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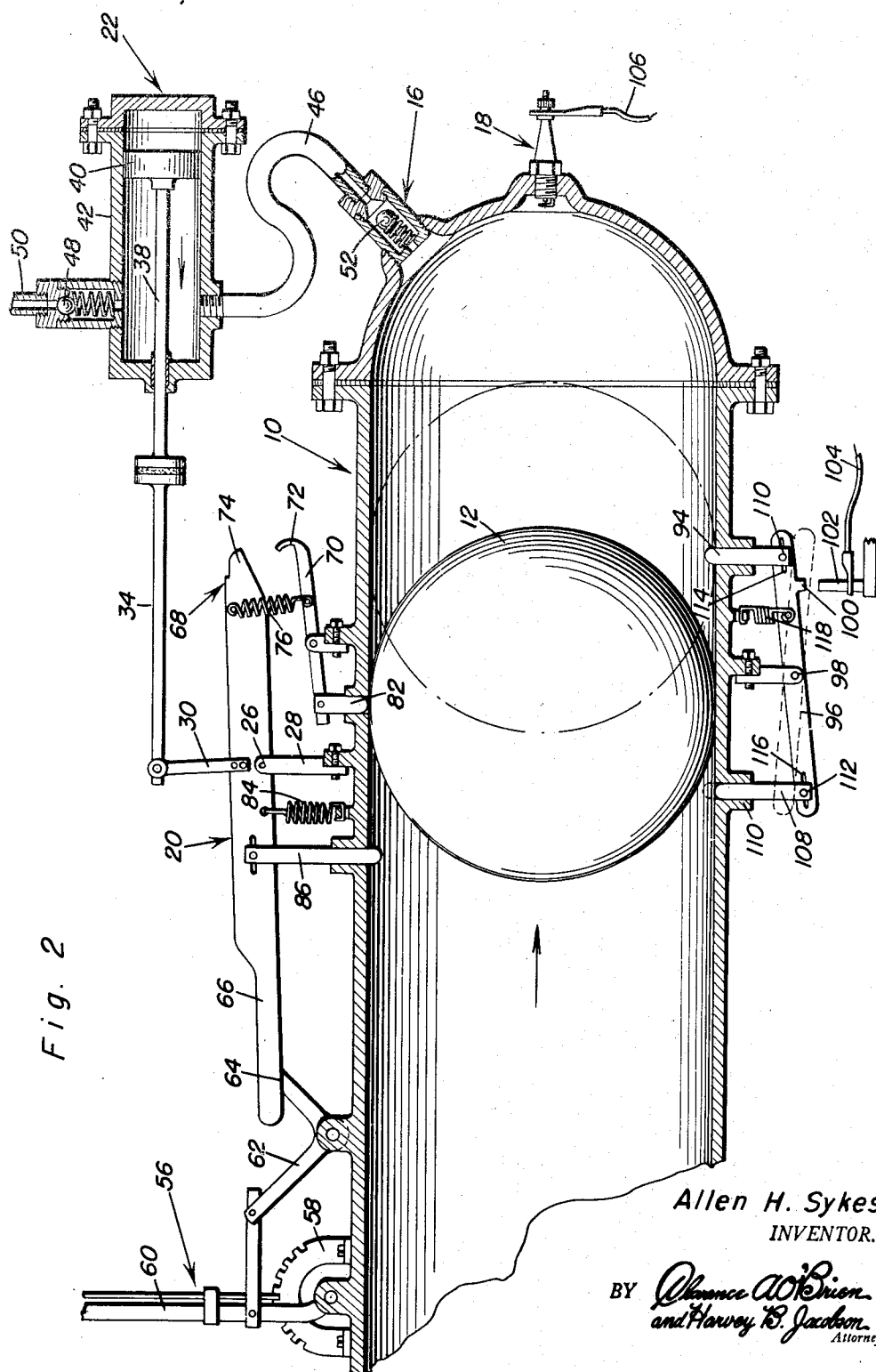
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2,716,971

FREE PISTON ENGINE

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2,716,971

FREE PISTON ENGINE

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5 Claims. (Cl. 123-46)

This invention relates generally to internal combustion engines and pertains more particularly to improved means for providing fuel injection and ignition timing to such engines.

