

No. 644,951.

Patented Mar. 6, 1900.

J. E. THORNTON & J. P. LEA.
INTERNAL COMBUSTION ENGINE.

(Application filed Aug. 1, 1898.)

(No Model.)

2 Sheets—Sheet 1.

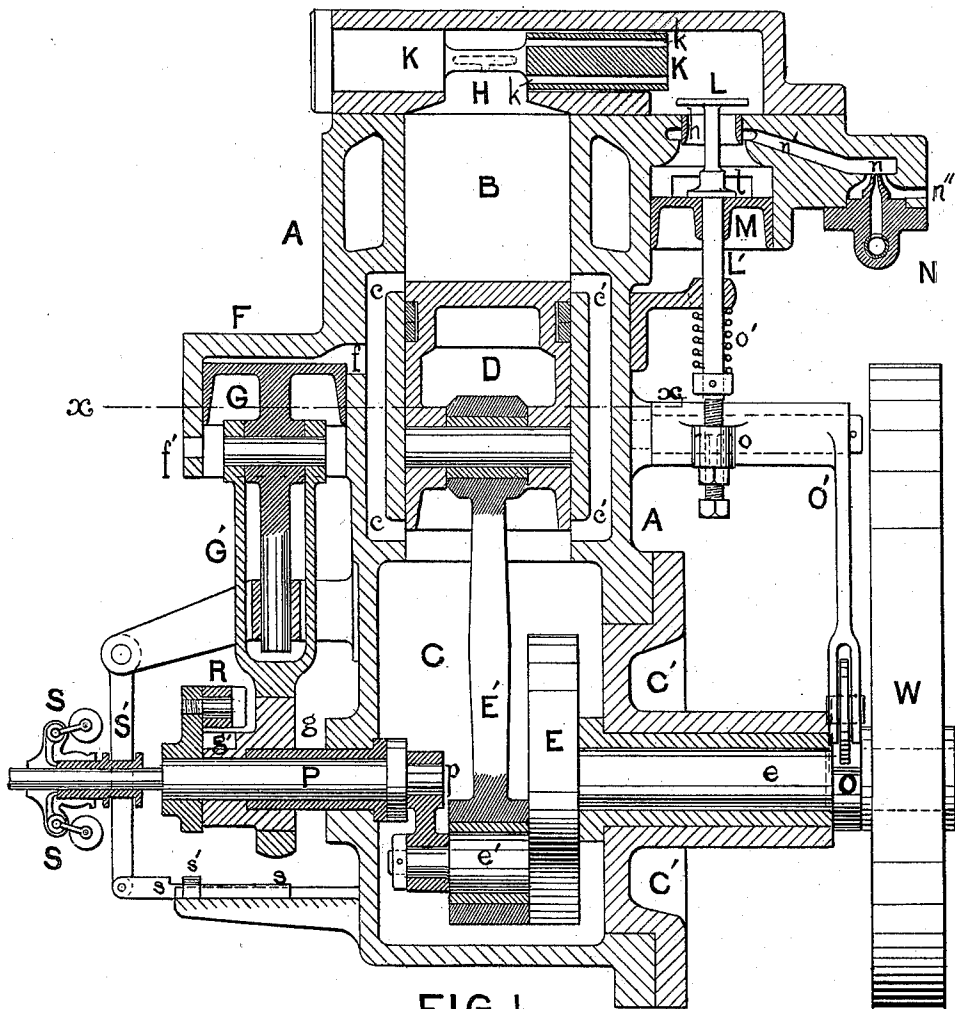


FIG. 1.

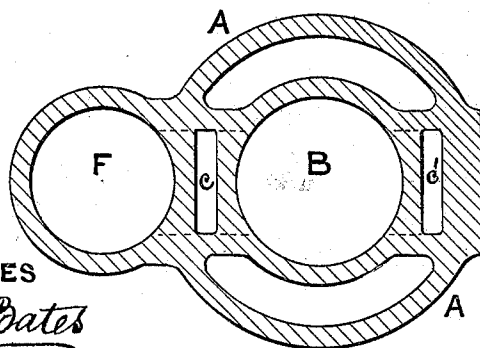


FIG. 2.

