Jan. 24, 1928.

L. M. WOOLSON

1,657,293

HYDROCARBON MOTOR

Filed Sept. 13, 1919

Fig. 2.

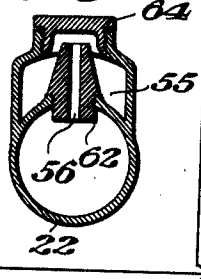


Fig. 1.

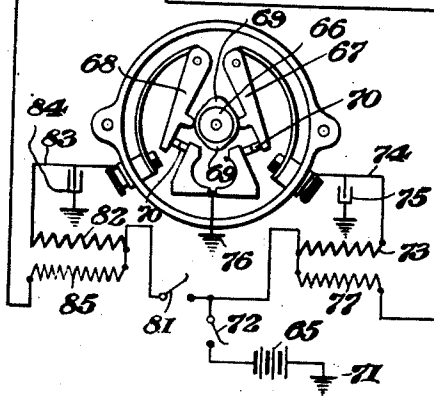
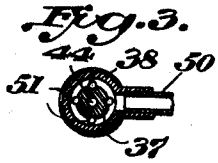


Fig. 3.



Inventor,
Lionel M. Woolson,
By Miller Sibbett,
Atty.

Patented Jan. 24, 1928. 1,657,293

UNITED STATES PATENT OFFICE.

LIONEL M. WOOLSON, OF DETROIT, MICHIGAN, ASSIGNOR TO PACKARD MOTOR CAR COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

HYDROCARBON MOTOR.

Application filed September 13, 1919. Serial No. 323,627.

This invention relates to hydrocarbon motors and particularly to means for heating the mixture passing from the carburetor to the motor cylinders.

The invention is particularly adapted for use in connection with motors or engines in motor vehicles, motor boats, aircraft, etc., but is not necessarily limited to such use.

The invention is particularly adapted for motors using the present low grade gasoline, but it may also be advantageously employed with even lower grades of fuel, such as kerosene, as well as with the higher grades or more volatile fuels.

The difficulties of starting hydrocarbon motors on the present low grade gasoline, particularly in cool or cold weather are well known. If the weather is not too cold the motor can usually be started by adjusting the carburetor to provide a very rich mixture. The mixture must be continued rich until the motor warms up sufficiently to supply it with heat by either heating the air entering the carburetor or heating the mixture passing from the carburetor to the motor. Some motors employ the exhaust gases for this heating process and others use the hot water from the water jackets.

Motor exhaust and jacket water heaters cannot supply initial heat to the carburetor or intake pipe and consequently are of no value in starting a cold motor. Initial electric heaters have been tried heretofore, but with unsatisfactory results due to the large amount of current required to effect volatilization of the fuel. Combustion heaters have been tried, but because of inherent defects, have not been successful.

The present invention is of the combustion heater type and contemplates using a small amount of fuel from the motor fuel line and mixing it with air in as nearly correct proportion as is possible to get a perfect combustile mixture and igniting that mixture and discharging the burnt gas into the motor intake pipe so that these hot burnt gases will be in direct contact with the mixture passing through the intake pipe and thereby quickly heat that mixture to such a degree that it will not condense but will pass through into the motor cylinders and be readily ignited there. It is one of the objects of this invention to provide means for effecting this contemplated result.

Another object of the invention is to so arrange the heating mechanism that with a nearly closed throttle, as when starting or idling, the heater will operate to its maximum degree and with a wider opened throttle the heater device will be less effective.

Another object of the invention is to so interconnect the main motor carburetor with the carburetor which supplies the heater that these carburetors may be simultaneously choked to thereby produce a richer mixture with both of them, which is desirable for starting in colder weather.

Another object of the invention is to provide a carburetor for the heater that will automatically produce a rich mixture for starting and a more nearly normal mixture for steady running.

Another object of the invention is to provide a separate ignition circuit for the heater, operated however, by the same mechanical means as is provided for operating the ignition circuits of the motor.

