No. 865,213. PATENTED SEPT. 3, 1907.

J. SCHAEFFERS.

ENGINE.

APPLICATION FILED AUG. 15, 1906.

3 SHEETS—SHEET 1.

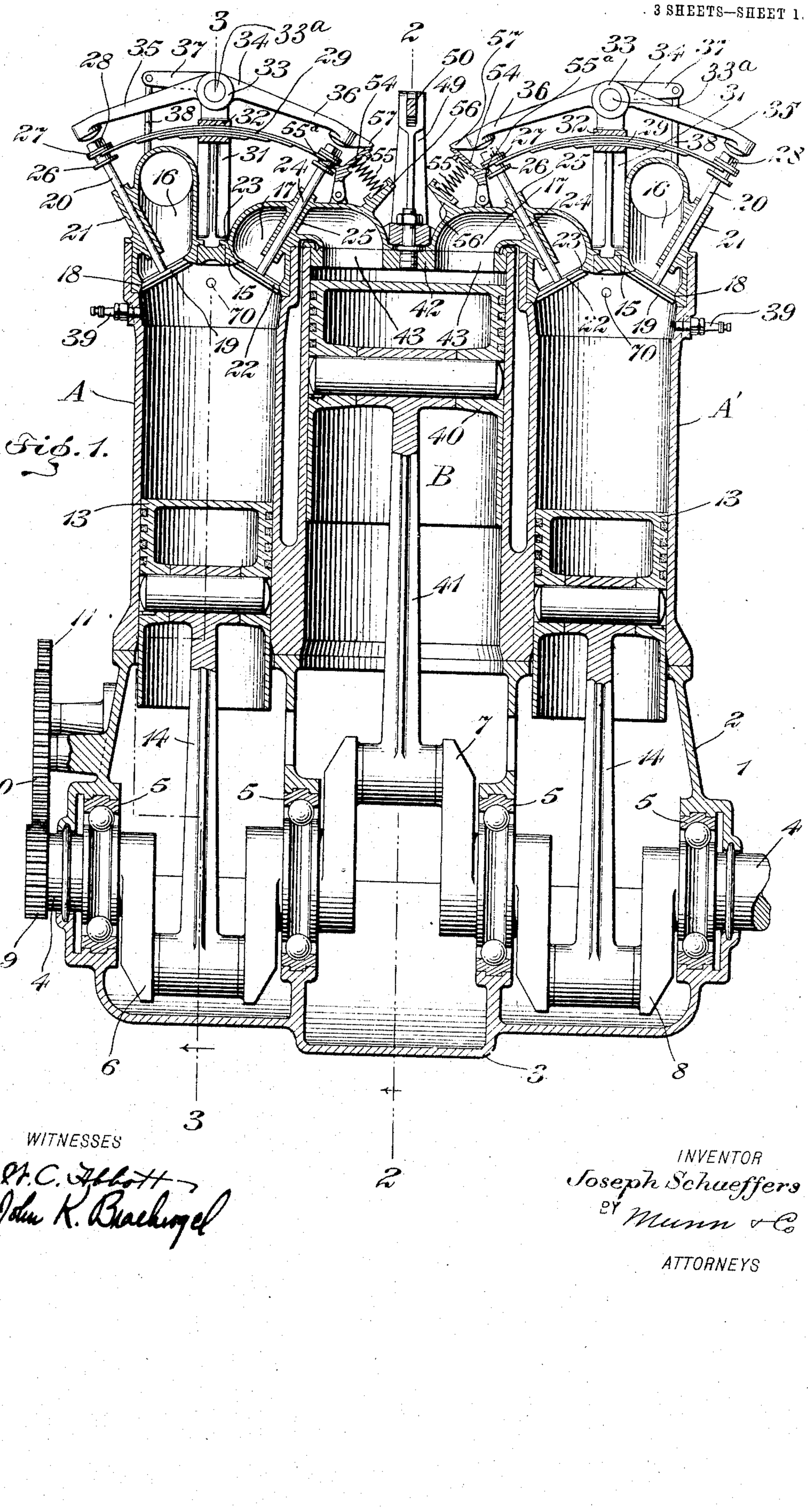

Fig. 1.