A primary object of this invention is to provide an improved form of fuel injection for internal combustion engines which includes a positively actuated pumping mechanism responsive to the position of the piston within the cylinder.

Another object of this invention is to provide an internal combustion engine with fuel injecting and ignition means which are responsive in actuation to positioning of the piston within the cylinder.

Another object of this invention is to provide an improved internal combustion mechanism which includes a fuel injecting assembly in conformity with the foregoing objects incorporating novel means for varying the quantity of fuel injected into the cylinder.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

Figure 1 is a vertical section taken through one form of internal combustion engine incorporating the novel fuel injecting and ignition assembly; and

Figure 2 is a vertical section of the assembly shown in Figure 1 but showing the component parts in different operating positions.

Referring now more particularly to the drawings, reference numeral 10 indicates generally the cylinder wall of the engine within which the free piston 12 is reciprocable. The end of the cylinder shown is provided with a suitable head 14 which includes the fuel injection nozzle assembly 16 and the spark plugs 18 and this head is also provided with the usual inlet and exhaust valve mechanism which may take any convenient form such as suitably correlated check valve assemblies, not shown.

Reference numeral 20 indicates generally the actuating mechanism for the fuel pump 22 and this mechanism includes the actuating lever 24 which is substantially medially pivoted as at 26 and supported by a pivot post 28 secured to the outer surface of the cylinder. This lever is provided with a laterally projecting rod 30 whose free end 32 is pivotally secured to a pump actuating rod 34, the opposite end of which is connected by means of the flexible connection 36 to the free end of the piston rod 38. The inner end of the piston rod is provided with a piston 40 which is reciprocable within the cylindrical pump chamber 42 and this chamber is provided with an inlet opening 44 and an outlet supply line 46 which connects with the previously described injecting nozzle assembly 16. Upon movement of the piston to the right within the chamber 42 as shown in Figure 1, the spring urged check valve 48 will be unseated to allow fuel to flow into the chamber through the inlet line 50 and upon movement of the piston to the left as shown in Figure 1 the fuel

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within the pump chamber or housing will be forced outwardly therefrom through the supply line 46 unseating the spring urged check valve 52 and forcing the fuel to be injected within the cylinder through the nozzle aperture 54.

The movement of the connecting rod 38 and the piston 40 is effected by a rocking action of the actuating lever 20, which rocking action will be described more fully hereinafter. The extent of the rocking action of the lever 20 and consequently the amount of fuel injected into the cylinder is controlled by the limiting mechanism indicated generally by the reference character 56 which includes the notched sector 58 and pawl lever 60 which selectively pivots the bellcrank 62 to effect relative upward and downward movement of the limit stop face 64 of the bellcrank. As the stop face 64 of the bellcrank is moved upwardly or downwardly, the limit stop end 66 of the actuating lever 20 is correspondingly limited in movement upon engagement with the stop face 64 to effect consequent variation of the stroke of the piston 40 and thus varying the quantity of fuel injected into the cylinder.

Referring now more particularly to Figure 1, it will be noted that the actuating lever 20 is normally disposed in the position shown with the free end 66 thereof spaced upwardly from the stop face 64 and with its opposite end 68 operatively engaged by the latching bar 70, the free end 72 of which is laterally hooked to engage the nose portion 74 of the actuating rod, these two members being normally urged together in the latching position under action of the tension spring 76 secured therebetween. The latching bar 70 is pivoted as at 78 at an intermediate portion to the bracket ear 80 rigidly secured to the cylinder and the free end of this bar pivotally carries the release plunger 82 which projects through a suitable guide opening through the cylinder wall 10 inwardly thereof into the path of movement of the piston 12. An intermediate portion of the actuating lever beyond the pivot point 26 is provided with a tension spring 84 which normally urges the lever into the position shown in Figure 2 and it will be noted that this spring effects the actual actuation of the piston 40 for injecting fuel into the cylinder. Return plunger 86 is reciprocable in its guide boss 88 on the cylinder wall and is pin connected as at 90 with the elongated slot 92 in the actuating lever.