Another object of the invention is to so position the ignition device or spark plug in the heater that the terminals or electrodes will be disposed in the path of the moving mixture thereby effectively igniting the mixture.

Other objects of the invention will appear from the following description taken in connection with the drawings, which form a part of this specification, and in which:

Figure 1 represents one form of my invention, a part only of the motor being shown, the carburetors and intake pipe and heater being shown largely in section, and the ignition apparatus being illustrated largely in diagram;

Figure 2 is a cross section on the line 2—2 of Figure 1; and

Figure 3 a section on the line 3—3 of Figure 1.

Referring to the drawings, 10 represents a hydrocarbon motor, a portion only of the cylinder casting being shown on the drawing. This may be a single or a multi-cylinder motor. The motor carburetor or fuel mixing device is indicated generally by the numeral 11, and in the form shown, which is of the well known Packard type, 12 is the mixing chamber, 13 the Venturi mixing tube, 14 the fuel nozzle arranged in the tube 13, 15 the main air intake and 16 the aux-

iliary air intake. A manually adjustable valve 17 is arranged in the main air intake, an arm 18 and rod 18' being provided to effect the adjustment. A poppet valve 19 yieldingly closed by springs 20 governs the amount of air passing through the auxiliary inlet 16. For the purpose of choking the carburetor, that is of shutting off practically all of the air thereto, the valve 17 may be turned to the position shown in dotted lines so that it practically closes the main air intake 15 and bears against an extension 21 on the valve 19 thereby holding the latter valve positively closed.

The fuel nozzle 14 may be supplied with gasoline or other fuel by any well known means, and in the present form it is supplied from an adjacent float chamber 27, a passage 28 leading to the lower end of the nozzle. A float 29 operates through pivoted levers 30 on a valve 31 to maintain a substantially constant level of gasoline in the float chamber, this level usually being arranged as shown slightly below the top of the nozzle 14. The valve 31 seats at 32 and controls the supply of gasoline entering the chamber from the main fuel line or pipe 33.

It will be understood that when there is a depression in the mixing chamber 12 as by reason of the suction from the motor, air will be drawn through the Venturi tube 13 past the nozzle 14 from which gasoline or other fuel will flow. The gasoline and air will mix as they pass upwardly through the tube 13 and will be further mixed with the air drawn into the mixing chamber 12 through the auxiliary air inlet 16, the valve 19 opening slightly because of the suction. The extent of valve opening will depend upon the suction and consequently approximately the correct mixture will be supplied to the motor at all speeds. When the valves 17 and 19 are closed only a slight amount of air will pass the valve 17 and none will pass the valve 19, and the greater suction thus produced on the fuel in the nozzle 14 will result in a very rich mixture in the chamber 12, this mixture being particularly adapted for starting purposes or when the motor is cold.

The mixing chamber of the carburetor 11 is adapted to be connected to the motor so that the mixture may be supplied to the cylinders of the latter. As shown, this connection is an intake pipe 22 in the shape of an elbow having a flange 23 for connection to a flange 24 on the carburetor, and a flange 25 for connection to the motor 10. Somewhere in the passage between the carburetor and the motor a throttle valve is arranged, and in this form a butterfly valve 26 is pivotally mounted near the upper end of the mixing chamber 12.

By this construction the intake pipe or conduit 22 becomes a continuation of the mixing chamber 12 and the mixture formed by the carburetor 11 will be drawn past the throttle valve 26 and through the mixture passage or conduit formed by the pipe 22 into the motor cylinders. It is this mixture which it is desired to heat in order that the particles of gasoline or other fuel being carried over may be volatilized and the mixture not permitted to condense on the walls of the passage.

Another carburetor or fuel mixing device, functioning and operating independently of the carburetor 11, is indicated generally by the numeral 34 and is for the purpose of supplying a combustible mixture to be ignited to thereby produce heat for raising the temperature of the mixture passing from the main carburetor 11 to the motor. This carburetor 34 is much smaller than the carburetor 11 and is connected with the motor suction so that it operates only when the motor is running and thereby producing suction through its intake valves, and the mixture it produces is ignited before it reaches the motor intake passage.

