No. 622,891. Patented Apr. 11, 1899.

E. W. GRAEF.

GAS ENGINE.

(Application filed Nov. 29, 1897.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

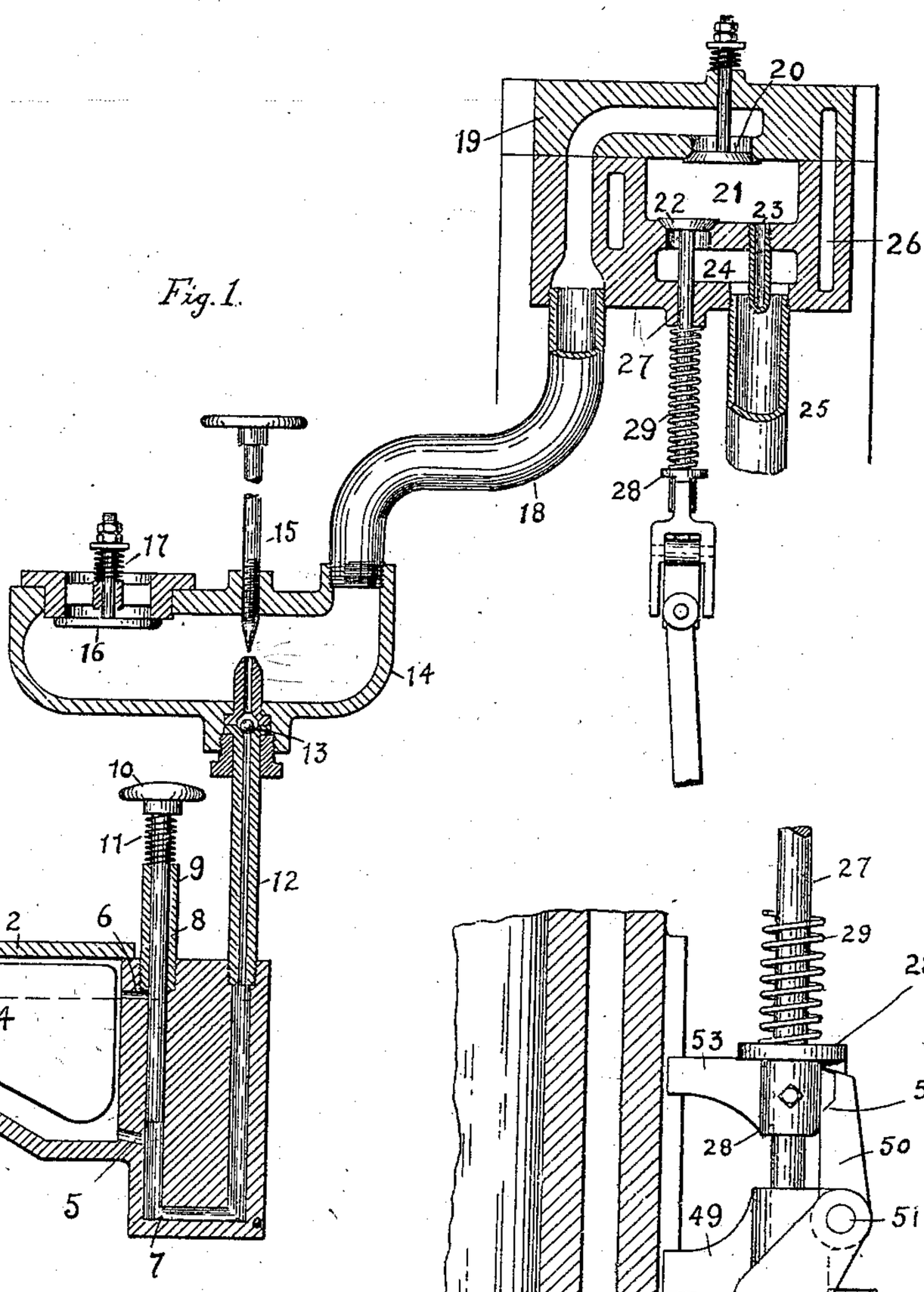
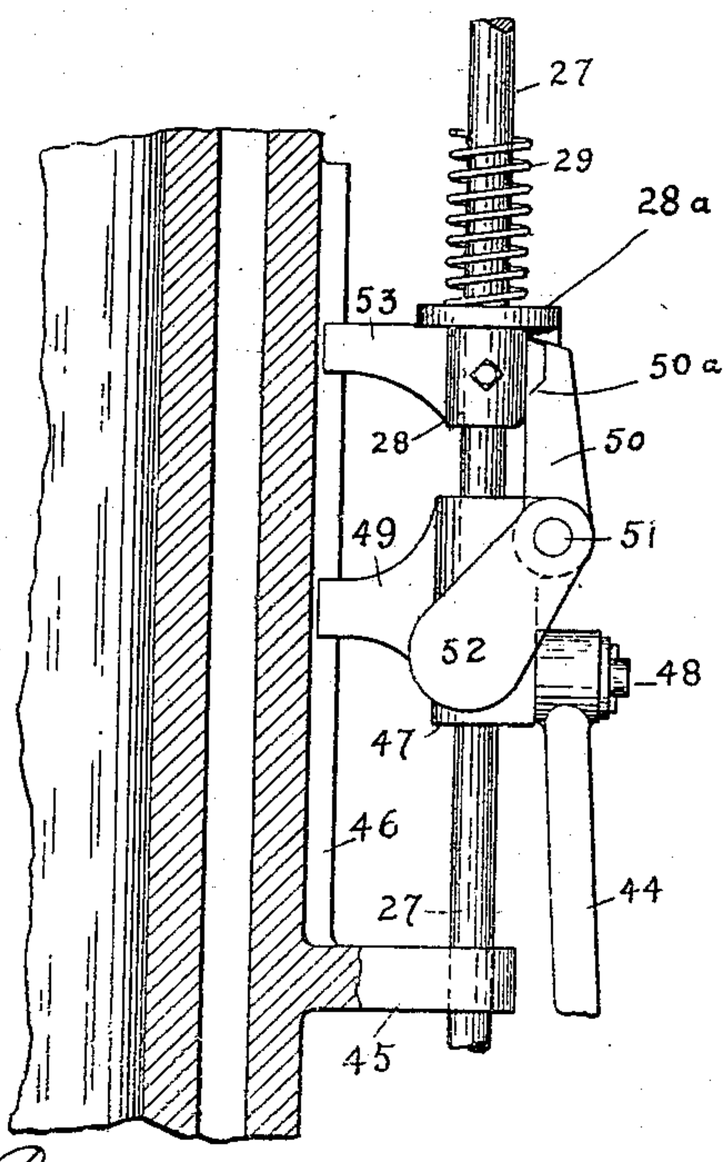


