(No Model.)

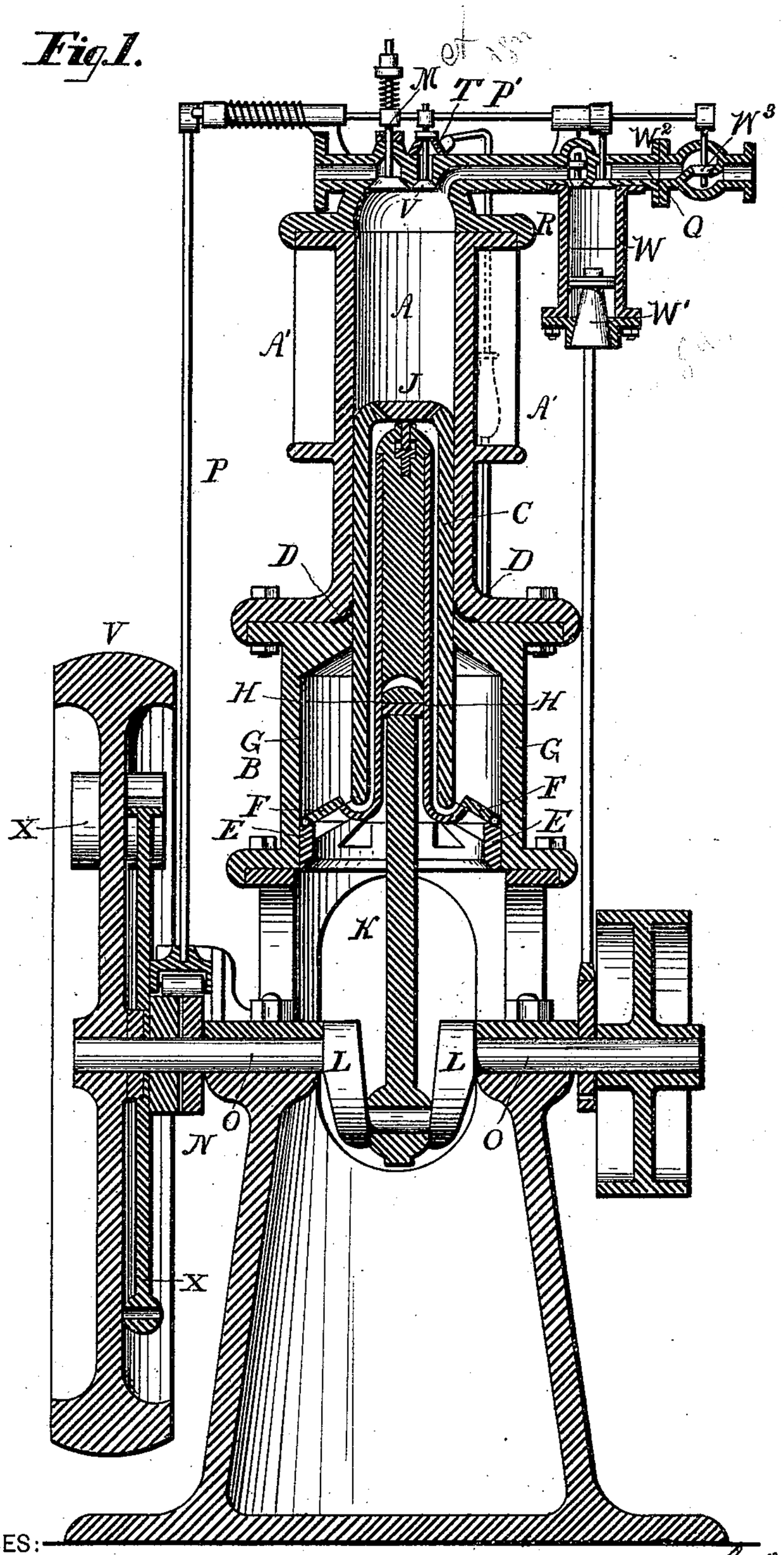
3 Sheets—Sheet 1.

S. L. WIEGAND.

GAS ENGINE.

No. 297,329. Patented Apr. 22, 1884.

Fig. 1.



