Nov. 10, 1959 E. F. GRIEP 2,911,958

ENGINE FUEL SYSTEM

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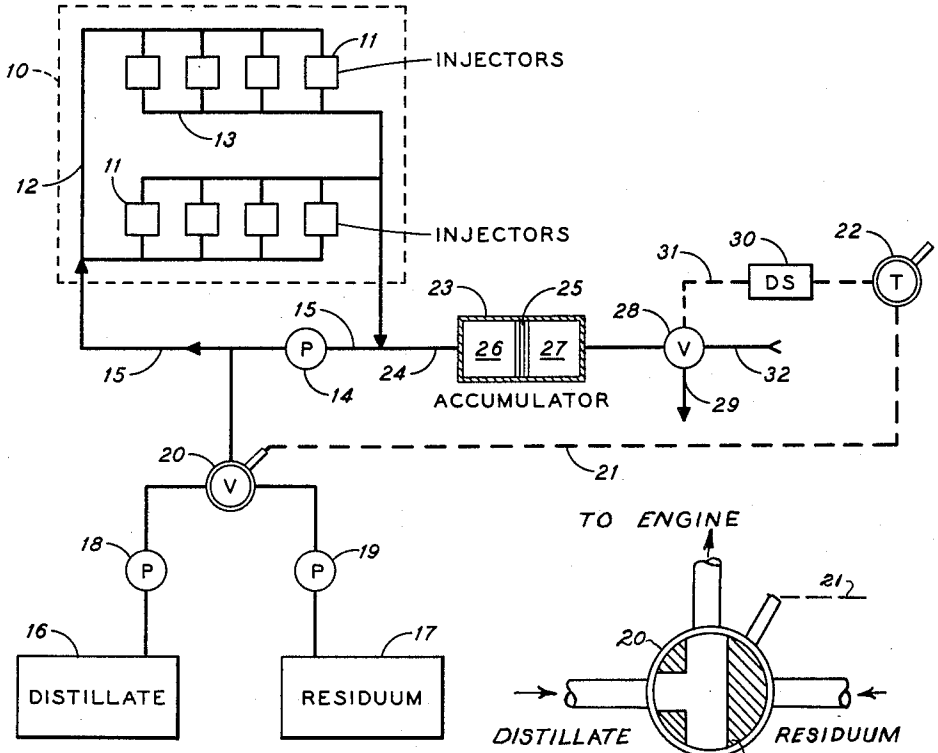


FIG. 1

FIG. 3

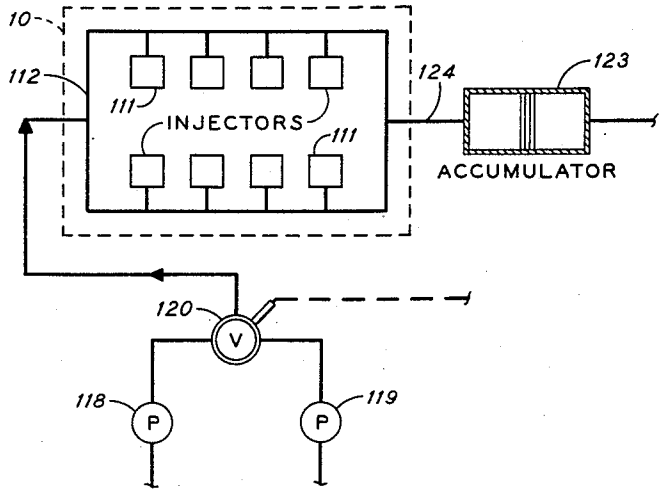


FIG. 2

INVENTOR
ELMER F. GRIEP
BY O. L. Lund
Walter G. Miller
ATTORNEYS

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ENGINE FUEL SYSTEM

Elmer F. Griep, Berkeley, Calif., assignor, by mesne assignments, to California Research Corporation, San Francisco, Calif., a corporation of Delaware

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6 Claims. (Cl. 123—30)

This invention relates to a fuel supply system for an internal combustion engine of the compression-ignition type that is being selectively operated upon one or both of two dissimilar liquid fuels, and particularly refers to a method and apparatus for sequestering a predetermined quantity of the fuel from the supply system and for rapidly transferring the fuel supply to a desired fuel source upon a predetermined change of operating conditions of the engine, and for returning the said sequestered fuel quantity to the supply system for consumption in said engine when the original operating conditions are restored.

