STUDY OF THE CONCEPT OF MULTI STROKE UNIFLOW SCAVENGING DIESEL ENGINE

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ABSTRACT

In this paper studied about the concept of MSUS diesel engine. ***Multi Stroke Uniflow scavenging*** *diesel engine is the full form of MSUS. Which means changing of no stoke by cutting fuel injection according to the load act on engine. Where the fuel injection provided by the electronic controlled CRDI. According to the structure of the engine it is basically uniflow scavenging type two stroke diesel engines. According to the concept it need extra accessories like as load detecting device, specially designed flywheel, specially programmed electronic processor etc. we can improve the comparatively high fuel economy engine through this concept. But the engine can act as normal two stroke engine during the time of high load condition. Hence study of extra accessories must be needed for the developing design of the concept. This type engine is mostly suitable for the industrial application, automobile field, locomotive department, marine power plant, diesel electric power plant etc.*

Keyword: - *MSUS engine, CRDI with electronic control, two strokes engine, etc….*

1. INTRODUCTION

Now the days two stroke engines are very essential to the power plant, locomotive, and industrial application. The advantages of two stroke engine[1], that is uniform torque output, high torque performance, better power drive output etc. but the basic problems of such engine is higher duel consumption, relatively high production of hydro carbons, burning of lubrication oil etc.[2]. if we replace the engine by four stroke it will provide less fuel consumption, less pollution less chance of burning of fuel etc[4]. but the problem sill occur of providing no uniform torque etc. then the MSUS diesel engine is suitable remedy for these problems. The MSUS provide high uniform torque at high load conditions and give less fuel consumption during the low loads condition. This can be done by the intelligent fuel supply system provide with the engine. Hence this engine can give advantages of both two and four stroke concept. And an additional operation is also provide with this engine is operation of six stroke engine concept during idling condition. Hence in this paper basically give the study of the description of principle, construction, working, and advantages of the MSUS diesel engine.

2. LITERATURE REVIEW

- **Ravikant Sahu, Eklabya Gupta Deepak and Kumar Dewangan** said that a compression ignition engine with uniflow valve scavenging of the cylinder and a transfer valve in the piston crown have been described. A great

disadvantage of two-stroke engines is ports which are made in the cylinder bearing surface. Under the heat which is realised during the combustion, the thermal extension of the range in proximity of the ports and other parts of the cylinder is different and so the distortion of the geometry of the cylinder liner surface force the designer to make the clearance between the piston and the cylinder liner bigger.

- **Ravikant Sahu, Eklabya Gupta Deepak and Kumar Dewangan** shows that the NOx is produce data great extent, due to the high local temperatures found in Diesel engines which are highly dependent on the initial rise of heat release. In addition, soot production and oxidation are both dependent on the mixing rate and local flame temperatures [3]. The injection velocity is one of the most influent parameters on the factors (which are mentioned before), since it controls both the mixing process and the rate of heat release. This is the reason that injection system parameters and nozzle geometry have been extensively studied due to their direct relation with the fuel injection rate and fuel velocity. To support this, it has been recognized that the characteristics of the injection system are the most important fact or sin influencing emissions and performance of CI engines.[4,5]

- **Ravikant Sahu, Eklabya Gupta Deepak and Kumar Dewangan** they remarks that In the uniform scavenging system, the air enters the cylinder from one end and leaves it from the other end, flowing through according to parallel flow lines normally flow lines normally having a slight rotation to stabilized the vertical motion,. Air acts like an ideal piston and replace it at least in principle, throughout the cylinder [9]. Two stroke engine the cycle is completed in one resolution of the crankshaft. The main difference between two-stroke and four-stroke engine is in the method of filling the fresh charge and removing the brunt gases from the cylinder. In the four-stroke engine these operations are performed by the engine piston during the suction and exhaust respectively. In a two-stroke engine, the filling process is accomplished by the charge compressed in crankcases or by a blower. The induction of the compressed charge moves out the product of combustion through exhaust ports. Therefore, no piston strokes are required for these two operations. Two strokes are sufficient to complete the cycle, owner for compressing the fresh charge and other for expression or power stroke.

- **Marı´a Isabel Lamas and Carlos Gervasio Rodrı´guez Vidal** they remarks that a CFD analysis was developed to study the scavenging process of the MAN B&W 7S50MC two-stroke marine engine. The CFD code can simulate the expulsion of burnt gases and the swirling flow created when fresh air flows into the cylinder. Compared with experimental measurements carried out on a MAN B&W 7S50MC engine installed on a container ship, the results of the in-cylinder pressure were satisfactory. This model is very useful when designing the scavenging system of new large and medium two-stroke engines. The pressure field helps identify areas where the gas flow is inefficient and should be corrected. On the other hand, the velocity field makes it easier to locate areas with too high, too low, or inadequate orientation velocities. The mass fraction field comes into play when checking how fresh gases fill into the cylinder and when detecting problems of short-circuiting and mixing. This model is also an efficient tool for studying factors such as piston chamber geometry, intake and exhaust port design, opening and closing timings, or intake and exhaust pressures, among others. Accordingly, future numerical investigations will focus on optimizing efficiency and performance by studying these parameters.

