July 2, 1940. D. BALACHOWSKY 2,206,685

CATALYZER

Original Filed March 19, 1935 2 Sheets-Sheet 1

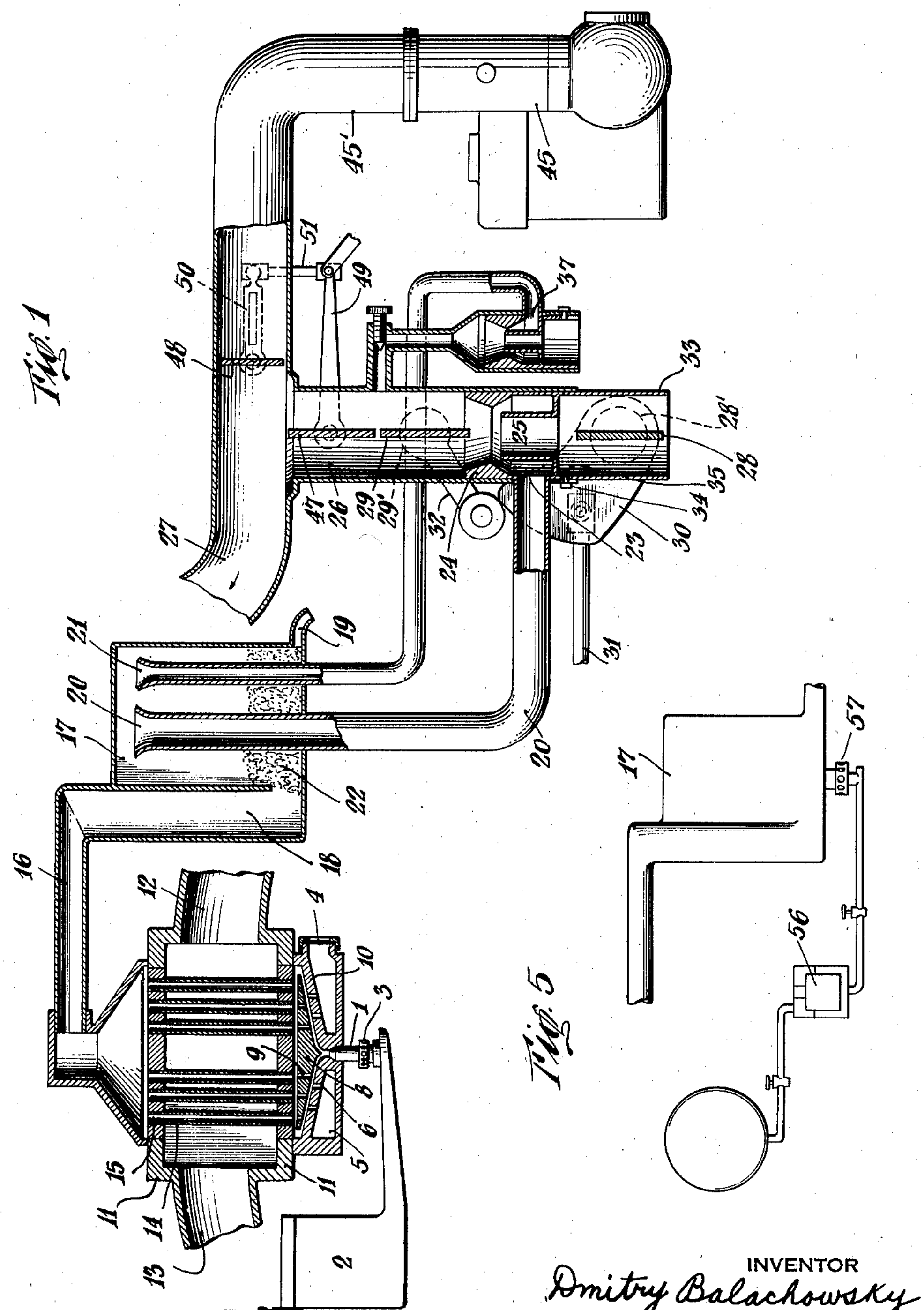

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Fig. 3

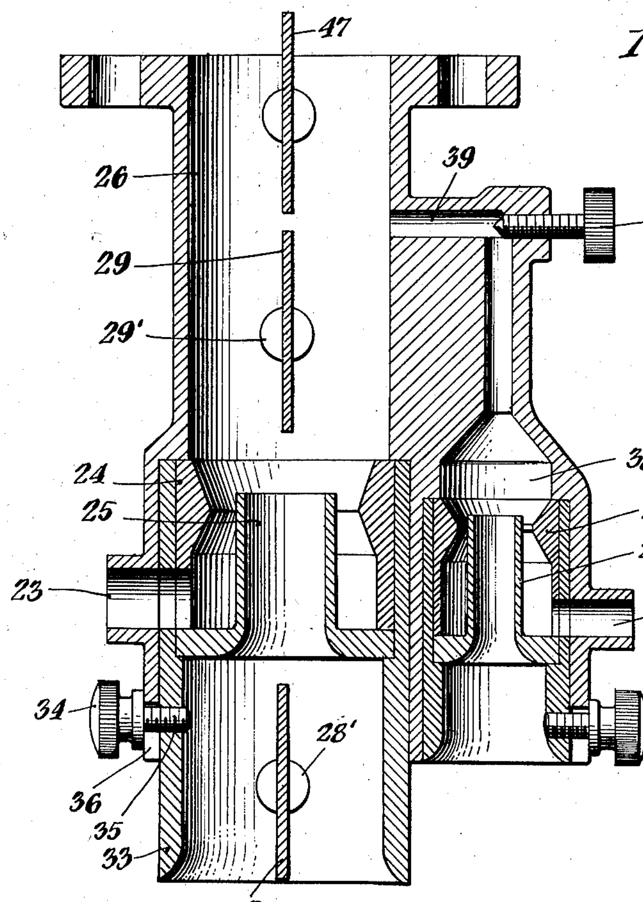


Fig. 2

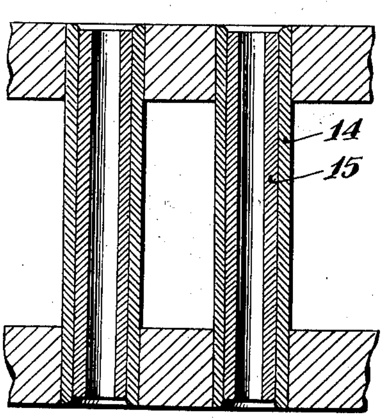
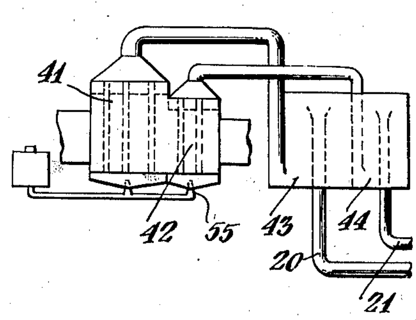


Fig. 4



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Patented July 2, 1940 2,206,685

UNITED STATES PATENT OFFICE

2,206,685

CATALYZER

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Application March 19, 1935, Serial No. 11,892. Renewed February 18, 1939. In France March 20, 1934

14 Claims. (Cl. 123—119)

This invention relates to a process and apparatus for the catalysis of hydrocarbons and the like, and more particularly to such an apparatus for the supply of fuel for explosion motors.

