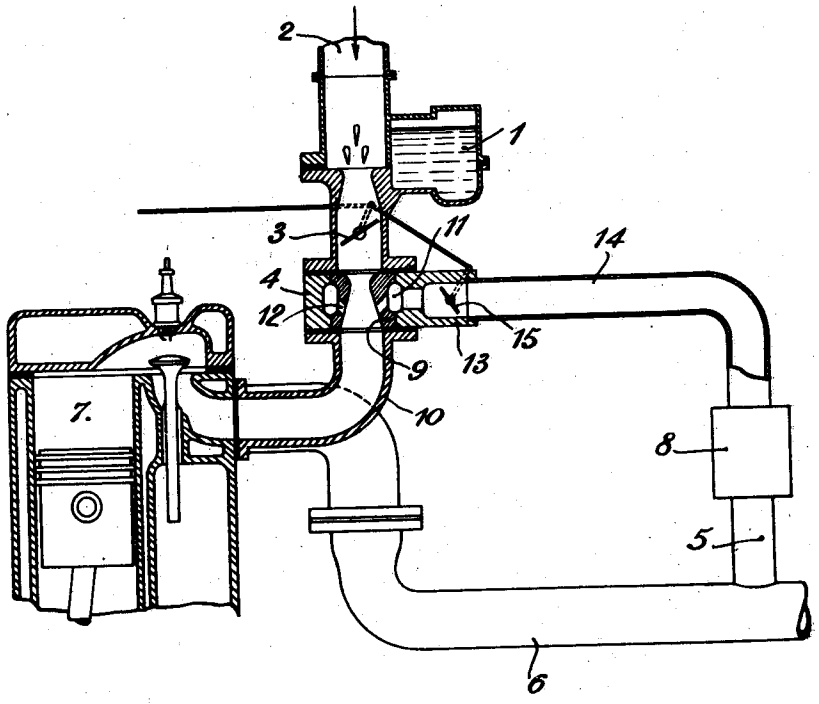
July 25, 1944. W. V. BLANC 2,354,179

CHARGE FORMING DEVICE

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Fig. 1.



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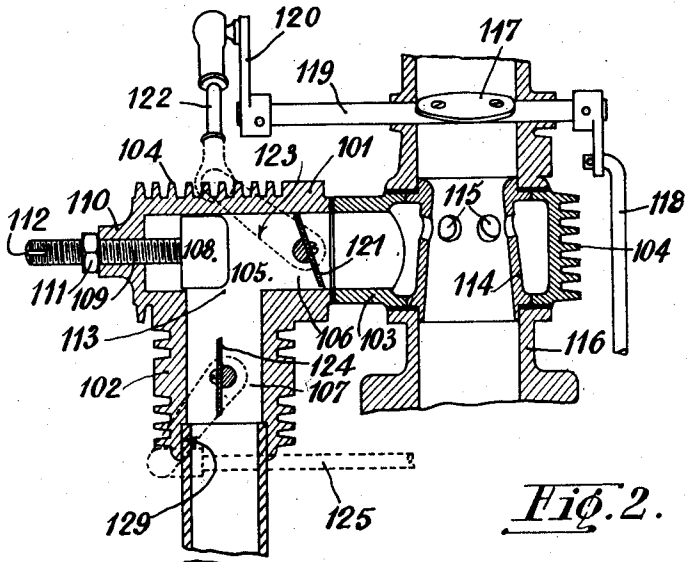
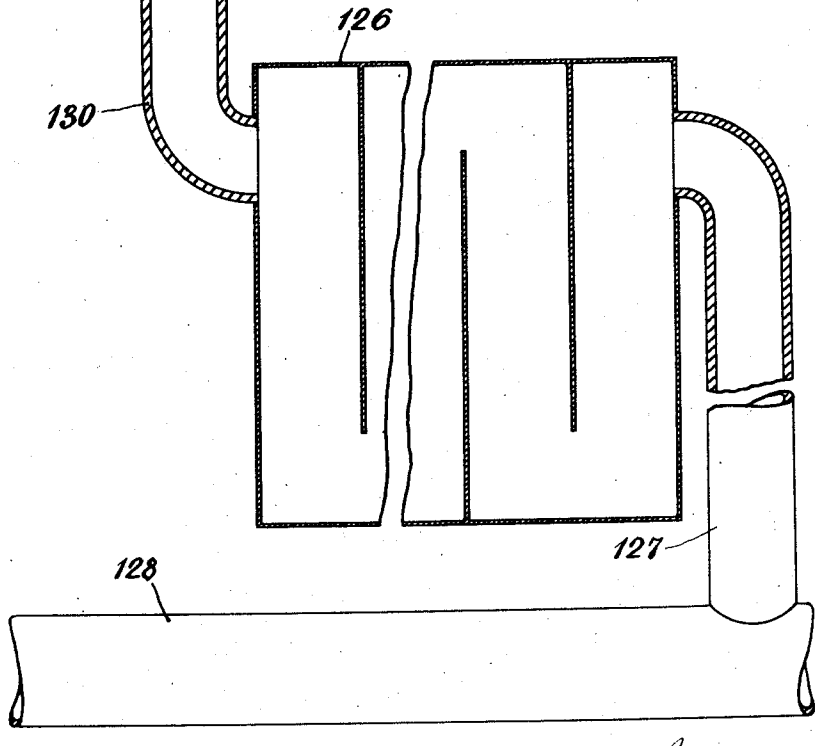


