May 11, 1937. A. OLIVOTTI ET AL 2,080,182

CHARGE FORMING APPARATUS

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Fig. 1

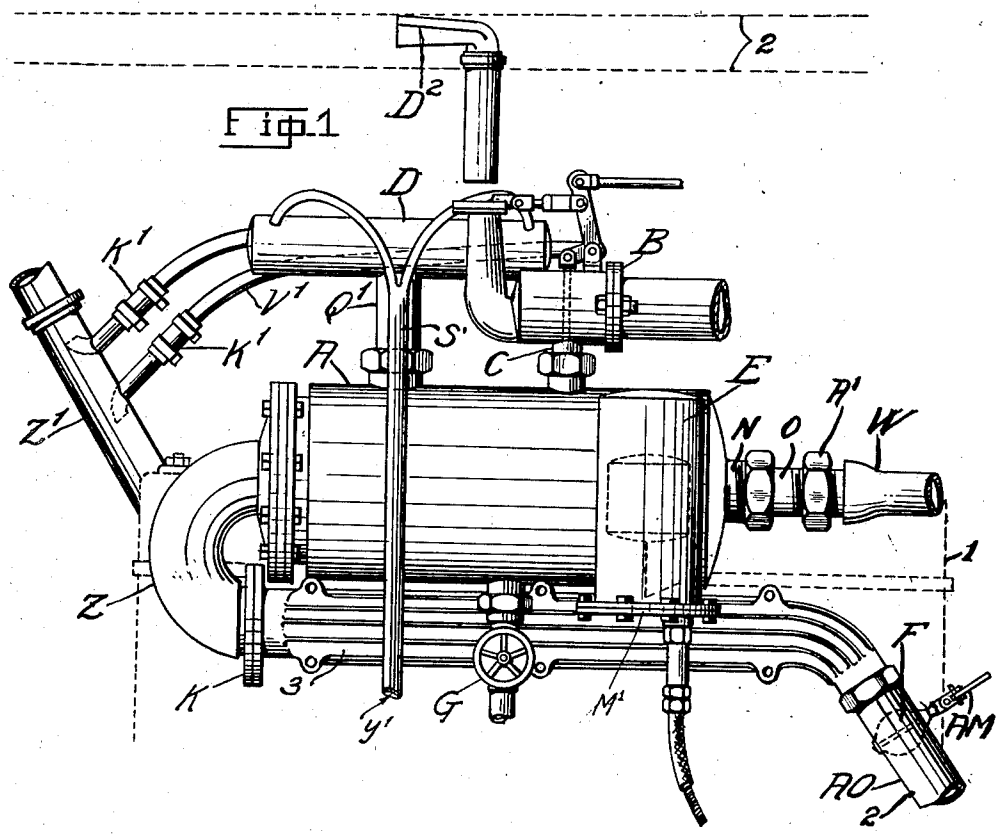
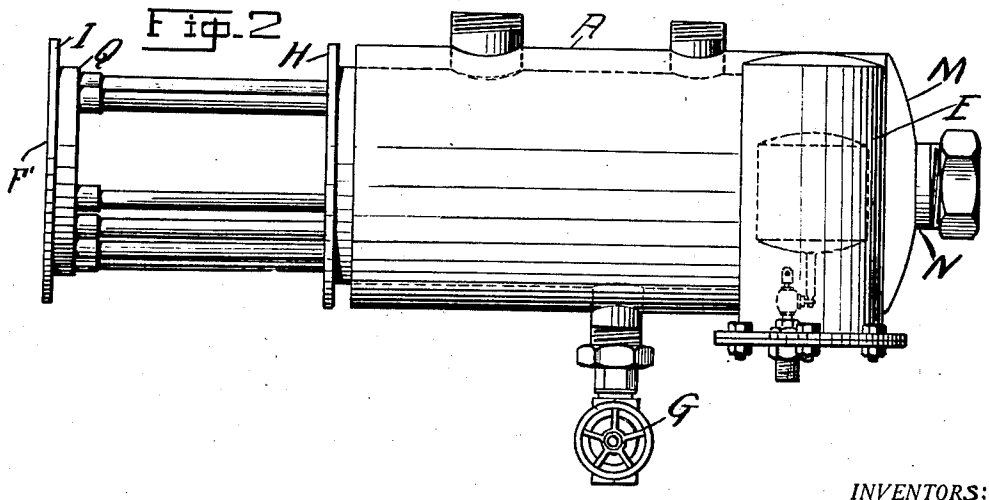


