

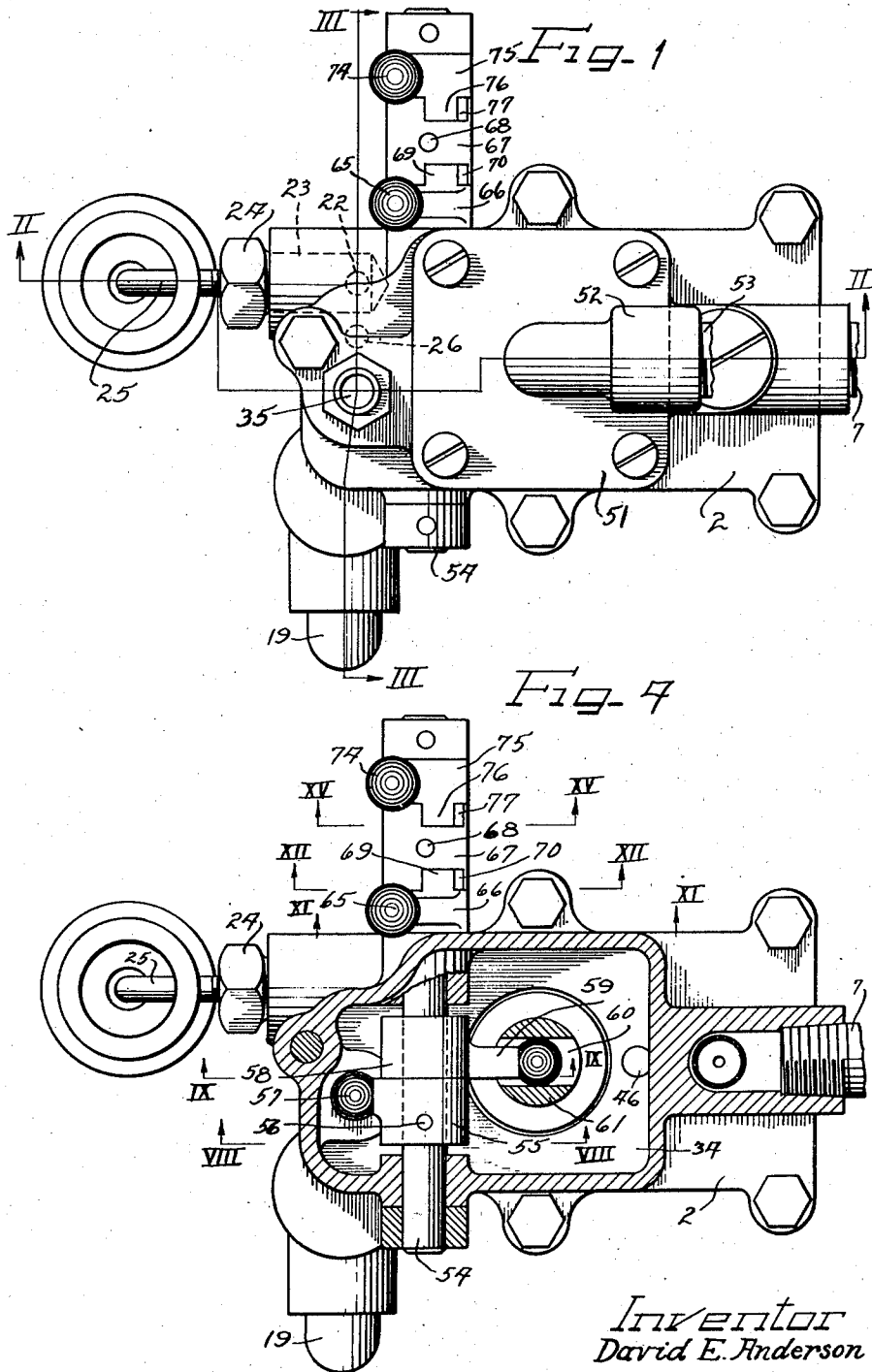
June 29, 1948.

