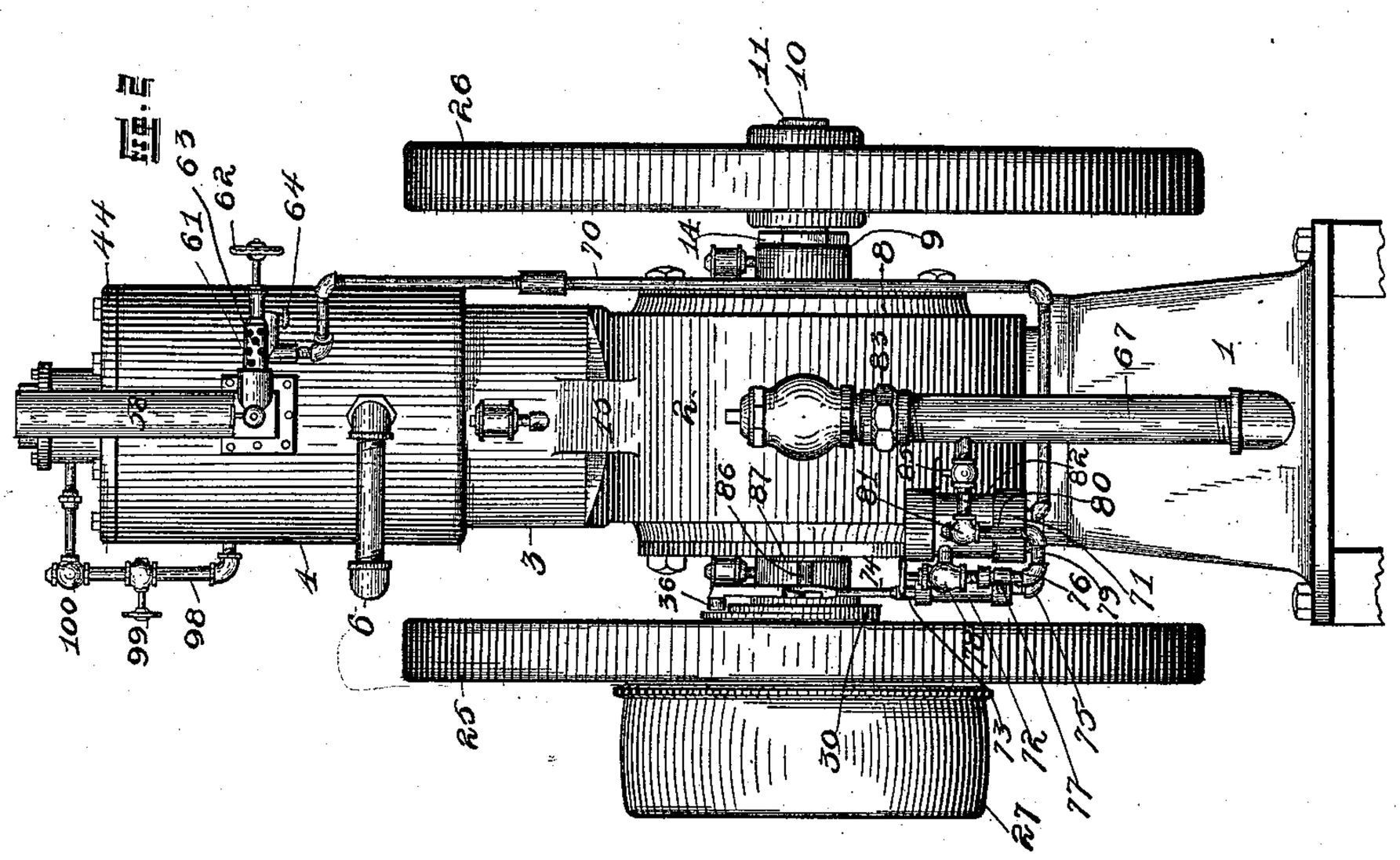
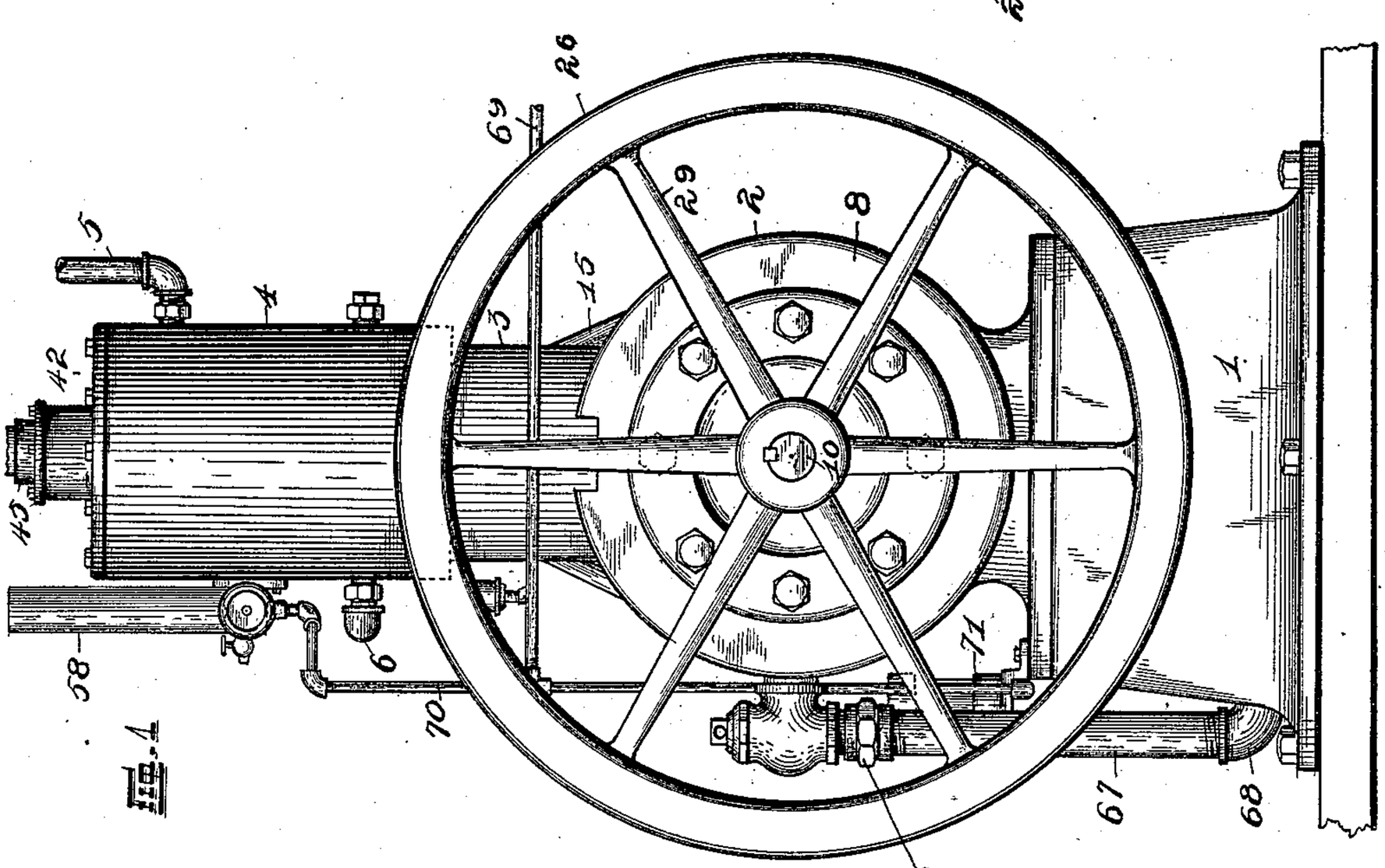
(No Model.) 4 Sheets—Sheet 1.

