W. E. LAWN.

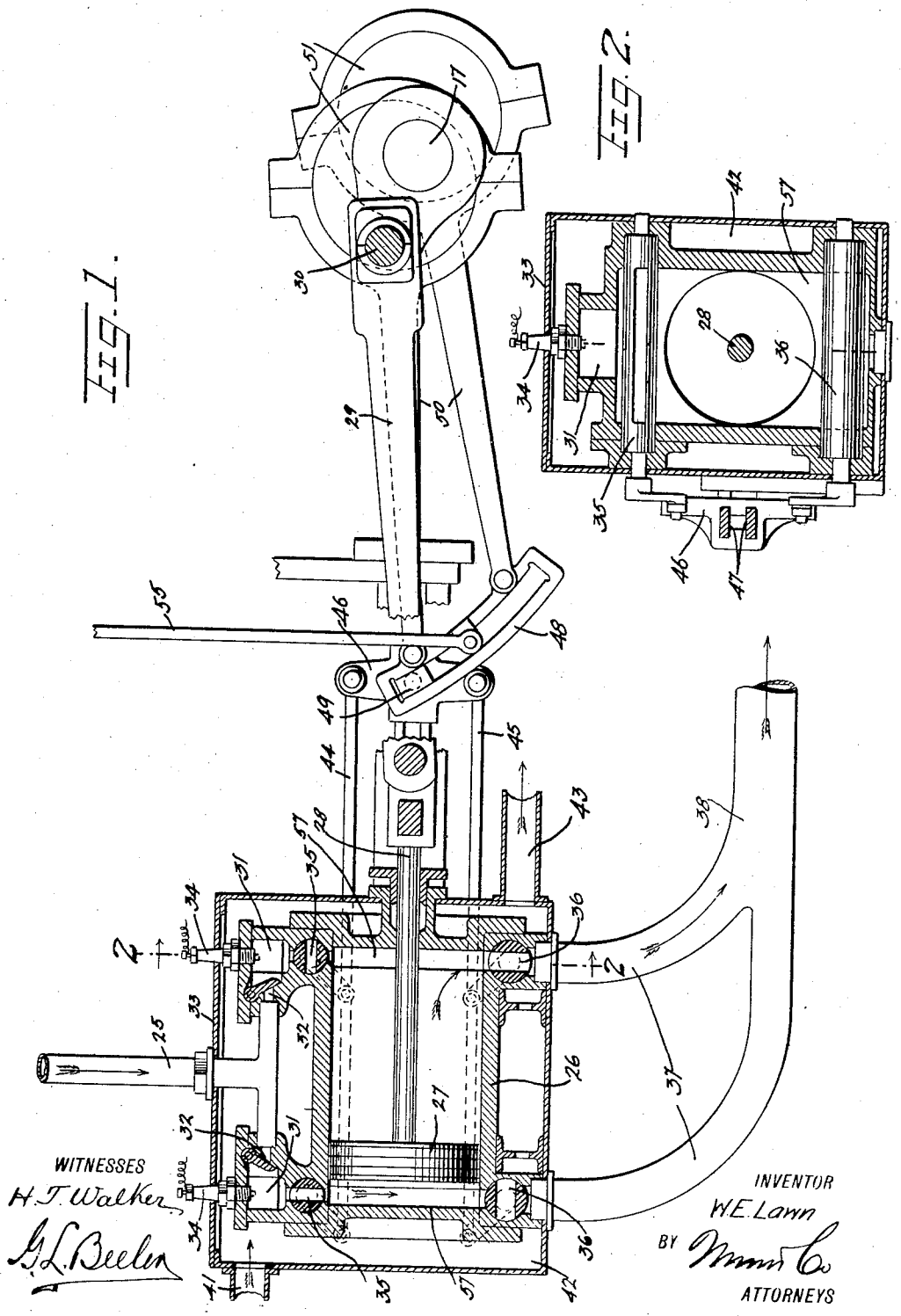
EXTERNAL EXPLOSION ENGINE.

APPLICATION FILED NOV. 23, 1917.

1,328,160.

Patented Jan. 13, 1920.