D. E. ANDERSON
APPARATUS FOR CONTROLLING INTRODUCTION OF
SUPPLEMENTARY ANTIKNOCK FUEL MIXTURES

2,444,179

Filed June 4, 1945

5 Sheets-Sheet 1



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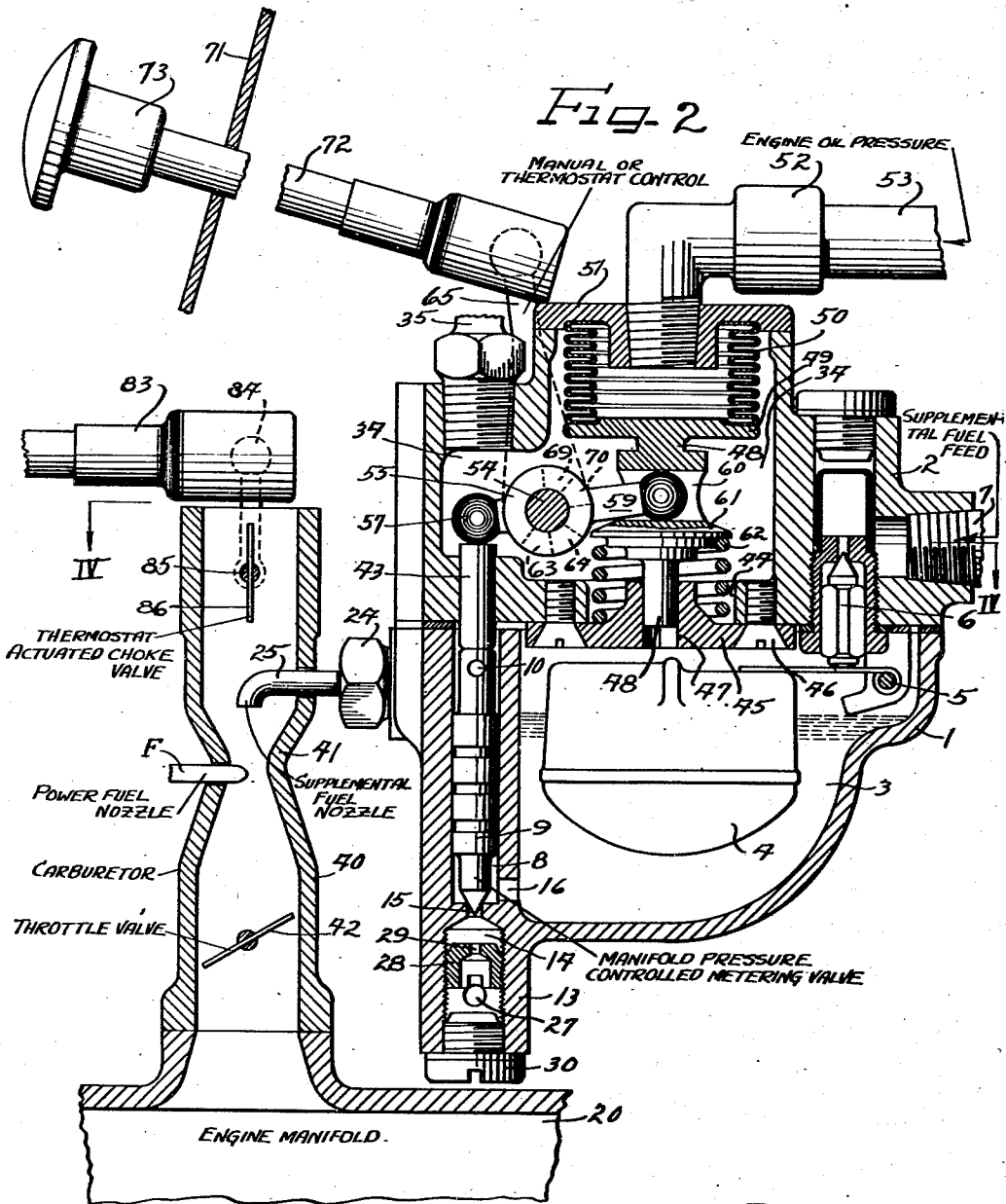
