

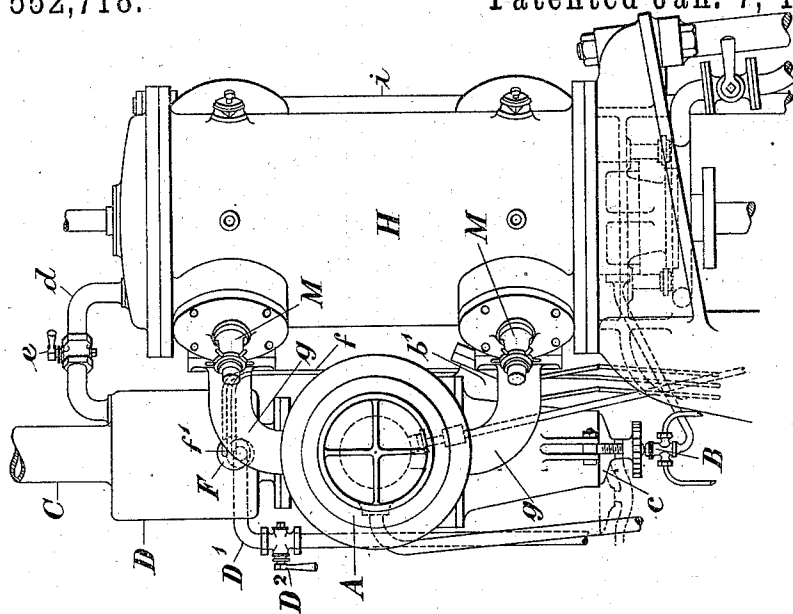
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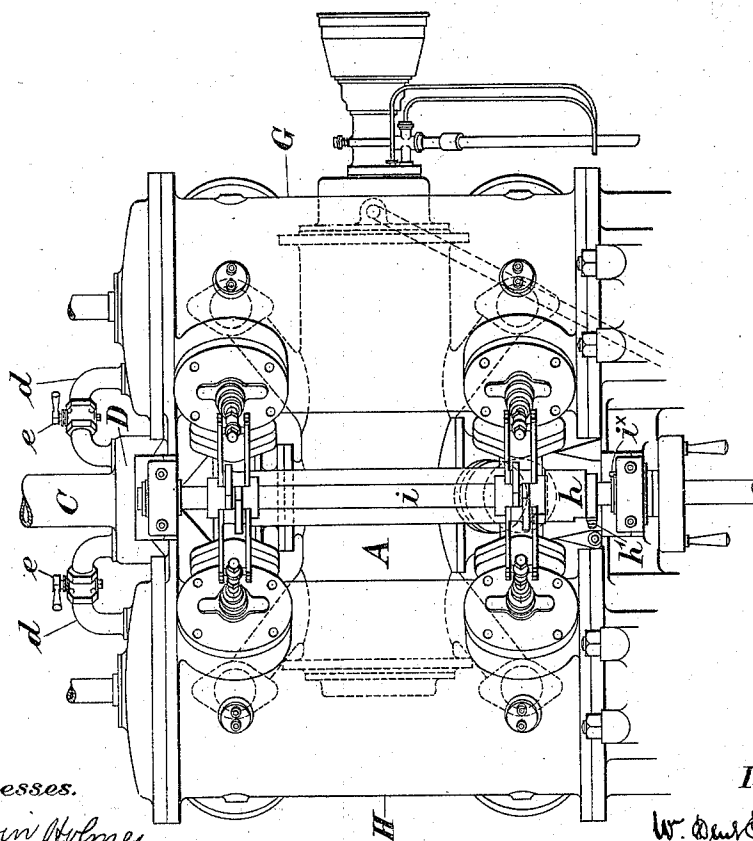
W. D. & S. PRIESTMAN.  
HYDROCARBON ENGINE.

No. 552,718.

Patented Jan. 7, 1896.



*Fig. 2.*



*Fig. 1.*

*Witnesses.*

Edwin Holmes  
Arthur E. Elton.