A. W. BROWN.

VAPOR ENGINE.

No. 532,865. Patented Jan. 22, 1895.





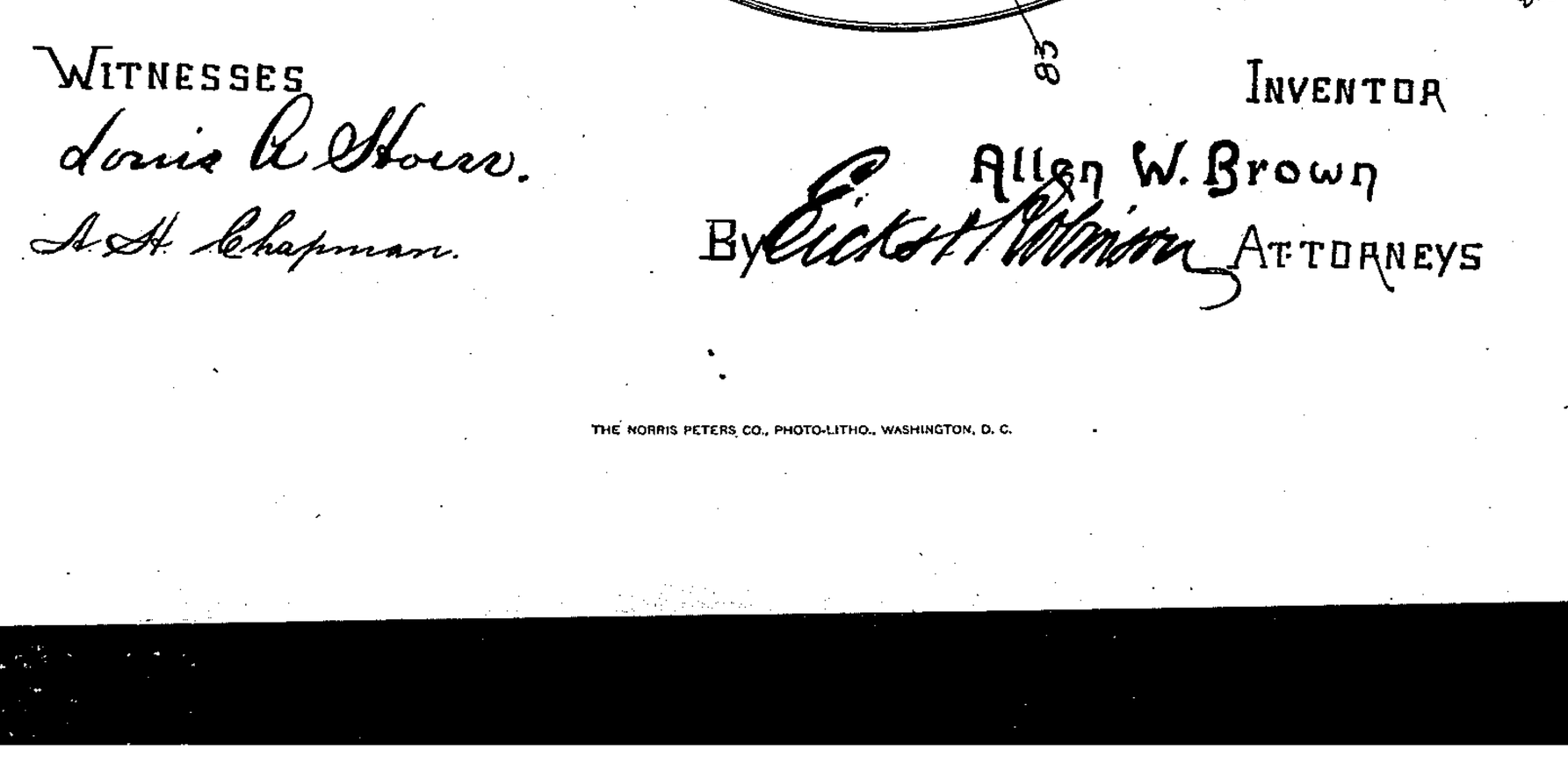


FIG. 1.

WITNESSES

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(No Model.)