Fig. 2



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CHARGE FORMING APPARATUS

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Fig. 3

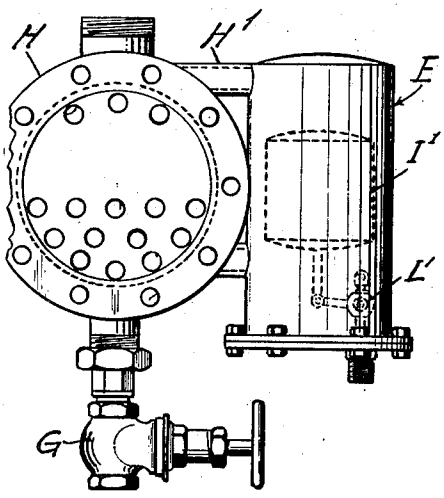

Fig. 5

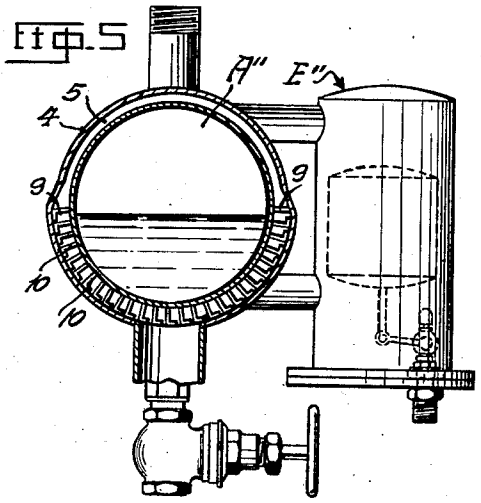

