

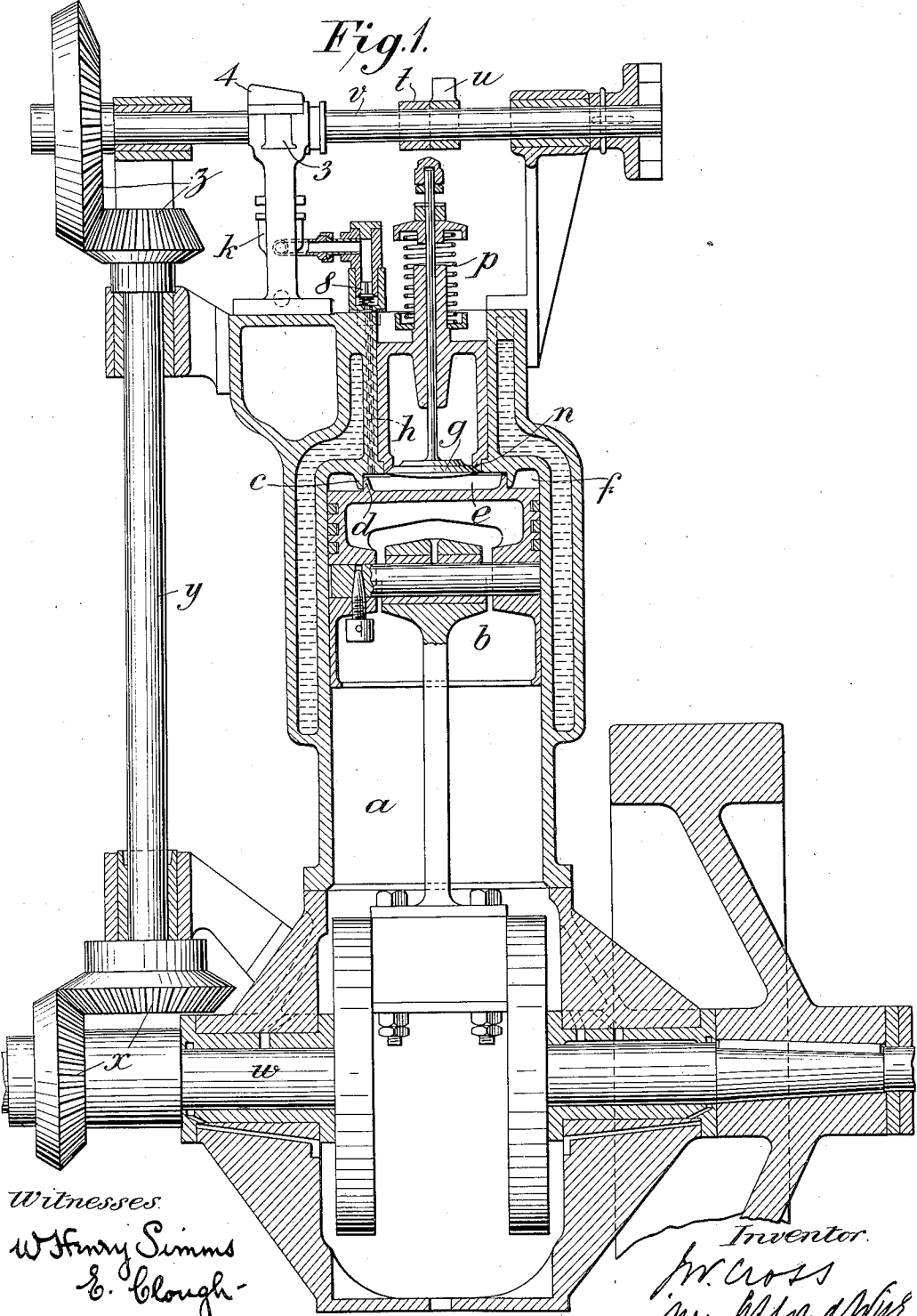
No. 820,285.

PATENTED MAY 8, 1906.

J. W. CROSS.
OIL ENGINE.

APPLICATION FILED FEB. 11, 1905.

