C. E. DURYEA.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAR. 22, 1907.

1,050,012.

Patented Jan. 7, 1913.

2 SHEETS—SHEET 1.

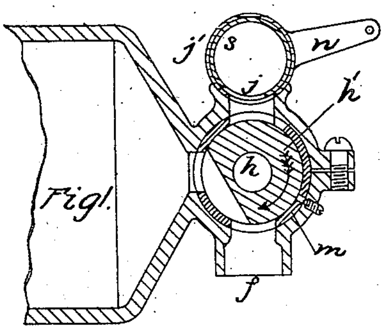


Fig1.

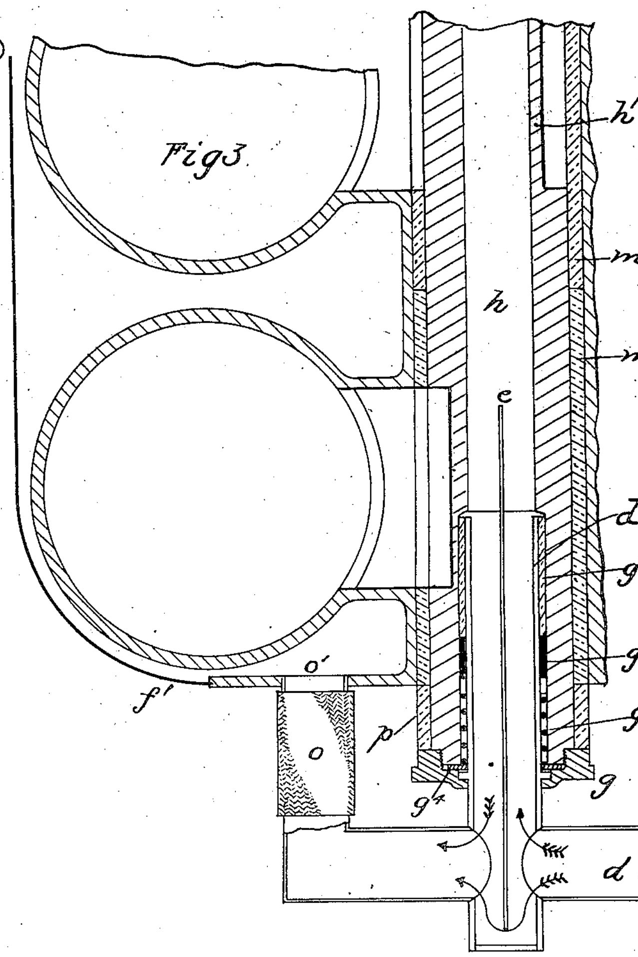


Fig3.

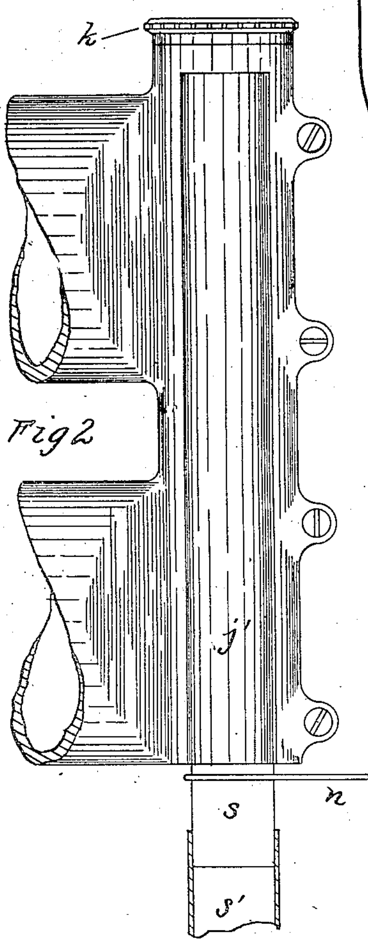
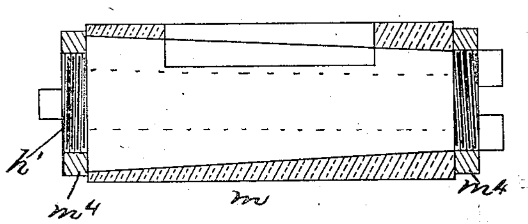


Fig2.

Fig.6.



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2 SHEETS—SHEET 2.

