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(54) COMBUSTION ENGINE OF THE PISTON ENGINE TYPE.

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Description

Technical Field

The invention relates to a combustion engine of the piston engine type in which the static compression ratio exceeds 15:1, especially in the range of from 15:1 to 20:1.

Background Art

It is known to use Diesel engines, petrol engines and gas engines for running vehicles, ships and other power systems. All the engines are of the Otto engine type and are operated by an amount of air/fuel mixture being ignited in a combustion chamber whereafter the combustion causes an increase in pressure. The increase in pressure does not follow immediately after the ignition, but occurs gradually over a period of time. The ignition mechanism of the Diesel engine is spontaneous ignition optionally combined with a hot-bulb tube during the heating process where the combustible mixture is ignited due to the increase in pressure in the combustion chamber. The other two types of engine, viz. the petrol engine and the gas engine, are ignited by means of a spark from an ignition system. The latter two types of engines do not usually use spontaneous ignition, but if spontaneous ignition is nevertheless established, for instance in a petrol engine, it is accompanied by a disadvantageous effect, viz. the pinking or detonation. Gas engines for running vehicles are usually structured on the principles of petrol engines which are structured either directly for gas or can be converted thereto. A significant difference between the Diesel engine and the petrol engine is found in the compression ratio. The compression ratio for Diesel engines often exceeds 12:1 while the compression ratio for petrol engines seldom exceeds 10:1. The ignition point in the petrol engine is usually in the range of from approximately 12° to approximately 3° before the top dead center (TDC) with the result that the maximum pressure is not reached in the combustion chamber until after the top dead center (TDC).

French published specification No. 2,619,415 discloses directions for having a Diesel engine ignited on a mixture of combustion air and combustible gas and where the combustion is effected in the combustion chamber of the engine. The combustion is started by means of a spark from the spark plug, however, considering that at the time of ignition and in the area outside the spreading zone of the spark (flame front) in the combustion chamber there is a lower temperature than the spontaneous ignition temperature of the mixture and which allows maintenance of the critical compression ratio which is usual for a Diesel engine. The piston displacement is maintained. The engine is especially used for natural gas working.

Disclosure of Invention

The object of the invention is to provide a combustion engine of a high efficiency, and to allow a simple conversion of a Diesel engine into a gas engine, as well as to provide a simple way of increasing the power.

The combustion engine according to the invention is characterized in that the ignition point controlled by an ignition system is situated after the top dead center (TDC), especially in the range of from 0° TDC to 20° after TDC, preferably 4° after TDC. As a result, it is possible to achieve an ignition of a fuel, the spontaneous ignition capacity of which at the predetermined compression ratio does not usually suffize and to achieve that the combustion velocity is increasing in a combustion chamber, where the pressure falls. The resulting ignition generates a maximum pressure in the cylinder of approximately 90° after TDC, whereby a decreased wear and tear and a high efficiency of the fuel is obtained without simultaneously involving a steep increase in the temperature in the combustion chamber.

An embodiment of the combustion engine according to the invention is such that the gas consists of liquid petroleum gas (LPG) in form of autogas mixed with air, where the LPG substantially includes propane and butane, and where the air is atmospheric air containing approximately 21% of oxygen. In this manner it is possible to increase the power of the combustion engine by using a conventional fuel of a high purity, where the combustion products are mainly carbon dioxide and water. Town gas might also be used, but compared to the liquid petroleum gas the evaporated energy of said town gas is signigicantly lower.

Another embodiment of the combustion engine according to the invention is characterized in that it is a six-cylinder engine of 9570 cm^3 with a bore of 125 mm and a stroke of 130 mm, and which is provided with an nition system, such as of the type Lumenition, an evaporation system, such as of the type Renzo Matic, a carburetion system comprising a Venturi and a standard exhaust system for Diesel rigs. As a result it is possible at low expense to convert a known Diesel engine into a gas engine of a high efficiency.