Fig. 4.



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(No Model.) 2 Sheets—Sheet 2

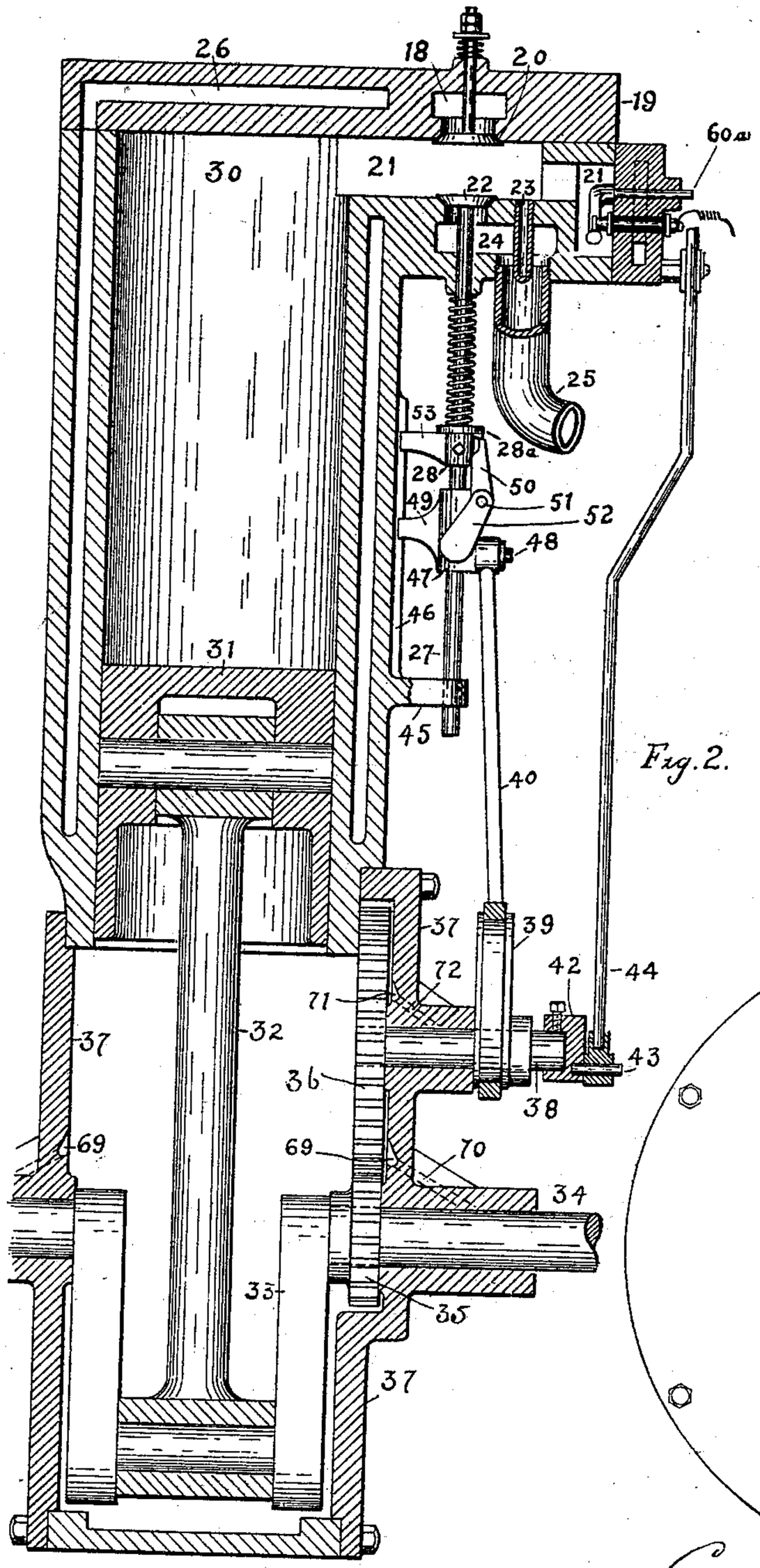

Fig. 2.

