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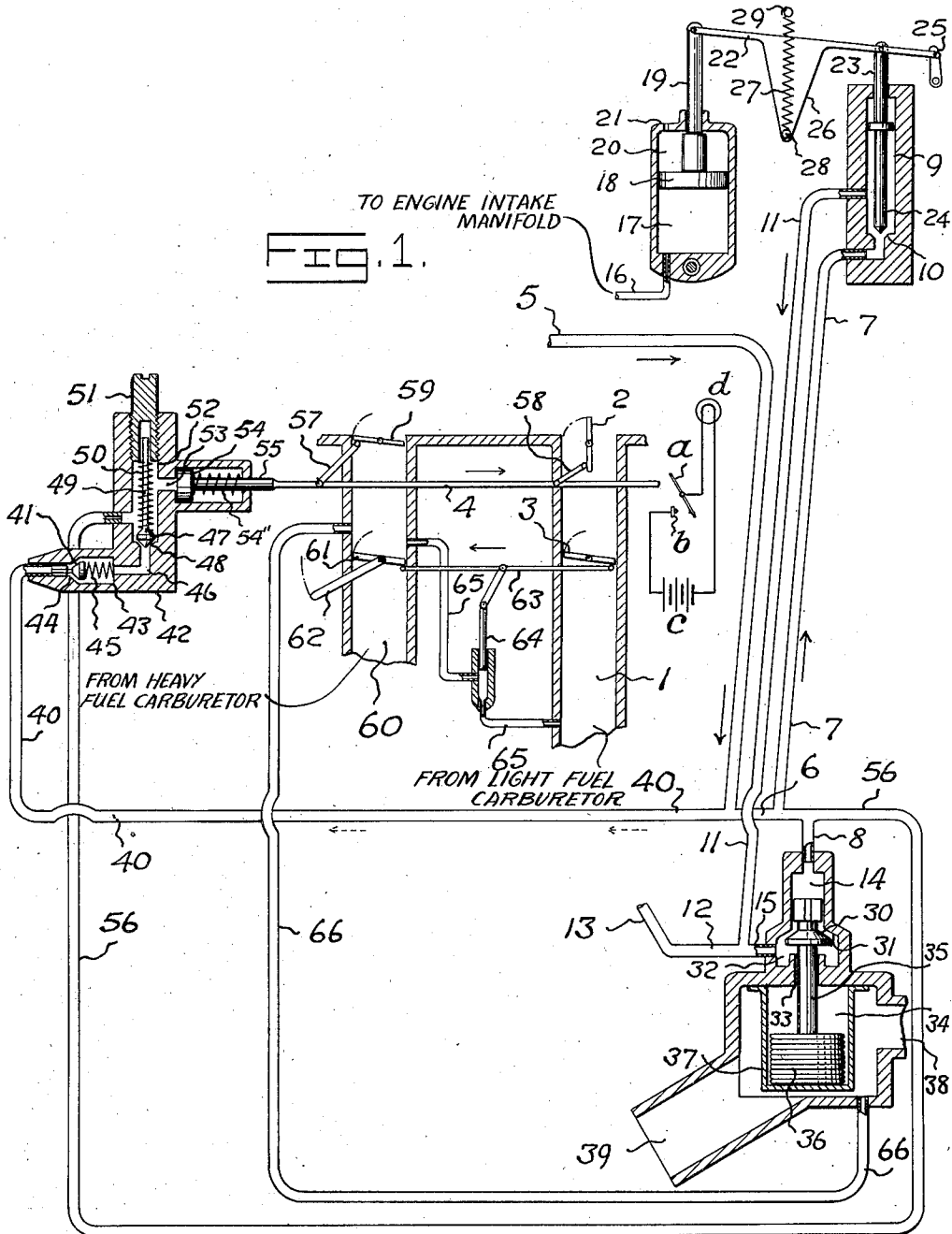
F. FLAMINI

2,098,575

SYSTEM FOR FEEDING FUELS TO INTERNAL COMBUSTION MACHINES

Filed Dec. 28, 1934

6 Sheets-Sheet 1



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Nov. 9, 1937.

