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Working, Advantages of Green Engine and Development Using CNG

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Abstract: This paper gives brief introduction about green engines, which is most important discovery in today's world. The green engine has unique features than conventional engine. There are many disadvantages of conventional engine one of which pollution. This engine is one of the pistons less with features like High expansion ratio, strong swirling, sequential variable compression ratio, direct intake etc. The significance of the engine lies in the efficiency when the present world is facing some serious problems regarding energy crisis. Various researches on this engine are being carried out and yet to find the demerits of thisengine. Generators have been produced by using green engine. Hence, the GREEN ENGINE is the ENGINE OF FUTURE
Keywords: Engine, CNG

I. INTRODUCTION

Now a days the number of vehicles are increasing as a result pollution also increases.All over the world the energy crisis is main problem.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.For such issue the green engine will become useful option than conventional engine.

A. Technical features

The green engine is operated at six phases with higher expansion ratio while the conventional engine is operated at four phases.The six working processes may be intake, compression, mixing, combustion ,power and exhaust . 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. 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.

1) *Intake air:* 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) *Strong Swirling:* As a tangential air duct in between combustion chamber and compression chamber, a very swirling which could lost 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.
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
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.
5) *Super Air-Fuels 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 denser near the spark plug.
6) *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 NOx emissions are decreased.
7) *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.

8) *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 has high efficiency.

II. CONSTRUCTION AND WORKING

As mentioned earlier the green engine is six phase internal combustion engine with high compression ratio. 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. 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.

A. *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.

B. *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 place before the injector by the already rotating rotor.

C. *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.

D. *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.

E. *Power*

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

F. *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.

1) *Green Engines Development Using Compressed Natural Gas as an Alternative Fuel:* Natural gas is produced from gas wells or tied in with crude oil production. Natural Gas (NG) is made up primarily of methane (CH4) but frequently contains trace amounts of ethane, propane, nitrogen, helium, carbon dioxide, hydrogen sulfide and water vapor. Methane is the principal component of natural gas. Normally more than 90% of natural gas is methane [6-11], the detail of natural gas compositions as shown in. But, according to Srinivasan[44], that in the natural gas composition more than 98% is methane.Natural gas can be

