

A. T. PORTER & H. E. RIDER.
METHOD OF PRODUCING A FUEL VAPOR.
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Fig. 1.

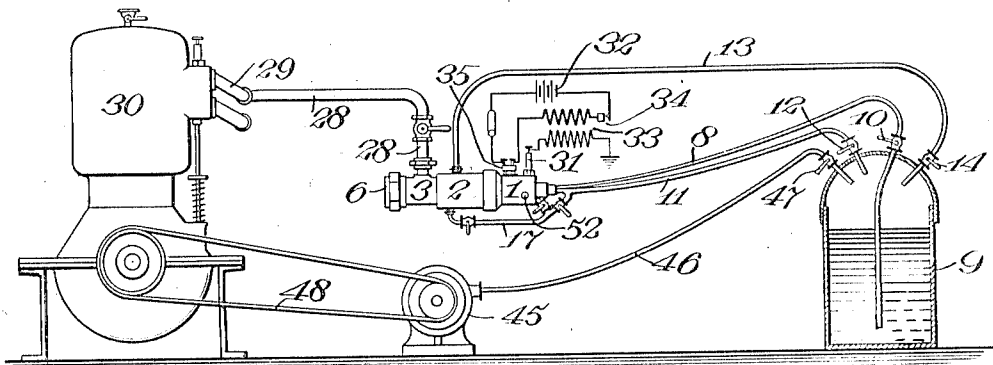
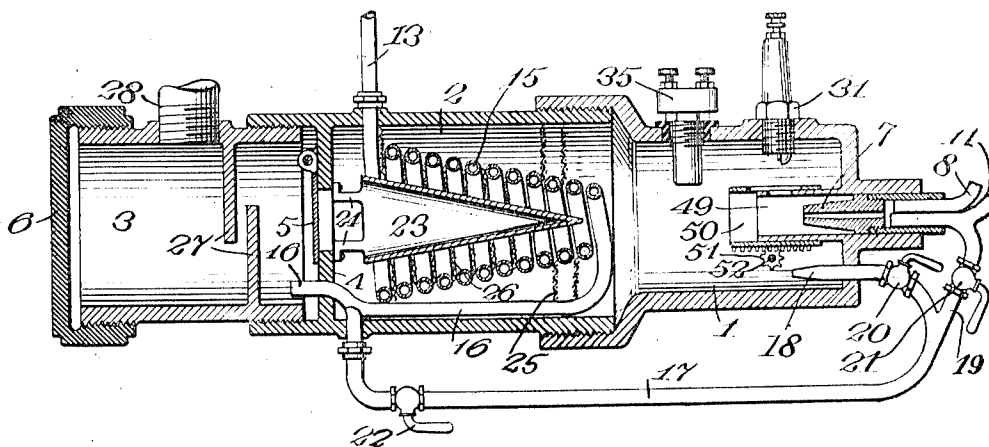


Fig. 2.



WITNESSES

Wm. Ashley Keeley
Victor D. Bond,

INVENTORS

Alexander T. Porter
Herbert E. Rider
BY
Henry D. Williams
ATTORNEY

UNITED STATES PATENT OFFICE.

ALEXANDER T. PORTER AND HERBERT E. RIDER, OF NEW YORK, N. Y., ASSIGNORS TO
OIL UTILITIES COMPANY, A CORPORATION OF NEW YORK.

METHOD OF PRODUCING A FUEL VAPOR.

1,064,086.

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To all whom it may concern:

Be it known that we, ALEXANDER T. PORTER and HERBERT E. RIDER, citizens of the United States, residing, respectively, in the borough of Manhattan, city of New York, county of New York, and State of New York, and in the borough of Brooklyn, city of New York, in the county of Kings and State of New York, have invented certain new and useful Improvements in Methods of Producing a Fuel Vapor, of which the following is a specification, reference being had therein to the accompanying drawings, forming part thereof.

Our invention relates to the production of a fuel vapor of a persistent nature suitable for use in internal combustion engines and also adapted to other uses, such as for heating purposes, and our present invention relates to the process or method involved in the production of such a fuel vapor from a fuel liquid, particularly from comparatively heavy oils, such as kerosene and crude petroleum.

