(No Model.) 2 Sheets—Sheet 1.

A. G. PACE.

COMBUSTION ENGINE.

No. 588,466. Patented Aug. 17, 1897.

FIG. 1.

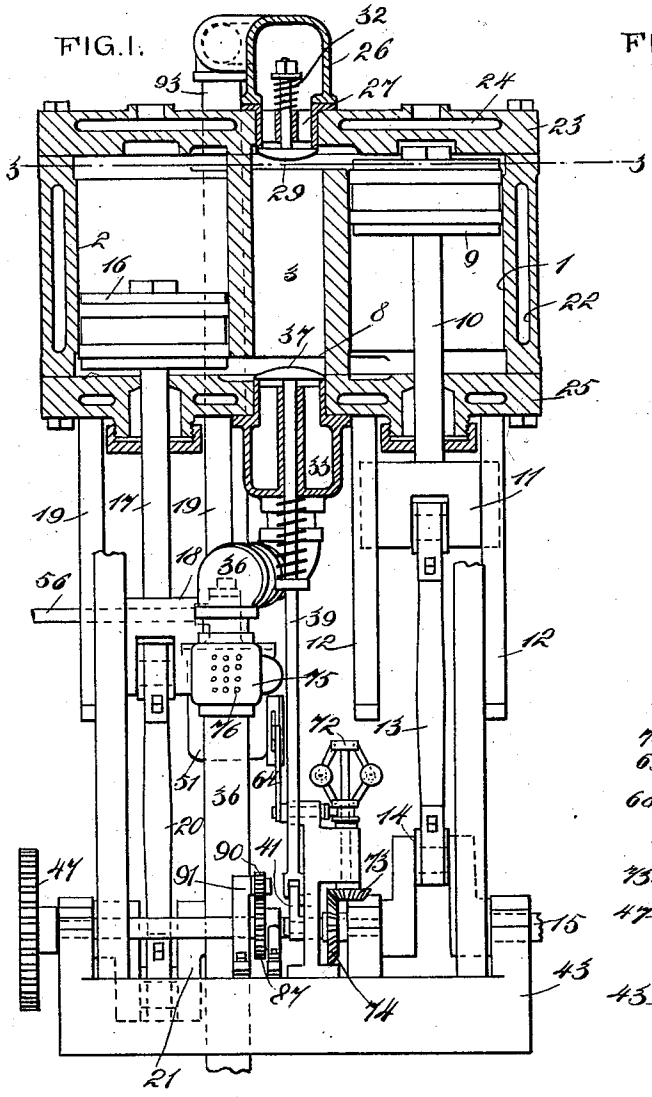


FIG. 2.

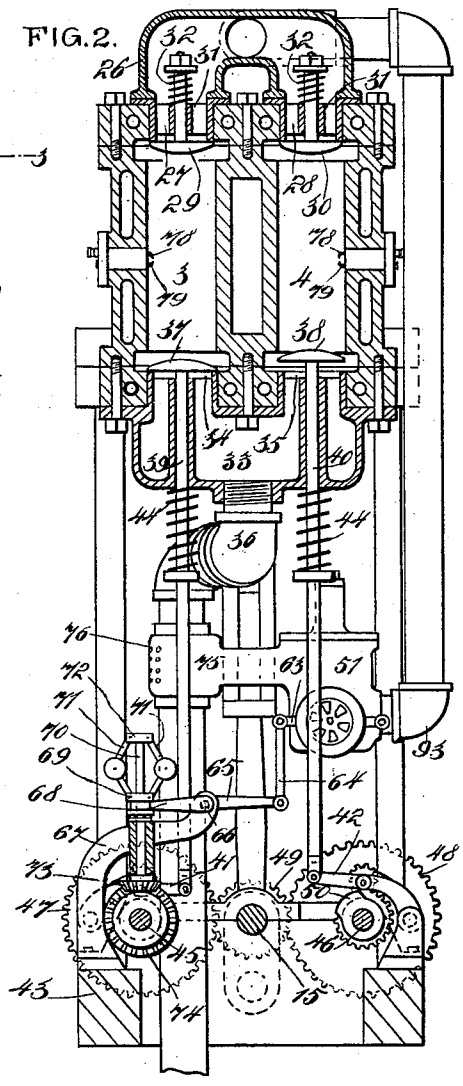
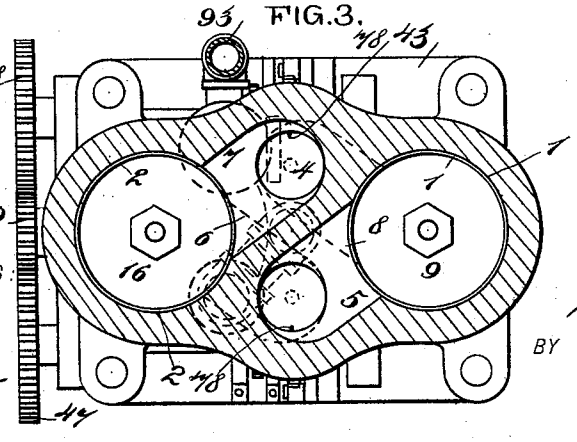


