June 9, 1964 C. S. KENWORTHY 3,136,305

FUEL INJECTION VALVE

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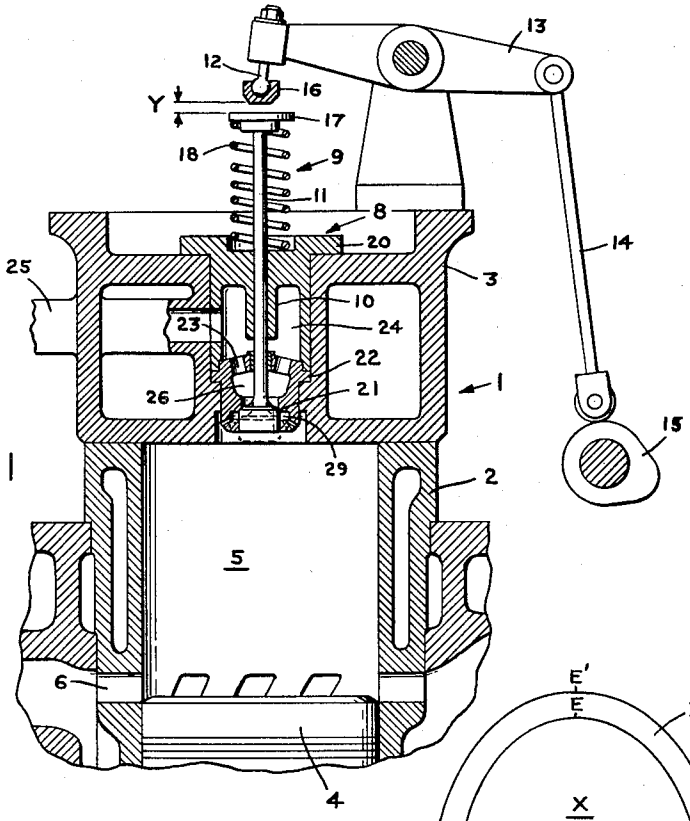

FIG. 1

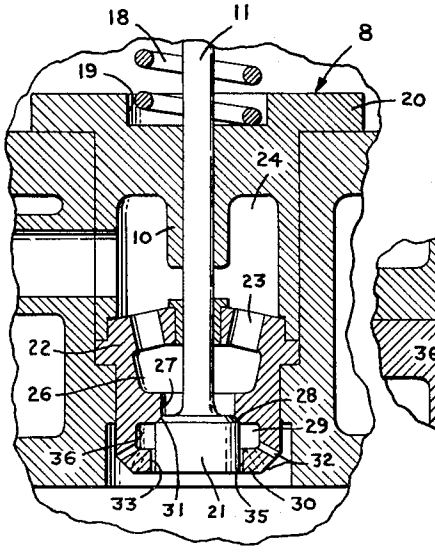

FIG. 2

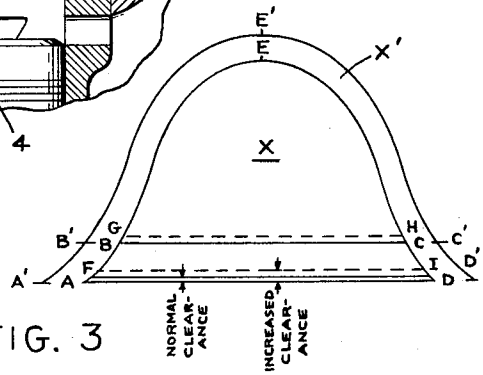

FIG. 3

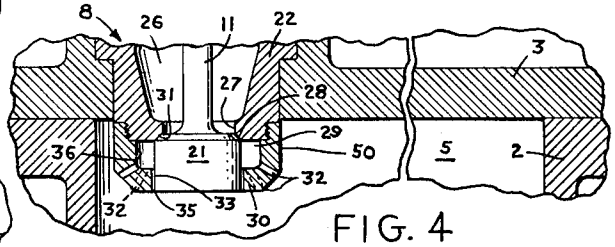

FIG. 4

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FUEL INJECTION VALVE

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This invention relates to fuel injection valves for internal combustion engines and more particularly to a fuel injection timing valve for use with two cycle internal combustion engines.

The fuel injection valve of an internal combustion engine wherein gas fuel is injected into the working cylinder during the compression stroke for mixture with trapped air, must be capable of properly distributing the fuel in the engine cylinder with the result that a thorough mixing of the fuel and air is provided for regardless of the location of the gas injection valve. Additionally the amount of gas admitted in the cylinder of engines of the type contemplated herein is subject to variations resulting from tappet clearance between the valve stem and the valve actuating means.

In order to obtain thorough mixing of the fuel and air which provides uniform combustion pressures and temperatures in the working cylinders, it is essential that these variations in tappet clearance be minimized as these variations will change both the timing of opening and closing of the fuel injection valve thus altering the period of fuel admission. Said another way increased tappet clearance which results from wear or misadjustment of the fuel injection valves and means for actuating same, causes decreased flow of fuel to the cylinder resulting in a leaner fuel and a poorer mixture.

