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Analyzing Vibrations Of Crank Shaft

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ABSTRACT

One of the most important parts of diesel and petrol motors that is studied for decreasing its vibration is the crank shaft. So removing the vibrations in motor industry is very important. A crank shaft is affected by many forces and it may be curved. Paying attention to this fact that power of crank shaft changes with the time, so it can rotates with different frequencies. This article studies the vibration of crank shaft. This study was done by forces that affected it. These forces are from combustion and inertia. Results of analyzing this piece show that its natural frequency is 400 HZ. In real work situation the highest motor rotation is 7000 rotates per minute. Paying attention to critical speeds of crank shaft set it is obvious that it isn't intensified while working.

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INTRODUCTION

One of the most important problems of motors is the problem of vibration caused by different parts that are affected by entropy forces. Basically all things that have mass can have vibration. In inner- burning motors because of form of crank shaft curving vibration of piston high frequency vibrations because of burning fuel inside motor vibrations of turning parts such as gear, polli and fan- belt non- wanted vibration is caused inside the motor and after that different parts may crack or cause sounds [1, 2, 3].

So studying motor vibrations seems necessary. One of the most important most expensive and most complicated parts of a motor from the point of designing producing and analyzing is its crank shaft. Always different forces are applied on crank shaft and this has made it difficult to design modeling and producing a crank shaft that can work for many years [4, 5, 6].

Besides changes of situations of a car applies different forces on crank shaft that it is difficult to predict them. The first changes are change of crank shaft turning other changes such as forces that are applied at the beginning of movement of a car or while stopping moving the car on slope changing burning condition and moment forces because of reverse change of gear that happens suddenly are among factors that affect crank shaft always transfers is curving entropy. This entropy causes vibration in fixed bearings[7, 8, 9].

Besides curving entropy vibrations of applied forces affects crank shaft. So the aim of present research is studying motor vibrations, there are many researches about crank shaft analyzing and are pointed to some of them in the following:

Mourelatos presents a model on basis of limited parts method for analyzing a crank shaft dynamically. Comparing experimented results with theoretical results confirmed our model. So results of this research show importance of the model for designing crank shaft [10]. Piraner et al analyzed crank shaft vibration in two stages using ANSIS software and resulted that bearings are affected more than other parts [11]. This article studies the vibration of crank shaft that this study was done by forces that affected it, these forces are from combustion and inertia.

Research method:

The equation of motion of a vibrating rod in torsion vibration equation of motion is similar to the longitudinal bars. So first, we consider a rod that is uniform along the length are narrow. U along the rod axial forces of change are places that are a function of location x and time t [12, 13]. Since the bar extremely high number of natural vibration modes, the distribution will change with each different mode. A component of the rod length dx we consider if u x is the shift in location $\mu + (\partial\mu/\partial x).dx, x + dx$ will change. So obviously a length dx

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in the new situation has to $(\partial\mu/\partial x).dx$ change. This consists of a single strain $(\partial\mu/\partial x)$. Hook the unit stress to the strain of the same unit elasticity, E may be written:

$$(\partial\mu/\partial x) = \frac{P}{A.E} \quad (1)$$

A bar area is the section width. Differential measurement with respect to x we have:

$$A.E.(\frac{d^2}{dx^2}) = \frac{dp}{dx} \quad (2)$$

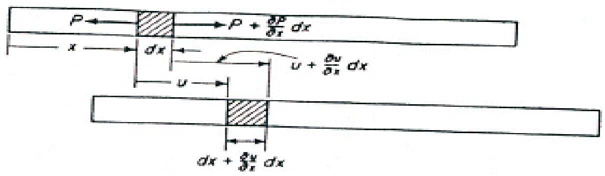

Fig. 1: Change the location of the bars

Vibration torsion bars will extend to this discussion. Figure 3 The angle of torsion bars in length *dx* of the torque T is the following:

$$d\theta = \frac{Tdx}{I_P G} \quad (3)$$

The torsion stiffness is a fertile area of cross-sectional polar moment of inertia and elasticity models to be cut. If the sides of the torque, T, and $T + (\frac{\partial T}{\partial x})dx$ that the net torque equation is 7.