*Inventors.*

W. Deschamps  
P. Priestman

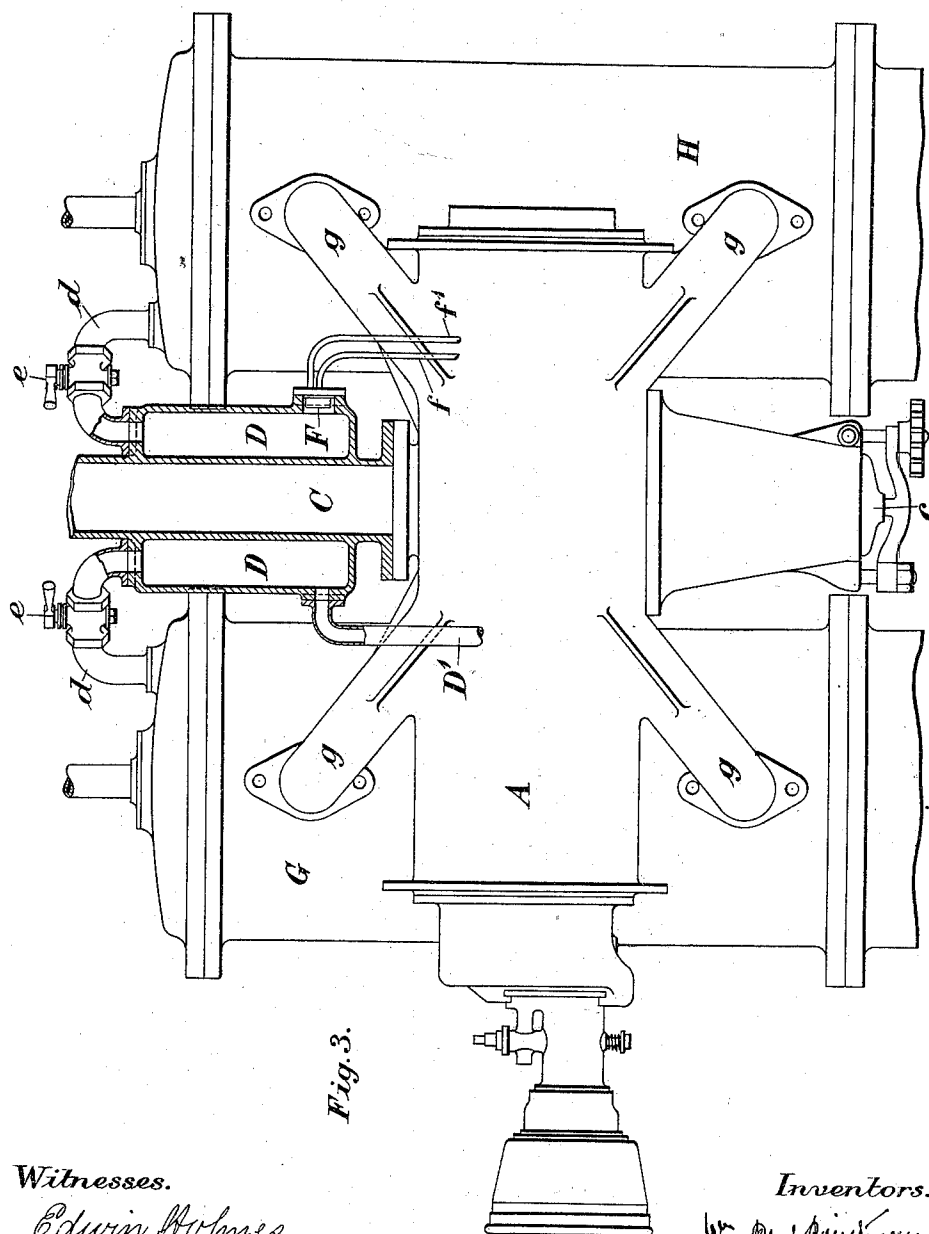
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