The combustion engine according to the invention may furthermore be characterized in that the fuel injection system of a Diesel rig including pump, tubing and nozzle system is replaced by an ignition system comprising an ignition coil, a distri-

butor, high tension leads and spark plugs. In this manner it is possible to use conventional, easily available components for the conversion.

The combustion engine according to the invention is further characterized in that the control of the fuel injection system of the Diesel rig is used for controlling the distributor of the ignition system, with the effect that a sufficiently accurate control of the ignition system is obtained simultaneously with a high efficiency.

An embodiment of the combustion engine according to the invention is characterized in that the spark generating device is of the spark plug type. In this manner it is possible to increase the efficiency of a known engine, the engine being rather expensive to construct from scratch. It is possible to run the engine rather efficient with a power increase of more than approximately 10% and a reduced fuel consumption of more than approximately 10%, and reduced fuel costs of more than approximately 20%.

Brief Description of Drawings

The invention is described in greater detail below with reference to the accompanying drawings, in which

Fig. 1 illustrates a combustion engine according to the invention,

Fig. 2 is a diagrammatical view showing the principles of a conversion, and

Fig. 3 is a sectional view of a converted cylinder head.

Best Mode for Carrying Out the Invention

The invention has been tested on the engine of Fig. 1, said engine being designated the reference numeral 1. The engine is a Fiat type 8220.12 which is a Diesel engine usually used for lorries and the like vehicles. The engine is a six-cylinder, four-stroke Diesel engine usually generating 151 kW corresponding to 205 h.p. at 2600 r.p.m. The engine has a torque of 638 Nm corresponding to 65 kgm at 1600 r.p.m. The bore is 125 mm, the stroke 130 mm which results in a displacement of 9570 cm^3. The compression ratio has been set for Diesel running without hot-bult tubes, said ratio here being 17:1. The engine is usually provided with various peripheral equipment, such as a generator for charging batteries, a water pump and a blower for the cooling system. All the peripheral equipment can be maintained in connection with the conversion of the engine into an engine for gas. The transmission can also be maintained, i.e. the connection from the engine to the road, and it is not necessary either to alter the total gear ratio because the characteristic of the engine does not change significantly. It is, of course, possible to make the engine generate more power at a higher r.p.m., but simultaneously the wear and tear is increased and the transmission must accordingly be changed. A vital factor associated with the conversion of the Diesel engine into an engine for gas is that very few parts need to be replaced.

Fig. 2 illustrates the parts of the Diesel engine which in principle are replaced. The inlet and exhaust manifolds of the Diesel engine are maintained, but the inlet manifold 11 is connected to a carburetion device 7 connected to an evaporation system 5, such as of the type Renzo Matic. The evaporator 5 is connected to a gas tank replacing the Diesel oil tank in the vehicle. The gas tank is of a conventional type and suited for autogas or liquid propane gas.

The ignition system 3 of the engine 2 comprises an electronic ignition system, such as of the type Lumenition comprising an ignition coil 31, a distributor 33, and in the present embodiment six spark plugs 37 associated with suitable high tension leads 35. The electronic ignition system and the ignition coil 31 are of a conventional type allowing the usual adjustment possibilities. The distributor cover, the high tension leads 35 and the spark plugs 37 are also of a conventional type, but the base member of the distributor 33 has been designed especially for the engine 1 used. The base member must be connected to a shaft in the engine, said shaft rotating synchronously with the crankshaft. The shaft may for instance be a camshaft or a balance shaft. Diesel engines are usually associated with an external pumping system feeding Diesel oil to the nozzles of each combustion chamber. As such a pumping system is not necessary after the conversion, the distributor 33 can advantageously be connected to the engine 1 on this location. A further advantage of the location is that the shaft is moved synchronously with the crankshaft of the engine 1, said shaft previously driving the pumping system and now driving the distributor 33.

