W. J. Stevens,

Direct Acting Engine.

No. 109,963. Patented Dec. 6. 1870.

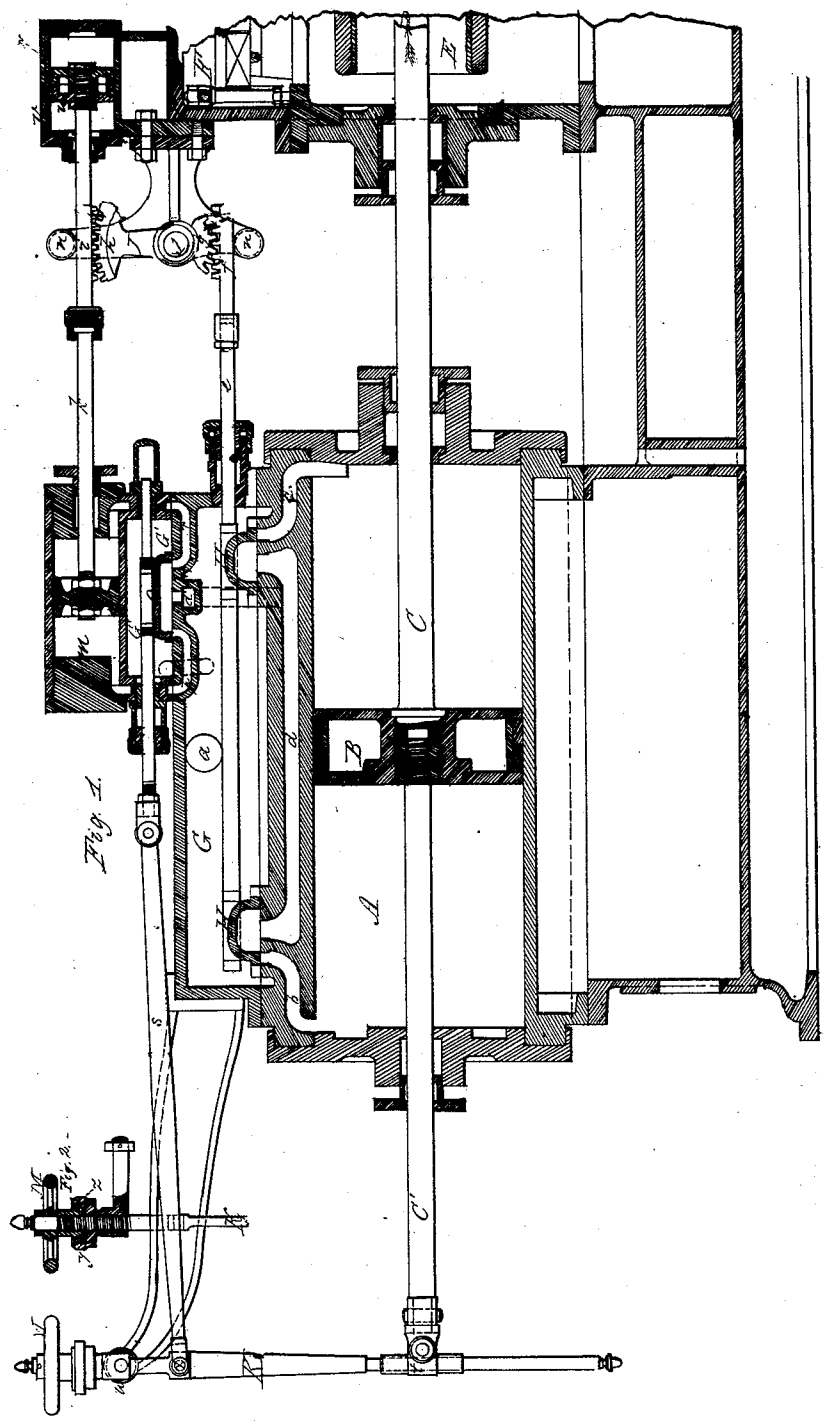

Fig. 1.

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IMPROVEMENT IN DIRECT-ACTING ENGINES.

Specification forming part of Letters Patent No. **109,963**, dated December 6, 1870.

To all whom it may concern:

Be it known that I, WILLIAM J. STEVENS, of the city of New York, in the county and State of New York, have invented certain new and useful Improvements in Direct-Acting Engines; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing, which forms part of this specification.

My invention consists in a novel combination, in a direct-acting steam-engine, of the main valves of a steam-cylinder with the piston of an auxiliary or valve-operating cylinder by means of a rocking lever, the ends of which take hold of a stem connected to said valves and the rod of said piston respectively, whereby a positive motion is insured and unequal wear of the valves is prevented.