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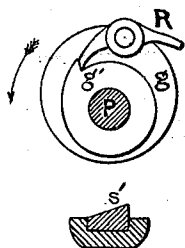


FIG. 4.

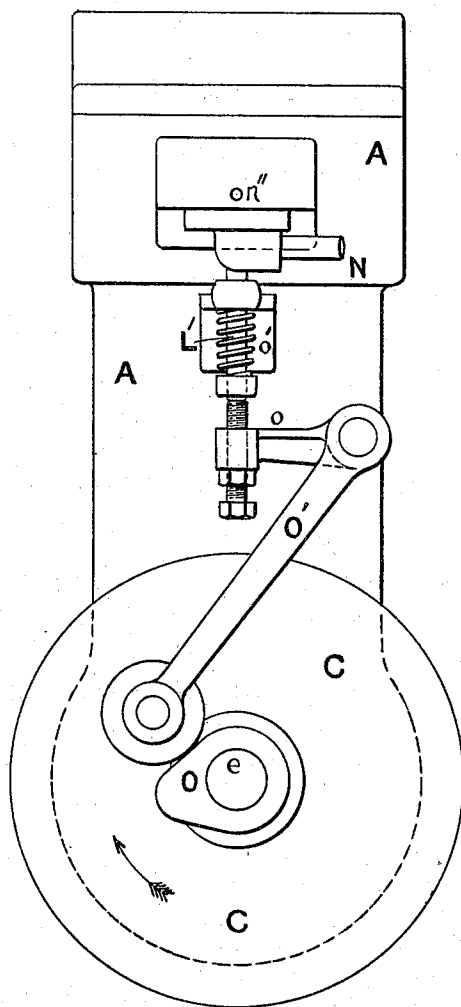


FIG. 3.

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UNITED STATES PATENT OFFICE.

JOHN E. THORNTON, OF ALTRINGHAM, AND JAMES P. LEA, OF MANCHESTER, ENGLAND.

INTERNAL-COMBUSTION ENGINE.

SPECIFICATION forming part of Letters Patent No. 644,951, dated March 6, 1900.

Application filed August 1, 1898. Serial No. 687,469. (No model.)

To all whom it may concern:

Be it known that we, JOHN EDWARD THORNTON, of Altringham, in the county of Chester, and JAMES POLLARD LEA, of Hulme, Manchester, in the county of Lancaster, England, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to improvements in internal-combustion engines, and is applicable with special advantage to such as work with heavy petroleum-oil or the like combustible.

The invention will be fully described with reference to the accompanying drawings.

Figure 1 is a sectional elevation; Fig. 2, a sectional plan on line *x x*, Fig. 1; Fig. 3, a side elevation; Fig. 4, an end view of eccentric *g* and pawl *R* for actuating same.

The casing or casting *A* comprises a cylinder *B*, in which the piston *D* works, a closed or air-tight chamber *C*, in which the crank *E* rotates, a second or auxiliary cylinder *F*, with a piston *G*, and a combustion-chamber *H*, with a vaporizer or charge-heater of special type.

The main or working cylinder *B* is separated or divided from the air-chamber *C* by the piston *D* and is connected thereto by the ports *c*, through which air compressed in the chamber *C* can at a certain position in the stroke of the piston *D* pass into the cylinder *B*.

At the side of the main cylinder *B* is placed a secondary or auxiliary cylinder *F*, which communicates with the main cylinder *B* and the air-chamber *C* by the ports *c* and *c'*. It is also in connection with the outer atmosphere by the port *f*. The piston *G* is moved to and fro in the cylinder *F* by an eccentric *g* and connecting-rod *G'*.

The main cylinder at the end remote from the crank is connected with or opens into a combustion or ignition chamber *H*, at the other end of which is a port *h*, closed by a valve *L*, of the usual disk type, on the end of a reciprocating valve-rod *L'*, by which it is opened and closed.

