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FUEL INJECTOR FOR HIGH COMPRESSION INTERNAL COMBUSTION ENGINES.

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1,361,711. Patented Dec. 7, 1920.

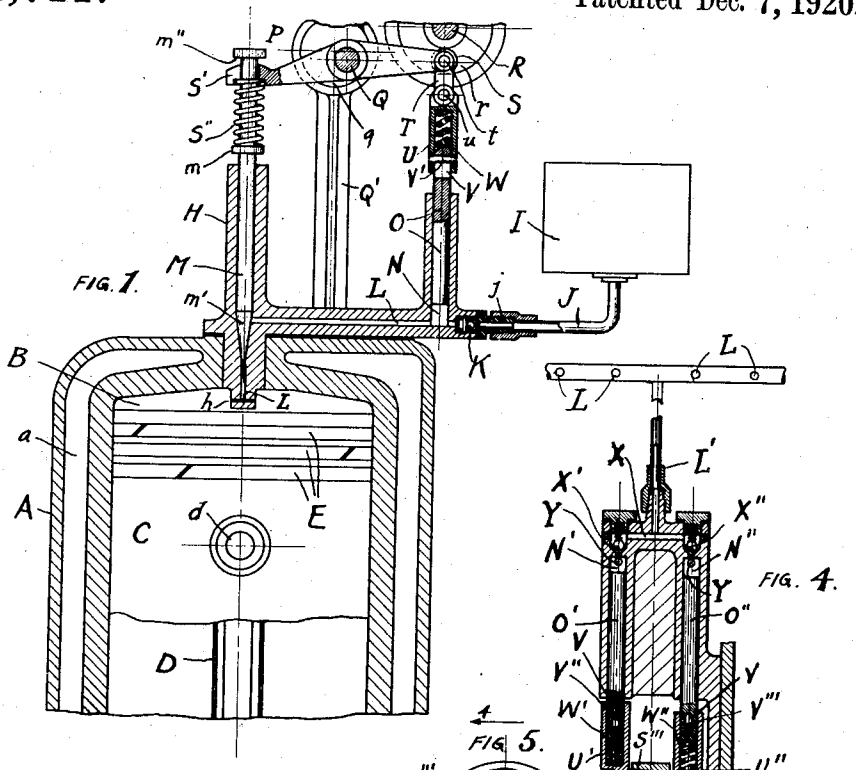


FIG. 1.

FIG. 4.

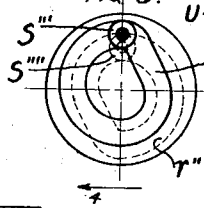


FIG. 5.

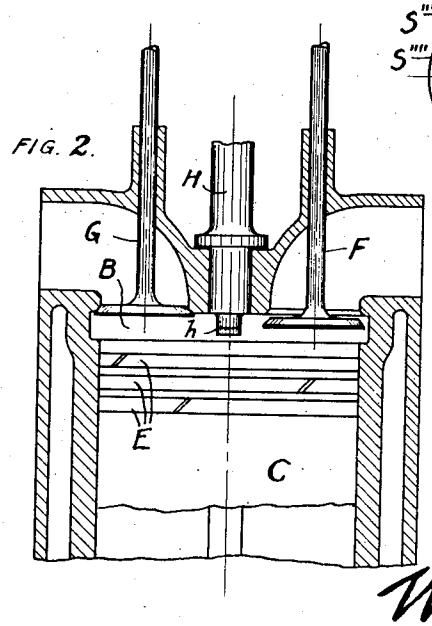


FIG. 2.

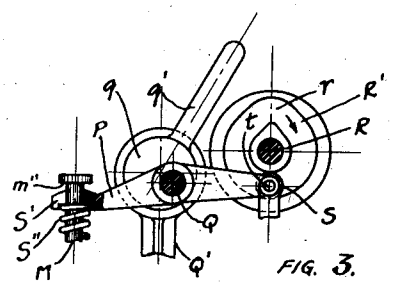


FIG. 3.

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FUEL-INJECTOR FOR HIGH-COMPRESSION INTERNAL-COMBUSTION ENGINES.

1,361,711. Specification of Letters Patent. Patented Dec. 7, 1920.

Application filed August 5, 1918. Serial No. 248,257.