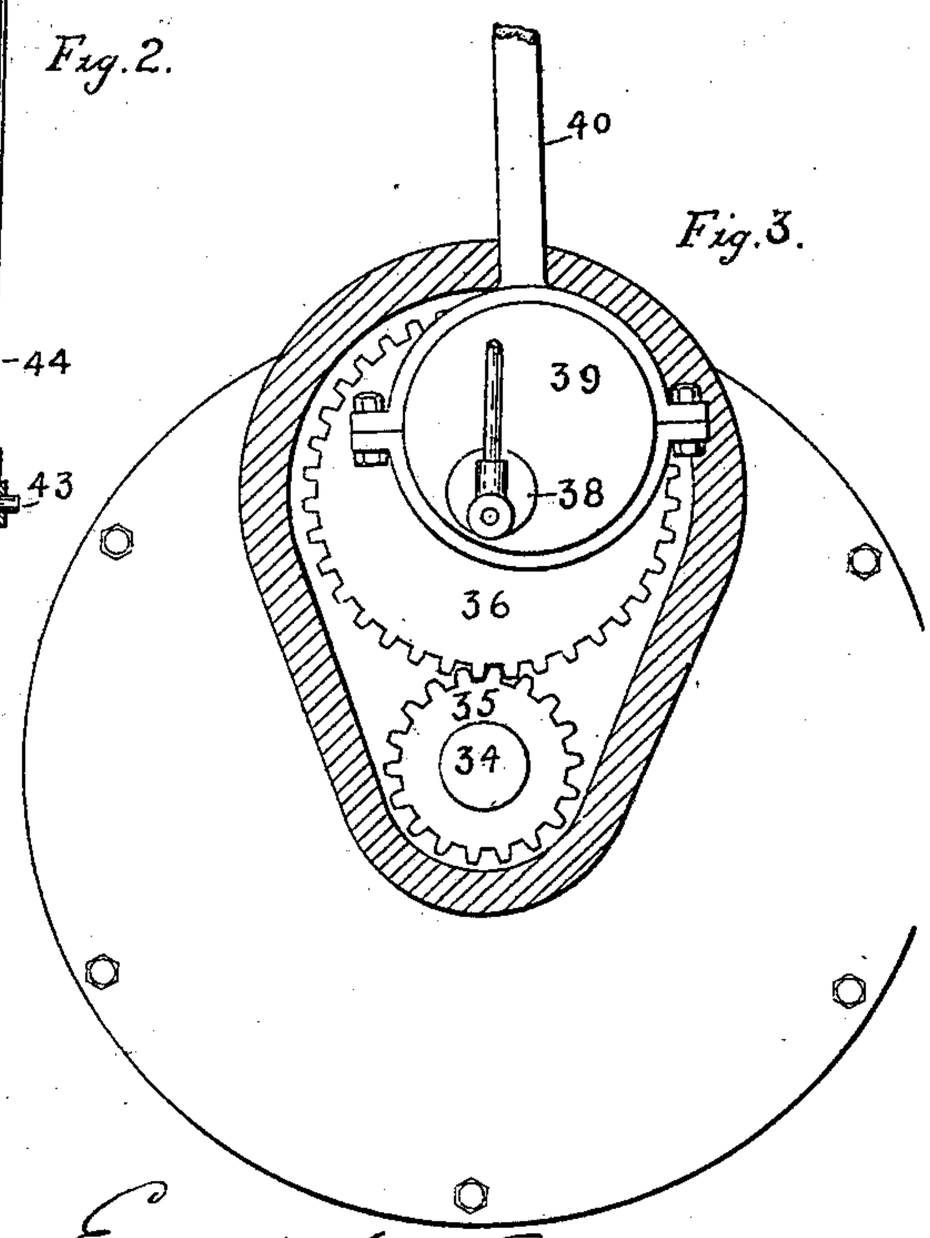

Fig. 3.

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UNITED STATES PATENT OFFICE.

ERNEST W. GRAEF, OF BALTIMORE, MARYLAND.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 622,891, dated April 11, 1899.

Application filed November 29, 1897. Serial No. 660,022. (No model.)

To all whom it may concern:

Be it known that I, ERNEST W. GRAEF, a citizen of the United States, and a resident of Baltimore city, in the State of Maryland, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

My invention relates to a governor for gas-engines, and has for its object to supply an accurate, prompt, and efficient governor which will reduce or increase the speed of the engine with all fluctuation of load.

Similar figures of reference indicate similar parts of the apparatus.

Figure 1 is a vertical section, showing some parts in full elevation, of the gasolene-supply apparatus, the gas-generating apparatus, the valves and the combustion-chamber, and the device for normally igniting the gas. Fig. 2 is a vertical section of the cylinder and case surrounding the crank and connecting-rod, also the combustion-chamber and igniting device, with the governor and the electrical igniter. Fig. 3 is a side elevation showing the gears by which the motion of the piston is reduced to operate the governor and igniter. Fig. 4 is an enlarged detail of the governor.

