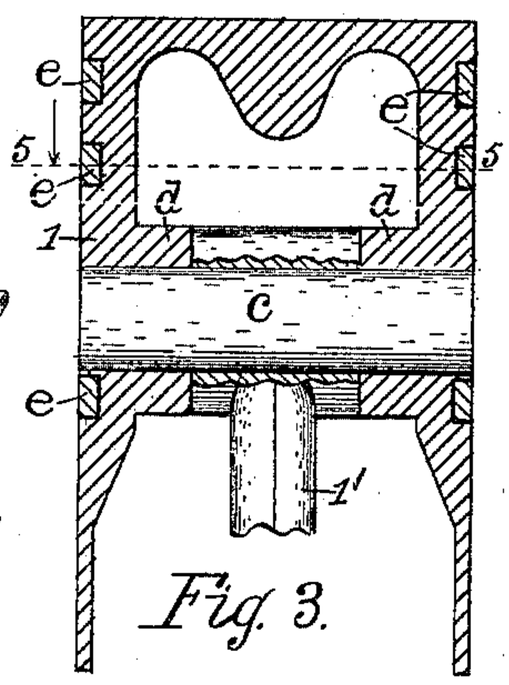
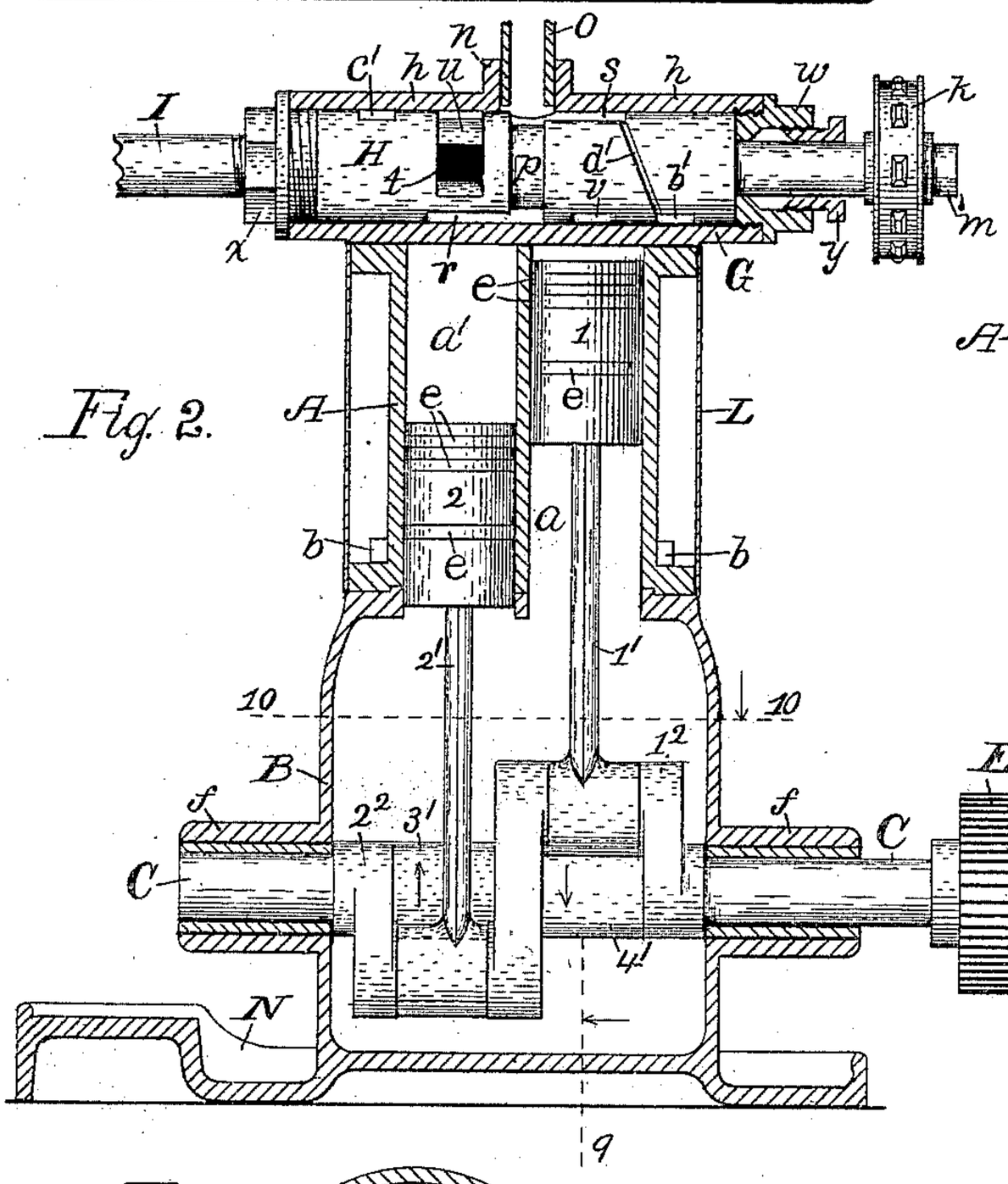


Fig. 3.

Fig. 2.



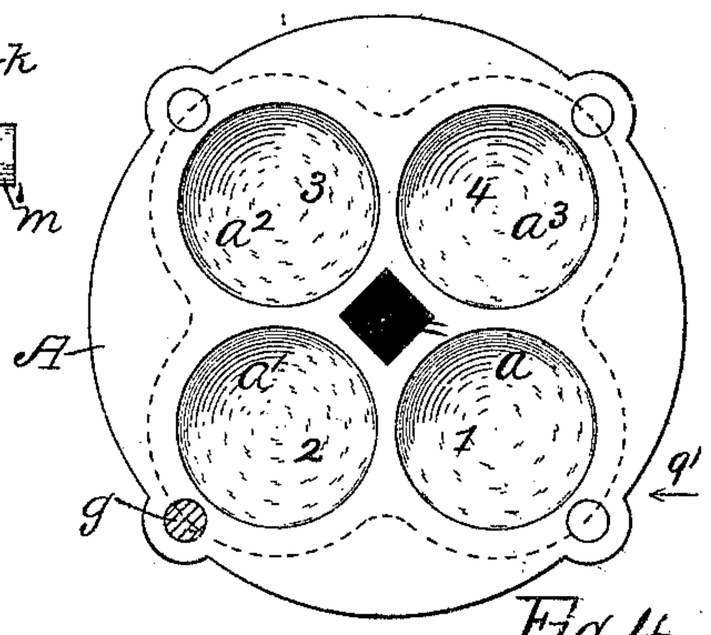


Fig. 4.