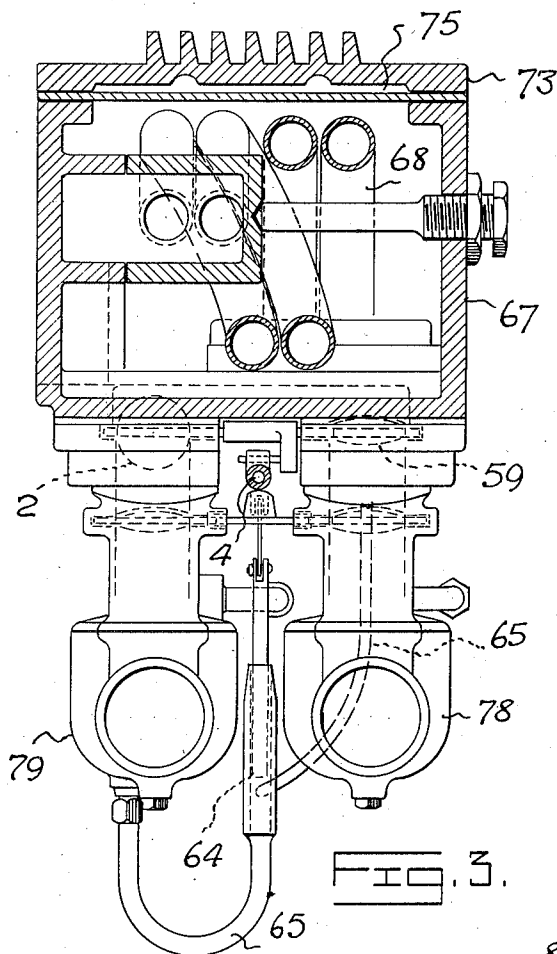
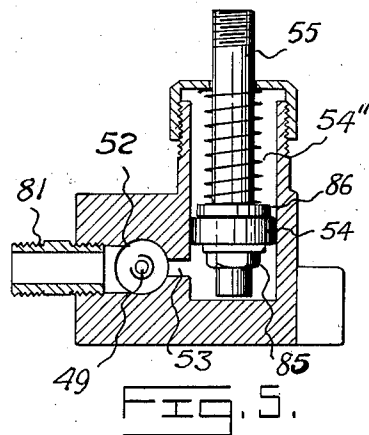
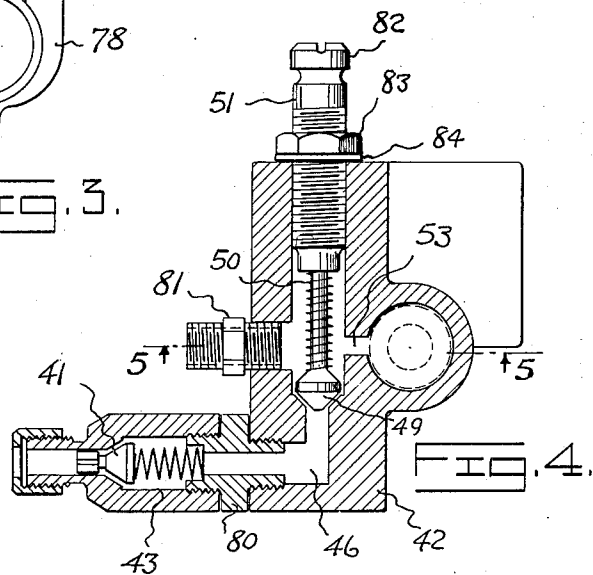
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SYSTEM FOR FEEDING FUELS TO INTERNAL COMBUSTION MACHINES

Filed Dec. 28, 1934

6 Sheets-Sheet 3



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Nov. 9, 1937.

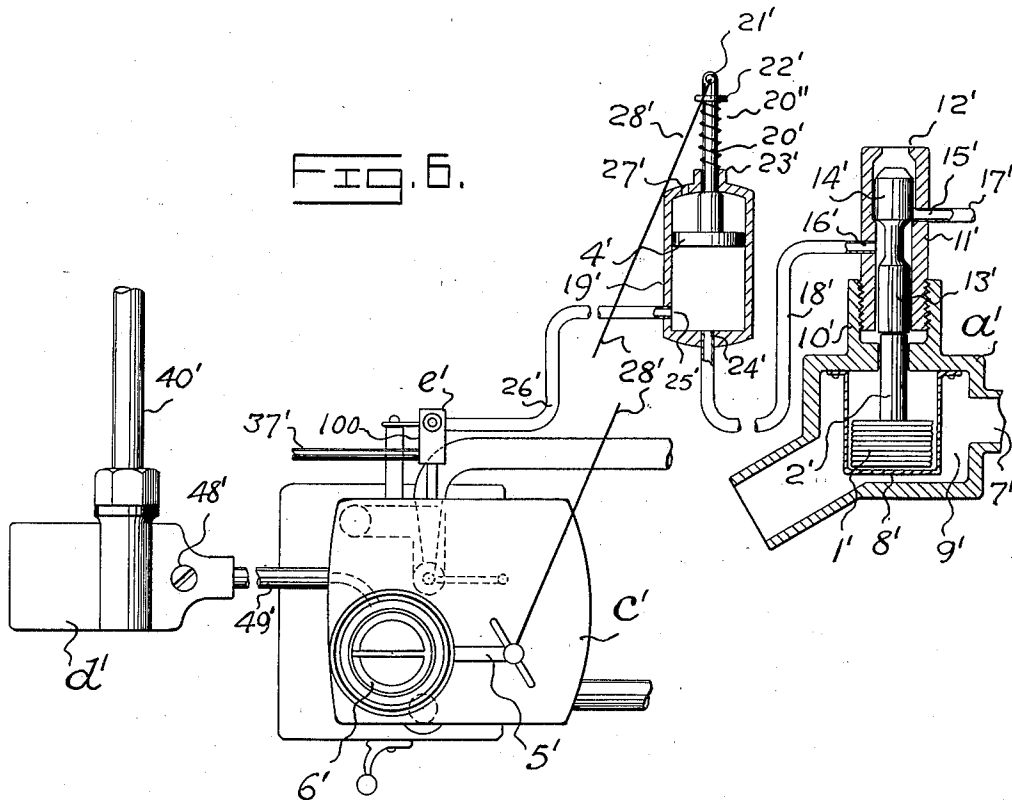
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Filed Dec. 28, 1934

