W. SIMPSON & A. GARDNER.

Reciprocating Steam-Engines.

No. 135,670. Patented Feb. 11, 1873.

FIG. 2.

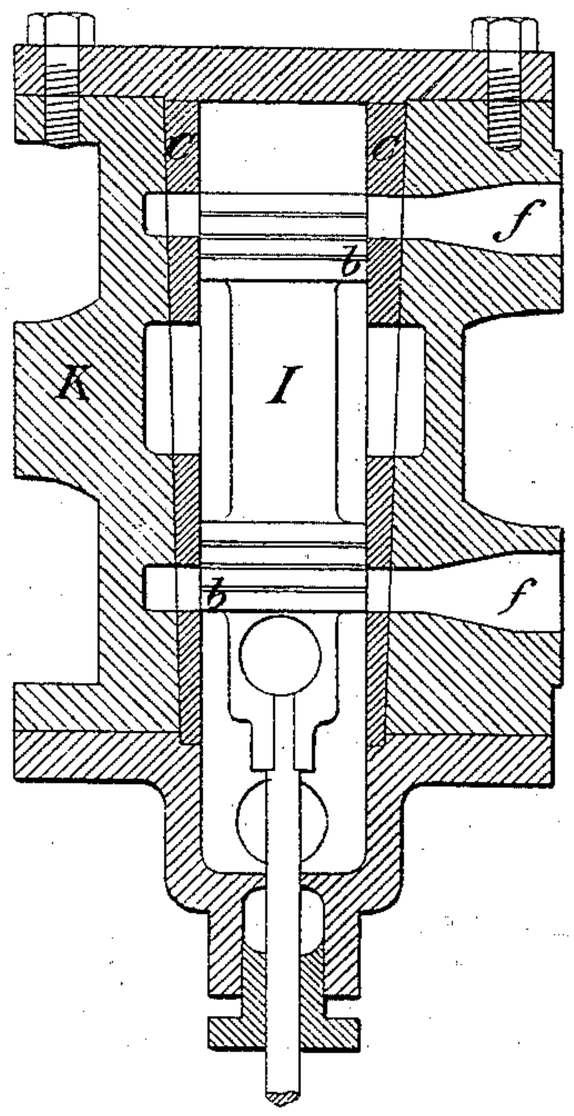


FIG. 1.