In the combustion or explosion chamber *H* is placed a charge-heater *K*, consisting, essentially, of a block or piece of metal with a number of passages *k*, which present a large surface to such gases as pass through it in either

direction. The capacity of these passages is small compared to the contents of the main cylinder. The charge-heater *K* is so constructed and arranged or placed that it absorbs heat from the intensely-hot gases which are in it during the working stroke of the main piston, and thus it may assume a temperature considerably higher than that of its working charge when fully expanded. The expanded charge as it leaves the cylinder passes through the charge-heater and carries off any excess of heat. Thus in ordinary work the charge-heater cannot fall in temperature lower than that of the fully-expanded charge at its moment of exhaust and cannot rise very much above it. The charge-heater is thus maintained at a practically-uniform temperature. Finely-divided oil mixed with a small amount of air is drawn through the charge-heater and heated thereby to vaporize the oil. The heat thus abstracted is more than replaced during the subsequent explosion or working stroke.

The spindle or rod *L'* of the exhaust-valve *L* is fitted with a piston-valve *M*, which opens and closes the exhaust-port *l*, so that the port *h* serves both for exhaust and the admission of part of the fresh charge. The oil enters from a pipe *N*, connected with the oil-supply, through a nozzle *n* into the ports *n'*, into which air is admitted through the port *n''*. The exhaust-gases in escaping pass through the charge-inlet port or nozzle *h*, which, extending over port *n'*, is similar in its action to an injector, thereby preventing the exhaust traveling down the inlet-port.

The exhaust-valve *L* is actuated by a cam *O* of suitable shape on the crank-shaft *e* and a spring *o'* on the spindle through a lever *O'*, pivoted to the side of the casing *A*, with an adjustable arm *o*, which engages the end of the valve-rod *L'*.

The crank *E* is situated in the air-chamber *C* and is connected to the piston by the crank-rod *E'*, being actuated or rotated in the usual way therefrom, the rotary movement being transmitted to the fly-wheel *W* on the crank-shaft *e*. The side of the chamber *C* is made with a cover *C'*, through which the crank-disk *E* is inserted in position. At the opposite side of the chamber is a small shaft or

spindle P, rotated as the crank rotates by a drag-link or connecting-link *p*, fitted to the crank-pin *e'*.

The eccentric *g*, by which the auxiliary piston G is actuated, is free to rotate around the shaft and at one side is fitted with a boss with a ratchet-notch *g'* therein. In the notch *g'* a pawl or catch R, carried around by the spindle P, engages and rotates the eccentric. Should the pawl R be thrown out of engagement, the piston G ceases to act.

On the end of the spindle P is placed a governor S, which as the speed varies moves the pivoted lever S' to and fro and with it the sliding piece *s*, with a projection *s'*. When the engine is running at normal speed, the projection *s'* on the sliding piece *s* is clear of the pawl R; but when running at an excessive speed the balls of the governor S expand and move the sliding piece *s* until the projection *s'* engages the tailpiece of the pawl R and throws it out of the notch *g'*, thus allowing the main piston D to make a stroke without the auxiliary piston G being moved.

The piston G stands when stopped by the governor at the bottom of its stroke, so as to leave port *f'* open and the crank-chamber open to the atmosphere.

The auxiliary piston G performs the double function of a valve to admit air to the air-chamber C and to draw the charge of oil and air into the main cylinder B.

