

April 21, 1936.

W. G. GERNANDT
INTERNAL COMBUSTION ENGINE

2,038,214

Filed Jan. 8, 1931

3 Sheets-Sheet 1

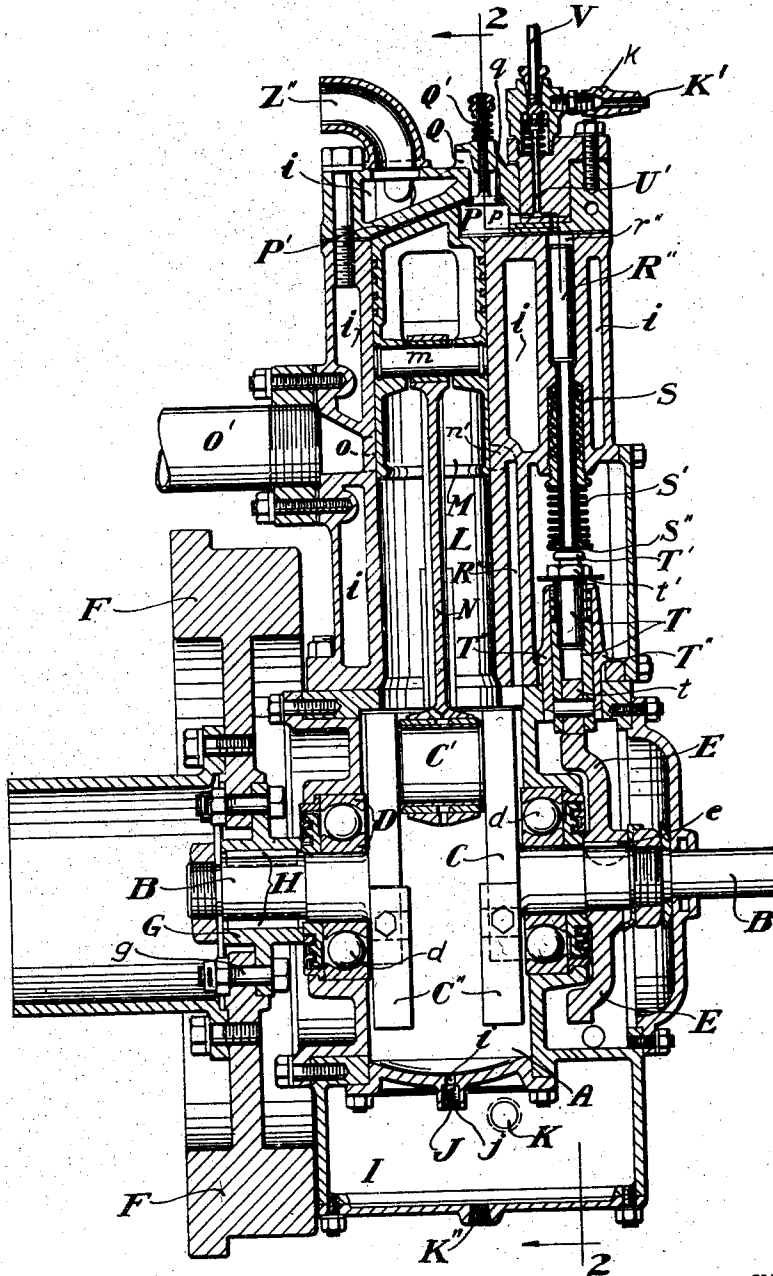


Fig. 1

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3 Sheets-Sheet 2

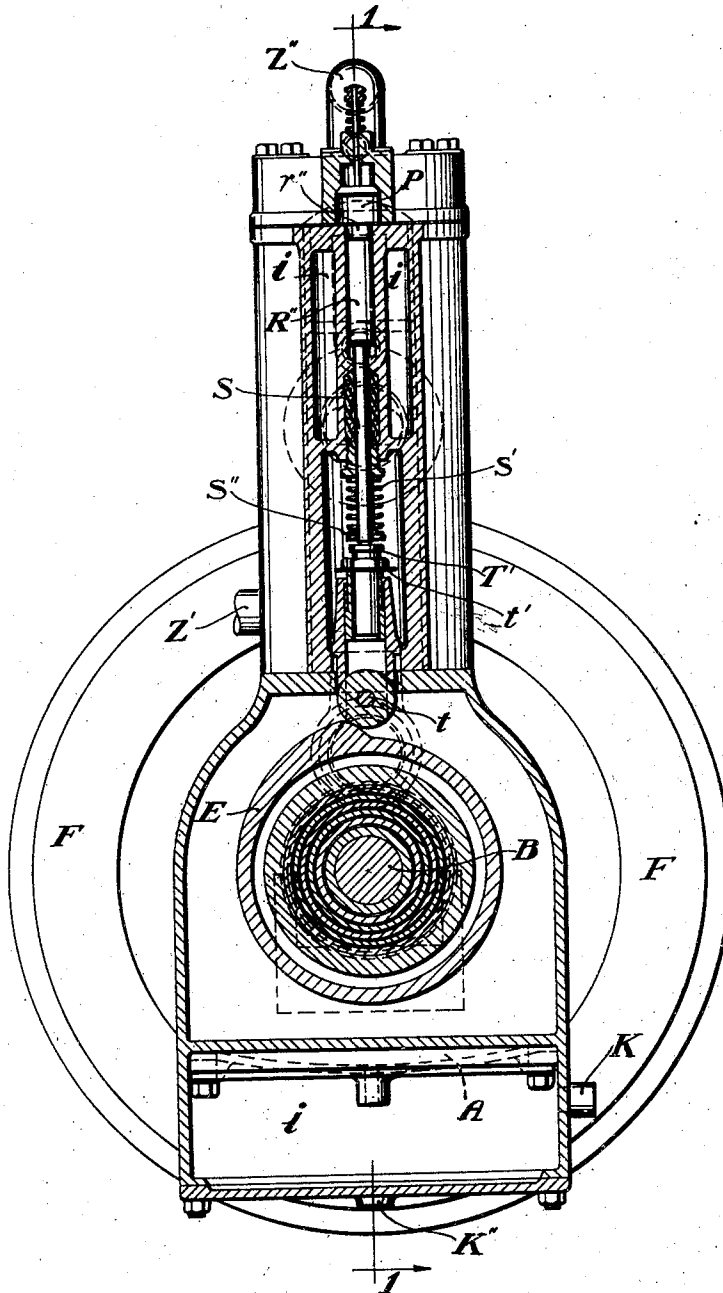


Fig. 2

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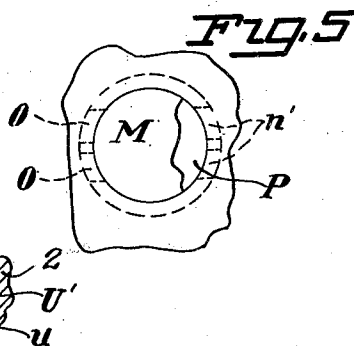
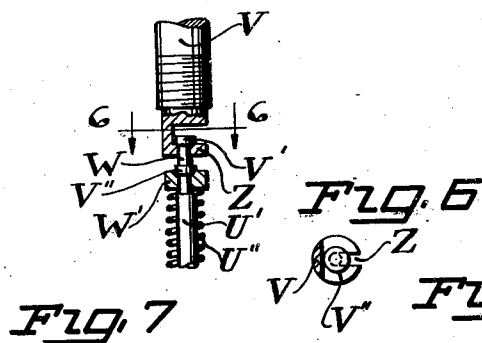
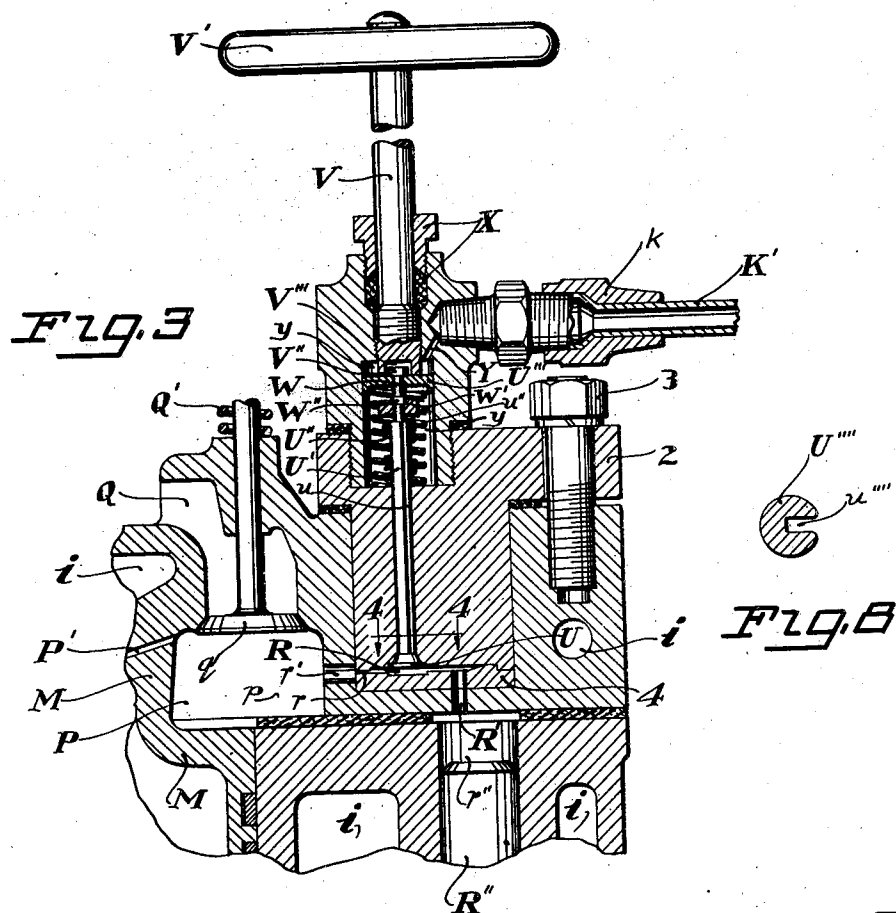
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UNITED STATES PATENT OFFICE

2,038,214

INTERNAL COMBUSTION ENGINE

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Application January 8, 1931, Serial No. 507,336

2 Claims. (Cl. 123—33)

This invention relates to internal combustion engines of the high compression type; that is, to engines wherein the rapid compression stroke of the piston or pistons, creates sufficient pressure (and corresponding temperature) in the combustion chamber, or chambers, related to said piston, or pistons, to produce ignition