Dec. 15, 1936. R. THOMPSON 2,064,185

CHARGE FORMING DEVICE

Filed May 22, 1935 3 Sheets-Sheet 1

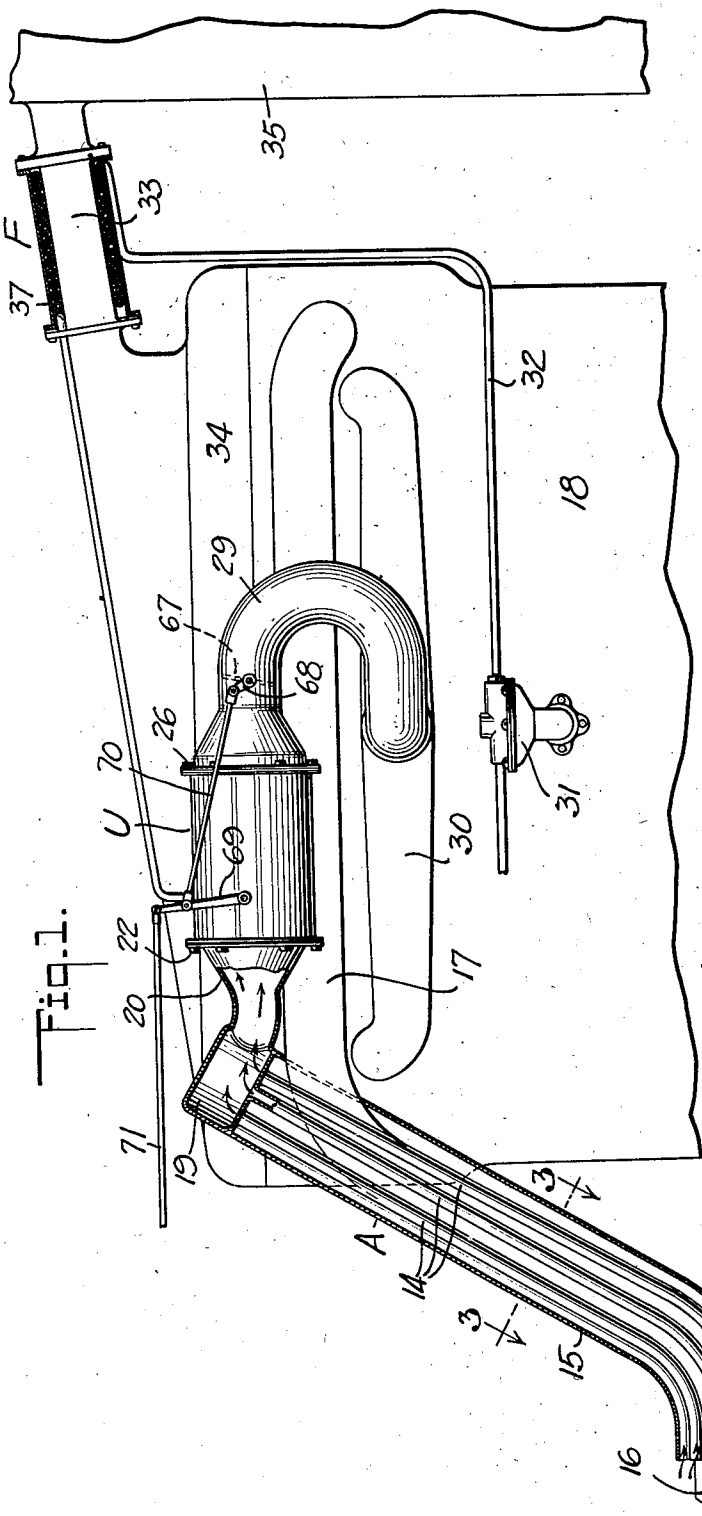


Fig. 1.

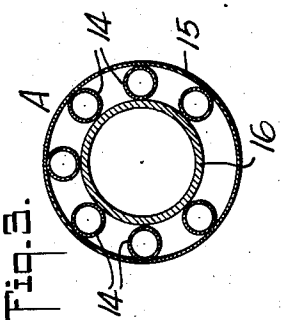


Fig. 3.