WITNESSES:

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(No Model.) 3 Sheets—Sheet 2.

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GAS ENGINE.

No. 297,329. Patented Apr. 22, 1884.

Fig. 2.

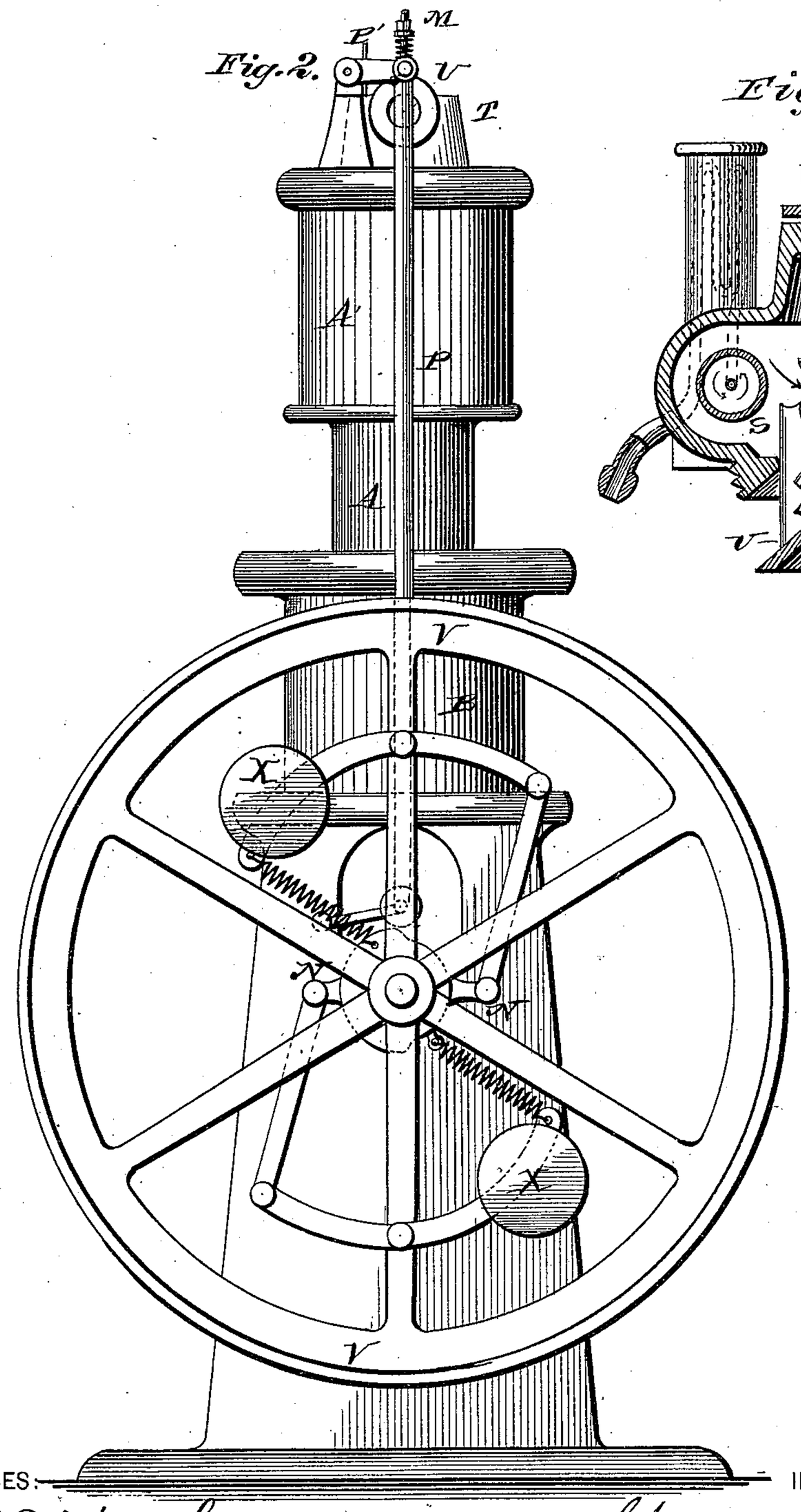

Fig. 11.

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(No Model.) 3 Sheets—Sheet 3.