$$\partial T/\partial x \, dx = I_p G \frac{\partial^2\theta}{\partial x^2} dx \quad (4)$$

The differential equations will be moved:

$$PI_p dx \frac{\partial^2\theta}{\partial t^2} = I_p G \frac{\partial^2\theta}{\partial x^2} dx \quad (5)$$

And thus we have:

$$\frac{\partial^2\theta}{\partial t^2} = (G/P)\frac{\partial^2\theta}{\partial x^2} \quad (6)$$

This equation is the equation of longitudinal vibration in the bars, which $G/P, \theta$ are respectively $E/p, u$ replaced. For solving differential equations using the answers θ to the following:

$$\theta = \left(A\sin w\sqrt{P/G} + B\cos w\sqrt{P/G}\,x\right)(C\sin wt + D\cos wt) \quad (7)$$

Figure 2 is geometric model drawn in ANSYS software. Z axis is crank shaft in this model. There aren't oiling holes in this model. Also because crank shaft rotates permanently so choosed element for meshing is useful.

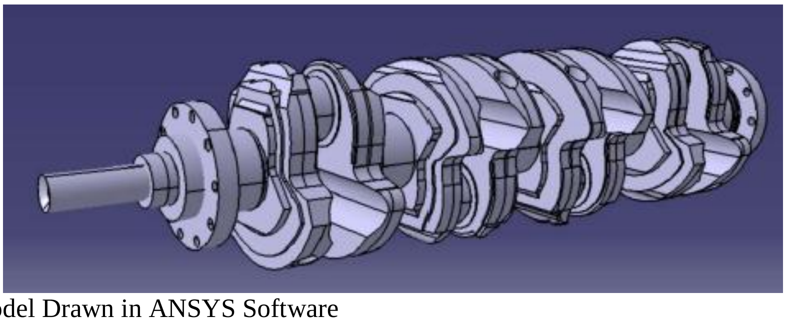

Fig. 2: Geometric Model Drawn in ANSYS Software

Fig. 3: Part of Crank Shaft that Has Been Meshed

Results:

Each system has natural frequency that is its essential especially. It means that if a system vibrates in premium conditions it will have some kind of fluctuation. If natural frequency becomes unit with stimulation frequency then there will be high vibration in the system and range of fluctuation increases rapidly and there will be intensification in the system.

Using limited parts model and applying materials qualities analyzing was performed and natural frequencies were achieved. Result of modal frequency is 400 HZ. In real work situation the highest motor rotation is 7000 rotates per minute and it is obvious that crank shaft won't receive intensification.

Conclusion and suggestion:

Crank shaft is one of the most important part of Diesel and petrol motors that is studied for decreasing vibration so removing these vibrations in motor industry is very important. Crank shaft of a motor is curved important. Crank shaft of a motor is curved because of forces that are applied to it. Resonance phenomena: Resonance phenomena are a main factor of damaging. The applying of torque to the crankshaft is motivational factor to engine and even transmission system (after the fluctuation absorbed by flywheel). By using frequency and amplitude of fluctuation and natural frequency of parts such as cylinder block and crankshaft (with flywheel), the design can be optimized for prevention from resonance.

Paying attention to this case that power of a crank shaft changes with time so it can rotates with different frequencies. Results of analyzing this piece show that its natural frequency is 400 HZ. In real work situation the highest motor rotation is 7000 rotates per minute. Paying attention to critical speeds of crank shaft set it is obvious that it isn't intensified while working. As the engine is damaged, stress analysis of different situation for some parts is essential. The fatigue analysis of moving part such as connecting rod and crankshaft could be done by using the diagrams. So it is proposed that stress analysis of crankshaft to be calculated as a future research.

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