4 Sheets—Sheet 2.

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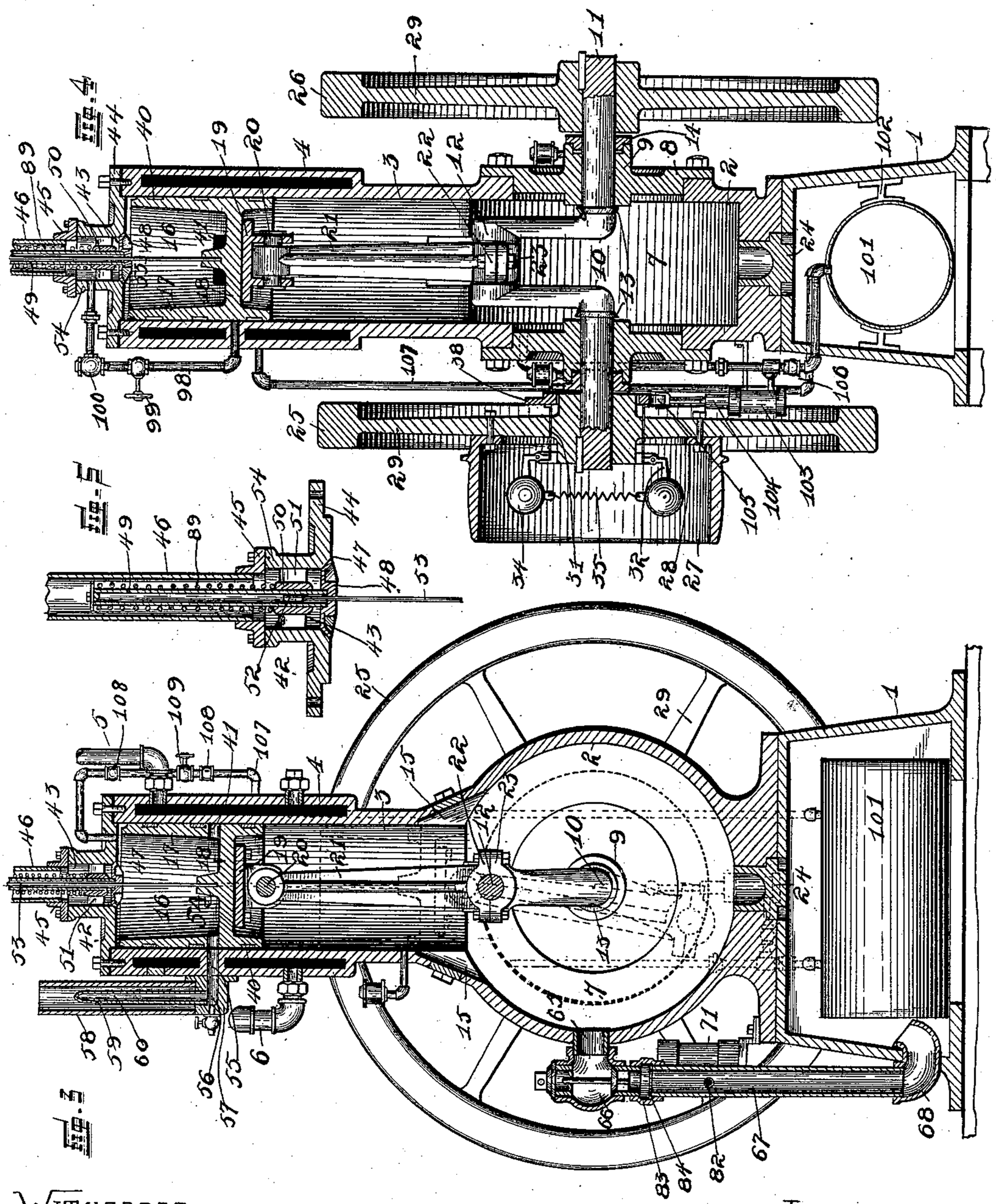
VAPOR ENGINE.

No. 532,865. Patented Jan. 22, 1895.



WITNESSES

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(No Model.) 4 Sheets—Sheet 3.

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VAPOR ENGINE.

No. 532,865. Patented Jan. 22, 1895.

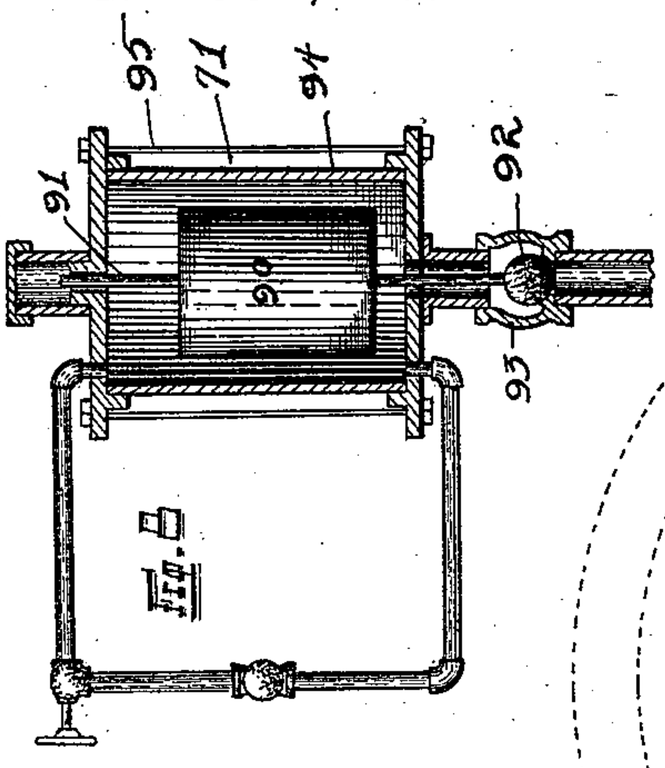

Fig. 6.

