

No. 752,619.

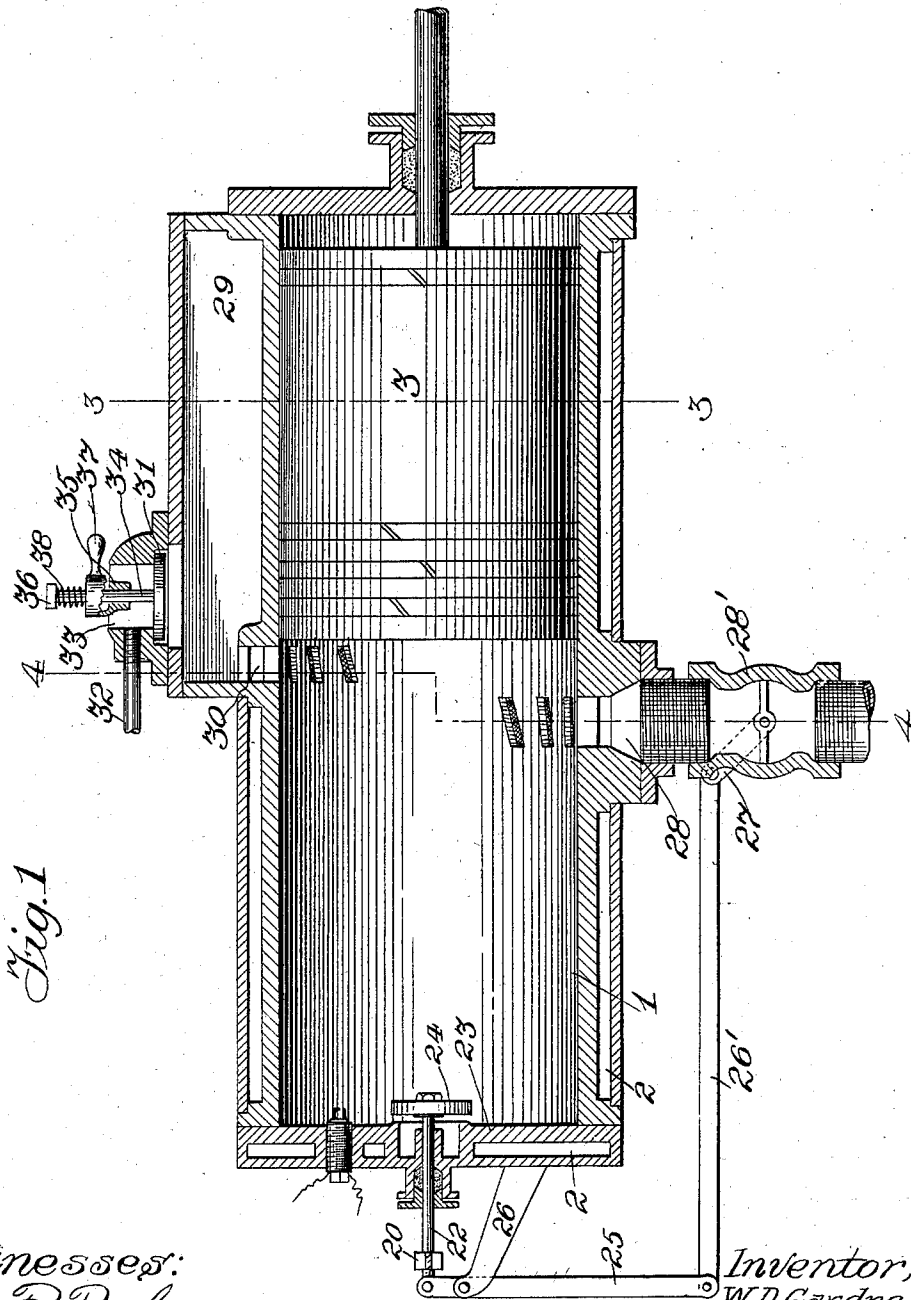
PATENTED FEB. 16, 1904.

W. D. GARDNER.
COMBINED STEAM AND EXPLOSION ENGINE.

APPLICATION FILED APR. 8, 1903.

