

(No Model.)

2 Sheets—Sheet 1.

C. N. DUTTON.
STEAM ENGINE.

No. 586,812.

Patented July 20, 1897.

FIG. 1.

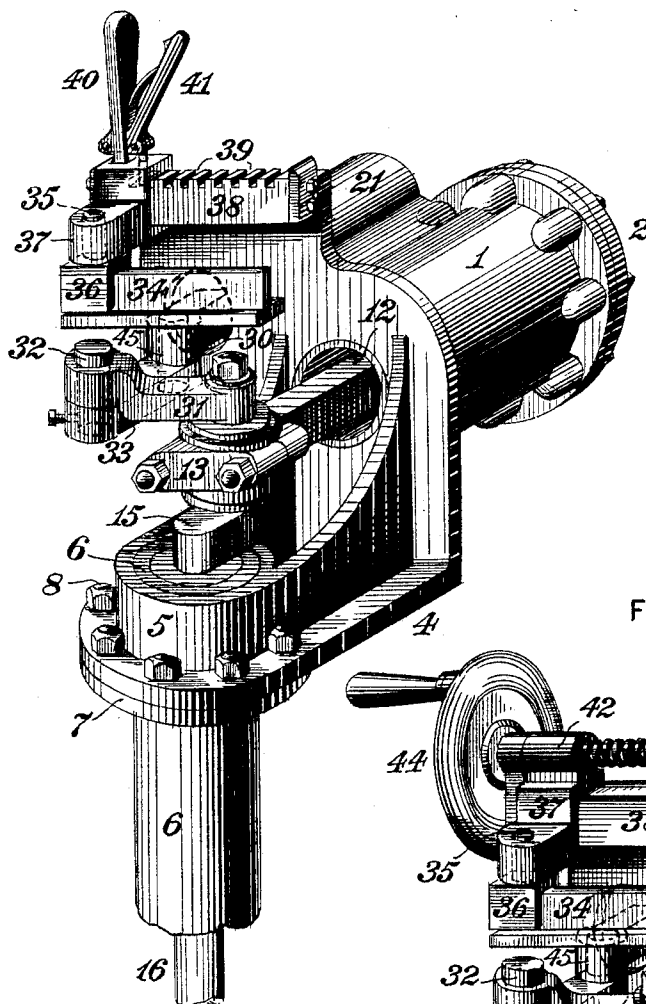
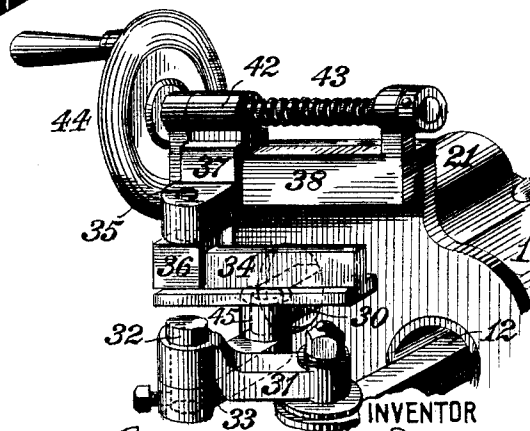


FIG. 8.



