No. 746,840. PATENTED DEC. 15, 1903.

H. J. HURD.

EXPLOSIVE ENGINE.

APPLICATION FILED DEC. 11, 1901.

NO MODEL.

Fig. 1.

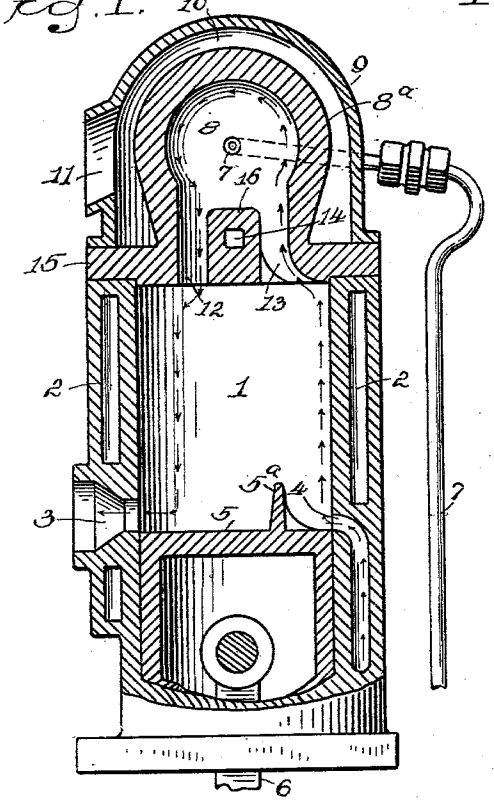



Fig. 2.

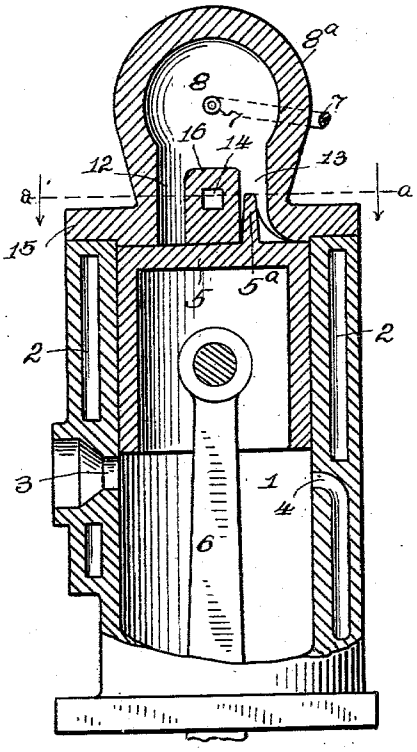



Fig. 4.

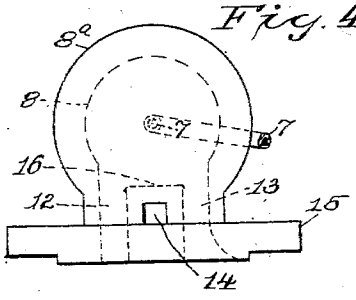
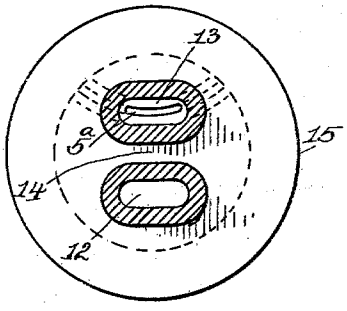



Fig. 3.




WITNESSES.

H. A. Lamb.

A. K. Lovell.

INVENTOR.

Hobart J. Hurd.

By his Atty.

Geo. D. Phillips.

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

No. 746,840. Patented December 15, 1903.

# UNITED STATES PATENT OFFICE.

HOBERT J. HURD, OF BRIDGEPORT, CONNECTICUT, ASSIGNOR TO THE ACME OIL ENGINE CO., OF BRIDGEPORT, CONNECTICUT.

## EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 746,840, dated December 15, 1903.

Application filed December 11, 1901. Serial No. 85,463. (No model.)

*To all whom it may concern:*

Be it known that I, HOBERT J. HURD, a citizen of the United States, and a resident of Bridgeport, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification.

My invention relates to an improvement in explosive-engines; and it consists in providing two oppositely-positioned ports between the interior of the cylinder and the explosive-chamber, whereby a current of fresh air is permitted to circulate through the combustion-chamber for the purpose of driving out the burned products of combustion from said chamber, and thus leave a clean and clear space, free from all impurities, for a fresh mixture of air and oil.

Heretofore in that class of explosive-engines which have the combustion-chamber located outside of the cylinder there is but a single narrow port leading from the said chamber to the cylinder. Now when an explosion takes place there is always more or less of the burned product of combustion remaining in the combustion-chamber in the form of carbon-dioxid, which occupies the space required for fresh air for the next explosion. With only one port it is impossible to remove this gas in time for the next explosion, and the result is a serious loss in the efficiency of the engine due to miss explosions.

With my improved construction the combustion-chamber is cleared of all impurities by a current of air at each and every explosion, thus leaving behind a body of fresh air to be mixed with oil for the next explosion, which explosion will always take place under such circumstances.

To enable others to understand my invention, reference is had to the accompanying drawings, in which—

Figure 1 represents a broken sectional view of the engine with the piston at its lowest point and the crank-case removed, broken view of the crank-rod and the oil-supply pipe. Fig. 2 is a broken sectional view of the engine with the crank-case and combustion-chamber case removed, showing the piston at the highest point, also broken view of the crank-rod and oil-supply pipe. Fig. 3 is an upper plan view of the cylinder-cover and sectional view of the two ports on line *a* of Fig. 2. Fig. 4 is a detail view of the cap or cylinder-cover on which is located the combustion-chamber, also broken view of the oil-supply pipe.