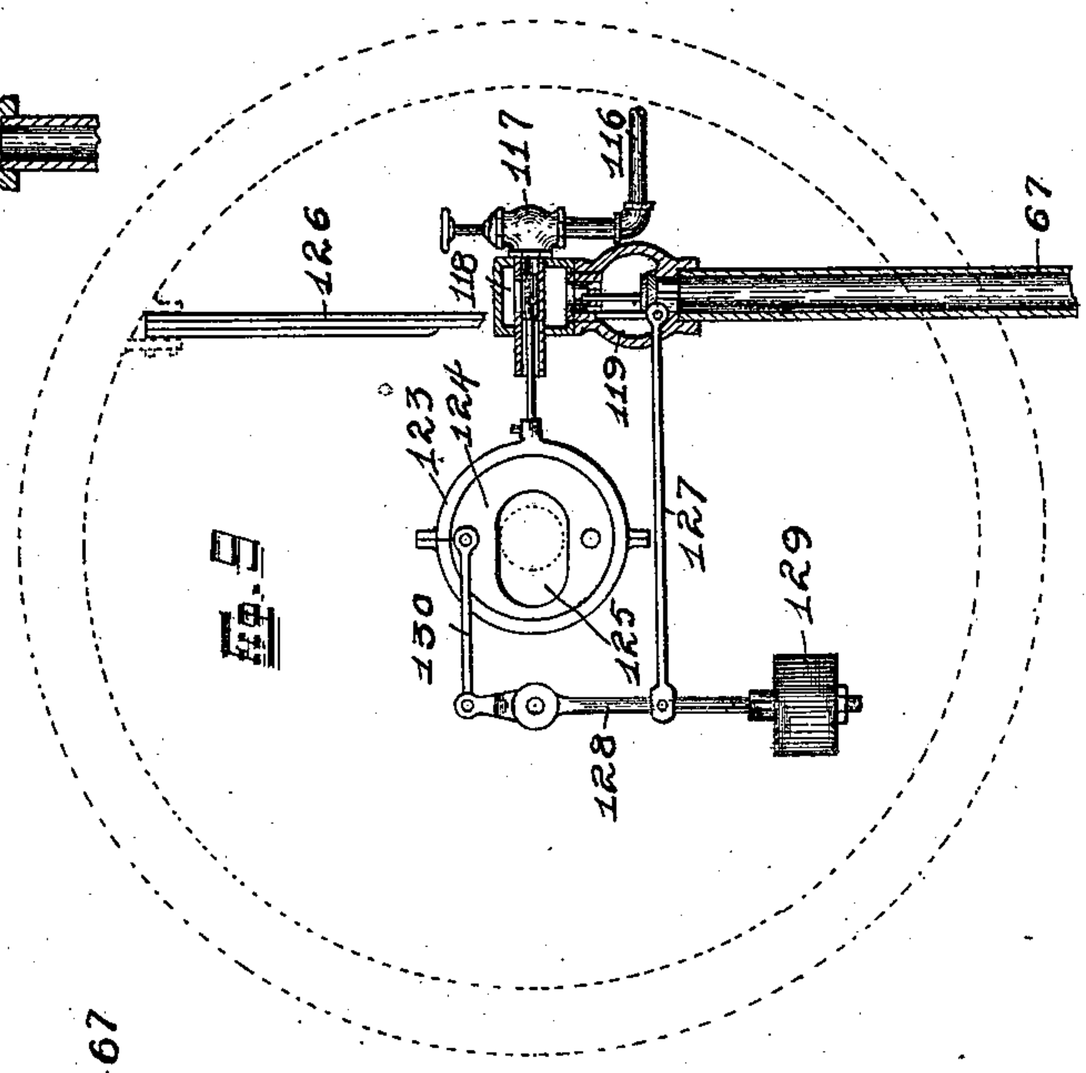

Fig. 5.

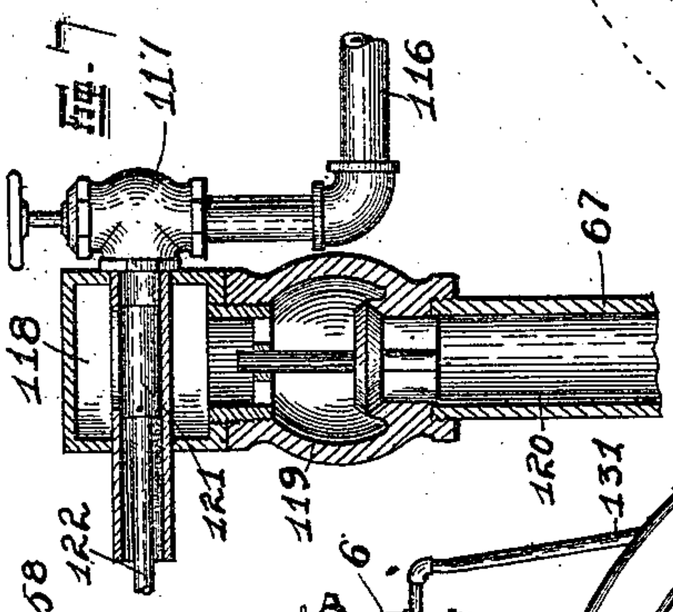

Fig. 7.

Fig. 8.

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(No Model.) 4 Sheets—Sheet 4.

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VAPOR ENGINE.

No. 532,865. Patented Jan. 22, 1895.

