No. 847,490. PATENTED MAR. 19, 1907.

C. H. MONROE.

STEAM ENGINE.

APPLICATION FILED DEC. 2, 1904.

3 SHEETS—SHEET 1.

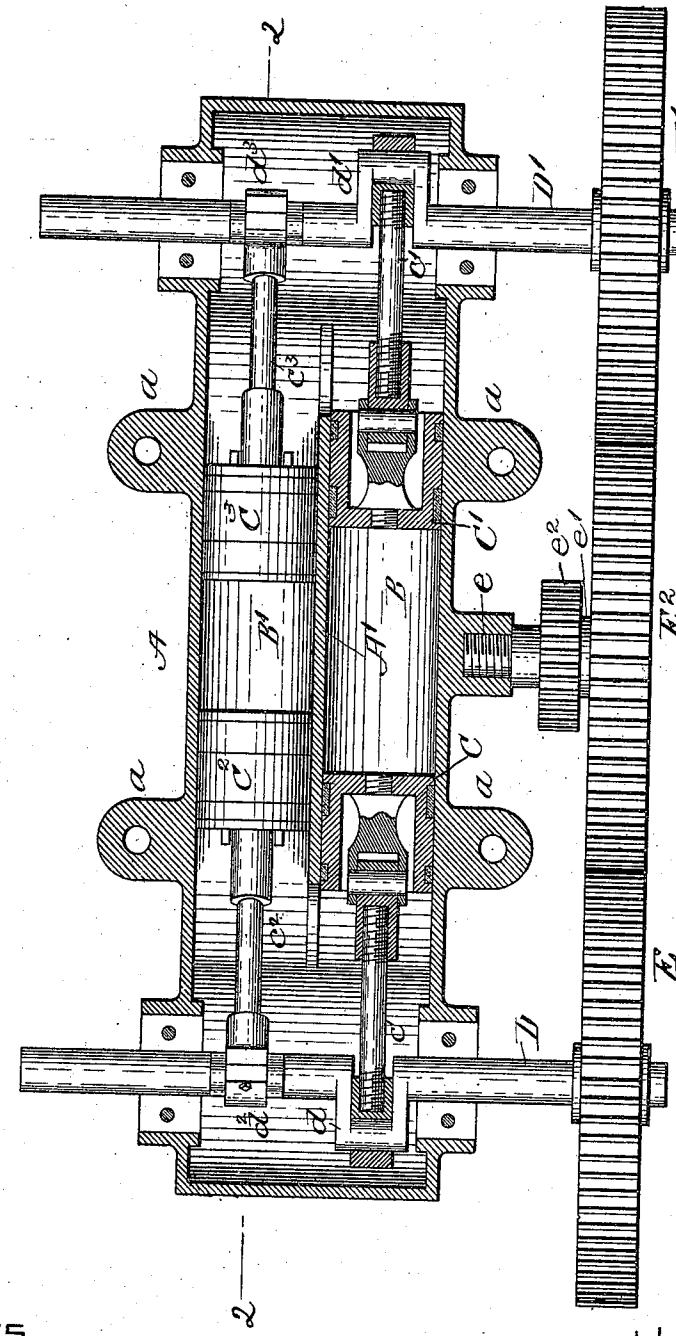

Fig. 1.

WITNESSES.
M. D. Newman.
M. V. Foley.

INVENTOR.
Charles H. Monroe
by his attys.
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3 SHEETS—SHEET 2.