Fig. 2.



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Fig. 4.

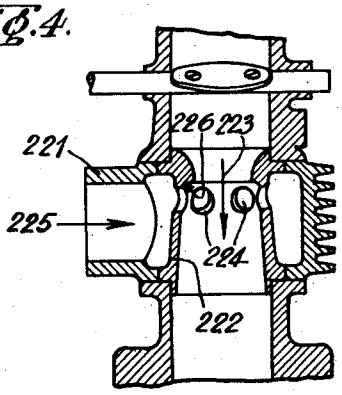


Fig. 3.

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UNITED STATES PATENT OFFICE

2,354,179

CHARGE FORMING DEVICE

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In Switzerland March 24, 1941

9 Claims. (Cl. 123—119)

This invention relates to an apparatus for the addition of a gas, particularly of an inert gas to the gaseous fuel mixture of a high compression or internal combustion engine.

This apparatus comprises a passage for the addition gas leading into a chamber equipped with a nozzle comprising calibrated holes, said nozzle discharging into the inlet piping of the engine for the purpose of forming a homogeneous gaseous mixture with the gaseous mixture forming the fuel of the engine in order to eliminate the knocking of the engine as well as in order to reduce the fuel consumption, a throttle controlling the inlet of the supplemental gas in order to admit a suitable quantity of the said gas to the gas forming the fuel.

It particularly comprises a proportioning device with a member for blocking of said passage, said member being adjustable in a given fixed position. The throttle controlling the inlet of the inert gas may be actuated in synchronism with the throttle of the engine carburettor, for example by being mechanically connected to the former; it may also be actuated by the vacuum in the engine, by a spring or by any other means.

The apparatus according to the invention has two main objects according to the nature of the added gas and of the gaseous mixture forming the fuel of the engine; they are:

(1) To incorporate an inert gas into the gaseous mixture forming the fuel when the latter possesses a high combustion value, the quantity of the admixed inert gas being exactly proportioned in order to eliminate the knocking of the engine at any given speed. The admixed inert gas is preferably engine exhaust gas, but it may be any other non-burning gas which does not attack the engine parts, such as for example nitrogen.

This addition of inert gas makes it possible to considerably increase the compression ratio of a given engine eliminating at the same time the phenomena of self-ignition, which occur when using standard gasoline, thus totally eliminating the knocking, and this without making use of fuels with a high octane number. The increase of the compression ratio brings about the very important advantage of maintaining the power of the engine and of simultaneously reducing the fuel consumption. The apparatus according to the invention thus makes it possible to run on ordinary gasoline, without any change, all engines with a high compression ratio or when the compression ratio has been highly increased, for example for the use of generator gas, and without knocking or risks for the mechanism; it further makes it possible to obtain a saving of fuel.