2 SHEETS—SHEET 1.



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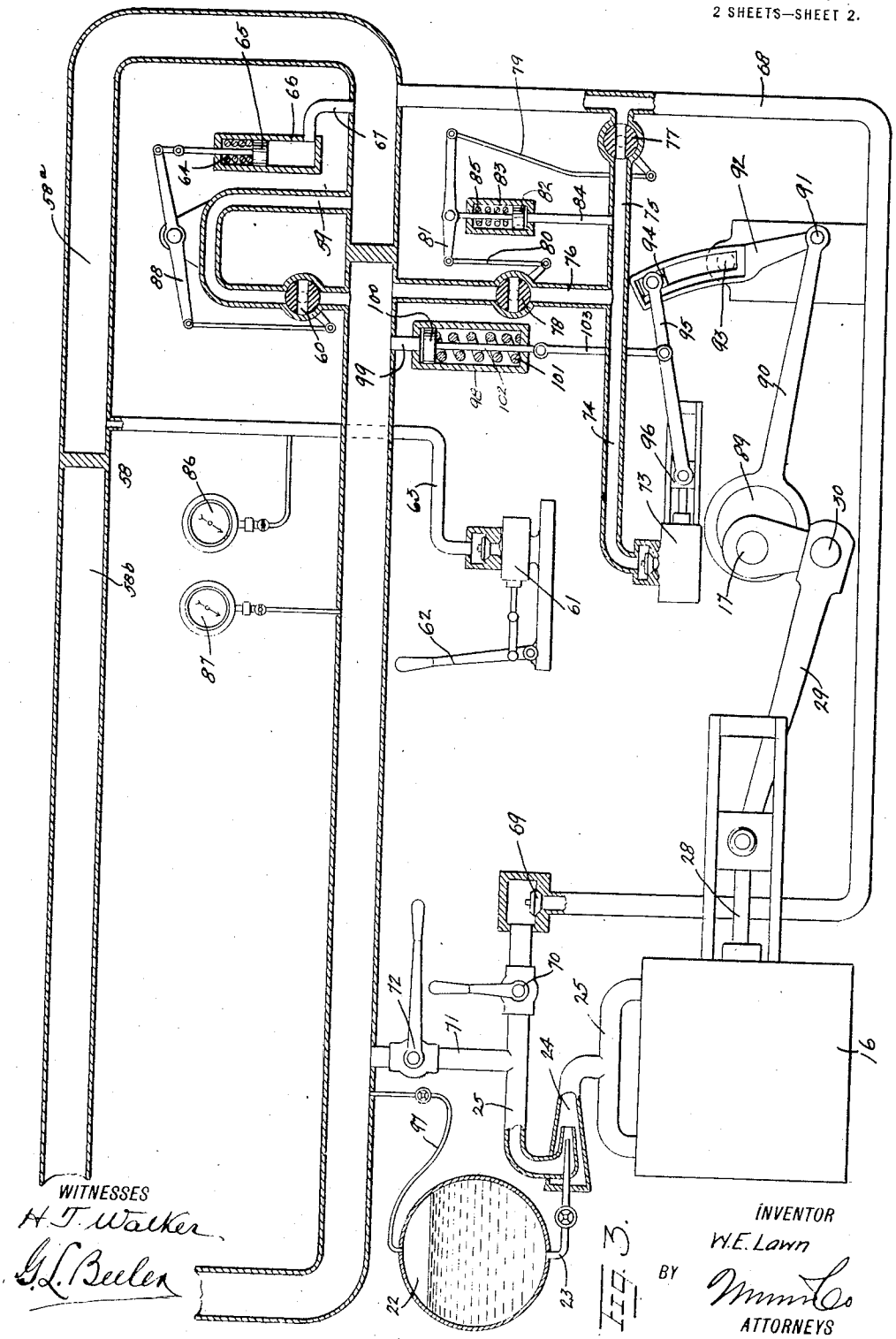
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WITNESSES

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FIG. 3.

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EXTERNAL-EXPLOSION ENGINE.

1,328,160. Specification of Letters Patent. Patented Jan. 13, 1920.

Application filed November 23, 1917. Serial No. 203,607.

To all whom it may concern:

Be it known that I, WILLIAM E. LAWN, a citizen of the United States, and a resident of Rochester, in the county of Monroe and State of New York, have invented a new and Improved External-Explosion Engine, of which the following is a full, clear, and exact description.

