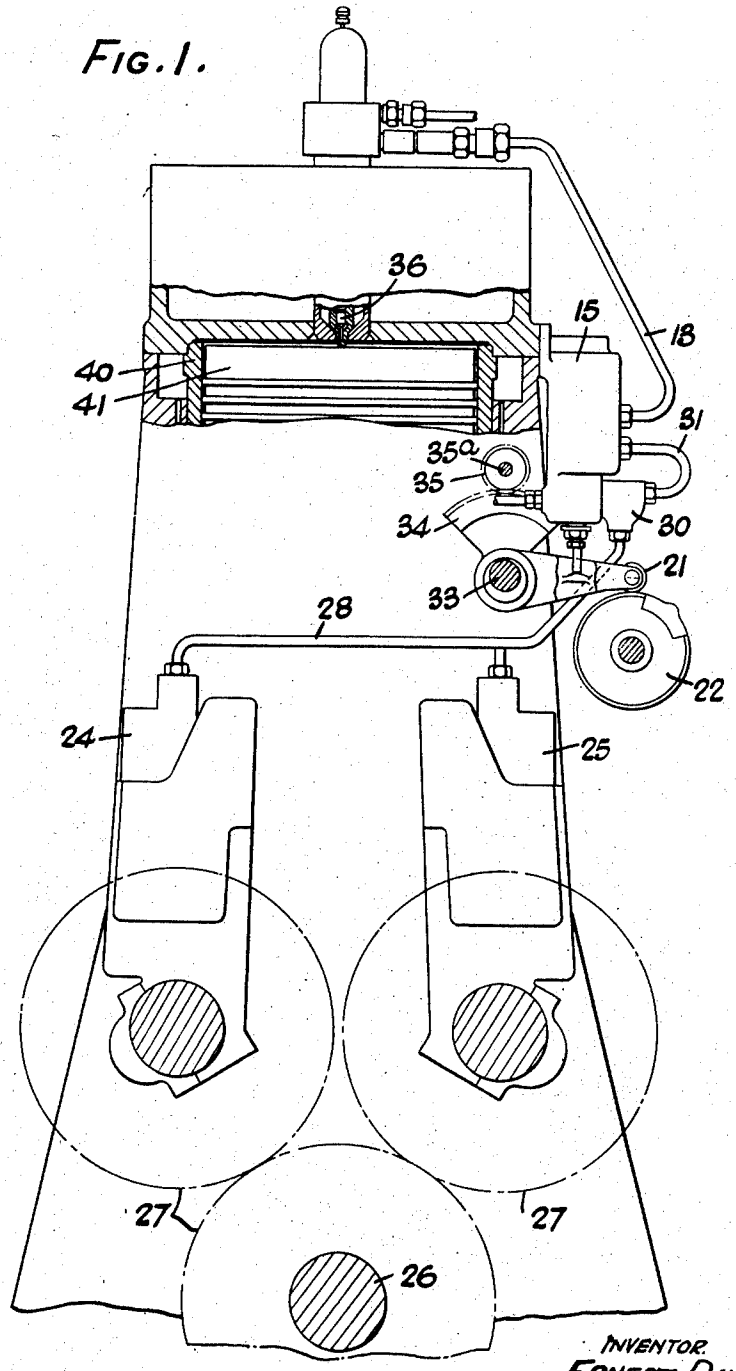
Aug. 26, 1952 E. DAVIES 2,608,375

VALVE FOR FUEL INJECTION SYSTEMS

Filed Aug. 20, 1946 2 SHEETS—SHEET 1

FIG. 1.



