

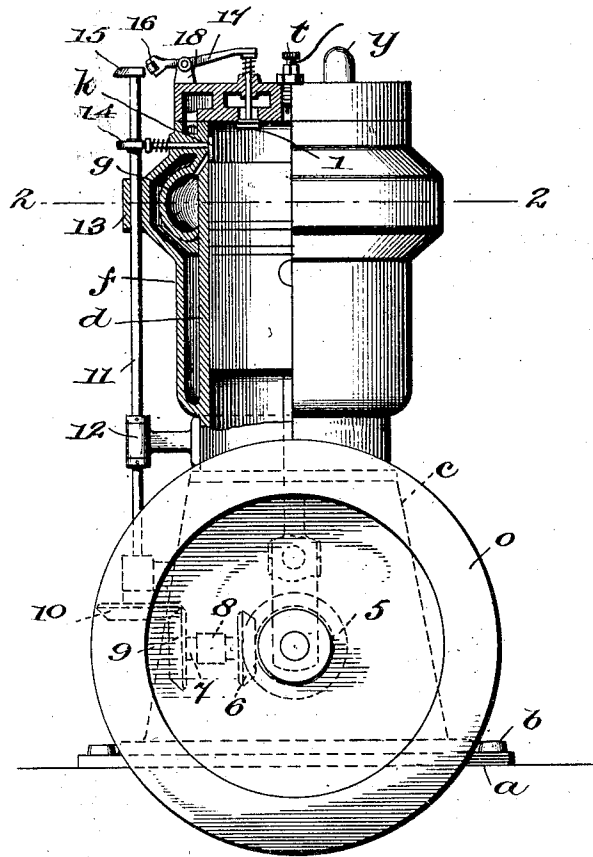
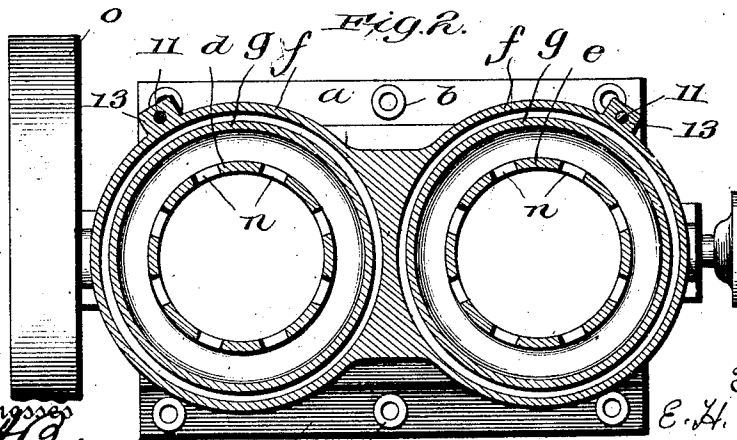
E. H. WILLIAMS.
 MULTIPLE EXPLOSIVE ENGINE.
 APPLICATION FILED NOV. 1, 1907.

906,345.

Patented Dec. 8, 1908.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses
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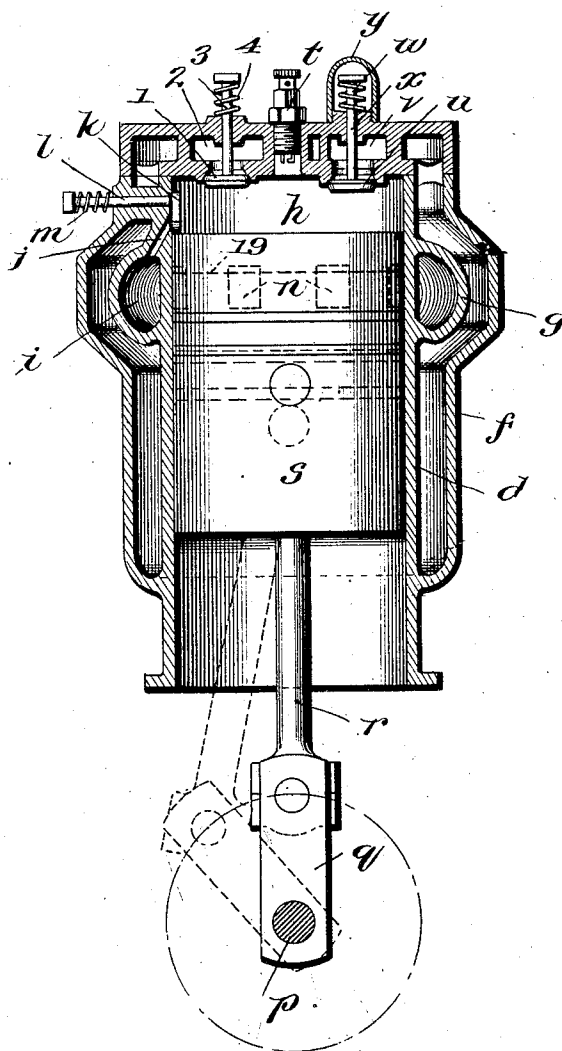
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2 SHEETS—SHEET 2.