This invention relates to prime movers and has particular reference to automatic power driven machines such as vehicles.

Among the objects of the invention is to provide a type of automobile or similar machine which carries its own engine, the engine being of a type resembling in some respects a reciprocating steam engine, but obtaining its driving force from the explosion or burning of liquid or gaseous fuels rather than from steam.

Another object of the invention is to provide an engine in which the explosion or combustion of the mixed air and vapors takes place externally of the cylinder and is caused to flow into the cylinder regulated by controlling valves in a manner somewhat similar to the action of an ordinary reciprocating steam engine.

A still further object is to provide a compressed air device comprising two compartments, one compartment being adapted to be regarded as a starting or priming member for starting the engine, while the other or larger compartment is designed to be kept charged with compressed air as a result of the operation of the pump driven from the engine when in operation, the compressed air from the reservoir being used for the double purpose of delivering the fluid fuel to the combustion chambers and also to produce the proper air mixing thereof.

Another object of the invention is to combine with the compressed air reservoir carried by the machine an automatic means whereby the action of the pump may be controlled in accordance with the degree of air pressure within the reservoir. I also provide a system of valves whereby the compressed air stored up by the operation of the engine will effect the transfer of such air from one chamber to the other.

With the foregoing and other objects in view the invention consists in the arrangement and combination of parts hereinafter described and claimed, and while the invention is not restricted to the exact details of construction disclosed or suggested herein, still for the purpose of illustrating a practical embodiment thereof reference is had to the accompanying drawings, in which like reference characters designate the same parts in the several views, and in which—

Figure 1 is a vertical longitudinal section indicating the structure of the engine and the reversing mechanism.

Fig. 2 is a vertical transverse section on the line 2—2 of Fig. 1; and

Fig. 3 is a diagram representing the compressed air reservoirs and their relation to the engine and automatic controlling valves.

Without limiting myself unnecessarily I will refer herein to the use of gasolene as the liquid fuel that I use for my engine 16 in connection with the compressed air. The fuel may be carried in a tank 22 at the front end of the vehicle above the engine and from which tank a valved pipe 23 conveys the fluid to a mixing chamber 24 communicating through a branched pipe 25 with each engine element, which for convenience will be referred to hereinafter as the engine.

I refer now to Figs. 1 and 2 for a detailed disclosure and description of the engine and its relation to the crank shaft 17. The engine comprises a cylinder 26 in which is a reciprocating piston 27 having a rod 28 connected to the crank shaft through a connecting rod 29 and wrist pin 30.

The upper portion of the cylinder constitutes or supports a duplex valve and combustion device which includes a pair of combustion chambers 31 in communication through check valves 32 with the aforesaid fuel pipe 25 which is branched within the outer casing or cooling jacket 33 spaced from the cylinder. A spark plug 34 with any usual or well known sparking devices is fitted into each of the combustion chambers 31 and guarding the exit from each combustion chamber to an end of the cylinder is an inlet valve 35. One of these valves is always open when the other is closed and vice versa, the open valve being adjacent to the piston when it is about to make its stroke. I provide also diametrically opposite each inlet valve 35 an exhaust valve 36, each inlet valve and its exhaust valve constituting a pair and when one valve of a pair is open the other valve is closed. In other words when the inlet valve is open at one end of the cylinder the exhaust valve is

open at the other end of the cylinder. The two exhaust valves communicate through branches 37 with an exhaust pipe 38. The action of the ejector, by virtue of the force of the exhaust gases, serves to cause a strong current of fresh air to be drawn inwardly and rearwardly through a branched pipe 41, through a casing or cooling space 42, and thence through a warm air pipe 43.