NO MODEL.

3 SHEETS—SHEET 1.



Witnesses:
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E. D. Potter,

Inventor;
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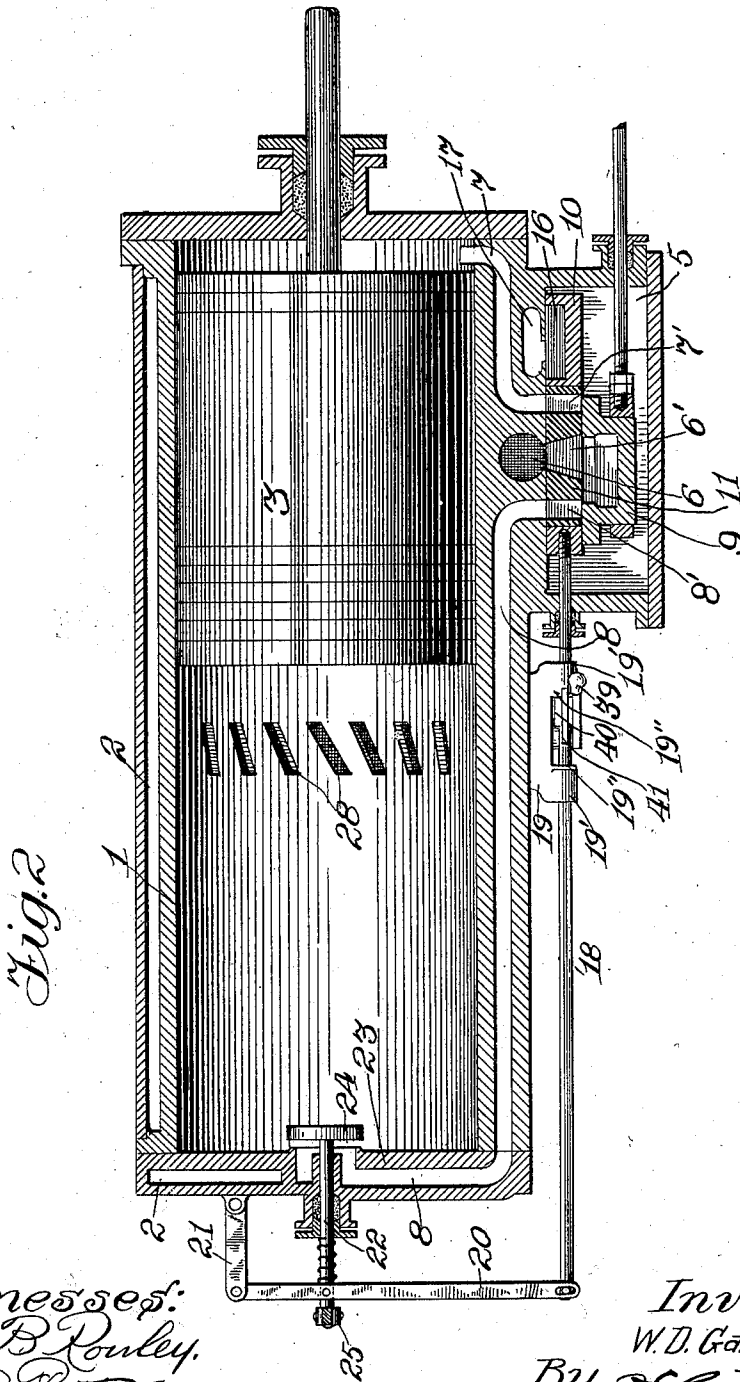