Fig. 3 is a sectional view of a cylinder head 9 of the engine 1 according to the invention, said view at the top showing the combustion chamber with the two valves, the inlet valve 93 and the exhaust valve 95. An injection nozzle is in connection with Diesel running placed betwen the above two valves. The injection nozzle has been replaced by a conventional spark plug 37. The replacement is allowed by providing a screwed connection in the opening 91 in the cylinder head 9 and in which the spark plug 37 can be inserted. The screwed connection can be such that the spark plug 37 is correctly positioned in the combustion chamber. Both the injection nozzle in the Diesel engine and the spark plug 37 in the gas engine are, theoreti-

cally speaking, placed on the same location in the combustion chamber, viz. on the location considered a geometrical center of the propagation of the pressure waves at the combustion. The above easy conversion is difficult in connection with engines where the fuel is not injected directly into the cylinder but instead sprayed on the inlet valve immediately before the air flow enters said cylinder, because the spark plug 37 must be placed in the combustion chamber. The injection nozzle is, however, usually placed in the combustion chamber of Diesel engines.

The combustion engine 1 to be used for the conversion according to the invention must present a static compression ratio of more than 15:1, especially in the range of from 15:1 to 20:1. The ignition point of the spark plug 37 is situated after the top dead center (TDC). The ignition point is in the range of from 0° TDC to 20° after TDC, preferably 4° after TDC. The ignition point depends especially on the composition of the gas, but when liquid propane gas is used the ignition point is relatively unaltered.

The fuel to be used for the combustion engine 1 is usually liquid petroleum gas in form of autogas admixed air and where the liquid propane gas substantially contains propane and butane. The air is ordinary atmospheric air containing approximately 21% of oxygen. It is, however, also possible to use other gas compositions, but natural gas requires very solid tanks as well as a very low temperature in order to maintain the liquid state necessary on a vehicle for the sake of the space. Other types of storing tanks may be developed which allow the use of natural gas in vehicles. Town gas might also be used, but compared to the liquid petroleum gas the evaporated energy of said town gas is significantly lower.

The conversion of the combustion engine 1 includes the steps of providing the openings 91 of the cylinder head 9 with plugs 37 of the sparking type, cf. Fig. 3, said openings previously being used for fuel nozzles for Diesel.

As far as the basic structure is concerned, the combustion engine 1 is a Diesel engine. The combustion engine 1 is provided with an ignition system 3, such as of the type Lumenition, an evaporation system 5, such as of the type Renzo Matic, and a carburetion device comprising a Venturi 71. The exhaust system previously used for Diesel running of the engine 1 can remain the same. The ignition system 3 and the evaporation system 5 can, of course, be of other types than the above. The ignition system 3 need not be an electronic ignition system, but may also be purely mechanical.

The fuel injection system of the Diesel engine including a pump, a tubing and a nozzle system is replaced by an ignition system 3 including an ignition coil 31, a distributor 33, high tension leads 35 and spark plugs 37.

The control, i.e. the driving shaft, controlling the fuel injection system of the Diesel engine is used for controlling the distributor 33 of the ignition system 3.

Claims

1. Combustion engine of the piston engine type, running on a mixture of liquefied petroleum gas (LPG) in form of autogas mixed with air, where the LPG substantially includes propane and butane, or liquefied natural gas (LNG) or town gas and air, where the charge in the combustion chamber is ignited by a spark generating device (37), **characterized** in that the static compression ratio exceeds 15:1, especially in the range of from 15:1 to 20:1 and that the ignition point is situated after the top dead center (TDC), especially in the range of from 0° TDC to 20° after TDC, preferably 4° after TDC.

2. Combustion engine as claimed in claim 1, **characterized** in that the gas consists of liquid petroleum gas (LPG) in form of autogas mixed with air, where the LPG substantially includes propane and butane, and where the air is atmospheric air containing approximately 21% of oxygen.

