

Green Engine

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By M.MAHESH 17L65A0321



**DEPARTMENT OF MECHANICAL ENGINEERING CHAITANYA COLLEGE
OF ENGINEERING KOMMADI
VISAKHAPATNAM - 530048**

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ABSTRACT

The green engine is one of the most interesting discoveries of the new millennium. It has got some unique features that were used for the first time in the making of engines. This engine is a piston less one with features like sequential variable compression ratio, direct air intake, direct fuel injection, multi-fuel usage etc. The efficiency of this engine is high when compared to the contemporary engines and also the exhaust emissions are near zero. The significance of the engine lies in the efficiency when the present world conditions of limited resources of energy are considered. Prototypes of the engine have been developed. Generators have been produced with the green engine.

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1. GLOBAL ISSUES

Everyday radios, newspapers, televisions and the internet warn us of energy exhaustion, atmospheric pollution and hostile climatic conditions. After few hundred years of industrial development, we are facing these global problems while at the same time we maintain a high standard of living. The most important problem we are faced with is whether we should continue “developing” or “die”.

Coal, petroleum, natural gas, water and nuclear energy are the five main energy sources that have played important roles and have been widely used by human beings.

The United Nations Energy Organization names all of them “elementary energies”, as well as “conventional energies”. Electricity is merely a “second energy” derived from these sources. At present, the energy consumed all over the world almost completely relies on the supply of the five main energy sources. The consumption of petroleum constitutes approximately 60 percent of energy used from all sources, so it is the major consumer of energy.

Statistics show that, the daily consumption of petroleum all over the world today is 40 million barrels, of which about 50 percent is for automobile use. That is to say, auto petroleum constitutes about 35 percent of the whole petroleum consumption. In accordance with this calculation, daily consumption of petroleum by automobiles all over the world is over

two million tonnes. At the same time as these fuels are burnt, poisonous materials such as 500 million tonnes of carbon monoxides (CO), 100 million tonnes of hydrocarbons (HC), 550 million tonnes of carbon (C), 50 million tonnes of nitrogen oxides (NO_x) are emitted into the atmosphere every year, severely polluting the atmosphere. At the same time large quantities of carbon dioxide (CO₂) gases, resulting from burning, have also taken the major responsibility for the “green house effect”. Atmospheric scientists now believe that carbon dioxide is responsible for about half the total “green house effect”. Therefore, automobiles have to be deemed as the major energy consumer and atmosphere’s contaminator. Also, this situation is fast growing with more than 50 million vehicles to be produced annually all over the world and place into the market. However, it is estimated that petroleum reserve in the globe will last for only 38 years. The situation is really very grim.



Addressing such problems is what a Green engine does or tries to do. The Green engine as it is named for the time being, is a six phase engine, which has a very low exhaust emission, higher efficiency, low vibrations etc. Apart from these features, is its uniqueness to adapt to any fuel which is also well burnt. Needless to say, if implemented will serve the purpose to a large extent.

2. TECHNICAL FEATURES

Compared to conventional piston engines, operated on four phases, the Green engine is an actual six phase internal combustion engine with much higher expansion ratio. Thus it has six independent or separate working processes: intake, compression, mixing, combustion, power and exhaust, resulting in the high air charge rate. Satisfactory air-fuel mixing, complete burning, high combustion efficiency and full expansion. The most important characteristic is the expansion ratio being much bigger than the compression ratio. Also, the other main features are the revolutionary innovations of the sequential variable compression ratio, constant volume combustion and self-adapting sealing system. Therefore, an engine having extremely high thermal efficiency, near-zero emissions, quietness, light and small, lower cost with capability of burning of various fuels has come into being.

2.1 Direct Air Intake

Direct air intake means that there is no air inlet pipe, throttle and inlet valves on the air intake system. Air filter is directly connected to the intake port of the engine, and together with the less heating effect of air intake process, benefited from lower temperature of independent intake chamber, a highest volumetric efficiency which makes engine produce a high torque of output on all speed range is achieved . The pump loss which consumes the part of engine power is eliminated .Also fuel measuring facilities are built-in, and parts are saved.

2.2 Strong Swirling

As a tangential air duct in between combustion chamber and compression chamber, a very swirling which could last until gas port is opened, can be formed while air is pumped into the combustion chamber. Consequently, the air-fuel mixing and the combustion process can have a satisfying working condition.