The conventional carburetors, heretofore in use, form heterogeneous mixtures of burning air, unstable vapors and liquid globules of different dimensions. This type of carburetor constitutes a very defective means of supply of fuel for explosion motors. For instance there is a lack of homogeneity of the mixture of air and fuel. The liquid globules of the carburetant collect loosely in the tubes and cylinders, and, in not being transformed into gases, leave residues, such as polymerized carbon, which when oxidized by the oxygen of the air, form resinous bodies that are not easily burned. The number of carburetants capable of being utilized in the conventional explosion motor carburetor is limited. Only volatile carburetants such as benzol, essence of petrol and alcohol are suitable for use with such carburetors. Less volatile carburetants, such as petrols, light and heavy gas-oils are not suitable without special precaution and serious inconvenience. Another disadvantage is the prevailing odor of unburned products and the freeing of carbon monoxide in the exhaust, especially in the range of medium and slow speed. Moreover in the conventional carburetors no means are provided for regulating or directing combustion in the cylinders. Such means, if present at all, are very defective and incomplete.

In order to facilitate and complete the combustion of hydrocarbons in the engine cylinders, I have found it to be advantageous to cause the hydrocarbons to undergo a preliminary treatment, that is to say, a disturbance of the molecule of the carburetant and its decomposition into products more simple than the ordinary molecule. This transformation may be obtained in the motor by suitable means, making use of the phenomena of catalysis which, well regulated and under special conditions, takes place at comparatively low temperature of 280° C., without any deposit of carbon and with very much reduced production of heavy polymerized bodies, resins, tars, etc. In this manner there are introduced into the cylinders only the products that are appropriate for combustion.

One of the primary objects of the invention is to provide a unitary system including an explosion motor and an apparatus akin to an oil-cracking device, whereby, after the motor is started, low grade hydrocarbon fuel may be automatically cracked or atomized, catalized, refined and mixed with air to constitute a proper volatile and easily burned fuel mixture for the motor cylinders.

Another object of the invention is to provide an apparatus for the treatment of low grade hydrocarbon fuel to make the same readily combustible for motor use and to utilize the exhaust gases of the motor for heating the catalizing agent and also for regulating the quantity of introduced air so as to prevent combustion of the fuel vapor during its treatment prior to its entrance into the motor cylinder.

With the foregoing and other objects in view, the invention resides in the combination of parts and in the details of construction hereinafter set forth in the following specification and appended claims, certain embodiments being illustrated in the accompanying drawings, in which:

Figure 1 is a diagrammatical view in elevation of the device shown partly in longitudinal section;

Figure 2 is a fragmentary view in section of the catalyzer tubes;

Figure 3 is a view in section of a suitable carburetor for injecting a fuel into the manifold;

Figure 4 is a view similar to Figure 1 of a modification of the device shown therein;

Figure 5 is a view similar to Figure 1 of a modification of the device shown therein.

Briefly, an atomizer 1 is connected to a constant level tank 2 that causes a mixture of the fuel and a small quantity of air. This mixture then passes into a catalyzer comprising a plurality of small pipes 14 provided interiorly with catalyzing liners 15 of copper, nickel, or other suitable alloy. These catalyzers are heated preferably by the exhaust of the motor passing through the conduit 12 and 13, or any other source of heat, for example electricity. The products of catalysis then pass as a mixture to a point where there is introduced a second quantity of air and after the mixture is refined in the chamber 17 it is then introduced into a motor by the usual intake manifold.

The products of catalysis consist of CH_4CO, light hydrocarbons C_nH_{2n} probably not saturated and oxidized on the surface or not in general more than 7 to 8 in proportion and heavy polymerized products in very small quantities not sufficient to be injurious to the functioning of the motor. Preferably, the primary introduction of air takes place twice, once into the atomizer and once above the atomizer.

The atomizer 1 is supplied with fuel from a tank 2 having a constant level tube. The atomizer at its base has a series of calibrated holes 3 equidistantly spaced around its periphery to permit the entry of a very small quantity of air. The mixture flowing from the atomizer is again subjected to a very small quantity of air flowing through the calibrated holes 6 from the chamber 5. The air absorbed in these two operations is too slight for the mixture formed thereby to explode or burn in the motor. The air absorbed by these two operations is predetermined according to the nature of the fuel and the power of the motor. The purpose of these operations is to cause a preoxidation of the carburetant at the expense of its oxygen.