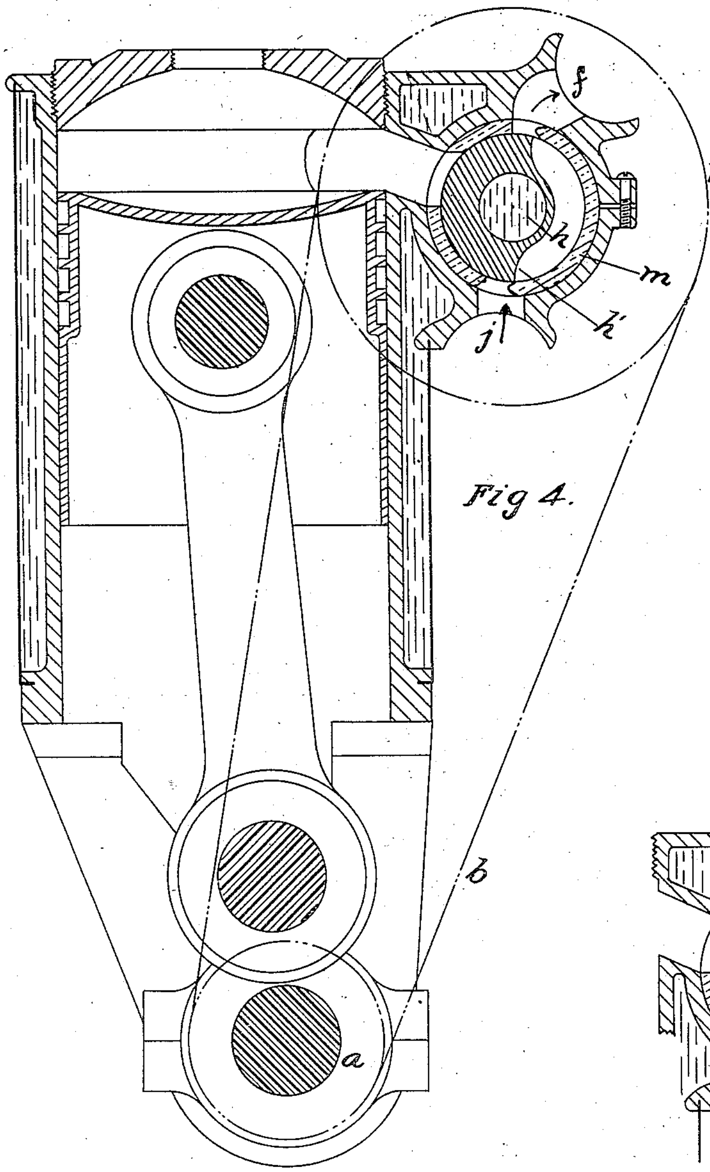
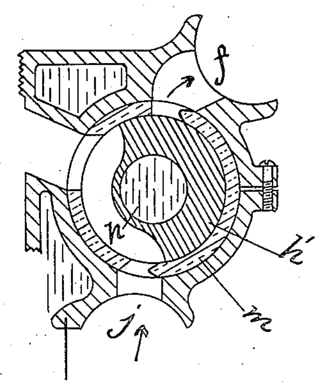


Fig 4.

Fig 5.



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,050,012. Specification of Letters Patent. Patented Jan. 7, 1913.

Original application filed October 2, 1905, Serial No. 280,974. Divided and this application filed March 22, 1907. Serial No. 363,961.

To all whom it may concern:

Be it known that I, CHARLES E. DURYEA, citizen of the United States, residing at Reading, in the county of Berks and State of Pennsylvania, have invented certain new and useful Improvements in Internal-Combustion 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 internal combustion engines and more particularly to that class of engines adapted for automobile or aeronautic service where the greatest reliability, fewest parts and lightest construction are of decided value. The generic idea is disclosed in my application Serial Number 280,974, filed October 2, 1905, of which this application is filed as a division.

The objects of my invention include the production of a valve of great durability, free from noise, having few parts and of positive operation, and I accomplish these objects by the mechanism shown in the accompanying drawings in which—

Figure 1 is a cross section of valve and head of cylinder showing the ports. Fig. 2 is a plan view of a two cylinder engine. Fig. 3 is a cross section plan through the valve and two cylinders of a multiple cylinder engine having the valve at the side of the cylinder instead of in the head as shown in Figs. 1 and 2. Fig. 4 is a cross section elevation of a single cylinder with valve at the side and Fig. 5 is a detail in cross section showing the valve in a different position from that in which it is seen in Fig. 4. Fig. 6 is a view, partly in section, of a modified form of valve and bushing.

