(No Model.)

H. G. WILLIAMS.

DIRECT ACTING ENGINE.

No. 460,616. Patented Oct. 6, 1891.

Fig. 1.

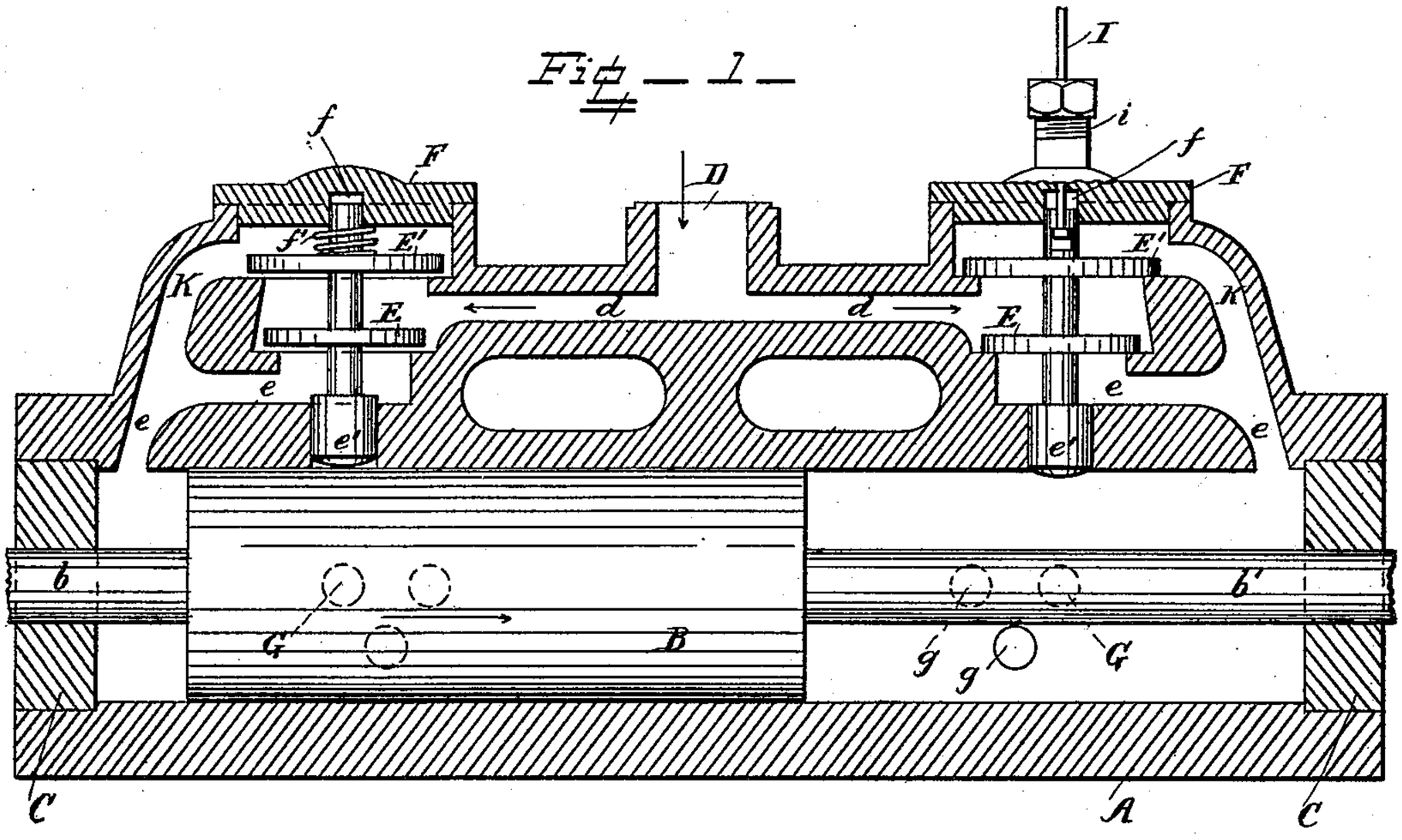
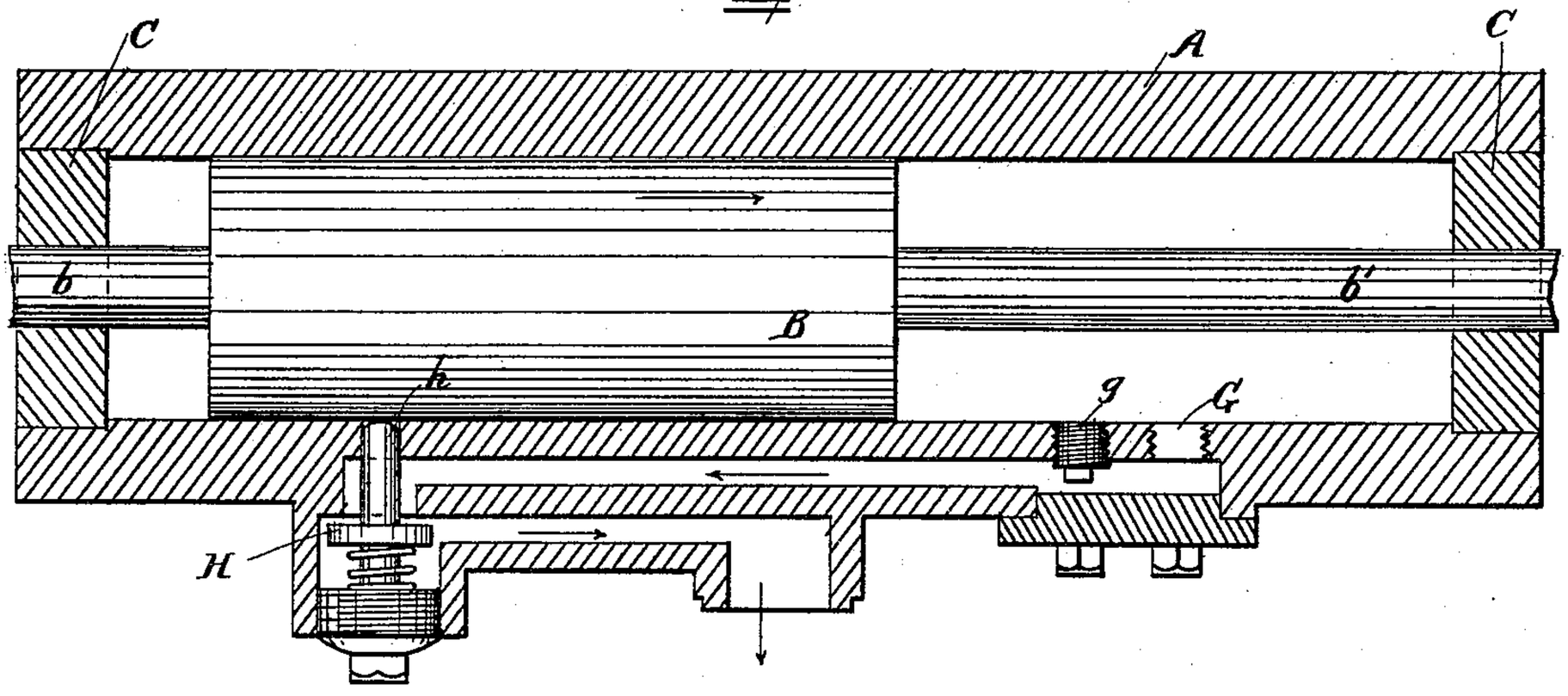