Assuming the piston 12 to be in the position shown in Figure 1, and moving in the direction of the arrow, the condition within the cylinder will be such that no fuel has been injected therinto. Upon movement of the piston to the position shown in Figure 2, the release plunger 82 will have then urged outwardly under contact with the piston 12 to release the actuating rod or lever 20 effecting fuel injection into the cylinder. The actuating rod will, of course, effect a stroke of the piston 40 in conformity with the movement it is allowed by the adjusting assembly 56. When the piston has traveled a predetermined distance further in the cylinder toward the cylinder head, the point breaker plunger 94 will be actuated to pivot the breaker bar 96 about its pivot 98 and disestablish contact between the ignition point 100 and 102. The points are electrically connected to the conductor 104 to a suitable ignition coil and in this respect it will also be noted that the spark plug 18 is provided with a high tension lead 106 from this same coil. To insure absolute rigidity in the movement of the breaker bar, and to prevent undue play between the points and excessive wearing thereof, the guide plunger 108 is provided which operates within the guide boss 110 provided in the cylinder wall. It will be noted that the guide plunger 108 is at no time actuated or engaged by the piston 12, this plunger being provided merely for the purpose of rigidifying and constraining the movement of the breaker bar 96. Both the plungers 94 and 108 are pivotally connected by

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means of the pins 110 and 112 respectively to the breaker bar in cooperation with the elongated slots 114 and 116. The breaker bar is, of course, normally urged to the coil saturating position under action of the tension spring 118.

By this construction, it will be readily appreciated that an extremely rugged and effective fuel injecting and ignition system is provided.

From the foregoing, the construction and operation of the device will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the appended claims.

What is claimed as new is as follows:

1. In an internal combustion engine having a wall defining a cylinder and a piston reciprocable therein, a fuel injecting nozzle communicating with said cylinder, and means including a member disposed within the path of movement of said piston for injecting fuel through said nozzle, said means also including a second member disposed within the path of movement of said piston when said means has effected the fuel injection, said second member being effective to position the means for subsequent fuel injection.

2. In an internal combustion engine having a wall defining a cylinder and a piston reciprocable therein, a fuel injecting nozzle communicating with said cylinder, a pivoted pump actuating lever for effecting fuel injection through said nozzle, said lever being spring urged in one direction to effect fuel injection, means for latching said lever against the action of its spring, means for releasing the latching means including a member disposed in the path of movement of said piston.

3. In an internal combustion engine having a wall defining a cylinder and a piston reciprocable therein, a fuel injecting nozzle communicating with said cylinder, a pivoted pump actuating lever for effecting fuel injection through said nozzle, said lever being spring urged in one direction to effect fuel injection, means for latching said lever against the action of its spring, means for releasing

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the latching means including a member disposed in the path of movement of said piston, and means carried by said lever projectible in the path of movement of said piston for urging said lever to the latched position.

4. In an internal combustion engine having a wall defining a cylinder and a piston reciprocable therein, a fuel injecting nozzle communicating with said cylinder, a pivoted pump actuating lever for effecting fuel injection through said nozzle, said lever being spring urged in one direction to effect fuel injection, means for latching said lever against the action of its spring, means for releasing the latching means including a member disposed in the path of movement of said piston, said latching means including a pivoted latching bar engageable with one end of said lever.

5. In an internal combustion engine having a wall defining a cylinder and a piston reciprocable therein, a fuel injecting nozzle communicating with said cylinder, a pivoted pump actuating lever for effecting fuel injection through said nozzle, said lever being spring urged in one direction to effect fuel injection, means for latching said lever against the action of its spring, means for releasing the latching means including a member disposed in the path of movement of said piston, means limiting the spring urged movement of said lever for varying the quantity of fuel injected into the cylinder.

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