C. A. SAWTELLE.

INTERNAL COMBUSTION ENGINE OF THE TWO-CYCLE TYPE.

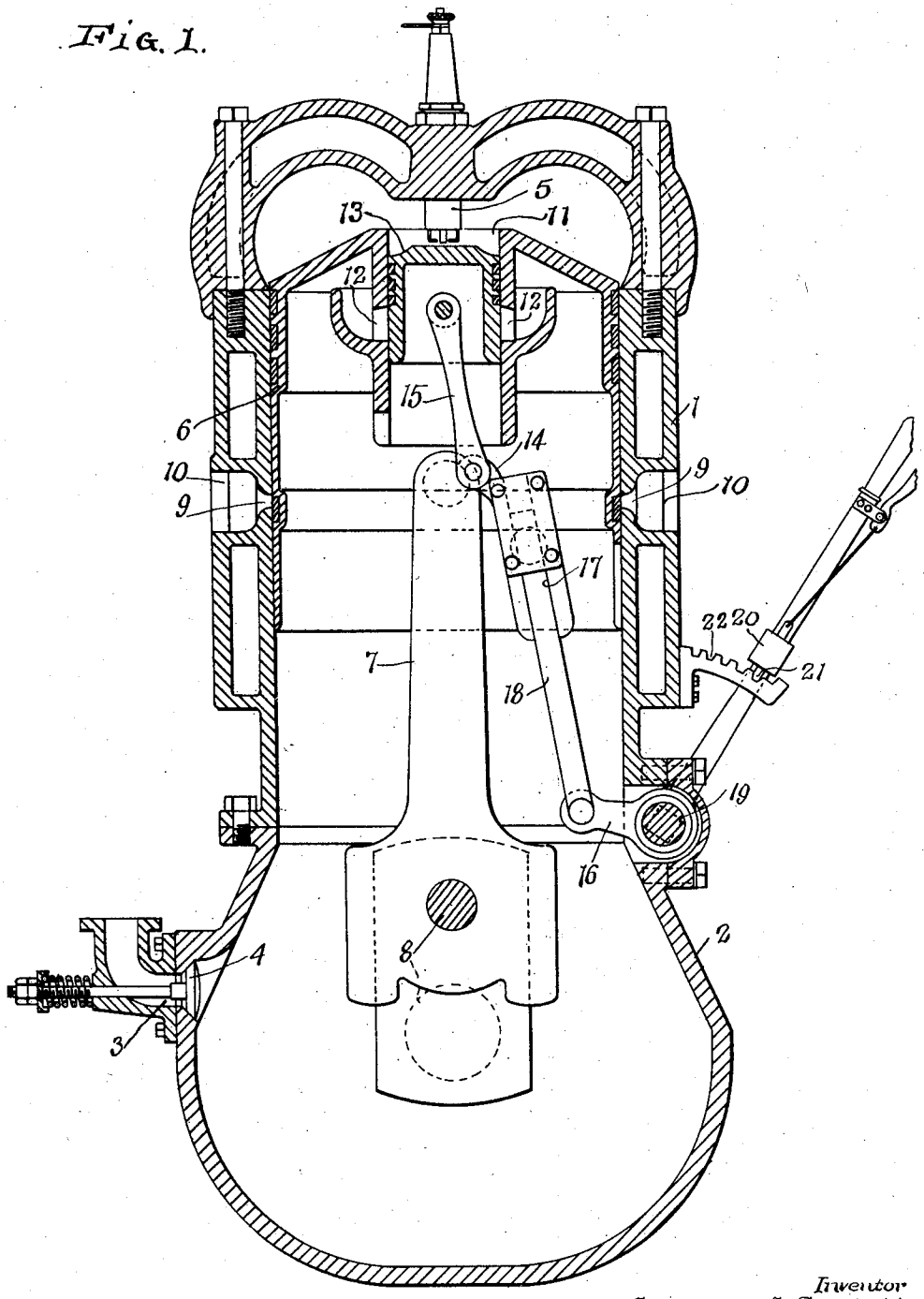
APPLICATION FILED AUG. 15, 1916.