The carburetor 34 may draw its gasoline or other fuel from any suitable source, but in the form of the invention herein shown it is arranged in connection with the float chamber 27 and receives gasoline therefrom. It is in fact mounted directly upon the cover 35 of the float chamber, said cover also having a vent 36 for maintaining atmospheric pressure in the chamber and permitting inflow of air for the use of the carburetor 34 as will hereinafter appear.

The carburetor 34 comprises an upright inner piece 37 which is threaded into an opening in the top of the cover 35, two outer pieces 38 and 39, and a lower piece 40, all of which pieces are designed and connected together to form the various passages and chambers of the carburetor. The piece 38 surrounds the middle part of the piece 37 and is secured between a flange 41 on the latter piece and the cover 35. The piece 39 surrounds the upper end, and the piece 40 surrounds the lower end, of piece 37, and both are threaded to it.

A combination air and gasoline chamber 42 is formed in the part of the carburetor that projects into the float chamber 27, the lower part of this chamber being submerged in the gasoline and one or more air openings 43 being provided in the upper part of the chamber 42 above the gasoline level. A central passage 44 is formed in the piece 37, which passage communicates by a restricted opening 45 with the interior of the float chamber 27 below the level of the gasoline therein, and which passage also communicates with the chamber 42 by means of a series of compensating ports or restricted openings 46 also below said gasoline level.

The passage 44 has one or more lateral outlet openings 47 at its upper end, and the piece 37 of the carburetor is contracted in the zone of these openings so that there is a very restricted air passage 47′ at this point. The upper end 48 of the piece 37 tapers upwardly so that this air passage widens out above the openings 47 and forms the upper or outlet end 53 of the carburetor.

The carburetor 34 has a second air inlet passage at 49, receiving air from a pipe 50, and one or a series of vertical air passages 51 lead this air to a chamber 52 which terminates in the air passage 47′ above referred to, thus carrying the air past the opening 47 when suction is created at the outlet end 53. The pipe 50 is shown connected, as at 50′, to the main air intake 15 of the carburetor 11, which does not affect the normal independent operation of either carburetor, but which permits of choking both carburetors simultaneously for starting in cold weather.

From the above description of the carburetor 34 it will be seen that its operation is as follows: The outlet openings of the carburetor are so positioned relative to the gasoline in the float chamber that there can be no overflow or leakage in any way. When the motor is not running or when there is no suction at the outlet 53, the gasoline or other liquid fuel will collect in the chamber 42 through the opening 45 up to the level of the gasoline in the float chamber 27, all of the compensating openings 46 being thus submerged, but the air openings 43 being above the level of the gasoline. When the motor is turned over by hand or by electric starter or otherwise and suction thus created at the point 53, (by connections hereinafter described) a stream of gasoline up to the capacity of the passage 44 will be delivered through the openings 47 until the greater part of the gasoline is withdrawn from the chamber 42. At the same time air will also be drawn through the passages 49 and 51 and the chamber 52 and restricted passage 47′ and will be mixed with the gasoline issuing from the openings 47, thus producing a fairly rich mixture of gasoline and air for starting purposes. As the level of gasoline in the chamber 42 reaches the openings 46 air is also drawn into the passage 44 thus forming a rich emulsion of gasoline and air, the richness decreasing as more of the openings 46 are uncovered. After the initial supply of gasoline in the chamber 42 has thus been exhausted the passage 44 can receive gasoline only through the restricted opening 45 and this will be emulsified by the air which will then be drawn in through all of the openings 46 and the passage 42 and air openings 43. This emulsion of gasoline and air will issue from the openings 47 to mix with the air from the inlet passage 49 and a less rich mixture will result. Thereafter, if the suction or depression at the outlet 53 drops so that the opening 45 can more than supply the requirements of the carburetor, the chamber 42 takes the surplus until one or more of the compensating openings 46 is again covered, and this level of gasoline in the chamber 42 works up and down in accordance with the decrease or increase in the pull on the carburetor. The openings and passages are intended to be so coordinated and proportioned that under this running condition the mixture which the carburetor will supply will be substantially perfectly proportioned in gasoline and air to most readily burn and this whether the motor is running at high or at low speeds.