Referring to Fig. 1, 1 is the gasolene or oil supply pipe connected with any suitable source of supply. 2 is an oil-reservoir. 3 is a check-valve consisting of a ball held by a spoon-shaped spring opposite the mouth of the oil-inlet. 4 is a float pivoted on the interior of the oil-reservoir 2 and floating in the oil therein. The heel of the float 4 bears upon the spoon-shaped spring which supports the valve 3 and presses it up and the ball with it, so as to close the oil-inlet when the reservoir is filled to a desired level. 5 and 6 are outlets from the reservoir to the gas-generating apparatus. 7 is a channel reaching from the reservoir to the gas-generating apparatus. 8 is a pump-plunger reciprocating in the channel 7. Said plunger is mounted in a guide 9 and has a knob upon its upper end and is maintained in a position of highest elevation by a spring 11. This plunger is adapted when depressed to force the oil up into the gas-generating chamber. 12 is a pipe of any desired length leading from the reservoir and the extremity of the channel 7 to the gas-generating chamber. 14 is the gas-generating chamber, and 13 is a check-valve lying in the channel of the pipe 12, so as to stop the abnormal flow of oil upward and check any return of the oil which has passed the valve. The pipe 12 projects into the gas-generating chamber 14 in the form of a nozzle. 15 is a pin secured into the top of the gas-generating chamber 14 and having a point located immediately opposite the mouth of the nozzle upon the end of the pipe 12. The aperture of said nozzle may be opened or closed by raising or lowering the pin 15. 16 is an air-valve sustained in suitable bearings in the top of the gas-generating chamber 14 and maintained closed by a spring 17. It opens inward for the admission of air when the pressure in the gas-generating chamber is reduced below the atmospheric pressure. 18 is a gas-pipe leading from the gas-generating chamber 14 to the valve 20 through a channel in the chest 19, and thence to the explosion-chamber 21. 19 is a chest or casing made integral with the cylinder, a part of which is attached to the side of the cylinder and part to the cylinder-head. The valve 20 is the gas-inlet valve. It is an ordinary circular valve mounted upon a stem seated upon a seat and maintained closed by a spring. 21 is the combustion-chamber, in which the gas is exploded and which communicates directly with the cylinder 30. This connection is better shown in Fig. 2. 22 is the exhaust-valve, which is a valve similar to 20, a circular valve mounted upon a stem and resting upon a seat. 23 is a thimble secured into the side of the combustion-chamber, the interior of which opens into the combustion-chamber and the exterior of which projects into the exhaust-pipe of the engine. 24 is the exhaust-chamber, through which the gas passes in escaping from the cylinder and combustion-chamber and surrounds the thimble 23. 25 is the exhaust-pipe. 26 is a water-channel which surrounds the combustion-chamber and cylinder and serves to reduce the temperature of the apparatus. 27 is the exhaust-valve stem. 28 is a collar having a flange 28^a, which is set fast upon the valve-stem 27. 29 is a spiral spring surrounding the exhaust-valve stem 27 and bearing upon the under side of the valve-chest 19 and the flange 28^a of the collar 28 to maintain the exhaust-valve closed.