Its construction and operation are as follows:

1 is the cylinder; 2, the water-jacket; 3, exhaust-port leading from the cylinder; 4, the air-inlet port; 5, the piston; $5^a$, the deflector; 6, the connecting or crank rod; 7, the oil-supply pipe leading from the oil-pump (not shown) and discharging into the combustion-chamber 8.

9 is the usual casing surrounding the combustion-chamber head $8^a$, having the space 10 for the circulation of hot air.

11 is the opening for the admission of a direct flame for the purpose of raising the temperature of the combustion-chamber necessary to cause the first explosion. However, as the manner of obtaining the initial explosion is well known further description is unnecessary.

12 and 13 are two ports connecting the combustion-chamber with the interior of the cylinder. When the explosion takes place, the piston is at its highest point, as shown at Fig. 2. The expansive force of the gas caused by such explosion will pass down through these ports and force the piston to its lowest point, as shown at Fig. 1. The descending piston will of course uncover both the exhaust-port 3 and fresh-air-inlet port 4, the former beginning to open first, so that the bulk of the gas which is still expanding will rush out through such port, and by the time the air-port opens most of the gas has escaped from the cylinder, but not from the combustion-chamber. When said air-port is uncovered, the air will rush up from the crank-case (not shown) through said air-port and into the cylinder and by means of the deflector $5^a$ will be diverted up in the direction of the arrows to the port 13, through the same into the combustion-chamber 8, and thence down through the port 12 and thence through the exhaust-port 3. The gas passing through the exhaust-port, combined with the inlet air-port, will act as a siphon to start the circulation, so that before the piston has closed these ports 3 and

4 in its upward movement both the cylinder and combustion-chamber will be entirely freed from the impurities of the last explosion and the space occupied by fresh air and in proper condition for a pure explosion mixture. The port 13, Fig. 2, enables the deflector $5^a$ to enter said port when the piston is in its extreme upward position, which will permit of the clearance being reduced to a minimum, thereby increasing the effectiveness of the explosion and adding greatly to the efficiency of the engine.

The walls of the head $8^a$ immediately surrounding the combustion-chamber are made preferably thick for retaining the heat, while the walls surrounding the ports 12 and 13 are comparatively thinner, so as to lower the temperature of the cylinder by radiating all the heat possible at this point. To still further assist in this radiation, the passage-way 14 is provided between the inner walls of said ports and immediately over the cylinder-cover 15 for the free circulation of air. The upper surface of the bridge-wall 16 being within the combustion-chamber will of course be hot, so that when a drop of oil is ejected from the pipe 7 into the combustion-chamber it will instantly be converted into vapor when it strikes such surface should it fail in doing so before.

I do not claim, broadly, an auxiliary combustion-chamber located outside of the cylinder and joined by a single passage-way or port through which the expansive force of the explosive gas enters the cylinder, as such a construction is old and, as before stated, is faulty by reason of the fact that the by-products of combustion cannot all escape from the combustion-chamber, and will therefore prevent the proper mixture of pure air and oil required for the next explosion. It would be impossible for a current of air to circulate through the combustion-chamber where only one port is used between the said chamber and cylinder for the reason that such port being necessarily restricted in area the air-current will be met and forced back by the greater pressure of the gas still in the combustion-chamber, and therefore under these circumstances there can be no circulation through the combustion-chamber; but with my arrangement of two or more ports between the said combustion-chamber and cylinder, it being understood that more than two of these ports can be employed, if desired, there is a positive circulation of air through the combustion-chamber due to the siphon effect produced by the current of escaping gas through the exhaust and the inflow of the current of fresh air from the crank-case, as fully set forth in the foregoing description.

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

1. The combination, in an explosive-engine having a cylinder provided with an exhaust-port and an air-inlet port, of a removable cover for the cylinder, a bulbous head forming the combustion-chamber and integral with said cover, said head restricted in cross-section at its junction with said cover, double ports located at such restricted portion of the head to convey the explosive gas from the combustion-chamber to the cylinder and also permit a current of air to pass through one port into and through the combustion-chamber and down through the other of said ports for the purpose of cleaning out said chamber, a bridge-wall integral with the walls of the combustion-chamber, and between said ports, the upper surface of said bridge adapted to vaporize the oil, a transverse air-passage through said bridge and opening into the outer air so that a current of outer air will circulate through said passage so as to keep the bridge at the proper vaporizing temperature, for the purpose set forth.

2. The combination, with the cylinder having exhaust-port and an air-inlet port, of the cylinder-cover carrying a combustion-chamber head and a combustion-chamber therein, a plurality of ports leading from said chamber and through said cover, the walls of said ports being thinner than the walls of said chamber to effect the radiation of heat at that point, an open air-circulating passage between the inner walls of said ports to still further assist in such radiation, a bridge-wall above such passage whose upper heated surface is adapted to convert the oil falling thereon into vapor, for the purpose set forth.

3. The combination, in an explosive-engine having a cylinder, an exhaust-port and an air-inlet port, and a piston carrying a deflector, of a cover for said cylinder carrying a combustion-chamber head, a plurality of ports leading from said chamber through said cover for the free admission of the explosive force into said cylinder, and for the circulation of air through said chamber after each explosion, one of said ports adapted to receive the piston-deflector so as to minimize the piston-clearance, a transverse open air-passage between said ports, for the purpose set forth.

Signed at Bridgeport, in the county of Fairfield and State of Connecticut, this 10th day of December, A. D. 1901.

HOBERT J. HURD.

Witnesses:
GEORGE W. FINN,
WM. N. BEARDSLEY.