In the past various means have been proposed for eliminating the effects mentioned above. One such arrangement calls for hydraulic valve lifters which eliminates the tappet clearance entirely. Arrangements of this type require a number of components and close tolerances must be maintained to insure proper operation thereof. It is obvious that such arrangements become complex and add to the overall expense of the engines including same.

The present invention eliminates the foregoing objections with the provision of a fuel injection valve that is not affected by variations in tappet clearance and which is capable of properly distributing the fuel in a gas cylinder regardless of these variations or its location in the cylinder.

Accordingly, it is an object of this invention to provide an improved fuel injection valve.

It is another object to provide a valve which is capable of distributing fuel in the cylinder of an engine to obtain a thorough mixing of the fuel and air.

It is a further object to provide a fuel injection valve which allows the maintenance of a high fuel injection pressure to the end of the injection period.

Other obects and advantages of the invention including the basic design and the nature of th improvements thereon will appear from the following description of several embodiments taken in conjunction with the following drawings and the novel features will be particularly pointed out hereinafter in the claims.

In the drawings:

FIGURE 1 is a schematic view of an engine cylinder partly in section including the fuel injection valve and the means for actuating same.

FIGURE 2 is an enlarged fragmentary view of the fuel injection valve shown in FIGURE 1.

FIGURE 3 is a diagram showing the effective valve lift area.

FIGURE 4 is another form of the improved fuel injection valve.

The drawings are to be understood to be more or less of a diagrammatic character for the purpose of illustrating and disclosing a typical or a preferred form of the improvements contemplated herein and in the drawings like reference characters identify the same parts in the several views.

Referring to the embodiment of the invention illustrated in FIGURES 1 to 3, in FIGURE 1 there is shown an internal combustion engine, generally designated **1**, having means forming a cylinder designated **2**. A cylinder head **3** is mounted on the means forming a cylinder and a piston **4** is disposed within the cylinder and cooperates with the means forming a cylinder **2** and cylinder head **3** to form a combustion chamber **5**. An inlet means **6** is formed in means **2** and regulates the entry of air into the combustion chamber **5**. An outlet means of at least one valve (not shown) in cylinder head **3** regulates the exit of exhaust gases from the chamber **5**. A housing **8** is disposed in the cylinder head **3** for receiving the fuel injection valve, generally designated **9**. Further, suitable ignition means are disposed in the combustion chamber **5** such as a spark plug (not shown).

Slidably mounted in the guide portion **10** of the housing **8** is a valve stem **11**. Operation of the fuel injection valve is through tappet **12** which is disposed in a movable lever **13** driven by a push rod **14**. As is usual the push rod **14** is driven by a cam **15** which is operated by the engine crank shaft (not shown).

Tappet clearance Y formed between the bottom portion **16** of the tappet **12** and a disc **17** connected to the top of the valve stem **11** is adjusted normally to manufacturers' setting recommendations.

The spring **18** as shown in FIGURE 2 is disposed in a counterbore **19** formed in the flange **20** of the housing **8** and normally holds the valve stem **11** upwardly so that the means at the bottom forming a mushroom-like disc is in the seated position as will be described hereinafter. Housing **8** through flange **20** is connected to head **3** in any convenient fashion.

The second guide portion **22** is mounted at the bottom of the housing **8**. A plurality of ports **23** are formed at the upper portion of the guide portion **22**. The ports **23** communicate a chamber **24**, in the housing which is connected by conduit **25** to a fuel source, with chamber **26**. Counterbore **27** in guide portion **22** with chamber **28** at the bottom thereof forms seat means for mushroom-like disc **21** formed at the lower end of valve stem **11**. A secondary chamber **29** having a diameter larger than counterbore **27** is formed by introverted annular flange **30** at the bottom of the guide portion **22**.

It is clear from the FIGURES 1, 2 and 3 of the drawings that the mushroom-like disc **21** mounted in the secondary chamber **29** and having seating portions **31** when seated on seat means **28** divides the inner portion of the housing into a primary chamber (chambers **24** and **26**) and a secondary chamber (chamber **29**). Passage means **32** connect the chamber **29** to the cylinder or combustion space **5**.

It will also be clear that the housing **8** and guide means **22** may be formed as a unit, however, it is preferred that they be of two-piece construction to facilitate removal of the valve for repair and replacement. Additionally to provide proper admission of fuel the counterbore **27**, chamber **29** and bore **33** are concentrically disposed.

Now referring to FIGURE 3, in the past, maximum fuel flow to the cylinder occurred as the fuel injection valve reached its maximum lift. This is shown by the area A, B, E, C, D.

A variation in valve tappet clearance will provide flow to the cylinder shown by the area A', B', E', C', D'.