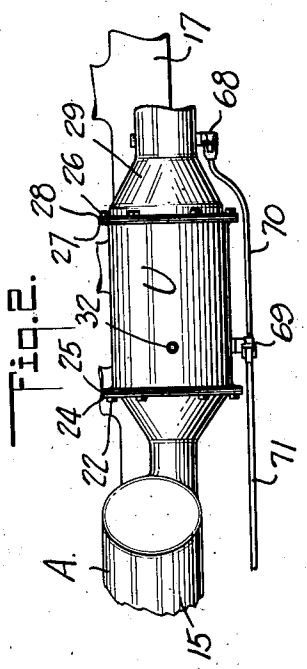


Fig. 2.

INVENTOR
RICHARD THOMPSON
BY
Munn, Anderson & Liddy
ATTORNEYS

Dec. 15, 1936. R. THOMPSON 2,064,185

CHARGE FORMING DEVICE

Filed May 22, 1935 3 Sheets-Sheet 2

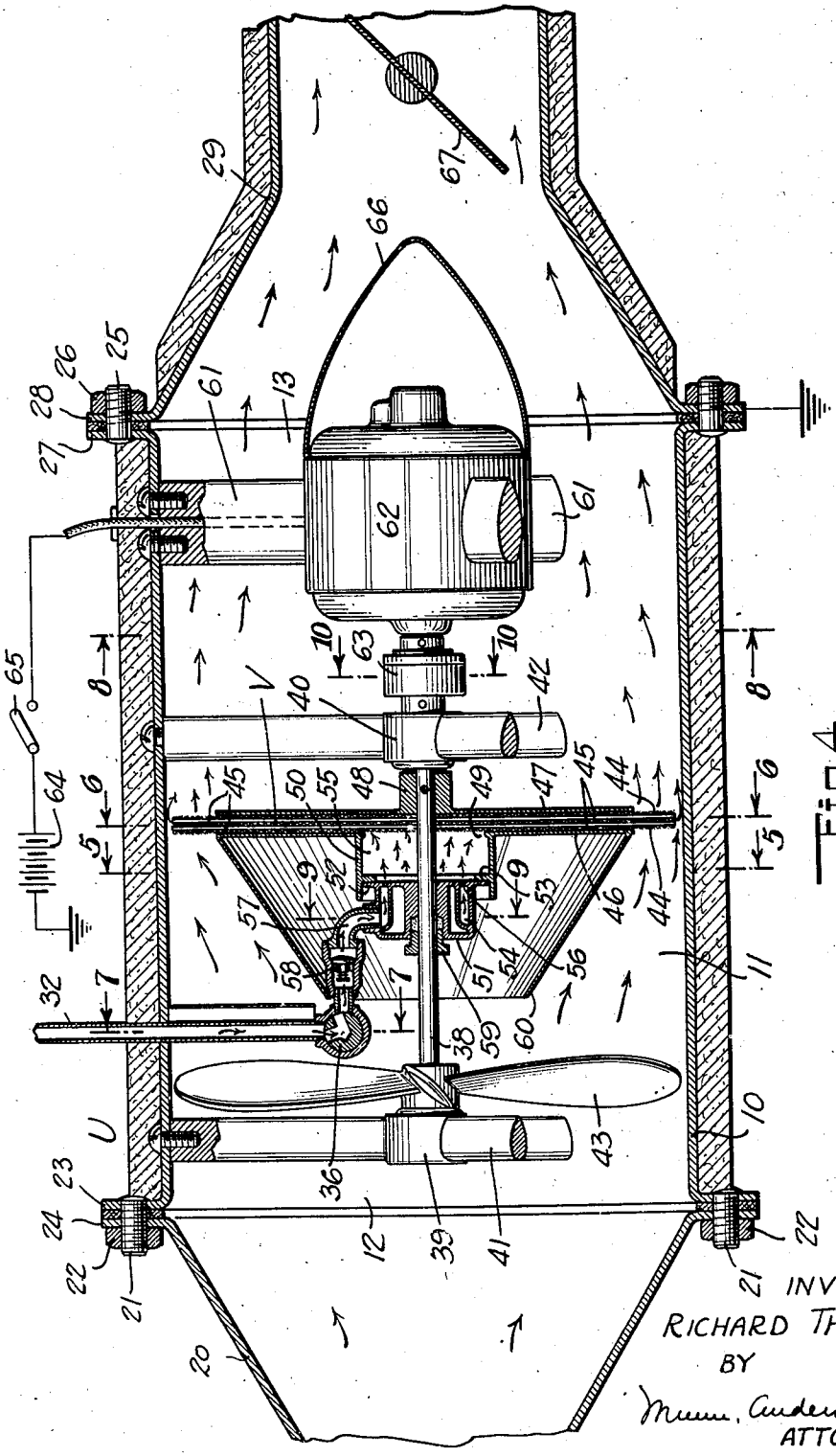


Fig. 4.

INVENTOR
RICHARD THOMPSON
BY
