

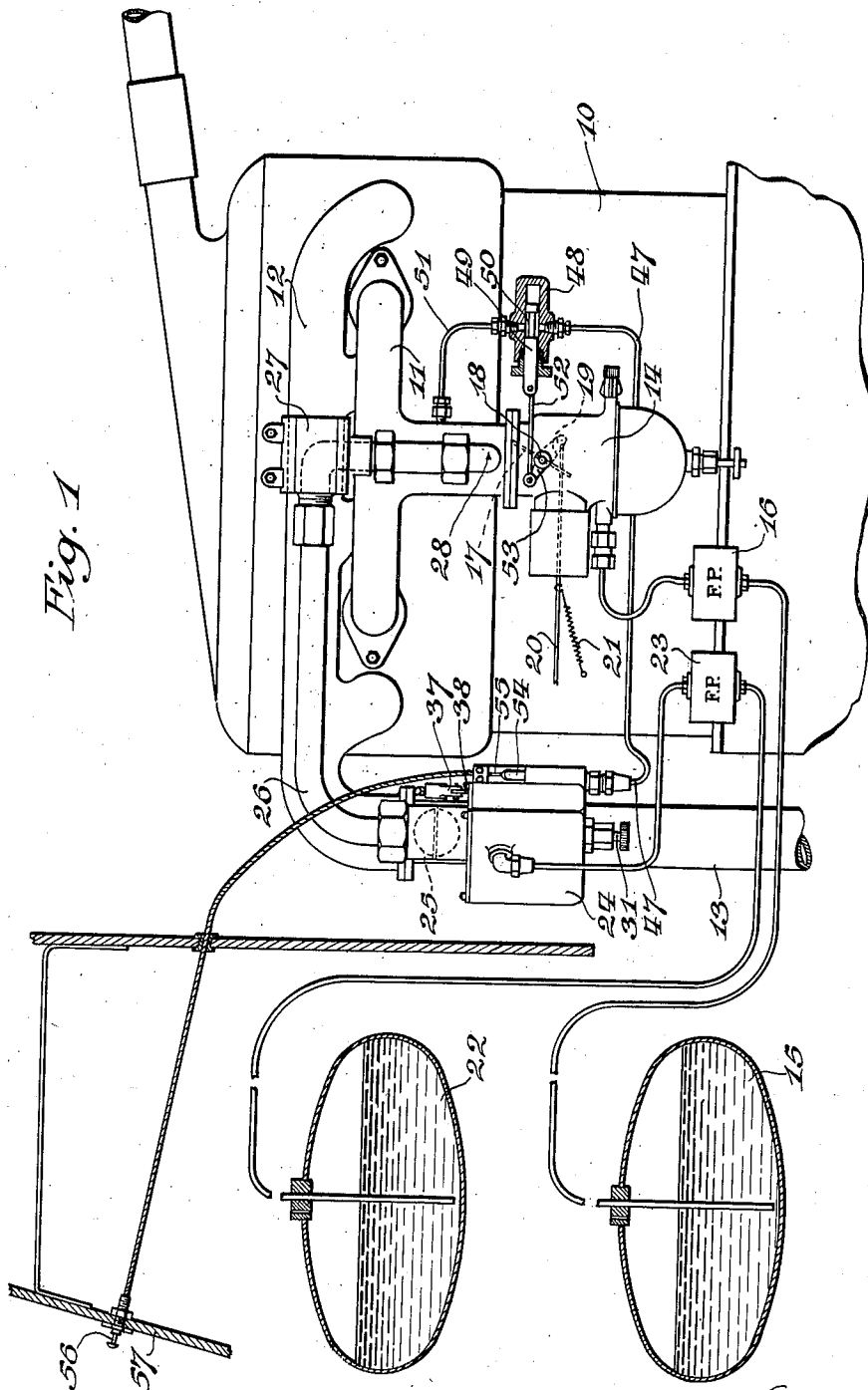
June 20, 1939.

