No. 861,711. PATENTED JULY 30, 1907.

J. CROFT.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 4, 1906.

3 SHEETS—SHEET 1.

FIG. 1

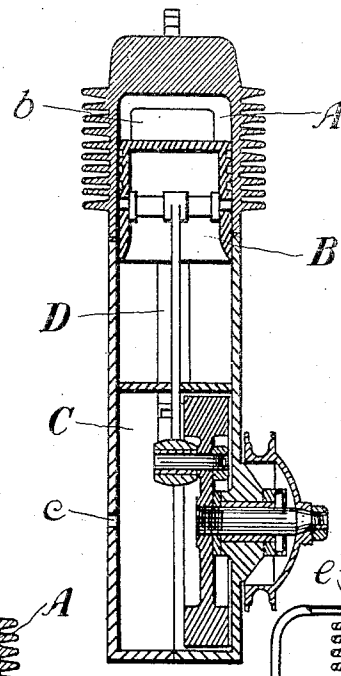


FIG. 2

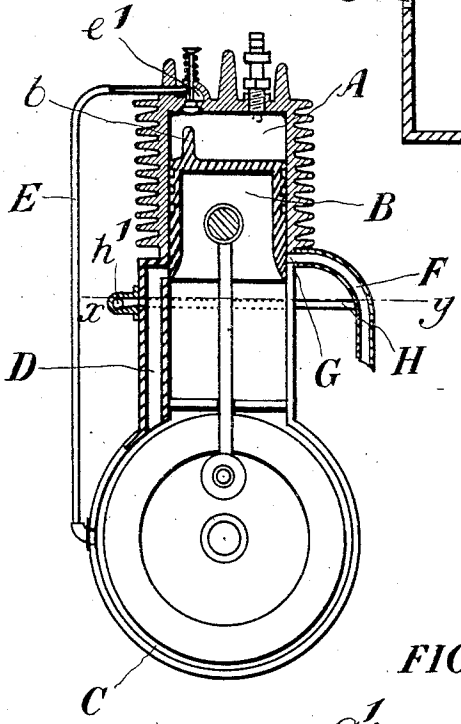


FIG. 3

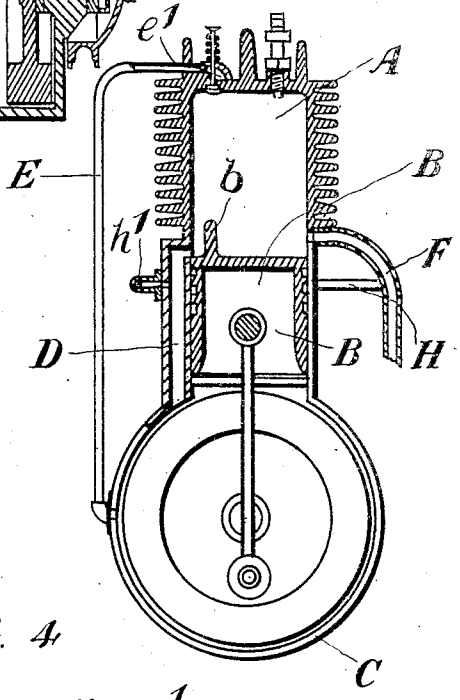
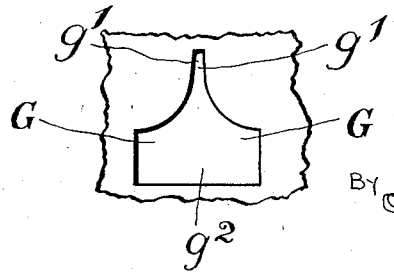


FIG. 4



WITNESSES:

George J. Schoenlank

Frank H. Logan.

INVENTOR,

John Croft,

BY W. H. Berrigan,

Attorney.

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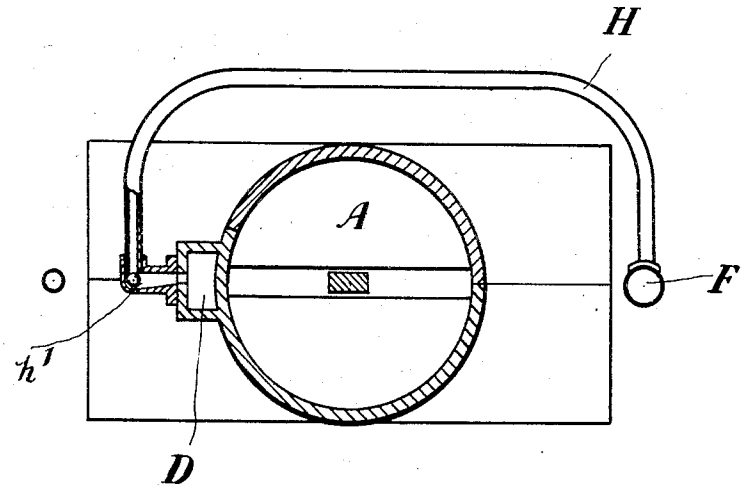
3 SHEETS—SHEET 2.