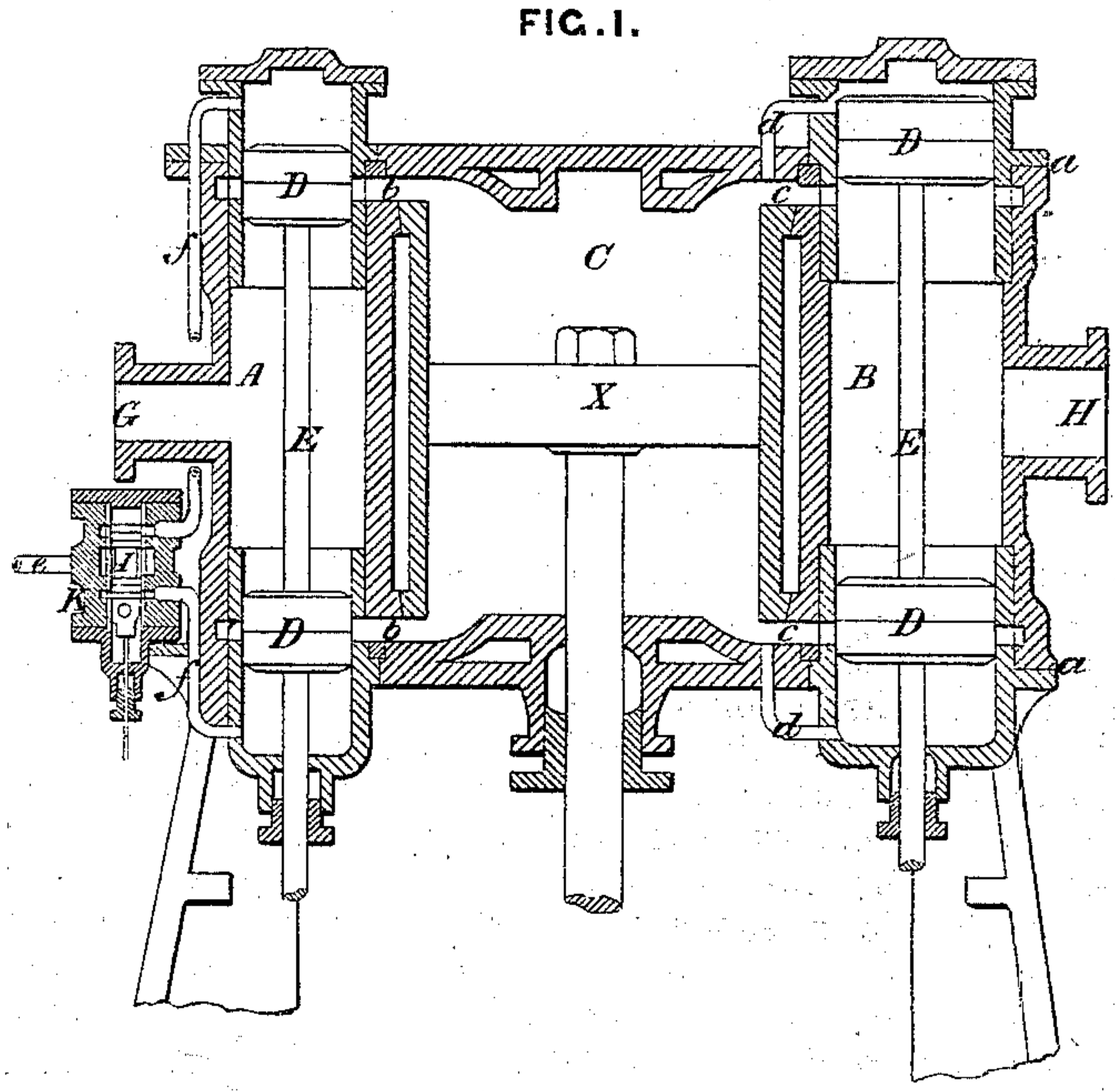


FIG. 3.

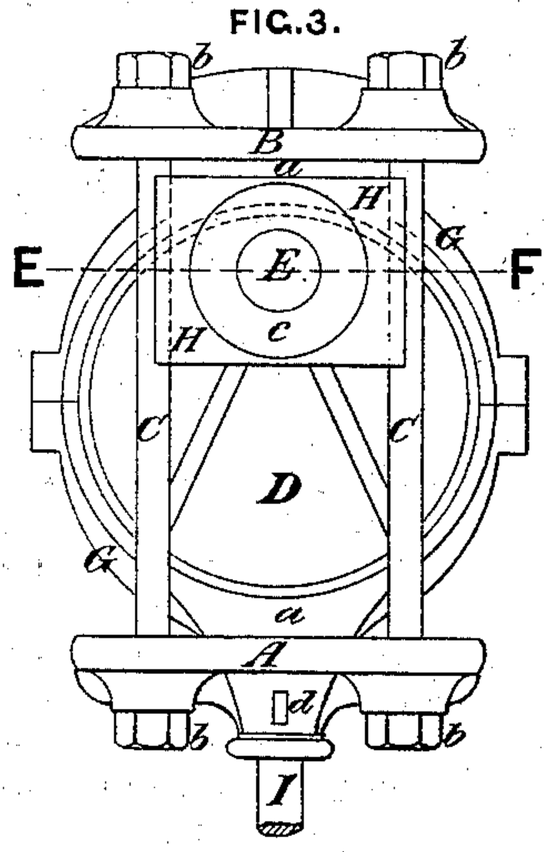


FIG. 4.