WITNESSES

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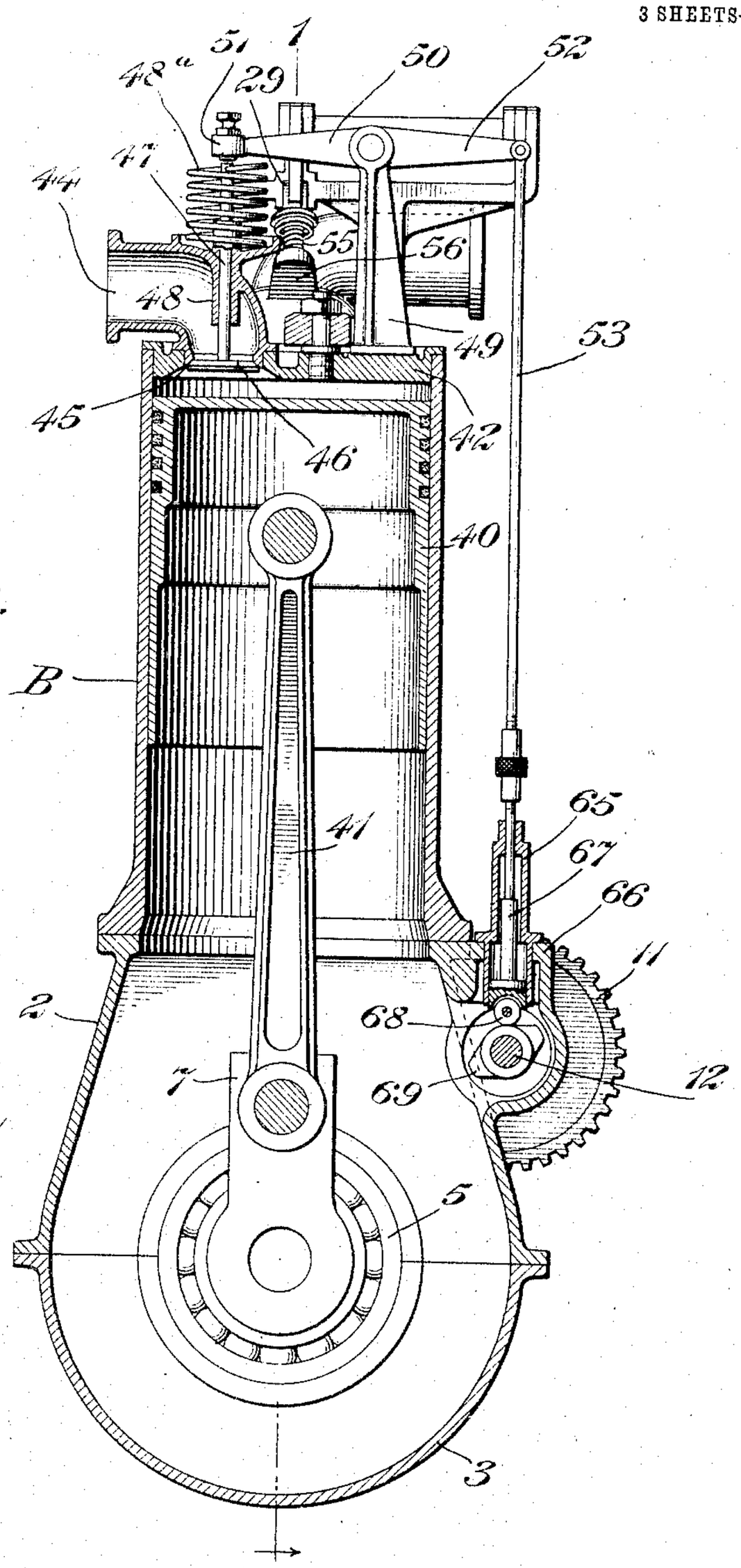

Fig. 2.