The mixture of fuel and atomizing air is reatomized by means of a distributor constituted as follows. The air flowing from an air filter 4 into a chamber 5 passes through the calibrated passages 6 in the upper wall 10. Between the catalyzer tubes is arranged a distributor 8, having passages 9 therethrough registering with the open tubes of the catalyzer but in staggered relation with the passages 6. The distance between the distributor 8 and the upper wall 10 of the chamber 5 from the entry of the catalyzing tubes, as well as the dimensions of the holes 6 and 9 may be predetermined or regulated. A large number of catalyzer tubes are attached to the two plates 11 and are heated by the exhaust gases of the motor entering the conduit 12 and leaving through the conduit 13. The tubes and plates form a single block which is fixed tightly in the exhaust pipe by any suitable means. The catalyzer, which is in general the only heated part of the apparatus, should be at a temperature above 280° C., the temperature at which the catalysis reactions begin, usually from 300° C. to 350° C.

Each catalyzer tube consists of a rigid exterior tube 14, of the same metal as the rest of the apparatus, preferably steel or unoxidized bronze, and an inner liner 15 of catalyzing material, the nature and proportions of which correspond to the nature of the fuel and the temperature of the catalyzer.

The purpose of the catalysis is to produce first the splitting of the heavier molecules into lighter ones, certain of which are gases at ordinary temperature, then the obtaining of slightly oxidized products, such as organic anhydrates, ketones, aldehydes, etc., and as complete as possible a transformation of the free carbon into carbon monoxide.

To produce successively and to accelerate these two effects, the nature of the catalyzing body may be different at the entrance and at the outlet of the catalyzing tubes. For example, the tubes at the entrance point may be formed by an allow of copper and nickel and the point of outlet or pure copper or copper combined with chromium.

The catalyzed mixture passes through the tube 16 into the refiner 17. It flows downward at 18, where, by loss of speed and cooling due principally to the delay resulting from the size of chamber 17, it gives up the heavy polymerized products, easily condensed, as well as the globules of liquid fuel and the dust carried along by the gaseous currents. These deposits are discharged from time to time by a tube 19.

At the upper part of the chamber 17 there open two tubes 20, 21 of different diameters through which the constant homogeneous mixtures of gases and light vapors flow. This inflammable mixture is non-condensable at the temperature of the motor, and even at the lower temperature of the parts of the apparatus through which it flows. The capacity of the refining chamber 17 is preferably between 0.3 to 0.5 litre for a motor of 30 to 40 horsepower having cylinders of from 3 to 4 litres. This provides for a considerable gas reserve.

In addition to the condensible bodies and the dust, the gaseous current reaching the motor may contain bodies that should be removed, principally sulphurated bodies or fatty acids or minerals. For this purpose the chamber 17 may be provided with products 22 designed to attract these undesirable bodies, such as first iron filings, sodium or potassium, etc.

The chamber 17 may also be used to put the gases in contact with products capable of improving the quality of the carbureted mixture, such for example as carbonyl, analine, odorous bodies, etc., counteracting the explosive effect, the smoke, and the odor of the exhaust gases.

This chamber 17 may also be provided with catalyzing bodies, such as for example zinc chloride, aluminum chloride, etc., to product a complementary catalysis for improving the carburetant. Also the refiner 17 instead of being heated by the exhaust of a motor may be heated by a suitable source of electricity.