H. H. HUBER
METHOD AND APPARATUS FOR UTILIZATION OF LOW
GRADE FUEL IN INTERNAL COMBUSTION ENGINES
Filed July 24, 1936 3 Sheets

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2,163,241

3 Sheets-Sheet 1



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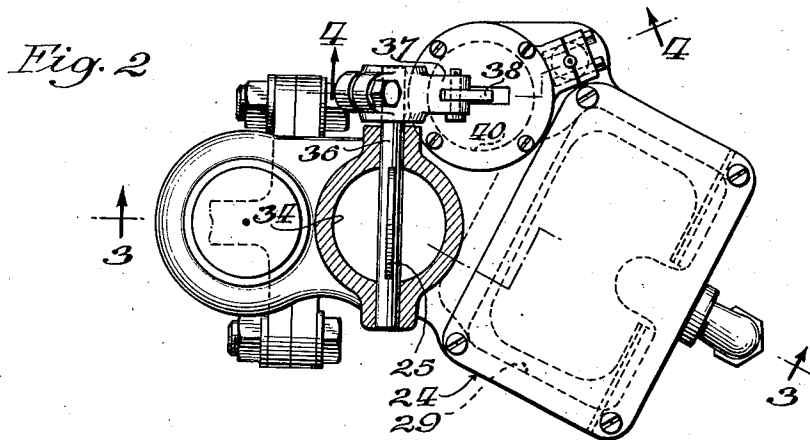