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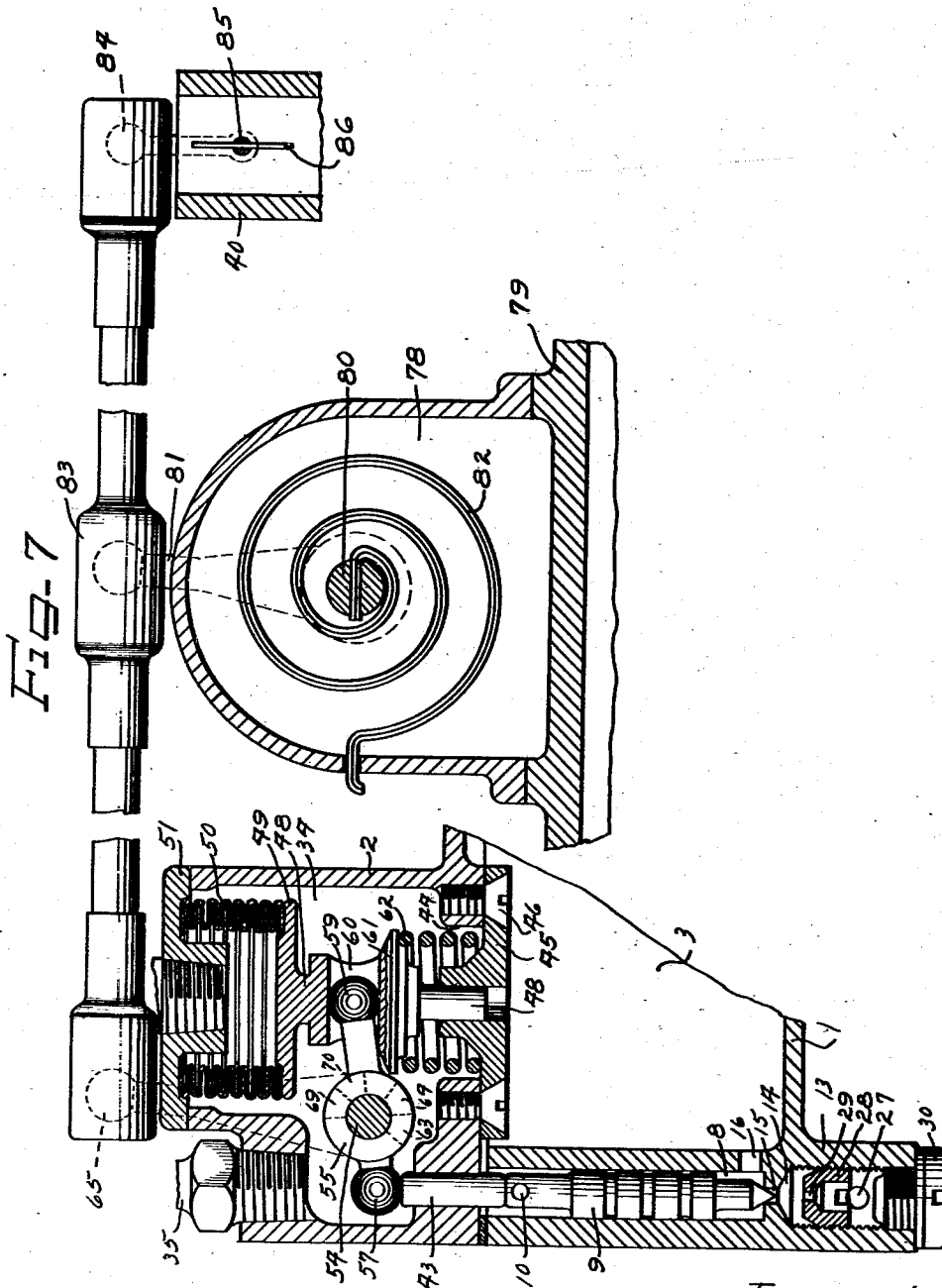
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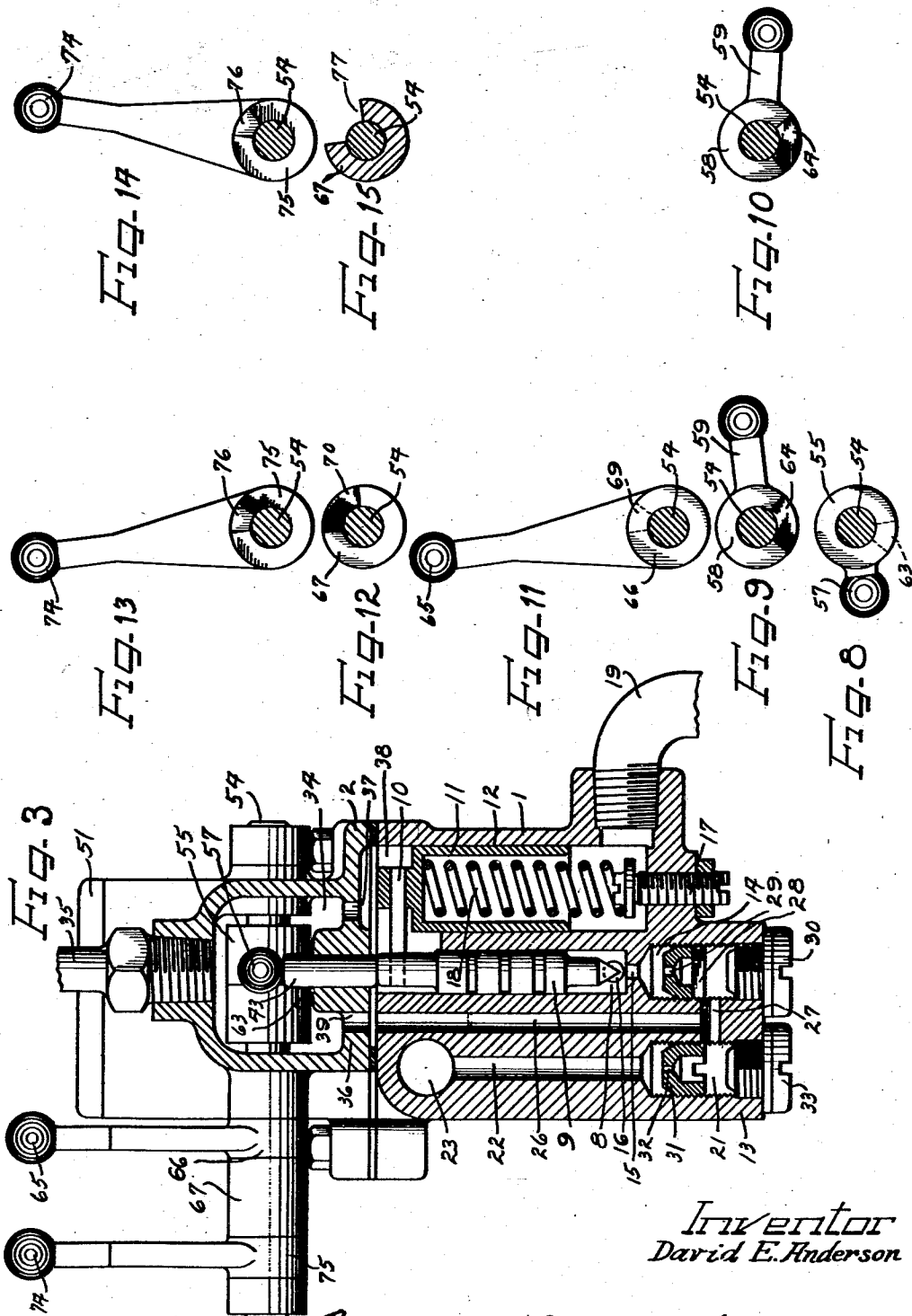
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5 Sheets-Sheet 5