In contra-distinction with the provision of secondary

chamber 29 and passage means 32 to restrict flow, maximum gas flow occurs before the valve and stem reach its maximum lift. This is obvious because the smaller area of the passage means 32 relative the valve lift area is small, or more particularly the valve lift area which is represented by the equation

$$A=\pi S(R_1+R_2)$$

where: S equals lift and R_1 and R_2 are radii at top and bottom respectively of the inverted conical frustum or flow passage to the valve seat; the total area of the opening of seat 31 is between three and four times the area of the passage means 32. It is obvious that one or more passage means 32 can be introduced to provide the above relationship. Since it is necessary to increase pressure in chamber 24 inversely to the ratio between the valve seat area and passage area it is obvious that the higher pressure required will provide a greater penetration of fuel through the dense air in the cylinder. Now referring again to FIGURE 3 in the valve of the contemplated invention fuel admission will begin at point A and at point B maximum admission is obtained. Accordingly flow to the cylinder is shown by the area A, B, C, D. Now if there is a variation in tappet clearance as shown in FIGURE 3 the area of the valve of the present invention becomes F, G, H, I, but this change has no effect on the operation of engine 2 because the improved valve is not sensitive of clearance changes or increases due to wear, etc. This is because of the fact that with a reduced proportion of valve lift the improved valve will deliver practically the same amount of fuel as with the full valve lift.

Further, it is obvious from the foregoing that the effects of the variations will be minimized on an engine including the valve of the present invention. This is because the area X is less than the area X' which results from prior type valves.

Additionally by selectively determining the clearance 35 between the flange 30 and disc 21 an increased fuel injection into the cylinder in a vertical direction may be provided as desired.

In the embodiment shown in FIGURE 4 an improved valve is shown which functions in a similar manner as described hereinbefore regarding the fuel injection valve shown in FIGURES 1 and 2.

Those parts having generally the same construction and purpose as the corresponding parts in FIGURES 1 and 2 have been given the same reference characters.

Instead of having housing 8 disposed centrally outside of the combustion chamber 5 it has been located to one side thereof and extended into the upper end of chamber 5, at least an amount sufficient to have all the outside ends of passages 32 clear of cylinder head 3. Further, housing 22 is now formed with a suitable detachable tip 50. Tip 50 serves substantially the same purpose that flange 30 did and has passage 32 disposed therein; the only difference being that tip 50 has more passages 32 disposed on the side remote from the closest wall of chamber 5 so that the open area of chamber 5 can get adequate dispersion of fuel. In addition clearance 35 may be made smaller and the angle of passages 32 can be individually selected for maximum, uniform dispersion of fuel in combustion chamber 5.

It will be understood that various changes in the details, materials and arrangements of parts which have been herein described and illustrated in order to explain the nature of the invention may be made by those skilled in the art within the principle and scope of the invention as expressed in the claims.

What is claimed is:

1. A fuel injection means adapted for use with an internal combustion engine having a fuel and air source and said internal combustion engine including means forming a cylinder, piston means slidably mounted in said cylinder, inlet and outlet means connected to the cylinder for controlling entry of air to the cylinder and exit of combusted gases from the cylinder, said fuel injection means comprising:

(*a*) a housing mounted on the means forming a cylinder,

(*b*) a valve means movably mounted in said housing,

(*c*) the housing comprising a primary chamber and a secondary chamber,

(*d*) the fuel source connected to the primary chamber,

(*e*) a seat means formed between the primary and secondary chambers,

(*f*) passage means connecting the secondary chamber to the cylinder,

(*g*) a mushroom-like disc formed at the end of the valve means remote from the seat means,

(*h*) the mushroom-like disc of the valve means to be selectively seated on said seat means to regulate flow of fuel from said primary chamber to said secondary chamber,

(*i*) means to seat or unseat the mushroom-like disc whereby the connection between said cylinder and said secondary chamber will be opened and closed as desired, and

(*j*) the flow area between the seat means and portion of the mushroom-like disc adapted to seat on the seat means is substantially larger than the area through the passage means interconnecting the secondary chamber and the cylinder.

2. The fuel injection means claimed in claim 1 wherein the secondary chamber is formed by providing the bottom of the housing with an introverted annular flange and said mushroom-like disc moves between the walls of said flange.

3. The fuel injection means claimed in claim 1 wherein the ratio between said valve seat area and said passage means lies in the range of from 3 to 1 and 4 to 1.

4. The combination claimed in claim 1 wherein said housing has an opening at the bottom thereof, said mushroom-like disc of smaller diameter than said housing opening and extending therein whereby a clearance exists therebetween which on the opening of said valve will permit fuel to pass therethrough.

5. The combination claimed in claim 4 wherein the clearance between said mushroom-like disc and the housing opening is selectively determined.

References Cited in the file of this patent

UNITED STATES PATENTS

1,346,204	Huid	July 13, 1920
2,951,647	Dreisin	Sept. 6, 1960
3,062,198	Richardson	Nov. 6, 1962

FOREIGN PATENTS

1,035,267	France	Aug. 20, 1953
736,264	Great Britain	Sept. 7, 1955