The carburetor 34 is connected with the motor intake passage, in the form of the invention shown in these drawings, through a pipe 54, a chamber 55 and a passage 56, and electrical means are provided for igniting and if necessary reigniting the mixture on its way from the carburetor to the motor intake passage. The mixture being first ignited will ordinarily continue to burn as as long as the motor runs, even though the ignition is discontinued, but the spark is usually operated continuously in order to insure reignition in case the flame should for any reason be extinguished. This burning or firing of the mixture takes place in the closed combustion chamber 55 so that there is not the danger of an open fire, and this chamber is mounted directly upon the intake pipe 22 of the motor whereby the heat radiating from the chamber 55 may in part at least be used for heating the walls of said intake pipe.

It is particularly important that the mixture shall be drawn into the chamber 55 at sufficient speed to prevent backfiring into the carburetor 34 or a back pressure that will extinguish the flame, and yet the mixture must remain in the chamber until it is substantially burned so that it will not carry over and ignite the mixture passing through the intake passage 22. Of course the mixture is considerably expanded as it is burned in the chamber 55 and if the inlet and outlet passages of the chamber 55 were of the same size a back pressure would be set up and a constant drawing in of the mixture would not take place. It is an important feature of this invention, therefore, that the outlet passage 56 shall be made larger than the inlet passage to the combustion chamber 55, so that the burned and expanded gases may be sufficiently withdrawn and the speed of the incoming mixture or gas be kept up to a sufficient degree to prevent the backward propagation of flame to the carburetor 34. The mixture from the carburetor 34, therefore, enters the combustion chamber 55 through a restricted passage 57 which passage is of less capacity than the outlet pas-

sage 56 from said combustion chamber. A valve 57′ may be provided merely for increasing the degree of difference between said passage 57 and 56, but even with the valve 57′ wide open the passages are still so proportioned that 56 is somewhat larger than 57. The valved arrangement may be used for adapting the device to different size motors or for adjusting it for different running conditions.

A screen 58 or similar device is provided for more fully breaking up the mixture just before it reaches the igniting device. The igniter shown is a spark plug 59 of well known construction having terminals 60 and 61 between which a spark is produced for igniting the mixture in the chamber 55.

Part of the combustion chamber 55 is formed by a member 55′ to which the pipe 54 is connected and in which the screen 58 and spark plug 59 are mounted. In the form of the invention illustrated the passage for the mixture through the member 55′ is somewhat restricted or limited in cross sectional area and it should be noted that the terminals 60, 61 of the spark plug extend a substantial distance beyond the body portion of the plug and into the passage, thereby being disposed directly in the path of the moving mixture. The member 55′ is provided with a glass window 55″ directly opposite the terminals 60, 61 of the sparkplug, for observing the sparking and the burning of the mixture in the chamber.

The passage 56 above referred to is formed in a plug 62 arranged in the wall between the intake pipe 22 and the chamber 55, this plug being inserted through an opening 63 which is closed by a recessed cap 64. The upper end of the plug 62 extends slightly into the recess of the cap 64 in order to provide a somewhat circuitous passage for the burnt gases passing from the chamber 55 to the interior of the intake passage or pipe 22 to thereby give more time for the gases to completely burn before entering said intake passage.

Carburetors 11 and 34 operate independently, and the operator usually controls only the mixture passing through the carburetor 11, the carburetor 34 operating whenever there is suction in the motor intake pipe 22. For cold weather starting, however, the operator may enrich the mixture of both carburetors by closing the butterfly valve 17. This not only chokes both air inlet passages of carburetor 11, but also chokes pipe 50 which normally supplies air to the passage 49 of carburetor 34, so that the only air that the carburetor 34 can receive under these conditions is that which is drawn through the vent 36 and air openings 43. This action, therefore, produces a very rich mixture for both carburetors, thus insuring more ready ignition both in the combustion chamber 55 and in the motor. At all other times the carburetor 34 supplies a mixture readily fired in the combustion chamber 55; and after being ignited the mixture normally remains burning as long as the suction is sufficient to keep it in operation.