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GAS ENGINE.

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Fig. 3.

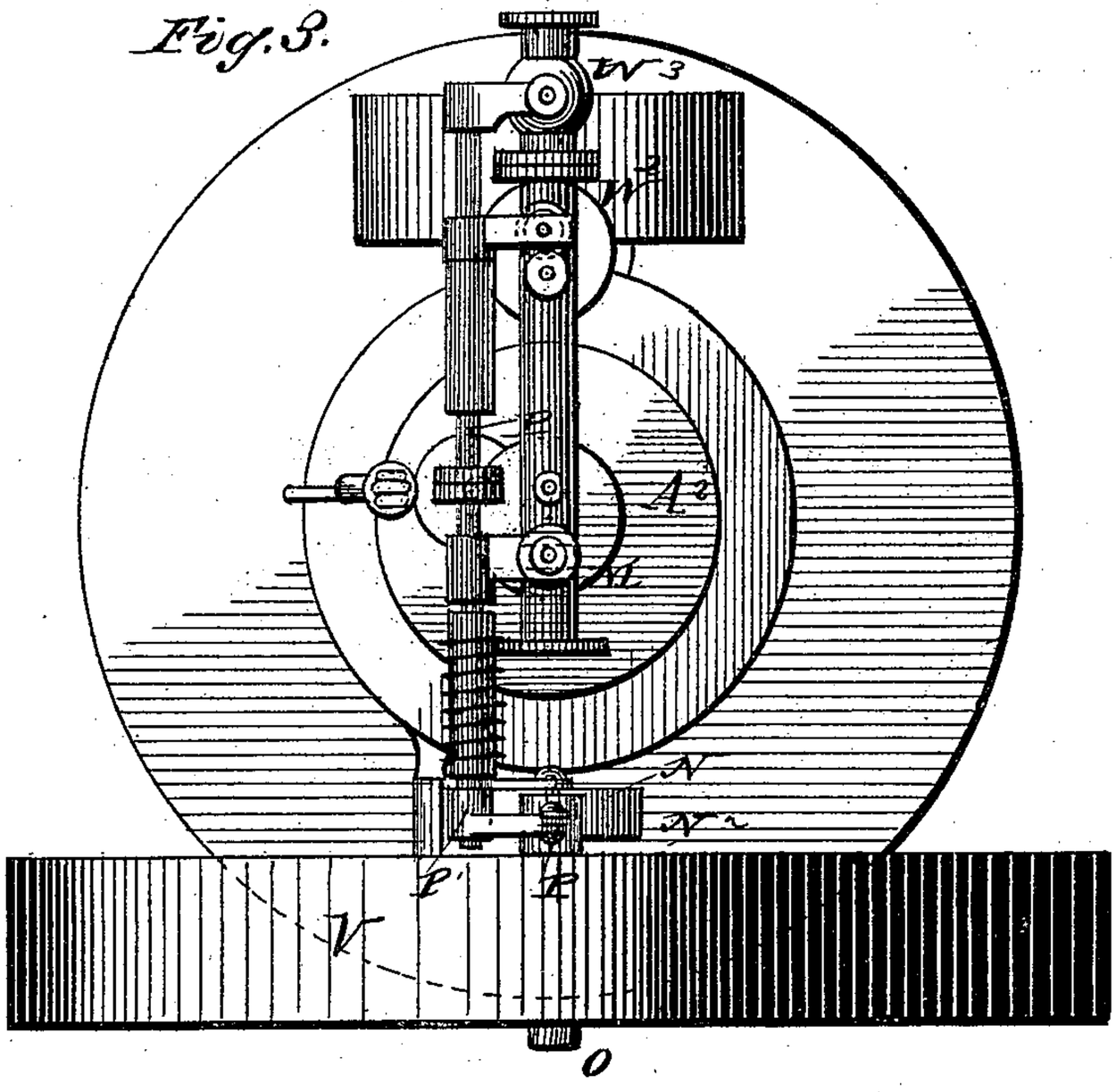


Fig. 4.

