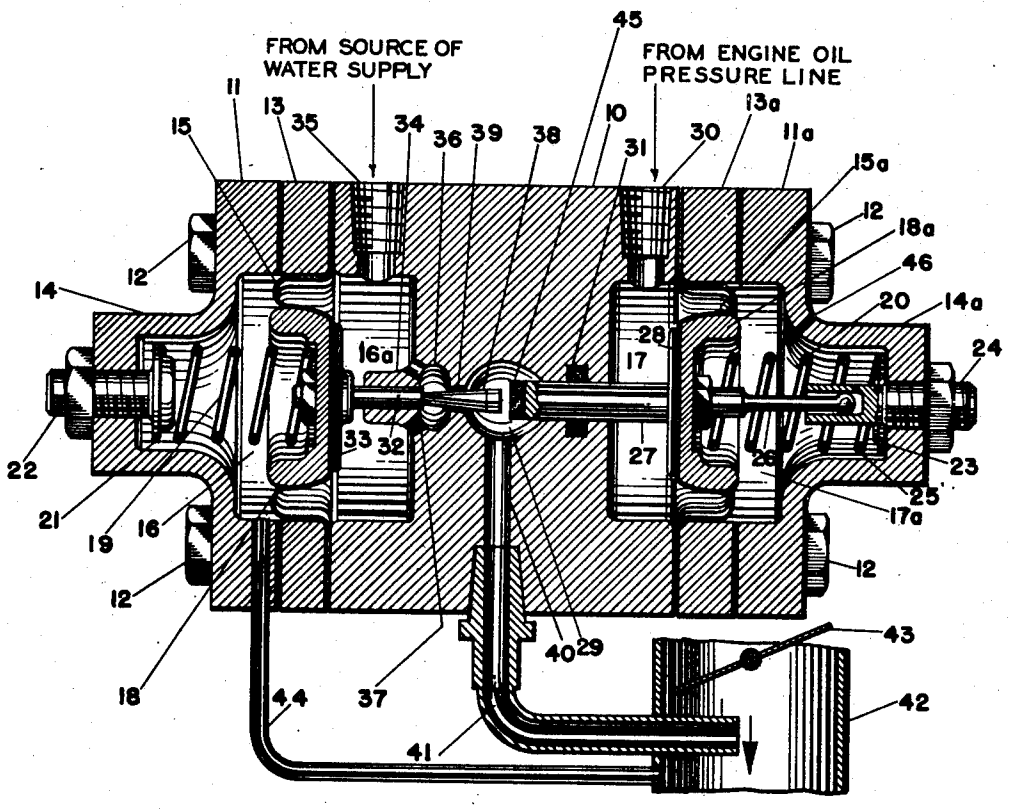
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INJECTION CONTROL SYSTEM

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INJECTION CONTROL SYSTEM

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The present invention relates to new and useful improvements in attachments for internal combustion engines, and more particularly to improvements in a fluid injection control system for internal combustion engines.

The invention is generally concerned with the injection of a fluid, such as water, into the fuel mixture supplied by the carburetor to the combustion chambers of internal combustion engines. Such water injection operates as a coolant and anti-detonator to reduce "knocking," particularly when the engine is under load.

An object of the present invention is to provide a compact and reliable device for selectively controlling the admission of anti-detonating fluid to an internal combustion engine.

Another object of the invention is to provide a mechanism in the form of a valve assembly for selectively metering water to the internal combustion engine according to the manifold pressure.

A further object of the invention is to provide a mechanism of the above type which operates to positively and automatically shut off the metered water supply upon stopping of the engine.

The invention still further aims to provide a mechanism of the above type which includes a metering valve operated in response to variations in pressures occasioned during operation of the engine and upon stopping thereof.

The above and other objects of the invention will in part be obvious and will be hereinafter more fully pointed out.

In the accompanying drawing the figure is sectional view taken longitudinally through the housing of the metering device and showing the same diagrammatically positioned with respect to the fuel mixture conduit.

Referring more in detail to the accompanying drawing, the device is illustrated as enclosed within a casing or housing which includes a central body portion 10 and end closure members 11, 11a which are secured to the body portion 10 by bolts 12, or the like, passing through annular spacer elements 13, 13a. The end closure members 11, 11a are each provided with outward extensions 14, 14a affording internal recesses facing countersunk recesses in the adjacent ends of the body portion to provide internal end cavities in the housing which are divided by flexible transverse diaphragms 15, 15a into pairs of chambers 16, 16a, and 17, 17a, respectively. The edges of the diaphragms are secured between the spacer elements and the adjacent faces of the body portion 10.