My invention further consists in the combination of a main cylinder and auxiliary cylinder and said rocking lever with a regulating-chamber, whereby convenience of access to the auxiliary cylinder and regulating-chamber is insured.

My invention further consists in an improved arrangement of a steam-chamber in such relation to the auxiliary cylinder and to the steam-chamber of the main cylinder as to cheapen the construction of the parts and enable the valve of the auxiliary cylinder to work on a horizontal seat.

My invention further consists in an improved means for adjusting the effective length of the lever which operates the valve of the auxiliary cylinder, and thereby regulating the length of the stroke of the main piston.

In the accompanying drawing, Figure 1 represents a central vertical longitudinal section of a direct-acting steam-engine embodying my improvements. Fig. 2 is a vertical cross-section, in detail, of the means employed for regulating the stroke of the main piston.

A designates the main cylinder; B, the main piston moving therein, the latter being, of course, provided with a piston-rod, C, passing through a suitable stuffing-box, and being connected to that part of an apparatus which is to receive a direct reciprocating motion.

In the drawing I have shown said piston-rod C as connected directly to the piston of a pump-cylinder, E, which cylinder is provided with proper valve-chambers F. These parts are all of well-known construction, and steam is supplied to the steam-chest G of the main cylinder in any suitable way—say through the opening or pipe *a*.

H H are the main valves, which are of the ordinary construction, and which operate in connection with the cylinder-port *b c* and an exhaust-passage, *d*, in the usual manner.

The main valves H are operated by a piston, *l*, of an auxiliary engine or cylinder, *m*, in the following manner: To the said piston *l* a piston-rod, *k*, is attached, and this piston-rod *k* is provided with a rack, *i*, which engages with a toothed segment, *h*, on the upper end of a lever, J, which lever is pivoted at a suitable part of its length—say at *j*—to any stationary object—the valve-cylinder F, for instance. A toothed segment, *g*, on the lower end of the lever J engages with the rack *f* on the valve-stem *e* of the valves of the main cylinder, and moves the latter in a direction opposite to that imparted to the upper end of the lever J by the piston *l* of the auxiliary cylinder.

Rollers *n n*, or other suitable guides, serve to keep the racks *f* and *i* in gear with the segments *g* and *h*. The lever J may be provided with simple pins in its ends, arranged to engage with or move in transverse slots in the rods *k* and *e*; or pins projecting from the said rods *k* and *e* may engage with or move in slots in the end of said lever; or said lever may be connected to said rods by links or connections in an obvious manner; but the arrangement I have shown I consider the simpler, and it involves less friction.

Steam is admitted to the auxiliary cylinder *m* to operate the piston *l* by means of the valve O, placed in a chest, G′, located between the said cylinder *m* and the main steam-chest G, so as to communicate freely with the latter by means of a side pipe or passage.

The ports of the auxiliary cylinder *m* are designated by the letters *p* and *r*, and they pass underneath the seat of the valve O outward to and upward through the walls of the steam-chest G′ of the auxiliary cylinder to the ends of the cylinder *m*, and each port is alternately placed in communication with the chest G′ and the secondary exhaust-port *d′*,

the latter connecting with the main exhaust-pipe *d* by the valve O, which valve is a slide-valve of the ordinary construction.

The said valve O is operated by the main piston in the following manner: The stem of the said valve O is pivoted to a connecting-rod, S, which latter is connected by a pin, *x*, to a lever, K, which lever is pendent from a swivel, which is secured to any suitable stationary object—for instance, to arms which project from the steam-chest G; and the piston-rod C′ is pivoted to the lower end of this lever K.

The manner of hanging the lever K forms the special subject of one feature of my in- tion, and a description thereof will be better understood after I state briefly the operation of the mechanism thus far described.

We will assume that the main valves H are at the left-hand extreme of their movement, the auxiliary piston *l* at the right, and the main piston B and valve O of the auxiliary cylinder in the position shown. Now, if steam be admitted through the opening or pipe *a* to the steam-chest G, it will enter the cylinder-port *c* and drive the piston B to the left until the piston-rod C′, by means of lever K and rod *s*, moves the valve O in the same direction—*i. e.*, to the left—when steam will enter the auxiliary cylinder *m* through port *r* and push the piston *l* to the left, and thereby, through rod *k*, lever J, and rod *e*, move the main valves to the right, thus admitting steam to the main cylinder A through the port *b* on the left side of the piston, and permitting the steam on the right of the piston B to escape to the exhaust-port *d* through port *c*, and thereby cause the main piston to move to the right until the valve O opens the port *p*, when the main valves are returned to the first position, and the operation is repeated.