Fig. 4

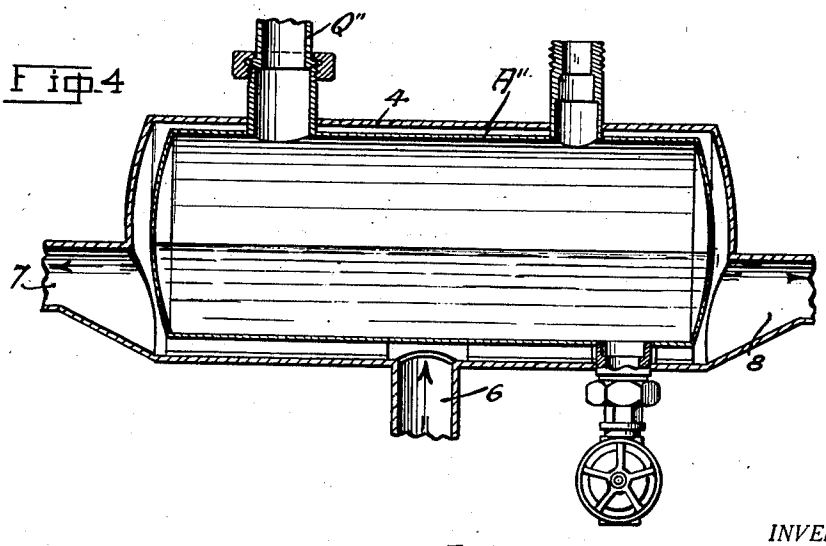

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Fig. 6

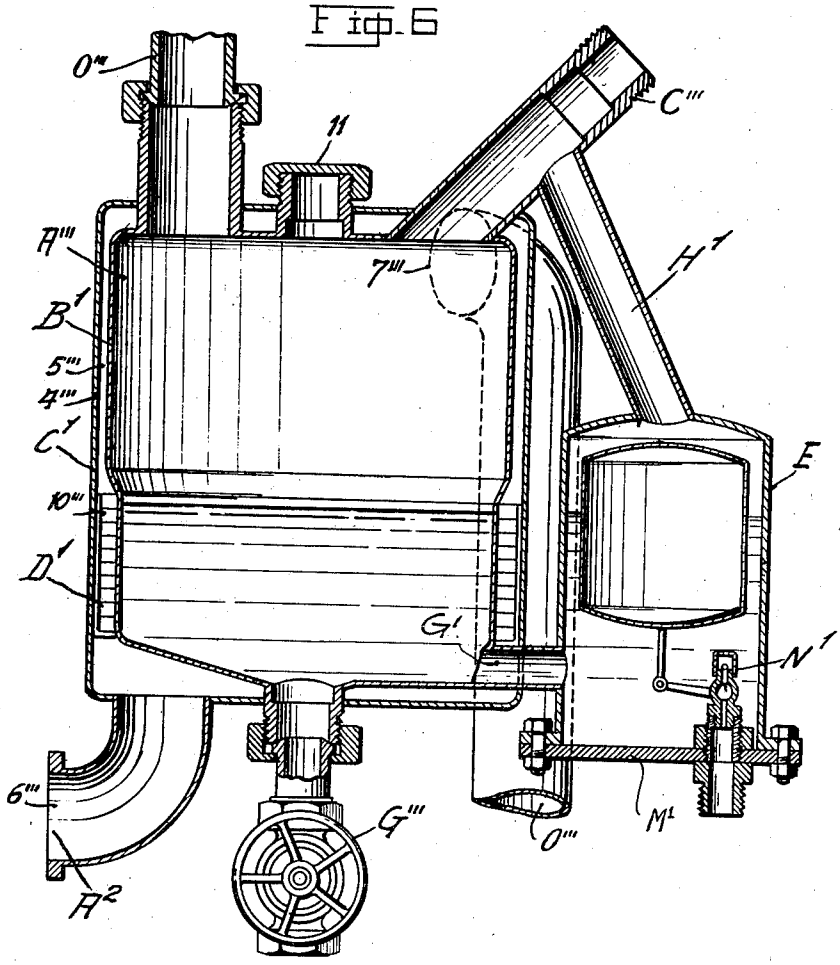


Fig. 7

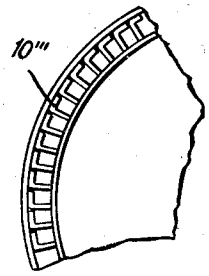
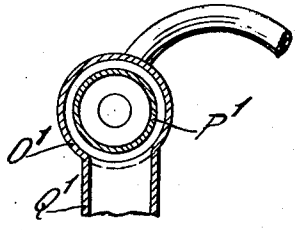