3. Combustion engine as claimed in claim 1 or 2, **characterized** in that it is a six-cylinder engine (1) of 9570 cm^3 with a bore of 125 mm and a stroke of 130 mm, and which is provided with an ignition system (3), such as of the type Lumenition, an evaporation system (5), such as of the type Renzo Matic, a carburetion system (7) comprising a Venturi (71) and a standard exhaust system for Diesel rigs.

4. Combustion engine as claimed in one or more of the preceding claims 1 to 3, **characterized** in that the fuel injection system of a Diesel rig including pump, tubing and nozzle system is replaced by an ignition system (3) comprising an ignition coil (31), a distributor (33), high tension leads (35) and spark plugs (37).

5. Combustion engine as claimed in one or more of the preceding claims 1 to 4, **characterized** in that the control of the fuel injection system of the Diesel rig is used for controlling the distributor (33) of the ignition system (3).

6. Combustion engine as claimed in one or more of the preceding claims 1 to 5, **characterized** in that the spark generating device is of the spark plug type.

Patentansprüche

1. Brennkraftmaschine des Kolbenmotortyps, welche mit einem Gemisch von verflüssigtem Petroleumgas (LPG) in Form Von mit Luft vermischtem Autogas läuft, wobei das LPG im wesentlichen Propan und Butan oder verflüssigtes Naturgas (LNG) oder Stadtgas und Luft umfaßt, wobei die Ladung in der Verbrennungskammer durch eine Funkenerzeugungsvorrichtung (37) gezündet wird,
dadurch gekennzeichnet, daß das statische Verdichtungsverhältnis 15:1 übersteigt, insbesondere in dem Bereich von 15:1 bis 20:1 liegt, und daß der Zündpunkt nach dem oberen Totpunkt (OT) ist, insbesondere in dem Bereich von 0° OT bis 20° nach OT, vorzugsweise 4° nach OT.

2. Brennkraftmaschine nach Anspruch 1, dadurch gekennzeichnet, daß das Gas aus flüssigem Petroleumgas (LPG) in Form von mit Luft vermischtem Autogas besteht, wobei das LPG im wesentlichen Propan und Butan umfaßt und wobei die Luft Atmosphärenluft ist, welche annähernd 21% Sauerstoff enthält.

3. Brennkraftmaschine nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß sie ein 9570 cm^3-Sechs-Zylinder-Motor (1) mit einer 125 mm-Bohrung und einem 130 mm-Hub ist, welcher eine Zündanlage (3), z.B. vom Lumenition-Typ, ein Verdampfungssystem (5), z.B. vom Renzo Matic-Typ, ein ein Venturielement (71) aufweisendes Vergasersystem (7) und ein Standard-Abgasanlagensystem für Dieselanlagen aufweist.

4. Brennkraftmaschine nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß das Kraftstoffeinspritzsystem einer Dieselanlage mit Pumpe, Rohrleitung und Düsensystem von einem Zündsystem (3) ersetzt ist, welches eine Zündspule (31), einen Verteiler (33), Hochspannungszuleitungen (35) und Zündkerzen (37) umfaßt.

5. Brennkraftmaschine nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Steuerung des Kraftstoffeinspritzsystems der Dieselanlage zum Steuern des Verteilers (33) des Zündsystems (3) verwendet wird.

6. Brennkraftmaschine nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die Funkenerzeugungsvorrichtung vom Zündkerzen-Typ ist.

Revendications

1. Moteur à combustion du type moteur à piston, fonctionnant avec un gaz combustible liquéfié (LPG) sous forme de gaz automobile mélangé avec de l'air, dans lequel le gaz combustible liquéfié comprend essentiellement du propane et du butane, ou du gaz naturel liquéfié (LNG) ou du gaz de ville et de l'air, dans lequel la charge dans la chambre de combustion est allumée au moyen d'un dispositif (37) générateur d'étincelle, caractérisé en ce que le rapport de compression statique dépasse 15:1, notamment dans la plage allant de 15:1 à 20:1 et en ce que le point d'allumage se situe après le point mort haut (TD C), notamment dans la plage allant de 0° point mort haut à 20° après le point mort haut, de préférence 4° après le point mort haut.