In the operation of the motor, with the throttle 26 nearly closed as for idling, the suction in the carburetor 11 will be very low, but due to the relatively high vacuum in the intake pipe 22 the suction in the carburetor 34 will be high, so that said carburetor 34 will operate to its maximum and there will be considerable heat produced by the heater or combustion chamber 55. Under these circumstances also there will be very little heat produced by combustion of the charges in the motor cylinders, because only enough gas is supplied to the cylinders to turn the motor over idly. As the motor throttle is opened, whether the speed or the load is increased, there is more pull on the carburetor 11 and a lower vacuum in the intake pipe 22 because the throttle is open sufficiently to permit that vacuum to be broken. This decreases the suction on the carburetor 34 and consequently less heat is supplied by the heater 55, and at this time less heat is required, because the motor itself is producing more heat by reason of the larger charges which it is firing. The carburetor 34 and the heater 55, therefore, act automatically to provide the maximum amount of heat when the maximum amount is needed, as when the motor is idling, and a lesser amount of heat when heat is not needed by the motor, as when the motor is working harder and, therefore, itself producing more heat.

Means are provided for operating the spark plug 59 independently of the ignition circuits of the motor. The various circuits are shown somewhat diagrammatically. A single battery 65 or similar device may be employed for supplying electric energy for both the motor and the heater ignition. Also a single rotating shaft 66 may be employed for operating the breaker arms 67 and 68 of the motor and heater igniters respectively. The breaker arms and associated mechanism are of the usual form, being operated by cams 69 on the shaft 66. Contact is made and broken at the points 70, as the cams operate the breakers.

One side of the battery 65 is grounded as at 71 and the other side is connected through a switch 72 to the primary winding 73 of an induction coil, the other side of the primary being connected through conductor 74 with the breaker arm 67, a condenser 75 being connected in parallel in the usual manner. The contact points 70 are grounded as at 76. The secondary winding 77 of the induction coil is connected to a distributor 78 through which the high tension current is carried by

wires 79 to the motor spark plugs 80, one only of which is shown in the drawing.

The battery 65 is also connected through switch 72 and a switch 81 with the primary winding 82 of another induction coil which is operated through a conductor 83 and condenser 84 by the breaker arm 68. The secondary 85 of this induction coil is connected by a wire 86 with the terminal 60 of the spark plug 59, the other terminal 61 being grounded on the metal part of the motor.

Thus the ignition supplied to the combustion chamber 55 in no way interferes with the motor ignition, though it is operated simultaneously with the motor ignition and by the motor.

While I have illustrated and described one specific embodiment of the invention it should be understood that modifications and changes may be made without departing from the spirit or scope of the invention as expressed in the appended claims.

Having thus described my invention, what I claim and desired to secure by Letters Patent is:

1. In a hydrocarbon motor, a mixture heater device comprising a chamber open through an imperforate passage to the engine suction, a carburetor having an elongated passage discharging solely into said chamber through a controlling opening smaller than the opening from the chamber to the engine suction, and means for igniting the mixture in said chamber.

2. In a hydrocarbon motor, a mixture heater device comprising a chamber open to the engine suction, a carburetor separate from and discharging solely into said chamber, means for igniting the mixture in said chamber, and means for choking the air inlet of the carburetor.

3. In a hydrocarbon motor, the combination with the carburetor and intake conduit, of a combustion chamber in heating relation to said conduit, a suction connection from said chamber to the motor, a carburetor connected to supply mixture to the chamber, means for igniting the mixture in the chamber, and means for simultaneously choking the air inlets of both carburetors.

4. The combination with the mixture conduit of a hydrocarbon motor, of a main carburetor for supplying mixture thereto, an independent secondary carburetor connected to said conduit, means for igniting the mixture from said secondary carburetor before it reaches said conduit to thereby heat the main carburetor mixture in said mixing conduit, and means for simultaneously choking the air inlets of both carburetors.