Munn, Anderson & Liddy
ATTORNEYS

Dec. 15, 1936. R. THOMPSON 2,064,185

CHARGE FORMING DEVICE

Filed May 22, 1935 3 Sheets-Sheet 3

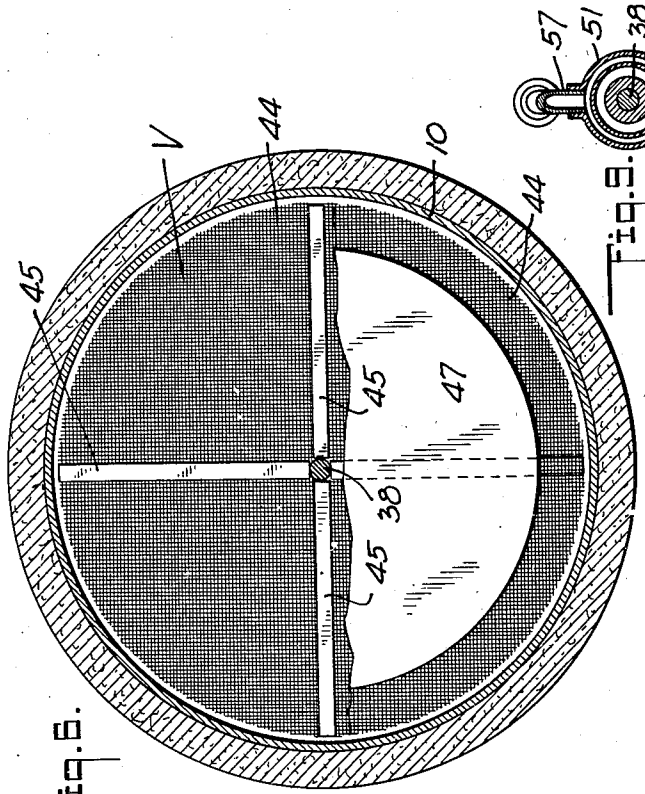


Fig. 6.

Fig. 9.

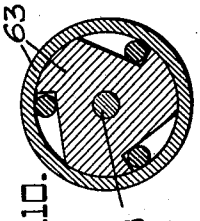


Fig. 10.

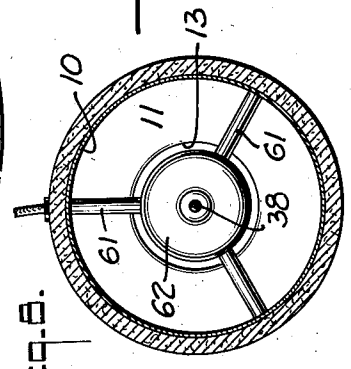


Fig. 8.