compressed, so it can stored and used as compressed Natural Gas (CNG), natural gas canbe liquefied (LNG) and stored cryogenically. CNG is often confused with LNG. While both are stored forms of natural gas, the key difference is that CNG is in compressed form, while LNG is in liquefied form. CNG has a lower cost of production and storage compared to LNG as it does not require an expensive cooling process and cryogenic tanks. CNG requires a much larger volume to store the same mass of natural gas and the use of very high pressure on about 200 bar or 2,900 psi. Natural gas is safer than gasoline in many respects. The ignition temperature for natural gas is higher than gasoline and diesel fuel. Additionally, natural gas is lighter than air and will dissipate upward rapidly if a rupture occurs. Gasoline and diesel will pool on the ground, increasing the danger of fire. Compressed natural gas is non-toxic and will not contaminate groundwater if spilled. Advanced compressed natural gas engines guarantee considerable advantages over conventional gasoline and diesel engines. Compressed natural gas is a largely available form of fossil energy. However, CNG has some advantages compared to gasoline and diesel from an environmental perspective It is a cleaner fuel than either gasoline or diesel as far as emissions are concerned. Compressed natural gas is considered to be an environmentally clean alternative to those fuels. According to Ganesan[8], some advantages of compressed natural gas as a fuel are octane number is very good for SI engine fuel, octane number is a fast flame speed, so engines can be operate with a high compression ratio, less engine emissions, less aldehydes than methanol and the fuel is fairly abundant worldwide. The disadvantages of compressed natural gas as an engine fuel are low energy density resulting in low engine performance, low engine volumetric efficiency because it is a gaseous fuel, need for large pressurized fuel storage, so there is some safety concern with a pressurized fuel tank, inconsistent fuel properties and refueling of the compressed natural gas is a slow process. Natural gas can be used as a fuel essentially in the form in which it is extracted. Some processing is carried out prior to the gas being distributed. Methane can also be produced from coal and from biomass or biogas and a whole variety of biomass wastes such as from landfill sites and sewage treatment plants. CNG as a green alternative fuel: Compressed Natural Gas (CNG) has long been used in stationary engines, but the application of CNG as a transport engines fuel has been considerably advanced over the last decade by the development of lightweight high-pressure storage cylinders. Any researcher was researched about the compressed natural gas as alternative fuel motivated by the economic, emissions and strategic advantages of alternative fuels. Several alternative fuels have been recognized as having a significant potential for producing lower overall pollutant emissions compared to gasoline and diesel fuel. Natural gas, which is composed predominately by has been identified as a leading candidate for transportation applications among these fuels for several reasons. Shasby identified tree reason, the first reason is availability, the second attraction reason of natural gas is its environmental compatibility and the third attraction reason of natural gas is that it can be used in conventional diesel and gasoline engines. According to, operating costs are another reasons, where natural gas powered vehicles theoretically have a significant advantage over petroleum-powered vehicles, the basis for this argument is the lower cost per energy unit of natural gas as compared to petroleum. The argument is somewhat more complex than this, however. While it is true that in the vast majority of the country natural gas is cheaper than gasoline or diesel, the analysis plays out differently. Compressed Natural Gas (CNG) is attractive for five reasons. It is the only fuel cheaper than gasoline or diesel. It has inherently lower air pollution emissions. It has lower greenhouse gas emissions. Its use extends petroleum supplies and There are large quantities of the fuel available in North America. The difficulties with CNG arise from vehicle range, fuel storage, infrastructure costs and ensuring sufficient supply. The importance of range as a vehicle characteristic is illustrated .In this case, the additional weight of batteries or storage cylinders requires considerable extra chassis weight, requiring still more fuel and storage cylinders or batteries. A large increase in the number of CNG vehicles would require new gas pipelines and other infrastructure. Although natural gas reserves are large, it is not clear whether extraction could be doubled over many years without an increase in extraction cost, the compressed natural gas vehicles exhibit significant potential for the reduction of gas emissions and particulates. There are any problems for compressed natural gas applications such as onboard storage due to low energy volume ratio knock at high loads and high emission of methane and carbon monoxide at light loads. However, these can be overcome by the proper design, fuel management and exhaust treatment techniques.

2) *Green CNG engines research and development:* The technology of engine conversion is well established and suitable conversion equipment is readily available. For petrol engines or spark ignition engines there are two options, a bi-fuel conversion and use a dedicated to CNG engine. The bi-fuel conversion of vehicles fitted with fuel-injected engines may utilize the original engine management system, if it can be modified to control the gas flow and revised ignition timing or alternatively, be fitted with a standard CNG control system. The fuel injectors must be disabled when the engine is running on gas, although fuel must still flow to the injectors and then pass directly to the return fuel line to provide cooling. The bi-fuel