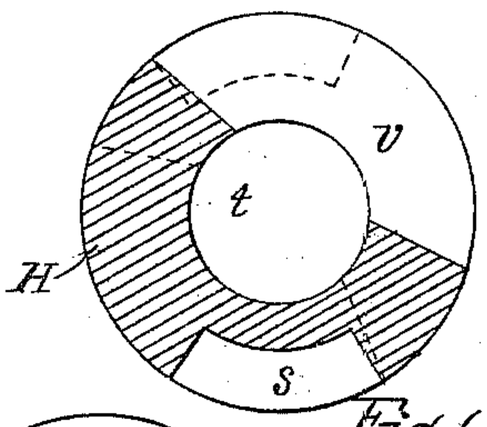


Fig. 6.

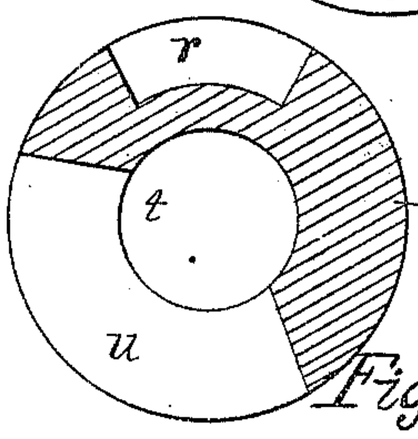
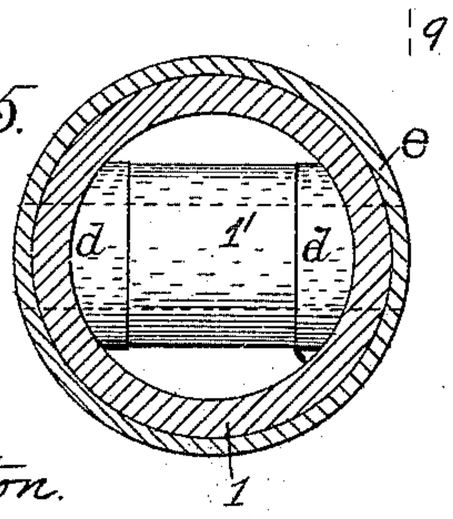


Fig. 7.

Fig. 5.



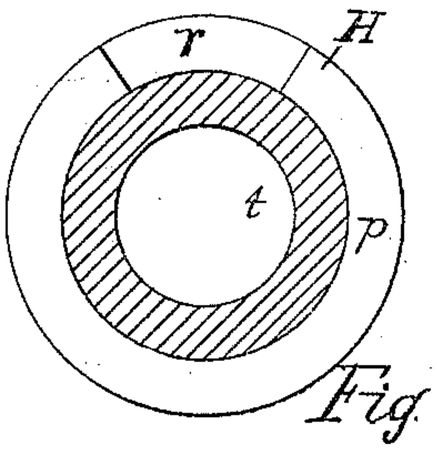


Fig. 8.

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Fig. 9.