An example of a fuel system to which the invention is particularly adapted is described in U.S. Patent No. 2,758,579 to P. L. Pinotti, which is characterized by a circulating header system that is selectively supplied by two dissimilar fuels, either singly or in predeterminable proportions, depending upon speed or load conditions of the engine. One fuel is desirably a distillate for operation at idle or low load conditions, and the other is a residual or heavy fuel which may be added to the distillate or supplant it entirely at high load conditions or when the engine can assimilate it readily. The particular fuel, or mixture of fuels, in that system is continuously circulated in the header until it is introduced by the injectors into the engine cylinder.

It has been found that sudden change in engine load, for example, a rapid reduction from high load to idle, as may occur in a railway diesel engine that is directed onto a siding immediately after ascending a long grade or after operating at high speed, will leave a quantity of a heavy fuel mixture or only heavy residual fuel in the fuel supply system immediately adjacent the injectors, for example, in the circulating header of Patent No. 2,758,579, that is relatively unsuited to the low load or engine idling condition. The engine, meanwhile, will require such a low rate of fuel consumption under these circumstances that this quantity of fuel, even if it is a fraction of a gallon, will require a relatively long time to be consumed. Under such conditions, undesirable results, such as smoking, carbon deposits on injectors, or sparking, may subsequently occur.

It is an object of this invention to provide a method and apparatus for rapidly sequestering a predetermined quantity of fuel from a fuel system, particularly of the type just described, at the time the load on the engine is reduced to idle or a low output, so that the more desirable fuel for the last-named condition will reach the injectors promptly and operate the engine at its optimum condition. Thereafter, when the higher load or speed is to be resumed, this sequestered quantity will be controllably returned to the fuel supply system, or circulating header, and blended with the fuel therein to be consumed without adversely affecting the engine operations. Desirably, but not necessarily, the functioning of the sequestering means is interconnected with the engine throttle or the load-governing mechanism. In any specific

installation, the most advantageous arrangement and mode of operation will be apparent to one skilled in this art.

Another object is to provide a method and apparatus of the type just described that is simple to operate and construct and is adapted to existing installations of engine fuel systems without extensive modifications.

These and other objects and advantages will be further apparent from the following description and the attached drawing, which forms a part of this specification and illustrates diagrammatically simple examples of the invention as applied to a circulating header internal combustion engine fuel system and to a non-return fuel system, each selectively supplied from two dissimilar fuel sources.

In the drawing, Figure 1 is a diagrammatic plan view illustrating an example of the invention as applied to a circulating header type system as may be employed on an electromotive (General Motors) diesel engine.

Figure 2 is a fragmentary diagrammatic plan view of part of the arrangement of Figure 1, which illustrates a non-return or non-circulating header for supplying fuel to the engine injectors of the type used on Baldwin and American Locomotive Company engines.

Figure 3 is an enlarged, fragmentary, diagrammatic view of one form of mixing or proportioning valve that will introduce only one fuel or a mixture of two fuels, depending on the engine throttle setting.

Referring to Figure 1 of the drawing, reference numeral **10** designates generally in outline an engine, in this case an internal combustion engine of the compression-ignition type, fitted with the usual banks of fuel injectors **11**. The inlets of injectors **11** are connected in parallel to an inlet conduit **12** and their outlets communicate with an outlet conduit **13**. A circulating pump **14** is connected between conduits **12** and **13** by means such as connecting conduit **15** to provide what may be termed a circulating fuel header. As is customary in these injectors, fuel oil supplied thereto through their inlets and not actually utilized or injected into the respective engine cylinders, flows to the outlet, so that, with the arrangement just described, there is a finite body or quantity of liquid fuel, the amount dependent upon the dimensions of the system, which fills that system and circulates to and through the several injectors.