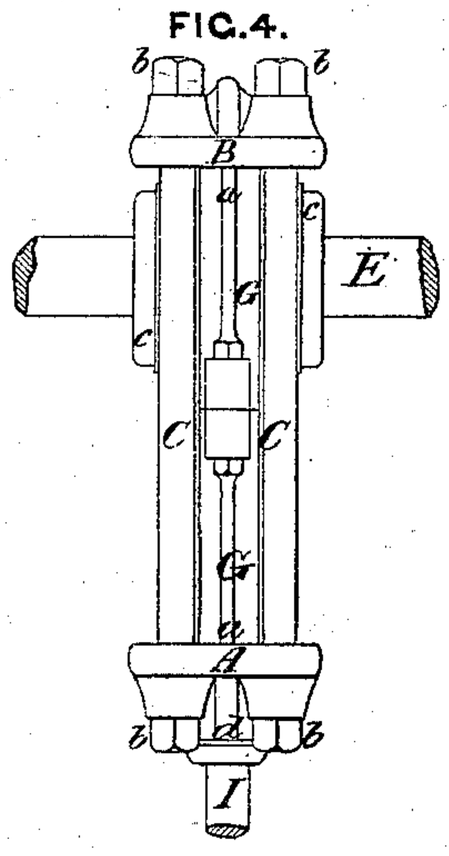
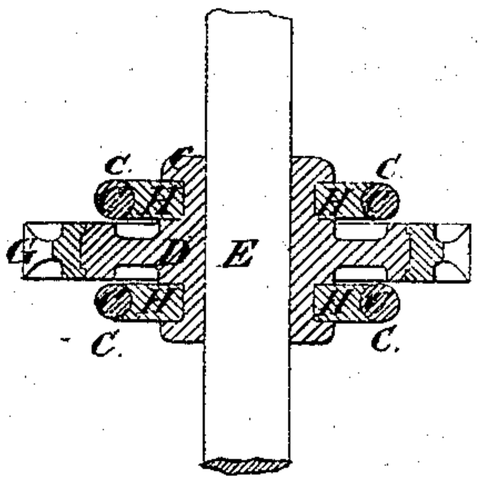


FIG. 5.



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UNITED STATES PATENT OFFICE.

WILLIAM SIMPSON AND ALFRED GARDNER, OF ILFORD, ENGLAND.

IMPROVEMENT IN RECIPROCATING STEAM-ENGINES.

Specification forming part of Letters Patent No. **135,670**, dated February 11, 1873.

To all whom it may concern:

Be it known that we, WILLIAM SIMPSON and ALFRED GARDNER, both of Ilford, in the county of Essex, England, have invented certain Improvements in Reciprocating Steam-Engines, of which the following is a specification:

This invention consists of an improved method of constructing the inlet and outlet valves of engines worked by steam or other motive power, and in the manner of arranging and combining the said valves with the cylinder of the engine, and of actuating the said slide-valves so as to dispense with the link-motion now employed for that purpose.

As regards this invention we proceed as follows: We connect two small cylinders with the main cylinder, one to the inlet and one to the outlet. The said small cylinders are truly bored and fitted with truly-turned solid piston-valves. These piston-valves are so constructed that the pressure between them makes them perfect equilibrium-valves. The aforesaid inlet-cylinder is also combined with a still smaller equilibrium-valve, and is connected with the main steam or other motive power, or with the condenser, or with both, according to the construction of the engine. The said smaller equilibrium-valve is worked from the main engine-shaft, and is also connected above and below the said inlet piston-valve, thus causing the pressure or vacuum, or both, to move the said inlet piston-valve according to the requirements of the engine. The aforesaid outlet-valves are perfect equilibrium-valves, and may be worked in the same manner as the inlet-valves; but we prefer connecting the top and bottom of the main cylinder to each end of the exhaust or outlet cylinder for its moving power.

The operation of an engine of the above construction is as follows: Supposing steam to be the motive power employed, the steam is admitted into this small inlet-cylinder at full pressure, and from thence to the main cylinder, also, at full pressure, where it is cut off, or the inlet piston-valve shut by the action of the small equilibrium-valve, thereby causing the steam to work expansively, while the exhaust or outlet piston-valve remains open during the extreme length of the stroke.