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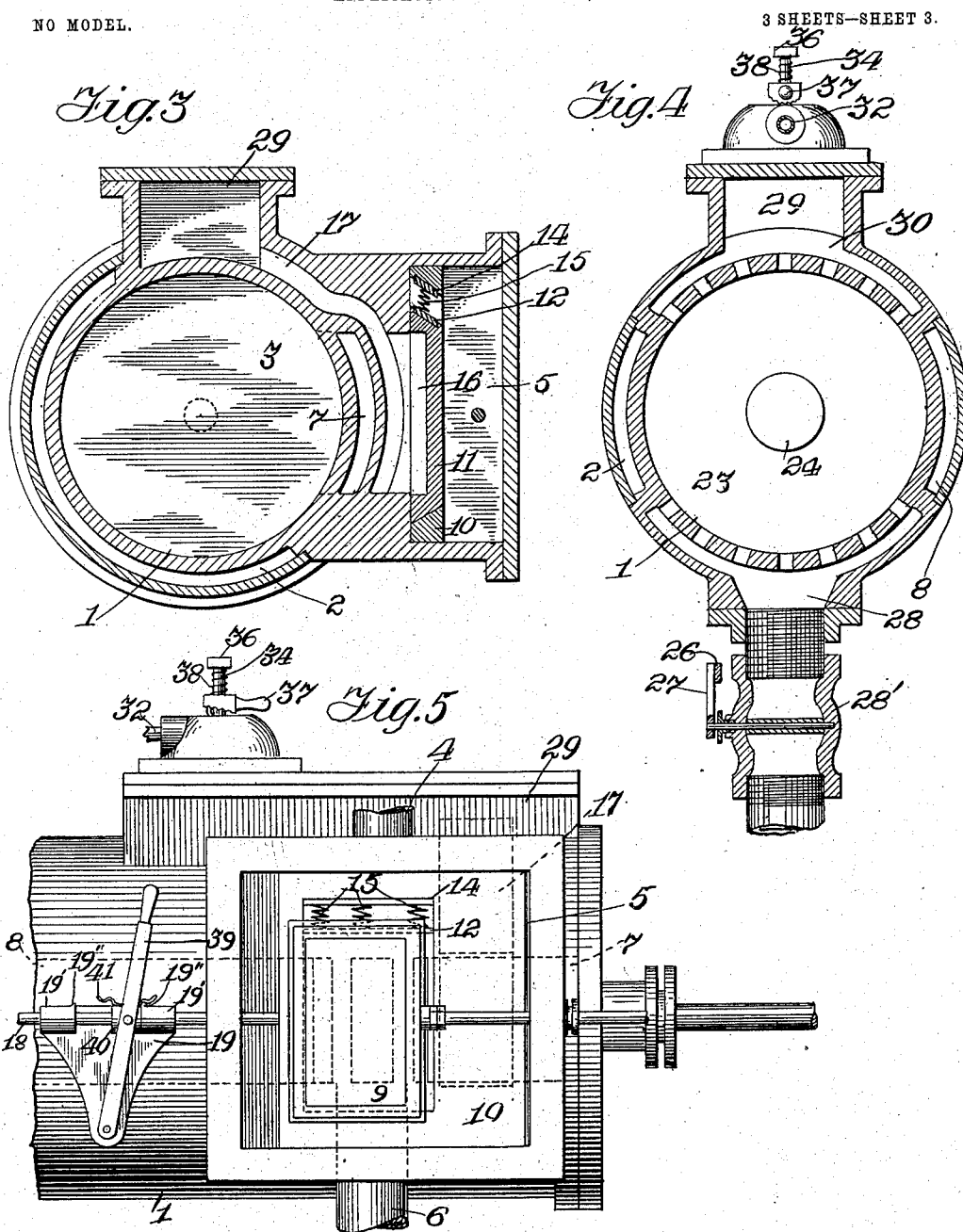
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3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE.

