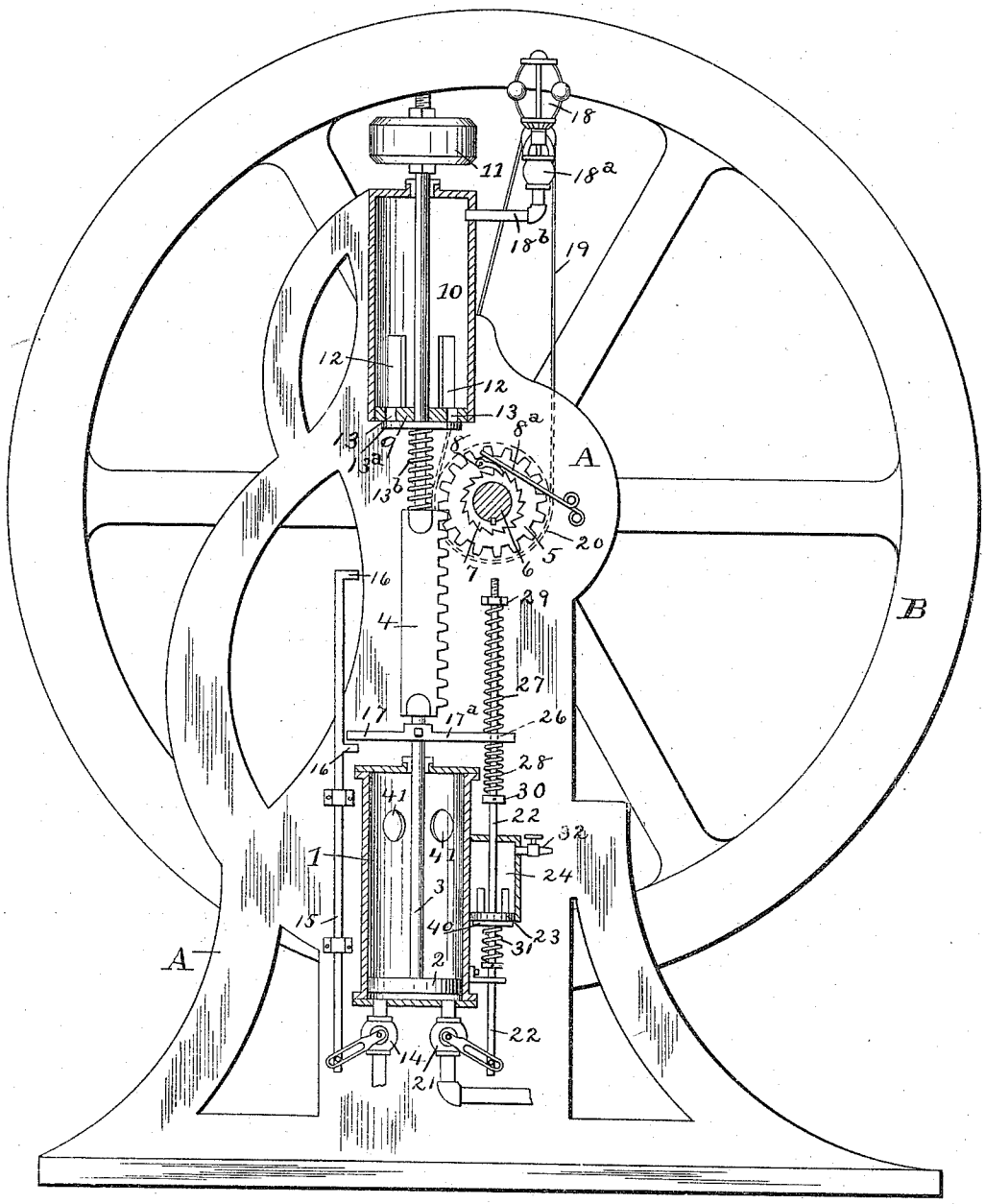
(No Model.)

J. D. GRAY.

DIRECT ACTING STEAM ENGINE.

No. 533,290. Patented Jan. 29, 1895.



WITNESSES :-

L. Leroy Van Dorn.

Charles B. Mann Jr.

INVENTOR :-

James D. Gray

By Chas B. Mann

ATTORNEY.

UNITED STATES PATENT OFFICE.

JAMES D. GRAY, OF BALTIMORE, MARYLAND, ASSIGNOR OF TWO-THIRDS TO WILLIAM B. PRICE AND ABRAHAM SHARP, OF SAME PLACE.

DIRECT-ACTING STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 533,290, dated January 29, 1895.

Application filed May 19, 1894. Serial No. 511,772. (No model.)