We would here observe that, in constructing engines with two or more cylinders, each cylinder must be fitted with a similar arrangement of valves to those above described, and may be similarly worked; and in order to explain this invention clearly, we will now proceed to describe the mode of constructing engines as represented by the annexed drawing.

Figure 1 represents a sectional elevation of the cylinder of an inverted engine, to be worked by steam or other motive power, and the manner of arranging and combining therewith slide-valves for the ingress and egress of the motive power. Fig. 2 is a sectional elevation of a hollow valve hereafter referred to. Figs. 3, 4, 5 represent three views of our improved mechanical arrangement to substitute the connecting-rod and crank: Fig. 3 is a front elevation; Fig. 4, an edge view of Fig. 3; and Fig. 5, a cross-section through the line E F at Fig. 3.

At Fig. 1, A B mark two small truly-bored cylinders, each connected to the main cylinder C by the flanges *a a*. The cylinder A is connected to the inlet ports or passages *b*, and the cylinder B to the outlet ports or passages *c*. D are slide-pistons, fitted steam-tight in the cylinders A B. E are piston-rods, to which the pistons D are securely fixed. G is a short pipe leading to a steam-boiler or other motive-power reservoir, and H is another short pipe leading to the exhaust. *d d* are small pipes for establishing a communication between the inside of the main cylinder C and the ends of the small cylinder B, for imparting motion to the pistons D that work therein at the proper times by pressure or vacuum, or both. I is a small equilibrium-valve fitted in a truly-bored cylinder, K, which is connected, by a pipe at *e*, with a steam-boiler or other motive-power reservoir, or with a condenser, or both, and *f f* are small pipes for establishing a communication between the cylinder K and the ends of the cylinder A, for imparting movement to this valve so as to uncover and cover the inlet-ports of the main cylinder at each stroke of piston thereof.

The drawing at Fig. 2 is drawn to an enlarged scale to show clearly the construction of the valve I, which is as follows: K marks the valve-box for the valve I to work in; C C, perforated rings of metal fitted steam-tight into recesses formed in the valve-box K, as

shown; I, the slide-valve, formed as a pipe, with a flange or head, *b b*, at each end thereof. The parts *b b* and C C should be turned and bored true, so as to be steam-tight one within the other.

Assuming the slide-valve I and piston D to be in position represented at Fig. 1 and steam to be admitted into the valve-box A by the pipe *e*, it will appear evident that there will be a uniform pressure of steam upon every part of the slide-valve, and, the ports or passages *b b* being covered, the steam cannot pass out of the valve-box into the cylinder C until the slide-valve is moved up or down. Now, suppose the slide-valve I to be moved downward, the steam wou'd enter at the bottom of the cylinder A and force the piston D thereof up and uncover the bottom part of the cylinder C, and allow the steam to enter therein to force the piston X thereof up, and the steam that is above the piston X will pass off through the port *c* and exhaust-cylinder B by the eduction-pipe H; and by the time the piston X has arrived at the top of the cylinder the position of the slide-valve D will be reversed, and steam be again admitted into the cylinder; and so on in succession at each stroke of the engine.

We now proceed to describe the construction of the parts represented at Figs. 3, 4, 5, as follows: A B mark two cross-heads, connected together by the rods C. D is an eccentric plate fixed on the driving-shaft E of an engine. G are semicircular shoes embracing the plate D, and the flat parts *a a* fit between the cross-heads A B, and may be adjusted by the nuts *b b*. H are guide-brasses held between the tie-rods C and fitting into grooves formed in the boss part *c* of the plate D. I is the piston-rod of an engine, keyed to the boss *d* of the cross-head A.

By the above arrangement the pressure of one or other of the cross-heads A B against the shoes G, and the plate D embraced thereby, will convert reciprocating motion of the piston-rod I into rotary motion of the shaft E, on which the plate D is fixed.

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

The combination, with the cylinder of a steam-engine, of the inlet and outlet valves and the equilibrium-valve, all constructed and arranged substantially as described, for the purpose set forth.

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