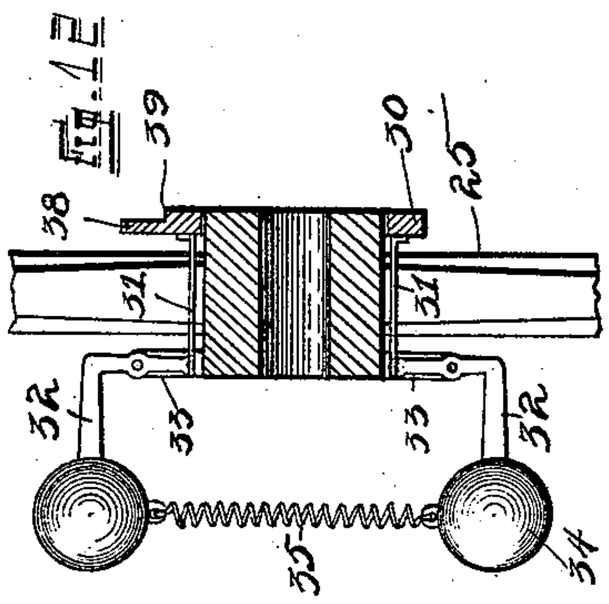

Fig. 12

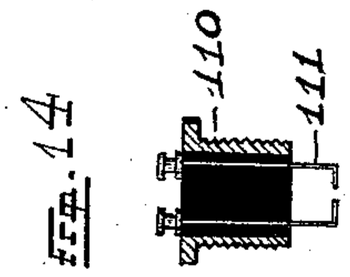

Fig. 14

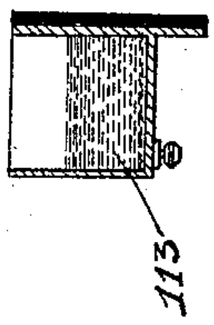

Fig. 13

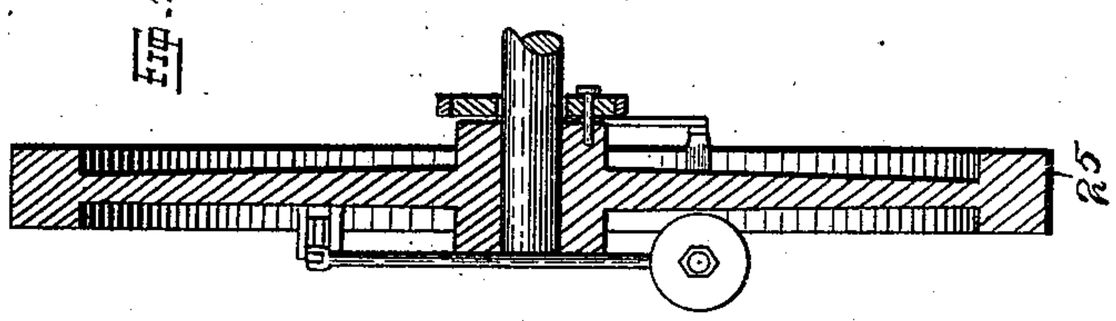

Fig. 11

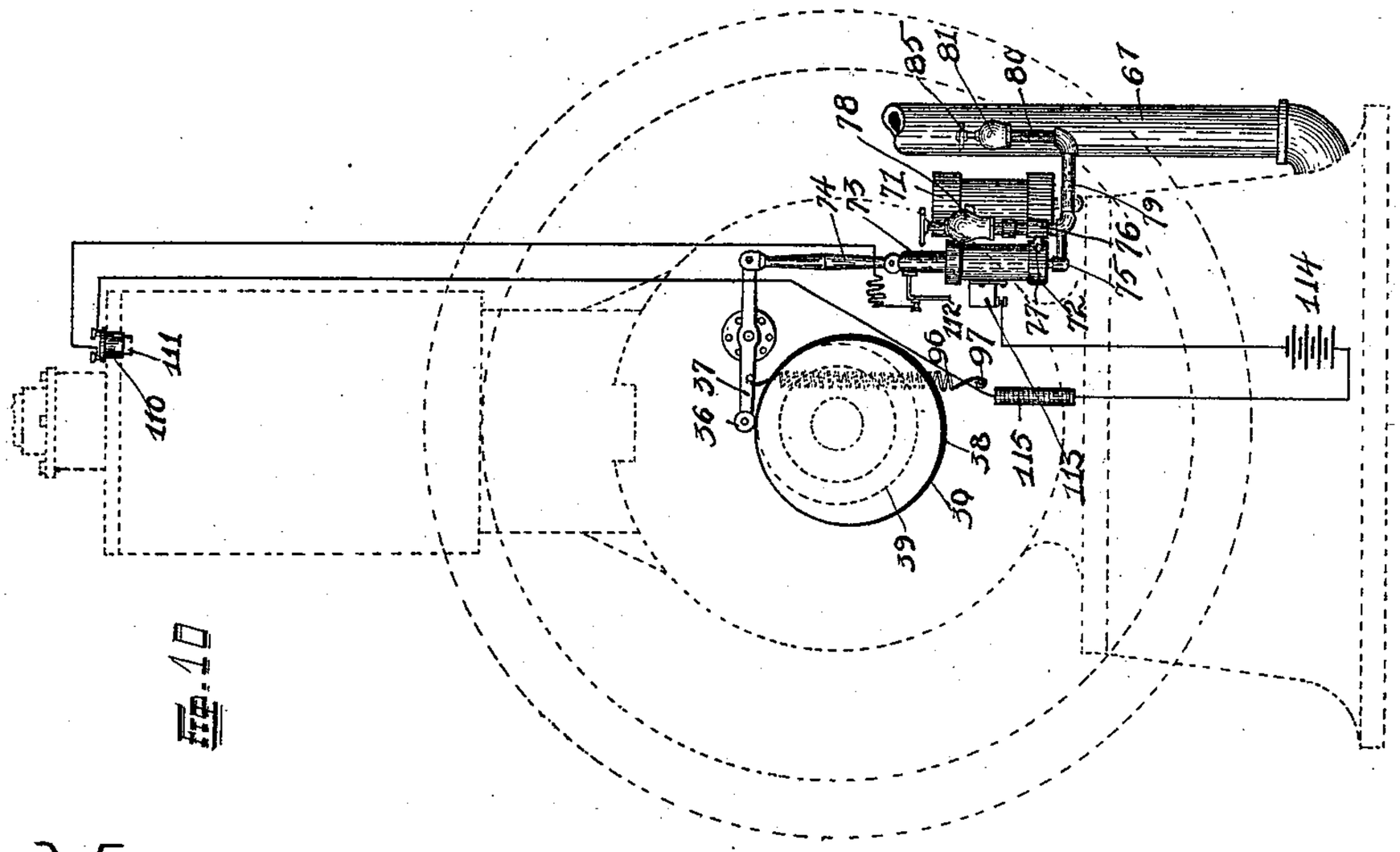

Fig. 10

WITNESSES

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UNITED STATES PATENT OFFICE.

ALLEN W. BROWN, OF ST. LOUIS, MISSOURI.

VAPOR-ENGINE.

SPECIFICATION forming part of Letters Patent No. 532,865, dated January 22, 1895.

Application filed December 22, 1893. Serial No. 494,457. (No model.)

To all whom it may concern:

Be it known that I, ALLEN W. BROWN, a resident of St. Louis, State of Missouri, have invented certain new and useful Improvements in Vapor-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention relates to improvements in explosive engines, and consists in the novel construction and combination of parts, more fully hereinafter set forth and designated in the claims.

The improvement relates particularly to the class of engines which use coal gas or gaseous vapors to exert their power, and which are commonly and commercially known as gas-engines. For practical demonstration, it may be assumed that all engines of this kind act upon two different methods or principles; one involving an impulse every revolution, and one receiving an impulse every other revolution. In the one instance the piston acts alternately as a pump and as a motor and develops only one half as much power as is derived from an engine in which every revolution is utilized. The advantages of an engine built after the latter principle are apparent, as every revolution is used to develop power, whereas other engines only utilize every other revolution, the force of the compression charge compelling the engine to do its duty.

Referring to the drawings: Figure 1 is a side elevation of an engine as constructed after my invention. Fig. 2 is a front view of the complete engine. Fig. 3 is a transverse vertical sectional view taken through the entire engine. Fig. 4 is a vertical cross-sectional view similarly taken. Fig. 5 is an enlarged vertical section of the cylinder cap and attendant parts, showing the construction and location of a valve which is included in my invention. Fig. 6 is a side elevation of the engine oppositely taken to the view shown in Fig. 1, but showing a modified form of governor. Fig. 7 is an enlarged vertical sectional view of a modification of oil and air mixer in which the oil is sprayed. Fig. 8 is an enlarged vertical section of a modified form of oil reservoir showing the controlling valve. Fig. 9 is a detail view of a modified form of governor showing its connection with the fly-wheel which is shown in dotted lines. Fig. 10 is an outline view of the complete engine, showing the application of electricity for igniting the charge. Fig. 11 is a vertical sectional view of the fly-wheel showing the modified form of governor and its connections. Fig. 12 is an enlarged section of the hub and a portion of the fly-wheel particularly illustrating the controlling parts of the original governor. Fig. 13 is a sectional view of one of the electrical appliances made use of. Fig. 14 is a sectional view in enlargement of a plug through which the connections are made to ignite the charge.

The general appearance of the engine is shown in the drawings, wherein it will be seen that it is built very compactly, thereby adapting it for use in many places where the commoner style of horizontal engines would occupy too much space.