To all whom it may concern:

Be it known that I, WALDO G. GERNANDT, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Fuel-Injectors for High-Compression Internal-Combustion Engines, of which the following is a specification.

This invention relates to fuel injectors adapted to be used in single or multiple cylinder high compression internal combustion engines.

One object of the invention is to obtain a fuel injector whereby the speed or work of the engine is controlled by the manipulation thereof; and to accomplish said object, the fuel injector is made so that by said manipulation the quantity of fuel discharged thereby, at timed intervals, into the combustion chamber of the engine is controlled, being lessened or increased as the exigency of the occasion demands.

A further object of the invention is to obtain a device whereof the operation is continuous and the determined maximum pressure at which fuel is injected into said combustion chamber, or chambers, is not increased by said continuous operation.

Additional objects are disclosed in the specification and claims.

I have illustrated devices embodying this invention in the drawing accompanying and forming a part hereof in which,

Figure 1, is a vertical sectional view of the upper end of an engine cylinder, showing (in vertical section), a fuel injector embodying my invention mounted thereon;

Fig. 2 a like section of an engine cylinder, at an angle of ninety degrees from the illustration in Fig. 1, showing the discharge end of the fuel injector in elevation; and

Fig. 3, a vertical section of the upper end of the construction embodying the invention which is illustrated in Fig. 1.

Fig. 4 is a vertical section of a modification of the construction embodying the invention which is illustrated in Figs. 1 and 3, on line 4—4 of Fig. 5, and viewed in the direction indicated by the arrows; and

Fig. 5 is a side elevation of camways forming elements of the construction which is illustrated in Fig. 4.

A reference character applied to designate a given part indicates said part throughout the several figures of the drawing, wherever the same appears.

A, represents an engine cylinder provided with the water space *a*, combustion chamber B, piston C, connecting rod D, pivotally attached to piston C, by pin *d*, and the ordinary spring rings E. F, Fig. 2, represents the inlet valve and stem of the combustion chamber of the engine. H, represents the discharge end of the fuel injector embodying the invention, *h* being radial apertures thereto positioned in the combustion chamber B, in a plane adjacent to the plane of the end of the piston C, when said piston is at the end of its extreme inward movement or travel. I, represents a fuel supply tank. J represents a supply pipe or tube connecting the fuel supply tank I, as by union *j*, to the inlet end of a fuel injector embodying this invention. K, represents a check valve which comprises a ball arranged to permit the flow from the pipe J to the passageway L of the fuel injector. The passageway L, is illustrated in Fig. 1 as having two legs one thereof positioned at a right angle to the other, and M, represents a needle valve which is adapted, when closed, to obstruct the discharge end of said passageway L. The timing of the closing of needle valve M on its seat, relative to the piston C, and to the combustion which occurs in the combustion chamber B, is such that said valve is closed immediately after the ignition of fuel in said combustion chamber, while said piston is in the pre-determined position to be actuated by said ignition. Said position of the piston may be when it is substantially on what is termed its dead center and it is so illustrated in the drawing. N, Fig. 1, represents a pump cylinder and O a longitudinally movable piston in said pump cylinder. P, represents a lever which is pivotally mounted on pin Q, and said pin Q is illustrated as mounted on the eccentric *q*. Q′ represents a standard, the eccentric *q* being rotatably mounted at the upper end thereof. Both the vertical and horizontal position of pin Q is varied by the movement of the eccentric *q* in said upper end of standard Q′ and *q*′ represents a handle which is attached to eccentric *q*, to control the position thereof in said standard.

R, represents a rotatably mounted shaft which, in the constructions illustrated, may

turn continuously say in the direction which is indicated by the arrow R′, Fig. 3, and *r*, Fig. 1, represents a cam runway which is rigidly secured to said shaft.

One end of the pivotally mounted lever P is provided with a roller, S, with which roller the cam runway *r* engages and by means of which said end of lever P is advanced and retracted. The opposite end of said lever P is forked, as at S′, in Fig. 1. The upper end of the valve M is engaged by the forked end S′ of said lever P. S″ represents a spring which is mounted on valve M so that the lower end thereof abuts against the annular flange *m* on said valve M, and the upper end abuts against the lever P. By this construction the valve M is advanced and retracted by the pivotal movement of lever P, the advancing movement of said valve being imparted thereto through the said spring S″, and said retracting movement being applied directly to shoulder *m″* by the forked end S′. The interposing of said spring S″ between the forked end S′ of lever P and the shoulder *m* on valve M is to obtain some compression of said spring on the seating of end *m′* of said valve.