6 Sheets-Sheet 4



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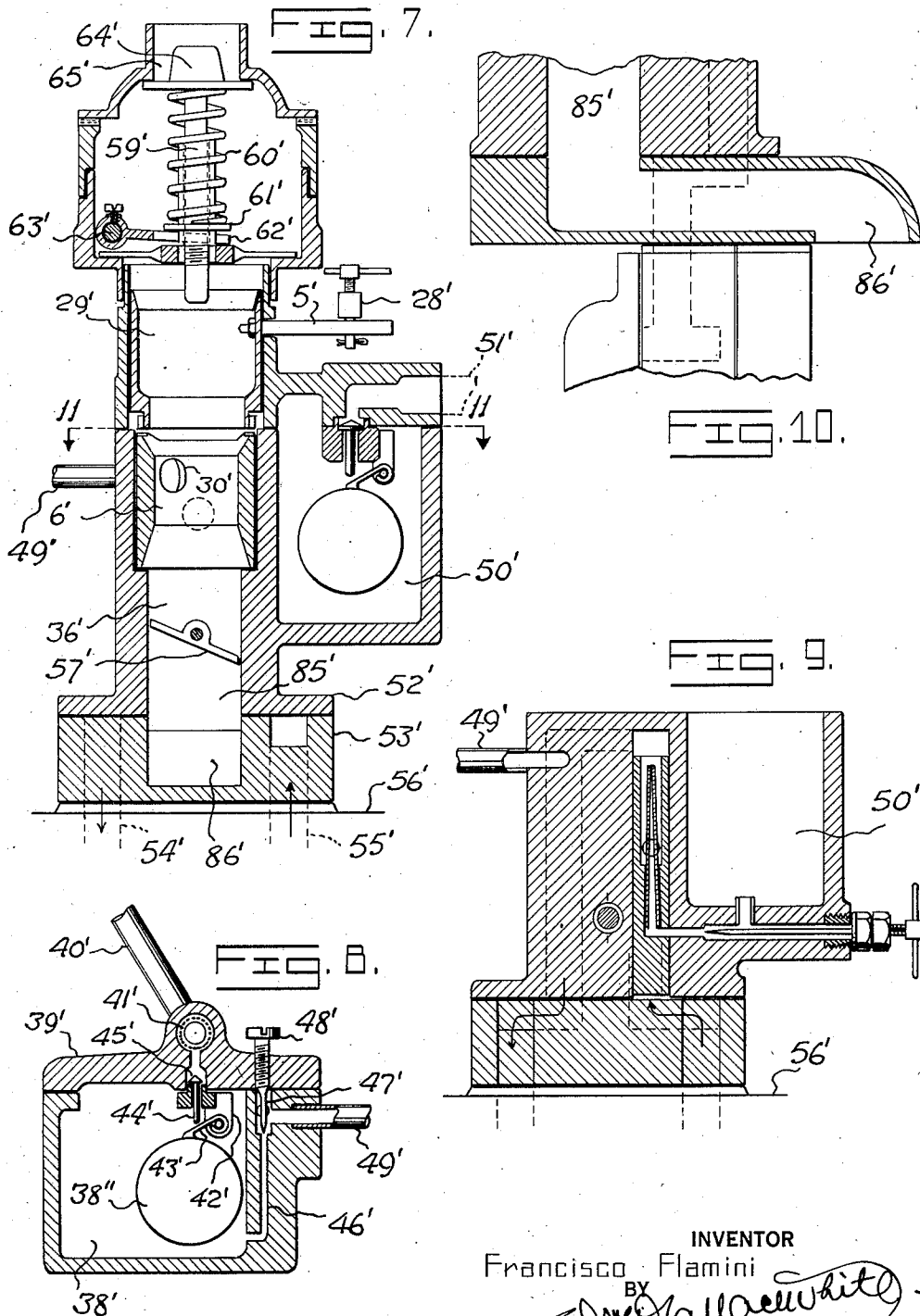
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2,098,575