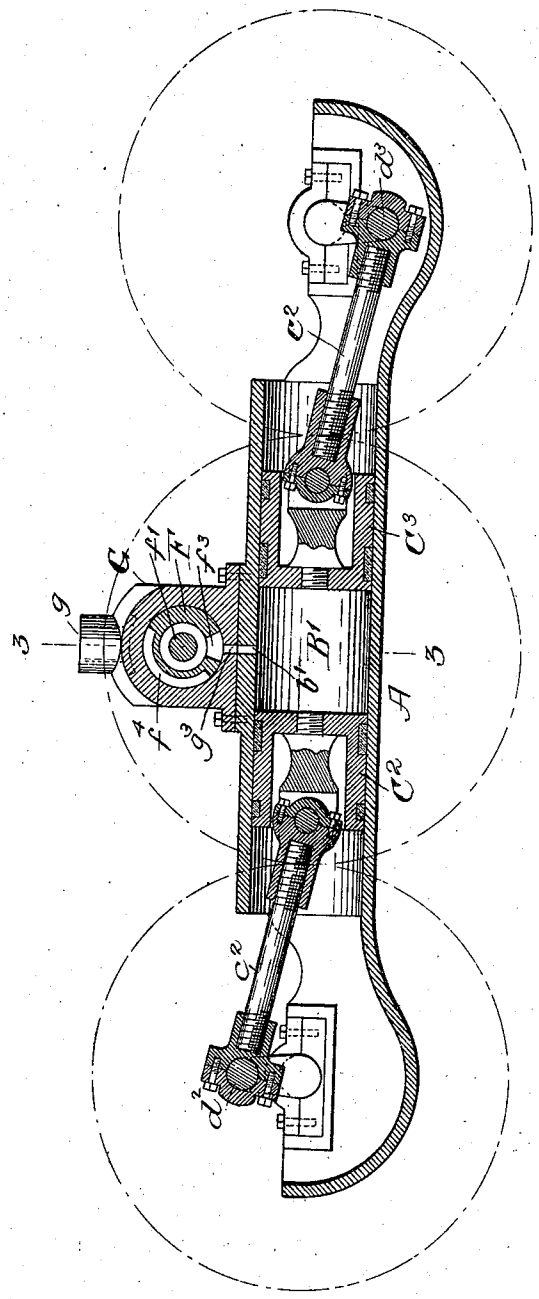

FIG. 2.

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3 SHEETS—SHEET 3.

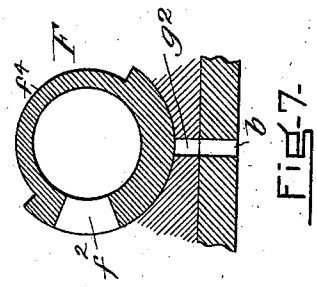

Fig. 7.

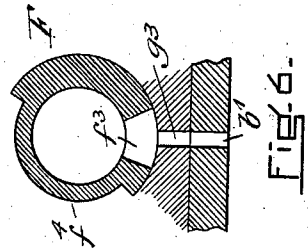

Fig. 6.

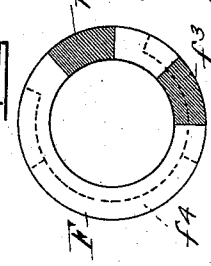

Fig. 8.

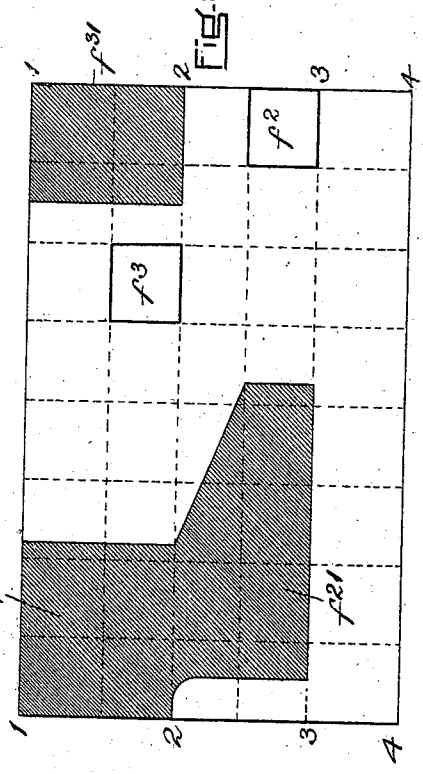

Fig. 9.

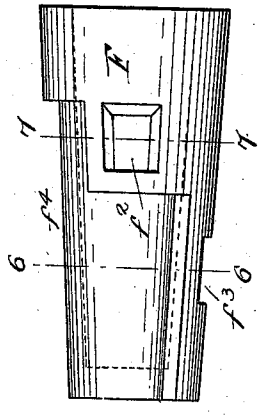

Fig. 5.

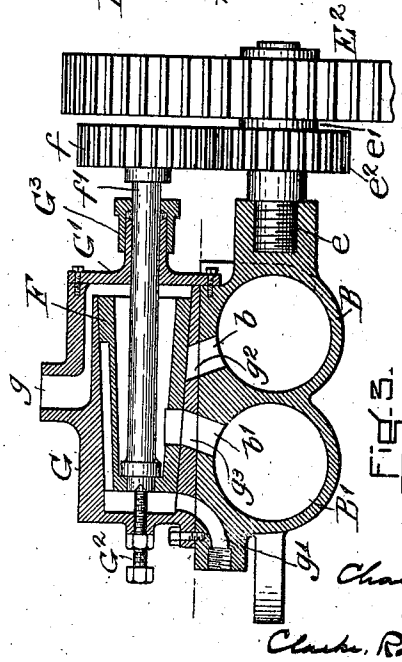

Fig. 3.

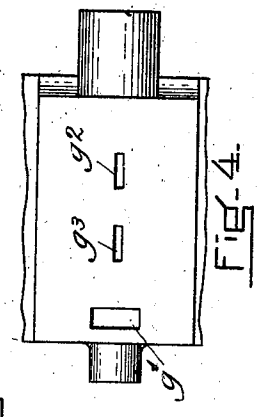

Fig. 4.