5. The combination with the suction intake conduit of a hydrocarbon motor, of two carburetors connected therewith, means for igniting the mixture from one of said carburetors before it reaches said conduit, and means for simultaneously increasing the richness of the mixture of both carburetors.

6. The combination with the mixture conduit of a hydrocarbon motor, of means for heating the mixture therein comprising a combustion chamber in parallel with the mixture conduit and having an outlet connection with said conduit, means separate from said chamber for forming and supplying mixture to said chamber at a speed faster than the propagation of flame to thereby prevent backfiring, and means for igniting the mixture in said chamber.

7. The combination with the mixture conduit of a hydrocarbon motor, of means for heating the mixture therein comprising a combustion chamber in parallel with the mixture conduit and means separate from said chamber for forming and supplying a combustible mixture to said chamber and withdrawing burnt mixture therefrom at such speed that the mixture will burn steadily and not back fire through the inlet, and means for igniting the mixture in said chamber.

8. The combination with the mixture conduit of a hydrocarbon motor, of means for heating the mixture therein comprising a combustion chamber, a carburetor, separate from said chamber, means connecting the carburetor with the chamber including an inlet opening, means connecting the chamber through an imperforate passage with said mixture conduit including a controlling outlet opening larger than said inlet opening, and means for igniting the mixture in said chamber.

9. The combination with a hydrocarbon motor, a carburetor therefor, and a conduit for passing the mixture from the carburetor to the motor, of a combustion chamber, a second carburetor remote from, and connected to supply mixture to, said chamber, means connecting the chamber directly with said conduit, and means for igniting the mixture in the combustion chamber.

10. The combination with a hydrocarbon motor having an intake conduit, of a mixture heater therefor comprising a combustion chamber in parallel with the conduit, means for supplying a combustible mixture to said chamber including a mixture inlet opening, means forming a passage from said chamber to said intake conduit larger than said inlet opening, and means for igniting the mixture in said chamber.

11. In a hydrocarbon motor, a mixture heater comprising a combustion chamber in parallel with the motor intake conduit and having a mixture inlet opening and a larger outlet opening.

12. In a hydrocarbon motor, a mixture heater in parallel with the motor intake conduit and comprising a combustion cham-

ber having an adjustable inlet opening and a larger outlet opening.

13. In a hydrocarbon motor, a mixture heater device comprising a vertically elongated chamber open to engine suction, means for supplying mixture to said chamber from its upper part downwardly, said means constituting the only inlet for said chamber, and an ignitor in the path of said mixture.

14. In a hydrocarbon motor, a mixture device comprising a vertically elongated chamber open to engine suction, a device at the upper part of said chamber for supplying a mixture downwardly into said chamber, said device constituting the only inlet for said chamber, and a spark plug below said device.

15. In a hydrocarbon motor, a mixture heater device comprising a vertically elongated chamber, means for supplying mixture downwardly into said chamber, said means constituting the only inlet for said chamber, and an ignitor in the path of said mixture.

16. In a hydrocarbon motor, a mixture heater device comprising a chamber open through an imperforate passage to the engine suction, a carburetor separate from and discharging into said chamber through an opening smaller than the controlling opening from the chamber to the engine suction, and means for igniting the mixture in said chamber.

17. The combination with the mixture conduit of a hydrocarbon motor, of means for heating the mixture therein comprising a combustion chamber separate from the mixture conduit, means for supplying mixture to said chamber including an inlet opening, means connecting the chamber with the mixture conduit through an imperforate passage including a controlling outlet opening larger than said inlet opening, and means for igniting the mixture in said chamber.

18. The combination with the mixture conduit of a hydrocarbon motor, of means for heating the mixture therein comprising a combustion chamber separate from the mixture conduit, said chamber having an inlet opening, a carburetor for forming a mixture, a conduit for leading the mixture from said carburetor to said inlet opening, means comprising an outlet opening larger than said inlet opening and connecting said chamber through an imperforate passage with the mixture conduit, and means for igniting the mixture in said chamber.