2.3 Sequential Variable Compression Ratio

This greatly revolutionary innovation can provide the most suitable compression ratio for the engine whatever operation mode it works on with burning variety of fuels. Therefore, an excellent combustion performance is attained.

2.4 Direct Fuel Injection

Direct fuel injection can provide higher output and torque, while at the same time it also enhances the response for acceleration.

2.5 Super Air-Fuel Mixing

Since the independent air-fuel mixing phase is having enough time for mixing air and fuel under strong swirling and hot situation, the engine is capable to burn any liquid or gas fuels without modifications. An ideal air-fuel mixture could delete CO emission. Also centrifugal effect coming

from both strong swirling and rotation of the burner makes the air-fuel mixture more dense near the spark plug. It benefits to cold starting and managing lean-burning.

2.6 Lowest Surface to Volume Ratio

The shape of combustion chamber herein can be designed as global as possible. Thus, a lowest surface to is obtained, and the engine is having less heat losses and high combustion efficiency.

2.7 Controllable Combustion Time

Due to the independent combustion phase, compared to the conventional engine whose performances lack of efficient combustion time, resulting in heavy CO emission and low fuel usage rate, the Green engine has a sufficient controllable combustion time to match any fuels.

2.8 Constant Volume Combustion

The fuels can generate more energy while the combustion occurs on the constant volume. Also, the constant volume combustion technology can allow the engine to have a stable combustion when the lean burning is managed. Moreover, more water can be added in to make the much higher working pressure and drop down the combustion temperature, so power is added; heat losses and NO_x emissions are decreased.

2.9 Multi-Power Pulses

The green engine operates on multi-power pulses with a small volume of working chamber contrasted to the conventional engine dose on the single power pulse with a large working chamber. Obviously, a small volume of chamber only needs little space, resulting in compact structure and limited size. Also, a small amount of air-fuel mixtures being ignited on each power pulse can greatly cut down explosion noise.

2.10 High Working Temperature

Because the burner, which is made of high heat resistance and low expansion rate material, such as ceramic, operates without cooling, a relatively high working temperature can eliminate the quenching zone which is the main source of emission and can greatly reduce the heat losses in the combustion chamber.

2.11 High Expansion Ratio

High expansion ratio can make the burnt gases to release much more power. In other words, the waste gases while they run out of the engine are only bringing much less energy with them. Therefore, the engine's thermal efficiency is greatly raised, and at the same time, the noise and temperature of the exhaust are tremendously dropped.

2.12 Self-Adapting Sealing System

This is another revolutionary innovation applied in the Green engine: it can eliminate a number of seal plates or strips to achieve gapless seal and to provide most efficient and reliable sealing system with less friction.

2.13 Vibration Free

As major moving parts, vanes which are counted in little mass and operated symmetrically, the performance of the engine is very smooth. Hence, vibrations are eliminated.

2.14 Modular Design

Use of modular design is the best way for engine mass production. Thus stacking of rotors easily extends range of available power.