Fig-5

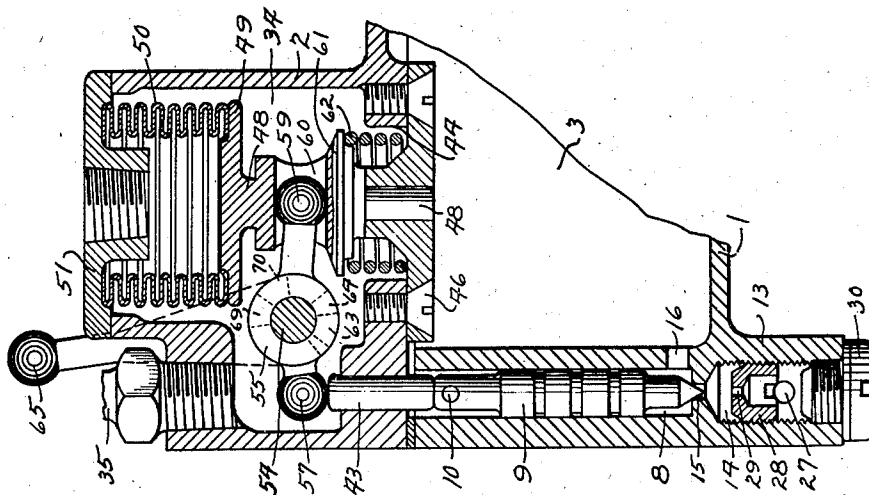
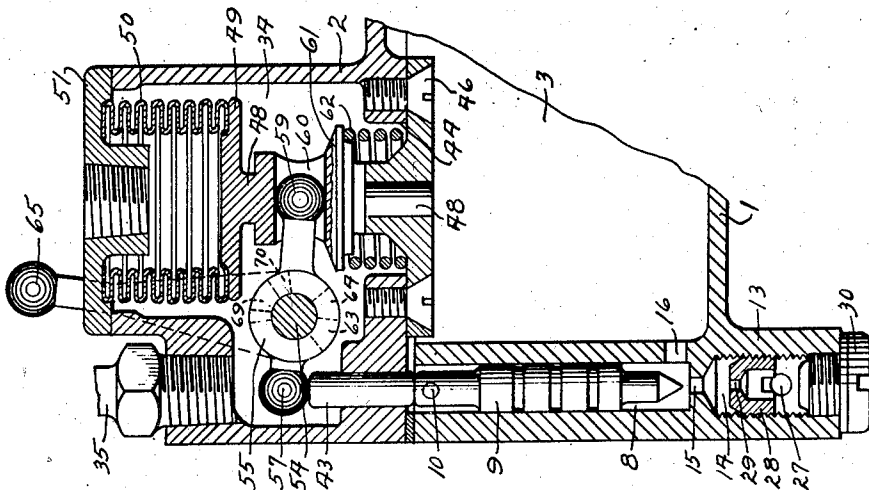


Fig-6



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UNITED STATES PATENT OFFICE

2,444,179

APPARATUS FOR CONTROLLING INTRODUCTION OF SUPPLEMENTARY ANTI-KNOCK FUEL MIXTURES

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12 Claims. (Cl. 123—127)

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My invention relates to apparatus for supplying supplementary antiknock fuel to internal combustion engines and particularly to improved means for controlling the functioning of said apparatus for supply of fuel only at such times as it is actually required by the engine.

An important object of the invention is to provide control means which will assure complete shutoff of supplementary fuel when the engine is not running, or at such other times during running of the engine when supplemental fuel is not desired.

A further object is to provide a control arrangement in which the opening of the flow controlling valve for the supplementary fuel supply is controlled by the pressure of the oil in the engine lubricating system, the control being in such manner that when the oil pressure is below a predetermined value, the supplemental fluid flow controlling valve will be held closed.

In general, the object of the invention is to provide improved controls for a supplementary fuel flow valve, with such controls manually operable or automatically operable in accordance with the engine's demand for antiknock fuel as determined by engine temperature and other operating conditions of the engine and the grade of primary fuel being used, in order that supplementary antiknock fuel will be delivered only at such time and in such quantity as will eliminate knocking when knocking might otherwise occur.

The various features of my invention are embodied in the structure shown on the accompanying drawings, in which:

Figure 1 is a plan view of the supplemental fuel supply structure and control therefor;

Figure 2 is a section on plane II—II Figure 1;

Figure 3 is a section on plane III—III Figure 1;

Figure 4 is a section on plane IV—IV Figure 2;

Figure 5 is a section similar to Figure 2 showing the arrangement of the control means for a running engine when cold;

Figure 6 is a similar section showing the control arrangement for a hot engine when running;

Figure 7 is a section similar to Figure 6 showing thermostat control of the supplementary fuel feed in accordance with engine temperature;

Figure 8 is a section on plane VIII—VIII Figure 4;

Figures 9 and 10 are sections on plane IX—IX Figure 4;

Figure 11 is a section on plane XI—XI Figure 4;

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Figure 12 is a section on plane XII—XII Figure 4;

Figures 13 and 14 are side elevations of a setting lever in two of its setting positions; and

Figure 15 is a section on plane XV—XV Figure 4.

Briefly describing the supplementary fuel delivery structure shown to which my improved controls are applied, it comprises a body 1 and a cover 2. In the body 1 is the float chamber 3 for a float 4 fulcrumed at 5 for operation of the valve 6 for control of the inflow of the supplemental fluid through a pipe 7 from a suitable supply tank (not shown). In the body 1 at one side of the float chamber is the vertical bore 8 for the outflow valve 9, the valve at its upper end being connected by a cross bar 10 with the upper end of a hollow piston 11 operable in the bore 12 adjacent the valve bore 8.

