E. M. LAWLER.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED APR. 8, 1918.

1,354,667.

Patented Oct. 5, 1920.

2 SHEETS—SHEET 1.

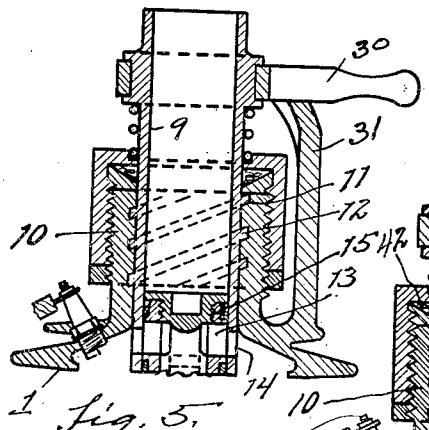


Fig. 5.

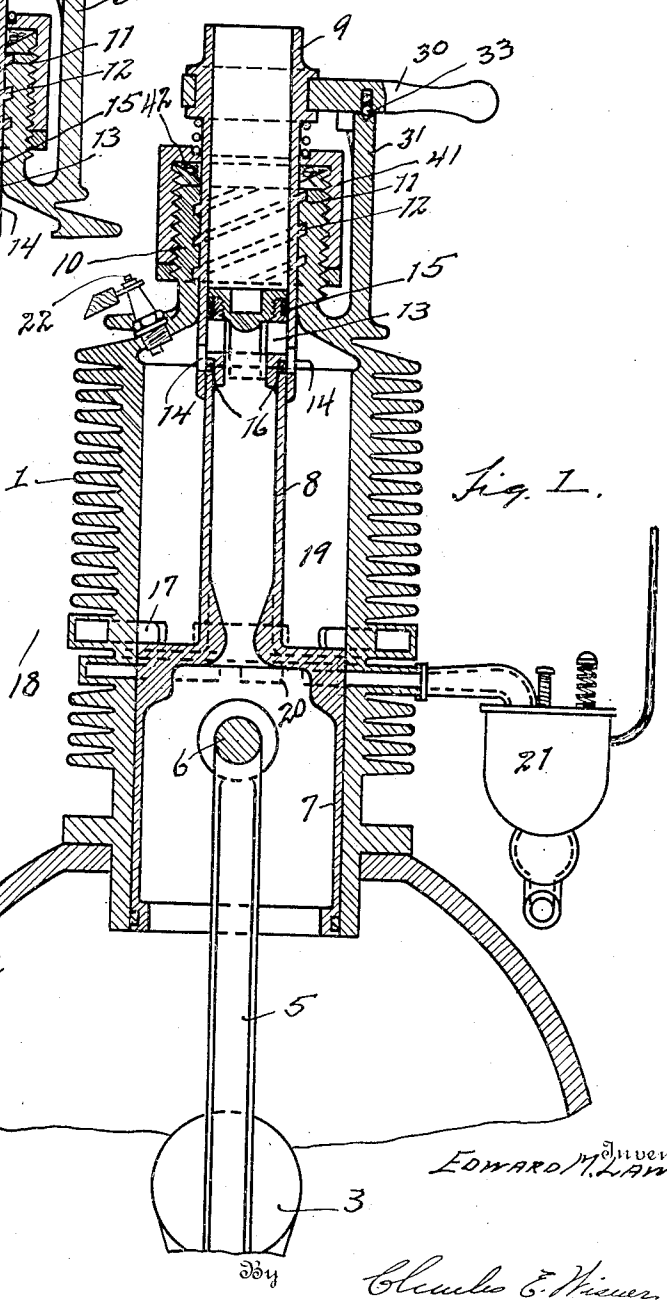


Fig. 1.

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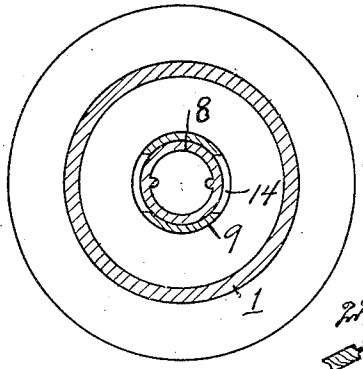


Fig. 3.