The larger tube 20 of the refiner 17 discharges at 23 adjacent the Venturi tube 24. Centrally disposed in the venturi is a nozzle 25 for the introduction of air of which the quantity represents the major part of the total air in the mixture. This Venturi tube 24 is arranged within the tube 26 which opens into the intake manifold 27. Below and above the venturi are butterfly valves 28 and 29. The shaft 28' of the valve 28 is rigid with a cam 30 actuated by a manually operated rod 31 to actuate the lever 32 rigid with the shaft 29' of the valve 29. The form of the cam 30 is adapted in such a manner as to cause, for each change of speed of the motor, the appropriate rate of carburization. In certain cases the refiner 17 may be arranged as shown in Figure 1, above the venturi 24 of the mixer so as to obtain the advantage of richer gases, generally heavier than air, flowing easily through the venturi.

In practice it may happen that on account of the mixture of the richer gases with the secondary air, the Venturi tube 24 and the air nozzle 25 will become fouled and after a space of time will require cleaning. In order to permit this to be easily carried out the end of the tube 26 has secured thereto a removable part 33, which carries the Venturi tube 24, the nozzle 25 and the butterfly valve 28. The tube 34 is secured to the tube 26 by a nut 34 cooperating with a screw 35 carried by the removable tube 33 and engaged in a vertical slot 36 in the fixed tube 26. To remove the portion 33 it is necessary to disconnect the accelerating rod 31 of the cam 30.

The small tube 21 of the refiner 17 terminates at 37 at a reduced mixer 38 including a small venturi 24' and nozzle 25' identical with the normal mixer but of smaller dimensions. This mixer opens at 39 into the tube 26 above the valve 29. Its output is regulated by a screw valve 40. As a modification, as represented in Figure 4, the catalyzer may be divided into two distinct unequal parts 41, 42, both of which communicate with a refiner separated into two parts 43, 44, in which there are open tubes 20 and 21 respectively for a change from a normal speed to a reduced speed. This arrangement has the advantage of feeding the reduced speed tube by an appropriate atomizer of dimensions less than those of the power atomizer.

To assure the starting of the motor in case it is to be run with heavy oil, the apparatus comprises a gasoline carburetor **45** with a conveyor **45'** opening into the intake manifold **27** of the motor. In the upper part of the tube **26** is a valve **47** which is connected with a valve **48**, links **49**, **50** and **51**, and controlled by any suitable hand control. One of the valves **47** and **48** is closed when the other is open. By this arrangement the fuel supply may be changed from heavy fuel to gasoline, or vice versa.

According to the modification shown in Figure 5, the gasoline carburetor is branched off directly from the refining chamber **17**. In this case it is reduced to a tank having a constant level **56** and to an atomizer **57**, and the valves **47** and **48** are eliminated. The mixture introduced into the refiner **17** when the motor is running on gasoline, the supply of heavy fuel being cut off, is adapted as above stated, for the richer gases coming from the catalyzer.

The means indicated above for the catalysis may be used for the catalysis of gaseous products whether or not mixed with liquid in different industries, notably for the industrial process of cracking heavy products such as petrols or the hydrogenation of charcoal derivatives. It will be understood that there can be many variations in the devices illustrated, and process described, such as for example, the arrangement of parts and elements of the assembly, variations in operating pressures in the catalyzer, and variations in the relative proportions of hydrocarbon and air to produce the non-combustible and combustible mixtures.

Therefore the embodiments of the invention should be considered as illustrative, only, and not as limiting the scope of the following claims.

I claim:

1. In a device for the treatment of heavy and light hydrocarbons and the like, an atomizer provided at its base with air-admitting apertures of predetermined size and number, a chamber located there above and provided with a means for filtering admitted air thereinto, a catalyzer comprising a series of catalyzing tubes and a distributor located between said catalyzer and said air chamber, said distributor comprising a member with apertures aligned with said catalyzing tubes but staggered in relation to apertures formed in said air chamber to provide a tortuous passage from said air chamber into said tubes.