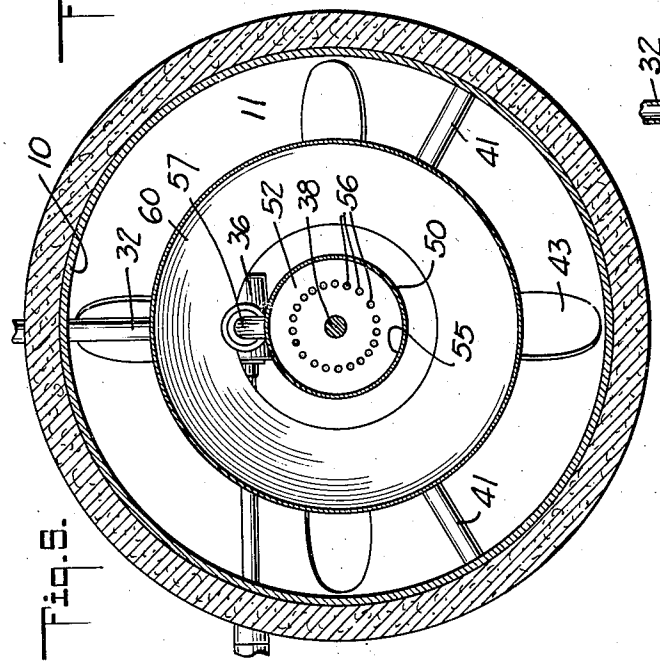


Fig. 5.

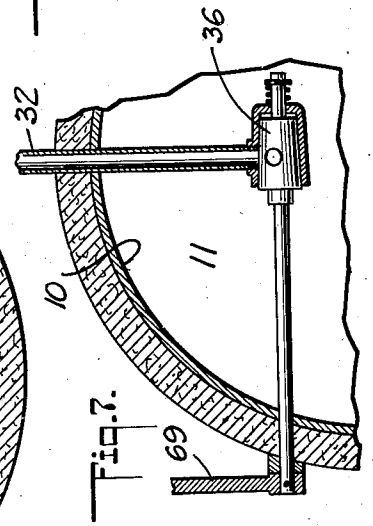


Fig. 7.

INVENTOR
RICHARD THOMPSON
BY
Munn, Anderson & Liddy
ATTORNEYS

Patented Dec. 15, 1936

2,064,185

UNITED STATES PATENT OFFICE

2,064,185

CHARGE FORMING DEVICE

Richard Thompson, Los Angeles, Calif.

Application May 22, 1935, Serial No. 22,911

8 Claims. (Cl. 261—83)

This invention relates generally to internal combustion engines, and more particularly to charge forming devices for supplying a combustible mixture of air and a liquid hydrocarbon thereto.

An object of this invention is to provide a charge forming device which, in its association with an internal combustion engine, functions to produce an air and liquid hydrocarbon mixture of maximum combustibility by causing the hydrocarbon to be thoroughly vaporized and uniformly mixed with the proper proportion of air necessary for the engine to deliver maximum power from the fuel, whereby to enable the fuel to be economically used, and the formation of carbon deposits in the engine, due to incomplete combustion of the fuel, prevented.

Another object of the invention is to provide a charge forming device of the above described character embodying means for preliminarily heating the liquid hydrocarbon and the air, preferably utilizing heat of the water in the engine's cooling system, and the heat of the exhaust gases discharging from the engine when in operation.

With these and other objects in view, the invention consists in the combinations and arrangements of elements set forth in the following specification and more particularly pointed out in the appended claims.

In the accompanying drawings

Figure 1 is a view partly in side elevation and partly in section of the charge forming device embodying this invention, applied to an internal combustion engine;

Figure 2 is a fragmentary plan view of the charge forming device;

Figure 3 is an enlarged transverse sectional view taken on the line 3—3 of Figure 1;

Figure 4 is an enlarged vertical longitudinal sectional view of the vaporizing and mixing unit of the charge forming device;

Figures 5 and 6 are transverse sectional views taken respectively on the lines 5—5 and 6—6 of Figure 4;

Figure 7 is a fragmentary transverse sectional view taken on the line 7—7 of Figure 4;

Figure 8 is a reduced scale transverse sectional view taken on the line 8—8 of Figure 4;

Figure 9 is a detail sectional view taken on the line 9—9 of Figure 4;

Figure 10 is an enlarged detail sectional view taken on the line 10—10 of Figure 4.