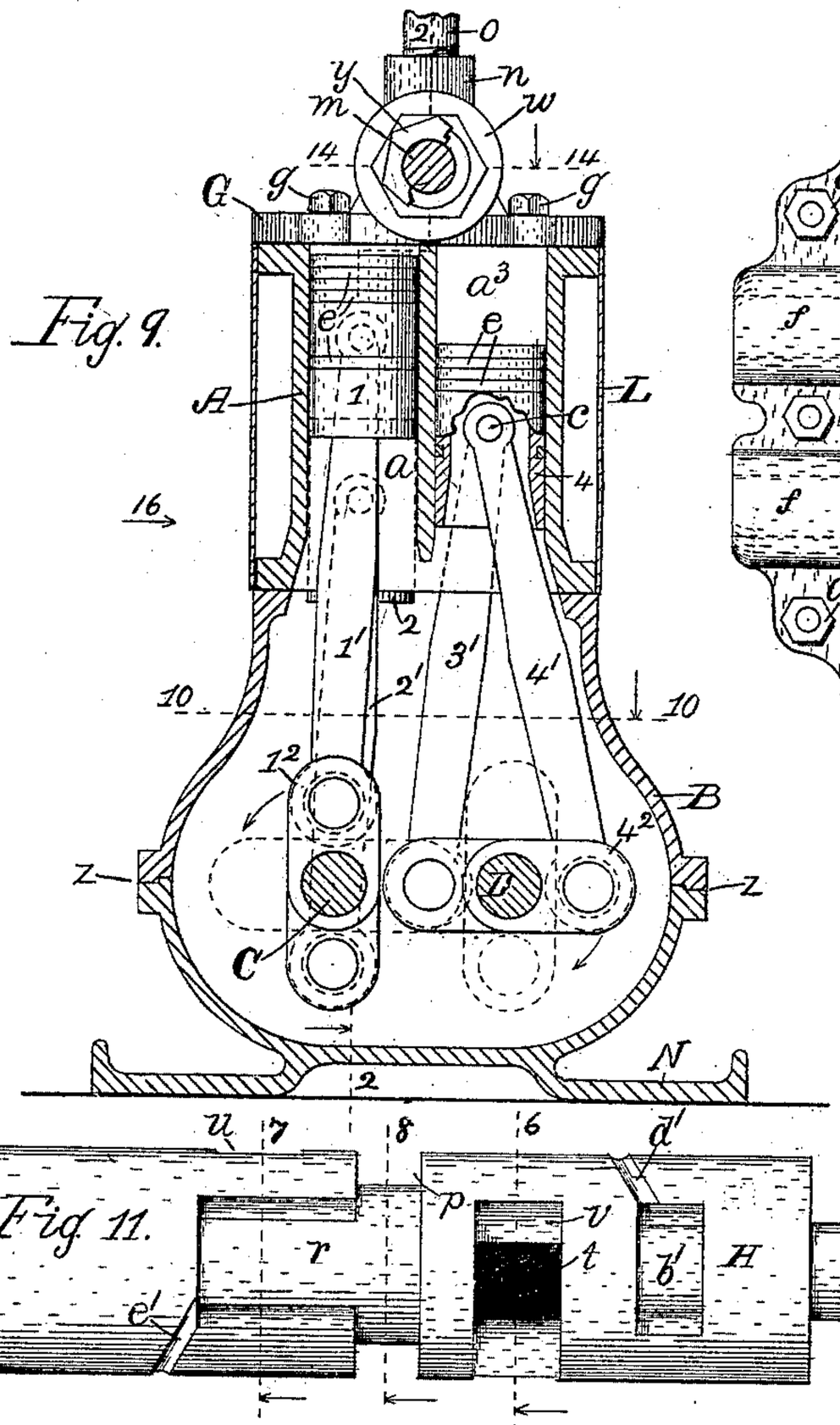


Fig. 10.

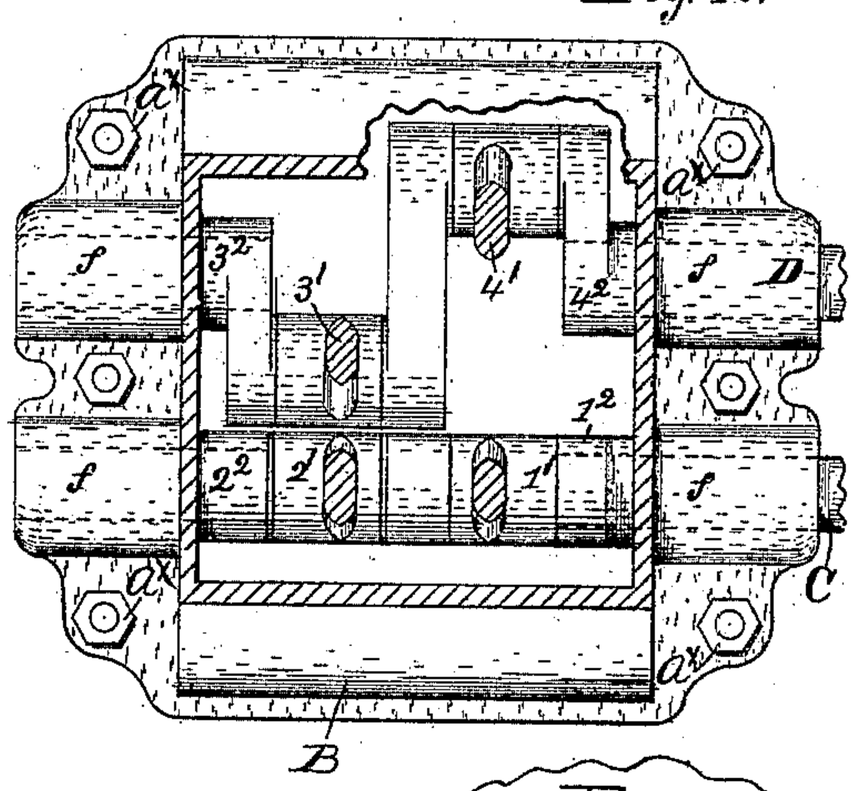


Fig. 13.

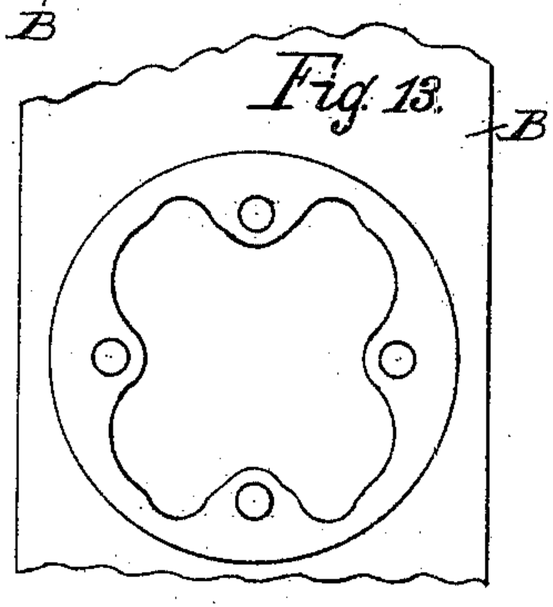


Fig. 11.

Fig. 12.

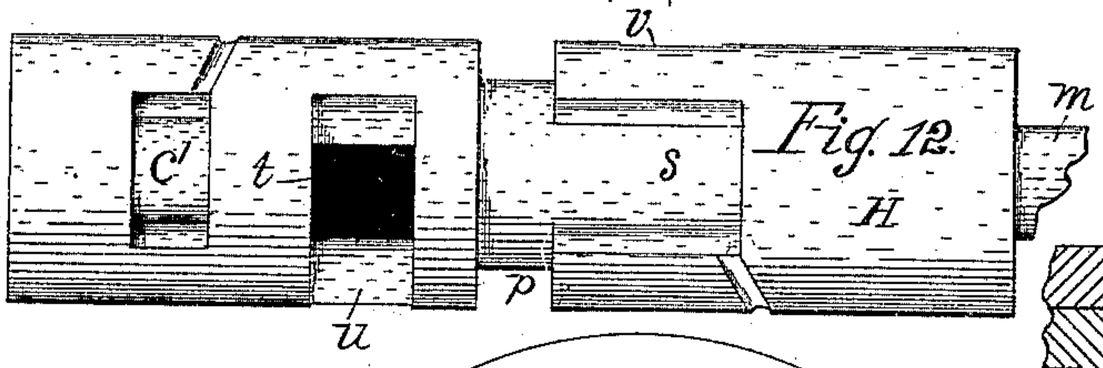


Fig. 15.