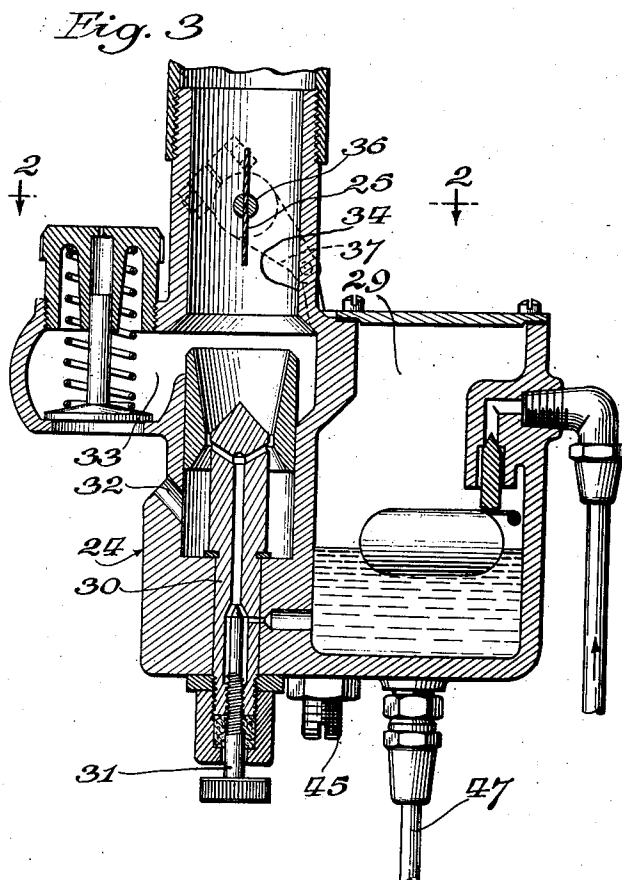
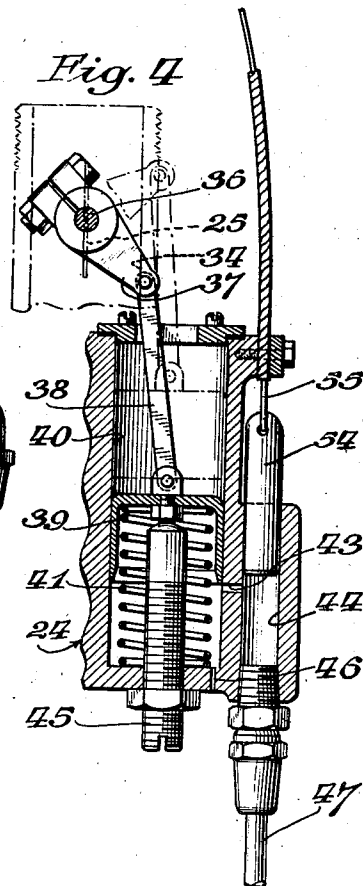
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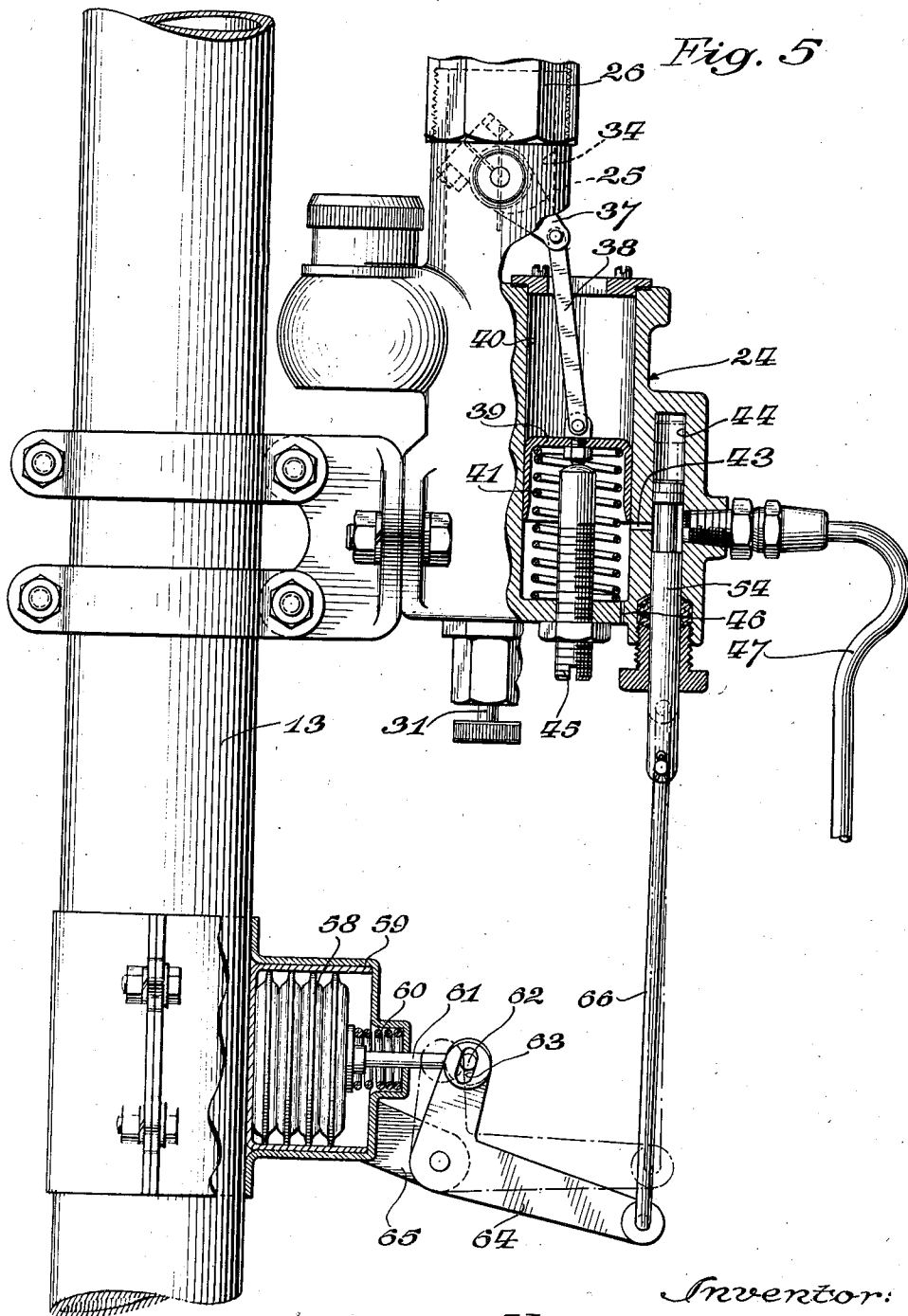
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UNITED STATES PATENT OFFICE