WITNESSES.

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UNITED STATES PATENT OFFICE.

CHARLES H. MONROE, OF SEARSPORT, MAINE, ASSIGNOR OF ONE-THIRD TO WILLIAM E. GRINNELL, OF SEARSPORT, MAINE, AND ONE-THIRD TO HENRY B. BLACK, OF EVERETT, MASSACHUSETTS.

STEAM-ENGINE.

No. 847,490. Specification of Letters Patent. Patented March 19, 1907.

Application filed December 2, 1904. Serial No. 235,222.

To all whom it may concern:

Be it known that I, CHARLES H. MONROE, a citizen of the United States, residing at Searsport, in the county of Waldo and State of Maine, have invented a new and useful Improvement in Steam-Engines, of which the following is a specification.

My invention is intended especially for use where compactness is necessary; and to that end the embodiment of my invention shown in the drawings comprises two parallel cylinders each containing two pistons separating from each other upon the introduction of steam, the whole being connected by suitable means so that the operation of each piston in each pair assists the other, all coöperating to convey power to a single shaft or to two parallel shafts, as may seem best.

My invention also relates to a valve mechanism; and it consists in other details of mechanism below described.

My invention will be understood by reference to the drawings, in which—

Figure 1 is a horizontal section of an engine embodying my invention, the shaft-bearings being omitted. Fig. 2 is a longitudinal vertical section thereof. Fig. 3 is a cross-section on line 3 3 of Fig. 2. Fig. 4 is a plan of a portion of the main casting on which the steam-chest sets, showing the inlet and exhaust ports. Fig. 5 is a side elevation of the valve enlarged. Fig. 6 is a cross-section on line 6 6 of Fig. 5, in which a portion of the valve-casing is added to show the relation between the valve and the valve-casing ports. Fig. 7 is a similar view taken on line 7 7 of Fig. 5. Fig. 8 and Fig. 9 are diagrams showing the relation of the inlet and exhaust ports to each other and to the periphery of the valve.

A is a casting forming the bed of the engine and provided with means, such as lugs *a*, whereby it may be bolted to any suitable support. This casting A is provided with a central longitudinal partition A′, and between this central partition and the outer walls of the casting are formed the cylinders B B′. Within each cylinder are two pistons C C′ C^2 C^3, each piston being of any ordinary construction and packed in any ordinary way and provided with a crank-rod *c* *c′* c^2 c^3, hinged thereto, the outer end of each crank-rod being connected with a crank *d* *d′* d^2 d^3 on a crank-shaft D D′. Each crank-shaft is supported in suitable bearings (not shown) and has upon it a gear E E′, both gears meshing with a central gear E^2, running upon a stud *e*, mounted on one side of the casting, as seen in Fig. 6. This central gear has a hub *e′*, upon which is fixed a pinion e^2, meshing with a pinion *f*, mounted on the end of the valve-shaft *f′*, attached to the rotary valve F.

The valve F is conical in shape and is chambered, its interior forming part of the steam-passage from the boiler to the cylinders. It is centered at one end by the valve-shaft *f′*, which passes out through the head G′ of the steam-chest G. The further end of the valve-shaft *f′* passes through the bottom of the valve-chamber and, being made, preferably, of hard steel, serves as a bearing for the end of the screw G^2, which passes through one wall of the steam-chest G and centers the other end of the valve and being adjustable serves also to limit its end movement. The screw G^2 is provided with set-nuts to hold it in place.

The steam-chest G consists of a casting having within it a conical chamber shaped to receive the valve F and also provided with a steam-inlet *g* and an exhaust *g′*. It is also provided with ports g^2 g^3 to register with corresponding ports *b* *b′* in the casting forming the cylinders B B′. The valve F is provided with two ports f^2 f^3, adapted to register with the ports g^2 g^3 in the steam-chest and connecting each cylinder at the proper time with the steam-supply. The exhaust-ports are provided by cutting away a portion of the periphery of the valve F, as at f^4, so that a passage will at the proper time connect the cylinder-ports *b* *b′* with the exhaust *g′*.

The end of the steam-chest G is closed by the head G′, provided with a suitable stuffing-box G^3, through which the valve-shaft *f′* passes.

An advantage of this construction and of using a conical valve in the manner described lies in the fact that it can at all times be adjusted to take up for wear, that the steam tends to keep it seated, and that by means of the set-screw G^2 it can be so adjusted that it will not develop too much friction with the walls of the interior of the valve-chamber.