A bed-plate 1 supports the crank chamber 2, 7 and the cylinder 3 which is located uppermost and provided with a water jacket 4. The water jacket 4 is provided with an inlet pipe 5 and outlet 6, through which the water should run continually when practical and possible. The diametric center of the crank chamber 2, 7 is at right angles to that of the cylinder bore, thus making the first chamber horizontal and the second vertical. The two crank chamber heads 8 provide bearings 9 for the crank shaft 10, the aligned horizontal ends 11 of which operate outside of the chamber, and the crank portion 12 within the same, the inner ends of the portions 11 being provided with flanges 13 which control the longitudinal movement of said shaft. The flanges 13 also serve to keep the oil in the chamber 2, 7 and the charge from escaping through the bearings. The outer extremities of said bearings are also provided with stuffing-boxes 14 which assist in the same function.

At diametrically opposite points in the inner surface of the cylinder 3 at its meeting point with the chamber 2 are canted cut-out passages 15 which perform a double function, viz: they allow the exit of the compressed charge from the crank chamber to the space above the piston at the extreme down stroke of the piston, and also form open channels which

permit free lateral movement of the connecting-rod in a manner hereinafter more fully described.

The piston 16 is of trunk form and comprises a cup-like casting 17 provided with a reinforced horizontal wall 18 which provides a seat underneath for the bearing 19 which supports the wrist-pin 20 of the connecting rod 21. The lower end of the rod 21 is in the form of a half bearing 22, which, with a cap 23, is secured over the crank pin 12 as shown in Fig. 3. By this means the relation of the shaft 10 and piston 16 is established, and their conjunctive operation defined. The crank pin 12 is enlarged at both sides of the bearings of the rod 21 to prevent lateral movement of the rod.

A plug 24 fills the boring-bar opening (used in boring the cylinder) in the bottom of the chamber 2, 7 and is removable from beneath in order to occasionally remove the sediment and oil from the chamber 7. In this connection I desire to state that owing to the fact that the interior parts are so thoroughly incased that it is impracticable to use oilers, it is preferably to keep the chamber 7 partially filled with a lubricant that the parts may always be well oiled.

In the drawings I have shown two fly-wheels 25 and 26, the wheel 25 being provided with a driving pulley 27 from which the power is transmitted to outside sources. Said pulley 27 is provided with an inwardly extending peripheral flange 28 through which the bolts are inserted to secure the pulley to the spokes 29 of the fly-wheel 25. Horizontally adjustable upon the hub of the wheel 25, and adjacent the spokes 29, is an eccentric 30 which is held to said hub by two horizontal sliding rods 31 which project through openings in the spokes 29. The outer ends of the rods are pivotally connected to the inner ends of weighted levers 32 which are centrally pivoted to ears 33 which project outwardly from the hub. The levers 32 are of bell-crank form, the outer arms of which support weights 34 which act in a manner similar to the balls of a common governor. The weights 34 are connected by a coil-spring 35.

The eccentric 30 has a circular periphery 39 in addition to its eccentric one in order that a small wheel or roller 36 upon the end of a toggle lever 37 may travel upon the eccentric periphery 38 when the engine is running normal speed and on the circular periphery 39 when the engine exceeds normal speed. This action causes the oil pump to remain inoperative when the engine is too fast, but as soon as the speed of the shaft and fly-wheel is reduced to normal, the oil pump is again started by the engagement of the wheel or roller 36 upon said eccentric periphery.

The governing operation is accomplished by the pumping of oil from the supply, the force of the charge being diminished by the inactivity of the pump when the speed is too great, as no oil is allowed to pass to carburization.

The exterior of the piston shell 17 is provided with packing rings which serve their usual function. The shell is provided at a point above the horizontal wall 18 with opposite openings 41 which correspond in width and alignment to the ports, or passages, 15 in the cylinder 3, and which are adapted to allow the charge to pass direct from the crank-chamber to the space above the piston when the piston is at its lowest point.

The cylinder 3 is provided with a cap or head 42 which is one of the main features of my invention. It has an inverted recess, or chamber, 43 located centrally and above its flange 44, and in which parts of the exhaust valve mechanism are located. The inverted recess 43 is contained in a vertical chamber 54 which is provided with a cap 45 made in the form of a circular flange, and into which is screwed an upright pipe 46 which serves as an exhaust. The lower extremity of the wall of the chamber 54 is circumferentially beveled to form a seat 47 for a circular valve 48, which is secured to the lower end of a vertical tube 49 which has its bearings in a shoulder 50 supported in the chamber 43 by four webs 51 connecting with the wall thereof. Within this tube is a sliding head, or enlargement, 52 secured to the upper end of a valve rod 53 which projects downwardly through the valve 48 and has its lower end secured in a boss upon the horizontal plate 18 of the piston.

In alignment with the opening 41 in the piston shell 17 and extending through the cylinder and water jacket walls is an ignition port 55 which corresponds to a recessed opening 56 in an igniter casting 57 which is secured exterior to the water jacket and serves to support several adjacent parts. A small cock, or valve, is connected to the opening 56 and is used for letting the air out when starting the engine. The casting 57 supports a vertical pipe 58, inside of which is located an igniter 59, which consists preferably of a piece of small tube closed at its upper end and with its interior 60 connecting with the opening 56.

The igniter 59 is heated to a high temperature to ignite the charge, the same being heated and kept in that state by an ordinary hydro-carbon burner 61 which is fixed adjacent thereto. This burner can be of any ordinary pattern now known and used, but in this instance consists of a valve 62 controlling the spraying of oil through a pipe and mixer 63, which is heated at first by oil in a pan 64 underneath and afterward by ignition of the gas formed by heating the sprayed oil. The force of the flame is directed against the igniter 59 keeping it at a high temperature all the time the burner is lighted.

A charge which rushes above the piston at

the down stroke is exploded after each upstroke of the piston to cause a repetition of the same.

Secured in the wall of the crank chamber 2, 7, is a nipple 65 which connects with a drop, or check, valve 66 located upon the upper end of an air pipe 67 which leads downwardly. The lower end is provided with a double elbow 68 which throws the opening of the pipe within the bed frame 1 where the risk of its filling up with sediment is small.

A pipe 69 leading from the oil supply tank leads to a vertical pipe 70, which extends upwardly to the hydro-carbon, or other form of burner 61 and downwardly to a small supply chamber 71. A pump cylinder 72, in which operates a plunger 73 upon the end of a pump rod 74 operated by the pivoted lever 37, is secured in close proximity to said chamber 71. A pipe 75 connects the lower ends of the oil chamber 71 and the pump cylinder 72, through which the oil is pumped when the engine is in operation.