Similar letters refer to similar parts throughout the several views.

It is a well recognized fact in gas engine practice that the cool incoming charge will effectually cool the exhaust valve if it can be caused to strike against the valve during its passage into the cylinder. It is also recognized that while the delicate parts such as valves should be kept as cool as possible to insure durability, the engine proper should be worked at a temperature as nearly that of boiling water or even higher as is compatible with other considerations. In air cooled engines, the best recognized practice places the valves and port passages well away from the cylinders, that the cylinders may not be distorted by irregularities of the valve passages and that the valves themselves may be more readily exposed to the air for cooling. I have, therefore, shown in this case, two different arrangements of the same device.

Figs. 1 and 2 are a preferred form for air cooled engines, while Figs. 3, 4 and 5 show the form preferred where the engine is water cooled; the principle in both cases being identical. It is also recognized that the extreme heat of the exhaust gases with soot and carbon frequently deposited by the burning charges, render the exhaust valve liable to cut and damage its seat. I have, therefore, not only provided efficient means of cooling but further provide a removable valve seat *m*, which is fixed in the engine cylinder by set screws and clamp screws, either, or both, in a self evident manner as shown in Fig. 1 and which being thus fixed may be readily removed for replacement or repair if needed. This removable valve seat prevents any possible damage to the cylinder, due to the cutting caused by the valve in any accidental case of overheating and seizing or lack of lubrication.

In my preferred construction I make the valve *h'* a straight shaft long enough to serve one or more cylinders as may be desired and carefully ground to an exact size and cylindricity, so as to fit its bushings *m* and *m'*. These bushings are likewise carefully ground and fitted both to the valve and to the passage through the cylinder casting which casting in its turn must be carefully fitted. With careful fitting the valve *h'* may revolve freely and yet at no place except when the ports are open will there be a passage permitting the escape of gases; so this form of device perfectly serves its purpose with a rotary motion instead of with the reciprocating motion of the ordinary puppet valve which requires cams, springs, guides and many parts to insure proper operation and which is accompanied with more or less noise and shock. It is quite evident that the valve *h'* may be tapered as is an ordinary stop cock and provided with nuts at one or both ends of each tapered portion or at the ends only of the full length valve. It is preferable to make it not tapered and of full length for multiple cylinders. I have used both forms with many modifications thereof but prefer the straight form, carefully made, rather than the tapered adjustable form, although I have shown in Fig. 6 a bushing and valve tapered with adjusting nuts by which the valve may be caused to fit as tightly as desired and prevented from wedging or becoming tighter.

A single length valve may be caused to drive its neighbor and may be connected by hose or other water tight connection so that the circulation of water may be effected in the tapered multiple-separate valve construction just as in the multiple one piece construction. The action of this valve is apparent from Figs. 1, 2, 4 and 5. In Fig. 4 is shown a sprocket *k* which is attached to one end of the valve *h'* and by chain *b* is driven at the proper speed from a suitable sprocket on the engine shaft *a*. In Figs. 1 and 2 this valve is driven right hand (clockwise) as indicated by arrow and the supply and exhaust ports are provided at the proper points to accommodate this direction of revolution. In Figs. 4 and 5 the valve is assumed to run in the opposite direction with the position of the inlet and exhaust ports correspondingly reversed. Fig. 1 shows the exhaust port *f* and valve in such position that a clear passage is open from the cylinder across the valve and out through the exhaust port. This passage is of the width shown and of a length equal to the length of the port so that a very large area is open and one that opens and closes quickly, thus making a more effective valve, than the usual puppet form, with no tortuous passages through which the gases go with difficulty. Rotation of the valve *h'* in the direction of the arrow closes the exhaust port *f* and immediately thereafter opens the inlet port *j*. The movement of the piston then causes a new charge to pass into the engine from the supply pipe *s'* if the throttle *s* is opened sufficiently to permit this. While any preferred form of throttle may be used, I have fitted to the port *j*, a tube *j'* in which a throttle tube *s* is revoluble by means of a lever *n*. Through both of these tubes are cut registering passages so arranged that when the throttle is moved, the passage is partly or completely closed.