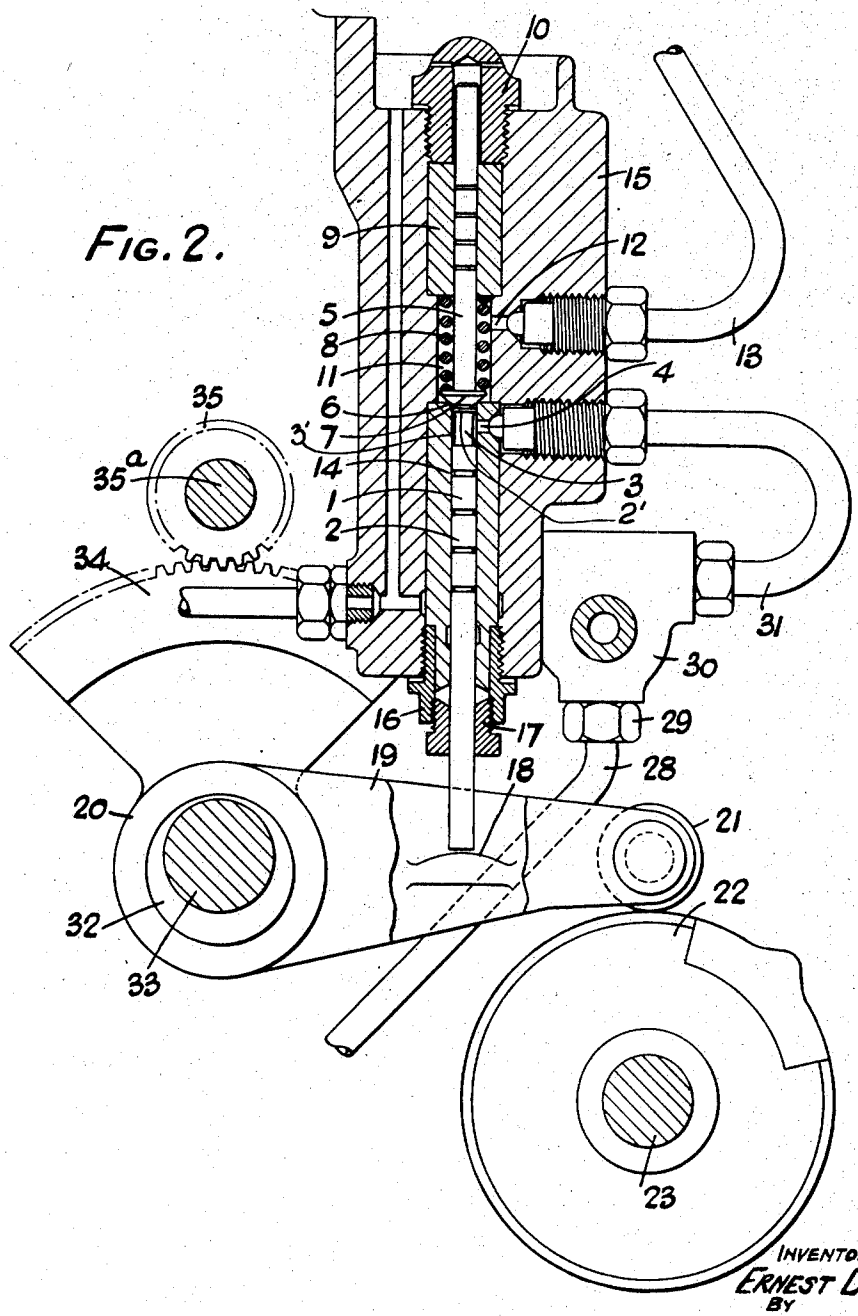
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VALVE FOR FUEL INJECTION SYSTEMS

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FIG. 2.