By a combination of pipe fittings, I have constructed a vertical stand 76 connecting with the lower end of the pump cylinder 72 by a pipe 77, and upon the upper end of which is located a common mixing valve 78 connecting with the upper part of the chamber 71. The lower end of the pipe stand connects by a horizontal pipe 79 with a vertical pipe 80, upon the upper end of which is a drop valve 81 connecting with a horizontal pipe 82 which terminates in the pipe 67 as is particularly shown in Fig. 3.

The connection of the valve 66 and pipe 67 is made by a union 83 in which is secured a fine gauze netting 84, through which the oil is sprayed when drawn upwardly by the suction attendant upon the upward movement of the piston when the oil enters the pipe 67.

In the pipe 82 is inserted a globe valve 85, which, with the valve 78, is used to control the oil inlet, and, consequently, the speed of the engine.

The parts above described are all securely fastened to some exterior portion of the engine, an ear 86 upon a plate 87 secured to the cap 8 serving as a pivot for the balancing of the lever 37. If it is desired to throw a very fine spray of oil into the pipe leading to the crank chamber 2, 7, the valve 85 is opened a very little, allowing a small quantity of oil to pass through into the pipe 67, while the valve 78 is opened far enough to allow most of the oil to be forced by the pump back into the tank 71 from whence it came. Therefore, by regulating the two valves 78 and 85, I am enabled to control the entrance of oil into the carburetor. The suction of air and oil through the drop valve 66 and gauze causes it to be in position in the crank chamber to be compressed by the downwardly moving piston. At the limit of the down stroke, the charge rushes through the passages 15 into the space above the piston where it is first recompressed and then exploded by passing through the ignition ports, in the piston and cylinder, to the igniting tube 59, the explosion causing the piston to make its down stroke and compress another charge in the crank chamber. At the beginning of the up stroke, the exhaust valve is opened by the connection of the piston and the exhaust valve, thereby allowing the escape of the exploded charge before the fresh one shall have entered. The charge rushes into the space above the piston through the passages 15 whereupon a repetition of the former movements is had, the above action taking place at the extreme down stroke of the piston. Upon the pipe 49 in the exhaust pipe is a coil-spring 89 which engages the shoulder 50 at its lower end and under a cap 90 which projects out over the upper end of the pipe 49, to which the same is secured. The spring 89 returns to its seat the exhaust valve after the down stroke of the piston, this construction permitting a full exhaust before the fresh charge enters. This is an important feature in my invention, as it insures a perfect explosion of the incoming charge, without being diluted by the exhaust.

The tank 71 is provided with a float 90, which closes the oil supply when a certain amount of oil has passed into the tank. This construction is shown in Fig. 8, wherein it will be seen that the float stem 91, which extends both above and below the float, is provided upon its lower end with a globular valve 92. The stem reciprocates in bearings provided by the top and bottom of the tank, and the valve itself is seated in the lower end of the tank, which is in the form of an addition secured to the tank proper. The seating of the valve stops the inlet of oil, or limits it as the case may be, as it is advantageous that only a certain amount of oil be held in this chamber to facilitate its passage to the carburetor.

The wall 94 of the chamber 71 is preferably made of glass to enable an examination of the amount of oil therein. The glass is held in position between the top and bottom plates by rods 95, which connect the two plates, thus also making the chamber air-tight.

The lever 37 is held in normal contact against the eccentric periphery, or its adjoining circular periphery, as the case may be, by a coil-spring 96, the lower end of which is held by a stud 97 secured in the crank chamber head.

If the compression above the piston at beginning of the up-stroke is too great, I have provided means for relieving the same by a series of pipes 98, in which series is included a valve 99 and a check-valve 100, the latter being used to prevent any back pressure, and the former for letting out some of the pressure into the exhaust. The pipes 98 lead from a point about midway of the height of the cylinder to the chamber 43 above the exhaust valve. This terminal of the relief pipe is had in order to have all exhausts lead to one

outlet, although this is a point of no consequence.

I will now describe the construction and application of a self starting apparatus, by means of which I am enabled to start the engine.

Within the bed frame 1 is located a reservoir, or tank, 101 supported by lugs 102 and used for storing a surplus charge, which is used to start the piston the first time. This tank is stored in this instance with compressed vapor from the crank chamber, but this is not an essential point, as in the case of a gas engine compressed air or gas would be used. A pump 103 is provided with a spring controlled plunger 104 upon the upper end of which is located a roller 105, which engages the eccentric 38, the connection between said roller and eccentric causing the reciprocatory action of the plunger. Said pump 103 is connected to a series of pipes 106 which lead from the tank 101 to the crank chamber. This connection is made near the top of said crank chamber, in order that the oil in said chamber will not enter the pipes. A series of pipes 107 provided with automatic drop valves 108 and a globe valve 109 connects the tank, or cylinder, 101 with the piston chamber, the point of its entrance being shown in Fig. 3. With the crank slightly off center and piston at lower end of cylinder, the charge from the tank 101 is discharged into the space above the piston through the passages 15. The charge is then compressed and fired and drives the piston down, compressing the vapor in the crank chamber and allowing it to rush through into the piston chamber, as before. It will thus be seen that the self-starting device is very important and forms one of the main features of my invention, as it is only necessary to put the crank off center to start the engine with, or without, a load.

Before entering into a description of the modifications which enable the use of gas for operating the engine, I will give a brief summary of the operation of the engine, from which can be gleaned the most important features of my invention.

After the igniting tube has reached a proper temperature, the contact therewith of the charge by way of the ignition port in the piston when the same is at the limit of its up stroke, causes an explosion which drives the piston down, this action compressing the vapor which has been injected into the crank chamber. This vapor, or carbureted air, then passes quickly through the passages 15 into the cylinder above the piston when the latter is at the limit of its down stroke. This charge is compressed above the piston and fires when admitted to the igniting tube and the piston rushes down, causing a repetition of the former action. The consistency of the carbureted air is easily regulated by manipulating the valves 78 and 85, the closing of the valve 85 stopping the engine entirely. The piping 107 is provided with drop valves 108 which prevent any possibility of a back pressure from the piston cylinder to the tank 101 after an explosion. I have found that electricity is well applicable for firing the charge, instead of using a gas igniter. In Fig. 10 is shown an outline view of the engine with the electrical connections shown in solid lines. A plug 110, made of some good insulating material, has two connections, or contact, points 111, which are so placed that an electric spark is thrown across the two to ignite the charge. This plug is secured in the cylinder cap in about the position shown in Fig. 10. The pump plunger 73 serves as a support for a contact wire 112 which is electrically connected to one of the contacts 111. Secured to the pump cylinder 72 is a receptacle 113 made of some good conductive material and filled with mercury, or some good conducting material. The receptacle 113 is insulated from the adjoining parts and is electrically connected through the batteries 114 and spark-coil 115 to the remaining contact 111 in the plug 110. The reciprocatory movement of the pump plunger causes the completion of the circuit by dipping the wire 112 into the contents of the receptacle 113, this contact being only momentary in durations. It will thus be seen that electricity serves perfectly as an igniter, being accurate and self-denoting, the spark occurring at the beginning of the down movement of the piston. This means of igniting is controlled entirely by the speed of the engine and the action of the governor.