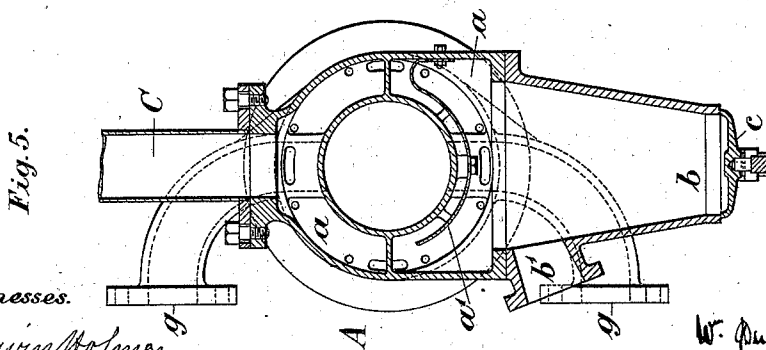
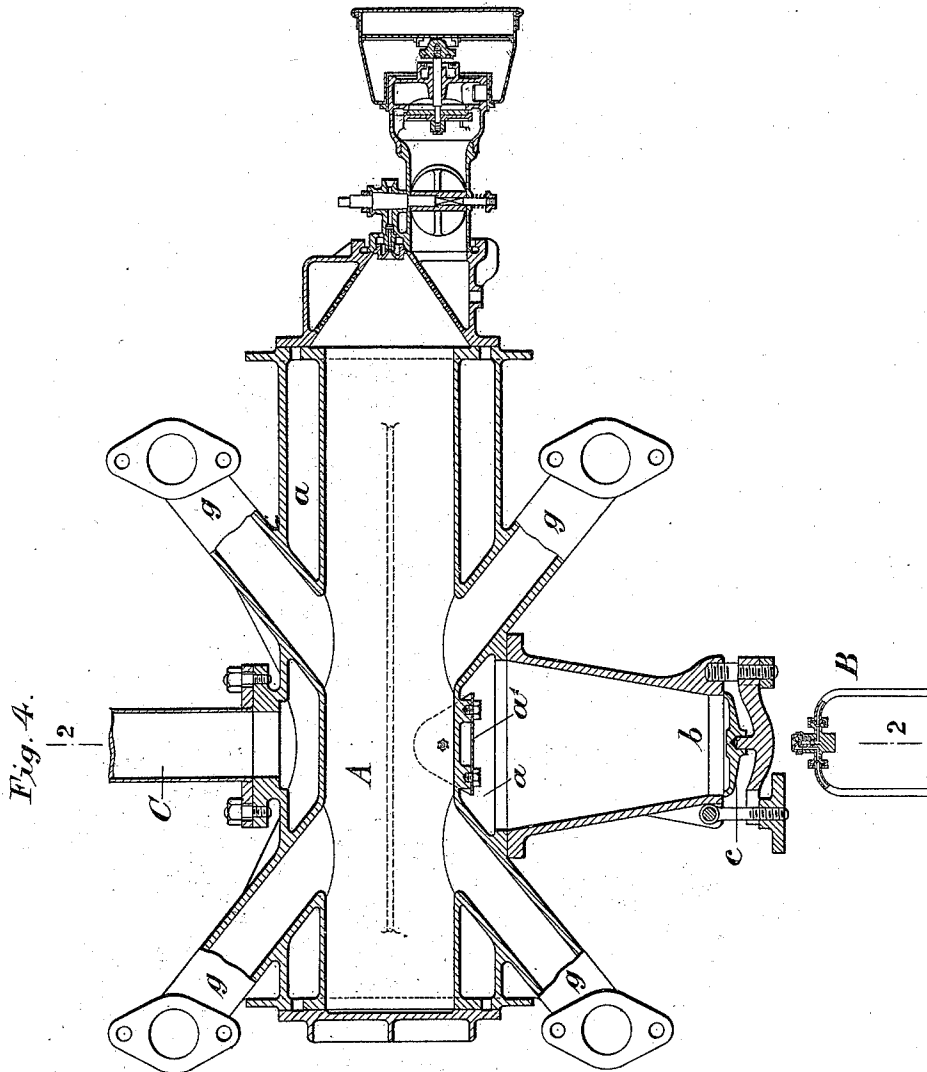
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(No Model.)