4 SHEETS—SHEET 1.



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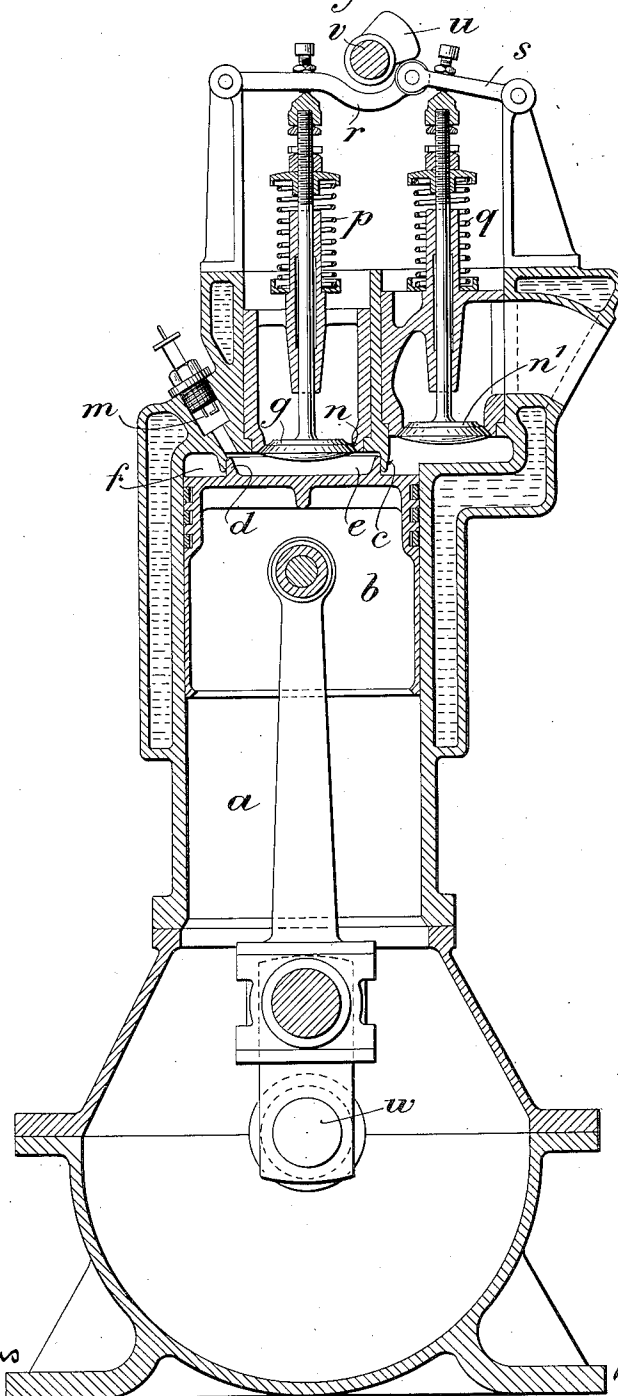
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4 SHEETS—SHEET 2.

Fig. 2.



Witnesses.