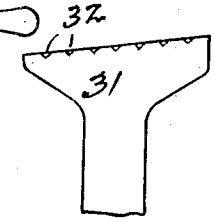


Fig. 4.

Fig. 2.

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INTERNAL-COMBUSTION ENGINE.

1,354,667. Specification of Letters Patent. Patented Oct. 5, 1920.

Application filed April 8, 1918. Serial No. 227,227.

To all whom it may concern:

Be it known that I, EDWARD M. LAWLER, a citizen of the United States, residing at Royal Oak township, county of Oakland, State of Michigan, have invented a certain new and useful Improvement in Internal-Combustion Engines, and declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

This invention relates to internal combustion engines, and a primary object thereof is to provide an engine of the two-cycle type having a sleeve valve in which an extension of the piston rides and by means of which the charge introduced into the explosion chamber may be controlled. A further object is an engine of the character stated wherein the inflowing charge is maintained at substantially constant pressure at the time of introduction into the explosion chamber. A further object is an engine of the character stated in which condensation in the compression chamber has little or no effect upon the introduced charge whereby an engine of the two-cycle type may be readily controlled by means of the throttle without erratic operation as with the usual types heretofore known in which condensation tends to enrich the charge at different periods. An additional object of the invention is involved in the construction whereby the intake and exhaust ports of the cylinder are positioned in contiguous relation and the exhaust port opened at the finish of the power and compression stroke and the intake port opened to the compression chamber at the time of firing the charge introduced into the explosion chamber. These objects and the several novel features of the invention are hereinafter more fully described and claimed, and an embodiment thereof illustrated in the accompanying drawings in which—

Figure 1 is a vertical section of an engine embodying my invention and showing the piston at the bottom of its stroke and the throttle valve so positioned as to allow a charge from the compression chamber to flow into the explosion chamber.

Fig. 2 is a similar section showing the piston at the upper point of its movement.

Fig. 3 is a cross section on line x—x of Fig. 2.

Fig. 4 is a side elevation of the segment used to control position of the throttle lever.

Fig. 5 is a detail in vertical section showing the throttle valve in full open position.

The engine consists of a cylinder 1 here shown as being provided with fins but is to be understood that the cylinder may be either water or air cooled as desired. The cylinder is mounted on a crank case, a portion of which is shown at 2 in which is a crank 3 on the crank shaft 4. This crank is connected by means of the piston rod 5 with the wrist pin 6 in the hollow piston 7. This piston has rising centrally from the upper end thereof a hollow stem 8 extending upwardly through the cylinder and the end thereof riding in a sleeve 9 preferably in threaded relation with a tubular extension 10 on the cylinder head. This extension has internal threads 11 in which threads 12 on the sleeve engage for a purpose hereinafter stated. The stem 8 has two circumferentially alined ports 13 in the upper end thereof through which the compressed charge from the interior of the stem and piston is introduced into the explosion chamber. The sleeve 9 controls the time and extent of open-the ports 13 and is preferably provided with similar ports 14 at the lower end. The upper end of the stem is provided with a packing 15 and below the ports 13 is also provided with a packing ring 16 to prevent an escape of the compressed gases.

From the construction described it will be noted that the piston on movement to lowermost position, as indicated in Fig. 1, uncovers the exhaust port 17 circumferentially positioned in the wall of the cylinder which opens into a manifold 18 connected therewith. At this time also the ports 14 of the sleeve 9 are opened to an extent depending upon the relative vertical position of the sleeve 9 in the extension 10. The compressed charge in the compression chamber and hollow piston at the time of the opening of the ports 14 flows through the ports into the explosion chamber 19 and assists in driving the burned gases out through the exhaust port 17. On succeeding upward stroke of the piston due to revolution of the crank, the stem and sleeve ports 13 and 14 are closed and the charge introduced into the explosion chamber 19 surrounding the

stem 8 is compressed into comparatively small compass as will be understood from Fig. 3.