2. Moteur à combustion selon la revendication 1, caractérisé en ce que le gaz comprend du gaz combustible liquéfié sous forme de gaz automobile mélangé avec de l'air, dans lequel le gaz combustible liquéfié comprend essentiellement du propane et du butane, et dans lequel l'air est de l'air atmosphérique contenant approximativement 21% d'oxygène.

3. Moteur à combustion selon la revendication 1 ou 2, caractérisé en ce que ce moteur est un moteur (1) six cylindres de 9570 cm^3 avec un alésage de 125 mm et une course de 130 mm, et qui est muni d'un dispositif d'allumage (3), tel que du type Lumenition, et un dispositif d'évaporation (5), tel que du type Renzo Matic, un dispositif de carburation (7) comprenant un Venturi (71) et un dispositif d'échappement standard pour banc Diesel.

4. Moteur à combustion selon l'une quelconque des revendications précédentes 1 à 3, caractérisé en ce que le dispositif d'injection de carburant d'un banc Diesel comprenant un dispositif à pompe, conduites et pulvérisateur est remplacé par un dispositif d'allumage (3) comprenant une bobine d'allumage (31), un distributeur (33), des conducteurs haute tension (35) et des bougies (37).

5. Moteur à combustion selon l'une quelconque des revendications précédentes 1 à 4, caractérisé en ce que la commande du dispositif

d'injection de carburant du banc Diesel est utilisée pour commander le distributeur (33) du dispositif d'allumage (3).

6. Moteur à combustion selon l'une quelconque des revendications précédentes 1 à 5, caractérisé en ce que le dispositif générateur d'étincelle est du type à bougie.