of fuel contents of said chamber, or chambers, without the presence of a flame, an electric spark or other igniting devices, and is a continuation in part of my co-pending application, Serial Number 443,176, filed February 7, 1921.

Among the objects of this invention is to obtain an internal combustion high compression engine of great flexibility, that is, an engine which is responsive to manipulation designed to vary the speed and power thereof; to obtain an engine of the kind named which is easily cranked or otherwise actuated to start it; to obtain an engine which is simple in construction, comprising few movable parts, which are arranged in timed relation by connecting mechanism which is simple in construction, certain in operation, permitting, but not requiring, considerable speed or velocity in the movement thereof, and not liable to break, be broken or get out of order. An additional object is to obtain an internal combustion, high compression engine, in which the fuel used may be of high flash point and low specific gravity, as say, kerosene, and in which it will not be found necessary to use fuel of low flash point and a higher gravity to start or warm it up.

A further object of my invention is to provide means for feeding or metering the fuel to the engine in such a manner as to obtain the flexibility heretofore referred to.

In order to carry out these objects, recourse is had to the fundamental idea of trapping in a compression chamber a fluid which poorly sustains combustion, such as the products of combustion from the engine cylinder, this idea being disclosed and broadly claimed in my Patent 1,305,894 issued June 3, 1919 and more specifically described and claimed in my Patent 1,305,533 of the same date and still further specifically described and claimed in my Patent 1,359,498 issued November 23, 1920. In my present application I have shown another specific way of accomplishing the general result, and this specific way will be understood by the following description taken in connection with the drawings.