2,163,241

METHOD AND APPARATUS FOR UTILIZATION OF LOW GRADE FUEL IN INTERNAL COMBUSTION ENGINES

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5 Claims. (Cl. 123—127)

This invention relates to an improved method and apparatus for utilizing low grade fuel in internal combustion engines, particularly of the type utilized on modern automotive vehicles.

One of the most important objects of the invention is the provision of an improved method and apparatus for utilizing low grade fuel in modern internal combustion engines, which results in a practically complete combustion of the low grade fuel, which may comprise the major portion of the fuel supply according to the present invention, without loss of power or satisfactory performance.

Another object of the invention is the provision of an improved method of operation of internal combustion engines with low grade fuel and an improved carburetion system for practicing this method.

A further object of the invention is to provide such a system in which the auxiliary fuel means supply is automatically rendered inoperative when the manual control, for example, the conventional throttle, is closed.

A further object of the invention is to provide such a system in which the auxiliary fuel supply means is automatically rendered inoperative when the engine is laboring under heavy load.

Another object of the invention is to reduce the cost of fuel required to operate an internal combustion motor by using a substantial portion of inexpensive fuel, such as kerosene, or distillate, along with the standard motor fuel.

Another object of the invention is the adaptation of the present method of utilizing low grade fuel to existing motors without requiring any expensive changes in the motor.

Motor fuels regularly sold throughout the country are blended to meet the requirements of the modern high compression motor, and are said to have a very high octane rating to overcome a disturbing and power robbing detonation otherwise present when the motor is put under a heavy load.

In the past many attempts have been made to mix, before atomization, fuels of low octane quality with the higher grade motor fuels, but such mixing causes the lowering of the octane rating so that it becomes unsatisfactory, when the motor is operating under a heavy load. I have discovered that using any substantial proportion of lower grade fuel, such as distillate, with the standard fuel causes an objectionable smoking through the exhaust, except when the motor is at high temperature.

In order to operate a motor satisfactorily over its entire range from idle to maximum load, the

fuel used must be very volatile. Any great reduction in the volatility of the fuel as a result of mixing fuels of low volatility with standard motor fuels has proven unsatisfactory.

When such mixtures are used there is a tendency to flood the motor during starting periods and during periods of long idling to cause crank case dilution, the excessive formation of carbon in the combustion chamber, and a discharge of an excessive amount of smoke from the motor exhaust, due to the incomplete combustion of such motor fuel.

It is, therefore, necessary to maintain at all times a very high volatility of the fuel mixture entering the cylinders of the internal combustion motor in order that complete combustion may always take place during the entire range of operation. With complete combustion there is no dilution of the lubricating oil, there is almost no formation of carbon, and the motor delivers full power without any tendency of overheating.

Complete combustion of the fuel in an internal combustion motor depends upon many things. If the motor temperature is low, as it is bound to be during starting and the warming up period, a fuel equal in volatility to the standard motor fuels now being sold is required. Any mixing of low grade or fuels of low volatility with standard motor fuels lowers the standard of the entire mixture.

I have discovered that a low grade fuel very finely atomized will operate quite satisfactorily in a hot motor at normal road load. I have also found that if a stream of very finely atomized fuel, such as distillate or kerosene, is admitted into the intake manifold of an internal combustion motor to mix with the regularly atomized mixture of motor fuels, such as standard gasoline, the motor operation will be highly satisfactory, without any evidence of smoke or without excessive detonation at normal road loads.