When highly compressed air is delivered into the mixing chamber 24 and acts upon the gasolene, not only to mix the same but to drive the mixture through the branched pipe 25, one or the other of the combustion chambers 31 will always be charged with a fresh fuel mixture, the quality or richness of which may be controlled in any well known manner and with which I am not particularly concerned in this instance. The ignition means represented by the spark plugs 34 are timed properly to ignite the mixture in the combustion chamber 31 adjacent to the open inlet valve 35 and piston, that is to say, in Fig. 1 it will be understood that a charge of fuel mixture has been ignited in the chamber 31 at the left end of the engine and the products of such combustion are being delivered forcibly through the elongated slot through the valve 35 into the left end of the cylinder and are acting to drive the piston toward the right, giving the crank shaft a clockwise rotation. At this instant the exhaust valve 36 at the opposite end of the cylinder is open and delivering the previously burned gases from the other side of the piston. It will be noted that both inlet valves are coupled to a rod 44 and the two exhaust valves are connected to a similar rod 45. These rods are parallel to each other and are connected to a cross head 46 slidable along guide bars 47 at one side of the engine. The position of the valves and hence the reversal of the engine is controlled by any convenient means such as a well known link motion including a slide 48 coöperating with a block 49 pivoted to the center of the cross head 46. To the opposite ends of the slide 48 are pivoted two eccentric blades 50 coöperating with eccentrics 51, the relative effect of which is controlled by the vertical position of the slide 48, the same being manipulated by any suitable devices including a lifting rod 55 connected to the slide.

It will be noted that while the main cylinder and piston slidable therein are for the best packing purposes of true cylindrical form, each end of the cylinder casing, as shown in Fig. 2 at 57 is preferably rectangular so as to provide for the maximum area of valve openings. The rectangular portion, however, of each cylinder at each end is of relatively small length. Since the combustion or explosion of the fuel mixture takes place in the chambers 31 externally of the cylinder the type of engine may be properly called external explosion engine. By the arrangement of the valves and ignition devices indicated, I secure a power stroke of the piston at each reciprocation thereof and with the use of two engines or elements I provide a practically continuous generation and transmission of power to the driven machine.

The reader's attention is now called to the compressed air mechanism shown best in Fig. 3. The compressed air reservoir is indicated as a whole at 58. The term "reservoir" as used herein may be understood to mean the reservoir structure but providing two internal compartments or chambers indicated as 58^a and 58^b respectively. These chambers may be brought into communication with each other through another pipe 59 in which is located a valve 60.

61 indicates a pump adapted to be operated by a hand lever 62 whereby air may be compressed and discharged through a pipe 63 to initially charge the air chamber 58^a, the valve 60 being closed at this time by virtue of a relatively light spring 64 acting upon a piston 65 in a cylinder 66, this cylinder being in communication with the chamber 58^a through a pipe 67. 68 indicates an air pipe leading from the priming chamber 58^a to the air pipe 25 above described. A check valve 69 prevents reverse flow of air through this pipe, and at 70 I indicate a sort of throttle valve, the opening of which by the operator will admit air to the mixing chamber 24 from the priming air chamber 58^a for the purpose of starting the engine. It will be noted that another pipe 71 leads directly from the main working air chamber 58^b to the same air pipe 25 but this pipe 71 will be closed when the engine is being started through the throttle 70. The main flow of air from the larger reservoir is controlled by a secondary throttle 72. When the engine is running and the air is controlled through the main secondary bottle 72 the throttle at 70 may be closed.

A power pump is shown at 73 which constitutes the main air compressor and adapted to automatically maintain the reservoir 58 charged with air at a sufficiently high degree of compression to meet the maximum demand, as for example, 100 pounds per square inch. The air from the power pump 73 is conveyed through a pipe 74 first through a branch pipe 75 and pipe 68 to the chamber 58^a and subsequently through a branch pipe 76 directly into the main reservoir 58^b. In the branch pipe 75 is located a valve 77 which is initially open, and in the branch pipe 76 is a valve 78 that is initially closed. These two valves are connected by links 79 and 80 respectively to a rocker 81 connected to the upper end of the stem of a piston 82 located in a cylinder 83. The end of the

cylinder opposite the rocker communicates with the pipe 75 between the valve 77 and the pump 73 through a pipe 84. The compressed air acting from the pipe 75 through the pipe 84 against the piston acts against the force of a relatively strong spring 85, and when the piston is thus operated against the force of this spring the valve 77 closes and the valve 78 opens. With the rocker 81 pivoted to the stem of the piston 82 closer to the link 80 than to the link 79 it may be provided that the valve 78 shall open prior to the closing of the other valve 77. A pair of pressure gages 86 and 87 are connected respectively to the pipe 63 representing the pressure of the primary chamber 58^a and to the main working pressure chamber 58^b.