To all whom it may concern:

Be it known that I, JAMES D. GRAY, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Direct-Acting Steam-Engines, of which the following is a specification.

My invention relates to an improved direct-acting engine, and has for its object to apply steam, or other actuating agent, under high pressure to a piston intermittently or at intervals, such intermittent application being controlled directly by the load and in accordance with the requirements thereof.

In order to make the improvements more clearly understood I have shown in the accompanying drawing certain means for carrying the same into practical effect, without, however, intending to limit my invention to the particular construction which, for the sake of illustration, I have set forth.

In the drawing the figure shown is a sectional elevation.

The figure 1 designates a steam cylinder in which operates the piston, 2, having a rod, 3, carrying outside of the cylinder a rack, 4, which meshes with a pinion, 5, loosely mounted on the main shaft, 6, and connected therewith so as to prevent the pinion from turning on the main or driven shaft one way by any ordinary or approved form of clutch. In this case the clutch comprises a ratchet wheel, 7, fixed rigidly on the main-shaft, and a pawl, 8, carried on the pinion engages with the ratchet wheel. The pawl may engage itself with the ratchet by the action of gravity, but to insure its engagement a stationary spring, 8^a, is attached to the frame, A, of the engine.

The main shaft, 6, preferably carries a fly wheel, B, or other momentum-perpetuating device. The clyinder, 1, also has perforations, 41, located near the upper end for the escape of air as the piston, 2, makes its stroke forward. The piston will compress the air in the cylinder after passing the perforations and the compressed air will form a cushion at the end of the stroke.

The cylinder may be left entirely open at the upper end whenever the engine is employed for work where the speed is so slow as to require no cushion for the piston.

The piston-rod at its upper end carries a plunger, 9, operating in a main dash-pot or air-chamber, 10. Above this dash-pot and connected with the rod is a retracting device, 11, which, in the form of my invention illustrated in the drawing, consists of a weight. The wall of the dash-pot, 10, is preferably provided with vertically-disposed slots, 12, which extend from an intermediate point thereof to its lower end, or that end at which the plunger, 9, is located when the piston, 2, is in position to receive the application of steam. These slots, 12, are arranged at one end of the dash-pot only, and are designed to facilitate the return of the plunger, 9, and hence of the piston, 2. The piston is provided with ports or openings, 13, and a valve, 13^a, below the plunger serves to close said openings on the down stroke. A spiral spring, 13^b, below the said valve is employed to hold the valve normally in contact with the plunger. On the up-stroke this spring will yield and allow the valve to uncover the ports or openings, 13.

The exhaust valve, 14, of the steam cylinder is opened and closed by means of a stem, 15, having two spaced stops, 16; and the piston-rod or rack is provided with an arm or knocker, 17, to engage said stops, 16, and thereby actuate the exhaust valve, both to open and close same, at the limits of stroke of the piston, 2.

The means for controlling the inlet of air to the main dash-pot, 10, above the plunger, 9, consists essentially of a governor valve, 18^a, of any preferred or well-known construction, and connected with the dash-pot by a pipe, 18^b. To this valve is connected a ball-governor, 18, actuated by a belt, 19, receiving motion from a pulley, 20, on the main shaft. The operation of this ball-governor, which may be replaced by any other approved type of controller, depends, of course, upon the speed of rotation of the main shaft, and when its speed falls below a certain rate the governor-valve, 18^a, is opened to admit air to the dash-pot, 10, in front of the plunger and thus release the latter and allow it to descend.

The steam inlet valve, 21, is opened and closed by means of a stem, 22, carrying an auxiliary plunger, 23, operating in an auxil-

iary dash-pot, 24, all similar to the main dash-pot, 10. The piston rod, 3, is provided with an arm, 17ª, having a perforation, 26, through which the inlet valve-stem, 22, loosely extends. Spiral pressure springs, 27, and 28, are arranged on the stem respectively above and below said arm. The upper pressure spring, 27, is on the rod between said arm and an adjustable nut, 29, and the lower pressure spring, 28, is on the rod between said arm and a suitable stop, 30, secured on the stem. A valve, 40, is controlled by a coiled spring, 31, to close the ports on the auxiliary plunger, 23, during its descent. The auxiliary dash-pot, 24, is slotted similarly to the main dash-pot, and is provided with a gage-valve, 32, which may be set to control the admission of air to the pot according to the demands of operation as hereinafter set forth.