Referring specifically to the drawings, this invention in its present embodiment comprises a vaporizing and mixing unit U composed of a metal body 10 in the form of an open ended cylinder providing interiorly thereof a mixing chamber 11 having an inlet 12 and an outlet 13, respectively, at opposite sides of the body.

With the inlet 12 is associated an air heater A comprising a plurality of open ended air pipes 14 enclosed by a jacket 15 and extending longitudinally of and in contact with the periphery of the usual exhaust pipe 16 leading from the exhaust manifold 17 of an internal combustion engine 18. The outlet ends of the pipes 14 open into an air header 19 which is connected by means of a flared fitting 20 to the inlet end of the body 10. Studs 21 and nuts 22 coact with mating flanges 23 and 24 on the body and fitting, respectively, to detachably secure the body to the fitting. Other studs 25 and nuts 26 coact with mating flanges 27 and 28 on the outlet end of the body and on a flared elbow fitting 29, to detachably secure the body to this fitting. The fitting 29 is connected to the intake manifold 30 of the engine 18 so that when the latter is in operation the suction induced thereby in the intake manifold will function to draw air from atmosphere through the pipes 14 for heating by conduction and radiation of heat from the exhaust pipe 16, the heated air then passing through the header 19, mixing chamber 10 and fitting 29 into the intake manifold.

Fuel such as gasoline or other liquid hydrocarbon is adapted to be delivered to the mixing chamber 10 by the usual fuel pump 31 driven by the engine, the fuel delivery pipe 32 from the pump being coiled about a section of the water pipe 33 connecting the cylinder head 34 of the engine with the top of the radiator 35. The pipe 32 extends from the coiled portion thereof along the water pipe 33 and enters the body 10 radially at a point adjacent the inlet end of the mixing chamber 10 where it is connected to a fuel valve 36 of the tapered plug type shown in Figure 7. Surrounding the coiled portion of the fuel pipe 32 is a jacket 37 which coacts therewith and with the water pipe 33 to provide a fuel heater F for delivering warmed gasoline to the mixing chamber for vaporization and mixing with heated air therein.

A shaft 38 is journaled in the mixing chamber coaxially with respect thereto, in anti-friction bearings 39 and 40 rigidly supported from the body 10 by streamlined arms 41 and 42 respectively, which offer but negligible resistance to the flow of air through the mixing chamber. Fixed to the shaft 38 is a fan 43 which, under the action

of air traversing the mixing chamber, is caused to drive the shaft at a high speed.

To the shaft is also fixed a fuel vaporizing element V which comprises a plurality of fine mesh metal screens 44 of which three are shown in the present instance. The screens are arranged side by side and are maintained in slightly spaced relation by flat bars or strips 45.

The screens are confined between impervious cheek plates 46 and 47, the screens, bars and plates being soldered or otherwise permanently secured together, and the plate 47 having a hub 48 pinned to the shaft 38, all as shown in Figure 4. The screens 44 are circular and are of slightly less diameter than the internal diameter of the mixing chamber so as to provide an annular space between the two at the peripheries of the screens, for the passage of air. The cheek plates 46 and 47 are somewhat less in diameter than the screens to expose an annular peripheral portion of the screens for the passage of air transversely therethrough in order to effect vaporization of gasoline and the mixing of air therewith in a manner to be later described.

The cheek plate 46 is provided with a central opening 49 bounded by a collar 50 with which is telescopically associated, a cylindrical fuel delivery head 51, the inner circular wall 52 of which coacts with an internal sealing flange 53 in the collar to seal the joint between the collar and head and yet permit rotation of the collar relative to the head. The head 51 is formed internally with an annular fuel space 54 communicating with the fuel chamber 55 defined by the collar 50 and wall 52, through the medium of a circular series of ports 56 (Figure 5) formed in the wall. A pipe 57 in which is interposed a check valve 58 supports the delivery head 51 from the fuel valve 36 and conducts fuel from the fuel pipe 32 to the fuel chamber 55 when the valve 36 is open. The shaft 38 passes centrally through the head 51, and the joint between the two is sealed by a suitable packing gland 59. A deflector 60 in the form of a cone frustum projects from the cheek plate 46 and functions to guide incoming air into the relatively restricted annular space between the periphery of the cheek plate and the internal diameter of the mixing chamber.