FIG. 2 A



WITNESSES;

John H. Hoving.

F. H. Logan.

INVENTOR,

JOHN CROFT,

BY John K. Berrigan.

Attorney.

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J. CROFT.

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3 SHEETS—SHEET 3.

FIG. 5

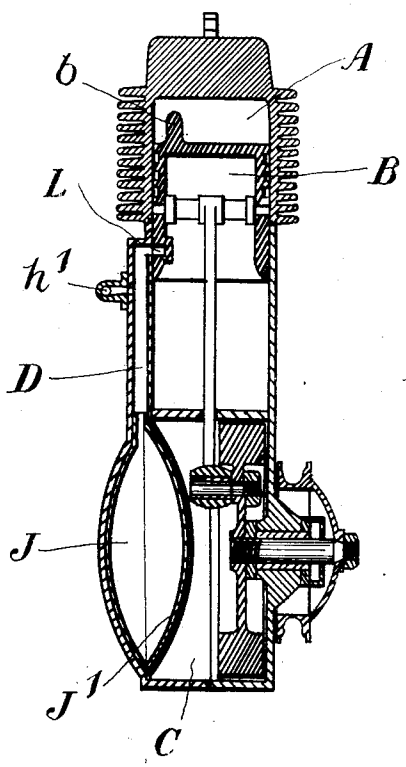


FIG. 6

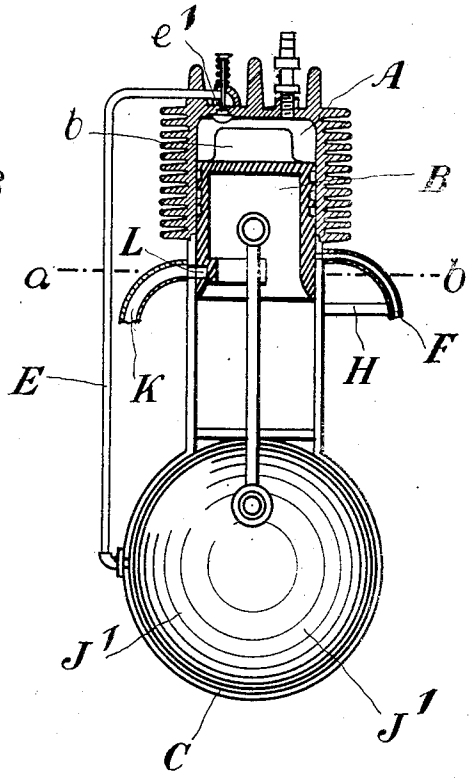
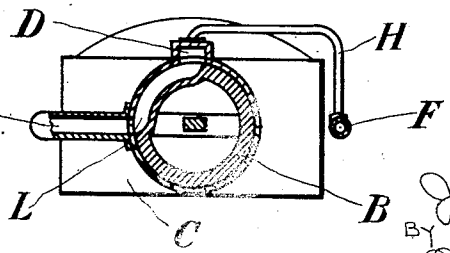


FIG. 7



WITNESSES;

George G. Schoenlank

Frank A. Hogan.

INVENTOR,

John Croft,

BY Thos. H. Berrigan,

ATTORNEY.

UNITED STATES PATENT OFFICE.

JOHN CROFT, OF BIRMINGHAM, ENGLAND, ASSIGNOR OF THREE-FOURTHS TO BENJAMIN JAMES BROADWAY, WILLIAM LINGHAM BROADWAY, AND JOSEPH BANNER BROADWAY, OF BIRMINGHAM, ENGLAND.

INTERNAL-COMBUSTION ENGINE.

No. 861,711. Specification of Letters Patent. Patented July 30, 1907.

Application filed October 4, 1906. Serial No. 337,401.