(2) To incorporate a gas of high combustion value into the gaseous mixture forming the fuel, when the latter possesses a relatively low combustion value in order to increase the output of the engine. The auxiliary gas may be for example acetylene and the gaseous mixture the one supplied by a gas generator.

In case the auxiliary gas is exhaust gas of the engine, the apparatus comprises at least one draw-off conduit for gas on the exhaust piping of the engine. In the preferred constructional form the apparatus comprises two such conduits for the gas on said exhaust piping, one—the main one after the silencer—and the other, the secondary one near the engine, both draw-off conduits functioning in parallel.

Thus, the secondary conduit will be up stream of the main conduit with regard to the gaseous flow in the exhaust piping and will have a smaller delivery as compared with the main draw-off.

The secondary conduit makes possible a regular supply of inert gas to the engine at all speeds, as well as during acceleration, when it has a compensating action before the suction current of gas taken behind the silencer has been established. Further, it maintains a more uniform temperature of the inert gas when the latter reaches the engine. The calibrated holes of the nozzle of the apparatus are preferably arranged at a certain angle with respect to the nozzle axis for the passage of the inert gas. This nozzle may comprise a recess on the passage of the gas flowing from the carburettor, and up stream of the calibrated holes. This recess causes a good suction of the inert gas.

Other objects of the invention relating particularly to details of construction will become apparent from the following description read in conjunction with the accompanying drawings in which

Fig. 1 is a schematic view partially in section of an apparatus according to the invention, showing the layout of the former with regard to the engine and its carburettor, which may be inverted, or horizontal or vertical;

Fig. 2 is a view partially in section of an apparatus comprising but one draw-off conduit for the gas on the exhaust piping of the engine; this view shows in detail the proportioning device with its adjustable blocking member for the passage for the added gas, as well as a construc-

tional form of synchronised inlet throttles for the combustion gas and for the inert gas;

Fig. 3 shows schematically an apparatus with two draw-off conduits for the exhaust gas, and

Fig. 4 is a sectional detailed view of a nozzle of a special shape arranged in the receiving chamber of the inert gas.

In the Fig. 1 a carburettor is shown with a constant level vessel 1 and with an air intake 2. A throttle 3 controls the flow of the mixture fuel-air to the proportioning device for the addition of the inert gas.

This apparatus comprises a draw-off conduit 5 on the exhaust piping 6 of the engine 7. A filter and a back-fire screen indicated schematically at 8 are arranged between the draw-off conduit 5 and a nozzle 9 mounted in a body 4 and on the inlet pipe 10 of the engine. The nozzle 9 is surrounded by an annular chamber 11 which is in communication by means of a number of calibrated holes 12 with the interior of the nozzle. This chamber 11 is connected to an adaptor 13, which is connected to the filter and to the back-fire screen 8 by means of a passage 14.

The throttle 15 is arranged in the adaptor 13. This throttle is connected to the throttle 3 by means of a set of levers and a rod, in such a manner that these throttles are controlled to execute a simultaneous forced movement when actuated by the throttle pedal of the engine. The throttle 15 may also be automatically controlled by suction, a spring or by other means.

The functioning of the apparatus described is the following:

The suction produced by the engine in the inlet pipe 10 brings about not only the suction of the mixture formed by the carburettor, but also of the gas in the chamber 11. According to the opening of the throttle 15 which is proportional to that of throttle 3, said suction causes the extraction from the pipe 6 of a part of the exhaust gas of the engine and its admixture with the mixture originating from the carburettor. The filter and the back-fire screen 8 prevent solid particles from being introduced into the apparatus and any risks of ignition of the fuel which is in the carburettor and in the pipe 10.