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HYDROCARBON ENGINE.

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Fig. 10.

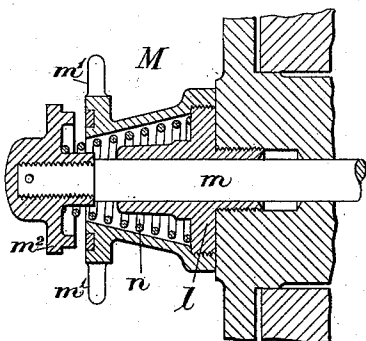


Fig. 6.

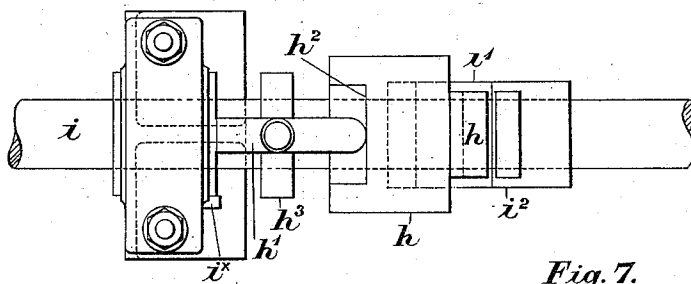
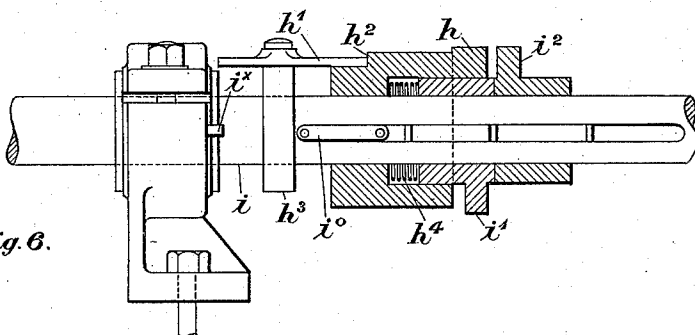
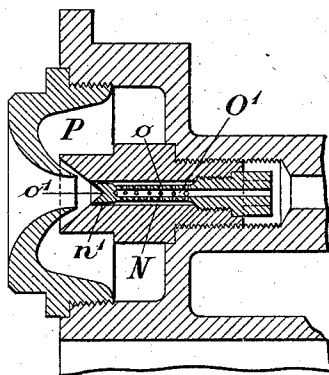


Fig. 7.

Fig. 14.



Witnesses.

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(No Model.)

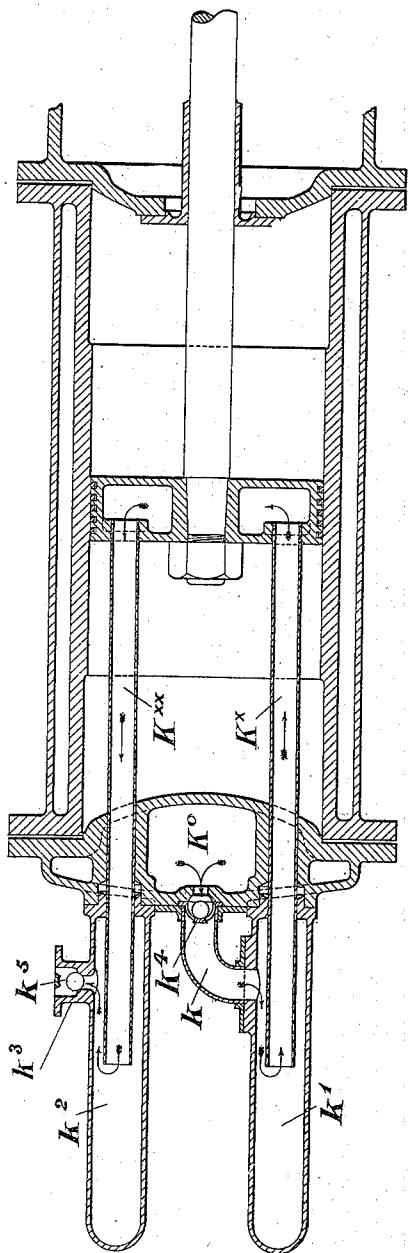
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Fig. 9.

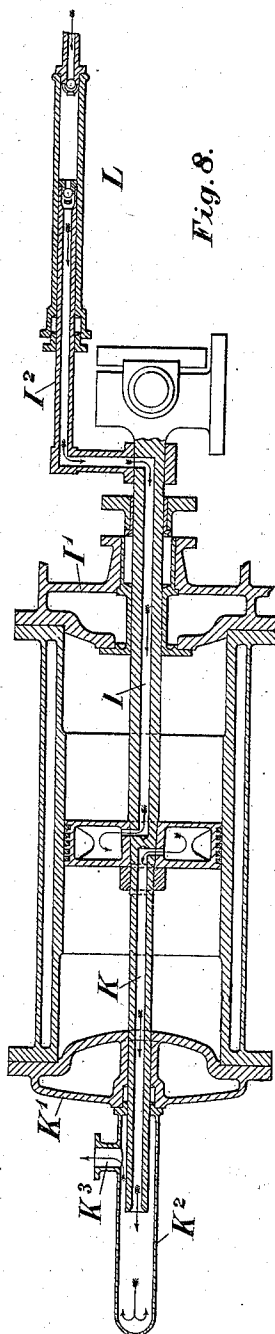


Witnesses.

Edwin Holmes

Arthur E. Elton

Fig. 8.