An object of our invention is to inexpensively produce a fuel vapor of high efficiency and of higher efficiency than has heretofore been attained, particularly with reference to internal combustion engines of all types.

Other more particular objects and advantages of our invention will hereinafter appear.

We have discovered that if a fuel liquid, such as a heavier hydrocarbon oil, for example, kerosene, be subjected, when in a finely divided condition, to the direct action of a naked flame for a properly limited short length of time, such fuel liquid will be converted into a combustible vaporous product particularly well adapted for use as fuel in an internal combustion engine.

In carrying out our present invention, the finely divided liquid material is passed into a flame of sufficient extent and intensity to effect only a vaporization of the liquid material while it is present in the flame, so that the material emerges from the flame as vapor, the vapor being generated in the flame and passing out of the flame at high velocity, the material being given freedom for expansion. It has been found that a fuel vapor thus produced from a heavy hydrocarbon oil is particularly well adapted for rapid or instantaneous combustion and

will not form the objectionable carbon deposits which usually result from the heavier hydrocarbons.

As a feature of our method the necessary flame is produced by reason of the combustion or oxidation of a comparatively small portion of the liquid material, the flame thus produced being utilized to effect only the vaporization of the principal part of the liquid. The flame is regulatable both as to extent or dimensions and as to its intensity. The flame may be held back or restrained within proper bounds by means of passing the burning vapors through a screen which extinguishes the flame at the desired predetermined point in the travel of the vaporous product and at the desired stage of action to secure the desired result in the production of the fuel vapor. The intensity of the flame, as well as the velocity and rapidity of passage of the material therethrough, may be regulated by means of concentrating the flame within a restricted or circumscribed area. The original kerosene or other fuel liquid may be sprayed into the flame in the presence of a regulated quantity of air, for maintaining the flame, which air may or may not be preheated, according to the nature and requirements of the material being treated, and also according to the nature of the final product desired. Under some conditions of operation, after the flame has been extinguished, the resultant product is immediately mixed with a regulated quantity of superheated air, which may or may not be sufficient in quantity to form a combustible mixture suitable for supplying explosive charges to the engine.

Our invention will be further explained with reference to the accompanying drawings illustrating an apparatus for carrying out our invention into effect, and thereafter we shall point out our invention in claims.

Figure 1 is an elevation, with parts in section, showing a fuel vapor generator associated with an internal combustion engine for supplying fuel vapor thereto. Fig. 2 is a central vertical longitudinal section on an enlarged scale of the gas generator proper.

In the apparatus illustrated in the drawings, the fuel vapor generator *per se* is shown as conveniently made up of a number of cylindrical sections or parts screwed together to form a flame-containing com-

bustion and vaporizing chamber 1, a flame-extinguishing chamber 2, which receives the extinguished products and a mixing chamber 3. The flame-extinguishing chamber 2 is shown as substantially continuous with the flame chamber 1, but the mixing chamber 3 is separated from the flame-extinguishing chamber 2 by means of a partition wall 4 formed in the adjacent end of the flame-extinguishing chamber 2, this partition wall having therein a central port controlled by a non-return flap valve or check valve 5. The outer or exposed ends of the flame chamber 1 and of the mixing chamber 3 are closed, the former by means of a head formed integral with the rest of the chamber and the latter by a screw-threaded end cap 6. In the apparatus shown in the drawings, liquid hydrocarbon, or other suitable fuel liquid, is sprayed into the flame chamber 1 through an ordinary atomizing nozzle 7 supplied with fuel oil under pressure through an oil duct 8 leading from near the bottom of a hermetically closed fuel tank or reservoir 9 and provided between such reservoir and the vapor generator with a hand valve or throttle valve 10. Air under pressure for spraying and atomizing the oil is supplied from the upper portion or top of the reservoir 9 to the nozzle 7 through an air tube 11 controlled by a hand valve 12. For supplying preheated air, when desired for the several steps of the vapor producing operation, a second air tube 13 controlled by a hand valve 14 extends from the upper portion of the reservoir 9 to a conical air preheating coil 15 located within the flame-extinguishing chamber 2 with the smaller end of the coil directed toward the flame chamber 1, and having the last and largest coil projecting through the wall of the flame-extinguishing chamber 2 and connected to the air tube 13. A tube 16 conveys the heated air from the smaller end of the coil 15 and opens into the mixing chamber 3 for supplying properly preheated air thereto. A branch tube 17 connects with the tube 16 and extends to the outside of the chamber 2 and thence extends parallel with the generator to a point in proximity to the outer end of the flame chamber 1 where such branch tube 17 divides into two other branches 18 and 19, the former branch 18 entering the outer end of the flame chamber 1 below the nozzle 7 and providing an auxiliary air supply of preheated air to the flame chamber, and the latter branch 19 connecting to the nozzle-supplying air supply tube 11 for supplying preheated atomizing air to the nozzle 7 when conditions require it. The branch tubes 18 and 19 are respectively controlled by hand valves 20 and 21, and the original branch tube 17 is also shown as provided with a similar hand valve 22.