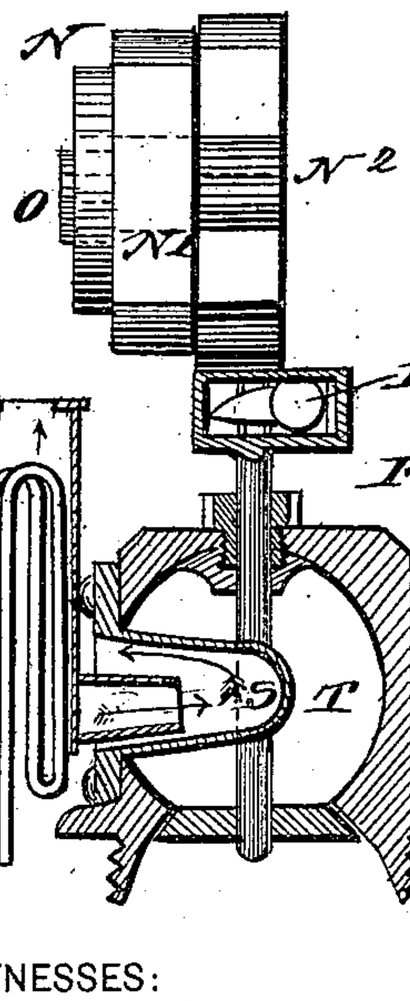


Fig. 5.

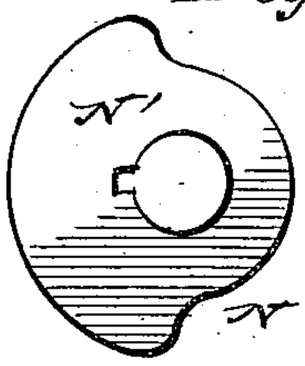


Fig. 6.

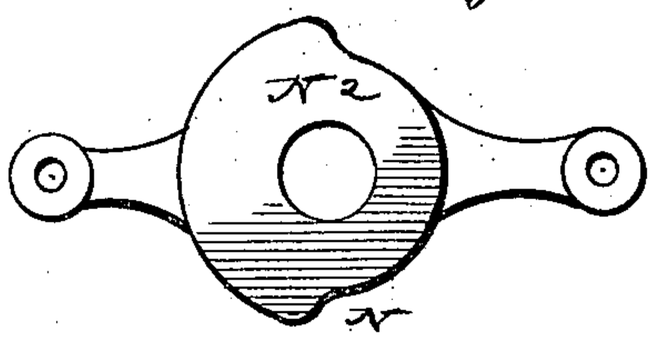


Fig. 7.

Fig. 8.

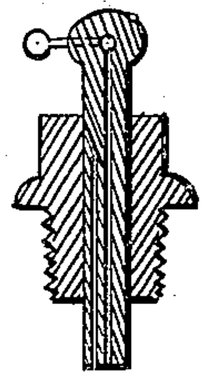


Fig. 9.

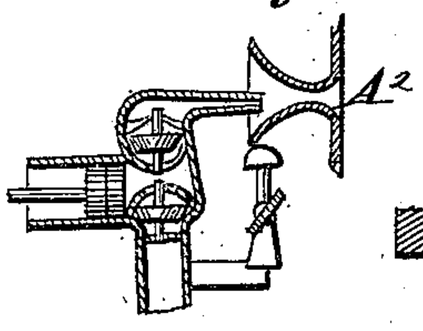
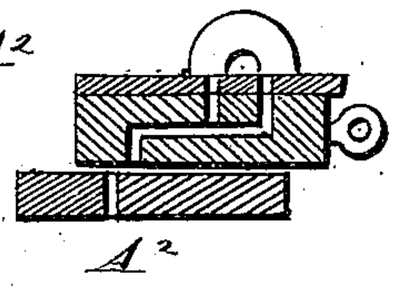


Fig. 10.



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UNITED STATES PATENT OFFICE.

S. LLOYD WIEGAND, OF PHILADELPHIA, PENNSYLVANIA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 297,329, dated April 22, 1884.

Application filed September 18, 1883. (No model.)

To all whom it may concern:

Be it known that I, S. LLOYD WIEGAND, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Gas-Engines; and I do hereby declare the following to be a sufficiently full, clear, and exact description thereof as to enable others skilled in the art to make and use the said invention.