T, represents a link which is pivotally mounted on one end of the lever P, and the pin or pivot which connects said link to said lever is illustrated in Fig. 1 as being the pivot *t* on which the roller S is rotatably mounted. U, Fig. 1, represents a member which is mounted on the upper end of piston O, and at its upper end is attached to the link T by pin *u*.

The piston O, is provided with slot, V and the member U is provided with a pin, which is positioned in slot V. W represents a spring which is interposed between the upper end of piston O and member U.

By the construction last above described, the movement of the lever P is communicated to piston O when the pressure in pump cylinder N (and passageway L) is not sufficient to overcome the resiliency of the spring W; and when said pressure in said pump cylinder N is sufficient to overcome the resiliency of said spring, the member U advancing on the upper end of said spring W compresses said spring without producing corresponding advancing movement of piston O; the pin V′, at such time, moving in slot V.

It will be observed that the pressure in the pump cylinder N and in the passageway L between check valve K and valve M, said valve being seated, is at all times equal, and that when said pressure is greater than the pressure in the fuel supply pipe J it will close the check valve K, to prevent said pressure being communicated to said fuel supply pipe.

The camway *r* is timed relative to the piston C, to retract piston O when piston C is advanced to near the position where a low pressure is obtained in the engine cylinder and combustion chamber, and at said time the pressure in the pump cylinder N and passageway L between check valve K and the seated valve M is less than the pressure at the discharge end of the fuel discharge pipe J; and at said time fuel flows from said supply pipe through check valve K into passageway L.

Said camway *r* is also so constructed and timed relative to said piston C that when said piston C moves toward the combustion chamber to its point of maximum travel, thereby producing the greatest pressure which is obtained in said combustion chamber prior to ignition, piston O is advanced. This is effected as piston C approaches the end of its compression travel, by lever P, which is moved by cam runway *r* so that the forked end S′ thereof is brought into contact with shoulder *m″*, and continued movement of said lever unseats valve M. The travel of forked end S′ before said end contacts with shoulder *m″* is varied by the position of pivot Q, and said variation, as hereinbefore stated, is obtained by moving the eccentric *q* by means of handle *q′*. In the movement of the eccentric *q* and lever *q′* in a contrary clock-wise direction, as viewed in Figs. 1 and 3, the timing of the opening of the valve M relative to piston C is changed, it being opened earlier; the extent of the said opening is changed, it being opened wider; and the duration of said opening is also changed, it being opened for a longer time. Said changes do not destroy the timed relation of the opening of valve M relative to the position of piston C, nor does said change of position of pivot Q destroy the timed relation of the advancing movement of piston O, but the length of travel of said piston is increased, (see member U) correspondingly with the increased aperture through the valve seat of end *m′*, and the longer period of time during which the valve M is unseated, so that the variation in the quantity of fuel supplied to the combustion chamber B varies with the above named variations in the movement of valve M.

Upon the advance of the piston O, by camway *r*, the pressure in passageway L is increased sufficiently to force the contents thereof, (including the fuel therein) into said combustion chamber B through passageway *h*: and ignition of the fuel mixture obtained thereby will occur in said combustion chamber because of the high temperature of the contents of said combustion chamber; and said temperature is produced by the quick compression of the air contents of an engine cylinder of large capacity into a combustion chamber of rela-

tively small capacity, on the compression travel of the piston.

Where my invention is embodied in a construction such as is illustrated in Figs. 1 and 3 and hereinbefore described, and said construction is used in an engine having a plurality of piston cylinders and pistons, a corresponding number of said constructions is installed therein.

In the modification illustrated in Figs. 4 and 5 the number of constructions embodying my invention is less than the number of cylinders in the engine. Said modification comprises a plurality of camways as r', r'', a plurality of pump cylinders, N', N'', a plurality of pistons, O', O'', which are actuated by a plurality of mountings comprising rollers S''', S'''', members U', U'', pins V'', V''' in slots V, and springs, W', W''. Said modification is provided with the passageway X and check valves X', X'' interposed between the discharge end of cylinders N', N'' and the passageway L. Y represents fuel inlets to the cylinders N', N''.