To supply dissimilar liquid fuels to the system just described, a pair of storage tanks **16** and **17** are provided, respectively, for distillate and residual fuel oil. Each is connected through its pump **18** and **19** and appropriate piping to a mixing point, which may be a selecting or proportioning valve **20**, the operating means of which is suitably connected as shown by dotted line **21** to the throttle or governor **22** of the engine. Valve **20** is arranged to supply either fuel alone to the system or to mix them in any desired proportion. Figure 3 illustrates a form of three-way valve **20** that, in the position shown, will admit only distillate fuel from tank **16** to circulating header **15**, as just described. When it is rotated clockwise through about 180°, it admits only residual fuel from tank **17**. At intermediate positions, it varies the proportions by the respective port openings of the rotor **200** in a manner well known in the fluid control art. Alternatively, each pump may be suitably individually controlled by the governor or throttled to supply the desired fuel quantity, in which case the valve **20** could be a simple T or other means adapted to constitute a point of introduction of the fuel to the engine supply system. The outlet of valve **20** is connected to the inlet conduit **12** of the circulating header. The specific construction and arrangement of the engine throttle **22** and proportioning valve **20**, as well as the usual filters, heaters, pressure regulators and the like, are not a part of this invention and, hence, need no discussion in this specification. Ref-

erence is made to U.S. Patent No. 2,758,579 for a typical illustration of such details.

In order to provide a method and means for rapidly withdrawing and sequestering the liquid contents of the circulating header and injector system, an accumulator chamber **23** is connected to conduit **15** between outlet conduit **13** and the inlet to circulating pump **14** by means of a short conduit **24**. Accumulator **23** is a simple cylindrical container fitted with a sliding piston **25** or other displaceable means, such as a flexible diaphragm, for accumulating liquid in the left end **26** under the influence of a pressure differential or a resilient means, such as a spring. The opposite end **27** of accumulator **23** is suitably connected to a three-way valve **28** arranged to vent **27** to atmosphere through line **29**, for example, when the accumulator is intended to withdraw a quantity of liquid fuel from the circulating fuel system **12**, **13**, and **15** under the pressure existing therein by virtue of pumps **18** or **19**. Desirably, valve **28** is connected through a time delay mechanism, generally designated **30**, to the engine throttle valve or load governor **22** by appropriate means designated by the dotted line **31**. This is so constructed and arranged that whenever the engine throttle or governor **22** is actuated to reduce the fuel supply to the engine from high load to an idle or low load condition, accumulator **23** functions as just described to rapidly withdraw a predetermined quantity of the liquid fuel from the circulating header and sequester it until such a time as is appropriate to return it to the header, as will be explained below. In practice, this quantity may range from about 100% to 200% of the total capacity of the circulating system and injectors.

In the usual case, when the load on the engine is rapidly reduced to idle or low condition, it is desirable to supply only distillate fuel until the high load or speed condition is resumed. The cooperation of throttle **22** with valve **20** provides such a supply, as that valve normally is effective, either alone or in cooperation with conventional accessories, to prevent pump **19** from adding residuum to the circulating header during this condition.

After the low load or idling condition is past and high or full load engine operation is to be resumed, throttle **22** is adjusted to govern the supply of distillate and, if desired, residual fuel to the circulating header in cooperation with valve **20** and pumps **18** and **19**. Time delay mechanism **30** is adjusted to allow a reasonable time period to elapse, so that it is assured that high load conditions will continue, whereupon it functions to actuate valve **28** to permit air or gas under suitable pressure from a supply line **32** to enter end **27** of accumulator **23** and return piston **25** to its initial position at the extreme left end of the accumulator. This displaces the sequestered liquid fuel from end **26** of the accumulator and returns it to the circulating fuel system **12**, **13**, and **15** under conditions where its composition, which may be preponderantly or entirely residuum, will not adversely affect the engine operation.

Referring now to Figure 2, which illustrates the application of the invention to a non-return or non-circulating type fuel supply system, reference numeral **10** designates generally and in outline the engine, on which is mounted a plurality of injectors **111** which receive fuel from a conduit **112** supplied from a proportioning valve or mixing point **120** and introduce it into the engine cylinders. Conduit **112** forms the fuel supply system and contains the finite quantity of liquid fuel already mentioned. To supply the two dissimilar liquid fuels to point **120**, pumps **118** and **119** are provided, each with a suitable tank (not shown) corresponding to **18** and **19** of Figure 1.