In Figs. 3, 4 and 5, the valve is so placed that the oil from the head of the piston will run into the valve passage and lubricate the valve properly. This arrangement can be depended upon if the air cooled form shown in Figs. 1 and 2 is placed head downward but it is preferable to use oilers, not shown, to lubricate the valve with the air cooled form of head upward. It is further preferable to place the water cooled form in an inclined position, so that the lower side of the chain *b* is practically horizontal. This insures that any steam formed near the valve rises to the opposite side of the cylinder without permitting the valve to get overheated. From the drawings it will be seen that the port leading into the cylinder from the valve is completely surrounded by water, so that the entire upper half of the opening in which the valve and bushing is placed, is water jacketed, while the lower half is exposed to the air and not to heating influence. The hole *h* is filled with water, thus keeping the valve cool from the inside. This hole may be used with the air cooled valve and permits much heat to be carried off if the blast of air is directed through it properly.

After the desired volume of charge is admitted, the continued rotation of the engine causes the piston to compress this charge and also carries the valve into the position shown in Fig. 4. At this point the explosion occurs and the piston is driven outward on the working stroke, which decreases the pressure as the valve rotates into the position for exhausting until, when near the close of the outward piston stroke, a long but narrow passage is opened, permitting the escape of the burned gases through the exhaust port *f*. This passage widens and is full open before the piston has returned half of the exhaust stroke. It closes at the close of the exhaust stroke, after which the inlet passage opens and is full open as shown in Fig. 5 at about the middle of the suction stroke.

In Fig. 3 the section shows by arrows, the course of the circulating water, part of which passing through the usual pipe *d*, is deflected by the diaphragm *e* and caused to flow into the valve hollow *h* and thence out of the valve on the opposite side of the deflector *e*. Another portion of the water passes around the outer end of the deflector *e* without much interruption, after which the full flow of water passes to the water jacket *f'* of the engine cylinders in the usual manner. This flow of water is permitted by the use of a stuffing nut or box *g* with packing *g'* gland g^2 and spring g^3. An abutment for the spring g^3 is provided at g^4 consisting of a washer clamped by the nut or box *g*. The pipe *d'* which enters the valve has a flange integral with it between the nut or box *g* and the washer g^4, which maintains the parts in position without undue friction. To permit easy removal of the water connection and stuffing box, a hose *o* joins the pipe *d* to the projecting stub *o'* permanently attached to the water jacket *f'*.

It is quite evident that the water would pass completely through the valve as does the air in Fig. 1 if suitable stuffing boxes at each end were provided but I have found that the small quantity passing through as shown in Fig. 3 is sufficient for all purposes and this permits the use of a single stuffing box only.

I have shown in Fig. 3 a collar p surrounding the valve and between the end of the bushing m and the stuffing box or nut g.

In Fig. 6 is shown a bushing m tapered internally with a single length valve h' having at each end, provision for engaging duplicates and also having nuts m^4 m^4 for holding the valve in proper relation lengthwise to the bushing. The hole h is indicated by dotted lines and water pipe connections can be made between these separate valves by short lengths of hose or in other self evident manner.

It is considered advantageous to have the cylinder port of as little depth as possible to prevent needless loss of heat and my valve arrangement secures the least possible port and valve surface exposure.

It is also an advantage to have the port of considerable length where it enters the valve so that the area of the valve opening may quickly reach the maximum. It is evident that this length of port cannot be obtained lengthwise of the cylinder because this would demand a long and large compression space, but it can be had with a small compression space by placing it crosswise of the cylinder and preferably at one side of the cylinder, as shown in Fig. 4 where the port is quite narrow in relation to or in the direction of the piston stroke and quite long in relation to the cylinder bore, as shown in Fig. 3.

I claim,

1. In an internal combustion engine, multiple cylinders in line with each other and having ports, and a single valve common to all of the cylinders and controlling said ports, combined with a valve casing having inlet and exhaust ports, means for interiorly cooling said valve, said cooling means embodying a pipe extending within the valve, and a deflector within said pipe and means for operating said valve, said valve having depressions in its cylindrical surface for coöperation with the cylinder ports and open throughout their entire length at the periphery of said valve and serving to effect the control of the admission and exhaust by alternately connecting the cylinder ports with the admission ports and then the exhaust ports.