1,333,635.

Patented Mar. 16, 1920.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

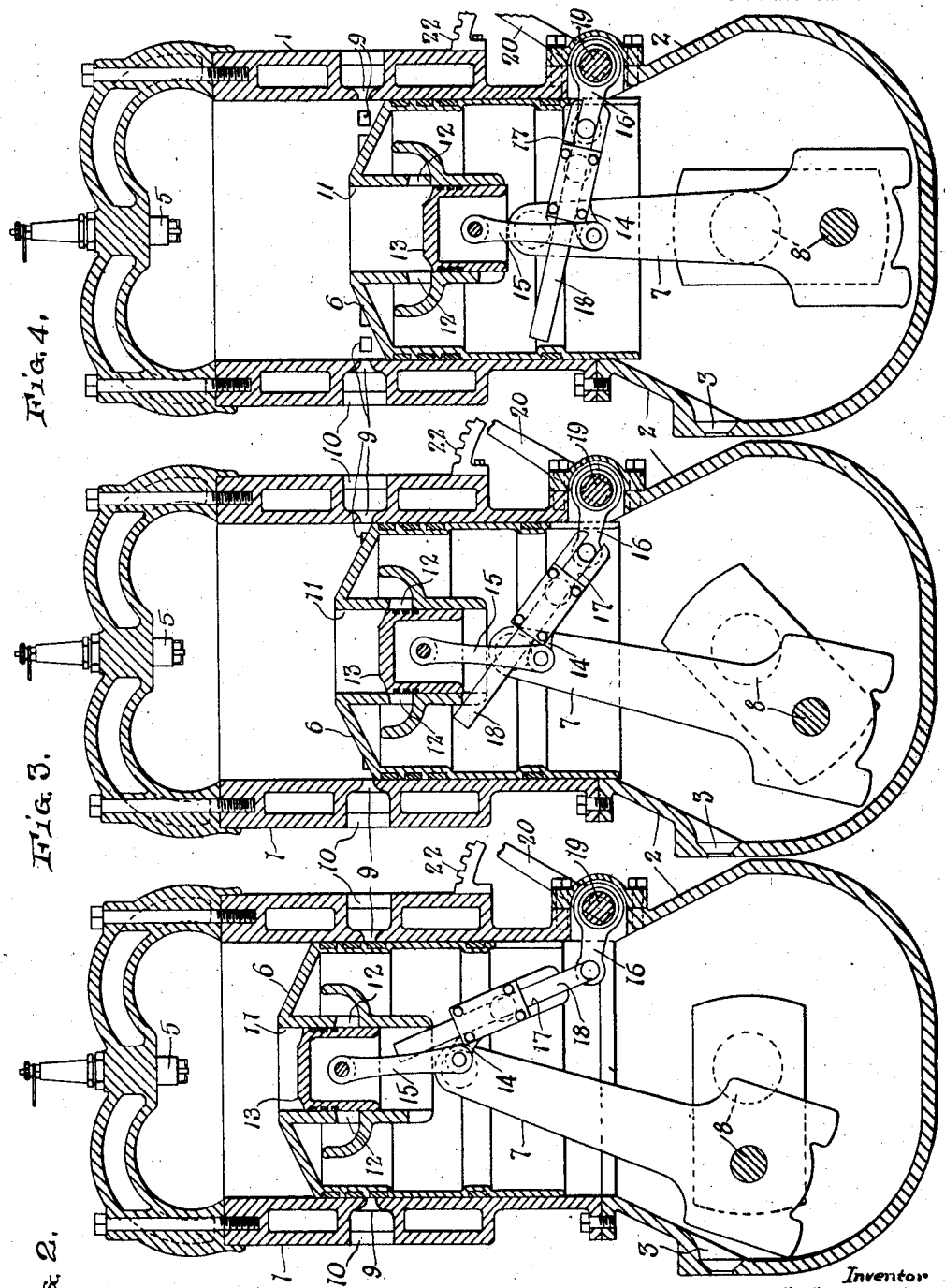


Fig. 4.