SYSTEM FOR FEEDING FUELS TO INTERNAL COMBUSTION MACHINES

Filed Dec. 28, 1934

6 Sheets-Sheet 5



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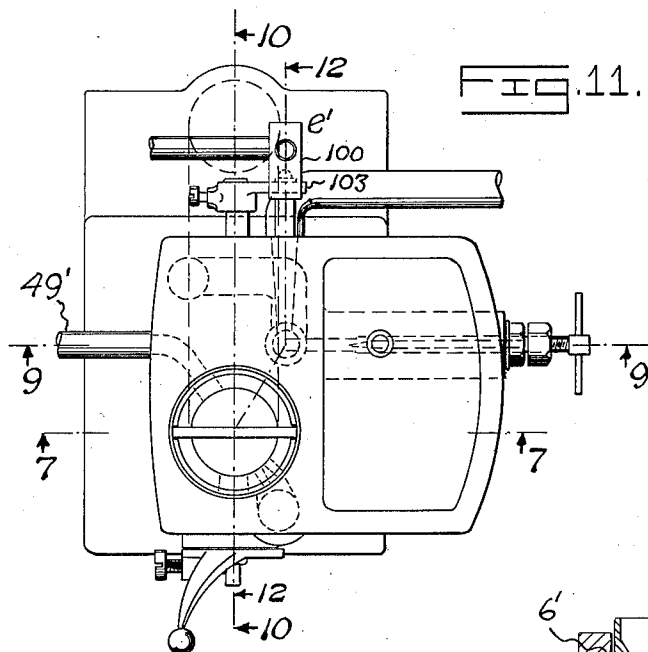
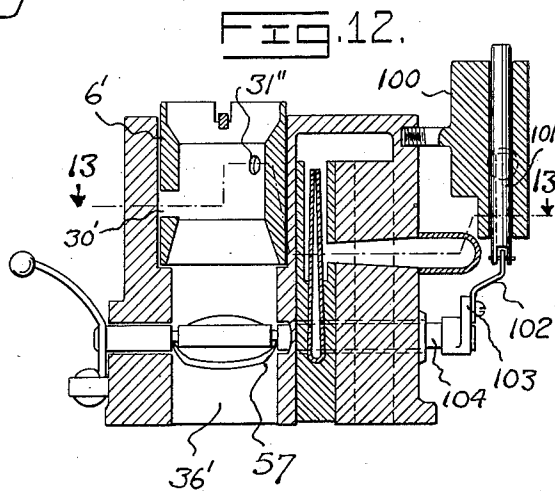
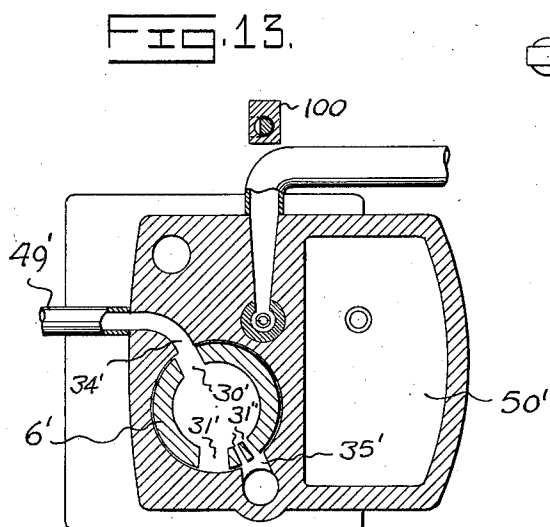
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SYSTEM FOR FEEDING FUELS TO INTERNAL COMBUSTION MACHINES

Filed Dec. 28, 1934

6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,098,575

SYSTEM FOR FEEDING FUELS TO INTERNAL COMBUSTION MACHINES

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Application December 28, 1934, Serial No. 759,531
In Argentina March 13, 1934

3 Claims. (Cl. 123—127)

This invention relates to an improved system for feeding fuels to internal combustion engines adapted to use both light and heavy fuels and having means for automatically changing over from one fuel to another so that the engine may operate at certain speeds and under certain conditions on the lighter fuel and so that the change from one fuel to the other may be automatically effected for economical running at predetermined speeds and under predetermined conditions.

One object of my present invention is to provide a new or improved fuel feed and control system whereby a lighter fuel is used during starting and at low speed and whereby the operation of the engine automatically controls the supply of fuels by variation in pressure in the lubricating system of the engine.

A still further object of my invention is to provide improved mechanism whereby the engine suction, the pressure in the lubricating system of the engine and the temperature of the engine cooling fluid or of the lubricating oil are all utilized for controlling the supply of fuel to the engine and for changing over from one fuel to another under predetermined conditions and speeds of operation.

With these and other objects in view my invention consists in the system hereinafter described and illustrated in the accompanying drawings and particularly pointed out in the appended claims, it being understood that various changes in the form and constructional details may be made without departing from the spirit of the invention or sacrificing any of the advantages thereof.