WILLIAM D. GARDNER, OF WASHINGTON, PENNSYLVANIA.

COMBINED STEAM AND EXPLOSION ENGINE.

SPECIFICATION forming part of Letters Patent No. 752,619, dated February 16, 1904.

Application filed April 8, 1903. Serial No. 151,596. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. GARDNER, a citizen of the United States of America, residing at Washington, in the county of Washington and State of Pennsylvania, have invented certain new and useful Improvements in a Combined Steam and Explosive Engine, of which the following is a specification, reference being therein to the accompanying drawings.

This invention relates to certain new and useful improvements in combined steam and explosion-engines, and relates more particularly to that class of engines which are adapted to be used either as explosive or fluid-pressure engines.

The object of this invention is to provide an engine which may be used either as an explosive or fluid-pressure engine, the means for changing the same from one to the other power being readily operated and the construction of the same being simple and efficient.

A further object of this invention is to provide means whereby when the same is used as an explosive-engine the charge of mixture is partially compressed before entering the explosive end of the cylinder, thereby securing better results in the operation of the same.

A still further object of this invention is to so arrange the gas-inlet that the engine when running as an explosive-engine is self-controlled, thereby maintaining a constant speed without the aid of mechanical means.

In describing the invention in detail reference is had to the accompanying drawings, forming a part of this specification, and wherein like numerals of reference indicate like parts throughout the several views, in which—

Figure 1 is a longitudinal elevation in section of my improved engine. Fig. 2 is a plan view in section of the same. Fig. 3 is a cross-section taken on the line 3 3 of Fig. 1 looking in the direction of the arrow. Fig. 4 is a cross-section taken on line 4 4 looking in the direction of the arrow. Fig. 5 is a side elevation of the forward end of the cylinder with the cover of the steam-chest removed.

The reference-numeral 1 indicates the cyl-

inder, which is provided around its outer side with water-jacket compartment 2, and a trunk-piston 3 is suitably mounted to operate therein. A steam-inlet 4 leads into the steam-chest 5, and a steam-exhaust 6 leads therefrom in the usual manner. This steam-chest has ports 7 and 8 leading through the wall of the cylinder to either end thereof, and a slide-valve 9, which is of the usual construction and which is operated in the usual manner, is provided therein, and interposed between the ports 7 and 8, the exhaust-port 6, and the slide-valve 9 is a plate 10, which is provided with a rectangular opening, in which the plate 11 is placed. The said plate 11 is held in position by plates 12 14, between which is interposed a spring 15, the plate 14 resting against one face of the rectangular opening, while the plate 12 rests against the one face of the plate 11. The plate 11 is provided with apertures 6' 7' 8', which in the position shown in Fig. 1 register with the ports 6 7 8, and the plate 10 is provided with a cut-away portion 16, which in the position as shown in Fig. 2 covers the port 17. The plate 10 has connected to its end and leading through a stuffing-box in the steam-chest a rod 18, which passes through bracket 19 and is connected at its rear end with the lever 20, which is connected by a link 21 with the rear head of the cylinder, and between said connection and the connection of the lever 20 with the rod 18 a valve-stem 22 is pivotally connected thereto and leading through the stuffing-box in the cylinder-head 23 carries on its inner end a valve 24, which is adapted to close port 8 when said rod 18 is moved to one of its positions. The lever 25 is pivotally connected to an extension of the valve-stem 22 and is fulcrumed to the bracket 26, secured to the head 23 of the cylinder, the free end of said lever 25 being pivotally connected to a link 26', which connects with the crank 27 of the winged valve 28', which is interposed in the exhaust 28, which is preferably in the form of a series of angularly-cut ports so formed that the piston may have proper support when passing over the same and also that the edges of said piston will have a smooth pas-

sage over them, which exhaust is used when the engine is running as an explosive-engine.