Fig. 8



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CHARGE FORMING APPARATUS

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Fig. 9

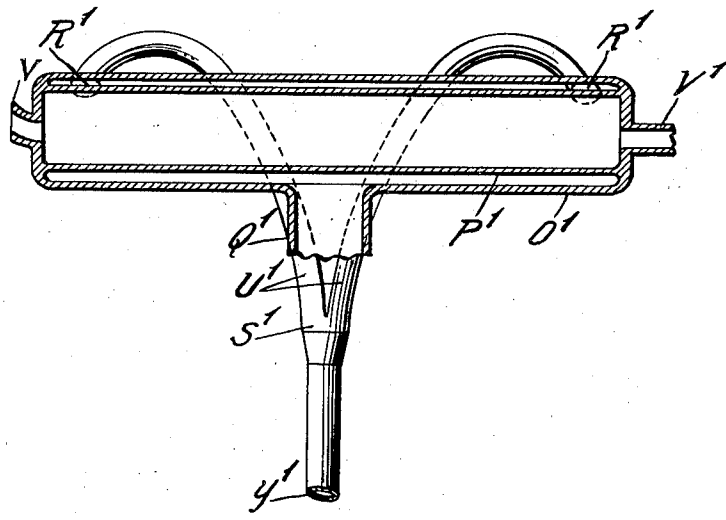

Fig. 11

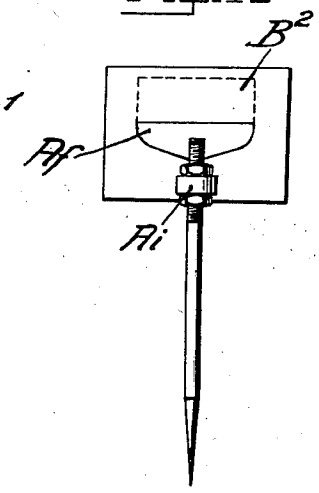

Fig. 12

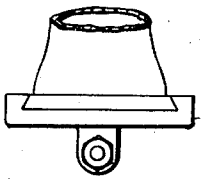

Fig. 10

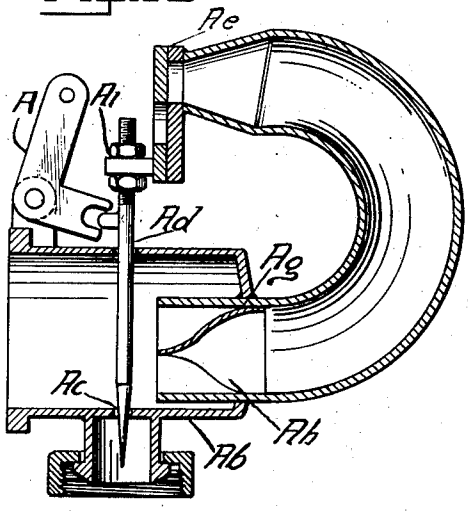

Fig. 13

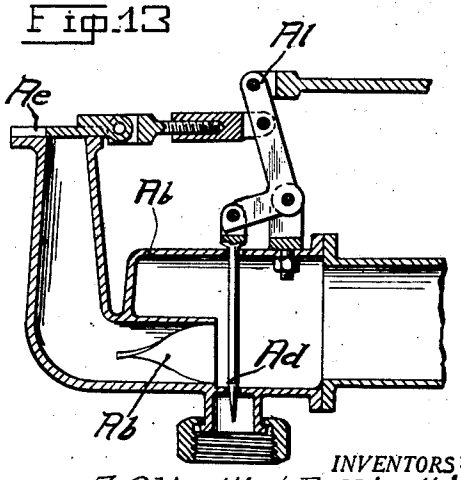

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Fig. 14

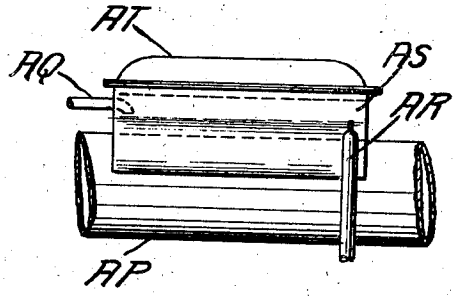


Fig. 15

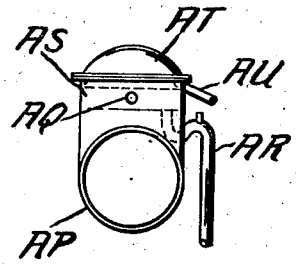
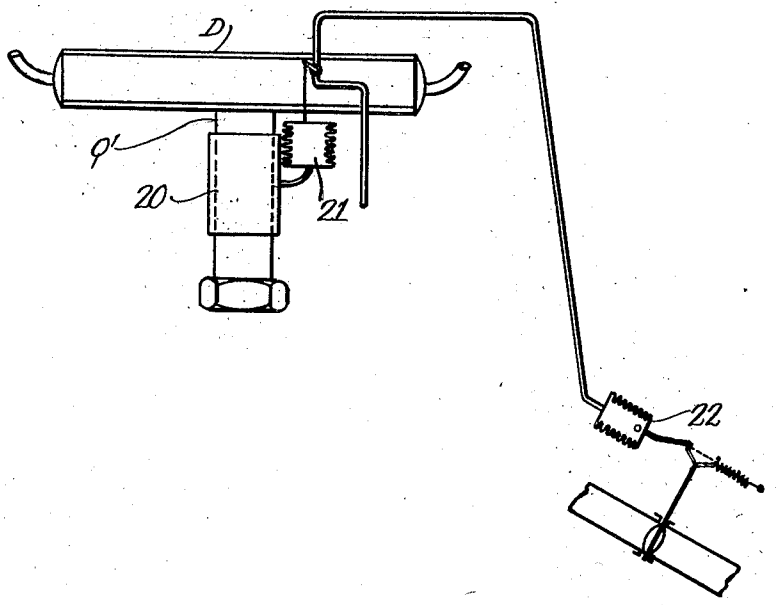