Fig. 3.

Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 5.

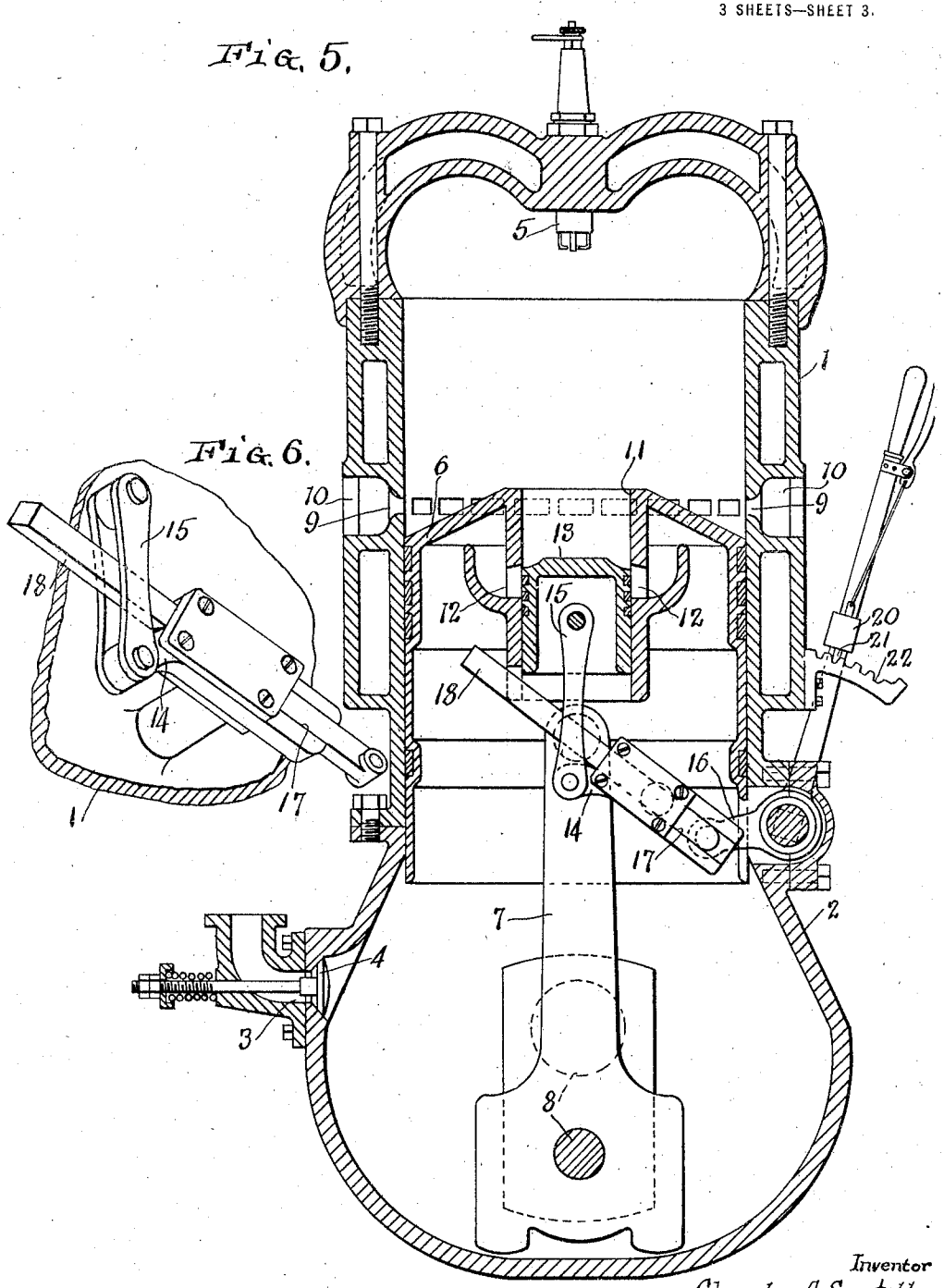


Fig. 6.