To all whom it may concern:

Be it known that I, JOHN CROFT, a subject of the King of Great Britain, residing at 131 Great Hampton street, Birmingham, in the county of Warwick, England, manufacturer, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

The invention consists of internal combustion engines and has for its object the construction of an engine with a higher efficiency which is more regular and silent in its working, easier in its control and in which the liability to back firing is practically entirely obviated. The engine is moreover very simple in its construction and may allow of the induction valve and exhaust and operating mechanism being dispensed with.

The improvements are particularly intended to be applied to engines of the type receiving an impulse every revolution but may also be applied to engines receiving an impulse every two revolutions. In this type the petroleum vapor is led into the crank case from which it passes to the cylinder head or combustion chamber by a side passage under impulse from the piston.

With the object of conserving the power and fuel a passage is arranged from the compression space of the cylinder back to the crank case with a control from the handle bar steering post, or other convenient position, so that when on less than full power a portion of the gases may be returned to the crank case. To prevent back firing a pipe or passage is carried from the exhaust pipe round to the side passage which latter leads the combustible element to the combustion space of the cylinder. A suitable valve is arranged at the entry of the pipe into the side passage so that on the suction of the piston following an exhaust, the damp remains of the products of combustion in the exhaust pipe caused by the formation of steam resulting from the rapid burning of the hydro-carbons in the presence of oxygen, is drawn into the side passage and forms a layer of non combustible matter in the side passage between the cylinder where burning may still be taking place and the crank case where the next charge is drawn in. This layer effectually prevents the danger of back firing and mingling with the charge as it passes into the cylinder enables it to sustain a higher degree of compression giving an explosion enhanced power.

The aperture for the exhaust in the cylinder is formed in a special way, having a narrow slit at its upper part toward the cylinder head, which is continued for some distance and gradually widening;—the widening becomes suddenly more pronounced until it finishes in a regular square or other opening. This is designed to produce a restricting and lengthening of the passage of the exhaust gases through the opening, diminishing their velocity and causing a gradual instead of the sudden expansion usually the case on opening into the atmosphere, thus a comparatively silent exhaust is effected.

In some cases, in the crank case a separate chamber is provided, preferably formed by a bag of flexible material and in any case is limited as to expansion on its inner side (that is towards the interior of crank case) by a suitable metallic guard or division. This flexible bag is in direct communication with the cylinder by means of the side passage which in other circumstances opens into the crank case itself. The induction pipe is arranged to open into the cylinder at a point approximately at right angles to, but on a line with the opening of the side passage and in the piston head I form a passage following the contour of the piston for a quarter of its circumference and this passage is adapted to come into the same plane and open communication with the before mentioned openings to the induction pipe and to the side passage when the piston is at the top of its stroke. As the piston rises to this position the flexible bag is inflated and its contents expelled to the cylinder compressed and fired, but as the piston reaches the top of the stroke the inner side of the bag is drawn out by the suction produced in the crank case and a vacuum which as the piston port comes opposite the induction pipe and side passage draws the charge into the latter and thence to the bag when the opening is again cut off by the piston on its descent until it is opened by the piston head clearing it when the bag is deflated and the charge expelled to the cylinder.

In the accompanying drawings;—Figure 1. is a vertical section of the engine looking from the front. Fig. 2. is a vertical section taken at right angles to Fig. 1. Fig. 2^A is a horizontal sectional view on the line *x*—*y* of Fig. 2. Fig. 3. is a similar view with the piston at the bottom of its stroke. Fig. 4. is an elevation of the exhaust opening showing its special shape. Fig. 5. is a vertical section of the engine constructed with the flexible division of the crank case. Fig. 6. is a vertical section taken at right angles thereto. Fig. 7. is a horizontal sectional plan on line *a*—*b* of Fig. 6.

In the construction shown at Figs. 1, 2, 3, and 4, A is the cylinder, B is the piston with usual deflect *b* and C is the crank case; the combustible material is drawn into the crank case at *c*, the intake being controlled by a valve in the usual manner. From the crank case C the side passage D communicates with the cylinder A and the combustible material passes to the cylinder from

the crank case through this passage under impulse from the piston in the manner common to this type of motor. The passage for returning portions of the gases from the cylinder to the crank case when working at less than full power is arranged from the cylinder head by the pipe E controlled by the valve e^1 operated from the handle bar or other convenient part. The pipe E passes down and opens direct into the crank case as clearly seen at Fig. 2. This arrangement enables a considerable saving in fuel to be effected as before stated.