A boss 13 depends from the body and has a bore 14 therein connected with the valve bore 8 by the passage 15 the flow through which is controlled by the valve 9, the float chamber being connected with the lower end of the bore 8 by the outflow passage 16. Threading into the bottom of the body 3 below the bore 12 is the abutment 17 for a spring 18 extending into the piston 11 for engagement with the top thereof, this spring tending to shift the piston 11 upwardly for corresponding movement of the valve 9 by the cross bar 10 for holding the valve open. The lower end of the bore 12 is connected by a pipe 19 with the intake manifold 20 of the engine so that the piston is subjected to intake manifold pressure for cooperation with the spring 18 to control the movement of the piston and thereby movement of the valve 9 for control of the passageway or jet opening 15.

Adjacent to the bore 14, the boss 13 has the bore 21 from which a passageway 22 extends through the body 1 to the outlet 23 in which is seated a plug 24 from which the supplemental fuel discharge nozzle 25 extends. A bore 26 extends through the body downwardly from the upper edge thereof and is connected at its lower end with the cross passage 27 connecting the bores 14 and 21. Within the bore 14 above the cross passage 27 is the jet plug 28 having the metering orifice 29, the bore 14 at its lower end being closed by a plug 30. In the bore 21 above the cross passage 27 is a jet plug 31 having the jet orifice 32, the lower end of the bore 21 being closed by a plug 33.

Within the cover structure 2 is the chamber 34 which is connected with the atmosphere

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through a pipe 35, and through the bottom wall 36 of the cover structure extends a passageway 37 to the space 38 above the piston and valve structure for subjecting this space to atmospheric pressure, this space 38 communicating with the space above the fuel in the float chamber for subjecting this space to atmospheric pressure. Another passageway 39 through the bottom of the cover structure communicates with the upper end of the bore 26. When the valve 9 is open fuel will flow from the float chamber through the jet orifices 15 and 29 and into the bore 26 in which the fuel level will normally be that of the fuel in the float chamber, this bore 26 thus functioning as a fuel supply well for delivering fuel through the jet orifice 32 and passage 22 to the outlet nozzle 25 under suction effect on the nozzle.

Referring to Figure 2, the carburetor 40 for the engine is mounted on the intake manifold 20, the supplementary fuel delivery nozzle 25 projecting into the carburetor power fuel inflow passageway above the Venturi throat 41 in advance of the power fuel nozzle F and the throttle valve 42. With this arrangement shown, the nozzle 25 is subjected to the Venturi suction while the piston 11 which controls the valve 9 is subjected to the pressure of the intake manifold so that the flow from the nozzle is normally controlled by the difference between the pressure at the carburetor venturi and in the engine intake manifold.

Describing now the various controls for the supplementary fuel, a pin 43 extends through a passageway in the bottom wall 36 of the cover structure in alignment with the bore 8 for the valve 9 for engagement with the upper end of the valve. Adjacent to the pin, the bottom wall 36 has the opening 44 therethrough closed by a cover 45 detachably secured to the bottom wall as by screws 46. The cover 45 has the guide passageway 47 therethrough for the lower end of a stem 48 extending downwardly from the head 49 of a pressure responsive element such as a bellows 50 which is secured at its open end to a cover 51 for the chamber 34 in the cover structure 2, the interior of the bellows communicating with the inlet in the cover which receives a fitting 52 from which a pipe 53 extends for connection with the pressure side of the engine oiling system (not shown).

Between the bellows stem 48 and the pin 43 a shaft 54 extends through the chamber 34 and is journaled at its ends by the side walls of the chamber. Within the chamber 34 a hub 55 is secured to the shaft 54 as by a pin 56 and this hub has the short ball ended lever 57 extending therefrom which terminates above the pin 43. Adjacent to the hub 55 the shaft 54 has the hub 58 rotatably mounted thereon and this hub has the ball ended lever arm 59 extending therefrom in the direction opposite to that of the arm 57. The ball end of the lever 59 engages in the cross slot 60 in the head 61 formed on the stem 48 below the bellows 50. A spring 62 interposed between the plate 45 and the underside of the head 61 tends to move the head and the stem 48 upwardly for upward swing of the lever arm 59 and counterclockwise rotation of the hub 58 on the shaft 54, while engine oiling system pressure against the bellows tends to shift the head 61 downwardly for swing of the arm 59 and rotation of the hub 58 in the opposite direction. The swing of the lever arm 59 is thus controlled by the difference between the pressure exerted by

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the spring 62 against the head 61 and the oil pressure exerted by the bellows against the head.