engines of the spark ignition petrol engines according to Poulton is of all sizes can be converted to natural gas by the fitting of a gas carburetor/mixer, regulator, shut-off valves, control system and fuel storage tanks. A bi-fuel arrangement exists when the petrol fuel system is retained, but this prevents the engine being fully optimized for the highoctane gas. This arrangement does provide a back-up fuel where CNG refueling facilities are not well developed. Dedicated natural gas engines is the engine dedicated to mono fuel of natural gas engines, there are optimized for the natural gas fuel. They can be derived from petrol engines or may be specifically designed for the purpose. With diesel engines converted or designed to run on natural gas, there are two main options discussed. The first is dual-fuel engines. These refer to diesel engines operating on a mixture of natural gas and diesel fuel. Natural gas has a low cetane rating and is not therefore suited to compression ignition, but if a pilot injection of diesel occurs within the gas/air mixture, normal ignition can be initiated. Between 50 and 75% of usual diesel consumption can be replaced by gas when operating in this mode. The engine can also revert to 100% diesel operation. The second is dedicated natural gas engines. Dedicated natural gas engines are optimized for the natural gas fuel. They can be derived from petrol engines or may be designed for the purpose. Until manufacturer original equipment (OE) engines are more readily available, however, the practice of converting diesel engines to spark ignition will continue, which involves the replacement of diesel fuelling equipment by a gas carburettor and the addition of an ignition system and spark plugs. Buses and trucks larger and greater numbers of cylinders are used than for light-duty engines. For compression ignition engines conversions to spark ignition, the pistons must be modified to reduce the original compression ratioand a high-energy ignition system must be fitted. The system is suitable for CNG and is ideally suited to timed (sequential) port injection system but can also be used for single point and low pressure in-cylinder injection. Gas production provides greater precision to the timing and quantity of fuel provided and to be further developed and become increasingly used to provide better fuel emissions performance. An approximate measure of the equivalent petrol or diesel fuel capacity of a cylinder filled with gas at 20 Map have be obtained by dividing the cylinder volume by 3.5-thus a 60-litre cylinder will provide the energy equivalent of 17 liters of conventional fuel. The design and installation of appropriate high-pressure onboard storage cylinders plays an important part of the efficient and safe operation of natural gas-fuelled vehicles. The cost constitutes a significant proportion of total vehicle installation cost. Most commonly used are chrome molybdenum steel gas cylinders, which are the cheapest, but one of the heaviest forms of storage container. It is possible that the space required and weight of CNG fuel storage systems will fall in the future result of improved engine efficiencies (as with dedicated designs) and lightweight storage tanks. For example, fibre-reinforced aluminum alloy or even allcomposite CNG pressure tanks demonstrate significant weight saving over steel-up to 57%. It is even possible to increase the stored fuel's energy density by, for example, increasing the storage pressure of the gas. Future dedicated gas-fuelled vehicles will benefit by the fuel storage system being integrated into the vehicle structure, taking up less of the storage space currently lost in conversions. One proposal for a future vehicle CNG storage system is the so-called "fortress frame". A modified vehicle frame structure, of significant crosssection, would be used to store the gas inside it at low pressure. Additionally, the frame would provide greater crash protection to the occupants. Although the design is likely to be as "safe" as conventional CNG vehicles, product liability issues, especially in the US, make the future development of this concept uncertain. Research is in progress to use adsorbent materials in a tank to store natural gas which reduces the required pressure (from 200 bar for CNG currently, to around 30 bar) and thereby avoids the need for high-pressure compressors and provides more design flexibility for the tank. Many types of adsorbent materials have been considered, including activated carbon, zeolites, clays and phosphates. With activated carbon at pressures of 300-400 psi (2-2,75 MPa or 20-27 bar), the percentage of natural gas adsorbed can be 10 to 15% of the weight of carbon. However, it has not yet been possible to find an adsorbent material which provides the same storage capacity of usable gas at the same cost, weight and volume as with high-pressure cylinders. Although LNG storage has been used in demonstration fleets, few NGVs are operating on LNG at present. Advances are being made in local bulk LNG storage and, when vehicles are able to refuel their cryogenic storage tanks from such LNG depots at a cost that is competitive with CNG, more extensive used will be made of this form of storage. Until such time most vehicles using natural gas will store it in compressed form.

3) *Advantages of green engine*

a) *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.

b) *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 antiwearing material is employed.

c) *Smooth Operation:* Due to inherence of good dynamic and static balance the performance of the Green engine is as smooth as an electric motor.

d) *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" vehicle.

e) *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.

f) Limited Parts: There are only some dozens of parts easy to be manufactured in the engine structure.

g) 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) *Disadvantages:*

a) choking of flow during combustion due high pressure difference and small clearance area

b) Friction and wear

c) Efficiency gets reduced due to leakage

III. CONCLUSION

As we have discussed there are lots of avanages of green engine over traditional engine 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.