Fig. 16



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Patented May 11, 1937 2,080,182

UNITED STATES PATENT OFFICE

2,080,182

CHARGE FORMING APPARATUS

Antonio Olivotti and Elia Olivotti, Venezia, Italy

Application October 24, 1932, Serial No. 639,358
In Italy October 23, 1931

2 Claims. (Cl. 123—133)

(Granted under the provisions of sec. 14, act of March 2, 1927; 357 O. G. 5)

The present invention has for its subject matter a process for a mixture of air and heavy hydrocarbons (naphtha, petroleum, mazout and any other hydrocarbon) which at the surrounding temperature does not evaporate in the air or evaporates in a quantity quite insufficient for the building of an explosive mixture at lower temperature, homogeneous, in the form of a quite white stable and perfectly explosive fog, for the feed of internal combustion engines.

The heavy hydrocarbons have thus far been employed as driving medium for internal combustion engines working on the principle of the mixture compression, by means of evaporation and mixing with hot air the hydrocarbons being conveyed to the engine in the form of a mixture which in this case is transparent.

With this method however it easily happens that the fuel evaporated in the air forming part of the mixture, condenses along the suction pipe and within the cylinders; this owing to the lower temperature of said pipe and cylinders as compared with the temperature of the mixture; it also happens that incrustations are formed.

Further, owing to the expansion of the mixture due to the considerable increase in temperature, the engine develops a very low specific power, also on account of the reduction of the compression ratio, such a reduction being necessary in order to avoid detonations; the consequence is that also the thermal efficiency is considerably reduced.

Now, according to the invention, the heavy hydrocarbon must not reach the engine in vapor form but in the form of a fog being perfectly white, cold as much as possible, homogeneous and stable viz. such as not to moisten the pipings—even cold—it flows through. With such a mixture, the above mentioned deficiencies inherent to the evaporated mixture, as well as the incrustations, are eliminated owing to the saturated, and consequently not siccative, nature of the mixture which is free from pitch parts and liquid parts deriving from the condensation.

The method for securing such a stable fog forms the subject matter of the present invention.

The method may be considered as comprising two stages: in the first stage a jet of vapor of the hydrocarbon employed strikes a current of cold air in the proportions requisite for complete combustion under such conditions as will secure the homogeneity in the meeting between air and fuel; in this meeting between vapor and cold air, the explosive mixture is formed which, when examined in a glass pipe, appears perfectly white and thick.

If the homogeneity is deficient as is the case for instance if the vapor issues at a low velocity from a large section, zones of pure vapor or zones rich in vapor (that is to say, mingled with but a small amount of air), would come into contact with the walls of the suction pipe and of the cylinders, and would give rise to an actual condensation. It is well known that condensation involves, not only a low efficiency, but also an irregular combustion and a dilution of the lubricating oil.

