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LIQUID FUEL CONTROL FOR INTERNAL COMBUSTION ENGINES

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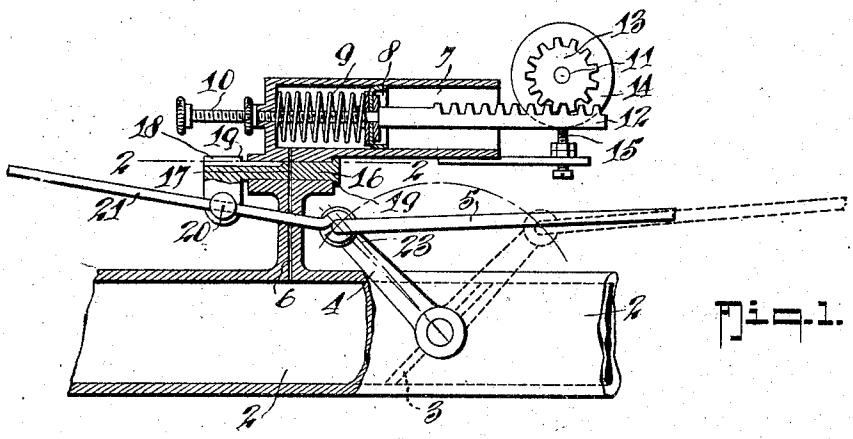
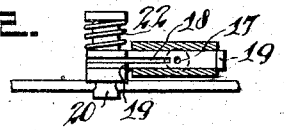


Fig. 1.

Fig. 2.



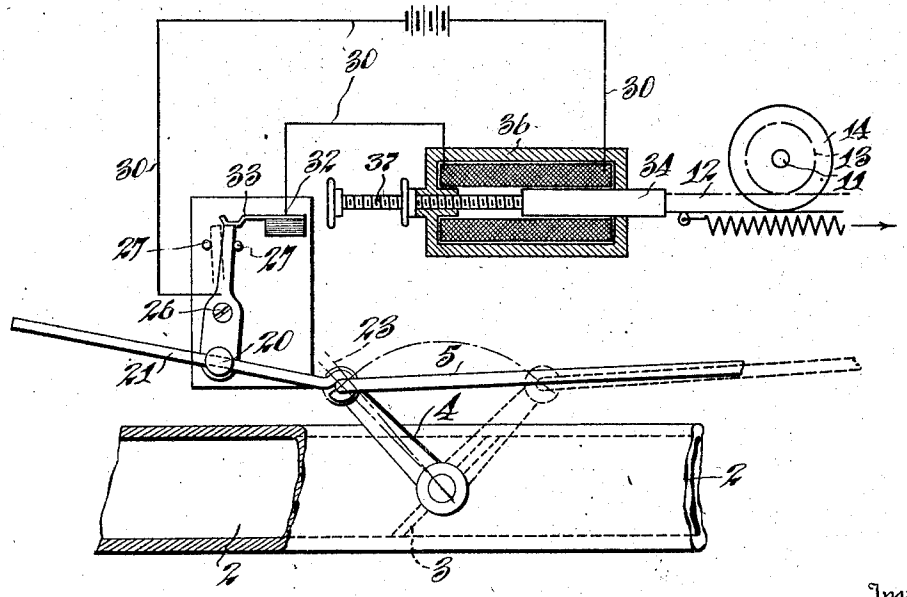


Fig. 3.

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LIQUID-FUEL CONTROL FOR INTERNAL-COMBUSTION ENGINES.

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This invention relates to a means for controlling the liquid fuel supply to an internal combustion engine cooperatively with the movement to open or close the throttle valve which controls the supply of the gaseous mixture to the engine intake.

It is particularly designed to effect the regulation of the liquid fuel between its "maximum power" and "maximum economy" limits cooperatively with any demand made on the gas; whereby, if the throttle valve is opened, even to a slight extent, to admit more gas to the engine the liquid fuel valve is opened to admit the full supply of the fuel to the "maximum power" limit, and conversely, when the throttle is moved to lessen the supply of gas to the engine, the liquid fuel valve is closed to its "maximum economy" limit: The "maximum power" and "maximum economy" limits of the liquid fuel valve having been previously adjusted.

The particular manner by which these results are attained is fully set forth in the following specification, reference being made to the drawings by which it is accompanied, in which:

Fig. 1 shows a means whereby this control is effected by the vacuum in the intake pipe.

Fig. 2 is a plan on the line 2—2 in Fig. 1, showing the frictional connection between the valve and its operating rod.

Fig. 3 illustrates more or less diagrammatically a modification wherein the same control is effected electrically instead of by the vacuum of the intake.

In these drawings 2 represents the gas intake pipe to the engine and 3 the throttle valve in this pipe, by which the amount of such gas is controlled, 4 being the lever and 5 the rod by which the throttle valve is manually operated between its closed and open positions, represented respectively by the full lines and the dot and dash lines in Fig. 1.