Extending from the inner side of the hub 55 is a tooth 63 (Figures 2 and 8) which is received in the arcuate recess 64 in the adjacent side of the hub 58 (Figures 9 and 10), this recess being of greater length than that of the tooth to allow for relative rotational movement between the hubs of the two lever arms 57 and 59. As shown on Figures 2, 8 and 9, the relative position of the tooth and recess is such that when the head 61 is moved upwardly by the spring 62 as the oil pressure in the bellows decreases, the left end of the recess 64 will come into engagement with the tooth for downward swing of the lever arm 57 as the lever arm 59 is swung upwardly, the lever arm 57 during its downward swing engaging the pin 43 to shift it downwardly against the valve 9 for movement of the valve toward its seat to reduce or shut off the fuel flow from the fuel chamber through the jet orifice 15 against the resistance of the spring 18. When the oil pressure on the diaphragm overcomes the pressure of the spring 62, the head 61 will be moved downwardly (Figures 6 and 10) for down swing of the lever arm 59 and clockwise rotation of its hub 58 for moving the left end of the recess 64 away from the tooth so that the spring 18 may again function in cooperation with the vacuum pressure on the piston 11 for movement of the valve 9 in opening direction, such opening movement of the valve causing the lever arm 57 to swing upwardly for clockwise rotation of its hub 55 and the shaft 54. Thus, when the engine is not running (Figure 2) and there is consequently no oil pressure in the bellows, the spring 62 will function through the lever arm assembly and the pin 43 to move the valve 9 to its closed position to shut off flow of fuel from the float chamber 3 through the metering orifice 29 to the supply well 26 for the nozzle 25. Furthermore, should the fuel supply valve 6 for the fuel chamber fail to close when the engine is not running, the valve 9 will be held closed against any flow of fuel from the float chamber. However, when the engine is running normally and the bellows is subjected to engine oil pressure, the valve 9 will be released for opening movement so that it may assume whatever position is dictated by the engine requirements for the proper delivery of supplementary fuel.

The spring 62 is calibrated so its strength will opposed a predetermined oil pressure plus the initial tension in bellows 50 and all friction in the mechanism, and the resulting load from the pressure of spring 18 in combination with the engine manifold vacuum. The spring calibration is arrived at by the engine's requirements for supplementary fuel at low operating speeds. When an engine is running at low speed with part throttle, the vacuum in the intake manifold may be low enough then to allow supplementary fuel to be fed due to the position of the vacuum piston 12 which might hold the valve 9 off its seat. Ordinarily, no detonation or knock takes place under this condition of engine operation and no supplementary fuel is needed, and therefore the spring 62 must be strong enough to oppose the oil pressure in the bellows plus the resultant upward pressure of the vacuum piston spring 18 to hold the valve 9 closed. When the throttle is now opened wider for increased engine speed, detonation may take place and supplementary fuel may be required. The engine oil pressure on the bellows increases with the engine speed, while the intake vacuum

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pressure may remain low. The calibration of the spring 62 should therefore be such that it will permit the bellows, under the engine oil pressure, to set the lever arm assembly 57 and 59 for release of the valve 9 so that the valve may be controlled by the spring 18 and vacuum pressure for the proper delivery of supplementary fuel to prevent detonation. In other words, the spring 62 must be balanced with the engine oil pressure of the bellows so that the lever arm 59 will be out of engagement with the lever arm 57 to allow freedom of movement of the valve 9 as dictated by the position of the vacuum piston 11, which position depends upon the balance between manifold vacuum and the opposing pressure of the spring 18.

When cranking the engine for starting, at which time no supplementary fuel may be desirable, the engine oil pressure is so low as to have no material effect on the bellows 50, and therefore the spring 62 will predominate to set the lever arm assembly for holding the valve 9 closed against the pressure of the spring 18.

When an engine is running, but is cold, as shown on Figure 5, there is no tendency to detonate under any condition of load or speed, and therefore no antiknock fuel is necessary. When the engine is running there will be engine oil pressure in the bellows 50 tending to effect setting of the lever arm assembly 57, 49 for release of the valve 9 and delivery of antiknock fuel to the carburetor. To prevent this, manually operable means are provided in the form of a hand lever 65. This lever extends from a hub 66 rotatable on the shaft 54 outside of the chamber 34 in the cover structure 2, and outside of the hub 66 a collar 67 is secured to the shaft 54 as by a pin 68. As shown on Figures 1, 2, 5, 11 and 12, the hub 66 has a tooth 69 extending into the arcuate recess 70 in the inner side of the collar 67, this recess being longer than the tooth so that the hub 66 may be rotated by the lever 65 independently of the shaft 54 to the extent of movement of the tooth in the recess. The lever 65 may be operable from the instrument panel 71 by a link 72 extending from the lever through the instrument panel and terminating in a knob 73. Under normal operating conditions of the engine, the knob will be pushed inwardly for setting of the lever 65 so that its tooth 69 will be away from the outer end of the recess 70 as shown on Figure 6 so that the shaft 54 and the collar 67 thereon may be rotated clockwise by the opening movement of the valve 9 under pressure of the spring 18, when the engine is running under conditions when supplemental fuel may be required. When no supplementary fuel is required as when the engine is running cold, or when the engine is at normal working temperature, or when the power fuel is high octane gasoline, the link 72 will be pulled out for outward swing of the lever 65 for engagement of its tooth 69 with the outer end of the recess 70 for counterclockwise rotation of the shaft and swing of the lever arm 57 against the pin 43 for closure of the valve 9 to shut off the supplementary fuel flow as shown on Figure 5. By setting the lever 65 at intermediate positions, the opening movement of the valve 9 will be correspondingly limited. When the engine is not running, the lever 65 may be swung out for positive closure of the valve 9, and if the fuel supply valve 6 for the float chamber should fail to properly function, the valve 9 may be positively closed by out swing of the lever

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65 to shut off flow of supplementary fuel to the engine.

