

Sept. 12, 1933.

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1,926,449

DUPLEX GASIFIER, FEEDER, AND REGULATOR FOR INTERNAL COMBUSTION ENGINES

Filed Aug. 16, 1929

5 Sheets-Sheet 1

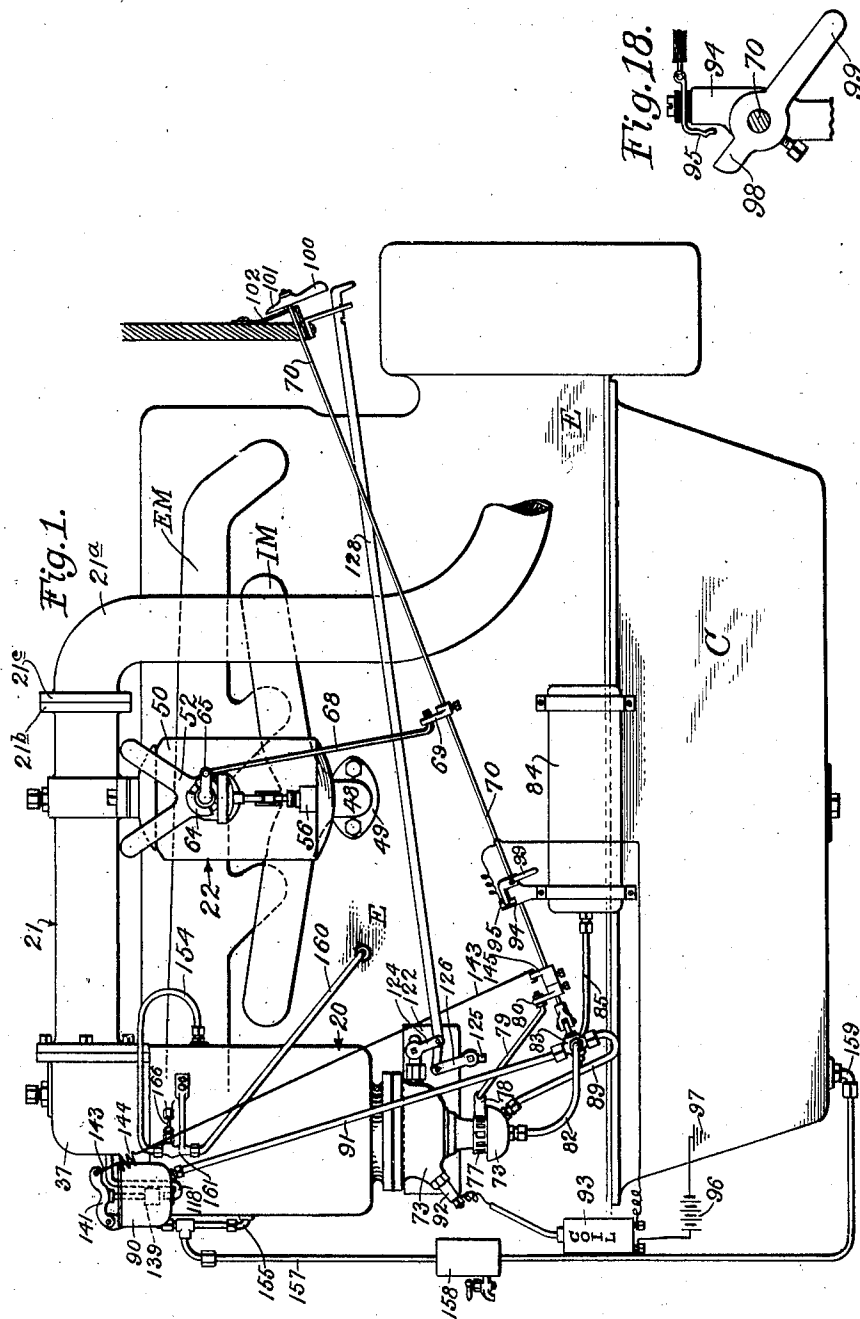
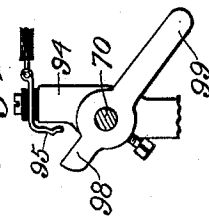


Fig. 18.



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5 Sheets-Sheet 2

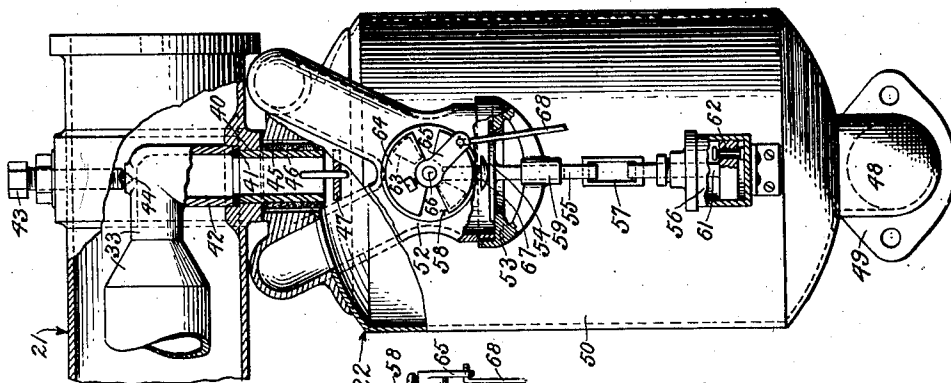


Fig. 3.

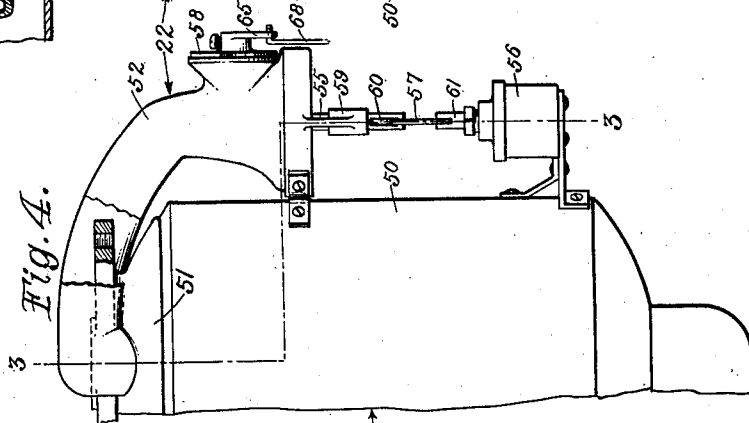


Fig. 4.