The intensity of the vaporizing flame

maintained in the fuel chamber 1 and also extending into the forward portion of the flame-extinguishing chamber 2 may be regulated by regulating the air supply to the flame chamber, by means of the instrumentalities hereinbefore described. Also the intensity and extent of the flame is determined and may be regulated by means of a flame-concentrating tube, shown as comprising a fixed tube 49 projecting inward from the end of the flame chamber 1 and surrounding the atomizing nozzle 7, and a movable sleeve 50 telescoping over the tube 49. The sleeve 50 may be adjusted on the tube 49 by means of a rack on such sleeve engaged by a pinion 51 mounted on an operating shaft 52 extending to the outside of the flame chamber 1 (Fig. 1) for manual actuation. The tube 49 and its telescopic sleeve 50 are provided with registering slots, as shown in Fig. 2, in order that initial flame-producing ignition may be more readily inaugurated. The adjustable flame-concentrating tube or combustion tube circumscribes or restricts the flame, causing the rapid expansion to supplement the action of the nozzle 7 and to impart a high velocity to the material being treated, so that it is violently projected forward through and out of the flame, leaving the flame after vaporization only has been effected and before any substantial amount of the material has been consumed or in any manner chemically changed. The flame is permitted to effect only a vaporization of the oil and then the flame is extinguished.

A hollow metal cone 23 is shown as supported at its base on the partition wall 4 by means of supporting legs 24 and is located centrally of the flame-extinguishing chamber 2 within the air heating coil 15 with the pointed end of the cone 23 well toward the flame chamber 1, this cone serving to spread the flame and to increase the intensity of the heat along the center line of the chambers, particularly in proximity to the point of the cone and augments the vaporizing action, particularly at the central portion of the flame where the atomized fuel liquid is denser or in a less finely divided condition.

Flame-extinguishing screens are arranged transversely of the flame-extinguishing chamber 2 and are shown as comprising two sets, an outer or first set of screens 25, shown as two in number, of annular form, disposed between the smaller end portion of the coil 15 and the cylindrical wall of the flame-extinguishing chamber 2 at a comparatively short distance inward from the flame chamber 1, and an inner or central second set of screens 26 disposed within the larger portion of the coil 15, and surrounding the cone 23, the last or innermost of these screens 26 be-

ing shown as extending entirely across the flame-extinguishing chamber 2. The screens 25 and 26 are removable and more or fewer of each may be employed according as may be required to produce the desired result. The location of these screens 25 and 26 determines the maximum extent or dimensions of the vaporizing flame in that direction, permitting it to extend farther or less so into the flame-extinguishing chamber 2 before it is extinguished by encountering the screens. The turns of the conical coil 15 are spaced, as shown in the drawings, to permit the free passage of the material between the turns of the coil, and the screens 25 and 26 are shown as inserted between the spaced turns of the coil 15. Under some conditions of operation, such, for example, as limiting the supply of air, the flame may be extinguished before the advancing material reaches the screens, but the screens provide a final limitation.