FIG. 3.



WITNESSES:

Donn Tunstall

C. R. Ferguson

INVENTOR

A. G. Pace.

BY

ATTORNEYS.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

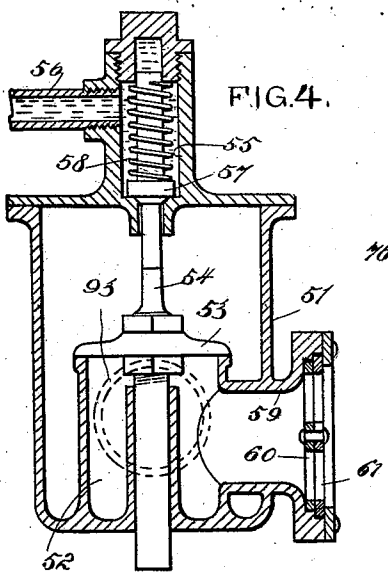
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A. G. PACE.

COMBUSTION ENGINE.

No. 588,466. Patented Aug. 17, 1897.

FIG. 4.



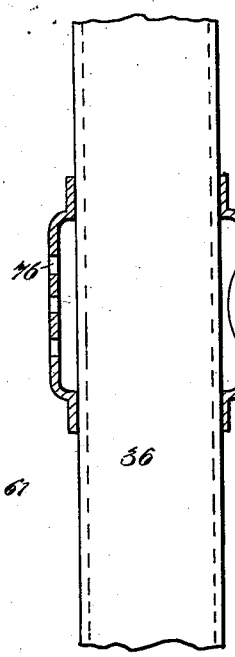


FIG. 5.

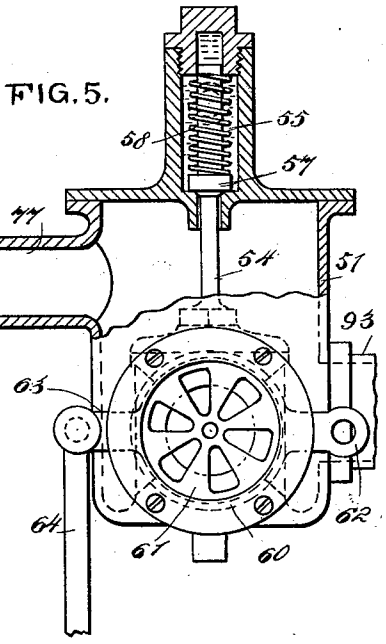


FIG. 7.