I will now describe the automatic action of the device after the hand pump is set into operation, with all of the valves in the position indicated in Fig. 3, except the valve 60 which is normally open when there is no pressure in the reservoir 58 or either chamber thereof. This is the condition of the air pressure when the machine is new or after it may have stood for an unusually long time inactive. The operator upon manipulation of the pump 61 may soon charge the small chamber 58^a with sufficient compressed air to actuate the piston 65 and close the valve 60 and thereafter it will be a relatively easy matter to more highly charge the small chamber sufficiently to operate the engine if the engine will not operate by the time the valve 60 closes. The operator then manipulates the throttle 70 to initiate the operation of the engine with a corresponding rotation of the crank shaft 17. An eccentric 89 secured to the crank shaft typifies a means for operating the pump 73 by power, the mechanism shown for this purpose including a blade 90 journaled on the eccentric 89 and connected at its free end 91 to one end of a lever 92 pivoted at 93. The other end of the lever is slotted and provided with a block 94 to which is connected a rod 95 whose other end is connected to the cross head 96 to which the pump piston is attached. The effective throw of the lever 92 and the corresponding stroke of the pump piston is determined by the distance of the block 94 from the pivot 93. As soon as the engine commences to operate, the pump 73 likewise begins its operation for the purpose of charging the main reservoir 58^b with air under high pressure. The first effect of this power pump is to cause the superior pressure in the pipes 74 and 75, soon filling the small chamber, to actuate the piston 82 causing the opening of the valve 78 and the closing of the valve 77. The force of the spring 85 is superior to that of the spring 64 and hence by the time the valve 77 is closed the smaller chamber 58^b is heavily charged with compressed air which is trapped therein by the closing of the valve 77. The air from the pump 73 is now being delivered directly through the pipe 76 into the main chamber whence it will be used as desired under the control of the throttle 72. An equalizing pipe 97 may extend from the gasolene tank to the main pressure chamber to prevent back pressure in the tank.

In order to automatically regulate the force of the pump 73 in accordance with the pressure in the main chamber I provide a cylinder 98 in communication with the main chamber through a pipe 99, said cylinder having a piston 100 therein acting against a spring 101, the compressibility of which is the measure of the desired pressure in the main chamber. To the stem 102 of the piston 100 is connected a link 103 whose other end is pivoted to the rod 95 intermediate the blocks 94 and 96. The position of the piston 100, therefore, determines the radial distance of the block 94 from the axis 93 and the effective stroke of the pump piston. When the desired pressure is reached in the main chamber 58^b the block 94 will be forced down into a position concentric with the axis 93 and the pump will be thereby thrown out of action. When the pressure drops in the main chamber the spring will move the piston 100 up with a corresponding change in position of the block 94 and starting of the pump again. Hence the pressure in the chamber will be automatically maintained at the desired point which may be indicated on the dial 87.

I claim:

1. In an engine of the character set forth, the combination of a cylinder, a pair of inlet valves at the opposite ends of the cylinder, means to cause the alternate opening and closing of the inlet valves, a pair of exhaust valves at the ends of the cylinder, means to cause the alternate opening and closing of the exhaust valves, the inlet and exhaust valves at each end of the cylinder being alternately opened and closed, a piston reciprocating in the cylinder, a pair of combustion chambers external to the cylinder and between which and the cylinder the inlet valves are located, ignition devices in the several combustion chambers, and means to deliver fuel mixtures into the combustion chamber in alternation under high pressure, substantially as set forth.

2. In an engine of the character set forth, the combination of a cylinder the main portion of which is of true cylindrical form but having rectangular clearances at both ends, a pair of inlet and exhaust valves at each end of the cylinder and diametrically opposed to each other at opposite ends of said rectangular clearance, said valves having elongated passageways substantially equal in length to the width of said clearance,

means to cause the opening of one of these valves while the other is being closed, a combustion chamber external to the cylinder and between which and the cylinder the inlet valve is located, ignition means in the combustion chamber, means to drive a fuel mixture under high pressure into the combustion chamber, the products of combustion from said chamber passing through the inlet valve into the clearance at the end of the cylinder, and a piston in the cylinder acted upon by said products of combustion.

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