After the flame has been extinguished, the vaporous product proceeds onward through the flap valve or check valve 5 into the mixing chamber 3, where it is mixed with the proper quantity of super-heated air supplied through the air-conveying tube 16, as hereinbefore described, a thorough intermixing being effected by means of overlapping baffle plates 27 projecting inward from the cylindrical wall of the mixing chamber 3. The introduction of highly heated air at this stage, immediately after the discontinuance of combustion, has been found to greatly improve the vaporous product as an engine fuel. The heated air introduced at this point need not necessarily be enough to form an explosive mixture. However, the oil supply and the various air supplies may be so regulated as finally to secure, if desired, the correct explosive mixture in the mixing chamber 3. A supply pipe 28 conveys the fuel vapor or mixture from the mixing chamber 3 and is shown as connected to the intake manifold 29 of an internal combustion engine 30 of usual or of any suitable construction. In the construction illustrated, the partial vacuum produced by the engine 30 at its intake 29 assists in maintaining the draft through the generator, such draft being initiated and in part maintained by the several jets of air. The projection at high velocity of the burning hydrocarbon through and from the flame-concentrating tube 49—50 across the area of flame also materially increases the draft through the device. The check valve 5 obviates any possibility of back draft or of back firing of the engine into the chambers 1 and 2.

In the construction shown initial ignition of the atomized oil in the flame chamber 1 is effected by means of an ordinary spark plug 31, receiving ignition current from a

battery 32 through a usual spark coil or induction coil 33, the primary circuit including a usual interrupter 34. The primary circuit also includes a thermostatic switch or circuit breaker 35, which may be of usual construction. The function of the thermostat 35 is to automatically discontinue the ignition sparking when the flame has been established in the flame chamber 1. Also should the flame in the flame chamber 1 for any reason become extinguished, the thermostat will automatically close the spark circuit to again effect ignition and re-establish the vaporizing flame.

The requisite pressure for feeding oil from the reservoir 9 through the oil duct 8 and for supplying air under pressure to the air supply tubes 11 and 13 is shown as produced by a positively acting air pump or air compressor 45 of ordinary or suitable construction connected to deliver compressed air to the upper portion of the reservoir 9 through a pressure-maintaining tube 46 controlled by a hand valve 47. The compressor 45 may be driven by any desired means and is shown as driven by a belt 48 from the engine 30.

The fuel vapor generated by our method is of a persistent nature, being composed almost entirely of vapor, but, of course, contains a very small percentage of products of combustion incident to the production of the flame, as well as nitrogen diluent from the air used. It will be noted that the fuel vapor generated by our method is not of a nature adapting it to be stored indefinitely nor piped long distances, and is preferably generated only as required for use, as indicated in the drawings and as hereinbefore described, but is sufficiently stable that none of its constituents will condense before it can be thus utilized in an internal combustion engine or otherwise, and may be conveyed in pipes comparatively short distances, such as across a street, for example. The fuel vapor of our production is comparatively cool, and the objectionable high temperatures prevailing in ordinary oil engines, in which the oil is sprayed directly into the combustion chamber of the cylinder or into a vaporizing chamber forming a part of such combustion chamber, are obviated. An internal combustion engine for utilizing the fuel vapor produced by our method may be of the usual type of construction commonly employed for gasoline, and that is the type of engine illustrated in the drawings. The fuel vapor produced by our method has been found to be extremely well adapted for and of very high efficiency as an internal combustion engine fuel.

It is obvious that various modifications may be made in the method above particularly described and also in the construction for carrying out such method shown in the

drawings and above particularly described, within the principle and scope of our invention.

We claim:

1. The method of producing a fuel vapor adapted for use in internal combustion engines, which consists in (1) providing a substantially continuous supply of finely subdivided fuel liquid, (2) producing a flame and subjecting such liquid in its finely divided condition to the direct action of said flame for a length of time sufficient to effect only a vaporization of the liquid, (3) extinguishing the flame at a point in the progress of the vaporized material before any substantial amount of the material has been consumed, and (4) collecting the resulting product for use.