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W. D. & S. Priestman  
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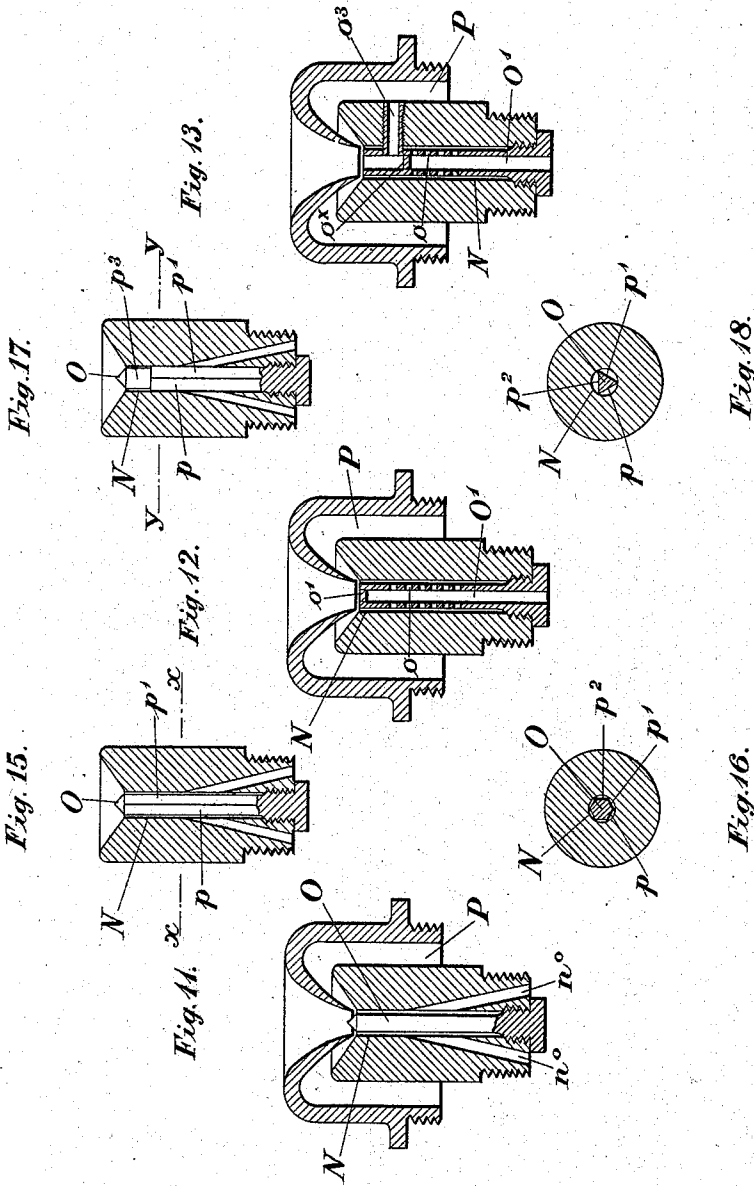
(No Model.)

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HYDROCARBON ENGINE.

6 Sheets—Sheet 6.

No. 552,718.

Patented Jan. 7, 1896.



Witnesses.

Edwin Holmes.  
Arthur E. Elbert.

Inventors.

W. D. & S. Priestman

# UNITED STATES PATENT OFFICE.

WILLIAM DENT PRIESTMAN AND SAMUEL PRIESTMAN, OF HULL, ENGLAND,  
ASSIGNORS TO THE PRIESTMAN OIL ENGINE AMERICAN SYNDICATE,  
LIMITED, OF SAME PLACE.

## HYDROCARBON-ENGINE.

SPECIFICATION forming part of Letters Patent No. 552,718, dated January 7, 1896.

Application filed January 2, 1895. Serial No. 533,625. (No model.) Patented in England November 2, 1893, No. 20,808, and August 17, 1894, No. 15,721.

*To all whom it may concern:*

Be it known that we, WILLIAM DENT PRIESTMAN and SAMUEL PRIESTMAN, directors of Priestman Brothers, Limited, subjects of Her Majesty the Queen of Great Britain and Ireland, residing at Holderness Foundry, in the town and county of Kingston-upon-Hull, England, have invented new and useful Improvements in Hydrocarbon-Engines, (in respect whereof we have applied for, but not yet obtained, Letters Patent in Great Britain, No. 20,808, to bear date November 2, 1893, and No. 15,721, to bear date August 17, 1894,) of which the following is a specification.

This invention relates to improvements in motor-engines operated by the combustion of hydrocarbon-vapor mixed with air.

Our present improvements are principally but not exclusively applicable to motor-engines of large size and in which two cylinders are employed, each cylinder being double acting, so that a charge can be ignited alternately on opposite sides of the piston.

The accompanying drawings represent apparatus constructed according to our improved method.