2.15 Limited Parts and Small Size



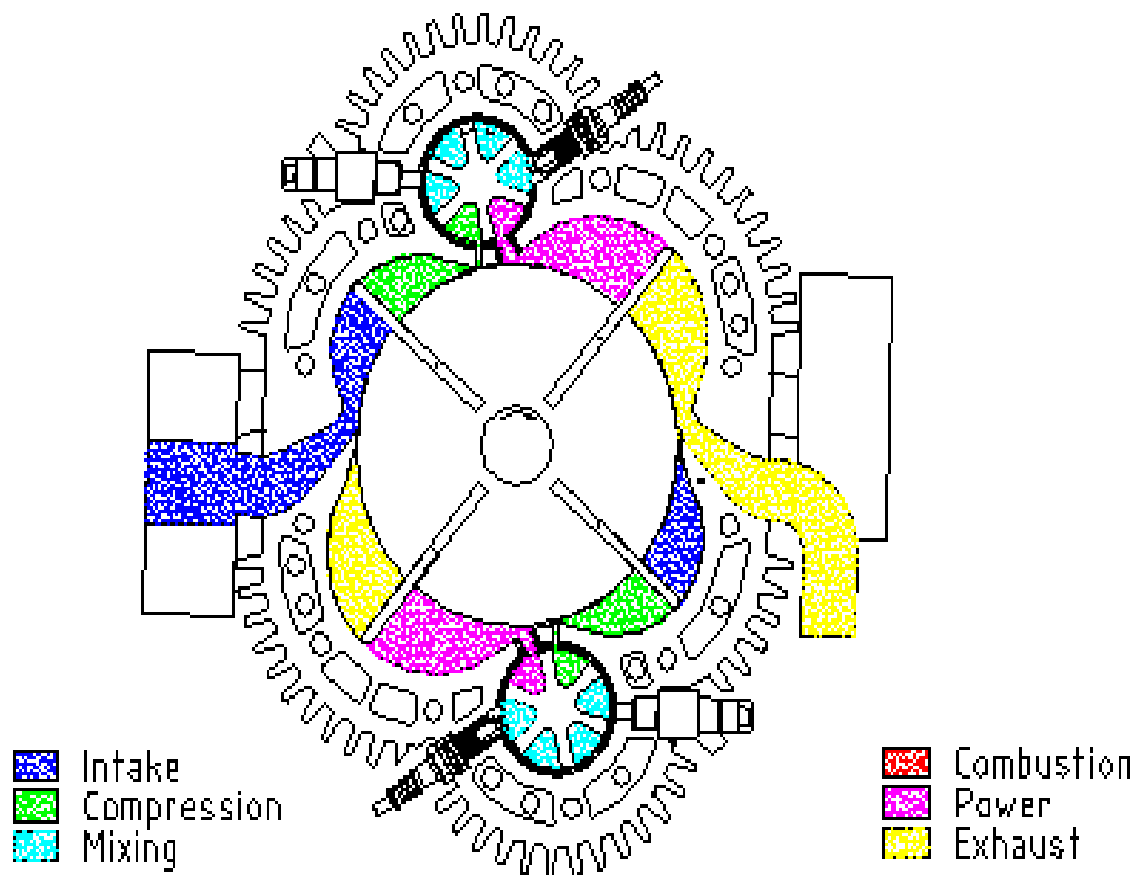
There is only a few dozens of parts which can be easily manufactured in the engine structure when compared with modern piston engine which comprises of more than a thousand parts. It suggests that the cost will be very low. Also, due to the compact structure the package and the weight of the Green engine will be only $1/5$ to $1/10$ of the regular engine on the same output.

3. CONSTRUCTION AND WORKING

As earlier mentioned, the Green engine is a six phase, internal combustion engine with much higher expansion ratio. The term “phase” is used instead of “stroke” because stroke is actually associated to the movement of the piston. The traveling of the piston from bottom dead centre to the top dead centre or vice versa is termed a stroke. But, in this engine pistons are absent and hence, the term “phase” is used. The six phases are: intake, compression, mixing, combustion, power and exhaust.

The engine comprises a set of vanes, a pair of rotors which houses a number of small pot-like containers. It is here, in these small containers that compression, mixing, combustion are carried out. The engine also contains two air intake ports, and a pair of fuel injectors and spark plugs. The spark plugs are connected in such a system so as to deactivate them, when a fuel which does not need sparks for ignition is used. The rotor is made of high heat resistance and low expansion rate material such as ceramic. Whereas, the metal used is an alloy of steel, aluminium and chromium.

Even though the engine is of symmetric shape, the vanes traverse an unsymmetrical or uneven boundary. This shape cannot be compromised as this a result of the path taken by the intake and exhaust air. This uneven boundary is covered by the vanes in a very unique fashion. The vanes are made in such a way that it comprises of two parts: one going inside a hollow one. At the bottom of the hollow vane is a compressive spring. On top of this spring is mounted the other part of the vane. Now, let us come to the working of the engine.



3.1 Intake

The air arrives to the engine through the direct air intake port in the absence of an air inlet pipe, throttle and inlet valves on the air intake system. A duct is provided on the sides of the vane and rotor. The duct is so shaped that when the air moves through, strong swirls generate when it gets compressed in the chamber. The air pushes the vane blades which in turn impart a proportionate rotation in the small rotor which houses the chambers. The inlet air duct ends with a very narrow opening to the chamber.

3.2 Compression

The rushing air from the duct is pushed by the blades into the small chambers in the rotor. The volume of these chambers is comparatively very small. Naturally, the compression obtained by such a procedure is very satisfactory. As earlier mentioned, the compressed air is in a swirling state, ready to be mixed with the fuel which will be injected into the chamber when it will be placed before the injector by the already rotating rotor.