2. In an internal combustion engine, multiple cylinders in line with each other and having ports, and a single valve common to all of the cylinders and controlling said ports, combined with a valve casing having inlet and exhaust ports, means for interiorly cooling said valve, said cooling means embodying a pipe extending within the valve, and a deflector within said pipe and means for operating said valve, said valve having depressions in its cylindrical surface for coöperation with the cylinder ports and open throughout their entire length at the periphery of said valve and serving to effect the control of the admission and exhaust by alternately connecting the cylinder ports with the admission ports and then the exhaust ports, said valve being disposed transversely to the length of the cylinder and at one side thereof.

3. In an internal combustion engine, multiple cylinders in line with each other and having ports, and a valve controlling said ports, combined with a valve casing having inlet and exhaust ports, means for interiorly cooling said valve, means for operating said valve, said valve having depressions in the peripheral surface thereof for coöperation with the cylinder ports and disposed transversely of the length of the cylinder and at one side thereof and serving to effect the control of the admission and exhaust by alternately connecting the cylinder ports with the admission ports and then the exhaust ports, a pipe extending into said valve, a deflector in said pipe, and a by-pass around the outer end of said deflector.

4. The combination with an engine cylinder, of a rotary valve, a stuffing box at one end only thereof, a pipe extending into said valve and through said stuffing box, means for introducing a cooling liquid into said pipe, and a diaphragm in said pipe extending in the direction of the length thereof to divide and deflect the water.

5. In combination with an engine cylinder, a rotary valve, a stuffing box at one end only thereof, a pipe extending through said stuffing box into said valve, means for introducing a cooling liquid into said pipe, a deflector in said pipe, and a by-pass around the outer end of said deflector for permitting a portion of the water to pass without entering the valve.

6. In an internal combustion engine, multiple cylinders having ports, a valve controlling said ports and having depressions in its cylindrical surface for coöperating with the cylinder ports and open throughout their entire length at the periphery of the valve, a valve casing having inlet and exhaust ports, a pipe extending into said valve, and a deflector in said pipe, said depressions serving to effect the control of the admission and exhaust by alternately connecting the cylinder ports with the admission ports and then the exhaust ports.

7. In an internal combustion engine, multiple cylinders having ports, a valve controlling said ports and having depressions in its cylindrical surface for coöperation with the cylinder ports and open throughout their entire length at the periphery of the valve, a valve casing having inlet and exhaust ports, a pipe extending into said valve, a deflector in said pipe, and a by-pass around

the outer end of said deflector, said depressions serving to effect the control of the admission and exhaust by alternately connecting the cylinder ports with the admission ports and then the exhaust ports.

8. In combination with an engine cylinder, a rotary valve, a stuffing box at one end only thereof, and rotatable with said valve, means passed through said stuffing box for introducing a cooling liquid into said valve in the direction of the length thereof, and means within said means for deflecting the water and permitting a portion of the same to pass without entering the valve.

9. In a device of the character described, a rotary valve, a stuffing box at one end thereof, a tubular seat for said valve, the end of said stuffing box serving also to hold said valve and its seat against endwise movement and a pipe entering said valve and provided with a flange engaged and held by said stuffing box.

10. In a device of the character described, a rotary valve, a stuffing box at one end thereof, a spring, a tubular seat for said valve, the end of said stuffing box serving also to hold said valve against endwise movement, a pipe entering said valve and passed through said stuffing box and held by said box, and means retained within said box and serving as an abutment for one end of said spring.

11. In a device of the character stated, multiple cylinders each having a short depth port, combined with a single hollow rotary valve having non-tortuous longitudinally elongated depressions in its surface open at the periphery throughout their entire length for coöperation with said cylinder ports whereby port and valve surface exposure is reduced to a minimum.

12. In an internal combustion engine, multiple cylinders having ports in line with each other and a valve controlling said ports and having shallow longitudinally elongated segmental depressions in its cylindrical surface whereby a long narrow passage is provided near the close of the outward piston stroke to permit the direct escape of the burned gases through the exhaust pipe, said valve being disposed transversely of the length of the cylinder at one side thereof, combined with means for operating said valve.

13. In a device of the character stated, multiple cylinders each having a short depth port, combined with a rotary valve having short depth longitudinally elongated segmental depressions in its cylindrical surface open at the periphery throughout their entire length for coöperation with said cylinder ports, whereby port and valve surface exposure is reduced to a minimum.

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

CHARLES E. DURYEA.

Witnesses:
S. P. SMITH,
SUE E. CONNER.