Referring particularly to Figure 1: From the intake pipe 2 on the engine side of the throttle valve 3 a small duct 6 connects that pipe to the closed end of a relatively small cylinder 7 in which a piston 8 is endwise movable against the resistance of a spring 9 within the cylinder, which spring, therefore, tends to hold the piston 8 at the outer limit of its movement, the amount of which movement is limited to what is required by a screw 10 threaded axially into the closed end of the cylinder 7.

The piston 8 may be connected in any convenient manner to operate the liquid control, but is here shown as rotating the stem 11 of the needle valve of the carburetter by a rack 12 connected to the piston 8 to project outward from it, the teeth of which rack mesh with those of a pinion 13 secured on the outer end of the needle valve stem, so that endwise movement of the piston will effect rotation of the valve stem the required amount to afford the desired control of the liquid fuel.

The rack 12 is movable between disc flanges 14 on each side of the pinion and is held up to pinion teeth by a screw 15 threaded through a projection from the open end of the cylinder to bear against the back of the rack 12.

In the duct 6 is a slide valve 16 which is apertured at 17 to register with the duct 6, when, as shown in the drawing, against one of its limiting stops 19, but which, if endwise moved against the other limiting stop, will close passage through the duct 6 and will connect the interior of the cylinder 7 to the atmosphere through a groove 18.

This valve 16 is frictionally connected at 20 to a rod 21 connected to the end of the lever 4 of the throttle valve to which the control rod 5 is connected.

The frictional engagement of the rod 21 to the valve 16 is such as will ensure movement of the valve but will permit the rod to move in the connection when the valve is against either of its stops 19. This frictional connection may, as shown in Fig. 2, consist of a headed pin 20 endwise movable in the valve 16 and apertured to receive the rod 21 with a spring 22 between the other side of the valve and the head of the pin. This spring draws the rod 21 into frictional engagement with the valve at its connection thereto, and enables the valve 12 to be opened or closed with the first slight movement of the control rod 5 from any position to open or close the throttle and thereafter allows the rod to slide through its aperture in the pin 20 to complete the desired movement of the throttle valve.

Thus, if the throttle valve 3 is moved from any position toward closure, the first portion of that movement will, through

the frictional engagement 20, move the slide valve 16 to open the duct 6 to the cylinder 7, and the vacuum of the intake 2, acting on the piston 8, will, through the rack and pinion 12, 13, rotate the stem 11 of the needle valve to lessen the supply of liquid fuel to the "maximum economy" limit: Conversely, if the throttle valve is moved from any position to admit more gas to the engine, the first slight movement of the lever 4 will endwise move the valve 16 against the other limit and will close communication with the intake pipe 2 and will admit atmospheric air to the cylinder 7 through the groove 18 when the spring 9 will carry the piston 8 to the outer limit of its movement and will rotate the needle valve stem to increase the liquid fuel supply to the "maximum power" limit.

The same control of the liquid fuel may be exercised electrically by the means shown in Fig. 3, where the rod 21 from the throttle valve lever 4 is frictionally connected at 20 in the same manner shown in Figs. 1 and 2, to one end of a short lever 25 pivoted at 26 intermediate its ends. and its movement in each direction limited by stop pins 27.

This lever 25 is connected to an energized circuit 30, in which is a solenoid 31, the other terminal of the solenoid circuit being connected at 32 to a resilient contact 33, which is insulated. This resilent contact is designed to be engaged by the free end of the lever 25 at one limit of its movement and to be clear of such engagement when at the other limit of its movement.

The solenoid 31 is enclosed within a casing 36 through the closed end of which a stop screw 37 is threaded, whereby the movement of the solenoid core 34 within its coil may be limited to what is required to effect the desired movement of the fuel control valve.

To the outer end of the core 34 of the solenoid a rack 12 is connected, the teeth of which mesh with those of the pinion 13 secured on the stem 11 of the liquid fuel valve, as in Fig. 1, whereby, when the core 34 is drawn within the coil of the solenoid the fuel control valve is closed to its "maximum economy" limit, and when the solenoid is de-energized and its core 34 is drawn out by the spring 35, the liquid fuel valve is opened to its "maximum power" limit.

Thus, when the throttle valve 3 is closed, as shown by the full lines in Fig. 3, or any slight movement toward closure is made to restrict the amount of gas delivered to the engine, one end of the lever 25 engages the resilient contact 33 and closes the circuit 30 to energize the solenoid 31 and the core 34 is drawn within the solenoid to close the liquid fuel control valve to its "maximum efficiency" limit, and conversely, on any movement of the lever 4 to open the throttle valve, the lever 25 is moved from engagement with the resilient contact 33 and the circuit 30 being opened the solenoid 31 is de-energized and its core 34 is withdrawn by the spring 35 to rotate the stem of the liquid fuel valve to open that valve to the "maximum power" limit.