Supported axially in the mixing chamber adjacent the outlet end thereof by streamlined arms 61 is an electric motor 62, which, through the medium of a conventional form of one-way roller clutch 63 is adapted to be utilized as a means to initially drive the shaft when starting the engine and until the latter is in operation to develop sufficient suction for rotation of the shaft by the fan 43.

Current is adapted to be supplied to the motor 62 from storage battery 64 under the control of a manual switch 65 (Figure 4). When the fan is being driven by the action of engine suction, and the operation of the motor 62 is discontinued, the clutch 63 automatically disconnects the shaft 38 from the motor shaft so as not to drive the latter. A streamlined tail hood 66 is attached to the motor 62 to minimize the resistance thereof to the air flow.

A throttle valve 67 of the butterfly type is arranged in the fitting 29 and is operatively connected to the fuel valve 36 by levers 68 and 69 fixed to the shafts of the respective valves and connected by a link 70 for operation in synchronism to concurrently and proportionately open and close the valves through the medium of a throttle rod 71 under the control of an operator.

The operation of the invention is as follows:

To start the engine, and assuming that the valves 36 and 67 are open to an extent enabling the engine to operate at at least idling speed, current is supplied to the electric motor 62 to drive the shaft 38 and thus rotate the vaporizing and mixing element V. As the engine is being cranked, fuel is pumped by the pump 31 past the check valve 58 and delivered to the fuel chamber 55 from which it impinges against the central portions of the screens 44 and spreads out over the areas of the screens to the exposed marginal portions thereof under the action of centrifugal force, the suction created by the engine functioning to aid the centrifugal force in drawing the fuel over the screens and to draw air from the inlet 12 through the exposed marginal portions of the screen for thorough and uniform mixing of the finely divided fuel particles with the air.

With the engine thus initially supplied with gaseous fuel, and with sufficient suction being developed to drive the fan 43, the supply of current to the motor 62 is discontinued. As the rotation of the shaft 38 at high speed is continued, the liquid fuel delivered to the chamber 55 in quantities determined by the position of the valve 36, impinges against the central portions of the screens 44. Centrifugal force aided by the engine suction will constantly cause the fuel to spread out over the combined areas of the screens in extremely thin films to the exposed marginal portions thereof, from which the fuel particles finely divided by the air passing through the extremely minute openings of the screens, are picked up and intimately mixed uniformly with the air for delivery in this state to the engine past the proportionately open throttle valve 67. The preliminary heating of the fuel and air materially aids vaporization of the hydrocarbon so as to provide a mixture of maximum combustibility. The check valve 58 automatically closes when the engine is stopped so as to prevent any leakage of fuel past the valve 36 in the normal idling position thereof.

The speed of the engine is of course controlled and varied by the synchronously actuated fuel and throttle valves 36 and 67 respectively, which maintain the correct proportion of fuel and air necessary to produce the most efficient mixture.

I claim as my invention:

1. In a charge forming device, means defining a mixing chamber adapted for connection to a source of engine suction; a plurality of screens arranged side by side in close proximity and rotatably mounted in the chamber co-axially with respect to the chamber; means for enclosing the screens while providing a central inlet to the screens and exposing an annular area at the periphery thereof for the flow of air therethrough; means for delivering a liquid hydrocarbon to the central inlet so that under the action of centrifugal force the hydrocarbon will spread out over the screens in a thin film and will be picked up by and mixed with air flowing through said exposed area of the screens to produce a combustible mixture; and means for rotating the screens.

2. In a charge forming device, means defining a mixing chamber adapted for connection to a source of engine suction; a plurality of screens arranged side by side in close proximity and rotatably mounted in the chamber co-axially with respect to the chamber; means for enclosing the screens while providing a central inlet to the screens and exposing an annular area at the

periphery thereof for the flow of air therethrough; a fuel delivery head correlated with said inlet and having a circular series of ports through which a liquid hydrocarbon is discharged into said inlet so that under the action of centrifugal force the hydrocarbon will spread out over the screens in a thin film and will be picked up by and mixed with air flowing through said area of the screens to produce a combustible mixture; and means for rotating the screens.