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UNITED STATES PATENT OFFICE.

CHARLES A. SAWTELLE, OF DETROIT, MICHIGAN, ASSIGNOR OF ONE-HALF TO SARAH J. PORTER, OF DETROIT, MICHIGAN.

INTERNAL-COMBUSTION ENGINE OF THE TWO-CYCLE TYPE.

1,333,635. Specification of Letters Patent. Patented Mar. 16, 1920.

Application filed August 15, 1916. Serial No. 115,073.

To all whom it may concern:

Be it known that I, CHARLES A. SAWTELLE, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Internal-Combustion Engines of the Two-Cycle Type, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to internal combustion engines of the two-cycle type and is in the nature of an improvement upon the engine described and claimed in the application for patent filed by me October 17th, 1912, Serial Number 726,197.

The object of the invention is to provide an engine of this kind in which the flow of fuel to the cylinder will be controlled by a simple, positively actuated mechanism having but a few parts and but a few movements; and to this end it is a further object of the invention to form the fuel inlet through the piston and to provide a single member to control the same, which member will be actuated by the movement of the piston; and to so control this member that the inlet will be maintained closed through the greater portion of the movement of the piston and will be quickly opened and closed while the piston is at or near the inner portion of its stroke.

It is also an important object of the invention to provide means for regulating the movement of the controlling member to regulate the amount of fuel delivered to the cylinder upon each movement of the piston, thus enabling the engine to be throttled down to develop a minimum of power.

Other objects of the invention will appear as the mechanism is described in detail.

In the accompanying drawings Figure 1 is a vertical sectional view taken centrally through an engine embodying my invention; Figs. 2, 3 and 4 are similar views showing the piston and the controlling device for the fuel inlet in successive positions; Fig. 5 is a similar view showing the actuating device for the controlling member adjusted to alter the amount of fuel admitted to the engine cylinder; and Fig. 6 is a detail view of the actuating device.

In these drawings I have illustrated one embodiment of my invention and have shown the same as embodied in an engine comprising a water jacketed cylinder 1 communicating at its lower end with a closed crank case 2 which communicates with a source of fuel supply through an inlet port 3 which is controlled by an automatically actuated valve 4, here shown as a puppet valve. At the outer end of the cylinder, and preferably arranged centrally thereof, is a spark plug 5 which may be of any suitable character. Mounted within the cylinder 1 is a power piston 6 connected by a connecting rod 7 with the crank shaft 8 which extends through the crank case 2. The cylinder 1 is provided with one or more exhaust ports and as here shown it has formed therein a series of ports 9 arranged circumferentially thereof at such a point that they will be normally closed by the piston 6, but will be cleared thereby before the piston reaches the inner limit of its movement. These ports communicate with a circumferential conduit which is connected at one or more points with the exhaust manifold. Preferably, the connection is made at two points arranged on opposite sides of the cylinder, as shown at 10, as this provides a freer exhaust of the burned gases.

The operation of the mechanism so far described is substantially that of the ordinary two-cycle engine. Upon the outward stroke of the piston a quantity of fuel is drawn into the closed crank case 2 and upon the inward stroke of the piston this fuel is compressed within the crank case and as the piston approaches the inner limit of its movement is admitted to the cylinder, thus forcing out the burned gases and supplying the cylinder with a fresh charge of fuel which is compressed and exploded upon the next outward stroke of the piston.