Fig. 3.



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UNITED STATES PATENT OFFICE.

ELMO HAMILTON WILLIAMS, OF THE UNITED STATES NAVY.

MULTIPLE EXPLOSIVE-ENGINE.

No. 906,345.

Specification of Letters Patent.

Patented Dec. 8, 1908.

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To all whom it may concern:

Be it known that I, ELMO HAMILTON WILLIAMS, midshipman United States Navy, and a citizen of the United States, and stationed on the U. S. S. *Nebraska*, have invented certain new and useful Improvements in Multiple Explosive-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in multiple explosion gas engines, and the object of my invention is to produce a simple gas engine in which more than one explosion is produced by each charge.

My invention is applicable to two cycle, four cycle, or six cycle engines.

With this object in view, my invention consists in the construction and combinations of parts as hereinafter described and claimed.

In the accompanying drawings—Figure 1 is an end view of the complete engine, one of the cylinders thereof being shown partly in section. Fig. 2 is a plan view on the line 2—2 of Fig. 1, and Fig. 3 is a section of the engine cylinder showing also the piston rod and driving crank with the means for operating the valves omitted.

In the drawing a two cylinder engine is shown, but I do not restrict myself to the number of cylinders employed, as any desired number may be used.

a represents a base plate secured by bolts *b* to any suitable support. Made integral with, or attached to this base plate is the supporting frame *c*, on which are mounted two cylinders *d* and *e*.

f is a casing surrounding said cylinders at some distance therefrom, leaving a place for the admission of water.

The cylinder *d* is of the ordinary shape, but it has either attached to, or made integral with it, an auxiliary casing *g*.

h represents the main compression space, and *i* represents the secondary compression space. These are connected together by a port *j*, leading into the top of the space *i* and ordinarily closed by the valve *k* mounted on a valve rod *l*, around which is coiled the spring *m* which normally holds said valve closed.

n represents ports leading from the cylinder into the space *i*.

o represents the fly-wheel which is mounted on the shaft *p*, which shaft is provided with a crank *q* pivoted to the piston rod *r* which is pivoted to the piston *s*.

t represents an igniter of any desired type.

u represents the inlet valve which ordinarily stops the passage *v* leading to the carbureter, and this valve is normally closed by the spring *w* coiled around the valve rod *x*.

y represents a casing surrounding the top of the valve rod *x*, but this casing is not strictly necessary.

1 represents the valve which covers the exhaust outlet 2. This valve is mounted upon a rod 3, and the spring 4 on said rod normally keeps the valve closed. The valve *u* is opened by suction and the valves *k* and 1 by means which will now be described. On the shaft *p* is mounted a beveled gear wheel 5, which meshes with a similar gear wheel 6 on a short shaft 7, mounted in a bearing 8 on the casing. The shaft 7 is also provided with another beveled gear wheel 9, which meshes with a similar wheel 10 on the shaft 11. This shaft is carried by a bearing 12 on the casing, and another bearing 13 on the water jacket. This shaft is provided with a cam 14, which at the proper time operates upon the end of the rod *l*, compressing the spring *m* and opening the valve *k*. The rod 11 is also provided with another cam 15, which acts upon a roller 16 upon the end of a lever 17, pivoted on a bracket 18 on the top of the cylinder head, the other end of said lever bearing against the end of the valve rod 3. It is obvious, however, that any desired means for opening the valves *k* and 1, at the proper time, may be employed.

The operation is as follows:—Assuming the parts to be in the position shown in Fig. 3, and the spaces or chambers *h* and *i* to be filled with a compressed charge, the charge in the chamber *h* is ignited in the ordinary way, and the resulting explosion drives the piston *s* down. As soon as the piston uncovers the upper parts of the ports *n*, as shown by the dotted line 19 in Fig. 3, the charge in the chamber *i* is ignited and a second explosion occurs, driving the piston downward with additional force. It should be noted that the first explosion occurs when the parts are nearly in the position shown in full lines in Fig. 3, and that the second explosion occurs when the parts are in the position shown in dotted lines in said figure. Obviously at the time of the second explosion there will be a

more effective leverage on the crank q than at the first explosion.

