

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

IMPROVEMENT IN STEAM-ENGINE VALVE-GEARS.

Specification forming part of Letters Patent No. **159,782**, dated February 16, 1875; application filed September 15, 1874.

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., of the city of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful Improvement in Steam-Engine Valve-Gear; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawing making a part of this specification, in which, like letters indicating like parts—

Figure 1 is a sectional view longitudinally through the cylinder, piston, and stem, illustrative of my improvement. Fig. 2 is an upper-end view of the devices of Fig. 1, but with the cap removed which covers or closes the end of the slide-valve chamber.

My present improvement relates chiefly to the valve-gear of the class of steam-engines known commonly as direct double-acting engines, though in some of its features it is applicable to steam-engines generally. The engine, in connection with which, for purposes of illustration, I have shown my improvement, is similar in some respects to those described in patents granted to me August 30, 1870, No. 106,899, and June 6, 1871, No. 115,668.

The main steam-cylinder A is substantially as set forth in those patents, as also the main steam-chest B. The piston D, stem D', with the plate *g*, are made substantially as set forth in Patent No. 115,668, and, in connection with the valve-stem *d* and knob *d'*, also of like construction as there represented, operate in like manner. Steam is admitted at the port B¹, passes alternately into the cylinder A by a like or other suitable arrangement of ports, *b b'*, and, by a like alternate action, is exhausted through the same ports, and is carried off at the exhaust B², all substantially as set forth in the patents named.

The cylinder-head A¹ is made with a valve-chamber, *a*, which, for convenience, is cylindrical. In it, and attached to the valve-stem *d*, is a slide-valve, *a'*, made with an exhaust-port, *a²*, in its working face, and to keep it from turning a groove, *a³*, is made in its opposite face or back, with a fixed feather or pin, *a⁴*, therein. The upper end of the valve-stem *d* extends through a stuffing-nut, A², to act as a guide where one is desired. The stem *d* is

made of different sizes in its different parts, on well-known principles, so that the pressure of steam thereon in opposite directions shall not be such as to interfere with the regularity of its action. The main steam-chest B contains two piston-valves, *n n'*, on a common stem, *n²*. These valves are in suitable position to cover and uncover alternately the ports *b b'*. The upper one, *n*, is made somewhat larger than the lower one, *n'*—say, of about double the area, more or less, in small sizes of engines—but such that the excess of steam-pressure against the upper valve over that against the lower, such pressure acting between the valves, shall suffice to give both valves an upward stroke, to the position they occupy in Fig. 1. The engine will then be taking steam above the piston D by the ports *b*, and exhausting below through the ports *b'*. Now, to give these valves a reverse stroke, I arrange in a chamber, P, a piston, *m*, with a stem, *m'*, in such position that the stem will engage or be engaged by the valve *n* or its stem. To operate this piston I make the steam-ports *s s¹ s²*. As the main piston D nears the end of its reverse or down stroke the plate *g* strikes the knob *d'* so as to move the valve *a'* till it uncovers the port *s* and closes connection between the exhaust-ports *s¹ s²*. Steam—which enters the chamber *a* by an open port from the steam-chest B, shown partly at *s³* in dotted lines, Fig. 2—then passes over the end of the valve *a'*, along the port *s*, into the chamber P above the piston *m*, forces it down, and, through the stem *m'*, shifts the valves *n n'* so that the cylinder A shall take steam at *b'* and exhaust at *b*. With the upstroke of the main piston D the plate *g* strikes the shoulder *d³*, moves the valve *a'* upward, so as to close the steam-port *s* and open the communication from the chamber P, through ports *s¹ a² s²*, to the exhaust. The valves *n n'* then make an upstroke, as already described, and in doing so force the piston *m* upward to the position shown. In order that there may be no back pressure on the latter in going up and no steam-pressure to check its downward motion, I connect the lower end of the chamber P with the exhaust port *s²* by a small port, *o*; but this port, as also that at *s*, is so far from the ends of the chamber P as to secure for the piston *m* a cushioning effect.

It should be noted that the piston *m* is larger than the larger valve *n*, and preferably of about double the area of the latter, more or less, but it should be enough greater so that the pressure on its upper side, when steam is admitted, shall be enough greater than the preponderance of steam-pressure on the under side of the valve *n* to give the downward stroke to the latter, as described.

The slide-valve *a*¹ may be of any desired construction, and in some engines may be worked by an eccentric. For convenience in removing the valves *n n*¹ for renewal or repairs, I line the chamber *P* with a bush, *c*, inside which the piston *m* plays.

For the piston-valves described, pistons and valves made separately may be substituted with a like operation, and such modification I hereby include as a part of my invention.

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

1. A pair of piston-valves, *n n*¹, of different

areas, subject to steam-pressure, so as to be operated in one direction by a preponderance of pressure, in combination with a third piston, *m*, of still greater area, arranged to give the piston-valves a reverse stroke, substantially in the manner set forth.

2. The combination of piston-valves, piston, and slide-valve, the piston-valves and piston having different areas, and the slide-valve being arranged to govern the supply and exhaust to and from the piston, substantially as set forth.

3. Ports *s, s*¹, *s*², and *o*, in combination with slide-valve *a*¹ and piston *m*, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEORGE WESTINGHOUSE, JR.

Witnesses:

JAMES M. CHRISTY,
GEORGE H. CHRISTY.