The operation may be briefly set forth as follows: The forward or upward movement of the piston, 2, is converted, by means of the rack and pinion into a rotary motion imparted to the main shaft, 6, and the piston is sustained at the limit of its forward stroke until the rate of speed of the shaft falls below the standard speed, thereby causing the governor-valve, 18ª, to open and admit air above or in front of the plunger, 9. The descent of the latter is accelerated as it approaches the lower end of the main dash-pot by the rapid admission of air through the slots, 12, thereby compressing the lower spring, 28, on the inlet valve-stem and causing the inlet valve, 21, to open after the piston, 2, has returned to its original position at the lower end of the cylinder. The arm, 17, engages with the lower stop, 16, thus closing the exhaust valve, 14, at the same time. Thus a maximum pressure of steam may be applied to the piston to give it an initial and then successive intermittent impulses which are communicated to the main shaft only as the load varies, thereby avoiding unnecessary reciprocation of the piston and also unnecessary consumption of steam energy.

It will be seen that I employ a main dash-pot or air chamber in which operates a plunger carried by the piston-rod; a loose or clutch connection with the main shaft, whereby when the piston is at rest said shaft turns independently thereof; and means for controlling the admission of air to the main dash-pot above or in front of the plunger, whereby when the speed of rotation of the main shaft falls below a predetermined rate, said plunger will be released, and by suitable intermediate connections will actuate the inlet and exhaust valves of the cylinder; and, furthermore, I employ an auxiliary dash-pot in which operates a plunger carried by the stem of the inlet valve, the admission of air to this auxiliary dash-pot being controlled by a gage-valve which may be set to admit the exact amount of air necessary to release the auxiliary plunger under a given pressure applied by the piston-rod, whereby the inlet valve will be opened when the piston reaches the limit of its down stroke.

While I have described my invention as it is specifically shown in the drawing, yet it is obvious that certain details of construction may be varied or certain parts altogether dispensed with without departing from my invention as hereinafter claimed.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a driven shaft; a piston actuated one way only by steam; a plunger carried by the piston-rod and operating in a dash-pot; connections between the said shaft and piston, whereby the former can rotate independently of the reciprocation of the latter; and means for controlling the movement of the plunger, substantially as specified.

2. The combination of a driven shaft; a piston actuated one way only by steam; a plunger carried by the piston-rod and operating in a dash-pot; connections between the said shaft and piston, whereby the former can rotate independently of the reciprocation of the latter; valve mechanism for controlling the inlet of fluid to the dash-pot; and connections between the driven shaft and said valve mechanism, substantially as specified.

3. The combination of a driven shaft; a piston actuated one way only by steam; a plunger carried by the piston-rod and operating in a dash-pot; connections between the said shaft and piston, whereby the former can rotate independently of the reciprocation of the latter; valve mechanism for controlling the inlet of fluid to the dash-pot; and a governor operated by the driven shaft to regulate the said valve mechanism.

4. The combination of a driven shaft; a piston actuated one way only by steam; a plunger carried by the piston-rod and operating in a dash-pot; connections between the said shaft and piston, whereby the former can rotate independently of the reciprocation of the latter; means controlled by the driven shaft for admitting air to the dash-pot; inlet and exhaust valves for the piston-cylinder; connections between the piston-rod and the exhaust-valve; and vacuum controlling mechanism for operating the said inlet valve.

5. The combination of a driven shaft; a piston actuated one way only by steam; a plunger carried by the piston-rod and operating in a dash-pot; connections between the said shaft and piston, whereby the former can rotate independently of the reciprocation of the latter; means controlled by the driven shaft for admitting air to the dash-pot; inlet and exhaust valves for the piston-cylinder; connections between the piston-rod and the exhaust-valve; an inlet valve-stem carrying an auxiliary plunger operating in an auxiliary dash pot; adjustable means for controlling

the inlet to the said auxiliary dash-pot; and spring-actuated connections between the piston-rod and the said inlet valve-stem.

6. The combination of a driven shaft; a pinion loose on said shaft; automatic clutch mechanism co-acting between the shaft and pinion, whereby the pinion is free to turn on the driven shaft one way but prevented from turning on the driven shaft the other way; a piston actuated one way only by steam; a rack bar carried by the piston engaging the said pinion; and a plunger also carried by the piston and operating in a dash-pot, and means for controlling the movement of the plunger.

7. The combination of a driven shaft; a pinion loose on said shaft; automatic clutch mechanism co-acting between the shaft and pinion, whereby the pinion is free to turn on the driven shaft one way but is prevented from turning on the driven shaft the other way; a piston actuated one way only by steam; a rack bar carried by the piston and engaging the said pinion; a plunger also carried by the piston and operating in a dash-pot; a valve to control the inlet of air to the dash-pot; and a governor operated by the driven shaft to regulate the said valve.

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

JAMES D. GRAY.

Witnesses:
CHARLES B. MANN, Jr.,
C. CALVERT HINES.