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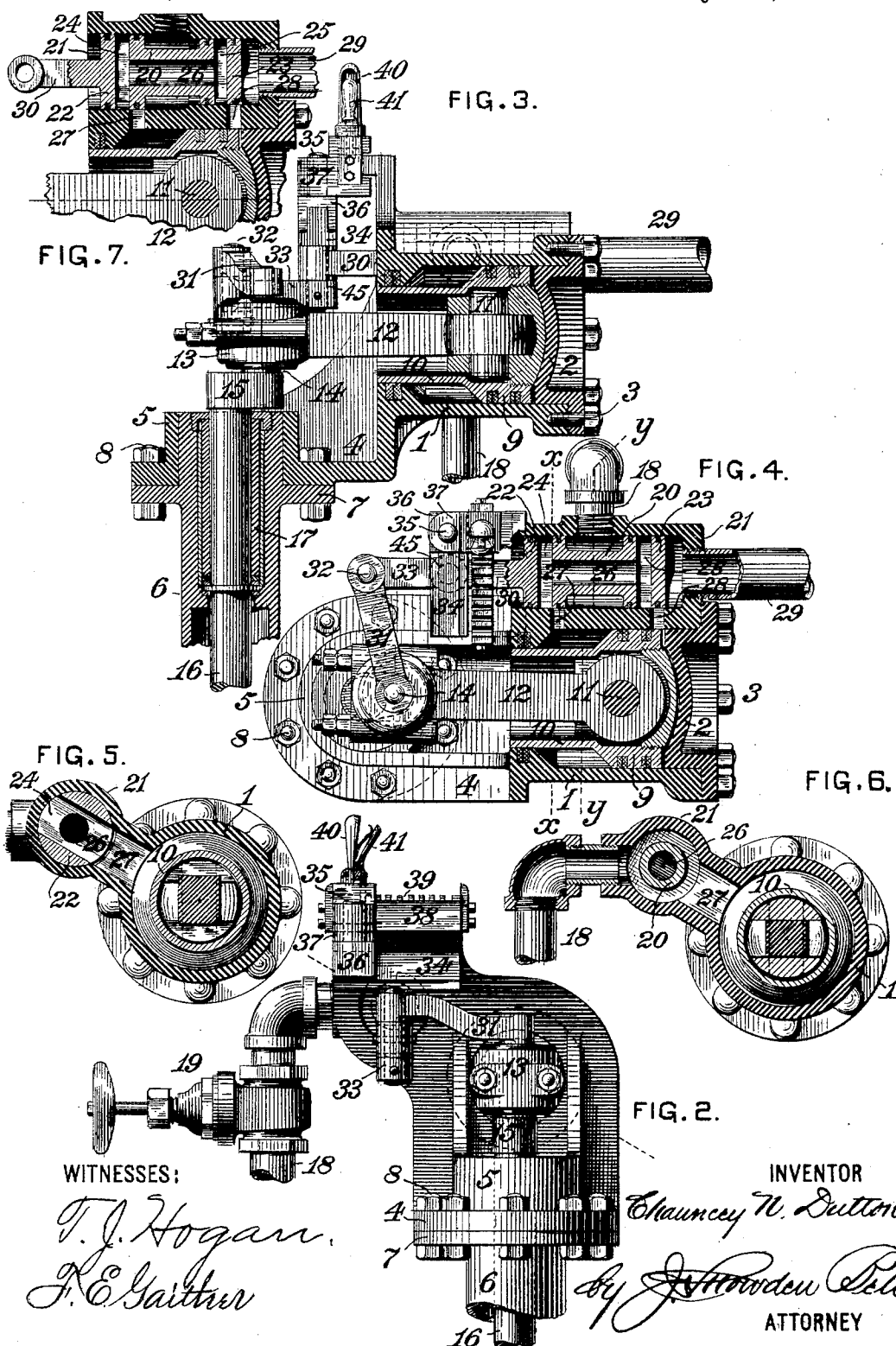
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2 Sheets—Sheet 2.

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CHAUNCEY N. DUTTON, OF NEW YORK, N. Y.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 586,812, dated July 20, 1897.

Application filed July 27, 1896. Serial No. 600,652. (No model.)

To all whom it may concern:

Be it known that I, CHAUNCEY N. DUTTON, of the city, county, and State of New York, have invented a certain new and useful Improvement in Steam-Engines, of which improvement the following is a specification.

The object of my invention is to provide a simple, compact, and inexpensive direct-acting engine or motor in the operation of which the compound principle of effecting two successive expansions of the same volume of steam or other motive fluid may be applied in a single cylinder controlled by a single distribution-valve, and which may be either reversible or non-reversible and capable of adjustment of the degree of initial expansion, and, with its frame, may be self-centering and self-lining relatively to the axis of the crank-shaft and capable of being fixed or turned about said shaft in or to the most favorable position for operation.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a view in perspective of a compound engine embodying my invention; Fig. 2, an end view in elevation of the same; Fig. 3, a vertical longitudinal central section; Fig. 4, a view, partly in plan and partly in section, on the horizontal central planes of the cylinder and valve-chest; Figs. 5 and 6, transverse sections at the lines *xx* and *yy*, respectively, of Fig. 4; Fig. 7, a longitudinal central section through the valve-chest and a portion of the cylinder, illustrating means for balancing the distribution-valve in a condensing-engine; and Fig. 8, a view in perspective illustrating a modification in the details of the reversing-gear.

The drawings illustrate a single cylinder, self-centering and self-lining, and an adjustable compound engine which is reversible and capable of adjustment of the point of cut-off and is of simple and durable construction, having neither stuffing-boxes, glands, guides, nor eccentrics and having simple pin connections of its working parts. In lieu of the complex and expensive eccentrics, links, &c., ordinarily employed in reversing-engines a bell-crank lever is provided which, in a reversible engine, is T-shaped, pivoted to the valve-stem, and fulcrumed on one side there-

of, said bell-crank lever being connected by a link with the crank-pin and the axis of the connection and the power transmission being at a right angle with the axis of the piston. In order to make the engine reversible and adjustable as to point of cut-off, the fulcrum about which the bell-crank lever vibrates is made movable upon a slide, so that it can traverse longitudinally from one side to the other of the axis of the valve and bell-crank.