In the second stage the perfectly white and thick fog thus formed travels from the spot where it has been built till inside the cylinder without being subjected to any lowering of its pressure, that is to say without encountering any obstacles, because any obstacle would cause a drop in the fog pressure, the obstacle representing a division between two pressures of different value; this passage from a given pressure to a lower one causes in the fog an intermediate precipitation viz. a separation of the fuel from the air, the precipitation being partial or total according to the greater or smaller drop, and lessening or totally destroying the stability. The engine fed with a fog that has lost its stability (such a fog appears paler and almost transparent if one lets it pass through a glass pipe) immediately gives a very smoky exhaust, rapidly dilutes the lubricating oil, sinks in power and misses strokes till it completely stops.

The usual system of acceleration by throttling the mixture (butterfly) constitutes the most frequent example of a cause of a drop in pressure; for this reason the said method is done away with in the present invention and is replaced by another method comprising two valves, one for the air and the other for the vapor, the vapor valve being arranged downstream of the air valve. With this method it is practicable to vary the charge of the engine without determining any pressure drop in the fog.

This second condition, viz. the avoidance of the fog being subjected to a lower pressure than that at which the fog has been formed, imparts to the fog the property of remaining stable.

It has also been ascertained that the stability of the fog increases according as the air for building it is colder.

The invention will be now explained with reference to the annexed drawings, which show, by way of example only, some execution forms of the apparatus.

Fig. 1 is a side elevation of the complete apparatus,

Fig. 2 is an enlarged elevational detail showing the boiler with the constant level cup and discharging cock for the concentrated naphtha; the tubular bundle heater being partly removed from the boiler,

Fig. 3 is an end elevational detail looking toward the boiler with the disc removed,

Figs. 4 and 5 show in longitudinal section and cross section respectively a modified form of an externally heated boiler provided with ribs,

Fig. 6 is a vertical sectional view of a further modification showing an externally heated vaporizer provided with ribs,

Fig. 7 is a fragmentary sectional view showing a series of ribs as arranged on the device shown in Fig. 6,

Figs. 8 and 9 show respectively a cross and a longitudinal sectional detail of the condenser,

Fig. 10 is an enlarged vertical sectional detail of the directly coupled carbureter,

Fig. 11 is an elevational detail of the slide of the modified carbureter provided with a needle,

Fig. 12 is a top plan detail of the slide,

Fig. 13 is a vertical sectional detail of a modified form of carbureter provided with levers,

Figs. 14 and 15 show the oil regenerator respectively in side and end elevation, and

Fig. 16 is a side elevational detail of the automatically controlled deflecting device.

The apparatus which is intended for use with a motor car engine employing naphtha as fuel is constituted by the following main parts:

A horizontal boiler A (Fig. 2) which is filled with naphtha until about the half of its height. It contains a tubular bundle heater which is dismountable with regard of the boiler by means of a flange H and stuffing-box N. The tubular bundle heater may be internally cleaned since the box Q (Fig. 2) is formed with removable bottom L. The heater is provided on the top with three pipes adapted for overheating of vapour.

The liability of the boiler together with the heater to be removed from the collecting main exhaust tube is ensured by flange K (Fig. 1).

To facilitate the autogene iron soldering of tubes constituting the bundle, which are of small thickness on the bottoms of the boxes, the end of each tube or pipe has soldered thereon a very short length of pipe of somewhat greater thickness X (Fig. 2).

The length of tube O, passing through the stuffing-box of the boiler N, (Fig. 2) is connected with another pipe constituting the projection thereof by means of the connecting branch W (Fig. 1).

The projection pipe W continues underneath of the motor car where it discharges the exhausted gas directly to the atmosphere.

In the modified construction according to Figs. 4 and 5 the boiler A' is heated from the outside. It is enclosed by a jacket 4 with a suitable space 5 between for circulation of the exhaust gases which enter at a middle point 6 below and leave at the two ends 7 and 8, but might also enter through one end and leave through the other end. It is desirable that the larger portion of the exhaust gases shall lick the bottom surface of the boiler A'', while a limited portion of the gases circulates through the upper zone, viz. through the zone corresponding to the vapor chamber of the boiler to the sole object of preventing the cooling down of this portion of the boiler. To this effect, the space between the boiler and the jacket is divided, about midway of the boiler height, by a horizontal wall extending round the boiler circumference and pierced with holes for connection between the lower and upper portion of said intermediate space.