3.3 Mixing

As soon as the chamber comes in front of the fuel injector, the injector sprays fuel into the compressed air. Because of the shape of the chamber, the fuel mixes well with the compressed air. The importance of ideal mixing leads to deletion of CO emission. And also because of the strong swirling, a centrifugal effect is exerted in the air-fuel mixture. Moreover, the rotation of the burner, makes this centrifugal effect all the more effective. Mixing phase has enough time to produce an ideal air-fuel mixture as the spark plug is positioned towards the other end of the rotor or burner.

3.4 Combustion

As the chamber rotates towards the “end” of its path, it is positioned before the spark plug. A spark flies from the plug into the air-fuel mixture. Because of the mixing phase, the air-fuel mixture is denser near the spark plug, thereby, enabling lean-burning of the charge and also a uniform flame front. As soon as the whole charge is ignited, the burner rotates to position itself in front of the narrow exit.

3.5 Power

The expanded gas rushes out of the chamber through the narrow opening, thereby pushing the piston in the process. The sudden increase in volume ensures that more power is released. Or in other words, the thermal energy is fully utilized.

3.6 Exhaust

As the thermal energy is fully utilized, the exhaust gases bring along comparatively less heat energy. This mainly helps in the thermal efficiency of the engine. It raises the engine's thermal efficiency and also because of the complete burning of the charge, poisonous gases like CO are absent in the exhaust emissions.

4. ADVANTAGES

As obvious from the technical features which include effective innovations, the advantages of the Green engine over the contemporary piston engines are many.

4.1 Small Size and Light Weight

As Green engine is very compact with multi-power pulses, the size and weight could be 1/5 to 1/10 of the conventional piston engines on same output. Its power to weight ratio could be more than 2 hp per pound without supercharge or turbo charge.

4.2 Limited Parts

There are only some dozens of parts easy to be manufactured in the engine structure.

4.3 High Efficiency

Because many great innovations are being employed in the engine design such as: direct air intake, sequential variable compression ratio, super mixing process, constant volume combustion, controllable combustion time, high working temperature of the burner, high expansion ratio and self adapting sealing system etc., the thermal efficiency of the engine could be potentially as high as 65 %, even more if water add-in technology is to be considered.

4.4 Multi-fuels

Due to six phases of working principle, super air fuel mixing process and constant volume combustion with controllable time, the Green engine becomes the only real multi-fuel engine on our planet; any liquid or gas fuels can be burnt well. Also it would be ideal to coal powder if special anti-wearing material is employed.

4.5 Near-zero Emissions

With perfect air-fuel mixture, complete combustion under lower peak temperature and free of quenching effect, the emission of CO, HC and NO_x could be near zero, thereby, a catalytic converter could be not required at all.

4.6 Smooth Operation

Due to inherence of good dynamic and static balance the performance of the Green engine is as smooth as an electric motor.

4.7 Fast Accelerating Response

Direct injection, little rotating inertia and deleted reciprocating motion can characterize the Green engine with operating at a very fast accelerating response.

4.8 Quietness and Low Exhaust Temperature

Burst out under small amount of mixtures, free of vibrations, and high expansion ratio make the Green engine much quieter. It is really environment-friendly. Green engine vehicles could transport troops on the battlefield of the future, and could serve as a vital source of auxiliary power in combat. This is because these engines are quiet, flexible and operate at low temperature, making them ideal for use in “stealth” vehicles.

4.9 Ideal to Hydrogen Fuel

Separation of working chambers from each other is an ideal design for any fuel to prevent backfire, especially for the hydrogen fuel.

4.10 Highly Reliable

As there are fewer moving parts operating smoothly, no crankshaft, valves, connecting rods, cams and timing chains, and intake and exhaust actions are accomplished directly by the motion of the vanes. Thus, it is highly reliable.

4.11 Low Cost

Limited parts, small in size, light in weight and depending upon current mature materials and manufacturing technologies, mean that it would be done at much lower cost on manufacture, transportation, installing to other devices, and maintenance.

5. CONCLUSION

The Green engine's prototypes have been recently developed, and also because of the unique design, limitations have not been determined to any extent. But even in the face of limitations if any, the Green engine is sure to serve the purpose to a large extent.

6. REFERENCE

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