The valve-inlet ports f^2 f^3 are located to register with the ports g^2 g^3 in the steam-chest as the valve turns. The ports f^2 f^3 are located a quarter of a circumference apart around the periphery of the valve, each port being of such size that each piston will be driven one-quarter of its stroke by live steam and the rest of its stroke by expansion. I prefer also to set the cranks a quarter of a revolution apart.

In the operation of this engine I have found that the best results are attained where the following cycle of operations takes place: Two pistons in the same cylinder being in position closest to each other, steam is introduced through the proper inlet-port b or b' until the pistons have moved a quarter of their stroke. By this time the inlet-port has been closed by the rotation of the valve and the piston is moved the remainder of its stroke by expansion. At the end of the stroke the exhaust-passage f^4 registers with the port b or b' and the steam exhausts during the return of the pistons, the two pistons approaching until they reach within a short distance of each other—say one thirty-second part of their stroke—when the exhaust is cut off and a slight amount of steam is left in the cylinder, which cushions the pistons. This cycle of operations is quite important and is indicated in diagrams Figs. 8 and 9. In Fig. 8 the ports are indicated at f^2 f^3, respectively, and the exhaust-surface corresponding with the port f^2 is lettered f^{21}, and the part corresponding to port f^3 is lettered f^{31}. Fig. 9 is a projection of the diagram shown in Fig. 8, the parts thereof being similarly lettered and the portions not shaded indicating the portions of the valve's movement during which the ports are closed. So much of this diagram as relates to that part of the valve which coöperates with the port b lies between the lines 1 1 2 2, and the part coöperating with the port b' lies between the lines 2 2 3 3. The part between 3 3 and 4 4 indicates the part of the valve which serves mainly as a bearing.

My engine above referred to is extremely simple and it will be seen that, while it is useful for many purposes, it is especially useful in such places—for example, automobiles, or motor-boats—where power must be secured within a small compass.

It will be noted that steam-pressure tends to pack the valve at all times and that the inlet-ports act to give the steam ample access to the cylinders, and the exhaust-port is so large that there can be no crowding of the steam as it leaves the cylinder. These are important features of my engine.

What I claim as my invention is—

1. The engine above described comprising two parallel cylinders, each containing two pistons adapted to reciprocate toward and from each other, a valve-chest, a rotary valve, two crank-shafts, each connected to two of said pistons, and each carrying a gear, an intermediate gear, and means for rotating said rotary valve connected to said intermediate gear, as described.

2. The engine above described comprising two parallel adjacent cylinders, each containing two pistons, a valve-chest provided with a rotary conical valve having a steam-chamber located therein, and a shaft extending from the inner end of its interior outward through said chamber to afford means of supporting and operating said valve, the valve-chamber in said valve-chest being longer than said valve, and provided with a bearing at one end thereof, the other end of said valve being open to the free inlet of steam, whereby said valve is held in place against said bearing, as described.

3. The engine above described having two parallel cylinders, a pair of separating-pistons in each cylinder and means whereby said pistons are moved for substantially a quarter of their stroke under direct steam-pressure and the remainder of their stroke under expansion, said means comprising a rotary valve having an inlet-port for each cylinder, each port extending for substantially an eighth of the circumference of said valve and having an exterior exhaust-chamber of substantially the operating length of the valve and of less than one-half the circumference thereof.

4. The engine above described having two parallel cylinders, a pair of separating-pistons in each cylinder and means whereby said pistons are moved for substantially a quarter of their stroke under direct steam-pressure and the remainder of their stroke under expansion, said means comprising a rotary valve having an inlet-port for each cylinder, each port extending for substantially an eighth of the circumference of said valve, said ports being located one-quarter of a circumference apart, and having an exterior exhaust-chamber of substantially the operating length of the valve and of less than one-half the circumference thereof, the exhaust-ports being connected to furnish a free exhaust common to both cylinders, as described.

5. The engine above described comprising two parallel cylinders, each containing two pistons adapted to reciprocate toward and from each other, two crank-shafts, each connected to two of said pistons, said crank-shafts being geared to an intermediate gear, a valve-chest, a valve therefor, means for driving said valve, said driving means being connected to said intermediate gear between said crank-shafts.

6. The engine above described, comprising two parallel cylinders, each containing two pistons adapted to reciprocate toward and from each other, two crank-shafts, each con-

nected to two of said pistons, said crank-shafts being geared to rotate together, a valve-chest superimposed on said cylinders, a rotary valve therein at right angles to the axes of the cylinders, a shaft for said valve, a pinion on said shaft, said pinion being directly in gear with the crank-connecting gears aforesaid the axis of said valve being in a plane substantially parallel with the axes of said cylinders and lying at right angles thereto.

CHARLES H. MONROE.

In presence of—
DANIEL S. GOODELL,
IDA A. ADAMS.