Accumulator chamber **123** is connected to conduit **112** by short conduit **124**, and its function, construction, mode of operation, and control by the engine throttle or load governor are otherwise identical with the arrangement of Figure 1. Accordingly, repetition of the descriptions already given for these elements is deemed to be unnecessary for an understanding of the invention.

In conclusion, it will be appreciated that this invention comprehends broadly the provision of a method and means for withdrawing and sequestering a predetermined quantity of liquid fuel from the fuel supply system of an internal combustion engine, which may be included in a circulating body or header system, or in a supply conduit system, under such a change in load or operating conditions of the engine, for example, low load or idle, that the said withdrawn fuel characteristics would impair the operation of the engine and, thereafter, when the load or operating conditions are appropriate, returning the said withdrawn sequestered quantity to the system for consumption in the engine. During the time interval when such an action has taken place, it is comprehended that a more suitable fuel would be supplied to the engine under the load conditions existing.

Although a simple embodiment has been illustrated and described with particular reference to an arrangement of a circulating header for a compression-ignition engine, exemplified by Patent No. 2,758,579, and an alternative non-circulating arrangement, it will be apparent that the invention is not so limited and that numerous changes could be made without departing from its essential features. Accordingly, all such changes and modifications that come within the scope of the appended claims are intended to be embraced thereby.

I claim:

1. In a method of operating a compression-ignition engine on a mixture of two dissimilar liquid fuels in predeterminable proportions, said mixture being continuously circulated in a conduit or the like in communication with the fuel injection system of said engine, the steps of withdrawing the contents of said conduit into a confined chamber to permit said conduit to fill with substantially only one of said fuels when the load on said engine is reduced, supplying said one fuel to said conduit during said reduced load period, and subsequently returning said withdrawn portion to said circulating conduit when the load on said engine is increased.

2. In a method of operating a compression-ignition engine on a mixture of two dissimilar liquid fuels in predeterminable proportions, said mixture being continuously supplied to a conduit or the like in communication with the fuel injection system of said engine, the step of withdrawing the contents of said conduit into a confined chamber to permit said conduit to fill with substantially only one of said fuels when the fuel supply to said engine is reduced, supplying said one fuel to said conduit during said reduced fuel supply period, and subsequently returning said withdrawn portion to said conduit when the fuel supply to said engine is increased.

3. In a method of selectively operating an internal combustion engine on one or both of two dissimilar liquid fuels in predeterminable proportions, and in which a finite quantity of said fuel is maintained in a closed system between a point of introduction and at least one point of utilization, the steps of sequestering a predetermined quantity of said fuel from said system when the load on said engine is reduced so that substantially only one of said fuels is utilized in said engine, supplying substantially only said one fuel to said closed system during said reduced load period, and subsequently returning said sequestered quantity to said system when the load on said engine is increased.

4. In a method of operating an internal combustion engine according to claim 3, the added step of delaying the return of said sequestered quantity to said system for a predetermined period of time after the load on said engine is increased.

5. In a fuel system for supplying a mixture of two dissimilar liquid fuels to a compression-ignition engine including a header chamber communicating with the injector system of said engine, means for supplying said

mixture thereto, means for circulating said mixture through said chamber, and means for controlling the rate of fuel supply to said engine; the combination comprising an accumulator for withdrawing the mixture within said chamber, means for supplying substantially only one of said fuels to said header chamber to circulate therein, and means responsive to the fuel supply control means of said engine for actuating said accumulator and said last-named fuel supply means.

6. In a fuel system for supplying a mixture of two dissimilar fuels to a compression-ignition engine including means for maintaining a finite quantity of said fuel under

pressure in a confined system between a point of introduction into said system and at least one point of utilization in said engine, and means for regulating the rate of fuel supply to said engine, the combination comprising an accumulator responsive to said regulating means for sequestering said finite fuel quantity, means for supplying thereafter substantially only one of said fuels to said confined system, and means responsive to said regulating means for discharging the sequestered fuel from said accumulator into said confined system.

No references cited.