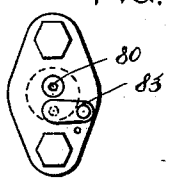
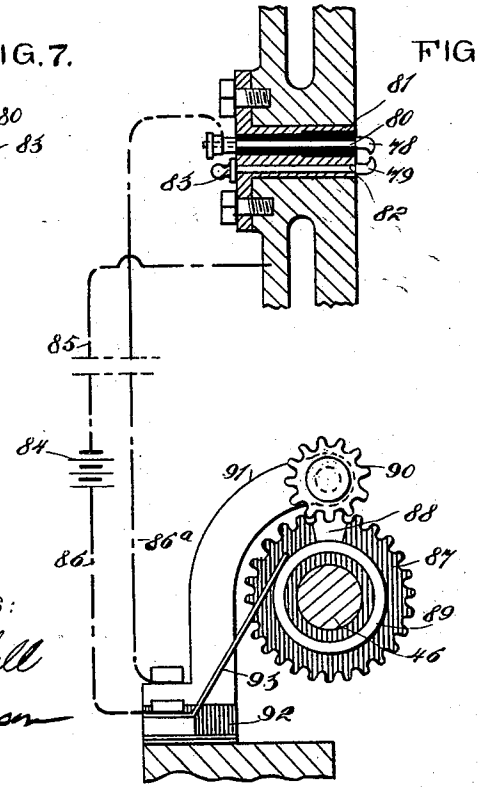


FIG. 6.



WITNESSES:

Donn Tirtchell

C R Ferguson

INVENTOR

A. G. Pace

BY

ATTORNEYS.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

AUGUSTUS G. PACE, OF NEW YORK, N. Y.

COMBUSTION-ENGINE.

SPECIFICATION forming part of Letters Patent No. 588,466, dated August 17, 1897.

Application filed February 12, 1897. Serial No. 623,067. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTUS G. PACE, of New York city, in the county and State of New York, have invented a new and Improved Combustion-Engine, of which the following is a full, clear, and exact description.

This invention relates to that class of engines in which the piston is operated by the expansive force of exploded gas generated by a mixture of hydrocarbon oil and air; and the object is to provide a double-acting engine of this character in which the two pistons are simultaneously acted upon in such manner that the force exerted on the under side of one piston is equal to the force exerted on the upper side of the other piston; and a further object is to provide an engine of this character in which the weight will be greatly reduced as compared with other combustion-engines and which will develop the same power as such other engines.

I will describe a combustion-engine embodying my invention, and then point out the novel features in the appended claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a partial elevation and partial vertical section of an engine embodying my invention. Fig. 2 is a partial elevation and partial vertical section at right angles to Fig. 1. Fig. 3 is a section on the line 3 3 of Fig. 1. Fig. 4 is a sectional view of a carbureter employed. Fig. 5 is a partial section and partial elevation of said carbureter and drawn at right angles to Fig. 4. Fig. 6 is a detail drawn on an enlarged scale, showing a sparking mechanism employed; and Fig. 7 is a detail showing a means for separating the sparking-points when desired.

The engine comprises a casing having two cylinders 1 and 2, and in this casing are also arranged vertically-disposed combustion-chambers 3 and 4. The upper end of the combustion-chamber 3 has a broad port connection 5 with the upper end of the cylinder 1 and at its lower end a broad port connection 6 with the cylinder 2. The combustion-chamber 4 has a broad port connection 7 at its upper end with the upper end of the cylinder 2 and a broad port connection 8 at its lower end with the lower end of the cylinder 1.

Operating in the cylinder 1 is a piston 9, having a stem 10 connected with the slide-block 11, movable vertically in guideways 12, depending from the lower side of the casing. From the block 11 a pitman 13 extends to a connection with a crank 14 on the driving-shaft 15. Movable in the cylinder 2 is a piston 16, having a stem 17 engaging with a slide-block 18, mounted to move in guideways 19, depending from the casing, and from this block 18 a pitman 20 extends to a connection with a crank 21 on the driving-shaft 15. It will be seen that these cranks 14 and 21 are extended in opposite directions, so that the pistons may operate in opposite directions. The piston-stems 10 and 17 will of course extend through suitable stuffing-boxes in the casing.

The walls of the casing are provided with waterways 22, and the top closure 23 of the casing is also provided with a waterway 24, as is also the bottom closure 25. These waterways will allow for a circulation of cold water to reduce the temperature caused by the explosion of gas in the cylinders and chambers.

