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PERFORMANCE AND EVALUATION OF 4 STROKE DIESEL ENGINE

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ABSTRACT

The review paper covers view on modification of 4 stroke diesel engine. In this paper, we are trying to summarize the parameters and modification done in diesel engines with suitable experimental data and its scope in our project on Diesel engine. Our paper deals with modification at primary grounds to reduce weight, vibrations and improve efficiency by replacing the conventional model with robust design. Our profound study came to conclusion that parameters such as air fuel ratio, vibrations, proper material selection will impart required output. Prior to the data collected we are summing up our ideas with relevant concepts and calculations. Our paper will reveal important aspects and will prove beneficial for upcoming paper channelizing our research on diesel engine.

Keywords: Exhaust valves, heat transfer rates, Inlet valve, Piston, liner materials, unbalanced forces.

I. INTRODUCTION

In diesel engine the common problem arises mainly in context of weight reduction, emissions, vibrations and durability, so to bring forth newer modifications a study must be made on the important parameters which contribute to account for the above factors. Given below are the modifications which will have positive outcome on diesel engine and these points will be considered for our study where our objective will be to design and perform thermal modeling on 4 stroke diesel engine. Firstly in context of air fuel ratio replacing the older 2-valve mechanism with newer and efficient 4-valve mechanism will ensure higher suction volume, complete combustion and less polluting exhaust. In case of vibrations minimizing the unbalanced forces acting on the engine will ensure durability by lowering fatigue failures and will check uniformity of forces acting on it. On considering comparative analysis on materials replacing aluminum as material for connecting rod instead of forged steel will ensure additional benefits and one of the important aspect for thermal considerations consist selection of liner materials for lower heat absorption.

II. REPLACING THE OLDER 2-VALVE MECHANISM WITH NEWER AND EFFICIENT 4-VALVE MECHANISM. [1].

In Conventional diesel engine, mostly 2 valves mechanism were used, but after discovery of 4 valves studies illustrated that 4 valves system proved to be beneficial in terms of thermal efficiency and other factors.

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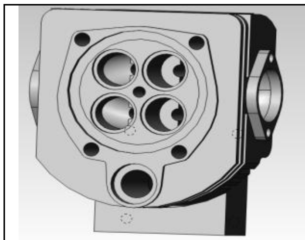
A sample calculation highlights the comparison and data which reveals that according to the study 4 valve system is efficient.

	
3D representation of 4 valves	Representation of 2 valves

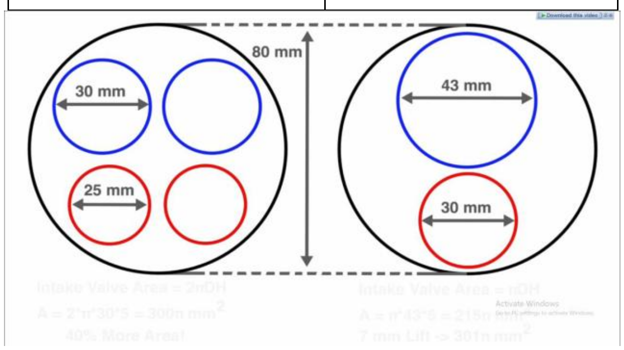


Fig. 1

In the above example if the bore is kept of same diameter = 80 mm

Then, if observed in side view the air flow area will be

For 2 valve = pi*diameter*Height of valve opening

= pi*43*5

=215*pi mm2

For 4 valve = 2*pi*30*5

= 300*pi mm2

So in accordance of considered example we can conclude that four valve system can impart and provide more air flow can give more thermal efficiency.

By performing CAD modeling on the a model of 4 valves single cylinder diesel engine is made which gives idea about quantity of material required, overall dimensions of head. The above two figure depict the same.

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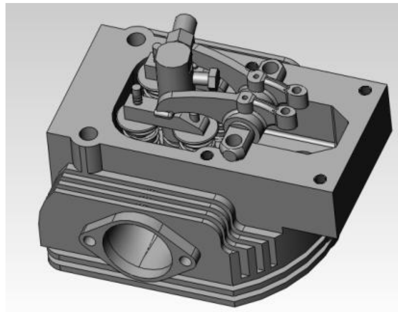

Fig. 2

The 3D view of the four valve cylinder head assembly which having four ports, i.e. two inlet and two outlet ports. Generally single cylinder diesel engine has two valves. But by increasing the number of valves fuel inlet get increases. It will help engine to increase efficiency. Fig: contains the rocker arm, valve springs, valves & injector. It shows assembly view of the cylinder head. Fig shows detail drawing of the cylinder head.