The heat of combustion of the atoms of high grade or very volatile fuel serve as a fuse to ignite the atoms of a less volatile fuel, bringing about complete combustion. However, even such a thoroughly mixed fuel will tend to cause smoke if the motor is permitted to idle for any great length of time and will cause detonation if the motor is maintained under very heavy load for any appreciable length of time.

Therefore, in order to secure the best results, I prefer to utilize the low grade fuel by supplying this fuel in a highly atomized state, to be mixed with the standard atomized motor fuel only during periods of normal road load and speed, after

the engine is warmed up, when complete combustion can take place. Admitting the low grade fuel at only normal road loads when vacuum in manifold is always very high insures the highest degree of atomization. Therefore, I prefer to provide a separate carburetor for the low grade fuel, a separate tank, and a separate fuel pump, the latter preferably being an electric pump, which is conveniently added to the ordinary equipment of the engine.

According to my method of utilizing low grade fuel or of operating an internal combustion engine, the low grade fuel is separately atomized, but it is not introduced into the manifold of the engine, except when the conditions are such that complete combustion can take place. Thus the engine should first be brought up to operating heat by the use of its normal fuel. When the engine is operating under heavy load, the low grade fuel should be shut off completely, as complete combustion is not possible under that condition, and when the motor is idling the low grade fuel supply should also be completely shut off.

Briefly stated, one of the most important characteristics of my method of utilizing low grade fuel or of operating an internal combustion engine primarily on low grade fuel comprises bringing the engine to a proper operating heat on normal fuel supply, separately atomizing the low grade fuel and introducing it into the combustion chambers of the engine only while the engine is operating at a suitable speed, so that complete combustion of the low grade fuel takes place, and excluding the low grade fuel at idling speed, under full load, or when the engine is not suitably heated.

Another object of the invention is the provision of an improved apparatus which is adapted to carry out the practice of the foregoing method and to effect the foregoing objects.

A further object of the invention is to provide such a system in which the auxiliary fuel supply means may be rendered inoperative at will.

A further object of the invention is to provide such a system in which the auxiliary fuel supply means is controlled thermostatically and is held out of operation until the engine warms up to a predetermined degree.

Other objects, advantages and capabilities of the invention will appear from the following description of preferred embodiments thereof, taken in conjunction with the accompanying drawings, in which:

Figure 1 is an elevational view of an internal combustion engine embodying my invention, the fuel supply tanks being shown diagrammatically;

Fig. 2 is a sectional plan, taken on the line 2-2 of Fig. 3, of a suitable auxiliary carburetor;

Fig. 3 is a vertical section therethrough, taken on the line 3-3 of Fig. 2;

Fig. 4 is a sectional detail view, taken on the line 4-4 of Fig. 2, showing the control cylinder of the auxiliary carburetor, and

Fig. 5 is an elevation partly in section, showing an automatic thermostatic control for the auxiliary carburetor.

Referring to the accompanying drawings, the reference numeral 10 designates a conventional automobile engine which is provided with an intake manifold 11, and an exhaust manifold 12 which delivers the products of combustion to the exhaust pipe 13.

A conventional carburetor 14 is connected to the intake manifold 11 in the usual way. This

carburetor is supplied with the usual automobile fuel, for example gasoline, from the storage tank 15, by means of a fuel pump 16. The carburetor 14 comprises a throttle valve 17 which is mounted on a shaft 18. On one end of the shaft 18 is mounted a throttle lever 19, which is adapted to be operated by a manual or pedal control through a rod 20. The throttle 17 is normally biased to closed position by spring means which are diagrammatically shown at 21.