3. In a charge forming device, a cylindrical mixing chamber; a shaft journaled in the chamber co-axially thereof; a screen unit fixed to the shaft and including impervious walls closing the sides of the unit while leaving a central inlet at one side of the unit and exposing an annular area at the periphery of the unit for the flow of air transversely therethrough; means for delivering a liquid hydrocarbon to said inlet so that under the action of centrifugal force the hydrocarbon will spread out over the screens in a thin film and will be picked up by and mixed with air flowing through said exposed area of the screen unit to produce a combustible mixture; and means for rotating the shaft.

4. In a charge forming device, a cylindrical mixing chamber; a shaft journaled in the chamber co-axially thereof; a screen unit fixed to the shaft and including impervious walls closing the sides of the unit while leaving a central inlet at one side of the unit and exposing an annular area at the periphery of the unit for the flow of air transversely therethrough; means for delivering a liquid hydrocarbon to said inlet so that under the action of centrifugal force the hydrocarbon will spread out over the screen in a thin film and will be picked up by and mixed with air flowing through said exposed area of the screen unit to produce a combustible mixture; an air-driven fan fixed to said shaft for rotating the latter; an electric motor; and a one-way clutch for operatively connecting the motor to the shaft to drive the latter when air flow through the chamber is insufficient to rotate the fan.

5. In a charge forming device, means defining a mixing chamber adapted for communication with a source of engine suction; means for delivering a liquid hydrocarbon to the chamber; means correlated with the aforestated means and responsive to the action of centrifugal force to discharge the hydrocarbon in a film across the path of air sucked through the chamber, so as to produce a combustible mixture; means for rotating the last means under the action of engine suction; a source of power from which said last means can be driven independently of engine suction; and an operative connection between the source of power and said last means operable only in one direction of rotation.

6. In a charge forming device, means defining a mixing chamber adapted for connection to a source of engine suction; a plurality of screens arranged side by side in close proximity and rotatably mounted in the chamber co-axially with respect to the chamber; means for enclosing the screens while providing a central inlet to the screens and exposing an annular area at the periphery thereof for the flow of air therethrough; means for delivering a liquid hydrocarbon to the central inlet so that under the action of centrifugal force the hydrocarbon will spread out over the screens in a thin film and will be picked up by and mixed with air flowing through said exposed area of the screens to produce a combustible mixture; means for rotating the screens; and means for causing the velocity of incoming air to be increased in the zone of the exposed annular area of the screens so as to effect a more intimate intermixing of the hydrocarbon and air.

7. In a charge forming device, a cylindrical mixing chamber; a shaft journaled in the chamber co-axially thereof; a screen unit fixed to the shaft and including impervious walls closing the sides of the unit while leaving a central inlet at one side of the unit and exposing an annular area at the periphery of the unit for the flow of air transversely therethrough; means for delivering a liquid hydrocarbon to said inlet so that under the action of centrifugal force the hydrocarbon will spread out over the screens in a thin film and will be picked up by and mixed with air flowing through said exposed area of the screen unit to produce a combustible mixture; means for rotating the shaft; and a conical deflector carried by the screen unit and operating to deflect incoming air outwardly into the exposed annular area of the screens to increase the velocity of the air for a more intimate mixing of the air with the hydrocarbon.

8. In a charge forming device, means defining a mixing chamber adapted for connection to a source of engine suction; rotary means having a reticulated surface; means for enclosing said reticulated surface while providing a central inlet thereto and exposing an annular area at the periphery thereof for the flow of air therethrough; means for delivering a liquid hydrocarbon to said inlet so that under the action of centrifugal force the hydrocarbon will spread out over the reticulated surface in a thin film and will be picked up by and mixed with air flowing through said exposed area; means for rotating said rotary means; and means for causing the velocity of incoming air to be increased in the zone of the exposed annular area of the reticulated surface so as to effect a more intimate intermixing of the hydrocarbon and air.

RICHARD THOMPSON.