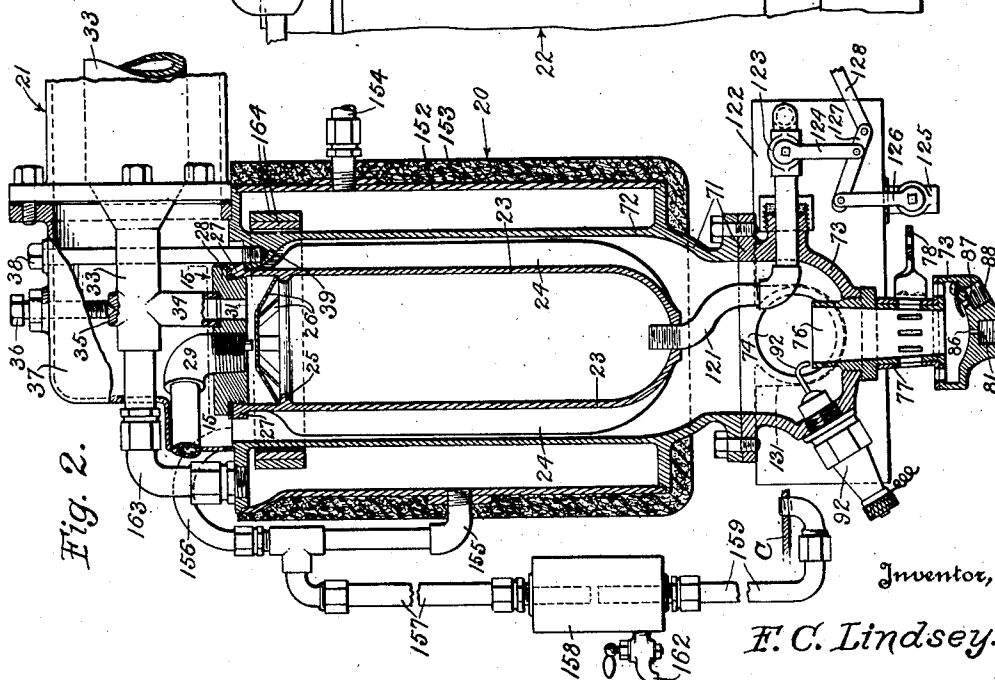


Fig. 2.

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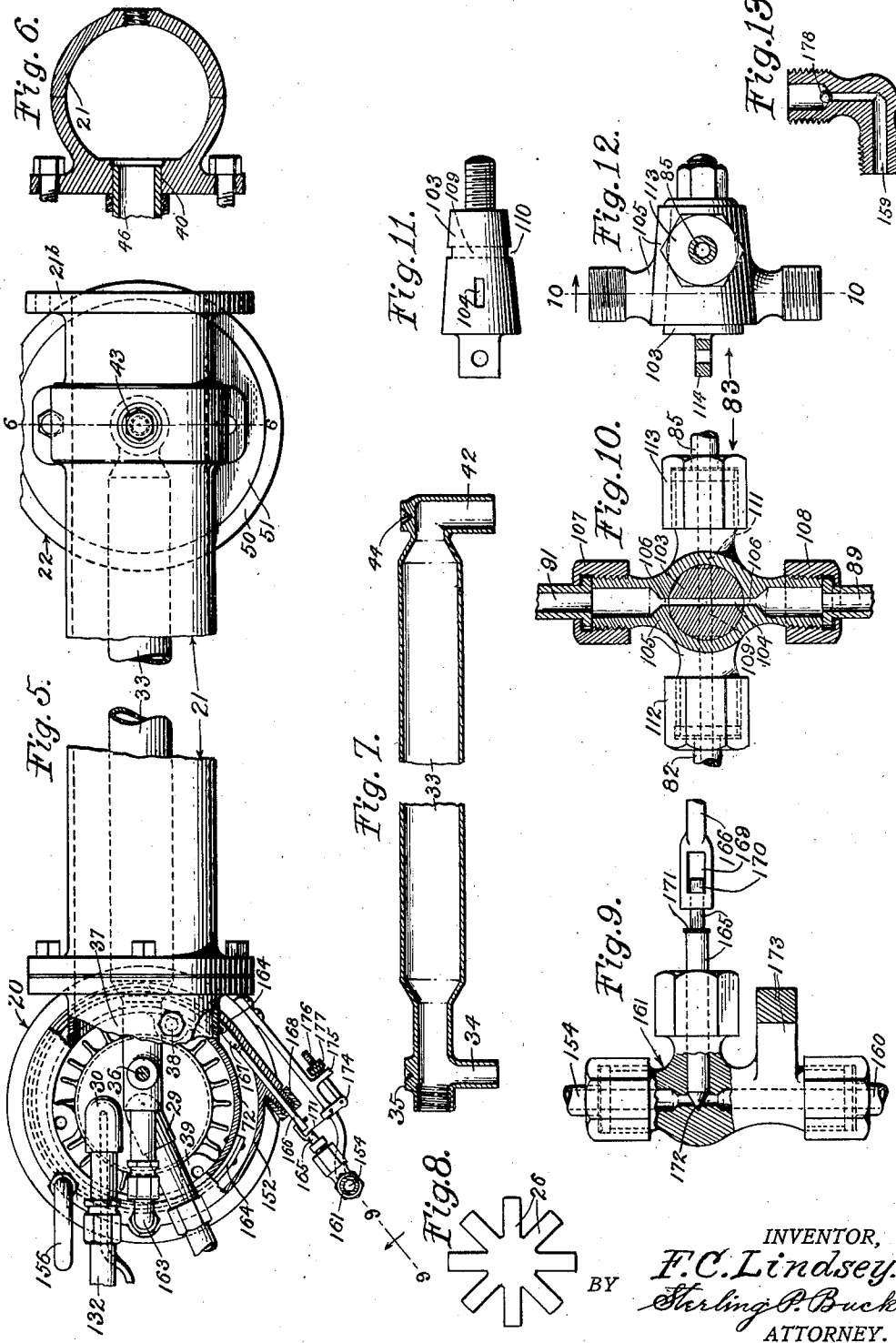
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5 Sheets-Sheet 3



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5 Sheets-Sheet 4

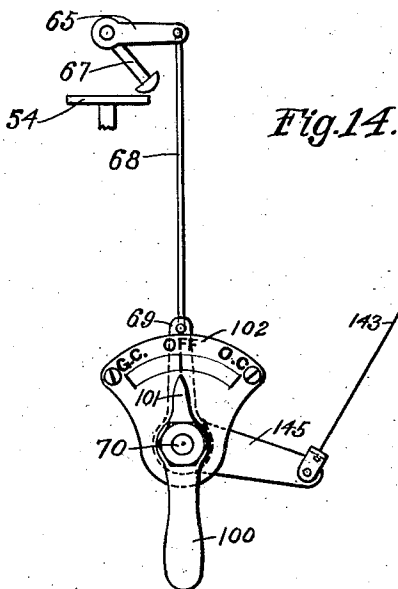


Fig. 14.

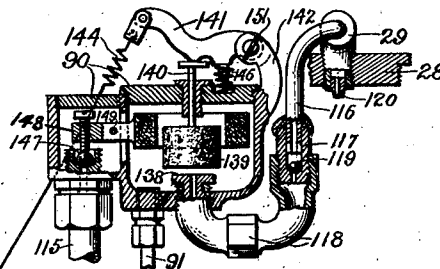


Fig. 15.

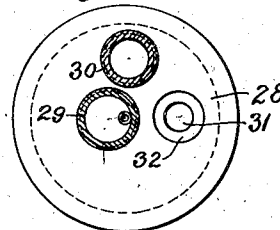


Fig. 16.