On the casing is mounted a housing 26, having a port communication 27 with the interior of the combustion-chamber 3 and also having a port communication 28 with the interior of the combustion-chamber 4. These respective ports are controlled by inwardly-opening valves 29 and 30. The valves 29 and 30 have stem portions extended upward through spiders 31, arranged in the ports, and between the said spiders and a collar on the upper end of the valve-stems coiled springs 32 are arranged. These springs 32 tend to hold the valves yieldingly against the valve-seats.

On the lower side of the casing is secured a housing 33, having port communications 34 and 35 with the chambers 3 and 4, and from this housing 33 an exhaust-pipe 36 extends downward. A plate-valve 37 is designed to control the port 34 by engaging upon its valve-seat, and the port 35 is controlled by a similar valve 38. The stems 39 and 40 of these valves 37 and 38 extend downward through tubular portions within the housing 33 and

pivotally engage at their lower ends with levers 41 and 42, pivoted to the base 43 of the engine. Springs 44 surround the stems 39 and 40 between the collars on said stems and the under side of the housing 33, and these springs 44 serve to hold the plate-valves 37 38 yieldingly against the valve-seats.

Counter-shafts 45 and 46 are mounted in bearings on the base 43, and on these counter-shafts gear-wheels 47 and 48 are secured, and these gear-wheels 47 and 48 mesh with a pinion 49 on the driving-shaft 15. Mounted on the shafts 45 and 46 are cam-blocks 50, designed to engage with the levers 41 and 42 to alternately raise the said levers and consequently impart an alternating opening movement to the valves 37 and 38.

Mounted on the frame of the engine is a casing 51, forming a carbureting-chamber, and within this casing 51 is an auxiliary chamber 52, the upper end of the wall of which provides a seat for a puppet-valve 53. From the puppet-valve 53 a stem 54 extends upward through the top wall of the casing 51 into an oil-receiving chamber 55, with which an oil-supply pipe 56 communicates. The opening through the top wall of the casing 51 is somewhat larger than the portion of the stem 54 that passes through it, so that an inlet for oil is produced between the wall of said opening and the stem. This oil or inlet opening is controlled by a valve 57, mounted on the stem portion within the chamber 55. A spring 58 surrounds the stem portion between the oil-inlet-controlling valve 57 and the top wall of the chamber 55. This spring serves to hold the valves 53 and 57 in a normally-closed position.

The air-chamber 52 has an inlet-pipe 59, and I provide means whereby the admission of air may be regulated manually and also means whereby the admission of air may be regulated automatically. The means for regulating the admission of air as here shown consists of perforated disks 60 and 61, mounted to rotate in the outer end of the pipe 59. The disks 60 and 61 are pivotally connected together at their center, so that each may rotate independently of the other. From the disk 60 a handpiece 62 extends outward, so that the said disk may be rotated by hand to cause its ports or openings to more or less register with the ports or openings through the disk 61. The disk 61 has an outwardly-extended arm 63, from which a link 64 extends to a pivotal connection with an arm 65, mounted on a shaft 66, having bearings in a bracket 67, secured to the base of the machine. From the other end of this shaft 66 an arm 68 extends and engages with its end in an annular channel formed in a block 69, mounted to slide vertically on a centrifugal governor-shaft 70.

The governor consists of weighted links 71, which have their upper sections pivotally connected to a collar 72, rigidly mounted on the governor-shaft, the lower sections being pivoted to the block 69. The governor-shaft 70 extends through a suitable bearing and has a bevel-pinion 73 on its lower end meshing with a bevel-gear 74, mounted on the shaft 45. By this construction it is obvious that as the speed of the engine increases the governor-balls will be forced outward by centrifugal action, and this motion will of course more or less rotate the disk 61 to regulate the openings for air.

It is desired that a small amount of heated air shall be drawn into the chamber of the carbureter to mix with the other air and with the oil to form a combustion-gas. For this purpose I have mounted a jacket 75 on the exhaust-pipe 36. At one side this jacket 75 is provided with a series of small perforations 76, and the other side of said jacket has a pipe connection 77 with the interior of the carbureting-chamber. As it is desired that the amount of heated air shall be quite small as compared with the air admitted through the openings in the disks 60 and 61, the combined area of the perforations 76 must consequently be much smaller than the combined area of the openings through the disks 60 and 61.

