

May 20, 1958

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2,835,240

CONTROL FOR FUEL INJECTION SYSTEM

Filed Nov. 29, 1956

2 Sheets-Sheet 1

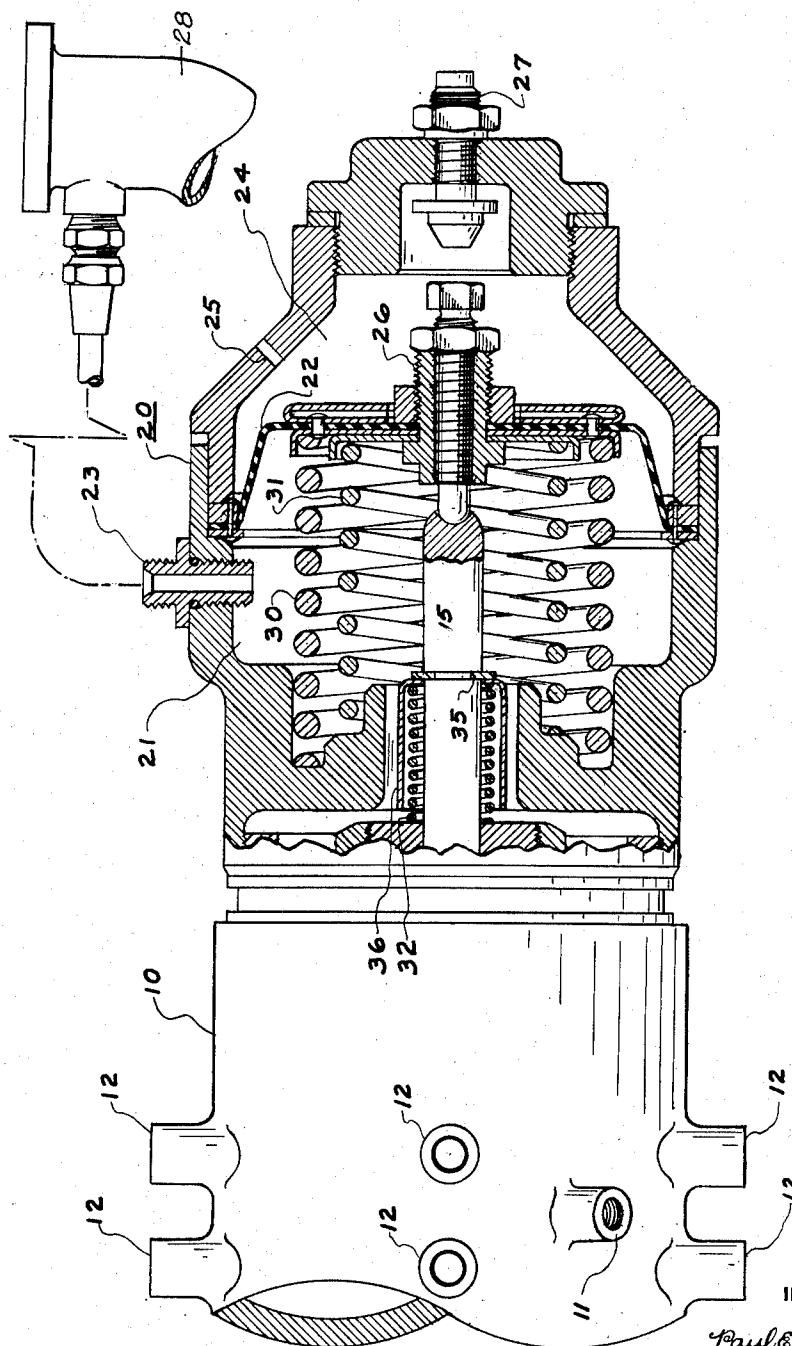


Fig. 1

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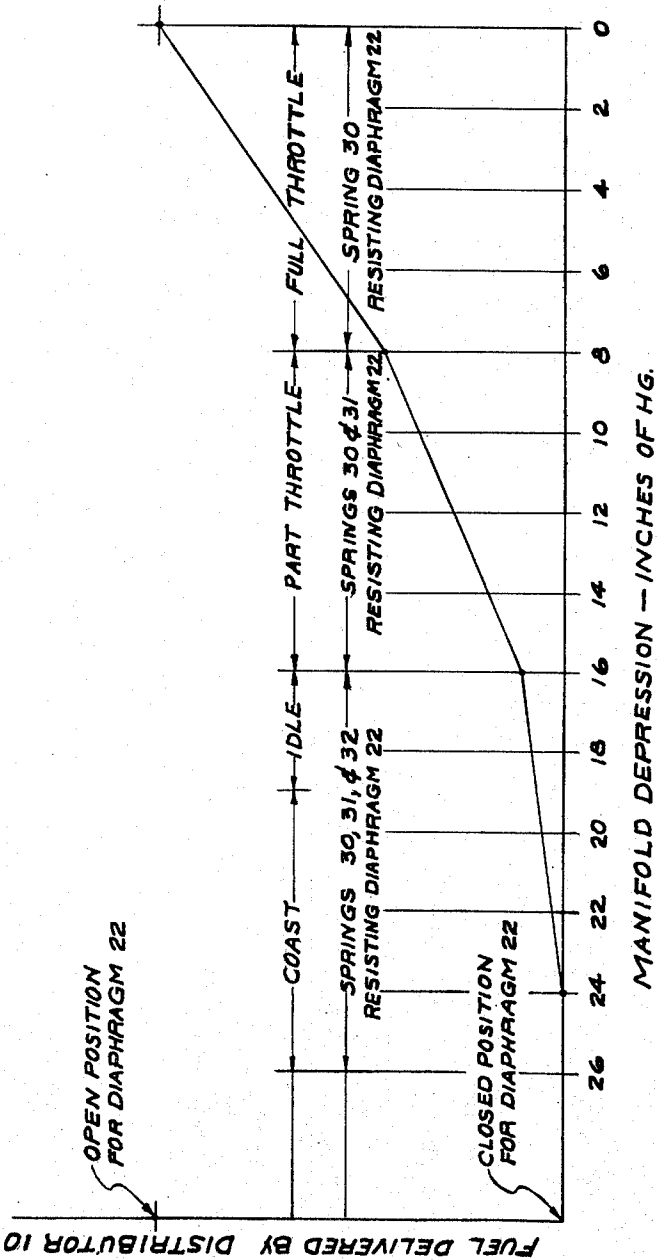


Fig. 2

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CONTROL FOR FUEL INJECTION SYSTEM

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Application November 29, 1956, Serial No. 625,089

4 Claims. (Cl. 123—140)

This invention relates to fuel injection systems for internal combustion engines and particularly to a new and improved control for a fuel injection distributor.

Fuel injection systems of the type to which the present invention pertains essentially include (1) a liquid fuel pump, (2) a liquid fuel distributor adapted to receive liquid fuel under pressure from the pump and effect the delivery of metered charges of the fuel to the combustion chambers of the engine and (3) control means responsive to the pressure of the air flowing in the intake manifold for controlling the metering of the fuel distributor.

A fuel distributor which may be utilized in connection with the present invention is known as the shuttle or free piston type although broadly the invention may also be utilized with other types of fuel distributors. In the shuttle type of fuel distributor a rotating sleeve is driven at camshaft speed and a shuttle or free piston in the sleeve is forced to reciprocate between a fixed stop and a stop which is axially movable in the sleeve. The distance between the fixed and movable stops determines the travel of the shuttle and concomitantly determines the quantities of the metered charges of liquid fuel delivered by the distributor. The position of the axially movable stop is varied continuously by distributor control means which are responsive to engine conditions including the pressure of air flowing in the engine intake manifold.