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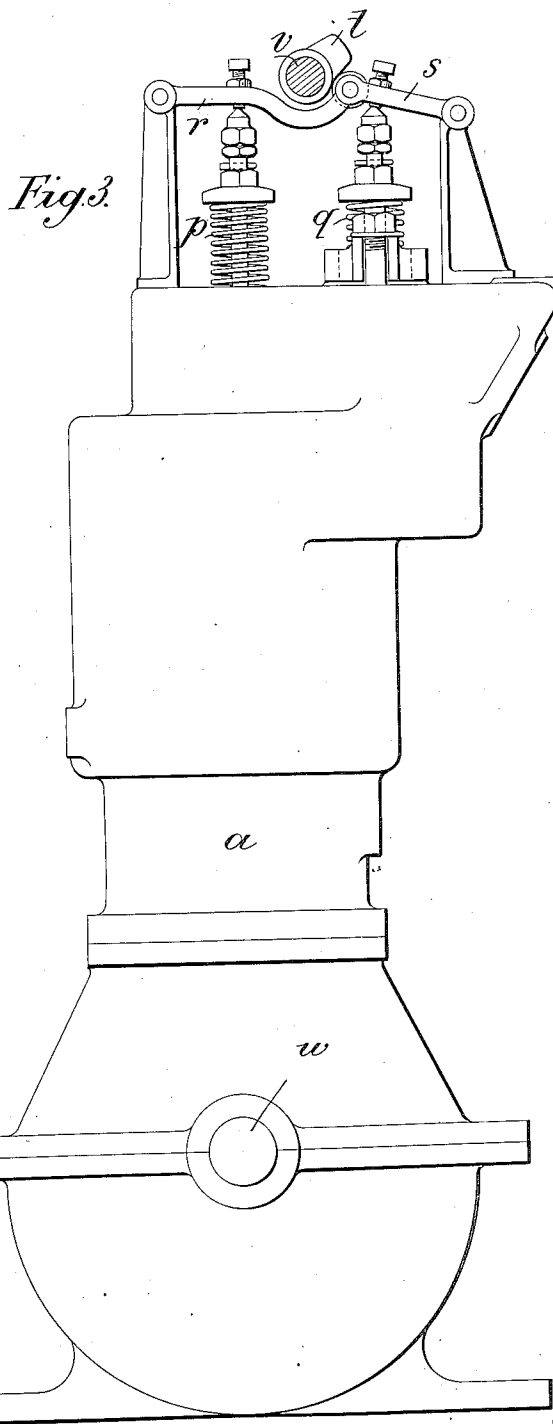
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Witnesses
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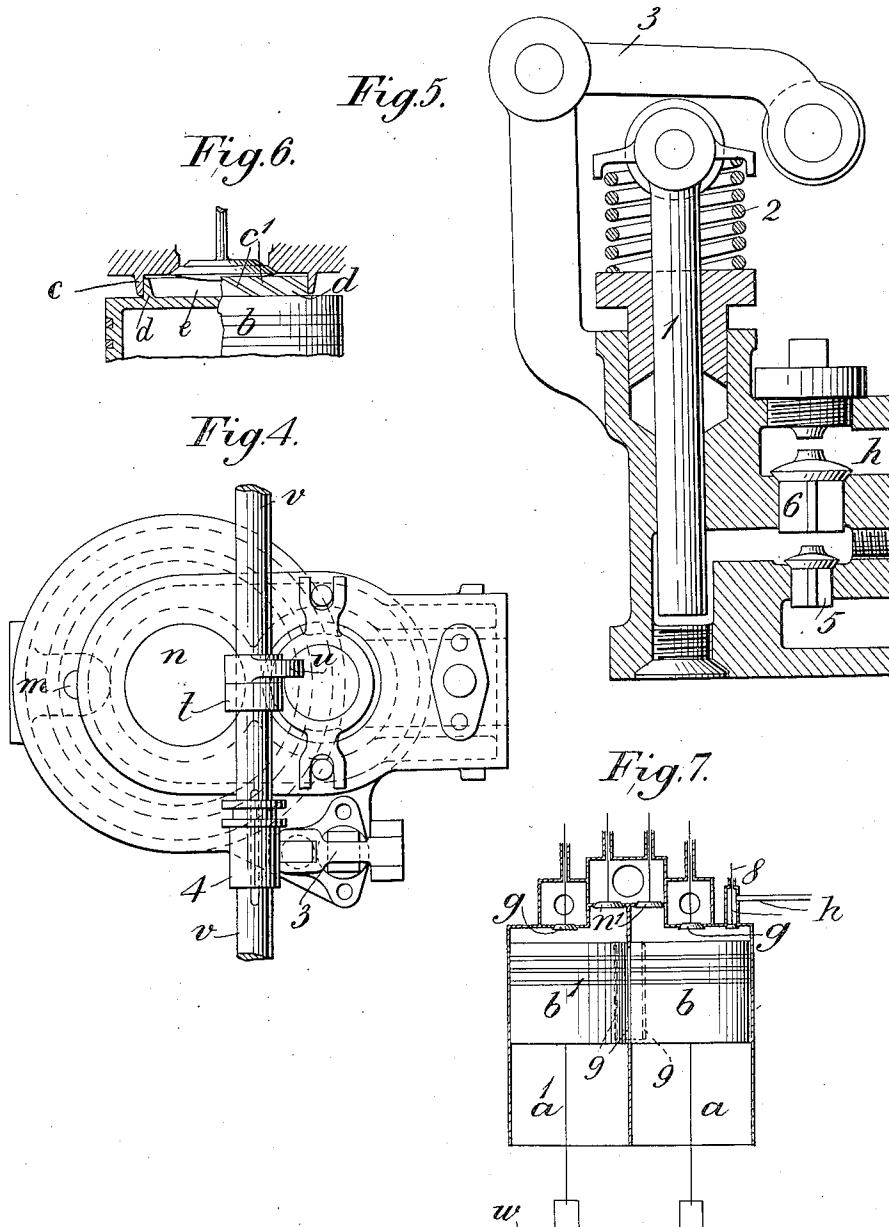
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UNITED STATES PATENT OFFICE.