The piston having been driven down to its lowest point of travel, the valves 1 and k are opened by the cams 14 and 15, and the burned gases are then driven out through the exhaust passage 2. On the next downward stroke a charge is sucked in through the passage v , the valve u yielding to permit this, and the entire space above the piston including the chambers h and i is filled with this charge. On the upward stroke this charge is compressed both in the space h and the space i , for as soon as the ports n are closed by the piston s the valve k is opened so that there is a free communication between the spaces h and i , with the result that the charge is compressed to an equal degree in each of these spaces. When the parts reach the position shown in Fig. 3, the valve k is closed, the explosion occurs and the whole cycle is repeated. The operation in the cylinders d and e is precisely the same but differently timed, as usual.

While I have thus described my invention, I wish it to be distinctly understood that I do not limit myself to the exact details shown and described, as many changes might be made that depart from the spirit of my invention. For example, any desired means of ignition could be used and any desired means of operating the valves.

I claim:—

1. In a multiple explosion gas engine, the combination of a cylinder, one end of which serves as the main compression chamber, a piston in said cylinder, a casing surrounding said cylinder and forming a secondary compression chamber, a connecting passage between said chambers being provided, and a valve normally closing said passage, said cylinder being provided with ports communicating with said secondary compression chamber, substantially as described.

2. In a multiple explosion gas engine, the combination of a cylinder, one end of which serves as the main compression chamber, a piston in said cylinder, a casing surrounding said cylinder and forming a secondary compression chamber, a connecting passage between said chambers being provided, a valve normally closing said passage, said cylinder being provided with ports communicating with said secondary compression chamber, and means for cooling said cylinder and said casing, substantially as described.

3. In a multiple explosion gas engine, the combination of a cylinder, one end of which serves as the main compression chamber, a piston in said cylinder, a casing surrounding said cylinder and forming a secondary compression chamber, a passage being provided connecting said chambers, a valve normally closing said passage, said cylinder being provided with ports connecting with said second-

ary compression chamber, and means for operating said valve at definite times, said means being operated by the movement of said piston, substantially as described.

4. In a multiple explosion gas engine, the combination of a cylinder, one end of which serves as the main compression chamber, a piston in said cylinder, a casing surrounding said cylinder and forming a secondary compression chamber, a passage being provided connecting said chambers, a valve normally closing said passage, said cylinder being provided with ports connecting with said secondary compression chamber, means for operating said valve at definite times, said means being operated by the movement of said piston, and means for cooling said cylinder and said casing, substantially as described.

5. In a multiple explosion engine, the combination of a cylinder, one end of which serves as the main compression cylinder, a casing surrounding said cylinder and forming a secondary compression chamber, a passage connecting said chambers being provided, a spring operated valve normally closing said passage, said cylinder being provided with ports communicating with said secondary compression chamber, a piston in said cylinder, a crank shaft operated by said piston, and gearing operated by said crank shaft for opening said valve at definite times, substantially as described.

6. In a multiple explosion engine, the combination of a cylinder, one end of which serves as the main compression cylinder, a casing surrounding said cylinder and forming a secondary compression chamber, a passage connecting said chambers being provided, a spring operated valve normally closing said passage, said cylinder being provided with ports communicating with said secondary compression chamber, a piston in said cylinder, a crank shaft operated by said piston, gearing operated by said crank shaft for opening said valve at definite times, and means for cooling said cylinder and said casing, substantially as described.

7. In a multiple explosion engine, the combination of a cylinder, one end of which serves as the main compression chamber, an inlet valve, an exhaust valve, a casing surrounding said cylinder and forming a secondary compression chamber, a passage being provided connecting said chambers, a valve normally closing said passage, said cylinder being provided with ports communicating with said secondary compression chamber, a piston in said cylinder, a crank shaft driven by said piston, and devices operated by the revolution of said crank shaft for opening the exhaust valve and the valve governing the passage between the compression chambers at definite times, substantially as described.

8. In a multiple explosion engine, the combination of a cylinder, one end of which acts

as the main compression chamber, a head closing said end, inlet and exhaust valves, and an igniting device located in said head, a casing surrounding said cylinder and forming a secondary compression chamber, a passage being provided connecting said chambers, a valve normally closing said passage, said cylinder being provided with ports connecting with said secondary compression chamber, and means for operating said ex-

haust valve and said valve governing the passage between the compression chambers at definite times, substantially as described.

In testimony whereof, I affix my signature, in presence of two witnesses.

ELMO HAMILTON WILLIAMS.

Witnesses:

GEORGE N. BARKER,
SCHUYLER F. HEINN.