I provide a tank 22 for an auxiliary supply of fuel. This fuel is ordinarily of a lower or cheaper grade than the normal gasoline delivered from the tank 15. For example, it may be kerosene, distillate, or the like, which have a higher boiling point than gasoline and usually have a lower octane rating. On the other hand, the fuel supplied from the tank 22 may comprise a gasoline of low octane value, which would detonate and cause knocking in the engine 10 under heavy load conditions, but which may be used as an auxiliary supply during optimum normal running conditions.

Fuel from the tank 22 is conveyed by a pump 23 to the auxiliary carburetor 24. This auxiliary carburetor comprises a shut-off valve 25 which controls the delivery of combustible mixture to a pipe 26. The carburetor 24 is conveniently mounted on the exhaust pipe 13. The pipe 26 leads the mixture to a hot spot 27 on the exhaust manifold 12 and the heated mixture is delivered into the intake manifold 11 at a suitable point 28. It will be understood that if it is intended to use gasoline of low anti-knock value in the carburetor 24, the hot spot 27 may be omitted.

The carburetor 24 may be of any suitable design, but that shown in detail in Figs. 2, 3, and 4 is preferred. This carburetor comprises a conventional float chamber 29, a jet 30, a jet control screw 31, a primary air inlet 32, and a secondary air inlet 33. The outlet passage 34 is controlled by the shut-off valve 25 which is mounted on a shaft 36. It may here be noted that the shut-off valve 25 is either fully open or fully closed. The shaft 36 carries an arm 37 which is connected by a link 38 to a piston 39, which operates in a cylinder 40, which is integral with the carburetor 24. Below the piston 39 is provided a compression spring 41, which normally tends to move the piston upwardly so as to close fully the shut-off valve 25.

The cylinder 40, below the piston 39, communicates through a port 42 to a small cylinder 44. With reference to Fig. 4, it will readily be understood that when suction is applied to the interior of the cylinder 40 through the port 43, the cylinder 39 will be drawn downwardly to its lowermost position and the valve 25 is fully opened. This lowermost position is controlled by a screw 45 so that by manipulating the screw 45 the extent of opening of the valve 25 may be accurately controlled. A small leakage port 46 is provided in the lower portion of the cylinder 40 so that when the port 43 is closed air may leak into the cylinder 40 below the piston 39 and permit the spring 41 to move the piston 39 upwardly so as to close completely the valve 25. The suction to operate the piston 39 is suitably provided by the intake manifold of the engine. Thus, the cylinder 44 is connected by a tube 47 to a valve housing 48 in which is located a slide valve 49. This slide valve is provided with a spool groove 50 whereby the tube 47 may be put into communication with a tube 51 which leads into the intake manifold 11 of the engine. The slide valve 49

is connected by means of a link 52 to an arm 53 on the end of the shaft 18 remote from the arm 19.

With reference to Fig. 1 it will be noted that when the throttle 17 is closed, the valve 49 is moved to the right shutting off communication between the tubes 47 and 51. When, however, the throttle 17 is opened, the slide valve 49 moves to the left and at a suitable speed of the engine, for example corresponding to about 15 miles per hour, the spool groove 50 establishes communication between the pipes 47 and 51. Within the cylinder 44 is provided a piston 54 which can be manually operated so as to prevent the communication of suction from the manifold of the engine to the interior of the cylinder. The piston 54 may be connected by a Bowden wire 55 to any suitable position convenient to the driver. Thus, the Bowden wire 55 may be actuated by a pull and push button 56 mounted on the instrument board 57. When the button 56 is pulled outwardly, the piston 54 is moved into the position shown in Fig. 4. When it is pushed inwardly the port 43 is definitely closed and the throttle 25 is maintained closed until the button 56 is pulled outwardly again.