JAMES WILLIAM CROSS, OF LONDON, ENGLAND.

OIL-ENGINE.

No. 820,285.

Specification of Letters Patent.

Patented May 8, 1906.

Application filed February 11, 1905. Serial No. 245,295.

To all whom it may concern:

Be it known that I, JAMES WILLIAM CROSS, a subject of the King of Great Britain and Ireland, residing at London, England, have
5 invented Improvements in Oil-Engines, of which the following is a specification.

This invention relates to internal-combustion engines of the type designed to burn heavy oil, such as paraffin or petroleum.

10 In internal-combustion engines designed to burn gas no trouble is experienced in producing combustible mixtures of gas and air that can be readily ignited and whereby
15 practically complete combustion of the gas can be insured. In the case of oil-engines, however, considerable difficulty is experienced in effecting complete combustion of the oil. If the oil in the form of vapor or spray
20 be added to sufficient air to effect its complete combustion, a mixture is obtained that is not readily ignited unless the air be previously compressed to a very high pressure, which for many purposes is found to be very objectionable in practice, and if the amount
25 of air be reduced, in order to obtain a mixture that can be readily ignited at moderate pressures, then the oil will not be completely consumed, which not only results in inefficient working, but causes the production of carbonaceous matter, which interferes with
30 the proper working of the valves and other parts of the engine.

Now the present invention has for object to enable the charges of oil supplied to an oil-engine to be readily ignited and burned in a
35 practically complete manner. For this purpose in an oil-engine according thereto the air admitted on one stroke is compressed on the next or compression stroke to a suitable pressure, and finally divided into two separate and confined portions. The charge of oil is then introduced into one of the portions of compressed air and the ignition of the mixture of oil and air effected, after which the
40 ignited mixture of oil and air is mixed with the remaining portion of the compressed air, so as to effect the complete combustion of the oil. In this way the best mixture for ignition purposes can be readily obtained and
45 the resulting products of combustion then diluted with an excess of air that will cause practically complete combustion of the oil.

The air may be compressed to any desired pressure, and the charge of oil forced into one
50 of the portions of such compressed air, as by a plunger-pump, may be ignited by a sepa-

rate ignition device, such as a sparking-plug or other suitable ignition apparatus.

Oil-engines to be worked in the manner described can be constructed in various forms. 60

In the accompanying illustrative drawings, Figures 1 and 2 are central vertical sections taken at right angles to each other; Fig. 3, an end elevation, and Fig. 4 a plan, showing an oil-engine embodying the present
65 invention. Fig. 5 shows in vertical section an oil-pump used with such engine. Fig. 6 is a part detail view. Fig. 7 shows diagrammatically another arrangement.

In carrying out the invention the combustion-chamber end of an engine-cylinder or
70 each cylinder and the inner end of the engine-piston used therein may, according to one construction, be so relatively formed that upon the piston nearing the end of its
75 compression-stroke it will divide the interior of the combustion-chamber end of the cylinder into two completely separate or disconnected compartments, and thus divide the compressed air therein into two com-
80 pletely separate portions, one of the compartments being provided with means for forcing into it a combustible charge of oil and also with means for igniting such charge, the arrangement being such that on the piston
85 making its outstroke, after ignition of the charge the two compartments will be placed in free and open communication with each other, so that the air in the one compartment will mingle freely with the ignited mixture of oil and air produced in the other compartment and effect complete combustion of the oil. Figs. 1 to 6, inclusive, show one arrangement of oil-engine of this kind, wherein the combustion-chamber end of the engine-
90 cylinder *a* and the inner end of the engine-piston *b* are respectively constructed with annular tubular extensions *c* and *d*, adapted to take one into the other when the piston arrives near the end of its compression-stroke
100 and form two separate or completely-disconnected concentrically-arranged compressed-air compartments *e* and *f*, the inner of which—viz., *e*—is provided with an air-inlet valve *g* and with an inlet-passage *h*, (or, it may be,
105 other means,) through which a charge of oil can be forced at the required times by any suitable mechanism, such as by an oil-pump *k*, and also with an ignition device, such as an ordinary sparking-coil *m*. The sizes of
110 the compartments *e* and *f* may be in any desired ratio. The arrangement is such that