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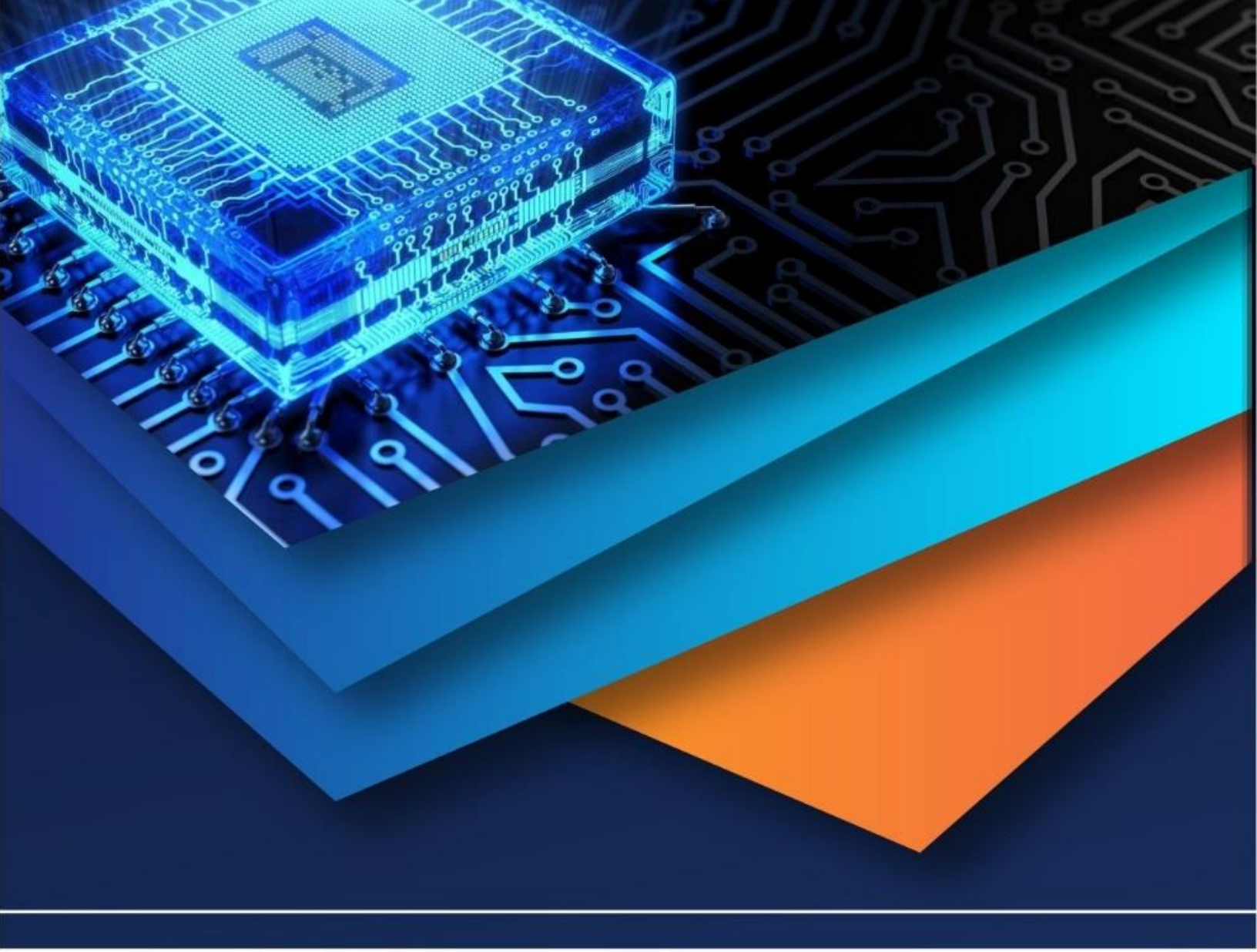

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