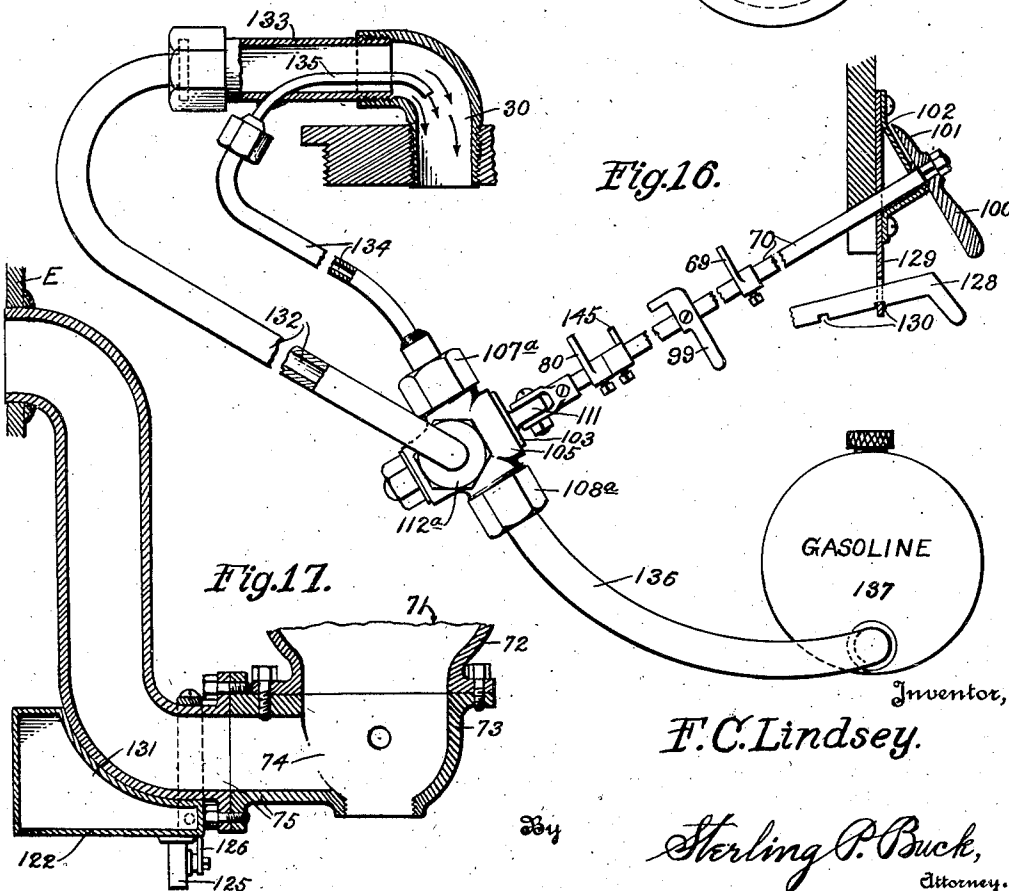


Fig. 17.

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5 Sheets-Sheet 5

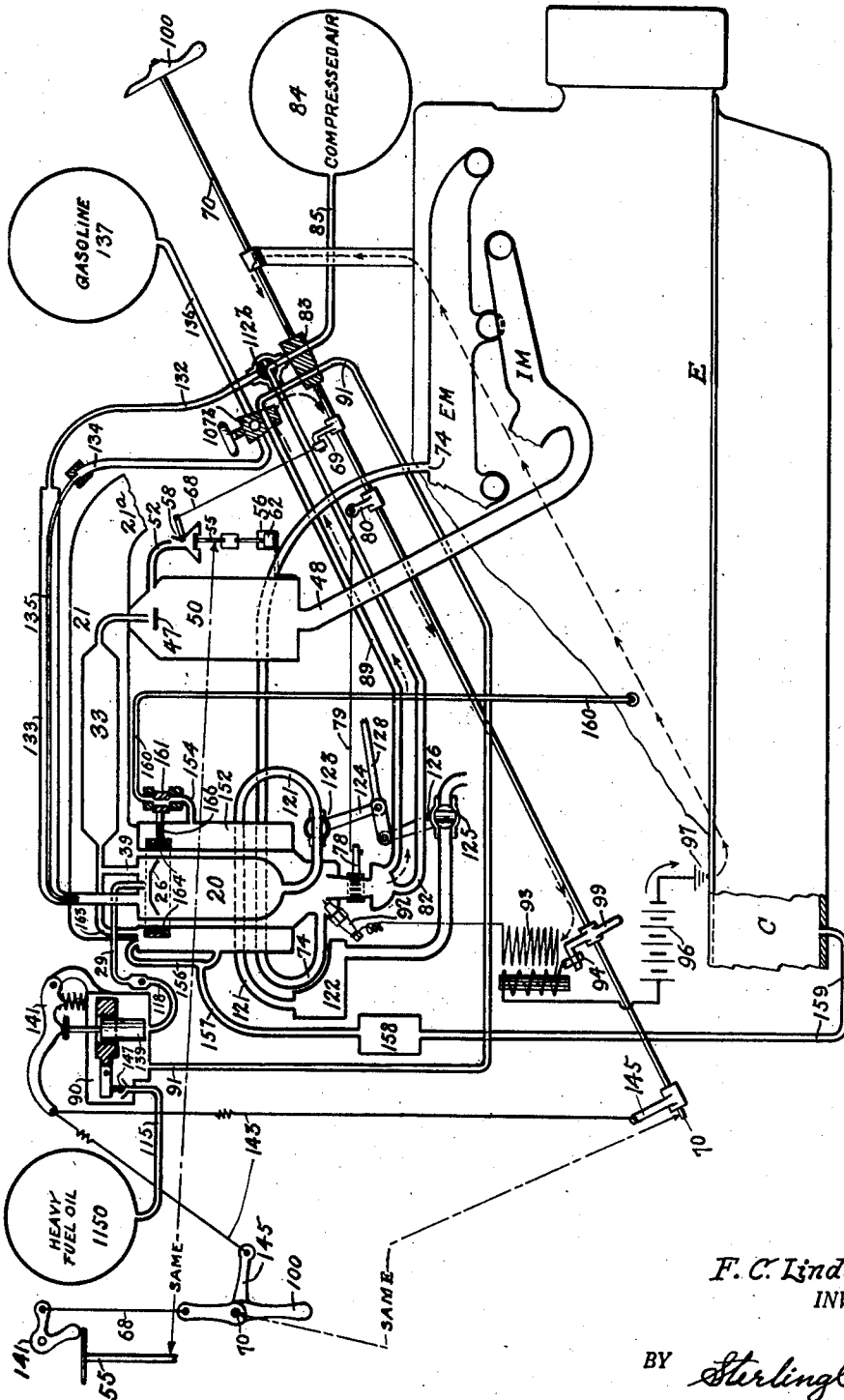


Fig. 19.

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UNITED STATES PATENT OFFICE

1,926,449

DUPLEX GASIFIER, FEEDER, AND REGULATOR FOR INTERNAL COMBUSTION ENGINES

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Application August 16, 1929. Serial No. 386,435

13 Claims. (Cl. 123—133)

This invention relates to internal combustion engines, and especially, to a duplex gasifier, feeder and regulator, for internal combustion engines.

At the outset, confusion may be avoided by explaining that the word "duplex" has reference to two ways of applying heat for gasifying heavy fuel-oil, rather than obtaining gases from two kinds of fuel oil or liquid fuel, although this invention contemplates using both heavy oil and gasoline, as explained hereinafter.

One object of the invention is to provide a duplex gasifying device which is in open communication with the exhaust manifold of a gas engine, and which also includes a starter comprising a gas burner and an electric igniter.