Referring to Fig. 2, 30 is the cylinder. 31 is a piston. 32 is the connecting-rod. 33 is the crank. 34 is the crank-shaft. 35 is a pinion keyed upon the crank-shaft. 36 is a gear keyed upon a counter-shaft 38. 37 is a casing containing the crank and connecting-rod and through the walls of which pass the crank-shaft 34 and the counter-shaft 38, which have bearings therein. 39 is an eccentric mounted upon the counter-shaft 38, surrounded by a strap which is connected to an eccentric-rod 40. 42 is a cap secured upon the end of the counter-shaft 38 and having located eccentrically in its face a crank-pin 43, upon which is journaled the end of a rod 44, which extends upward and operates the igniter. 45 is a lug cast on the side of the cylinder and perforated in its end and through which perforation passes the exhaust-valve stem 27. This lug 45, together with the perforation in the valve-chest 19, through which the valve-stem passes, forms guides for said stem. 46 is a guideway or feather cast on the side of the cylinder 30. 47 is a sleeve mounted and sliding freely upon the exhaust-valve stem 27. 48 is a pin projecting from one side of said sleeve and by which the eccentric-rod 40 is connected thereto to impart reciprocating motion to the sleeve. 49 is a lug projecting from the opposite side of said sleeve 47 and engaging the guide or feather 46. 50 is a latch pivoted to the upper corner of the sleeve 47 at the point 51 and provided at its lower end with a counterbalance-weight 52. The extremity of the latch on the side next the valve-stem 27 is notched. The notch has an obtuse angle. One surface is parallel to the latch and the other is inclined downward, so as to form a beveled surface 50^a. The latch is shown in enlarged view in Fig. 6, and a view at right angles to Fig. 6 is shown in Fig. 1. The counterbalance-weight 52 is divided and swings on both sides of sleeve 47. 53 is a lug projecting from one side of the collar 28 and bifurcating at its extremity and embracing the guide or feather 46 to guide the reciprocating motion of the collar 28. The extremity of the latch 50 when in its normal position will escape the lower edge of the collar 28, but the beveled surface 50^a will strike upon the lower edge of the collar, and the force with which the said bevel 50^a will strike the collar is dependent upon the speed with which the trigger is traveling, and the distance which the trigger will be thrown out of its vertical position will depend upon the speed of its motion and the weight of the counterbalance-weight 52. When the device is running at the desired speed, the force of impact of the bevel 50^a upon the collar 28 will cause the latch 50 to be thrown only so far as to engage the under side of the flange 28^a and lift the valve. If, however, the speed increases abnormally, the force of impact will increase and the latch will be thrown beyond the flange 28^a and the valve will not be opened. 44 is the igniter-rod, reciprocating by the crank-pin 43.

The operation of the device is as follows: Referring to Fig. 1, when oil is supplied through the pipe 1 to the reservoir 2 it fills said reservoir until the float 2 rises to a desired level and closes the valve 3, thus cutting off the ingress of oil. When it is desired to start the engine, the plunger 8 is depressed by hand and a portion of oil in the channel 7 is forced through the valve 13 and into the chamber 14. In starting the engine the fly-wheel is turned by hand and the downward motion of the piston will suck the contents of the generating-chamber 14 into the combustion-chamber and cylinder. Another half-revolution of the fly-wheel will carry the piston to the other end of the cylinder and compress the gas therein and in the combustion-chamber. As the crank-shaft is turned the counter-shaft 38 will be turned and the rod 44 reciprocated. With each reciprocation of the rod 44 an electric igniter will be operated and a spark produced within the combustion-chamber so long as the electric igniter is maintained in operation. When, however, the automatic thimble igniter is sufficiently heated to continue the combustion, the electric igniter may be thrown out of action and the engine will continue to operate with the automatic igniter alone. Inasmuch as the cylinder has but one port this must serve as both gas and exhaust port, besides which the cylinder has to pump in its own gas and then compress it before explosion occurs. Hence the explosion can only take place at every other stroke of the piston and the exhaust apparatus and explosion device must only operate, the former on the return of the piston after an explosion and the latter at the moment of compression of the gas in the explosion-chamber. As the explosion of gas in the igniting-chamber and the explosion-chamber and cylinder occurs the piston will be driven to the extremity of the cylinder, turning the crank 33 and the pinion 35. Before any more gas is admitted for a second explosion the gas in the cylinder must be exhausted. Hence the piston must make two strokes under the impulse of the first explosion, for which reason the motion of the counter-shaft is reduced by the pinion and gears 35 and 36, so that the motion of the rod 40, operated by the eccentric 39, is only one-half as frequent as that of the piston. When the eccentric 39 is turned, it will raise the sleeve 47 and the latch 50, engage the flange 28^a of the collar 28, raise the exhaust-valve 22, and allow the gas contained in the cylinder and combustion-chamber to escape through the exhaust. This gas is hot, and as it escapes it will surround and heat the thimble 23. The next stroke of the piston will draw gas into the combustion-chamber and cylinder. As it does so the pressure in the gas-generating chamber will be reduced below atmospheric pressure and air will enter through