Figure 1 is an elevation of a portion of a hydrocarbon-engine embodying our improvements in starting. Fig. 2 is a corresponding side view. Fig. 3 is a view of the vapor-chamber and its communications with the cylinders, showing the air-receiver in section. Fig. 4 is a longitudinal section through the vapor-chamber and its jacket, and showing the spray apparatus and air-inlet valve in position. Fig. 5 is a transverse section on the line 2 2 in Fig. 4. Fig. 6 is a view, partly in section and partly in elevation, of the device for operating the exhaust-valve and for preventing back-pressure on the piston when starting the engine. Fig. 7 is a corresponding side elevation thereof. Fig. 8 is a longitudinal section through a cylinder and hollow piston and piston tail-rods, showing one method of keeping the piston cool and regulating the expansion so as to correspond with that of the cylinder. Fig. 9 is a similar view of a modified arrangement for effecting this object and in which water is forced into the hollow piston and

piston tail-rods. Fig. 10 is a sectional view drawn to a larger scale of the improved construction of intake-valve for preventing the combustible vapor entering one of more of the combustion-chambers of the working cylinders. Fig. 11 represents a longitudinal section of mixing or spraying apparatus. Fig. 12 is a similar view illustrating a modified construction. Fig. 13 illustrates another modification. Fig. 14 is a longitudinal section of mixing or spraying apparatus specially adapted for use in engines of the class herein referred to. Fig. 15 shows a solid plug having flats formed on its sides. Fig. 16 is a section on the line *x x*, Fig. 15. Fig. 17 illustrates a solid plug also having flats formed on its sides, but terminating in a solid cylinder of slightly-less diameter than the passage. Fig. 18 is a section on the line *y y*, Fig. 17.

In order to rapidly heat the vapor in the vapor-chamber A we allow the flame from the heating-lamp B to enter the space *a* between the vapor-chamber and its jacket, the flame bathing the outer surface of that chamber and the products of combustion escaping by way of a chimney C specially provided. After the engine has been started the heating-lamp B is extinguished and removed, and the orifice *b*, through which the flame from the heating-lamp passed, is closed by a cover *c*, the waste gases from the engine thereupon escaping by way of the chimney C, which then serves as an exhaust-pipe.

*a'* is a deflecting-plate to prevent the flame from burning the wall of the vapor-chamber.

In starting the engine we employ a heated air chamber or receiver D, Fig. 3, which surrounds the chimney or exhaust pipe C. Compressed air is pumped into this receiver by way of the pipe D' fitted with a stop-cock D<sup>2</sup> and becomes heated by the products of combustion yielded by the lamp B beneath the vapor-chamber A. When the air in the receiver D has become sufficiently compressed and heated, a charge of vapor is forced into the heated vapor-chamber A, and a mixture of air from the receiver D and vapor from the vapor-chamber A are admitted, by means of the pipe (or pipes) *d* controlled by a cock *e*,

into one (or both) of the motor-cylinder combustion-chambers and there ignited to afford an impulse to the piston.

F is the sprayer for supplying the mixture of oil and air to the chamber or receiver D,  $f, f'$  being respectively the pipes for conveying air and oil to said sprayer F.

When the engine has been started, the heating-lamp B removed and the cock  $c$  closed, the combustible vapor generated in the vapor-chamber A flows into the combustion-chambers of the working cylinders G H by way of the communicating passages or pipes  $g g g g$ .

In starting a hydrocarbon-engine of large size and having two cylinders, each working as regards each of its ends on what is known as the "four-cycle" system, it is found desirable to obtain an impulse in one cylinder, and at the same time an impulse from the opposite end of the other cylinder. As the ignition of a charge would occur four times in every two revolutions, and should take place once for each piston-stroke or half-revolution, it follows that, whereas the exhaust-valve for the chamber of one cylinder would be opened at the next half-revolution, the exhaust-valve for the chamber of the second cylinder would be closed and the waste gases in the latter cylinder locked up, considerable "back-pressure" being presented to the piston and resistance offered to the starting of the engine. To obviate this we employ a special device for opening the particular exhaust-valve at the requisite time. Referring to Figs. 6 and 7, this device consists of an extra cam  $h$  which slides on a feather  $i^0$  on the cam-shaft  $i$ , such cam  $h$  being retained in operative position on the cam-shaft by a lever  $h'$  which engages under a ledge  $h^2$  in the lower end of the cam  $h$ . This lever is pivoted on a ring  $h^3$  attached to the cam-shaft. After this cam  $h$  has effected the opening of the exhaust-valve, and that valve has been held open a sufficient time to permit the waste gases to escape, the lower end of the lever  $h'$  comes into contact with a pin or catch  $i^x$ . The extra cam  $h$  having been released by means of the tilting of the lever  $h'$  on its coming into contact with the pin  $i^x$ , is, under the influence of the spring  $h^4$  forced into an inoperative position, whereupon the conditions of working assume an ordinary character.