It is not always possible to obtain in the field a grade of power fuel such as gasoline as low as that for which the supplementary fuel supply apparatus was originally adjusted. The higher the grade of gasoline, the less antiknock fuel will be required. I therefore provide means for controlling the range of movement of the valve 9 relative to the jet orifice 15 controlled thereby. As shown, the area of the orifice 15 is greater than the area of the metering orifice 29. When the valve 9 is unseated and the exposed flow area through the orifice 15 is greater than the area of the orifice 29, the orifice 29 will function to meter the fuel flow to the well 26, but when the valve is moved to reduce the flow area of the orifice 15 below that of the orifice 29, then the orifice 15 will function to meter the flow. I therefore provide control means for limiting the movement of the valve 9 so that the orifice 15 may be controlled thereby for metering of the flow of the fuel for the desired service. Such control means includes a second lever 74 which extends from a hub 75 adjacent to the collar 67 on the shaft 54, the hub having the tooth 76 extending into the recess 77 in the inner side of the collar 67 and which recess is wider than the tooth, see Figures 1, 4, 13, 14 and 15. Now, when the metering orifice 29 is too large for the grade of power fuel being used by the engine, the lever 74 will be swung inwardly from the position of Figure 13 to a position of Figure 14 to move the tooth 76 inwardly in the recess 77 in the collar 67 so that, depending upon this distance of setting of the lever, the upward swing of the lever arm 57 will be limited so that the valve 9 can be moved upwardly under control of intake vacuum and spring 18 only a distance to prevent the exposed area of the orifice 15 from exceeding that of the orifice 29, and after such setting of the limit of operation of the valve 9, the lever 65 may be swung within the setting limit for control of the fuel outlet flow through the orifice 15. The lever 74 can also be set for complete closure of the valve 9. The lever 74 may be connected to the instrument panel by a link, like the link 72 for the lever 65.

The lever 65, instead of being manually operated, may be automatically controlled by the automatic setting of the carburetor choke valve in accordance with the temperature in the exhaust manifold of the engine. Referring to Figure 7, a housing 78 is mounted on the engine exhaust manifold 79, and journals a shaft 80 having a lever 81 extending therefrom, a spiral bi-metal thermostat element 82 being connected with the shaft and the housing to respond to the temperature in the exhaust manifold for corresponding swing of the lever 81. A connecting link 83 connects the end of the lever 81 with the end of a lever 84 extending from the shaft 85 of the choke valve 86 in the air intake for the carburetor 40. The link 83 also connects with the lever 65 for control of the supplementary fuel valve 9 in accordance with the temperature of the engine and the choke control. With such automatic control of the supplementary fuel supply, the link 72 from the lever 65 to the instrument panel may be omitted.

Figures 6 and 7 show the condition when the engine is hot. When the hot engine is running and only the manual control 72 is provided for the lever 65 (Figure 2), this manual control is operated for desired setting of the valve 9. With

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the thermostatic control (Figure 7), the thermostat when heated will swing the lever 81 and the levers 65 and 84 towards the right for opening of the choke valve 86. With the lever 65 swung to the right, and with the hot engine running (Figure 6), the engine oil pressure acting on the bellows 50 will set the lever arm assembly 57, 59 for release of the arm 57 by the arm 59 so that the valve 9 will be released for setting by the cooperation of the engine intake manifold vacuum and the spring 18. By setting of the lever 74, in a manner already explained, the valve 9 may be permitted to be operated for metering by the orifice 29 of the flow to the nozzle 25, to limit the range of movement of the valve 9 so that the orifice 15 will assume the metering of the flow.

When the hot engine is not running and the lever 65 is in the hot position (Figure 7), there will be no engine oil pressure in the bellows and the spring 62 will control and will swing the lever arm assemblies 57 and 59 for downshift of the pin 43 to hold the valve 9 down for closing the orifice 15 to entirely shut off the flow from the float chamber to the metering line.

When the engine cools off down to normal temperature where no supplementary fuel may be required, the thermostat 82 will shift the link 83 for swing to the left of the lever 65 for correspondingly decreasing the range of swing of the lever arm 57 and movement of the valve 9 for corresponding reduction in rate of outflow of fuel from the float chamber, until the valve is fully closed when the engine stops or is running at its normal working temperature or under other conditions when the oil pressure in the bellows is not sufficient to overcome the spring 62.

Any suitable means (not shown) may be provided for the lever 74, or a link extending therefrom to the instrument panel, to hold said lever in any set position for control of the operation range of the valve 9. During any setting of the lever 74, the lever 65 will be free for control of the valve arm 57 within the range established whether the lever 65 is manually operated, or automatically in accordance with engine temperature. With the tooth and recess arrangement between the lever arm 57, 59 and the tooth and recess arrangement between the levers 65 and 74 and the collar 67, the levers can impart rotary motion to the shaft 54 only in counterclockwise direction. The shaft 54 can be turned at all times counterclockwise by either or both of the levers at all times except when the engine is not running in which case the shaft is turned in counterclockwise direction by the lever arm 59 under power of the spring 62. The shaft 54 can be turned clockwise only by pressure from the piston spring 18 acting through the valve 9 and the pin 43. The lever arm 59 is swung in clockwise direction, independently of the lever arm 57 when the oil pressure in the bellows overcomes the spring 62, but when the spring 62 overcomes the oil pressure the lever arm 59 is swung in counterclockwise direction for engagement with and counterclockwise swing of the lever arm 57.

The metering orifice 32 which meters the flow of the fuel from the fuel well 26 to the nozzle 25 should be sufficiently smaller than the orifice 29 in order that the orifice 29 may permit sufficient flow to keep the well 26 supplied with fuel from the float chamber.

I have thus produced improved and efficient controlling means for the outflow controlling valve of a supplementary fuel supply apparatus

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which will control the operation of the valve for delivery of supplementary antiknock fuel only at such times and in such quantities as will eliminate knocking when knocking would otherwise occur, and which will hold the valve closed at such times as no antiknock fuel is necessary.

