May 31, 1932. M. B. JACKSON 1,860,673

INTERNAL COMBUSTION ENGINE

Filed March 18, 1930

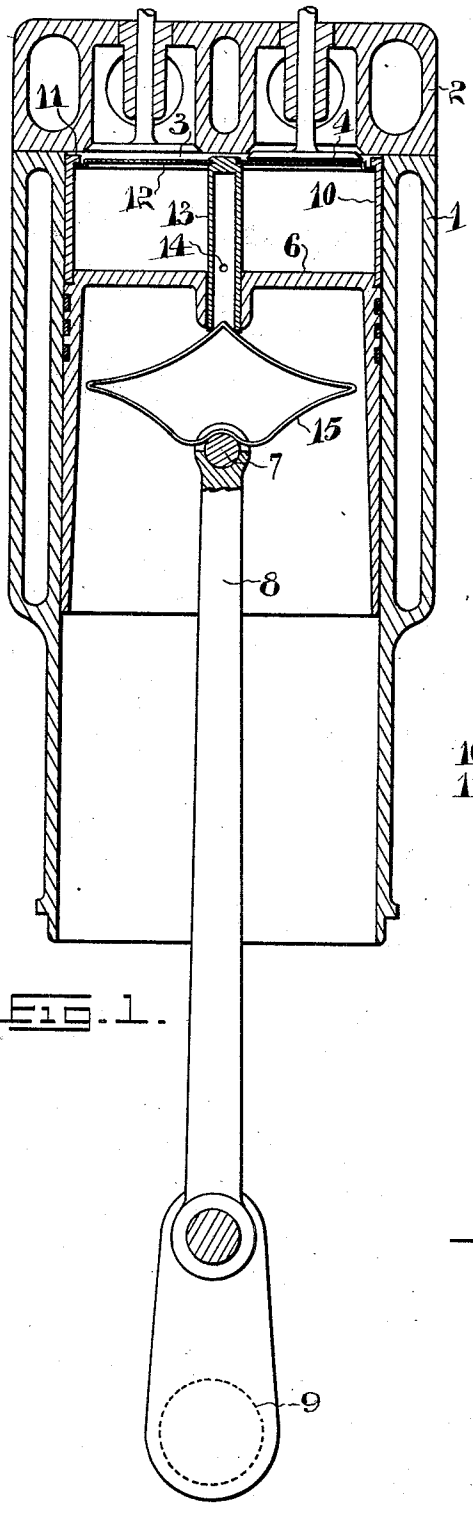


Fig. 1.

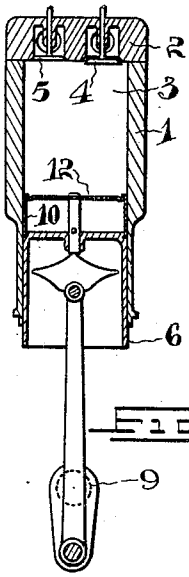


Fig. 2.

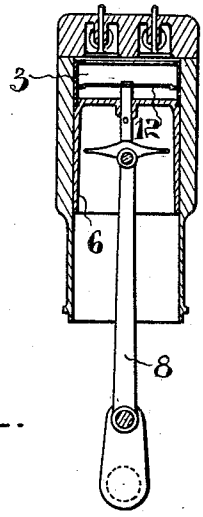


Fig. 3.

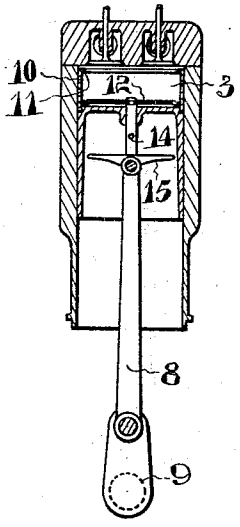


Fig. 4.

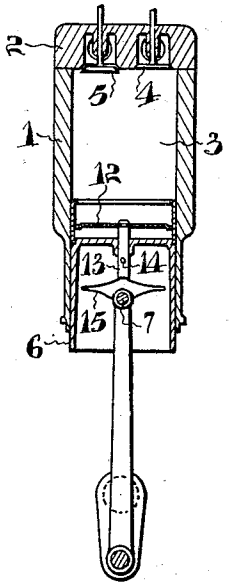


Fig. 5.