$i^i, i^j$  are the cams at present in use for actuating the exhaust-valves under the ordinary conditions of working.

To keep the piston cool for the purpose of regulating the expansion so as to correspond as nearly as may be with that of the cylinder, we carry hollow piston tail-rods I K through the cylinder-covers I' K' at each end of the cylinder. The tail-rod I forms the inlet and is furnished with an extension I<sup>2</sup> which acts as a plunger in the pump-barrel L. The other tail-rod K forms the passage for the delivery after the water has passed through both the hollow piston tail-rods and

circulated through the hollow piston, the water from said tail-rod K entering a hollow casing K<sup>2</sup> attached to the cylinder-cover K' and provided with an outlet-nozzle K<sup>3</sup>. If preferred, a small force-pump suitably connected with the hollow piston-rod I near the cross-head may be used for forcing water through the piston, or a force-pump attached to and worked by the engine may be utilized for forcing water by way of hollow piston-rods through the piston.

In the arrangement illustrated in Fig. 9 two hollow tail-rods K<sup>x</sup> K<sup>xx</sup> are fitted to a hollow piston and carried through the cylinder-cover K<sup>0</sup> at one end of the cylinder, the piston-rod being solid. The pump employed for forcing water into the cylinder-jackets for keeping the cylinders cool may be utilized in this arrangement, the water entering the cylinder-cover K<sup>0</sup> and passing by way of the communication  $k$  into the casing  $k'$ , thence through the tail-rod K<sup>x</sup>, and after circulating in the piston escaping by way of the other tail-rod K<sup>xx</sup> into a second hollow casing  $k^2$  and through the outlet-nozzle K<sup>3</sup>; or a suction-valve  $k^4$  and a delivery-valve  $k^5$  may be provided, thereby dispensing with a separate pump on the engine for the purpose of circulating water through the piston and other parts which are required to be kept cool.

In starting the engine it is found advisable to prevent combustible vapor entering one or more of the four chambers of the two working cylinders. To enable this to be accomplished, we construct the casings for the intake-valves so that they can be screwed back to lock those valves against their seats.

M is the casing which screws on the sleeve  $l$  for the valve-spindle  $m$ . The casing M is formed with projections  $m'$  for facilitating its rotation when locking or releasing the valve.  $n$  is the spring which maintains the valve in its normal position. It will be apparent that when the stop or casing M is screwed back against the button  $m^2$  on the end of the valve-spindle  $m$ , the valve will be prevented from opening. Thus either or any of the intake-valves can be easily rendered inoperative, the charge or charges of combustible vapor being consequently prevented from entering the combustion chamber or chambers.

As an engine of the character herein referred to in which two cylinders are employed, each cylinder being double-acting, consumes a considerable quantity of combustible vapor, we prefer to employ spraying or vaporizing apparatus of the kind hereinafter described and illustrated in Figs. 11, 12, 13, and 14 of the accompanying drawings.

Our improvements in the construction of spray apparatus applicable for use in mixing hydrocarbon oil or other liquid with atmospheric air or other gas in the manufacture of vapor have for their object to furnish an increased yield or to enable the apparatus to

be worked at a comparatively low pressure without effecting a less minute subdivision of the liquid.

Heretofore we have employed mixing devices comprising two concentric tubes, to which the fluids to be mixed are respectively supplied under pressure, the extremity of the outer tube being so formed in relation to that of the inner tube that the two fluids are caused to meet at right angles to one another or at an obtuse angle.

In a spraying or mixing device constructed according to our invention the passage N, through which the liquid is supplied, is of somewhat larger diameter than usual, but is for the most part occupied by a fixed needle or plug O, the diameter of which is only slightly less than that of the passage N. Thus the effective area for the supply of the liquid is restricted to the minute annular space intervening between the surface of the needle or plug O and the inner wall of the passage N. P is the passage for air or other gas. The needle or plug O, Fig. 11, is solid, the liquid flowing to the minute annular space through ducts  $n^0$ .

According to the construction illustrated by Fig. 12 the plug O' is hollow and is formed with lateral openings  $o$ , its outer extremity being closed at  $o'$ . In this case the liquid escapes through the lateral openings  $o$  along the length of the hollow or tubular plug O' to the annular passage N, and the resistance due to friction is diminished.