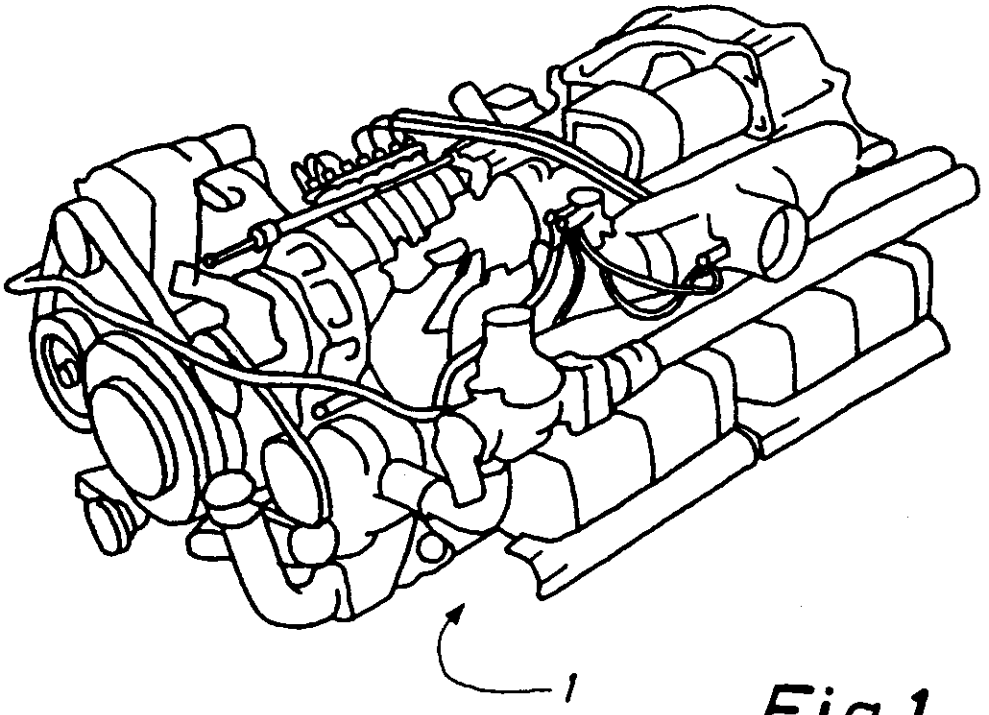

Fig.1

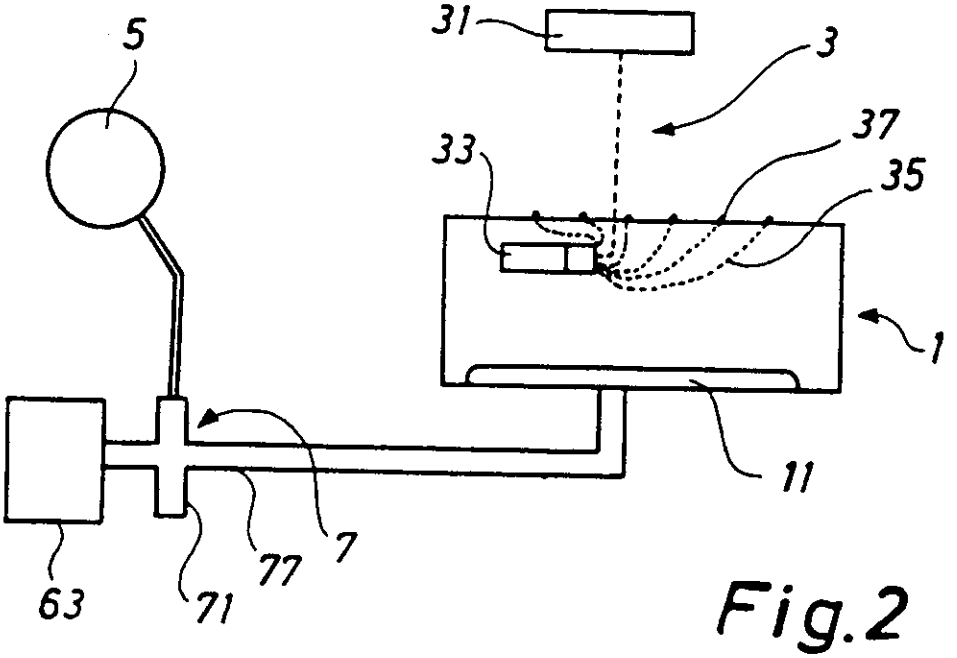

Fig.2

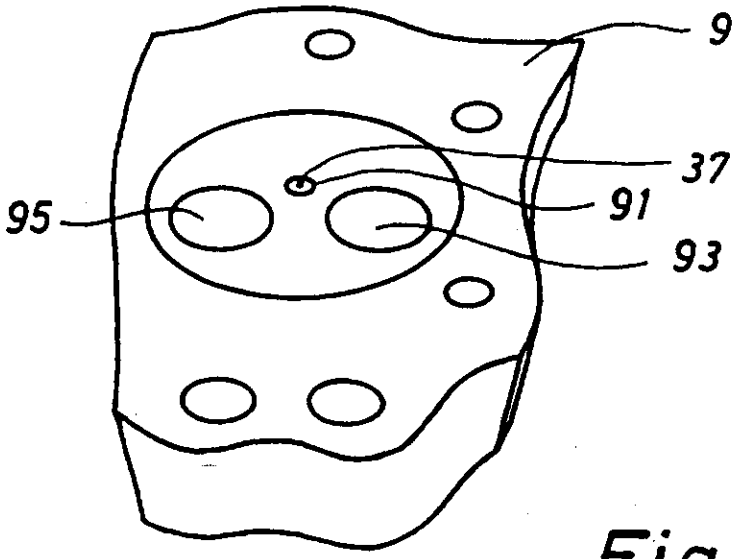

Fig.3

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