INVENTOR.

M. B. Jackson.

by J. Edward Maybee.

atty.

Patented May 31, 1932 1,860,673

UNITED STATES PATENT OFFICE

MAUNSELL B. JACKSON, OF TORONTO, ONTARIO, CANADA, ASSIGNOR TO ALBERT E. DYMENT, JAMES H. LUMBERS, AND WILLIAM S. GRAY, ALL OF TORONTO, CANADA, AS TRUSTEES

INTERNAL COMBUSTION ENGINE

Application filed March 13, 1930. Serial No. 436,838.

This invention relates to internal combustion engines. Heretofore the piston in the conventional type of engine has been depended on to clear the burnt gases from the combustion chamber with the result that a certain percentage of the burnt gases has been left in the combustion chamber at the end of the exhaust stroke of the piston. These burnt gases mix with the fresh charge drawn into the chamber on the following suction or intake stroke of the piston, and decrease the efficiency of the engine. My object is to provide simple and inexpensive means to overcome this objectionable feature, to increase the rate of flow and the volume of the combustible charge drawn into the combustion chamber of the engine especially at high speeds thereof, to increase the life of the lubricating oil carried in the crank case of the engine, and to eliminate so-called carbon knocks.

I attain my objects by interposing a floating displacement member between the cylinder head and the top of the piston so that the clearance volume between the top of the displacement member and the cylinder head will be reduced to a minimum. The burnt gases will thus be thoroughly removed at the end of the exhaust stroke, and the member will be positioned to draw in a fresh charge immediately the piston descends on the suction stroke. This will result in an increase in and an acceleration of the partial vacuum created by the descent of the piston so that a larger volume of the fresh charge will be drawn in, especially at high speeds of the engine, than is possible with the conventional type of engine.

The constructions are hereinafter more fully described and are illustrated in the accompanying drawings in which

Fig. 1 is a vertical section through the cylinder showing the floating displacement member in its position at the commencement of the suction stroke;

Fig. 2, a section on a reduced scale showing the parts as they are positioned at the end of the suction stroke;

Fig. 3, a section at the end of the compression stroke just before ignition takes place;

Fig. 4, a section similar to Fig. 3 at the end of the compression stroke just after ignition takes place; and

Fig. 5, a section at the end of the working stroke, the exhaust stroke being just about to commence.

Referring to Figs. 1 to 5, the engine includes a cylinder 1, cylinder head 2, combustion chamber 3, intake valve 4, exhaust valve 5, piston 6, wrist pin 7, connecting rod 8, and crank shaft 9. The upper end of the piston 6 is provided with an extension 10 which has an inwardly directed lip or flange 11. In the extension 10 is reciprocably mounted a displacement member 12 which is carried on a stem 13. The stem 13 is slidably carried in the head of the piston 6 and the outer periphery of the member 12 is free of the inner periphery of the extension 10. This freedom obviates the necessity of lubrication between the member 12 and extension 10 and also serves another purpose as hereinafter set forth. When the member 12 comes to rest against the lip 11 it makes a substantially tight joint therewith. The lower end of the stem 13 is hollow, and in the wall of the stem is formed a hole 14 adapted to establish communication between the space within the skirt of the piston and the space behind the member 12 when the latter is positioned in engagement with or near the flange 11. The pressure behind the member is thus brought to that of the atmosphere once in each cycle, and therefore any tendency for leakage past the member to become accumulative is corrected each cycle.

A spring 15 bearing against the wrist pin 7 tends to maintain the member 12 in engagement with the flange 11.