In the practice of my invention I provide a cylinder 1, which is open at one end and closed at the other by a head 2, secured to the cylinder by studs 3. The cylinder 1 is preferably, as shown, cast integral with a bed-plate 4, which may be secured to any suitable foundation, but which in the instance shown is provided with a sleeve 5, concentric with the driving or crank shaft of the engine and bored to fit truly on a tubular support 6, having an annular flange 7, on which the bed-plate 4 rests and to which it is secured by bolts 8. A properly-packed piston 9 is fitted in the bore of the cylinder 1 and is provided with a trunk or cylindrical extension 10, which projects outwardly through the open end of the cylinder and reduces the effective area on the adjacent side of the piston, so as to make the same a differential one relatively to opposite ends of the cylinder. A pin 11, fixed in the piston 9, is coupled by a connecting-rod 12, having a cap 13, to the pin 14 of a crank 15, fixed upon a driving or crank shaft 16, which is journaled to rotate in a bearing 17, fixed on the tubular support 6, or in any other suitable and desired support connected to the bed-plate.

Motive fluid is delivered to the engine from a steam-boiler or other source of supply through a supply-pipe 18, controlled by a valve 19, and is supplied and exhausted to and from the opposite sides of the piston 9 by a balanced-piston distribution-valve 20, fitted to reciprocate in a valve chest or chamber 21, having a cylindrical bore, which is connected with opposite ends of the cylinder 1 by ports 27 and 28 and is open at its end nearest the crank-shaft. The supply-pipe 18 is led into the valve-chest 21 between the cylinder-ports 27 and 28, and an exhaust-pipe 29 leads from one end of the valve-chest to the atmosphere or to a condenser, as the case

may be. The distribution-valve 20 has a cylindrical body and two end pistons 22 and 23, in which, respectively, are formed transverse ports 24 and 25. The ports 24 and 25 are connected by a passage 26, extending through the body of the valve, and are adapted, respectively, to be brought into communication with the ports 27 and 28, leading from the valve-chamber to opposite ends of the cylinder 1. While the ports 24 and 25 are shown as extending entirely through the end pistons 22 and 23 of the distribution-valve, as is desirable to facilitate its manufacture, it is obvious that as their function is merely that of exhausting motive fluid from the cylinder-port 27 to the opposite end port 28 through the passage 26 they may, if preferred, extend merely from the peripheries of the pistons 22 and 23 to said passage 26. In the reciprocation of the distribution-valve 20, which is effected as presently to be described, motive fluid from the supply-pipe 18 is admitted around the body of the valve and through the high-pressure cylinder-port 27 to the high-pressure side of the piston 9 and acts upon the annular area of the same surrounding the trunk 10 to effect the right-hand stroke of the piston, after which it is exhausted through the cylinder-port 27, the left-hand valve-port 24, the valve-passage 26, the right-hand valve-port 25, and the low-pressure cylinder-port 28 to the low-pressure side of the piston. The left-hand stroke of the piston is effected by the expanded motive fluid acting upon the full area of its right-hand side, and fluid is finally exhausted from the cylinder through the port 28 and exhaust-pipe 29 to the atmosphere or to a condenser.

In the case of a non-condensing engine the distribution-valve will be perfectly balanced, inasmuch as the motive fluid acts upon the equal annular areas of the inner sides of the two valve-pistons 22 and 23, and said pistons are exposed to atmospheric pressure on their outer sides. In a condensing-engine, however, the valve would be unbalanced by reason of the action of atmospheric pressure on its left-hand side, tending to move it to the right as opposed to the vacuum in the condenser which is in communication with the valve-chest on the right-hand side of the piston. In order to counteract such excess of external pressure, the distribution-valve 20 may be and is preferably in condensing-engines provided with end pistons of unequal diameters, the piston 22, which is nearest the open end of the valve-chest, being made sufficiently larger than the piston 24, which is nearest the condenser, to permit the steam-pressure on its inner side to balance the excess of atmospheric pressure on its outer side. The valve-chest is in such case, of course, counterbored to correspond with the increased diameter of the piston 22, as shown in Fig. 7.

The distribution-valve is reciprocated in its chest by a connection to the crank-pin 14

through the intermediation of a bell-crank or elbow lever 33 34, provided with a movable fulcrum or pivot 35, by proper adjustment of which the direction of rotation of the engine may be reversed and variation of the point of cut-off effected, as desired. A link 31 is coupled at one end to the crank-pin 14, and its opposite end is coupled to a pin 32, fixed on an arm 33 of the bell-crank or elbow lever 33 34, before referred to. The arms 33 and 34 are rigidly connected by a pin 45, (indicated in dotted lines in Figs. 1, 3, 4, and 8,) to which is coupled the outer end of a stem 30, formed on or fixed to the distribution-valve 20, the arm 34 extending at a right angle to the arm 33 for substantially equal distances on opposite sides of the center line of the latter. The bell-crank lever thus has in plan the form of a T, as shown most clearly in Fig. 4. The fulcrum or pivot 35 of the bell-crank lever is formed on a block 36, which is fitted to traverse longitudinally on the arm 34 and to be held in any desired position thereon on either side of the center line of the arm 33. The arm 34 is preferably of T-section, in order to serve as a guide for the block 36, and the block 36 is recessed to fit truly over the central web of said arm.