I will now describe a means for igniting the gas in the combustion-chambers 3 and 4, and as the devices for this purpose are similar in construction and action a description of one will answer for both.

Projected through the wall of the casing and into the combustion-chamber are sparking-points 78 and 79. The sparking-point 78 has a rod 80 extended through a tube 81 of insulating material, the said tube 81 being extended through the wall of the casing. The rod 82 of the sparking-point 79 extends also through the wall of the casing and is in electrical contact therewith. This last-named rod 82 is mounted to rotate, and it is provided on its outer end with a finger, which is here shown in the form of a crank 83. The object in providing means to rotate the point 79 away from the point 78 is to provide means whereby any possible sediment, such as oil, may be discharged should there be any collected between the points 78 and 79, and, further, by turning the points 78 and 79 out of sparking distance in one combustion-chamber the engines may be arranged for single action, as at times might be necessary, particularly in marine engines.

Any desired source of electricity may be employed for causing a spark between the points 78 and 79. I have here shown a battery 84, one pole of which has a wire connection 85 with a casing of the combustion-chamber, and consequently with the point 79. I provide a simple means for making and breaking the electric circuit, the said means being operated by rotary parts of the engine. As here shown, this means consists of a gear-wheel 87, of insulating material, mounted on the counterlshaft 46. This gear-wheel of insulating material has a metal block 88 in its periphery engaging at its inner end with a metal ring 89, secured to the face of the gear 87 and adapted to engage its teeth with a pin-

ion 90, mounted to rotate on a bracket 91, supported on the base of the machine and insulated therefrom by a block 92 of insulating material. A brush 93 is attached to the frame or base of the machine and bears with its free end upon the ring 89. From the bracket 91 a wire 86ª extends to a binding-post on the outer end of the rod 80, and a wire 86 from the battery is in connection with the brush 93.

The device thus described will be used for igniting the gas within the chamber 4, and a similar device is to be mounted on the counter-shaft 45 to control the current for igniting the gas in the chamber 3.

The operation is as follows: Assuming the piston 16 to be about to start on its upward movement, the compressed gas in the combustion-chamber 3 will be ignited and impart its force to the under side of the piston 16 and to the upper side of the piston 9. During the downward movement of the piston 9 the gas underneath it will be discharged around the opened valve 38, and the suction caused by the downward movement of the piston will draw the value 27 of the combustion-chamber 3 slightly open, and this suction will draw the gas from the carbureter through the pipe 93, which provides communication between said carbureter and the housing 26, and this same suction will move the valves 53 and 57 upward, thus allowing the admission of outer air and also allowing the admission of a small quantity of oil, which will mingle and form into gas to be drawn into said combustion-chamber 3. During this movement the gas previously drawn into the chamber 4 will be compressed by the upward movement of the piston 16, and then of course it will be ignited and the pistons consequently moved in the opposite directions. As the pressure on one side of one piston is equal to that on one side of the other piston it is obvious that a perfectly-balanced engine is provided, thus reducing the ordinary shocks which take place in gas-engines to a minimum and making it practicable to construct an engine of comparatively light weight, and, further, this perfect balance will greatly reduce the friction, thereby reducing the amount of fuel employed. As the valves open directly into the explosion-chambers there will be no loss of heat, as in engines as commonly made with ports or passages. As the ports leading from the combustion-chambers to the cylinders are quite wide, or of large area, the gas will not be subjected to cooling, as in certain engines as now constructed.

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

1. A combustion-engine, comprising a casing having two cylinders, pistons operating in the said cylinders, combustion-chambers in the casing having port communications at the top and bottom with the cylinders, whereby the pressure of exploded gas will be exerted on the top of one piston and on the bottom of the other piston, means for igniting the gas in the combustion-chambers, valves for controlling the admission of gas, and valves for controlling the exhaust, substantially as specified.