The operation is as follows. The button 56 is pushed inwardly so that the auxiliary carburetor 24 is rendered inoperative for the time being. Consequently, during starting, the fuel is exclusively supplied from the tank 15 by the carburetor 14, this fuel being better adapted to complete combustion in a cold engine. The engine is allowed to warm up with this supply of fuel and then the button 56 is pulled outwardly so that the carburetor 24 may be automatically brought into operation subject to control from the carburetor 14. It is undesirable to use lower grade fuel in the engine under idling conditions since under such conditions a heavy boiling fuel is not atomized easily and is not completely consumed, giving excessive carbon deposits. Under idling conditions, the throttle 17 is substantially closed and the valve 49 closes communication between the intake manifold and the cylinder 40, so that the valve 25 remains closed during idling conditions. As indicated above, the valve 49 is arranged to bring the carburetor 24 into operation when a predetermined engine speed is attained, for example, a speed corresponding to a vehicle speed of 15 miles per hour. When the throttle 17 is open to the extent corresponding to that vehicle speed, manifold suction is exerted upon the lower side of the piston 39 so that the valve 25 is opened to its fullest extent. Under normal running conditions the carburetor 24 is in operation supplying the heated mixture to the manifold. When, however, the engine is subjected to a severe load, as when climbing a steep hill, the manifold vacuum 11 decreases very substantially and the spring 41 is able to overcome the suction and effect the complete closing of the valve 25. Consequently, the engine operates exclusively on fuel from the tank 15 which has better anti-knock qualities.

The embodiment of the invention illustrated in Fig. 5 differs from the embodiment just described in that the piston 54 is automatically controlled by means of a thermostat 58 which may suitably consist of a metal bellows. The metal bellows is mounted adjacent the exhaust pipe 13 in a suitable housing 59. A spring 60 within the housing tends to compress the bellows 58.

A rod 61 rigidly secured to the outer end of the bellows 58 extends through the housing and carries at its outer end a pin 62. The pin 62 extends through a slot 63 in a bell crank lever 64 which

may suitably be pivoted on a bracket 65 carried on the housing 59. The other arm of the lever 64 is connected by a link 66, which is pivotally connected to the valve 54. As in the previously described embodiment, the valve 54 controls communication between the tube 47 and the cylinder 40 of the carburetor 24.

When the engine is cold, the bellows 58 is collapsed and the bell crank lever 64 has the position shown in dotted lines in Fig. 5. As a consequence of this position, the valve 54 is moved to its uppermost position so that communication is shut off between the intake manifold and the cylinder 40. Consequently, the shut-off valve 25 is closed. When the engine is started, it is supplied exclusively by the main carburetor 14. After the engine is started, the bellows 58 is expanded and the bell crank lever 64 is moved into the full line position in Fig. 5, with the result that the valve 54 opens communication between the interior of the cylinder 40 and the intake manifold of the engine. As long as the engine speed remains below the predetermined speed, the valve 49 remains closed and the valve 25 remains completely closed. When, however, the throttle of the carburetor 14 is opened to a sufficient degree to establish communication between the tubes 51 and 47, the suction applied to the underside of the piston 39 causes the valve 25 to move to its fully open position. When the throttle 17 moves to its idling position or to a low speed position; that is a speed corresponding to a vehicle speed of less than 15 miles per hour, the valve 25 closes and the same occurs when the vacuum in the intake manifold falls owing to the engine laboring under heavy load. Thus, the operation of this embodiment is precisely the same as that of the first described embodiment with the exception that the control exercised by the button 56 in the first described embodiment is exercised automatically by the thermostat 58. As a result of my invention I am enabled to use an auxiliary supply of lower grade fuel during the normal operation of the automobile. Under conditions of heavy load, and under low speed and idling conditions, the supply of auxiliary low grade fuel is cut off, and the disadvantages which would arise from the employment of auxiliary low grade fuel under these conditions are obviated. These disadvantages, as have heretofore been pointed out, are incomplete combustion under low speed conditions and detonation or knocking under heavy load conditions.