III. MINIMIZING THE UNBALANCED FORCES ACTING ON THE ENGINE.

The internal combustion (IC) engine is the concentrated mass in vehicle and if not properly design edit will cause vibrations and transfer to the supporting structures ride comfort, driving stability and drivability are important factors for the performance of a vehicle and are affected by the engine vibrations. Because of the environmental considerations, as well as changes in consumer preferences regarding vibration induced must be reduced. Vibration behavior of an IC engine depends on unbalanced reciprocating and rotating parts, cyclic variation in gas pressure, shaking forces due to the reciprocating parts and structural characteristics of the mounts. Engine vibrations are caused due to the reciprocating and rotating masses of the engine. The variations of inertial forces are due to the combustion and the compression differences of the piston cylinder arrangement during their operation. The engine inertial forces leads to the unbalanced forces of the engine and they are quiet varying with respect to speed, fuel supply and combustion characteristics of the fuel. To predict the vibration output of an engine and to minimize the possible durability and consumer perceived quality problems associated with engine vibration, a robust and accurate design and simulation model is needed. To reduce the engine vibration proper mounting must be provided as dampers at the interface of the engine and chassis. Priory if design is replaced with V engines with each cylinder head at 45 degrees and the cylinders and pistons are aligned, in two separate planes or 'banks', so that they appear to be in a **"V"** when viewed along the axis of the crankshaft. The configuration generally reduces the overall engine length, height and weight compared to an equivalent inline configuration. Thus if a single cylinder engine is considered at 45 degrees it will damp vertical as well as horizontal vibrations and for balancing a counterweight or in case of agricultural application a pump can be installed.

3.1MOUNTINGS

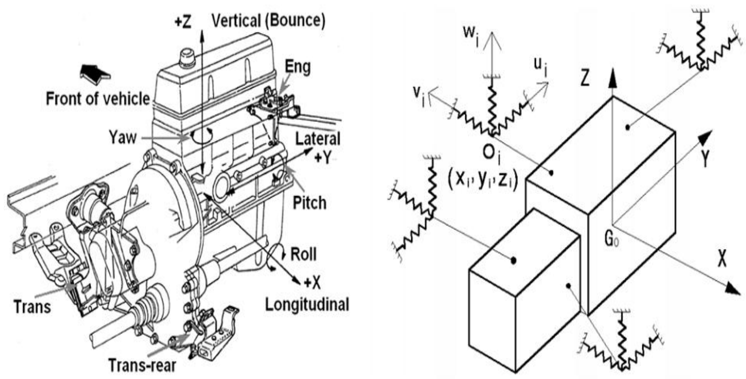

Fig.3

The unbalanced forces produced from the engine are transferred to the engine supporting members and causes the structure borne vibrations. To reduce the vibratory forces from the engine to the structures, the engine is supported by the damping members called vibration isolators (engine mountings). The mountings are the final most sources to reduce the vibratory forces by its damping property. Mounts are designed to satisfy two important criteria the first is the support function, reduction of the large amplitude vibration, at lower resonance bands. It requires the mountings to have higher stiffness and damping. The other is noise control, the mountings have to reduce the noise in the supporting structures induced by small amplitude vibration of the engine, at higher bands. It requires the mountings to posses lower stiffness and damping. These two requirements are contradictory, and the main aim in the design of engine mounts is to stabilize these two different conflicting requirements.

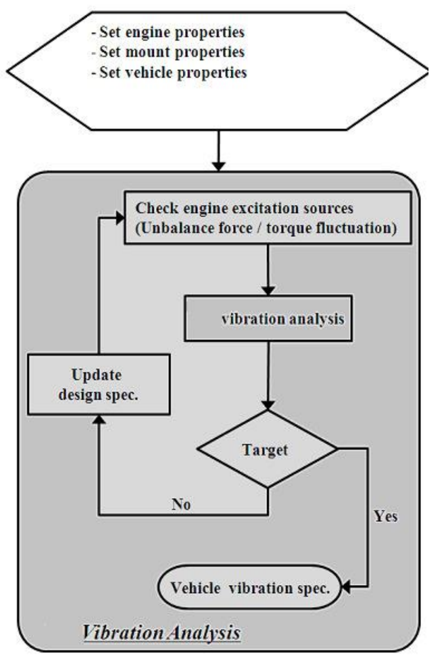

Fig.4.