the piston *b* on its suction outstroke will draw in air through an opening at *n*, controlled by the inlet-valve *g*, and on its succeeding instroke it will compress the air so admitted and finally divide it into two completely separate portions by reason of the tubular extensions *d'* and *c* taking the one into the other. A charge of oil is then introduced by the pump *k* into the compressed air in the central compartment *e* through the passage *h* and ignited by the igniting device *m*, and the piston *b* commences to make its working outstroke, and upon the tubular extension *d* leaving the tubular extension *c* the two compartments *e* and *f* will be placed in free communication with each other and their contents allowed to freely mix together, with the result that the combustion of the oil will be completed by the excess of air. On the next inward or exhaust stroke the hot gases will escape in the usual way past an exhaust-valve *n'*.

Means may be provided to assist the admixture of the contents of the two compartments *e* and *f*. For this purpose those surfaces of the tubular extensions *c* and *d* that are adjacent to each other when in position to divide the interior of the cylinder into two compartments *e* and *f* may be formed with spiral grooves *c'*, Fig. 6, through which the heated contents of the inner compartment *e* can, after ignition has taken place, escape in a spiral direction into the compressed air in the outer compartment *f* until the two compartments are placed in free and open communication with each other by the complete moving apart of the tubular extensions *c* and *d*.

In the constructional form of oil-engine shown the inlet and exhaust valves *g* and *n'* are normally held closed by springs *p* and *q*, respectively, and are opened at the required times against the action of such springs by separate levers *r* and *s*, which are respectively depressed by cams *t* and *u*, fixed upon the half-speed shaft *v*, which is rotated from the crank-shaft *w*, through the bevel-gearing *x*, shaft *y*, and bevel-gearing *z*. The plunger 1 of the oil-pump is caused to make its upward suction-strokes by a coiled spring 2, Fig. 5, and its downward or compression strokes by a lever 3, which is depressed at the required times, as herein set forth, by a cam 4 on the shaft *v*, the oil entering by the suction-valve 5 and escaping by the delivery-valve 6 into the inlet-passage *h*. This passage is connected to the air-space *e* inside the annular extension *c* and is controlled by a spring-loaded non-return valve 8. The cam 4 is feathered to the shaft *v*, so that it can be moved end-wise thereon by mechanism under the control of the engine-governor in order to vary the stroke of the pump-plunger 1 to suit requirement, as well understood.

In the modified construction illustrated in

Fig. 7 the engine is constructed with two cylinders *a* and *a'*, fitted with plain pistons *b* and *b'*, and connected together at a point or points near to their inner ends, as by one or more ports 9, (several are shown,) that are closed by the pistons just before these reach the end of their inward stroke. The arrangement is such that in the working of the engine air will be drawn into each cylinder *a* *a'* on the suction-stroke, then compressed in each cylinder on the compression-stroke, the two cylinders being in communication with each other during the greater portion of such stroke through the ports 9 and then being cut off from each other by the pistons *b* *b'*, closing the ports 9 between them just before completing the compression-stroke, so as to form two separate volumes of compressed air into one of which—namely, that in cylinder *a*—a charge of combustible oil or other fuel is then forced and ignited, as before, and on the pistons making their next working outstroke the two cylinders will be again placed in communication with each other through the ports 9, so that their contents can intermingle for the purposes hereinbefore explained.

By my invention heavy oils can be burned in internal-combustion engines so completely as practically to avoid the formation of carbonaceous matter—for example, soot—therein.

The invention can be applied to oil-engines working on two, four, or other number of cycles and having any desired number of cylinders.

What I claim is—

1. In an oil-engine, a power chamber and piston so relatively shaped that just before the piston completes its compression-stroke it will divide the air-space within the combustion end of said chamber into two separate closed compartments, that will be again placed in communication with each other only after the piston has made part of its working outstroke, a valve adapted to admit air to said chamber on the suction-stroke of the piston, an oil-pump, means arranged to cause said pump to inject oil into one of said compartments after the same has been separated from the other compartment by said piston, and means for igniting the mixture of oil and air in the first compartment before this compartment is again placed by the movement of the piston in communication with the second compartment.