- **K. Kannan[1] and m. Udayakumar[2]** said about the injector in journal of **experimental study of the effect of fuel injection pressure on diesel engine performance and emission** that is The light duty diesel engine is normally employed for agricultural water pumping, electrical power generation etc. where the engine mostly operated above 75% load. At 5 kW load, the engine performance parameter brake thermal efficiency found increasing in the order 250-200-150 bar injection pressure and brake specific fuel consumption found decreasing in the order of 250-200-150 bar injection pressure. Though at 150 bar higher brake thermal efficiency and lower brake specific fuel consumption were obtained the percentage of improvement was at the maximum of 1%. So, increasing injection pressure gave insignificant effect on engine performance. At 5 kW load, CO_2 and NOx emissions were found the lowest at 200 bar and HC emission and smoke level were found lowest at 150 bar. CO_2 is 15% and 24% and NOx is 12% and 20% lower compared with 150 bar and 250 bar respectively. HC emission is 30% and 34% lower and smoke level is 7% and 1% lower compared with 200 bar and 250 bar, respectively. Fuel economy is important for engine. But environmental protection is more important than fuel economy. So, decreasing emission is the primary concern which demands moderate injection pressure for a light duty diesel engine. Hence I can understand the relation between fuel injection and pollution concept with NOx emission. Both are depends upon with their combustion pressure.

- **Luca Piancastelli, Leonardo Frizziero and Giampiero Donnici** said that about application of CRDI in the diesel engine is CRDIDs are brilliant systems with remarkable performance. However these systems are very complex and their correct dynamics should be understood before trying to adapt them to industrial applications. CR main issues are introduced in this paper; problems and solution are discussed for the most common CR system available in the automotive field. The necessity of understanding the HW is fundamental to operate on SW input during engine tuning. In automotive to industrial CRDIDs conversions the original ECU is substituted by a more reliable FADEC. This unit should be programmed and integrated with a different set of sensors. In order to obtain acceptable understanding a comprehension of the differences between industrial CRDIDs and automotive ones is strictly necessary. In this paper the CRDIDs are briefly introduced and the more important differences are discussed, along with optimization problems. Even without any changes in engine geometry, it then possible to obtain a reliable and powerful unit for industrial application.

- **Shekaina*, Dr. T. Jayasingh** said about the concept of **turbo lag depends with CRDI injection** that is The subsystem has many advantages over the existing electric super charger system which requires 350 amps current for acceleration. The switching off of the air conditioner can be adapted for this configuration too. The proposed subsystem has just two simple components; accumulator and pressure regulator valve. The subsystem doesn't require high power battery, complex power electronics or electric compressor. Reduction in noise, vibration, un-burnt fuel emissions and fuel consumption are anticipated. The addition of the subsystem will lead to better acceleration and deceleration characteristics with improvement in efficiency. As desirable air fuel ratio is maintained for all the operating cycles, the EGR and its connections can be avoided thereby reducing the pumping loses.

- **Krunal P.Mudafale1, Sandip V.Lutade2, Ganeshgir D.Gosavi about the CRDI,** it said that In this system it is seen that the CRDI engine developed more power and also increased the fuel efficiency. By using this system there is reduction of noise and Pollutants. Particulates of exhaust are reduced. Exhaust gas recirculation is enhanced and precise injection timing is obtained. More pulverization of fuel is obtained in this system. The powerful microcomputer makes the whole system more perfect and doubles the torque at lower engine speeds.

- **Electroninc fuel injection** by **Malleboyena Mastanaiah** is said that After performing test on a Engine with EFI system using compressor, following conclusions may be drawn: By using EFI system, the power available at the shaft can be saved by using compressor with cut-off system instead of fuel pump which continuously operates and receive the power from engine. And by using EFI system, we can maintain the air-fuel ratio same as in case of normal engine without the carburetor. Then using EFI system, we can reduce the fuel consumption of engine up to little extent but definite amount. And using EFI system, the engine can be run economically with prolonged application over the cost of compressor and microcompressor. By using EFI system, the brake thermal efficiency can be increased.

- **study of six stroke engine and analysis by B. Ramya** is remarks that It is commercially obvious that the big market it for automobile, heavy goods, construction site and industrial application. This is a priority for the six stroke engine, reducing fuel consumption and pollution without any effect on performance will reassessed the concept of the automobile and manufacturing industries. There is, at this day, no wonder solution for the replacement of the internal combustion engine. Only improvements of the current technology can help it progress within reasonable time and financial limits. The six-stroke engine fits perfectly into this view. It's adoption by the any industry would have a tremendous impact on the environment and world economy, assuming up to 40% reduction in fuel. Consumption and 60% to 90% in polluting emissions, depending on the type of the fuel being used.

3. PRINCIPLE

According to the principle concept the MSUS diesel engine is basically have structure of two stroke diesel engine with providing of uniflow scavenging operation, but here provide different stroke operation of four stroke, two stroke and six stroke operations etc. which means of providing of cutting of fuel injection[3] controlled by intelligent

electronic CRDI system[7]. Which is work according to the monitoring the load and speed condition of the engine. Hence this can give the merits of four, six, two stroke engine.