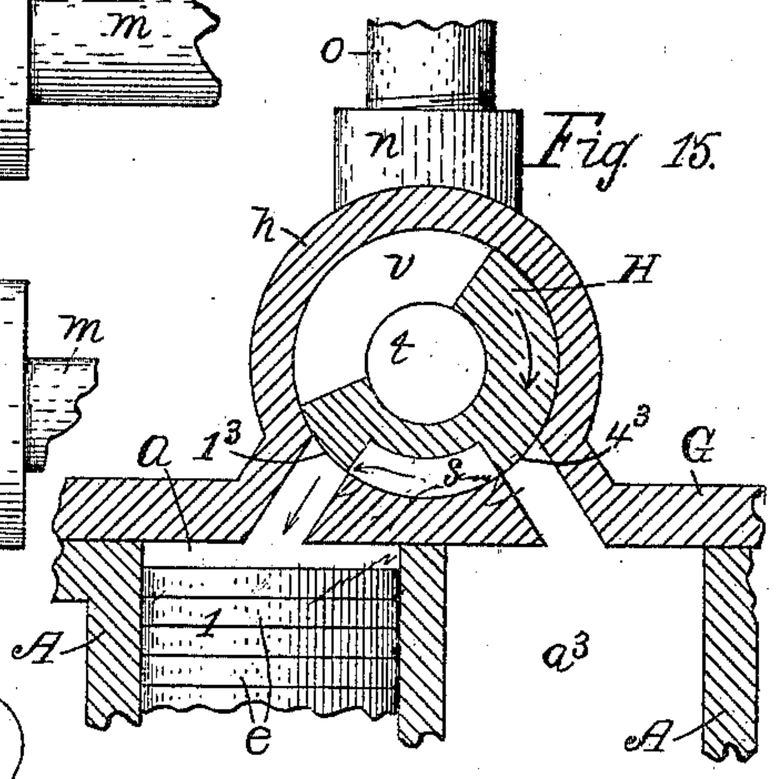
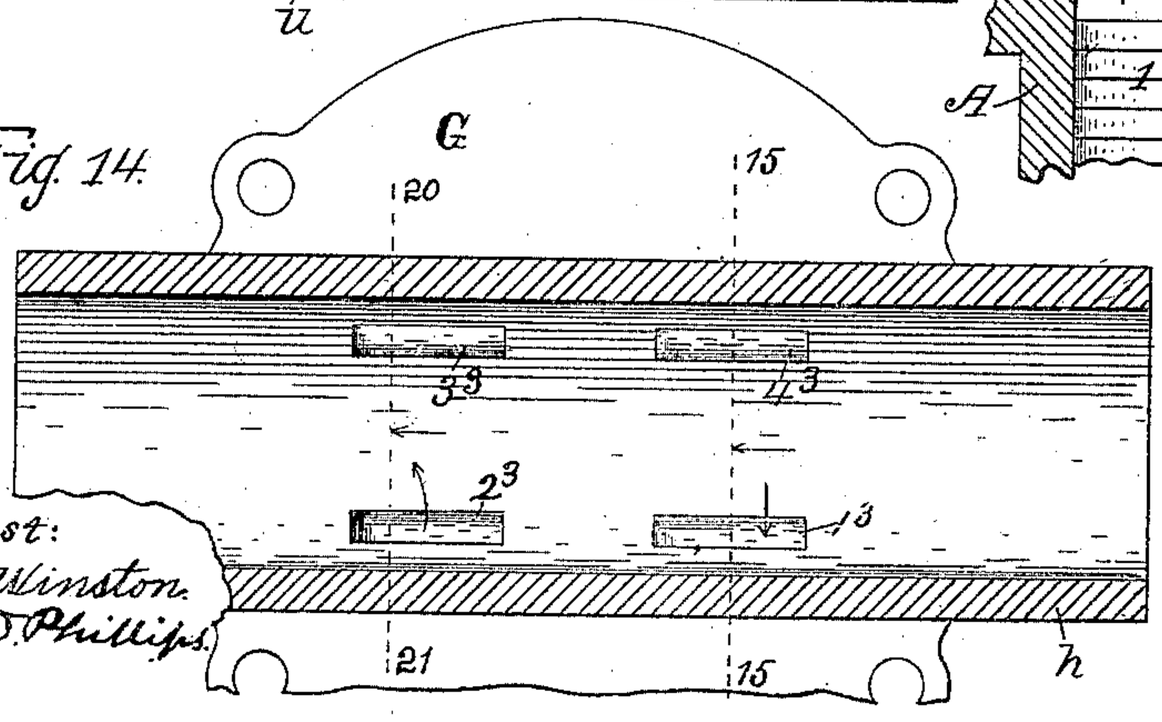


Fig. 14.



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Patented Apr. 4, 1899.

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STEAM ENGINE.

(Application filed Nov. 5, 1897.)

(No Model.)

3 Sheets—Sheet 3.

Fig. 16.