In the modification illustrated by Fig. 13 the extremity of the hollow plug O' is open, but the passage therethrough is intercepted at  $o^x$ , and a lateral passage  $o^s$  communicates with the air or gas channel P. The air or other gas is thus caused to overtake as well as to meet the stream of liquid as it issues from the annular passage N.

In Fig. 14 is shown a modified construction of sprayer specially applicable for use in engines of the class hereinbefore referred to—viz., those of large size. The plug O' is hollow and is formed with lateral perforations  $o$ , its outer extremity being closed at  $o'$ . The solid end  $o'$  is of slightly larger diameter than the hollow portion of the plug in which the lateral perforations  $o$  are formed. In this case the liquid escapes through the lateral openings  $o$  into the annular passage N and is conducted under comparatively slight frictional resistance nearly to the extremity of the plug, where it encounters and is forced through the further reduced annular passage  $n'$ .

According to another variation (illustrated in Figs. 15 and 16) the diameter of the needle or plug O corresponds with that of the pipe or passage N, but the sides of the former are filed to form three, four or other number of flats  $p\ p'\ p^2$ , &c., the spaces intervening between these flats and the inner wall of the passage N forming small ducts for the con-

veyance of the liquid. Under such circumstances, although the total effective area for the escape of the liquid may be equal to that of the annular passage previously referred to, the maximum width of the duct is somewhat greater, a consideration of some importance unless the liquid be perfectly strained for the interception of solid matters. If preferred, the flats  $p\ p'\ p^2$  may stop short of the extremity of the needle or plug O, the latter terminating in a solid cylinder  $p^3$  of slightly less diameter than the surrounding passage N, as illustrated in Figs. 17 and 18. Under such circumstances the liquid is conducted nearly to the extremity of the passage under comparatively little frictional resistance and is then forced through a comparatively short passage of fully-restricted area.

What we claim, and desire to secure by Letters Patent, is—

1. In a hydrocarbon engine, the combination with the combustion chamber of the engine, of a chamber to contain combustible vapor, another chamber to contain compressed air mixed with hydrocarbon vapor, pipes connecting the two chambers last named with the combustion chamber, heaters adapted to simultaneously heat the charges in said two chambers, and means for admitting these separately heated charges simultaneously to the combustion chamber for starting the engine, substantially as set forth.

2. In a hydrocarbon engine, the combination with the chimney or exhaust pipe C, of a compressed air-chamber or receiver D traversed by the said pipe, a pipe  $d$  connecting the receiver D with the combustion chamber, a cock  $e$  controlling said pipe, and a sprayer F for injecting oil and air to the compressed air-receiver, substantially as and for the purpose set forth.

3. In a hydrocarbon engine, the combination with the two double-acting cylinders provided with exhaust-valves, of an automatic valve-opener adapted for opening one of said exhaust valves at such a time as to produce in one cylinder an impulse at the same time that an impulse takes place in the opposite end of the other cylinder, substantially as set forth.

4. In a hydrocarbon engine having two double-acting cylinders, the combination with the cam-shaft  $i$  and cam  $h$ , of the lever  $h'$  and the catch  $i^x$ , substantially as and for the purpose set forth.

5. In a hydrocarbon engine, the combination with a hollow piston of two tubular tail-rods  $K^x\ K^{xx}$ , both of which pass through the cylinder cover  $K^0$  and work in tubular casings  $k^1\ k^2$ , a valve  $k^4$  on the suction side, and a valve  $k^5$  on the delivery side of the system the whole operating to circulate water through the piston and cylinder cover or other parts to be cooled, substantially as set forth.

6. In a hydrocarbon engine, the combination with the valve stem  $m$  of the longitudinal-

nally adjustable body M and the button  $m^2$  secured to the said valve stem, substantially as and for the purpose set forth.

7. In a hydrocarbon engine, the improved  
5 sprayer or mixing device, comprising an annular passage for the liquid, an air-passage, and a plug formed in such a manner that the fully restricted portion of the passage through which the liquid has to pass extends but a  
10 short distance longitudinally, the frictional resistance being thereby reduced to a minimum, substantially as herein described.

8. In a hydrocarbon engine vaporizing or

mixing nozzle, a hollow plug O' provided with lateral perforations  $o$  and a closed end  $o'$ , the 15 latter being somewhat larger in diameter than the stem of the plug, and nearly filling the passage N, within which the said plug is mounted, substantially as and for the purpose set forth.

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Witnesses:

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