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Patented Aug. 26, 1952

2,608,375

UNITED STATES PATENT OFFICE

2,608,375

VALVE FOR FUEL INJECTION SYSTEMS

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Application August 20, 1946, Serial No. 691,694
In Great Britain June 6, 1945

Section 1, Public Law 690, August 8, 1946
Patent expires June 6, 1965

1 Claim. (Cl. 251—130)

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This invention relates to fuel injection systems of internal combustion engines, and more particularly is concerned with the type of fuel injection systems in which the liquid fuel is injected into the combustion chamber or working cylinder by a pump via a non-return valve supported in the cylinder or wall. The pump may be driven by the prime mover or by some other outside source of power. There may be more than one pump and each pump is of adjustable output to enable the liquid fuel to be supplied under varying pressure, according to the requirements of the engine and when there are a plurality of combustion or working chambers the pump or pumps supply a common rail or supply pipe off which branches are taken into the various chambers, such branch pipes communicating with the chambers by means of the non-return valves. Such non-return valve can be of any suitable known type and construction.

An object of this invention is to simplify and improve upon the means for timing and controlling the supply and admission, and cut-off periods and also to minimise undesirable pressure difference in the supply pipes or each branch pipe and the rail when the appropriate non-return valves opens. Yet a further object is to minimise pressure in the supply pipe or each branch pipe when the non-return valve closes in the appropriate head, thus tending to a quick closing action of the non-return valve, and increasing the efficiency of the action.

The present invention is more particularly concerned with the control and operation of a timed valve for regulating the supply of liquid fuel to the aforesaid non-return valve in a, or each cylinder head or wall, the timing valve, or each such timing valve being arranged in a supply pipe or one of the branch pipes, and being capable of being opened and closed for any position of the engine piston in its stroke, the valve preferably being of the balanced or nearly balanced type, and having combined therewith means for infinitely variably controlling the timing of the valve over a wide range.

In order that the invention may be clearly understood and readily carried into effect drawings are appended hereto illustrating an embodiment thereof, and wherein:

Figure 1 is a somewhat diagrammatic and broken sectional side elevation view showing the connection across the timing valve housing and e. g. a cylinder of an internal combustion engine.

Figure 2 is a detail sectional elevation to a larger scale of the timing valve and the means operating it.

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Referring to the drawings, one of the compression cylinders or the working chamber of the engine or generator is indicated by the reference numeral **40** and the piston operating therein by the reference numeral **41**. The details of the timing valve are more clearly shown in Figure 2, the timing valve being indicated by the reference numeral **1**. This valve is located in a housing **15** and is of the nearly balanced type embodying a piston **2** with the necessary reduced diameter or neck part **3** to produce the annular space **3'** to co-operate with an inlet port **4** in a tubular guide **14** for the piston, a balancing stem **5** smaller in diameter than the piston **2** being formed in axial prolongation with the valve, the valve being provided at the junction therewith of the stem with a conical, enlargement **7** engaging the seating of a port **6** to seal finally the flow of fuel.

A coiled compression spring **8** is interposed between the conical or mitre enlargement **7** of the valve or other appropriate abutment and the annular lower face of an upper guide sleeve **9** in which slides the stem like prolongation **5** of the valve, this sleeve being held in position by a plug or cap nut **10** threaded into the top of the housing **15**, the chamber **11** accommodating the coiled compression spring serving to establish communication between the inlet port **4** of the housing and the outlet port **12**, connected to the branch pipe **13** when the conical enlargement **7** is disengaged from the seating of the port **6**. The sleeve **14** is held in the housing **15** by a bush **16** and a gland nut and packing **17** receives the lower part of the valve which passes downwards through the housing. The lower extremity of the valve **1** engages an abutment **18** on a lever **19** having an eccentric adjustable fulcrum **20** and a free end carrying a roller **21** engaging the perimeter of a single crest cam **22** driven off a cam shaft **23** or other convenient part of the engine mechanism.