Another object is to provide a combined lubrication rectifier and insulating jacket around the heating chamber in which the gas-generating chamber is enclosed.

Another object is to provide an exceedingly compact, effective, efficient and thoroughly practical unit which includes a duplex gasifier, carbureter for the gas therefrom, lubricant rectifier, tank for receiving and discharging residue from the oil being gasified, and means to secure this unit to any one of a number of previously known or novel forms of internal combustion engines, for either supplementing or superseding the usual gasoline carbureting and feeding system.

Another object is to provide an apparatus, such as defined in the preceding paragraph, with an automatic controller for the circulation of lubricating oil, including a thermostat within the oil-jacket around the heating chamber, yielding means to retard the action of the thermostat, and external manipulative means to adjust the tension of the yielding means.

Another object is to provide a universal manipulative controller for the combination of devices (mentioned in the preceding paragraphs), for opening and closing an ignition circuit which includes a spark plug for igniting the starting burner of the oil gasifier, for opening and closing a compressed air passage that leaves from a tank to the burner, and for operating a shutter or damper of the burner.

Another object is to provide a means of open communication between the oil rectifier and the gas-feeding passage, whereby the combustible gas from the lubricating oil is mixed with the combustible gas of the fuel oil and thus adds to the motive power of the engine.

Another object is to provide an attachment or device for spraying gasoline directly into the gas-generating chamber, with atmospheric air by

which it is atomized and with which it mixes, for use in case of emergency, as where the burner or its igniter is disabled.

A further object of this invention is to provide a device or apparatus of this character which is especially useful and important as a part of or attachment to a tractor, where heavy loads cause superheating of the exhaust gas or fluid, so the superheated fluid quickly and effectively transmits its heat to the heavy fuel-oil and thereby vaporizes or gasifies such fuel-oil.

A further object is to provide an apparatus of this character which effects a very uniform combustible mixture under various loads and other conditions to which internal combustion engines are subjected.

Another object is to provide a simple and effective means to retard the opening of the air-choking valve, while permitting such valve to open gradually, thereby providing a relatively rich combustible mixture when the engine starts, and automatically thinning the mixture as the engine speeds up, thus providing combined economy and efficiency.

A further object is to provide an improved engine mechanism of this character which minimizes the danger of fire or explosion such as might destroy the engine and damage or destroy persons or things adjacent thereto.

A further object is to minimize or eliminate the accumulation of carbon within the engine or upon the spark plugs.

Other objects and important features are pointed out or implied in the following details of description in connection with the accompanying drawings in which:

Figure 1 is a diagrammatic view including a left side elevation of an engine body and crank case having my invention applied thereto, every element of the invention being shown exteriorly and in working relation to one another.

Figure 2 is a vertical sectional view of the gas-generating and fuel-oil rectifying unit, the section being taken approximately through the center of this unit, and the upper end thereof being united with a tubular exhaust fluid passage.

Figure 3 is a left side view of a mixing chamber or carbureter having its upper end secured to the same exhaust fluid passage or tube mentioned in connection with Figure 2, a part of these members being in vertical section along the line 3—3 of Figure 4.

Figure 4 is a fragmental detail view showing the front side of the air-passage and the air-controlling devices connected thereto.

Figure 5 is a top plan view of the unit which includes the gas generator or gasifier, the carbureter and the exhaust fluid passage or pipe, shown in Figures 2 and 3, parts being broken out of the intermediate part of this unit.

Figure 6 is a vertical sectional view along the line 6—6 of Figure 5.

Figure 7 is a longitudinal vertical sectional view of the tubular member or fuel-gas passage which is shown broken at the intermediate part of Figure 5.

Figure 8 is a top plan view of a fuel-oil spreader such as shown in central vertical section in Figure 2, in the upper end of the gasifying chamber.

Figure 9 is a detail view, partly in section, showing a thermally controlled valve for automatically regulating the flow of lubricating oil through the oil-jacket of the gasifier, and through the crank-case of the engine, the section being taken along the line 9—9 of Figure 5.

Figure 10 is a detail view showing a form of duplex valve for simultaneously controlling the flow of air and fuel-oil to the burner which constitutes one means of heating the gasifying chamber.

Figure 11 is a detail view of the rotary valve member shown in Figure 10.

Figure 12 is a view showing the duplex valve turned at right angles from the position shown in Figure 10.

Figure 13 is a central sectional detail view of a check valve such as used in the lower end of the lubricating oil pipe where it connects to the crank case of the engine.

Figure 14 is a somewhat diagrammatic view showing the float-cup and certain of its adjuncts in central vertical section, also showing its flexible connection with the universal controlling unit, and also showing the connection of the universal controlling unit with the device for closing the choke-valve.

Figure 15 is a horizontal sectional detail view, the section being taken along the line 15—15 of Figure 2.

Figure 16 is a somewhat diagrammatic view, partly in section, showing the controlling device in connection with a gasoline spraying or atomizing attachment including a spraying nozzle on the top of the gasifying chamber for injecting a spray of atmospheric air and gasoline into the gasifying chamber from whence it passes through the heating pipe to the mixing chamber and thence to the engine cylinders, for use where fuel-oil cannot be obtained, or where any part of the fuel-oil starting or operating system may become disabled.

Figure 17 is a detail view, in vertical section, of the lower end of the heating chamber, the tubular connection which connects the heating chamber in open communication with the exhaust manifold of the engine, and the tank which receives and discharges the residue after vaporizing the volatile part of the oil.

Figure 18 is a rear elevation of the circuit closing device, its support, and the controlling rod, the latter being in cross section.

Fig. 19 is a diagrammatic view showing all the parts showing the functional relation of all the elements, without regard to their actual positions relative to one another, some of the parts being repeated or duplicated, at the upper left, and being enlarged to more clearly show the details, as indicated by the words "Same", in connection with the dot-dash lines that connect

some of the duplicate parts, the broken arrows showing the course of the electric igniting current.

Referring to these drawings in detail, in which similar reference characters correspond to similar parts in the several views, and in which the engine body E and crank case C are shown with conventional forms of exhaust manifold EM and intake manifold IM, the invention will now be described in detail as follows:

Referring first to Figures 1, 2 and 5, it will be seen that the invention includes a unitary member comprising three separable and originally separate members 20, 21 and 22. The member 20 constitutes a combined fuel-oil gasifier, lubricating oil heater and heat-insulating jacket, a starting burner, a residue receiving and discharging tank, a tubular passage for connection with the exhaust manifold or outlet of an internal combustion engine, inlet connections for admission of either heavy oil or gasoline into the gasifying chamber, an outlet connection for communication with the tubular member (Figure 7) which is in open communication with the gasifying chamber and the mixing chamber or carbureter, and a flanged outlet connection for securing it to the tubular exhaust fluid member or passage 21.