Fig. 2.



WITNESSES

Van Buren Hillyard.

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UNITED STATES PATENT OFFICE.

HORACE G. WILLIAMS, OF LYKENS, PENNSYLVANIA.

DIRECT-ACTING ENGINE.

SPECIFICATION forming part of Letters Patent No. 460,616, dated October 6, 1891.

Application filed January 17, 1891. Serial No. 378,141. (No model.)

To all whom it may concern:

Be it known that I, HORACE G. WILLIAMS, a citizen of the United States, residing at Lykens, in the county of Dauphin and State of Pennsylvania, have invented certain new and useful Improvements in Direct-Acting Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to direct-acting engines, and more particularly to engines used to actuate rock-drills. These engines are operated either by compressed air, steam, or other similar fluid, and may also be used to actuate pumps, air-compressors, and any other machines requiring a quick reciprocating movement.

This invention consists in the novel construction and combination of the parts hereinafter fully described and claimed.

In the drawings, Figure 1 is a longitudinal section through the inlet-ports of the engine. Fig. 2 is a longitudinal section through one of the exhaust-ports, showing an exhaust-valve applied to it.

A is the cylinder.

B is a long piston working in the cylinder, and provided with a piston-rod *b* at one end for connecting it to the drill or other mechanical device to be worked by the engine, and *b'* is a spindle at the other end of the piston, affording a means for revolving the piston when the engine is used to actuate a rock-drill.

C are buffers of india-rubber at each end of the cylinder, provided with holes for the rod *b* and spindle *b'* to pass through. The cylinder-covers, stuffing-boxes, &c., are not shown, as they do not differ from those ordinarily employed.

D is the inlet for compressed air or steam, and *d* is a longitudinal passage communicating therewith and formed in the side wall of the cylinder A.

E are the inlet-valves at the ends of the passage *d*, and *e* are the inlet-ports extending from the under side of the inlet-valves and entering the cylinder near its ends. Each valve E is provided with a tappet *e'*, projecting from its under side through a hole in the side of the cylinder for the piston to strike against.

F is a removable cap, provided with a guide *f* for the valve-stem to work in and permitting the valve to be taken out when requisite. In order to relieve the valve E from the great pressure upon the back of it, which makes it very hard to lift and causes the end of its opening-tappet to become worn away very rapidly, the valve is constructed so that it will be very nearly balanced. This is accomplished by means of the disk E' on the valve-stem above the valve E. This disk is, in fact, a separate valve and rests upon a separate valve-seat above the seat of the valve E.

K is a passage, which connects the space above the disk or valve E' with the inlet-port *e*. As long as the valves E and E' are closed they are in equilibrium as regards the pressure of the air between them, and therefore they are easily raised. A spring *f'* may be arranged to close the valve, if desired, but will seldom be found necessary, as the weight of the valve will cause it to close automatically. The valve E and disk E' can also be so proportioned that there will be a slight excess of pressure behind the valve, which will cause it to close automatically.

G are exhaust-ports formed through the side of the cylinder. Only one of these exhaust-ports is used in each end of the cylinder, but several of them are provided at short distances apart longitudinally. Those exhaust-ports which are not required are temporarily closed by removable plugs *g* or any other equivalent means for closing them, and the stroke of the piston may be varied by removing the plugs from the ports which give the desired length of stroke and closing the remaining ports. When the piston is forcibly propelled toward one end of the cylinder, it lifts the tappet-valve at that end; but before the air can rush through the port the piston has been carried along by its momentum a considerable distance farther, compressing the air in the space between the port *e* and the buffer. This continued movement of the piston uncovers one of the exhaust-ports G at the other end of the cylinder and permits the pressure behind the piston to fall suddenly. The piston starts upon its return movement, being

shot back by the high-pressure compressed air in the end of the cylinder and by the air which rushes at full pressure through the valve E and through the valve E′, which are held open until the edge of the piston leaves the tappet arranged centrally underneath the said valves.

The length of the stroke of the piston may be varied within certain limits by varying the position of the exhaust-ports, as the piston ends its stroke when it has uncovered the exhaust-port and sufficient time has elapsed to permit the high-pressure air to escape freely through the port. The momentum of the piston carries it farther than is sufficient to merely open the port; but the length of the stroke is nevertheless determined by the position of the port, and will always be substantially the same under the same working pressure of air or steam.

In Fig. 2 an exhaust-valve H is shown and is provided with a tappet *h*, adapted to be lifted by the piston as it approaches the other end of the cylinder. When these exhaust-valves are used, the exhaust-ports do not lead directly through the side of the cylinder, but are carried longitudinally in opposite directions, in the thickness of the metal, from one end of the cylinder to the other. The use of the exhaust tappet-valves H permits the exhaust-ports to be fully uncovered by the piston before any material reduction of pressure is effected, and the action of exhausting is therefore very quick and sudden; but the engine will work very satisfactorily without them.