From the cylinder A, exhaust takes place by a pipe F ending in the usual silencer; the aperture G in the cylinder leading to the pipe however is formed in a special manner having a narrow slit g^1 at its upper part, continuing some distance and gradually widening until it suddenly opens out into a regular square or other lower part g^2. As stated this effects a gradual release of the exhaust gases and is found to effectually reduce the resulting noise following the expansion of the gases on opening into the atmosphere.

From the exhaust pipe F a pipe H is carried round to the side passage D providing it at its entry into the passage with a ball or other valve h^1 (as shown in Fig. 2^A) for opening or closing the pipe according to the impulse from the piston. This pipe upon suction from the piston carries the vapor formed in the pipe F by the exhaust to the side passage D forming in that passage a layer of incombustible matter which entirely prevents back firing, and which, mingling with the charge as it passes to the piston enables on explosion enhanced power to be obtained due to the formation of steam in the cylinder.

In the arrangement shown at Figs. 5, 6, and 7, the crank case C is divided and on one side is arranged a flexible compartment J which is limited on its inner side by a metal or other guard J^1. This flexible bag or compartment is secured at its upper end in the lower part of the side passage D so that the only communication the passage has with the crank case is with the bag. The induction pipe for the petroleum vapor or other combustible is arranged to enter the cylinder at K, the opening of the pipe being on a line with the opening of the passage D. For providing a means of communication between the two, so that the charge may pass into D, the piston B is formed with a port L extending for a quarter of its inner contour or other distance corresponding to the relative positions of the port K and opening of passage D. By this arrangement, when the piston is at the top of its stroke, the two passages are placed in communication and the charge drawn into the bag or compartment J from which it is expelled and passes to the cylinder on the descent of the piston as already explained. In this case the return E from the cylinder and the pipe H from the exhaust pipe F and the other parts are as in the case illustrated at Figs. 1, 2, and 3, except that the pipe communicates with the bag J instead of the crank case proper. It will be seen that the flexible compartment enables me to dispense with the usual induction valve while the proper charge is drawn into this compartment by the port in the piston and is regulated by the size of that port.

The illustrations and the foregoing descriptions refer only to a motor with a single fly wheel and bearing on one side only but the invention is of course equally applicable to a motor with two as it would only be necessary to provide the division of the crank chamber stout enough to carry the bearing.

What I claim then is:—

1. In an internal combustion engine, having a casing, a cylinder, and an exhaust pipe from the latter, a supply passage communicating with said cylinder and said casing, means for drawing the damp remains from the exhaust pipe and for preventing back firing, and comprising a passage provided with a valve and connecting the first-named passage with said exhaust pipe, in combination with separate means for returning fuel from the cylinder to the crank casing when working at less than full power and thereby varying the charge in said cylinder and the exhaust through said pipe.

2. In an internal combustion engine having a crank casing, a cylinder and an exhaust pipe from the latter, means for supplying fuel to said crank casing, a supply passage from the latter to the cylinder, and means for drawing the damp remains from the exhaust pipe and for preventing back firing, and comprising a passage provided with a valve and connecting the first-named passage with said exhaust pipe.

3. In an internal combustion engine having a crank casing, a cylinder and an exhaust pipe from the latter, means for supplying fuel to said crank casing, a piston having a port therein and operating in said cylinder and a crank in said casing for operating said piston, a supply passage from the casing to the cylinder and for registering with the port in the piston, and means for drawing the damp remains from the exhaust pipe and for preventing back firing, and comprising a passage with which the port of the piston is brought into register and which is provided with a valve and connecting the first-named passage with the exhaust pipe.

4. In an internal combustion engine having a crank casing, a cylinder, and an exhaust pipe from the latter, means for supplying fuel to said casing, a supply passage communicating with said cylinder, and said casing, and means for returning non-combustible matter from said exhaust pipe to said supply passage.

5. In an internal combustion engine, a crank casing having a flexible compartment, a cylinder, and an exhaust pipe from the latter, in combination with a supply passage communicating with said cylinder and said flexible compartment, and means for returning non-combustible matter from said exhaust pipe to said supply passage.

6. In an internal combustion engine, a casing, a cylinder, an exhaust aperture from the latter and having a slit gradually widened and becoming suddenly more pronounced, an exhaust pipe connected with said aperture, a supply passage leading to the cylinder, and means for returning non-combustible matter from said exhaust pipe to said supply passage.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN CROFT.

Witnesses:
F. GILBERT BRETTELL,
STANLEY BANNER.