It is well here to note that the maximum capacity desired of carburetor 24 must be determined by driving conditions and adjusted accordingly by screw 45. As it is apparent when carburetor 24 is brought into operation by valve 49, the vehicle will continue its increase in speed until the maximum carburetor capacity is reached. If driving conditions are so that a maximum of approximately 40 M. P. H. can be maintained without too many interruptions, then screw 45 should be adjusted to a position of valve 25 to maintain that speed.

Any speed greater than 40 M. P. H. desired would be obtained in the normal way by opening valve 17 in carburetor 14. If, however, speeds of less than 40 M. P. H. and over 15 M. P. H. on the above adjustment of screw 45 is desired, by causing carburetor 24 to become inoperative by operating button 56, carburetor 14 will function over complete range as in normal motor vehicles.

It is well here to also note that as the engine approaches a heavier load, the vacuum 11 in

manifold gradually decreases, the spring 41 gradually moves throttle 25 toward a closed position. Therefore, as the operating condition when heavy detonation occurs in the motor approaches, the volume of cheap fuel mixture is decreased until a closed position of valve 25 effects an elimination of the cheap fuel entirely. In this way it is possible at all times to use as great a proportion of cheap fuel as possible and still maintain a highly satisfactory operation.

Although the invention has been disclosed in connection with the specific details of preferred embodiments thereof, it must be understood that such details are not intended to be limitative of the invention except in so far as set forth in the accompanying claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A carburetor system for an internal combustion engine having an intake manifold, a carburetor having a manually operated throttle for controlling the supply of one fuel to the manifold, a carburetor having a valve for controlling the supply of another fuel to the manifold, manifold suction responsive means controlled by the manually operated throttle for opening said valve, and thermo-responsive means for controlling the opening of the said valve.

2. A carburetor system for an internal combustion engine having an intake manifold and an exhaust manifold, a carburetor having a manually operated throttle for controlling the supply of one fuel to the intake manifold, a carburetor having a valve for controlling the supply of a heavier fuel to the intake manifold, means for transferring heat from the exhaust manifold to the heavier fuel, manifold suction responsive means controlled by said throttle for moving said valve to open or closed position, and means for controlling the opening of said valve except at predetermined manifold suction.

3. A carburetor system for an internal combustion engine having an intake manifold and an exhaust manifold, a carburetor having a manu-

ally operated throttle for controlling the supply of one fuel to the intake manifold, a carburetor having a valve for controlling the supply of a heavier fuel to the intake manifold, means for transferring heat from the exhaust manifold to the heavier fuel, manifold suction responsive means controlled by said throttle for moving said valve to open or closed position, and thermo-responsive means for controlling the said valve.

4. The method of utilizing low grade fuel in internal combustion engines which comprises operating an internal combustion engine during its starting and preliminary heating solely on its normal grade of fuel and thereafter separately atomizing the low grade fuel, reducing the supply of normal grade fuel and supplementing the normal grade fuel in reduced supply with the separately atomized low grade fuel to be ignited by the heat of combustion of the more volatile normal grade fuel supply, to effect a complete combustion, said supplementing of the normal fuel supply with low grade fuel being carried on only when the engine is operating at predetermined manifold suction and only when receiving more than a predetermined minimum supply of normal grade fuel.

5. The method of utilizing low grade fuel in internal combustion engines which comprises operating an internal combustion engine during its starting, preliminary heating, and laboring at reduced speed slowly on its normal grade of fuel and thereafter separately atomizing the low grade fuel, reducing the supply of normal grade fuel, and supplementing but not replacing entirely the normal grade fuel in reduced supply with the separately atomized low grade fuel to be ignited by the heat of combustion of the more volatile normal grade fuel supply to effect a complete combustion, the supplementing of the normal fuel supply with low grade fuel being carried on responsive to the existence of predetermined manifold suction in the engine and only when the engine is receiving more than a predetermined minimum supply of normal grade fuel.

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