The auxiliary valve O is provided with "outside lap"—that is, it is longer than the distance between the outer edges of the cylinder-ports *p* and *r*; hence the main piston must necessarily move a sufficient distance past its mid position to open one of the said ports before the main valves will be moved.

In order to regulate this distance on the stroke of the main piston, means are provided to lower or raise the lever K in the swivel *w*, so as to bring the point *x* where the auxiliary valve-rod *s* connects farther from or nearer to the fulcrum at the swivel *w*, thereby increasing or decreasing the throw of the valve O, and admitting steam to the auxiliary cylinder to move the main valves sooner or later in the stroke of the main piston. To effect this regulation, the upper part of the lever K is provided, as shown in Fig. 2, with a screw-thread, which passes through the swivel *w* and enters a nut formed in the hub of the hand-wheel M. The said hub of the hand-wheel is secured to the swivel *w* by the screw-cap *y* and ring *z*, as shown in Fig. 2, so that the wheel cannot be lifted off the swivel, but may be freely revolved, so as to move the lever K up and down, and thus alter the throw of the valve O.

To regulate the movement of the piston *l* of the auxiliary cylinder and prevent it from striking its heads, I attach to the rod *k* of said piston *l* a piston, *u*, moving in a regulating-cylinder, *v*. This cylinder is filled with air, water, or other fluid, and, in one method of construction, the piston *u* fits a little loose, so that the air or fluid is slowly displaced from one side of it to the other, thus retarding the motion of the auxiliary piston *l*.

By another plan the piston fits tightly; but the ends of the cylinder are connected by a pipe provided with a stop-cock, to regulate the velocity of the flow.

In a more approved mode of construction, a groove or counterbore, N, (shown in dotted lines,) is made in the interior of the cylinder, so as to extend from the center nearly to the ends. This latter construction permits the free movement of the piston at mid position; but it is cushioned at either end on fluid, which cannot escape after the piston runs over the end of the groove.

In direct-acting steam-engines as heretofore constructed the valve-operating pistons have usually been connected to the valves at a considerable distance from their seats, which causes unequal wear on their faces.

In the above arrangement I operate the valves by a stem placed as near the face as is usual in engines having a crank movement, and by means of the lever J shown I am enabled to place the auxiliary and regulating cylinders at the upper part of the apparatus, where they are accessible and have sufficient room for freedom of operation.

By the use of the lever J, having arms of unequal length, I am enabled, also, to give any desired length of stroke to the auxiliary piston for a given throw to the main valves. By making the lower part of the auxiliary cylinder so that it forms the steam-chest of the auxiliary valve, I save in parts and gain the additional advantage of providing a horizontal seat for the said valve.

It is of the greatest importance in using direct-acting engines to be able to regulate the time at which the steam is admitted to change the direction of the main piston. If the engine be running slowly, the steam need not be introduced till near the end of the stroke; but at high speeds the piston acquires so much momentum that it will strike the cylinder-heads unless checked by the admission of steam considerably before the end of the stroke. This can be readily accomplished when the engine is in motion by turning the hand-wheel M.

The adjustment is useful, also, in some cases to reduce the stroke of the engine at moderate speeds, as is often required in drilling-engines and sometimes in pumps.

In Patent No. 44,232, granted to me September 13, 1864, I have shown a method of regulating the stroke of the pump, in which a block

is moved up and down in a slot in the valve-operating lever. The arrangement herein described is superior, for the reason that the adjusting-wheel M is nearer the fulcrum, and therefore derives less motion from the lever K, so that the stroke is more readily adjusted when the pump is in rapid motion. It also gives the auxiliary valve a motion coincident with that of the main piston, while the first plan reverses it, and would therefore be inapplicable in many cases.

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

1. The combination of the auxiliary cylinder, rocking lever, and main valves of a direct-acting steam-engine, substantially as and for the purpose herein specified.

2. The combination of the regulating-chamber with the auxiliary cylinder, rocking-lever, and main valves of the main cylinder in a direct-acting steam-engine, substantially as herein specified.

3. The arrangement of the steam-chest of the auxiliary cylinder between said auxiliary cylinder and the steam-chest of the main cylinder, substantially as and for the purposes herein specified.

4. The combination of the adjusting-wheel M and swivel *w* with the lever K and connecting-rod *s* and valve O, substantially in the manner and for the purpose herein specified.

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