The fuel inlet for the cylinder 1 is preferably formed through the piston 6, after the manner shown in the above mentioned application. To accomplish this the piston is provided with an inlet passage adapted to communicate both with the cylinder 1 and with the closed crank case, or other suitable source of supply for fuel under pressure. This inlet is of such a character that it can be controlled by a single controlling member which is actuated in such a manner as to maintain the inlet closed while the piston is in the outer portion of the cylinder, but to quickly open and close the same while the piston is in the inner portion of the cylin-

der, to permit a charge of fuel to enter the cylinder. Preferably, this inlet is arranged centrally of the piston and it is here shown as a supplemental cylinder 11 arranged lengthwise of the piston, having its inner end in open communication with the cylinder and provided between its ends with openings, or ports, 12, by which it may be connected with the crank case, or other source of supply for fuel under pressure. Mounted within this supplemental cylinder is a controlling member, or valve, which is preferably in the form of a supplemental piston 13. This supplemental piston, or valve, is actuated by, and in timed relation to, the movement of the main piston so as to open and close the inlet at the proper times during the movement of the main piston. For this purpose I have provided an actuating device which is preferably mounted on the piston and connected with the supplemental piston, or valve, 13. In the present construction this actuating device is mounted on the piston for rocking movement and is connected with the controlling member 13 and with a fixed part of the engine so that the movement of the main piston will impart a rocking movement to the actuating device, which in turn will impart reciprocatory movement to the controlling member. Preferably, the actuating device is in the form of a lever, as shown at 14, connected at one end with the controlling member by means of a link 15, which is pivotally connected at one end with the controlling member and at the other end with the lever. This lever is pivotally mounted between its ends on the piston at one side of the longitudinal center thereof and is pivotally connected at its opposite end with a fixed part of the engine. This point of connection is preferably near the side wall of the cylinder and the lever is here shown as connected with a bracket, or arm, 16, extending into the engine near the juncture of the cylinder with the crank case and beyond the lower limit of movement of the main piston. This arm is normally fixed against movement so that the lever turns about a fixed axis. The lever 14 is preferably extensible and is here shown as comprising two parts, one of which is slidably mounted upon the other, one of said parts being pivotally connected with the piston and the other pivotally connected with the fixed bracket 16. In the present construction, that part of the lever which is mounted on the piston is provided with a guideway 17, in which is slidably mounted a rod 18 constituting the inner portion of the lever 14 and pivotally connected with the arm 16. This construction is such that as the main piston begins its inward movement the lever will extend lengthwise of the cylinder and at a very sharp angle to the line of movement of the piston. Further, the pivotal center of the part 17 and the pivotal connection of the part 18 with the bracket 16 will be spaced apart a relatively long distance. Consequently, during the first portion of the inward movement of the piston the controlling member will have but a very slight movement relatively thereto. As shown in Fig. 2 the crank shaft has made a quarter revolution on the inward stroke of the piston and it will be noted that only a very short movement has been imparted to the controlling member, relative to the piston. During the further movement of the piston the relative movement of the controlling member is greater, but the inlet is maintained closed until the piston approaches the inner limit of its movement and until the exhaust ports have been opened, as shown in Fig. 3. After the main piston is moved inward a distance sufficient to open the exhaust ports, the controlling member is very quickly moved to its innermost position relatively to the main piston, thus fully opening the inlet, as shown in Fig. 4, and permitting the fuel to enter the main cylinder through the inlet and to force the exhaust gases out of that cylinder through the exhaust ports. The inlet port remains open while the crank shaft crosses its central position and is closed during the first portion of the outward stroke of the piston, the movement of the controlling member relative to the piston decreasing on the outward movement of the piston in the same ratio that it increased on the inward movement of the piston. In this manner I am enabled to maintain the fuel inlet closed during the greater portion of this stroke of the piston and to quickly open and close the same at the proper time by the use of a very simple mechanism which is positive in its operation and has its few parts of such a character that there is little or no liability of their becoming disarranged so as to interfere with the proper operation of the engine. Further, the parts are of such a character that they can be very readily manufactured at a low cost.