Upward movement of the piston in the cylinder tends to produce a negative pressure in the crank case and interior of the piston which is normally closed to atmosphere and as the piston reaches its uppermost point of movement the intake ports 20 are opened to the compression chamber. These ports are connected by means of a manifold with a carbureter 21 and, by reason of the negative pressure in the compression chamber and cylinder, a charge flows thereinto from the carbureter to the extent demanded by the extent of vacuum produced therein.

With the piston at its uppermost point as shown in Fig. 2 the compressed charge in the explosion chamber is ignited by means of a spark plug 22 and the piston driven downward on its power stroke. This movement of the piston compresses the gases in the crank case, or compression chamber, and cylinder so that at the time the stem and sleeve ports 13 and 14 are opened, which is at the bottom of the stroke of the piston, the charge in the hollow piston and compression chamber is under its highest pressure and this pressure is relieved to a degree determined by the extent of opening of the ports 13 and 14. If the ports 14 are only slightly opened only a small charge will flow into the explosion chamber, and if fully open a greater charge will flow thereinto. The amount of charge delivered into the explosion chamber will determine the degree of vacuum attained in the compression chamber and hollow piston on upward movement of the piston. Thus, if a small charge be delivered into the explosion chamber, then, on upward movement of the piston and opening of the inlet ports, only a small charge may be introduced into the compression chamber due to the small degree of vacuum produced therein. If a greater amount of charge is delivered into the explosion chamber, then, on upward movement of the piston a greater degree of vacuum is attained in the compression chamber requiring a greater volume of flow of fuel from the carbureter to supply the same. It will thus be seen that the volume of fuel is maintained practically constant in the compression chamber and the piston so that on the down stroke of the piston the pressure prior to the opening of the ports 13 and 14 is the same at all times. By reason of the delivery of the fuel charge at the upper end of the cylinder, the greatest possible distance away from the crank case and through the heated stem 8, condensation occurring in the crank case is unlikely to materially vary the character of the inflowing charge as regards the percentage of oil to air. By reason of the charge flowing into the explosion chamber being uniform in character the throttling of the engine may be accomplished as readily as with the usual four-cycle type of engine and the engine therefore flexible as regards the variability in speed of operation and power attained.

To throttle the engine, the sleeve 9 is turned about its longitudinal axis in the threads 11 provided therefor in the extension 10 of the cylinder head. This sleeve may be turned by means of a lever 30 clamped about the upper end of the sleeve as shown, and this handle extends laterally across the face of a retainer segment 31. This segment has notches 32 in the upper face thereof and the arm 30 carries a spring-pressed ball 33 adapted to seat in the notches to prevent accidental displacement of the handle, and thus the handle may be set at any position on the segment as is required for the desired time of opening the ports 13 in the stem 8. As will be understood from Fig. 4, the upper face of the segment lies at an angle to the horizontal, the reason for this being that upon turning the sleeve about its longitudinal axis it is moved longitudinally of its axis and the angle of the upper face of the segment 31 corresponds to the variation in height of the handle upon the turning of the same for the purpose of throttling.

The various positions of the sleeve 9 by movement of the lever are shown in Figs. 1 and 5. In Fig. 1 the ports 13 are shown only partially open whereby the charge flowing into the explosion chamber is restricted in volume. In Fig. 5 the ports are shown as being fully open at the time the upper end of the stem 8 has moved downward with the piston and by the notches 32 provided in the segment 31 the position of the ports 14 relative to the ports 13 may be varied to any desired extent. The upper end of the cylinder, as before stated, is threaded to receive the sleeve and the upper tubular portion 10 of the cylinder end is externally threaded to receive a cap 41. Packing 42 is provided between the end of the cap and the end of the tubular portion 10 to prevent leakage of the gas in the interstice between the wall of the sleeve 9 and the inner face of the tubular extension.

No attempt is made in the drawings shown to give the exact sizes of the ports or piston stroke which vary depending upon the design of the engine, but the relationship of the parts and the piston length to control the ports; that is, to open the exhaust port at the downward stroke and maintaining the intake port of the cylinder until completion of the upper stroke is clearly disclosed as is also the relationship of the ports 13 in the stem of the piston to the ports 14 of the sleeve valve 9.