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The central portions of the diaphragms 15, 15a are secured to supporting cup members 18, 18a, respectively, which also serve as seats for the inner ends of coil springs 19, 20, respectively. The opposite end of the spring 19 within the chamber 16 is centered on a flange 21 at the inner end of a bolt 22 which extends through the end of the closure extension 14 and may be adjusted to vary the effective influence of the spring on the diaphragm as desired. The opposite end of the spring 20 within the chamber 17a bears on an annulus 23 carried by a bolt 24 which is also adjustably mounted in the end of the closure extension 14a. The inner end of the bolt 24 is longitudinally bored, as at 25, to receive the end of a stem 26 which is secured to a spindle 27 on the opposite side of the diaphragm 15a which is clamped thereby between the surface of the cup member 18a and a plate 28.

The body portion 10 is provided with a centrally disposed valve chamber 29 into which the spindle 27 extends from the chamber 17. The chamber 17 is adapted to be connected through the passage 30 in the body portion with a source of fluid under pressure when the engine is operating, such as the fuel, oil or water system thereof. A ring seal 31 is carried by the body portion and cooperates with the spindle 27 to prevent leakage of fluid between the chambers 17 and 29. A valve stem 32 is scecured to the cup member 18 and serves to clamp the central portion of the diaphragm 15 between the cup member and a plate 33. The valve stem extends through an axially bored boss 34 extending into the chamber 16a which is adapted to be connected through passage 35 with a source of anti-detonating fluid, such as a water supply tank (not shown). The chamber 16a is in communication with a collecting recess 36 through passages 37. The valve stem carries a valve member 38 at the inner end thereof and this valve member is provided with a tapered metering surface cooperating with the surface of a passage 39 which provides communication between the recess 36 and the chamber 29. A passage 40 in the body portion 10 affords communication between the chamber 29 and a conduit 41 which opens centrally into the throttle tube which may be the fuel mixture or air conduit 42 leading to and under the suction of the engine manifold (not shown). The passage of air and/or fuel is controlled by a conventional throttle valve 43 in the tube 42. The closed chamber 16 is in communication with the conduit 42 through a suitable form of conduit 44 so that the chamber 16 is thus under the influence of the manifold pressure, or rather suction, as is the chamber 29. The

water may be admitted at any point between the carburetor and the valves.

In operation, when the engine is stopped with no pressure in the chamber 17, the relative forces of the springs 19, 20 are so adjusted that the spring 20 will force the diaphragm 15a inwardly and with it the spindle 27 until the rubber pad 45 at the inner end of the spindle will seat against the adjacent surface of the chamber 29 with the valve member 38 closed so as to provide a positive seal against flow of water through the passage 39. During this positioning of the parts the spring 20 will overcome the force of the spring 19 so as to maintain the valve member seated. Upon starting of the engine, the chamber 17a being vented to the atmosphere through a hole 46 in the closure member 14a, the pressure of the fuel, oil or water system which is connected to the passage 30, will force the diaphragm 15a outwardly and with it the spindle 27 so as to permit the spring 19 to tend to force the valve member 38 away from the valve seating surface 39 to admit water from the chamber 16a to the chamber 29. When the engine is idling and not under load, the throttle valve 43 will be toward a closed position and the suction in the manifold and in the conduit 42 will be relatively high and this suction or relatively low pressure will be transmitted to the chamber 16 through the conduit 44 so that the diaphragm 15 will be urged outwardly of the body portion against the action of the spring 19, thus tending to close the metering valve to reduce or stop the passage of water, into the fuel conduit, depending on the manifold suction. As the throttle valve is opened under increasing engine load, the manifold suction will be reduced (or, conversely the manifold pressure will increase) and the same change will occur in chamber 16 so that resistance to movement of the valve member 38 under influence of the spring 19 will decrease and the valve member will be shifted toward open position. This will progressively admit more water to the chamber 29 and to the conduit 41 so that the water will be injected into the fuel mixture in the conduit 42. Thus, the admission of water to the explosion chambers is increasingly metered as, the suction decreases, or conversely as the absolute manifold pressure increases. The setting of the springs 19, 20 may be varied for any pressure valves required for the selected operating conditions of the metering valve. Under normal operating conditions, the valve is under positive spring pressure tending to open the same and under variable manifold suction tending to close the same by counteracting the force of the spring 19. Thus, the valve is under the influence of the resultant differential between the spring force and manifold pressure.