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C. USING ALUMINUM AS MATERIAL FOR CONNECTING ROD INSTEAD OF FORGED STEEL

In a reciprocating piston engine, the connecting rod connects the piston to the crank or crankshaft. In modern automotive internal combustion engines, the connecting rods are most usually made of steel for production engines, but can be made of aluminum (for lightness and the ability to absorb high impact at the expense of durability) or titanium (for a combination of strength and lightness at the expense of affordability) for high performance engines, or of cast iron for applications such as motor scooters. They are not rigidly fixed at either end, so that the angle between the connecting rod and the piston can change as the rod moves up and down and rotates around the . stretching and being compressed with every rotation, and the load increases to the third power with increasing engine speed. Failure of a connecting rod, usually called "throwing a rod" is one of the most common causes of catastrophic engine failure in cars, frequently putting the broken rod through the side of the crankcase and thereby rendering the engine irreparable.

EXPERIMENTS

Table 1

	Aluminum alloy 6061	Aluminum alloy 7075	Aluminum alloy 2014
Young modulus	68.9Gpa	71.7Gpa	72.4GPa
Poisson's ratio	0.33	0.33	0.33
Density	2.1g/cc	2.80g/cm3	2.80g/cm3
Shear Modulus	26Gpa	26.5GPa	26.5GPa
Tensile Strength	290MPa	572MPa	220Mpa
Shear Strength	186Mpa	331MPa	124MPa

Table 2

		GRAY CAST IRON		
Load	Von-misses elastic strain	Von-misses elastic stress	Maximum shear stress	Total Deformation
500N	1.0719	1.074E5	1.074E5	500.46
1000N	2.1437	2.1437E5	2.1508E5	1000.9
1500N	3.215	3.219E5	3.219E5	1501.35
		ALUMINUM		
500N	1.0739	38251	38251	509.53
1000N	2.1478	76503	76503	1000.1
1500N	3.2215	114753	114753	1501.59

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D. SELECTION OF LINER MATERIALS TO LOWER HEAT ABSORPTION

A cylinder liner or also known as sleeve is a cylindrical component that is placed in an engine block to form a cylinder. It is an important part because it gives a wear protective surface for piston and piston rings. There are two types of liner which are wet liner and dry liner. Wet liner will contact with coolant while dry liner will contact directly with cylinder block. Among important functions of cylinder liners are to form a sliding surface, to transfer heat and to compress a gas.

In combustion process approximately 35% of heat is lost through the cylinder walls; heat transfer in excess to the coolant will also reduce the engine performance. The scope of this project is to select proper material for the cylinder liners, so that the heat loss through liner wall in IC engine can be reduced. To achieve this low thermal conductivity materials with required mechanical properties is considered and compared

COMMONLY USED LINER MATERIALS

1. GREY CAST IRON:_ Density: 7100 kg/m^3 Tensile Strength: 430 Mpa
Yield Strength: 276 Mpa Thermal Conductivity: 46 W/mk

2. NICKEL ALUMINIUM BRONZE ALLOY:
Density: 7500 kg/m^3 Tensile Strength: 660 Mpa
Yield Strength: 360 Mpa Thermal Conductivity: 42 W/mk

3. CARBON STEEL AISI 1095:
Density: 7500 kg/m^3 Tensile Strength: 660Mpa
Yield Strength: 360 Mpa Thermal Conductivity: 50 W/mk

IV. CONCLUSION

So the above mentioned data and listed experimental workout illustrates modification in 4 stroke diesel engine and the positive outcomes of replacing the conventionally used materials to newer and better ones. This has shown a promising improvement in IC engines where weight reduction is very essential. The mentioned factors will lead to robust design with optimum cost and efficiency benefits. Also significant changes in efficiency can be observed. This can set a new benchmark in upcoming world.

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