It is evident from the foregoing description the device is extremely simple in construction and is readily and easily controlled in operation, and the various objects of the invention heretofore mentioned are accomplished.

What I claim and desire to secure by Letters Patent of the United States is—

1. In an internal combustion engine, a cylinder having intake and exhaust ports in adjacent relation intermediate its ends, a cylindrical extension at the head thereof, a cylindrical, open-ended sleeve adjustably mounted in the extension, a hollow piston reciprocable in the cylinder, and controlling the said intake and exhaust ports, the intake port being opened to the interior of the piston on completion of upward stroke and the exhaust port being opened to the exterior of the piston on the completion of the downward stroke, a central hollow stem on the piston extending into the sleeve, the stem having ports at the upper end and the sleeve having ports opening within the cylinder with which the ports of the stem are adapted to register, the said stem ports being opened subsequent to the time of opening of the exhaust ports of the cylinder by the piston and providing a means for throttling the compressed charge, and means for supplying the interior of the piston and stem with a fuel charge.

2. In an internal combustion engine, a cylinder having a cylindrical extension provided in the head thereof, a sleeve rotatably mounted in the extension and projecting into the cylinder, a hollow piston reciprocable within the cylinder and having a ported extension reciprocable in the sleeve, the parts thereof being adapted to be opened and closed by the said sleeve, a compression chamber closed to atmosphere into which the piston and cylinder both open, said cylinder having an exhaust port opened at the completion of the power stroke of the piston and an intake port below the exhaust port opened at the completion of the upward movement of the piston, a fuel supply device connected with the intake port, and means for varying the position of the sleeve longitudinally of its axis to vary the time and extent of opening of the ports in the piston extension substantially as described.

3. In an internal combustion engine, a cylinder having a tubular extension provided at the head thereof, a sleeve in threaded relation with said extension having ports opening into the cylinder, means for turning the sleeve to vary the vertical position of the ports, a hollow piston reciprocable within the cylinder having a hollow stem extending into the said sleeve, the stem having ports adapted to open the sleeve ports to the interior of the piston, a compression chamber normally closed to atmosphere into which both the cylinder and piston open, the cylinder having an exhaust port opened at the completion of the power stroke of the piston and an intake port below the exhaust port opened at the completion of the upward movement of the piston, a fuel supply device connected with the said intake ports, the downward stroke of the piston compressing the gases in the compression chamber and hollow piston to discharge the same through the sleeve ports, the sleeve ports being opened just subsequent to the opening of the exhaust port and a succeeding upward stroke of the piston producing a degree of vacuum in the compression chamber determined by the volume of fuel previously discharged through the sleeve ports, the intake port being open to the compression chamber when the greatest degree of vacuum has been attained therein and a carbureter connected with the intake port.

4. In an internal combustion engine, a cylinder having intake and exhaust ports and provided with a tubular extension at the head thereof, a ported sleeve extending into the cylinder and mounted in threaded relation with said tubular extension, a piston reciprocating in the cylinder and controlling the intake and exhaust ports provided therein, said piston having a central hollow stem extending into the sleeve and adapted to open the ports therein to the interior of the piston subsequent to the time of the opening of the exhaust port by the piston, means for supplying the interior of the piston with a charge under compression at the time of opening of the sleeve ports, and means for varying the position of the sleeve to vary the time and extent of opening of the ports therein relative to the ports in the said stem of the piston.

5. In an internal combustion engine, a cylinder having intake and exhaust ports intermediate its ends and being provided with a tubular extension at the head thereof, a sleeve in threaded relation with the tubular extension and extending into the cylinder, said sleeve having ports, a piston reciprocable in the cylinder and controlling the intake and exhaust ports therein, the piston having a central hollow stem extending into the sleeve adapted to open the ports therein to the interior of the piston at the time of the opening of the exhaust ports by the piston, means for supplying the interior of the piston and stem with a fuel charge placed under compression at the time of the opening of the sleeve ports to the interior of the piston, and manual means for varying the position of the sleeve to vary the time and extent of opening of the ports therein.

In testimony whereof, I sign this specification.

EDWARD M. LAWLER.