In more specific detail, the unit 20 includes a gasifying chamber 23, the outer surface of which is formed with an annular series of vertical ribs 24 which receive heat by their intimate contact with hot products of combustion from the engine or from the burner, and conduct the heat to the interior of the gasifying chamber and to the oil within the latter. The upper end of the gasifying chamber has an internal rib or shelf 25 on which is seated a spider-like oil spreader 26 which is preferably of sheet metal, has an imperforate middle part, and has radial tongues extending out from the imperforate middle part, as more clearly shown in Figure 8, where it will be seen that spaces are provided between the tongues, so fuel-oil can pass therebetween, and flow down the inner surface of the member 23. The upper end of the chamber 23 is formed with an internal screw thread and with an external supporting flange 27. The internal thread is engaged with an external thread of a closing cap 28 (shown in detail in Figure 14). This closing cap is provided with three apertures, two of which are screw-threaded for receiving tubular connections 29 and 30, and the third, shown at 31, is provided with a gasket seat 32. These connections 29 and 30 constitute, respectively, inlets, for heavy fuel-oil, and for atomized gasoline and air, so that these combustible fluids can be used alternatively, as will be more clearly understood from the description which will follow. It will be understood, however, that the inlet 30 is not needed where the invention is designed to use only one kind of fuel, for instance, for tractor-engines, or other engines, operating locally in a warm or moderate climate where any one of the numerous liquid fuels can always be obtained. The aperture 31 constitutes the outlet opening or a part of the fuel gas passage which includes a tubular member 33 such as shown separately in Figure 7. The front end of this member 33 has a vertical tubular element 34 which extends into the gasket-seat 32, is seated on a gasket therein, and has open communication with the outlet opening 31. The upper side of the member 33 is provided with a set-screw-seat 35 which receives the lower end of the set-screw 36, and presses the member 34 tightly

against the gasket in the seat 32. The set-screw 36 is screwed into and through the top of the hollow cover or housing 37 and which is held in unitary relation with the member 20 by one or more screws 38 whose lower ends are in threaded engagement with lugs 39 which also constitute shelves on which is seated the flange 27 of the gasifying chamber 23.

Referring again to the tubular member or gas passage 33, it will be seen that it extends longitudinally through the middle of the heating fluid passage 21, and that the latter is provided with an outlet opening 40 which has a gasket-seat 41 at its upper end. The member 33 has a tubular outlet element 42 which is seated on a gasket on the seat 41, and held therein by means of a set-screw 43 which is screwed through the upper side of the member 21 and has its lower end in a set-screw-seat 44 of the member 33.

The mixing chamber or carbureter 22 has an inlet-opening 45 into which extends a tubular member 46 which is integral with or secured to the heating pipe 21. Through this member 46, the tubular member 33 is in open communication with the mixing chamber of the unit 22. A clearance or annular space is provided around the nozzle 46 to keep this nozzle for hot gas fuel as hot as possible. A spreading plate or disk 47 is secured in horizontal and spaced relation to the lower end of the tubular member 26, and serves to spread the inflowing gas in all horizontal directions, thus facilitating the mixing of the gas with atmospheric air which is introduced by means which will presently be described in detail. The lower end of the mixing chamber is provided with a flanged tubular outlet 48, and its flange 49 is apertured for receiving bolts to secure it to the intake manifold or pipe IM, as shown in Figure 1.

Referring now to Figures 3 and 4, it will be seen that the mixing chamber of the member 22 is indicated at 50 and has secured thereto a primarily separate unit which includes a cap 51, a dual or bifurcated passage or tubular member 52, an air inlet connection 53, a choke-valve 54 having a stem 55, a dash-pot 56, a link or connecting member 57, and a damper or air regulating device 58. The member 53 may be screw-threaded or otherwise united with the lower end of the member 52, and includes a tubular guiding element 59 through which the stem 55 is guided vertically. This member 55 has a slot 60 through which the link 57 extends, and which permits the choke-valve to be closed quickly while the piston 61 of the dash-pot descends slowly. The piston 61 is provided with a leak-valve 62 which permits oil in the dash-pot to pass slowly through the valve-opening while the piston is descending or rising through the oil in the dash-pot. This valve 62 also retards the choke-valve against opening too quickly, while permitting it to open gradually, so the combustion mixture will not be too thin while the engine is starting or when opening the throttle quickly while running, but which is sufficiently thin when the engine speeds up, and thus provides the maximum of economy and efficiency. The tubular air-passage 52 is provided with one or more openings 63 and with one or more dampers or closure elements 64, the latter being operable to open and close the opening or openings 63, by means of a crank 65 on an axle 66 which forms the pivotal mounting of the closure 64. On this same axle 66 is secured an arm 67 which has a curved lower end and is operable to be swung from the position shown in Figure 14 to the position shown in Figure

3, for pressing the choke-valve 64 down on the valve-seat of the member 53. A link or flexible element 68 connects the arm 65 to an actuating arm 69 which is mounted on the universal actuating rod or shaft 70 which is shown in Figures 1, 14 and 16, and will be later referred to in connection with other features of this invention.

Referring again to Figures 1 and 2, it is seen that the gasifying chamber 23 is enclosed within the heating chamber 71 which has the supporting and securing lugs 39 on its upper end. There may be any appropriate number of these lugs 39, but three are deemed sufficient, and are shown in Figure 5. By means of these lugs abutting against the outer wall of the gasifying chamber, the latter is held spaced from the inner surface of the heating chamber 71, and uniform heating of the gasifying chamber is thereby provided. The products of combustion pass out through the spaces between the lugs 39, thence into the hood or housing 37, thence into the heating tube 21, and thence out through a tubular exhaust extension 21a (Figure 1), to the atmosphere or to a muffler (not shown). A flange 21b is shown on the rear end of the member 21, and a companion flange 21c is provided on the front end of the member 21a, these flanges being apertured to receive bolts to secure them to one another; so the members 37, 21 and 21a combine to form an exhaust passage from the heating chamber to the atmosphere.

The heating chamber 71 (Fig. 17) is preferably formed in two originally separate sections, viz., an upper section 72 and a lower 73, the latter having an inlet opening 74 in open communion with an exhaust-fluid passage 75 which connects to the exhaust-port or manifold of the engine body E, and includes two originally separate flanged units bolted to one another, as shown in Figure 17. The lower end of the heating chamber is apertured and internally screw-threaded for holding a blow-torch type of gas-burner 76 whose upper end is open and disposed under the gasifying chamber 23, a damper 77 is provided to admit and control air currents through all sides of the burner 76, and the damper is provided with an actuating arm 78, the latter being connected to a link 79 which connects to an arm 80 on the actuating member or rod 70. The lower central part of the burner 76 is provided with an opening which is screw-threaded at 81 for connection with an air pipe 82, having communication with a duplex valve 83 which connects to a compressed air tank 84 thru the medium of a pipe 85. These members 82, 83, 85 and a jet-opening 86, in the burner, constitute an air passage from the compressed air tank to the interior of the burner 76.

The burner is provided with a jet-opening 87 in communication with a threaded pipe connection 88 in which is secured one end of an oil-fuel feed pipe 89 which connects to a float-cup 90 thru the medium of the duplex valve 83 and a pipe 91; so the parts 87, 88, 83 and 91 constitute a fuel-oil passage from the float-cup 90 to the burner 76. By turning the controlling rod 70, the duplex valve 83 is caused to simultaneously open the compressed air passage and fuel-oil passage and establish a flow of compressed air and fuel-oil into the mixing chamber of the burner 76, and in such relation that the air atomizes or sprays the fuel-oil in the sump around the jet-opening 86. A spark-plug 92 is provided through the wall of the member 73 of the heating chamber, and its terminal connects to a vibrating spark-coil 93 which gets its cur-

rent from the engine's battery 96, thru a circuit which is grounded to a combined supporting and bearing member 94 in which the controlling rod 70 is journaled. The terminal of the spark-coil is connected to a switch member 95, secured on and insulated from the member 94 (see Figure 18), while its other terminal connects to the battery 96 which may be grounded on any conducting part of the engine, as at 97.