In the drawings referred to I have illustrated an embodiment of this invention in a single unit of a two cycle engine; and

Figure 1 is a vertical section on line 1—1 of Figure 2, viewed as indicated by arrows;

Figure 2 is a vertical section at right angles to Figure 1, on line 2—2 of Figure 1, viewed as indicated by arrows;

Figure 3 is a section similar to Figure 1, and viewed in the same direction, of the upper end or portion of the engine, on an enlarged scale;

Figure 4 is a horizontal section on line 4—4 of Figure 3, viewed as indicated by arrows;

Figure 5 is a top plan view of a piston head;

Figure 6 is a section, on line 6—6 of Figure 7, a modification of some of the members of the fuel feed control, viewed as indicated by arrows; and

Figure 7 is an elevation of said modification;

Figure 8 is a modification of a valve stem.

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

A represents the crank case. B represents the crank shaft, and C the crank of said shaft. C' represents the wrist pin of crank C and C'' the counter balance weights of crank C. D represents ball bearings of the crank shaft B, and d the balls of said bearings. E represents a cam which is mounted on shaft B to turn therewith and e represents the key securing said cam in place. F represents a balance wheel which is illustrated as firmly secured to hub G by bolts g. Hub G is rigidly secured on crank shaft B and H H represents keys between said hub and said crank shaft. I represents a compressed air chamber beneath the crank case A from which the compressed air is received and communicating therewith by passageway i and J a ball valve which is yieldingly held seated by spring j. K represents the air outlet from chamber I. Outlet K is designed to be in communication with the fuel supply tank of the engine above the fuel in the usual manner, but said means of communication and said fuel supply tank being well known in the art are not illustrated, nor is the larger portion of the communicating fuel pipe or passage K' from said fuel tank to connection k. See Figures 2 and 3. K'' represents a condensation liquid relief outlet from chamber I.

L represents the water jacketed cylinder of the engine illustrated and l the space for water to circulate. M represents the piston and N the connecting rod between said piston, and wrist pin C. m represents the pin in piston M on which the upper end of connecting rod N is pivotally mounted. R represents the passageway from crank case A to inlet ports n', (indicated by

broken lines in Figures 1 and 5). O, Figures 1 and 5, are broken lines indicating the outlet for products of combustion from the cylinder when the engine is in operation, and O' (Figure 1) the exhaust pipe of the engine.

In the operation of this engine the upper face of the piston M approaches closely the upper end of cylinder L. P represents a recess on one side of the head of piston M and p a similar recess at the compression end of the cylinder L, arranged to register with recess P when piston M is at or near the end of its compression stroke. Q represents an outlet from recesses P, p, and q a valve which is yieldingly seated by spring Q'. It will be observed when the valve q is unseated as against the resiliency of spring Q' no compression is obtainable on the compression stroke of piston M in cylinder L. When said valve is closed the piston M produces, on the compression travel thereof considerable pressure between the end of piston M and the end of the cylinder L (lettered P', Figures 1 and 3) as well as in recesses Pp and as is hereinafter set forth said space P' between the end of the piston and the end of the cylinder together with recesses Pp constitute the combustion chamber of the engine.

It is to be understood that the recesses Pp and space P' form a pocket of such shape and so positioned that the fluid products of combustion cannot be completely scavenged therefrom. Also the volume of this pocket is sufficiently large that it will contain fluid products of combustion sufficient to fill the entire fuel depository R, passageway R' and compression chamber r'' at a pressure equal to the compression pressure in the engine cylinder.

A plug 2 (Figure 3) is mounted in the engine adjacent the pocket Pp being fastened to the engine head as by bolts 3. On the inner end of the plug 2 is attached, in any satisfactory manner as by screws (not shown in the section taken), a plate 4, thereby forming a fuel depository R and a restricted passageway r from said depository to part p of the pocket by way of passageway r'. Plate 4 has an opening near one end of the fuel depository adapted to register with a passageway R' that communicates with the cylinder or compression chamber r'' in which chamber a movable plunger R'' is positioned. From the construction just described, it will be seen that the gas pocket Pp is in continuous communication with the compression chamber r'' by way of the fuel depository, but the communicating passage is restricted by the very small opening r, the object of which will be presently pointed out. As will be seen from the drawings, Figure 3, the construction is such that the fuel depository and restricted opening is built in as a part of the plug so that the changing of a plug or the reinstallation of the same plug will not vary the size of the depository or the restricted opening from the depository to the gas pocket. In other words, the plug serves to complete or form communication between the said pocket and the compression chamber.