A gaseous mixture formed at least partially by the fuel, oxygen, nitrogen, carbon dioxide and by vapours of water is obtained in the inlet pipe; in said mixture the quantity of inert gas (nitrogen, carbon dioxide, water vapours) is superior to that originating from the air admitted to the carburettor. The proportion of exhaust gas admixed with the gas from the carburettor is adjustable and depends upon the opening of the throttle 15. This proportion may vary for example between 20 and 50%. Thus, it is possible to supply the engine with a mixture diluted by exhaust gas and, by altering the compression ratio of the engine, to obtain a development of power at least equal to that which would develop without this change and by supplying the engine exclusively with fuel and air. Thus, owing to the dilution of the explosive mixture a corresponding saving in fuel consumption is obtained. Furthermore, the fuel need not possess qualities (high octane number) which are necessary when employed in engines with a high compression ratio.

In an alternative of the apparatus described, the nozzle 9, instead of being mounted on the inlet piping of the engine down stream with regard to the carburettor, could be arranged on the air intake of the carburettor.

With reference to Fig. 2 the apparatus comprises a proportioning device made from a light alloy and consisting of two parts 102 and 103 and provided with cooling fins 104. A passage 105 arranged at the interior of the piece 101 has two portions 106 and 107 set at right angles to one another, the portion 106 being rectilinear and ending in a distribution chamber around a nozzle 114.

A piston 108 constituting an adjustable blocking member is arranged in such a manner that it may move in the rectilinear portion 106. This piston is supported by a threaded rod 109 screwed into an eye 110 of the piece 101. This rod carries a nut 111 and comprises a slot 112 at its free end for the introduction of a screw driver. It will be understood that the position of piston 108 in the passage 105 with respect to the opening 113 connecting both portions 106 and 107 may be adjusted and that it is possible to fix the piston 108 in a given position along the rectilinear portion 106.

The nozzle 114, with a calibrated bore and comprising calibrated holes 115 with their axes at a certain angle with respect to the axis of the nozzle, is arranged in the part 103 forming an annular distribution chamber. Said nozzle is removable and it is possible to introduce into the piece 103 various nozzles possessing bores and calibrated holes of different diameters. Said nozzle discharges into the engine inlet passage 116 down stream with respect to a throttle 117 controlling the passage of the gaseous mixture forming the fuel. Said throttle is actuated by the usual throttle lever, not shown in the drawing, by means of a rod 118. The gaseous mixture may originate from a carburettor (not shown), or it may even be only air in the case of an engine running on injected solid or liquid fuel.

The axis 119 of the throttle 117 bears a lever 120 which actuates a shutter 121 by means of an adjustable rod 122 and a lever 123. The shutter 121 controls the flow of inert gas into the passage 105 in the direction of the nozzle 114; it is actuated by a forced simultaneous movement with the throttle 117 by means of the throttle handle. Said shutter 121 may also be actuated automatically for example by the suction of the engine, by means of a spring or by any other means.

A shutter 124 is arranged in the portion 107 of the passage. Said shutter may be set to a certain position by means of a lever (not shown) connected to it by the rod 125; thus the passage 105 may be completely closed for example when the engine is running on mixed fuel (gas generator or gasoline).

An expansion vessel 126 with baffle plates is arranged between the draw-off conduit 127 of the exhaust gas mounted on the exhaust piping 128 of the engine (after or in front of the silencer) and the proportioning device. This expansion vessel 126 serves as a back-fire screen, filter, expansion vessel and as a reservoir for the exhaust gas. It is formed by a metallic box containing baffle plates. It prevents pressure variations of the exhaust gas in the tubing 128.

As the apparatus according to the invention may also be mounted on already existing engines (engines of motor cars and other) it must in this case adapt itself to the various existing designs. For this purpose the device 101 consisting of two parts 102 and 103 is arranged to make it possible

to adjust the orifice 129 of the passage 105, and the pipe 130 connecting said orifice to the vessel 126 may be flexible or rigid.

The functioning of the apparatus described is the following:

It is mounted on an ordinary engine running for example on fuel supplied by a carburettor. The compression ratio of this engine has been increased for example by a modification of the cylinder heads or of the pistons.

When the engine is running exhaust gas drawn from the pipe 128 passes through the expansion vessel 126, the pipe 130, the passage 105, is controlled by the piston 108 and the shutter 121, and is finally mixed with the gas forming the fuel in the nozzle 114. The resulting mixture is directed to the engine through the inlet passage 116.