2. In an oil-engine, a power-chamber having at the combustion end thereof two air spaces or compartments that communicate with each other only through said chamber, a piston adapted, just before the completion of its inward or compression stroke, to close the communication between said spaces or compartments and thereby divide the air compressed therein on the compression-stroke of the piston into two separate con-

finer portions, an air-inlet valve arranged to open on the suction-stroke of said piston, means arranged to force oil into one of the portions of compressed air while it is separated from the other portion, and means adapted to ignite the mixture of oil and compressed air while the same is separated from the second portion of air, said piston acting to place the second air space or compartment in connection with the first one shortly after commencing its working outstroke.

3. An oil-engine having an engine cylinder and piston so relatively constructed that upon the piston nearing the end of its compression-stroke it will divide the interior of the combustion-chamber end of the cylinder into separate and disconnected compartments and thus divide the compressed air therein into separate portions but will place said compartments in communication with each other after it has partially effected its following outstroke, an oil-pump and means for causing the same to force a charge of oil into one of the said compartments after the air compressed therein has been completely separated from the remaining portion of compressed air, and an igniting device adapted to fire the mixture of oil and air in one compartment while still separated from the second portion of compressed air, the said piston after partly effecting its working outstroke acting to open the second compartment and allow the portion of compressed air therein to become afterward mixed with the gases resulting from the ignition of said mixture of air and oil and complete the combustion thereof.

4. An oil-engine comprising a cylinder having at its combustion end an inlet for air and an outlet for spent gases, valves normally closing said inlet and outlet, means for automatically opening the inlet-valve on the suction-stroke of the piston, means for automatically opening the outlet-valve on the exhaust-stroke of the engine, a piston adapted to divide the combustion-chamber end of the cylinder into two separate and disconnected compressed-air compartments one of which contains the air inlet and valve and the other the gas outlet and valve, an oil-pump arranged to deliver oil in the former compartment, means for operating said pump after said piston has separated the said compartments from each other and for thereby injecting oil into the said former compartment, and igniting means adapted to fire the mixture of air and oil in the said former compartment while the same is disconnected from the second compartment, said piston acting to place the two compartments in communication with each other shortly after commencing to make its working outstroke.

5. In an oil-engine, a cylinder having at its inner or combustion chamber end, an outwardly-extending wall or partition, a piston

adapted on nearing the end of its compression-stroke and in conjunction with said cylinder and wall or partition to form two completely separated and disconnected compartments, an oil-pump, means adapted to cause said pump to force a charge of oil into the separated portion of compressed air in one of said compartments after such compartment has been separated from the other compartment, and means for igniting the mixture of air and oil while still separated from the other compartment, the two compartments being placed in communication with each other after the mixture of air and oil has been ignited and after the working stroke of the piston has been partially effected.

6. An oil-engine wherein the combustion-chamber end of the engine-cylinder and the inner end of the piston are constructed with extensions adapted to slide one past the other when the piston arrives near the end of its compression-stroke and form two completely separated and disconnected compartments, an air-inlet with non-return valve for admission of air to the cylinder on the suction-stroke of the piston, an oil-pump and means arranged to cause the same to force a charge of oil into one of the said compartments after the same has been separated from the other compartment by said piston, and means for igniting the mixture of oil and air in the first-mentioned compartment while still separated from the other compartment, the two compartments being placed in communication with each other after the mixture of air and oil has been ignited and after the working stroke of the piston has been partially effected.

7. In an oil-engine, a cylinder and piston the adjacent inner ends of which are provided with tubular extensions adapted to take one into the other when the piston arrives near the end of its compression-stroke and form completely separated and disconnected concentrically-arranged compressed-air compartments, means for admitting air to the inner end of the cylinder on the suction-stroke of the engine, an oil-pump, means for causing the same to force a charge of oil into one of the compartments after the same has been separated from the other compartment by said piston, and means for igniting the mixture of oil and air in such compartment while still separated from the other compartment, the two compartments being placed in communication with each other after the mixture of air and oil has been ignited and after the working stroke of the piston has been partially effected.

Signed at London, England, this 31st day of January, 1905.

JAMES WILLIAM CROSS.

Witnesses:

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F. L. RAND.