In the drawings:

Fig. 1 is a side view drawn partly in section and showing one form of the improved fuel feed and control mechanism;

Fig. 2 is a detail longitudinal section of the gasifier for the heavier fuel;

Fig. 3 is a vertical cross-section taken on the line 3—3 of Fig. 2;

Fig. 4 is a detail view—in vertical section—of part of the valve control mechanism;

Fig. 5 is a horizontal section taken on the line 5—5 of Fig. 4;

Fig. 6 is a view corresponding to Fig. 1, but showing a modified arrangement;

Fig. 7 is a vertical cross-section through the heavy fuel carbureter of Fig. 6 taken on the line 7—7 of Fig. 11;

Fig. 8 is a vertical section through the light fuel carbureter;

Fig. 9 is a section taken on the line 9—9 of Fig. 11;

Fig. 10 is a vertical section taken on the line 10—10 of Fig. 11;

Fig. 11 is a plan view showing the parts beneath the line 11—11 of Fig. 7;

Fig. 12 is a vertical section taken on the line 12—12 of Fig. 11; and

Fig. 13 is a sectional plan view taken on the line 13—13 of Fig. 12.

Referring to Fig. 1, the conduit 1 carries an atomization of the lighter fuel to the explosion engine.

The arrangement of the butterfly valves 2 and 3, as well as the position of the control rod 4, clearly determine that the engine is operating by the admission of the lighter fuel.

With the initial operation of the engine by means of low burning point or lighter fuel, the temperature of the cooling water and the crank-case oil will increase.

A tube 5 is connected to the oil circulation of the usual lubricating pump by which oil is forced from the engine. A flow of oil will thus be produced through this tube 5 in the direction of the arrows, and the oil will pass from the tube 5 through a tube 6 to tubes 7 and 8. The tube 7 carries the oil to a chamber 9, the oil passing a valve seat 10 and through a tube 11 to a tube 12 which communicates by means of a tube 13 with the engine crank-case. The said tube 8 leads to a small chamber 14 which also communicates by tubing 15 with the said tube 12 and consequently with the crank-case through the tube 13. A small conduit 16 is connected to a suitable point in the intake manifold of the engine in such a manner that when the suction is produced due to the normal engine operation, said conduit 16 communicates the suction to a chamber 17 and therefore to a plunger 18 having a stem 19 firmly secured thereto. In the upper part of the chamber 17 above the plunger 18 there is an atmospheric chamber 20 which communicates with the outer air by means of an orifice 21. A lever arm 22 connects the stem 19 with the stem 23 of a needle valve 24, the lever having as a fulcrum the end 25. The lever arm 22 has an extension 26 where a spring 27 is applied, said spring connecting the end 28 of said extension 26 to a fixed point 29.

At the commencement of the operation of the engine, suction is conveyed through the conduit 16 and creates a vacuum or atmospheric depression in 17, which causes an unbalanced condition with the chamber 20 thus lowering the

plunger 18 and the stem 19 and causing the lever 22 to turn about the center 25, against the action of the spring 27. Between the fulcrum 25 and the stem 19 is the stem 23 which is thus lowered, 5 thereby causing downward movement of the needle 24 which becomes seated on the valve seat 10, thereby closing the communication of the oil from the pipe 7.

The closing of this communication causes the 10 circulation which entered by the tube 6 to lose one of its two branches, the branch 7, so that it is caused to follow the branch 8.

The conduit 8 communicates with the small chamber 14 having therein a valve 30 for engaging a valve seat 31, and a small chamber 32 15 is separated by an opening 33 from a closed chamber 34. Extending through this opening 33 is a stem 35 which forms part of a thermostat 36 enclosed within the chamber 34. The wall 37 forming this hermetically sealed chamber 34 is accommodated in a conduit wherein the inlet 38 leads to the external surface of said wall 37 and thence to an outlet extension 39. The outlet to the said tube 15 is located in the small 20 chamber 32.

The passage through the tube 7 being closed, the oil is caused to continue through the tube 8, enters the chamber 14 and, as the valve 30 is separated from its seat 31, the oil reaches the 30 chamber 32 to pass out by 15 and as the tube 11 is also closed, the oil continues by the tube 12 and the tube 13 into the crank-case.

The connection 38 receives the cooling water from the engine, which water will circulate 35 around 37 and pass by 39 to the general cooling liquid.

The engine is now in operation and the cooling liquid is gradually acquiring temperature, and the outer surface of 37 is absorbing heat. This 40 increase in temperature in the casing 37 reaches the thermostat 36 which in expanding raises the stem 35 which passes through the orifice 33 and pushes the valve 30 upwardly against its seat 31.

The liquid which at first had free circulation 45 through the tubes 7 and 8 is now compelled to pass through the tube 40 as indicated by the broken arrow and to pass upwardly to the pressure valve 41.

In a casing 42 there is located a small chamber 50 43 housing the said valve 41 which is provided with a valve seat 44 and is controlled by the spring 45. From the chamber 43 there extends a conduit 46 having a control valve 47 closing said conduit 46 by engagement with a valve seat 55 48, said valve 47 having a stem 49 surrounded by a spring 50. This stem is held by a plug 51 screwed in the casing of a chamber 52 and which acts directly on the spring 50.