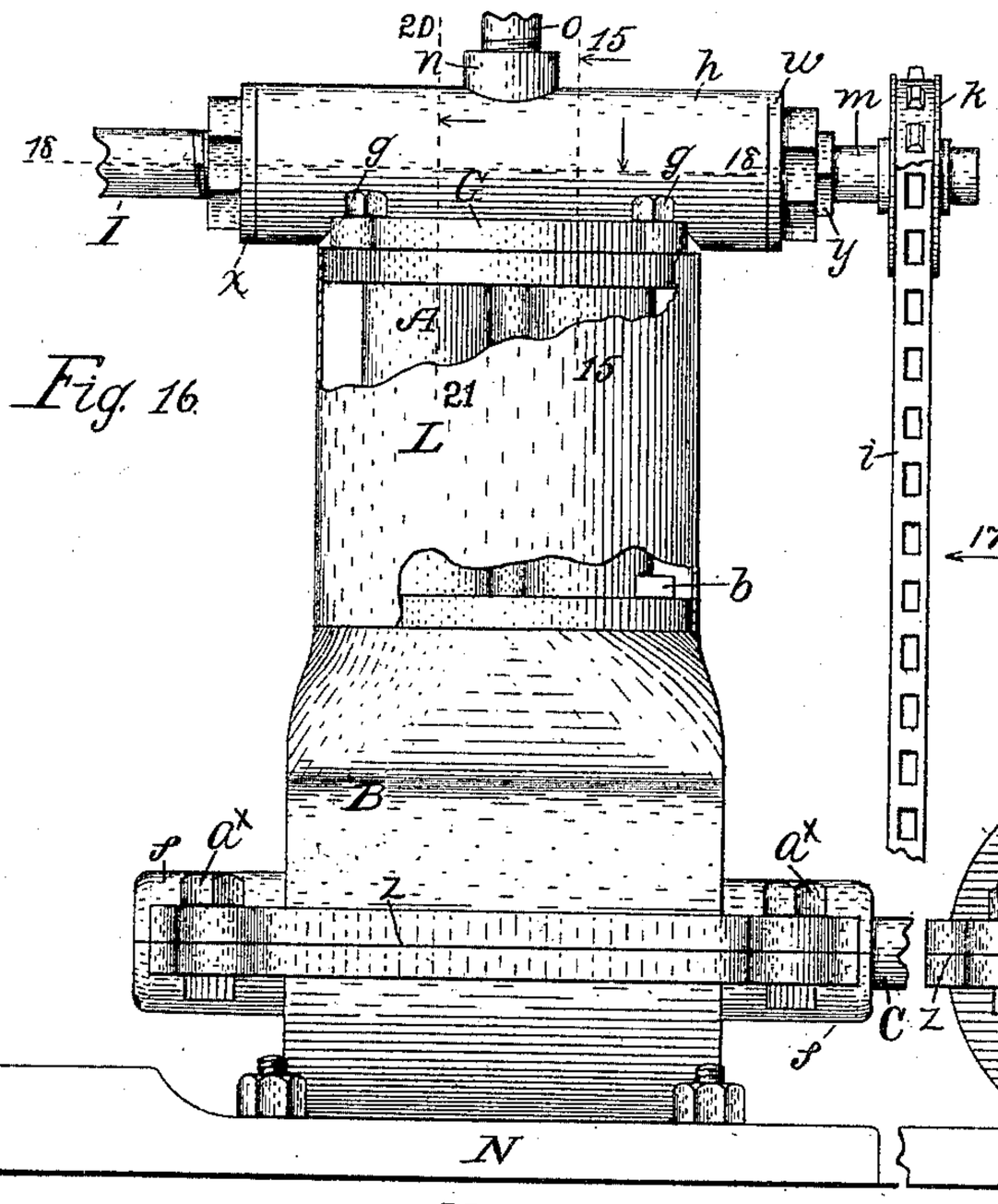


Fig. 17.

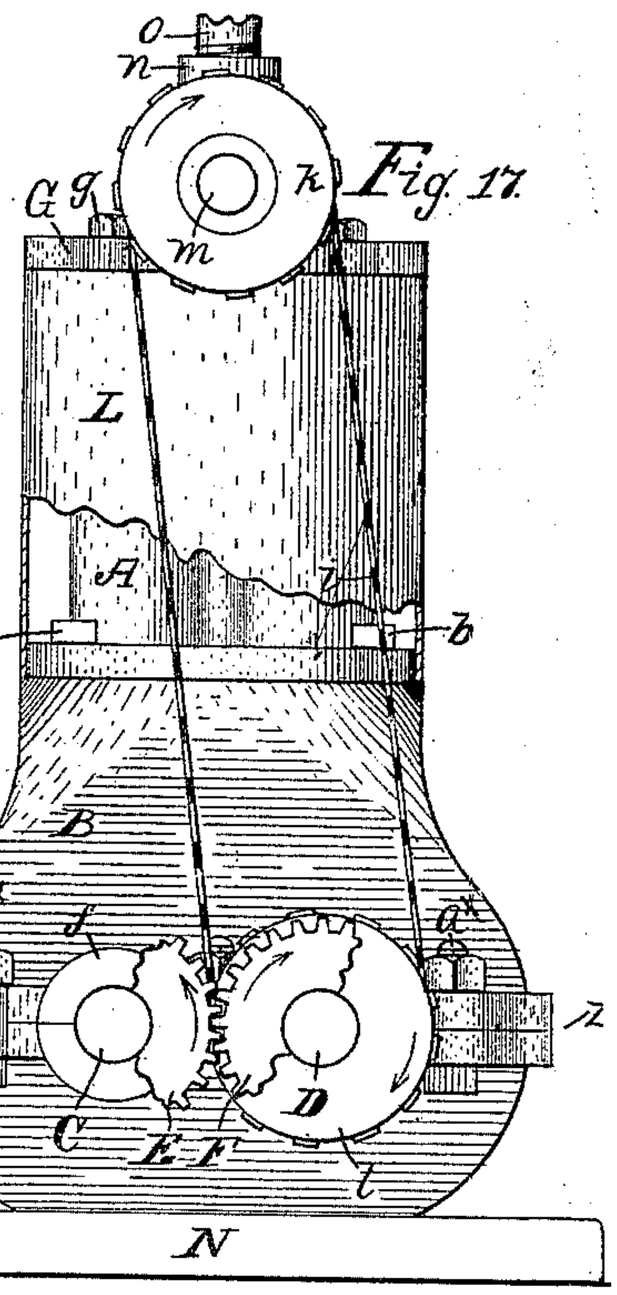


Fig. 18.