19. In a hydrocarbon motor, the combination with the motor intake conduit, of a combustion heater comprising a combustion chamber in parallel with said intake conduit and having a discharge opening into said intake conduit, means for supplying mixture to said combustion chamber including an opening into said combustion chamber smaller than the outlet opening therefrom, said combustion chamber being closed to the atmosphere except for said inlet and said outlet openings.

20. A regenerator for an internal combustion engine comprising a casing adapted to envelope a portion of the intake manifold of the engine, an ignition chamber mounted on the casing, a torch nozzle extending from an outlet of the chamber into the casing toward the manifold, an expansion head forming a fuel inlet to the chamber, and means for maintaining ignition of the charge passing through the chamber.

21. The combination of a source of fuel supply and the intake manifold of an engine, with a regenerator consisting of a casing adapted to envelope a portion of the manifold; a torch nozzle in the casing directed toward the manifold, an ignition chamber in the casing for which the nozzle is an outlet, means in the ignition chamber for igniting fuel passing therethrough and an expansion head connected with the source of fuel supply and arranged to deliver fuel into this chamber.

22. The combination of an intake manifold of a gas engine and a source of fuel supply with a casing adapted to envelope a perforated portion of the manifold and provided with a torch nozzle directed toward an imperforate portion of the manifold within the casing, an expansion fuel head adapted to deliver fuel vapor from the source of supply into the casing, a foraminous screen at the outlet of the expansion head into the casing and means for igniting the fuel.

23. The combination with the intake manifold of a gas engine and a source of fuel vapor supply, with a regenerator consisting of a casing concentrically disposed around a perforate portion of the manifold, a torch nozzle entering the casing toward an imperforate portion of the manifold, an ignition chamber mounted on the casing for which the nozzle is an outlet, an expansion head forming the inlet to the casing and having direct connection with the source of fuel supply, ignition means in the chamber between the head and nozzle and a safety screen between the ignition means and the outlet of the expansion head.

24. The combination of the source of fuel supply and a partially perforated portion of an engine manifold with a casing enveloping the perforate section of the manifold, a torch nozzle inserted in the casing and directed toward the imperforate portion of the manifold, an ignition chamber secured on the casing for which the nozzle is a fuel outlet, an expansion head forming the fuel inlet to the chamber and having connection with the source of fuel supply, a safety screen between the expansion head and chamber

and a spark plug inserted in the wall of the chamber and arranged to be connected with the ignition system of the engine.

25. In a hydrocarbon motor, a mixture heating device comprising a chamber open to engine suction, means forming a part of and in flame communication with said chamber and comprising a substantially vertically arranged passage of restricted cross section relative to said chamber, means for supplying mixture to the upper part of said passage downwardly therethrough, and an ignitor in the path of said mixture.

26. In a hydrocarbon motor, a mixture heating device comprising a chamber open to engine suction, means forming a part of and in flame communication with said chamber and comprising an elongated passage arranged substantially vertically and having a cross section that is restricted relative to that of the chamber, means for supplying mixture to the upper part of said passage downwardly therethrough, and an ignitor in the path of said mixture.

27. The combination with the suction intake conduit of a hydrocarbon motor and a carburetor connected therewith and adapted to supply mixture thereto, of means for heating the mixture in said intake conduit comprising a chamber in parallel with the intake conduit, a restricted passage into said chamber, said passage constituting the only inlet for said chamber, a carburetor connected with said restricted passage, and means for igniting the mixture in said restricted passage.

28. The combination with the suction intake conduit of a hydrocarbon motor and a carburetor connected therewith and adapted to supply mixture thereto, of means for heating the mixture in said intake conduit comprising a chamber in parallel with the intake conduit, a restricted passage into said chamber, said passage constituting the only inlet for said chamber, means for supplying said passage with mixture, and means for igniting the mixture in said passage.

In testimony whereof I affix my signature.

LIONEL M. WOOLSON.