It is a main object of the invention to provide new and improved fuel distributor control means for varying the quantities of metered fuel charges delivered by the fuel distributor to the combustion chambers of the engine in accordance with engine conditions.

Other objects of the invention will become apparent from the following specification, the drawing relating thereto, and the appended claims.

In the drawing:

Fig. 1 shows a fuel distributor for a fuel injection system constructed in accordance with the present invention with the control for the distributor being shown in section; and

Fig. 2 is a graph which illustrates the manner in which the new and improved control functions to regulate the amount of fuel delivered by a shuttle or free piston type fuel distributor in accordance with the air pressure in an engine air intake manifold.

In Fig. 1 of the drawing there is illustrated a fuel distributor 10 for a fuel injection system which preferably is of the shuttle or free piston type as shown in United States Patent 2,137,384 to K. A. Browne. The invention is directed to the control for the distributor and the distributor control is shown in section.

In general the distributor 10 receives liquid fuel under pressure through inlet 11 from a source such as an engine driven pump (not shown). Distributor 10 functions to supply metered charges of the liquid fuel to injection nozzles (not shown) through outlets 12. The number of outlets 12 correspond to the number of combustion chambers to be serviced by the distributor.

Distributor 10 is adapted to be engine driven and the

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metered charges of fuel it supplies to an engine are delivered in timed relation with respect to the speed of the engine.

Regulating means are provided for varying the quantities of the metered charges delivered by the distributor 10 between limits corresponding to a closed position and a fully open position. The regulating means is illustrated as a rod 15 which when moved to a closed position is effective to entirely cut off the delivery of fuel by distributor 10 through the outlets 12 thereof. When rod 15 is moved a predetermined distance to the right, to a position corresponding to a fully open position, the metered quantities of fuel delivered by distributor 10 through outlets 12 will be as large as is permitted by the rated capacity of the distributor. If the distributor is of the shuttle or free piston type it will be understood by those familiar with this art that the rod 15 corresponds to the adjustable or moveable stop of this type of fuel distributor. In general the control to which the present invention is directed functions to move rod 15 between its limiting positions to increase and decrease the quantities of the metered charges of fuel delivered by the distributor in accordance with pressure variations in the air intake manifold of an engine.

Referring to the control for the distributor, there is illustrated stationary supporting structure for the control which includes a casing 20 formed in three parts. An expansible chamber 21 is formed by providing a movable element such as a diaphragm 22 in casing 20. Expansible chamber 21 has a port or opening 23 to provide for fluid pressure communication between chamber 21 and an engine air intake manifold, a portion 28 of which is shown. A chamber 24 on the opposite side of diaphragm 22 has a port 25 for exposing this side of the diaphragm to the atmosphere.

Connecting means for attaching diaphragm 22 to the distributor regulating means, which is illustrated as the rod 15, comprises a short, internally threaded, rod-like member or fitting 26. Rod-like fitting 26 is connected to the central portion of the diaphragm and rod 15 has external threads for threaded engagement with fitting 26. By this arrangement the effective length of rod 15 is adjustable relative to the diaphragm. An adjustable stop member 27 is threadably mounted in the casing 20 for abutting engagement with fitting 26 to limit the stroke of diaphragm 22 in the direction in which the fuel delivered by fuel distributor 10 increases.

Movement of diaphragm 22 and the fuel distributor regulating means (rod 15) in a direction to decrease the fuel delivered by distributor 10 is effected by a decrease of the pressure of the air in expansible chamber 21. Thus as the pressure in the engine air intake manifold to which expansible chamber 21 is connected decreases, the diaphragm 22 moves to the left to decrease the fuel delivered by distributor 10.

Resilient means are provided which resist the suctional force exerted on diaphragm 22 and biases the diaphragm in a direction to increase the fuel delivered by distributor 10. The resilient means comprises three coil springs 30, 31 and 32 nestled in expansible chamber 21 in surrounding relation to rod 15 and fitting 26. Each of the coil springs has one end thereof in abutting engagement with supporting structure which is stationary relative to the casing 20.