In a convenient arrangement of a fuel supply system a pair of pumps **24** and **25** (see Figure 1) are disposed symmetrically in relation to the axis of the engine crank shaft **26** and are driven through suitable gearing **27** from the crank shaft so as to obtain a unidirectional constant flow of liquid fuel into the aforesaid housing, it being understood that both pumps communicate with a common rail conduit **28** feeding into an appropriate union **29** which can be carried by a lateral enlargement **30** of the valve housing **15** from which extends a connection **31** leading to the inlet port **4** of the timing valve, this lateral enlargement if desired including means for controlling the effective cross-sectional area of the

orifice through which the liquid fuel flows into the housing. The pumps **24** and **25** may be driven from an independent source of power, which has the additional advantage that, in the free piston system, full fuel pressure is available when the main pistons come to rest at the firing dead centre, thus enabling fuel to be injected after the pistons have come to rest.

The timing of the valve is effected by means of the aforesaid eccentrically adjustable fulcrum **20** of the lever **19**, and for this purpose one end of each lever operates upon the periphery of an eccentric **32** carried by a shaft **33** to which is fixed a worm segment **34** meshing with a worm **35** fixed to a shaft **35***a* carrying or connected to, a remote control operating handwheel or lever.

The abutment **18** on the lever **19** which is engaged by the lower end of the valve is curved to a contour to give the desired duration of opening of the valve in conjunction with the timing of the valve, and in relation to the linear position of the piston **41**.

The balancing stem **5** for the valve is, as stated aforesaid, slightly less in diameter than the piston **2**. Owing to the presence on the upper end of the plunger **2** of a lap **2'** which "trails" the conical enlargement **7** when the valve is urged upwards to the open position and to the difference in diameter between the parts **2** and **5** there will be obtained a slight pumping action in the pipe **13** as the control valve lifts before the fluid-actuated valve **36** in the cylinder head or wall actually opens and also before the ports **4** and **12** communicate with each other. This will have the tendency of quickly raising the pressure in the branch pipe to the fluid-actuated valve, so that the time lag to open the fluid-actuated valve is not so great as normally occurs in present practice. Conversely, a reverse effect will obtain when the control valve closes because such an arrangement will cause a drop in pressure in the branch pipe and thereby minimise the opposition to the quick closing action of the fluid-actuated valve.

I claim:

A timing valve structure for a liquid fuel injection system comprising a reciprocating balanced type of piston valve member embodying an elongated piston-like part and a piston-like balancing stem part formed in integral prolongation of the first mentioned part, a valve housing, a sleeve forming a guide for the first mentioned piston-like part of the valve member, an

integral enlargement on the valve member between the said two parts of the valve member and seating against one end of said sleeve, a further sleeve spaced coaxially from the aforesaid sleeve and forming a guide for said stem part, a spring between the said latter sleeve and said enlargement urging said enlargement against the said end of the first mentioned sleeve, said first mentioned piston-like part of the valve member extending at one end beyond the housing, driving means operating against said latter end of the valve member to impart axial lift to the valve member against the influence of said spring, an outlet port in the housing communicating with the space between the opposed ends of said sleeves, an inlet port in said housing and extending through said first mentioned sleeve, a reduction in diameter of said first mentioned piston-like part and positioned and dimensioned axially so as to be exposed permanently to the inlet port and forming an annular chamber which, when the valve is moved to the open position, communicates with the space between the opposed ends of said sleeves so as to establish communication between the two ports, and a lap on the piston valve between said enlargement and the inlet port which produces a lag in the communication between the inlet port and outlet port as the said enlargement is moved away from its seating against the end of the first mentioned sleeve.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
Re. 15,225	Jarvis	Nov. 15, 1921
623,270	Block	Apr. 18, 1899
1,153,759	Brunker	Sept. 14, 1915
1,508,656	Hesselman	Sept. 16, 1924
1,593,510	Smith	July 20, 1926
1,825,290	Stevens	Sept. 29, 1931
1,970,039	Fraser	Aug. 14, 1934
2,163,313	Voit	June 20, 1939
2,397,269	Kelly	Mar. 26, 1946

FOREIGN PATENTS

Number	Country	Date
312,573	Great Britain	May 30, 1929
545,507	France	of 1922