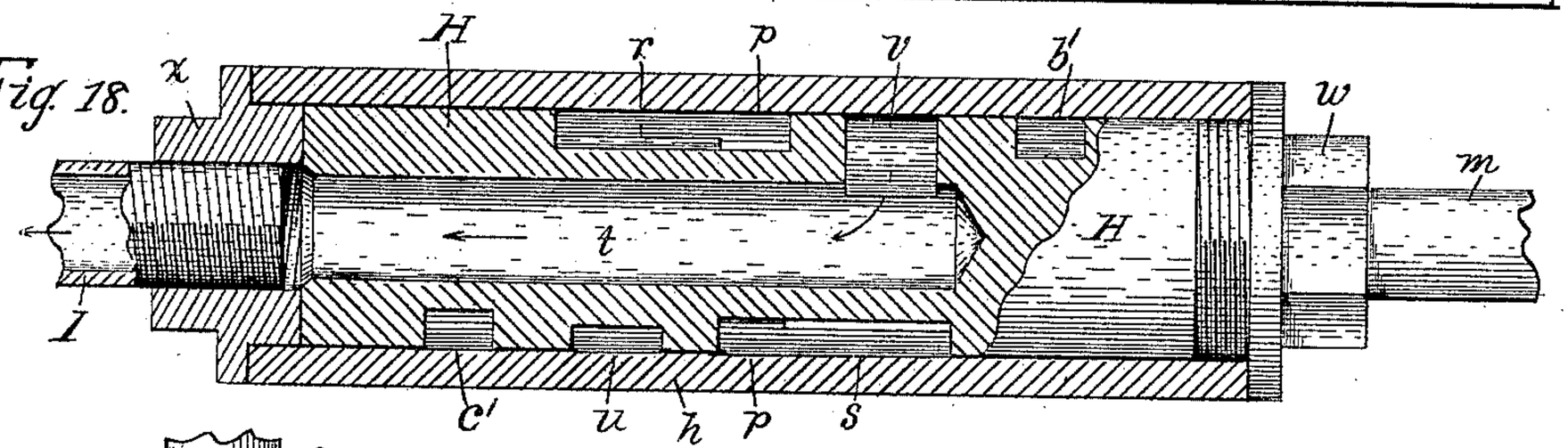


Fig. 19.

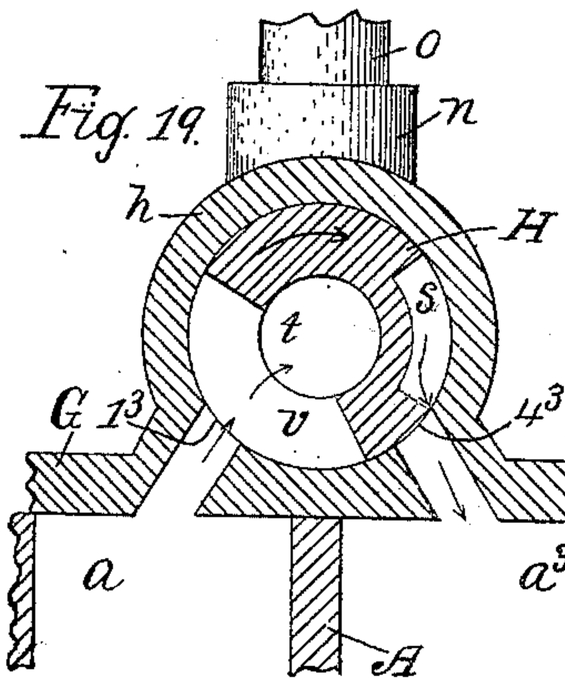


Fig. 20.

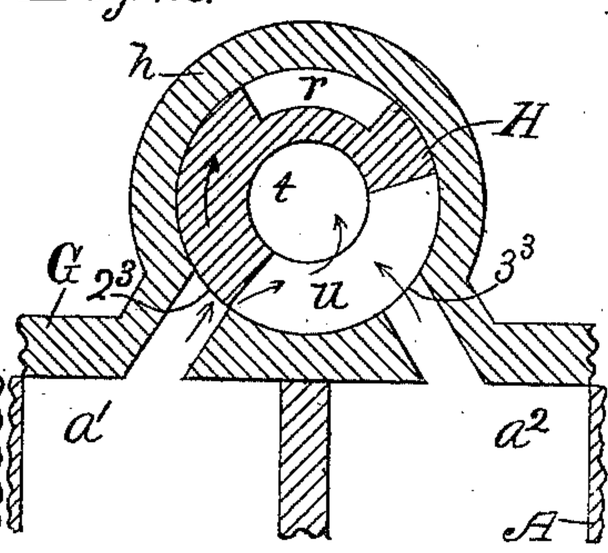
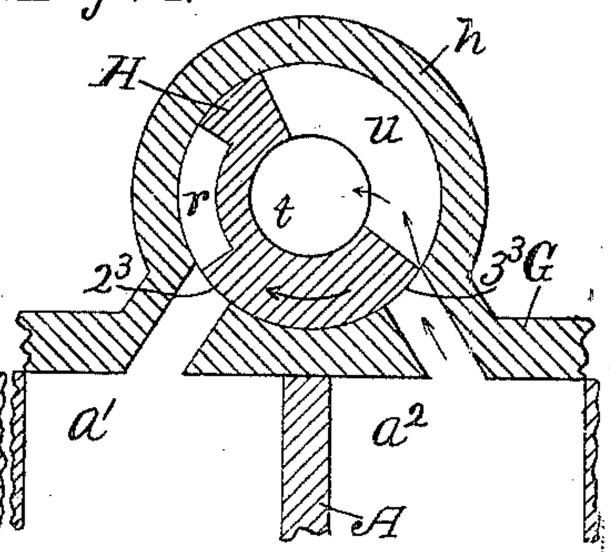


Fig. 21.



Attest:
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M. D. Phillips.

Inventor:
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By E. B. Whitmore,
Atty.

UNITED STATES PATENT OFFICE.

JONATHAN B. WEST, OF ROCHESTER, NEW YORK.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 622,577, dated April 4, 1899.

Application filed November 5, 1897. Serial No. 657,550. (No model.)

To all whom it may concern:

Be it known that I, JONATHAN B. WEST, of Rochester, in the county of Monroe and State of New York, have invented a new and useful Improvement in Steam-Engines, which improvement is fully set forth in the following specification and shown in the accompanying drawings.

My invention relates to multiple-cylinder engines, more particularly to the upright style; and it has for its object the concentration into a small space of the working parts of the engine to adapt the latter for use where space or room is limited—as, for example, in the holds of yachts, upon motor-carriages, and the like.