It will be seen that by moving the block 36 and connected fulcrum 35 from one side of the center line of the arm 33 to the other the direction of the movements of the distribution-valve 20 relatively to those of the piston 9, and consequently the direction of rotation of the crank-shaft 16, will be reversed. The point of cut-off, when running in either direction, will also be shorter or longer, accordingly as the fulcrum 35 is moved nearer to or farther from the center line of the arm 33. The adjustment of the fulcrum 35 to vary the point of cut-off may be effected either by hand or automatically through a connection to a governor, and any suitable reversing mechanism adapted also to vary the point of cut-off may be applied. As shown in Figs. 1 to 4, inclusive, the fulcrum 35 is journaled in an adjusting-block 37, which is fitted to slide longitudinally on a guide-bar 38, fixed to the cylinder and provided with an operating-handle 40, and is held in desired position by a spring-lever 41, carrying a bolt which engages in either of a series of recesses 39, cut in the guide-bar 38.

In the modification shown in Fig. 8 the adjusting-block 37 is similarly fitted on the guide-bar 38 and carries a nut 42, which engages an adjusting-screw 43, journaled above and parallel with the guide-bar, and having a hand-wheel 44, by which it may be rotated in either direction to effect corresponding longitudinal movement of the adjusting-block 37, fulcrum-block 36, and fulcrum 35.

The engine is specially adapted to use under conditions in which a high-speed compound motor occupying comparatively small space is desirable, and having but few working parts can be manufactured at a low cost

and maintained by unskilled operators without material liability of breakage or undue wear in service.

I claim as my invention and desire to secure by Letters Patent—

1. The combination of a cylinder, a trunk-piston working therein, a crank-shaft having a crank coupled to said piston, a valve-chest which is open at one end and provided with an exhaust-pipe at the other, a distribution-valve working in said valve-chest and having differential end pistons the larger of which is nearest the open end of the chest, internal ports and a passage in the distribution-valve for the exhaust of motive fluid from the trunk side of the piston to the opposite side, cylinder-ports controlled by the distribution-valve, and connections for reciprocating said distribution-valve from the crank-shaft.

2. The combination of a cylinder, a piston working therein, a crank-shaft having a crank coupled to said piston, a distribution-valve governing the supply and exhaust of motive fluid to and from said piston, a bell-crank coupled to said distribution-valve, a fulcrum on which one arm of said bell-crank is pivoted, and a connection coupling the other arm of said bell-crank to a pin on the crank-shaft.

3. The combination of a cylinder, a piston working therein, a crank-shaft having a crank coupled to said piston, a distribution-valve governing the supply and exhaust of motive fluid to and from said piston, a bell-crank coupled to said distribution-valve, a fulcrum on which one arm of said bell-crank is pivoted, a connection coupling the other arm of said bell-crank to a pin on the crank-shaft, and means for moving and fixing the fulcrum in position on either side of the line of traverse of the distribution-valve.

4. The combination of a cylinder, a piston working therein, a crank-shaft having a crank

coupled to said piston, a distribution-valve governing the supply and exhaust of motive fluid to and from said piston, a bell-crank having one of its arms extended on opposite sides of its other arm, a pin at the junction of said arms, a stem fixed to the distribution-valve and fitting on said pin, a block carrying a fulcrum or pivot pin and adapted to slide longitudinally on the extended arm, an adjusting-block fitting on the fulcrum, and movable longitudinally on a fixed guide, means for moving and holding the adjusting-block in position on the guide, and a link coupling the other arm of the bell-crank to a pin on the crank-shaft.

5. The combination of a bell-crank or elbow lever for transmitting movement from the crank-shaft to the distribution-valve of a fluid-pressure engine, having one of its arms extending transversely to the other and connected thereto by a pin adapted to serve as a member of a joint, and a block fitted to slide longitudinally on the extended arm and carrying a fulcrum or pivot pin.

6. The combination of a cylinder, a valve-chest fixed thereto, and a bed-plate, connected to the cylinder and having a sleeve or socket adapted to fit a tubular support and a flange projecting from said sleeve for connection to said tubular support.

7. The combination of a cylinder, a piston working therein, a tubular support, a bed-plate connected to the cylinder and having a sleeve or socket fitting on said tubular support and a flange connected thereto, a bearing fixed in said tubular support, and a crank-shaft journaled in said bearing and having a crank coupled to the piston.

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Witnesses:

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