The operation of the engine is as follows: In the position shown in the drawings the main piston D has nearly completed its working or power stroke. The exhaust-valve L is open, and the auxiliary piston G is near the end of its inward stroke, and the main piston has compressed the air contained in the air-chamber C. As soon as the exhaust-valve L is opened the heated gases of combustion pass through the charge-heater K, carrying off any excess of heat from it before passing the exhaust-valve L, leaving the charge-heater K at a high temperature, as previously described. The compressed air in the chamber C as soon as the upper ends of the ports *c c'* are uncovered passes through them into the main cylinder B and expels the remaining products of combustion which have not escaped of their own pressure. As the piston D travels farther the lower ends of the ports *cc'* are closed by it, thus shutting off the crank-chamber from the cylinder during the suction-stroke of the auxiliary piston G. At the same time the piston-valve M on the exhaust-valve spindle L' is raised and closes the exhaust-port *l* and the auxiliary piston G moves on sharply on its outward stroke. The outward stroke of the auxiliary piston G draws a charge of oil and air through the port *h* and charge-heater K into the interior of the main cylinder before the main piston moves sufficiently far on its return stroke to close the upper end of the port *c'*. The exhaust-valve L is then closed by the operation of the cam O on the crank-shaft and the spring *o'*, and the main

piston D continues its return stroke, compressing the charge and drawing air into the chamber C through the port *f'*, which has been uncovered toward the close of the outward stroke of the piston G. The combustible part of the charge is thoroughly heated and vaporized by the charge-heater K as it is drawn in, and at the completion of the compression-stroke of the main piston it is ignited and exploded, driving the main piston again forward. The auxiliary piston G, commencing its return stroke, closes the port *f'* as the main piston approaches the completion of its compressing stroke. While the main piston is dwelling at its inner dead-center, the piston G makes the greater part of its return stroke, forcing the air in the cylinder F into the air-chamber through the port *f*, thus increasing the amount of air compressed therein, which at the end of the power-stroke rushes into the cylinder to force or sweep out the remaining exhaust-gases. The governor acts by stopping the movement of the auxiliary piston G in such a position for one or more strokes when the speed is so high that air cannot be compressed in chamber C, and also preventing the drawing of a charge into the cylinder B.

What we claim as our invention, and desire to protect by Letters Patent, is—

1. An internal-combustion motor comprising in its construction a main cylinder B, a main piston D working therein, an air-chamber C at the back of the piston communicating with the main cylinder by ports *c c'* in which air is compressed and forced into the main cylinder at the completion of the stroke of the piston, an auxiliary cylinder F and piston G communicating both with the main cylinder and the air-chamber by which the combustible part of the charge is drawn into the main cylinder (and air forced into the chamber) a charge-heater K at the end of the cylinder by which the charge is vaporized and valve L and port *h* by which the exhaust is discharged and the combustible part of the fresh charge drawn in, substantially as described.

2. In an internal-combustion motor the combination with the main cylinder B, main piston D and air-compressing chamber C connected to the cylinder by the ports *c c'* of the auxiliary cylinder F connected to the main cylinder and air-chamber by the ports *f* and *c* and with the atmosphere by the port *f'* and the auxiliary piston G by which the combustible part of the charge is drawn into the cylinder and air forced into the air-chamber, substantially as described.

3. In an internal-combustion engine the combination with the main cylinder B and piston D, the air-chamber C connected thereto by ports *c* and *c'*, the auxiliary cylinder F and piston G connected by ports *f* and *c*; of the charge-heater K by which the combustible part of the charge is heated; the exhaust-valve L controlling the port *h*, the piston-valve M, controlling the port *l* and the oil-inlet noz-

zle in the inlet-port *n*, substantially as described.

4. In an internal-combustion engine the combination with the main cylinder B and piston D and air-chamber C connected thereto by ports *c* and *c'* of the auxiliary cylinder F and piston G connected thereto by the ports *f* and *c* by which the charge is drawn into the cylinder and the air forced into the air-compressing chamber substantially as described.

5. In an internal-combustion engine the combination with the main cylinder B, main piston C and crank E of the auxiliary cylinder F and piston G the eccentric for operat-

ing the auxiliary piston, the pawl rotated by the spindle engaging therewith, the governor on the rotating spindle, and the sliding piece with projection to engage the pawl and throw it out of gear when the speed is excessive, substantially as and for the purpose described.

In witness whereof we have hereunto signed our name in the presence of two subscribing witnesses.

J. E. THORNTON.

J. P. LEA.

Witnesses:

J. OWDEN O'BRIEN,
JOSEPH BATES.