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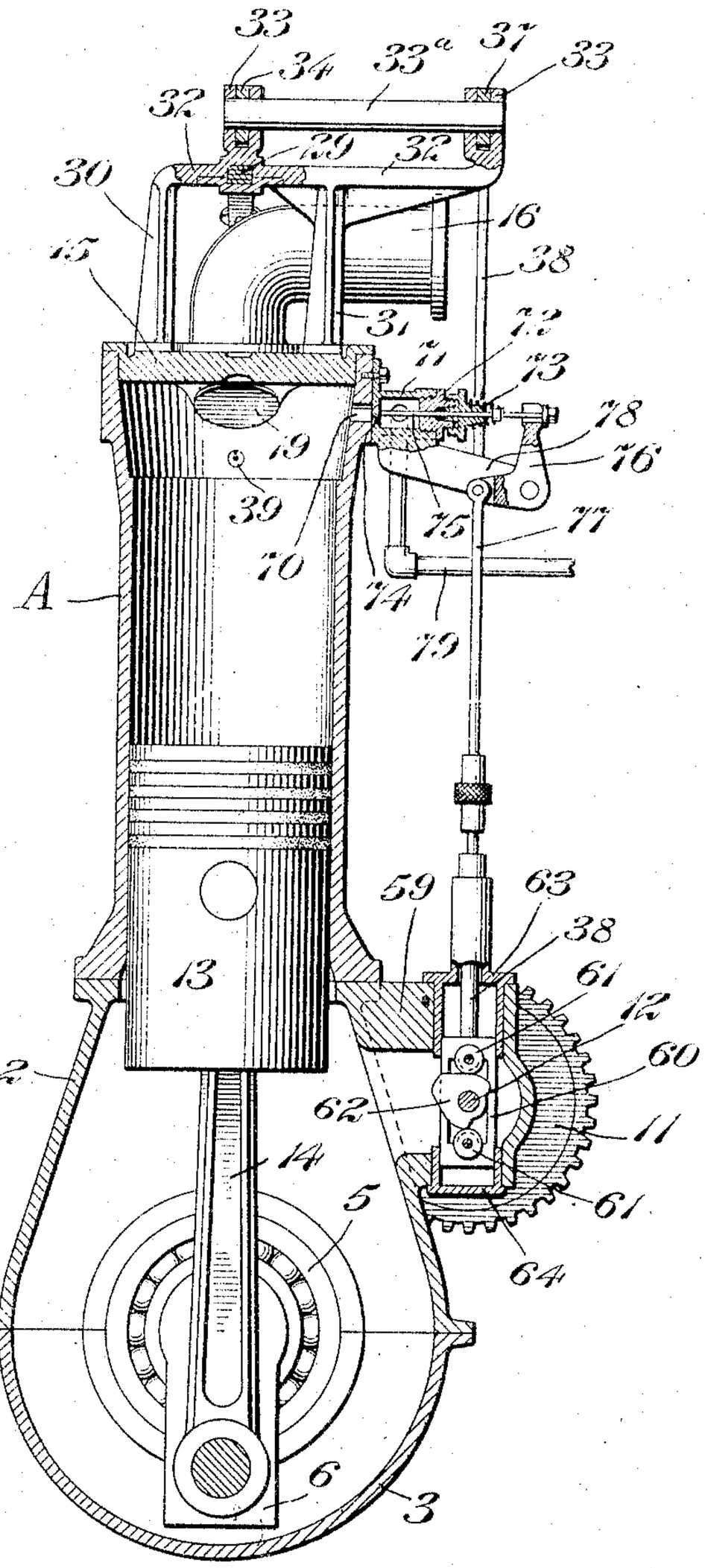
3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

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ENGINE.

No. 865,213. Specification of Letters Patent. Patented Sept. 3, 1907.

Application filed August 16, 1906. Serial No. 330,678

To all whom it may concern:

Be it known that I, JOSEPH SCHAEFFERS, a subject of the Emperor of Germany, and a resident of the city of New York, borough of Manhattan, in the county and State of New York, have invented a new and Improved Engine, of which the following is a full, clear, and exact description.

This invention relates to engines and is particularly useful in connection with internal combustion engines in which the heat of the exhaust gases is used to generate vapor which is employed to actuate a piston in a cylinder provided for the purpose.

The object of the invention is to provide a simple, strong and durable engine in which water or other liquid is injected into the internal combustion cylinders at the end of the power strokes, thereby forming a vapor which is exhausted into a cylinder to actuate the piston therewithin.

A further object of the invention is to provide an engine in which the heat from the exhaust gases of the internal combustion cylinders is used to vaporize a liquid injected into these cylinders at the end of the power strokes, whereby the cylinders are cooled and the necessity of water-jacketing the same is obviated.

The invention consists in the construction and combination of parts to be more particularly described hereinafter and fully set forth in the 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 figures, and in which

Figure 1 is a vertical longitudinal cross section of my invention; Fig. 2 is a vertical transverse cross section on the line 2—2 of Fig. 1; and Fig. 3 is a similar cross section on the line 3—3 of Fig. 1.