10 A switch member 98 is secured on the controlling shaft 70, so as to make and break contact with the member 95 which is preferably a spring or yielding contact. A handle 99 is provided as an extension of the member 98, so the user can

15 operate the device from the left side of the engine, as well as from the rear, at the driver's seat (not shown). In this connection, it should be understood that a handle 100 is secured on the rear end of the controlling rod 70 and has an

20 extension 101 which constitutes a pointer or index by which the user is guided as to the proper respective positions for the controlling rod and its adjuncts, according to the mode of operation presently explained.

25 An index-plate 102 is secured on the dashboard (Figures 1, 14 and 16), and it also constitutes a bearing for the rear end of the rod 70. This plate 102 has three index markings, at right, center and left, and adjacent words or abbreviations to register with the pointer 101, for showing the respective working conditions of the engine; for instance; the word "off" means that the starting heater or burner 76 is not in

30 operation, the fuel being cut off therefrom; "O. C." means that oil (heavy oil) is being fed to the burner, and the air-valve 54 is choked; and "G. C." means that gasoline is being fed and that the valve 54 is choked.

Referring now to the duplex valve 83, and especially to the details shown in Figures 10, 11 and 12, it is seen that the rotary valve member has a long and narrow radial opening 104 therethrough, constituting a part of the fuel oil passage, so a slight turn of the member 103 will

45 open or close this passage, the valve body 105 having similar openings 106 at opposite sides of the part 103. Securing nuts 107 and 108 engage with the pipe sections and with the body 105 for forming the fuel-oil passage through which the fuel-oil can flow, by gravity, from the float-cup 90 to the burner or heater 76 when the valve 83 is open, as in Figure 10. The valve member 103 is also formed with a radial opening 109 which terminates in tangential slots 110, the latter being in registration with openings 111

55 of the body 105 when the valve is open, as in Figure 10. Securing nuts 112 and 113 hold the pipes 82 and 85 in engagement with the body 105, thereby forming the complete compressed air passage from the air-tank 84 to the burner 76 (at the threaded socket 81). In consequence of the tangential slots 110, the compressed air passage may remain open after the fuel-oil passage is closed, so all of the fuel-oil in the burner-bowl will be atomized and burned. The valve member has an apertured actuating lug 114 to which the controlling rod 70 is secured by means such as shown in Figures 1 and 16.

Referring now to Figures 1 and 14, it is seen that the float-cup 90 is provided with a fuel-oil inlet pipe 115 that connects with a fuel-oil supply tank 1150 (Fig. 19) and the fuel-oil is fed therethrough to the float-cup by gravity. The oil-fuel-nozzle 29 is in open communication with the float-cup thru the medium of an oil passage formed by

pipe sections 116, 117 and 118, one of these sections (or L's) being secured in an opening in the bottom of the float-cup, and another (117) having a check-valve 119 therein to prevent the oil from retracting in the oil-passage. The nozzle 29 is provided with a reducing outlet member 120 which is disposed over the center of the spreader or distributing plate 26 (see Figure 2), and because of its small size, it forms the oil into drops or a small stream and this prevents it from passing to the outlet 31 by capillary attraction. The oil flows in all horizontal directions on the plate 26, thence down the hot wall of the gasifying chamber 23 and is gasified before it reaches the bottom, except the asphalt and other non-gasifiable substances that are present with the heavy, lowgrade fuel-oil. Such non-gasifiable substances flow out through a pipe 121, into a refuse-tank 122.

The pipe 121 is provided with a valve 123 which is normally open and has an actuating arm 124. The refuse-tank 122 has a valved outlet 125 provided with an actuating arm 126. The valve of this outlet is normally closed, so the refuse can be allowed to accumulate in the tank 122 until a convenient time and place are arrived at for discharging the refuse. A link 127 is pivoted to the arms 124 and 126, and has pivoted thereto an actuating member or rod 128 which extends to a point near the handle 100 (see Figures 1 and 16), and extends through a slot in a plate 129 that is secured on the dashboard or instrument board. Notches 130 are provided in the rod 128, to engage with the plate 129 and hold the rod in either its foremost position or its rearmost position. When in its foremost position, the valves of the refuse tank are in such relation that refuse can flow into the tank, but not out; and when in its rearmost position, the refuse can flow out, while the valve 123 keeps any of it from being sucked into the chamber 23 by suction of the engine. The refuse tank is depressed or concaved at 131 (Figures 2 and 17) to fit closely around the L of the exhaust-inlet-pipe 75, and by this means, the asphalt is kept warm and in a liquid state so it will flow out of the tank 122 when the rod 128 is operated for permitting it to flow out.

Operation with only one kind of fuel

While broadly, the term "fuel-oil", as used herein, may include gasoline, and while gasoline may be used and gasified in the same way and by the same means described in the foregoing, this term "fuel-oil" is herein used to distinguish from gasoline and to specifically refer to any heavy gasifiable fuel-oil. To operate the engine by fuel-oil exclusively, the procedure is as follows:

Assuming that the engine is cold, and it is desired to start it: The user first closes the engine's ignition circuit, then moves the handle 100 so as to move the pointer 101 to the right, so it registers with "O. C.", thus closing the choke valve 64, closing the switch 95—98 (Figure 18), opening the duplex valve 83, and opening the burner-damper by its arm 78. This operation results in limiting the carbureting air, in supplying atmospheric air to the burner, in supplying fuel-oil to the burner, in supplying compressed air to the burner, and in supplying igniting sparks to the burner, by means previously described. The fuel-oil is directed to the bottom of the burner-bowl by means of a baffle over the inlet 87, and the compressed air, entering thru the inlet 86, atomizes the fuel-oil in the presence of the sparks from the spark-plug 92, so a flame is kindled in the mouth of the

burner 76, and this flame passes upward around the vaporizing chamber and between the ribs 24 thereof, thoroughly heating this chamber, so the fuel-oil therein is vaporized and passes thru the outlet 31, thence into and thru the tubular member 33 and into the mixing chamber or carbureter 22 from which it is fed, thru the intake manifold, into the cylinders of the engine. It should be understood, however, that the engine must be cranked for drawing the fuel-oil into the vaporizing chamber. It may be cranked in about thirty seconds after the burner is lighted, and then the fuel-oil flows from the float-cup 90, thru the oil-passage which includes the nozzle 29—120, and is quickly vaporized; whereupon, when the user judges that the vaporizer is so hot that gas will be generated by it in consequence of heat from the exhaust which enters thru the opening 74, the pointer 101 is turned to the "off" position; whereby the duplex valve is closed, the igniting circuit is broken through the spark plug 92, the burner-damper is closed, and the choke-valve 64 is permitted to open. If the user desires to partly close the choke-valve while the engine is running, he can do so by moving the pointer 101 the necessary distance to the left, as this will operate the choke-valve without opening the duplex valve or the burner-damper, and without closing the switch 95—98.