Upon stalling or stopping of the engine, the fluid pressure in chamber 17 which pressure varies with engine R. P. M., drops so that the spring 20 tends to force the spindle 27 inwardly. At the same time, the manifold pressure and hence the pressure in chamber 16 tends to increase to atmospheric, but as previously pointed out, the tension of spring 26 is such as to overcome opening tendencies of the valve member under the aforesaid forces so that the valve member is urged by the spindle 27 toward a closed position with the pad 45 ultimately seating around the passage 39 to provide a positive seal which will prevent additional water being drawn into the engine after stopping or stalling thereof.

It will be seen from the foregoing description in connection with the drawing that a highly efficient and relatively simple metering valve assembly is provided for selectively controlling the admission of water, as an anti-detonator, to the explosion chambers of an internal combustion engine is hereby provided. However, although one form of the invention has been shown for purposes of illustration, it is to be clearly understood that various changes in the details of construction, arrangement of parts and mode of operation may be accomplished without departing from the scope of the invention as set forth in the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. In a fluid injection system for internal combustion engines having a throttle tube subject to manifold pressure, the provision of a housing having fluid conduit means therethrough connected to the throttle tube, a metering valve in said conduit means for controlling the passage of the fluid to the throttle tube in amounts inversely proportional to the manifold pressure, means providing a chamber in said housing subject to pressure created by revolution of the engine, a valve closing member normally held in inoperative position by the pressure within said chamber, and spring means for shifting said closing member when the pressure in said chamber drops below a predetermined point whereby to positively close said valve.

2. A device for selectively controlling the admission of water to the fuel mixture of an internal combustion engine in response to the manifold pressure thereof, comprising a housing having conduit means providing communication between the engine and the source of supply of the water to be added, metering valve means in said housing for controlling the passage of water through said conduit means in response to manifold pressure, and means for positively closing said metering valve upon stopping of the engine or upon reduction of the engine revolutions per minute below a pre-set minimum.

3. A device for selectively controlling the admission of water to the fuel mixture of an internal combustion engine in response to the manifold pressure thereof, comprising a housing provided with a cavity and a diaphragm dividing said cavity into a pair of chambers, one of said chambers being subject to manifold pressure and having spring means therein acting on said diaphragm and opposing said manifold pressure, the other of said chambers being in communication with the source of supply of the water to be admitted and with the engine, valve means connected to said diaphragm and operated thereby for controlling the admission of water to the engine according to the differential force exerted on said diaphragm by said spring means and the manifold pressure, and means operable upon stopping of the engine for positively closing said valve means.

4. A device for selectively controlling the admission of water to the fuel mixture of an internal combustion engine in response to the manifold pressure thereof, comprising a housing provided with a cavity and a diaphragm dividing said cavity into a pair of chambers, one of said chambers being subject to manifold pressure and having spring means therein acting on said diaphragm and opposing said manifold pressure, the

other of said chambers being in communication with the source of supply of the water to be admitted and with the engine, valve means connected to said diaphragm and operated thereby for controlling the admission of water to the engine according to the differential force exerted on said diaphragm by said spring means and the manifold pressure, and spring loaded means held in open position by the oil pressure of the engine but operable upon stopping of the engine to positively close said valve means.

5. A device for selectively controlling the admission of water to the fuel mixture of an internal combustion engine in response to the manifold pressure thereof, comprising a housing provided with a cavity and a diaphragm dividing said cavity into a pair of chambers, one of said chambers being subject to manifold pressure and having spring means therein acting on said diaphragm and opposing said manifold pressure, the other of said chambers being in communication with the source of supply of the water to be admitted and with the engine, valve means connected to said diaphragm and operated thereby for controlling the admission of water to the engine according to the differential force exerted on said diaphragm by said spring means and the manifold pressure, an additional chamber having

a flexible wall portion and in communication with the oil pressure line of the engine, a spindle carried by said wall portion and normally held in retracted position by the oil pressure, and spring means for forcing said spindle into contact with said valve means to positively close the same upon stopping of the engine and resultant failure of the oil pressure.

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