When the engine is applied to a rock-drill, it may be started by moving the cylinder forward by the ordinary feed-screw, which is not shown in the drawings, the piston being held stationary by placing the point of the drill against the rock until the back end air-inlet tappet is raised. If the cylinder is then moved backward, the expansion of the air thus admitted will force the piston forward and cause it to raise the air-inlet tappet-valve at the front end of the cylinder, and the piston will commence to reciprocate rapidly and will continue to work as long as compressed air is supplied. The buffers prevent the piston from striking the cylinder-covers at starting, when there is no compressed air in advance of the piston to arrest its motion.

When the engine is stationary, the engine may be started by trip mechanism applied to the inlet-valves for raising them by hand. In Fig. 1 a trip-rod I is shown connected to a valve and passing through a stuffing-box *i* on the cap F; but any other equivalent mechanism may be used to open either valve and start the engine.

What I claim is—

1. The combination, with a cylinder provided with inlet-ports, of a long piston working in the cylinder, and tappet-valves normally and automatically closing the said inlet-ports and adapted to be opened by the piston as it approaches the ends of its stroke, whereby the said piston may be reciprocated, substantially as set forth.

2. The combination, with a cylinder, of a long piston working therein, inlet-valves adapted to close automatically and provided with tappets projecting through holes in the side of the cylinder and adapted to be raised by the piston as it approaches the ends of its stroke, and inlet-ports connecting the under side of the said valves with the end of the cylinder, substantially as set forth.

3. The combination, with a cylinder, of a long piston working therein, inlet-valves adapted to close automatically and provided with tappets for the said piston to strike against, disks on the inlet-valve stems for relieving the pressure behind the said valves, and inlet-ports connecting the under side of the said valves with the ends of the cylinder, substantially as set forth.

4. The combination, with a cylinder, of a long piston working therein, inlet-valves adapted to close automatically and provided with tappets for the said piston to strike against, disks on the inlet-valve stems for relieving the pressure behind the said valves, inlet-ports connecting the under side of the said valves with the ends of the cylinder, and passages connecting the spaces above the said disks with the said inlet-ports, substantially as set forth.

5. The combination, with a cylinder provided with inlet-ports *e*, the longitudinal passages *d*, and the inlet D, of a long piston working in the cylinder, and the inlet-valves in the ends of the said passage normally and automatically closing the said ports and provided with tappets projecting through holes in the side of the cylinder and adapted to be raised by the piston as it approaches the ends of its stroke, substantially as set forth.

6. The combination, with a cylinder provided with inlet-ports, of a long piston working in the cylinder, tappet-valves normally and automatically closing the said inlet-ports and adapted to be opened by the piston as it approaches the ends of its stroke, and trip mechanism for opening the said valves independent of the piston and thereby starting the engine, substantially as described.

7. The combination, with an engine-cylinder provided at each end with a series of exhaust-ports through its side at different distances from its ends, of a long piston having a variable length of stroke in the cylinder and adapted to uncover the said exhaust-ports, and means, such as removable plugs, for closing certain of the exhaust-ports and determining the length of the stroke of the piston, substantially as set forth.

8. The combination, with a cylinder provided with exhaust-ports near each end of it and inlet-ports between the said exhaust-ports and the ends of the cylinder, of tappet-valves normally closing the said inlet-ports, and a long piston sliding in the cylinder and adapted

to uncover the exhaust-port behind it, to open the inlet-port in front of it by raising the tappet-valve, and to cover the exhaust-port in front of it alternately at each stroke, according to the direction of its motion, whereby the said piston may be caused to reciprocate rapidly, substantially as set forth.

9. The combination, with a cylinder provided with exhaust-ports near each end of it and longitudinal exhaust-passages extending therefrom toward its opposite ends, of outlet tappet-valves normally closing the outlets from the said exhaust-passages, and a long piston sliding in the cylinder and adapted to uncover the exhaust-ports with its rear end and open the respective outlet-valves with its front end alternately, according to the direction of its motion, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

HORACE G. WILLIAMS.

Witnesses:

FRANK PUCKEY,

T. W. THOMAS.