A further object of the invention is to provide an engine in which there shall be no dead-centers, but which shall be ready to start when in any position of rest.

A further object of the invention is to produce a multiple-cylinder engine which though cutting off at half-stroke, more or less, shall always and in all positions of its cranks have one or more of its pistons in position to receive effective steam-pressure and so need no changing of the cut-off mechanism while starting or while running at full speed.

The invention is hereinafter fully described, and more particularly pointed out in the claims.

Referring to the drawings, Figure 1 is a general plan of the engine. Fig. 2 is a vertical section on the broken dotted line 2 2 in Fig. 9 and seen as indicated by arrow 16 in Fig. 4. Fig. 3 is a central longitudinal section of a piston. Fig. 4 is a plan of the cylinder-body, showing the upper ends of the cylinders and pistons. Fig. 5 is a transverse section of a piston, taken on the dotted line 5 5 in Fig. 3. Figs. 6, 7, and 8 are transverse sections of the valve on the dotted lines 6, 7, and 8, respectively, in Fig. 11. Fig. 9 is a longitudinal section on the dotted line 9 in Fig. 2 seen also as indicated by arrow 9′ in Fig. 4, parts being shown in various positions by full and dotted lines and other parts broken away. Fig. 10 is a transverse section of the frame or crank-chamber on the dotted lines 10 10 in Figs. 2 and 9. Figs. 11 and 12 show opposite sides of the valve. Fig. 13 is a top view of the crank-chamber. Fig. 14 is a central horizontal section of the valve-case, taken on the dotted line 14 14 in Fig. 9. Fig. 15 is a transverse section of the valve and valve-case with some associated parts, taken on the dotted lines 15 15 in Figs. 14 and 16. Fig. 16 is a side elevation seen as indicated by arrows 16 in Figs. 4 and 9, parts being broken away. Fig. 17 is a side elevation seen as indicated by arrow 17 in Fig. 16, parts being broken away. Fig. 18 is a central longitudinal section of the valve, the valve-case, and some associated parts, taken on the dotted lines 14 14 in Fig. 9 and 18 18 in Fig. 16. Figs. 19, 20, and 21 are cross-sections of the valve-case and valve, showing different relative positions of the latter, Fig. 19 being taken on the dotted lines 15 15 in Figs. 14 and 16 and Figs. 20 and 21 on the dotted lines 20 21 in Figs. 14 and 16. Figs. 3, 5, 6, 7, and 8 are drawn full size; Fig. 4, one-half size; Figs. 1, 2, 9, 10, 13, 16, and 17, one-third size, and the remaining figures two-thirds size.

Referring to the figures, A, Figs. 2, 9, and 16, is a cylinder-body having four equal parallel vertical cylinders $a\,a'\,a^2\,a^3$, Fig. 4, equally spaced about the axis of the cylinder-body.

B is an inclosure constituting a frame or crank-chamber, upon the upper end of which the cylinder-body rests, being secured in place by vertical bolts *b*, Figs. 2 and 16. Within the four cylinders are placed, respectively, pistons 1 2 3 4, Figs. 2, 4, and 9, adapted to receive steam (or other fluid under pressure) against their upper ends only. The pistons are hollow with their lower ends epen, and connected with them are rods 1′ 2′ 3′ 4′, Figs. 2, 9, and 10, the manner of joining the rods to the pistons being shown in Figs. 3 and 5. A transverse pin *c*, held in internal bosses *d* of the piston, passes through the head of the connecting-rod, upon which the latter is adapted to swing. The pistons are provided with the usual packing-rings *e*.

The crank-chamber or frame B is divided horizontally at *z*, Figs. 9, 16, and 17, the two parts being held together by bolts $a^{\times}$. This chamber or frame holds two parallel horizontal crank-shafts C and D, Figs. 1, 2, 9, and 17, the axes of the shafts being in the plane of the division *z* of the frame. Each shaft is

provided with two oppositely-projecting cranks, the shaft C having cranks 1^2 and 2^2, and the shaft D having cranks 3^2 and 4^2, the rods 1′, 2′, 3′, and 4′ connecting, respectively, with the cranks 1^2, 2^2, 3^2, and 4^2. These crank-shafts rest in bearings *f*, projecting horizontally from opposite sides of the crank-chamber or frame, and are connected by means of equal overhanging gears E F, engaging each other, as shown in Figs. 1 and 17. The two cranks on either shaft are turned opposite each other in line; but the two shafts are relatively so geared together that when the cranks of one are vertical the cranks of the other are horizontal, as shown in Fig. 9. By means of this arrangement the two shafts work close together, and the cranks nearly touch each other, but do not interfere, though as the shafts revolve the cranks occupy the same spaces in rapid succession. The cranks being thus set bring one of the four pistons at the top of its travel and in position to take steam at every one-fourth of a revolution of the shafts—that is to say, at each fourth of a revolution of the shafts steam is let into one of the four cylinders against a piston and one of the cylinders is exhausted—and as the valve is formed to give the usual "lead" to the steam, it will be understood that the flow of steam toward the cylinders will be continuous while the engine is running and that under all conditions the valve will present an open passage for the steam to one or two of the cylinders.

Over and for the purpose of closing the cylinders at their upper ends is placed a cap or head G, Figs. 1, 9, and 16, held to place by bolts *g*. This head comprises a horizontal cylindrical valve-case *h*, holding a cylindrical revoluble valve H, Figs. 11, 12, and 18. This valve is turned within the case by means of a chain *i*, Figs. 1, 16, and 17, running on sprockets *k l*, the former secured to an extended part *m* of the valve and the latter to the crank-shaft D. The valve-case is formed at its lower side with four equal parts 1^3 2^3 3^3 4^3, Figs. 14 and 15, opening into passages leading into the respective cylinders *a a′* a^2 a^3.