R' represents a passageway from near one end of fuel tray R to cylinder r'', and R'' represents a longitudinally movable plunger in cylinder r''. S represents packing for plunger R'' and S' represents a spring which yieldingly moves plunger R'' to and maintains it normally in a retracted position as is illustrated in Figures 1, 2, and 3, by means of said spring abutting against disk S'' which is secured rigidly on the lower end of the stem of said plunger R'', T represents a tappet which is provided with the rotatably mounted

roller t arranged to rest on cam member E. T' represents an adjusting bolt at the upper end of tappet T, between said tappet and the lower end of plunger R'' and t' a set nut by means of which the bolt T' is maintained in an adjusted position. T'' represents the shell or case in which tappet T is longitudinally movable.

U represents a valve carried by the plug 2 which is seated to close vertical passageway u above fuel depository R and U' represents the stem of valve U which is triangular in cross section to permit liquid fuel to flow, by gravity downward in passageway u to the head of valve U. U'' represents an inner spring which yieldingly holds valve U normally seated. U''' represents a separate disk which is forced downward onto an outer spring u'' by means of the vertical screw threaded member V which is illustrated as controlled by hand wheel V'. V'' represents an enlarged end or annular flange at the upper end of stem U', and V''' represents a recess at the lower end of member V in which recess head V'' fits to move freely. The disk U''' is provided with an aperture through which the part W of stem U' extends and fits loosely. W' represents a collar mounted on stem U' to rest on spring U''. W'' represents an annular flange on stem U', which forces the collar W' downward when the valve U is moved downward and off its seat, against the resiliency of spring U'' by difference in pressure on opposite sides thereof. X represents a gland with packing to stem V. Y represents a passageway from the fuel inlet pipe K' to the cylindrical chamber y in which the upper end of stem U' and the springs U'' and u'', disk U''' and collar W' are positioned. The plug 2, therefore, is seen to carry all of the mechanism necessary for variable metering of the fuel to the fuel depository and a fixed metering of the fuel or fuel mixture to the engine cylinder.

In the modification illustrated in Figures 6 and 7, the lower end of the screw threaded member V is provided with the fork Z in which fork the upper end (W) of the stem U' is positioned.

In the modification illustrated in Figure 8, the valve stem (U''') is cylindrical and provided with longitudinally extended groove u''' for the flow of fuel.

Z', Figures 1 and 2, represents the inlet to the water space or chamber of the engine and Z'' the outlet therefrom.

Fuel under suitable pressure supplied to inlet pipe K' flows, when the engine is in operation, through passageway Y into cylindrical chamber y and from thence downward to passageway u, (around the stem U') onto the valve U.

The operation of the engine is as follows:

Since the drawings show the valve U in the shut-off position, which must be the position when the engine is not running, in order to prevent pressure in the fuel tank from forcing fuel by the valve, it is necessary to unseat the valve U a definite amount by turning the adjusting wheel V' in order to give a certain clearance between the collar V'' on the valve stem and the disc U''' or the corresponding parts shown in Figure 7.

To start the engine, valve q is unseated, against the resiliency of spring Q'. The crank shaft B is then rotated by any suitable means, no pressure from the compression of air in cylinder L above piston M resulting from the movement of said piston because of said crank rotation, so long as said valve q is unseated. When crank