Before proceeding to a more detailed description of my invention it should be understood that I utilize preferably two internal combustion or explosive cylinders of the usual type in which a mixture of air and vapor of gasolene, benzin, alcohol or the like is exploded in the conventional manner. Intermediate of these internal combustion cylinders is located a third cylinder, preferably of greater diameter and adapted to receive the exhaust from the explosive cylinders. I provide means for injecting a spray of water or other suitable liquid into the explosive cylinders near the end of the power strokes of the same. The heat from the gases of combustion instantly converts this liquid into a vapor which, together with the exhaust gases, passes through the outlet valves of the cylinders, which are opened at the end of the power strokes, into the middle cylinder, there to actuate the piston within said cylinder. The arrangement is such that the internal combustion cylinders exhaust alternately into the vapor cylinder, and as the latter is two-cycle, while the former are each four-cycle, it will be understood that one of the three cylinders gives a power stroke at each half revolution of the shaft. If desired, the engine may comprise more than three cylinders and may be formed of two or more three-cylinder units such as is illustrated herewith.

Referring more particularly to the drawings 1 represents a crank shaft casing having an upper portion 2 mounted by means of the usual flanges and bolts upon a lower or supporting section 3. The crank shaft 4 is mounted in suitable ball-bearings 5 formed between the sections of the crank case and is provided with three cranks, 6, 7 and 8. A pinion 9 on the crank shaft transmits the rotation of the same through an intermediate gear wheel 10 and a second gear wheel 11 which are mounted upon the crank case, to a cam shaft 12 rotatably mounted at one side of the crank case. Two similar internal combustion cylinders A and A′ are mounted upon the upper section 2 of the crank case near the ends thereof. The cylinders A and A′ are exactly alike and have the same operative parts, wherefore but one will be described.

Within the cylinder A is a piston 13 of the usual form having a pivoted connecting rod 14, mounted at its lower end on the crank 6; the corresponding connecting rod 14 of the cylinder A′ is similarly mounted on the crank 8. The cylinder A is provided with a cylinder-head 15 having an inlet 16 and an outlet 17; the opening of the inlet 16 into the cylinder forms a valve-seat 18, outwardly against which seats the valve 19 having a rod 20 passing through a suitable guide 21 formed integrally with the cylinder-head. An outlet-valve 22 seats against a corresponding valve-seat 23 at the outlet-opening between cylinder A and the outlet 17, and has a rod 24 passing through a similar guide 25. The outer ends of the valve-rods 20 and 24 have rigid collars 26 and 27 secured in place by nuts 28. The ends of a leaf-spring 29 mounted upon a transverse member 32 carried by supports 30 and 31 extending upwardly from the cylinder-head, engages with the valve-rods between the collars, and tends normally to force these rods outwardly, thereby holding the valves against the valve-seats and closing both the inlet and outlet openings of the cylinder. The supports 30 and 31 have bearings 33 carrying a rock-shaft 33^a, upon which is rigidly mounted a double-armed lever 34 having an arm 35 adapted to engage with the end of the valve-rod 20 and a corresponding arm 36 adapted to engage with the oppositely-located valve-rod 24. An arm 37, rigid with the shaft 33^a, has a cam-rod 38 pivoted at the end thereof, and is adapted to rock the lever 34 and reciprocate the rods 20, 24, thus actuating the valves 19, 22 as will appear here-

inafter. The cylinder A is provided with the usual sparking plug 39 by means of which the mixture which enters through the inlet 16 from the carbureter or other source is ignited.

Intermediate of the two similar cylinders A and A′ is a third cylinder B preferably of greater diameter, and having a correspondingly larger piston 40 provided with the pivoted connecting rod 41 mounted on the crank 7. The cylinder B has a cylinder-head 42 provided with oppositely located inlet openings 43 each of which communicates through the outlet 17 with a respective exhaust of one of the internal combustion cylinders. The intermediate cylinder requires no inlet valve as the outlet valves of the cylinders A and A′ answer for this purpose. The cylinder-head 42 has an outlet 44 presenting at its inner opening a valve-seat 45 provided with a valve 46 seating outwardly thereagainst, as shown in Fig. 2. A valve-rod 47 passes through a suitable guide 48 and is provided with a helical spring 48ª seating against a member formed integral with the cylinder-head and adapted normally to force the valve upwardly against the valve-seat to close the outlet 44. An upwardly-extending support 49 upon the cylinder-head carries a centrally-pivoted lever 50, one arm 51 of which is adapted to loosely engage with the end of the valve rod 47 to actuate the valve, while the opposite arm 52 has pivoted to it the upper end of a cam rod 53 adapted to be actuated from the cam shaft, as will appear hereinafter.