4. CONSTRUCTION

The MSUS diesel engine basically is a uniform scavenging two stroke engine. But the different stroke operation can be done by the assembling of extra electronic fuel injection to the CRDI system. And provide comparatively four stroke engine flywheel is provided. Hence this paper next gives the description of essential modern parts which assembled to the engine. They are

- Rpm sensor
- Load monitoring system
- processor
- intelligent electronic fuel system
- Electromagnetic

4.1 RPM sensor

This component is used to measure the speed of the crankshaft of the engine. This is a laser optical device, which sense the speed of engine when it id operate. When the load will change, this will lead the varying of speed of the engine hence the system can monitoring and give speed as input parameters to the engine processor.

Fig -1: RPM sensor

4.2 Load monitoring system

This system consists of watt indicator system, low power rate generator (only for machine operation purpose not for the power generator condition), Which are helped to identify the power and load on the engine then which give as input signal to the processor.

4.3 Processor

It is the one of the basic parts of the engine which is helped to provide processing the input signal from the RPM sensor and load monitoring system. And determine how much load is activated on the engine, and determine fuel injection operation wit varying fuel injection time and fuel quantity.

4.4 Intelligent electronics fuel system

This is an output parameter monitoring component which control and regulate the fuel supply to the system for different stroke operation. This is helped to provide better fuel economy for the engine. And which id helped the varying stroke operation of the engine concept. This is actually embedded with CRDI system [5][6]. And give accurate fuel injection with suitable fuel conception for the different load condition.

4.5 Electromagnetic valves

This is a modern type engine poppet valve for replacing of conventional cam operated valve. This will operate by means of Electromagnetic operation. And the solenoid will operate according to the signal form the processor. The merit of using solenoid valve is less power for operation, easy to assembling and maintains Very accurate operation. Hence which is helped the charge and exhaust gas flow through combustion chamber to the exhaust manifold.

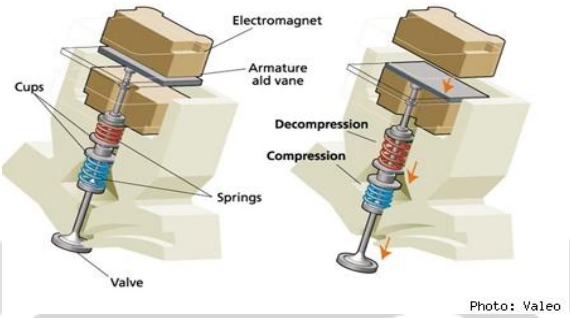

Fig -2: Electromagnetic valve

5. WORKING

According to the working the engine is work as normal two stroke engine at only high load condition. The same engine will be working as four stroke engines at medium or above medium load condition. And it will be work as six stroke engine at very low load or idling condition. The varying of stroke with corresponding to the load is actually done by the help of some sensors and processor. According to the working the engine is work as normal two stroke engine at only high load condition. When the load is varying the rpm sensor and voltage and current sensor of the low rate dynamo of the engine unit is give the input signal to the processor. Then arithmetic and logic unit of the processor determine load on the engine. After this in formations pass to the control unit of processor, Control nit controls the electronic injector and its timing and quantity of fuel injection. With help of cutting of injection engine can changes into different stroke operation.

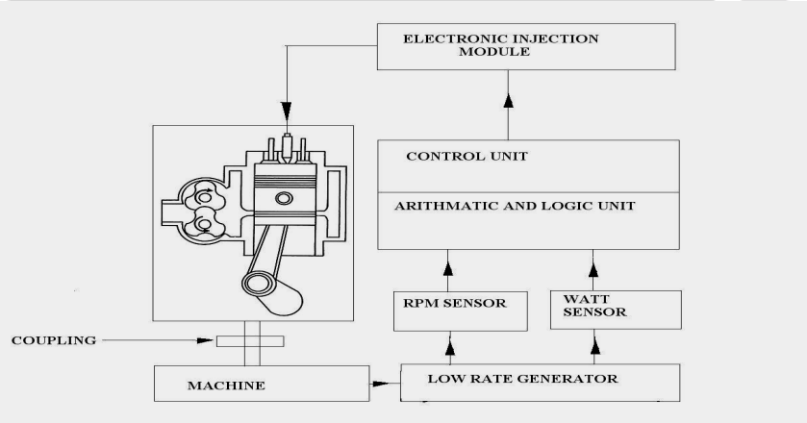

Fig -3: Schematic diagram

6. CONCLUTION

The MSUS diesel engine is actually very powerful with less fuel consumption and less pollution. Hence its implementation on various fields very useful. This type of engine is intelligent with different load condition and provides better output power without compromising of less fuel consumption. The one of the drawback of the concept is, it is only applicable for multi cylinder engine of above three cylinder, because for the below number of three cylinder engine during four or six stroke operation the power needed to upward stroke is relatively high and thus sufficient power cannot be generate through the combustion stage of downward stroke condition [1][2].

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