In the lower portion of said space, metal ribs 10 are arranged lengthwise, the ribs being provided with holes and their object being to subtract from the exhaust gases as much heat as possible. Each rib is bent at right angles and welded to the boiler wall.

In the example shown (Figs. 6 and 7), the boiler A''' is cylindrical in shape and vertically arranged. The upper portion of the boiler is larger in diameter than the lower portion, in order to facilitate the disengagement of the vapour. The wall thickness of the lower portion is relatively thin in order to facilitate the heat transmission by conductiveness, while the wall thickness of the upper portion is greater. The boiler has welded to its outer surface a large number of ribs 10''' arranged in its lower portion. The boiler is lodged in a vessel 4''' traversed by the exhaust gases, these entering from below through the aperture 6''' and leaving at the top through the aperture 7''' to which the exhaust pipe O''' is connected. The plug 11 at the top serves for the internal inspection and scaling of the boiler. The upper portion of the boiler fitted with ribs is smaller in diameter than the heater so as to leave an annular space 5''' for passage of the exhaust gases before they leave through 7'''. As usual the boiler is fitted with drain cock G and with constant level vessel E connected at G^1 and H^1 with the lower portion of the boiler and with the vapor chamber respectively.

A special constant level vessel E (Figs. 1, 2, 6) serves for maintaining the liquid fuel within the boiler about at a half of the height of the vessel, as shown in F^1 (Fig. 2); said vessel has no communication with the external air, but only at the bottom G^1 with the bottom part of the boiler and at the top H^1, with the upper part of the boiler to provide that pressure above the naphtha be equal to that within the boiler and the vessel. The same contains a float I^1, which operates a small cock through which the naphtha enters the vessel. The float together with the cock may be removed through the base plate M^1.

The cock may be formed with a spherical valve N^1 to prevent possible outflow of boiling naphtha from the piping when breakage should occur.

A special condenser 1d, (Figs. 8, 9) is provided for condensing the excess of vapour to avoid that this latter produces in the boiler a higher than the atmospheric pressure. The condensed vapour drops back into the boiler. Said condenser is formed with two pipes O^1—P^1, arranged slightly excentrically one within the other. Within the interior pipe P^1, circulates the cooling water of the engine. The condenser is connected with the boiler by means of the tube Q^1. The excess of vapour is free to enter the intervening space thus expelling the air through the two holes R^1, which are followed by two pipings which become united in only one piping S^1, which project to a suitable length from the engine.

The two holes R^1 are necessary to ensure the greatest effect of the condenser.

Opposite to the point U^1 (Fig. 9) are arranged two small holes to prevent formation of a syphon action. The circulation of the water within the internal pipe P^1, is effected through a small pipe V^1 (Figs. 1, 9) which conducts away the water at the water outlet of the condenser. The water

circulation within the condenser is effective as the small pipes K^1, (Fig. 1) enter the pipe 2^1 with pitots as shown in Fig. 1.

A special carbureter shown in Fig. 10 serves to form the mixture of air and vapour of naphtha in such a manner as to secure constantly at various speeds the just ratio between air and vapour, as well as the homogeneity and stability of the mixture.

The vapour sucked in by the engine passes through a nozzle Ac (Fig. 10) and is controlled by a needle Ad, which is connected with the air slide Ae (Figs. 10, 11), through which the air sucked-in enters.

The slide has a specially shaped hole Af, which is empirically established and may, of course, vary with the conical degree of the needle. The air sucked in prior to being blown against the vapour strikes against the fixed screw Ah, which imparts to the air a turbulent motion to render the fog or spray homogeneous. The operation of the slide-needle group is obtained by means of a lever Al, which is connected to the mixture control pedal.

The carbureter instead of being directly connected with the needle-slide group may be connected thereto by means of levers as appears from Fig. 13 and Fig. 1.

In order that the air used to form the mixture be as cold as possible it is convenient that the cover of the motor car carries an air inlet D^2, (Fig. 1).