This invention relates to that class of gas-engines wherein air under compression, together with a charge of explosive gas or combustible vapor mingled with air, so as to form an explosive mixture, is ignited and exploded or burned in a cylinder, so as to propel the piston therein contained, and has for its object the simplification of such engines in construction and corresponding reduction in cost of manufacture thereof, and at the same time an economy in gas or other combustible consumed and greater facility of running at high speeds without involving frequent cleansing of the working-surfaces of the cylinder and piston.

To this end the nature of this invention consists in the combination, with the exploding-cylinder of such engines, of a trunk or long piston having channels through which air is forced into the exploding-cylinder, and working through a packing located considerably below the portion of the cylinder wherein the gas is exploded and the power developed, such cylinder and trunk or piston being in a vertical position, and a larger piston formed in the lower end thereof acting as a guide for the lower end of the trunk, and also with suitable valves, and the cylinder in which it reciprocates operates as an air-pump for purging the working-cylinder from the charge from the preceding pressure-stroke, which function is effected by the peculiar adjustment of valves, more fully hereinafter set forth; and in combination with the above an igniting apparatus, whereby leakage and expense of closely-fitted working parts heretofore found necessary are avoided; also, in measuring definitely the proportions of gas and air introduced into the cylinder at each compressing-charge by means of pumps, the time of closing of certain valves of each being automatically varied and controlled by a speed-regulator, so as to introduce explosive charges sufficient to compensate for any variations in velocity of the engine arising from variations in resistance of work, and by such automatic adjustment maintain nearly uniform speed with an economy of fuel or gas, the whole arrangement dispensing with the necessity for the usual cooling-water jacket and water-supply, and securing more thorough combustion by reason of a higher temperature of the cylinder and greater elastic force and consequent power. As a result of the higher temperature of the gases and air during the working-stroke, a further economy is realized by protecting the portion of the cylinder in which the explosion or combustion is performed from radiation, whereby the sensible heat developed in the compression of the charge contributes to the elastic force of the charge, instead of being absorbed by contact with a cooling or radiating cylinder, as has been heretofore practiced.

I will now proceed to fully describe the construction and operation of this invention, referring in so doing to the drawings annexed and letters of reference marked thereon.

Figure 1 is a sectional elevation of the machine; Fig. 2, a side elevation; Fig. 3, a ground plan; and the remaining figures show parts of the apparatus in detail and modifications thereof.

A represents the working or pressure cylinder of the engine, having its axis vertical, with a jacket, A′, of non-conducting material, on its upper part.

B represents a larger cylinder attached to the lower part of the cylinder A, and in the same vertical axial line.

C is a trunk or long piston working through a packing, D, considerably below the lowest point of the stroke or of the top of the piston C.

E is a second piston attached to the lower portion of the piston C, and fitting in the cylinder B.

Air is admitted through valves F into the annular space G in the cylinder B, around the piston C, above the piston E, and below the packing D, and is discharged from said annular space through channels H and valves or valve J opening upward through the piston C into the cylinder A above the piston C.

To the piston C is attached a connecting-

rod, K, communicating motion on the downward stroke to the crank L. The stroke of the crank L is such that when the pistons C and E are at their lowest point in the stroke the heated portion of the piston C does not reach the packing D, and when the piston C is at its highest point of its stroke there shall be a space between it and the upper end of the cylinder A. The upper end of the cylinder A is preferably made in the shape of a truncated cone. Upon it is placed a valve-chamber, A^2, containing the exhaust-valve M, operated by a cam or eccentric, N, on the shaft O through a rod, P, and rock-shaft P'. The adjustment of the eccentric N relatively to the crank L on the shaft O is such that the exhaust-valve, M is closed during the entire downward stroke of the piston, is opened during the first part of the upward stroke, and is closed during the latter part of the upward stroke, so that the air forced by the piston C through the channels H into the cylinder A blows through the exhaust-valve M during the first portion of the stroke and purges the cylinder of whatever air or gaseous products may have been in it previously, and during the latter part of the upward stroke the further supply of air is compressed in the upper part of the cylinder A.