Heretofore much difficulty has been experienced in throttling a two-cycle engine and for this reason they have been generally considered as unsuited for certain purposes. With the construction above described the throttling of the engine becomes a simple matter. By shifting the point of connection of the actuating device with the fixed part of the engine the amount of movement imparted to the controlling device can be regulated, and consequently, the size of the fuel inlet can be so controlled as to admit only the desired amount of fuel to the cylinder. To accomplish this, I have made the supporting bracket or arm 16 adjustable and it is here shown as mounted

on a shaft 19 rotatably mounted in suitable bearings on the engine and as having secured thereto, on the outside of the engine, an actuating lever 20 having a dog 21 cooperating with a toothed segment 22 to hold the lever and the arm 16 rigidly in adjusted positions, thus providing a rigid point of connection for the actuating device. With the arm 16 adjusted to the position shown in Figs. 1 to 4, the controlling device will be moved to its fully opened position, as shown in Fig. 4. By shifting the arm to the position shown at Fig. 5, the movement of the controlling member will be so shortened that when the piston is in its innermost position the controlling member will have been moved but a short distance past the outer edge of the ports in the supplemental cylinder, thus providing only a small opening through which a correspondingly small amount of fuel can enter the cylinder. In the case of a multiple cylinder engine, the shaft 19 will extend alongside of the several cylinders and the supporting arm 16 for each cylinder will be connected thereto so that the movement of the actuating lever 20 will simultaneously adjust the several actuating devices to the same extent. It will be obvious that the adjustment of the actuating device may be secured in any suitable manner, but the lever shown in the present instance is well adapted for the engine when applied to certain uses, such as marine purposes. If applied to an automobile engine, the actuating device for the shaft would be extended so that it could be operated by the driver from his seat. Further, the present adjusting device is adapted to adjust the actuating device to a comparatively few positions, but this is in many instances preferable as the ordinary throttle valve in the intake manifold may be retained and used in connection herewith.

While I have shown and described one embodiment of my invention, I wish it to be understood that I do not desire to be limited to the details of construction here shown as various modifications will occur to a person skilled in the art.

Having now fully described my invention, what I claim as new, and wish to secure by Letters-Patent, is:

1. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet to connect said cylinder with a source of fuel supply, a member to control said inlet, and an actuating lever having separate connections with said piston and with said controlling member and controlled by the movement of said piston to maintain said controlling member in a position to close said inlet during the first portion of the power stroke of said piston and to move said controlling member into a position to open said inlet during the last portion of the power stroke of said piston.

2. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to connect said cylinder with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, a lever separately connected with said piston and said controlling member and actuated by said piston to move said controlling member into a position to close said inlet and to maintain the same in such position during the first portion of the power stroke of the piston and to move said controlling member into a position to open said inlet during the last part of the power stroke of said piston.

3. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to connect said cylinder with a source of supply for fuel, a single member to control said inlet, and an actuating device for said member connected with said piston and so arranged that the movement of said piston, in either direction, in the outer portion of said cylinder will impart slow movement to said member, and the movement of said piston, in either direction, in the inner portion of said cylinder will impart rapid movement to said member.

4. In an engine, a cylinder, a piston mounted in said cylinder and having a ported inlet passage to connect said cylinder with a source of supply for fuel under pressure, a slide valve to control said passage, and means controlled by the movement of said piston to maintain said slide valve in a position to close the ports of said passage while said piston is in the outer portion of said cylinder and to move said slide valve into a position to open said ports when said piston is in the inner portion of said cylinder.

5. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet to connect said cylinder with a source of fuel supply, a crank shaft, a connecting rod to connect said piston with said crank shaft, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and an actuating device mounted on said piston independently of said connecting rod and said controlling member, and operatively connected with said controlling member and coöperating with a relatively fixed part of said engine to actuate said controlling member.

6. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of

fuel through said inlet and a pivoted actuating device connected with said controlling member and with a relatively fixed part of the engine, and arranged to be actuated by the movement of said piston to impart movement to said controlling member.

7. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and an actuating device mounted on said piston for rocking movement and connected with said controlling member and with a relatively fixed part of said engine, whereby the movement of said piston will cause said actuating device to be rocked and operative movement to be imparted to said controlling member.

8. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and an actuating device pivotally mounted on said piston and having pivotal connection with said controlling member and with a relatively fixed part of said engine, whereby the movement of said piston will impart pivotal movement to said lever and cause said controlling member to be actuated.

9. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and an extensible lever pivotally mounted on said piston and connected with said controlling device and with a relatively fixed part of said engine, whereby the movement of said piston will impart pivotal movement to said lever and cause said controlling member to be actuated.

10. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and an actuating device pivotally mounted on said piston, connected with said controlling member and having an extensible portion pivotally connected with a relatively fixed part of said engine.

11. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and an actuating device pivotally mounted on said piston and connected with said controlling member and comprising a slidable part pivotally connected with a relatively fixed part of said engine.

12. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and an actuating device pivotally mounted on said piston, connected with said controlling member and having a movable part pivotally connected with a relatively fixed part of said engine, whereby the distance between the points of connection of said device with said piston and with said engine will vary as said piston moves in its cylinder.

13. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and an actuating device pivotally mounted on said piston at one side of the longitudinal center thereof and connected with said controlling member, said actuating device having extensible means for connecting the same with a relatively fixed part of said engine.

14. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and an actuating device pivotally mounted on said piston at one side of the longitudinal center thereof and connected with a relatively fixed part of said engine, that part of said device between its points of connection with said piston and with said fixed part being extensible to accommodate it to the movement of the piston, and means for connecting said device with said controlling member.

15. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and an actuating device pivotally mounted on said piston and connected on one side of its axis with said controlling member and having on the other side of its axis an extensible part pivotally connected with a relatively fixed part of said engine.

16. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel

inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, an actuating device comprising two parts slidably connected one with the other, one of said parts being pivotally mounted on said piston and the other of said parts being pivotally connected with a relatively fixed part of said engine, and a connection between said actuating device and said controlling member.

17. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and a lever comprising two parts one of which is pivotally mounted on said piston and is connected with said controlling member, and the other of which is slidably connected with the first-mentioned part and is pivotally connected with a relatively fixed part of said engine.

18. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, and an actuating lever comprising a part pivotally mounted on said piston, connected with said controlling member and having a guideway, and also comprising a second part slidably mounted in said guideway and pivotally connected with a relatively fixed part of said engine.

19. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, an actuating lever comprising a part pivotally mounted on said piston at one side of the longitudinal center thereof and having one end extending to a point near the longitudinal center of said piston, and also comprising a second part slidably connected with the first-mentioned part and pivotally mounted on a relatively fixed part of said engine, and a link connecting said end of said lever with said controlling member.

20. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, an actuating device within said engine to impart movement to said controlling member in timed relation to the movement of said piston, and means arranged exteriorly of said engine to regulate the movement imparted to said controlling member by said actuating device.

21. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, an actuating device controlled by the movement of said piston to actuate said controlling member, and means to regulate the amount of movement imparted to said controlling member by said actuating device.

22. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, an actuating device mounted on said piston and connected with said controlling member and with a relatively fixed part of said engine, and means to adjust the point of connection with said fixed part of said engine to regulate the amount of movement imparted to said controlling member.

23. In an engine, a cylinder, a piston mounted in said cylinder, and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, an actuating device pivotally mounted on said piston and pivotally connected with said controlling member and with a relatively fixed part of said engine, and means to vary the distance between the points of connection of said device with said piston and with said fixed part of said engine to regulate the amount of movement imparted to said controlling member.

24. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, an actuating device pivotally mounted on said piston and connected with said controlling member, said device having an extensible part connected with a relatively fixed part of said engine, whereby the movement of said piston will move said actuating device about its pivot, and means for adjusting the point of connection of said extensible part of said device with the fixed part of said engine.

25. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said

cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, an actuating device pivotally mounted on said piston, connected with said controlling member and having an extensible part pivotally connected with a normally fixed part of said engine, and means arranged exteriorly of said engine to adjust said normally fixed point of connection.

26. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, an actuating device mounted on said piston, connected with said controlling member and having an extensible portion, a normally fixed bracket pivotally connected with said extensible part of said device, and means for shifting the position of said bracket.

27. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, an actuating device pivotally mounted on said piston and connected with said controlling member, a bracket pivotally mounted on said engine and having a pivotal connection with said actuating device, and means for rocking said bracket about its axis and for locking the same in adjusted positions.

28. In an engine, a cylinder, a piston mounted in said cylinder and having a fuel inlet adapted to communicate with said cylinder and with a source of fuel supply, a controlling member carried by said piston and having movement to control the flow of fuel through said inlet, a two-part lever having one part pivotally mounted on said piston and connected with said controlling member and having its other part slidably connected with the first-mentioned part, a bracket pivotally mounted on said engine and having pivotal connection with the last-mentioned part of said lever, and means for moving said bracket about its axis and for locking the same in its adjusted positions.

29. In an engine, a main cylinder, a main piston mounted in said cylinder and having a supplemental cylinder communicating with said main cylinder and adapted to be connected with a source of fuel supply, a supplemental piston mounted in said supplemental cylinder to control the flow of fuel from said source of supply to said main cylinder, and an actuating device connected with said supplemental piston and with a relatively fixed part of said engine, and arranged to be actuated by the movement of said piston to actuate said supplemental piston.

30. In an engine, a main cylinder, a main piston mounted in said main cylinder and having a supplemental cylinder communicating with the main cylinder and adapted to be connected with a source of fuel supply, a supplemental piston mounted in said supplemental cylinder to control the passage of fuel from said source of supply to said main cylinder, and an actuating device pivotally mounted on said main piston, connected with said supplemental piston and with a relatively fixed part of said engine.

31. In an engine, a main cylinder, a main piston mounted in said main cylinder and having a supplemental cylinder communicating with the main cylinder and adapted to be connected with a source of fuel supply, a supplemental piston mounted in said supplemental cylinder to control the passage of fuel from said source of supply to said main cylinder, and a lever pivotally mounted on said piston at one side of the longitudinal center thereof, pivotally connected with said supplemental piston and having an extensible part pivotally connected with a normally fixed part of said engine.

32. In an engine, a main cylinder, a main piston mounted in said main cylinder and having a supplemental cylinder communicating with the main cylinder and adapted to be connected with a source of fuel supply, a supplemental piston mounted in said supplemental cylinder to control the passage of fuel from said source of supply to said main cylinder, a two-part lever having one part pivotally mounted on said main piston and pivotally connected with said supplemental piston, and having its other part slidably connected with the first-mentioned part and pivotally connected with a relatively fixed part of said engine.

33. In an engine, a main cylinder, a main piston mounted in said main cylinder and having a supplemental cylinder communicating with the main cylinder and adapted to be connected with a source of fuel supply, a supplemental piston mounted in said supplemental cylinder to control the passage of fuel from said source of supply to said main cylinder, a two-part lever having one part pivotally mounted on said main piston and pivotally connected with said supplemental piston, and having its other part slidably connected with the first-mentioned part and pivotally connected with a relatively fixed part of said engine, and means to adjust the point of connection with said relatively fixed part of said engine.

In testimony whereof, I affix my signature hereto.

CHARLES A. SAWTELLE.