The oil, when flowing through the tube 40, 60 moves the valve 41 from its seat and enters the chamber 43 and passes to the conduit 46 where it moves the valve 48 from its seat, thus entering the chamber 52.

The pressure of the oil being consequently 65 admitted to the chamber 52, this pressure is communicated by 53 to a piston 54, said piston 54 having a stem 55 with a spring 54'' which presses the piston 54 against the mouth of the passage 53. The stem 55 forms part of, or is joined to, the 70 said control rod 4.

A restricted conduit 56 leads from the tubes 6, 7 and 8, and leads into the chamber 52. This communication has a purpose which will be appreciated from the description of the operative 75 cycle of the system, as given below.

The rod 4 is shown at Fig. 1 in the position with the engine at rest or with the engine operating with the lighter fuel.

The rod 4 has two arms 57 and 58 actuating respectively the butterflies or valves 59 and 2; 5 these valves 2 and 59 operate in an alternative manner, that is to say, when 2 is open 59 is closed, and when 59 is open 2 is closed.

These two butterfly valves are located in the admission passages of the two carburetors required by the system, one for the lighter fuel 10 such as naphtha or gasoline, which will feed through the conduit 1, and the other for gas-oil or heavy fuel which will enter by the conduit 60.

Beneath the butterfly valves 2 and 59 are 15 two additional valves 3 and 61 which operate together and are moved by the arm 62 responding to the action of the accelerator of the engine or automobile, thus regulating the speed of said engine.

The action of the small piston 64 is controlled from the rod 63 by which the butterfly valves 3 and 61 are caused to move simultaneously, said piston 64 operating in a bore connected to a conduit 65 by which the tube 1 for the admission of 20 lighter fuels communicates with the upper side of the butterfly valve 61 in the inlet tube 60 for the heavier fuels.

The accelerator, actuating through the said arm 62 will open in the usual manner the butterfly valves 3 and 61, but as in the case of Fig. 1 30 the butterfly valve 2 is open, the suction of the engine will be produced in the tube 1 which sucks the mixture of the lighter fuel to the engine.

In operation, the starting of the engine produces a suction in the tube 16 which suction is conveyed to the chamber 17 so that after a predetermined period a sufficiently unbalanced condition will be established between the chambers 17 and 20 to cause the piston 18 to move 40 downwards.

With the lowering of the piston 18, the stem 19 causes angular movement of the arm 22 against the action of the spring 27. With the downward movement of the lever 22 the stem 23 is 45 lowered, and the needle 24 closes the communication of the tube 7 with the tube 11. The oil then passes through the tube 8, but after a further period of operation of the engine, the circulating cooling water which passes between 38 and 39 has transferred heat to the thermostat 36, thus raising the stem 35 until it causes the valve 30 to close the passage between 8 and 15. The oil from the tube 5 can now pass either by 40 or by 56, and the tube 40 offers less resistance on normal operation, since the restricted tube 56 only operates when it is required that the plunger 54 rapidly returns for the closing of the conduit 53, and for returning the system to the operation with gasoline which enters by 1. 60

Normally, therefore, the oil under pressure will pass by 40 to open the valve 41 and raise the valve 48, consequently causing the oil to exert pressure on the plunger 54 which will move the rod 4 to the position for the opening of the butterfly valve 59 and the closing of valve 2, thus transferring the suction from the admission tube 1 to the admission 60. 65

Meanwhile, during the time in which the transfer from lighter to heavier fuel is effected, the tube 65 is open to the upper part of the butterfly valve 61, so that lighter fuel is fed at the initial opening of the butterfly valve 59, so that there is no noticeable transition from one fuel to another. The said plunger 64 moves downward- 75

ly, thus intercepting said indirect feed when the butterfly valve 61 opens to admit the suction of the engine from the tube 60 providing the gasification of the heavier fuel.

5 When the valves 59 and 61 are open for the supply of the heavier fuel the suction draws a supply of water through a restricted supply tube 66 extending from the cooling system to the pas-
10 sage 60, this tube being so arranged that the water cannot flow therethrough by gravity but only when the outlet end is subjected to the engine suction, and the water thus supplied is mixed in the form of steam with the atomized fuel.

15 Referring particularly to Figs. 2 and 3 of the drawings, the object of the gasification casing 67 is to provide a great accumulation of heat in a coil 68 arranged within the said casing so as to assist in the gasification of the heavier fuel. On
20 the upper part of this casing 67 there is a cover plate 73 forming a conduit 75 which communicates with a tube 74 feeding hot air through a casing 76 and a pipe 77 to the heavy fuel carbureter 78. Underneath the casing 67 are the
25 carbureters 78 and 79, the carbureter 79 corresponding to the admission 1 and the carbureter 78 to the admission 60.