Attention is drawn to the fact that by the manner of frictionally connecting the throttle valve control lever to the needle valve operating means, whether as shown in Fig. 1 or in Fig. 2, a very slight movement only is necessary to effect full movement of the liquid control valve between the limits of "maximum power" and "maximum economy", viz, that represented by the dot and dash lines 23.

I do not desire to be confined to the particular manner for operating the liquid control valve described and illustrated, but consider the essential feature of my invention to reside in the operation of the liquid control valve by the first slight movement in either direction of the mechanism which operates the gas throttle valve of the engine.

I make no claim to a means for operating the needle valve which controls the liquid fuel supply cooperatively with the movement of the throttle, as I am aware that these valves have been connected to work together, but in all with which I am acquainted they are cooperatively connected in a manner that will movement of the throttle valve is necessary to communicate full movement to the liquid fuel supply valve, but what I regard as the essential feature of my invention is that the liquid fuel supply is either fully opened or fully closed within predetermined limits, on a slight movement of the gaseous supply throttle, whether to open or close it.

Having now particularly described my invention, I hereby declare that what I claim as new and desire to be protected in by Letters Patent, is:

1. A means for controlling within desired limits the amount of liquid fuel supplied to an internal combustion engine, said controlling means being cooperative with the first portion only of the movement to open and close the gas intake throttle valve from any position.

2. A means for controlling the amount of liquid fuel supplied to an internal combustion engine between the desired limits of "maximum power" and "maximum economy", said means being cooperative with the first portion only of a movement to open or close the gas intake throttle valve of the engine from any position of that valve, the required movement to operate the liquid fuel valve being relatively a small portion only of the opening and closing movement of the throttle valve.

3. A means for opening or closing the liquid fuel valve of an internal combustion

engine cooperatively with a relatively small portion of the movement to open or close the gas intake throttle valve from any position, whereby the amount of liquid fuel delivered to the engine is increased when the throttle valve is moved to admit more gas to the engine and is reduced when the amount of gas admitted is reduced.

4. A means for controlling the amount of liquid fuel admitted to an internal combustion engine between desired limits cooperatively with a movement of the gas engine throttle valve, said means comprising a means for imparting the required control movement of the liquid fuel valve from the control of the gas intake throttle valve through a yielding connection that will not prevent movement to further open or close the gas intake throttle after the required movement is imparted to the liquid fuel valve.

5. A means for controlling the amount of liquid fuel admitted to an internal combustion engine between the desired limits cooperatively with a movement to open or close the gas intake throttle, said means comprising a means for imparting the required movement of the liquid fuel valve from the control of the gas intake throttle valve with a frictional hold in such connection that with the first slight movement of the throttle control will operate the liquid fuel valve through the desired limits and that will permit further movement of the intake throttle in the same direction.

6. A means for controlling the liquid fuel supply of an internal combustion engine between adjusted limits, said means comprising the combination with the liquid fuel valve of the engine and the throttle valve which controls delivery of the gaseous mixture to the same, of a chamber the interior of which is connected by a duct to the gas intake pipe between the throttle valve and the engine, whereby the vacuum of the intake is maintained in the chamber, means operative by the vacuum in the chamber for moving the liquid fuel valve to regulate the amount of liquid fuel delivered, and means operable by movement of the throttle control mechanism for destroying the vacuum in the chamber.

7. A means for controlling the liquid fuel supply of an internal combustion engine between adjusted limits, said means comprising the combination with the liquid fuel valve of the engine and the throttle valve which controls delivery of the gaseous mixture to the same, of a cylinder the interior of which is connected by a duct to the gas intake pipe between the throttle valve and the engine, a piston endwise movable in the cylinder, a spring normally retaining the piston at one limit of its movement, means for connecting the piston to the liquid fuel valve to open and close the same within desired limits, means for closing the duct between the intake pipe and the cylinder and for admitting atmospheric air thereto, means for connecting this duct closing means to the operating mechanism of the throttle valve whereby the movement of the valve throttle to open or close it from any position will close or open the duct between the cylinder and the gas intake pipe.

8. In combination with the throttle valve of an internal combustion engine, a fuel supply valve for controlling the flow of fuel, and means for operating the throttle valve; means cooperative with the throttle operating means to move said fuel valve during only the first portion of the movement of said throttle valve operating means.

9. In combination with the throttle valve of an internal combustion engine, a fuel supply valve for controlling the flow of fuel, and means for operating the throttle valve; means cooperative with the throttle operating means to move said fuel valve during only the first portion of the movement of said throttle valve operating means, said cooperating means comprising devices for turning the fuel valve toward the open and closed positions, a rod actuated by the throttle valve, and a slip connection between said rod and said devices.

In testimony whereof I affix my signature.

FRANCIS H. P. BEATSON.