2. In a device for the treatment of heavy and light hydrocarbons and the like, an atomizer provided at its base with air-admitting apertures of predetermined size and number, a chamber located there above and provided with a means for filtering admitted air thereinto, a catalyzer comprising a series of catalyzing tubes and a distributor located between said catalyzer and said air chamber, said distributor comprising a member with aperture aligned with said catalyzing tubes but staggered in relation to apertures formed in said air chamber to provide a tortuous passage from said air chamber into said tubes, a refiner for the mixture flowing from said catalyzer.

3. In combination with an explosion motor means for treating heavy and light hydrocarbons and the like for use in said motor, said means comprising an atomizer and a catalyzer, means for subjecting said hydrocarbons to mixture with a predetermined quantity of air prior to the catalysis of the mixture in said catalyzer, a refiner for said catalyzed mixture and first carbureting means for said motor for the aeration of said mixture for rendering the hitherto non-combustible mixture combustible for use in said motor, means for conveying the exhaust gases of said motor to said catalyzer for heating the catalyzing tubes for the purpose of catalysis of said hydrocarbons, each of said tubes being formed of a metal corresponding to the metal used in the remainder of said device and an inside liner of metal alloy suitable for bringing about a catalytic action, said refiner being provided with two conveyors, one adapted for normal speed and the other for lesser speed, said motor being provided with a second carbureting means for supplying said motor with a combustible mixture of high grade fuel and air for heating said motor in readiness for drawing in said catalyzed low grade fuel, said first carbureting means being provided with Venturi tubes and nozzles leading from the conveyors from said refiner, valve means located in said first carbureting means for injecting air into said catalyzed mixture and valve means actuated in unison for conveying said aerated mixture into the intake manifold of said motor.

4. In combination with an explosion motor means for treating heavy and light hydrocarbons and the like for use in said motor, said means comprising an atomizer and a catalyzer, means for subjecting said hydrocarbons to mixture with a predetermined quantity of air prior to the catalysis of the mixture in said catalyzer, a refiner for said catalyzed mixture and first carbureting means for said motor for the aeration of said mixture for rendering the hitherto non-combustible mixture combustible for use in said motor, means for conveying the exhaust gases of said motor to said catalyzer for heating and catalyzing tubes for the purpose of catalysis of said hydrocarbons, each of said tubes being formed of a metal corresponding to the metal used in the remainder of said device and an inside liner of metal alloy suitable for bringing about a catalytic action, said refiner being provided with two conveyors, one adapted for normal speed and the other for lesser speed, said motor being provided with a second carbureting means for supplying said motor with a combustible mixture of high grade fuel and air for heating said motor in readiness for drawing in said catalyzed low grade fuel, said first carbureting means being provided with Venturi tubes and nozzles leading from the conveyors from said refiner, valve means located in said first carbureting means for injecting air into said catalyzed mixture and valve means actuated in unison for conveying said aerated mixture into the intake manifold of said motor, valve means for admitting said carbureted high grade fuel into said motor, and means connecting said last named valve means with said first named valve means for automatically causing one of the same to be open while the other is closed and vice versa.

5. A catalyzing device for converting relatively non-combustible hydrocarbons into readily combustible motor fuel, comprising a plurality of thermo-conductive tubes, means for heating said tubes, thermo conductive catalytic linings for said tubes, an atomizer below the tubes for mixing the hydrocarbon with air, means for supplying additional air, and a distributor between

the tubes and the atomizer for thoroughly mixing the atomized hydrocarbon with air.

6. The device set forth in claim 5, in which the tubes are composed of metal not readily attacked by exhaust gases and the linings include catalytic copper.

7. The device set forth in claim 5 in which the linings of the tubes are made of a plurality of different catalytic materials.

8. The method of supplying an internal combustion motor with a combustible fuel, which comprises mixing a relatively non-combustible hydrocarbon with a small amount of air, atomizing the same, adding to the mixture a second quantity of air insufficient to permit combustion, catalyzing the mixture to convert the hydrocarbon into a combustible fuel containing some non-volatile impurities, refining the catalyzed mixture by removing the non-volatile impurities, further catalyzing the hydrocarbon while keeping the fuel in a state of non-combustibility, mixing it with a sufficient amount of air to permit combustion and feeding the last-named mixture to a motor.