Catches 54 are pivotally mounted on each of the outlets 17 of the internal combustion cylinders and have fingers 55ª adapted to engage with the under side of collars on the outlet valve rods 24 to prevent the opening of a corresponding valve unless the catch is displaced. A spring 55 seating against a projection 56 upon the outlet 17 normally forces the adjacent catch into engagement with the valve rod. The arm 36 of the lever 34 has an extension 57 which throws the catch out of engagement with the valve rod when said arm 36 descends to open the valve; thus when the valve is opened by the arm 36 at the proper time in the cycle of the cylinder, the catch is displaced. However, when the arm 36 is out of engagement with the valve rod, the catch securely locks the same against the accidental opening from back pressure in the cylinder B, or from other causes.

The cam shaft is carried in suitable bearings upon the crank case and is geared down from the crank shaft in the ratio of two to one; thus for every two revolutions of the crank shaft, the cam shaft revolves but once, in the manner usual in four-cycle engines. Adjacent to each of the internal combustion cylinders the cam shaft passes through a bracket 59 extending outwardly from the crank case. The rod 38 carries at its end a slotted member 60 through which the cam shaft passes and at each end of which is mounted one of two rollers 61 adapted to engage with a single-step cam 62 which alternately raises or lowers the rod 38 by engagement with the upper and lower rollers 61 alternately as the cam shaft revolves. The member 60 moves in suitable guides 63 and 64 secured to the bracket 59. It will be understood that by the alternate raising and lowering of the rod 38 the lever 34 is rocked from side to side, thereby opening the inlet valve 19 once in four strokes and correspondingly opening the outlet valve once in four strokes. The cam rod 53 passes through a sleeve 65 mounted upon a bracket 66 projecting from the crank case adjacent to the cylinder B and has a guide section 67 within the sleeve 65 and a roller 68 at its end engaging with a double lift cam 69 on the cam shaft. By means of this double lift cam the exhaust valve of the cylinder B is opened once in every two strokes in the usual manner.

Near the edge of each of the internal combustion cylinders is an opening 70 over which is mounted upon the outside of the cylinder, a cylindrical member 71 having a head 72 forming with a member 73, a stuffing-box. The cylindrical member 71 presents a needle-point opening 74 at the opening 70 and within the fine opening 74 is normally located the pointed end of a rod 75 which closes said opening 74 and passes through the stuffing-box. A bell crank lever 76 is pivoted at the end of an extension 78 of the member 71 and has an arm secured to the end of the rod 75, and another arm at which is pivotally mounted a rod 77 actuated by the cam shaft. A supply pipe 79 conducts water or other liquid into the cylindrical member 71 at one side thereof. The liquid flows through the pipe 79 under pressure and thus when the end of the rod is removed from the opening a spray of liquid is forced into the cylinder by the pressure of the liquid itself.

The operation of my invention is as follows: After a charge of the explosive mixture has been drawn into the cylinder A in the usual manner the inlet valve is automatically closed and the charge is compressed and ignited in the usual manner; a power stroke results from the explosion, the piston moving downward. Near the end of the power stroke a cam on the shaft lifts the rod 77, thereby opening the liquid inlet and a spray of the liquid is forced into the cylinder; this is immediately converted into vapor by the great heat of the gases of combustion. At the end of the power stroke, the outlet valve 22 is opened and the exhaust gases, with the vapor, under pressure, rush into the intermediate cylinder and actuate the piston of the same which moves downward, producing a second power stroke. It will be understood that meanwhile the outlet valve 22 of the cylinder A′ is locked by means of the catch 54, and consequently none of the gases from the cylinder A can enter the cylinder A′. While the cylinder A is producing a power stroke resulting from the combustion of the mixture therewithin, the cylinder A′ is drawing in a charge of the mixture through the inlet opening 16 which was opened by the arm 35 of the lever. At the next upward stroke of the piston within the cylinder A′, that is during the power stroke of the piston in the cylinder B, the charge in the cylinder A′ is being compressed, and at the next stroke, or while B was exhausting and A is drawing in a charge, the mixture in A′ is exploded, resulting in a power stroke. At the next stroke, while A′ is exhausting, the cylinder B is giving a power stroke followed by a power stroke in the cylinder A which has been compressing its charge while A′ has been exhausting into B, resulting in a power stroke of the latter. The cycle is continued in a similar manner, the power strokes forming the rotation defined by A, B, A′, B, A, B, A′, etc., there being one power stroke within the three cylinders in the order named at each half revolution of the crank shaft.