Diaphragm 22 has an axial travel between limits such that when it is at its furthest position towards the left, corresponding to a fully closed position, the fuel distributor 10 delivers no fuel. When the diaphragm is at its furthest position towards the right, corresponding to a fully open position, the fuel distributor delivers a maximum amount of fuel.

Spring 30 is disposed between the supporting structure

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of casing 20 and diaphragm 22 and exerts a biasing force on diaphragm 22 during the entire travel of the diaphragm from a fully closed position to a fully open position.

Spring 31 has a free length such that it is uncompressed and does not biasingly engage diaphragm 22 until the diaphragm has moved a predetermined distance from its fully open position towards its closed position.

Spring 32 is disposed between the supporting structure of casing 10 and a washer 35 which is attached to rod 15. A cylindrically shaped cover 36 serves as a guide for spring 32. The free length of spring 32 relative to the position of washer 35 is such that spring 32 does not biasingly engage washer 35 until diaphragm 22 has travelled a predetermined distance after engaging spring 31 as the diaphragm moves in the direction towards its closed position.

Stated another way, as it is in the claims, spring 32 is in operable biasing engagement with diaphragm 22 during the travel of the diaphragm from a closed position to a first intermediate position. Spring 31 is in operable biasing engagement with diaphragm 22 during the travel of the diaphragm from a closed position to a second intermediate position, the second intermediate position being between the first intermediate position and the fully opened position. Spring 30 is in operable biasing engagement with diaphragm 22 during the entire travel of diaphragm 22 between its closed and fully opened positions.

From the above description it is seen that there are three stages involved in the travel of diaphragm 22 as it travels between the limits of its fully open and fully closed positions. Starting from a fully open position, the first stage of the travel of diaphragm 22 is resisted by spring 30, the second stage is resisted by springs 30 and 31, and the third stage is resisted by springs 30, 31 and 32. Springs 30, 31 and 32 are selected or designed in accordance with the engine characteristics of the engine in which the distributor 10 is installed.

The three stages referred to above are related to the full range of pressures communicated from the air intake manifold of an engine to the expansible chamber 21. The first stage corresponds to full throttle when diaphragm 22 is resisted only by spring 30. The second stage corresponds to part throttle when diaphragm 22 is resisted by springs 30 and 31. The third stage corresponds to idling and coasting when diaphragm 22 is resisted by springs 30, 31 and 32.

The graph shown in Fig. 2 illustrates the three stages referred to above and shows by way of example the relationship between air intake manifold depression and the fuel delivered by distributor 10. The graph is self-explanatory of the operation of the control for distributor 10 in that the ordinate of the graph represents the positions of diaphragm 22 between the limits of its travel for the full range of pressure conditions in an air intake manifold. Of special interest is that for a manifold depression between 16 and 26 inches of Hg, the three springs 30, 31 and 32 acting in parallel are operative to control the positioning of diaphragm 22 for both idling and coasting conditions.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment of the invention is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

It is claimed and desired to secure by Letters Patent:

1. A control for an engine driven fuel injection distributor having regulating means for varying the quantities of the metered charges delivered by the distributor between limits corresponding to a closed position and a fully open position; said control comprising stationary structure and a movable fluid pressure responsive element cooperable therewith to form an expansible chamber; said movable

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element being movable between limits corresponding to the limits of said distributor regulating means; said chamber having an opening to provide for fluid pressure communication between said chamber and an air intake manifold; connecting means operably attached between said movable element and said distributor regulating means; said movable element being responsive to a decrease in pressure in said chamber to move said connecting means in a direction to decrease the fuel delivered by said distributor; first, second and third resilient means operably disposed between said supporting structure and said movable element for biasing said movable element in a direction to increase the fuel delivered by said distributor; said first resilient means being in operably biasing engagement with said movable element during the travel of the movable element from a closed position to a first intermediate position, said second resilient means being in operable biasing engagement with said movable element during the travel of the movable element from a closed position to a second intermediate position, said second intermediate position being between said first intermediate position and said fully open position, and said third resilient means being in operable biasing engagement with said movable element during the entire travel of said movable element between its closed and fully opened positions.