Starting with gasoline, and changing to fuel-oil

In extremely cold weather, when the fuel-oil is very thick and sluggish, this invention may be used with gasoline, for starting and running the engine, either by using common switch-valves 107b and 112b (Fig. 19), or by interchanging certain of the previously described parts with parts which will now be described as follows:

Securing nuts 107 and 108 may be removed, and in their respective places, securing nuts 107a and 108a may be attached to the duplex valve body 105, as shown in Figure 16. Similarly, the nut 112 is replaced by a nut 112a. Again referring to Figure 16, it is seen that the nut 112a is secured to a pipe 132, one end of which connects to a tubular member 133, while the latter connects to the gasoline inlet connection or L 30 (see Figures 5 and 16); so that the members 30, 133, 132 and the valve body 105 constitute an air passage through which atmospheric air can be drawn by suction of the engine. In this connection, it should be understood that the compressed air pipe 85 is disconnected when using gasoline, the securing nut 113 being removed. The nut 107a connects to a pipe 134, and the latter connects to a nozzle 135 which extends through an opening in the member 133, and has its outlet end curved downward within the L 30. The nut 108a connects a pipe 136 to the valve casing 105, and the pipe 136 also connects to a gasoline tank 137. Therefore, the parts 136, 105, 134 and 135 constitute a gasoline passage from the tank 137 into the nozzle or L 30.

From the foregoing paragraph, in connection with Figure 16, it may be seen that the operation of starting the engine with gasoline is as follows:

The handle 100 is manipulated for turning the pointer 101 to the right sufficiently to open the duplex valve, but not sufficiently to close the circuit which includes a spark-plug 92. This results also in closing or partly closing the choke-valve 64. The engine is now cranked, and the ignition circuit of the engine is closed, so

the suction of the engine draws gasoline from the tank 137 through the gasoline passage and into the nozzle or L 30. The suction of the engine also draws atmospheric air through the valve body 105 and pipes 132 and 133, and discharges it into the L 30, in the presence of the gasoline being discharged from the nozzle 135. This mixing of the air and gasoline begins to carburete the latter within the member 30, and the carbureting is continued within the gasifying chamber 23. From the chamber 23, the mixture of air and gasoline passes out through the outlet 31, thence through the tubular member 33, thence into the mixing chamber or carbureter 50 where the carbureting is completed, being regulated by the air-regulating device 58 which includes the choke-valve 54. This carbureted fuel passes out through the outlet 48, and into the engine where it is ignited for running the latter. As soon as the engine begins to run, the exhaust therefrom heats the gasifying chamber 23, the nozzle 29, and the tubular member 33, so the mixture is well heated when it enters the carbureter 50, and so the maximum efficiency is obtained. The engine may continue running with gasoline; or the duplex valve may be closed for cutting off the gasoline, while the fuel-oil is permitted to pass from the float-cup 90, whence it passes through the valved passage (including the nozzle 29) into the vaporizing chamber 23 and is vaporized, controlled and utilized in the manner previously described. The means whereby the flow of fuel-oil is stopped and released will now be described as follows:

Referring to Figure 14, it is seen that the float-cup 90 has its outlet passage provided with a valve-seat 138 adapted to be closed by a float-valve 139 which has a stem 140 extending thru and guided in an opening in the cover of the float-cup. A lever 141 is pivoted to a supporting bracket 142, and this lever is connected to one end of a link or wire 143 which includes a retractile spring 144 and has its other end connected to an arm 145 which is mounted on the controlling rod 70 and operable thereby to pull the link 143. When the pointer 101 is set at the "Off" position, the lever 141 is held up by a spring 146 and the float-valve is held open by its buoyancy; but when the pointer is set at the position for starting with heavy fuel-oil, the valve 138—139 is held closed by the lever 141, link 143 and arm 145. The inlet opening of the float-cup is provided with a valve 147. A float-lever 148 is pivotally mounted at 149 and has an adjusting screw 150 which bears on the ball or movable member of the valve 148 for holding the valve closed when the float-cup contains enough oil to hold up the annular buoyant part of the lever 148. This annular buoyant part surrounds the float-valve 139, so these controlling devices operate independently of one another without interference. When the engine is to be run with oil-fuel exclusively, a thumb-screw 151 may be turned for tightening the pivotal connection of the lever 141 and holding it up, so the spring 144 will yield when the arm 145 is moved down, and the valve 149 will be free from control of the lever 141. On the other hand, in a case of emergency, for instance where the fuel-oil is extremely heavy and the weather is extremely cold, so the fuel-oil is too sluggish for best results, it may be desired to cut off the flow of the fuel-oil and to use gasoline exclusively until the emergency is relieved; and in such case, the thumb-screw 151 can be tightened while the

lever 141 is down, thereby keeping the valve 138—139 closed while gasoline is used exclusively during such emergency.

thickness; and the valve 161 can be adjusted according to the thickness of the oil.

Thermostatic control of lubricant

Combined lubricant rectifier and fuel supplementing

Referring to Figures 1, 2, 5 and 9, it is seen that the unit 20 includes a casing or oil-jacket-member 152 which surrounds the heating chamber 72 and provides an annular lubricating oil-tank having the parts 72 and 152 as its inner and outer walls. This oil-tank or oil-jacket is encased in a heat-insulating cover 153 for retaining the heat within the body 20, so the lubricating oil is kept hot by the heating chamber. Oil-pipes 154 and 155 connect to opposite sides of the oil-tank 72—152, and the top of the oil-pipe 155 terminates in a downturned vent-portion 156. A vertical oil-pipe 157 is connected to the oil-pipe 155 and also connected to and extends into an oil-testing tank 158, while the upper end of an oil-pipe 159 is connected to the lower end of the testing tank and extends up thereinto. The lower end of the oil-pipe 159 is connected to the crank-case C and communicates with the interior thereof (Figure 2), while the oil-pipe 154 also communicates with the crank-case thru the medium of the engine-body E, an oil-pipe 160, and a thermostatically controlled oil-regulating valve, the latter shown in detail in Figures 5 and 9. The oil-pipes mentioned in this paragraph, the oil-tank 158, the oil-controlling valve 161 and the annular oil-jacket 72—152 combine to constitute a lubrication-oil-passage which has its ends in open communication with the oil-container within the engine. The oil-tank 158 is provided with a faucet 162 through which samples of the lubricating oil can be drawn out for testing purposes. The top of the oil-jacket is in open communication with the fuel-gas-pipe 33 thru the medium of a fuel-gas-pipe 163, so the gas which arises from the hot lubricating oil (in the oil-jacket) passes thru the pipe 163, into the pipe 33, and there mixes with the fuel-gas from the gasifier 23, as a byproduct of the rectified lubricant, and as a supplemental fuel-gas. Referring to Figures 1 and 2, and especially to the rectifying and sampling tank 158, it is seen that the pipe 159 extends a considerable distance up into this tank, as indicated by dotted lines, and the space around this pipe-end serves as a trap for collecting particles of metal and other foreign substances which gravitate in the comparatively quiescent body of oil around this pipe-end. It should be understood that while parts of the oil are heated by the engine and by the heater 72, other parts are being cooled within the oil-pipes which connect with the crank-case, engine-body and oil-jacket. This difference in temperature causes a circulation of oil thru the oil-pipes and their adjuncts, thereby assisting the engine's oil-pump, not shown. As the lubricating oil circulates thru the rectifying tank 158, the heavier impurities are trapped in the manner just previously explained, and such impure oil can be drawn out through the faucet 162. However, the rectifying of lubricating oil consists not only in extracting the heavy impurities therefrom, but also in extracting the light volatile part of the lubricating oil, so the greatest lubricating efficiency is obtained, and so the combustion gas is supplemented in the manner explained. The lubricating oil gets thicker in proportion to the amount of the lighter oil that is vaporized and passes out; so the tank 158 and faucet 152 are useful for testing the lubricating oil as to its

