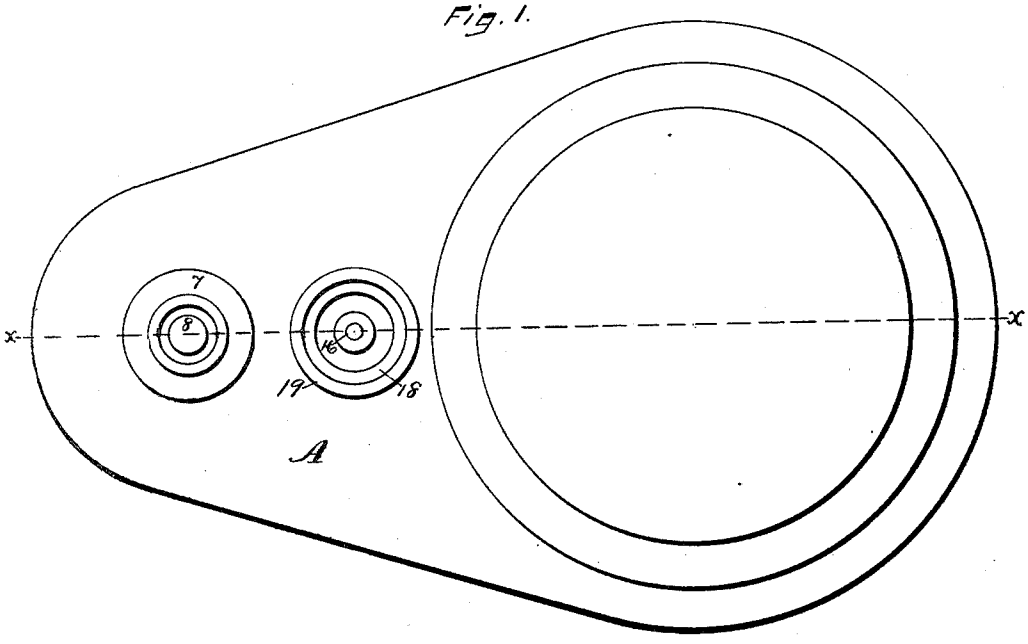
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A. H. EDDY.

COMPOUND ENGINE.

No. 426,252. Patented Apr. 22, 1890.

Fig. 1.



Witnesses.
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W. H. Pierce

Inventor.
Arthur H. Eddy.
By James Shepard Atty

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

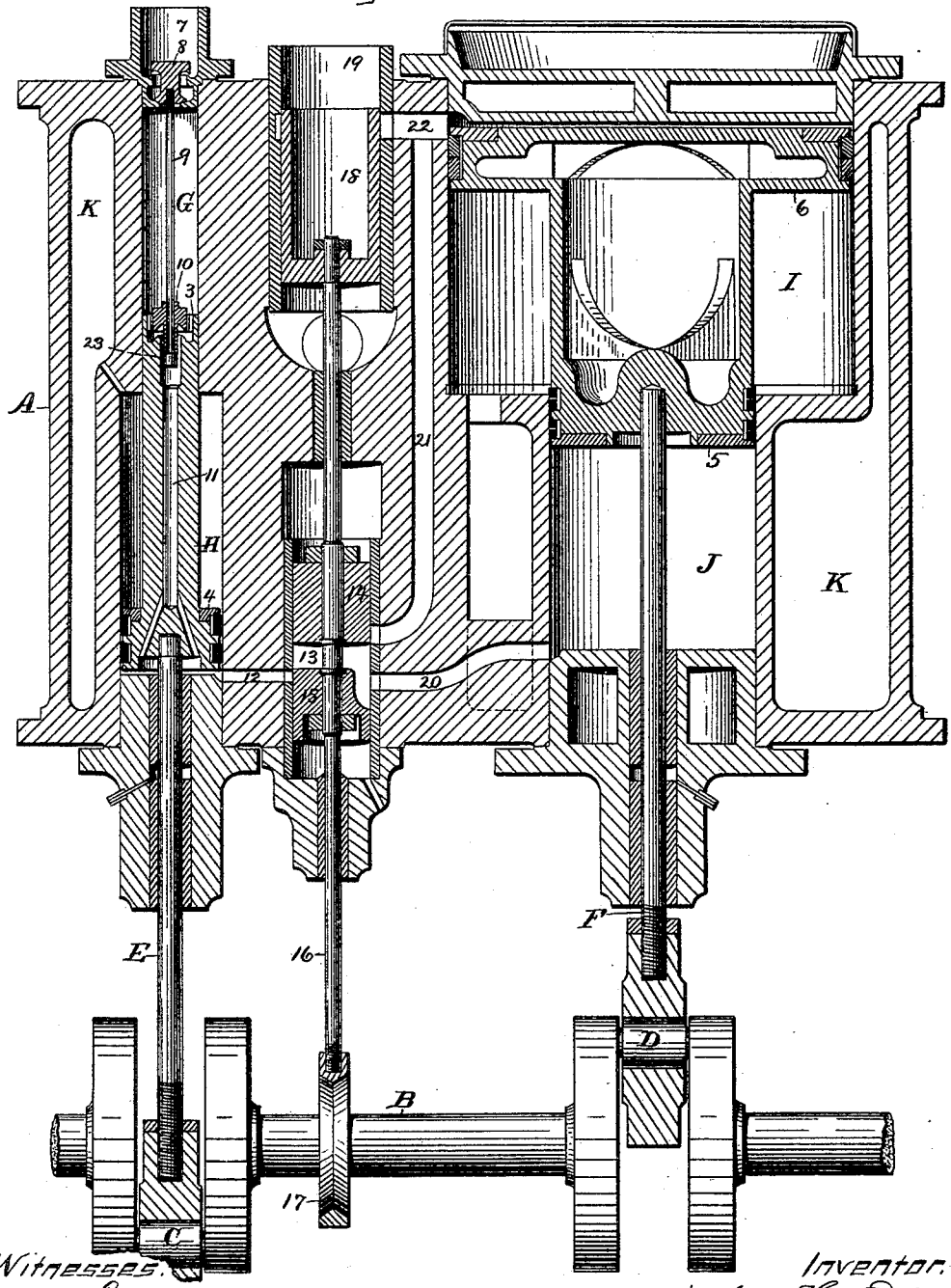
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Fig. 2.