The operation of the butterfly valves 2 and 59 is effected by means of the rod 4 shown in Figs.
30 2 and 3.

The tube 65 with the plunger 64 provides the initial feed of light fuel of the carbureter 78, suitable for the moment wherein the butterfly valve 59 is about to open and the butterfly valve 61 is
35 about to be opened by the operation of the accelerator.

Fig. 4 shows a suitable form of the pressure actuated device for the control of the rod 4, in which the casing 42 has, in its angular conduit
40 46, a double threaded piece 80 connecting 46 with 43. A nipple 81 is provided for connection with the conduit 56. The plug piece 51 has a head 82 and a lock nut 83 with a washer 84, for regulating the action of the spring 50. The other ele-
45 ments of this device were fully described in connection with Fig. 1.

Fig. 5 shows a modified arrangement of the plunger 54 with respect to the conduit 53 and shows said plunger secured to the stem 55 by
50 means of a nut 85 and an abutment 86.

In order that the operator may know when the change of operation of the one carbureter to the other is effected, the rod 4 actuates by means of an extension on one end thereof, a balance beam
55 *a* (see Fig. 1), adapted to close an electric contact *b* which by means of an electric current source *c* lights a signal lamp *d*. The light will be produced when the valve 2 is closed and the valve 59 is opened.

60 Referring to the modified system shown at Fig. 6, the positions of the parts as shown correspond to the starting of the engine with the lighter fuel.

The thermostatic device *a'* is located in contact with one of the two fluids, water or oil, which
65 will acquire temperature as a result of the operation of the engine to which this system is applied, so that, through the expansion of its bellows 1', it will give a stem 2' an upward movement on the absorption of heat by said bellows 1'.

70 While said bellows 1' has a temperature corresponding to that of the atmosphere, the position of same will be that shown in Fig. 6 with the stem 2' inactive. The plunger 4' in the casing 19' is shown in its raised position, and the control arm 5' of the heavy oil carbureter *c'* is in the

position whereby a cylinder 6' (connected thereto by means of a rod 28') provides communication for the fuel from the light fuel carbureter *d'*, in the usual manner when this fuel is used.

The thermostatic element *a'* has a conduit 7' 5 through which passes the fluid affecting the condition of the bellows 1' which is housed in a chamber 8' accommodated within an enlarged portion 9' of said conduit 7'. The stem 2' extends from the bellows 1' and screwed into an extension 10' is a cylinder 11' which has in its upper part an opening 12'. Within this cylinder 11' is a valve having heads 13' and 14', which in their upward and downward movements cover and uncover the openings 15' and 16'.
15

The conduits 17' and 18' communicate with the openings 15' and 16' respectively and are arranged at different heights. The conduit 17' communicates directly to the intake manifold of the engine. The conduit 18' leads to the lower part of the cylindrical casing 19' which contains the plunger 4', the stem 20' of which extends above the casing 19' and has an eye 21' and a flange 22'. A spring 20'' is provided between the flange 22' and the collar 23' for the purpose of
25 maintaining the plunger 4' in the position illustrated in Fig. 6.

The conduit 18' communicates with the casing 19' through an opening 24', and this casing also has a further opening 25' where a tube 26' is
30 connected. This same casing is provided with a third opening 27' in the upper part, which serves as a vent.

The tube 26' leads from the casing 19' to an automatic device *e'* which has the function of
35 closing the tube 26' when the valve 57' in the passage 36' (Fig. 7) is open. When the valve 57' is closed, however, for the idling of the engine or for low speed operation, the device *e'* admits atmospheric air to the tube 26' through a tube
40 37'. The device *e'* consists of a valve casing 109 (Fig. 12) having a bore containing a piston valve 101 actuated by a link 102 connected thereto and to an arm 103 on the end of a spindle 104 carrying the said valve 57' and the valve 101 is adapted
45 to cover and uncover ports leading to the said tubes 26' and 37'.

The heavy fuel carbureter *c'* is provided with the arm 5' which is joined by the rod 28' to the said eye 21' in the stem 20'. This arm 5' imparts angular movement to a hollow cylinder 29' (see Figs. 7, 12 and 13) which is connected to and actuates a hollow cylinder 6' having two main ports 30' and 31', which may register with fixed ports 34' and 35' respectively, which receive the
55 combustible gases coming from the carbureters *c'* of heavy fuel and *d'* of lighter fuel.

As already stated, the tube 17' communicates with the admission of the engine, so that when the thermostat *a'* is at atmospheric temperature and therefore in the position of Fig. 6, the suction passage is closed by the valve head 14'.
60

Meanwhile, the plunger 4' is inactive, due to the atmospheric pressure actuating on the upper part of the plunger through the orifice 27' while
65 atmospheric pressure is exerted—due to the position of the device *e'*—on the opposite face of said plunger 4' which causes the rod 28' to maintain the arm 5' in such a position that the orifice 30' of the cylinder 6' (see Figs. 11 to 13) faces
70 the fixed orifice 34' causing the light fuel carbureter to feed the passage 36' (Fig. 7) leading to the cylinders of the engine.