the valve 16 into the chamber 14 and oil will automatically arise through the pipe 12 and be sprayed into the said chamber 14 around the pin 15 and be converted into gas, which will mix with atmospheric air, producing the explosive mixture. The operation of explosion will then be repeated by the action of the electrical igniter, and the engine will continue its operation until such time as the heat of explosion and the heat of the exhaust have raised the thimble 23 to a temperature sufficient to ignite the gas without the aid of the electrical igniter. Then the electrical igniter may be cut out of action. The apparatus will then be operated automatically by the heat of the thimble 23 and the battery material will be saved. The heat imparted to the thimble 23 by the exhaust-gas is sufficient to ignite the inflowing gas as soon as it enters the combustion-chamber; but I find that this does not occur, and I have concluded that the failure to so ignite the inflowing explosive gas is due to the fact that only the lower end of the thimble is heated and the interior of the thimble is filled with gas which has already exploded from the last charge. Hence the fresh explosive gas does not come into contact with the hot part of the thimble until the return of the piston and the compression of the gas in the explosion-chamber, when the gas already in the thimble will also be compressed and the explosive gas forced down in the thimble to the point at which it is heated inside. I believe that the temperature of the thimble is also somewhat increased by the compression of the gas. As the operation of the engine continues the gas will be admitted to the combustion-chamber with each successive operation of the exhaust-valve 22, exploded, and exhausted. The rapid repetition of these explosions will accelerate the motion of the piston, and consequently of the sleeve 47, carrying the latch 50, and increase the force of impact of the latch against the collar 28, and until the speed of the latch exceeds the desired limit the force of impact will only throw the latch far enough to permit it to engage the flange 28^a; but as soon as this speed exceeds the desired limit the latch will be thrown beyond the flange and the exhaust-valve will not open. The failure of the exhaust-valve to open and to exhaust the contents of the explosion-chamber and cylinder will maintain the pressure within said chamber and cylinder and fresh gas will not enter through the valve 20. The load upon the engine, in addition to the resistance of the gas imprisoned within the cylinder, will reduce the speed of the piston and bring the sleeve 47 back to its normal speed and the latch 50 into position, where it will engage the flange 28^a and open the exhaust-valve 22, when the operation of admission and explosion will be repeated.

The incandescent igniter and the sparker described in this application are not claimed herein, because they have been made the subject of two other applications which are pending concurrently with this one.

The incandescent igniter application was filed June 25, 1898, Serial No. 684,234, and the electric igniter June 23, 1898, Serial No. 684,235.

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

1. In valve-operating mechanism of a gas-engine the combination of a valve-stem provided with a fixed tappet having shoulder and projecting flange or lug, a pivoted latch having a beveled extremity and a counterbalance-weight to maintain and restore its normal position and means for reciprocating the latch in the path of the tappet, so that the beveled end of the latch will strike the shoulder of the tappet and at normal speed also the flange or lug and operate the valve, but at excessive speed the impact of the latch upon the shoulder will throw it beyond the flange or lug and the valve will not be operated, substantially as described.

2. In a gas-engine the combination, of the exhaust-valve of such an engine, with a latch and means for reciprocating the latch to open the exhaust-valve at desired periods, the latch being pivoted and adapted to swing under the force of impact into engagement with the valve mechanism and swinging out of engagement with the valve mechanism when the speed of the engine passes the desired limit.

Signed at Baltimore city, State of Maryland, this 24th day of November, A. D. 1897.

ERNEST W. GRAEF.

Witnesses:

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CARROLL T. BOND.