I have shown a practical and efficient embodiment of the features of my invention but I do not desire to be limited to the exact construction, arrangement or operation as shown and described as changes and modifications are possible without departing from the scope of the invention as defined by the appended claims.

I claim as my invention:

1. In combination with supplementary antiknock fuel supply mechanism for an internal combustion engine in which a valve under control of the engine intake manifold pressure controls the supply of the supplementary fuel for delivery into the engine carburetor, of means under control of the pressure of the engine lubricating oil system for holding said valve closed when the engine is at rest or when the oil pressure is below a predetermined value when the engine is running.

2. The combination with supplementary antiknock fuel supply apparatus for an internal combustion engine in which a float operated valve controls the inflow of supplementary fuel into a float chamber and an outflow valve under control of the vacuum in the engine intake manifold controls the outflow from the float chamber to metering means for delivery to the engine carburetor, of means for positively holding said outflow valve closed in the event of failure of closure of said float operated valve.

3. The combination with supplementary antiknock fuel supply apparatus for an internal combustion engine in which a float operated valve controls the inflow of supplementary fuel into a float chamber and an outflow valve under control of the vacuum in the engine intake manifold controls the outflow from the float chamber to metering means for delivery to the engine carburetor, of means for positively holding said outflow valve closed in the event of failure of closure of said float operated valve, said means being controlled by the pressure of the engine lubricating oil system.

4. The combination with supplementary antiknock fuel supply apparatus for an internal combustion engine in which a float operated valve controls the inflow of the antiknock fuel to a supply chamber and from which chamber fuel flows through metering orifices for delivery to the engine carburetor, of a valve responsive to engine oil pressure for shutting off flow from said chamber when the engine oil pressure is below a predetermined value.

5. The combination with supplementary antiknock fuel delivery apparatus for an internal combustion engine in which antiknock fuel is delivered from a supply chamber through a metering system to the engine carburetor, of a valve interposed between said chamber and the metering system, and means operable either by hand or thermostatically or by both for controlling said valve and thereby the flow of the fuel from said chamber to said metering system.

6. The combination with supplementary antiknock fuel feeding apparatus for internal combustion engines in which metering means meters the flow from a supply chamber to the engine carburetor and an outflow valve under control of the engine intake manifold vacuum controls the

outflow from said chamber to said metering means, of manual means operable independently of the vacuum control of said valve for positively closing said valve or for limiting the opening movement thereof under control of said vacuum.

7. The combination with supplementary antiknock fuel feeding apparatus for internal combustion engines in which metering means meters the flow from a supply chamber to the engine carburetor and an outflow valve under control of the engine intake manifold vacuum controls the outflow from said chamber to said metering means, of means controlled by the pressure of the engine lubricating oil for controlling the opening movement of said valve independently of the vacuum control of said valve.

8. In a supplementary antiknock fuel feeding system for internal combustion engines in which a valve controls the outflow from a fuel supply chamber to the carburetor of the engine, the provision of means automatically controlled by the pressure of the engine lubricating oil system for holding said valve closed when the engine is not running or when the oil pressure is below the predetermined value.

9. The combination with supplementary antiknock fuel delivery apparatus for an internal combustion engine in which antiknock fuel is delivered from a supply chamber through a metering system to the engine carburetor and a valve is interposed between said chamber and the metering system, spring means tending to move said valve in opening direction and means responsive to the pressure in the intake manifold of the engine tending to move said valve in closing direction, locking means effective when the engine is not running for holding said valve closed, and means responsive to the oil pressure of the engine lubricating oil system for releasing said locking means in accordance with the oil pressure when the engine is running, whereby said valve may then function correspondingly for controlling the outflow of fuel from said chamber to the metering system.

10. The combination with supplementary antiknock fuel delivery apparatus for an internal combustion engine in which antiknock fuel is delivered from a supply chamber through a metering system to the engine carburetor and with a metering orifice in the metering system normally metering the flow for delivery to the carburetor, of a valve interposed between said chamber and said metering system, a metering port between said chamber and said metering

orifice in the metering system and controlled by said valve, said metering port being of larger area than said metering orifice, whereby when said valve is moved for full exposure of said metering port said metering orifice will meter the flow to the carburetor, means for limiting the opening movement of said valve beyond a point at which the exposed area of said metering port is greater than the area of said metering orifice whereby the exposed portion of said metering port will then meter the flow through the metering system, and means for moving said valve through its limited range of movement.

11. In a device for metering fluid to an internal combustion engine under the influence of the manifold pressure of said engine, a metering valve controlled by intake manifold pressure, a first lock for holding said metering valve in closed position, a bellows for opening said first lock, a conduit venting said bellows to engine lubricating oil pressure, a second lock for holding said valve in closed position, and a thermostat heated by said engine for opening said second lock whereby said metering valve can be opened only after engine oil pressure and engine temperature have increased to a predetermined amount for unlocking said first and second locks.

12. In a device for metering fuel to an internal combustion engine, a metering valve, a spring for urging said valve toward opened position, a piston connected to said metering valve, a conduit venting said piston to the engine intake manifold for moving the piston against the pressure of said spring to close said valve as intake manifold pressure decreases, a lock for holding said valve in closed position, and an expansible bellows vented to engine oil pressure for unlocking said lock whenever the engine oil pressure reaches a predetermined pressure.

DAVID E. ANDERSON.

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