The port 17, which connects with steam-chest at one end, has its other end connected
5 with the compression-chamber 29, which is located on the upper side of the cylinder. This compression-chamber 29 also has a port 30, which communicates with the cylinder, said connection being preferably in the form
10 of angularly-cut slots so formed for the same purpose as described in connection with the exhaust-ports, and a spring-held valve 31 is provided on its upper side, through which the mixture is drawn when the suction is applied
15 to said compression-chamber. The gas or gasolene inlet 32 communicates with an air-inlet 33 at right angle above the valve 31, the said valve having a stem 34, extending through a suitably-formed bracket 35, and
20 the upper end of said stem having a collar 36 and an adjusting-handle 37, a spring 38 being interposed between said collar and adjusting-handle and encircling said valve-stem, the lower end of said adjusting-handle 37 being
25 cut on an angle and provided with notches in order that when said handle is slightly rotated the distance between the upper end of said handle and the collar 36 will be decreased, thereby increasing the compression of said
30 spring, thus requiring a greater suction to open the valve 31 and draw in the mixture. The gas-inlet 32, leading in at right angles to the air-inlet 33, provides means for regulating the richness of the mixture which will be drawn into
35 the compression-chamber, as should the engine be running at a high rate of speed the air passing through the air-inlet port 33 will draw in less gas from pipe 32 than would be the case were the air coming through slower.
40 Thus the richness of the mixture is determined by the speed of the engine and the position of the handle 37. The bracket 19, through which rod 18, which is connected with plate 10, passes, has connected to its lower extension the controlling-lever 39, which is pivotally connected
45 intermediate its length to the block 40, which is secured to the rod 18 between the two ears 19' 19' of the bracket, these two ears being provided at their upper edges with slight projections 19'' 19'', and the block 40 carries a
50 spring 41, each end of which is slightly raised and provided with a notch which is adapted to engage one of these projections 19'' 19'' when the lever is thrown in either one of its
55 two positions. The engine as illustrated throughout the several views is shown in the position in which it would be when running as a steam-engine, and to change the same to an explosive or gas engine the lever 39 would
60 be thrown to the position reverse to that shown in Fig. 5, when the plate 10, carrying with it the plate 11, would be moved to such position that the ports 6 and 8 would be cut off from communication with the steam-chest

and the ports 7 and 17 would be connected 65 by means of the cut-away portion 16 in the plate 10. Thus the steam-pressure, while being in the steam-chest, would have no connection with the several ports. The throwing of the lever 39 to position just described would
70 also move the lever 20 to a position where the valve 24 would close the communication between the port 8 and the cylinder and the lever 25 would be moved to a position where the winged valve 28 would be opened, thereby
75 opening the explosive-exhaust.

The operation of the engine when running as a steam-engine is the same as is usual in this class of engines, and the operation of the same when running as an explosive-engine is
80 as follows: The trunk-piston 3 being in position as shown in the drawings will by having suitable movement imparted to it be forced rearwardly, thereby creating suction in the compression-chamber 29 by being connected
85 with the same through the ports 7 and 17, the port 30 being closed by rearward movement of said piston 3. This suction in the compression-chamber will cause the valve 31 to be opened, thereby drawing in a certain amount
90 of mixture until the piston has reached its rearward position, when it will start to move forward, and the compression within said chamber consequent upon said movement will permit the valve 31 to close and the compression
95 will continue until such time as the rear of the piston has passed the beginning of the ports 30, when the mixture in the chamber, which is under compression, will rush in and fill the space at the rear of the piston. Upon
100 the piston again moving rearwardly the mixture will again be compressed to a suitable state of density, and when it has reached its rearward position the spark is caused to ignite the same, thereby causing the explosion
105 of the mixture, when the force of the explosion will cause the piston to move forward, said explosion being expanded until such time as the rear of the piston is past the beginning of the exhaust-port 28, when the exhaust will
110 take place, which is known as the "scavenger-exhaust" in engines of this type. While the piston has been moving forward consequent upon this explosion another charge of mixture has been compressed within the compression-chamber 29, and the exhaust having taken
115 place through the port 28 the rear of the piston will again permit the compressed mixture from the chamber 29 to pass through ports 30 into the rear of the cylinder, when the piston
120 may again be moved rearwardly, compressing the same, and the operation just described is repeated.

It will be noted that various changes may be made in the details of construction without
125 departing from the general spirit of my invention.