Fig. 4 shows the cam operating the valve of the engine, consisting of two parts or cams N and N^2, respectively shown separately in side view in Figs. 5 and 6. The part of the cam marked N is keyed to the shaft, and always maintains the same angular position in relation to the crank, while the part N^2 is susceptible of turning upon the shaft, and is controlled in its position by a speed-regulator connected to the projecting arms shown in Fig. 6. The form of the cam N is such that the exhaust-valve M is closed and the igniting-valve open during the whole of the descending stroke, and the form of the cam N^2 is such that the igniting-valve V and exhaust-valve M are open during the first part of each ascending stroke, and both valves, V and M, are closed during the latter part of the ascending stroke, for a proportion of the stroke depending on the adjustment of the cam N^2 as controlled by the regulator. The time of closing of the valve M is varied by a centrifugal regulator connected with the eccentric or cam N.

Gas or combustible mixtures of air and vapor are admitted into the cylinder A by a tube, Q, from a gasometer, gas-pump, or other supply. By mechanism hereinafter described, whenever the valve M is open to the atmosphere, communication from the pipe Q to the cylinder A is closed, and communication from the pipe Q opens after the valve M has closed, during the latter part of the upward stroke of the piston C, and is again closed during the whole of the descending stroke of the piston C. The supply of combustible gas or vapor is preferably introduced by a pump, W, the piston W' of which moves in the same time, or nearly so, with the stroke of the piston C, and the inlet-valve W^2 of which opens and closes at the same time as the exhaust-valve M, so that no gas or inflammable vapor is forced into the cylinder A by the pump W during the emptying of the products of the previous explosion from the cylinder A; but the pump W returns the gas to the supply-pipe until the inlet-valve W^2 closes, which it does at the same time that the valve M closes the cylinder A. The effect of this is to force gas into the cylinder A only during the time when the air in the cylinder A is undergoing compression, and the velocity of the piston compressing the air and the piston compressing the gas being relatively the same at all times, the proportions of gas and air are maintained, although the quantity of air and gas compressed at each stroke is varied to meet the changing requirements for power to maintain uniform velocity under varying conditions of work or load, the opening and closing of the valve R being varied in the same manner and by the same means as the variable motion of the valve M is effected.

Figs. 7 and 11 show sections upon an enlarged scale of the igniting device, which consists of a small chamber (marked T) susceptible of being placed in fluid communication or shut off from the cylinder A by a valve, V. In this chamber T is a metallic bulb or tube, S, which is heated by a jet of burning gas forced in by a jet of air previously heated by passing through a circuitous pipe located in the chimney, through which the waste products of the igniting-flame are discharged, thus securing by the heated air and gas-jet such a temperature of the tube S as to ignite any explosive mixture entering the chamber T from the cylinder A when the valve V is opened. The air for the jet flows from the pump B through the igniting-chamber, as indicated by arrows shown in Fig. 11. The valve V is made hollow through its stem or guide, with a series of openings made across both the lower and upper part of its stem. The effect of these openings is to induce a current of air downward through the center of the valve when the valve is open and air is forcing out through the exhaust-valve M during the purging operation, in the same manner that similarly-shaped chimney caps induce an outward current from chimneys by air blown across them. Air at the same time entering between the wings of the valve-guide, the products of combustion of the previous explosion are effectually removed.

Fig. 8 shows an igniter having a central insulated platinum wire, through which a current of electricity may be discharged to another conducting-point connected with the opposite electrode or other source of electric current, as has been practiced in the well-known "French Lenoir engine."

Fig. 9 shows a small forcing-pump adapted to drive a jet of gas forcibly through an igniting-flame, through a funnel, A^2, into the cylinder A.

Fig. 10 is a section of an igniting-slide of the usual construction, for transferring small portions of gas in combustion in the cylinder A from an external flame.

Neither of the devices shown in Figs. 8, 9, and 10 is claimed as part of this invention, but may be substituted for the device shown in Figs. 7 and 11 in conjunction with other features of this invention.