Assuming the piston 5 to be just commencing its downward stroke as shown in Fig. 1, and the intake valve 3 to be opening, the operation is as follows. The displacement member 12 will be either resting against or very nearly resting against the flange 11 and the very small space between the member and the cylinder head 2 will be the clearance volume if the engine be considered as an air pump instead of the very considerable space between the piston 6 and the cylinder head

2 which would be the clearance volume of the conventional type of engine. If the engine be considered as an air pump it will readily be seen that the member 12 will greatly increase the partial vacuum formed in the cylinder as the piston descends and will make the maximum vacuum occur earlier in the downstroke when the piston is travelling comparatively slowly. This results in a greater suction in the cylinder during the suction stroke and also gives the increased suction a longer time to draw in the combustible charge. During the suction stroke the hole 14 establishes communication between the space behind the member 12 and the atmosphere as hereinbefore described.

Fig. 2 shows the position of the parts at the end of the suction stroke. The space between the member 12 and the cylinder head 2 is now filled with uncontaminated combustible charge and the space between the member and the piston 6 is filled with inert gases at atmospheric pressure. The intake valve 4 is now just closing or is just about to close.

As the piston rises on the compression stroke the fresh charge above the member 12 will be compressed which will result in the member 12 being moved towards the head of the piston 6, the inert gases below the member being compressed and the hole 14 being closed. Fig. 3 shows the relative positions of the parts at the end of the compression stroke.

Ignition then takes place and the pressure above the member 12 rises to a maximum almost immediately and the member 12 is forced towards the piston as illustrated in Fig. 4. It is to be noted that the flatness of the member and of the head of the piston ensures a cushion of gas between them at all times.

The piston moves down the cylinder during the working stroke and the hereinbefore described small annular space between the outer periphery of the member and the inner periphery of the extension would permit a slight leakage of gas to take place if there be for any reason a difference in pressure per square inch on the top and underside of the member 12. It is found advisable to cause leakage from above to below the member 12 during the working stroke and this is accomplished by properly proportioning the cross sectional area of the stem 13 and the strength of the spring 15.

If we consider the member 12 as in equilibrium at any moment the sum of the forces acting to raise it must be equal to the sum of the forces acting to press it down. The first mentioned forces, i. e. those tending to raise the member, are the gas pressure on the underside of the member 12 in pounds per square inch multiplied by the area of the underside of the member which is exposed to the said gas pressure, and the upward pressure of the spring 15. The force tending to counteract these forces is the gas pressure on the upper side of the member 12 in pounds per square inch multiplied by the total area of the member 12. That is to say if we assume that:—

The gas pressure above member 12 = P_1 lbs. per sq. in.
The gas pressure below member 12 = P_2 lbs. per sq. in.
Total area of member 12 = A_1
Total cross sectional area of stem 13 = A_2
Force of spring 15 = F

Then when member 12 is any position of equilibrium

$$P_1 \times A_1 = P_2 (A_1 - A_2) + F$$

Considering the upward forces $P_2 (A_1 - A_2)$ and F, it is evident, since the sum of these two forces has a definite value, that the larger either one is, the smaller the other must be. That is to say if the spring 15 be very strong, the force F will be very great, the force $P_2 (A_1 - A_2)$ will be very small and the pressure P_2 consequently will be small since $A_1 - A_2$ is a constant quantity.

On the other hand, if the spring 15 be weak enough to be negligible we would have the following equation:

$$P_1 \times A_1 = P_2 (A_1 - A_2)$$

$$\frac{A_1}{A_1 - A_2} = \frac{P_2}{P_1}$$

but A_1 is greater than $A_1 - A_2$ and becomes increasingly greater if A_2 be increased. Then P_2 must be greater than P_1 and becomes increasingly so if A_2 be made greater. It is thus possible, by using a stem 13 of small diameter and a strong spring 15, to make P_1 greater than P_2 and cause leakage past the member 12 from above to below it. This gas that has leaked downwardly past the member 12 on the working stroke assists the spring 15 to raise the member 12 on the following exhaust stroke and re-position the parts for the suction stroke as shown in Fig. 1.

What I claim as my invention is:

An internal combustion engine including a cylinder; a piston; a combustion chamber; an extension carried by the piston and provided with an inwardly directed flange at its upper end; and a displacement member loosely mounted in the extension to reciprocate relative to the piston to vary the volume of the combustion chamber, the said member being adapted to rest on said flange to close the upper end of the extension.

Signed at Toronto, Canada, this 19th day of March, 1930.

MAUNSELL B. JACKSON.