It will be understood that by my invention I am enabled to make use of the heat which is usually wasted, in internal combustion engines, and thereby can produce increased power with a smaller consumption of hydro-carbon explosive mixture.

It is usual to cool the cylinders of an explosive motor by means of water-jackets surrounding the cylinders and thereby allowing heat which would be otherwise available, go to waste. By injecting water into the cylinders at the end of the power stroke I not only cool the cylinders and thereby obviate the water-jacket, but at the same time utilize the available heat of the exhaust gases to vaporize the liquid injected, which under the resulting pressure is adapted to perform useful work in the cylinder provided therefor, and into which the internal combustion cylinders exhaust.

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

1. In an engine in combination, an internal combustion cylinder having means for spraying a liquid thereinto near the end of the power stroke, a second cylinder adapted to exhaust into the atmosphere, and means for exhausting said first cylinder into said second cylinder.

2. In an engine in combination, two internal combustion four-cycle cylinders having means for introducing liquid thereinto near the end of the power strokes, a two-cycle cylinder, and means for exhausting said four-cycle cylinders alternately into said two-cycle cylinder.

3. An engine comprising two internal combustion four-cycle cylinders, a two-cycle cylinder, means for introducing liquid into said four-cycle cylinders near the end of the power stroke thereof, and means for exhausting said four-cycle cylinders alternately into said two-cycle cylinder, the arrangement being such that when one four-cycle cylinder is giving a power stroke the other four-cycle cylinder is drawing in a charge, and the two-cycle cylinder is exhausting.

4. An engine comprising a four-cycle cylinder having inlet and exhaust openings and valves to close the same, a two-cycle cylinder having an inlet, said exhaust opening of said four-cycle cylinder communicating with said inlet of said two-cycle cylinder, a rocking member adapted to be actuated from a cam shaft and alternately to open said valves of said four-cycle cylinder, and means for locking said exhaust valve of said four-cycle cylinder when said valve is normally closed.

5. An engine having two internal combustion four-cycle cylinders having inlet and exhaust openings, intermediate of said cylinders, a two-cycle cylinder having two inlet openings, an exhaust opening of each of said four-cycle cylinders communicating with an inlet opening of said two-cycle cylinder, means for spraying liquid into said four-cycle cylinders near the end of the power strokes of the same, and means for alternately exhausting said four-cycle cylinders into said two-cycle cylinders.

6. An engine comprising two internal combustion four-cycle cylinders having inlet and exhaust openings, a two-cycle cylinder having two inlet openings, an exhaust opening of each of said four-cycle cylinders communicating with an inlet opening of said two-cycle cylinder, valves to close said inlet openings of said four-cycle cylinders, and valves to cut off communication between said exhaust openings of said four-cycle cylinders and said inlet openings of said two-cycle cylinder, means for spraying liquid into said four-cycle cylinders near the end of the power stroke of the same, and means for exhausting said four-cycle cylinders alternately into said two-cycle cylinders.

7. In an engine, in combination, an internal combustion cylinder having inlet and exhaust openings, a second cylinder having inlet and exhaust openings, said exhaust openings of said first cylinder communicating with said inlet openings of said second cylinder, a valve to close said exhaust openings of said first cylinder, and means for locking said valve when the same is normally closed.

8. An engine, comprising a four-cycle internal combustion cylinder having inlet and exhaust openings and valves to close the same, a two-cycle cylinder having an inlet and an exhaust opening, and a valve to close said exhaust opening, said exhaust opening of said four-cycle cylinder communicating with said inlet of said two-cycle cylinder, a rocking member adapted to be actuated from a cam shaft alternately to open said valves of said four-cycle cylinder, and means controlled by said rocking member for locking said exhaust valve of said four-cycle cylinder when said valve is normally closed.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEPH SCHAEFFERS.

Witnesses:
JNO. M. RITTER,
JOHN K. BRACHHOOGEL.