2. A control for an engine driven fuel injection distributor having regulating means for varying the quantities of the metered charges delivered by the distributor between limits corresponding to a closed position and a fully open position; said control comprising stationary structure including a casing; diaphragm means disposed in said casing to form a chamber; said diaphragm being movable between limits corresponding to the limits of said distributor regulating means; said casing having an opening to provide for fluid pressure communication between said chamber and an air intake manifold; connecting means operably attached between said diaphragm and said distributor regulating means; said diaphragm being responsive to a decrease in pressure in said chamber to move said connecting means in a direction to decrease the fuel delivered by said distributor; first, second and third resilient means operably disposed between said supporting structure and said diaphragm for biasing said diaphragm in a direction to increase the fuel delivered by said distributor; said first resilient means being in operable biasing engagement with said diaphragm during the travel of the diaphragm from a closed position to a first intermediate position; said second resilient means being in operable biasing engagement with said diaphragm during the travel of the diaphragm from a closed position to a second intermediate position; said second intermediate position being between said first intermediate position and said fully open position; and said third resilient means being in operable biasing engagement with said diaphragm during the entire travel of said diaphragm between its closed and fully opened positions.

3. A control for an engine driven fuel injection distributor having regulating means for varying the quantities of the metered charges delivered by the distributor between limits corresponding to a closed position and a fully open position; said control comprising stationary structure including a casing; diaphragm means disposed in said casing to form a chamber; said diaphragm being movable between limits corresponding to the limits of said distributor regulating means; said casing having an opening to provide for fluid pressure communication between said chamber and an air intake manifold; connecting means operably attached between said diaphragm and said distributor regulating means; said diaphragm being responsive to a decrease in pressure in said chamber to move said connecting means in a direction to decrease the fuel delivered by said distributor; first, second and third coil springs nestled in said chamber and operably disposed between said supporting structure and

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said diaphragm for biasing said diaphragm in a direction to increase the fuel delivered by said distributor; said first coil spring being in operable biasing engagement with said diaphragm during the travel of the diaphragm from a closed position to a first intermediate position, said second coil spring being in operable biasing engagement with said diaphragm during the travel of the diaphragm from a closed position to a second intermediate position, said second intermediate position being between said first intermediate position and said fully open position; and said third coil spring being in operable biasing engagement with said diaphragm during the entire travel of said diaphragm between its closed and fully opened positions.

4. A control for an engine driven fuel injection distributor having regulating means for varying the quantities of the metered charges delivered by the distributor between limits corresponding to a closed position and a fully open position, said control comprising stationary structure including a casing, diaphragm means disposed in said casing to form a chamber, said diaphragm being movable between limits corresponding to the limits of said distributor regulating means, said casing having an opening to provide for fluid pressure communication between

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said chamber and an air intake manifold, a rod operably attached between said diaphragm and said distributor regulating means, said diaphragm being responsive to a decrease in pressure in said chamber to move said rod in a direction to decrease the fuel delivered by said distributor; first, second and third coil springs nestled in said chamber in surrounding relation to said rod and operably disposed between said supporting structure and said diaphragm for biasing said diaphragm in a direction to increase the fuel delivered by said distributor; said first coil spring being in operable biasing engagement with said diaphragm during the travel of the diaphragm from a closed position to a first intermediate position, said second coil spring being inoperable biasing engagement with said diaphragm during the travel of the diaphragm from a closed position to a second intermediate position, said second intermediate position being between said first intermediate position and said fully open position, and said third coil spring being in operable biasing engagement with said diaphragm during the entire travel of said diaphragm between its closed and fully opened positions.

No references cited.