The quantity of the exhaust gas admitted to the fuel mixture is in proportion to the gas supplied to the engine and this due to a forced connection of the two shutters 117 and 121 or due to an automatic action of the shutter 121. The adjustment of the apparatus is obtained by means of the piston 108 of a fixed, adjustable position and by means of an interchangeable nozzle 114. Thus it results that for a given engine supplied with a fuel of a given quality by a carburettor of determined dimensions, the compression ratio of this engine (either after a change or originally) being higher than may normally be used with ordinary fuel, an appropriate nozzle is mounted for feeding the carburettor and all that has to be done is the adjustment of the piston 108 in order to avoid any knocking of the engine. Once said adjustment has been carried out the functioning of the apparatus is automatic. After such adjustments it will be noted that the engine develops a power which is at least equal to its original value, and that the fuel consumption has been reduced and this without any knocking in spite of the use of ordinary gasoline (65 octanes).

Furthermore, in addition to the case just described, the apparatus may be mounted on an engine with a standard compression ratio but supplied with a fuel of a combustion value higher than usual, for example with acetylene. The addition of quite definite quantities of exhaust gas will avoid the inconveniences inherent in acetylene and under certain conditions will even make it possible to increase the compression ratio.

Inversely, if the gaseous fuel mixture has a low combustion value, instead of adding an inert gas, a gas with a high combustion value such as acetylene may be supplied through the passage 105, the orifice 129 being connected in this case to a source of such a gas with a high combustion value.

In the case when the apparatus is mounted on a motor vehicle equipped for example with a gas generator, with its engine possessing an increased compression ratio for the use of a gas with a low combustion value, the rigging 125 controlling the shutter 124 may end somewhere within the reach of the driver; thus the apparatus may be put out of action when using a gas with a low combustion value, and put back into action to prevent knocking as soon as the engine will be running on gasoline. This rigging 125 may also be actuated automatically by the motion of the mixer controlling the feeding of the engine either with a gas with a low combustion value or with gasoline.

It is also possible to provide a controlling device permitting the supply to the orifice 129 of the apparatus of either an inert gas or a fuel with a high combustion value. Other modifications may also be applied to the apparatus which has been described and which is represented in Fig. 2, especially in connection with the manner in which the adjustment of the blocking member, formed by the piston 108, is carried out.

Fig. 3 shows schematically a carburettor 210, an engine 211 with its exhaust piping 212, feeding a silencer 213 and with a further extension at 214.

A draw-off conduit for exhaust gas is provided at 215 down stream with regard to the silencer 213, and a secondary draw-off conduit 216 is provided up stream with respect to said silencer directly at the outlet of the exhaust in the vicinity of the engine; this second draw-off conduit serves as a compensator.

The gas drawn at 215 passes through an expansion vessel 217 provided with baffle plates and is led into a second expansion vessel 218 comprising the draw-off conduit 216. The expansion vessel 218 is formed by a simple closed container. Gas drawn at 215 and 216 flows through the pipe 219 to a proportioning device 220 for addition of burnt gas and is added to the fuel mixture originating from the carburettor 210. It will be seen that the secondary draw-off conduit 216 is constituted by a tube of a small internal diameter and of a relatively great length, offering a certain resistance to the gas.

The device 220 comprises in its part 221 a nozzle 222 (Fig. 4), through which the gas supplied by the carburettor 210 flows in the direction of the arrow 223. This nozzle possesses lateral inclined calibrated holes 224 through which the exhaust gas supplied from 225 passes. It also possesses a recess 226 up hill with respect to the holes 224 and to the direction of flow of the gas supplied by the carburettor. The change in section produced by said recess along the passage of the carburettor gas causes a strong suction of exhaust gas at all speeds of the engine.

The functioning of the apparatus represented in Fig. 3 is the following:

When the engine 211 is running, a certain quantity of exhaust gas is drawn from the exhaust tubing through the two draw-off conduits 215 and 216. Said exhaust gas is directed to the engine through the pipe 219 and the proportioning device 220.