An arcuate thermostatic member 164 has one end secured to the upper member 72 of the heating chamber, and extends around the upper part of the latter, within the oil-jacket, and is surrounded by the lubricating oil which is being heated in the oil-jacket. This thermostatic member is shown in Figures 2 and 5, and in the latter figure, it is seen that the oil-controlling valve 161 has a plunger or needle valve member 165 connected thereto thru the medium of a rod 166 and a link 167, the latter being pivotally connected to the thermostatic member and to the rod 166. This rod 166 extends thru a stuffing box 168 which is provided on the wall 152 of the oil-jacket, and the rod is provided with a slot 169 into which extends the lateral projection 170 of the needle valve member 165. A spring 171 bears against a shoulder on the rod 165, and tends to hold its valve-point 172 in the valve-seat of the body or main valve-member 161. It should be understood, however, that when the oil has reached a predetermined temperature, the thermostatic member 164 tends to straighten, and pulls the link 167, thereby pulling the rods 166 and 165, so as to open the valve 161—172, thus permitting the oil to circulate thru the oil-passages previously described. For the purpose of supporting the valve-member 161, a bracket 173 is secured on the unit 20, and has its outer ends united with the valve-member 161. A lever 174 is pivotally mounted on the bracket 173, and the spring 171 is secured to this lever. An apertured ear 175 projects from the bracket 173 and an adjusting screw 176 extends therethrough and has one end pivotally connected to the lever 174. By means of a nut 177, the adjusting screw 176 and lever 174 can be adjusted for tensioning the spring 171, thereby increasing or decreasing the resistance of the valve 161—172 against the action of the thermostatic member 164.

Referring now to Figure 13, it is seen that the oil-pipe 159 is provided with a check-valve 178 which prevents the lubricating oil from passing upward thru the part of the oil-pipe 159 which connects to the rectifying tank 158.

Although I have described this embodiment of my invention specifically, I do not intend to limit my patent protection to these exact details of construction and arrangement, for the invention is susceptible of numerous changes within the scope of the inventive ideas as implied and claimed.

What I claim as my invention is:

1. In combination, a gas generating chamber having means to introduce gasifiable material thereinto, and being closely connected to the exhaust outlet of an internal combustion engine for receiving heat therefrom, a gas burner for pre-heating said gas-generating chamber and being external to the latter, and an electric circuit including an ignition device for igniting the gas of said gas burner.

2. In combination, a gas-generating chamber having means to introduce gasifiable material thereinto, a heating chamber in which the generating chamber is enclosed, a gas burner to impart heat to the heating chamber, an air regulator for the gas burner, an electric circuit including an ignition device to ignite the gas of the gas burner, and a controlling device operable to

simultaneously actuate the air regulator and energize the electric circuit.

3. In combination a gas-generating chamber, a burner to heat the same, means to supply fuel to the burner, means to supply compressed air to the burner, means to supply atmospheric air to the burner, and means including a controlling member operable to control the means for supplying fuel and compressed air and atmospheric air.

4. In combination, a gas-generating chamber, a burner to heat the same, means including a float-cup to introduce gasifiable liquid to the gas-generating chamber, an electric circuit including a device for igniting the fuel of the burner, a manipulative member, and means operable by said manipulative member for simultaneously controlling said valve and said device for igniting the fuel.

5. In combination, a gas-generating chamber, means including a valve to introduce gasifiable liquid into the gas-generating chamber, and to regulate the flow of said liquid, a heater for heating said gas-generating chamber, means to energize the heater, a mixing chamber in open communication with the gas-generating chamber and adapted to receive gas therefrom and having an air inlet and a choke-valve for the air inlet, a manipulative member, and means operable by the manipulative member to control the first said valve and the said means to energize the heater and the said choke-valve.

6. In combination, a gas-generating chamber, means including a valve to introduce gasifiable liquid into the gas-generating chamber and to regulate the flow of said liquid, a burner to heat said gas-generating chamber, means including a valve to convey fluid fuel to the burner and to control the flow of said fuel, a manipulative member, and means operable by said manipulative member for operating both of said valves.

7. In combination, a gas-generating chamber, means including a valve to conduct gasifiable liquid into the gas-generating chamber and to control the flow of said liquid, a burner to heat said gas-generating chamber, means including a valve to convey fuel to said burner and control the flow of said fuel, an igniting device for said burner, a manipulative member for controlling both of said valves and said igniting device.

8. In combination, a gas-generating chamber, means including a valve to conduct gasifiable liquid into said chamber and to control the flow of said liquid, a burner to heat said gas-generating chamber, means including a valve to conduct fuel to said burner, and control the flow of said fuel, an igniting device to ignite said fuel, air-supplying means to conduct air into said burner, a manipulative member, and means operable by said manipulative member to control both of said valves and said air-supplying means.

9. In combination, a gas-generating chamber, means including a valve to conduct gasifiable liquid into the gas-generating chamber and to control the flow of said liquid, a burner to heat said chamber, means including a duplex valve for conveying fuel and compressed air to said burner and controlling the flow thereof, a manipulative member, and means operable by said manipulative member to control the first said valve and said duplex valves.

10. In combination, a gas-generating chamber, a burner to heat the gas-generating chamber, means including a duplex valve to conduct fuel and compressed air to said burner and control the flow thereof, an igniting device for the burner, a damper for the burner, a manipulative device, and means operable by the manipulative device to control said duplex valve and said igniting device and said damper.

11. In combination, a gas-generating chamber having a gas-outlet, a carbureter having a gas inlet, a passage in open communication with the gas outlet of the gas-generating chamber and carbureter, a passage to conduct gasifiable liquid into said gas-generating chamber, a valve to close the second said passage, an air-choke valve for said carbureter, a burner for heating said gas-generating chamber, a damper for said burner, a fuel supplying passage including a valve for conducting fuel to said burner, an igniting means for the burner, a manipulative member, and means operable by said manipulative member to control all of said valves and said damper and said igniting means, substantially as shown.

12. In combination, a heating chamber having an inlet and an outlet thru which the exhaust of an engine can pass for heating it, a burner in the lower end of the heating chamber and provided with fuel supplying means and fuel igniting means and operable to pre-heat the heating chamber, a gas-generating chamber within the heating chamber and provided with a means to supply it with gasifiable material and with an outlet for the gas.

13. In combination, a heating chamber, a gas-generating chamber therein and provided with an inlet for gasifiable liquid and with an outlet for the gas generated therein, said heating chamber having an oil-jacket therearound and provided with circulation pipes in open communication with a lubricating oil reservoir of an internal combustion engine, and a gas-passage to conduct gas to an internal combustion engine, said heating chamber and oil-jacket having outlets in open communication with said gas-passage, whereby the gas from the lubricating oil supplements the gas from said gasifiable liquid.

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