Having fully described my invention, what

I claim as new, and desire to secure by Letters Patent, is—

1. In an engine of the character described, the combination of a cylinder having a piston adapted to operate within the same, a steam-chest located adjacent to said cylinder, a compression-chamber located adjacent to said cylinder, ports leading from said chest to either end of said cylinder, a slide-valve adapted to operate in the usual manner when said engine is running under fluid-pressure, a plate interposed between said ports and slide-valve whereby said ports may be cut off from communication with said steam-chest, a port leading to the rear of the cylinder being provided with a valve for cutting off communication between said cylinder and steam-chest, the port leading to the forward end of said cylinder being connected with the port leading to the compression-chamber when the plate interposed between said slide-valve and said ports is in one of its positions, said compression-chamber having a port communicating with the rear of the cylinder when the piston is in its forward position, a spring-held valve being connected with said compression-chamber to permit the mixture to be drawn into the same, means for adjusting the pressure of said spring, an exhaust-port communicating with the rear of said cylinder when the piston is near the end of its forward stroke, a valve in said exhaust adapted to be open when the engine is running as an explosive-engine and closed when the same is running as a fluid-pressure engine, and a lever adapted to operate said valve, said means also operating the valve in the port connecting the rear of the cylinder with the steam-chest, and also operating the plate interposed between the slide-valve and the port which it controls, and means whereby the lever is held in one of its two positions, substantially as described.

2. In an engine of the character described, the combination of a cylinder having a piston adapted to operate in the same, a steam-chest located adjacent to said cylinder and having ports connecting it with either end of the cylinder, a slide-valve adapted to control the same, a spring-held plate carried by the yoke interposed between the said slide-valve and said ports, said plate in one of its positions cutting off communication between said ports and the steam-chest and said yoke in one of its positions connecting the port leading to the forward end of the cylinder with the port leading to the compression-chamber located adjacent the said cylinder, said compression-chamber having a spring-held inlet-valve and a port connecting the same with the rear end of the cylinder, an exhaust for the rear end of the cylinder being open when the same is running as an explosive-engine, a piston operating within said cylinder forming a means of

controlling said port leading from the compression-chamber to the cylinder and said exhaust-port, a rod connecting the yoke carrying the plate interposed between the slide-valve and its ports, said rod being connected with the valve adapted to close the port leading from the steam-chest to the rear of the cylinder and also being connected with a valve interposed in the exhaust connected with the rear of the cylinder whereby by moving the said rod, the different parts are so actuated that the engine may be changed from fluid-pressure to an explosive engine, substantially as described.

3. In an engine of the character described, the combination with the cylinder and the steam-chest, said cylinder having ports communicating with its opposite end and with the steam-chest, a compression-chamber provided with air and gas inlets, ports leading from said chamber, one communicating with the cylinder and the other with the steam-chest, a slidable plate formed with openings adapted to simultaneously register with the first-named ports, and with a steam-exhaust port, a piston operating in said cylinder, a spring-pressed valve controlling the inlets of said compression-chamber, a valve mounted in the end of the cylinder for controlling the port thereof, means for simultaneously moving said last-named valve and said plate, said plate when moved to one position permitting one of the compression-chamber ports to communicate with one of the first-named ports, an exhaust for the cylinder, a valve for controlling the same, and a slide-valve acting in conjunction with said plate, substantially as described.

4. In combination with the cylinder formed with gas and steam inlet and outlet ports, a piston operating in said cylinder, a steam-chest, a slidable plate arranged in said chest and being formed with openings adapted to register with said steam inlet and outlet openings, and with a cut-out portion adapted to establish communication between one steam-inlet opening and one of the gas-inlet openings, a valve controlling the other steam-inlet opening, a slide-valve cooperating with the openings of said plate, means for simultaneously operating said plate and said inlet-valve, and independent valves for controlling the gas inlet and outlet ports.

5. In combination with the cylinder formed with gas and steam inlet and outlet ports, the piston, and a compression-chamber through which the mixed air and gas passes, a port leading from said chamber to a point adjacent one of the steam-inlet ports, means for establishing communication therebetween, means for controlling all of the inlet and outlet ports, and means for changing the condition of the engine whereby the same will be changed from a fluid-pressure to an explosive engine.

6. In combination with the cylinder formed
with steam and gas, inlet and outlet ports,
means for controlling said gas inlet and outlet
ports, means for controlling said steam-ports
5 including a valve mounted in one of the cyl-
inder ends, a slidable plate formed with open-
ings alining with the steam inlet and outlet
ports, a slide-valve coöperating therewith,

and means for simultaneously operating said
plate and valve. 10

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

WILLIAM D. GARDNER.

Witnesses:

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A. M. WILSON.