Due to the action of the secondary draw-off conduit 216, the device 220 is regularly supplied with inert gas at all speeds of the engine, as well as during the acceleration period, because it works as a compensator 8 in case of insufficient supply of inert gas originating from the first and distant draw-off conduit, it further helps to equalise the depression in the tubing of said draw-off at various engine speeds and also to maintain a uniform temperature of the inert gas, so that its composition remains the same. Such a regular supply is still further improved by the action of the expansion vessel 218 which forms to a certain extent a reservoir for the inert gas. The secondary draw-off conduit 216, as well as the main draw-off conduit 215 may be equipped with any regulating members, such as a tap, a nozzle, etc. which will maintain a delivery according to requirements.

What I claim is:

1. An apparatus for the addition of exhaust gas to the gaseous fuel mixture of a high compression or internal combustion engine in order to eliminate the knocking of the engine and to reduce its fuel consumption, said apparatus comprising a passage for the added gas leading into a chamber, a nozzle provided in said chamber and having calibrated orifices, said nozzle dis-

charging into the inlet piping of the engine for the purpose of forming a homogeneous gaseous mixture with the gaseous mixture forming the fuel of the engine, and a throttle controlling the inlet of the added gas in order to admix said added gas to the gas forming the fuel in substantially constant ratio, the passage for the added gas comprising a blocking member, the latter being adjustable into a given fixed position.

2. An apparatus according to claim 1, in which the passage for the added gas comprises two draw-off conduits on the exhaust piping of the engine which function in parallel, one being the main draw-off conduit, the other being the secondary draw-off conduit, which acts as a compensator.

3. An apparatus according to claim 1, said blocking member being formed by a piston movable in a rectilinear portion of said passage and in front of an orifice in the latter.

4. An apparatus according to claim 1, said blocking member being formed by a piston movable in a rectilinear portion of said passage and in front of an orifice in the latter, and said piston being mounted on a threaded rod which is maintained in a given fixed position by means of a nut.

5. An apparatus according to claim 1, said blocking member being formed by a piston movable in a rectilinear portion of said passage and in front of an orifice in the latter, and said rectilinear portion being at right angle to the one conducting the added gas to said last-named orifice.

6. An apparatus according to claim 1, in which the passage for the added gas comprises two draw-off conduits on the exhaust piping of the engine which function in parallel, one being the main draw-off conduit, the other being the secondary draw-off conduit, which acts as a compensator, and in which apparatus the secondary draw-off conduit is situated up stream with respect to the main draw-off conduit with reference to the gaseous flow in the exhaust piping of the engine.

7. An apparatus according to claim 1, in which the passage for the added gas comprises two draw-off conduits on the exhaust piping of the engine which function in parallel, one being the main draw-off conduit, the other being the secondary draw-off conduit, which acts as a compensator, and in which apparatus the secondary draw-off conduit possesses a smaller delivery than that of the main draw-off conduit, adjusts the delivery of the added gas, equalizes the depression in the delivery passages of this gas at various engine speeds and maintains the added gas at a practically constant temperature.

8. An apparatus according to claim 1, in which the passage for the added gas comprises two draw-off conduits on the exhaust piping of the engine which function in parallel, one being the main draw-off conduit, the other being the secondary draw-off conduit, which acts as a compensator, an expansion vessel being arranged down stream of the main draw-off conduit and another expansion vessel being arranged down stream of the secondary draw-off conduit.

9. An apparatus according to claim 1, in which the passage for the added gas comprises two draw-off conduits on the exhaust piping of the engine which function in parallel, one being the main draw-off conduit, the other being the secondary draw-off conduit, which acts as a compensator, in which apparatus the secondary draw-off conduits possess a smaller delivery than that of the main draw-off conduit, in which apparatus an expansion vessel is arranged down stream of the main draw-off conduit and another expansion vessel is arranged down stream of the secondary draw-off conduit, and in which apparatus the two expansion vessels are arranged on the passage for the added gas, the expansion vessel of the main draw-off conduit being up stream with regard to that of the secondary draw-off conduit with reference to the gaseous flow in said passage.

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