9. The method of supplying an internal combustion motor with a combustible fuel, which comprises mixing a relatively non-combustible hydrocarbon with a small amount of air, atomizing the same, adding to the mixture a second quantity of air insufficient to permit combustion, catalyzing the mixture to convert the hydrocarbon into a combustible fuel containing some non-volatile impurities, refining the hydrocarbon by removing the non-volatile impurities, adding to the catalyzed hydrocarbon an anti-detonating substance while keeping the fuel in a state of non-combustibility and mixing it with a sufficient amount of air to permit combustion and feeding the last-named mixture to a motor.

10. The method of supplying an internal combustion motor with a combustible fuel, which comprises mixing a relatively non-combustible hydrocarbon with a small amount of air, atomizing the same, adding to the mixture a second quantity of air insufficient to permit combustion, catalyzing the mixture to convert the hydrocarbon into a combustible fuel containing some condensible impurities, refining the hydrocarbon by removing the condensible impurities, further catalyzing the hydrocarbon adding to the catalyzed hydrocarbon an anti-detonating substance while keeping the fuel in a state of non-combustibility and mixing it with a sufficient amount of air to permit combustion and feeding the last-named mixture to a motor.

11. The method of supplying an internal combustion motor with a combustible fuel which comprises mixing a hydrocarbon with an amount of air insufficient to render the mixture inflammable but capable of partially oxidizing said hydrocarbon, turbulently adding to and mixing with the mixture a second quantity of air insufficient to render the mixture inflammable, catalyzing the mixture to convert the hydrocarbon into a readily combustible fuel containing undesirable condensible and non-condensible products, refining the hydrocarbon by removing the non-condensible undesirable products by adsorption and removing the condensible undesirable products by cooling and mixing the refined fuel with a sufficient amount of air to permit combustion.

12. The method of supplying an internal combustion motor with a combustible fuel which comprises mixing a relatively non-volatile hydrocarbon with an amount of air insufficient to render the mixture inflammable but capable of partially oxidizing said hydrocarbon, adding to the mixture a second quantity of air insufficient to render the mixture inflammable, catalyzing the mixture with a plurality of different catalysts to convert the hydrocarbon into a readily combustible fuel containing condensible impurities, refining the catalyzed mixture by removing the impurities while keeping the fuel in a state of non-inflammability, mixing the fuel with a sufficient amount of air to permit combustion and feeding the last named mixture to a motor.

13. In a device for converting heavy and light hydrocarbons into fuel for internal combustion engines, the combination of a chamber, a first series of catalyzing tubes in said chamber, a second series of catalyzing tubes in said chamber, means for heating said catalyzing tubes, a separate atomizer for said hydrocarbons associated with each of said first and second series of catalyzing tubes, a gas chamber having a plurality of apertures therein for delivering gas to said catalyzing tubes, a distributor interposed between each atomizer and its associated catalyzing tubes and said chamber, said distributor comprising a member with apertures aligned with said catalyzing tubes but staggered with respect to the apertures in said chamber to provide a tortuous passage for mixing said hydrocarbons with said gas.

14. In a device for converting heavy and light hydrocarbons into fuel for internal combustion engines, the combination of at least two atomizers for said hydrocarbons, common means for supplying said hydrocarbons to said atomizers, a chamber having a plurality of apertures therein for supplying gas located adjacent to each atomizer, at least two catalyzers, each comprising a plurality of catalyzing tubes, a distributor located between each chamber and each catalyzer, said distributor comprising a member having apertures therein staggered with relation to the apertures in said chamber to form a tortuous passageway for mixing said hydrocarbons with said gas, and means for heating said catalyzing tubes.

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