I will now describe the valve and governor used where artificial gas is employed to operate the engine. (See Figs. 7 and 9.) A pipe 116 leads from the main into a globe valve 117 located adjacent the controlling valve chamber 118, which is connected to an automatic drop valve 119, upon the upper end of the air inlet pipe 67. A reciprocatory valve 121 in the chamber 118 is connected by a rod 122 to an eccentric-strap 123 which fits over an eccentric disk 124. This disk 124 is mounted to move laterally of the engine shaft, being provided with an elongated opening 125 in which the shaft revolves. A spring 126 secured at its outer end to the rim of one of the fly-wheels is fastened at its inner end to a rod 127 connecting with a lever 128, upon one end of which is located an adjustable weight 129. The lever 128 is pivoted near its other end and secured to a rod 130 which connects with the disk 124, as shown in Fig. 9. When the engine is running at normal speed, the shaft is in one end of the opening 125, but when the speed varies the weight 129 is moved, thus giving the rod 122 a reciprocating movement which alternately opens and closes the valve 121 and admits the gas to be mixed with air admitted through the pipe 67. When the engine exceeds its normal speed, the weight 129 flies out in the position shown in Fig. 9, thus causing the valve mechanism

to be inactive and closed against the admittance of gas until the normal speed has been regained. A pipe 131 connects with the pipe 116 and furnishes fuel for heating the igniting tube. It will be observed that throughout all the piping of the engine, a free use of drop and check valves is had, to prevent any possibility of back pressure.

I desire especially to direct attention to the fact that my improved engine will run in one direction as well as in the opposite direction, without alteration whatever in its mechanical construction by simply starting it in the direction desired. This is permitted by reason of the peculiar construction of the exhaust valve, it being connected direct to the upper end of the piston by a vertical rod located within the cylinder.

I desire also to direct especial attention to what I term my "impact vaporizing surface" shown very clearly applied to the pipe 67 in Fig. 3, whereby the oil thrown by the pump against the vaporizing surface is quickly vaporized and conditioned for immediate use in the cylinder.

I desire also to direct especial attention to my improved automatic governor which varies the strength of each charge at each stroke of the piston in proportion to the load on the engine, whereby if the engine be running light, or without load, a very slight charge will be admitted to the cylinder, and if the engine be heavily loaded a correspondingly heavy charge will be admitted to the cylinder at each stroke of the piston.

What I claim is—

1. The combination, in an explosive-engine, of a cylinder and its proper connections, an automatically-controlled gas and air mixing-valve mounted to reciprocate at each stroke of the engine, an eccentric for reciprocating said valve, and an automatic governor connected to move said eccentric across the engine shaft and thereby vary the movement of said valve at each stroke, substantially as herein-specified.

2. The combination, in an explosive-engine, of a cylinder and its proper connections, a source of supply of inflammable-liquid, a float-chamber located in a plane below said cylinder, a carbureting-device connected to said float-chamber, a valve connected to said float-chamber, a float in said chamber for controlling said valve, an ignition-burner, and pipes connecting said float-chamber and said burner, whereby the carbureting-device and the burner are supplied with liquid fuel from a single source or supply-tank, substantially as herein specified.

3. The combination, in an explosive engine, of a cylinder, a piston, an exhaust valve having a central perforation, and a rod in said cylinder engaging said perforation in said valve and loosely connecting said exhaust valve to said piston, so that the latter will move the valve in one direction only substantially as herein specified.

4. The combination, in an explosive engine, of a cylinder, a piston, an exhaust valve connected to said cylinder to open inward, a rod mounted interior of said cylinder and connected at one end with said piston and constructed to open said exhaust valve upon retreat of said piston from said valve, and means separate from said rod for automatically closing said valve before the piston reaches the limit of its stroke in an opposite direction, substantially as herein specified.

5. The combination, in an explosive engine, of a cylinder, a crank-chamber upon which said cylinder is mounted, a piston and operative connections, an air-and-gas mixing device, and a governor constructed to admit gas and air to said crank-chamber in determinate proportions and vary such proportions in proportion to the load on the engine, substantially as herein specified.

6. The combination, in an explosive engine, of a cylinder, a piston, an exhaust valve connected to said cylinder, and a rod loosely connecting said piston and said exhaust valve interior of the cylinder, to move said valve in one direction, a spring to move said valve in an opposite direction, and an exhaust-pipe whereby the engine may run in either direction without alteration of any of its parts by simply starting the engine in the desired direction.

7. The combination, in an explosive engine, of a cylinder, a crank-chamber upon which said cylinder is mounted, opposite inclined passages 15 opened throughout their lengths and connecting the lower end of said cylinder with said crank chamber, a piston in said cylinder and having a chamber at its upper end and provided with opposite ports, or passages, 41 communicating with the lower end of the chamber in said piston, an igniter located exterior of said cylinder, said cylinder having an igniter port in alignment with one of the ports, or passages, 41 when said piston is at the limit of its up-stroke and communicating with the igniter, an exhaust valve at the upper end of said cylinder, and a rod located interior of said cylinder and of the chamber in said piston and connecting said piston with said exhaust valve, whereby the ports, or passages, in said cylinder perform the two-fold function of permitting passage of the charge from said crank-chamber to the chamber in the piston while said piston is at the limit of its down stroke, and permitting ignition of the charge in the piston chamber at the beginning of the down stroke of said piston, and also permitting the movement of the engine in either direction without alteration of its parts, substantially as herein specified.

8. The frame of an explosive engine, a cylinder mounted on said frame, a crank-chamber also mounted on said frame and in open communication with one end of said cylinder, a crank in said chamber, a connecting-rod connected to said crank, a piston and proper

connections, and said crank-chamber and cylinder having the opposite combined transfer-passages and connecting-rod ways 15, 15 formed at the point of their connection, whereby as the crank-shaft revolves the connecting-rod may engage said ways and the charge of gas may be transferred from said chamber to the said cylinder through said ways when the piston is at the limit of its in-stroke, and permitting the use of a short connecting-rod, substantially as herein specified.

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

ALLEN W. BROWN.

Witnesses:
ALFRED A. EICKS,
HERBERT S. ROBINSON.