The valves M and U and W^2 or W^3, as the case may be, perform some of their motions at fixed times relatively to the strokes of the piston, and others at variable times, as controlled by the regulator under the influence of the slight changes of velocity due to variations in resistance or work on the engine. The cam N is double, or constructed in parts N and N^2, so as to effect these results, and resembles the cam shown in Letters Patent of the United States, numbered 45,199, and dated November 19, 1864, for improvement in steam-engines, one of said cams, N′, working always with a fixed angular adjustment to the crank L, and the other, N^2, being varied in angular adjustment by the action of a regulator to which it is connected.

The operation of this machine is to produce force by fluid-pressure in the cylinder A in a mixture of air and gas exploded therein, and to drive the piston downward, and thus rotate the shaft, by means of the crank L and connecting-rod K, the return or upward stroke being effected by the momentum of a fly-wheel, V, turning the shaft O, and during the early part of the returning or rising stroke of the piston C the air from the chamber G flows through the valve M, expelling the gases or products of combustion remaining in the cylinder A from the preceding stroke, and during the latter portion of the upward stroke a charge of gas is introduced and compressed, together with the air confined in the cylinder A, and this charge, with the air compressed from the space G into the said cylinder A, is ready for explosion or ignition in the next descending stroke. The volume of air and gas compressed in the space in the cylinder A is varied and controlled by the change of the eccentrics N and N′ on the shaft O in its angular relation to the crank, which change is effected by connecting the said eccentric N with a speed-regulator, X, rotating with the fly-wheel V and shaft O, so that the amount of force developed in each succeeding descending stroke is graduated to compensate for any deviations from the normal speed of the engine during the preceding revolution. By locating the piston-packing below the heated part of the cylinder, difficulties arising from expansion of the parts experienced in other gas-engines in maintaining a tight-fitting piston and cylinder are avoided, and, by permitting the cylinder to become heated, more prompt ignition of the charge in the cylinder A is effected, and the engine is enabled to run at higher speed, and consequently to develop the same amount of power demands a smaller engine than has heretofore been practicable; and, further, by not cooling the cylinder A the elastic force of the gas is maintained with a less expenditure of combustible material, and by regulating the amount of air inclosed and compressed in each upward stroke of the air pump and cylinder, and also at the same time regulating the volume of gas inclosed in the gas-pump at each stroke, a proper and exact relation of the volumes of gas and air admitted to the cylinder, and the best and most effective mixture of air and gas are procured in the cylinder A.

Having described this invention and the mode of operating the same, what is claimed therein is—

1. In an explosive-gas engine, a vertical exploding-cylinder provided with a heat non-conducting jacket at the upper part and a packing fitting a piston or plunger at the lower portion, substantially as and for the purpose set forth.

2. In a compression exploding-gas engine, the combination of an exploding-cylinder with an air-pump of greater displacement than the exploding-cylinder discharging air directly into said cylinder, and a compression gas-pump delivering gas directly into said cylinder, and arranged during the same stroke to first purge the exploding-cylinder and afterward compress therein a charge of air and inflammable gas or vapor, substantially as and for the purpose set forth.

3. In a compression explosive-gas engine, in combination with a vertically-reciprocating piston or plunger working in a heated compression exploding cylinder or chamber, a packing located below the heated portion of said cylinder, fitting between the exploding-cylinder and air-pump and around the piston or plunger, substantially as and for the purpose set forth.

4. In a compression explosive-gas engine, the combination of an exploding-cylinder provided with an exhaust-valve operated by a cam controlled by a speed-regulator, so as to automatically vary the time of closing said valve in the compressing or return stroke, with a pump arranged to force gas or mixtures of air and inflammable vapor into the said exploding-cylinder, and having a valve arranged to admit gas or air and inflammable vapor to the said pump during the outward stroke thereof, and to be held open by a cam controlled by a speed-regulator to varying points during the returning stroke, and thereby permit varying portions of the charge to return through the said admission-valve to the supply-pipe, and automatically regulate the speed of the engine by changing the volume of inflammable charge introduced into the exploding-cylinder, substantially as and for the purpose set set forth.

5. In an explosive compression gas-engine, the combination of an igniting-chamber containing a body heated by an external flame, with a valve opening and closing communication between said chamber and the explod-

ing-cylinder, said valve being operated by a cam varied and controlled in position by a speed-regulator, so as to change the time of closing communication between the igniting-chamber and the exploding-chamber, substantially as and for the purpose set forth.