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UNITED STATES PATENT OFFICE.

ARTHUR H. EDDY, OF HARTFORD, CONNECTICUT.

COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 426,252, dated April 22, 1890.

Application filed April 8, 1889. Serial No. 306,311. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR H. EDDY, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Compound Engines, of which the following is a specification.

My invention relates to improvements in compound engines; and the objects of my improvement are simplicity of construction and increased efficiency.

In the accompanying drawings, Figure 1 is a plan view of my engine, and Fig. 2 is a vertical section thereof on line *x x* of Fig. 1.

My engine is specially designed for use with anhydrous ammonia-gas; but it is applicable to other expansive gases or fluids.

A designates the case or frame, and B a portion of the driven shaft provided with cranks C D, by which to connect the two piston-rods E F. Within the case there are four cylinders G H I J, of gradually-increasing diameters, and provided with pistons 3 4 5 6, the pistons 3 and 4 being rigidly connected to the piston-rod E, while the pistons 5 and 6 are connected with the piston-rod F. The propelling-fluid is admitted through a suitable conduit connected with the hub or socket 7, within which is the puppet-valve 8, which will open and close the passage leading to the cylinder G. A rod 9 is connected with this puppet-valve 8, and extends downward through the cylinder G to the second valve 10, which loosely rests in the upper end of the piston 3 and is fitted to a valve-seat therein. From this valve-seat there is a passage 11, which leads down through the piston 4 and opens into the cylinder H at the lower end of said piston. From the lower and effluent end of this cylinder H there is a passage 12, that leads to the valve-chamber 13. Within said chamber there are valves 14 and 15, connected with the rod 16, said rod being actuated by the eccentric 17 on the shaft B. The same rod has also connected therewith a valve 18 in the valve-chamber 19, through which latter chamber the propelling-fluid is discharged from the engine to a condenser or other place of discharge. Leading from the valve-chamber 13 there is a passage 20, which leads to the lower end of the cylinder J, and another passage 21, that leads to the cross-passage 22, one end of which opens into the upper end of the cylinder I, and the other end of which opens into the valve-chamber 19. The steam or propelling-fluid is admitted through the puppet-valve 8 when the pistons 3 and 4 are at the upper end of their stroke. The valve 10 at the upper end of the cylinder 3, sliding upwardly upon the rod 9 in front of the piston 3, comes in contact with the valve 8 to open it as said piston reaches the upper end of its stroke. The valve 10 is then firmly seated, so as to close the upper end of the piston 3 and all the force of the fluid will be brought to bear on the piston 3 to force it downwardly. In thus moving downwardly the valve 10 is withdrawn from under the valve 8, so that the pressure of the steam or fluid closes said valve 8 as soon as the piston has moved a short distance, leaving the piston to be actuated by expansion. At near the lower end of the stroke of the pistons 3 and 4 the downward movement of the valve 10 is arrested by its coming against the head 23 at the lower end of the rod 9, whereby the further movement of the pistons opens the valve 3, and the fluid then passes down through the passage 11 to the lower end of piston 4, the parts being represented in Fig. 2 with the pistons 3 and 4 at the lower end of their stroke. The valve-rod 16 is then at about the middle of its stroke, whereby the valve 15 closes the passage 12 at the lower end of the cylinder H. Consequently the expansion of the fluid through the valve 10 and passage 11, acting upon the piston 4, carries the pistons 4 and 3 to the upper end of their stroke. The valve 10 and its seat are of such form that the fluid passing through it will tend to keep it open until said valve 10 contacts with the valve-seat at the upper end of the cylinder G. The valve-rod 16 in Fig. 2 is represented as making its upward stroke. By the time the piston 4 reaches the upper end of its stroke the valve-rod 16 and valve 15 will have been moved upwardly the rest of their movement and returned downwardly, so as to uncover the passage 12 and permit the fluid to pass through the valve-chamber 13 and the passage 20 to the lower end of the cylinder J, the piston 5 then being at the lower end of its stroke. The valve 8 is again opened and the piston 3 receives a fresh impulse, while the