The camways r', r'' are so constructed that there is quick retraction of the pistons O', O'', at timed intervals, an advancing movement of one of said pistons at all times, and advancing movement of both of said pistons most of the time. The compression of the contents of pump cylinders O', O'' and the discharge thereof into passageways X, L' and L, is, therefore, practically continuous, and the pressure so obtained is greater than the pressure in the combustion chamber B prior to the ignition therein.

In the constructions which are illustrated and described, the shaft R, camway r, and said shaft and camways r', r'' continuously rotate, and the maximum pressure in the pump cylinders N, N' and N'' which is obtainable by pistons O, O', O'', is determined by the resiliency of the several springs W, W' and W''.

In the constructions herein described and illustrated fuel from the fuel receptacle I flows into the passageway L on the retraction of the pistons O, O', O'' and on the simultaneous advance of said pistons and retraction of valve M a quantity of said fuel corresponding with the advance of said pistons is injected from said passageway into the combustion chamber.

In the construction which is illustrated in Figs. 4 and 5, and herein before described, the passageway L extends to a plurality of passageways L, said passageways L forming branches of the passageway L', respectively communicating at the discharge ends thereof with a corresponding combustion chamber of the engine; and each of said branches is provided with a valve M, which is in timed relation to the corresponding engine piston, as in the construction illustrated in Figs. 1, 2 and 3.

I claim:—

1. A fuel injector comprising, in combination, a passageway provided with branches, the discharge ends whereof communicate with the combustion chambers of an engine provided with a plurality of cylinders and movable pistons, means to obstruct said branches, means to supply fuel to said passageway, yielding means to obtain a pre-determined maximum pressure in said passageway and branches, and means to remove said obstructions in timed relation to said pistons.

2. A fuel injector comprising, in combination, a passageway provided with branches, the discharge ends whereof communicate with the combustion chamber of an engine provided with a plurality of cylinders and movable pistons, means to obstruct said branches, means to supply fuel to said passageway, yielding means to obtain a pre-determined maximum pressure in said passageway and branches, and means to remove said obstructions in timed relation to said pistons, said removing means comprising means to vary the timed relation the duration and the extent of said removal.

3. A fuel injector comprising, in combination, a passageway the discharge end whereof communicates with the combustion chamber of an engine provided with a cylinder and movable piston therein, means to obstruct said passageway, means to supply fuel to said passageway, yielding means to obtain a predetermined maximum pressure in said passageway, said means comprising a longitudinally movable piston, means to actuate said piston and a resilient member interposed between said actuating means, independent of said means to establish maximum pressure, and said piston and means to remove said obstruction in timed relation to said piston actuating means.

4. A fuel injector comprising, in combination, a passageway the discharge end whereof communicates with the combustion chamber of an engine provided with a cylinder and movable piston therein, means to obstruct said passageway, means to supply fuel to said passageway, yielding means to obtain a predetermined maximum pressure in said passageway, said means comprising a longitudinally movable piston, means to actuate said piston and a resilient member interposed between said actuating means, independent of said means to establish maximum pressure, and said piston and means to remove said obstruction in timed relation to said piston, said removing means comprising means to vary the timed relation, the duration and the extent of said removal.

5. A fuel injector comprising, in combination, a passageway provided with branches the discharge ends whereof communicate with the combustion chambers of an engine provided with a plurality of chambers and movable pistons, means to obstruct said branches of said passageway, means to supply fuel to said passageway, yielding means to obtain a pre-determined maximum pressure in said passageway, said yielding means comprising longitudinally movable pistons, means to actuate said pistons, and resilient members interposed between said actuating means and said pistons, said actuating means arranged so that one thereof is at all times advancing, and means to remove said obstruction in timed relation to said piston.

6. A fuel injector comprising a passage way the discharge end whereof is communicable with the combustion chamber of an engine, and means to supply fuel to the receiving end of said passage way, in combination with a fulcrumed lever, means to vary the position of said fulcrum, and means to rock said lever on said fulcrum, a cylindrical member in communication with said passage way between said receiving and discharge ends, a plunger in said cylindrical member, said lever arranged to retract and to yieldingly advance said plunger, and a valve arranged to normally obstruct the communicable end of said passage way, said lever arranged to retract and to yieldingly advance said valve.

WALDO G. GERNANDT.

In the presence of—
CHARLES TURNER BROWN,
J. SCUDDER.