shaft B is in sufficiently rapid revolution so that the balance wheel F will, by its inertia, carry the piston M over a compression stroke, the valve stem of valve *q* is released and yielding seated by spring Q'. On the subsequent power stroke of piston M upon inlet port *n'* and outlet port O being uncovered (or at about said time) the pressure in cylinder L above piston M as also in recesses Pp fuel depository R, restricted passageway *r*, passageways *r'*, R' and cylinder *r''*, is less than the pressure in passageway *u* and valve U is automatically unseated against the resilience of spring U''; the extent of said unseating being controlled by the position of disk U'''; by the enlarged end V'' being brought downward on to the upper face of said disk. A measured quantity of fuel is thus deposited in fuel tray R. Upon the opening of inlet port *n'* air under pressure in the crank case A flows therefrom through passageway *n* and inlet ports *n'* into the cylinder L above piston M, and upon the compression stroke of said piston, the air forces the fluid products of combustion which have not been scavenged from the pocket Pp through the restricted passageway *r*, the fuel depository R, passageway R' and into the compression chamber *r''*, it being understood that the compression chamber, fuel depository and the passageways just recited were filled on the previous cycle with fluid products of combustion at a pressure considerably in excess of the compression pressure in the engine cylinder and that during the period when the exhaust port is open, these products of combustion are trapped by the restricted passageway *r* and consequently the pressure during the brief interval that the exhaust port is open is considerably above atmospheric pressure. During the time when the fluid products of combustion held in the pocket Pp, are being forced through the fuel depository after the deposition of the fuel therein, the action of the hot gases starts to vaporize and atomize the fuel. About the time when the piston M reaches its full compression stroke, the cam E suddenly forces tappet T and plunger R'' upward, thereby compressing the fluid products of combustion in the compression chamber and forces the contents of the cylinders *r''* through passageway R', fuel depository R, restricted passageway *r* into the pocket Pp where ignition occurs, said recess or pocket thereby forming the initial combustion chamber and the ignition extends from said chamber into the space P' and the power cycle of the engine is effected. I have found, the same as in other internal combustion engines, that an advance of the cam E is necessary in order to get the best results from the engine; that is to say, the plunger R'' starts compressing the gas in the compression chamber and injects the fuel into the main cylinder before the piston therein reaches the end of its stroke, or the point of maximum compression. This timing of the plunger with respect to the main piston prevents any substantial amount of air getting into the compression chamber *r''*, which further acts as has been pointed out, with the fuel depository as a mixing chamber due to the turbulence set up by

the first movement of products of combustion through the depository toward the compression chamber and then by the reverse motion of the contents of the compression chamber outwardly from the main cylinder.

Upon the ignition last above set forth, the pressure in the several passageways *r'*, *r* and R', depository R and cylinder *r''* corresponds substantially with the pressure in the combustion chamber of the engine, the products of combustion flowing freely therethrough.

Upon the uncovering of the outlet ports of the engine, valve U will be unseated by the minimum pressure resulting in depository R, and fuel will again be deposited in the depository. The above recited operation will be repeated so long as the disk U''', or end Z, (Figure 7) is in position to permit valve U to be automatically opened as above set forth.

I claim:

1. In an internal combustion engine provided with a cylinder, an exhaust port and a longitudinally movable piston, a fuel depository and means to deposit fuel in said depository in timed relation to said piston, said means comprising a fuel passageway connected to a source of fuel under a pressure substantially above atmospheric provided with a valve seat at its discharge end, and a spring-pressed valve arranged to coact with said seat and to normally close said discharge end, a stem on said valve positioned in said passage way and so related thereto in cross section as to be guided thereby and to permit the flow of fuel therethrough on to said valve, in combination with a longitudinally movable member in substantially axial alinement with said stem and related thereto to limit the travel of said valve from its seat, means to control the position of said movable member, said valve arranged to be unseated in timed relation to said piston by the difference of pressure on opposite sides thereof upon the opening of said exhaust port, and means for feeding fuel from said depository to said cylinder.

2. In an internal combustion engine having a cylinder and a piston reciprocable therein, a fuel depository, means comprising a fuel passageway connected with a source of fuel under pressure substantially above atmospheric provided with a valve seat at its discharge end and a spring-pressed valve arranged to coact with said seat and to normally close said discharge end to deposit fuel in the depository in timed relation to the movement of the piston, a stem on said valve slidable within said passageway and shaped to permit fuel to pass longitudinally thereof, a longitudinally movable member associated with the valve to limit the displacement thereof from its seat, manual means to vary the position of the movable member, said valve being adapted to be unseated in timed relation to the movement of said piston by the differential of fluid pressures on opposite sides thereof during exhaust, and means for feeding fuel from the depository to the cylinder.

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