fluid within the cylinder H in advance of the piston 4 passes to the cylinder J, in the manner described, and acts to impart to the piston 5 its upward stroke. The valve 15 is so formed as to leave the passage 20 open at all times. When the fluid within the cylinder J has thus raised the piston 5 and said piston makes its return-stroke, the valve-rod 16 moves the valve 14 upwardly, so as to uncover the passage 21, while at the same time the valve 18 covers that end of the passage 22, whereby the expanding fluid may pass from in front of the lower end of the piston 5 back through the passage 20, valve-chamber 13, passages 21 and 22 to the front of the piston 6 at the upper end of the cylinder I for imparting to said pistons 6 and 5 their downward stroke under a further expansion of the actuating-fluid. When the pistons 5 and 6 are making their upward stroke, the valve 18 moves downwardly, so as to uncover that end of the passage 22, and thereby permit the passage of the fluid through the valve-chamber 19 to the condenser or other place of final discharge.

The cranks C and D are arranged opposite each other, so that while the piston-rod E and pistons 3 and 4 are moving in one direction the rod F and pistons 5 and 6 are moving in the opposite direction. The relative diameters of the cylinders and pistons will be made proportionate to the expansion of the actuating-fluid, so that the parts may operate together with a constant flow of the actuating-fluid through the successive cylinders, the pistons 3 and 5 acting simultaneously and alternating with the simultaneous action of the pistons 4 and 6.

The case A may be provided with an air chamber or chambers K, into which openings may be made to the several cylinders on the back side of the pistons.

I have not described the packing-rings and various details of construction, as such minor parts are not peculiar to my invention and may be changed or varied at pleasure, as judgment and mechanical skill may dictate.

I claim as my invention—

1. In a compound engine, the combination of the cylinders G and H, pistons 3 and 4, rigidly united and provided with the passage 11 through said pistons, leading from in front of one to the front of the other, valves for opening and closing the influent end of the said cylinder G and the effluent end of the cylinder H, and the valve 10, for opening and closing the passage 11 between said cylinders, substantially as described, and for the purpose specified.

2. In a compound engine, the combination of the piston-rod E, pistons 3 and 4, both secured to said rod, the cylinders G and H, the valve 8, rod 9, and sliding valve 10 on said rod, said pistons being provided with the passage 11, and a valve-seat for said valve 10, substantially as described, and for the purpose specified.

3. The combination of the cylinders G H I J, pistons 3 4 5 6, piston-rods, shaft, and cranks, valve-rod 16, its operating devices, valves 14 15 18, valve-chambers 13 19, and the passages 12, 20, 21, and 22, substantially as described, and for the purpose specified.

4. The combination of the pair of cylinders G H, their pistons and rod, the pair of cylinders I J, their pistons and rod, the connecting-passages between said pairs of cylinders, and the valves controlling said connecting-passages, substantially as described, and for the purpose specified.

ARTHUR H. EDDY.

Witnesses:
JAMES SHEPARD,
JOHN EDWARDS, Jr.