6. In a compression explosive-gas engine, the combination of a gas-pump, arranged to deliver gas into the exploding-cylinder, with a valve admitting gas into said pump, operated by a cam to close at varying positions of the pump, said cam being adjusted automatically, and controlled by a connected speed-regulator, substantially as and for the purpose set forth.

7. In an explosive compression gas-engine, the combination of a vertical air-pump piston, E, with a vertically-moving propelling trunk or piston, C, having a less displacement than the piston E, and reciprocating in an exploding-cylinder, A, of less capacity than the said air-pump cylinder B, and having ducts H, for admitting air into the exploding-cylinder A from the air-pump cylinder B, substantially as shown and described, and for the purpose set forth.

8. The combination of the piston C, provided with air-channels H, valve J, and piston E, having valves F, arranged to work in the cylinder G, substantially as and for the purpose set forth.

9. In an explosive compression gas-engine, the combination of a pump arranged to compress inflammable gas or inflammable mixtures of air and vapor and deliver the same directly into the pressure or exploding cylinder, with an inlet-valve arranged to admit gas or inflammable mixtures of air and vapor to the said pump throughout the outward stroke, and controlled by a cam operated by a connected speed-regulator, so as to close said valve at varying points in the returning stroke of the pump, for the purpose of varying the quantity of gas or equivalent inflammable charge introduced into the exploding-cylinder at each stroke by permitting variable portions thereof to return through the inlet-valve to the supply-pipe or reservoir, substantially as set forth.

10. In a compression gas-engine, the combination of a speed-regulator with a cam arranged and connected with the exhaust-valve of the exploding-cylinder, so as to control and regulate the volume of air shut up and compressed in the exploding-cylinder proportionately to any variations in the velocity of the engine, for the purpose of compensating and correcting such variations, substantially as shown and described.

11. The combination, in an explosive compression gas-engine, of a speed-regulator with the cam connected with and arranged to operate the exhaust-valve of the pressure-cylinder and the inlet-valve of the gas-pump, so as to open and close said valves at varying points in the piston-stroke of the engine, and thereby varying the volumes of air and inflammable gas or vapor to the pressure-cylinder for the purpose of compensating for variations in speed and maintaining uniform velocity of the engine.

12. In a compression explosive gas-engine, the combination of an air-pump forming a guide for the piston of the pressure-cylinder, and directly forcing air through the pressure-cylinder, for first purging the same of the products of the preceding combustion, and afterward for compressing charges of air in definitely-measured proportions to charges of gas forced into said cylinder, substantially as and for the purpose set forth.

13. In a compression explosive gas-engine, the combination of an igniting-chamber with a valve communicating with and shutting off communication with the exploding-chamber, and adapted, when open, to direct a current of air through the igniting-chamber, substantially as and for the purpose set forth.

14. In a compression explosive gas engine, the combination of an igniting-chamber containing an incandescent body with an exploding or pressure cylinder, and having a valve controlling communication between them connected with an operating mechanism, to close the igniting-chamber from the pressure-cylinder at low pressure in both vessels, and to open and admit a portion of the explosive charge from the cylinder to the igniting-chamber when under higher pressure, for the purpose of igniting the same.

15. In a compression explosive gas-engine, an igniting-chamber containing an incandescent body heated by a flame-jet applied internally to said incandescent body, substantially as set forth.

16. In a compression explosive gas-engine, an igniting-chamber containing an incandescent body heated by a jet of flame external to the said chamber, supplied with air heated by the escaping products of combustion of said flame, substantially as set forth.

17. In a compression exploding gas-engine, the combination of an air-pump forming a guide for the power-receiving piston, and arranged to directly purge the exploding-cylinder, and during the same stroke compress air therein, a gas measuring and compressing pump, a speed-regulator connected with and operating the inlet-valve of the gas-pump and the exhaust-valve of the pressure-cylinder, and an igniting-chamber connected by a valve with the exploding-cylinder, and operated by a cam rotated with a fly-wheel and shaft, receiving motion through a crank and pitman, operated by the piston or trunk propelled by the explosion of air and combustible gas in the exploding-cylinder, substantially as and for the purpose set forth.

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Witnesses:
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