It is also formed with a boss *n* on its upper side, in which to receive an inlet-pipe *o* for the steam or other fluid used to propel the engine. The valve is formed with a central transverse groove *p* opposite the inlet-pipe, so the steam may pass wholly around the valve. To the left of the groove is made an opening *r*, Fig. 11, and to the right a similar opening *s*, Fig. 12, by means of which steam is permitted to flow into the ports and the cylinders beneath. The valve is also formed with an axial chamber *t*, (see also Figs. 18 to 21,) into which the cylinders successively exhaust through openings *u v*, leading from the surface of the valve into the axial chamber. The valve is held in the case by means of plugs *w x*, threaded in the respective ends of the case, Figs. 2 and 18, which prevent any endwise motion of the valve. The plug *w* is given internally the form of a stuffing-box and provided with a threaded gland *y*, all of the usual form, to prevent leakage along the stem *m* of the valve. The opposite plug *x* is formed to receive a threaded pipe I, Fig. 18, out through which the steam from the cylinders exhausts as the valve is turned.

The cutting off of steam from the cylinders is effected and determined by the width given the openings *r* and *s*. These openings are alike, and the width of each, as here shown, is such as to cut off the steam at about half-stroke. There will always be two pistons out of the four under steam-pressure, the steam acting expansively against one of them, and thus, although the cylinders are each cut off at half-stroke, there is no time when one, or it may be two, of the pistons will not be in position to be acted upon by the steam when let in from the generator. Thus without any changing of the cut-off mechanism to control the flow of steam the engine is always ready to start, even when the cylinders are only half filled with live steam. This I regard as of great importance in this construction of engine.

Viewing Fig. 9 it will be seen from the positions of the parts that piston 1 is just ready to take steam, while piston 2 has completed its work on the downstroke and ready to have its cylinder exhausted; also, that piston 4 has moved half-way down under the pressure of steam and that piston 3 is moving upward, its cylinder a^2, Fig. 20, having been exhausted. Figs. 15 and 20 show the relative position of the valve when the pistons occupy the positions shown in Fig. 9. The opening *s* is just approaching the port to allow a flow of steam into cylinder *a*, while cylinder *a′* is just commencing to exhaust, the cylinder a^2 having completely exhausted. Fig. 19 shows the valve in position to allow steam to flow into cylinder a^3, the cylinder *a* being completely exhausted, while Fig. 21 shows cylinder *a′* fully supplied with steam and cylinder a^2 just ready to exhaust. The valve is preferably formed with balance-openings *b′ c′*, Figs. 11, 12, and 18, with steam-passages *d′ e′* leading to them from the respective openings *s* and *r*. These openings are on the sides of the valve opposite the respective openings *s* and *r* and serve to balance the pressure of steam on the valve.

The cylinder-body is inclosed by a jacket L, of sheet metal or other material, and the engine is formed with a base-pan N for the usual purpose of catching the drip from the working bearings. The crank-chamber B is closed at the bottom and imperforate, and oil and water are placed therein in a sufficient quantity to be struck by the cranks as the latter pass their lowest positions. The oil being thus splashed over the cranks keeps their bearings with the connecting-rods lubricated. These cylinders, it is understood, may be placed horizontal, as well as vertical, as shown,

or in any inclined position, this being a matter of adaptation.

In connecting this engine with machinery to be driven either gear E F may be made to engage another gear or pinion, or either shaft may be lengthened to receive a belt-pulley or other wheel or device for the purpose.

It will be understood that any other means—as, for example, toothed gearing—may be employed in place of the chain *i* for actuating the valve. The means for connecting a crank-shaft with the valve is not essential to my invention, the precaution only being taken to have such connection positive in action, so that the relation of the valve and the crank-shafts shall not become changed.

What I claim as my invention is—

1. A multiple-cylinder engine having pistons in the cylinders, in combination with two shafts each having two oppositely-projecting cranks with the cranks on opposite shafts at right angles to each other and all within a single chamber, and rods connecting the pistons with the respective cranks, the shafts being mounted in proximity to each other and the cranks being set so as to successively revolve through the same space between the shafts and connectors, as toothed gears, for the shafts, substantially as set forth.

2. In an engine, four cylinders equally spaced about a center line within one cylinder body and jacket, and pistons in the cylinders, in combination with two shafts each having oppositely-projecting cranks, and rods connecting the pistons with the respective cranks, a single chamber inclosing said cranks and rods and connectors for the shafts, the cranks of the two shafts being set so as to successively revolve through the same space between the shafts, as specified.

3. An engine having four cylinders, and pistons in the cylinders, in combination with two shafts each having oppositely-projecting cranks, and rods connecting the pistons with the respective cranks, the latter being set so that when the two on either shaft are horizontal the two on the other shaft will be vertical the cranks of the two shafts being set so as to successively revolve through the same space between the shafts, substantially as shown and described.

4. A four-cylinder engine having pistons in the cylinders, coacting shafts having cranks, and rods connecting the pistons with the respective cranks, a single cylinder-body inclosing said cylinders and a single chamber inclosing the cranks and rods, in combination with a valve for controlling the steam, the cranks being set, and the cranks of the two shafts being set so as to successively revolve through the same space between the shafts, to bring a piston in position to take steam at every one-fourth revolution of the shafts, as specified.

5. In a multiple-cylinder engine, in combination four cylinders equally spaced about a center line with one cylinder-body, a series of pistons, a series of cranks, a series of rods connecting the pistons with the respective cranks, two parallel equally-revolving shafts carrying the cranks the cranks of the two shafts being set so as to successively revolve through the same space between the shafts, a revoluble valve, and means for automatically turning the valve from one of the shafts, substantially as specified.

6. A multiple-cylinder engine having four cylinders equally spaced about a center line a series of pistons, a series of cranks, and rods connecting the pistons with the cranks, the cranks of the two shafts being set so as to successively revolve through the same space between the shafts in combination with a valve for controlling the flow of steam to the cylinders, formed to cut off the steam from each cylinder before it is filled, and to at all times present an open passage for steam to one or more of the cylinders, as specified.

In witness whereof I have hereunto set my hand, this 28th day of October, 1897, in the presence of two subscribing witnesses.

JONATHAN B. WEST.

Witnesses:
ENOS B. WHITMORE,
M. L. WINSTON.