As the fluid passing by the duct 7' increases in temperature owing to the operation of the 75

engine, the thermostatic element 1' will expand and will raise the stem 2', due to the upward pressure, and will cause the head 14' of the valve to open the port 15' to the port 16', allowing the suction in 17', to communicate with the conduit 18'.

If the valve 57' is now opened the device e' will close the communication between the tube 26' and the tube 37' communicating with the atmosphere, and consequently the engine suction will be felt in the chamber of the cylinder 19', causing the plunger 4' to descend, due to the difference in pressure. This action of the plunger 4' causes the stem 20' to descend, overcoming the spring 20'' and actuating the rod 28' which will transmit an angular movement to the arm 5', which in turn rotates the cylinders 29' and 6'. The rotary movement of the cylinder 6' causes the orifice 30' formed in the wall thereof to move away from the fixed orifice 34' which was feeding the mixture from the light fuel carbureter d'. At the same time the movement of the member 6' causes the orifice 31' to register with the fixed orifice 35' which is fed with the gases from the heavy fuel.

The constructional features are hereinafter described with reference to Figs. 7 to 13 of the drawings.

The light fuel carbureter d' has a constant level chamber 38', Fig. 8, with a cover 39' receiving a tube 40' in the orifice 41' through which the fuel is received. Inside the chamber 38' is a float 38'' pivoted on the support 42' by means of the supporting arm 43' producing the movement of the stem 44' of the valve 45'. A passage 46' allows the outlet of the fuel past the needle 47' which is adjusted from the screw head 48'. The tube 49' communicates with the port 34' (Fig. 13) leading to the carbureter c'.

The heavy fuel carbureter c' also has a constant level chamber 50' with a similar arrangement of float (Figs. 7 and 9), and receives the fuel through the conduit 51'. This carbureter c' rests with its base 52' on a pedestal 53' communicating with conduits 54' and 55' which, respectively, introduce the mixture in the pre-heaters 56', on which said piece rests, and feed said mixture, with suitable addition of air.

The conduit 36' (Fig. 7) communicates with the engine in a downward direction and through the butterfly valve 57'.

The conduit 49' to the light fuel carbureter d' enters directly to the conduit 36' when the orifices 30' and 34' register, as may be seen in Figs. 11 and 13. In this case the carbureter c' operates as a common light-fuel carbureter. At the same time it must be understood that the small ports 31'' (Fig. 13) will introduce into the current of gas or light mixture, a supplementary amount of heavy fuel atomization, which tends to a greater economy in the cost of fuel.

For the admission of extra air there is provided in the upper part of Fig. 7 a valve 64' in an air opening 65'. This valve 64' is mount-

ed on a stem 59' having a spring 60' held in compression between the valve and a washer 61'. In order to vary the compression of the spring and thus modify the tendency to admit extra air the washer 61' is carried upon a forked arm 62' extending from a cross-pin 63' which extends through the casing and is provided externally with suitable means of any well-known type for its convenient adjustment or control.

When the member 6', due to the angular movement transmitted thereto by the rod 28' causing the orifice 31' to register with the orifice 35' the heavy fuel mixture heated and mixed with heated air will pass the butterfly valve 57' reaching the conduit 35' which carries these gases to the admission conduit 36', Figs. 7 and 10.

It should be understood that each of the elements acting in complementary operation of the system may be the subject of a suitable and more convenient construction for the purpose intended, provided it efficiently brings this result.

What I claim is:—

1. A fuel-feed system for internal combustion engines of the character described having means for the separate supply of light and heavy fuels to the engine, and control means for closing one fuel supply and opening the other, and means for actuating said control means comprising alternative passages for the flow of fluid from the engine, means actuated by the engine-suction for interrupting the flow of fluid in one of said passages, a thermostatic device for interrupting the flow of fluid in another of said passages, and means actuated by fluid pressure in still another passage to actuate the said control means.

2. A fuel-feed system for internal combustion engines of the character described comprising means for the separate supply of light and heavy fuels to the engine, control mechanism for closing one fuel supply and simultaneously opening the other, and means for actuating said control mechanism comprising alternative passages for the flow of lubricating oil from the engine, means actuated by the engine-suction for interrupting the flow of oil in one of said passages when the suction reaches a predetermined value, a thermostatic device for interrupting the flow of oil in another of said passages, means for conducting a fluid from the engine to control said thermostatic device, and means actuated by oil pressure in still another passage to actuate the said control mechanism after actuation of the thermostatic device.

3. A fuel-feed system according to claim 1, comprising two carbureters, one for light and one for heavy fuel, a fuel admission tube leading from each carbureter to the engine, a control valve in each tube, means connecting said valves, a duct for the admission of fuel from one of said tubes to the other, and means connected with said valves for interrupting the passage of fuel through said duct.

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