2. A combustion-engine, comprising a casing having two cylinders, pistons operating in the cylinders, combustion-chambers in the casing having port communications at the top and bottom with the cylinders, whereby the pressure of exploded gas will be exerted on the top of one piston and on the bottom of the other, means for igniting the gas in the combustion-chambers, gas-admission valves operated by the suction of the pistons, and exhaust-valves operated by a rotary part of the engine, substantially as specified.

3. A combustion-engine, comprising a casing having two cylinders, pistons operated in said cylinders, combustion-chambers in the casing, means for igniting gas in the combustion-chambers, a carbureter having communication with the combustion-chambers, valves for controlling said communication, valves for controlling the exhaust from the chambers, and means for automatically controlling the admission of air to the carbureter, substantially as specified.

4. A combustion-engine, comprising a casing having two cylinders and two combustion-chambers, pistons operating in the cylinders, a carbureter having communication with the combustion-chambers, automatically-regulated valves for controlling said communications, automatically-operated valves for controlling the exhaust, an auxiliary chamber in the carbureter, the upper end of the wall of which forms a valve-seat, a valve for said seat, an oil-inlet, a valve for said oil-inlet having connection with the valve of the auxiliary chamber, and means for controlling and regulating the admission of air to the carbureter through the auxiliary chamber, substantially as specified.

5. A combustion-engine, comprising a casing having two cylinders and two combustion-chambers, pistons operating in the cylinders, a carbureter having communication with the combustion-chambers, valves for controlling said communications, an exhaust-pipe, a jacket surrounding said exhaust-pipe and having perforations, a pipe connection between said jacket and the carbureter, an oil-supply having connection with the carbureter, a valve for controlling the admission of oil, a valve for controlling the admission of atmospheric air and operating coincidently with the oil-controlling valve, and means for regulating the admission of air, substantially as specified.

6. A combustion-engine, comprising a casing having two cylinders and two combustion-chambers, means for igniting gas in the combustion-chambers, pistons operating in the cylinders, a housing on the casing having port communications with the combustion-cham-

bers, valves for controlling said communications and operated by the suction of the pistons, a carbureter having communication with the housing, an exhaust-pipe, valves for controlling the exhaust, a jacket surrounding the exhaust-pipe and having a series of perforations, a pipe connection between said jacket and the carbureter, an auxiliary chamber in the carbureter, the upper end of the wall of said auxiliary chamber forming a valve-seat, a puppet-valve for engaging the said seat, an oil-inlet, a valve for controlling said oil-inlet and having connection with the puppet-valve, an inlet-pipe for the auxiliary chamber, a valve in said inlet-pipe, a governor operated by the engine, and a connection between said governor and the valve in the inlet-pipe, substantially as specified.

7. A combustion-engine, comprising a casing having two cylinders and two combustion-chambers, pistons operating in said cylinders, a carbureter having communication with the combustion-chambers, valves for controlling said communications, an air-inlet for the carbureter, two perforated disks in said inlet, one of said disks being adapted to be turned manually, and means for automatically turning the other disk, substantially as specified.

8. A combustion-engine, comprising a casing having cylinders and combustion-chambers, pistons operating in the cylinders, a carbureter having communication with the combustion-chambers, valves for controlling said communications, an exhaust-pipe, valves for controlling the exhaust, a jacket surrounding the exhaust-pipe, the said jacket having perforations through its wall and also having communication with the carbureter, an air-inlet pipe for the carbureter, disks mounted to rotate in said inlet and having openings, the said openings having a greater area than the combined area of the perforations in the jacket, and means for operating said disks, substantially as specified.

9. A combustion-engine, comprising a casing having a cylinder and a combustion-chamber, a piston operating in the cylinder, a gas-supply for the engine, a fixed sparking-point in the combustion-chamber, a rotary sparking-point in the combustion-chamber, a source of electricity with which said sparking-points are engaged, a gear-wheel of insulating material operated by the engine, a metal block on said gear-wheel, a pinion engaging with the gear-wheel and comprised in the electric circuit, a metal ring on the gear-wheel, and a brush engaging the said ring and with one of the wires of the electric circuit, substantially as specified.

AUGUSTUS G. PACE.

Witnesses:
A. A. HOPKINS,
C. R. FERGUSON.