2. The method of producing a fuel vapor adapted for use in internal combustion engines, which consists in (1) providing a substantially continuous supply of finely subdivided fuel liquid, (2) producing a flame fed by a comparatively small portion of such finely divided liquid to vaporize only the remaining larger quantity of such liquid by means of and in the presence of such flame, (3) extinguishing the flame before any substantial amount of the material has been consumed, and (4) collecting the resulting product for use.

3. The method of producing a fuel vapor adapted for use in internal combustion engines, which consists in (1) providing a substantially continuous supply of finely subdivided fuel liquid, (2) producing a flame and subjecting such liquid in its finely divided condition to the direct action of said flame for a length of time sufficient to effect only a vaporization of the liquid, (3) permitting expansion of the material, (4) extinguishing the flame at a point in the progress of the vaporized material before any substantial amount of the material has been consumed, and (5) collecting the resulting product for use.

4. The method of producing a fuel vapor adapted for use in internal combustion engines, which consists in (1) providing a substantially continuous supply of finely subdivided fuel liquid, (2) producing a flame fed by a comparatively small portion of such finely divided liquid to vaporize only the remaining larger quantity of such liquid by means of and in the presence of such flame, (3) permitting expansion of the material, (4) extinguishing the flame before any substantial amount of the material has been consumed, and (5) collecting the resulting product for use.

5. The method of producing a fuel vapor adapted for use in internal combustion engines, which consists in (1) providing a substantially continuous supply of finely subdivided fuel liquid, (2) producing a flame

and subjecting such liquid in its finely divided condition to the direct action of said flame to effect only a vaporization of the liquid while the material is present in the flame and traveling therein at high velocity, (3) extinguishing the flame at a point in the progress of the vaporized material before any substantial amount of the material has been consumed, and (4) collecting the resulting product for use.

6. The method of producing a fuel vapor adapted for use in internal combustion engines, which consists in (1) providing a substantially continuous supply of finely subdivided fuel liquid, (2) producing a flame and subjecting such liquid in its finely divided condition to the direct action of said flame to effect only a vaporization of the liquid while the material is present in the flame and traveling therein at high velocity, (3) permitting expansion of the material, (4) extinguishing the flame at a point in the progress of the vaporized material before any substantial amount of the material has been consumed, and (5) collecting the resulting product for use.

7. The method of producing a fuel vapor adapted for use in internal combustion engines, which consists in (1) providing a substantially continuous supply of finely subdivided fuel liquid, (2) producing a flame fed by a comparatively small portion of such finely divided liquid to vaporize only the remaining larger quantity of such liquid by means of and in the presence of such flame, (3) concentrating and circumscribing the area of flame in lateral directions to impart a high velocity to the material during its presence in the flame, (4) extinguishing the flame before any substantial amount of the material has been consumed, and (5) collecting the resulting product for use.

8. The method of producing a fuel vapor adapted for use in internal combustion engines, which consists in (1) providing a substantially continuous supply of finely subdivided fuel liquid, (2) producing a flame and subjecting such liquid in its finely divided condition to the direct action of said flame for a length of time sufficient to effect only a vaporization of the liquid, (3) extinguishing the flame at a point in the progress of the vaporized material before any substantial amount of the material has been consumed, (4) bringing the extinguished product at this stage into contact with a supply of superheated air which is mixed therewith, and (5) collecting the resulting product for use.

9. The method of producing a fuel vapor adapted for use in internal combustion engines, which consists in (1) providing a substantially continuous supply of finely subdivided fuel liquid, (2) producing a flame fed by a comparatively small portion of such

finely divided liquid to vaporize only the
remaining larger quantity of such liquid by
means of and in the presence of such flame,
(3) concentrating and circumscribing the
5 area of flame in lateral directions to impart
a high velocity to the material during its
presence in the flame, (4) introducing suffi-
cient air into the area of flame to maintain
the flame, (5) permitting expansion of the
10 material, (6) extinguishing the flame before

any substantial amount of the material has
been consumed, and (7) collecting the re-
sulting product for use.

In testimony whereof we have affixed our
signatures in presence of two witnesses.

ALEXANDER T. PORTER.

HERBERT E. RIDER.

Witnesses:

WM. ASHLEY KELLY,

VICTOR D. BORST.