A means for carrying away the exhaust gas F (Fig. 1) to control the amount of heat passing through the heater of the boiler to be regulated by the hand of the driver may be provided for.

The control of the deflecting device may be automatic by arranging around the vertical pipe Q^1, (Figs. 1, 8, 9) a metallic jacket **20** and by introducing within the intervening space thus resulting a fluid expansible by the effect of the temperature of the pipe heated in its turn by the excess of vapour, said fluid acting on a metallic resilient diaphragm **21** operating the deflector by means of an auxiliary vacuum control generally designated by the numeral **22**.

To avoid the phenomenon of knocking of the engine as well as for increasing the thermical efficiency it has been arranged that to the mixture is added a certain amount of exhaust gas controllable (not shown) at will by means of a small throttle.

In order to maintain a good viscosity of the lubricating oil for the engine in the case of possible dilution by the naphtha, the apparatus comprises an oil regenerator the operation of which is based upon the principle of the ebullition of oil diluted with naphtha.

This regenerator consists of a vessel (Fig. 14), and (Fig. 15) which is soldered on the exhaust pipe coming from the boiler which has practically a constant moderated temperature. The said vessel has for its bottom the exhaust pipe itself Ap; from an end Aq enters slowly the diluted oil coming from a piping connected with that conducting towards the pressure gauge of the oil and issues in regenerated condition at the opposed side through the pipe Ar, which is somewhat higher in respect to the bottom. The oil level thus will remain constant.

The naphtha which is condensed on the cover At, is collected within the gutter As, and is discharged through Au.

The cover At is fixed by means of screws.

While we have herein illustrated and described a preferred embodiment of the present invention, it will be understood that changes in the construction and arrangements of the parts may be made without departing either from the spirit of the invention or the scope of our broader claims.

What is claimed and desired to be secured by Letters Patent is:

1. A charge-forming apparatus for internal combustion engines including a carburetting chamber, ports in said chamber for receiving air and vapor said chamber being in direct communication with the engine for supplying a cold stable homogeneous fog in its original pressure condition, a needle valve arranged in said chamber and adapted to reciprocate in one of said ports for opening and closing said port for controlling the admission of the vapor to said chamber, a slide valve for controlling the admission of cold air through a second port into said chamber, the air control valve being arranged up-stream of the vapor control valve, means for connecting the valves together so as to obtain synchronous operation thereof, said connecting means constituting an acceleration means, the air valve having a suitably shaped hole in order to maintain the proportions between air and vapor entering said chamber constant with all engine speeds; the port in said carburetting chamber for the vapor control valve delivering direct into the air current and lying at the periphery of the air current and pointing to the center of this current, so that the vapor issues into the air current with a velocity which increases as the needle valve moves toward closed position in said port, and a stationary helix occupying the whole cross section of the air passage adjacent said needle valve for effecting a vigorous whirling action of the air in order to produce an intense turbulent and rapid movement of the air before the air encounters the vapor.

2. A charge forming apparatus for internal combustion engines including in combination a boiler for the liquid fuel, means associated with the exhaust of the engine for heating the boiler to produce a vapor, means for automatically and constantly maintaining the fuel at the desired level in the boiler, means communicating with the boiler for condensing the excess vapor and returning the same to the source of supply and thereby maintaining the vapor at atmospheric pressure, means for adjusting the heating of the boiler including a deflector for the exhaust gases, means associated with the point of communication between the boiler and condensing means and responsive to the temperature of the heated fuel for automatically regulating the operation of the deflector, a carburetting chamber in communication with the boiler, a valve for controlling the admission of cold air to the chamber, a valve controlling the admission of vapor to the chamber, an operable connection between the valves to ensure of synchronous operation thereof and constituting an accelerating means, and effecting introduction of fuel vapor into the air stream in dependence on the working condition of the engine thereby producing a cold stable homogeneous fog within the chamber and means for delivering the fog at uniform pressure and velocity directly from the chamber to the combustion chamber of the engine.

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